



INTRODUCTION TO VARSKIN+

RAMP 2020 FALL USERS VIRTUAL MEETING
OCTOBER 26-30, 2020

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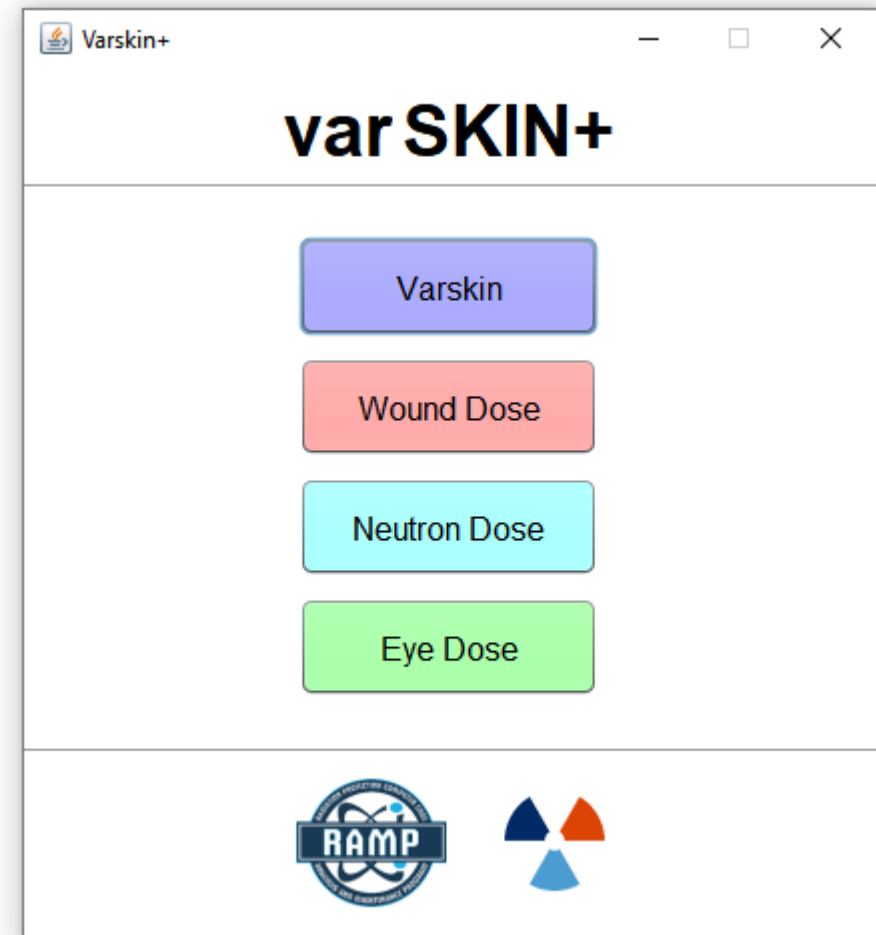
Senior Software Developer

RENAISSANCE CODE DEVELOPMENT



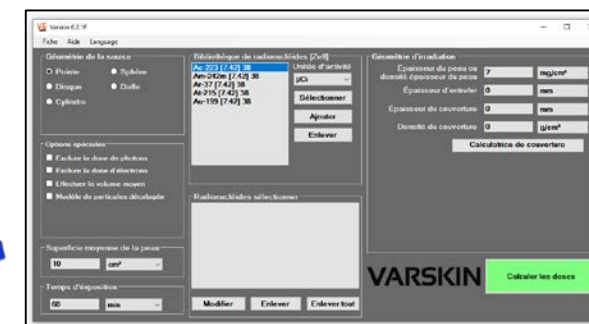
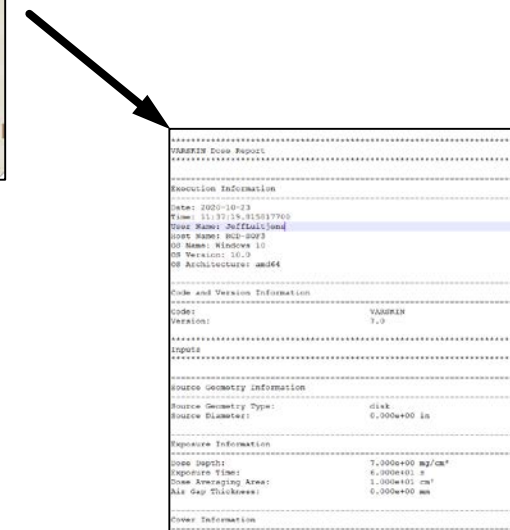
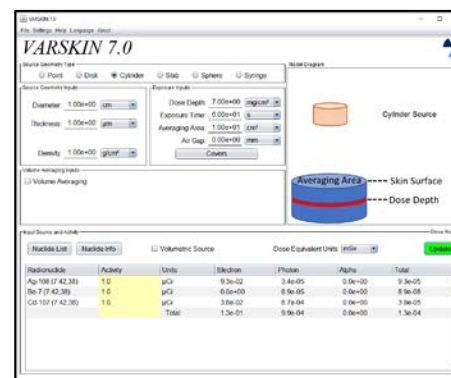
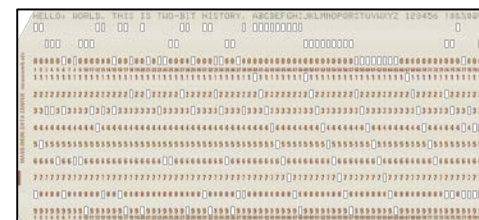
OUTLINE

- Upgrade Philosophy
- Description of Varskin+
- VARSKIN v7.0
 - Modernization
 - New Functionality and Models
- Wound Dose Introduction (New Model)
- Neutron Dose Introduction (New Model)
- Eye Dose Introduction (New Model)



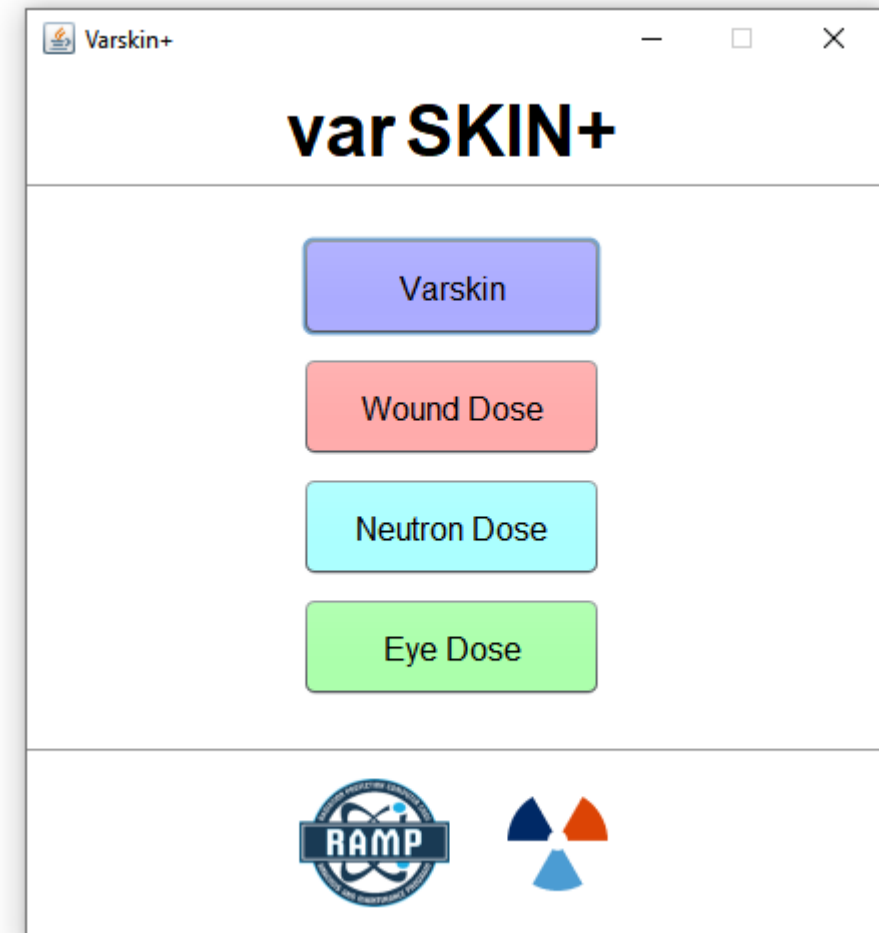
UPGRADE PHILOSOPHY

- Technology and standards change
 - Operating systems change and software must adapt to continue to be useable
 - Hardware gets better and software should take an advantage of that
 - Machines change in the way the user interacts with them and the software should reflect that
- User experiences and expectations change with time
 - Ensure a level of comfort for current and potentially new user base
 - Punch cards -> Text inputs -> Graphical User Interfaces (GUIs)
- Increase Usability and Functionality
 - JAVA as the user interface with Fortran as the physics calculator



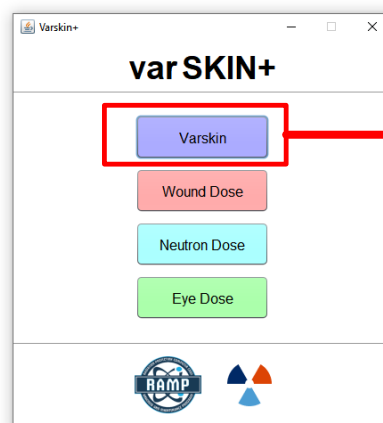
DESCRIPTION OF VARSKIN+

- Varskin+ is a collection of different physics modules/packages
 - VARSKIN v7.0 for shallow dose calculations
 - Wound model for internal shallow, local, and systemic dose calculations
 - Eye dose model for total dose to the eye
 - Neutron model for shallow dose
- The goal is to collect related functions into a single package for ease of access



MODERNIZATION OF VARSKIN V7.0

- Brand new user interface
 - Maintained similar input structure as previous versions for ease of transition
 - Added a diagram to provide a visual display of what the user is modeling
 - Reduced inputs and results to a single screen to provide a clean one-look overview



VARSKIN 7.0

File Settings Help Language About

Source Geometry Type: ☐ Point ☐ Disk ☒ Cylinder ☐ Slab ☐ Sphere ☐ Syringe

Source Geometry Inputs:

Diameter: 1.00e+00 mm

Thickness: 1.00e+00 μm

Density: 1.00e+00 g/cm^3

Exposure Inputs:

Dose Depth: 7.00e+00 mg/cm^2

Exposure Time: 6.00e+01 min

Averaging Area: 1.00e+01 cm^2

Air Gap: 1.00e+00 mm

Covers

Model Diagram:

Cylinder Source

Covers (x2)

Air Gap

Averaging Area

Skin Surface

Dose Depth

Volume Averaging Inputs:

☐ Volume Averaging

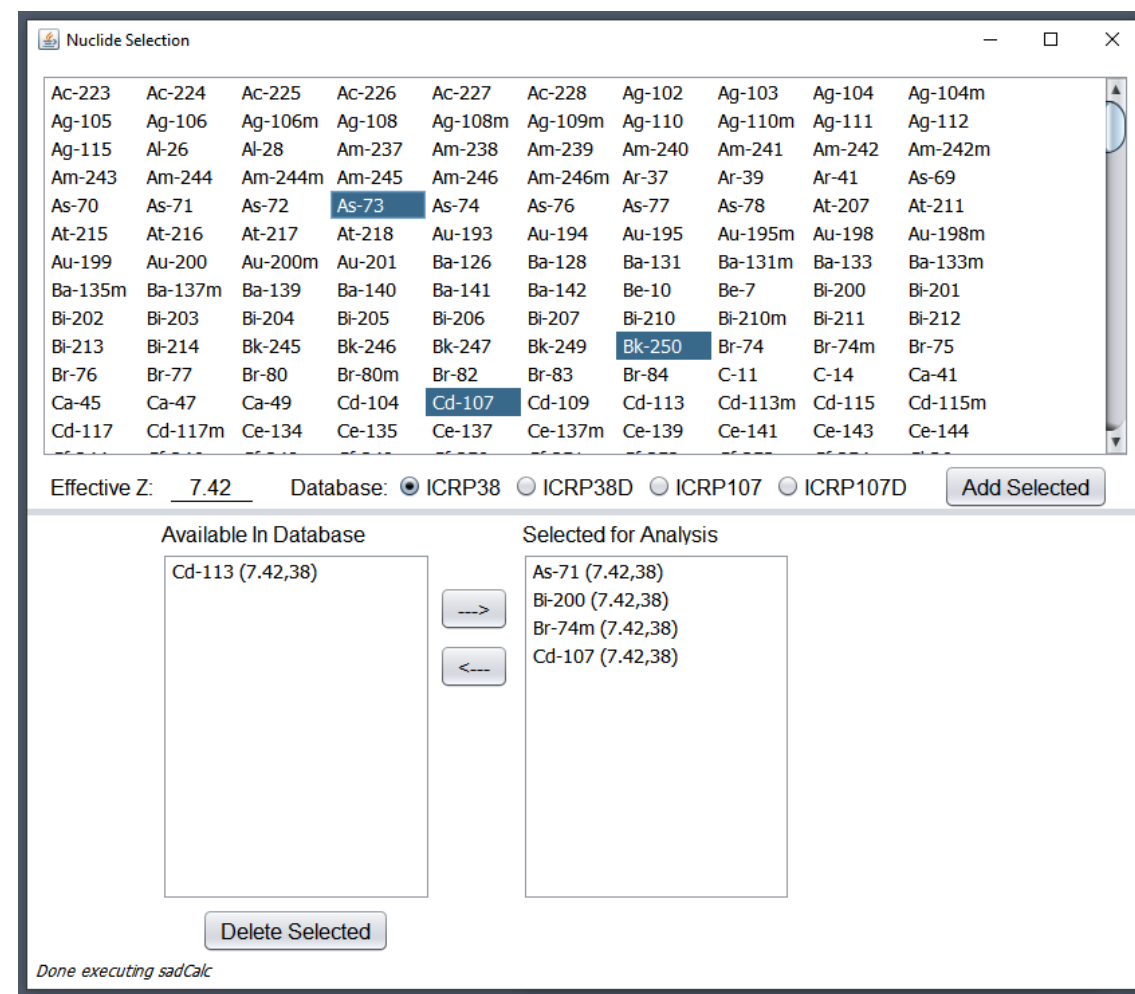
Input Source and Activity:

Nuclide List Nuclide Info ☐ Volumetric Source Dose Equivalent Units: mSv Updated

Radionuclide	Activity	Units	Electron	Photon	Alpha	Total
As-71 (7.42,38)	1.0	μCi	0.0e+00	1.5e-02	0.0e+00	1.5e-05
Bi-200 (7.42,38)	1.0	μCi	3.0e-04	1.8e-02	0.0e+00	1.8e-05
Br-74m (7.42,38)	1.0	μCi	8.2e-02	2.1e-02	0.0e+00	1.0e-04
Cd-113 (7.42,38)	1.0	μCi	0.0e+00	0.0e+00	0.0e+00	0.0e+00
Total:			8.2e-02	5.4e-02	0.0e+00	1.4e-04

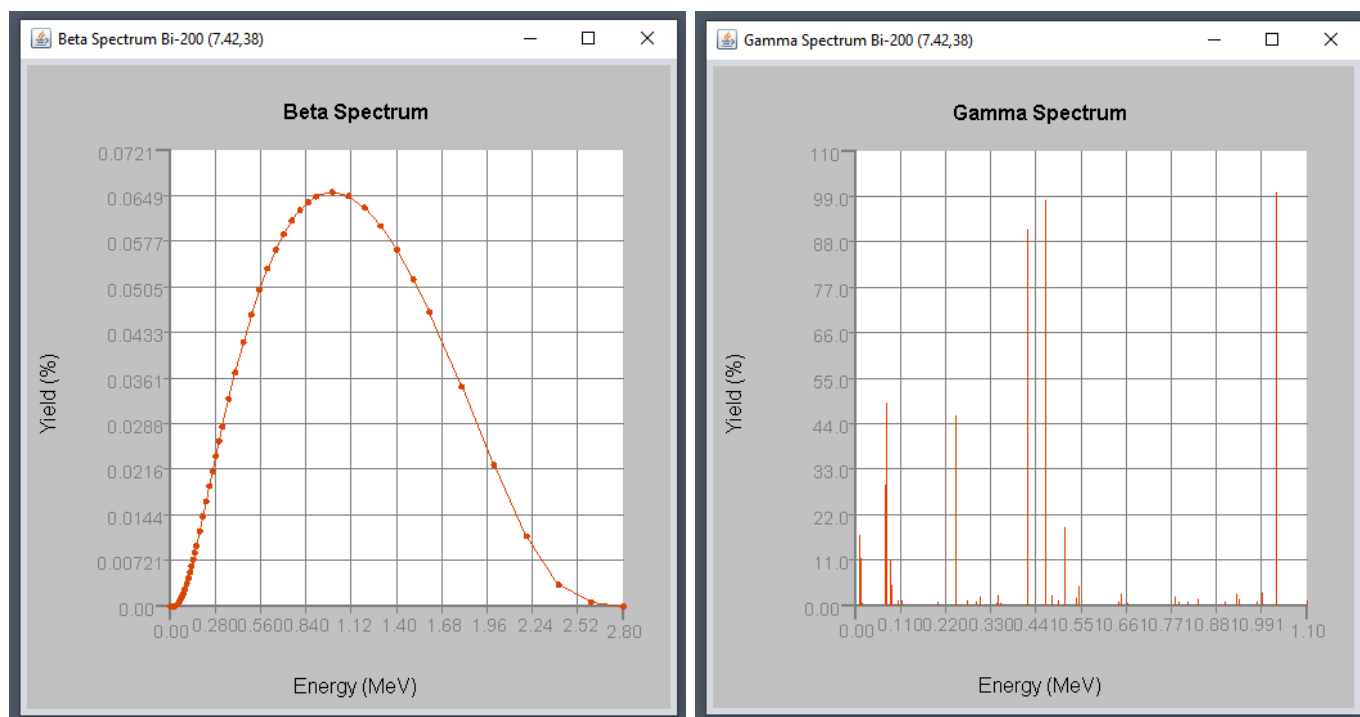
MODERNIZATION OF VARSKIN V7.0

- Calculation Speed Improvements
 - Adding a nuclide only takes about 5 seconds compared to 20 seconds in the previous version
 - Multiple nuclides can now be added once
 - Calculation speed improvement for general dose calculations



NEW FUNCTIONALITY OF VARSKIN V7.0

- Access to spectrum information for each nuclide



Nuclide Information (Bi-200)

Nuclide: Bi-200

Database: ICRP38

Half Life: 3.64e+01 min

Show Beta Spectrum Show Photon Spectrum

Decay Type	Yield	Energy
B+ (4)	0.084192	0.962706
B+ (4)	0.214607	1.04953
B+ (4)	1.07304	1.08832
B+ (4)	1.15558	1.09298
B+ (4)	1.27939	1.10967
B+ (4)	3.54928	1.13886
B+ (4)	2.06353	1.22268
AQ (3)	18.8392	0.511
G (1)	0.412269	0.0837999
IE (6)	0.0763354	0.0679391
IE (6)	2.20625	0.0685999
IE (6)	1.86238	0.0707647
IE (6)	1.09087	0.0807335
IE (6)	0.351888	0.0837999
G (1)	0.3	0.0980999
IE (6)	2.52751	0.0100955
IE (6)	0.394822	0.082239
IE (6)	0.0409771	0.0828999
IE (6)	0.00328972	0.0850646
IE (6)	0.10309	0.0950335
IE (6)	0.0339178	0.0980999
G (1)	1.3	0.10325
IE (6)	9.45294	0.0152455
IE (6)	1.47587	0.0873891
IE (6)	0.153181	0.0880499
IE (6)	0.0122406	0.0902147
IE (6)	0.385268	0.100184
IE (6)	0.126891	0.10325
G (1)	1.2	0.1144



NEW FUNCTIONALITY OF VARSKIN V7.0

- Generation of Reports that can be used as a formal record

```

1 *****
2 VARSKIN Dose Report
3 *****
4
5 -----
6
7 Execution Information
8 -----
9 Date: 2020-10-23
10 Time: 12:36:01.248642600
11 User Name: [REDACTED]
12 Host Name: [REDACTED]
13 OS Name: Windows 10
14 OS Version: 10.0
15 OS Architecture: amd64
16
17 -----
18 Code and Version Information
19 -----
20 Code: VARSKIN
21 Version: 7.0
22

```

```

23 *****
24 Inputs
25 *****
26
27 -----
28 Source Geometry Information
29 -----
30 Source Geometry Type: cylinder
31 Source Diameter: 1.000e+00 mm
32 Source Thickness: 1.000e+00 µm
33 Source Volume: 7.854e-07 cm³
34 Source Density: 1.000e+00 g/cm³
35
36 -----
37 Exposure Information
38 -----
39 Dose Depth: 7.000e+00 mg/cm²
40 Exposure Time: 6.000e+01 min
41 Dose Averaging Area: 1.000e+01 cm²
42 Air Gap Thickness: 1.000e+00 mm
43
44 -----
45 Nuclide Database Source Z Activity Units
46 | As-71 ICRP38 7.42 1.000e+00 µCi
47 | Bi-200 ICRP38 7.42 1.000e+00 µCi
48 | Br-74m ICRP38 7.42 1.000e+00 µCi
49 | Cd-113 ICRP38 7.42 1.000e+00 µCi
50 | Cd-107 ICRP38 7.42 1.000e+00 µCi
51
52 -----
53 Results
54 *****
55
56 -----
57 Shallow Dose Equivalent (mSv)
58 -----
59 Nuclide Database Electrons Photons Alphas Total
60 | As-71 ICRP38 0.000e+00 1.528e-02 0.000e+00 1.528e-05
61 | Bi-200 ICRP38 2.962e-04 1.801e-02 0.000e+00 1.831e-05
62 | Br-74m ICRP38 8.164e-02 2.111e-02 0.000e+00 1.027e-04
63 | Cd-113 ICRP38 0.000e+00 0.000e+00 0.000e+00 0.000e+00
64 | Cd-107 ICRP38 0.000e+00 8.253e-03 0.000e+00 8.253e-06
65
66 | Total: 8.193e-02 6.265e-02 0.000e+00 1.446e-04
67
68 -----
69 End of Report
70 *****
71

```



NEW MODELS OF VARSKIN V7.0

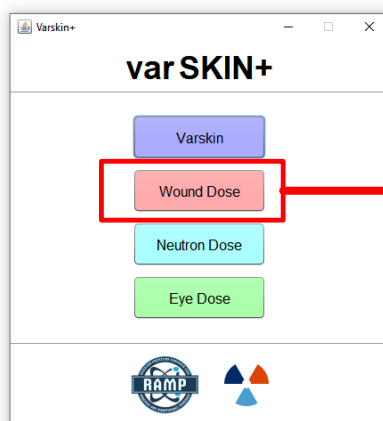
- Addition of Alpha Dose
- Addition of a Syringe Model

The screenshot displays the VARSKIN 7.0 software interface. The 'Source Geometry Type' is set to 'Syringe'. The 'Source Geometry Inputs' show a Diameter of 1.00e+00 mm and a Length of 1.00e+00 μm. The 'Exposure Inputs' show a Dose Depth of 7.00e+00 mg/cm², Exposure Time of 6.00e+01 min, Averaging Area of 1.00e+01 cm², and Air Gap of 1.00e+00 mm. The 'Model Diagram' shows a syringe source, covers (x2), air gap, and averaging area. The 'Input Source and Activity' section shows a table of radionuclides and their activities. The 'Dose Results' section shows the calculated doses for each radionuclide, with the 'Alpha' column highlighted.

Radionuclide	Activity	Units	Electron	Photon	Alpha	Total
As-71 (7.42,38)	1.0	μCi	0.0e+00	1.3e-02	0.0e+00	1.3e-05
Bi-200 (7.42,38)	1.0	μCi	2.1e-04	1.6e-02	0.0e+00	1.6e-05
Br-74m (7.42,38)	1.0	μCi	8.2e-02	1.8e-02	0.0e+00	1.0e-04
Cd-107 (7.42,38)	1.0	μCi	0.0e+00	7.2e-03	0.0e+00	7.2e-06
Total:			8.2e-02	5.4e-02	0.0e+00	1.4e-04

WOUND DOSE (NEW)

- Brand new model for internal dose calculations
 - Shallow dose
 - Local dose
 - Systemic dose
- Dose can be calculated from an embedded particle or uniform line source



Wound Dose 1.0

File Settings Help Language About

Wound Dose 1.0

Source Type

☒ Point Source (hot particle) ☐ Line Source (uniform contamination)

Wound Geometry

Dose Depth

Injury Depth

Abrasion Thickness

Averaging Area

Retention Class

☒ Weak (Tb = 0.40 d)

☐ Moderate (Tb = 4.0 d)

☐ Strong (Tb = 150 d)

☐ Avid (Tb = 560 d)

☐ Colloid (Tb = 760 d)

☐ Particle (Tb = 1,700 d)

☐ Fragment (Tb = 110,000 d)

☐ Custom

Model Diagram

skin surface

abraded thickness

dose depth

averaging area

injury depth

point source (hot particle)

Input Source and Activity

Nuclide List Nuclide Info

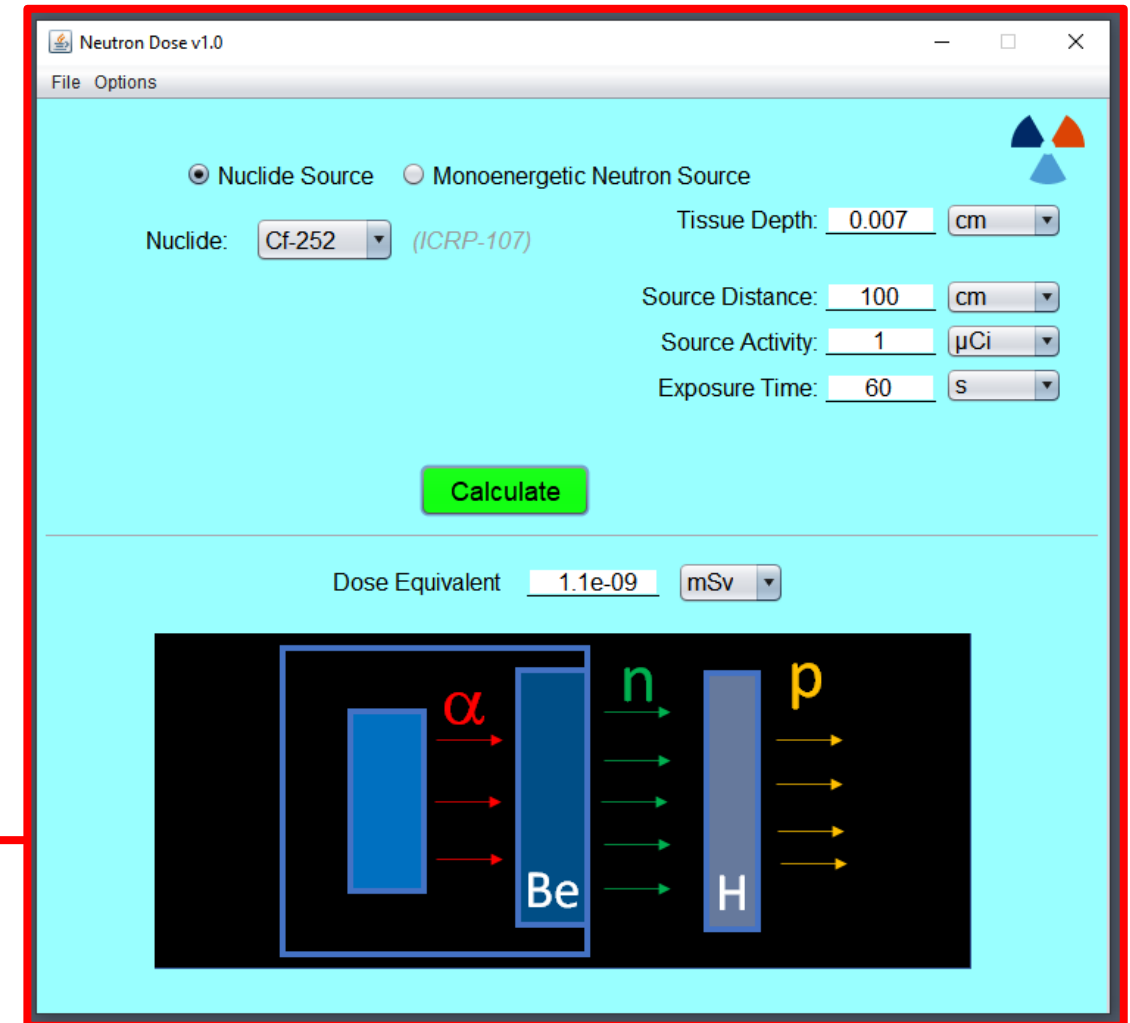
Dose Equivalent Units

☐ Shallow Dose ☒ Local Dose ☐ Systemic Dose

Radionuclide	Activity	Units	Electron	Photon	Alpha	Total
Au-195m (7.42,38)	1.0	μCi	3.0e-05	1.7e-06	0.0e+00	3.2e-05
Bk-249 (7.42,38)	1.0	μCi	1.6e-01	1.0e-08	7.8e-03	1.7e-01
Br-80 (7.42,38)	1.0	μCi	4.0e-03	1.6e-05	0.0e+00	4.0e-03
Total:			1.7e-01	1.8e-05	7.8e-03	1.8e-01

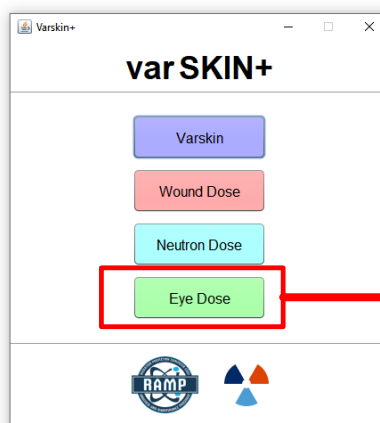
NEUTRON DOSE (NEW)

- Brand new model for neutron shallow dose calculations
- Dose can be calculated from a mono-energetic source a nuclide source



NEUTRON DOSE (NEW)

- Brand new model for total eye dose
- Dose can be calculated from a mono-energetic source a nuclide source



Eye Dose v1.0

File Options

☒ Nuclide Source ☐ Monoenergetic Particle Source

☐ ICRP-38 ☒ ICRP-107

Nuclide:

Distance (x):

Activity:

Exposure Time:

Lens Dose Equivalent

	Unshielded	Shielded*
Photon:	<input type="text" value="4.7e-09"/>	<input type="text" value="3.9e-09"/>
Electron:	<input type="text" value="4.0e-11"/>	<input type="text" value="1.9e-14"/>
Total:	<input type="text" value="4.7e-09"/>	<input type="text" value="3.9e-09"/>

The diagram illustrates the geometry for eye dose calculation. It shows a cross-section of an eye with a blue lens and a yellow target volume. A dashed line labeled 'Geometric Axis' extends from the target volume to a point 'E' (the source). The distance between the target volume and the source is labeled 'x'.

QUESTIONS

