



Department of Energy
Thomas Jefferson Site Office
12000 Jefferson Avenue, Suite 14
Newport News, Virginia 23606
April 19, 2010

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:

DOE RADIATION PROTECTION ASSESSMENT MARCH 2010

The enclosed Radiation Protection Program Assessment Final Report documents the Department of Energy's (DOE) review of Jefferson Laboratory's (JLab) Radiation Protection program. This report has received a factual accuracy review from JLab and comments have been dispositioned. The assessment identified two Findings; (P-2 Findings), eight Observations (P-3 Findings), and two Proficiencies. This assessment did not include a review of 10 CFR 835 Subpart I, *Reports to Individuals*, and 10 CFR 835 Subpart N, *Emergency Exposure Situations*.

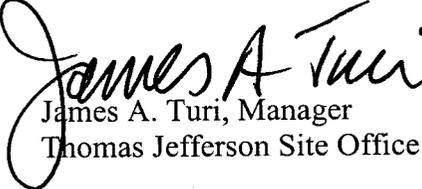
For the two Findings, please submit within thirty days of receipt of this letter a Corrective Action Plan (CAP) for Site Office approval. At a minimum, the corrective action plan (CAP) should identify each P-2 Finding, a description of the actions taken or committed to, and the JLab Corrective Action Tracking System (CATS) entry number. Prior to closing out the Findings in CATS, please ensure the Site Office has concurred with closure. Additionally, please contact Thomas Jefferson Site Office if any deviation from the CAP is anticipated (i.e., significant change in scope or time to closure, etc.).

Due to the repetitive and programmatic nature of Finding RP.3-P2-002, the Site Office intends to perform an effectiveness review at a later date to validate that the corrective action(s) have prevented recurrence of similar issues. Also, the Very High Radiation Area posting issue discussed in Section 3 of pages B-7 and B-8 does not have to be addressed at this point in time, pending discussions with DOE headquarters.

The Site Office recommends the eight Observations be reviewed for implementation, as they would strengthen the JLab radiation protection program. In the above mentioned CAP, please identify disposition of the Observations.

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

Sincerely,


James A. Turi, Manager
Thomas Jefferson Site Office

Enclosure

cc w/encl:
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M. Dallas
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**U.S. Department of Energy
Thomas Jefferson Site Office**

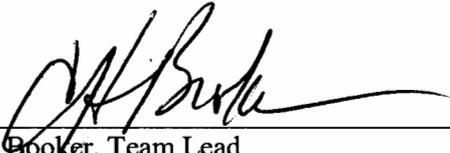


Final Report

**Radiation Protection Program
Assessment of the Thomas Jefferson
National Accelerator Facility**

April 2010

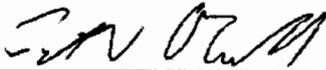
Approval



Craig H. Booker, Team Lead
DOE Oak Ridge Office

4/12/2010

Date



Peter O'Connell, Team Member
DOE Office of Health, Safety and Security

4-09-2010

Date

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Acronyms and Abbreviations

| | |
|---------------|---|
| ALARA | As Low As Reasonably Achievable |
| ARM | Assigned Radiation Monitor |
| Be-7 | Beryllium-7 |
| CFR | Code of Federal Regulations |
| DAC | Derived Air Concentration |
| DOE | U.S. Department of Energy |
| HSS | Office of Health, Safety and Security |
| HQ | Headquarters |
| P | Priority |
| PPE | Personal Protective Equipment |
| PRO | Proficiency |
| RCD or Radcon | Radiation Control Department |
| RCM | Radiation Control Manual |
| RCT | Radiation Control Technician |
| RMA | Radioactive Material Area |
| RPP | Radiation Protection Program |
| RWI | Radiation Worker I |
| RWII | Radiation Worker II |
| RWP | Radiological Work Permit |
| TJNAF | Thomas Jefferson National Accelerator Facility, Jefferson Laboratory, or JLab |
| TJSO | Thomas Jefferson Site Office |

Definitions

| | |
|-------------|---|
| P1 Finding | Findings of major significance. (Examples include imminent threats to worker protection, public safety, or environmental quality or the presence of a major risk or vulnerability). Such findings can be a systematic breakdown in, or a failure to implement, a major work control element necessary for safety, quality, or the environment or a significant noncompliance with requirements. |
| P2 Finding | Findings that represent nonconformances, deviations, and/or deficiencies in the implementation of requirements, procedures, standards, and/or regulatory requirements. |
| P3 Finding | Observations that the assessor deems to be an isolated, minor, quick fix or nonadherence to best practices/internal procedures/accepted standards. |
| Proficiency | A performance item that exhibits a level of performance deemed worthy of communicating to other organizations because it is innovative or may be indicative of the highest level of excellence. Formerly-used terms that meant essentially the same thing were Noteworthy Practice and Strength. |

**Final Report
Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility**

1.0 PURPOSE

At the request of the U.S. Department of Energy (DOE) Thomas Jefferson Site Office (TJSO) Manager, an assessment was conducted to evaluate the implementation of the Code of Federal Regulations (CFR)-required Radiation Protection Program at the Thomas Jefferson National Accelerator Facility (TJNAF, Jefferson Lab, or JLab). The assessment was conducted on February 22–25, 2010.

2.0 SCOPE

This assessment included a performance-based evaluation of the implementation of work practices, engineered controls, and selected management system elements. The specific scope elements scheduled for verification included the following objectives:

- RP.1 A Radiation Protection Program has been approved by the DOE and has been implemented.
- RP.2 Workers' radiological exposures are maintained As Low As Reasonably Achievable (ALARA).
- RP.3 Radiological workplace controls have been developed and implemented.
- RP.4 Personnel are appropriately qualified and trained commensurate with radiological work activities.
- RP.5 Radiological records are completed and maintained as required.

The above objectives were assessed by reviewing the implementation of applicable Jefferson Laboratory procedures, management systems, and regulations. This assessment did not include a review of 10 CFR 835 Subpart I, *Reports to Individuals*, and 10 CFR 835 Subpart N, *Emergency Exposure Situations*.

3.0 REQUIREMENTS

For the scope of this assessment, the performance criteria include Title 10 CFR Part 835, *Occupational Radiation Protection*, and Jefferson Laboratory radiation protection procedures.

4.0 ASSESSMENT METHODS

4.1 Conduct of the Review

The assessment was conducted in accordance with an approved review plan and the applicable TJSO procedure. The review was conducted on site the week of February 22-25, 2010. An opening briefing was conducted on February 22, and a closeout briefing was conducted on February 25.

The assessment was a performance-based assessment in that the team verified that the requirements of 10 CFR 835 (except as identified in Section 2.0 above) are in place in Jefferson Lab's procedures and adequately implemented in practice. The assessment approach included:

- Review of procedures, documents, and records.
- Interviews with line management, operations, and operations support personnel.
- Observation of current work practices.

4.2 Assessment Review Criteria

Appendix A provides the review objectives and criteria for the assessment. These requirements-based criteria were developed to ensure that the scope of the assessment was aligned with 10 CFR 835. Five objectives were evaluated during the assessment.

4.3 Forms

The reviewers completed assessment forms for each of the five objectives reviewed to document the results of the review and the basis for the conclusions reached. These assessment forms contain the discussion of the results and are included in Appendix B.

5.0 FINDINGS AND PROFICIENCIES

5.1 Findings

Two Priority 2 (P2) findings and eight P3 findings were identified during the review.

- RP.1-P2-001** JLab is not complying with the conditions granted by a 10 CFR 835 June 1998 exemption decision which allows JLab to use higher surface contamination values for beryllium-7 (Be-7) in meeting 10 CFR 835 requirements.
- RP.3-P2-002** Numerous radiological areas were not posted and labeled in accordance with 10 CFR 835, Subpart G, *Posting and Labeling*, and JLab Procedure HPP-SUR-005, *Radiological Posting*.
- RP.1-P3-001** The JLab RCM does not adequately reflect the site's current Radiation Protection Program.
- RP.1-P3-002** JLab may benefit from having a more formal mechanism for scheduling 10 CFR 835 audits to ensure compliance with the 36-month time requirement.
- RP.1-P3-003** Peer review audits could be improved by providing audit team members who have limited radiological backgrounds with focused training such as DOE HDBK-1141-2008, *Radiological Assessor Training*.
- RP.3-P3-004** The assumptions used in the technical basis document explaining why an internal dose monitoring program was not needed at JLab were not reasonable, both conservatively and non-conservatively.
- RP.3-P3-005** JLab does not perform any periodic bioassay sampling to validate the assumptions in the technical basis and confirm its position that the performance of bioassays, in accordance with 10 CFR 835, is not required.
- RP.3-P3-006** Many radiological work permits (RWPs) often listed high and low levels of required training (i.e., Radiation Worker I [RWI] and Radiation Worker II [RWII]), but often did not indicate which portions of work in the RWP required the higher level of training.

RP.3-P3-007 There was no technical basis showing that the airborne radioactivity posting did not have to be based on the 12 derived air concentration (DAC)-hours in a week.

RP.4-P3-008 The JLab Radiation Protection Program may benefit from updating its training to adequately address radiological beacons, Be-7 labeling requirements, and the Radioactive Material Area (RMA) labels.

5.2 Proficiencies

Two proficiencies were identified during the course of the review.

RP.1-PRO-001 Having radiological protection personnel from other laboratories participate in JLab's annual peer review helps assure that its program audits are performed by highly qualified radiation protection individuals.

RP.3-PRO-002 The KeyWatcher system used by JLab to control and dispense the exempt sources requested by seal source users was considered to be a proficiency (PRO).

6.0 CONCLUSION

JLab has a DOE-approved Radiation Protection Program (RPP) which adequately addresses the requirements of 10 CFR 835 and adequately covers all the types of radiological activities conducted on site. However, JLab is not complying with the conditions granted by a 10 CFR 835 June 1998 exemption decision which allows JLab to use higher surface contamination values for Be-7 in meeting 10 CFR 835 requirements. One P2 finding and three P3 findings were issued for Objective RP.1—Radiation Protection Program. There was also a proficiency noted for Objective RP.1 which was given for having radiological personnel from other laboratories participate in JLab's annual peer review.

Workers' radiological exposures are maintained As Low As Reasonable Achievable (Objective RP.2). In addition, management's commitment to keeping exposures ALARA was apparent.

JLab uses a combination of its Radiological Control Manual and Procedure HPP-SUR-005 to specify requirements for radiological posting, labeling, and control of areas (Objective RP.3). The team reviewed these requirements, and several areas of improvement were noted during the review. One P2 finding and four P3 findings were identified by the team.

The team reviewed the lesson plans and exams for RWI and RWII training (Objective RP.4) and verified that randomly selected individuals had the appropriate level of training as specified on the radiological work permit by which they performed work. One area for improvement was noted by the review team. This was in the area of updating training to adequately address radiological beacons, Be-7 labeling requirements, and RMA labeling.

During the conduct of this assessment, the team reviewed a variety of radiological records associated with the functional areas identified in 10 CFR 835 (Objective RP.5). The team determined that JLab has a radiological records program that appears to be compliant with 10 CFR 835 Subpart H.

While there is room for improvement in the Radiation Protection Program at TJNAF, the team determined that all of the five objectives were met.

Appendix A – Review Objectives and Criteria

Objectives and Review Criteria

OBJECTIVE RP.1: A Radiation Protection Program has been approved by the DOE and has been implemented.

CRITERIA:

- Is there a DOE approved RPP?
- Does the RPP adequately address the requirements of 10 CFR 835?
- Does the RPP include formal plans and measures for applying the as low as reasonably achievable process to occupational exposure?
- Are radiological activities being conducted in accordance with the RPP?
- Are identified guides and technical standards, that are to be adopted as the means to meet 10 CFR Part 835, being followed?
- Does the RPP clearly identify any exemptions that have been approved from the subject requirements?
- If yes, are the conditions on the exemption decision being implemented?
- Does the site RPP adequately cover all the types of radiological activities conducted?
- Are updates of the RPP submitted to DOE as required?
- Are changes submitted whenever a change or an addition to the RPP is made?
- Are changes submitted prior to the initiation of a task not within the scope of the RPP?
- Are subcontractor activities addressed in an approved RPP (are they covered under a single site-wide RPP or do subcontractors have their own RPPs)?
- Do the audit plans and completed audits include examination of program content and implementation?
- Are assessors who review program content qualified (per 835.103)?
- Do the audit plans and completed audits reflect that the process ensures that all functional elements are reviewed no less frequently than every 36 months?
 - Are there adequate qualification standards for the personnel reviewed?
- Do the records show that, for the personnel reviewed, personnel meet qualification standards and have completed required training and retraining?
- Are procedures commensurate with the radiological hazards created by the activity?
 - Are procedures technically adequate?
 - Are the procedures consistent with the education, training, and skills of the individuals exposed to those hazards?
 - Are affected personnel knowledgeable of procedure requirements and understand their role in effectively implementing requirements?
- Are procedures effectively implemented?

OBJECTIVE RP.2: Workers' radiological exposures are maintained As Low As Reasonably Achievable.

CRITERIA:

- Is there evidence of management commitment to the ALARA program?
- Is there evidence of ALARA training consistent with the provisions of 10 CFR 835.103 and 835.901?
- Are the plans and measures for applying the ALARA process to occupational exposures reflected in procedures that are commensurate with the expected level of exposure, per §835.104?
- Are the design and control provisions in 10 CFR 835 subpart K being met?
- Is there evidence of either physical design features (e.g., confinement ventilation, remote handling, shielding) or administrative controls in radiological work areas?

- Were optimization methods used to ensure that exposure is maintained ALARA in developing facility design and physical controls?
- Do the dose rates in facilities built or modified after 1995 meet the design objectives? – ALARA and less than 0.5 mrem/hr for a continuously occupied area.
- In facilities built or modified after 1995, are there design features that minimize the chance of releases of airborne radioactive materials and should a release occur, do these features control intakes to levels that are ALARA?
- During routine operations, are doses in any workplace greater than the limits in 835.202?
- Do the physical and administrative controls in place implement the ALARA process?

OBJECTIVE RP.3: Radiological workplace controls have been developed and implemented.

CRITERIA:

- Is area monitoring performed to: (1) Document radiological conditions, (2) Detect changes in radiological conditions, (3) Detect the gradual buildup of radioactive material, (4) Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure, and (5) Identify and control potential sources of individual exposure to radiation and/or radioactive materials?
- Through document reviews and interviews, determine the frequencies of radioactive surface contamination surveys. Are these frequencies appropriate?
- For the radionuclide being measured, are the field or laboratory instruments used to analyze surface swipes or to take direct surface contamination measurements sufficiently sensitive to detect the surface contamination at the levels specified in Appendix D of 10 CFR 835?
- Are the instruments and equipment used for monitoring: (1) Periodically maintained and calibrated on an established frequency; (2) Appropriate for the type(s), levels, and energies of the radiation(s) encountered; (3) Appropriate for existing environmental conditions; and (4) Routinely tested for operability?
- Is airborne radioactivity monitored where an individual is likely to receive an exposure of 40 or more DAC-hours in a year?
- Is airborne radioactivity monitored as necessary to characterize the airborne radioactivity hazard where respiratory protective devices are required for protection against airborne radionuclides?
- Is real-time air monitoring performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material?
- Are packages received from transportation containing radioactive material exceeding a Type A quantity (as defined in 10 CFR 71.4) monitored for external radiation levels?
- Are packages received from transportation containing radioactive material (other than special form or gaseous materials) monitored for surface contamination?
- Is the monitoring of packages containing radioactive material described above completed as soon as practicable following receipt of the package, but not later than 8 hours after the beginning of the working day following receipt of the package?
- Are RWPs required for:
 - Entry into radiological areas?
 - Handling of materials with removable contamination that exceed the values of 10 CFR 835?
 - Work in localized benchtop areas, laboratory fume hoods, sample sinks, and containment devices that have the potential to generate contamination in areas that are otherwise free of contamination?
 - Work that disturbs the soil in soil contamination areas?
 - Work that involves digging in underground radioactive material areas?

- Do the RWPs adequately describe the:
 - Work activities?
 - Work area radiological conditions?
 - Dose rate?
 - Contamination levels?
 - Airborne levels?
 - Dosimetry requirements?
 - Pre-job briefing requirements?
 - Training requirements for entry?
 - Protective clothing and respiratory protection requirements?
 - Radiological control coverage requirements and stay time controls?
 - Limiting radiological conditions that may void the RWP?
 - Special dose or contamination reduction considerations (ALARA reviews)?
 - Special personnel frisking considerations?
- Do the RWPs have authorizing signatures?
- Have people signed in or out on the RWPs as required?
- Observe ongoing work – are people adhering to RWP requirements?
- Discuss with workers and Radiation Control Technicians (RCTs) – are they knowledgeable about their RWP and its requirements and the work area radiological conditions?
- Do individuals have General Employee Radiation Training equivalent prior to unescorted access to controlled areas (see 835.901(a))?
- Are personnel entry controls maintained for each radiological area?
- Is the degree of control commensurate with existing and potential radiological hazards within the area?
- Does access to radiological areas require appropriate training?
- Are one or more of the following methods used to ensure control?
 - Signs and barricades
 - Control devices on entrances
 - Conspicuous visual and/or audible alarms
 - Locked entrance ways
 - Administrative controls
- Are control(s) installed at radiological area exits such that they will not prevent rapid evacuation of personnel under emergency conditions?
- For each entry into a high radiation area:
 - Is the area monitored as necessary during access to determine the exposure rates to which the individuals are exposed?
 - Is each individual monitored by a supplemental dosimetry device or other means capable of providing an immediate estimate of the individual's integrated deep dose equivalent during the entry?
- Are adequate controls established (per 10 CFR 835.502(b)) for each entrance or access point to a high radiation area where radiation levels exist such that an individual could exceed a deep dose equivalent to the whole body of 1 rem (0.01 sievert) in any one hour at 30 centimeters from the source or from any surface that the radiation penetrates?
- Are additional measures implemented (per 10 CFR 835.502(c)) to ensure individuals are not able to gain unauthorized or inadvertent access to very high radiation areas?
- Is protective clothing required for entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in 10 CFR 835?
- Is the selection and use of the protective clothing appropriate for the hazard?
- Are individuals exiting contamination, high contamination, or airborne radioactivity areas monitored for the presence of surface contamination?

- Is the monitoring adequate?
- Do postings and labels include the standard radiation warning trefoil in black or magenta imposed upon a yellow background?
- Are signs clearly and conspicuously posted and do they include radiological protection instructions?
- Do site procedures adequately require posting and labeling consistent with 10 CFR 835?
- Are areas posted as required by 10 CFR 835?
- Are items and containers appropriately labeled?
- Do labels provide sufficient information to permit individuals handling, using, or working in the vicinity of the items or containers, to take precautions to avoid or control exposures?
- Does the site control the release of material and equipment with removable surface contamination levels on accessible surfaces exceeding the removable surface contamination values specified in 10 CFR 835?
- Does the site control the release of material and equipment if prior use suggests that the removable surface contamination levels on inaccessible surfaces are likely to exceed the removable surface contamination values specified in 10 CFR 835?
- Does the site implement appropriate monitoring and controls for the movement on-site from one radiological area for immediate placement in another radiological area of material and equipment with removable surface contamination values exceeding the values specified in 10 CFR 835?
- Does the site control material and equipment with fixed contamination levels that exceed the total surface contamination values specified in 10 CFR 835 which is released for use in controlled areas outside of radiological areas?
- Are removable surface contamination levels below the removable surface contamination values specified in 10 CFR 835?
- Is the material or equipment routinely monitored and clearly marked or labeled to alert personnel of the contaminated status?
- Are appropriate controls maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions?
- Are areas in which contamination levels exceed the values specified in 10 CFR 835 controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels?
- Are areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in 10 CFR 835 adequately controlled when located outside of radiological areas?
- Are the areas routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in 10 CFR 835?
- Are the areas conspicuously marked to warn individuals of the contaminated status?
- Is each accountable sealed radioactive source inventoried at intervals not to exceed six months?
- Does the inventory establish the physical location of each accountable sealed radioactive source; verify the presence and adequacy of associated postings and labels; and establish the adequacy of storage locations, containers, and devices?
- Is each accountable sealed radioactive source subject to a source leak test upon receipt, when damage is suspected, and at intervals not to exceed six months?
- Is the source leak test capable of detecting radioactive material leakage equal to or exceeding 0.005 microcurie?
- Are sources stored in a controlled location, subject to periodic inventory, and subject to source leak testing prior to being returned to service?

- Are accountable sealed radioactive sources, found to be leaking radioactive material, controlled in a manner that minimizes the spread of radioactive contamination?

OBJECTIVE RP.4: Personnel are appropriately qualified and trained commensurate with radiological work activities.

CRITERIA:

- For General Employee Radiation Training equivalent, has each individual completed radiation safety training on the topics established at § 835.901(c) commensurate with the hazards in the area and the required controls?
- Was the training provided/required before individuals were permitted unescorted access to controlled areas?
- Was the training provided/required before individuals received occupational dose during access to controlled areas at a DOE site or facility?
- Was the training provided/required before individuals were permitted unescorted access to radiological areas?
- Was the training provided/required before performing unescorted assignments as a radiological worker?
- Have individuals completed radiation safety training, examinations, and performance demonstrations required for entry to the area and performance of the work?
- Do procedures require that all escorted individuals comply with the documented radiation protection program?
- Does the retraining include successful completion of an examination?

OBJECTIVE RP.5: Radiological records are completed and maintained as required.

CRITERIA:

- Does the site have a records retention program?
- Per § 835.1(c), are individual monitoring records collected and maintained for occupational exposure resulting from activities excluded from 10 CFR 835 (e.g. work for the Nuclear Regulatory Commission)?
- Are these records used to assess compliance with the dose limits in § 835.202?
- Per § 835.4, are the quantities for radioactivity, absorbed dose, dose equivalent and exposure, used in records indicated in units of curie, rad, roentgen, or rem?
- Are records maintained to document doses received by all individuals for whom monitoring was required pursuant to § 835.402 and to document doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of § 835.402, and authorized emergency exposures?
- Are the results of individual external and internal dose monitoring that is performed, but not required by § 835.402, recorded? Recording of nonuniform shallow dose equivalent to the skin is not required if the dose is less than 2 percent of the limit specified for the skin at § 835.202(a)(4).
- Are the records sufficient to evaluate compliance with the dose limits in subpart C of 10 CFR 835?
- Are the records sufficient to provide dose information necessary to complete reports required by subpart I of 10 CFR 835?
- Do the records include the following quantities for external dose received during the year: (i) The effective dose equivalent from external sources of radiation (deep dose equivalent may be used as effective dose equivalent for external exposure); (ii) The lens of the eye dose equivalent; (iii) The shallow dose equivalent to the skin; and (iv) The shallow dose equivalent to the extremities?

- Do the records include the following information for internal dose resulting from intakes received during the year: (i) Committed effective dose equivalent; (ii) Committed dose equivalent to any organ or tissue of concern; and (iii) Identity of radionuclides?
- Do the records include the following quantities for the summation of the external and internal dose: (i) Total effective dose equivalent in a year; (ii) For any organ or tissue assigned an internal dose during the year, the sum of the deep dose equivalent from external exposures and the committed dose equivalent to that organ or tissue; and (iii) Cumulative total effective dose equivalent?
- Do the records include the dose equivalent to the embryo/fetus of a declared pregnant worker?
- Has documentation of all occupational doses received during the current year (except for doses from planned special exposures and emergency exposures) been obtained to demonstrate compliance with the dose limits in § 835.202(a)?
- Have reasonable efforts been made to obtain complete records of prior years occupational internal and external doses for workers monitored in accordance with § 835.402?
- Are the records specified in this section, that are identified with a specific individual, readily available to that individual?
- Have data necessary to allow future verification or reassessment of the recorded doses been recorded?
- Does the records management program include a process to ensure that all records required by this section be transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals?
- Have the results of monitoring for radiation and radioactive material, as required by subparts E and L of this part (except for monitoring required by § 835.1102(d)), been documented and maintained?
- Have the results of monitoring used to determine individual occupational dose from external and internal sources been documented and maintained?
- Have the results of monitoring for the release and control of material and equipment (as required by § 835.1101(d)) been documented and maintained?
- Have the results of maintenance and calibration performed on instruments and equipment (as required by § 835.401(b)) been documented and maintained?
- Have training records been maintained, to demonstrate compliance with § 835.901?
- Have actions taken to maintain occupational exposures ALARA (including the actions required for this purpose by § 835.101, as well as facility design and control actions required by §§ 835.1001, 835.1002, and 835.1003) been documented?
- Have records been maintained to document the results of internal audits and other reviews of program content and implementation?
- Have records containing written declarations of pregnancy, including the estimated date of conception, and revocations of declarations of pregnancy been maintained?
- Have changes in equipment, techniques, and procedures used for monitoring been documented?
- Have records been maintained to demonstrate compliance with the requirements for sealed radioactive source control, inventory, and source leak tests?

Appendix B – Completed Assessment Forms

Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility
Assessment Form

| | |
|---|----------------------------|
| Criterion/Requirement Area: | Objective ID: RP.1 |
| Approval of Radiation Protection Program | Date: February 2010 |

Objective

A Radiation Protection Program has been approved by the DOE and has been implemented.

Criteria and Lines of Inquiry

Title 10 CFR, Part 835, *Occupational Radiation Protection*
DOE-Headquarters (HQ) Office of Health, Safety and Security (HSS) Radiation Protection Lines of Inquiry

Records Reviewed

JLab Radiation Protection Program and Implementation Plan, January 4, 2008
DOE Approval of Jefferson Laboratory Radiation Protection Program and Implementation Plan, January 23, 2008
JLab Radiation Protection Audit Plan
JLab Radiation Control Manual, Revision 3, January 2004
HPP SUR-005, *Radiological Posting*, October 22, 2009
Peer Review of the JLab Radiation Protection Program, October 2009
Peer Review of the JLab Radiation Protection Program, November 2008
Peer Review of the JLab Radiation Protection Program, September 2007

Interviews Conducted

JLab – RadCon Manager
JLab – RCT, Field Operation Group Leader

Activity Observations

Experimental Halls A, B, and C

Discussion

JLab has a DOE-approved RPP which adequately addresses the requirements of 10 CFR 835 and adequately covers all the types of radiological activities conducted on site. The RPP identifies that JLab was issued a 10 CFR 835 exemption in June 1998. The exemption allows JLab to use higher surface contamination values for beryllium-7 in meeting 10 CFR 835 requirements. It was noted that a condition of the exemption decision was that the RPP shall identify locations historically known to have areas with Be-7 contamination above 10 CFR 835 Appendix D values (i.e., 1000 and 5000) and post, mark, or label them to warn individuals not to enter without the proper radiological control authorization. While the RPP cites this requirement, it does not identify these areas.

JLab personnel stated that these areas would include air handling equipment and accumulators in Halls A and C. While many of these items had labels instructing individuals to notify the Radiation Control Department (RCD or RadCon) before opening the item, several were observed to contain no such warning label. It was also noted that site procedures, such as HPP-SUR-005, did not address the requirement to label such items, nor did site procedures provide locations or discuss which areas are applicable.

The exemption decision also requires that JLab clearly state in its RPP that the exemption only applies to activities conducted in the controlled area as defined in 10 CFR 835. The JLab RPP did not state this requirement. In fact, it states “Any additional areas the criteria for the exemption shall also be marked.” Table 2-2 of the JLab Radiation Control Manual contains a footnote that restricts the use of the contamination limit as required by the exemption and requires that items released from Controlled Areas must meet the more restrictive (Appendix D) limit.

The RPP was observed to list the total contamination limit for Be-7 as “NA.” While the team recognizes that JLab has not encountered fixed Be-7 contamination, the exemption decision included a value of 30,000 dpm 100 cm². Based on interviews, activity observations, and documentation reviews, the team determined that JLab was not complying with the conditions in the June 1998 exemption decision.

The Radiation Protection audit plan for the next three years includes the functional areas identified in 10 CFR 835 and an examination of JLab's radiation protection program content and implementation. A review of the past three years of peer review audits of the program indicated that many of the assessors were highly qualified, as required by 10 CFR 835.103. Specifically, radiological protection personnel from other laboratories participate in the annual peer review and one is always assigned team lead. This exchange assures that every peer review team contains a least a few highly qualified radiation protection specialists. The team determined this to be a proficiency. However, some of the 10 CFR 835 audit team members often have no formal radiological control training beyond Radiological Worker I training (e.g., JLab Quality Assurance personnel). JLab's RPP audit program could be improved by providing these individuals with some additional training such as DOE HDBK-1141-2008, *Radiological Assessor Training*, which is offered a few times a year. The training material may be downloaded from DOE website <http://www.hss.energy.gov/HealthSafety/WSHP/radiation/RST/rstmater.htm>.

A review of past audits over the past 36 months revealed that the functional areas of 10 CFR 835 had been included in audits and assessments. As an opportunity for improvement, JLab may benefit from tracking the dates when the various 10 CFR 835 subparts are due for re-assessment (e.g., use the JLab Maximo system as a tickler/reminder).

JLab uses various manuals and procedures to implement the requirements of 10 CFR 835 and its RPP. The team reviewed the Radiation Control Manual (RCM) and determined that it did not adequately reflect the current radiation protection program at JLab. Some of the many examples in which the RCM was observed to be outdated and/or incorrect are as follows:

1. The RCM did not discuss the dosimeter type which has been in use for over a year.
2. The RCM was inconsistent in defining Very High Radiation Areas.
3. The RCM limits Assigned Radiation Monitors (ARMs) to performing radiation surveys to specified conditions in the Accelerator Enclosure and Experiment Halls. ARMs perform these surveys in other areas.

Conclusion

This objective was met.

Findings

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|--------------------|---|
| RP.1-P2-001 | JLab is not complying with the conditions granted by a 10 CFR 835 June 1998 exemption decision which allows JLab to use higher surface contamination values for beryllium-7 in meeting 10 CFR 835 requirements. |
| RP.1-P3-001 | The JLab RCM does not adequately reflect the site's current Radiation Protection Program. |
| RP.1-P3-002 | JLab may benefit from having a more formal mechanism for scheduling 10 CFR 835 audits to ensure compliance with the 36-month time requirement. |
| RP.1-P3-003 | Peer review audits could be improved by providing audit team members who have limited radiological backgrounds with focused training such as DOE HDBK-1141-2008, <i>Radiological Assessor Training</i> . |

Proficiencies

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| RP.1-PRO-001 | Having radiological protection personnel from other laboratories participate in JLab's annual peer review helps assure that its program audits are performed by highly qualified radiation protection individuals. |
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Assessed by: Craig Booker and Pete O'Connell

Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility
Assessment Form

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| Criterion/Requirement Area: Workers' Radiological Exposures | Objective ID: RP.2 Date: February 2010 |
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Objective

Workers' radiological exposures are maintained As Low As Reasonably Achievable.

Criteria and Lines of Inquiry

Title 10 CFR, Part 835, *Occupational Radiation Protection*
DOE-HQ HSS Radiation Protection Lines of Inquiry

Records Reviewed

JLab 2008 Radiation Exposure Monitoring Report

Interviews Conducted

JLab – RadCon Manager

Activity Observations

N/A

Discussion

Discussions with the RadCon Manager indicated that there is an ongoing review process. Management's commitment to keeping exposures as low as reasonably achievable was apparent. The scope and detail of the ALARA program was consistent with the levels of personnel exposures at JLab. A review of site's annual exposure records indicated that radiation exposures are kept ALARA. In 2008, the collective site dose was 1,521 mrem and only 51 individuals received a measurable radiation exposure. The individual with the highest exposure in 2008 received a dose of 173 mrem.

Conclusion

This objective was met.

Findings

None identified.

Proficiencies

None identified.

Assessed by: Craig Booker and Pete O'Connell

Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility
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| Criterion/Requirement Area: Radiological Workplace Controls | Objective ID: RP.3 Date: February 2010 |
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Objective

Radiological workplace controls have been developed and implemented.

Criteria and Lines of Inquiry

Title 10 CFR, Part 835, *Occupational Radiation Protection*
DOE-HQ HSS Radiation Protection Lines of Inquiry

Records Reviewed (list document number, title, issue date)

DOE N234.1, *Reporting of Radioactive Sealed Sources*
JLab Radiation Control Manual, Revision 3, January 2004
JLAB-TN-05-070, *Technical Basis Document for Inapplicability of Internal Dosimetry Monitoring Program at Jefferson Lab*
HPP-SUR-005, *Radiological Posting*, Revision 3, October 22, 2009
HPP-ADM-013, *Sealed Source and Radioactive Compressed Gas Control and Inventory*, Revision 4, March 3, 2009
HPP-OSP-001, *Radiological Work Permit Issuing and Tracking*, Revision 6, January 4, 2010
HPP-OSP-006, *KeyWatcher User Input*
JLab Sealed Source Tracking Log Book
JLab Active Inventory Reports, February 18, 2009, and October 5, 2009
JLab RWP 2010-G001, *Accelerator Tunnel, Hall A, Hall B, Hall C, Free Electron Laser and Associated Service Buildings*, January 31, 2010
JLab RWP 10-J001, *Hall A Target Chamber Reconfiguration and Collimator Maintenance*, January 6, 2010
JLab RWP 2010-S006, *Vertical Test Area/High Power RF Operations*, January 31, 2010

Interviews Conducted

JLab – RadCon Manager
JLab – RCT, Field Operation Group Leader
JLab – Instrument Maintenance and Calibration Manager
JLab – RCT, Sealed Source RCT

Activity Observations

Experiment Halls A, B, and C
North LINAC Area
Beam Transport Tunnel
Test Laboratory (Building 58)

Hall C Beam Dump Cooling Building (Building 95)
Experimental Equipment Lab
Sealed Sources Keywatcher System

Discussion

Radiological Posting

JLab uses a combination of its Radiological Control Manual and Procedure HPP-SUR-005 to specify requirements for radiological posting, labeling, and control of areas. The team reviewed these requirements and conducted tours to observe the radiological postings in and around various locations of JLab. Concerns were identified as discussed below.

1. Maintenance work was observed in progress adjacent to a Contamination Area established around the catch tanks for the dehumidification system in Hall C. Equipment associated with this work was observed to have been placed on top of the tanks (approximately four feet in height) inside the Contamination Area. It was observed that there was no radiological rope around the Contamination Area. The associated Contamination Area postings were observed attached to the basin sides of the catch tanks. The height of the postings (from the top of the posting signs to the floor) was approximately twelve inches. The workers were questioned about the tank area and did not appear to be aware that they were bringing their *clean* tools in and out of a Contamination Area (i.e., without a radiological contamination survey or radiological protection equipment).

Procedure HPP-SUR-005, Section 6.1, states, “Required postings on buildings and control points should be constructed at eye level when possible or at 1 to 2 meters above the ground or floor.” Contrary to the procedure, the Contamination Area postings were at floor level. This was most likely the cause of the workers being unaware they were bringing clean tools in and out of a Contamination Area.

2. The area around a Quality Assurance Quadrupole Magnet in the Hall A Beam Transport Tunnel was observed to be roped off with radiological rope and posted as a Contamination Area. However, the configuration of the rope (i.e., the front and right side of the area were double-roped) made it difficult to distinguish what components were inside or outside the Contamination Area.
3. Title 10 CFR 835 defines a Very High Radiation Area as any area accessible to individuals in which radiation levels *could* result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates. While operating, the experimental halls have dose rates above this dose threshold for extended periods of time while the accelerator tunnel has the potential for very high bursts of radiation in the event the electron beam is mis-steered. Thus, the tunnel has the potential to be a Very High Radiation Area and the experimental halls regularly contain Very High Radiation Areas, contrary to how they are currently posted (as High Radiation Areas).

Physical access controls, as listed in 10 CFR 835, are required for any entrance or access point to a High Radiation Area. For Very High Radiation Areas, additional measures must be implemented to ensure individuals are not able to gain unauthorized access. There is nothing

stated in 10 CFR 835 which provides that these controls are in addition to classifying and controlling these types of areas as High Radiation or Very High Radiation Areas. Implementing these controls does not obviate the requirement to treat these areas as high radiation or very high radiation areas.

The team recognizes that the Department needs to provide additional clarification on this topic, as DOE guidance for accelerators (DOE Guide 420.2-1) appears to conflict with DOE's guidance for 10 CFR 835 in regards to whether areas protected by interlocks need to be posted. Regardless, if posted, it must be done correctly.

4. Inconsistent wording for the same types of radiological postings were observed in the accelerator tunnel. Some stated "Do Not Enter" while others stated "Exclusion Area." Some radiation beacons had instructions posted with the beacon while others did not. The team considers optimal tunnel beacon posting/labeling as very important, since multiple, similar beacons are regularly in close proximity to each other throughout the accelerator tunnel, which can lead to confusion.
5. In the Test Lab, a posting associated with a high radiation beacon was located directly below a blue Oxygen Deficient Hazard beacon instead of the high radiation beacon.
6. As the team reviewed a Contamination Area (see #2 above), an RCT stated the Contamination Area did not have loose surface contamination. The RCT then rested his hand on a component inside the Contamination Area without use of personal protective equipment (PPE) and without surveying out. Later, at another Contamination Area (see #1 above), the workers' tools that were moved in and out of the Contamination Area were not required to be surveyed out, nor did a discussion take place with the workers regarding proper PPE, etc. Upon further discussion with the RCT, the RCT indicated that this Contamination Area also did not have loose surface contamination. Sites have latitude and are often encouraged to post conservatively. However, it is a poor conduct of operations practice to not consistently apply radiological controls commensurate with the postings, as this can perpetuate lack of respect for postings and can be confusing to the work force.
7. Inconsistent wording was observed on shelving within several RMAs in the JLab Halls as follows:
 - a. One shelf had a label that stated "Items on top shelf are radioactive and must be stored in radiological areas." The team observed that the shelf was not in a Radiological Area.
 - b. One shelf had a label that stated "Items requiring contamination survey place on this shelf" and, on the same shelf, a label that stated "Rad shelf released."
 - c. A sign stating "This shelf is for items awaiting radcon surveys" was on one shelf while a sign stating "This shelf is for potentially contaminated components" was on another. It was unclear what the difference in the intent of the posting was and what items could go on which shelf.

- d. One shelf in an RMA was labeled “Items requiring contamination survey place on this shelf” while an adjacent posting stated “Place items to be surveyed on bottom shelf.”

Numerous radiological areas were not posted and labeled in accordance with 10 CFR 835, Subpart G, “Posting and Labeling” and JLab Procedure HPP-SUR-005, *Radiological Posting*. A 2007 peer review of JLab also detailed posting/labeling concerns. The report finding statement read, “The review panel identified several problems with the radiological posting. Radiological postings were found to be inconsistent, out of date, with incorrect wordings (per 10 CFR 835) and confusing.” (Reference Observations 12 – 14 and 18 – 20 of the report.)

Radiological Work Permits, Surveys, and Instrument Calibration

The team reviewed most of the job specific radiological work permits for the year 2009. The RWPs were appropriately completed and indicated appropriate reviews and approvals. The team reviewed radiological surveys supporting the RWPs and noted that they were well documented and provided sufficient information to identify and control radiological hazards. The team randomly selected several radiological instruments used in conducting the surveys associated with the RWPs and found them all to be within the required calibration date. It was observed on many of the RWPs that both Radiological Worker I and Radiological Worker II training were required with no explanation of which tasks listed on the RWP required which level of the training. The team was told that it was left up to the RCT to know which tasks required what training and to relay the information to the workers. It was noted that a few RWPs did list which steps required the higher level of training; however, it was not consistently applied.

Three active RWPs (one job-specific, one standing, and one general) were reviewed. All appeared to be well documented, including attached radiological surveys, job briefing sheets, and sign-in sheets. The instruments used in conjunction with the RWP’s surveys were within their calibration due date. The training records of 37 individuals who performed work in accordance with the RWPs were reviewed, and all of these were observed to be current.

Sealed Sources Program

The JLab RCD currently tracks 143 radioactive sources as part of its sealed source and radioactive compressed gas inventory. Of these sources, 12 are accountable in accordance with 10 CFR 835. Active Inventory Reports were reviewed and indicated that all of the sealed sources (accountable and exempt) are inventoried and leak tested semi-annually. Discussions with RCD personnel and document reviews indicated the leak tests were capable of detecting radioactive material leakage equal to or exceeding 0.005 microcurie. The accountable sealed sources were maintained in the RCD source locker and the calibration range. Observations of these locations and the accountable sealed sources revealed that the sources were adequately stored and posted. Discussions with the Sealed Source RCT indicated that there have been no instances to date where accountable sources were found to be leaking. Specific training for source users is documented on the Sealed Source User Agreement sheets which were observed to be maintained by the Sealed Source RCT.

JLab uses the KeyWatcher system to control the exempt sources requested by sealed source users. The team reviewed the system and was provided a demonstration of its use. Essentially, the sealed sources are physically stored in three electronically locked boxes in the Experimental Equipment Lab Building and controlled by a software database maintained by the Sealed Source RCT. Once the required training has been completed and authorization has been granted electronically by the Sealed Source RCT, the sealed source users can access a specific source assigned to them by using their JLab site badges. This system assists the RCD in tracking sealed sources and maintaining an efficient inventory, as well as providing a history of source use and user activity.

In summary, the JLab sealed source and radioactive compressed gas inventory is well documented and maintained by a very competent staff. The KeyWatcher system used to control and dispense the exempt sources requested by seal source users was considered by the team to be a proficiency.

Internal Dosimetry Technical Basis

The team reviewed the technical basis explaining why an internal dose monitoring program was not needed at JLab. The technical basis makes some very nonconservative assumptions, such as an individual only working in a Hall for 12 hours. It also frequently uses unrealistically conservative assumptions (e.g., internal exposure scenarios). Additionally, it does not analyze a scenario for surface contamination becoming airborne and leading to an intake.

Since the technical basis will need to be updated to support the 10 CFR 835 July 2010 implementation due date, this is an opportune time to revise the technical basis to make defensible assumptions in the exposure scenarios. Also, JLab should consider a small periodic bioassay sampling program to validate the assumptions in the technical basis and confirm its position that the performance of bioassays in accordance with 10 CFR 835 is not required.

Experimental Halls A and C have airborne radioactivity warning postings which activate at 1 DAC. Title 10 CFR 835 requires this posting but also includes a requirement to post areas where an individual could receive 12 DAC hours in a week (0.3 DAC on average). There was no technical basis showing that the airborne radioactivity posting did not have to be based on the 12 DAC- hours in a week. This should be included in the internal dosimetry technical basis revision.

Conclusion

This objective was met.

Finding

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| RP.3-P2-002 | Numerous radiological areas were not posted and labeled in accordance with 10 CFR 835, Subpart G, <i>Posting and Labeling</i> , and JLab Procedure HPP-SUR-005, <i>Radiological Posting</i> . |
| RP.3-P3-004 | The assumptions used in the technical basis document explaining why an internal dose monitoring program was not needed at JLab were not reasonable, both conservatively and non-conservatively. |
| RP.3-P3-005 | JLab does not perform any periodic bioassay sampling to validate the assumptions in the technical basis and confirm its position that the performance of bioassays in accordance with 10 CFR 835 is not required. |
| RP.3-P3-006 | Many RWPs often listed high and low levels of required training (i.e., RWI and RWII), but often did not indicate which portions of work in the RWP required the higher level of training. |
| RP.3-P3-007 | There was no technical basis showing that the airborne radioactivity posting did not have to be based on the 12 DAC- hours in a week. |

Proficiencies

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| RP.3-PRO-002 | The KeyWatcher system used by JLab to control and dispense the exempt sources requested by seal source users was considered by the team to be a proficiency. |
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Assessed by: Craig Booker and Pete O'Connell

**Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility
Assessment Form**

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|---|---|
| Criterion/Requirement Area: Personnel Training | Objective ID: RP.4 Date: February 2010 |
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Objective

Personnel are appropriately qualified and trained commensurate with radiological work activities.

Criteria and Lines of Inquiry

Title 10 CFR, Part 835, *Occupational Radiation Protection*
DOE-HQ HSS Radiation Protection Lines of Inquiry

Records Reviewed

JLab Radiation Protection Program and Implementation Plan, January 4, 2008
Radiological Worker I Study Guide, Revision 2.0, 1996
Radiological Worker II Study Guide, April 2007
Radiological Worker I Exams
Radiological Worker II Exams
Radiological Control Technician Qualification Records
Accelerator Tunnel Worker Awareness Training
Training completion records for selected personnel

Interviews Conducted (list titles only)

JLab – RadCon Manager
JLab – Radiological Training Manager
JLab – Tunnel Access Trainer

Activity Observations

N/A

Discussion

The team reviewed the lesson plans and exams for Radiological Worker I and II training and verified that randomly selected individuals had the appropriate level of training as specified on their RWP by which they performed work. No deficiencies were observed in this area. The team reviewed the training and qualification program records for selected RCTs and the records of completed training for ARMs. Again, no deficiencies were noted. The team noted that JLab needs to update its training materials to reflect the amendment to 10 CFR 835 by July 2010. The team informed JLab that DOE has updated training material available for its use in developing the updated training material.

The team noted three areas for improvement in the training program as follows:

1. Training is needed on the radiation beacons used in the Accelerator Tunnel and Experiment Halls. The radiation beacons indicate that a radiological hazard exists or could exist not in the area where the beacon is located, but in the adjacent area, contrary to how beacons are most often utilized in industry and in DOE. The individual who provides tunnel access training stated that she does explain the beacons and their location; however, the training material did not reflect that this topic was covered in the training. Discussions with JLab personnel who recently completed tunnel access training indicated that they did not recall discussions regarding beacons. The team determined that a clear description of the beacon use is needed in the training materials.
2. As addressed earlier, the 10 CFR 835 Be-7 exemption granted to JLab requires labeling of items with historic Be-7 contamination at specified levels. The team determined that training provided to radiological workers and RCTs could be improved by specifically detailing how the JLab radiation protection program works with regards to the exemption.
3. As addressed earlier, JLab uses multiple labels for the storage of materials in RMAs. The team determined that additional training explaining the various labels and their intent would benefit radiological workers and RCTs.

Conclusion

This objective was met.

Findings

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|--------------------|---|
| RP.4-P3-008 | The JLab Radiation Protection Program may benefit from updating its training to adequately address 1) radiological beacons, 2) Be-7 labeling requirements, and 3) the RMA labels. |
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Proficiencies

None identified.

Assessed by: Craig Booker and Pete O'Connell

**Radiation Protection Program Assessment of the
Thomas Jefferson National Accelerator Facility
Assessment Form**

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| Criterion/Requirement Area: Radiological Records | Objective ID: RP.5 Date: February 2010 |
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Objective

Radiological records are completed and maintained as required.

Criteria and Lines of Inquiry

Title 10 CFR, Part 835, *Occupational Radiation Protection*
DOE-HQ HSS Radiation Protection Lines of Inquiry

Records Reviewed

JLab Radiation Protection Program and Implementation Plan, January 4, 2008

Interviews Conducted

JLab – RadCon Manager
JLab – Radiological Training Manager
JLab – RCT, Field Operation Group Leader

Activity Observations

N/A

Discussion

In the conduct of this assessment, the team reviewed a variety of radiological records associated the functional areas identified in 10 CFR 835. The types of records reviewed are as follows:

1. Documentation of radiological monitoring used to control individual occupational dose from external sources
2. Records documenting surveys for the release and control of material and equipment
3. Records of maintenance and calibration performed on instruments and equipment
4. Training records, including RWI and RWII student guides, exams, practical factors and records of completion of training for selected individuals; ARM training records of completion of training for selected individuals; RCT exams; job performance qualification records; and Tunnel Access Training, lesson plan, and overhead slides
5. Internal audits and other reviews of program content and implementation
6. Records to demonstrate compliance with the requirements for sealed radioactive source control, inventory, and source leak tests

The team determined that JLab has a radiological records program that appears to be in compliance with 10 CFR 835 Subpart H.

Conclusion

This objective was met.

Findings

None identified.

Proficiencies

None identified.

Assessed by: Craig Booker and Pete O'Connell