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Main Injector Residual Radiation Data 2004 - 2007

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Introduction

In preparation for the 2004 Facility Shutdown, a survey for high radiation areas was conducted in the Main Injector. Data from that and subsequent surveys were stored in spreadsheet files. By Fall 2005, a system for regular monitoring of radiation using a new dual-range meter with bar-code reading capability was implemented. This document will briefly describe these monitoring efforts. The spreadsheet data from these sets of monitoring efforts will be stored in Beams DocDB with this document. Information on the operational use of the meter and a list of bar coded locations will be included.

Intensive Surveys

Using Log Survey Meters (LSM's) from the supply in the Main Control Room, measurements were taken to locate and monitor areas of the Main Injector which showed significant residual radioactivity. This was done with a goal of surveying the situation, thus the limits for recording information were being developed and therefor varied. Typically, any location with more than 10 to 25 milliRem/hr on contact was documented. It was not obvious what problem would create residual radiation but it is likely that the most activated items would be adjacent to the beam pipe. At most interesting locations, data was recorded for top, bottom, aisle (radially inside) and wall (radially outside) at (in contact with) or near the beam pipe. Exceptions included the regions between quadrupoles and corrector sextupoles where it was not possible to touch the beam pipe. The LSM's have a range from 2 mR/hr to 2000 mR/hr. Some readings were recorded of a bit less than 2 mR/hr by noting readings below the lowest mark. Readings of a bit above 2000 mR/hr were estimated by observation of the increase of the reading as probe approached the desired measuring location.

Data from these surveys were recorded on paper using copies of the radiation survey maps for the Main Injector. Almost all of this data was then entered into a spreadsheet for tracking and comparisons. Measurements were made on several occasions between November 2003 and June 2004 by Dave Capista and/or Alberto Marchionni. Between June 2005 and August of 2005, measurements were recorded by Bruce Brown on more than a dozen dates including many complete tours of the Main

Injector tunnel. Some early conclusions were reported in [Beams-doc-1382](#).

Bar-Coded Location Surveys

Based on the intensive surveys in 2004-2005, it was determined that a monitoring program of measurements at a set of locations marked by Bar-code labels would assist in further monitoring. This was in part to be sure that repeatability from survey to survey would be possible. In addition, the need to reduce personnel exposure during the survey was essential. With this in mind an extensive set of monitor locations was established, about half of which are at Lambertson Magnet locations, and bar codes were printed and installed. A radiation meter with bar-code reading capability and data storage was purchased. Since that time, almost all surveys have been done with the new meter. On one occasion, the batteries were dead so a bar-code location survey was done with an LSM.

RAM DA-3 2000 Meter

The meter chosen is a ROTEM meter capable of storing 347 measurement records in non-volatile memory. For details on its capability, one should consult the manual. However, let us describe the use pattern developed for the Main Injector measurements.

- Cycle the power switch to ON.
- Confirm that the measuring units are set for R/h (or mR/h).
- Depress the count button to activate the FREEZE mode (maintains the highest rate reading).
- Place the meter on top of (in contact with) the bar code. (It defines the standard location for Main Injector radiation monitoring readings.) It requires 7 - 10 seconds to reach a stable reading.
- Depress the SPEAKER button to activate the bar-code reader. The LED display will now show 'bAr', indicating that it has been activated. Point the red beam to scan the bar code. Success will be indicated by both a LED display and a sound. Repeat if the bar code is not recognized. The ion-pump magnet is adjacent to the downstream bar code on the ILA Lambertson magnets and it causes the scanning beam to point in a different direction so extra care is required for that measurement. Some Lambertson magnet bar codes have suffered dis-coloration of the protective cover. Despite this visual change, the bar code reader nearly always can read these bar-codes. [A small number of the installed bar codes are now difficult or impossible to read. One can (should) take a complete list on paper and scan the paper copy if necessary to allow the data to contain a complete list of bar codes. This has not been done for recent surveys because in addition to complete failures, a small number of bar codes in each survey are mis-read, requiring a manual editing of the information, anyway.]
- When the bar code reading is complete, check to assure that FREEZE mode was correctly activated, then depress the LIGHT button to execute the data store sequence. WARNING: depressing LIGHT for 5 seconds causes the memory to be reset! The meter briefly displays the number of remaining memory locations so one can monitor for lost data by requiring the count to continue to decrease.
- Prepare for the next location. While in an area with lower radiation, cycle the COUNT button from FREEZE and back into FREEZE mode.

One more than one occasion, the author accidentally pressed the LIGHT button and erased the data when attempting to record data at an awkward location (behind the protective barrier at the MI40 Lambertson magnet). Awareness of this complication may help avoid repetition of this mistake. To protect the data from accidental erasure, one should turn off the meter when the scanning effort is complete. One then takes the meter to a computer on which the Rotem Meter View (RMV) software has been installed. One connects the meter to the computer via RS232 and reads out the data. Usually the data is stored in both .csv and .xls data formats. Good practice will be to label the downloaded files with

the name MIResRadyyyymmdd.csv although this naming has not been consistently followed.

Files

Radiation Surveys 2004 - 2005

This spreadsheet was initiated by Alberto Marchionni and was carried forward until the LSM measurements were replaced by the ROTEM meter readings at bar-coded locations. It is not organized for presentation but is being preserved to make it available for others. It contains nine worksheets and 15 charts. This includes the basic data in worksheet RadiationSummary and extracts of that data or supplements to it in Lambertsons, DQuadLoss, and FQuadLoss. Worksheet Notes contains a brief list and description of the measurements including, in some cases, the cooldown time between beam off and start of measurements. Other worksheets are a mixture of calculations and some additional measurements. The charts contain running efforts to make presentations as the measurements progressed.

MI Radiation Monitor Locations

This file was the source of information for printing the bar codes. It contains an ordered list (almost) of the labels for radiation monitoring bar codes as well as a description of the location to which that bar code was applied. The bar code label shows the ASCII and bar code representations for these labels.

Residual Radiation at Monitor Points

This file contains the data for measurements at the bar-coded monitor locations. Data from prior to the commissioning of the ROTEM meter as well as one tunnel tour when the batteries were dead are included as well as all data transferred from the .csv files from the ROTEM meter surveys. In addition to the data, many columns are devoted to ratios from different dates. The first column contains the label value and the last column is the description of the monitor location where that label was applied. Sheet 1 contains the data while various charts occupy the other worksheet tabs.