

Radiological Safety Analysis Document

This Radiological Safety Analysis Document (RSAD) identifies the radiological controls for the experiment and controls with regard to production, movement, or import of radioactive materials.

I. Description

Experiment [PR12-11-105](#), Polarized Electrons for Polarized Positrons (PEPPo) will be conducted using the CEBAF injector beginning approximately May 25, 2012, and lasting about 5 weeks. The experiment will be in an extended commissioning phase from February up to the May 18 shutdown. The experiment will involve operation of the injector, through the ¼-cryo-module, at energies up to 8MeV and current up to 5 μ A. Experiment documentation can be found at https://positron.jlab.org/wiki/index.php/Main_Page.

II. Summary and Conclusions

This experiment does not impact the Laboratory site boundary dose. No “radiation budget” is calculated for it. All beam parameters in the injector are well within the normal operating range for injector operation. New beam-line and apparatus to create and monitor polarized positrons are used in the experiment. Operation of the experiment occurs with the North LINAC locked and interlocked in the normal configuration for operating the injector above 500 keV. Non-standard conditions for the experiment include operating the beam above 5 MeV from the ¼ cryo-unit, and the possibility of operating the experiment after the temporary shield wall at the Hall D Tagger building has been removed. Each of these conditions and their potential radiological implications is discussed below. Radiation monitoring through active surveillance will be conducted continuously in affected areas and specific radiation surveys will be made as detailed in this document. **Adherence to this RSAD is vital.**

III. Calculations of Radiation Dose at Site Boundary

The radiation budget for a given experiment is the amount of radiation that is expected at site boundary as a result of a given set of experimental conditions. This experiment does not involve any operations that impact the site boundary.

IV. Radiation Hazards

The following controls shall be used to prevent the unnecessary exposure of personnel and to comply with Federal, State, and local regulations, as well as with Jefferson Lab and the Experimenter's home institution policies.

A. From Beam in the Accelerator Enclosure

When the tunnel status is Beam Permit, there are potentially lethal conditions present. Therefore, prior to going to Beam Permit, several actions will occur. Announcements will be made over the intercom system notifying personnel of a change in status from Restricted Access (free access to the tunnel is allowed, with appropriate dosimetry and training) to Sweep Mode. All magnetic locks on exit doors will be activated. Persons trained to sweep the area will enter by Sweep Mode protocol and search in all areas of the tunnel to check for personnel.

After the sweep, another announcement will be made, indicating a change to Power Permit, followed by Beam Permit. The Run-Safe boxes will indicate "OPERATIONAL" and "UNSAFE". **IF YOU ARE IN THE TUNNEL AT ANY TIME THAT THE RUN-SAFE BOXES INDICATE "UNSAFE", IMMEDIATELY PRESS THE "PUSH TO SAFE" BUTTON ON THE BOX.**

Controlled Area Radiation Monitors (CARMs) are located in strategic areas around the beam enclosure to ensure that unsafe conditions do not occur in occupiable areas. This experiment should not create any unusual regions of increased radiation outside the beam enclosure. The RadCon Department will monitor the CARMs and make surveys as necessary to assess the impact of the experiment on radiation levels around the injector.

During injector operation, radiation is transported down the North Linac, which is inaccessible. The closest point of access with line of sight to the injector is at the North Linac/Hall D tunnel interface. This area will remain inaccessible by means of an installed shield wall and personnel access barrier, through the end of the normal CEBAF operational period leading up to the 12 GeV long shutdown, beginning May 18, 2012. The shield wall will be removed in accordance with the long shutdown schedule (currently, the wall is expected to remain in place during PEPPo operations). Calculations show that the shield wall is not critical or required for normal or worst-case conditions caused by PEPPo operation. Under a worst-case beam loss event in the injector (conservatively calculated without any absorbing materials between the injector and tunnel fence), radiation levels could reach ~ 200 mrem/h at the barrier fence located at the North Linac/Tagger tunnel interface. This is well below the JLab design criteria for worst-case beam loss events. Therefore, additional shielding is not required.

Specific requirements for PEPPo, are as follows.

1. The access barrier fence, secured with TUN-7 lock, must remain in place.
2. A CARM must remain in place at the nearest accessible point beyond the access barrier. The CARM must provide local alarm capability to alert workers in the area of any unusual radiation levels. Currently, the CARM is located just beyond the shield wall in the Tagger building. If the shield wall is removed during PEPPo, the CARM must be moved to a point just beyond the tunnel barrier fence.

The CEBAF injector PSS segment makes use of a “rapid access system” that monitors radiation levels in the injector segment. This system acts as an independent means to verify that no radiation-producing processes are occurring during periods of access to the injector. If the established trigger levels for the system are exceeded, a beacon will be illuminated at the entrance point to the injector. Established procedures are in place for access under these conditions. The system will also detect buildup of any activation products that might be produced (see section B).

B. From Activation of Targets, Beamline Components and Other Materials

The PEPPo experiment involves directing the beam onto a tungsten target at energies up to about 8 MeV. Under these conditions, some activation may be produced in the tungsten target (γ, n threshold ~ 7.2 MeV). Other materials in the vicinity of the target have considerably higher photo-nuclear production thresholds. Significant levels of activity in the target are not expected but several techniques will be employed to monitor this condition.

1. A neutron monitor is positioned at the injector segment gate. This monitor is connected to the injector segmentation CARM (RM-01). In the injector/North Linac mode, the CARM is masked and will not terminate beam. When beam energy above 7 MeV is achieved, RadCon will periodically review the signal from this monitor for indications of neutron production.
2. The experiment liaison will contact RadCon once CW beam ≥ 7.2 MeV has been established, and RadCon will conduct investigative surveys of the target and surrounding area to check for buildup of activity.
3. A detector connected to the rapid access system is positioned in proximity to the target. The detector will trigger the rapid access system warning indicator in the event any significant activation occurs at the target. This condition will require surveys to be conducted in accordance with established procedures.

4. Any maintenance involving disassembly or removal of the target chamber/assembly will require RadCon notification (after operations at > 7.2 MeV). RadCon will affix appropriate caution labeling on the target assembly to reinforce this requirement.

Activation from neutrons in materials beyond the target proper is not expected, but neutron radiation levels during operation along with investigatory surveys will be used to evaluate this condition as well. Any indications that activation may be occurring in any components beyond the target proper will require the institution of release surveys from the injector area. Normally the injector segment is not a posted Radioactive Materials Area. RadCon will post the injector area appropriately in the event radioactive materials are produced in the target or surrounding materials.

The PEPPo experiment will not operate at energies capable of producing activation in air or liquids. No surface contamination external to beam vacuum envelope is possible.

C. Other Sources

All radioactive materials brought to Jefferson Lab shall be identified to the Radiation Control Department. These materials include, but are not limited to radioactive check sources (of any activity, exempt or nonexempt), previously used targets or radioactive beamline components, previously used shielding or collimators, or He-3 containers. The RCD inventories and tracks all radioactive materials onsite. The Radiation Control Department may survey the experimental setup before experiments begin as a baseline for future measurements if significant residual activity levels are present. Use of sealed sources shall be done in compliance with standard procedures.

V. Incremental Shielding or Other Measures to be Taken to Reduce Radiation Hazards

None expected.

VI. Operations Procedures

A. All experimenters must comply with experiment-specific administrative controls. These controls begin with the measures outlined in the experiment's Conduct of Operations and Experiment Safety Assessment Documents, and also include, but are not limited to, Radiation Work Permits, Temporary Operational Safety Procedures, and Operational Safety Procedures, or any verbal instructions from the Radiation Control Department. A general access RWP governing access to the Halls and the accelerator enclosure must be read and followed by all participants in the experiment. This RWP can be read and electronically signed online at:

http://www.jlab.org/accel/RadCon/pdf_forms/Gen%20Acc%20RWP.pdf

B. Any individual with a need to handle radioactive material at Jefferson Lab shall first complete Radiation Worker (RW-I) training.

C. There shall be adequate communication between the experimenter(s) and the Accelerator Crew Chief and/or Program Deputy to ensure that all power restrictions on the target and beamline are well known. The beam current/power and other beam parameter restrictions shall be documented in the Operational Restrictions list at

http://opweb.acc.jlab.org/internal/ops/ops_webpage/restrictions/ops_restrictions/html.

D. Radiation Work Permits (RWPs) are the standard work authorization documents used to control radiological work. RadCon will require RWPs based on established trigger levels.

Standard RSAD controls apply: RadCon shall be contacted for any of the following activities:

1. Entry to Radiation Areas or High Radiation Areas
2. Movement of shielding
3. Breaching the target chamber physical envelope
4. Maintenance of known or potentially contaminated systems
5. Any destructive modifications to activated components (drilling cutting, welding, etc.)

All posted guidance and instructions for contamination controls, shielding configuration, and access to radiological areas must be adhered to.

NOTE: Work planning for all radiological work shall be coordinated through the Operability Manager (S. Suhring) using the ATLis work planning tool.

VII. Decommissioning and Decontamination of Radioactive Components

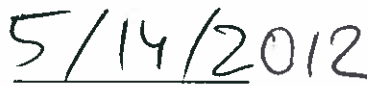
Experimenters shall retain all targets and experimental equipment brought to Jefferson Lab for temporary use during the experiment. After sufficient decay of the radioactive target configurations, they shall be delivered to the experimenter's home institution for final disposition. All transportation shall be done in accordance with United States Department of Transportation Regulations (Title 49, Code of Federal Regulations) or International Civil Aviation Organization (ICAO) regulations. In the event that the experimenter's home institution cannot accept the radioactive material due to licensing requirements, the experimenter shall arrange for appropriate funds transfers for disposal of the material. Jefferson Lab cannot store indefinitely any radioactive targets or experimental equipment.

The Radiation Control Department may be reached at any time through the Accelerator Crew Chief (269-7045) or directly by calling the RadCon Cell Phone (876-1743). On Weekends, Swing Shift, and Owl Shift, requests for RadCon support should be made through the Crew Chief. This will ensure that there is prompt response with no duplication of effort.

Approvals:



Radiation Control Department Head



Date