



# Radiation Protection Computer Code Analysis and Maintenance Program (RAMP) 2020 Fall Users Group Virtual Meeting

## Introduction to Turbo FRMAC Turbo FRMAC Primer



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# What is Turbo FRMAC?

- Turbo FRMAC automates FRMAC Assessment Manual methods
- Turbo FRMAC eliminates most human errors
- Turbo FRMAC is a deployable software application
- Turbo FRMAC is not a replacement for Health Physics knowledge and experience





# Accessing Turbo FRMAC

- Software may be issued to response organizations/individuals with justification
- Registration required via the following site:

<https://nirp.sandia.gov/>

**Sandia National Laboratories** **NUCLEAR INCIDENT RESPONSE PROGRAM** **Sandia National Laboratories**

Home Software Lab Analysis Portal 1.1 Training Contact Us My Profile

Due to new NNSA regulations, we can no longer allow .EXE files (installers) to be downloaded from the website. ZIP files are now provided for all installers, so after downloading the ZIP file, extract the EXE and run the installer.

## Welcome

Login Register

**News and Updates**  
**Latest Software Releases**  
Turbo FRMAC 2019

**Our Mission**  
The NIRP program provides research and technical solutions, expert analysis, and highly trained emergency response



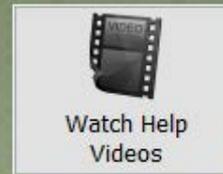
# Turbo FRMAC 2020



New  
Calculation



Open  
Calculation



Watch Help  
Videos



FEMA



Sandia  
National  
Laboratories

### Export Controlled Information (ECI)

Export Administration Regulations  
(EAR99)

Treat this material per Department of  
Commerce Export Administration  
regulations, 15 CFR 732.3.



# 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?'



## 3 Choose Template



### Blank

Create a Calculation using all default inputs.



### Copy from Existing

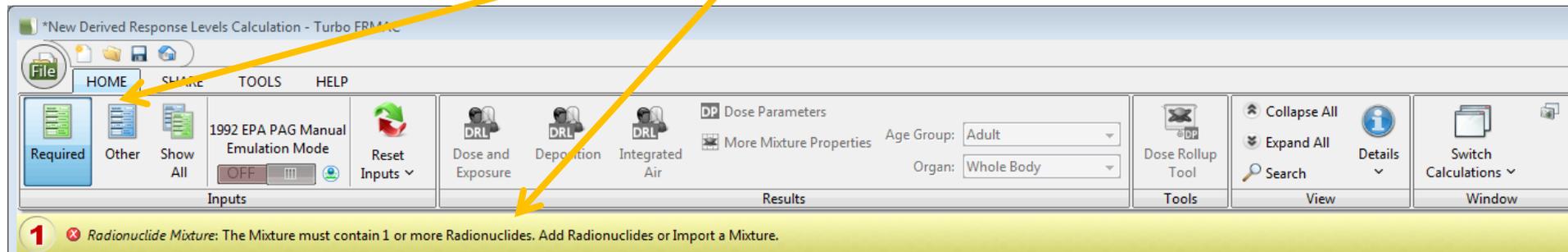
Make a copy of a saved Calculation to get started.



# Turbo FRMAC General Layout

## Ribbons and Tabs

- Controls calculations
- Allows movement to other work options
- Provides any error messages

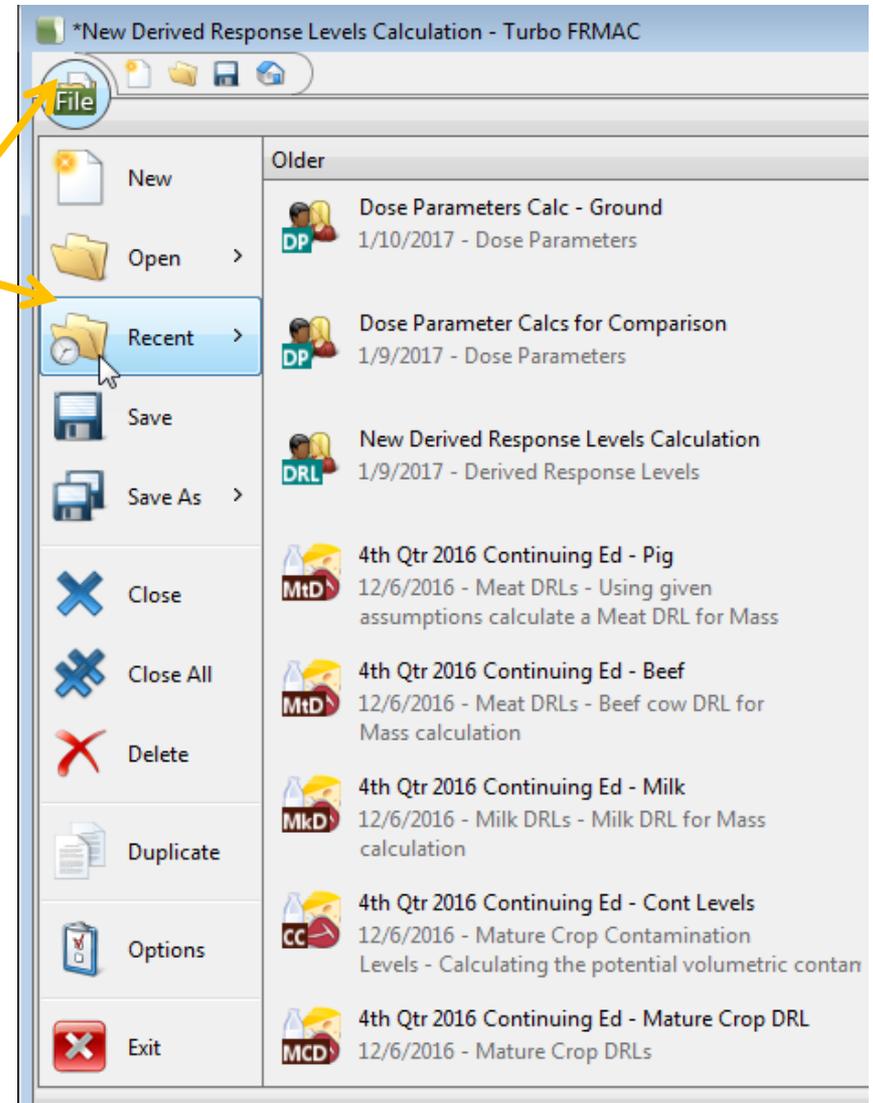




# Turbo FRMAC General Layout

## Drop Down Menu

- Emulates Microsoft layouts
- Provides easy access to many commands

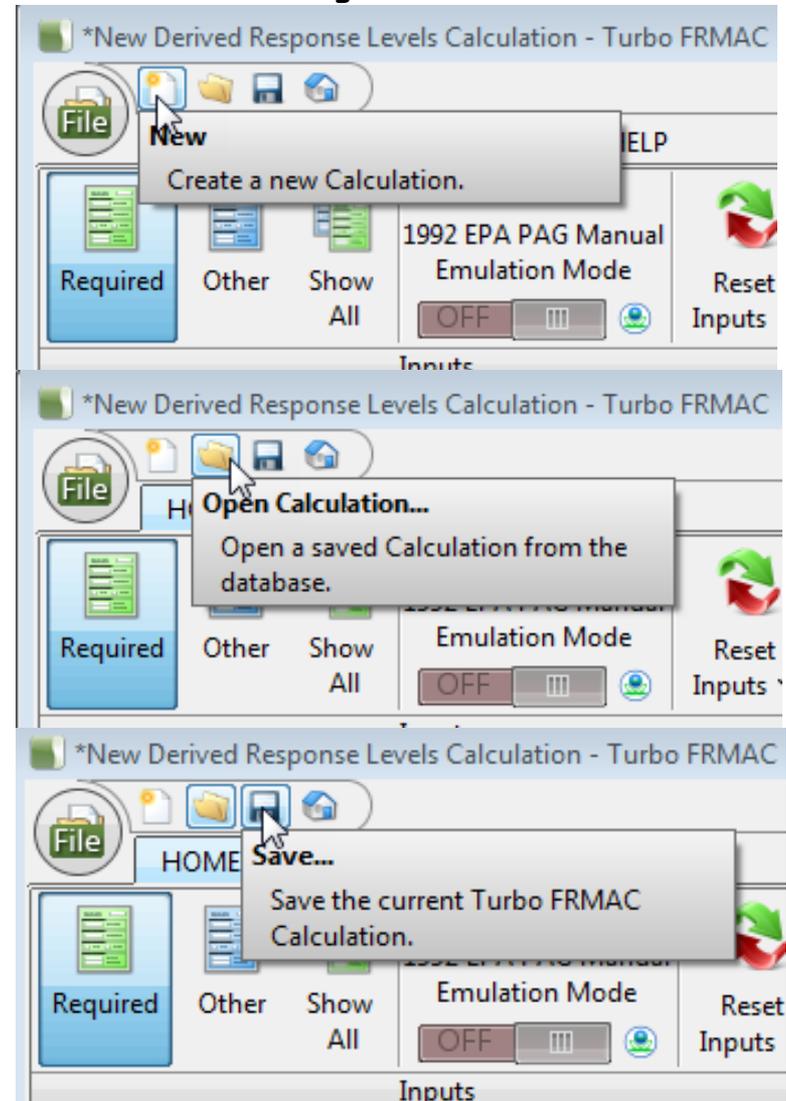
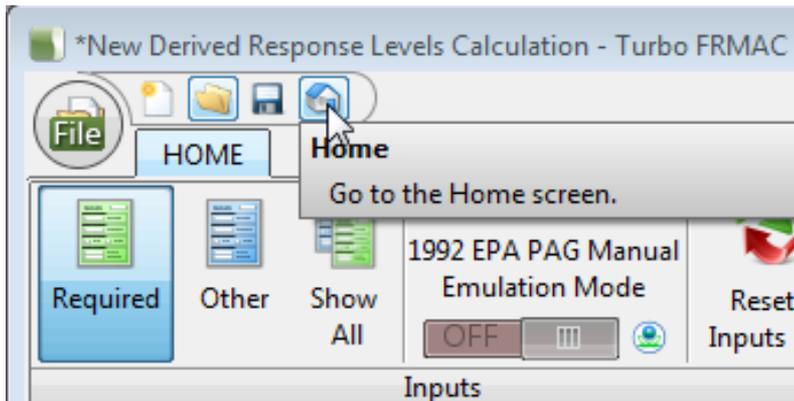




# Turbo FRMAC General Layout

## Quick Access Tool Bar

- Start New Calculation
- Open Existing Calculation
- Save Current Calculation
- Start from Home





# Turbo FRMAC General Layout

- Buttons
  - Required Inputs
  - Other Inputs
- Panels
  - Individual data



# Features → Main Window

All data in panels are viewable and editable

Derived Response Levels | Show all inputs (both Required and Other) that can impact the calculations.

Show All Inputs

- Name and Description
- Time Settings
- Radionuclide Mixture
- ICRP Settings
- Protective Action Guides (PAGs)
- Breathing Rates**
- Constant Factors
- Instrument Thresholds
- Particle Size Distribution
- Protection Factors
- Resuspension Factor
- Weathering Factor

### Breathing Rates

Select Gender: Male

**Inputs**

Activity Time:  Indicates a valid summation of 24 hours

Activity	3 Month Old	1 Year Old	5 Year Old	10 Year Old	15 Year Old	Adult
Sleeping	17.0	14.0	12.0	10.0	10.0	8.50
Sitting	7.00	3.33	4.00	4.67	5.50	5.50
Light Exercise	N/A	6.67	8.00	9.33	7.50	9.75
Heavy Exercise	N/A	N/A	N/A	0.0	1.00	0.250

24.0 hrs  
  24.0 hrs  
  24.0 hrs  
  24.0 hrs  
  24.0 hrs  
  24.0 hrs

Activity Time Units: hr  
[0.0, 24.0]

**Breathing Rates:**

Activity	3 Month Old	1 Year Old	5 Year Old	10 Year Old	15 Year Old	Adult
Sleeping	2.16	3.60	5.76	7.44	10.1	10.8
Sitting	4.56	5.28	7.68	9.16	11.5	13.0
Light Exercise	N/A	8.40	13.7	26.9	33.1	36.0
Heavy Exercise	N/A	N/A	N/A	53.3	70.1	72.0

Breathing Rate Units: m<sup>3</sup> / d  
(0.0, 8.64E2)

**Results**

Activity-Averaged Breathing Rates:

3 Month Old	1 Year Old	5 Year Old	10 Year Old	15 Year Old	Adult
2.86	5.17	8.72	15.3	20.1	22.2

Activity-Averaged Breathing Rate Units: m<sup>3</sup> / d  
(0.0, 8.64E2)



# Features → Main Window

- Clicking the button brings the panel into viewing area
- Panel provides information about the error message

Derived Response Levels | Review and edit the most commonly used inputs for the calculations.

Required Inputs

- Name and Description
- Time Settings
- Radionuclide Mixture**
- ICRP Settings
- Protective Action Guides (PAGs)

Radionuclide Mixture

Name: Unknown

Description:

Type of Measurement

Generic  Activity per Area  Mass per Area

*The Mixture's Physical Form partitioning and Deposition Velocities will be adjusted for the selected Mixture Type.*

Known Mixture Values

What values do you know for the Mixture?

Activity per Area  Integrated Air Concentration  Both

*'Integrated Air Concentration' values will be calculated using the 'Deposition Velocity'.*

Add Radionuclide:

Search... Import Export & Email Fill Age Scale Options

Physical Form	Radionuclide	Activity per Area	Integrated Air Concentration	Deposition Velocity	Particle Size Distribution
---------------	--------------	-------------------	------------------------------	---------------------	----------------------------

0 parents, 0 daughters, 0 total

$\mu\text{Ci} / \text{m}^2$  ( $\mu\text{Ci} \cdot \text{s} / \text{m}^3$ )  $\text{m} / \text{s}$

[ -4.86E303, 4.86E303 ] [ -4.86E303, 4.86E303 ] [ -∞, ∞ ]

**The Mixture must contain 1 or more Radionuclides. Add Radionuclides or Import a Mixture.**



# Features → Main Window

- Lets preview a few of the more important Panels
- Begin with the Time Settings Panel

Derived Response Levels | Review and edit the most commonly used inputs for the calculations.

Required Inputs

- Name and Description
- Time Settings**
- Radionuclide Mixture
- ICRP Guidance
- Protective Action Guides (PAGs)

### Time Settings

Release Date & Time: 10/19/2020 12:47 CST/MDT (UTC-06:00)

Date/Time Mode:  Date & Time  Time After Release

+ Add - Delete... Reset

Time Phase	Start Time	Duration	End Time	Evaluation Time	Plume Inhalation	Plume Submersion	Resuspension Inhalation	Groundshine
Early Phase (TD)	0.0	96.0	96.0	12.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Early Phase (AD)	12.0	96.0	1.08E2	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
First Year	12.0	8.76E3	8.77E3	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Second Year	8.76E3	8.76E3	1.75E4	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fifty Year	12.0	4.38E5	4.38E5	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

hr hr hr hr  
[ 0.0, 8.77E5 ] [ 1.67E-2, 8.77E5 ] [ 0.0, 8.77E5 ]



# Features → Main Window

- 5 Time Phases are pre-populated (Time Phases can be added/deleted)
- Each Time Phase has exposure pathways assigned

**Time Settings** Help

Release Date & Time:    ▼

Date/Time Mode:  Date & Time  Time After Release

+ Add ✗ Delete... ↺ Reset

Time Phase	Start Time	Duration	End Time	Evaluation Time	Plume Inhalation	Plume Submersion	Resuspension Inhalation	Groundshine
Early Phase (TD)	0.0	96.0	96.0	12.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Early Phase (AD)	12.0	96.0	1.08E2	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
First Year	12.0	8.76E3	8.77E3	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Second Year	8.76E3	8.76E3	1.75E4	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fifty Year	12.0	4.38E5	4.38E5	12.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

▼
 ▼
 ▼
 ▼

[ 0.0, 8.77E5 ] [ 1.67E-2, 8.77E5 ] [ 0.0, 8.77E5 ]



# Features → Main Window

The Radionuclide Mixture Panel provides the user with multiple options

Derived Response Levels | Review and edit the most commonly used inputs for the calculations.

Required Inputs

- Name and Description
- Time Settings
- Radionuclide Mixture**
- ICRP Guidance
- Protective Action Guides (PAGs)

### Radionuclide Mixture

Name: Unknown

Description:

Mixture and Measurement Type

Generic  Activity per Area  Mass per Area

What Values are Known for the Mixture?

Activity per Area *Integrated Air Concentration values will be calculated using the Deposition Velocity.*

Integrated Air Concentration

Both

Add Radionuclide:

Searching Search All Radionuclides

- Ac-223
- Ac-224
- Ac-225
- Ac-226
- Ac-227
- Ac-228
- Ac-230
- Ac-231
- Ac-232
- Ac-233

Import Export & Email Manage Daughters Scale View 2015 ICRP 60

per Area Integrated Air Concentration Deposition Velocity Particle Size Distribution

total forms Truncation: ON Equilibrium: ON

$\mu\text{Ci} / \text{m}^2$  ( $\mu\text{Ci} \cdot \text{s}$ ) /  $\text{m}^3$  m / s

city of their parent.

The Mixture must contain 1 or more Radionuclides. Add Radionuclides or Import a Mixture.



# Features → Main Window

Clicking on the “Generic” button allows the user to select the type of mixture to use

Most commonly used inputs for the calculations.

Radionuclide Mixture

Name: Unknown

Description:

Mixture and Measurement Type

Generic  Activity per Area  Mass per Area

What V

Act  Inte  Bot

Add Radionuclide:

Search... Import Export & Email Ma

Form	Radionucli...	Activity per Area	Integrated Air Concentrat

parents, 0 daughters, 0 total radionuclides, 0 total forms

$\mu\text{Ci}$  /  $\text{m}^2$  ( $\mu\text{Ci}$  • s)

Mixture and Measurement Type

Mixture Properties

Specify the Type of Measurement and the Mixture Type.

Generic  Activity per Area  Mass per Area

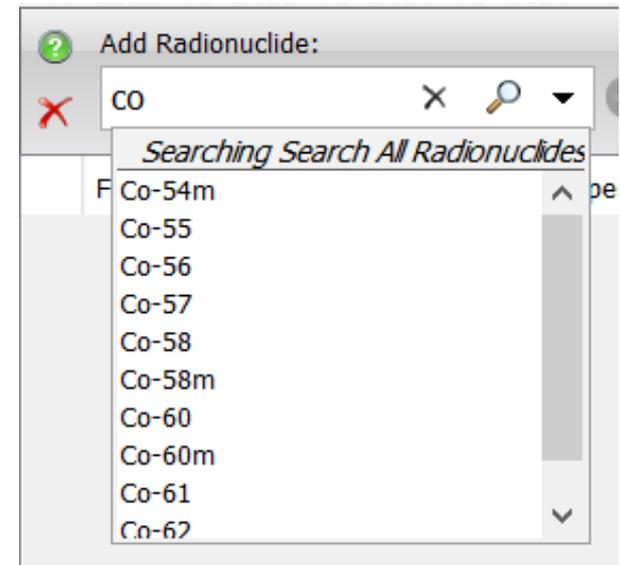
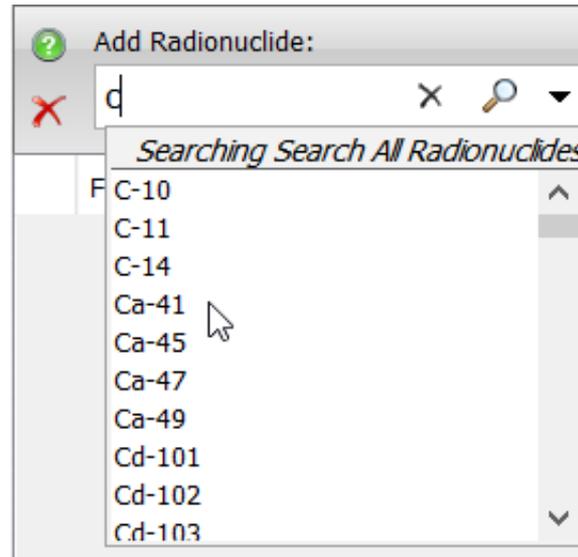
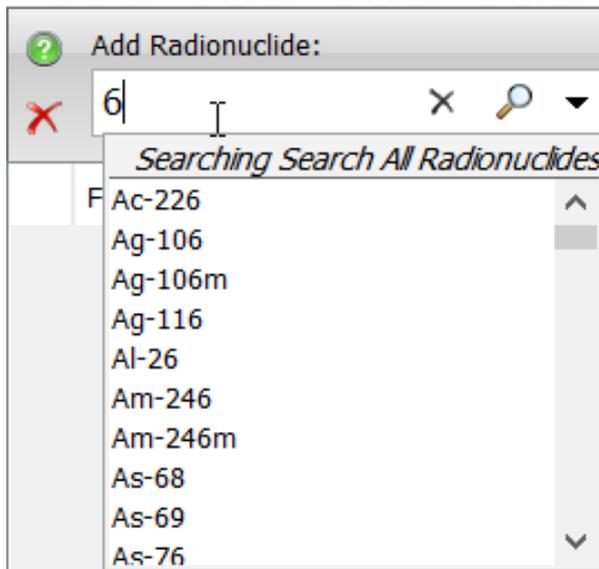
- Generic
- Uranium Enriched
- Plutonium
- Nuclear Power Plant
- Nuclear Weapon
- Aged Fission Product
- Radiological Thermal Generator
- Nuclear Detonation
- Nuclear Power Plant Coolant**
- Criticality Accident
- Nuclear Power Plant Monitored Mixture



# Features → Main Window

The software allows the user to search for a radionuclide in multiple ways

- Using a number
- Using the just first letter of the name
- Using the radionuclide symbol





# Features → Main Window

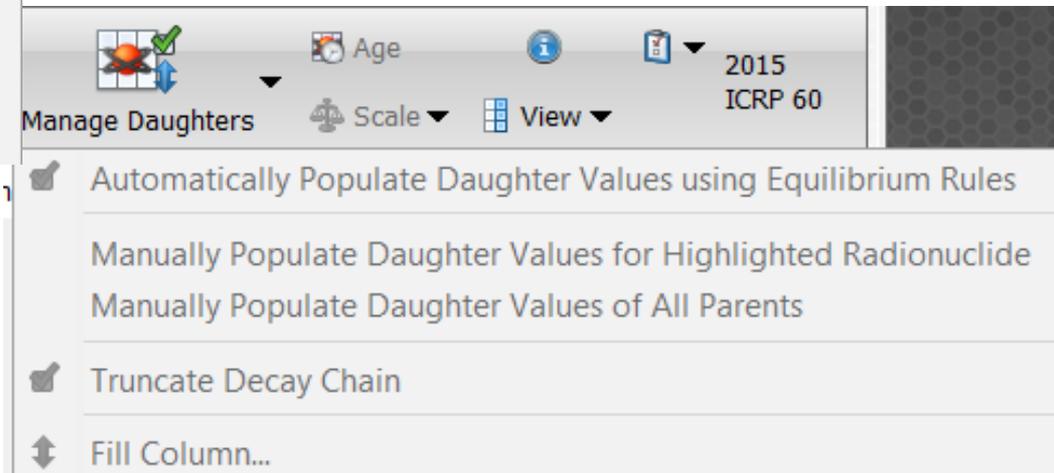
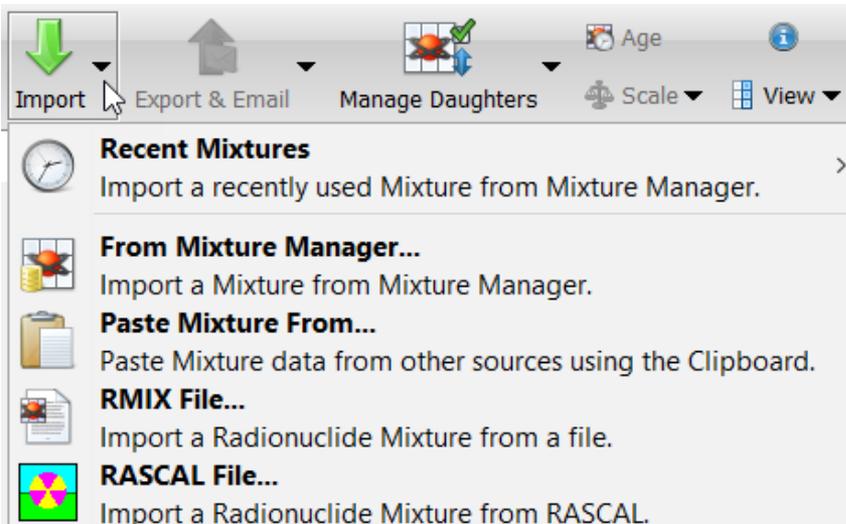
The Radionuclide Panel provides several other options to manage the mixture

The screenshot displays two configuration panels and a toolbar. The left panel, titled "Mixture and Measurement Type", includes a "Generic" button with a grid icon and two radio buttons: "Activity per Area" (selected) and "Mass per Area". The right panel, titled "What Values are Known for the Mixture?", includes three radio buttons: "Activity per Area" (selected), "Integrated Air Concentration", and "Both". A note next to the "Integrated Air Concentration" option states: "Integrated Air Concentration values will be calculated using the Deposition Velocity." The toolbar at the bottom features an "Add Radionuclide:" section with a search box, and buttons for "Import", "Export & Email", "Manage Daughters", "Age", "Scale", and "View". The version "2015 ICRP 60" is displayed in the bottom right corner.



# Features → Main Window

Most used are the Import and Manage Daughters drop downs





# Features → Main Window

Several other calculation factors are available for viewing and editing

Relative Biological Effectiveness

Breathing Rates

Building Protection Factors

Exposure to Dose Factors

ICRP and Lung Clearance

Instrument Thresholds

Occupancy Factors

Particle Size Distribution

Resuspension

Weathering Correction



# Features → Main Window

Once required data is provided, error message is removed and calculation buttons are “active”

Derived Response Levels | Review and edit the most commonly used inputs for the calculations.

Required Inputs

- Name and Description
- Time Settings
- Radionuclide Mixture
- ICRP Settings
- Protective Action Guides (PAGs)

Radionuclide Mixture

Name: Cs-137

Description:

Type of Measurement

Generic  Activity per Area  Mass per Area

Known Mixture Values

What values do you know for the Mixture?

Activity per Area  Integrated Air Concentration  Both

'Integrated Air Concentration' values will be calculated using the 'Deposition Velocity'.

Add Radionuclide: Search... Import Export & Email Fill Age Scale

Physical Form	Radionuclide	Activity per Area	Integrated Air Concentration	Deposition Velocity	Particle Size Distribution
P	<sup>137</sup> Cs	1.00E-2	3.33	3.00E-3	Mono 100%
	<sup>137m</sup> Ba	9.46E-3	3.15	3.00E-3	Mono 100%

1 parent, 1 daughter, 2 total

$\mu\text{Ci} / \text{m}^2$   $(\mu\text{Ci} \cdot \text{s}) / \text{m}^3$  m s

[0.0, 1.74E29] [0.0, 1.74E29] [0.0, 100]



# Features → Results

Calculation completed for all radionuclides and for all age groups

\*New Derived Response Levels Calculation - Turbo FRMAC

File HOME SHARE TOOLS HELP

Required Other Show All 1992 EPA PAG Manual Emulation Mode OFF Reset Inputs

Dose and Exposure DRL Deposition DRL Integrated Air DRL Dose Parameters Age Group: Adult Organ: Adult

Collapse All Expand All Search Details Switch Calculations

Derived Response Levels | View the calculated results for the Alpha, Beta, and Radionuclide-specific Deposition Results

Deposition Results

- Alpha DRLs
- Beta DRLs
- Radionuclide-Specific DRLs

**Alpha DRLs**

Whole Body values are displayed for **Adult** for a **Chronic** Commitment Period.

Early Phase	First Year	Second Year	Fifty Year	User Defined
N/A	N/A	N/A	N/A	N/A

Alpha Units:  $\mu\text{Ci}_{\text{alpha}}$  /  $\text{m}^2$

**Beta DRLs**

Whole Body values are displayed for **Adult** for a **Chronic** Commitment Period.

Early Phase	First Year	Second Year	Fifty Year	User Defined
1.46E3	41.6	12.5	6.57	1.72E4

Beta Units:  $\mu\text{Ci}_{\text{beta}}$  /  $\text{m}^2$

**Radionuclide-Specific DRLs**

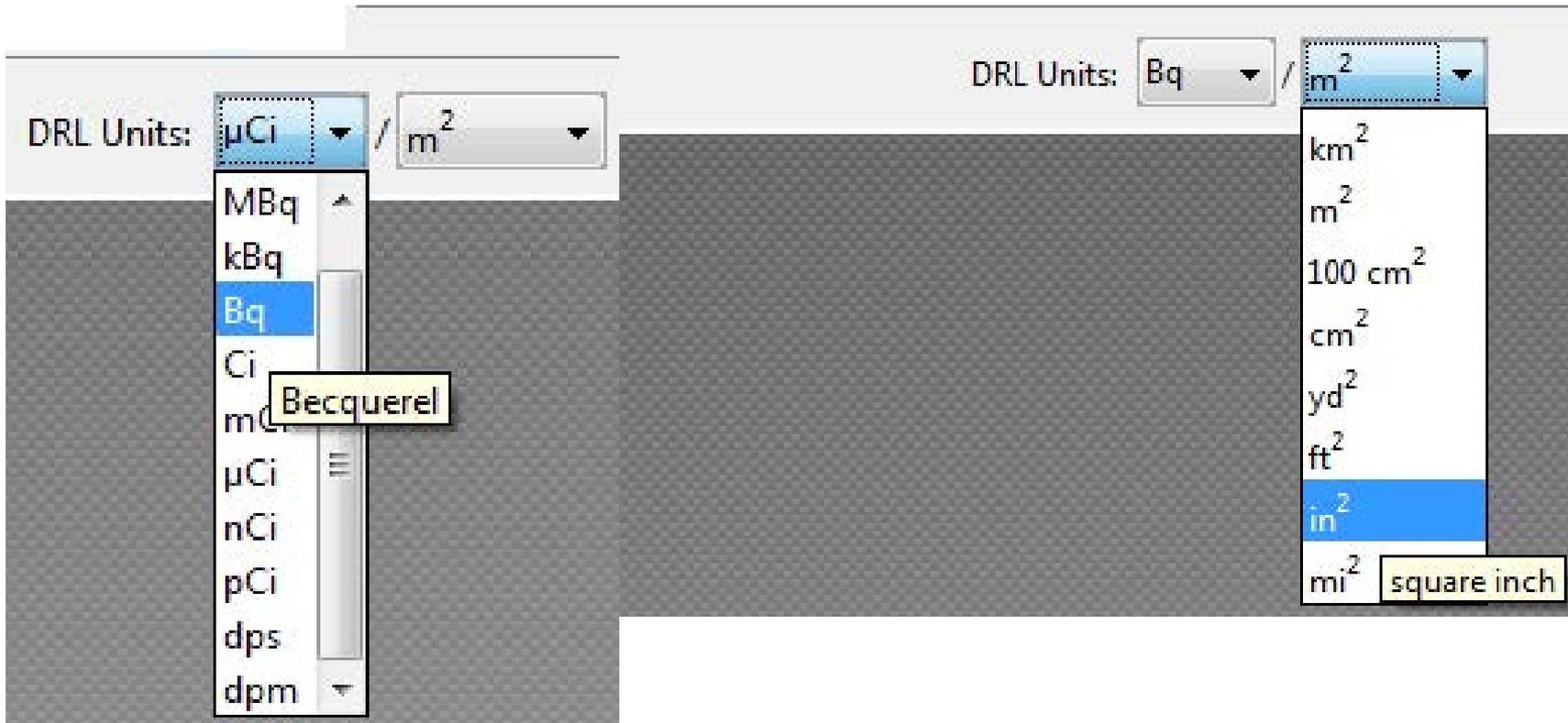
Whole Body values are displayed for **Adult** for a **Chronic** Commitment Period.

Radionuclide	Physical Form	Early Phase	First Year	Second Year	Fifty Year	User Defined
$^{137\text{m}}\text{Ba}$	P	1.38E3	39.4	11.8	6.22	1.62E4
$^{137}\text{Cs}$	P	1.46E3	41.6	12.5	6.57	1.72E4



# Features → Results

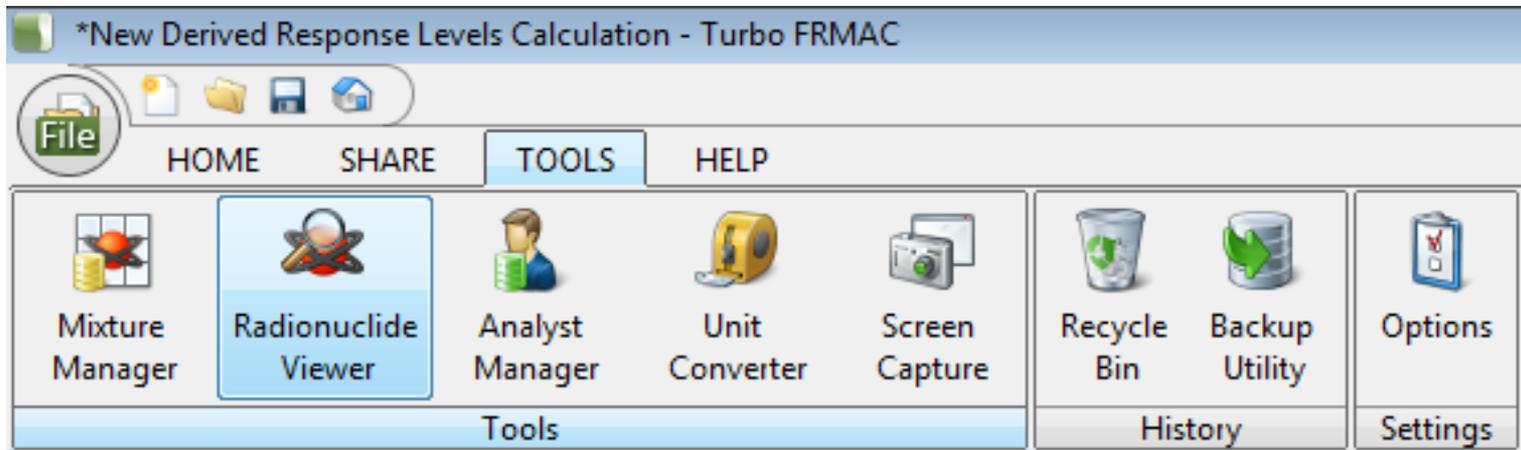
Units can be converted as needed





# Radionuclide Viewer

- Displays Full Radionuclide Decay Chain
- Displays basic nuclide data
  - Half Life
  - Decay mode
- Provides access to Dose Coefficients for each nuclide





# Radionuclide Viewer

Radionuclide Viewer

File Tools Help

## Radionuclide Viewer

View the decay chain, dose coefficients, and other properties of Radionuclides.

**Radionuclides**

View Options

ICRP Guidance:

Age:

Commitment Period:

Instrument Threshold:

Select Radionuclide

Filter:

Search:

- Cs-125
- Cs-126
- Cs-127
- Cs-128
- Cs-129
- Cs-130
- Cs-131
- Cs-132
- Cs-134
- Cs-134m
- Cs-135
- Cs-135m
- Cs-136
- Cs-137**
- Cs-138

Decay Properties: Cs-137

Columns Show Legends

Radionuclide	Half-Life	Decay Mode	Decay Constant	Branch Factor	Specific Activity	Fire Release Fraction	Total Emitted Alpha Energy	Total Emitted Beta Energy	Total Emitted Photon Energy
$^{137}\text{Cs}$	1.10E4 B-		6.33E-5	N/A	8.71E10	1.00E-2	0.0	1.87E2	0.0
$^{137\text{m}}\text{Ba}$	1.77E-3 IT		3.91E2	0.946	5.38E17	1.00E-2	0.0	65.1	0.596

**Dose Coefficients**

**Cs-137 Stochastic Inhalation Dose Coefficients**

**Dose Coefficients**

- External
  - Surface
  - 1 cm Soil Depth
  - 5 cm Soil Depth
  - 15 cm Soil Depth
  - Infinite Soil Depth
  - Air Submersion
  - Water Immersion
- Inhalation**
- Ingestion

**Inhalation**

Organ	Dose Coefficient
Adrenal	17.6
Bone Surface	17.3
Brain	14.8
Breasts	14.1
Kidneys	16.9
Liver	17.1
Lower Large Intestine	20.9
Lung	16.0
Muscle	15.8
Ovaries	18.0
Pancreas	18.1
Red Marrow	16.5
Skin	13.5
Small Intestine	17.6
Spleen	16.9
Stomach	16.5
Testes	15.8
Committed Effective Dose	17.3

ICRP Guidance: ICRP 60  
 Age: Adult  
 Commitment Period: Chronic

View Particle Sizes for:

Compound Distribution

Vapor or Gas

Compound Distribution

Distribution Summary:  
 1 Monodispersed

**Lung Clearance Type**

Maximum

**Fast (F) - ICRP Recommended**

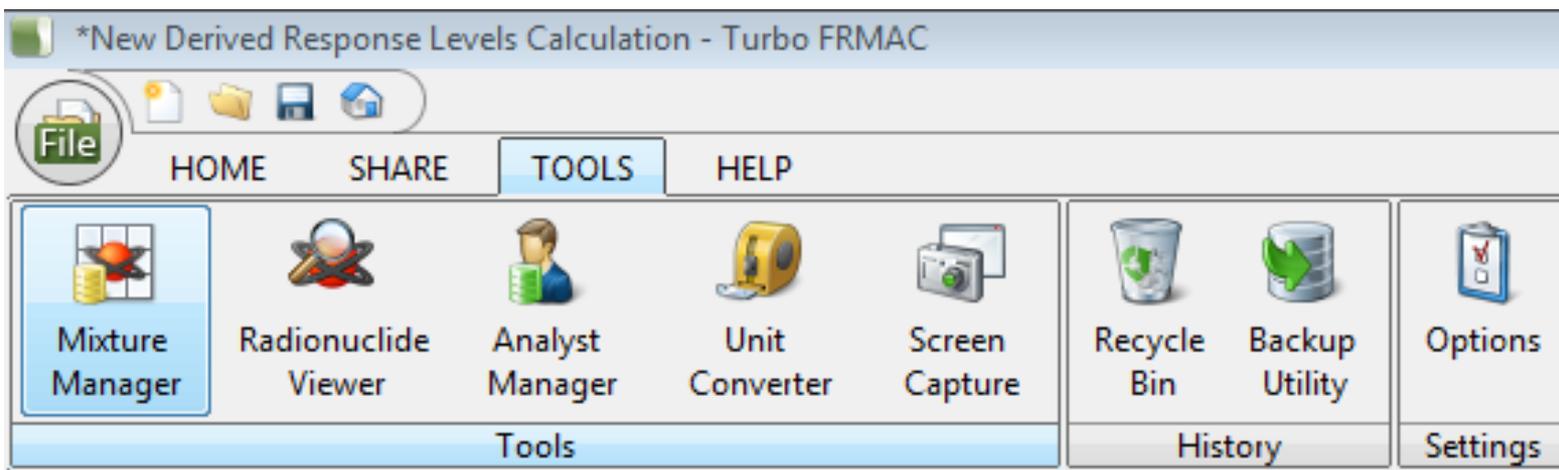
Medium (M)

Slow (S)



# Radionuclide Mixture Manager

- Allows User to Create/Save/Export/Import Custom Mixtures
- User may select Pre-determined Mixtures





# Radionuclide Mixture Manager

Mixture Manager

Home Share Tools Online Build 163

**Create**  
New Mixture, New Uranium Enriched Mixture, New Folder

**Mixture**  
Edit, Rename, Delete, Duplicate, Move, Age Mixture, Details

**Folder**  
Rename, Delete, Select

**Report**  
Generate Report

Radionuclide Mixtures

- Aged Fission Product
- Nuclear Detonation
- Nuclear Power Plant**
- Nuclear Weapon
- Other
- Plutonium
- Radiological Thermal Generator
- Uranium Enriched

**Nuclear Power Plant** | Click below to view a Mixture in the 'Nuclear Power Plant' folder.

- [Accident 1 hour\(s\) After](#)
- [Accident 12 hour\(s\) After](#)
- [Accident 15 day\(s\) After](#)
- [Accident 24 hour\(s\) After](#)
- [Accident 3 day\(s\) After](#)
- [Accident 30 day\(s\) After](#)
- [Accident 6 hour\(s\) After](#)
- [Accident 7 day\(s\) After](#)
- [Risks At Time of Accident](#)



# Turbo FRMAC System Requirements

- Turbo FRMAC has been designed for Windows 10 and is compatible with Windows Vista, 7 and 8
- 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 30 GB Free Disk Space
  - Recommended: 50 GB Free or higher
- 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)



# Questions?

Questions?