Turbo FRMAC Overview

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Fall 2022 NRC RAMP Users' Group Meeting

October 2022

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Outline

- Turbo FRMAC introduction
- Turbo FRMAC 2023 (v11.2) release overview
- Accessing Turbo FRMAC and web-based training opportunities
- Demonstration problem using a field measurement

Introduction

Introduction

- Sandia National Laboratories (SNL), located in Albuquerque, New Mexico, USA
- Government owned, contractor operated
- Provide research and technical solutions, expert analysis, and highly trained emergency response professionals to support the U.S. government's response to a nuclear or radiological accident

Federal Radiological Monitoring and Assessment Center (FRMAC)

Mission: Provide timely, high-quality predictions, measurements, analyses, and assessments to promote efficient and effective emergency response for the protection of the public from the consequences of nuclear or radiological incidents

Aerial Measurements

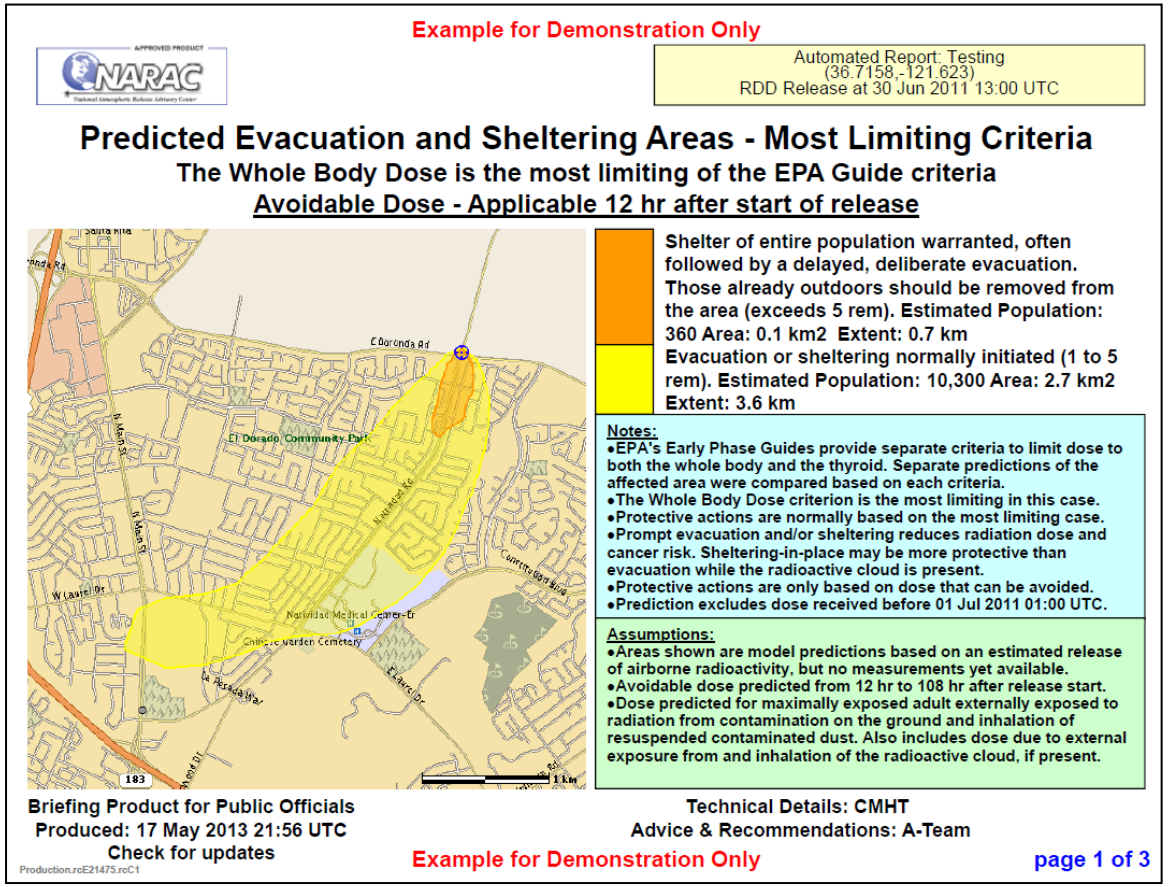
Field Monitoring

Sample Control and Analysis

Data Assessment

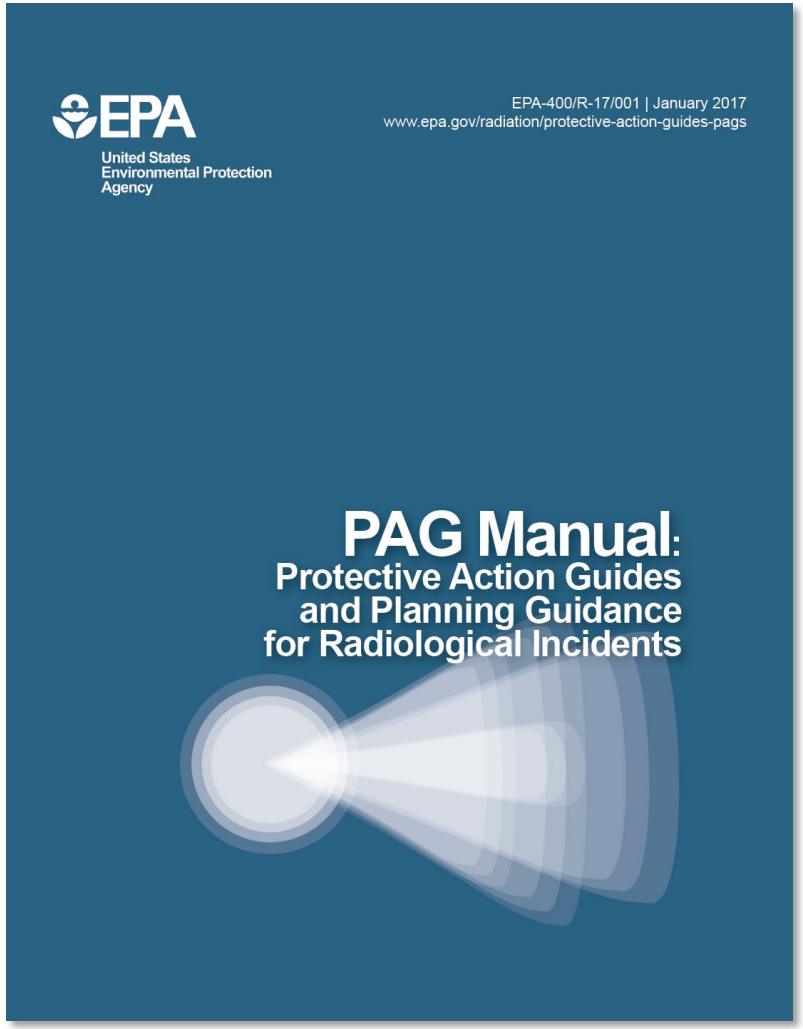
Assessment Capability

- Analyze models and data available to develop an understanding of the radiological environment
- Provide decision makers with radiological information that can be used to issue protective actions



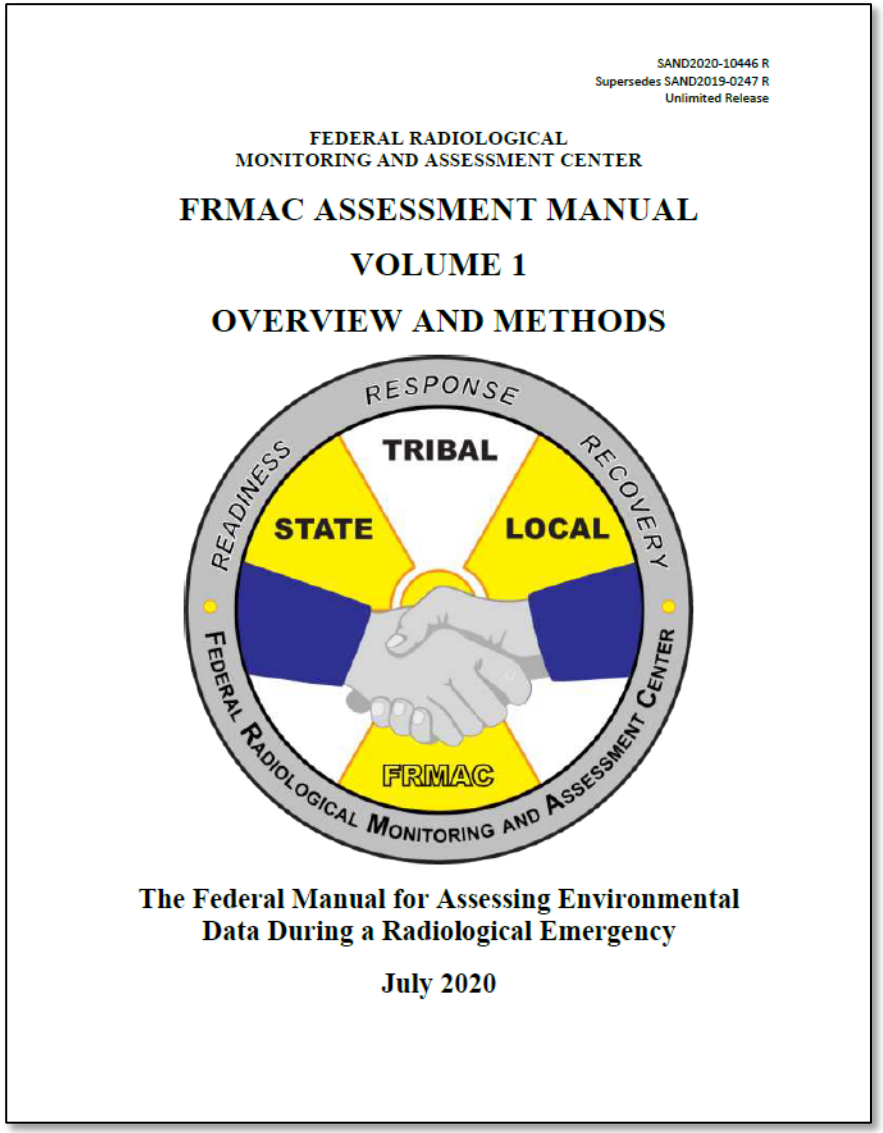
U.S. Protective Action Guidance

- Environmental Protection Agency (EPA) Protective Action Guide (PAG) Manual
- PAGs are based on 3 principles:
  - 1. Prevent acute effects
  - 2. Reduce risk of chronic effects
  - 3. Balance protection with other factors and ensure that actions result in more benefit than harm
- PAGs are predetermined for use in emergencies without regard to the magnitude or type of radiological release
- Decision makers may implement protective actions at higher or lower levels than the recommended PAGs



FRMAC Assessment Manual

- The technical consensus of multiple U.S. federal agencies with expertise in and authority over aspects of radiological emergency response
- Defines the standard dose assessment methods for responding to nuclear or radiological incidents
- Serves as the scientific basis for Turbo FRMAC
- SNL leads development of this manual
- https://www.nnss.gov/pages/programs/FRMAC/FRMAC_DocumentsManuals.html



SAND2020-10446 R
Supersedes SAND2019-0247 R
Unlimited Release

FEDERAL RADIOLOGICAL
MONITORING AND ASSESSMENT CENTER

FRMAC ASSESSMENT MANUAL

VOLUME 1

OVERVIEW AND METHODS

RESPONSE
RECOVERY
READINESS
TRIBAL
STATE
LOCAL
FRMAC
FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER

The Federal Manual for Assessing Environmental Data During a Radiological Emergency

July 2020

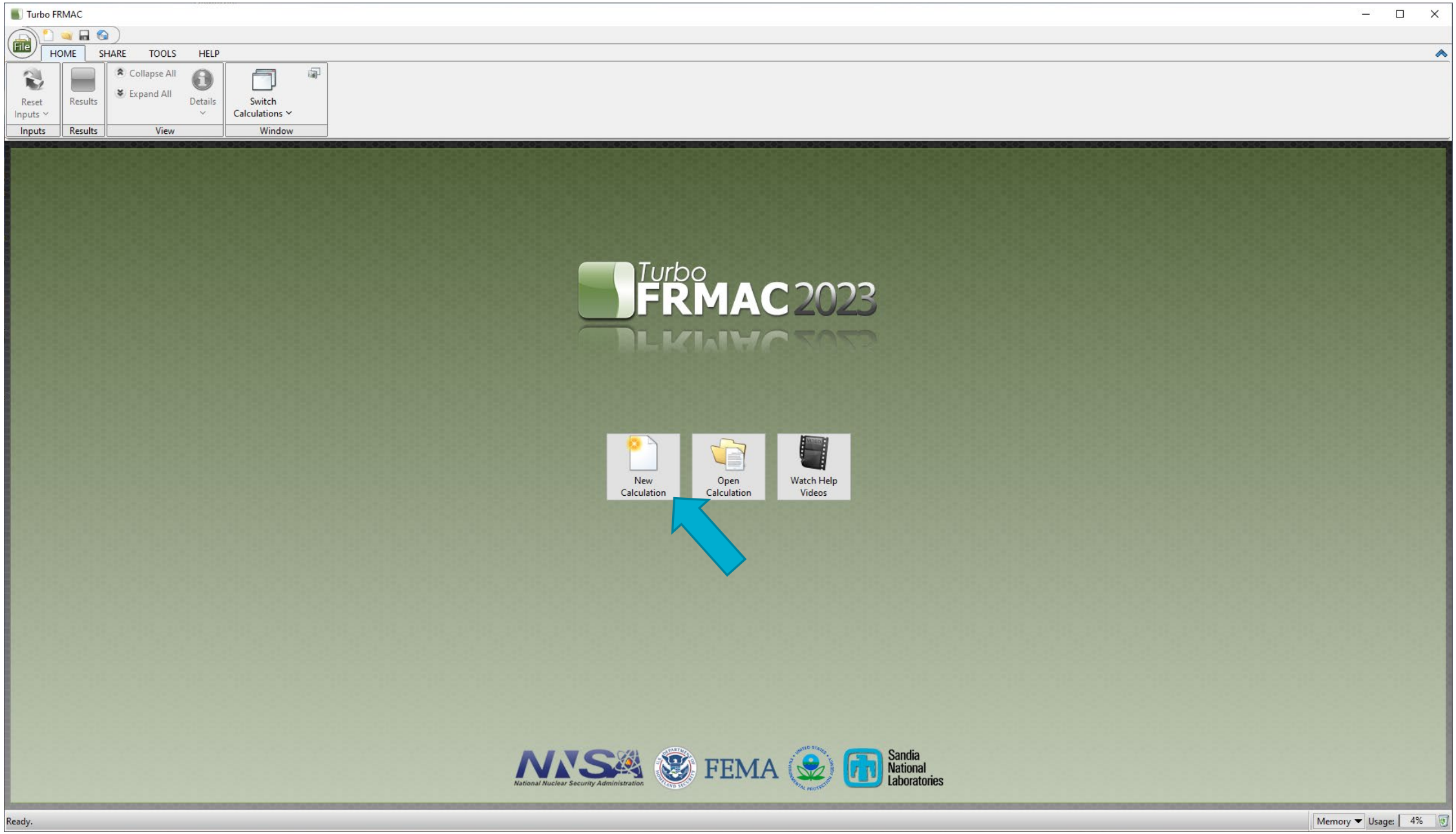
Turbo FRMAC

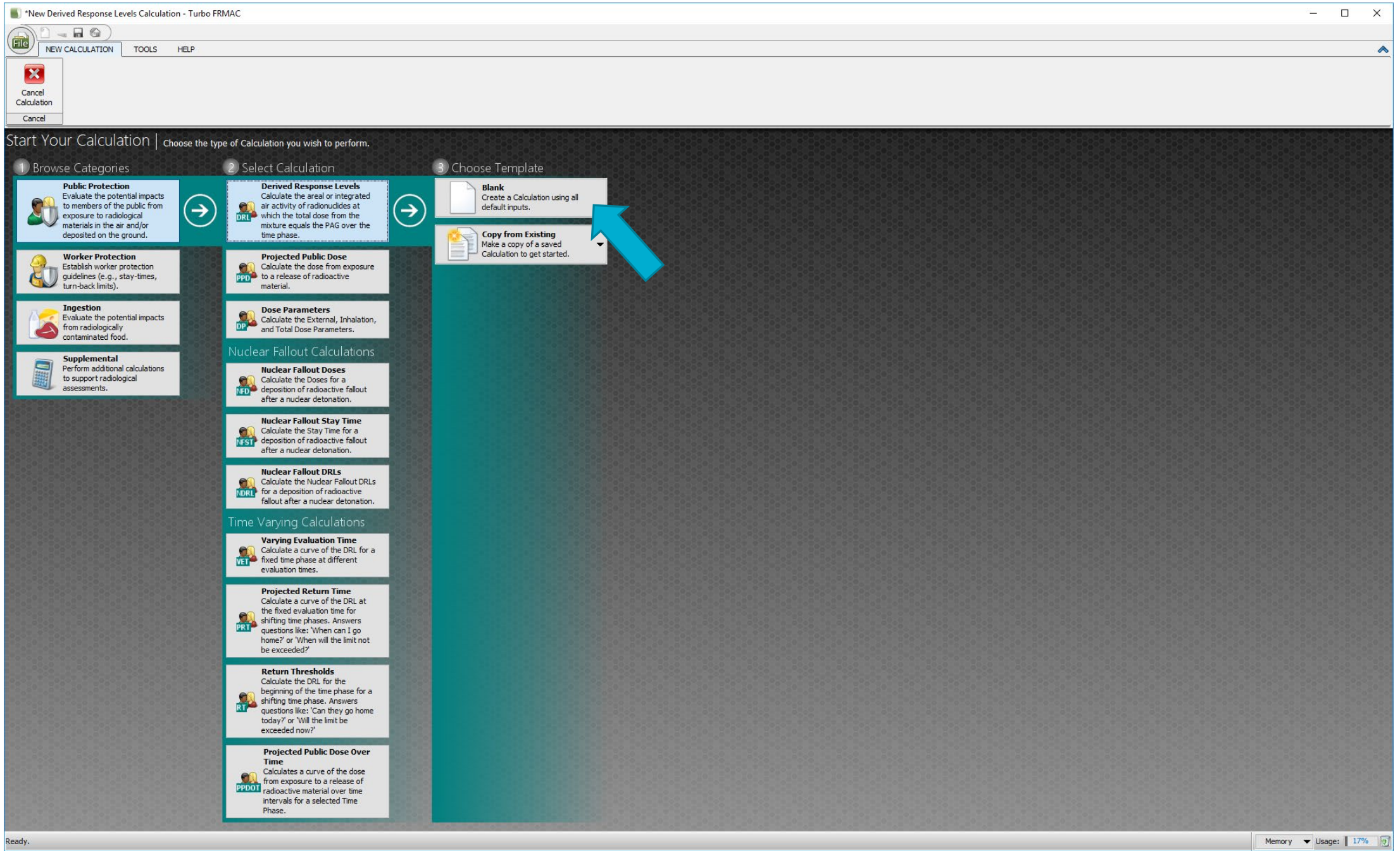
- Software performs complex calculations to quickly evaluate radiological hazards during an emergency response by assessing impacts to the public, workers, and the food supply
- Automates FRMAC Assessment Manual methods
- Deployable software application developed by SNL
- Does not require internet connection
- Updated periodically to implement new and revised methods
- NOT a replacement for health physics knowledge and experience

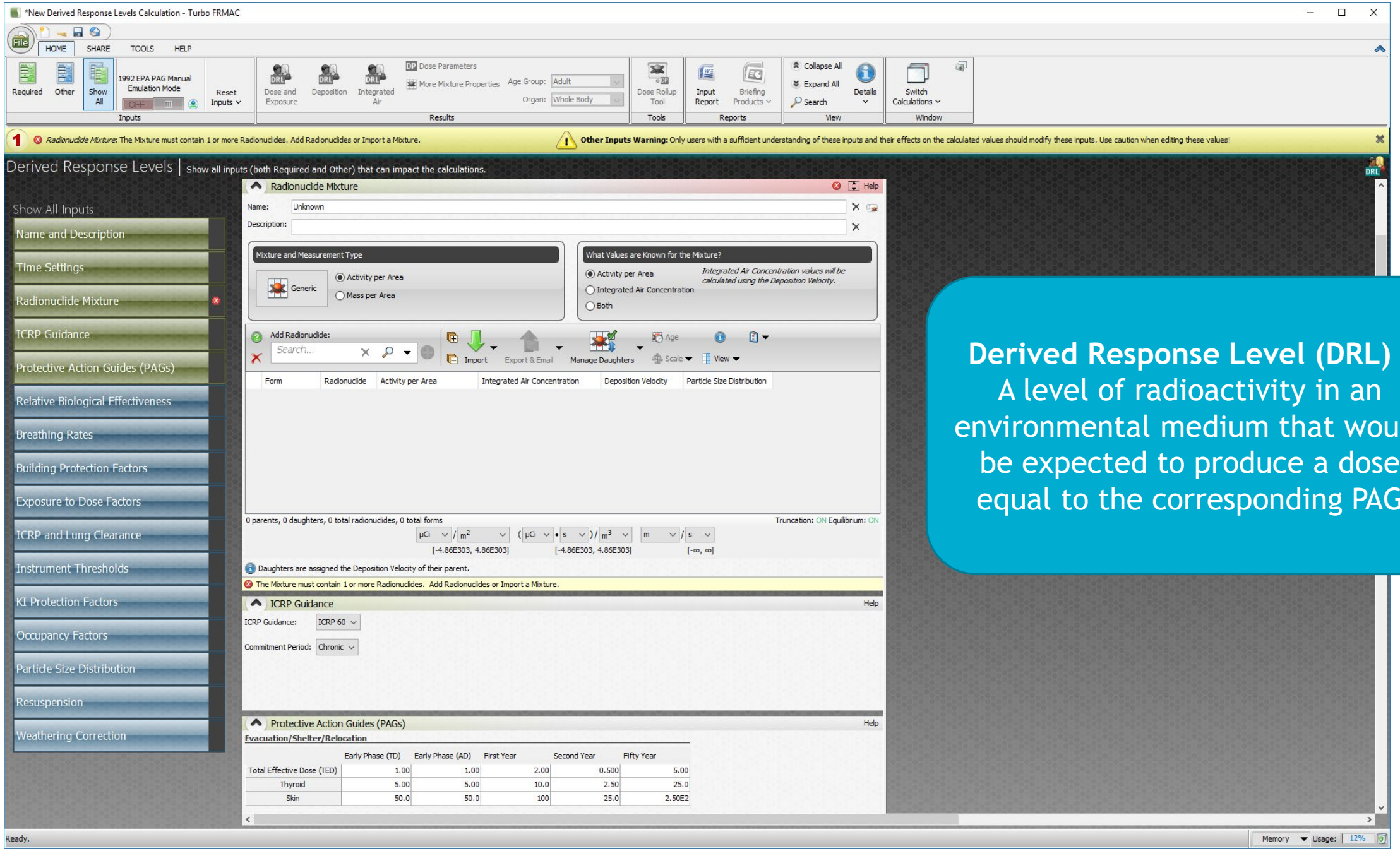
Turbo FRMAC Purpose

Results are used to support protective action decisions, such as:

- Should a population be sheltered, evacuated, or relocated?
- When can a relocated population return home?
- What field measurements would indicate that a protective action is warranted?
- How long can a worker remain in a contaminated area?
- Might a food crop in an area need to be considered for removal from commerce?
- When can a crop be planted so as not to exceed food contamination guidelines?


Turbo FRMAC
File
HOME
SHARE
TOOLS
HELP
Reset Inputs
Results
Collapse All
Expand All
Details
Switch Calculations
Inputs
Results
View
Window
Turbo FRMAC 2023
New Calculation
Open Calculation
Watch Help Videos
National Nuclear Security Administration
FEMA
Sandia National Laboratories
Ready.
Memory
Usage:
4%

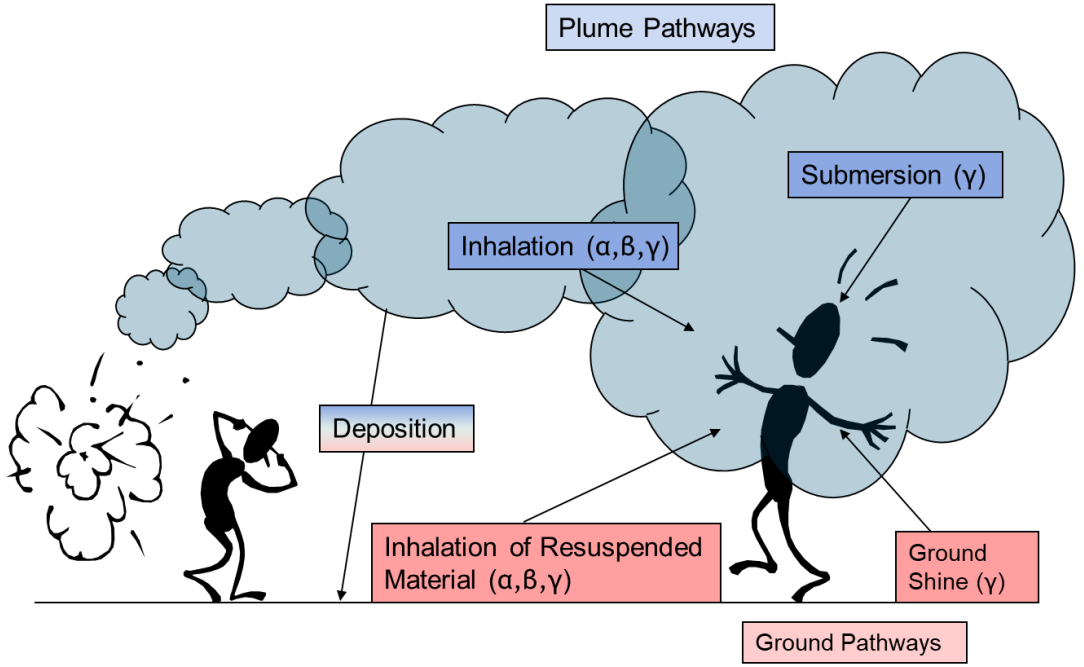

*New Derived Response Levels Calculation - Turbo FRMAC
File
NEW CALCULATION
TOOLS
HELP
Cancel Calculation
Cancel
Start Your Calculation | Choose the type of Calculation you wish to perform.
1 Browse Categories
Public Protection
Evaluate the potential impacts to members of the public from exposure to radiological materials in the air and/or deposited on the ground.
Worker Protection
Establish worker protection guidelines (e.g., stay-times, turn-back limits).
Ingestion
Evaluate the potential impacts from radiologically contaminated food.
Supplemental
Perform additional calculations to support radiological assessments.
2 Select Calculation
Derived Response Levels
Calculate the areal or integrated air activity of radionuclides at which the total dose from the mixture equals the PAG over the time phase.
Projected Public Dose
Calculate the dose from exposure to a release of radioactive material.
Dose Parameters
Calculate the External, Inhalation, and Total Dose Parameters.
Nuclear Fallout Calculations
Nuclear Fallout Doses
Calculate the Doses for a deposition of radioactive fallout after a nuclear detonation.
Nuclear Fallout Stay Time
Calculate the Stay Time for a deposition of radioactive fallout after a nuclear detonation.
Nuclear Fallout DRLs
Calculate the Nuclear Fallout DRLs for a deposition of radioactive fallout after a nuclear detonation.
Time Varying Calculations
Varying Evaluation Time
Calculate a curve of the DRL for a fixed time phase at different evaluation times.
Projected Return Time
Calculate a curve of the DRL at the fixed evaluation time for shifting time phases. Answers questions like: 'When can I go home?' or 'When will the limit not be exceeded?'
Return Thresholds
Calculate the DRL for the beginning of the time phase for a shifting time phase. Answers questions like: 'Can they go home today?' or 'Will the limit be exceeded now?'
Projected Public Dose Over Time
Calculates a curve of the dose from exposure to a release of radioactive material over time intervals for a selected Time Phase.
3 Choose Template
Blank
Create a Calculation using all default inputs.
Copy from Existing
Make a copy of a saved Calculation to get started.
Ready.
Memory
Usage: 17%



Derived Response Level (DRL) – A level of radioactivity in an environmental medium that would be expected to produce a dose equal to the corresponding PAG

How are public protection doses calculated in Turbo FRMAC?

- Public protection calculations include four exposure pathways:
  - Plume Inhalation
  - Plume Submersion
  - Resuspension Inhalation
  - Groundshine
- Ingestion exposure pathway is handled separately
- Bateman equations used for decay and in-growth
- Dose is integrated over a user-specified time period



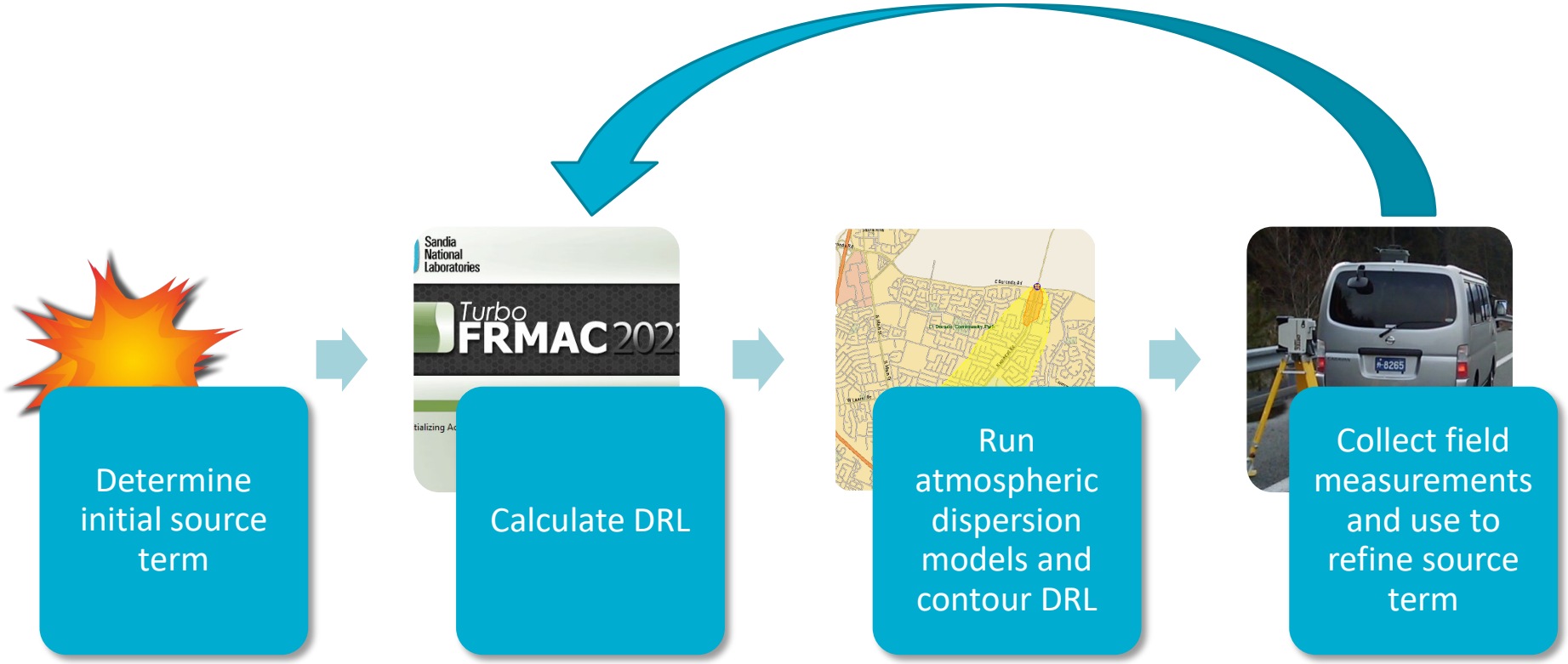
FRMAC Default Assumptions

- Adult receptor, Whole Body (Effective) dose
- The receptor is outside and unprotected
- The plume is in contact with the ground
- Airborne noble gases are not deposited
- Deposition is immediate
- Deposition is assumed to be dry particulates with a default particle size of 1-micron Activity Median Aerodynamic Diameter (AMAD)
- ICRP Recommended Lung Clearance Type
- ICRP 60 based dose coefficients and breathing rates
- Maxwell and Anspaugh (2011) resuspension model[1]
- Anspaugh (2002) weathering model[2]

Turbo FRMAC settings can be adjusted to use different models or event-specific data

[1] Maxwell, R. and Anspaugh, L., "An Improved Model for Prediction of Resuspension" in *Health Physics*, Vol. 101, pp. 722-730, December 2011
[2] Anspaugh, L., et al., "Movement of Radionuclides in Terrestrial Ecosystems by Physical Processes" in *Health Physics*, Vol. 82, pp. 670-679, April 2002

Initial Assessment Process



Potential data sources include regulatory agencies, intel, models, and measurements

Turbo FRMAC is used to calculate DRLs

Resulting map products are used by local officials to decide where to take protective actions

DRLs can also be calculated for specific areas and compared to field measurements

Model Limitations

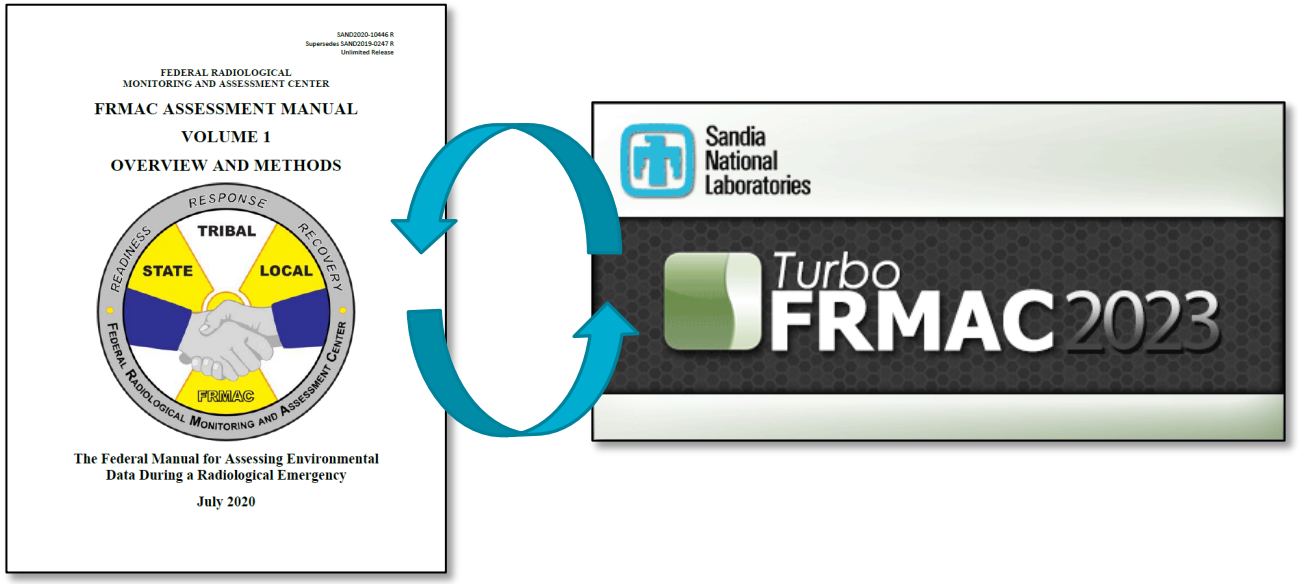
- Turbo FRMAC is not an atmospheric dispersion model, so assumptions are used to estimate the relative radionuclide activities in the air and on the ground
- However, monitoring and sampling, and atmospheric dispersion model data can be entered to improve the accuracy of dose projections and DRLs
- Because Turbo FRMAC does not perform atmospheric dispersion, DRLs are calculated for a single radionuclide mixture that does not account for spatial variance

Examples of Turbo FRMAC Use

- Turbo FRMAC has proved to be a valuable tool to guide protective action decisions following real-world releases including the 2011 Fukushima Daiichi Nuclear Power Plant disaster, the 2017 Ru-106 release, and other accidental releases in the U.S.
- Turbo FRMAC is also used to support Federal, State, and Local emergency response planning and preparedness activities

Ongoing Development

- We release new versions of Turbo FRMAC about twice a year
- New versions include bug fixes as well as new calculations and features developed to fill gaps identified during drills, exercises, and real world responses
- All new calculations must be approved by the FRMAC Assessment Working Group
- We do our best to sync Turbo FRMAC releases with updates to the FRMAC Assessment Manual



Turbo FRMAC 2023 (v11.2)

Released October 2022

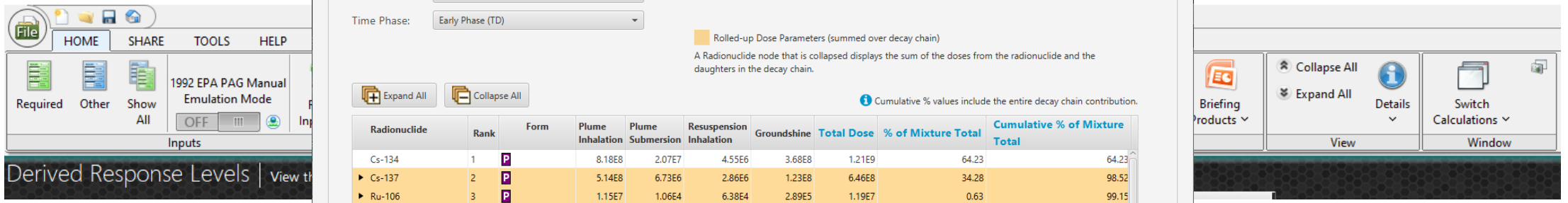
What's New in Turbo FRMAC

- Added new Interactive Dose Parameter Rollup tool to Public Protection calculations
- Added new Public Protection DRL Calculation Report
- Added ability to convert "grab" air sample results into integrated air sample results using Mixture Adjustment Tool in Mixture Manager
- Updated RASCAL import feature to recognize RASCAL 4.3.4 files
- Added ability to optionally include software (tfx) files with bug submissions
- Other bug fixes

A complete list of improvements and bug fixes is available
by viewing the Release Notes located on the website

Turbo FRMAC 2023

Interactive D



Interactive Dose Rollup Tool

Interactive Dose Rollup Tool

View radionuclide dose parameters ranked by their contribution to total dose by dose pathway or mixture total dose.

Select an Age Group, Organ, and Time Phase, and then choose the Sort order.

Age Group: Adult

Organ: Whole Body

Time Phase: Early Phase (TD)

Sort by: Total Dose

Commitment Period: Chronic

Rolled-up Dose Parameters (summed over decay chain)

A Radionuclide node that is collapsed displays the sum of the doses from the radionuclide and the daughters in the decay chain.

Expand All | Collapse All

Cumulative % values include the entire decay chain contribution.

Radionuclide	Rank	Form	Plume Inhalation	Plume Submersion	Resuspension Inhalation	Groundshine	Total Dose	% of Mixture Total	Cumulative % of Mixture Total
Cs-134	1	P	8.18E8	2.07E7	4.55E6	3.68E8	1.21E9	64.23	64.23
Cs-137	2	P	5.14E8	6.73E6	2.86E6	1.23E8	6.46E8	34.28	98.52
Ru-106	3	P	1.15E7	1.06E4	6.38E4	2.89E5	1.19E7	0.63	99.15
Nb-95	4	P	4.71E6	2.66E5	2.53E4	4.52E6	9.53E6	0.51	99.65
Te-127m	5	P	4.65E6	6.50E2	2.56E4	2.34E4	4.70E6	0.25	99.9
Sr-90	6	P	1.03E6	35.62	5.75E3	4.61E3	1.04E6	5.50E-2	99.96
Te-129m	7	P	6.87E5	8.67E2	3.68E3	2.69E4	7.18E5	3.81E-2	99.99
Ru-103	8	P	4.71E4	1.03E3	2.54E2	1.81E4	6.65E4	3.53E-3	100.0
Sr-89	9	P	1.72E4	2.96	93.33	3.84E2	1.77E4	9.37E-4	100.0
Cm-244	10	P	8.75E3	3.16E-6	48.74	3.92E-4	8.80E3	4.67E-4	100.0
Pu-238	11	P	8.40E3	1.46E-6	46.8	2.22E-4	8.45E3	4.48E-4	100.0
Pu-241	12	P	3.40E3	9.46E-7	18.93	2.38E-5	3.42E3	1.81E-4	100.0
Cs-136	13	P	7.01E2	1.34E2	3.54	2.08E3	2.92E3	1.55E-4	100.0
Cm-242	14	P	1.86E3	3.34E-6	10.28	4.82E-4	1.87E3	9.92E-5	100.0
Pu-240	15	P	9.23E2	1.45E-7	5.14	2.13E-5	9.28E2	4.92E-5	100.0
Am-241	16	P	7.60E2	2.94E-5	4.23	8.09E-4	7.64E2	4.05E-5	100.0
Rb-86	17	P	4.53E2	5.67	2.35	1.51E2	6.12E2	3.25E-5	100.0
Pu-239	18	P	3.91E2	7.05E-8	2.18	4.86E-6	3.94E2	2.09E-5	100.0
Te-127	19	P	3.77E2	2.38	0.33	8.91	3.88E2	2.06E-5	100.0
Ce-144	20	P	2.77E2	6.00E-2	1.54	2.78	2.82E2	1.49E-5	100.0
I-131	21	P	37.61	0.21	0.39	6.93	45.13	2.39E-6	100.0
Ba-140	22	P	18.94	0.71	9.84E-2	13.0	32.75	1.74E-6	100.0
Zr-95	23	P	5.04	8.79E-2	2.78E-2	1.58	6.74	3.58E-7	100.0
Y-91	24	P	4.0	8.12E-4	2.18E-2	8.33E-2	4.11	2.18E-7	100.0
Y-90	25	P	1.8	2.46E-3	6.39E-3	0.18	1.99	1.06E-7	100.0
Ce-141	26	P	0.44	1.02E-3	2.33E-3	1.85E-2	0.46	2.43E-8	100.0
Te-131m	27	P	0.18	6.71E-3	8.90E-4	5.60E-2	0.25	1.30E-8	100.0
Te-132	28	P	5.99E-2	7.80E-3	2.28E-4	9.35E-2	0.16	8.56E-9	100.0
I-133	29	P	3.10E-2	1.49E-3	1.19E-4	2.15E-2	5.41E-2	2.87E-9	100.0

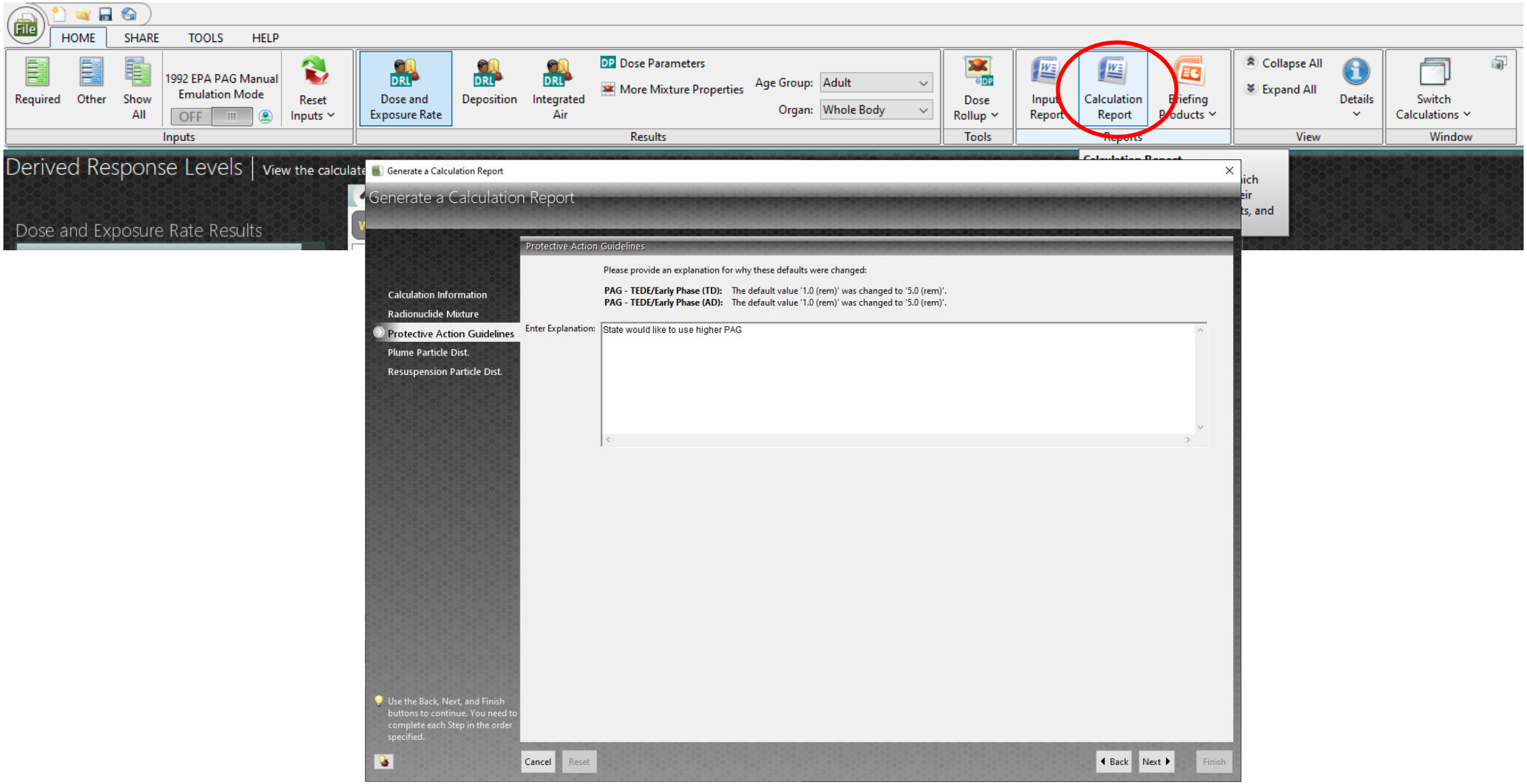
57 radionuclides

Mixture Total Dose:	1.35E9	2.77E7	7.54E6	4.96E8	1.89E9
Percent Contribution:	71.85%	1.47%	0.40%	26.28%	

Units: mrem

Close

Public Protection DRL Calculation Report



Turbo FRMAC Calculation

Public Protection DRLs Calculation

Assessment Scientist(s)

Name	Telephone	Email
Lainy Cochran	(505) 844-1890	ldcochr@sandia.gov

RFI Information

RFI Number: 0001

Name and Description

Calculation Name: Derived Response Levels Calculation
Calculation Description: 2nd Exercise NPP 2021-12-02

Changed Defaults

Input	Default	Changed Values	Reason for Change
Radionuclide Mixture Type	Generic	Nuclear Power Plant	
Daughters Always Populated Using Equilibrium Rules	true	false	
PAG - TEDE/Early Phase (TD)	1.0 (rem)	5.0 (rem)	State would like to use higher PAG
PAG - TEDE/Early Phase (AD)	1.0 (rem)	5.0 (rem)	State would like to use higher PAG

Results

In all results, Whole Body values are displayed for Adult for a Chronic Commitment Period.

Dose Rate DRLs (mrem/hr)

Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
14.63	93.7	4.42	2.1	2.31

Exposure Rate DRLs (mR/hr)

Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
14.63	93.7	4.42	2.1	2.31

Ground Concentration Alpha DRLs ($\mu Ci_\alpha/m^2$)

Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
N/A	N/A	N/A	N/A	N/A

Ground Concentration Beta DRLs ($\mu Ci_\beta/m^2$)

Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
1.29E3	8.24E3	3.88E2	1.85E2	2.03E2

Radionuclide Specific Ground Concentration DRLs ($\mu Ci/m^2$)

Turbo FRMAC© 2023 DEV Installer (v11.2) Public Protection DRLs Calculation Report
Calculation ID: 1638474697465-0001999419
Report Created: 2022-09-30 09:45 MDT

Radionuclide	Form	Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
Ba-137m	Particulate	23.37	1.50E2	7.05	3.35	3.68
Ba-139	Particulate	1.13E-5	7.23E-5	3.41E-6	1.62E-6	1.78E-6
Cs-134	Particulate	36.54	2.34E2	11.02	5.24	5.76
Cs-135	Particulate	3.65E-8	2.34E-7	1.10E-8	5.24E-9	5.75E-9
Cs-136	Particulate	11.43	73.18	3.45	1.64	1.8
Cs-137	Particulate	24.75	1.59E2	7.47	3.55	3.9
Cs-138	Particulate	7.37E-6	4.72E-5	2.22E-6	1.06E-6	1.16E-6
Cs-139	Particulate	1.52E-25	9.74E-25	4.59E-26	2.18E-26	2.40E-26
I-129	Multiple	8.53E-6	5.46E-5	2.57E-6	1.22E-6	1.35E-6
I-130	Multiple	2.35	15.03	0.71	0.34	0.37
I-131	Multiple	2.79E2	1.79E3	84.21	40.05	44.0
I-132	Multiple	2.86E2	1.83E3	86.24	41.02	45.06
I-133	Multiple	3.62E2	2.32E3	1.09E2	51.91	57.03
I-134	Multiple	1.42E-2	9.08E-2	4.28E-3	2.03E-3	2.24E-3
I-135	Multiple	1.10E2	7.03E2	33.12	15.75	17.3
Kr-85	Gas	N/A	N/A	N/A	N/A	N/A
Kr-85m	Gas	N/A	N/A	N/A	N/A	N/A
Kr-87	Gas	N/A	N/A	N/A	N/A	N/A
Kr-88	Gas	N/A	N/A	N/A	N/A	N/A
Rb-87	Particulate	N/A	N/A	N/A	N/A	N/A
Rb-88	Particulate	N/A	N/A	N/A	N/A	N/A
Te-125m	Multiple	0.6	3.84	0.18	8.60E-2	9.44E-2
Te-127	Multiple	12.31	78.8	3.71	1.77	1.94
Te-127m	Multiple	3.3	21.11	0.99	0.47	0.52
Te-129	Multiple	7.75	49.64	2.34	1.11	1.22
Te-129m	Multiple	12.19	78.04	3.68	1.75	1.92
Te-131	Multiple	5.18	33.17	1.56	0.74	0.82
Te-131m	Multiple	23.01	1.47E2	6.94	3.3	3.63
Te-132	Multiple	2.75E2	1.76E3	83.1	39.52	43.41
Te-133	Multiple	5.92E-4	3.79E-3	1.79E-4	8.49E-5	9.33E-5
Te-133m	Multiple	2.62E-3	1.68E-2	7.90E-4	3.76E-4	4.13E-4
Te-134	Multiple	1.22E-4	7.79E-4	3.67E-5	1.75E-5	1.92E-5
Xe-131m	Gas	9.66E-2	0.62	2.91E-2	1.39E-2	1.52E-2
Xe-133	Gas	27.63	1.77E2	8.34	3.96	4.36
Xe-133m	Gas	1.87	11.96	0.56	0.27	0.29
Xe-135	Gas	1.20E2	7.68E2	36.17	17.2	18.9
Xe-135m	Gas	18.92	1.21E2	5.71	2.71	2.98
Xe-138	Gas	N/A	N/A	N/A	N/A	N/A

Integrated Air Concentration Alpha DRLs ($\mu Ci_\alpha*s/m^3$)

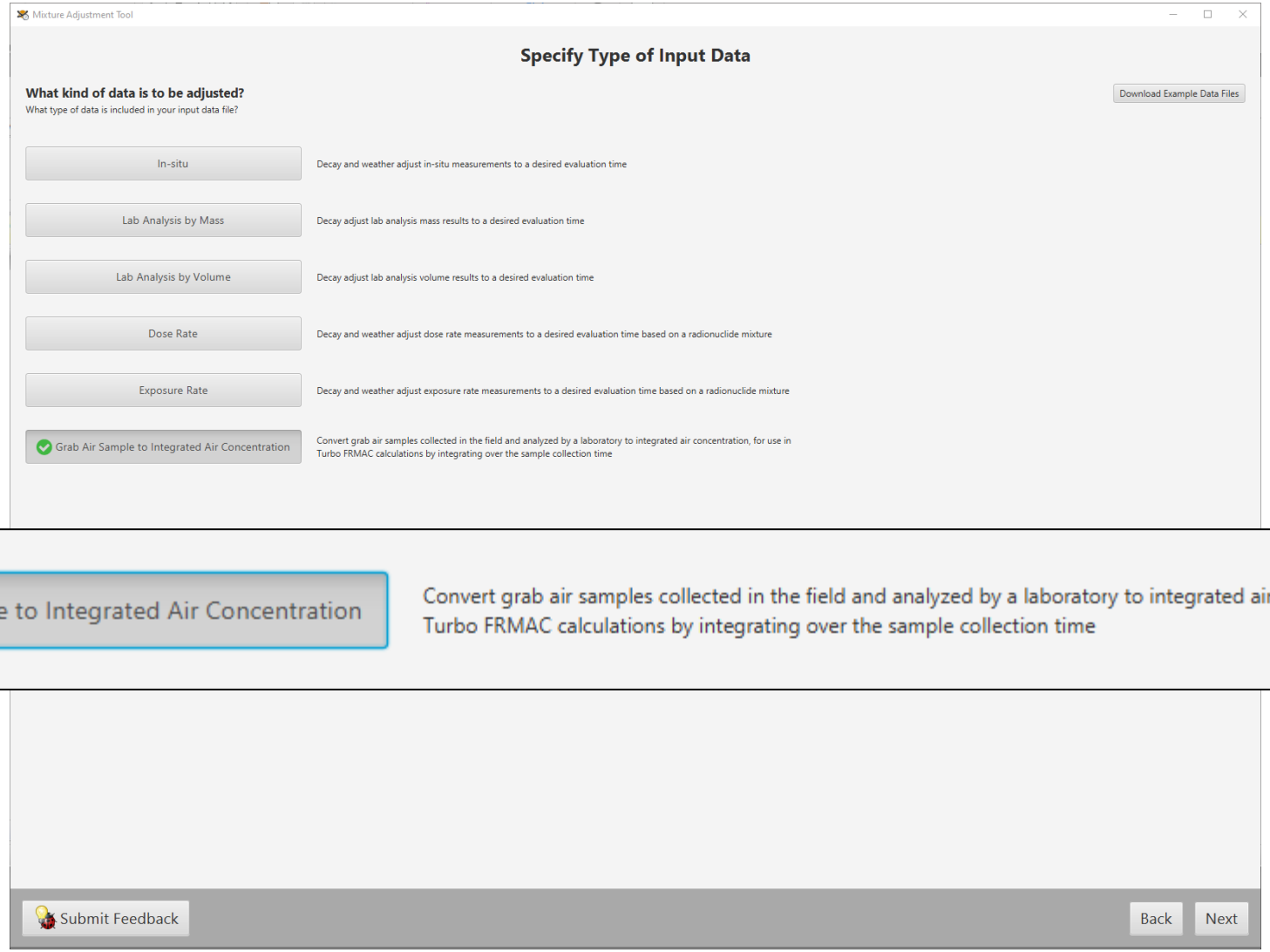
Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
N/A	N/A	N/A	N/A	N/A

Integrated Air Concentration Beta DRLs ($\mu Ci_\beta*s/m^3$)

Early Phase (TD)	Early Phase (AD)	First Year	Second Year	Fifty Year
1.39E7	8.90E7	4.19E6	1.99E6	2.19E6

Radionuclide Specific Integrated Air Concentration DRLs ($\mu Ci*s/m^3$)

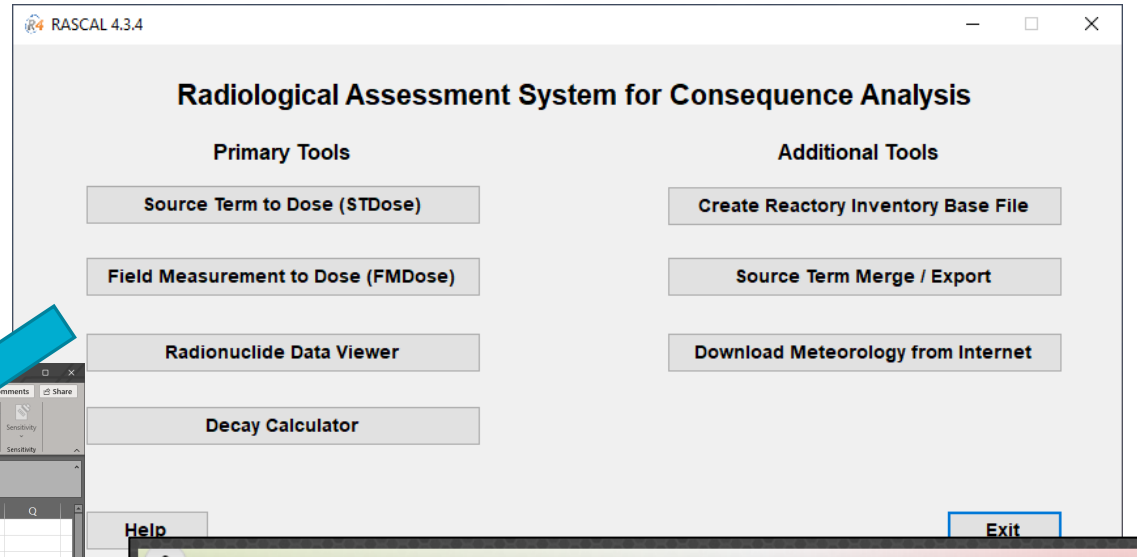
Convert "Grab" Air Sample Results to Integrated Air Concentration

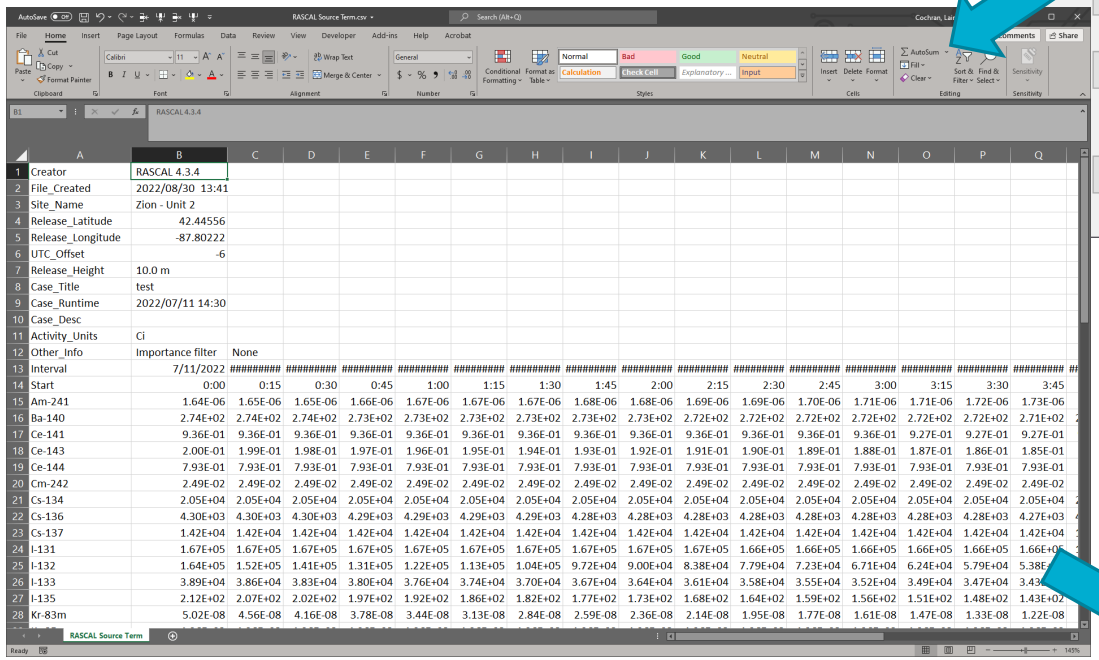


Grab Air Sample to Integrated Air Concentration

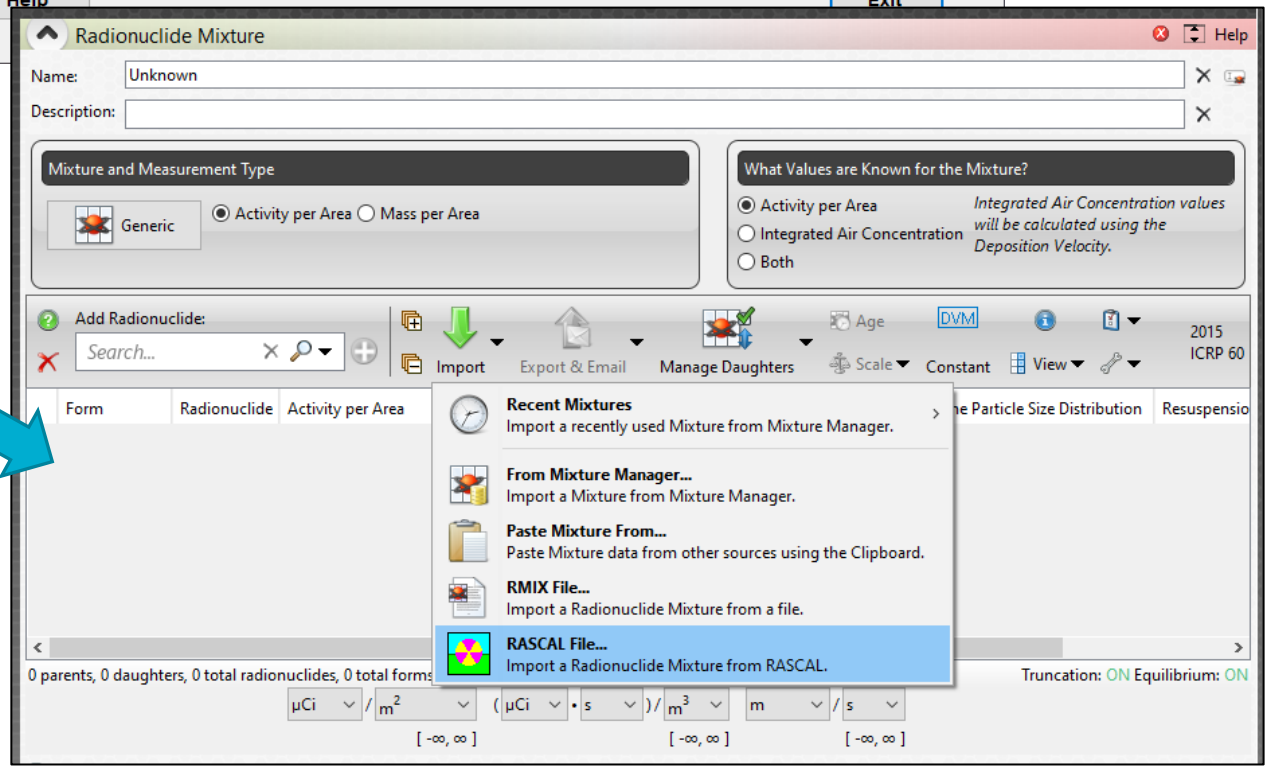
Convert grab air samples collected in the field and analyzed by a laboratory to integrated air concentration, for use in Turbo FRMAC calculations by integrating over the sample collection time

RASCAL 4.3.4 Import





	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Creator	RASCAL 4.3.4															
2	File_Created	2022/08/30 13:41															
3	Site_Name	Zion - Unit 2															
4	Release_Latitude	42.44556															
5	Release_Longitude	-87.80222															
6	UTC_Offset	-6															
7	Release_Height	10.0 m															
8	Case_Title	test															
9	Case_Runtime	2022/07/11 14:30															
10	Case_Desc																
11	Activity_Units	Ci															
12	Other_Info	Importance filter	None														
13	Interval	7/11/2022	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########
14	Start	0:00	0:15	0:30	0:45	1:00	1:15	1:30	1:45	2:00	2:15	2:30	2:45	3:00	3:15	3:30	3:45
15	Am-241	1.64E-06	1.65E-06	1.65E-06	1.66E-06	1.67E-06	1.67E-06	1.67E-06	1.68E-06	1.68E-06	1.69E-06	1.69E-06	1.70E-06	1.71E-06	1.71E-06	1.72E-06	1.73E-06
16	Ba-140	2.74E+02	2.74E+02	2.74E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.72E+02	2.72E+02	2.72E+02	2.72E+02	2.72E+02	2.72E+02	2.71E+02
17	Ce-141	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.36E-01	9.27E-01	9.27E-01	9.27E-01
18	Ce-143	2.00E-01	1.99E-01	1.98E-01	1.97E-01	1.96E-01	1.95E-01	1.94E-01	1.93E-01	1.92E-01	1.91E-01	1.90E-01	1.89E-01	1.88E-01	1.87E-01	1.86E-01	1.85E-01
19	Ce-144	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01	7.93E-01
20	Cm-242	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02	2.49E-02
21	Cs-134	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04	2.05E+04
22	Cs-136	4.30E+03	4.30E+03	4.30E+03	4.29E+03	4.29E+03	4.29E+03	4.29E+03	4.28E+03	4.28E+03	4.28E+03	4.28E+03	4.28E+03	4.28E+03	4.28E+03	4.28E+03	4.27E+03
23	Cs-137	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04	1.42E+04
24	I-131	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.67E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05
25	I-132	1.64E+05	1.52E+05	1.41E+05	1.31E+05	1.22E+05	1.13E+05	1.04E+05	9.72E+04	9.00E+04	8.38E+04	7.79E+04	7.23E+04	6.71E+04	6.24E+04	5.79E+04	5.38E
26	I-133	3.89E+04	3.86E+04	3.83E+04	3.80E+04	3.76E+04	3.74E+04	3.70E+04	3.67E+04	3.64E+04	3.61E+04	3.58E+04	3.55E+04	3.52E+04	3.49E+04	3.47E+04	3.43
27	I-135	2.12E+02	2.07E+02	2.02E+02	1.97E+02	1.92E+02	1.86E+02	1.82E+02	1.77E+02	1.73E+02	1.68E+02	1.64E+02	1.59E+02	1.56E+02	1.51E+02	1.48E+02	1.43E+02
28	Kr-83m	5.02E-08	4.56E-08	4.16E-08	3.78E-08	3.44E-08	3.13E-08	2.84E-08	2.59E-08	2.36E-08	2.14E-08	1.95E-08	1.77E-08	1.61E-08	1.47E-08	1.33E-08	1.22E-08



Turbo FRMAC will also try to import unknown versions of RASCAL files in a similar way to the latest version handled

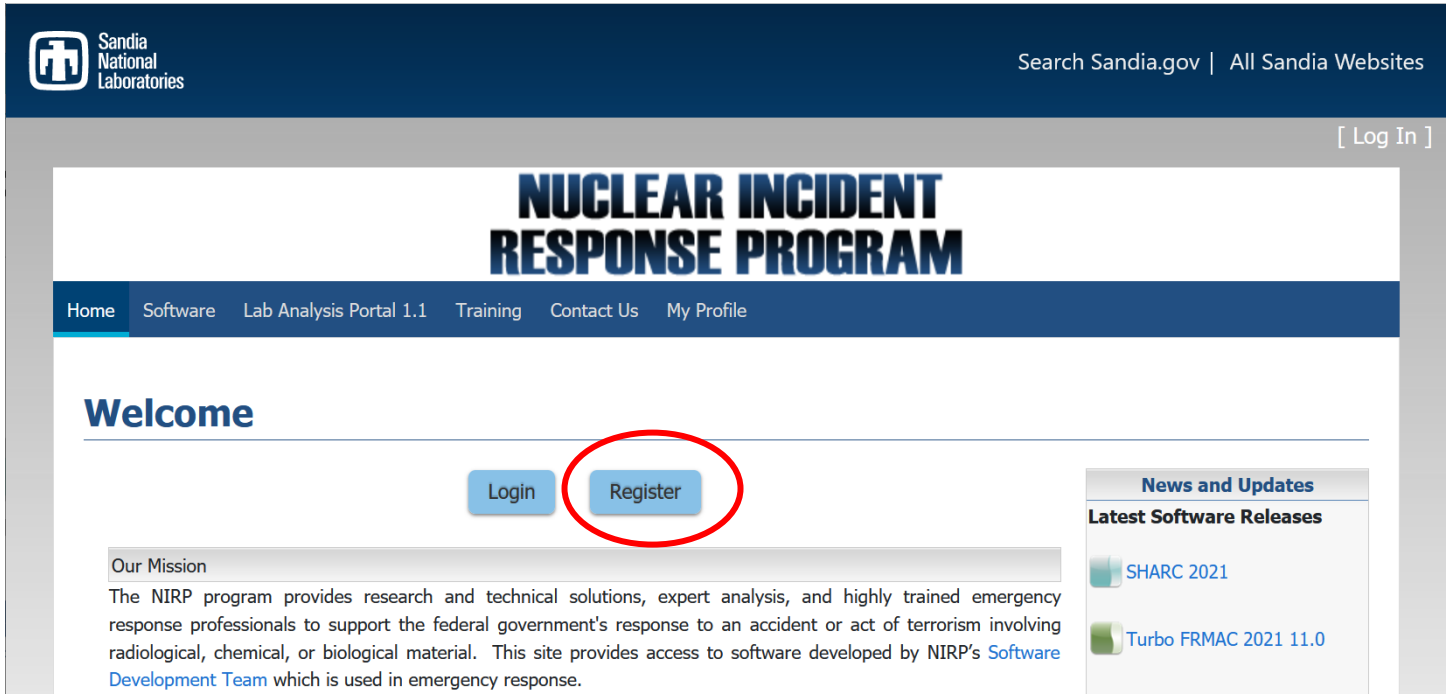
Accessing Turbo FRMAC

Turbo FRMAC and RAMP

- Turbo FRMAC is a part of RAMP to promote awareness of the software and provide training opportunities to RAMP members
- We currently cannot recognize RAMP registrants and maintain a separate process for gaining Turbo FRMAC access

Accessing Turbo FRMAC

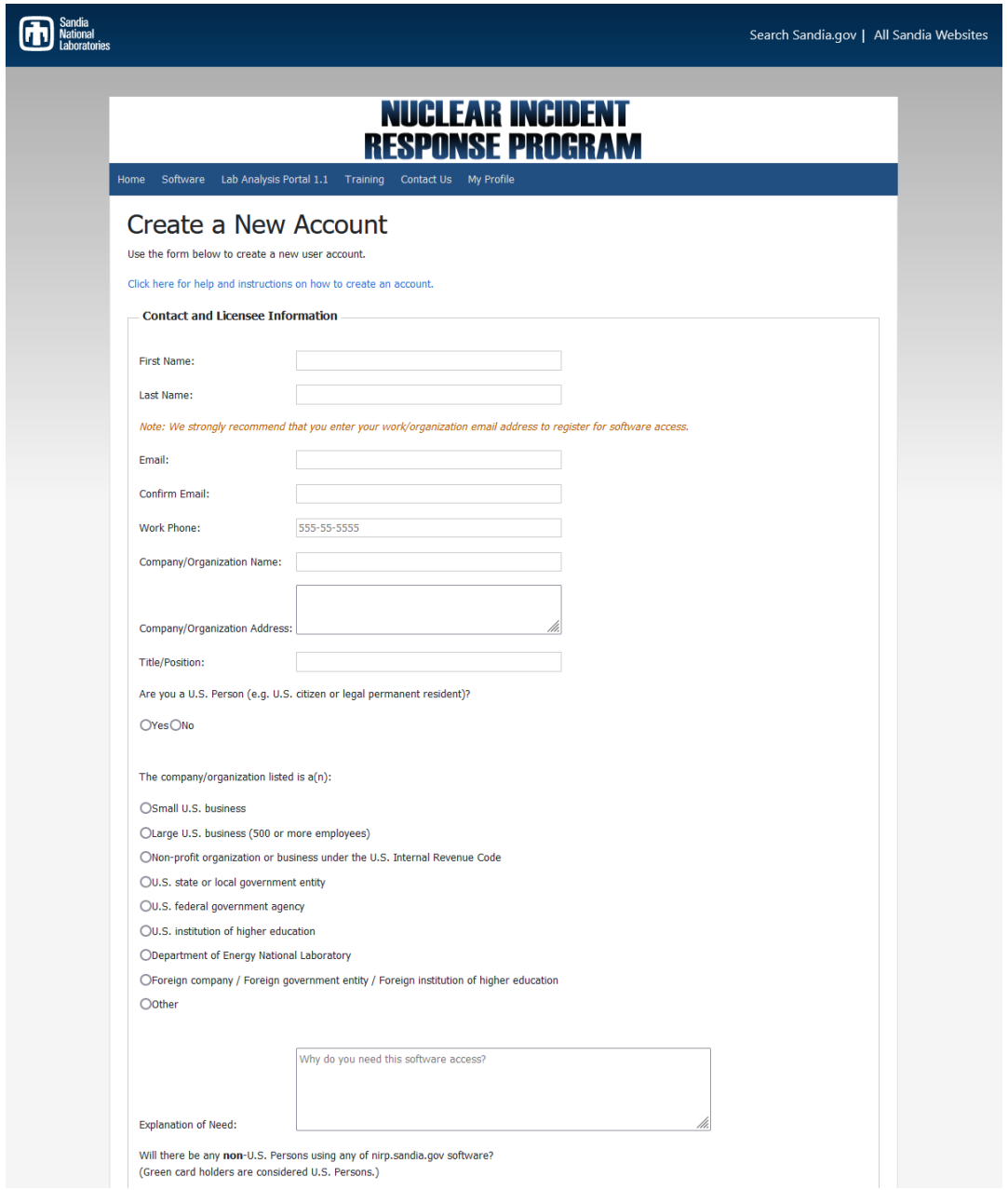
- Software may be issued to response organizations/individuals with justification
- Registration required via the following site: https://nirp.sandia.gov



Registration Page

https://nirp.sandia.gov/register

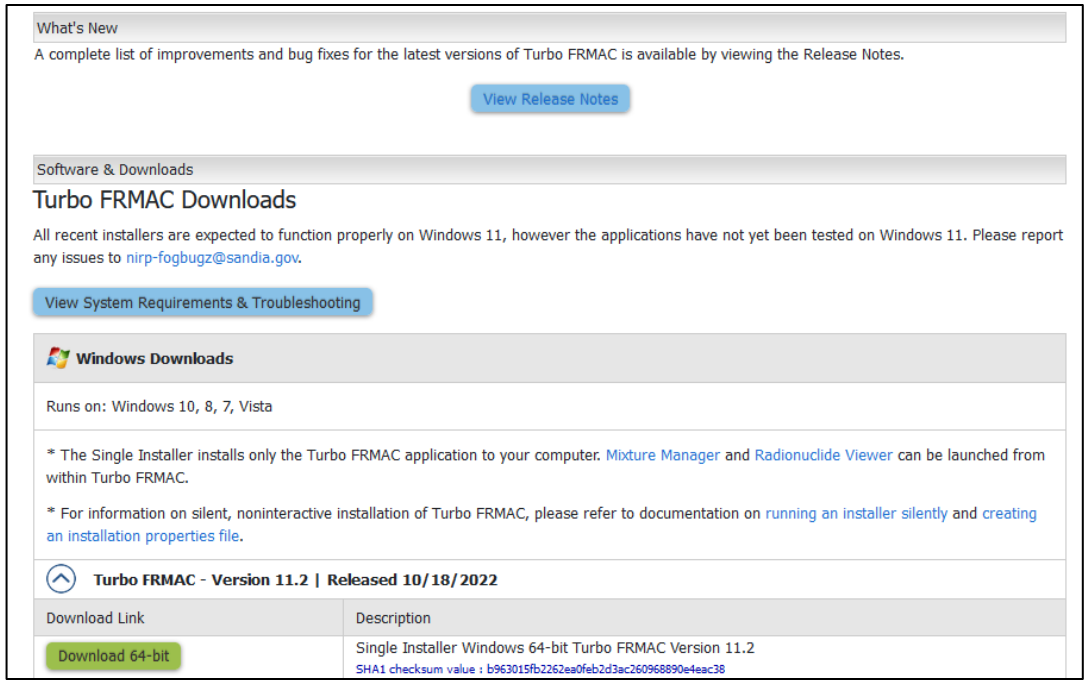
- Once you create an account, check your email for an email verification link
- Once your email has been verified, you can then start requesting access to software



Turbo FRMAC Page

https://nirp.sandia.gov/Software/TurboFRMAC/

- After logging in, request access to Turbo FRMAC at bottom of software page
- Once access is approved, page will list available installers for download



Approval Process

- The software licensing process may take up to 10 business days to complete for a U.S. person and up to 30 days to complete for international users
- If a license agreement is not in place for your organization, you will be asked to complete a Participant Data Sheet
- If a license agreement is already in place for your organization, the process is faster
- If you have not heard anything after 10 business days, contact NIRP-support-fogbugz@sandia.gov

Computer Requirements

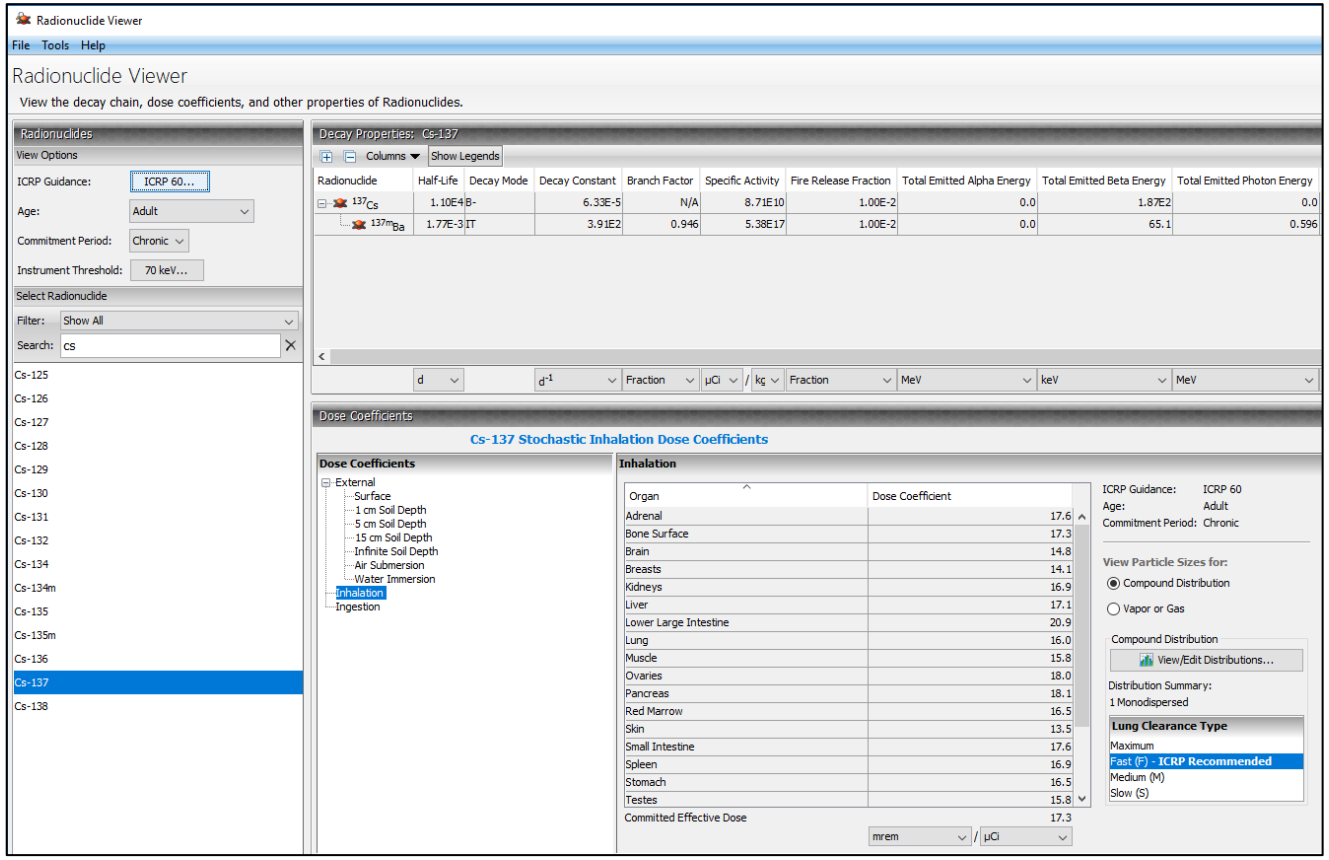
- Turbo FRMAC has been designed for Windows 10 and is compatible with Windows Vista, 7, 8, and 10
- Compatible with Mac OS 10.6 or newer

- Minimum 2 GHz Pentium 4 Processor
  - Recommended: Dual- or Quad-Core or higher
- Minimum 2 GB RAM Memory
  - Recommended: 4 GB RAM or higher
- Minimum 15 GB Free Disk Space
  - Recommended: 25 GB Free or higher
- Minimum 1024 x 768 Screen Resolution
  - Recommended: 1280 x 1024 or higher

- Other Software
  - MS Excel 2007 or newer (for special data export capabilities)
  - MS Outlook 2007 or newer (for built-in email attachment support)
  - MS PowerPoint 2007 or newer (for briefing products)
  - MS Word 2007 or newer (for report generation)
  - Adobe Acrobat Reader (for viewing related documents)

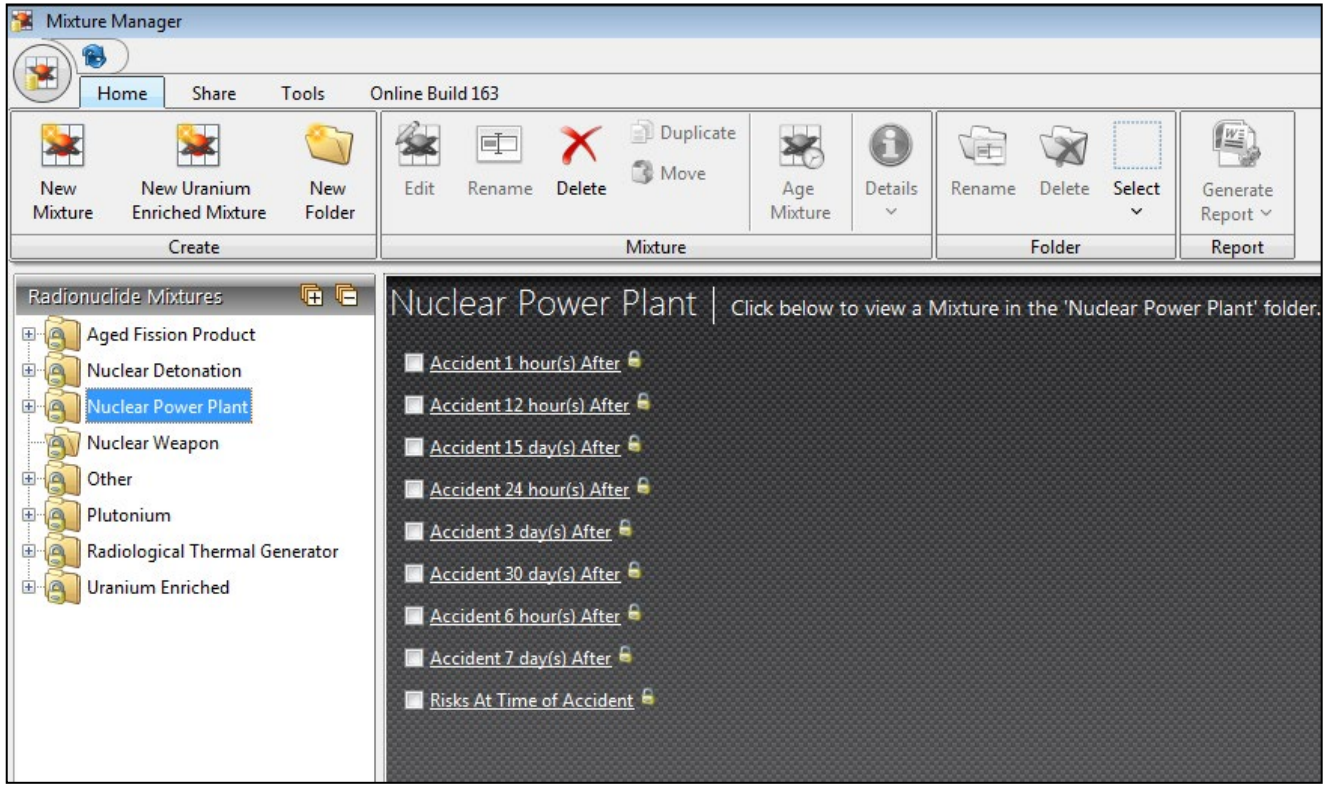
Radionuclide Viewer

- Tool that comes with Turbo FRMAC
- Displays full radionuclide decay chain
- Displays basic radionuclide data (half life, decay mode)
- Provides access to dose coefficients for each radionuclide



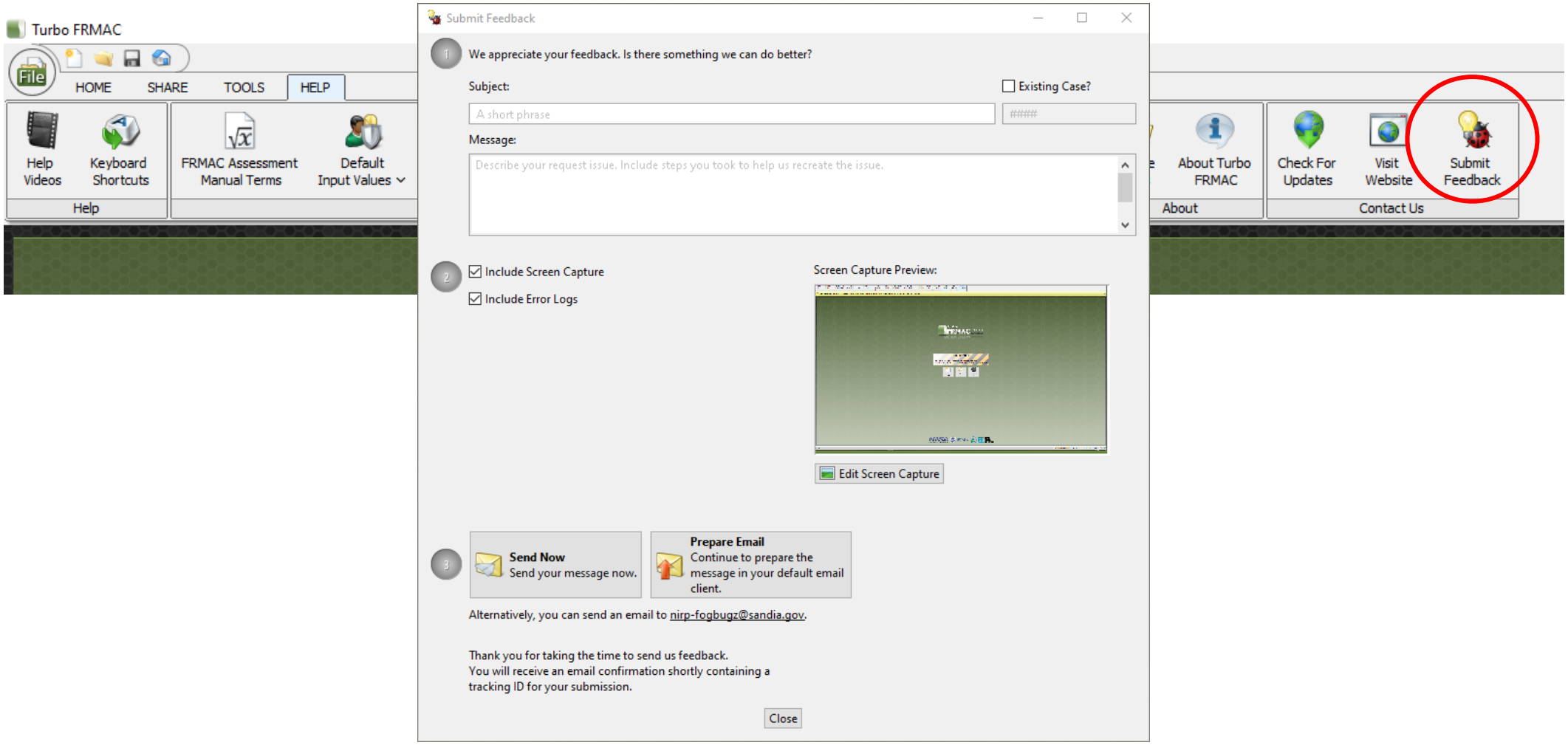
Mixture Manager

- Tool that comes with Turbo FRMAC
- Allows user to create, save, export, and import custom radionuclide mixtures
- Pre-determined radionuclide mixtures are also provided



Submitting Feedback

- Find a bug? Have a good idea for an improvement or new feature?



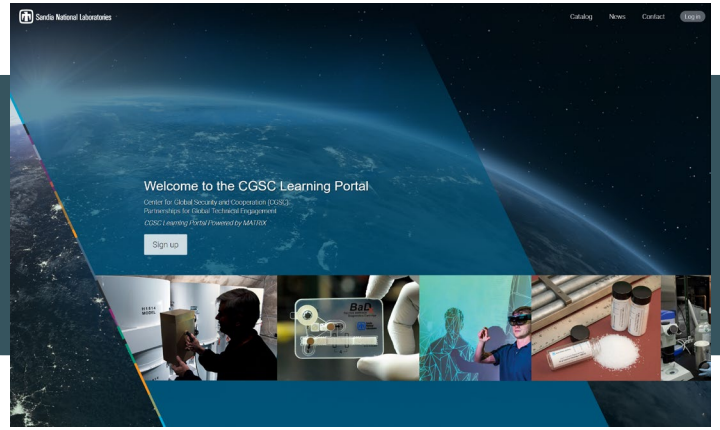
Nuclear Incident Response Self-Paced Learning Opportunities

AS-100: Introduction to Assessment Science
24 ABHP CECs
- 22 module course covering FRMAC Assessment methods for public protection, worker protection, and ingestion pathway ***PNNS-KDXC***

Turbo FRMAC Advanced Methods
1 ABHP CEC each
- Administration of Potassium Iodide Derived Response Level Calculation ***OMXL-NMBV***
- Analytical Action Level Calculation ***HZAK-EWAX***

LA-050: Support Laboratory Briefing (Coming soon!)
- What labs should expect when called to help FRMAC

Gamma Spectroscopy (Coming soon!)
- Detector Calibration Methods
- Sample Analysis
- Software Functions
- Mathematical Instrument Calibration
- True Coincidence Summing Corrections
- In-Situ Gamma Spectrometry



Sandia and partners have developed *free, online* training!
Learn more: https://snl.matrixlms.com/

AS-100: Introduction to Assessment Science

Course Objectives

- Understand the basis of the EPA and FDA Protective Action Guides
- Understand the basis of the FRMAC Assessment Manual and how it is organized
- Understand the FRMAC Assessment methods for public protection, worker protection, and ingestion pathway
- Demonstrate ability to calculate values using Turbo FRMAC

Course Organization

- 24 hours of self-paced content
- Each topic structured by:
  - Part 1: Topic overview
  - Part 2: Method discussion
  - Part 3: Turbo FRMAC demonstration

Prerequisites

- A working knowledge of health physics
- Turbo FRMAC software installed

Demonstration

Using Field Measurements for Projected Public Dose

- In the Intermediate phase of a response, questions about protective actions such as relocation for specific areas or populations might arise requiring calculation of projected doses based on measurement data
- **Example:** A field team was dispatched to an area where models indicate material from a nuclear power plant release has deposited. Should the population in this area be relocated? The field team measured the following:

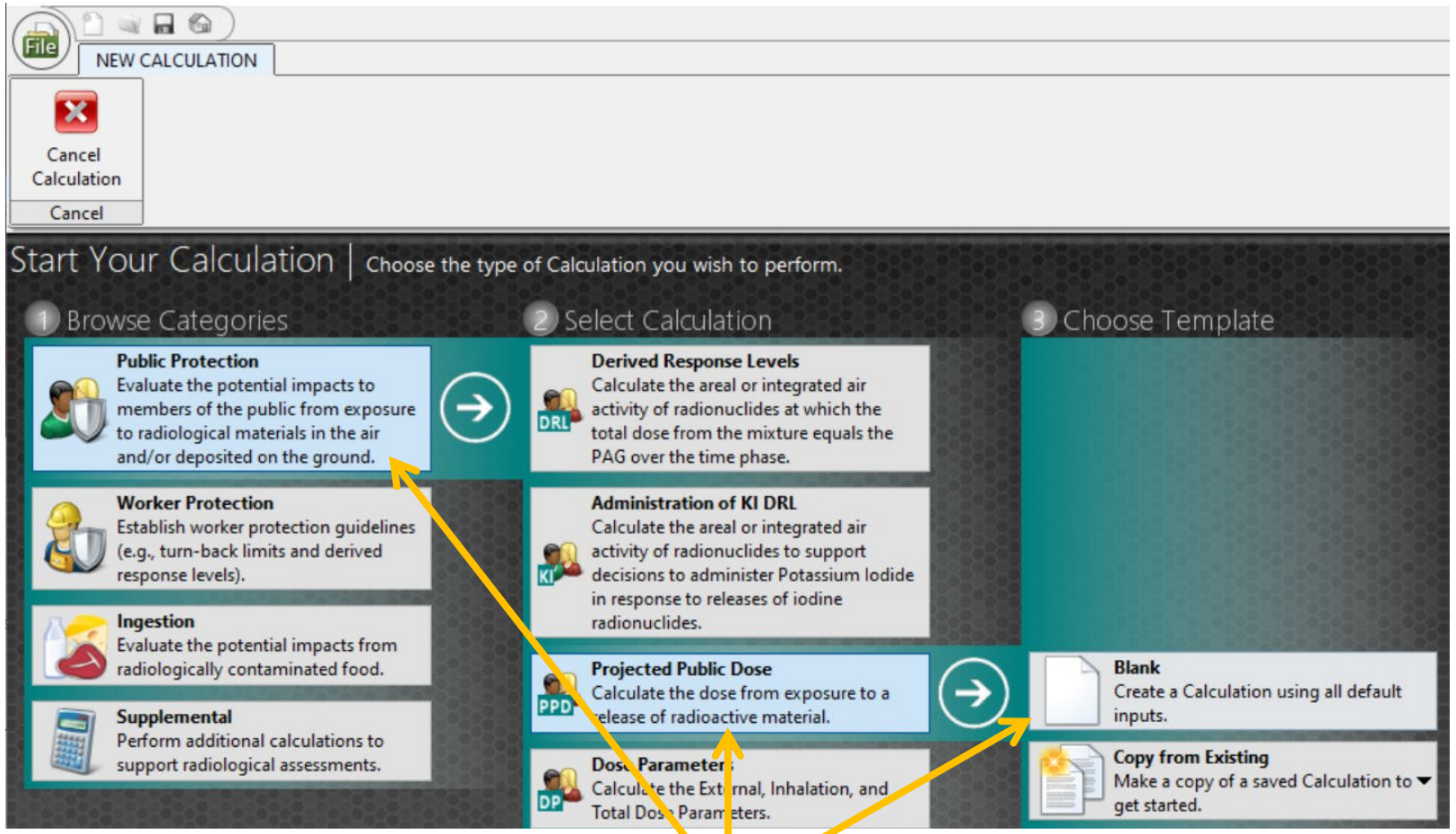
Radionuclide	Measured Deposition ($\mu Ci/m^2$)
Ba-140	1.4
Cs-134	0.6
Cs-137	0.35
I-131	1.7
I-132	1.3
La-140	1.3
Sr-89	1.0
Te-132	1.2

We will use Turbo FRMAC to calculate a **projected public dose** and compare it to the appropriate PAG for relocation

Open Turbo FRMAC

Select New Calculation

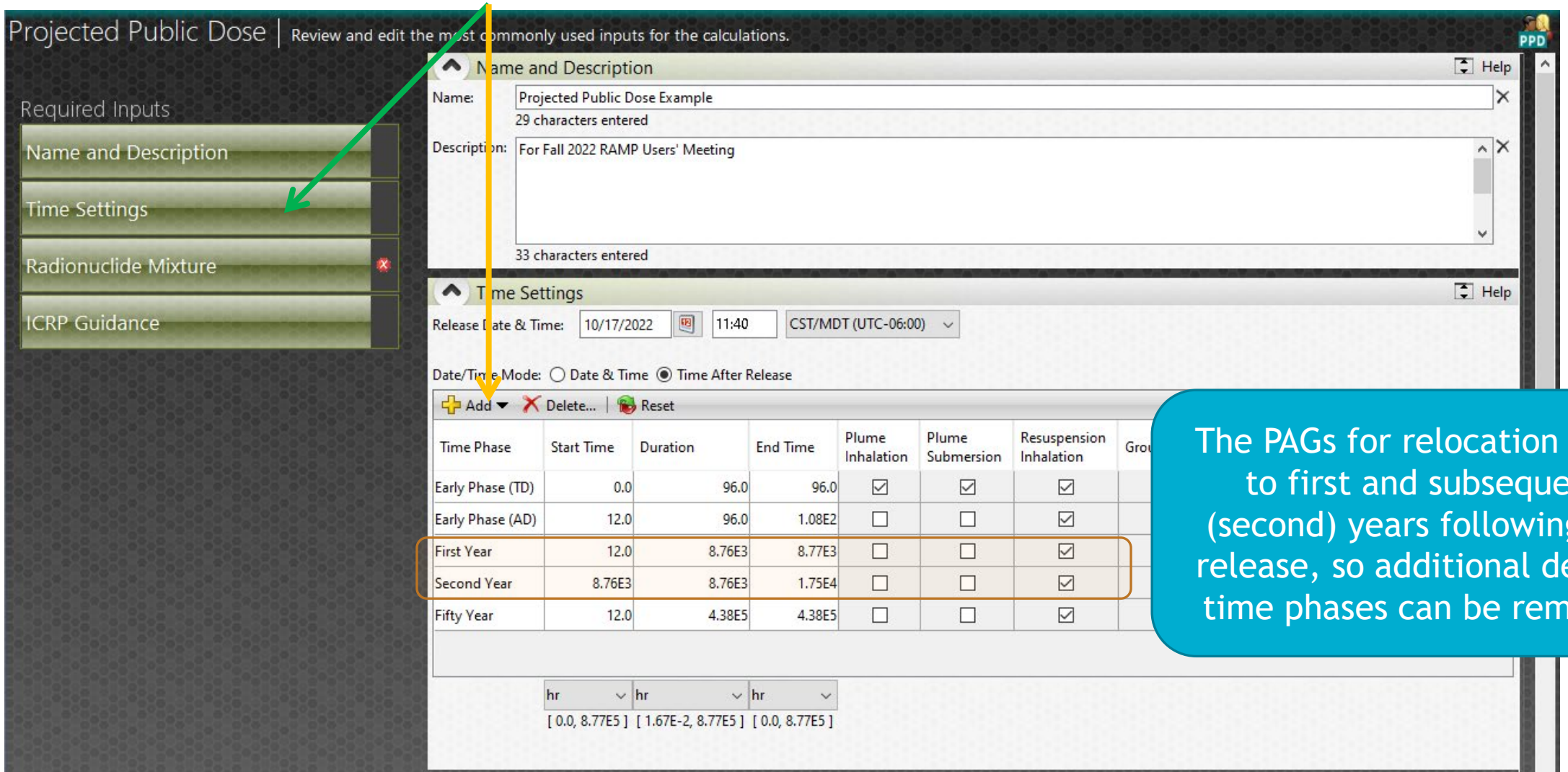
Select New Calculation



Select Public Protection, then Projected Public Dose, then Blank

Verify Time Phases

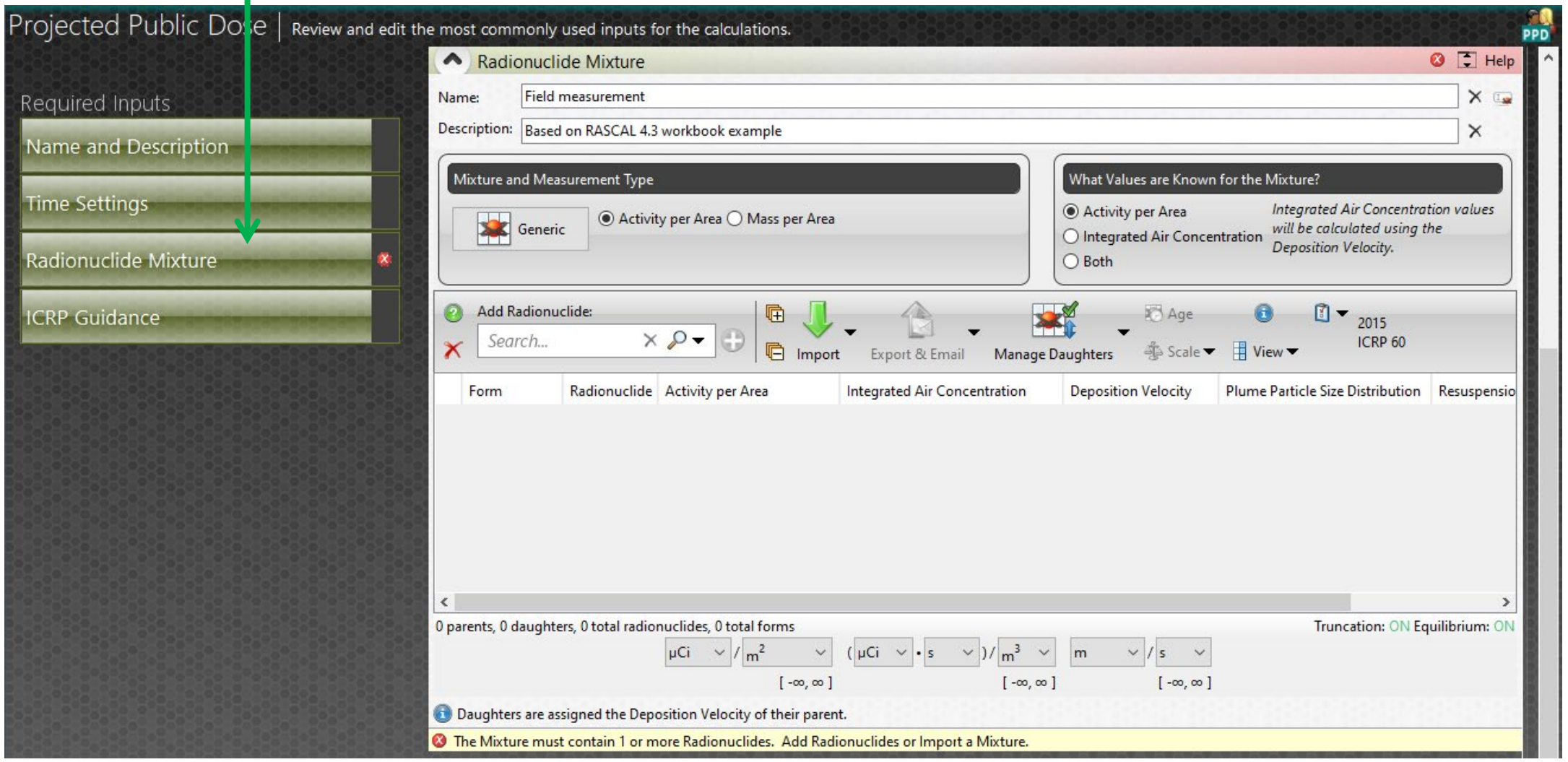
Click on Time Settings Button
Edit default time phases as needed for the question being asked



The PAGs for relocation apply to first and subsequent (second) years following the release, so additional default time phases can be removed

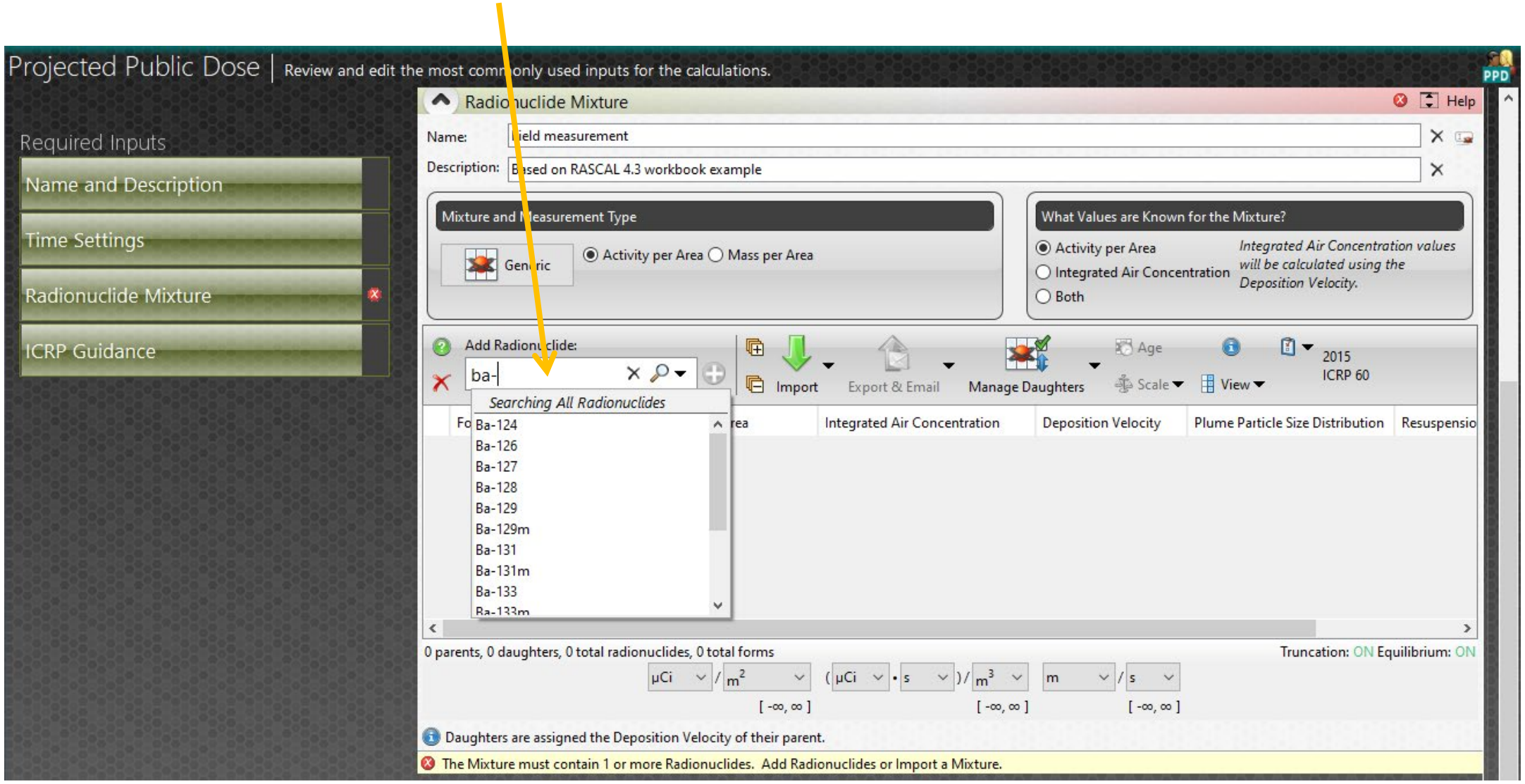
Build Radionuclide Mixture

Click on Radionuclide Mixture Button



Build Radionuclide Mixture

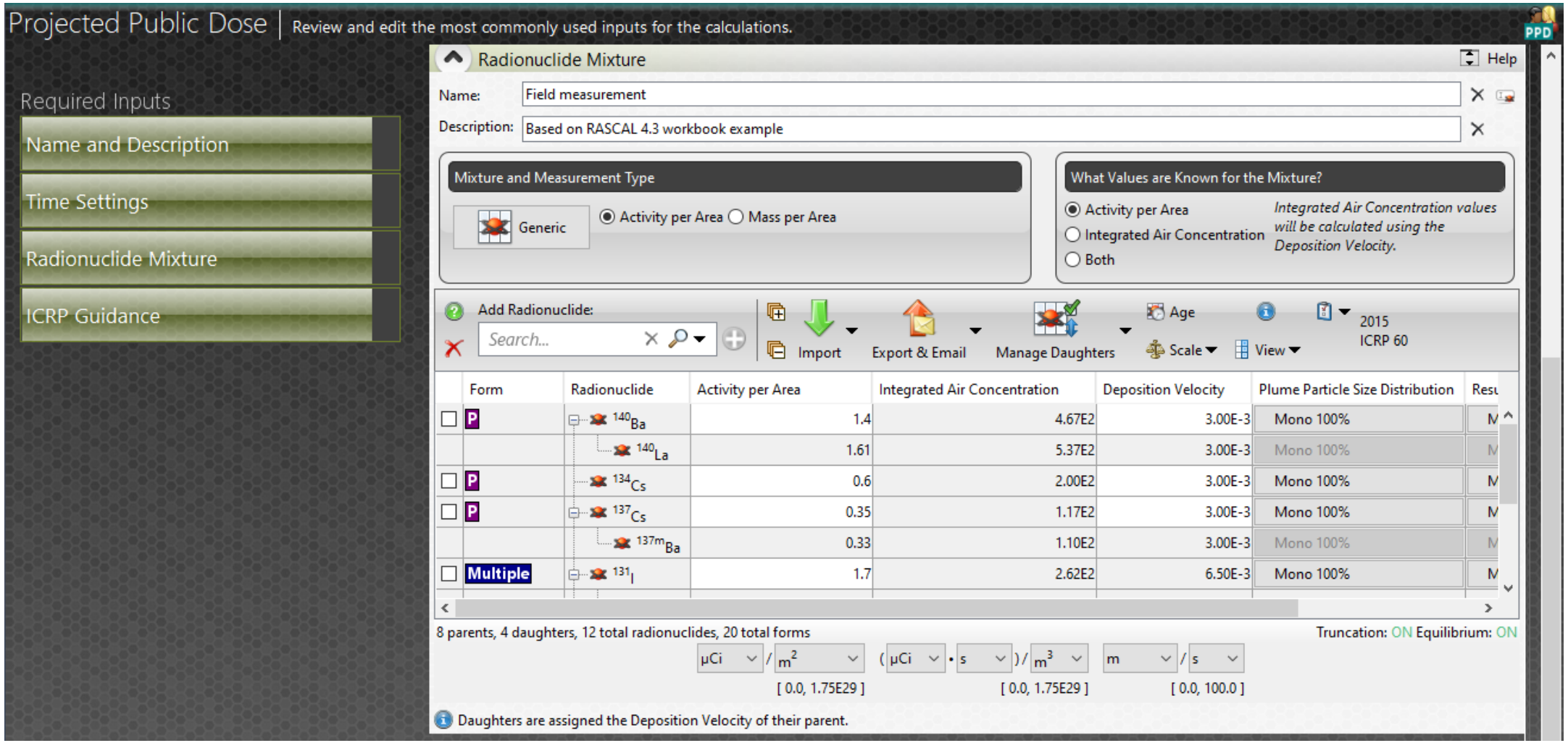
Click on Search and begin to populate radionuclides



Build Radionuclide Mixture

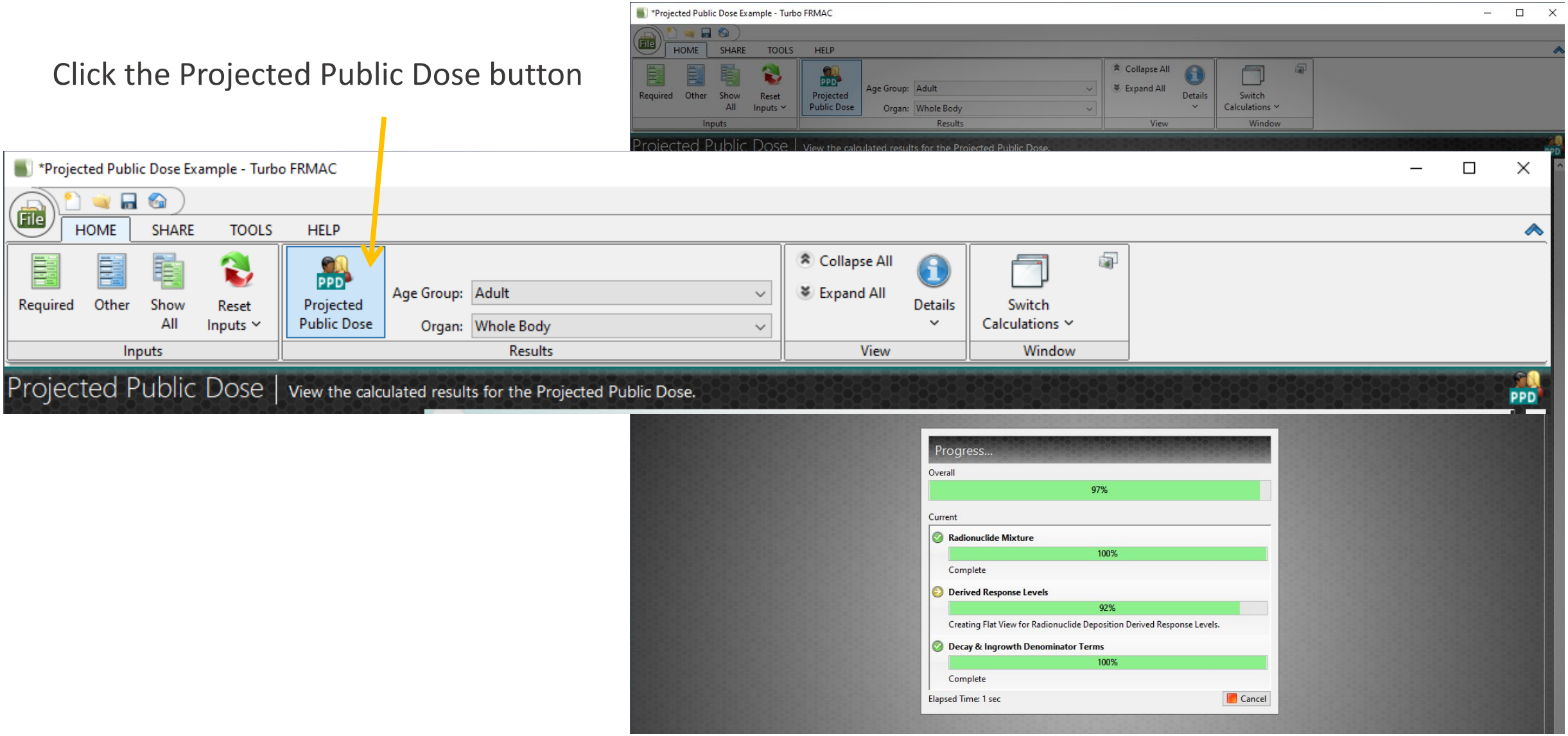
Enter each radionuclide in the mix and enter the measured Activity per Area

Turbo FRMAC will autopopulate concentrations for daughters present in equilibrium



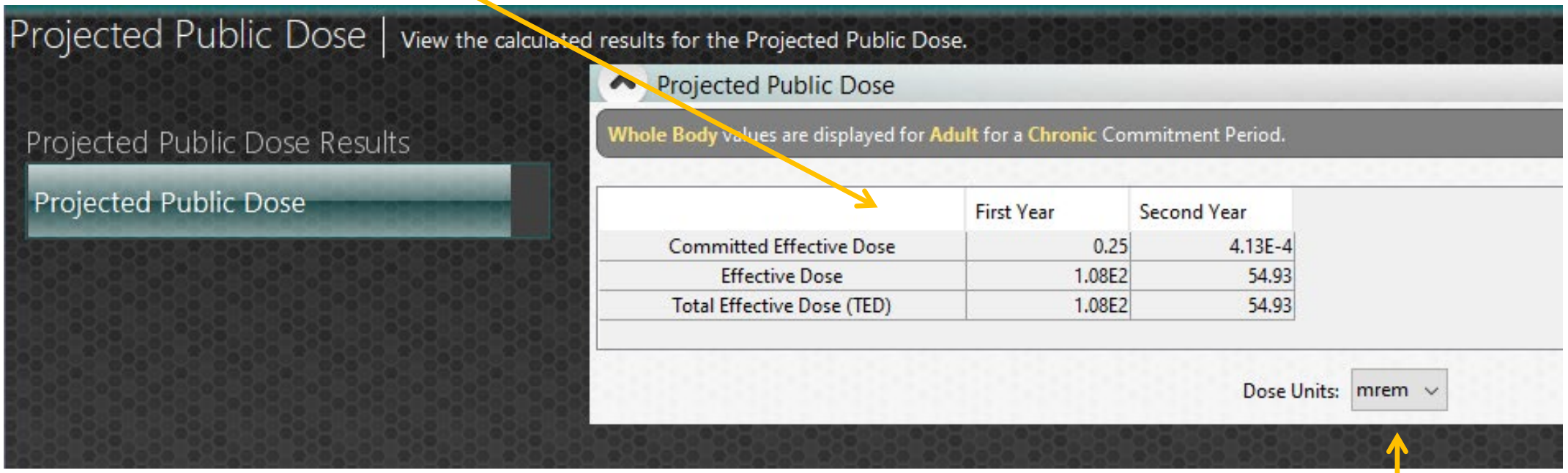
Run Calculation

Click the Projected Public Dose button



Projected Public Dose Results

Final results displayed



Drop-down menu can be used to select units other than default mrem

What do the results mean?

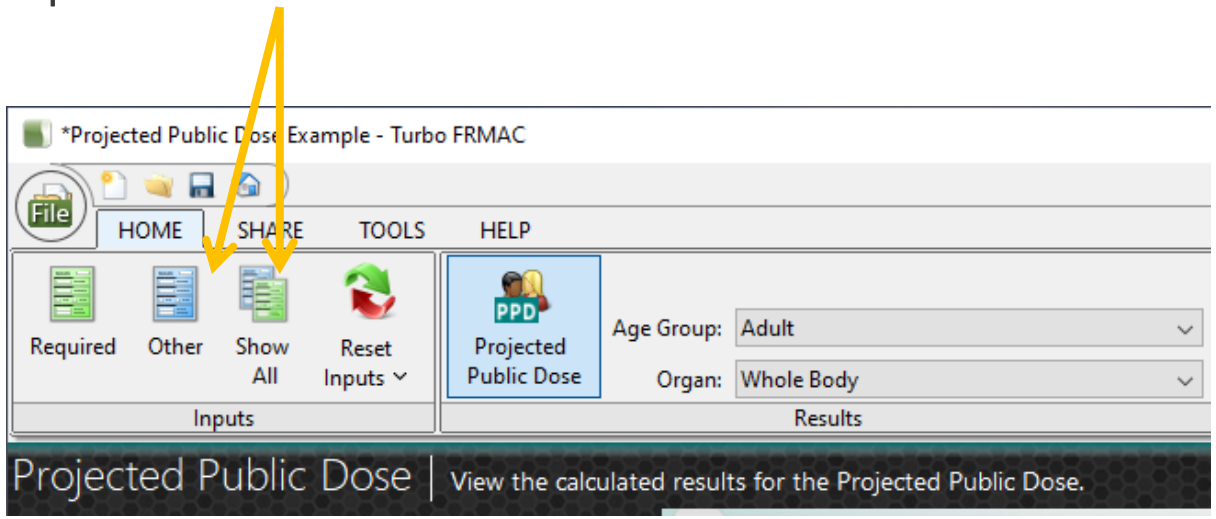
Time Phase	Projected Public Dose (rem)	EPA PAG (rem)
First Year	0.11	2
Second Year	5.5E-02	0.5

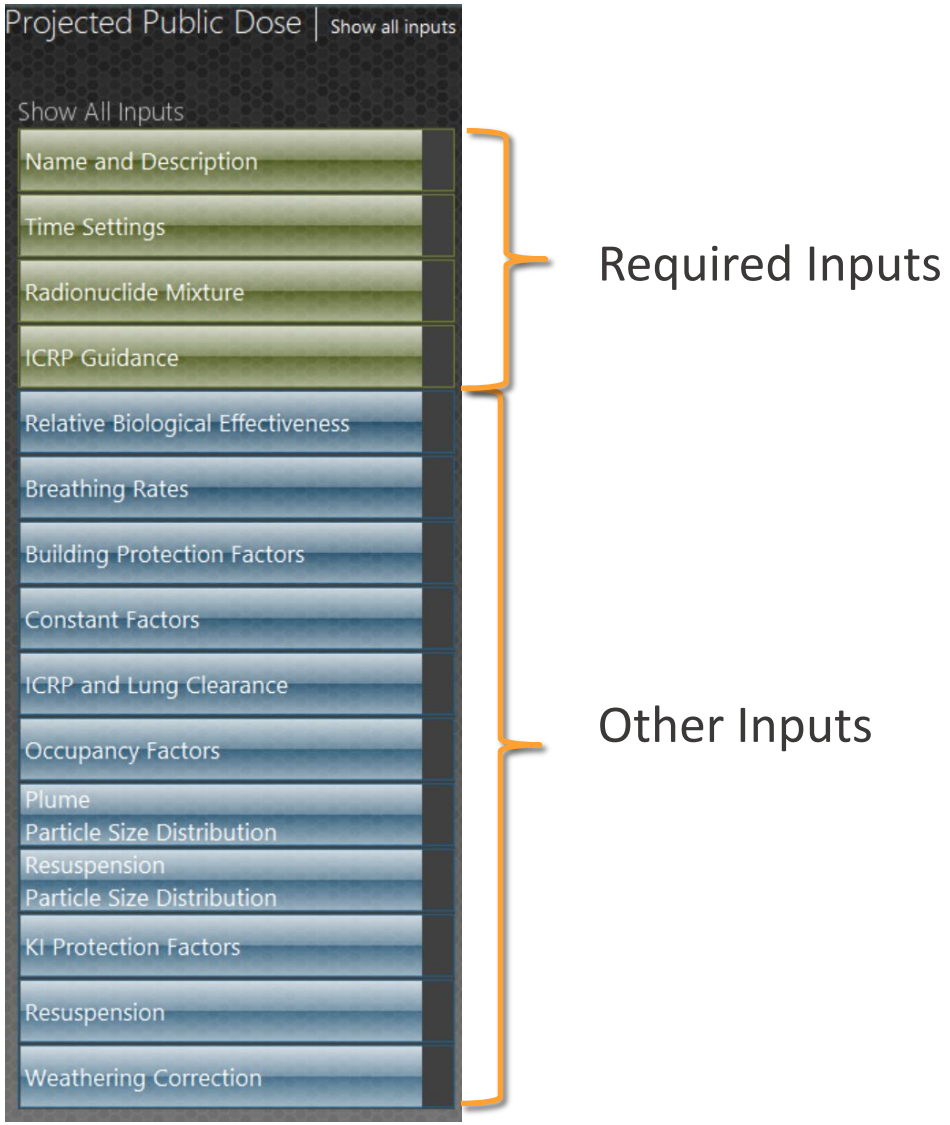
- Results are far below the PAGs for the intermediate phase
- Note, this is a conservative assessment based on a single measurement and might not be enough basis for a decision to relocate a population
- If results were close to the PAG, Assessment Scientist should consider acquiring more information about the population (e.g., time spent outdoors in the contaminated area) and tailor the calculation accordingly

Other Inputs

Only the radionuclide mixture was required to run this calculation

Selecting “Other” or “Show All” reveals the blue button inputs for advanced customization of the inputs





Questions?

Thursday October 27, 2022	DAY 4–Virtual
8:00 AM–8:50 AM	Morning Primer – Code Consolidation
9:00 AM–12:00 PM	RASCAL Intermediate
1:30 PM–4:00 PM	RASCAL Advanced/Turbo FRMAC Discussion

Thank You

Lainy Cochran

ldcochr@sandia.gov