



Department of Energy
Thomas Jefferson Site Office
12000 Jefferson Avenue, Suite 14
Newport News, Virginia 23606

August 12, 2009

Dr. Hugh E. Montgomery
President and Laboratory Director
Jefferson Science Associates, LLC
Thomas Jefferson National Accelerator Facility
12000 Jefferson Avenue
Newport News, VA 23606

Dear Dr. Montgomery:

**REVIEW OF THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY
(TJNAF) NUCLEAR FACILITY HAZARD CATEGORIZATION, 10CFR830 SUBPART A**

Attached is the DOE Office of Science review of applicability/implementation of 10 CFR 830, subpart B, *Nuclear Safety – Safety Basis Requirements*, and DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, at the Thomas Jefferson National Accelerator Facility from May 5-7, 2009. All of the review criteria were met and no Findings were noted. Two observations (best management practices) were identified for your consideration. This report has received a factual accuracy review from Jefferson Science Associates and comments have been dispositioned.

If you have any questions pertaining to this review, please contact me or David Luke of my staff at extension 7139.

Sincerely,

James A. Turi, Manager
Thomas Jefferson Site Office

Enclosure

cc w/encl:
M. Dallas
M. Logue
B. Lenzer
V. Vylet
K. Welch
R. Kelly, SC-OR

DOE Office of Science
Review of Thomas Jefferson National Accelerator Facility
Nuclear Facility Hazard Categorization



August 10, 2009

**Report for Office of Science (SC) – Review of
Thomas Jefferson National Accelerator Facility
Nuclear Facility Hazard Categorization**

Signature Page

Carol G. Sohn

August 10, 2009

Carol Sohn, Team Leader

Date

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**Report for Office of Science (SC) – Review of
Thomas Jefferson National Accelerator Facility
Nuclear Facility Hazard Categorization**

Executive Summary:

DOE Office of Science (SC) conducted an off-site review of implementation of DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, Change Notice 1 (CN1), September 1997 (see Reference 2) at the Thomas Jefferson National Accelerator Facility (TJNAF) from May 5-7, 2009. The SC Senior Nuclear Safety Advisor was requested by the SC Deputy Director for Field Operations to verify implementation of DOE-STD-1027 for SC facilities as part of an extent of condition review.

Ten criteria from DOE-STD-1027 and 10CFR830, Subpart B (see Reference 20) were used. All of the ten review criteria were met. The review identified two observations in accordance with the Office of Science Management System (SCMS) procedure, *Quality Assurance and Oversight* (see Reference 21).

No Level 1 (L1) findings were identified.

No Level 2 (L2) findings were identified.

Two Level 3 findings (includes observations) were identified as follows:

- **FIND-OBS-01: Some items were identified in the TJNAF self assessment that if improved would ensure greater accuracy and robustness of the self assessment.**
- **FIND-OBS-02: It is recommended that TJNAF identify the potential for criticality limits in their existing procedures since the U²³⁵ limit is significantly below the threshold quantity so that if the mission would evolve, inventories not associated with accelerator operations remain below the potential for criticality limits.**

The review did not identify any noteworthy practices (NWP).

TJNAF activities are primarily associated with accelerator operations. The inventories associated with accelerator operations are still significantly below the Hazard Category 3 threshold quantities. Very small quantities of inventory are used in conjunction with work not related to accelerator operations. TJNAF does not use most of the ground rules of DOE-STD-1027 since their inventories are very small. Staff were knowledgeable of most of the ground rules of DOE-STD-1027. Procurement procedures exist to control the flow of radiological inventories into the Laboratory. Informal processes and subject matter experts ensure that inventories remain below the Hazard Category 3 threshold quantities. Unless there are changes to the TJNAF mission, the existing processes with some recommended enhancements should be adequate.

**Report for Office of Science (SC) – Review of
Thomas Jefferson National Accelerator Facility
Nuclear Facility Hazard Categorization**

Background: During the past three years, the Office of Science (SC) has identified several sites that have not appropriately applied use of DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, Change Notice 1, September 1997, resulting in incorrect hazard categorization of nuclear facilities. 10CFR830, Subpart B, *Safety Basis Requirements*, states that "contractors shall categorize facilities consistent with DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, Change Notice 1, September 1997". Based upon discussions with the SC Deputy Director for Field Operations, the Senior Nuclear Safety Advisor was requested to verify implementation of DOE-STD-1027 for SC facilities as part of an extent of condition review. A review plan (see Reference 5) was prepared utilizing ten criteria from DOE-STD-1027 and 10CFR830 Subpart B. This report documents the review of the Thomas Jefferson National Accelerator Facility (TJNAF) for hazard categorization in conformance with DOE-STD-1027-92, Change Notice 1, September 1997 (referred to as DOE-STD-1027 for the remainder of this document). The review was completed off-site by the Office of Science Senior Nuclear Safety Advisor (SNSA) with assistance by the Thomas Jefferson Site Office (TJSO). TJNAF mission is focused on three major research topics that study the structure of nuclear matter:

- Structure of the nucleus;
- Structure of nucleons; and
- Tests of the standard model

Scientists are using the Continuous Electron Beam Accelerator Facility to study completeness of the standard model. The Lab is operated by Jefferson Science Associates, LLC for the Department of Energy under contract DE-AC05-06OR23177. TJNAF has two accelerators with multiple support buildings and equipment. There are currently no declared Hazard Category 2 or 3 nuclear facilities. In preparation for this review, TJNAF performed a self assessment that confirmed that radiological inventories were primarily associated with accelerator operations.

The review team utilized the Office of Science Management System (SCMS) procedure on *Quality Assurance and Oversight* (see Reference 21) for categorizing findings and practices. Findings were defined as an identified inadequacy with implementation of a requirement. Findings were categorized as Levels 1, 2, or 3. This categorization was necessary to identify the degree of management formality and rigor required for the correction, tracking to closure, and trending of findings. Listed below is an explanation of each of the levels.

- **Level 1 Findings**
These are issues of major significance that warrant a high level of attention on the part of line management. Typically these reflect a gap in addressing requirements or a systemic problem with implementing the requirements. If left uncorrected, this level of finding could negatively impact the adequacy of operations and/or accomplishment of the SC mission.
- **Level 2 Findings**
These are issues that represent a non-conformance and/or deviation with implementation of a requirement. Multiple issues at this level, when of a similar nature, may be rolled-up together into one or more Level 1 Findings.

- **Level 3 Findings**

These are issues where it is recognized that improvements can be gained in process, performance or efficiency already established for meeting a requirement. This level of finding should also include minor deviations observed during oversight activities that have been promptly corrected on the spot and verified as completed. This level includes observations.

Good practices of benefit to other organizations, lessons learned or exemplary performance were also to be identified and documented as noteworthy practices (NWP).

The discussion that follows describes the evaluation of each of the ten review criteria identified in the review plan (see Reference 5).

Criterion Evaluation:

1. *The SC site has categorized facilities consistent with DOE-STD-1027, Change Notice 1. (10CFR830.202)*

Thomas Jefferson National Accelerator Facility (TJNAF) is located in Newport News, Virginia. Most of the radiological inventory is used in conjunction with accelerator operations. Two sources associated with accelerator operations exceed the Hazard Category 3 threshold quantities and are discussed in greater detail under criterion 5. These sources are excluded since they meet the special form criteria and are associated with accelerator operations. There are limited quantities of radiological materials used outside of the accelerator activities. The total inventory of radiological materials excluding the two accelerator sources as of February 2009 was approximately 9% of the Hazard Category 3 threshold quantities.

In preparation for the DOE review, TJNAF performed a self assessment. Some minor items were identified by DOE that TJNAF has agreed to address. These items were focused on ensuring greater accuracy and robustness of the self assessment as the mission may evolve and included:

- Removal of Table 5 from the self assessment
- Separating/identifying sealed sources in Table 3 that are used exclusively for accelerator support operations
- Showing the sum of fractions value for the sealed sources that are not excluded as special form
- Deletion of duplicate Am²⁴¹ entry that resulted in higher inventory quantities than actually exist

FIND-OBS-01: Some items were identified by DOE in the TJNAF self assessment that if improved would ensure greater accuracy and robustness of the self assessment.

TJNAF has procurement processes to oversee the acquisition of radiological materials. The procurement process does not identify the thresholds in DOE-STD-1027. But, procurements of radioactive materials must be approved by the Radiation Control Group. There is a Health Physics procedure that specifically states that any source acquired or brought physically to the site must comply with DOE-STD-1027 limits.

This criterion was met.

2. *The SC site has adequately categorized facilities either as Hazard Category 1, 2 or 3 or not applicable depending only on the quantities of radioactive material in the facility given the threshold quantities in Table A.1 as well as the appropriate ground rules for evaluating the facility (DOE-STD-1027-92, Change Notice 1, Section 3.1).*

TJNAF personnel were very familiar with the most of the ground rules of DOE-STD-1027. The site utilizes the exclusion of materials associated with accelerator operations for almost all radiological inventories. TJNAF has appropriately concluded that there are no hazard category 1, 2 or 3 nuclear facilities.

TJSO conducted a field walkthrough to confirm inventories associated with accelerator operations. For the facilities checked, radiological materials were associated with accelerator operations.

This criterion was met.

- 3. The SC site has determined final hazard categorization based on an "unmitigated release" of available hazardous material. For the purposes of hazard categorization, "unmitigated" is meant to consider material quantity, form, location, dispersibility and interaction with available energy sources, but not to consider safety features (e.g., ventilation system, fire suppression, etc.) which will prevent or mitigate a release. (DOE-STD-1027-92, Change Notice 1, section 3.1.2)**

The inventories at TJNAF are very small relative to applications not associated with accelerator operations. As a conservative method, TJNAF has looked at all radiological inventories and is still significantly below the Hazard Category 3 threshold quantities. TJNAF has based their information on unmitigated release.

This criterion was met.

- 4. As applicable, the SC site has appropriately utilized facility segmentation consistent with the ground rules of Attachment 1 of DOE-STD-1027. (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-1)**

Based upon a review of the site map and interviews, TJNAF does not segment any facilities. No inadequacies were identified.

This criterion was met.

- 5. As applicable, exclusions of sealed sources used by the SC site are consistent with 49CFR173.469 or testing specified by ANSI N43.6 for hazard categorization. The facility has documentation that the source or prototypes of the source have been tested and passed the tests specified by DOT or ANSI. The facilities also have a source control policy that complies with DOE Notice 5400.9, "Sealed Source Control Policy" and the source control policy specified in Article 431 of the DOE Radiological Control Manual (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-1)**

An inventory of sealed sources at TJNAF that were excluded from the inventory was provided to the review team. Two sealed sources (Cs¹³⁷ and Am²⁴¹/Beryllium) were excluded as special form items although both are associated with accelerator operations. Under 10CFR830, Subpart B, accelerator materials may be excluded. No discrepancies were identified.

TJNAF provided a listing of the remaining sealed sources which were well below the Hazard Category 3 threshold quantities.

TJNAF utilizes EH&S Manual Part 3 as their sealed source control policy.

This criterion was met.

- 6. As applicable, exclusions of commercially available products used by the SC site for hazard categorization are consistent with 10CFR30, Parts 30.11-30.19 and include timepieces, illumination devices, thermostats, electron tubes, microwave receiver tubes, etc. (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-2)**

TJNAF does not include commercially available products in its radioactive material inventory. There is no formal exclusion of such products in their source control procedure. No discrepancies were identified.

This criterion was met.

- 7. As applicable, exclusions of material contained in DOT Type B shipping containers (with or without overpack) with current certificates of compliance used by the SC site for hazard categorization are consistent with Attachment 1. Materials stored are authorized by the certificate. (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-2)**

TJNAF does not exclude any radiological materials in Type B shipping containers. This exclusion is not used by TJNAF. No discrepancies were identified.

This criterion was met.

- 8. As applicable, the SC site has appropriately categorized facilities that are involved with an inventory of hazardous materials that vary with time on the basis of their maximum inventory of hazardous materials. (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-2)**

The radiological inventories at TJNAF are fairly small even including accelerator operations. Inventory information and interviews indicated that staff understood the concept of maximum inventory.

This criterion was met.

- 9. As applicable, the SC site has categorized facilities consistent with Attachment 1 related to the potential for criticality for the lower threshold values of three isotopes (Pu^{239} , U^{233} and U^{235}). (DOE-STD-1027-92, Change Notice 1, Attachment 1, page A-12)**

Inventories at TJNAF are very small. While Table 4 of the TJNAF self assessment indicated the low fissile quantities for isotopes such as Pu^{239} , U^{233} and U^{235} , the footnote in Attachment 1 of DOE-STD-1027 associated with the potential for criticality listed was not described. TJNAF needs to ensure that the U^{235} Hazard Category 2 criticality limit (700g) is understood and maintained since this limit is lower than the Hazard Category 3 threshold quantity (1.9E06g). TJNAF is relying upon experts within their health physics area to understand this nuance of DOE-STD-1027. **FIND-OBS-02: It is recommended that TJNAF identify the potential for criticality limits in their existing procedures since the U^{235} limit is significantly below the threshold quantity so that if the mission would evolve, inventories not associated with accelerator operations remain below the potential for criticality limits.** Note that the current quantity of U^{235} at TJNAF is still well below this limit.

This criterion was met.

- 10. Exemptions to 10CFR830, Subpart B are consistent with 10CFR820 Subpart E. (10CFR830, page 1816-1817 and 10CFR820.60)**

TJNAF currently has no exemptions to 10CFR830, Subpart B. Under 10CFR830, Subpart B, TJNAF can exclude radiological inventories associated with accelerator operations. Use of radiological materials outside of accelerator operations is incidental and very small. A walkthrough of some areas at TJNAF was performed by TJSO and confirmed that inventories were associated with accelerator operations.

This criterion was met.

Summary of Findings: This review identified no Level 1 findings, no Level 2 findings and three Level 3 finding (includes observations). Listed below is each of the findings:

Level 1 Findings:

None

Level 2 Findings:

None

Level 3 Findings:

FIND-OBS-01: Some items were identified in the TJNAF self assessment that if improved would ensure greater accuracy and robustness of the self assessment.

FIND-OBS-02: It is recommended that TJNAF identify the potential for criticality limits in their existing procedures since the U²³⁵ limit is significantly below the threshold quantity so that if the mission would evolve, inventories not associated with accelerator operations remain below the potential for criticality limits.

Noteworthy Practices (NWP):

None

Conclusion:

TJNAF activities are primarily associated with accelerator operations. The inventories associated with accelerator operations are still significantly below the Hazard Category 3 threshold quantities. Very small quantities of inventory are used in conjunction with work not related to accelerator operations. TJNAF does not use most of the ground rules of DOE-STD-1027 since their inventories are very small. Staff were knowledgeable of most of the ground rules of DOE-STD-1027. Procurement processes, health physics procedure and subject matter experts exist to control the flow of sources and ensure that inventories remain below the Hazard Category 3 threshold quantities. All ten review criteria were met. The two observations provide opportunities to enhance the TJNAF self assessment and formality to prevent exceeding Hazard Category potential for criticality limits. Unless there are changes to the TJNAF mission, the existing processes with some recommended enhancements should be adequate.

Documents reviewed:

- Letter from M. Logue to J. Turi on Request for JSA Determination of Applicability of 10CFR830, Subpart B, dated March 6, 2009
- Email from C. Sohn to S. Mallette, Questions for TJLab, dated March 25, 2009
- TJNAF EH&S Manual RadCon Supplement, Radioactive Source Controls, revised December 10, 2004
- TJSO Field Walk-Through in Support of the department of Energy - Office of Science Extent of Condition Review of Nuclear Facility Hazard Categorization, D. Luke, June 10, 2009
- Letter from M. Logue to J. Turi, Jefferson Lab's Factual Accuracy Review of the Draft report of Thomas Jefferson National Accelerator Laboratory Nuclear Facility Hazard Categorization, July 9, 2009
- Jefferson Lab Site map

Interviews conducted:

- Deputy Associated ES&H Director
- Associate Director
- TJSO Facility Representative
- TJSO Deputy Site Office Manager
- Oak Ridge Office (ORO) Accelerator subject matter expert

Observations completed:

- Field Walkthrough completed by TJSO

References:

- 1) DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis*, Change Notice No. 3, March 2006
- 2) DOE-STD-1027-92, Change Notice No. 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, September 1997
- 3) LA-12981-MS, *Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides*
- 4) LA-12846-MS, *Specific Activities and DOE-STD-1027-92 Hazard Category 2 Thresholds*, November 1994
- 5) *DOE Headquarters Office of Science Review Plan Review of SC Facilities Nuclear Facility Hazard Categorization*, January 12, 2009
- 6) DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, Volume 1, Change Notice No. 1, March 2000
- 7) ANSI/ANS-8.1-1983, *American National Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*
- 8) ANSI/HPS N43.6-1997, *Sealed Radioactive Sources – Classification*, November 1997
- 9) 49 CFR 173, Part 173.469, *Tests for Special Form Class 7 (Radioactive) Materials*
- 10) DOE N 5400.9, *Sealed Radioactive Source Accountability*, expired December 24, 1995
- 11) DOE-STD-1098-99, *Radiological Control, Part 3 (431), Sealed Radioactive Source Controls*, March 2005
- 12) DOE N 234.1, *Reporting of Radioactive Sealed Sources*, expires February 27, 2009
- 13) 10 CFR 30, Parts 30.11 through 21, *Byproduct Material Exemptions*
- 14) 49 CFR 173, Part 173.403, *General Requirements for Shipments and Packagings – Definitions*
- 15) 49 CFR 173, Part 173.416, *Authorized Type B Packages*
- 16) 49 CFR 173, Part 173.417, *Authorized Fissile Materials Packages*
- 17) 49 CFR 173, Part 173.431, *Activity Limits for Type A and Type B Packages*
- 18) 49 CFR 173, Part 173.435, *Table of A₁ and A₂ Values for Radionuclides (A₁ – values for special form and A₂ – values for normal form)*
- 19) 49 CFR 173, Part 173.436, *Exempt Material Activity Concentrations and Exempt Consignment Activity Limits for Radionuclides*, October 1, 2007
- 20) 10CFR830, Subpart B, *Safety Basis Requirements*, January 10, 2001
- 21) SCMS Quality Assurance and Oversight, *Issues Management, Procedure 1., Managing Issues Identified in Oversight Activities*, March 20, 2008