Sandia National Laboratories

Turbo FRMAC and RASCAL

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Fall 2022 NRC RAMP Users' Group Meeting

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U.S. DEPARTMENT OF ENERGY | National Nuclear Security Administration

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Outline

- Turbo FRMAC introduction
- Accessing Turbo FRMAC and web-based training opportunities
- Demonstration of how to import a RASCAL-generated source term into Turbo FRMAC

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

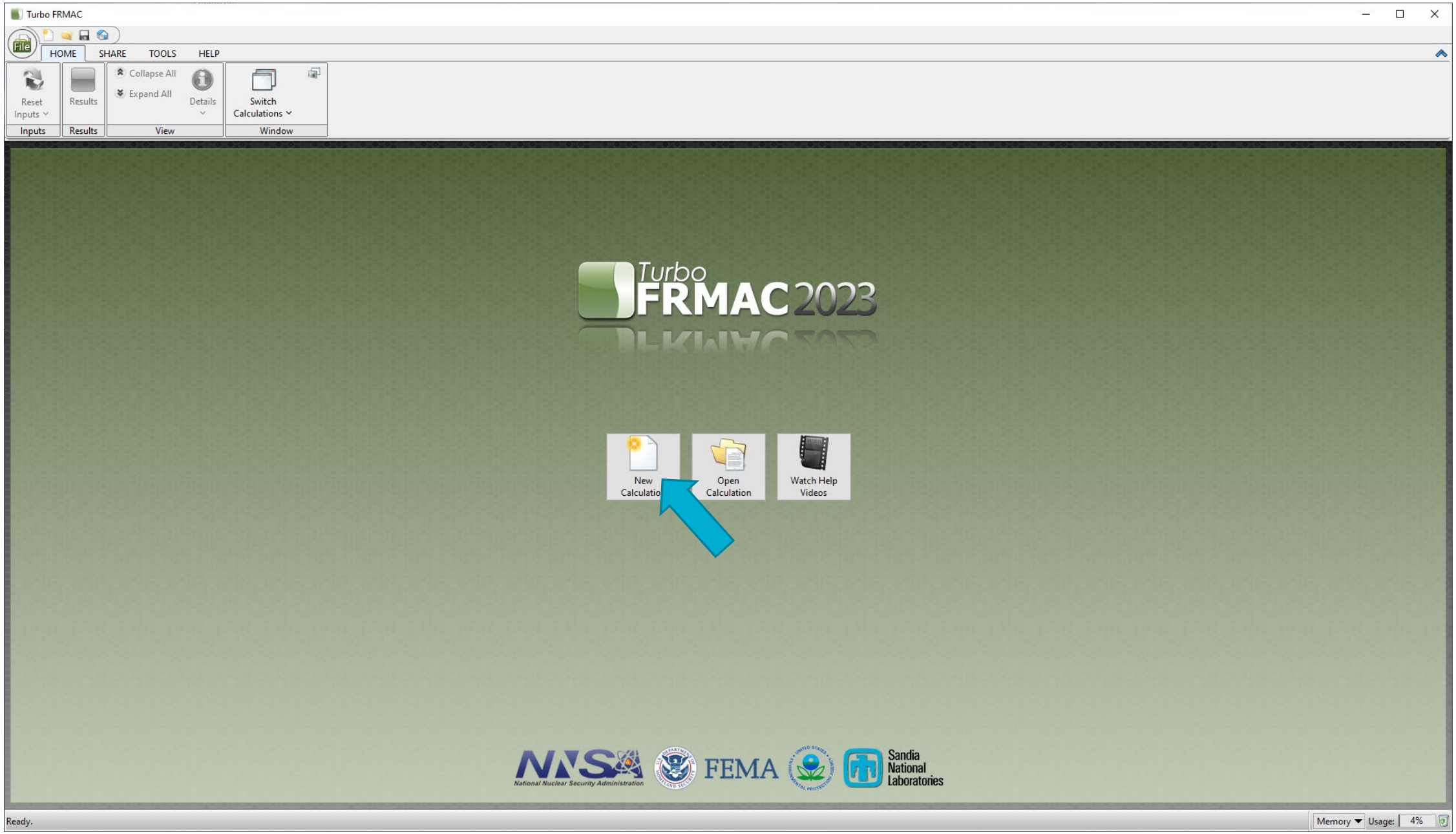
Turbo FRMAC

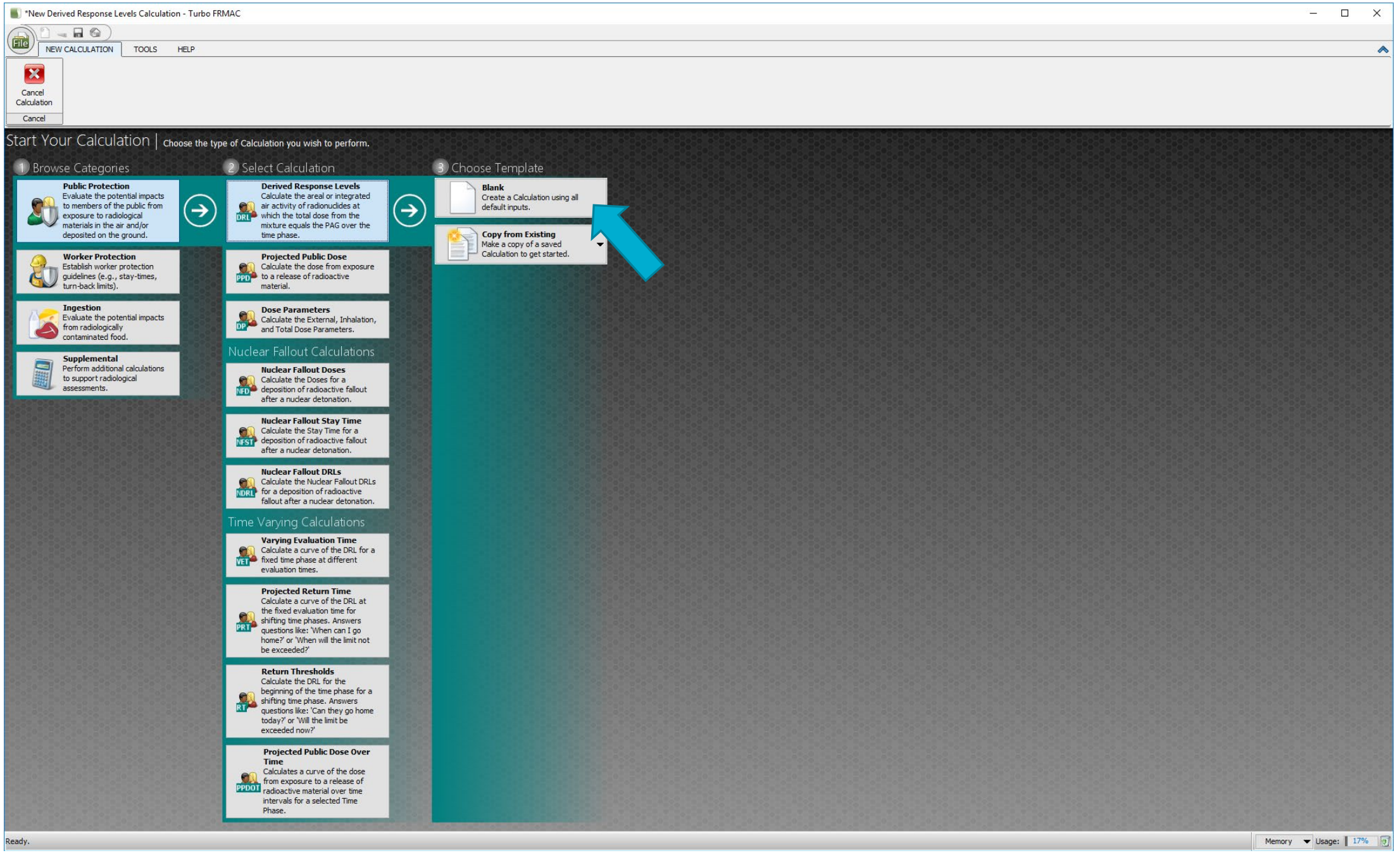
- Software performs complex calculations to quickly evaluate radiological hazards during an emergency response by assessing impacts to the public, workers, and the food supply
- Deployable software application developed by SNL
- Does not require internet connection
- Automates FRMAC Assessment Manual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

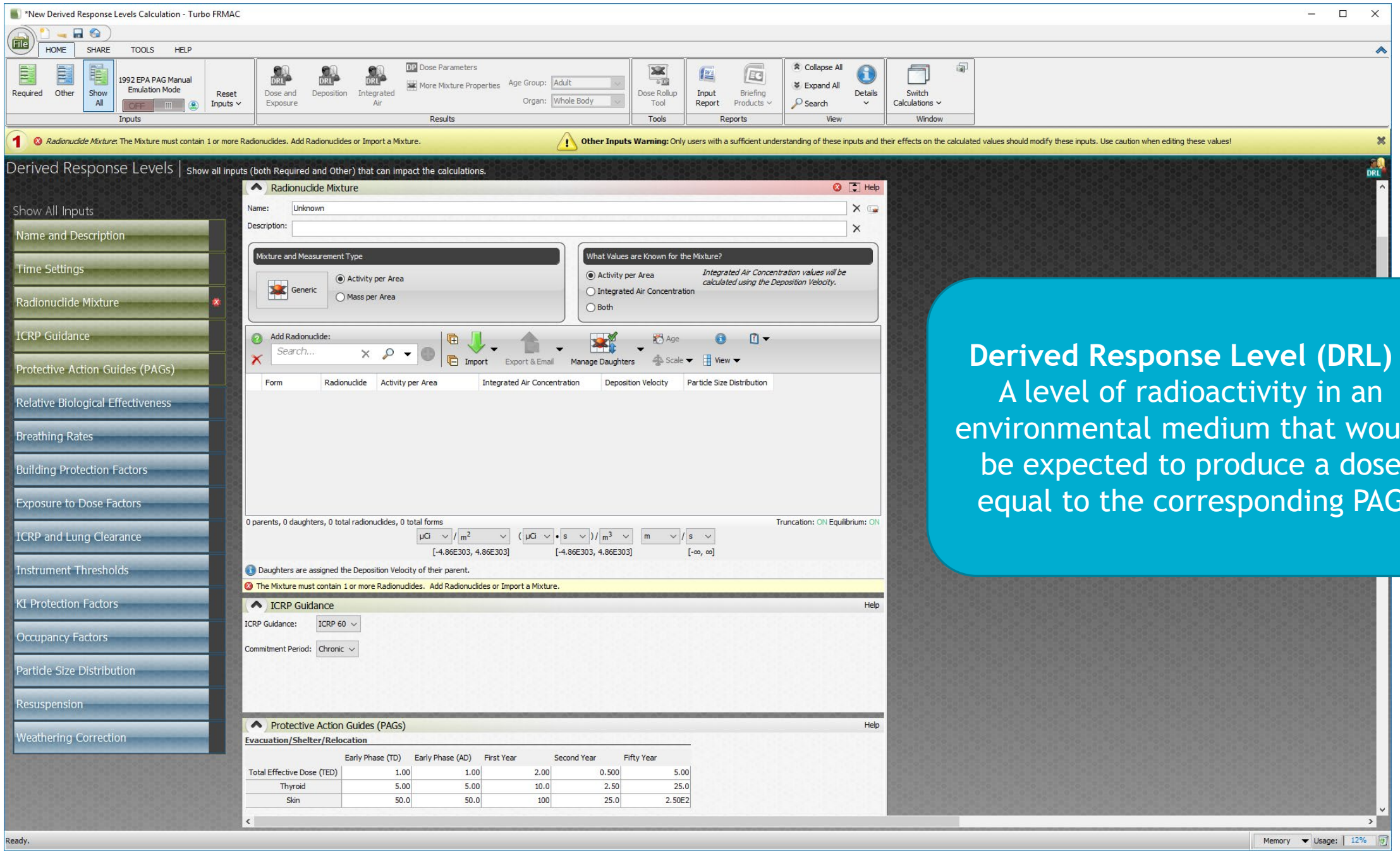
Turbo FRMAC Purpose

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 Calculatio
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

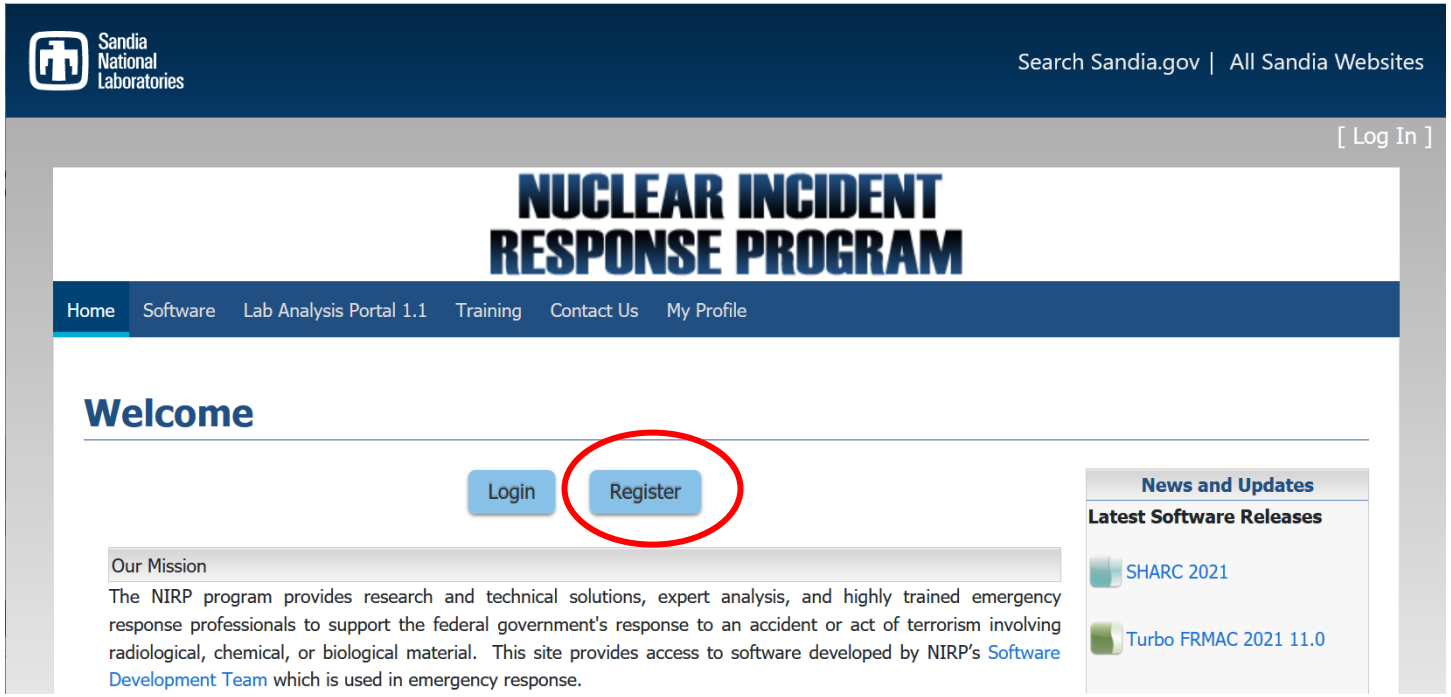
Accessing Turbo FRMAC

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

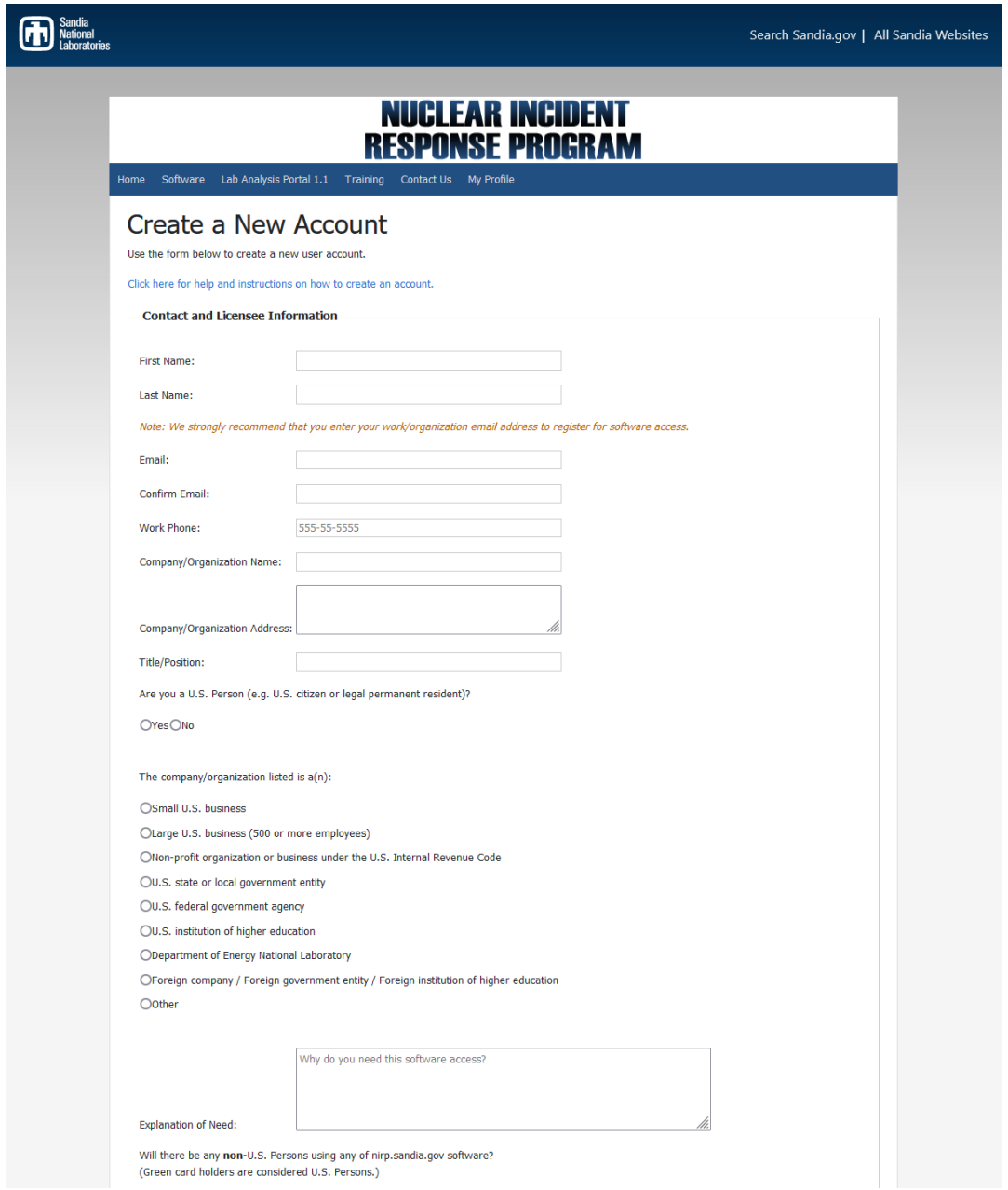
- Software may be issued to response organizations/individuals with justification
- Registration required via the following site: https://nirp.sandia.gov



Registration Page

https://nirp.sandia.gov/register

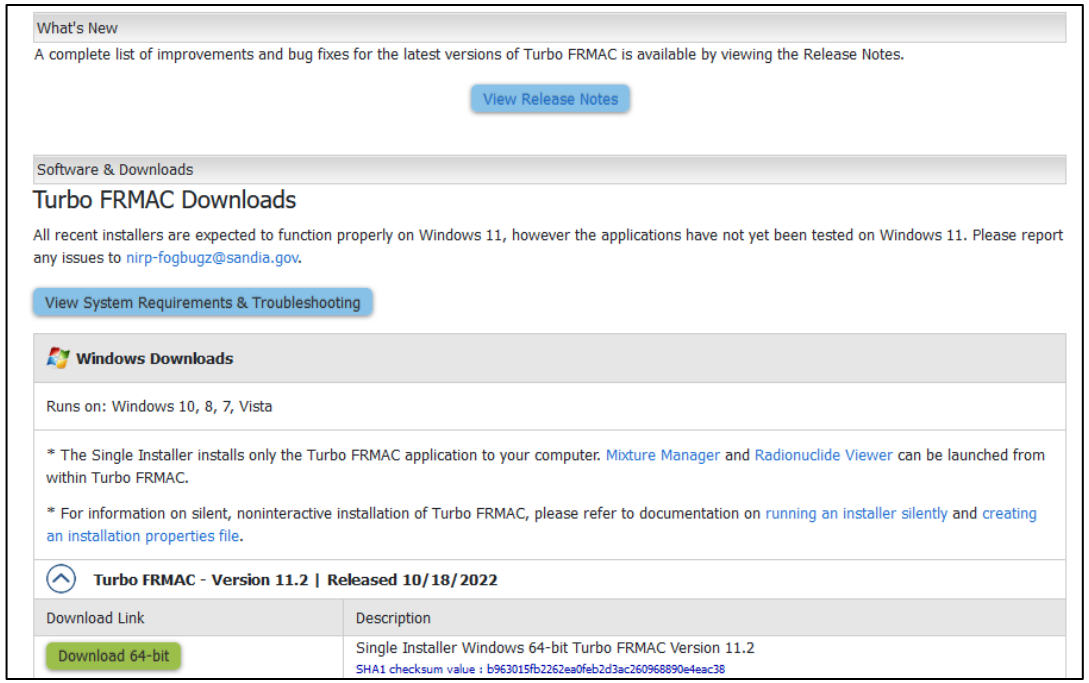
- Once you create an account, check your email for an email verification link
- Once your email has been verified, you can then start requesting access to software

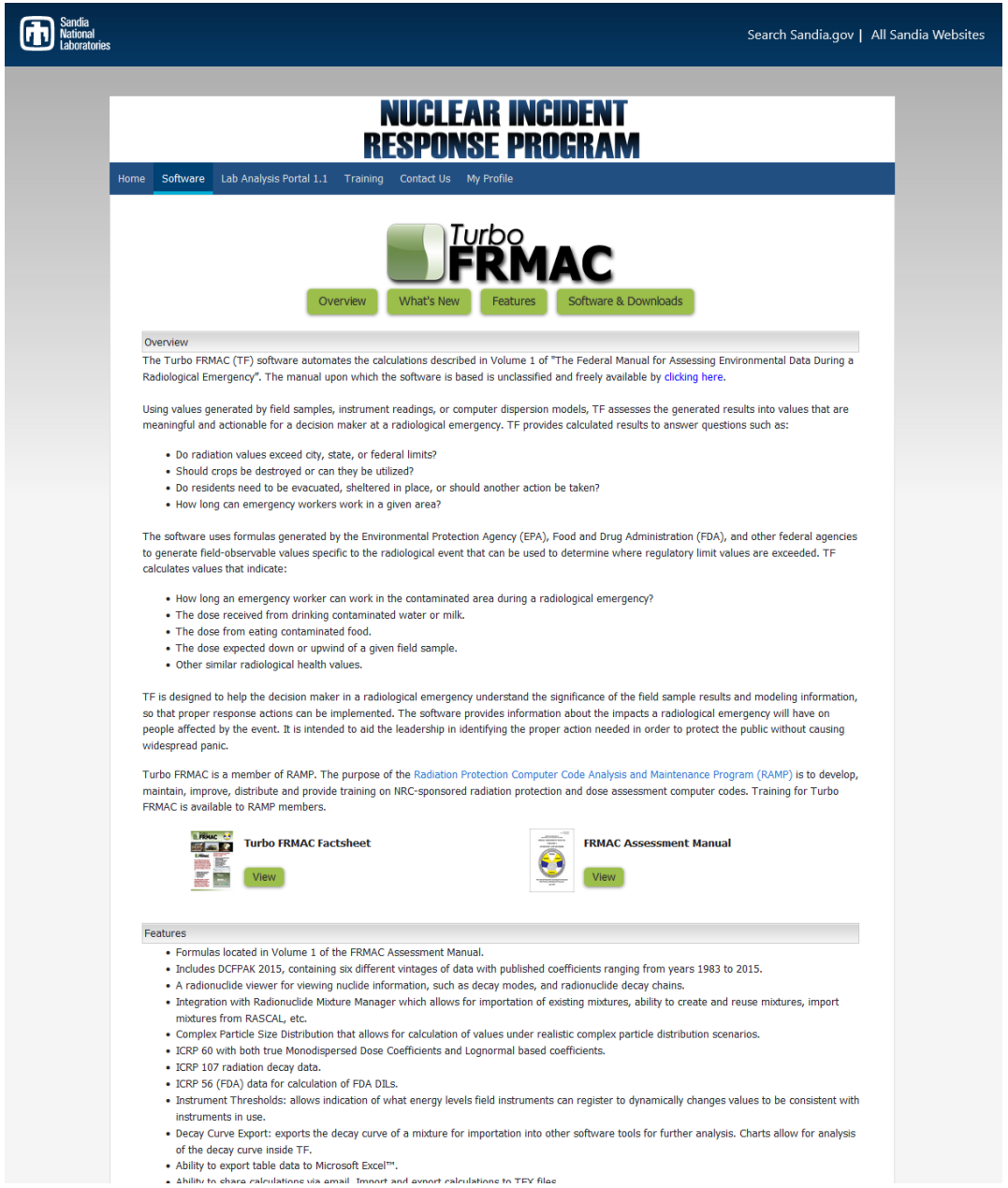


Turbo FRMAC Page

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

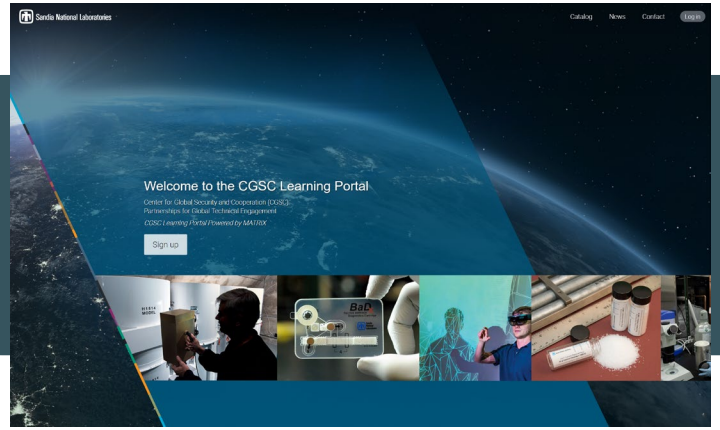
Nuclear Incident Response Self-Paced Learning Opportunities

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/

Demonstration

Initial Assessment Process

Nuclear power plant source terms initially used by FRMAC could come from RASCAL

Determine initial source term

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

Calculate DRL

Turbo FRMAC is used to calculate DRLs

Run atmospheric dispersion models and contour DRL

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

Collect field measurements and use to refine source term

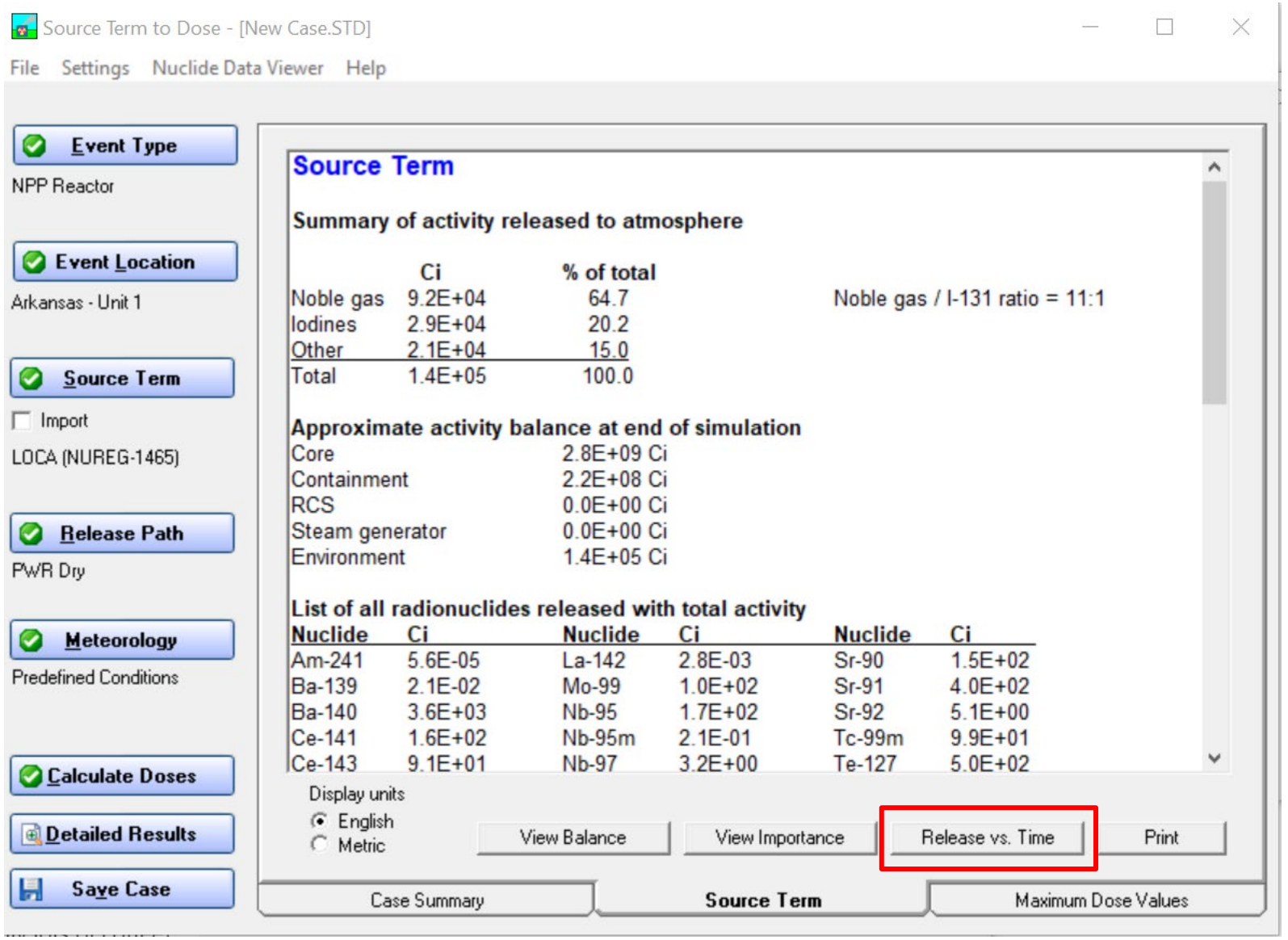
DRLs can also be calculated for specific areas and compared to field measurements

RASCAL Import Feature

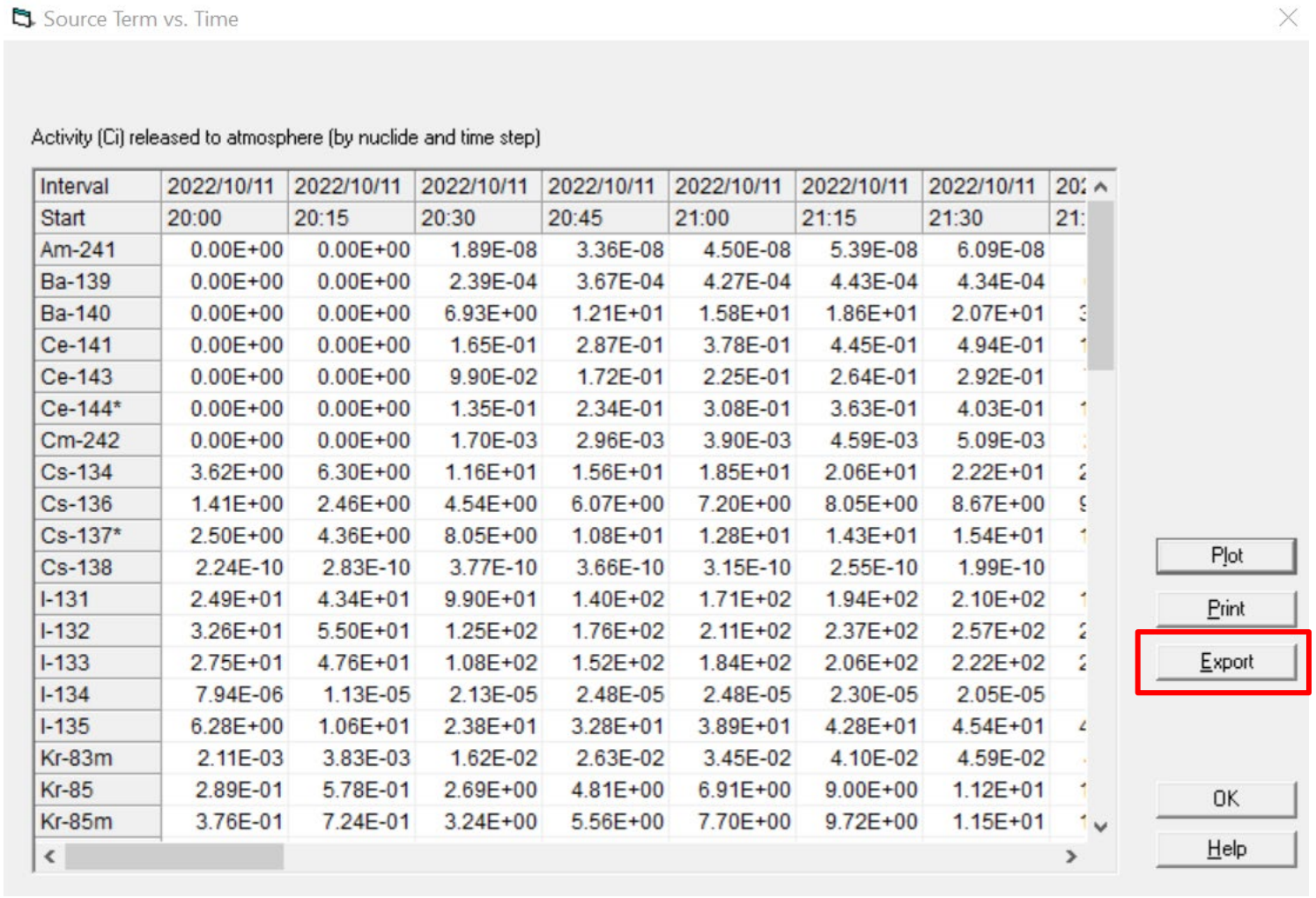
File Type	Purpose
STDose Source Term vs. Time	Used in Turbo FRMAC and NARAC models for initial protective action products
STDose Total Surface Concentration by Nuclide	Used in Turbo FRMAC to calculate projected doses at a specific location
Atmospheric Source Term Merge/Export	Used in Turbo FRMAC and NARAC models for initial protective action products

How do you import RASCAL source terms into Turbo FRMAC?

Generating a Source Term in RASCAL STDose



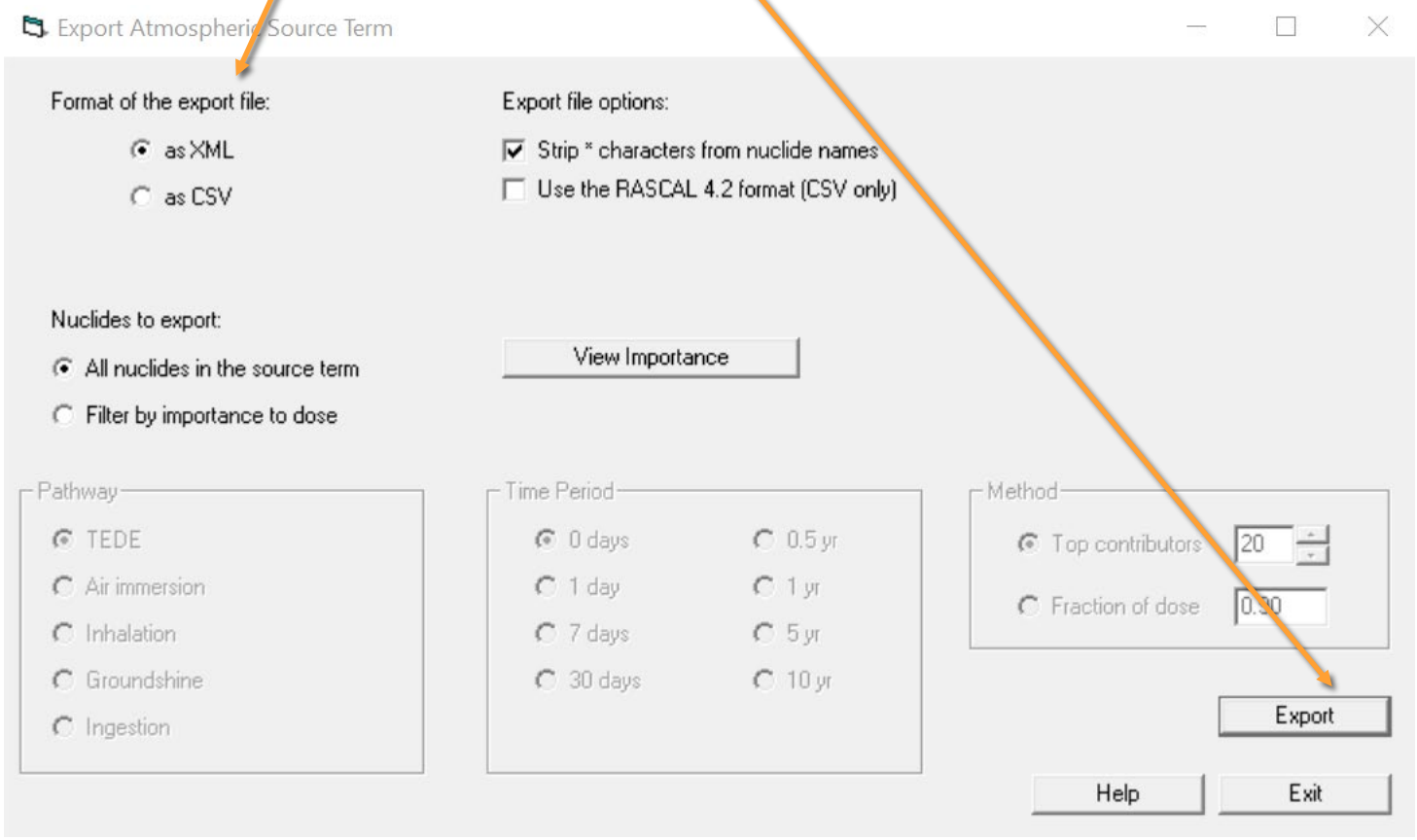
Exporting a RASCAL STDose Source Term



Interval	2022/10/11	2022/10/11	2022/10/11	2022/10/11	2022/10/11	2022/10/11	2022/10/11	202
Start	20:00	20:15	20:30	20:45	21:00	21:15	21:30	21:
Am-241	0.00E+00	0.00E+00	1.89E-08	3.36E-08	4.50E-08	5.39E-08	6.09E-08	
Ba-139	0.00E+00	0.00E+00	2.39E-04	3.67E-04	4.27E-04	4.43E-04	4.34E-04	
Ba-140	0.00E+00	0.00E+00	6.93E+00	1.21E+01	1.58E+01	1.86E+01	2.07E+01	3
Ce-141	0.00E+00	0.00E+00	1.65E-01	2.87E-01	3.78E-01	4.45E-01	4.94E-01	1
Ce-143	0.00E+00	0.00E+00	9.90E-02	1.72E-01	2.25E-01	2.64E-01	2.92E-01	
Ce-144*	0.00E+00	0.00E+00	1.35E-01	2.34E-01	3.08E-01	3.63E-01	4.03E-01	1
Cm-242	0.00E+00	0.00E+00	1.70E-03	2.96E-03	3.90E-03	4.59E-03	5.09E-03	
Cs-134	3.62E+00	6.30E+00	1.16E+01	1.56E+01	1.85E+01	2.06E+01	2.22E+01	2
Cs-136	1.41E+00	2.46E+00	4.54E+00	6.07E+00	7.20E+00	8.05E+00	8.67E+00	9
Cs-137*	2.50E+00	4.36E+00	8.05E+00	1.08E+01	1.28E+01	1.43E+01	1.54E+01	1
Cs-138	2.24E-10	2.83E-10	3.77E-10	3.66E-10	3.15E-10	2.55E-10	1.99E-10	
I-131	2.49E+01	4.34E+01	9.90E+01	1.40E+02	1.71E+02	1.94E+02	2.10E+02	1
I-132	3.26E+01	5.50E+01	1.25E+02	1.76E+02	2.11E+02	2.37E+02	2.57E+02	2
I-133	2.75E+01	4.76E+01	1.08E+02	1.52E+02	1.84E+02	2.06E+02	2.22E+02	2
I-134	7.94E-06	1.13E-05	2.13E-05	2.48E-05	2.48E-05	2.30E-05	2.05E-05	
I-135	6.28E+00	1.06E+01	2.38E+01	3.28E+01	3.89E+01	4.28E+01	4.54E+01	4
Kr-83m	2.11E-03	3.83E-03	1.62E-02	2.63E-02	3.45E-02	4.10E-02	4.59E-02	
Kr-85	2.89E-01	5.78E-01	2.69E+00	4.81E+00	6.91E+00	9.00E+00	1.12E+01	1
Kr-85m	3.76E-01	7.24E-01	3.24E+00	5.56E+00	7.70E+00	9.72E+00	1.15E+01	1

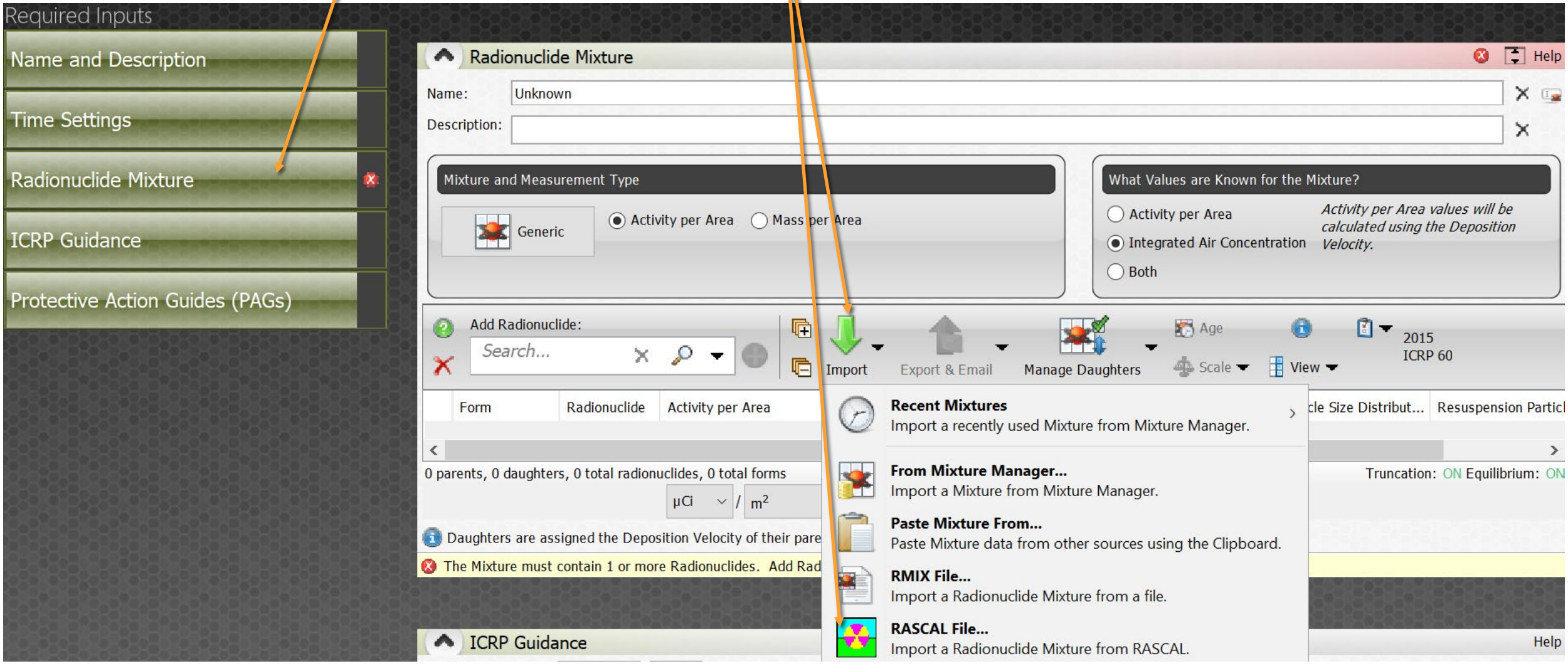
Exporting a RASCAL STDose Source Term

- Choose your desired file format and click Export



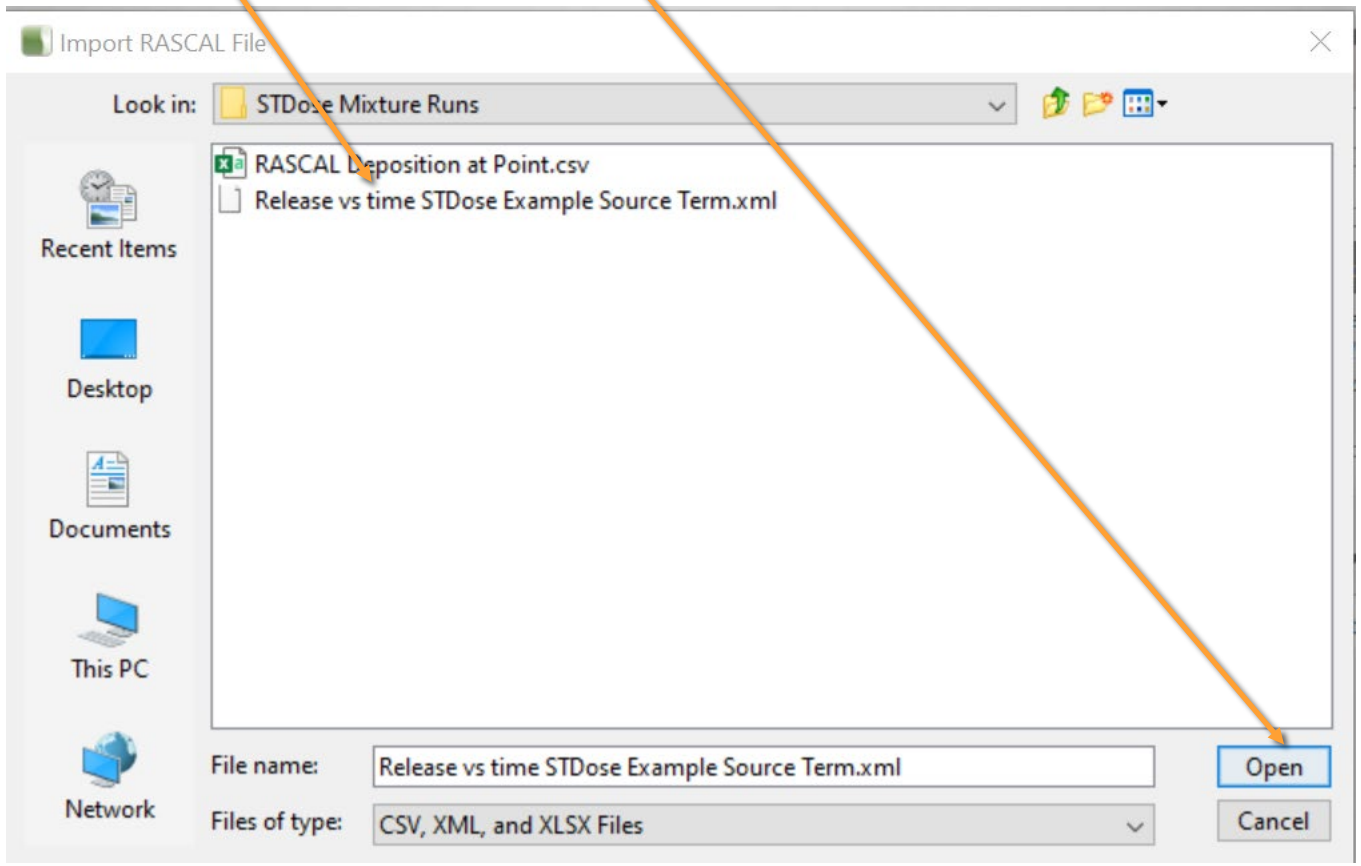
Importing a RASCAL Source Term into Turbo FRMAC

Select the Radionuclide Mixture button. Select Import, then RASCAL File…



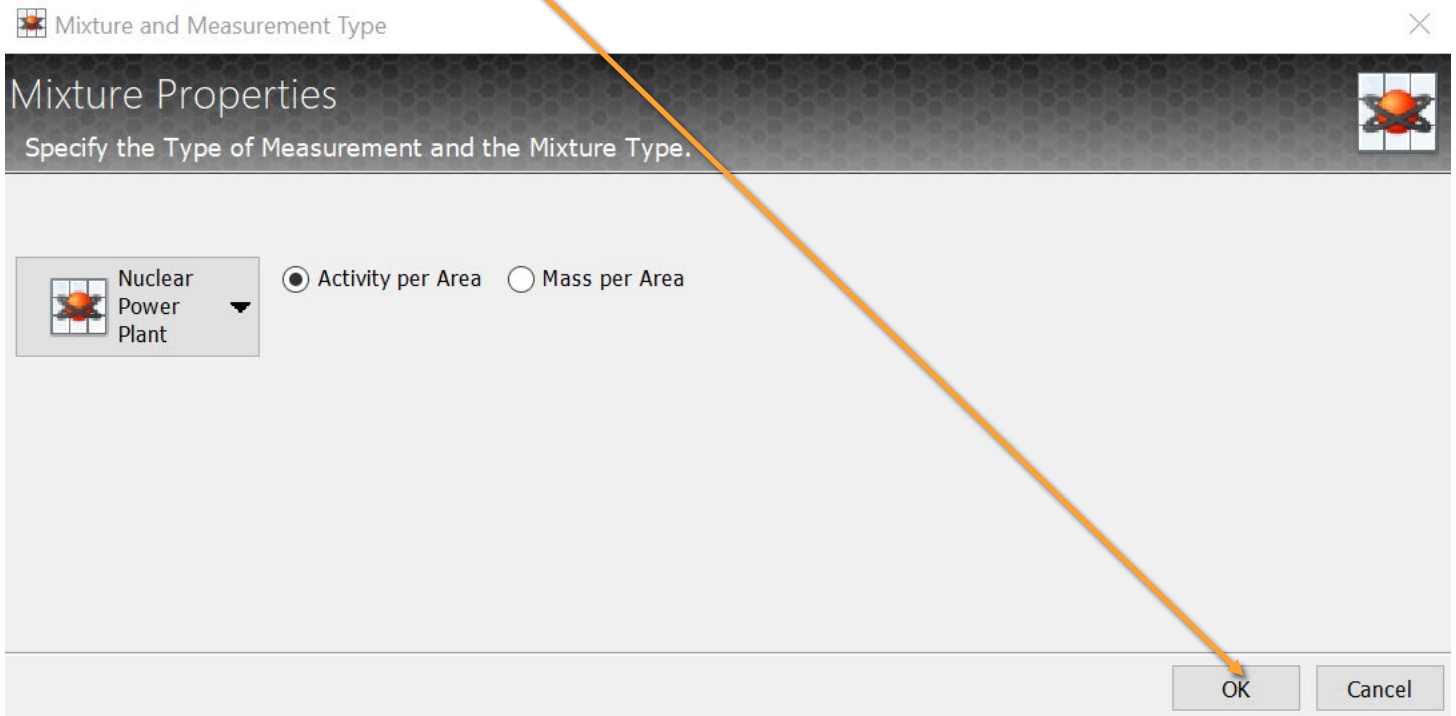
Importing a RASCAL Source Term into Turbo FRMAC

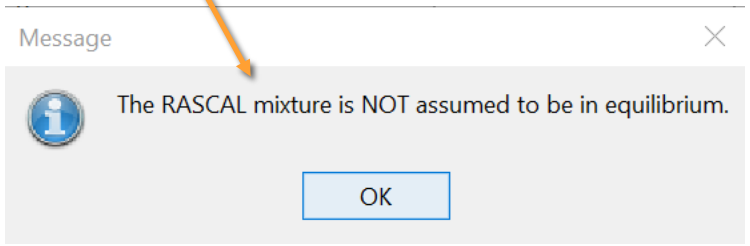
Select the appropriate RASCAL file, then click Open.



Importing a RASCAL Source Term into Turbo FRMAC

When importing a mixture, a transitional panel appears that defaults to Nuclear Power Plant release type. Click OK (no changes needed) for this calculation. A warning message will then appear. Click OK.





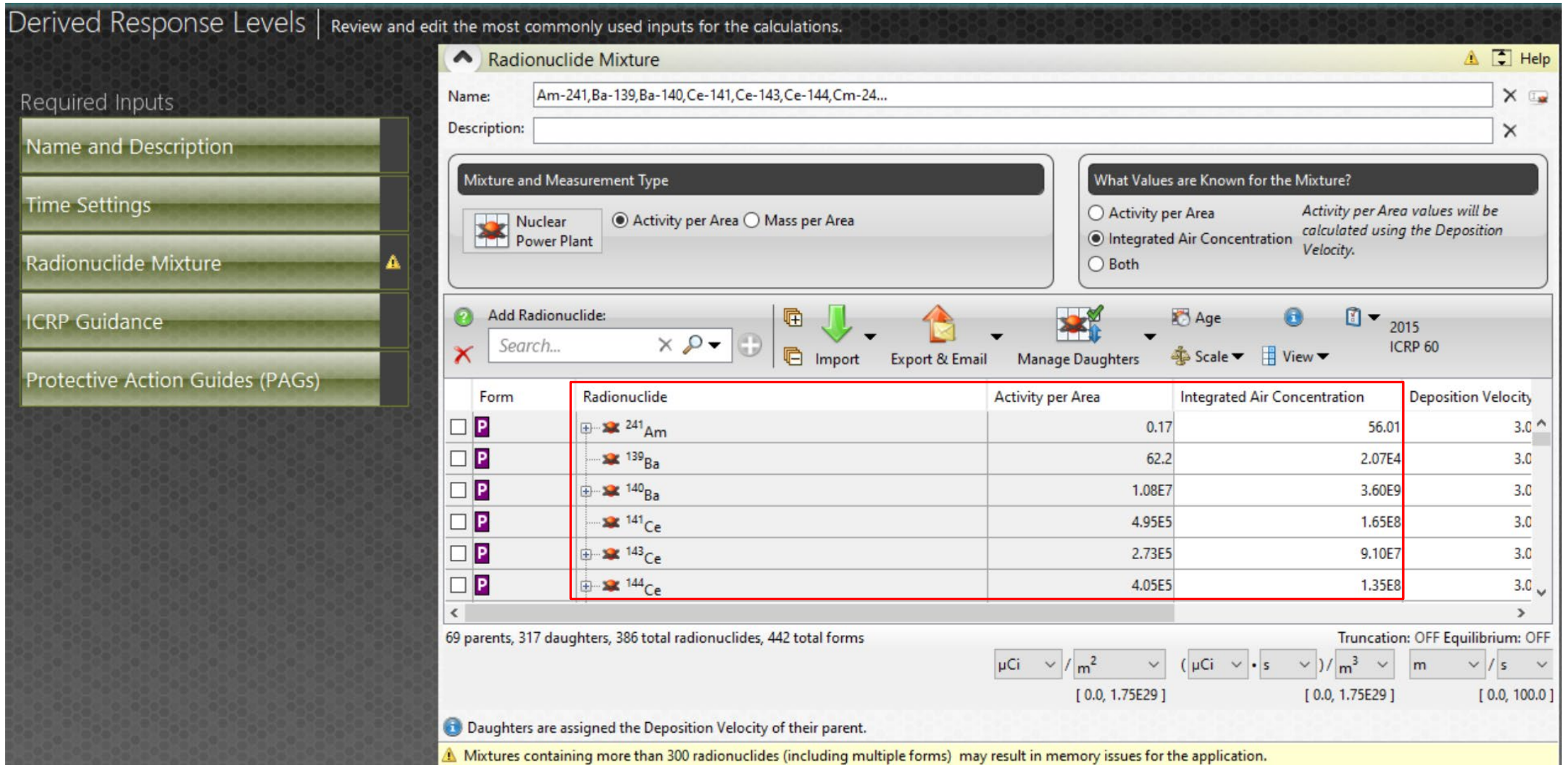
Nuclear Power Plant mixture type

Iodine released from a nuclear power plant under accident conditions is partitioned as follows in order to be consistent with NRC calculations as described in NUREG-1940

Form	Partition	Deposition Velocity (m/s)
Methyl Iodide/Non-reactive Gas (CH_3I)	45%	0
Iodine Vapor/Reactive Gas (I_2)	30%	6.4E-03
Particulate	25%	6.5E-03

Importing a RASCAL Source Term into Turbo FRMAC

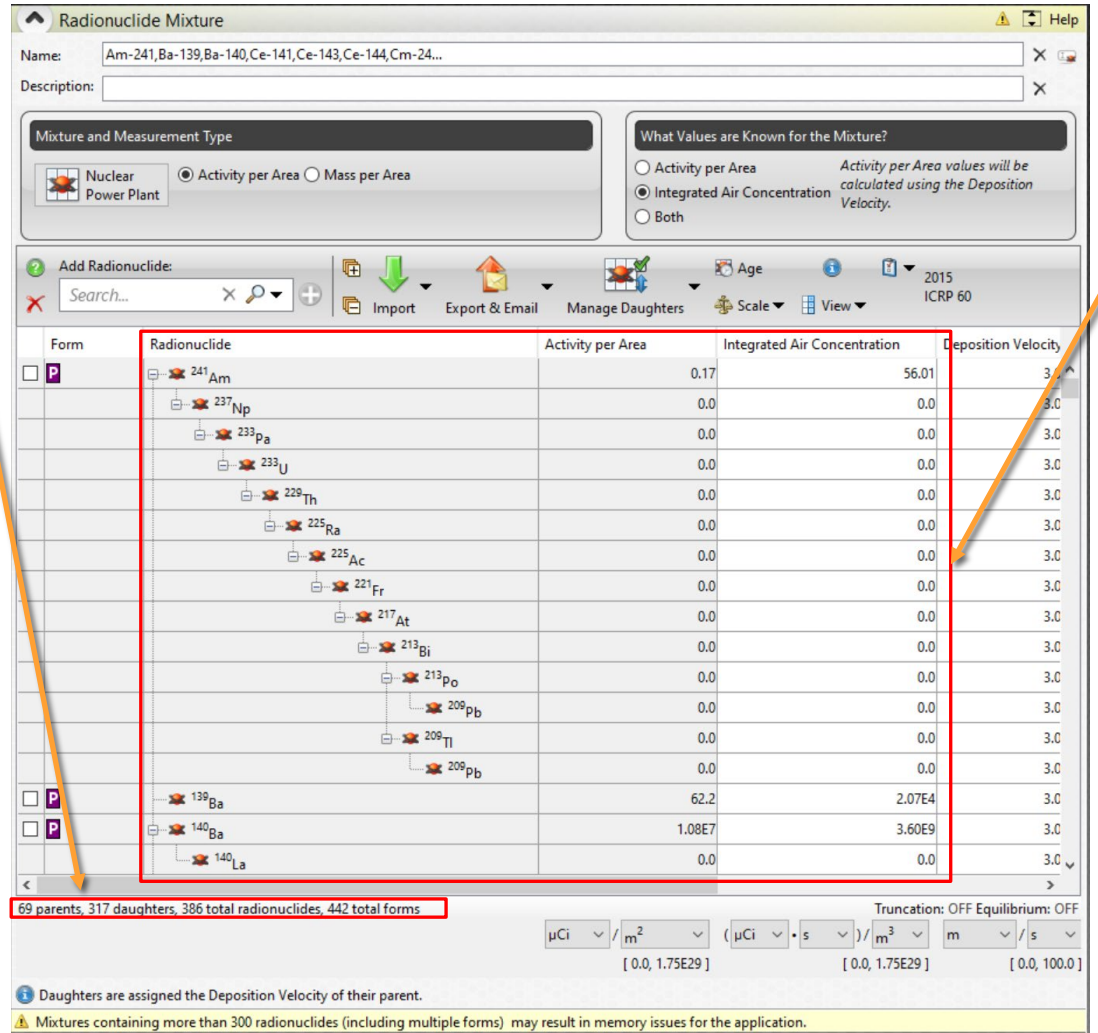
RASCAL source term is populated in TF



Mixture Handling in Turbo FRMAC

Turbo FRMAC automatically generates the full decay chains for the parent radionuclides in a RASCAL mixture. This can expand a mixture of 30 to 60 parent radionuclides in RASCAL to 300+ radionuclides in Turbo FRMAC

RASCAL mixtures are imported with equilibrium turned off, so daughters in the decay chain are populated with zero values



Thank You

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