Determination of Access controls for PXIE cave during RFQ RF powered operation

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Initial assumptions

• No radiation worker training required
  – Requires normal dose rate <0.05 mrem/hr
  – Accident condition <1 mrem/hr

• No access controls to cave with RFQ RF powered

• Source term per Steimel/Prost calculation
procedure

• Use MARS with EGS5 to make a calculation

• Source term:
  – 85 keV
  – 1.75 A
Range of electrons

• \( R = 412 \times E^{(1.265 - 0.0954 \times \ln(E))} \)

• Where:
  – E is energy in MeV
  – R is range in mg/cm²

• For 85 keV electrons
  – R = 0.0011 cm in copper
    • Maximum x-ray production
    • Minimum shield
Model Geometry

With electron and x-ray tracks
Detector volumes

Full Model

Without Cu shield

With 0.4 cm Cu shield
X-ray spectra

unshielded

0.4 cm Cu shield
Angular distributions

photon/electron yield as a function of angular bin

unshielded

0.4 cm Cu shield
Full model - 4 cm radius Cu shield
Conclusion

• Initial assumptions are incongruous
  – Can’t guarantee required dose rates can be observed, especially at vacuum ports and at couplers
  – Shielded cave with access controls should be used
    • Under normal operation – no personnel access to the cave while RFQ is RF powered
RFQ Commissioning Cave Layout

- Add labyrinth to South end of cave, install gates and roof blocks
- All blocks in-house, ~ 3-4 weeks to install