Shielding for TRIUMF’s new High-Power Electron LINAC

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BEAM LINES AND EXPERIMENTAL FACILITIES
• 50 MeV, 10 mA, CW (100 MeV, 5 mA)
• 3-stage acceleration
  – 10, 30, 50 MeV
• 500 kW beam power
Placed into existing vault – needs to be upgraded
• 500 kW eLINAC
• Placed into existing vault – needs to be upgraded
• Two simulations:
  – 30 MeV
  – 100 MeV
Shielding Requirements

- **TRIUMF policy:**
  - Never higher than 1 Sv/hr (300 mSv/hr) at a potentially-occupied location
  - Occupancy level of 10 μSv/hr (5 μSv/hr)
  - Completely redundant monitoring system if a potentially-occupied location can exceed 50 mSv/hr

- **Accelerator anticipated to have chronic losses better than 1 part in 10^4** (most likely 10^5)

- **Shielding will be designed for accidental losses of ~50 mSv/hr and so will handle chronic losses of 5 μSv/hr**
• 500 kW eLINAC
• Placed into existing vault – needs to be upgraded
• Two simulations:
  – 30 MeV
  – 100 MeV
Top View 30 MeV

Dose (5mA at 30MeV) usrbin 51 photons

X Distance (cm)

Z Distance (cm)

5955, 35, -2890, 59

1e+12
1e+10
1e+08
1e+06
10000
100
1

μSv/hr
Top View 30 MeV
Side View 30 MeV
Side View 30 MeV
End View 30 MeV
End View 30 MeV
500 kW eLINAC

Placed into existing vault – needs to be upgraded

Two simulations:
- 30 MeV
- 100 MeV
Top View 100 MeV
Side View 100 MeV

Dose (5mA at 100MeV) usrbins51 X -760 to -720cm

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M. Trinczek - Shielding for TRIUMF's new High-Power Electron LINAC
End View 100 MeV
Lower-ceiling shielding of 5 ft concrete is okay for 30 MeV but not 100 MeV

Roof beams with 0.5 cm gaps more of a problem for gammas than for neutrons
  – Need for a shroud above higher-energy section?

Likely need second monitoring system over the roof beams, but since radiation is diffuse can get by with only a few monitors above the higher-energy section

Need ~10 ft concrete for shielding gammas in the forward direction
Conclusions(2)

- Service chase mounted high on wall appears okay
- Corner overlap of roof beam on side walls is insufficient
  - Need 2 more ft of concrete
Future Work

• More statistics!
• Add in beam dump, stair well, and tunnel shielding in forward direction as designers converge on layout
  – What is the field at ground level in the forward direction?
• Look into adding a shroud (local shielding) in higher-energy sections
• More statistics!
Thank you!
Merci!

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