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WORK INSTRUCTION

For: Radiation Survey Procedure Following Beam Operation




DID No.

19851

VID No.

3


Made from template DOC01-4, VID: 3

Notes	Initial and date steps as they are completed on: Form 20096 Radiation Safety Survey Report. Note: Not all sections of Form 20096 will need to be completed every time—only perform radiation surveys on the devices that were used in most recent beam run. Note: Move the radial probe out to 380 mm (SAFE) before surveying and only move it in to 200 mm for the last measurement.
Training Required	TR-042 Radiation Safety Training Must be trained and certified by the RSO or their designee to perform surveys.
Special Tools Required	Geiger counter (CAL-0340) and Dose meter Red/Yellow (CAL-0228 Fluke Biometer) or White (CAL-0072 Technical Assembly)
Safety Equipment Required	-Safety Glasses, gloves and ring dosimeters should be worn (on the hand holding the probe) when performing a radiation survey -Bump caps should also be worn inside the tube.
Environmental Requirements (or Considerations).	Place all removable radioactive material on a table designated as “Radioactive Materials” in the radiation area next to the PIB.
 Cautions	The purpose of this procedure is to measure residual radiation. You may be exposed to low-level radiation. Make sure the Magnet Power Supply is LOTO.
 Warnings	Possible exposure to radiation. Survey meters contain ferromagnetic parts and should be used with extreme care around permanent magnets.
 Dangers	Possible exposure to radiation. Survey meters contain ferromagnetic parts and should be used with extreme care around permanent magnets.


Part Number: _____ Revision: _____ Work Order #: _____

Completed By: _____ Date: _____

Inspected By: _____ Date: _____

Instruction(s)	Illustration
<p>Note: Performing radiation surveys is the responsibility of the cyclotron operator and safety operator. Before performing a survey, the operator must be trained in the survey procedure by the RSO or his designee. Once trained, the operator is responsible for the safety of others entering radiation areas, including performing surveys of the area and objects in the beam path before they are handled/removed to ensure sufficiently low/safe levels of residual radiation.</p>	
<h2>I. Performing Radiation Surveys (in General)</h2>	
<p> <u>Check to make sure the area to be surveyed is safe: any power supplies are LOTO, the Magnet is de-energized (or far enough away from the object to be surveyed, as the survey meters contain ferromagnetic parts) and the necessary interlocks are tripped to prevent harm from gantry rotation, beam, etc. Always follow all PPE guidelines (Safety glasses, gloves and ring dosimeters, plus bump caps in the tube).</u></p>	
<p>1. <u>Obtain both a Geiger counter and a dose meter. Check the calibration due dates and note them on FORM 20096.</u></p>	<p>Note: FORM 20096 has 2 pages. Page 1 is specific to Radiation Surveys of the cyclotron itself, as well as of surrounding aspects of the Vault or PIB. Page 2 is a general survey checklist, useful for irradiated items such as water phantoms and other devices in the beam path.</p>
<p>2. <u>Following a significant beam run, the operator should perform a radiation survey of the overall room and any objects in the beam path before allowing others access to the room or objects.</u></p>	
<p>3. <u>The Geiger counter should be used first, followed by the dose meter should any location or object register more than 200 CPM. Operating instructions vary between meters, but instructions for three types of meters used are given below in steps 4, 5 and 6 of Section II.</u></p>	<p>Record all information on FORM 20096. Note: Not all sections of Form 20096 will need to be completed every time—only perform radiation surveys on the devices that were used in most recent beam run. Fill in the object or location surveyed if using page 2 of Form 20096.</p>
<p>4. Operators of the Cyclotron are responsible for ensuring that radiation levels are below 2 mRem/hr for workers to enter an area after an irradiation.</p>	<p><u>WARNING: DO NOT CONTINUE SURVEY IF YOU MEASURE OVER 2 mREM/Hr! NOTIFY OPERATOR IMMEDIATELY!</u></p>
<p>5. Once finished, place survey results into a designated folder.</p>	<p>Note: Remember to turn off ALL survey meters after use as to not drain the battery.</p>

II. Performing Radiation Surveys (In/On the Cyclotron, Vault and/or PIB)

- 1)  **Check with the Cyclotron Operator to ensure that the Magnet is DE-ENERGIZED and that it is safe to open the plug and survey. Make sure the magnet power supply is LOTO.**



- 2) Obtain a calibrated Geiger counter and dose meter (the red/yellow or the white) from the Safety Cabinet or the Radiation Area next to the PIB.

Check the calibration due dates and note them on FORM 20096.



- 3) Perform a Radiation Survey per FORM 20096 - Radiation Safety Survey Report.
- First fill out all fields of the header, noting the names of all surveyors.
- Record a background in air with the Geiger counter and record the measured value in the proper field.
- Then proceed to survey the locations noted on FORM 20096 with the Geiger counter. If any location produces more than 200 CPM, survey that location with one of the dose meters as well.
- Leave the covers on the meters unless you are expecting disproportionately large amounts of beta radiation (such as on irradiated films).

FORM 20096 Mevion Medical Systems RADIATION SAFETY SURVEY REPORT Form 20096 rev. 3

TODAY'S DATE	TODAY'S TIME	Surveyor
LAST RUN DATE	LAST RUN Operator	CAL DUE DATE
Geiger counter: METER CAL #		CAL DUE DATE
Dose Rate: METER CAL #		CAL DUE DATE

Record ACTIVITY using Geiger counter (CAL-0340) in "CPM". If more than 200 CPM also record the DOSE RATE with Red (CAL-0228 Fluor-Biometer) or White (CAL-0072 Technical Associates) Ion Chamber Meter in "mRem/Hr"

LOCATION TO SURVEY	CPM	DOSE RATE (if >200CPM)	EQUIPMENT CHECK	Record background Radiation
OUTSIDE SURVEY				
BEAMLINE POINT "EX"				
BEAMLINE Faraday Cup "FC"				
BEAM DUMP POINT "BD"				
BEAM DUMP SHIELD WALL POINTS "SW 1"				
"SW 2"				
"SW 3"				
Faraday-cup FC at ISO CENTER				
Other: (Indicate Survey Point (Faraday Cup or other Object in place of SW))				
Perform inside survey with Radial Probe at R=380mm (OUT) until last measurement				
INSIDE SURVEY				
GENERATOR BY POLE FACE THAT OPENS "RG"				
CYCLOTRON CENTRAL REGION "CR"				
CYCLOTRON OUTER RADIAL ELEMENTS "OR 1"				
"OR 2"				
"OR 3"				
"OR 4"				
CYCLOTRON SEPTUM "SP"				
END OF RADIAL PROBE "RP"				

FIRST fill out **ALL** of this header

NEXT survey the areas and devices indicated here only if they were used in the most recent beam run

LASTLY survey **ALL** areas indicated here

- 4) Using the Geiger counter: First turn the knob to 'BAT' and replace the batteries as needed.
- Turn the knob to the most sensitive scale (x0.1) to start and hold the probe approximately 2" from the object to be surveyed. If the needle goes over the maximum reading (5K), decrease the sensitivity to 1.0. Multiply the final needle reading by the final sensitivity to get the actual reading and record this number on Form 20096. (Example: If the needle points to 2K cpm and the sensitivity is set to 0.1, the actual reading is 200 cpm).
- Always start with the toggle switch in the FAST position, but if the needle bounces too much to get an accurate reading, flip it to the SLOW position.

Note: All fields might not need to be filled out on form 20096. Example: if the Faraday cup or beam dump were not used since the last radiation survey, then there is no need to survey those locations.



5) Using the Red/Yellow Dose Meter: Push the power button and wait for the initialization process to finish—the reading will start high and fall off to either 0.00 mR/hour or 0.01 mR/hr. Verify on the screen that the battery is ok or replace batteries as needed.

Double-check that the meter is in rate-mode, reading mR/hr, and not simply mR. To toggle between modes, press the “mode” button.

Hold the dose meter about 2 inches away from any object that previously measured over 200 cpm for about 20 seconds, or until the reading appears stable, and record the measurement in the appropriate column on Form 20096.

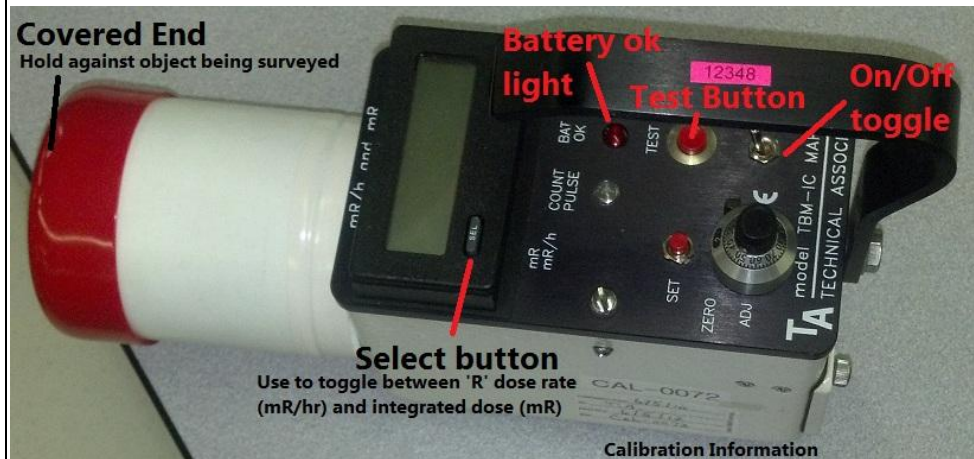
6) Using the White Dose Meter: Flip the switch to on and wait for the initialization process to finish. Push the ‘Test’ button and look for the ‘Battery ok’ light, or replace batteries as needed.

Double check that the meter is in rate-mode, as indicated by the large letter R on the left side of the screen. To toggle modes, use the ‘SEL.’ (select) button.

Touch the covered end of the white dose meter to any object that previously measured over 200 cpm for about 20 seconds, or until the reading appears stable, and record the measurement in the appropriate column on Form 20096.



Instead of just recording the “counts” or number of particles counted like the Geiger counter, the dose meters actually measure the energies of those particles and convert them into a dose. Therefore, the dose meters read in mRem or mRem/hr instead of counts per minute (cpm).



7) Operators of the Cyclotron are responsible for ensuring that radiation levels are below 2 mRem/hr for workers to enter an area after an irradiation.

WARNING: DO NOT CONTINUE SURVEY IF YOU MEASURE OVER 2 mREM/Hr NOTIFY SENIOR OPERATOR, SUPERVISOR or RSO BEFORE CONTINUING!
WARNING: LEVELS ABOVE 10 mRem/Hr REQUIRE SPECIAL PRECAUTIONS AND THE RSO OR HIS DESIGNEE SHOULD BE CONSULTED.

8) Place Survey Results in Radiation Survey Binder for that accelerator. The Test vaults and PIB have folders on the console. On-site consult field service for the location of survey reports.

Note: Remember to turn off ALL survey meters after use as to not drain the battery.

