RSAD for Summer/Fall 2021 Experimental Run in Hall A
E12-09-19 (GMn), E12-17-004 (Gen-RP), E12-20-010 (nTPE), and E12-20-008 (WAPP)

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

I. Description

A group of four experiments will run in Hall A in summer and fall of 2021. Three of these (E12-09-019, E12-17-004, E12-20-010) are dedicated to the measurement of the nucleon form factors.

Experiment E12-09-019 (https://hallaweb.jlab.org/collab/PAC/PAC34/PR-09-019-gmn.pdf) measures the magnetic form factor of the neutron (GMn) up to a Q^2 of 13.3 GeV^2 with a simultaneous measurement of quasi-elastic electron-neutron and electron proton scattering off deuterium. Including the commissioning, the experiment plans to use about 12.1 PAC days of beam at various energies from 3.7 to 9.9 GeV, with maximum beam currents up to 60 microamperes.

Experiment E12-17-004 (https://www.jlab.org/exp_prog/proposals/17/PR12-17-004.pdf) will measure the electric form factor of the neutron (GEn) with the recoil polarization technique, at Q^2 = 3.8 GeV^2. In practice, the quasi-elastic electron-neutron is measured off deuterium, with the recoil neutron polarization being measured. Run time is planned to be 4.5 PAC days, at 5.6 GeV beam energy and 30 microamp beam current.

Experiment E12-20-010 (https://misportal.jlab.org/pacProposals/proposals/1599/attachments/127361/Proposal.pdf) will measure the two photon exchange contribution in elastic electron-nucleon scattering. The experimental technique (and setup) is the same as E12-09-019. In practice, this experiment is an additional measurement to E12-09-019, at Q^2 = 3.8 GeV^2, but a different beam energy. Run time is planned to be about 1.7 PAC days, at 5.6 GeV beam energy and up to 30 microamp beam current.

Experiment E12-20-008 (https://misportal.jlab.org/pacProposals/proposals/1597/attachments/127355/Proposal.pdf) is dedicated to measure the pion photoproduction process at wide angle. To produce the photon beam, a 0.06 X_0 copper radiator has been placed upstream of the target. It has been grouped with the other three since it uses the same experimental setup as GEn-RP. Run time is planned to be about 2.2 PAC days, at 7.4 GeV beam energy and up to 5 microamp beam current.

II. Summary and conclusions

The boundary dose accumulation in 2021 due to this group of experiments in HallA is estimated to be approximately **0.58 mrem**, i.e. **5.8%** of the annual design goal. Radiation levels will be continually recorded and periodically checked by the Radiation Control Department to ensure that the site boundary goal is not exceeded. Radiation hazards associated with activation of the targets and the beam line hardware require special consideration. The experiment will likely cause Radiation Areas and High Radiation Areas in the Hall. There will be no regular need to access the target platform during the experiment. As specified in Sections IV, VI, and VII, the manipulation and/or handling of targets or beam

line hardware (potential radioactive material), the transfer of radioactive material, or modifications to the beam line downstream from the target assembly must be reviewed and approved by the Radiation Control Department (RCD).
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 budget may be specified in terms of dose accumulation (in 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 Head, and the Director of Jefferson Lab.

The radiation budget for the Summer/Fall of 2021 Run in Hall A is approximately **0.58 mrem**, or **5.8%** of Jefferson Lab's annual design goal. The attached Radiation Budget Forms illustrate the calculations, performed separately for the four experiments using the standard calculation tools by Rad. Physics.

The Hall's contribution to the boundary dose will be verified during the run period by using the active monitors at the Jefferson Lab site boundary to keep up with the dose for the individual setups. If it appears that the radiation budget will be exceeded, the Radiation Control Department 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 not proceed until a resolution is reached and approved by the Lab Director.

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 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 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. The Radiation Control Department (RCD) will monitor the CARMs and make surveys as necessary to assess the impact of the experiment on radiation levels around the hall.

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 Jefferson Lab RadCon Manager, in consult with Physics and Accelerator Division Safety Officers.

B. From activation of target and beamline components and other materials in the hall

It is not expected that extraordinary high radiation conditions will be present in the Hall during and after the run. However, the customary radiation protection measures must be taken, especially during and after running the target configurations including the use of copper radiator in addition to the regular targets.

1. **Given the conditions for this run period, it is expected that a High Radiation Area will develop near the target, downstream septum area, and at the interface between the hall and the beam dump tunnel; whole body dose rates in these areas could exceed 1 rem/hr.** Suitable barriers are to be staged in the Hall for use around these locations in the event this condition occurs, in order to comply with regulatory requirements for physical access controls.
2. **The target chamber area and downstream beamline are expected to become significantly activated.** No work on this portion of the beamline is to be conducted without RCD review. For ALARA purposes, no access to the target should be expected during first 2-3 days after operations. If access to the target is needed, it is possible that the work will need formal approval by the Jefferson Lab Radiation Review Panel. All work on or around the target area will require a job-specific RWP at minimum.

   NOTE: Work planning for all radiological work shall be coordinated through the hall Work Coordinator (Jessie Butler).

3. **The area around the beam dump/hall interface will become a radiation area and may become a high radiation area.** The area around the Moller polarimeter targets may also become a Radiation Area. **Always confer with RCD prior to entry to any posted Radiation or High Radiation Area.**
4. **No work is to be performed on beamline 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 by the Radiation Control Department.

5. **This experiment is expected to produce low levels of airborne radioactivity which may impact environmental effluent standards and produce localized or generalized buildup of surface contamination in the hall.** Airborne radioactivity concentration in the hall is measured continuously. **If airborne radioactivity concentration as monitored by the AMS-4 air monitor in the experimental hall exceeds an average of 1.0E-5 µCi/cc for a period of greater than 5 consecutive days**, RCD 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 be needed to reduce the airborne radioactivity effluent levels and control/minimize contamination inside the hall.
6. **Low levels of surface contamination are expected on and around the target chamber and downstream beamline**. The RCD will monitor for the presence of this hazard as appropriate, and will require administrative controls and/or PPE commensurate with the conditions. **All posted guidance for contamination control must be observed.** Refer to the General Access RWP for details regarding controls for potentially affected systems.
7. **Under high-current running conditions, deposition of short-lived air activation products may occur in general areas of the hall.** RCD will periodically monitor for this condition. In the

event that such conditions are detected, the RCD, in consultation with Physics Division, will institute an appropriate access delay protocol to allow time for these radionuclides to decay prior to entry to the hall.

8. **Some sections of beamline may contain indium gaskets/seals**. These components should always be considered potentially contaminated. Always consult with RCD prior to disassembling any beamline components incorporating indium seals.

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.

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.

V. Incremental shielding or other measures to be taken to reduce radiation hazards

The RCD Manager will notify the Hall Leader and Physics Division Safety Officer of any identified trends, which might impact access to the hall or create conditions requiring broad changes to radiological working standards (i.e. General Access RWP revision). In case of detecting such trends, the RCD Manager will recommend engineered or other controls considered necessary to prevent significant degradation of the radiological conditions in the hall.

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 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 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: https://misportal.jlab.org/railsForms/rad_work_permits/108811/briefing.

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 are well known. Exceeding these power restrictions may lead to excessive and unnecessary contamination, activation, and personnel exposure. 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. No target 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 site boundary dose.

E. Any requested changes outside of the experimental parameters submitted for the calculation of the radiation budget (i.e., current, energy, target material, target thickness, run time) for this experiment shall require a formal review by the Radiation Control Department, and a new revision to the RSAD.

F. Standard procedures

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

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

1. Entry to Radiation Areas or High Radiation Areas
2. Movement of shielding or collimators
3. Breaching the target chamber physical envelope
4. Any work on beamline components downstream of the target
5. Maintenance of known or potentially contaminated systems
6. 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 hall work coordinator (J. Butler) 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 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 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 transfer of funds for disposal of the material. Jefferson Lab cannot indefinitely store radioactive targets and 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

Attachment A1

Hall: A **RADIATION BUDGET FORM** *page:* 1 of 1

Exp. # GMn comm **rev: 0** **run dates: Aug-Dec 2021** **name of liaison: David Flay, Eric Fuchey**

E12-09-019

setup number			1	2	3	4	5	6	7	8	9	10	11	
beam	energy	GeV	5.6	5.6	5.6	3.7	3.7	3.7	3.7	5.6	5.6	5.6	5.6	*totals:*
	current	uA(CW)	50.0	50.0	50.0	60.0	30.0	20.0	20.0	60.0	30.0	20.0	20.0	
radiator	element						Cu		Cu		Cu		Cu	
	thickness	mg/cm2					772		772		772		772	
	dist. to pivot	m					-0.15		-0.15		-0.15		-0.15	
	Z		0	0	0	0	29	0	29	0	29	0	29	
	A		0	0	0	0	64	0	64	0	64	0	64	
exp't target	element		C	H	C	H	H	Al	Al	H	H	Al	Al	
	thickness	mg/cm2	26	1062	138	1062	1062	935	935	1062	1062	935	935	
	dist. to pivot	m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Z		6	1	6	1	1	13	13	1	1	13	13	
	A		12	1	12	1	1	27	27	1	1	27	27	
cryo tgt window	element			Al		Al	Al			Al	Al			
	thickness	mg/cm2		83		83	83			83	83			
	dist. to pivot	m		0.0		0.0	0.0			0.0	0.0			
	Z		0	13	0	13	13	0	0	13	13	0	0	
	A		0	27	0	27	27	0	0	27	27	0	0	
critical window	radius	cm	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	
	dist. to pivot	m	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	
scattering weighting factor			0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
time	run time	hours	20	28	12	2	12	2	2	3	12	1	1	95
	(100% eff.)	days	0.8	1.2	0.5	0.1	0.5	0.1	0.1	0.1	0.5	0.0	0.0	4.0
	installation time	hours												0
		days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
dose rate at the fence post (run time)	method 1	urem/hr	0.04	0.51	0.23	0.61	2.29	0.84	2.44	0.61	2.46	0.93	2.67	
	method 2	urem/hr												
	conservative	urem/hr	0.04	0.51	0.23	0.61	2.29	0.84	2.44	0.61	2.46	0.93	2.67	
dose per setup		urem	1	14	3	1	27	2	5	2	29	1	3	87.82
% of annual dose budget		%	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0	0.878
% of allowed dose for the total time														80.98
% of allowed dose for the run time only														80.98

If > 200%, discuss result with Physics Research EH&S officer

date form issued: July 22, 2021 *authors:* P.Degtiarenko

Attachment A2

Hall: A **RADIATION BUDGET FORM** *page:* 1 of 1

Exp. # GMn E12-09-019 **rev: 0** **run dates: Aug-Dec 2021** **name of liaison: David Flay, Eric Fuchey**

setup number			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
beam	energy	GeV	3.7	3.7	3.7	6.0	6.0	6.0	8.0	8.0	8.0	9.9	9.9	9.9	4.0	4.0	4.0	*totals:*
	current	uA(CW)	19.2	30.9	35.1	24.0	30.0	54.0	30.0	30.0	52.9	30.0	30.0	55.4	19.2	30.9	34.5	
exp't target	element		D	Al	H	D	Al	H	D	Al	H	D	Al	H	D	Al	H	
	thickness	mg/cm2	2435	935	1062	2435	935	1062	2435	935	1062	2435	935	1062	2435	935	1062	
	dist. to pivot	m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Z		1	13	1	1	13	1	1	13	1	1	13	1	1	13	1	
	A		2	27	1	2	27	1	2	27	1	2	27	1	2	27	1	
cryo tgt window	element		Al		Al	Al		Al	Al		Al	Al		Al	Al		Al	
	thickness	mg/cm2	83		83	83		83	83		83	83		83	83		83	
	dist. to pivot	m	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0	
	Z		13	0	13	13	0	13	13	0	13	13	0	13	13	0	13	
	A		27	0	27	27	0	27	27	0	27	27	0	27	27	0	27	
critical window	radius	cm	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	
	dist. to pivot	m	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	
scattering weighting factor			0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
time	run time	hours	15	3.5	10.5	30	5	10	18	4	8.5	50	4	6.5	15	3.5	12	195.5
	(100% eff.)	days	0.6	0.1	0.4	1.3	0.2	0.4	0.8	0.2	0.4	2.1	0.2	0.3	0.6	0.1	0.5	8.1
	installation	hours																0
	time	days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
dose rate at the fence post (run time)	method 1	urem/hr	0.92	1.30	0.36	1.33	1.43	0.55	1.81	1.54	0.55	1.93	1.64	0.59	0.94	1.32	0.35	
	method 2	urem/hr																
	conservative	urem/hr	0.92	1.30	0.36	1.33	1.43	0.55	1.81	1.54	0.55	1.93	1.64	0.59	0.94	1.32	0.35	
dose per setup		urem	14	5	4	40	7	5	33	6	5	97	7	4	14	5	4	248.2
% of annual dose budget		%	0.1	0.0	0.0	0.4	0.1	0.1	0.3	0.1	0.0	1.0	0.1	0.0	0.1	0.0	0.0	2.482
% of allowed dose for the total time																		111.2
% of allowed dose for the run time only																		111.2

If > 200%, discuss result with Physics Research EH&S officer

date form issued: July 22, 2021 *authors:* P.Degtiarenko

Attachment B

Hall: A **RADIATION BUDGET FORM** *page:* 1 of 1

Exp. # E12-17-004 **rev: 0** **run dates: Aug-Dec 2021** **name of liaison: David Flay, Eric Fuchey**

setup number			1	2	3	
beam	energy	GeV	5.6	5.6	5.6	*totals:*
	current	uA(CW)	30.0	30.0	30.0	
exp't target	element		D	Al	H	
	thickness	mg/cm2	2435	935	1062	
	dist. to pivot	m	0.0	0.0	0.0	
	Z		1	13	1	
	A		2	27	1	
cryo tgt window	element		Al		Al	
	thickness	mg/cm2	83		83	
	dist. to pivot	m	0.0		0.0	
	Z		13	0	13	
	A		27	0	27	
critical window	radius	cm	13.8	13.8	13.8	
	dist. to pivot	m	5.10	5.10	5.10	
scattering weighting factor			0.50	0.50	0.50	
time	run time (100% eff.)	hours	86	10	12	108
		days	3.6	0.4	0.5	4.5
	installation time	hours				0
		days	0.0	0.0	0.0	0.0
dose rate at the fence post (run time)	method 1	urem/hr	1.63	1.40	0.30	
	method 2	urem/hr				
	conservative	urem/hr	1.63	1.40	0.30	
dose per setup		urem	140	14	4	157.7
% of annual dose budget		%	1.4	0.1	0.0	1.577
% of allowed dose for the total time						127.9
% of allowed dose for the run time only						127.9

If > 200%, discuss result with Physics Research EH&S officer

date form issued: July 22, 2021 *authors:* P.Degtiarenko

Attachment C

Hall: A **RADIATION BUDGET FORM** *page:* 1 of 1

Exp. # E12-20-010 **rev: 0** **run dates: Aug-Dec 2021** **name of liaison: David Flay, Eric Fuchey**

setup number			1	2	3	4	5	
beam	energy	GeV	5.6	5.6	5.6	5.6	5.6	*totals:*
	current	uA(CW)	30.0	30.0	30.0	15.0	15.0	
exp't target	element		D	Al	C	D	Al	
	thickness	mg/cm2	2435	935	138	2435	935	
	dist. to pivot	m	0.0	0.0	0.0	0.0	0.0	
	Z		1	13	6	1	13	
	A		2	27	12	2	27	
cryo tgt window	element		Al			Al		
	thickness	mg/cm2	83			83		
	dist. to pivot	m	0.0			0.0		
	Z		13	0	0	13	0	
	A		27	0	0	27	0	
critical window	radius	cm	13.8	13.8	13.8	13.8	13.8	
	dist. to pivot	m	5.10	5.10	5.10	5.10	5.10	
scattering weighting factor			0.50	0.50	0.50	0.50	0.50	
time	run time (100% eff.)	hours	16	2	4	16	2	40
		days	0.7	0.1	0.2	0.7	0.1	1.7
	installation time	hours						0
		days	0.0	0.0	0.0	0.0	0.0	0.0
dose rate at the fence post (run time)	method 1	urem/hr	1.63	1.40	0.14	0.81	0.70	
	method 2	urem/hr						
	conservative	urem/hr	1.63	1.40	0.14	0.81	0.70	
dose per setup		urem	26	3	1	13	1	43.82
% of annual dose budget		%	0.3	0.0	0.0	0.1	0.0	0.438
% of allowed dose for the total time								95.96
% of allowed dose for the run time only								95.96

If > 200%, discuss result with Physics Research EH&S officer

date form issued: July 22, 2021 *authors:* P.Degtiarenko

Attachment D

Hall: A **RADIATION BUDGET FORM** *page:* 1 of 1

Exp. # E12-20-008 **rev: 0** **run dates: Aug-Dec 2021** **name of liaison: David Flay, Eric Fuchey**

setup number			1	2		
beam	energy	GeV	7.4	7.4		*totals:*
	current	uA(CW)	5.0	5.0		
radiator	element		Cu			
	thickness	mg/cm2	772			
	dist. to pivot	m	-0.15			
	Z		29	0		
	A		64	0		
exp't target	element		D	H		
	thickness	mg/cm2	2435	1062		
	dist. to pivot	m	0.0	0.0		
	Z		1	1		
	A		2	1		
cryo tgt window	element		Al	Al		
	thickness	mg/cm2	83	83		
	dist. to pivot	m	0.0	0.0		
	Z		13	13		
	A		27	27		
critical window	radius	cm	13.8	13.8		
	dist. to pivot	m	5.10	5.10		
scattering weighting factor			0.50	0.50		
time	run time (100% eff.)	hours	48	4		52
		days	2.0	0.2		2.2
	installation time	hours				0
		days	0.0	0.0		0.0
dose rate at the fence post (run time)	method 1	urem/hr	0.78	0.05		
	method 2	urem/hr				
	conservative	urem/hr	0.78	0.05		
dose per setup		urem	37	0		37.69
% of annual dose budget		%	0.4	0.0		0.377
					% of allowed dose for the total time	63.5
					% of allowed dose for the run time only	63.5
					If > 200%, discuss result with Physics Research EH&S officer	

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