

## Radiological Safety Analysis Document for the Fall 2018 GlueX (E12-06-102) Run in Hall D

**This Radiological Safety Analysis Document (RSAD) will identify the general conditions associated with the Fall 2018 GlueX (E12-06-102) run in Hall D, and controls with regard to production, movement, or import of radioactive materials.**

### 1 Description

The Fall 2018 Hall D run is scheduled from 08-22-18 to 12-19-18 with the total running time of 13.0 weeks. It will utilize up to 12 GeV electron beam. Most of the run will be limited to the standard operating conditions: 20  $\mu\text{m}$  and 50  $\mu\text{m}$  diamond radiators, 3.4 mm or 5 mm diameter collimator, 30 cm liquid hydrogen target in the hall. In addition, up to 600 nA beam will be used in the  $1 \times 10^{-4} X_0$  aluminum radiator run for up to 1 week, and up to 2  $\mu\text{A}$  beam – in the high luminosity test runs for up to 3 shifts.

Radiator	Current (nA)	Total Time	Comment
4.1x10 <sup>-4</sup> X <sub>0</sub> (50 $\mu\text{m}$ diamond) 1.7x10 <sup>-4</sup> X <sub>0</sub> (20 $\mu\text{m}$ diamond)	< 200 < 600	11 weeks	Standard running conditions, 30cm liquid hydrogen target
1x10 <sup>-4</sup> X <sub>0</sub> Al	< 600	1 week	Standard running conditions, 30cm liquid hydrogen target

Table 1. Hall D Fall 2018 run plan

### 1.1 Addendum

During the last week of operation the standard liquid hydrogen target may be replaced with 5% r.l. Be target, using lower beam currents under 100 nA , and  $3 \times 10^{-4} X_0$  aluminum radiator. A portion of the downstream vacuum beam line will be removed.

Radiator	Current (nA)	Total Time	Comment
$3 \times 10^{-4} X_0$ Al	< 100	1 week	Non-standard running conditions: 5% r.l. Be target (or 30cm liquid hydrogen target); downstream vacuum beam line removed

Table 2. Hall D run plan for the last week of operation in the Fall of 2018

The run plan is summarized in Tables 1 and 2.

## **2 Summary and Conclusions**

The Fall 2018 Hall D run is not expected to produce significant levels of radiation at the site boundary. However, it will be continuously monitored by the Radiation Control Department (RCD) to ensure that the site boundary goal is not exceeded. Activation of targets, collimators and beam line hardware must also be considered. As specified in Sections 4 (4.2) and 7, the manipulation and/or handling of targets and beam line hardware (potentially radioactive material), the transfer of radioactive material, or modifications to the beam line after the target assembly must be reviewed and approved by the RCD.

**Adherence to this RSAD is vital.**

## **3 Calculations of Radiation Deposited in the Experimental Hall (the Experiment Operations Envelope)**

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 experiments. This budget may be specified in terms of mrem at site boundary or as a percentage of the Jefferson Lab design goal for dose to the public, which is 10 mrem per year. The Jefferson Lab design goal is 10% of the DOE annual dose limit to the public, and cannot be exceeded without prior written consent from the RCD Head, the Director of Jefferson Lab, and the Department of Energy.

Comparison of the beam configuration parameters of the Fall 2018 run with the previous Hall D runs, as well as with the parameters used in the “Shielding Basis for Hall D Complex” (JLAB-TN-08-033) indicate that it will have negligible contribution to the site boundary dose. The last non-standard configuration includes running beam on the 5% Be target replacing the standard 30 cm liquid hydrogen target, with the 300 cm long vacuum section in the beam dump line removed. These running conditions are expected to produce noticeably larger neutron dose rates per beam current, compared with the standard. However, due to low beam current operations and relatively short duration of the runs, the contribution to the dose rate accumulation at the boundary will be small.

This expectation will be verified during the run using the active monitors at the Jefferson Lab site boundary. If it appears that the radiation budget will be exceeded, RCD will require a meeting with the experimenters and the Head of the Physics Division to determine if the run conditions are accurate, and to assess what actions may reduce the dose rates at site boundary. If the site boundary dose approaches or exceeds 10 mrem during any calendar year, the run program will stop until a resolution can be reached.

## **4 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.

#### **4.1 Beam in the Hall**

When the Hall 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 Hall 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 keyed access (Controlled Access) and search in all areas of the Hall to check for personnel.

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

Controlled Area Radiation Monitors (CARMs) are located in strategic areas around the Hall and the Counting House to ensure that unsafe conditions do not occur in occupied areas.

#### **4.2 Activation of Target and Beam line Components**

All radioactive materials brought to Jefferson Lab shall be identified to the RCD. These materials include, but are not limited to radioactive check sources (of any activity, exempt or non-exempt), previously used targets or radioactive beam line components, or previously used shielding or collimators. The RCD inventories and tracks all radioactive materials onsite.

The RCD will coordinate all movement of used targets, collimators, and shields. The RCD will assess the radiation exposure conditions and will implement controls as necessary based on the radiological hazards.

There shall be no local movement of activated target configurations without direct supervision by the RCD. Remote movement of target configurations shall be permitted, providing the method of movement has been reviewed and approved by the RCD.

No work is to be performed on beam line components, which could result in dispersal of radioactive material (e.g., drilling, cutting, welding, etc.). Such activities must be conducted only with specific permission and control of the RCD.

#### **5 Incremental Shielding or Other Measures to be Taken to Reduce Radiation Hazards**

None.

## 6 Operations Procedures

All experimenters must comply with experiment-specific administrative controls. These controls begin with the measures outlined in the experiment's Conduct of Operations Document, 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 is in place that governs access to Hall D tagger building, Hall D proper, and the accelerator enclosure, which may be found in the Machine Control Center (MCC); it must be read and signed by all participants in the experiment. Any individual with a need to handle radioactive material at Jefferson Lab shall first complete Radiation Worker (RW I) training.

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 radiator and the target are well known. Exceeding these power restrictions may lead to excessive and unnecessary contamination, activation, and personnel exposure.

The radiator assembly and the downstream beam-line components may not be altered outside the scope of this RSAD without formal RCD review. Alteration of these components may increase radiation production in the Hall and subsequently increase the site boundary dose.

## 7 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 returned 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 Air Transport Association 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 transfer of funds for disposal of the material. Jefferson Lab cannot store indefinitely radioactive targets and experimental equipment.

**The Radiation Control Department may be reached at any time through the Accelerator Crew Chief (269-7050).**

### Approvals:

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Radiation Control Department Head

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Date

**Appendix A: Radiation Damage to the Hall D Electronics**

Due to the low overall beam power planned to be delivered to the hall during the Fall 2018 Hall D run, no problems are anticipated with respect to radiation damage to the electronics, including the most vulnerable silicon photomultipliers.