An Afternoon of VARSKIN Training

D.M. Hamby, C.D. Mangini, and L.J. Anspach

VARSKIN TRAINING

- 1:00 – 1:30 pm
  - Photon dosimetry methods (Logan Anspach)

- 1:30 – 2:00 pm
  - Electron dosimetry methods (Colby Mangini)

- 2:00 – 4:30 pm (w/ short break)
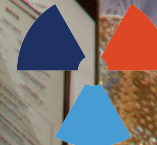 - Introducing the *new* VARSKIN WorkBook training series

You're Invited

RAMP Social Night

Network with RAMP administrators, code developers, and other RAMP members
Hors D'oeuvres & Cocktails | City Perch Kitchen + Bar |11830 Grand Park Avenue
Monday, October 28th | 6:00 – 8:00 pm

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VARSKIN WorkBook Examples

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Introduction

- 15 examples of which we'll work through several over the next couple of hours
- *WorkSheets* are being passed out
- The VARSKIN *WorkBook* will be made available once we're finished
  - allowing you to review the examples in more detail
  - available on the RAMP website as a .PDF

Example 1 (DMH)

- Calculation of point-kernel photon dose
- 662 keV photon
- 15 cm separation in homogeneous water
- Compares (5%) to fundamental hand calculation
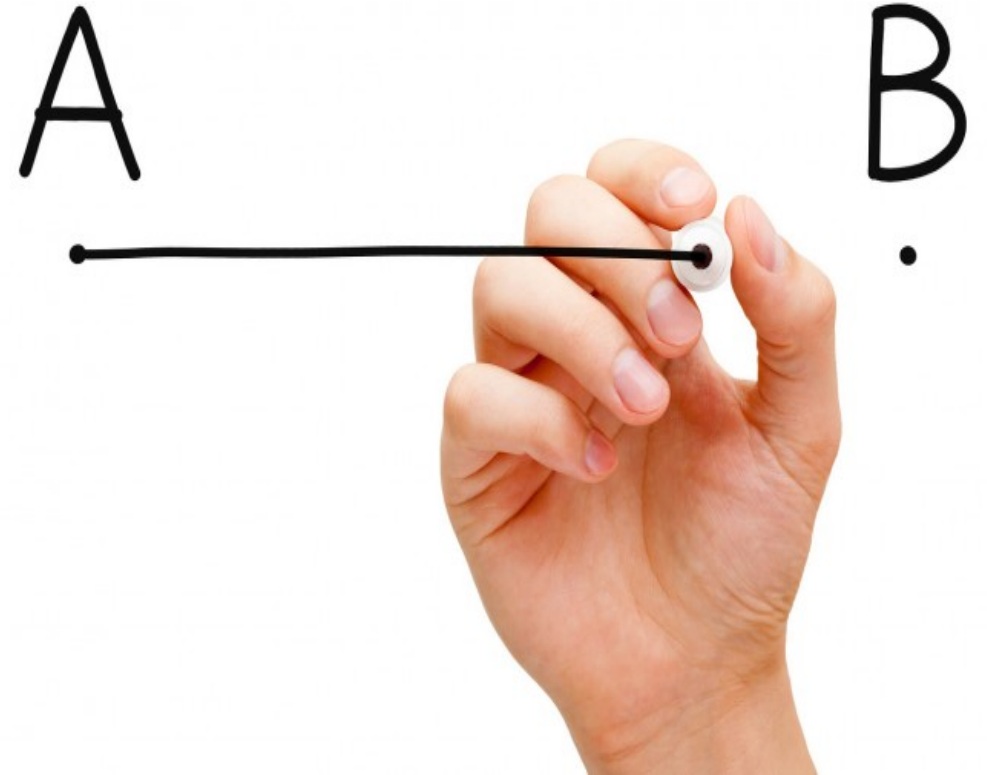
Example 2 (CDM)

- 3D Hot particle on a gloved hand
- ^{60}Co in stellite
- Comparisons to electron dose-rate factors (20%)
- If eliminating backscatter (0.1%)
- Then, dose from point and cylindrical geometries
- And, both shallow and deep dose

Example 3

- Liquid source on the skin
- Little exposure information
- Trying to bound the dose estimate
- Several different geometry possibilities

Example 4
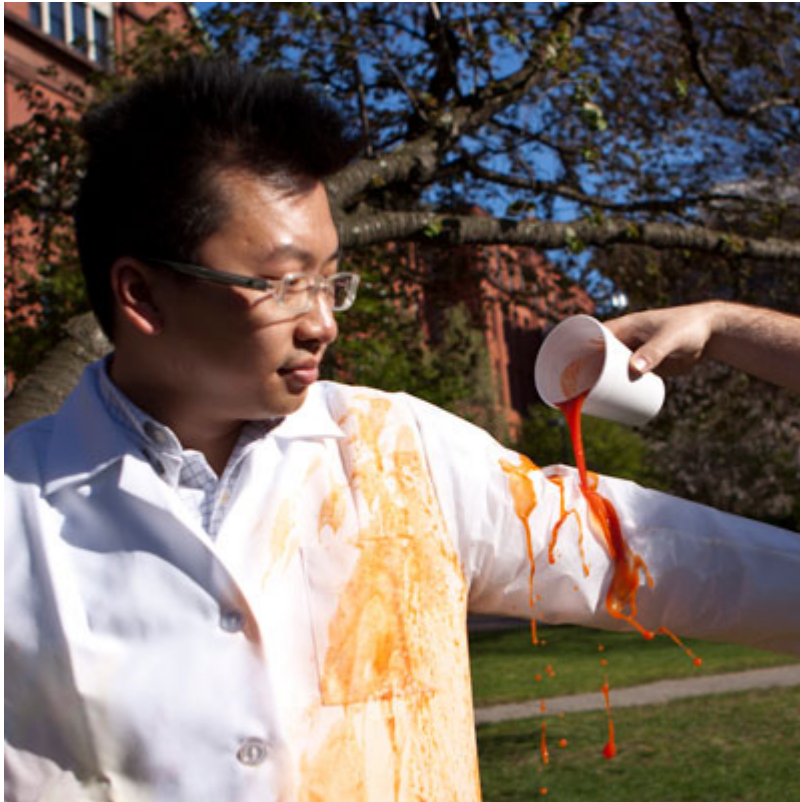
- Liquid contamination on a lab coat
- How do we treat the lab coat?
  - As a source? As a shield?
- Comparison to an electron dose-rate factor from the literature (10%)
- Electron dose spans an order of magnitude depending on geometry assumptions

Example 5

- Photon dose from two nearby particles
- Using offset particle model
- Only works for photon point sources
- ^{57}Co and ^{60}Co sources separated by 5 cm
- How does separation distance compare to 10 cm^2?
- 10 CFR 20.1201 says that we must calculate greatest dose to contiguous 10 cm^2 averaging disk at 7 mg/cm^2
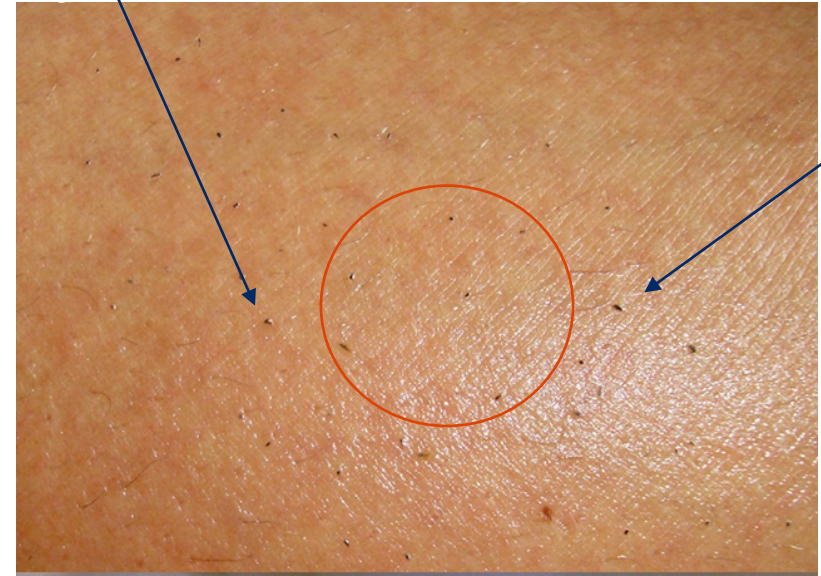
Example 6
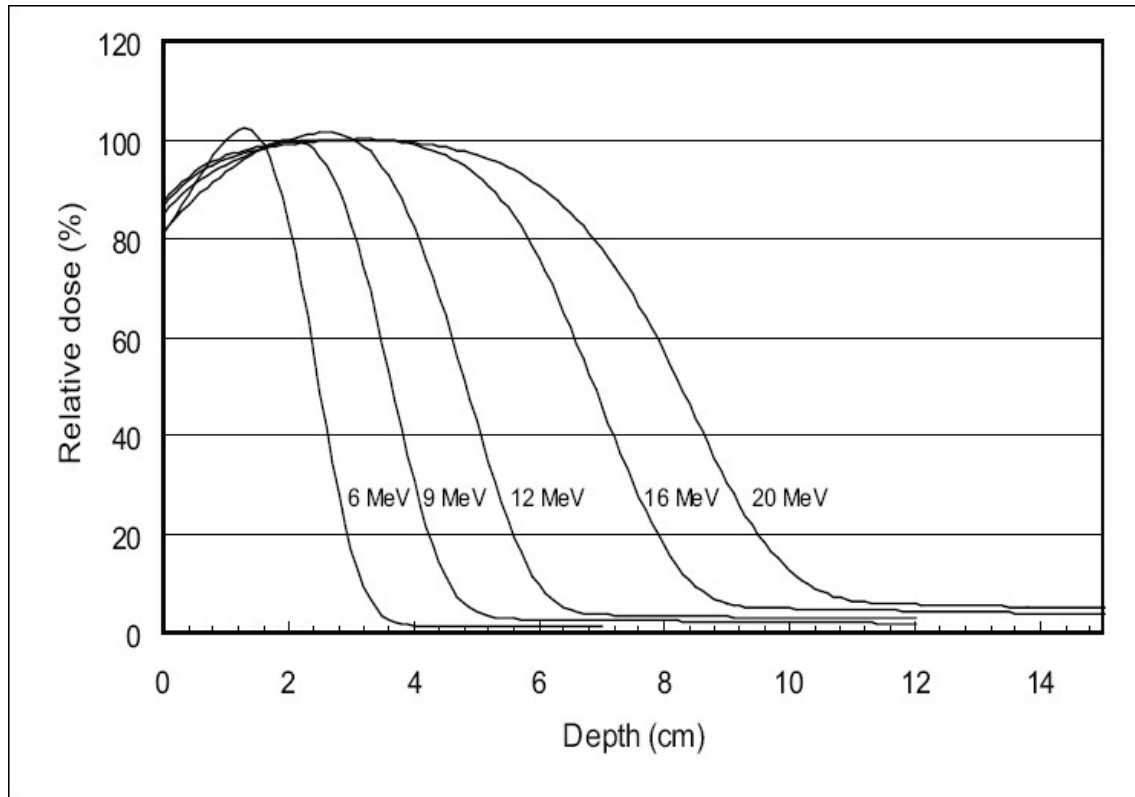
- Using VARSKIN to calculate a depth-dose profile
  - estimating electron and/or photon dose at various depths
- We'll determine the depth-dose profile for 4 nuclides (w/ progeny)
- Electron and photon profiles

Example 7

- Using the airgap model
- Point source to point receptor
- Multiple VARSKIN runs, varying airgap each time
- Comparison to a simple inverse-square reduction in dose to see how the airgap itself affects photon and electron dose
- ^{60}Co point source
- Photon dose follows inverse square law
- Electron dose decreases faster than inverse square with airgap greater than 10 cm
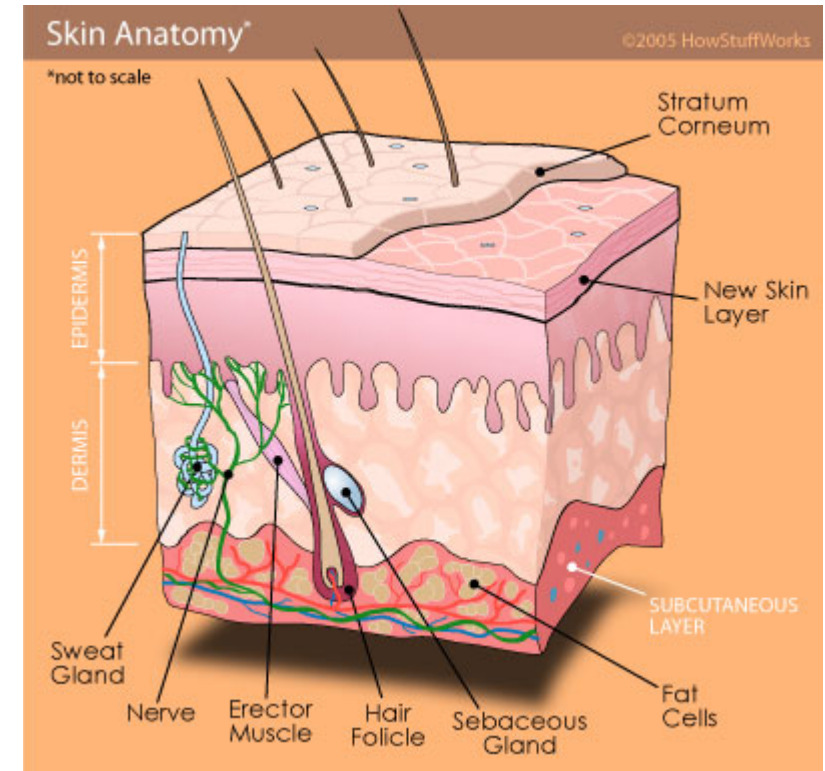
Example 8

- Using the multiple-cover calculator
- To simulate having several different cover types
- Scenario assumes two cotton coveralls, three airgaps, and one heavy cotton shirt
- The multiple-cover calculator determines a single thickness and density to simulate the covers
- VARSKIN currently allows up to 5 covers
- For photons:
  - density < 1.25 g/cm^3 treated as latex
 - density ≥ 1.25 g/cm^3 treated as cotton

Example 9

- Volume averaging dose model
- Examining how volume averaging works and how it compares to "slice-specific" dose estimates
- Volume-of-Cell must be selected for each nuclide because the range of electrons is different for each
- Average dose as a function of depth will show where averaging is important
- Also gives indication of ΔD as a function of depth and averaging thickness

Example 10

- Decay-Corrected vs No-Decay-Time dose estimates
- Q: Why would we want to calculate radiation dose that does NOT consider radioactive decay?
- A: Whenever dose is calculated in a secular equilibrium condition and dose is calculated for each nuclide in the decay chain (as opposed to using the "D" option, which you'll see next).
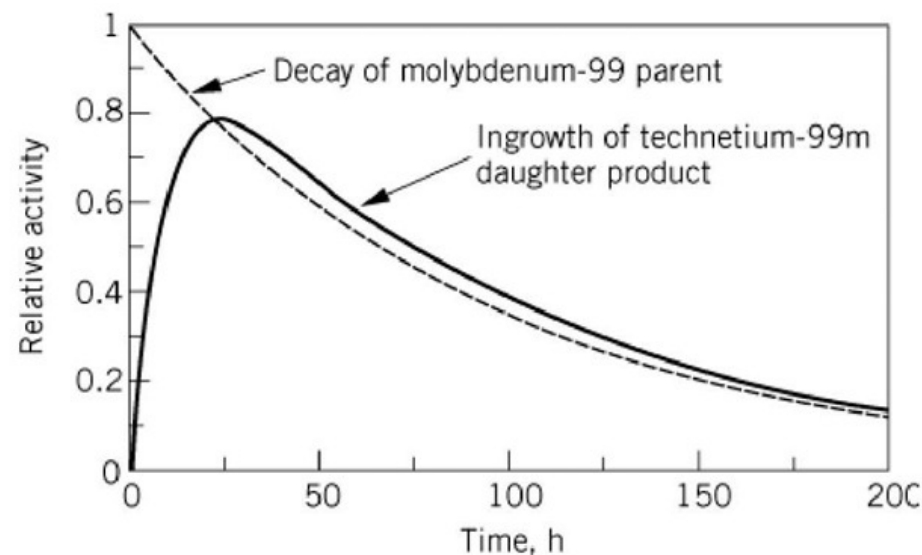
Example 11
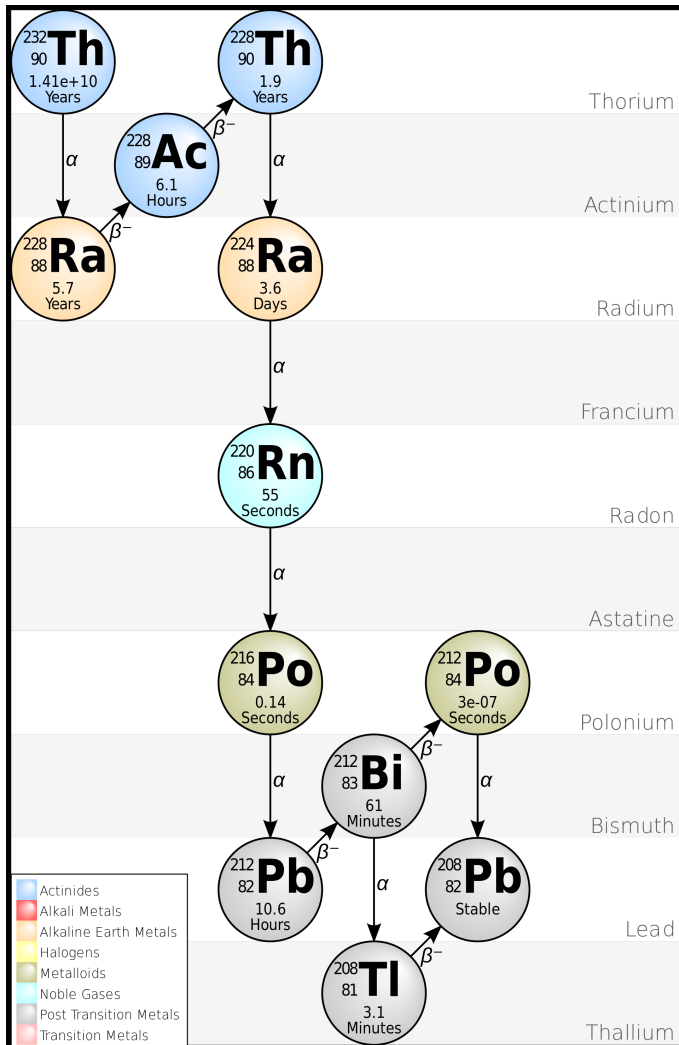
- Decay databases and automatic progeny selection
- This is a comprehensive example to show what goes into the progeny dose calculations
- Decay chains could be run independently
  - or, the "D" option will have VARSKIN do the calculation for you
- Several examples are provided
- Branching ratio is stressed

Example 12

- Simulating a syringe in the hand
- About 8 years ago, the "Syringe Geometry" was removed
- This example shows how you can simulate the syringe to estimate dose to a technician who might carry the syringe
- We'll use the slab geometry
- And, we'll examine how to account for backscatter, or the lack thereof (with the syringe top)
- We'll also look at how a cover (syringe bottom) can be simulated

Example 13

- Modeling mono-enegetric photon and electron sources
- Electrons limited to 8 MeV
- Photons limited to 3 MeV
- When comparing these results to nuclide-specific results there are many things considered that might not be immediately evident to the user
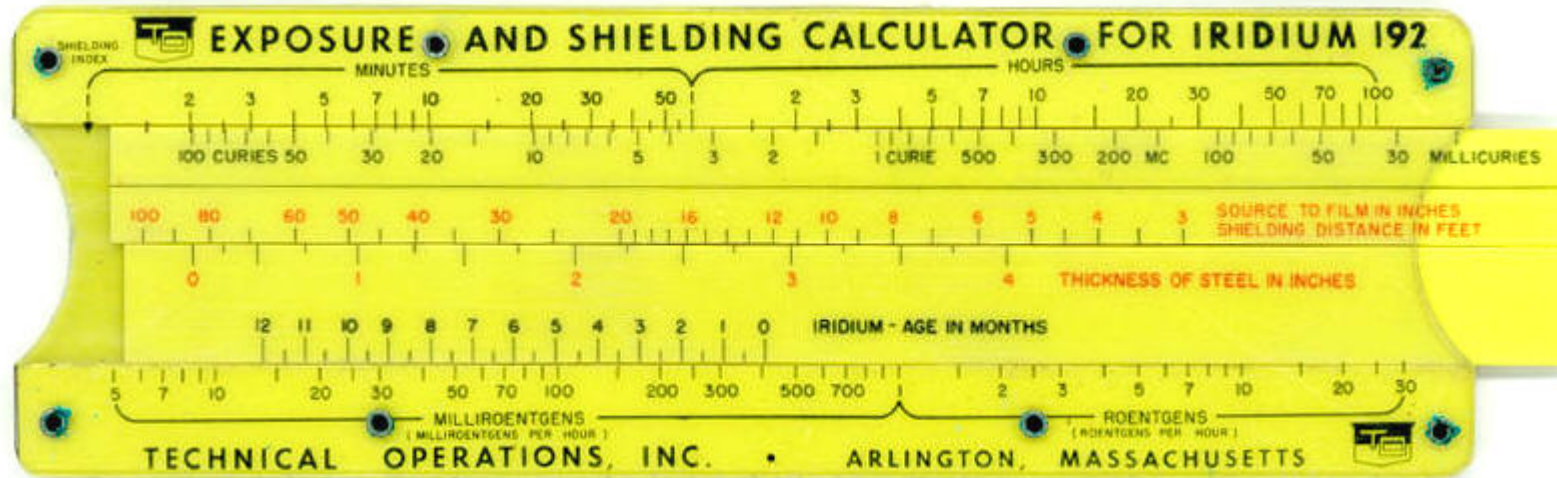
Example 14

- Estimating the activity on a metal plate found in the back of a hood

- You've determined that an aluminum plate is contaminated with ^{14}C

- Using VARSKIN and the results from a GM detector to back-calculate the activity distribution that would provide that measured result

Example 15

- Exposure to a high-activity ^{192}Ir radiography source

- Multiple gamma rays and X rays

- Typically, radiography sources don't have an electron component because of their encapsulation

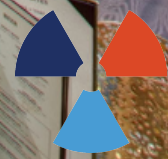- Hand-calculations provided with comparison to VARSKIN (50%)

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