Memo

Date: October 11, 2017
To: RSC, K. Kusche, and M. Palmer
From: D. Beavis
Subject: Fault studies at ATF (246 and 247)

Two fault studies were conducted at ATF. The radiation dose rates at the intensities operated were small. The chipmunk at the east gate will protect personnel outside the gate from excessive dose. Operations to the ASE limit of 5 Watts may be possible but would require changes in shielding or changing the area outside the gate to a Radiation Area. It is unlikely that the experiments in the near future would operate at high intensity. It is also expected that the changes to the rear of the experimental area will decrease the radiation dose rate at the east gate but then the wall penetrations will need to be considered.

Fault Study 247

FS 247 measured the dose rates for the FFAG in BL1. The beam power was 0.008 Watts for the measurements conducted at 54 MeV. The highest dose rate detected was 0.5 mrem/hr. Scaling radiation measurements by large factors may not be advisable. Scaling to 0.8 watts (a factor of 100) would produce dose rates on the order of 5 mrem/hr at the east gate where the chipmunk is located. At the ASE limit the dose rate at the gate would be 54 mrem/hr. The chipmunk can provide the necessary protection if intensity excursion were to occur to this level. The results of measurements are given in the table below:
The fault study plan is reproduced below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Dose Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration #2 along the wall</td>
<td>0.0</td>
</tr>
<tr>
<td>East exit gate</td>
<td>0.0</td>
</tr>
<tr>
<td>East Wall at Beam Height</td>
<td>0.0</td>
</tr>
<tr>
<td>U/S of Penetration #2 East Wall at Beam Height</td>
<td>0.0</td>
</tr>
<tr>
<td>D/S of Penetration #2 East Wall at Beam Height</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Survey Data**

Surveyed By: J. Vignola
Reviewed by

Notes:
Readings were taken for two minute integrations.
Readings in mrem/hr
ATF experimental hall Beamline 1 (FFAG experiment) fault study plan

Prepared by: Karl Kusche (person(s) knowledgeable in the area beam properties).

Reviewed by: RSC representative

Date: 5/13/17

Fault Study No. 247

Goal(s):

1. Measure locations for routine and beam fault dose rates for the beamline #1 FFAG experiment in the experimental hall. Beamline #1 has been configured for ATF experiment AD-028-2017-JAN-12 (AE79 NS-FFAG) such that it now has a new beam dump in the horizontal plane. Routine operation with ~70 MeV electrons transported cleanly will be established and documented before documenting the dose rates for routine operations.

For details, refer to “Minutes of RSC Subcommittee of January 25, 2017”.

Previous calculations for the area can be found within RSC references.

Method(s):

**Configuration:** ~70 MeV, 1.5 Hz, ~100 pC, W-beam shutter retracted (open)

- Beam parameters will be controlled so as not to exceed 0.05 W. The linac operator will monitor the control room diagnostics.

- The photocathode drive laser will be set to a repetition rate of 1.5 Hz. The “YAG-to-Gun” laser shutter will be opened.

- The linac operator will follow OPM 21.1.1 (ATF Linac Operation Procedure) for delivery of accelerated electron beam into the experimental hall. The operator will use the computer control system to load the parameter file representing the last known good beam tune for ~70 MeV.

- The chicane dipoles will be off for the duration of the study.

- When operation of the linac is achieved as described above, a printout of the parameters will be made to capture the test conditions.
Routine:

A) Establish a stable beam to the Beamline 1 90-degree dipole ("GD2") dump, with routine settings for unmodulated ~70 MeV electrons, ~100 pC delivered. Ensure that the machine parameters are recorded.

Measure the following locations (red asterisks on drawing) for the routine numbers:

All dose rates are expected to be low.

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. East wall at beam height

B) Beamline 1 dipole GD2 off, beam delivered to FFAG

The RCTs should scan for any elevated levels besides the locations specifically noted. Areas on the east and west side should have personnel removed until the studies are conducted to avoid any unnecessary exposure.

i) Beam energy ~68-72 MeV

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. East wall at beam height

ii) Beam energy 54 MeV

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. East wall at beam height

iii) Beam energy ~36-40 MeV

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. East wall at beam height

Figure 1
Fault Study 246

The fault study examined the potential dose rates if the two dipoles in BL2 were operated on separate power supplies. This allows for faults due to miss-matched magnet currents and polarities. The 48 MeV beam had a beam power of 0.02 Watts. The highest dose rate was at the east gate and was 0.25 mrem/hr. Scaling to the ASE limit of 5 Watts a dose rate at the gate would be 60 mrem/hr. The chipmunk can provide protection for this magnitude of beam escalation.
ATF experimental hall Beamline 2 dipole “ID2” zero degree fault study plan

Prepared by: Karl Kusche (person(s) knowledgeable in the area beam properties).

Reviewed by: Dana Bell (ASC representative)

Date: 3/23/17

Fault Study No. CA-248

Goal(s):

1. Measure locations for routine and beam fault dose rates for the beamline #2 dipole “ID2” in the experimental hall. ID2 has been configured for ATF experiment ADO-029-2017-JAN-19 (AE62 Sub-fsec diagnostic) such that it now has its own power supply independent of ID1 and a new beam dump in the zero-degree direction. Routine operation with 48 MeV electrons transported cleanly will be established and documented before documenting the dose rates for routine operations.

Previous calculations for the area can be found within RSC references.

Method(s):

**Configuration:** 48 MeV, 1.5 Hz, 300 pC, W-beam shutter retracted (open)

- Beam parameters will be controlled so as not to exceed 0.05 W. The linac operator will monitor the control room diagnostics.

- The photocathode drive laser will be set to a repetition rate of 1.5 Hz. The "YAG-to-Gun" laser shutter will be opened.

- The linac operator will follow OPM 21.1.1 (ATF Linac Operation Procedure) for delivery of accelerated electron beam into the experimental hall. The operator will use the computer control system to load the parameter file representing the last known good beam tune for ~48 MeV. This will set the H-line magnets for delivery of accelerated beam to the dipole HD1. It will also set the dipole HD1 for delivery of the beam to the high energy slit (HES). The operator will view the beam profile at monitors (BPMs) positioned along the beam line and adjust magnet settings to fine tune the beam. Ultimately, the position of the beam on the HES and the dipole current will be used to calculate the electron beam energy. Typically, up to one hour is required to achieve a fairly stable beam profile on the HES.

- The chicane dipoles will be off for the duration of the study.
To place ID2 into the wrong polarity the following must be done:

A) (ATF computer scientist) Set/confirm CAIN power supply firmware current range is set to -60 to +60 Amps.

B) (ATF computer scientist) Set/confirm control system software current range is set to -60 to +60 Amps.

III) Dipole ID2 at negative current for -20 degrees

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. North end wall (aligned with BL2 axis)
4. NW corner
5. West wall at air handler (less than 1 mrem/hr)
6. West labyrinth gate.
7. High above shield blocks at building end (less than 16 mrem/hr)

IV) Dipole ID2 at maximum negative current

1. Penetration #2 along the wall (FEL room)
2. East exit gate
3. North end wall (aligned with BL2 axis)
4. NW corner
5. West wall at air handler (less than 1 mrem/hr)
6. West labyrinth gate.
7. High above shield blocks at building end (less than 16 mrem/hr)

Remove changes for the incorrect Polarity:

A) (ATF computer scientist) Set/confirm CAIN power supply firmware current range is set to -5 to +60 Amps.

B) (ATF computer scientist) Set/confirm control system software current range is set to -5 to +60 Amps.
- When operation of the linac is achieved as described above, a printout of the parameters will be made to capture the test conditions.

**Routine:**

**A)** Establish a stable beam to the Beamline 2 dipole ID2, with routine settings for unmodulated \textbf{48 MeV} electrons, 300pC delivered. This includes +20-degree transport through ID2 to the original beam dump. Ensure that the machine parameters are recorded.

Measure the following locations (red asterisks on drawing) for the routine numbers:

- **All dose rates are expected to be low.**
  1. Penetration #2 along the wall (FEL room)
  2. East exit gate
  3. North end wall (aligned with BL2 axis-20 degree dump)
  4. NW corner
  5. West wall at air handler
  6. West labyrinth gate.

**B)** Repeat section A but with ID2 off. Measure the following locations for the routine numbers:

- **All dose rates are expected to be low.**
  1. Penetration #2 along the wall (FEL room)
  2. East exit gate
  3. North end wall (aligned with BL2 axis-zero degree dump)
  4. NW corner
  5. West wall at air handler
  6. West labyrinth gate.

**Faults: Beamline 2 dipole ID2 mis-steering**

The RCTs should scan for any elevated levels besides the locations specifically noted. Areas on the east and west side should have personnel removed until the studies are conducted to avoid any unnecessary exposure.

**I) Dipole ID2 at maximum positive current**

- 1. Penetration #2 along the wall (FEL room) \textbf{(less than 4 mrem/hr)}
- 2. East exit gate
- 3. East wall at beam height \textbf{(less than 2 mrem/hr)}
- 4. North end wall (aligned with BL2 axis)
- 5. NW corner
- 6. West wall at air handler
- 7. West labyrinth gate.