# Review of

# Natural Phenomena Hazards (NPH) Requirements Currently Applied to the Thomas Jefferson National Accelerator Facility (TJNAF)

**By:**

**Integrated NPH Team:**

**David Luke, Lead, TJSO**
**Rusty Sprouse, JSA**
**Michael A. Epps, TJSO**
**Richard Korynta, TJSO**

**March 2014 (updated Oct 2014)**

**A Review of Natural Phenomena Hazards (NPH) Requirements Pertaining to the Thomas Jefferson National Accelerator Facility (TJNAF)**

## Summary

Except as noted in the next paragraph, the NPH requirements contained in DOE O 420.1C, *Facility Safety*, along with the NPH requirements of DOE-STD-1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, are applicable. However, these requirements are already being met via existing TJNAF practices (i.e., the Order does not impose additional requirements above TJNAF normal conduct of business.)

The NPH periodic review requirements contained in DOE O 420.1C, att. 2 chapter IV, sections 3.d(1) and 3.d(2), do not apply to TJNAF and should be removed from the TJNAF Contract.

- [Note: requirements only applicable to nuclear facilities have already been excluded from the Contract and thus are not discussed in this review. Specifically, portions of sections 3.a (nuclear safety basis documentation), 3.c (safety SSCs), and all of 3.c(1) were removed from the contract.]

TJNAF is exempt from the NPH standards invoked by EO 12941, *Seismic Safety of Existing Federally Owned or Leased Buildings*.

The DOE-approved TJNAF implementation plan for DOE O 420.1C, dated Aug. 16, 2013, should be revised to reflect the above conclusions.

**Background:** In 2013, DOE O 420.1C, att. 2 chapter IV, *Natural Phenomena Hazards Mitigation*, was placed in the DOE/JSA Contract, minus a few sentences applicable only to nuclear facilities as noted above. Executive Order (EO) 12941 and DOE-STD-1020-2012 are both invoked by DOE O 420.1C.

TJNAF is currently working to an implementation plan to become fully compliant with the requirements contained in these documents. Additionally, seismic ground motion studies have already been performed on select TJNAF facilities.

## Basis for No Additional Actions on Order Requirements that are Applicable

1. DOE O 420.1C ,att. 2 ch. IV section 3.b states, *"[Design] Requirements for non-nuclear facilities are described in Section 2.1 of DOE-STD-1020-2012.*"

2. Section 2.1 of DOE-STD-1020-2012 states, "*For facility risk categorization and design of SSCs subjected to seismic, wind, flood, and precipitation (snow, ice, and rain) loads, the criteria and guidelines given in ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures, shall be used.*"
    a. STD-1020 also discusses that ASCE/SEI 7-10 may be used only if the facilities are less than an NPH Design Category (NDC) of 3, (e.g., STD-1020 section 2.1.5 discusses the potential for a higher NDC determination for facilities with significant hazards). At TJNAF, all facilities are < NDC 3, as discussed below:
        i. Radiological hazard: Utilizing Table A-1, Appendix A of DOE STD-1189, *Integration Of Safety Into The Design Process*, TJNAF facilities would categorize as Seismic Design Category (SDC) 1. Specifically, unmitigated dose to a collocated worker from an NPH event would be < 5 rem. This was analyzed in the TJNAF Final Safety Assessment Document (rev. 7), Table 4-5 Hazards, *Postulated Initiating Events, and Worst-Case Accident Scenarios*.
        ii. Chemical hazard: It takes a significant chemical hazard to screen equivalent to "safety significant" (as a thumb rule, safety significant = SDC 2). Specifically, it would take a Protective Action Criteria (PAC) 2 exposure to the public, or a PAC-3 exposure to a co-located worker. Chemical exposures at this level could not happen at TJNAF. This was analyzed in the DOE-approved TJNAF hazard survey (i.e., the *Jefferson Lab Technical Basis Document for Emergency Planning, Rev. 5.0)*. Thus, TJNAF chemical hazards would categorize as SDC 1. [Reference Appendix B of DOE STD-1189, Introduction and section B.2.]
        iii. SDC levels correspond with the NDC levels, meaning a 1 in SDC translates to a 1 in NDC. Thus TJNAF radiological and chemical hazards would categorize well below NDC 3.

3. ASCE/SEI 7 is invoked by reference into the International Building Code (IBC) for facilities with a NDC of < 3 (i.e., TJNAF). [Note: IBC is the "code of record" for all TJNAF buildings.] A few of the many examples of ASCE/SEI 7 invoked by IBC include (from the 2006 IBC edition):
    a. 1613.1 Scope. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of ***earthquake*** motions in accordance with ASCE 7.
    b. 1608.1 General. Design ***snow*** loads shall be determined in accordance with Chapter 7 of ASCE 7…
    c. 1609.1.1 Determination of wind loads. ***Wind loads*** on every building or structure shall be determined in accordance with Chapter 6 of ASCE 7.

4. Because TJNAF only contains < NDC 3 facilities *and* TJNAF designs to IBC, TJNAF thus meets STD-1020, which in turn means <u>TJNAF currently meets all the Order's</u>

NPH design requirements (i.e., ch. IV sections 3.a (*General Requirements*), 3.b (*NPH Design Criteria*), and 3.c (*NPH Accident Analysis*.)

Note: Per language in the Order ch. IV section 2, APPLICABILITY, the following sections constitute the NPH Design Requirements (i.e., not just section 3.b): sections 3.a, 3.b, and 3.c.

Lastly, for the remaining ch. IV Order sections:

- Section 3.e (Seismic Detection) is already being met via utilizing nearby monitoring at Fredericksburg, VA (Lab declared full compliance with this section in the Implementation Plan).
- Section 3.f (Post-Natural Phenomena Procedures) is met via severe weather inspection procedures such as the Facilities and Logistics Management Disaster Recovery Plan. (Lab declared full compliance with this section in the Implementation Plan.)

**Basis for Non Applicability of DOE O 420.1C Sections 3.d(1) and 3.d(2), NPH Assessments/Upgrade Evaluations, and**
**Basis for TJNAF exemption from NPH standards invoked by EO 12941**

1. (upcoming rev?) DOE O 420.1C, att. 2 ch. IV section 3.d(1) states, "*section 9.2 of DOE-STD-1020-2012 contains criteria and guidance for performing these reviews* [NPH assessments]."

   *and*

   (upcoming rev?) DOE O 420.1C, att. 2 ch. IV section 3.d(2) states, "Section 9.3 of DOE-STD-1020-2012 contains guidance on performing upgrade evaluations."

2. Section 9 (which is inclusive of section 9.2 and 9.3 mentioned above) of STD-1020 states, "*… Criteria and guidance for evaluation of existing nuclear, radiological, and chemical hazard facilities with SSCs in NPH Design Categories below NPH Design Category 3 is given in Section 2.1.4.*"
   - TJNAF is a "below NPH Design Category 3", as discussed previously.

3. Section 2.1.4 of STD-1020 states,

   "*To comply with Public Law 101-614 and Executive Order 12941, Seismic Safety of Existing Federally Owned or Leased Buildings, the guidelines provided in the Interagency Committee on Seismic Safety in Construction's (ICSSC) RP-8, Standards of Seismic Safety for Existing Federally Owned and Leased Buildings, shall be used to:*
   - *determine when a seismic evaluation and retrofitting of an existing non-nuclear facility will be necessary; and*

- *establish the evaluation and mitigation requirements...*"

  Background: Issuance of EO 12941 invoked by reference the ICSSC series, including RP-8 via the following language in the EO, "*The Standards of Seismic Safety for Existing Federally Owned or Leased Buildings (Standards), developed, issued, and maintained by the Interagency Committee on Seismic Safety in Construction (ICSSC), are hereby adopted as the minimum level acceptable for use by Federal departments and agencies in assessing the seismic safety of their owned and leased buildings and in mitigating unacceptable seismic risks in those buildings.*"

4. ICSSC RP-8, Section 1.3.b, states, "*Exemptions. The following buildings are exempt from the [ICSSC] Standards: … All buildings located where $S_{DS}$ < 0.330 g and $S_{D1}$ < 0.133 g unless designated for an occupancy-based performance objective."*
   - Background: $S_{DS}$ and $S_{D1}$ are the Design Earthquake Spectral Response Acceleration Parameters at short periods and at a 1 second period, respectively, as defined in ASCE-7. They are spectral accelerations that are measures of shaking intensity at a site. The value of $S_{DS}$ is more applicable to short stiff buildings and $S_{D1}$ is more applicable to taller, more flexible buildings.

5. Based on TJNAF having a Soil Site Class D, $S_{DS}$ = 0.137 and $S_{D1}$ = 0.08. This meets the above spectral acceleration criteria.

6. The second criteria of the exemption is the site must not have an occupancy-based performance objective. TJNAF meets this criteria.
   - Background: Occupancy-based performance objectives are assigned by each agency at their discretion. These objectives are more stringent than Life Safety performance, targeted for those buildings where it is necessary to control damage to maintain function in the post-earthquake period. Occupancy-based objectives are generally appropriate for what building codes call "essential" facilities, such as fire, rescue, police stations, hospitals, etc. [reference ICSSC RP-8, Sections 1.1.2 and C1.1.2.]

7. Because TJNAF meets the ICSSC exemption criteria,
   - <u>The NPH standards of EO 12941 are not applicable</u>. This in turn means that the DOE-1020-2012, section 2.1.4 NPH review and upgrade criteria for non-nuclear facilities do not apply. Consequently,
   - By reference in the Order, <u>sections 3.d(1) and 3.d(2) of DOE O 420.1C are not applicable</u>.

**Citations**:

DOE O 420.1C, *Facility Safety*
https://www.directives.doe.gov/directives/0420.1-BOrder-c/view

DOE-STD-1020-2012, Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities
http://energy.gov/sites/prod/files/2013/06/f1/DOE-STD-1020-2012.pdf

ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures*
*(available by subscription)*

International Building Code
(available by subscription)

DOE STD-1189, Integration of Safety Into The Design Process
http://energy.gov/sites/prod/files/2013/06/f1/DOE-STD-1189-2008.pdf

Public Law 101-614, *National Earthquake Hazards Reduction Program Reauthorization Act*
http://www.gpo.gov/fdsys/pkg/STATUTE-104/pdf/STATUTE-104-Pg3231.pdf

Executive Order 12941, *Seismic Safety of Existing Federally Owned or Leased Buildings*
http://www.wbdg.org/ccb/FED/FMEO/eo12941.pdf

Interagency Committee on Seismic Safety in Construction (ICSSC) Recommended Practice 8 (ICSSC RP 8), *Standards of Seismic Safety for Existing Federally Owned and Leased Buildings* (NIST GCR 11-917-12)
http://www.gsa.gov/portal/mediaId/154235/fileName/ICSSC_RP8_December_2011_508c.action