

# LTB Fault Study CA-222

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## 1 Study Plan

### 1.1 Goal

The goal of this study is to produce a loss of Linac beam on or near LTB vacuum valve ltb-sv-114 and measure the resulting prompt radiation on the Linac side of the EBIS-Booster feed-through pipes. The study is to be conducted in accordance with C-A-OPM 9.1.9.

### 1.2 Conditions

1. The proton kinetic energy is 200 MeV.
2. The repetition period is at least 4 seconds.
3. The intensity is no more than  $5 \times 10^{11}$  protons per repetition period at vacuum valve ltb-sv-114.

### 1.3 Energy Deposition and Radiation Estimate

1. Under the above conditions the average rate of beam loss is at most  $1.25 \times 10^{11}$  protons per second. The average rate of energy deposition due to the loss is at most 4 watts.
2. Dana Beavis [1] has estimated the dose rate at the feed-through pipe openings in the Linac building due to a local beam loss near the pipe openings in Booster. According to his analysis the conservative dose rate estimate for a loss of  $10^{12}$  protons per second at 2 GeV kinetic energy is 130 mrem/hr using the curves of Sullivan [2] and 4 mrem/hr using the Goebel [3] formula.

3. Under the conditions of this fault study the corresponding dose rates would be 1.6 and 0.05 mrem/hr.

#### 1.4 Instrumentation

1. The beam current in the LTB line is to be monitored with current transformer XFMR100. This is located is 14 feet upstream of valve ltb-sv-114.
2. Losses downstream of XFMR100 can be monitored with loss monitor LM107.
3. Radiation surveys are to be conducted with the HP1010 meter or comparable instrument.
4. Chipmunk NM114 has been placed near the EBIS-Booster feed-through pipe openings in the Linac building. The scaler readout from this device is to be monitored (via the Chipmunk Viewer application) during the fault study.

#### 1.5 Method

1. Prepare for the fault condition as per C-A-OPM 9.1.9.
2. With the beam OFF, measure and record the radiation levels near the EBIS-Booster feed-through pipe openings in the Linac building.
3. With LTB vacuum valve ltb-sv-114 closed establish the desired loss conditions at (or near) the valve.
4. Measure and record the radiation levels under the loss condition. Record the beam current upstream of the loss. **The beam loss is to be maintained only as long as necessary to make the measurements. Turn the beam OFF when not in use.**

## 2 Results

With  $4.86 \times 10^{11}$  protons incident on valve ltb-sv-114 per 4 second repetition period, the radiation levels measured by Ken Boland at the

three feed-through pipe openings in the Linac building were 0.1, 0.15, and 0.1 mrem/hour. (0.15 mrem/hour is the reading at the center pipe.)

With beam OFF the measured levels were less than 0.05 mrem/hour.

The recorded details of the study may be found in the 12–13 January 2009 FaultStudies-2009 elog and in the Fault Study Logbook residing in the Main Control Room.

## References

- [1] D. Beavis, “Cable Penetrations into Booster for Ebis”, October 9, 2008.
- [2] A.H. Sullivan, “A Guide to Radiation Protection and Radioactivity Levels near High Energy Accelerators”, Nuclear Technology Publishing, 1992.
- [3] K. Goebel, et al., CERN LABII-RA/Note/75-10 (1975).