

## Radiological Safety Analysis Document for the Fall 2019 - Spring 2020 GlueX-II (E12-12-002, with DIRC Commissioning)

**This Radiological Safety Analysis Document (RSAD) will identify the general conditions, and controls with regard to production, movement, or import of radioactive materials, associated with the fall 2019 - spring 2020 runs in Hall D.**

### 1 Description

The fall 2019 - spring 2020 Hall D run is scheduled from 11-25-2019 to 05-20-2020 with the total running time of 143 days. It will utilize up to 12 GeV electron beam. The run will be split into two parts: DIRC commissioning for GlueX-II, and the nominal GlueX running. The time allocation will depend on the DIRC Commissioning progress.

Beam conditions for both parts of the run period are planned to be close to the nominal Hall D parameters, with the maximum beam current requested using 30 cm liquid Hydrogen target at 600 nA electron beam current, and maximum radiator thickness at  $5e-4$  RL. Most of the run time operations are planned at 400 nA,  $5e-4$  RL radiator, significant portion of the run is at 150 nA with  $3e-4$  RL radiator, and about 3 shifts at 600 nA,  $5e-4$  RL radiator. These conditions are not expected to present unusual radiological conditions in and around the Hall. Previous Hall D operations did not show significant radiation dose rate production at the site boundary; we do not expect such problems even if the worst requested operational conditions are assumed for the whole run period. There will be a short-duration test run “Tagger accidentals rate scan”, described at [https://halldweb.jlab.org/wiki/index.php/Tagger\\_accidentals\\_rate\\_scan,\\_Fall\\_2019](https://halldweb.jlab.org/wiki/index.php/Tagger_accidentals_rate_scan,_Fall_2019). The experimental target will be empty during this test, and no special radiation problems in the Hall are envisaged. The dose rates at the Tagger enclosure will stay within the specifications.

Planned modifications of the experimental equipment in the Hall will not change the radiological conditions around the beam line and won't change the radiation environment significantly.

The list of operating parameters planned for this run period is given in Table 1. Beam time spent in every configuration is not known at this point; radiologically the configurations are all acceptable, but will require continuous monitoring and verification as declared in this RSAD.

Radiator	Current (nA)	Target	Comment
$5 \times 10^{-4}$ X <sub>0</sub> Diamond	< 600	30 cm LH2	Standard running conditions
$3 \times 10^{-4}$ X <sub>0</sub> Al	< 500	30 cm LH2	Standard running conditions
$5 \times 10^{-4}$ X <sub>0</sub> Diamond	< 600	empty	Standard running conditions
$5 \times 10^{-4}$ X <sub>0</sub> Diamond	< 100	30 cm LH2	Standard running conditions, Solenoid Magnet OFF
$4.5 \times 10^{-4}$ X <sub>0</sub> Al	< 2100	empty	Tagger accidentals rate scan

Table 1. Hall D fall 2019 - spring 2020 run operating parameters

## **2 Summary and Conclusions**

The fall 2019 -spring 2020 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 2019 – spring 2020 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 acceptably low contribution to the site boundary dose.

The expectation of the small contribution of Hall D to the boundary dose accumulation 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.

**Tanks or cylinders of He-3 containing more than 10 mCi of tritium (H-3) shall not be stored or used in an experimental hall without the express, written permission of the RCD manager. Any containers of He-3 brought on site shall be assessed for the tritium content before use.** Additionally, He-3 containers should not be stored in the experimental hall when not in use.

#### **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**

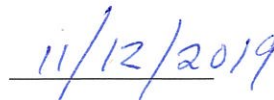
Experimenters shall retain all targets and experimental equipment brought to Jefferson Lab for temporary use during the experiment. After sufficient decay of the radioactive target configurations, they shall be returned to the experimenter's home institution for final disposition. All transportation 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:**



Radiation Control Department Head



Date