PEER REVIEW OF THE RADIATION CONTROL PROGRAM AT THE THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

September 5, 2007 – September 7, 2007

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Executive Summary

Starting Wednesday, September 5, 2007 through Friday, September 7, 2007, a review was conducted of the Thomas Jefferson National Laboratory (TJNAF) radiological control program. The TJNAF radiological control program is defined as those functions required by 10 CFR 835 (Occupational Radiation Protection), DOE Order 435.1 (Radioactive Waste Management), and DOE Order 5400.5 (Radiological Environmental Protection). The Review Panel examined the program for regulatory compliance, efficacy, and resource optimization.

The Review Panel consisted of:

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Invited Observers: Linda Even, Steve Neilson, David Luke (TJSO),

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Results

The assessment of the program resulted in 5 findings and 37 Observations. Also the Team provides some recommendations for consideration by the TJNAF staff for radiological program improvements. Although any actual corrective actions contemplated by the TJNAF staff will be the result of their own assessment of the

findings, root cause analysis to determine the underlying issues and the development of appropriate corrective action plans.

The Panel found that the Radiological Control Group (RCG) is in addition to providing comprehensive health and safety support, provides important programmatic support (e.g., shielding design, experiment support, and detector development). The dosimetry program, instrument calibration, shielding design, and radiological engineering are adequate except the lack of defense in depth. TJNAF needs additional independent technical review of details of radiological engineering calculations.

The panel found that currently the radiological control operations are marginal. The panel recognizes that this review occurred at a time that the RCG is going through several transitions: TJNAF has just hired a new radiological control manager, three new radiological control technicians (RCTs) who are in the process of getting trained and the lab is in the process of filling one more RCT position. After all the RCTs are fully trained and put in operation, this program can be re-evaluated for adequacy.

The team noted because of the workload of the RCG and paying attention to immediate needs, attention to some routine operations has been less than what could be termed good practice. This is evidenced, for example, in the areas of posting, entry control and lack of required documentation of work accomplished. Preparation for compliance with the new 10CFR835, the 12 GeV upgrade and Hall D operations could agrevate this situation further. However, we think that the additional new staff will help to significantly improve the program.

Several noteworthy practices are identified. The Panel has several observations, findings, and recommendations that may help ensure the quality of the radiological control program.

While the audit team was focused to identify the compliance, efficiency and resource optimization of the TJNAF's radiological control program several good practices were observed, some of which we are compelled to note:

- Calibration Facility and program is in excellent shape and well managed.
- Engineered radiation detectors for use in the Vertical Test Area and the beam lines to monitor operations and control exposure.
- The radiological environmental monitoring program is well managed. The radiological environmental monitoring detector enclosures have been modified to mitigate problems with seasonal temperature variations. Environmental and public doses and their TJNAF source terms are very well understood and tracked.

Methodology

The Panel reviewed the following document

- The previous peer review reports from 2002 and 2004.
- Independent assessment reports of 10CFR835 subparts B(IA-2007-01), F,G (IA-2007-011), H, I (IA-2006-01, 3/15/06), L(IA-2006-4)
- Revision 3 of the TJNAF Radiation Control Manual (RadCon Manual)
- Sample employee training records
- Radiation Work Permits for halls A, B and C and VTA
- Various documents regarding the investigation of activated untagged diagonastic equipment, including the draft ORPS report.
- Various related Radiological Control procedures.
- Various Survey maps

Presentations

- Overview of the RadCon Program by K. Welch,
- Radiation Budgeting for Experimental Programs by P. Degtiarenko
- 12 GeV Upgrade by P. Degtiarenko

Tours

- Vertical Test Area
- Hall A, B and C experimental Areas
- Instrument calibration and repair facilities

Interviews and discussions with

- Keith Welch
- Vashek Vylet
- Robert May
- RCG technicians and their supervisors
- VTA operator

Random employees working in Hall C

Findings

A finding results from one or more observations and is what the review team would consider to be a more basic cause of observation(s). A finding is a potential violation of 10CFR835 or could lead to serious regulatory problems. Specific observations can be corrected ad nauseam, but until the more basic cause of the observations is corrected the probability of that observation recurring is very high.

- Radiological postings

The review panel identified several problems with the radiological posting. Radiological postings were found to be inconsistent, out of date, with incorrect wordings (per 10CFR835) and confusing. (O12 - O14, O18 - O20)

- Entry control issues

Entry controls into the radiological areas depend on RWP, postings, barriers and training. The review panel found RWPs and the attached survey maps did not reflect the existing radiological conditions. Specific RWPs for work in specific radiological areas did not exist. Different access points to a radiological area had different radiological postings. Access to Contamination Areas should have tighter controls. (O23 - O26, O12- O15)

- Radioactive material controls

Current procedures and techniques are not sufficient to find all radioactive materials in a reasonable time. A technical basis document for the release of radioactive material specific to TJNAF was not made available to the team. Such a document should be reviewed for current requirements and practices since it was last updated in 1990. Current technique of leaving suspect radioactive materials outside the radiological areas for later determination and tagging by RCG is not sufficient. Material with tags should not have found their way back into the radiological areas. Material from Contamination Areas should not be mixed with non-contaminated material. Material released from the radiological areas should not be allowed to stay at the locations where new material are placed for survey and release status determination. Cross contamination is possible. (O2 – O4, O9 - O11, O15 - O16, O19)

- Training

Not all RCTs have gone through a DOE approved core training and practical class room training for all RCT functions are provided. Some new RCTs, that have had training at places other than TJNAF, more than ten years ago, are credited with current RCT qualifications without formal qualification training; however they do receive facility specific, task specific training. Procedures and training modules for all RCT functions do not exist. (O1, O6 – O7)

- Shielding assessments

Radiological shielding design calculations are not checked by an independent expert reviewer. Optimization documentations, per 10CFR835.1002a do not exist. (O27, O28)

Observations

Observations are viewed as statement of fact based on the information gathered by one or more of the audit team members.

A. Radiation Controls Department personnel were interviewed

O1. One individual currently administers the dosimetry program, which is contracted out to Global Dosimetry, along with other multiple duties. This individual has been with the radiological controls organization for 15 years acting in many operational roles including a Radiological Control Technician, and back up for sampling of water and soil around the site.
The radiation protection group performs the sampling most of the time since no other group at TJNAF has that function, such as the maintenance group. Interview with individual showed minimal knowledge on LCW systems, expected sampling results and action levels of abnormal radioactivity conditions (i.e. when is a spill a Contamination issue).
Asked one RCT about the tritium activity controls levels regarding contamination controls, spill actions and minimum detectable activity (MDA) levels were. The individual did not know.

O2- At the time of our review there was a call for a scheduled "Clean up day", a period when many personnel from around the laboratory participate in cleaning the halls and tunnels, including personnel who do not work in such areas, and who would be escorted by RCG personnel. Removed materials are surveyed and released by radiation protection personnel. The release criteria of 2 times background with the **Bicron Microrem-meter** was stated by the interviewee and others during our review period.

O3- When asked about a technical basis document describing these release criteria and whether they thought this was adequate for all the isotopes produced, a document was not produced by the individual. Note: *it would have been expected a release action to include a test for low energy isotopes in addition to the Bicron Microrem-meter such as the use of a GM pancake detector in addition to the photon detector*.

O4- Tour of the site with other radiation protection personnel also verified the release criteria and policy. RP personnel were observed surveying material for release with a Bicron Microrem-meter. The instruments did not have audible response which responds faster then a meter face.

O5- When asked for training records for one of the interviewee and of another RCT, the records were easily retrieved, which showed the RCT courses were current.

O6. Newly hired individual (July 2007) has many years of previous experience in the radiological field as a Navy ELT and a RCT contractor for nuclear power plants. The last time the individual worked in the radiological industry was 1993. The individual is not considered fully qualified RCT but has been trained to perform many of the routine functions in the radiation protection field group.

O7- The RCG supervisor stated that an individual is "fully qualified" when a *modified* DOE core academics exam is completed. No formal classroom training was being offered since the RCT was credited with previous experience.

B. Facility Tours 9/5/07 and 9/6/07

O8- Several hours were spent with a newly hired RCT, visiting various areas of TJNAF conducting various routine tasks. The individual conducted some surveys of materials and toured various areas including North LINAC elevator area, LINAC housing, FEL, and Hall A. All areas had been shutdown for many weeks.

O9- RCT personnel visit locations where materials leave accelerator housings twice a day and materials are generally placed in a roped area if that area is outside of accelerator housings.

O10- While these areas were established, the postings were in some cases in poor condition, poorly installed, some misspelled and in many instances there were multiple versions of the same caution signs.

O11- The technician surveyed some materials and questioned some materials in a trash bag container stating that he would draw a sample for gamma analysis. This action was correct, demonstrating that the RCT was aware of the release criteria. He later verified with the RP supervisor the source of the substance found in the trash bag.

O12- RWP for Hall A stated to "See survey maps posted at access points for radiological survey data. The posted radiological survey was out of date and showed radiological areas which did not exist and radiation dose rates were out of date (Survey conducted 7/13/01). Survey for FEL (5/22/07)

O13- In many areas, posting was installed poorly, signs were inconsistent including hand written basic instructions where inserts were available, hand written contamination signs, radiological area signs without RWP required for entry inserts, different phone number instructions, and various versions of same instructions, and Radioactive Material signs without instructions for dosimetry requirements for entry.

O14- White rope was sometimes used to designate radiological boundaries. Yellow and or magenta color boundary material should be used. (See guideline 441.1-1b part 12 for posting guidelines). Postings are a main method of communication of radiological

hazards to workers and are an indication to others of the presence of radiological area boundary and its strict expectations of abiding with the posted requirements.
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O15- In one location temporary steps had been installed into a Contamination Area that was posted on one side which was the normal access location. Whoever installed the steps either did not notice the area was a Contamination Area posting or may not have taken it seriously. This could present a situation where personnel could have been reaching into the Contamination Area.
Some old "Contaminated Area" signs instead of "Contamination Area" sign inserts were still in use in some areas. The exact wording on the sign is a 10CFR835 requirement.

O16- Many radioactive material tags attached with string fell off or had fallen off throughout the areas toured. There were pieces of equipment inside Hall C that had tags hanging from them. Some released materials at exits date back to 2004.

O17- Two persons were asked what the rules were regarding material leaving the end station. They correctly knew the rules for Radiation Protection to survey all material which were in the halls when the beam was on.

O18- Vertical Test Facility has excellently engineered, and installed radiation monitors and policy of dose rate action levels. A Radiologically Controlled Area (RCA) is established prior to the operation of any RF device in the shielded bays. At the time of the tour there were no devices operating.

O19- Two Radioactive Material Areas were established in the building where VTA is located. One Radioactive Material Area was a small open face hood. A comment regarding the policy regarding wearing of personnel dosimetry to handle radioactive material was discussed since the RMA was not within a RCA. Personnel dosimetry is not required to handle radioactive material unless the dose rate at 30 cm is larger than 0.05 mR/h. While in theory this may be acceptable, in practice personnel may not know the specific dose rates and material may be held closer than 30 cm. The radioactive material in the box was less than 0.05 mR/h on contact per label. Taking an object apart may expose the worker to higher dose rates from the inner parts which due to self-shielding an outside measurement may not detect.

O20- High Radiation Area signs are attached to floor boards in the RF test area stating the area is a High Radiation Area when testing is in progress. The signs do not state how to recognize when this condition is present.

C. Controlled Area Access

O21- All facilities visited had magnetic ID badge identification readers to unlock doors to Controlled Areas, Accelerator housings, and support facilities. This is exceptional control and reduces the risk of unqualified visitors inadvertently entering these areas.

O22- The main gate that was posted as Controlled Area, was well controlled by security that checked the team members who had visitor status. The security gate made sure the visiting team had an escort, reviewed briefing documentation and identification before allowing access. TJNAF personnel pass their ID badges across a reader to gain access past the Controlled area gate.

D. Radiological Work Permits

O23- Radiological Work permits 2007-G001 (Accelerator tunnel, Hall A, Hall-B, Hall-C, FEL), 2007-S002 (Accelerator and FEL RadCon technician surveys), and 2007-S006 (Vertical Test Facility High Power RF operations) were reviewed. These RWPs seem to be Work Authorizations.

O24- RWP 2007-G001, written 1-31-2007, was not current regarding the specific radiological hazard levels of the radiological areas within each hall. The survey maps referred to on the RWP were last documented in July 2007.

O25- On the RWP 2007-G001 there was a statement under "General" instructions stating "Do Not enter any area posted as Radiation Area unless authorized on the posting or by the Radiation Control Department, yet none of the posting had any statement regarding authorized entry.

O26- - On the RWP 2007-G001 there were 16 General Instructions and 5 Special Instructions. These instructions seem to cover many radiological instructions pertaining to the entire accelerator and experimental halls. DOE expectation, , as expressed in Radiological Control Standard 1098-99 and Guidance document 441.1-1b, is to plan each specific job or radiological area entry.

E. Shielding assessments

O27- Facility design for the 12 GeV upgrade, has not had an independent review of the shielding calculations.

O28- 10CRF835.1002a requires documentation that optimization methods "shall" be ALARA in design. Documentation to show compliance with this requirement is not compiled. This could become a significant Institutional Vulnerability.

F. Records Management

O29- Assessment IA-2006-01 indicates a growing backlog of records that need to be scanned for archival. The team concurs and notes that the backlog has increased.

G. Quality Assurance

O30- Triennial 835 assessment is not fully accomplished. This program is on track for completion within the 36 month cycle.

O31- A review of the TJNAF radiological control manual found a few examples of mixed 'shall' statements (largely, but not wholly, based on 10 CFR 835 requirements); 'should' statements and 'instructional' statements (based on opinions of the DOE RadCon Manual authors and generally directed at operational workers); 'must' statements (that appear to be requirements not associated with 10 CFR 835); 'is' and 'will' statements that could be interpreted as 'commitment' statements; and philosophical statements (also based on opinions of the DOE RadCon Manual authors but seemingly directed to the RCG).

H. Dosimetry

O32- Personnel handling RAM without personnel dosimetry.

O33- TJNAF has been trying to incorporate current and historical records for ease of retrieval into single system. This effort has been in beta test for 5 years.

I. Calibration of Instruments

O34- Currently radiation instruments are calibrated biannually.

O35- Extant experience with the condition of the instruments returned for calibration show that the calibration is still well with in the acceptable tolerance.

Recommendations

Recommendations are the review team's specific suggestions to improve the radiological protection program for program improvement. Although any actual corrective actions contemplated by the TJNAF staff will be the result of their own assessment of the findings, root cause analysis to determine the underlying issues and the development of appropriate corrective action plans.

(1): Include LCW sampling knowledge and practical training into the RCT training program. Include knowledge of tritium action levels and develop criteria for actions to tritium spills. Include this in Continuing RCT training. (O1)

(2): Acquire more instruments with audible indicators to easily survey materials for release and develop a TBD and SOP document regarding release criteria actions: Low Level radioactive material can be easily missed by simply trying to observe a meter face. Audible instruments help for surveys of areas as well to easily identify hot spots etc. (O2 – O4)

(3): Require RCT personnel to complete a full DOE core academic exam both initially and at requalification periods, drawing from all learning objectives. Additionally develop

a continuing training program incorporating site-specific lessons. (See DOE 441-1b). (O5 – O7)
(4): More frequent radiological surveys (See DOE-STD-1098-99, Part 5) including updating of survey maps, and possibly make information available remotely. (O8 -O12)
(5): Tour and update radiological postings, correct as necessary to be consistent with current or potential radiological conditions. Raise the acceptance standards regarding radiological postings. Remove all Contaminated Area signs from training areas and accelerator areas. Management should ensure RCTs are correcting all radiological posting. Use uniform radiological posting rather than several versions for the same hazard condition and instructions. (O13 – O15)
(6): consider using a more robust attachment system for radioactive material tags. Make sure the tags are removed from the material coming back to the radiological areas. (O16)
(7): Management walk-through spaces for posting and radiological housekeeping. (O8-O16)
(8): Add a statement on sign indicating how to recognize the High Radiation Area condition (i.e. when flashing red light). (O17 – O20)

(9): TJNAF may want to take a conservative approach and require personnel dosimetry monitoring for handling any radioactive materials unless specifically authorized. (O17 – O20)
(10): For each Radiological Area including Radiation Area, High Radiation Areas and Contamination Areas develop specific RWPs. For any radiologically significant work, prepare individual job specific RWPs, not using the current general RWP.
The current RWPs (i.e. 2007-G001) at TJNAF may still be maintained and the information discussed on them is important. Thus this could be used and annually signed. However, in addition to those, other RWP procedures should be developed. RWP usage is narrower in scope than what is used at TJNAF, which seem to indicate a broader use. Specifically, each radiological area should have an individual RWP associated with the individual Radiological Area and Radiological work, (see DOE STD-1098-99 articles 321 and 322). (O23 – O26)
As an example; SLAC developed a system of 3 types of RWPs. 1) Routine entry RWP for entering each Radiological Area to perform observations, Tours etc. which is renewed quarterly 2) Job Type RWP for performing radiological significant work in Radiation and Contamination Areas or any work in High Radiation Areas and 3) Routine Task RWP for reoccurring job type work, which is renewed annually; such as TJNAF 2007-S002 and2007-S006.
(11): Independent assessment of shielding calculations and documentation of the shielding design optimization. (O27 – O28)
(12): Recommend RCG to procure outside help to archive records. (O29)
(13): Advent of the 2007 10CFR835 is a good chance for the author(s) of the new revision of the TJNAF radiological control manual to purge the unnecessary language mentioned. (O30, O31)
(14): Recommend TJNAF continue the automation of dosimetry records. (O32 – O33)
(15): Recommend TJNAF to reduce the calibration frequency of the survey instruments to annual. (O34 – O35)

(16): Recommend for the future reviews, TJNAF perform topical assessments with external assessors.

Future Issues

- Development of new RPP
- Gap assessment of the 10CFR835 with old and new versions.
- Write a crosswalk of program requirements and implementations.
  The crosswalk will tie the regulatory requirement, TJNAF Radcon Manual and the procedures.
- Refer to DOE 441.1-1b for examples of DOE expectations.

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