

ACCELERATOR DIVISION ES&H PROCEDURE

ADSP-10-0101

RADIATION DETECTOR CHANGE PROCEDURE

RESPONSIBLE DEPARTMENT AD ES&H

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1 PURPOSE

This procedure describes how to properly change out Accelerator Division interlocked/non-interlocked detectors whenever it is necessary. There are many reasons a detector may require changing. Calibration is the main reason for detectors to be changed. However, occasionally detectors will fail for various reasons. If they are interlocked this will cause the safety system to experience a rad trip which will cause beam to be disabled for the associated beam line. This procedure covers steps to be taken should it be deemed necessary to change a detector. If replacement of an interlocked detector does not correct the condition, contact AD Radiation Safety for further guidance.

2 PERSONNEL AUTHORIZED TO PERFORM THIS PROCEDURE

- Accelerator Division Radiation Safety Group
- Accelerator Division Operations Department

3 BACKGROUND

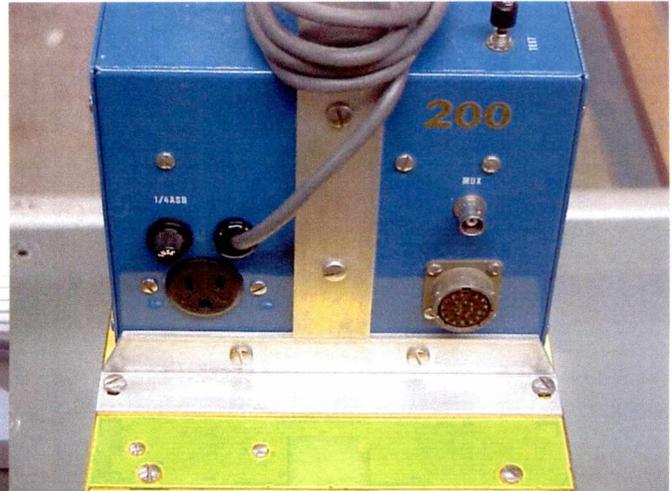
There are three types of detectors used in association with the Radiation Safety System regardless of whether interlocked or non-interlocked. The majority of them are Chipmunks used primarily outside of enclosures and Scarecrows located inside enclosures. The third type is the lessor used instrument called the Fox. The procedure for non-interlocked detectors is the same with the exception of safety system reset.

Interlocked detectors are installed around the accelerators and beam lines to prevent radiation levels in specified areas from exceeding the limits of the Fermilab Radiological Control Manual (FRCM). This prevents personnel who may be occupying those areas from exceeding FRCM exposure limits. It is imperative that these detectors be installed correctly to ensure that the requirements established by the FRCM are adhered to.

Types of Detectors



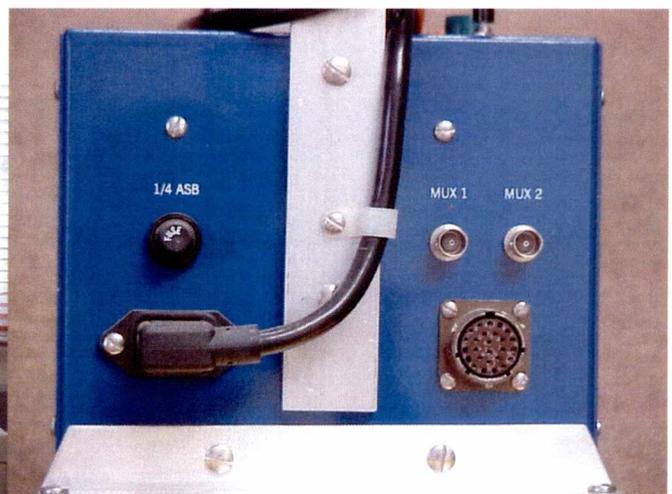
Type III Chipmunk Front View



Type III Chipmunk Connector Side View



Type IV Chipmunk Front View



Type IV Chipmunk Connector Side View

Shown here are two types of chipmunks used in our Radiation Safety Interlock System.

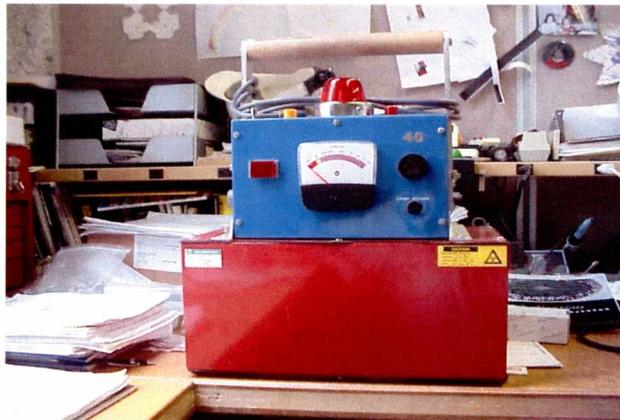
Note: All chipmunks perform the same function. Type IV's are considered a new and improved version of Type III's

On the front left-hand side of the type III chipmunk, you will see two colored LED mode indicators (green and yellow). These LEDs indicate the mode or quality factor that the detector is set for. The type III chipmunk has three modes: QF=5 or Neutron mode (green light), QF=2.5 or Mixed mode (green & yellow lights), and QF=1 or Muon mode (yellow light). From the side there is a 115V receptacle present. This receptacle should NEVER be used.

On the front left-hand side of the type IV chipmunk, you will see four red LEDs which are mode indicators. These LEDs indicate the mode

or quality factor that the detector is set for. The type IV chipmunk has four modes: QF=1 or Muon mode, QF=2.5 or Mixed mode, QF=5 or Neutron mode, and QF=10 (additional Neutron mode). Setting the quality factor will be discussed later, in Section 6.

From the side, you can see that the type 4 chipmunk has an extra BNC connection. Either of these connections can be used for replacement purposes.



Scarecrow Front View

Shown here is a scarecrow. Scarecrows operate on the same fundamental principles as chipmunks; the only important difference is that a scarecrow is for use in higher radiation fields than a chipmunk. NEVER replace a chipmunk with a scarecrow or vice versa. Scarecrows have one mode of operation, QF=4.



FOX Front View

Shown here is a FOX detector. The FOX is primarily used for detection of x-rays. FOX has one mode of operation, QF=1.

4

MATERIALS/PREREQUISITES

- Appropriate Detector Type
- Detector Installation Form
- If necessary-Interlocked Detector Book (For portions of this procedure only)
- Tools/Equipment used for specific locations as described in the Interlocked Detector Book

5 DETECTOR REPLACEMENT

5.1 For failed detectors determine which interlocked detector needs to be replaced by looking at the Accelerator Division Radiation Monitors page or the AD/ESH Safety System Status page in the MCR. Tripped detectors will be indicated in red.

5.2 Find the location of the desired detector to be changed in the Interlocked Detector Book, which is located in the spare interlocked detector locker in the Cross Gallery High Bay. Note the following:

- Detector Type
- Detector Location
- Required materials for replacement
- Detector Quality Factor (QF) setting (Required for chipmunks only)
- Entry Control requirements for the location
- Restrictions on personnel required for replacement

Note: Some interlocked detectors are located in areas where special detectors or special training are required. These restrictions are listed in the Interlocked Detector Book. Contact the AD RSO for replacement of these detectors.

5.3 Obtain the appropriate type of detector and plug it in, to ensure the QF is correct. If the QF setting is not correct, refer to Section 6 of this procedure.

5.4 Proceed to the location of the detector to be changed with the replacement detector and all required tools and materials.

5.5 Unplug the detector, remove the signal cable(s), and set it aside.

Note: The Accelerator and P-Bar areas utilize both a 2-pair cable and an RG-58 cable. The 2-pair cable provides input to the Radiation Safety System, and the RG-58 provides input to the MUX system. Both cables are required for proper operation and monitoring. The external beam line detectors utilize a 3-pair cable. For these, the input to the MUX system(s) is taken from the interlock Rad chassis.

5.6 Install the replacement detector by re-connecting the signal cables and plugging it in.

5.7 Install any necessary equipment (e.g. plastic bags, cable ties) as outlined in the Interlocked Detector Book.

5.8 Allow the detector to pass through the start-up cycle (usually 2-3 minutes). Detector will alarm when powered up, wait for it to settle down below alarm levels.

Note: 1 sec TC detectors have a short alarm time when starting up

- 5.9 Fill out the Detector Installation Form. Be sure to fill out the ENTIRE form. Ensure that the information you provide is as specific as you can get it, calibration due date and instrument serial number stickers are provided on each instrument. The rest of the information should be available in the Interlocked Detector Book. See attachment 1.
- 5.10 Proceed to the MCR and reset the Radiation Safety System by pressing the "Safety System Master Reset" button located above the Accelerator Division Radiation Monitor terminal. Detectors that reset will be indicated in green on the Radiation Monitors page. If it does not reset trouble shoot as necessary. If problems persist it may require involvement from the Interlock group.
- 5.11 Return the failed interlocked detector to the spare locker. Fill out an "Out of Service" (OOS) tag and attach it to the failed instrument. Ensure that all the information on the tag is filled in.
- 5.12 Place the completed Interlock Detector Change form in the pouch provided on the door of the spare locker.

6 SETTING THE QUALITY FACTOR

6.1 Determine the proper Quality Factor (QF) setting of the detector by looking at the Interlocked Detector Book.

6.2 De-energize the detector, or ensure the detector is de-energized.

6.3 Remove the back top (blue) portion of the chipmunk.

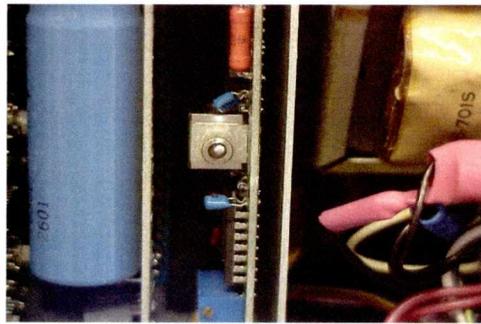
6.4 Adjust the QF as follows:

6.4.1 For a Type 3 Chipmunk, adjust the three-position toggle switch as follows:

Up → QF = 5
(Neutron Mode)

Middle → QF = 2.5
(Mixed Mode)

Down → QF = 1
(Muon Mode)



6.4.2 For a Type 4 Chipmunk, adjust the four-position rotary switch as follows:

Top → QF = 10
(Additional Neutron Mode)

Top-Middle → QF = 5
(Neutron Mode)

Bottom-Middle → QF = 2.5
(Mixed Mode)

Bottom → QF = 1 (Muon Mode)



6.5 Replace the back top portion of the chipmunk.

6.6 Energize the chipmunk to verify the proper mode is indicated. The Type 3 chipmunk has (1) green and (1) yellow light. In the QF = 5 (Neutron) mode, only the green light should be illuminated. In the QF = 2.5 (Mixed) mode, both of the lights should be illuminated. In the QF = 1 (Muon) mode, only the yellow light should be illuminated. The Type 4 Chipmunk has (4) red LEDs, each of which correspond to (1) QF. The Top LED is for the QF = 10 mode, the second from the top is for QF = 5 mode, the second from the bottom is for the QF = 2.5 mode, and the bottom one is for the QF = 1 mode.



Accelerator Division



Detector Installation Form

Detector Location: _____	MUX
Quad/Add: _____	
Type: <input type="checkbox"/> Chipmunk <input type="checkbox"/> 1 sec TC	<input type="checkbox"/> Scarecrow
	<input type="checkbox"/> Other: _____
QF Setting: <input type="checkbox"/> Neutron	<input type="checkbox"/> Muon
	<input type="checkbox"/> Mixed
New Serial Number: _____	Old Serial Number: _____
Cal Due Date: _____	
Reason for Change/Adjustment:	
<input type="checkbox"/> Due for Calibration	
<u>Replaced Bad Detector - Nature of Problem:</u>	
<input type="checkbox"/> Trips off Rad Safety System due to zero or low counts	
<input type="checkbox"/> Trips off Rad Safety System due to high counts	
<input type="checkbox"/> Trips off Rad Safety System for no apparent cause	
<input type="checkbox"/> Other (explain) _____	

<input type="checkbox"/> Adjust QF - New QF Setting: <input type="checkbox"/> Neutron <input type="checkbox"/> Muon <input type="checkbox"/> Mixed	
<input type="checkbox"/> Change Detector Type - Old type: <input type="checkbox"/> Chipmunk <input type="checkbox"/> Scarecrow	
Signature(s)	
Completed by: _____	Date: _____