15 May 2010

To: J.N. McKamy, Manager, US DOE NCSP
From: C.M. Hopper, Chair, US DOE NCSP CSSG CMH

In response to Tasking 2011-03, a subgroup of the Criticality Safety Support Group (CSSG) was organized to draft a *CSSG Response to DNFSB Staff Member on CSSG Position in Regards to Seismic Design*.

The drafting team consisted of the following CSSG members:

James A. Morman, Writing Team Lead
Thomas P. McLaughlin
David P. Heinrichs
E. Fitz Trumble, Deputy Chair CSSG (coordinator)

The draft response was reviewed by the members of the CSSG. Comments from that review were considered for the enclosed final version of the response that is attached to this memo. This version represents a consensus position by the entire CSSG.

Cc: CSSG Members
A.N. Ellis
J.R. Felty
L. Scott
G.O. Udenta

CSSG Response to Tasking 2011-03
CSSG Response to DNFSB Staff Member on CSSG Position in Regards to Seismic Design
May 10, 2011

In Tasking 2011-3 (included as Attachment 1), the Criticality Safety Support Group (CSSG) has been asked to respond to an email by Mr. Roy Kasdorf (included as Attachment 2) in which he questions the conclusions presented by the CSSG in the response to Tasking 2010-01, *Balanced Technical Approaches for Addressing Potential Seismically Induced Criticality Accidents in New Facility Design*, dated November 19, 2010 (included as Attachment 3). The following response represents the consensus opinion of the CSSG on Mr. Kasdorf's comments.

Precluding Criticality Events

In the second paragraph of his email, Mr. Kasdorf cites Section III.3.a(1) of DOE O 420.1B which states that:

> CSPs must be implemented to ensure that fissionable material operations will be evaluated and documented to demonstrate that operations will be sub-critical under both normal and credible abnormal conditions.

In the next paragraph, he cites DOE-STD-3009-94, which states in the content guidance for Chapter 6, Section 6.4.1, *Engineering Controls*, of a Documented Safety Analysis that:

> This section summarizes the safety design limits on engineered controls, either passive or active, and the bases place on equipment designs or operations to ensure subcritical conditions under all normal, abnormal and accident conditions.

The CSSG agrees with these two excerpts, which are consistent with current DOE practices and are consistent with the CSSG response to Tasking 2010-01. In fact, these two statements are also consistent with the overarching nuclear criticality safety requirement that has been in force within the U.S. nuclear criticality safety community (both the DOE and NRC have accepted this requirement for decades) as stated in ANSI/ANS-8.1, paragraph 4.1.2:

> Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions.

DOE Order 420.1B and all its predecessor orders pertaining to nuclear criticality safety have always accepted this "shall" statement (i.e., a requirement) in ANS-8.1. In addition, no other DOE regulations (rules, orders, standards, etc.) have made statements that might be construed to modify this requirement. It is important to note that this requirement is based on the protection of personnel from excessive exposure caused by a credible criticality event.

Seismic Design Criteria and Limit States

Thus, the CSSG agrees that a Design Basis Earthquake (DBE) should always be considered a "credible abnormal condition." While this may not always be spelled out as a specific event in Nuclear Criticality Safety Evaluations (NCSEs), the impacts of material and equipment movement and leaks should always be considered, even if they are addressed generically as situations caused by any number of possible events. Any engineered features required to ensure that such events do not lead to the credible likelihood of a criticality accident will be identified in the applicable NCSEs. If any such features are required to maintain their functionality following the DBE, the NCSEs will state this fact and the DSA for the facility or operation will assign the appropriate seismic design criterion (SDC) and limit state (LS).

The opening sentence in the fourth paragraph of Mr. Kasdorf's email is not correct. The cited requirements do not say that a criticality event must be precluded and there is no such statement in any DOE regulation. The requirement is to ensure that operations will be subcritical under all normal and credible abnormal conditions. If the abnormal conditions that follow a DBE have not been considered, the NCSE must be considered inadequate.

Also in his fourth paragraph, Mr. Kasdorf states that "seismic damage can only be precluded by assigning a seismic design category and limit state that prevents the criticality accident." This is perhaps the root of the misunderstanding with the CSSG response to Tasking 2010-01. It is not necessary in all cases to preclude seismic damage in order to preclude a criticality accident under DBE conditions.

As recommended in the conclusions of the CSSG Response to Tasking 2010-01, the role of the criticality safety engineer is to identify structures, systems and components (SSCs) for defense-in-depth and worker safety based on their function credited in NCSEs. The selection of SDC and LS determines the risk of equipment failure beyond the specified deformation limit in a design DBE. The CSSG recommends that such seismic-induced deformation be considered the credible abnormal condition following the DBE. Key assumptions used to establish the LS of credible seismic-induced damage should be documented in the NCSE as required by DOE-STD-3007-2007, Section II.G, "Credited Controls and Assumptions."

In many cases prevention of failure or deformation of equipment is not credited in the NCSEs for maintaining subcriticality following a DBE, and in such cases the CSSG recommended defaults of SDC-1 and LS-B are appropriate. The CSSG expectation is that engineering design features be sufficiently robust such that the DBE does not exceed the limit states credited in NCSEs as sufficiently functional to preclude a criticality accident. As stated in the CSSG response to Tasking 2010-01,

> Significant cost savings may be realized though the appropriate assignment of seismic design criteria and limit states such as assigning limit state A for equipment that may be assumed to fail (no performance criteria credited in a criticality safety evaluation) or considering moderate (limit state B) or limited distortion (limit state C) based on crediting realism in the criticality safety evaluation rather than requiring no damage (limit state D) for reasons of convenience to the analyst. In any case, credited performance based on limited damage should be clearly identified in NCSEs as key assumptions per DOE-STD-3007-2007.

The CSSG response also states that

> Criticality safety engineers are encouraged to work closely with structural analysts to consider possible cost savings by suggesting innovative and inexpensive preventive measures such that seismic damage does not result in a

> criticality accident. This would permit limit states A, B and C and not require designing to the "no damage" limit state D.

Thus, in contrast to the conclusion by Mr. Kasdorf in paragraph five of his email, the CSSG conclusion is that the SDC and the LS should be assigned such that seismic damage up to that resulting from the DBE does not result in a criticality accident.

Beyond Design Basis Accidents and Dose Consequences

While in the response to Tasking 2010-01 the CSSG did not recommend assignment of SDC and LS values based solely on dose consequences, dose does play a role when considering a Beyond Design Basis Earthquake (BDBE), especially in light of the fact that the SDC-1 through SDC-3 criteria are based on dose values (see Table A-1 of DOE-STD-1189-2008). As stated in the CSSG response to Tasking 2010-01,

> Specifically, and consistent with the recent CSSG response to tasking 2010-02, it is concluded that criticality accidents are expected to be worker safety issues and not pose significant risks to co-located workers or the public.

It is this conclusion that led to the CSSG recommendation that in most cases SDC-1 and LS-B are appropriate for SSCs important to criticality prevention under DBE scenarios, provided that the applicable NCSEs do not identify more stringent criteria as being necessary to preclude a criticality accident.

> Criticality safety programs (CSP) must also consider the effects of a BDBE, even though they are not considered credible upset or accident conditions. Note that in this context "not credible" does not imply that the event will never happen, but only that the probability of occurrence is so low that its consequences do not have to be analyzed in detail. DOE-STD-3007-2007, Section IV.B, *Need for Consideration of Beyond Design Basis Accidents*, provides additional guidance.

Therefore, this standard addresses both DBE criticality risks and BDBE criticality risks. A BDBE criticality accident in general is not expected to challenge the Evaluation Guideline of 25-rem to the maximum exposed offsite individual as defined in DOE-STD-3009-94, Change 3; consequently, no formal cost-benefit analysis is required. However, the evaluation of consequences of Beyond Design Basis Accidents (BDBAs) such as a BDBE leading to a criticality accident is required simply to provide insight into the magnitude of possible increased consequences for risk acceptance by DOE. Insights from BDBA analyses have the potential for identifying additional facility features that could prevent or reduce severe BDBA consequences.

The graded approach and common sense must always be applied when arriving at reasoned, cost-effective risk control. In particular, if one were to conjecture a BDBE, the analyst would have to attempt to judge material movements under extreme conditions. This would generally be very difficult to forecast.

The primary goal of the criticality safety program following the ANS-8 standards is the protection of people from exposures to significant doses of radiation, preferably by prevention of the accident. If this can been accomplished by shielding inherent to the system, and/or evacuation from a potential criticality accident site then the CSE may be somewhat less rigorous in documenting subcriticality under extreme conditions. This is consistent with

ANSI/ANS-8.10, *Nuclear Criticality Safety in Operations with Shielding and Confinement*. ANSI/ANS-8.10 states that "distance may serve in lieu of some or all of the shielding, provided personnel entry into the intervening process is constrained", which would be the case post BDBE and then goes further to state that "…this may be reflected in reduced conservatism in the process analysis." As stated in the CSSG response to Tasking 2010-01,

> DOE O 420.1B, Change 1, requires facilities or sites with hazardous materials to "have instrumentation or other means to detect and record the occurrence and severity of seismic events". Such instrumentation, if equipped with an immediate evacuation alarm or procedurally coupled with emergency evacuation procedures, would obviate the need for (costly) seismic tolerance of an installed criticality accident alarm system (CAAS). If a seismic instrument is credited with performing the immediate evacuation function, the Criticality Safety Program Description Document should describe compliance with ANSI/ANS-8.3, §5.3, "Seismic Tolerance".

It is in this context that the CSSG considered dose consequences, and did not base their general conclusions for SDC and LS assignments on dose consequences alone.

Conclusion

In summary, in addition to the requirements in DOE-STD-1189-2008, the CSSG did consider design requirements for criticality safety as given in DOE O 420.1B, DOE-STD-3009-94, DOE-STD-3007-2007 and the accompanying series of ANSI/ANS-8 criticality safety standards. The conclusion that SDC-1 and LS-B may be assigned to SSCs important to criticality safety is valid, provided that NCSEs show that no credible upset condition, including the potential SSC damage/deformation caused by the DBE consistent with the SDC and LS selected, results in a criticality accident. The CSSG recommendation for the SDC and LS assignments is not based on dose considerations alone.

Attachment 1

CSSG TASKING 2011-03
Date Issued: April 26, 2011

Task Title: ***CSSG Response to DNFSB Staff Member on CSSG Position in Regards to Seismic Design***

Task Statement:

The CSSG is directed to develop a response from the CSSG to the email from DNFSB staff member Roy Kasdorf dated April 7, 2011. The email is included as Attachment 1 to this tasking statement.

The CSSG should create a small subgroup to respond to the questions and comments by Mr. Kasdorf which are included in his email. His comments are related to the CSSG response to Tasking 2010-1, *Balanced Technical Approaches for Addressing Potential Seismically Induced Criticality Accidents in New Facility Design*, dated November 19, 2010.

Resources:

The CSSG chair will create a subgroup (having two to three members) of the CSSG to support the response development. When a draft is ready for review, the CSSG will review the draft and provide comments to the CSSG Deputy Chair, who will address the comments and forward the resulting response to CSSG Chair for transmittal to the NCSP Manager. 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. CSSG response team develops draft response to DNFSB staff questions by April 29, 2011.
2. CSSG to provide comments on the draft response to the CSSG Deputy Chair by May 4th.
3. CSSG Deputy Chair to consolidate comments and provide revised draft to the CSSG for concurrence by May 9th.
4. CSSG Chair briefs the NCSP Manager on the response by May 10, 2011.
5. CSSG Chair transmits the CSSG response to NCSP Manager by May 13, 2011.

Task Due Date: May 13, 2011

Signed: Jerry N McKamy
Jerry N. McKamy, Manager US DOE NCSP

Attachment 2

Email from Roy Kasdorf to Jerry McKamy

From: Roy Kasdorf [mailto:ROYK@DNFSB.GOV]
Sent: Thursday, April 07, 2011 10:13 AM
To: McKamy, Jerry
Cc: Ernest Elliott; Tontodonato, Rich <Alert>; Timothy Dwyer
Subject: CSSG position on seismic accidents

Jerry

I just read the recent NNSA Tech Bulletin containing your CSSG response to Tasking 2010-01 on seismically induced criticality accidents. While I don't argue with your interpretation of STD-1189 application of dose consequences, I am very concerned that you have missed the fact that there are other design requirements that go beyond O 413.3 and STD-1189.

O420.1 requires that "CSPs must be implemented to ensure that fissionable material operations will be evaluated and documented to demonstrate that operations will be sub-critical under both normal and credible abnormal conditions." I consider a seismic event a credible abnormal condition.

STD-3009 guidance for criticality controls states, "... summarize the safety design limits on engineered controls, either passive or active, and the bases placed on equipment designs or operations to ensure subcritical conditions under all normal, abnormal, and accident conditions." I interpret this mean that a criticality should be prevented under accident (seismic) events.

These design requirements say a criticality event must be precluded. This is regardless of the dose consequences which we understand is typically a localized event. In particular for design of new facilities, if a criticality event can be caused by the seismic event --- lost of configuration, fissile material tanks rolling around, primary confinement rupture, etc --- then is must be precluded. Seismic damage can only be precluded by assigning a seismic design category and limit state that prevents the criticality event. SDC-1 in general doesn't not provide seismic integrity when subjected to a DBE.

I disagree with the papers conclusion that the seismic design category and limit state can be assigned based on dose consequences in this case where there are other design requirements that must be met.

What consideration was given by the CSSG to these other design requirements in reaching the papers conclusion?

Regards
Roy Kasdorf

Attachment 3

CSSG Response to Tasking 2010-01

Balanced Technical Approaches for Addressing Potential Seismically Induced Criticality Accidents in New Facility Design

19 November 2010

Executive Summary

The Criticality Safety Support Group (CSSG) was directed in Tasking 2010-01 to develop a white paper on the use of balanced technical approaches for addressing potential seismically induced criticality accidents in new nuclear facility design (see Attachment 1). This white paper addresses this tasking by providing a thorough review of regulatory compliance issues and by providing recommendations for the application of a graded approach using sound practical judgment regarding risk and cost-benefit considerations.

Generally, it is recommended that criticality safety engineers participate in all stages of the design process, including the conceptual design phase, to ensure proper hazard categorization of the facility based on radiological risks and to ensure the assignment of the appropriate seismic design criteria and limit states to structures, systems and components important for the prevention of criticality accidents.

Specifically, and consistent with the recent CSSG response to tasking 2010-02, it is concluded that criticality accidents are expected to be worker safety issues and not pose significant risks to co-located workers or the public. Thus, Seismic Design Criteria (SDC) 1 is appropriate for structures and equipment important to criticality accident prevention. Also, it is recommended that emergency plans and procedures associated with earthquakes address personnel evacuation. This could prevent large expenditures that might otherwise be spent on making a criticality accident alarm system seismically tolerant.

Hazard Categorization

Early in the design process, DOE O 413.3A, Change 1, and DOE-STD-1189, require development of a Conceptual Safety Design Report that: (a) identifies and analyzes the primary facility hazards – including criticality hazards; (b) identifies and analyzes facility design basis accidents – including the design basis earthquake (DBE); (c) determines the preliminary seismic design category for the facility; (d) determines the safety class and safety significant structures, systems, and components (SSC); and (e) establishes the preliminary hazard categorization of the facility.

The CSSG Response to Tasking 2010-02 provides detailed guidance on the "Role of Criticality Safety in Facility Hazard Categorization". That CSSG guidance concludes that facilities with credible criticality accident risks should be classified no greater than Hazard Category 3 based on the localized radiological consequences of actual and realistically postulated criticality accidents. In particular, the CSSG Response to Tasking 2010-02 documents that historical criticality accidents and reasonably postulated potential accidents are highly likely to produce doses at 100 meters that are less than 0.5 rad and doses to the public that are negligible. These consequences for the postulated accidents do not take into consideration radiation shielding present in facility construction or process equipment that would further reduce radiological consequences. Therefore, the appropriate seismic design category for the facility for criticality safety is SDC-1 with no facility-level safety class or safety significant SSCs based on the criteria of DOE-STD-1189, Appendix A, §A.2.1, "Public Protection Criteria", and §A.2.2, "Collocated Worker Protection Criteria", respectively.

If dose assessment in or near specific facility structures is desired, guidance on criticality accident sources term and radiation dose estimations are available in American National Standard ANSI/ANS-8.23, Nuclear Criticality Accident Emergency Planning and Response.

Seismic Design Criteria, Performance Goals and Limit States

The primary guidance documents for assessing any seismic event – including criticality accidents induced by an earthquake – in new facility design are DOE-STD-1189, ANSI/ANS-2.26, ASCE/SEI 7-05 and ASCE/SEI 43-05. These standards provide a graded approach in the form of seismic design criteria, performance goals and limit states (LS).

The seismic design criteria are based on total effective dose equivalent (TEDE) consequences to the public and collocated workers as shown in Table 1. Collocated workers are defined in DOE-STD-1189 as workers 100 meters distant from the criticality accident (i.e., "the release point") or from the building perimeter.

Table 1. Seismic Design Criteria (SDC)

Unmitigated Consequence of SSC Failure from a Seismic Event		
Category	Collocated Worker at 100 m	Public
SDC-1	Dose < 5 rem	N/A
SDC-2	5 rem < Dose < 100 rem	5 rem < Dose < 25 rem
SDC-3	100 rem < Dose	25 rem < Dose

The target performance goal for each SDC, shown in Table 2, is the mean annual probability of exceedance of the specified limit state of structures and equipment due to the design seismic event. The corresponding qualitative likelihood based on the criteria of DOE-STD-3009 is also provided in the table.

Table 2. Target Performance Goal for SDC

SDC	Target Performance Goal	Qualitative Likelihood
1	< 1 x 10 -3 yr -1	Unlikely
2	< 4 x 10 -4 yr -1	Unlikely
3	~ 1 x 10 -4 yr -1	Unlikely/Extremely Unlikely
4	~ 4 x 10 -5 yr -1	Extremely Unlikely
5	~ 1 x 10 -5 yr -1	Extremely Unlikely

Note that the target performance goal frequency (for facility structures and equipment) is different than the frequency of the design basis earthquake (DBE), which is specified as a 2500-year return (mean) event for SDC-1, SDC-2, SDC-3 and SDC-4. The principal difference being that the design methods are specified by the U.S. Geological Survey, International Building Code, and ASCE/SEI 7-05 for SDC-1 and SDC-2; and, ASCE/SEI 43-05, ANSI/ANS-2.26, ANSI/ANS-2.27 and ANSI/ANS-2.29 for SDC-4. For SDC-5, the DBE is a 10,000-year (mean) event using the same design methods as SDC-4.

The limit states provided in Table 3 are deformation limits to be credited in safety analyses, including criticality safety evaluations, for the response of facility structures or equipment to the design basis earthquake. In criticality safety evaluations, such seismic-induced deformation should be considered the "credible abnormal conditions" for compliance with American National Standard ANSI/ANS-8.1-1998, Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors, §4.1.2, "Process Analysis".

Table 3. Structural Deformation Limit States

LS	Structural Deformation Limits	Damage
A	Large permanent distortion, short of collapse	Significant damage
B	Moderate permanent distortion	Generally repairable damage
C	Limited permanent distortion	Minimal damage
D	Essentially elastic behavior	No damage

Together, the SDC, design basis earthquake, target performance goal, and limit state establish the design and construction practices to be applied to facility SSCs. In the case of SDC-1 and SDC-2, the seismic design criteria are provided in ASCE/SEI 7-05; whereas ASCE/SEI 43-05 applies to SDC-3, SDC-4 and SDC-5.

The limit state to address equipment-distortion related criticality concerns will be no worse than limit state B in most cases. The structures or vessels specified as safety significant SSCs would be selected from the control set identified in the nuclear criticality safety evaluation (NCSE) and the documented safety analysis for each accident of concern. The SSC safety function described in the safety basis documentation would prevent fissile material from reaching the critical state. SSCs may suffer some loss of stiffness and strength in a seismic event, but still maintain the ability to provide the safety function described in the safety basis. The design team should carefully consider the increased cost of a more conservative design before specifying criteria beyond limit state B.

Equipment distortion/breakage leading to a potential criticality accident would primarily involve vessels that contain larger volumes and fissile masses in liquid forms or possibly large quantity vault storage. For example, fissile-bearing liquid leaking from pipes and process vessels could potentially flow into a sump or other unfavorable geometry location. Usually this is readily foreseen as a possibility and precluded with relatively inexpensive measures involving the application of neutron absorbers. Criticality concerns associated with loss of container spacing in vault storage subsequent to a seismic event are also often readily precluded by either seismic qualification of the shelving arrangement or by fissile density measures associated with container fissile mass limits and sizes.

Due to the expected, very limited consequences of a seismically induced criticality accident, safety class SSCs for protection of the public and safety significant SSCs for protection of the collocated worker are not expected to be identified in hazard analysis documentation addressing the criticality hazard. However, hazard analysis, including NCSEs, may identify SSCs as called out in DOE-STD-3007-2007 for specific aspects of defense-in-depth and worker safety.

Cost-Benefit Considerations

Participation of criticality safety engineers in the safety design strategy ensures criticality safety issues are addressed through all stages of the design process and included in the development of key safety documentation. Significant cost savings may be realized though the appropriate assignment of seismic design criteria and limit states such as assigning limit state A for equipment that may be assumed to fail (no performance criteria credited in a criticality safety evaluation) or considering moderate (limit state B) or limited distortion (limit state C) based on crediting realism in the criticality safety evaluation rather than requiring no damage (limit state D) for reasons of convenience to the analyst. In any case, credited performance based on limited damage should be clearly identified in NCSEs as key assumptions per DOE-STD-3007-2007.

When evaluating the cost of implementing different limit states, consideration must be given to the risk reduction provided by the SSC. In particular, if the fissile material can be shown to remain in the subcritical state subsequent to a seismic event then assigning the least costly limit state, A, is appropriate. Applying increasingly stringent seismic design requirements beyond those derived from applying the DOE-STD-1189 process, should not be pursued without a comprehensive assessment documenting cost versus benefit.

DOE O 420.1B, Change 1, requires facilities or sites with hazardous materials to "have instrumentation or other means to detect and record the occurrence and severity of seismic events". Such instrumentation, if equipped with an immediate evacuation alarm or procedurally coupled with emergency evacuation procedures, would obviate the need for (costly) seismic tolerance of an installed criticality accident alarm system (CAAS). If a seismic instrument is credited with performing the immediate evacuation function, the Criticality Safety Program Description Document should describe compliance with ANSI/ANS-8.3, §5.3, "Seismic Tolerance". Guidance on responding to a criticality accident including re-entry following an accident is provided in

ANSI/ANS-8.23-2007.

Conclusions

Criticality safety engineers should participate throughout all facility design stages to ensure appropriate hazard categorization of the facility, generally Hazard Category 3 or less, based on the guidance provided in the CSSG Response to Tasking 2010-02. The corresponding seismic design criterion for structures and equipment important to criticality safety would be SDC-1.

The principal role of the criticality safety engineer throughout the design process is to identify SSCs for defense-in-depth and worker safety based on their function credited in criticality safety evaluations following an earthquake. The purpose of a CAAS is to provide an immediate evacuation alarm to protect facility workers. Additional, often very large, costs associated with the seismic tolerance of criticality accident alarm systems may be avoided if emergency evacuation is provided by seismic instrumentation or earthquake evacuation procedures.

Criticality safety engineers are encouraged to work closely with structural analysts to consider possible cost savings by suggesting innovative and inexpensive preventive measures such that seismic damage does not result in a criticality accident. This would permit limit states A, B and C and not require designing to the “no damage” limit state D.

References

1. ANSI/ANS-2.26-2004, Categorization of Nuclear Facility Structures, Systems
2. ANSI/ANS-2.27-2008, Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments
3. ANSI/ANS-2.29-2008, Probabilistic Seismic Hazard Analysis
4. ANSI/ANS-8.3-1997, Criticality Accident Alarm Systems
5. ANSI/ANS-8.23-2007, Nuclear Criticality Accident Emergency Planning and Response
6. ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures
7. ASCE/SEI 43-05, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities
8. CSSG Response to Tasking 2010-02, Role of Criticality Safety in Facility Hazard Categorization
9. DOE O 413.3A, Change 1, Program and Project Management for the Acquisition of Captial Assets
10. DOE O 420.1B, Change 1, Facility Safety
11. DOE-STD-1189-2008, Integration of Safety into Design Process
12. DOE-STD-3007-2007, Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities
13. DOE-STD-3009, Change 3, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses
14. International Building Code, International Code Council, Falls Church, Virginia