DOE Order (O) 420.1C
Facility Safety

Changes to DOE O 420.1C and Expectations for Effective Implementation

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Objectives

- Obtain feedback and/or address issues or concerns
- Understand the history of DOE O 420.1
- Understand the drivers for changes in DOE O 420.1C
- Understand the major differences between

- Understand DOE expectation for effective implementation

History of DOE Order 420.1

- **DOE Order 420.1 issued in October 1995 and combined the following DOE Orders:**
  - DOE Order 6430.1A, General Design Criteria
  - DOE Order 5480.7A, Fire Protection
  - DOE Order 5480.24, Criticality Safety
  - DOE Order 5480.28, Natural Phenomena Hazards Mitigation
- **DOE Order 420.1, Change 3 (November 2000) added criticality training and qualification requirements.**

History of DOE Order 420.1

- DOE Order 420.1A issued in May 2002 added the system engineer program requirements, in response to DNFSB Recommendation 2000-2.

- DOE Order 420.1B issued December 2005 was general revision which elevated some key requirements, such as single failure and safety related fire separation.

- DOE Order 420.1B Change 1 issued in April 2010 invoked DOE-STD-1189-2008.

Driver for recent changes

- **Secretary's Directives Reform Initiative**
  - *"In 2009, the Office of Health, Safety and Security (HSS) began reforming its approach to enforcement and oversight by recognizing line management's responsibility for safety and security, reviewing opportunities for streamlining requirements, and eliminating directives that do not add value to safety and security. I have tasked HSS to continue this reform path, but they will need your input, cooperation and support."* **– Memo issued March 16, 2010 from Daniel B. Poneman**
- **Reform Objectives: (1) Streamline requirements, (2) clarify applicability, and roles and responsibilities, (3) use industry codes and standards, and (4) eliminate redundant and unnecessary requirements**
- **Reform Result: 107 directives → 55 directives**

History of DOE Order 420.1C

- Justification Memorandum approved September 2010
- Draft Order to Red Team review January 2011
- Draft Order to RevCom review March 2011
- Draft Order to Concurrence review September 2011
- Order approved on December 2012

What's issued?

- **Department's 2010 Safety & Security Directives Reform Initiative led to revision and issuance of the following directives and standards related to DOE O 420.1:**
  - DOE O 420.1C, *Facility Safety*, dated 12-04-12
  - DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Guide for use with DOE Order 420.1C, Facility Safety*, dated 12-04-12
  - DOE-STD-1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, dated December 2012
  - DOE-STD-1066-2012, *Fire Protection*, dated December 2012

What's cancelled?

- **Directives revision cancelled and archived following:**
  - DOE O 420.1B, *Facility Safety*
  - DOE G 420.1-1, *Nonreactor Nuclear Safety Design Guide*
  - DOE G 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear and Nonnuclear Facilities*; and
  - DOE G 420.1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Program*

What's cancelled?

- **Associated DOE technical standards revisions also cancelled and archived following standards:**
  - DOE-STD-1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*
  - DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*
  - DOE-STD-1022-94, *Natural Phenomena Hazards Characterization Criteria*
  - DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria*
  - DOE-STD-1066-99, *Fire Protection Design Criteria*
  - DOE-STD-1088-95, *Fire Protection for Re-locatable Structures*

DOE O 420.1C
Applicability of Order

- DOE/NNSA elements and contractors
- Responsible for design, construction, management

- All government-owned and government-leased facilities, and on-site contractor-leased facilities

DOE O 420.1C Major Changes

- **Main Body of the Order**
  - Streamlines and clarifies the Order by removing all requirements that were not specific to DOE
  - Clarifies the requirements for delegation of authority related to the DOE responsibilities as building code official and fire protection authority having jurisdiction (AHJ)
  - Clarifies the requirement for oversight of the cognizant system engineer (CSE) Program

DOE O 420.1C
Key DOE Requirements

- Approve and oversee contractor programs
- Implement CRD requirements for GOGOs
- Provide oversight of contractor CSE program and operability of safety systems
- Document AHJ responsibilities assigned to the contractor
- Document building code official authorities assigned to the contractor
- Establish a site-wide wildland fire management plan

DOE O 420.1C
Field Element Responsibilities

(1) Ensure compliance with DOE O 420.1C.

(2) Identify applicable contracts and notify contracting officers.

(3) Approve equivalencies to applicable codes and standards.

(4) Approve contractors' emergency services organization baseline needs assessments (BNAs).

(5) Approve contractors' fire protection program.

(6) Serve as AHJ for matters involving fire protection.

(7) Serve as the Building Code Official.

DOE O 420.1C
Field Element Responsibilities

(8) Perform as ‘owner’ for implementing codes and standards.

(9) Approve the contractors’ criticality safety program.

(10) Approve periodic NPH assessment evaluations, and associated update actions and upgrade plans.

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

(12) Implement an appropriate self assessment and oversight program.

DOE O 420.1C - CRD
Major Change & Key Requirements

- **Major Change to Attachment 1- *Contractor Requirements Document***
  - Clarifies the requirements for equivalencies and exemptions

- **Key requirements of Attachment 1- *Contractor Requirements Document***
  - Flow down of requirements to applicable subcontractors
  - Satisfy Attachment 2 and Attachment 3 of DOE O 420.1C
  - Comply with applicable industry codes and standards
  - Process for approval of equivalencies and exemptions

DOE Order (O) 420.1C
What are key subject areas?

- **Nuclear Safety Design Criteria (includes: selection of applicable codes and standards)**
- **Fire Protection**
- **Criticality Safety**
- **Natural Phenomena Hazards (NPH) Mitigation**
- **Cognizant System Engineer (CSE) Program**

Note: Explosive, chemical, and other industrial safety hazards are addressed in other DOE rules and Directives.

DOE O 420.1C
Applicability of Chapters

Nuclear Design (Att 2, Chapter I)	**Nuclear Facilities**	**Design (New Facilities & Major Modifications)**
Fire Protection (Att 2, Chapter II)	**Nuclear and Non-Nuclear Facilities**	**Design & Operations**
Criticality Safety (Att 2, Chapter III)	**Nuclear Facilities**	**Design & Operations**
NPH Mitigation (Att 2, Chapter IV)	**Nuclear and Non-Nuclear Facilities**	**Design & Operations**
System Engineers (Att 2, Chapter V)	**Nuclear Facilities**	**Operations**

DOE Order (O) 420.1C
What are the key linkages?

10 CFR Part 830, *Nuclear Safety Management*

DOE P 420.1, *DOE Nuclear Safety Policy*

DOE O 420.1C, *Facility Safety*

Nuclear Safety
(Attachment 2, Chapter I)

G 420.1-1A, *Nonreactor Nuclear Safety Design Guide*

DOE-STD-1189, *Integration Of Safety Into The Design Process*

Attachment 3 *Codes and Standards*

Fire Protection
(Attachment 2, Chapter II)

DOE-STD-1066, *Fire Protection*

Criticality Safety
(Attachment 2, Chapter III)

DOE-STD-3007, *Guidelines for Preparing Criticality Safety Evaluations at DOE Non-Reactor Nuclear Facilities*

ANSI/ANS-8 Series Standards

NPH Mitigation
(Attachment 2, Chapter IV)

DOE-STD-1020, *NPH Analysis and Design Criteria for DOE Facilities*

System Engineering
(Attachment 2, Chapter V)

DOE O 420.1C Major Changes

- **Att 2, Chapter I: *Nuclear Safety Design Criteria***
  - Removes the explosive safety requirements, which are addressed by:
    - DOE O *440.1B, Worker Protection Program for DOE Federal Employees,*
    - 10 CFR 851, *Worker Safety and Health Program*, and
    - DOE-STD-1212-2012, *Explosive Safety*.
  - Adds confinement strategy (active vs. passive) requirements per DOE response to DNFSB Recommendation 2004-2*, Active Confinement Systems*
  - Clarifies design requirements related to protection from chemical hazards (see DOE-STD-1189)
  - Clarifies defense-in-depth principles, and order of preference for controls selection strategy

DOE O 420.1C Key Requirements

- **Chapter I - Nuclear Safety Design Criteria**
  - Integration of safety into design (STD-1189)
  - Defense-in-Depth
  - Confinement Ventilation System
  - Design for future D&D
  - Design for maintenance and testing
  - Design for ALARA and waste minimization
  - Integration with design requirements for explosive safety, industrial safety, and nuclear explosive safety

Defense in Depth

(Chapter I - Nuclear Safety Design Criteria)

- Site location
- Material-at-risk
- Conservative design margins
- Quality assurance
- Multiple physical barriers
- Multiple means to ensure safety functions are met, including preventive and mitigative safety features
- Use of automatic and administrative controls
- Accident monitoring
- Emergency planning

DOE-STD-1189-2008 Key Requirements

- Safety Design Strategy (SDS)
- Risk and Opportunity Assessment (R&OA)
- Conceptual Safety Design Requirements (CSDR)
- Preliminary Safety Design Requirements (PSDR)
- Preliminary Documented Safety Analysis (PDSA)
- Documented Safety Analysis (DSA)

Confinement Ventilation

(Chapter I - Nuclear Safety Design Criteria)

- An active confinement ventilation system is the preferred design approach for nuclear facilities with potential for radiological releases.
- Alternate approaches may be acceptable if a technical evaluation demonstrates that the alternate approach results in very high assurance of confinement.
- Additional guidance provided in G 420.1-1A.

DOE O 420.1C Major Changes

- **Att 2, Chapter II: *Fire Protection***
  - Rearranges chapter structure to better mirror the structure of the supporting standard DOE-STD-1066-2012
  - Clarifies use of applicable building codes, NFPA codes and other industry standards, and clarifies resolution of conflicts.
  - Clarifies protection thresholds for construction type, fire protection systems, and property protection.
  - Recognizes NFPA 1143, *Standard for Wildland Fire Management,* as applicable standard for wildland fires.
  - Recognizes DOE-STD-1066-2012 as an acceptable method for implementing DOE O 420.1C requirements.

    - Note: DOE-STD-1066-2012 was revised to address DNFSB Recommendation 2008-1 Safety Classification of Fire Protection Systems

DOE O 420.1C
Key Requirements

- **Chapter II – Fire Protection**
  - General Program Requirements
  - Program Administration
  - Design
  - Operations
  - Emergency Response
  - Fire Hazard Analyses and Building Assessments
  - Wildland Fire
  - Specific Program Criteria (DOE-STD-1066-2012)

DOE-STD-1066-2012 Major Changes

- Serves as the single document for criteria and guidance for fire protection programs supporting implementation of DOE O 420.1C, Attachment 2, Chapter II. Major topic areas: Program Administration, Design, Operations, Emergency Response, Facility Evaluations, Wildland Fire.
- Significant revisions throughout including careful review of "shall" and "should" statements.
- Enhances requirements and guidance regarding fire protection design in nuclear safety applications. Adds Appendix A which addresses safety class/safety significant fire protection systems, consistent with the Department's implementation plan in response to DNFSB Recommendation 2008-1.

DOE O 420.1C Major Changes

- **Att 2, Chapter III: *Nuclear Criticality Safety***
  - Clarifies that the criticality safety program (CSP) must describe the implementation of ANSI/ANS-8 series consensus criticality safety standards
  - Clarifies the use of DOE-STD-3007, *Guidelines for Preparing Criticality Safety Evaluation at DOE Nonreactor Nuclear Facilities*

DOE O 420.1C Key Requirements

- **Chapter III - Nuclear Criticality Safety**
  - **Criticality Safety Program (CSP)**
  - **Criticality Safety Evaluations (DOE-STD-3007-2007)**
  - **Fissile Material Accumulation Control**
  - **Criticality safety evaluations must show that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.**
  - **Guidelines for fire fighting**

DOE O 420.1C
Major Changes

- **Att 2, Chapter IV: *Natural Phenomena Hazards (NPH) Mitigation***
  - Invokes DOE-STD-1020, which was significantly revised and invokes appropriate national consensus standards.
  - Clarifies requirements for ten year NPH assessments.

DOE O 420.1C Key Requirements

- **Chapter IV- Natural Phenomena Hazards Mitigation**
  - **NPH Design Criteria (DOE-STD-1020-2012)**
  - **NPH Accident Analysis**
  - **Review and Upgrade Requirements for Existing DOE Facilities (NPH assessments must be reviewed at least every 10 years for any significant changes)**
  - **Seismic Detection**
  - **Post-Natural Phenomena Procedures**

DOE-STD-1020-2012 Major Changes

- Consolidates and streamlines the requirements from DOE-STDs 1020,1021,1022,1023 into a single document supporting implementation of DOE O 420.1C, Attachment 2, Chapter IV.
- Revises the set of industry codes and standards that is invoked to address DOE NPH analysis and design needs
- Updates criteria and guidance for major modifications to existing hazard category 1, 2, and 3 nuclear facilities, and for 10-year NPH reassessments.
- Provides new criteria and guidance for analysis and design of SSCs for lightning, precipitation, and volcanic eruption events.
- Introduces NDC (NPH Design Category) terminology

DOE O 420.1C Major Changes

- **Att 2, Chapter V: Cognizant System Engineer (CSE) Program**
  - Clarifies implementation of CSE program for hazard category 1, 2 and 3 facilities to ensure continued operational readiness of systems
  - Clarifies CSE support for operations and maintenance
  - Clarifies use of DOE-STD-1073, *Configuration Management Program,* as an acceptable method.

DOE O 420.1C
Key Requirements

- **Chapter V - Cognizant system engineer program**
  - **General**
  - **CSE Program Coverage**
  - **Configuration Management**
  - **CSE Support for Operations and Maintenance**
  - **CSE Qualification Requirements**

DOE O 420.1C Major Changes

- **Attachment 3 – *Design Criteria for Safety Structures, Systems, and Components***
  - Provides a list of DOE technical standards and industry codes and standards that must be evaluated for applicability (previously contained in DOE G 420.1-1)
  - Provides a requirement for nuclear facilities to identify the complete set of codes and standards necessary to meet the design criteria. General design criteria are:
    - Conservative design margin,
    - System reliability,
    - Environmental qualification,
    - Safe failure modes,
    - Support systems and interface design
    - Protection against fire
    - Quality assurance

DOE O 420.1C Key Requirements

- **Attachment 3 - Design criteria for safety SSCs**
  - **General Design Criteria**
  - **Use of National Codes and Standards**
    - **Structural**
    - **Mechanical and Process Equipment**
    - **Ventilation**
    - **Mechanical Handling Equipment**
    - **Electrical**
    - **Instrumentation, Control, and Alarm Systems**
    - **Fire Protection Systems**

Guide 420.1-1A Major Changes

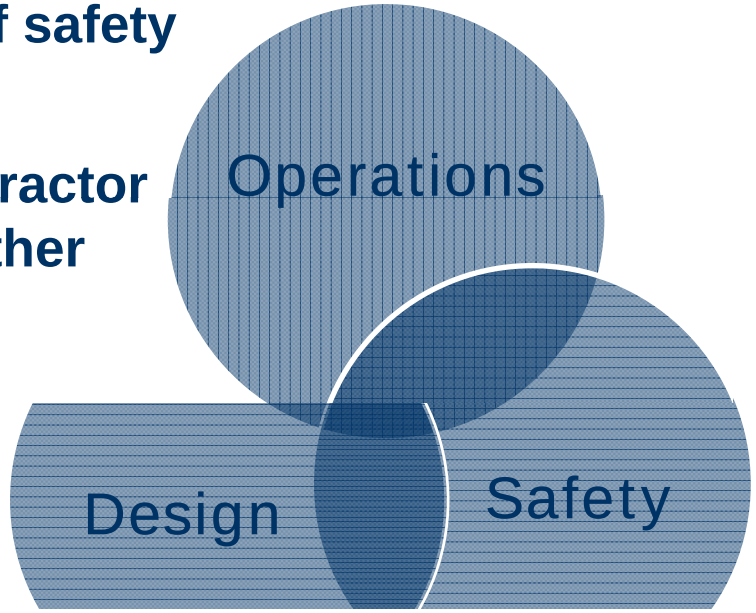
[Supports Attachment 2, Chapter I and Attachment 3]

- **Adds guidance on confinement ventilation system design (see Section 5.3, and Appendix A.)**
- **Clarifies the use of DOE-STD-1189 for nuclear design, including protection from chemical hazards (see Sections 4 & 5).**
- **Removes the general design criteria and criteria for application of industry codes and standards from the Guide; moved to DOE O 420.1C, Attachment 3.**
- **Provides guidance regarding how to evaluate equivalencies for the recommended codes and standards (see Section 5.4.16).**

DOE-STD-1189-2008
Safety Design Integration Team

- **Provides working-level integration of safety into design for the project**
- **Usually composed of subset of Contractor Integrated Project Team (IPT) plus other**
- **Core team**
  - **Safety**
  - **Design**

and standards takes place



DOE O 420.1C
Applicability to Current Projects

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

Exemptions and Equivalencies

- **Exemptions – Release from requirements.**
- **Equivalencies – Alternatives to how a requirement is fulfilled.**

Exemptions and Equivalencies Approval Process

	Exemption	Equivalency
DOE O 420.1C Requirements ("Must" Statements)	Approved at the PSO level; requires CTA concurrence and OPI consultation. [DOE O 251.1C]	Approved at the PSO level; requires CTA concurrence and OPI consultation. [DOE O 251.1C]
Requirements of: Applicable Codes & Standards and DOE Technical Standards	Approved at the PSO level; requires CTA concurrence and OPI consultation. [DOE O 251.1C]	Approved at the field level; must demonstrate an equivalent level of safety

Summary

- The revised Order clarifies, streamlines and updates DOE and contractors' requirements and responsibilities
- The revised Order updates the requirements to reflect current industry practices
- HSS is open to feedback from implementing organizations
- HSS is available to provide assistance in understanding the Order requirements and how to effectively implement them.

For Further Information

On Order, Nuclear Safety Design, and Use of Codes & Standards	**Pranab Guha (HS-31)** *301-903-7089* *pranab.guha@hq.doe.gov*
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On Criticality Safety	**Jerry McKamy (NNSA)** *301-903-7980* *jerry.mckamy@nnsa.doe.gov*
On NPH Mitigation	**Jerry Meyers (HS-32)** *301-903-3190* *gerald.meyers@hq.doe.gov*
On System Engineers	**Earl Hughes (HS-32)** *202-586-0065* *earl.hughes@hq.doe.gov*

Questions ?

Frequently Asked Question

- **For existing facilities how do I determine the list of applicable design codes and standards?**

  It is the existing Code of Record for the facility.

Frequently Asked Question

Is DOE-STD-1066-2012, *Fire Protection*, required by this Order?

No. It is strongly recommended and use of an alternate approach requires justification

Frequently Asked Question

- **For equivalencies, how do you demonstrate an "equivalent level of safety"?**

  No simple answer. It depends on the situation. See G 420.1-1A for more information.

Frequently Asked Question

- **Are the requirements in the CRD automatically applicable to all DOE Facilities?**

  No. They are not applicable until they are put in the contract.

Frequently Asked Question

- **What requires the contractor to submit the Fire Protection Program for approval?**

DOE Field Element should direct contractors to submit Fire Protection Plans for their approval.

Frequently Asked Question

- **Are the requirements in Attachment 3 of DOE O 420.1C new requirements?**

  No. Actually, language came from Guide 420.1-1, which was invoked by STD-1189, which was invoked by DOE O 420.1B and DOE O 413.3B.

Frequently Asked Question

Section 2.2.2 of DOE-STD-1066-2012 states:

"2.2.2 Building code. The acquisition and construction of new facilities and significant modifications of existing facilities shall meet the applicable parts of the *latest edition* of the *International Building Code* (IBC), NFPA standards, and other nationally recognized consensus standards for electrical, fire, and life safety."

Does this mean that the latest published IBC is required regardless of whether it has been adopted into law by the local state or community?

A: Use of the local and state adopted codes and standards (which in many cases are older versions) can also be justified and has been anticipated by DOE O 420.1C.

Frequently Asked Question

Section 3.a.(2) of Attachment 2, Chapter II states:

"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."

Is this an Order-level requirement that requires approval by DOE Headquarters and the CTA for equivalencies?

A: No. Relief from applicable codes and standards is described in Attachment 1