

**Proposed DOE Guidance When Performing Structural Design and Analysis and Guidance for Handling Temporary Power and Lighting during Decommissioning and Demolition (D&D) Work - 11514**

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**ABSTRACT**

Decontamination and decommissioning (D&D) of facilities at U.S. Department of Energy (DOE) sites require engineering standards to safely accomplish D&D missions. Current engineering standards do not adequately address the unique situations arising during D&D activities. Therefore, it is proposed that for D&D activities, a new DOE guidance document be developed that addresses structural work using SEI/ASCE 37-02 “Design Loads on Structures During Construction” as a base document. Electrical work, as it applies to D&D activities, will be addressed through a separate new DOE guidance document.

**INTRODUCTION**

The national consensus codes provide design guidance, which ensures safe occupancy of permanent structures but which may not be applicable to D&D projects. During D&D work, the structures will be demolished and have a temporary occupancy and a temporary life span. Additional DOE guidance is needed to clarify standards to allow for safe but reduced load factors for use when performing structural calculations. For example, compliance with the existing structural codes during demolition activities may actually put workers at a higher risk because following the structural codes may preclude the use of heavy equipment. If appropriate and less-conservative safety factors are used, it is possible that heavy equipment may be safely deployed, thus removing workers from increased industrial and radiological hazards.

The purpose of this paper is to provide information about two proposed D&D Guidance documents. The first document, “Structural Code Guidance for Decontamination and Decommissioning Activities,” establishes new code guidance governing structural design and analysis during D&D phases. The second document, “Electrical Code Guidance for Decontamination and Decommissioning Activities,” provides interpretations of the NFPA 70 “National Electric Code,” Article 590, related to D&D work.

**STRUCTURAL CODE GUIDANCE FOR D&D ACTIVITIES**

The structural guidance document addresses, in tabular form, design loads on structures during D&D work, using SEI/ASCE 37-02 as its baseline document, and modifies and/or clarifies specific portions of SEI/ASCE 37-02 to make it applicable to design and analysis of structures during D&D work. The structural guidance document uses the same format used in SEI/ASCE 37-02, which consists of a standard column and an applicable commentary column.

Included in the structural guidance document are considerations for loads placed on structures during the D&D process and consideration for the temporary nature of the loads. The load factors that should be considered when designing or analyzing a structure during D&D are in Table 2.2.2 of the guidance document. The most significant change between ASCE 37-02 and the structural guidance document is allowance for reduction in equipment reactions, and/or live load factor from 1.6 to 1.2. This reduction is allowed if the maximum magnitude of the load

is known and the location in the facility where the load is placed is well defined. Impact loading of equipment on structures shall be considered in the design and analysis.

Some highlights out of the structural guidance document include:

Section 2.2.3: This section provides load combinations to consider during design and analysis of D&D structures.

Section 4.6.4: During D&D of a structure the main level of a structure may be demolished but the basement may continue to be occupied. Thus it is important that the impact of falling debris be mitigated by placing impact absorbing material down.

Chapter 6, environmental loads, allows for reduction in earthquake loads on structures (depending on location of the facility), and reduction in wind and snow loads depending on duration of the D&D of the structure.

It is important to consider natural phenomena loads for partially demolished buildings to ensure safe demolition sequence of a structure so that important load resisting members are not removed making the structure unstable.

### EXAMPLE PROBLEM

This example demonstrates the reduction in a load combination when calculating design loads using the structural guidance document versus a load combination provided in ASCE 7-95. Figure 1 is used to develop the load combination.



**Figure 1:** Lift of the ETR Reactor Vessel using a Gantry Crane.

The estimated weight of the permanent concrete floor (dead load) that the gantry crane is on is:

$$D = 350 \text{ kip}$$

The estimated weight of the equipment weight (gantry crane) plus the lifted load (reactor vessel) is:

$$DD_R = 350 \text{ kip}$$

The applicable structural guidance document load combination is:

$$1.2D + 1.2DDFML + 1.4DDVML + (1.2DDP \text{ or } 1.6DDP) + (1.2DDR \text{ or } 1.6DDR) + 1.6DDH + 0.5L$$

Where:

*D*: Dead Load

*DDFML*: D&D Fixed Material Load

*DDVML*: D&D Variable Material Load

*DDP*: D&D Personnel and Equipment Load

*DDR*: D&D Equipment Reactions

*DDH*: Horizontal D&D Loads

*L*: Live Load

The applicable ASCE 7-95 load combination is:

$$1.2(D+F+T) + 1.6(L+H) + 0.5(Lr \text{ or } S \text{ or } R)$$

Where:

*D*: Dead Load

*F*: Loads due to fluids with well-defined pressures and maximum heights

*T*: Self-Straining Force

*L*: Live Load

*H*: Load due to the weight and lateral pressure of soil and water in soil

*Lr*: Roof Live Load

*S*: Snow Load

*R*: Rain Load

For an equipment load where the maximum magnitude of the load is known and the location in the facility where the load is placed is well defined the equipment reaction load factor reduces from 1.6 to 1.2. Thus the structural guidance document load combination reduces to:

$$1.2D + 1.2DD_R = 1.2*350 \text{ kip} + 1.2*350 \text{ kip} = 840 \text{ kip}$$

The ASCE 7-95 load combination reduces to:

$$1.2D + 1.6L = 1.2*350 \text{ kip} + 1.6*350 \text{ kip} = 980 \text{ kip}$$

This example problem shows that when using the structural guidance document load combination for a well defined equipment load there is a 16% increase in the design load carrying capacity of the permanent floor. This increase may allow heavy equipment to be safely deployed, removing workers from increased industrial and radiological hazards.

## **ELECTRICAL CODE GUIDANCE FOR DECONTAMINATION AND DECOMMISSIONING ACTIVITIES**

The proposed electrical guidance document will establish or interpret new code guidance governing electrical design during D&D phases. NFPA 70, “National Electric Code,” Article 590, “Temporary Power,” is used to establish the basis of this document. This electrical guidance document provides guidance on how to interpret NFPA 70, “National Electric Code” (NEC), Article 590, “Temporary Power,” for D&D electrical requirements at DOE sites.

The NEC was written to regulate electrical installations; consequently, all provisions may not be suitable for D&D activities. Having an electrical guidance document that clarifies the code to make it applicable for temporary installations for D&D activities would ensure safety as well as efficiency and consistency during temporary use of electrical utilities and isolations.

The electrical guidance document format is similar to the NEC, Article 590 code in that each page consists of two text columns. The first column includes the new D&D code interpretation; the second column includes the applicable commentary to the code interpretation. The numbering system of the electrical guidance document matches the numbering system used in the NEC, Article 590 code, which facilitates quick reference between the two documents. Several sections in the electrical guidance document simply state required modifications or additions to the existing text in the NEC code and do not restate the entire code section.

### **Highlights of Proposed Electrical Code Guidance for D&D**

[Apply temporary power standard to D&D buildings and structures](#)

[Allow support structures for D&D \(i.e. trailers\) to be powered under temporary power rules and guidance](#)

[Require use of separate ground conductors](#)

[Install temporary cords on jersey barriers and fencing](#)

### **CONCLUSIONS**

The structural guidance document for D&D provides engineers guidance on how to calculate load combinations when performing a design or analysis for a structure undergoing D&D.

The electrical guidance document for D&D provides clarification and interpretation of NEC section 590 to make it applicable to D&D activities.

### **REFERENCES**

Draft DOE GUIDANCE, “ELECTRICAL CODE GUIDANCE FOR DECONTAMINATION AND DECOMMISSIONING ACTIVITIES.”

Draft DOE GUIDANCE, “STRUCTURAL CODE GUIDANCE FOR DECONTAMINATION AND DECOMMISSIONING ACTIVITIES.”

ANSI/ASCE 7-05, “Minimum Design Loads for Buildings and Other Structures.”

NFPA 70, NEC

SEI/ASCE 37-02, “Design Loads on Structures During Construction.”