

ES&H DIVISION
RADIATION CONTROL DEPARTMENT

radiological safety analysis document

CLAS12

Hall B Run Group K

Liaison: Daniel Carman

October 04, 2023

RCD-RSAD-10.04.2023-HB


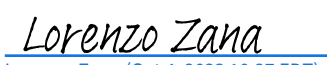
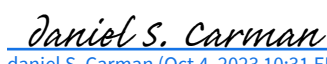
Priority review level	1
Document classification	4
Next review due	n/a

Submit for approval	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	yes	no

Thomas
Jefferson
National
Accelerator
Facility



CLAS 12
Hall B Run Group K
RCD-RSAD-10.04.2023-HB

Approver	 <u>Keith Welch (Oct 4, 2023 10:26 EDT)</u>	Oct 4, 2023
	_____ Keith Welch, Manager Radiation Control Department	_____ Date
Preparer	 <u>Lorenzo Zana (Oct 4, 2023 10:27 EDT)</u>	Oct 4, 2023
	_____ Lorenzo Zana, Radiation Physicist Radiation Control Department	_____ Date
Liaison	 <u>daniel S. Carman (Oct 4, 2023 10:31 EDT)</u>	Oct 4, 2023
	_____ Daniel Carman, Staff Scientist Hall B	_____ Date

Contents

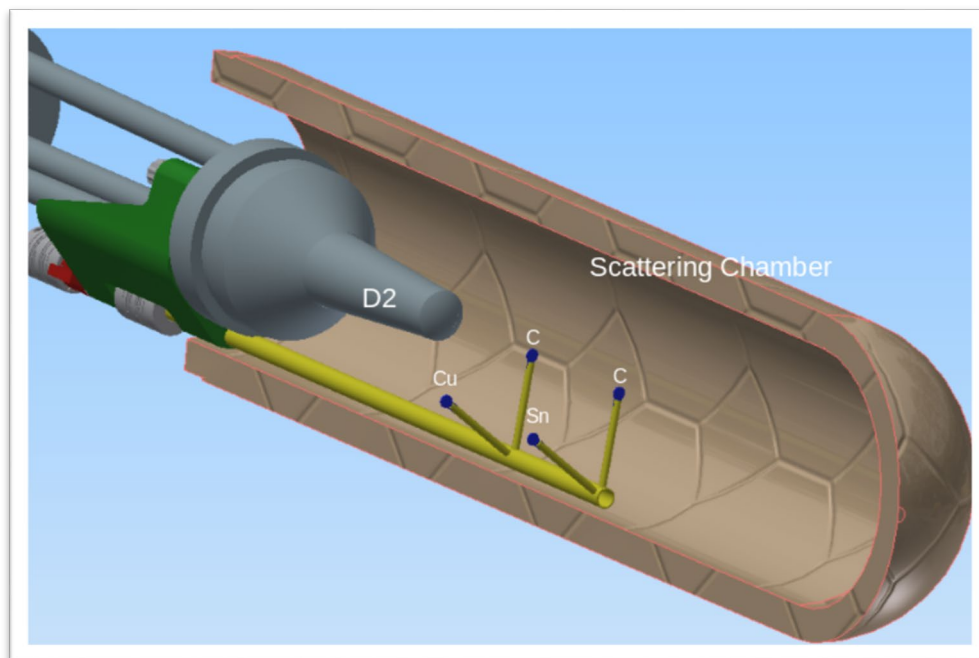
1	DESCRIPTION.....	1
2	SUMMARY and CONCLUSIONS.....	2
3	CALCULATIONS of RADIATION DEPOSITED in the EXPERIMENTAL HALL	2
4	RADIATION HAZARDS	2
4.1	Beam in the Hall.....	3
4.2	Activation of Target and Beamline Components and with Other Materials in the Hall	3
5	INCREMENTAL SHIELDING or OTHER MEASURES to REDUCE RADIATION HAZARDS	3
6	OPERATIONS PROCEDURES	3
7	DECOMMISSIONING and DECONTAMINATION of RADIOACTIVE COMPONENTS	4

This Radiological Safety Analysis Document (RSAD) identifies the general conditions associated with the CLAS12 (Run Group K [RG-K]) run in Hall B, as well as the controls associated with production, movement, or import of radioactive materials.

1 DESCRIPTION

The Physics Division CLAS12 RG-K run will take place during the fall/winter of 2023/2024 in Experimental Hall B. CLAS12 is a multi-purpose detector system based on toroidal (Forward Detector) and solenoid (Central Detector) superconducting magnets. The detector system includes Cherenkov counters, drift chambers, scintillator counters, silicon-strip detectors, micromegas gas detectors, and calorimeters.

During this run period, CLAS12 will be used in its standard detector and shielding configuration with the Forward Tagger (FT) OFF. The RG-K run will use both 3-pass and 4-pass polarized electron beams and a liquid-hydrogen (LH_2) target at nominal beam energies of 6.4 GeV and 8.4 GeV, respectively, with currents up to 200 nA during the luminosity scans and empty target runs. This run will use the standard Hall B cryogenic target system first used with RG-D in fall 2023.



Run Group D target design to be used, only with the liquid target (LH_2), during this experiment

The target cell will be located inside a vacuum foam scattering chamber of wall thickness 6.5 mm installed within the 5 T solenoid magnet of the Central Detector. The target cell is a 20 mm diameter, 5 cm long Kapton tube with entrance and exit windows of 30 mm thick aluminum. The center of the target cell is positioned at $z = -3$ cm along the beamline in the nominal CLAS12 coordinate system. The vacuum will be disconnected between the upstream and downstream beamlines with ~ 71 cm of air between the exit window of the target scattering chamber and the entrance window of the downstream beamline. Both these windows are 75 mm thick aluminum. The nominal beam-target luminosity during data taking will be $\sim 1 \times 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$ (corresponding to a typical beam current of ~ 70 nA),

the nominal design value for CLAS12. For beam tuning and Möller runs, the beam will be directed into the Hall B Tagger dipole magnet yoke as has been standard for operations in Hall B.

The details of all beamline and target components for RG-K are shown on the beamline drawings at [Design link](#).

2 SUMMARY and CONCLUSIONS

The experiment is not expected to produce significant levels of radiation at the site boundary. However, it will be periodically monitored by the Radiation Control Department to ensure that the site boundary goal is not exceeded. The main consideration is the manipulation and/or handling of target(s) or beam line hardware. As specified in Sections 4.2 and 7, the manipulation and/or handling of target(s) or beam line hardware (potential radioactive material), the transfer of radioactive material, or modifications to the beam line after the target assembly must be reviewed and approved by the Radiation Control Department (RCD, or RadCon).

Adherence to this RSAD is vital.

3 CALCULATIONS of RADIATION DEPOSITED in the EXPERIMENTAL HALL

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 Radiation Control Department Manager, the TJNAF Director, and the Department of Energy.

Calculations of the contribution to Jefferson Lab's annual radiation budget that would result from running under a broad variety of conditions typical of Hall B operations indicate that the contribution from this experiment will be negligible. With this expectation, we have not carried out calculations for the specific running conditions of this experimental group.

This expectation will be verified during the experiment by using the active monitors at the Jefferson Lab site boundary to keep up with the dose for the individual setups from Hall B and the other Halls. If it appears that the radiation budget will be exceeded, RadCon will require a meeting with the experimenters and the Head of the Physics Division to determine if the experimental 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 experimental 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 TJNAF and the Experimenter's home institution policies.

The following controls shall be used to:

- prevent unnecessary exposure of personnel;
- comply with federal, state, and local regulations;
- adhere to TJNAF procedures; 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 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 PRESS THE *PUSH TO SAFE* 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 occupiable areas.

Note: Any indication that the levels may exceed 5 mrem/h dose rate in an occupied area will require immediate mitigation, with continued operations contingent on a formal review of conditions and operational parameters, and final approval of operations exceeding this threshold by the TJNAF RCM, in consult with Physics and Accelerator Division Safety Officers.

4.2 Activation of Target and Beamline Components and with Other Materials in the Hall

The RCD shall be notified of all radioactive materials brought to Jefferson Lab. These materials include, but are not limited to

- radioactive check sources of any activity, exempt or non-exempt;
- previously used targets or radioactive beamline components; or,
- previously used shielding or collimators.

The RCD inventories and tracks all radioactive materials onsite. If radioactive materials are incorporated into an experimental setup, surveys may be conducted on the setup before experiments begin.

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

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

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

5 INCREMENTAL SHIELDING or OTHER MEASURES to REDUCE RADIATION HAZARDS

none

6 OPERATIONS PROCEDURES

All experimenters must comply with experiment-specific administrative controls which begin with the measures outlined in the experiment's Conduct of Operations document. These controls may include radiological work permits (RWP), temporary operational safety procedures (TOSP), operational safety procedures (OSP), and/or any verbal instructions from RadCon. A General Access RWP (GARWP) that governs access to Hall B and the accelerator enclosure is in place and may be found in the Machine Control Center (MCC). All those who participate in the RG-K experiment must be read and electronically sign the GARWP signifying that they understand and will

abide by the permit. Any individual with a need to handle radioactive material at Jefferson Lab shall first complete Radiation Worker Level I (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 target are well known. Exceeding these power restrictions may lead to excessive and unnecessary contamination, activation, and personnel exposure.

No scattering chamber or downstream component may be altered outside the scope of this RSAD without formal Radiation Control Department review. Alteration of these components (including the exit beamline itself) may result in increased radiation production from the Hall and a resultant increase in dose at the site boundary.

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 such 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 (Title 49, Code of Federal Regulations) 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. *TJNAF cannot store indefinitely any radioactive targets or experimental equipment.*

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