



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

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

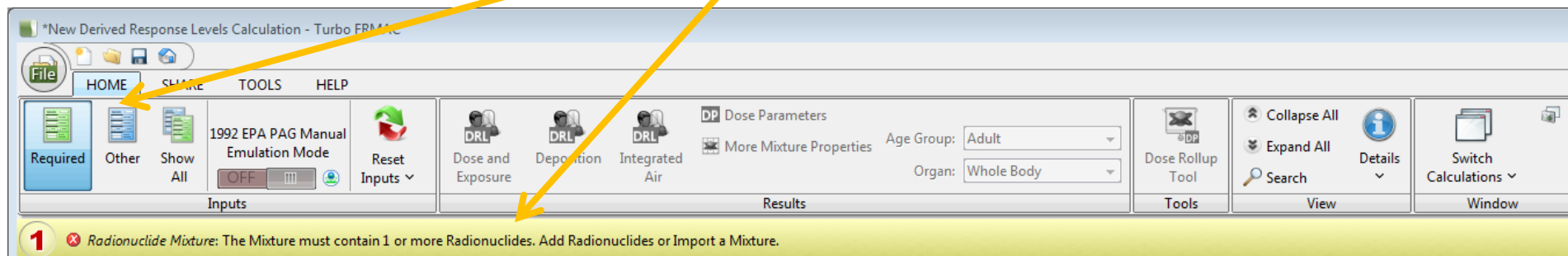
Make a copy of a saved Calculation to get started.



Turbo FRMAC General Layout

Ribbons and Tabs

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

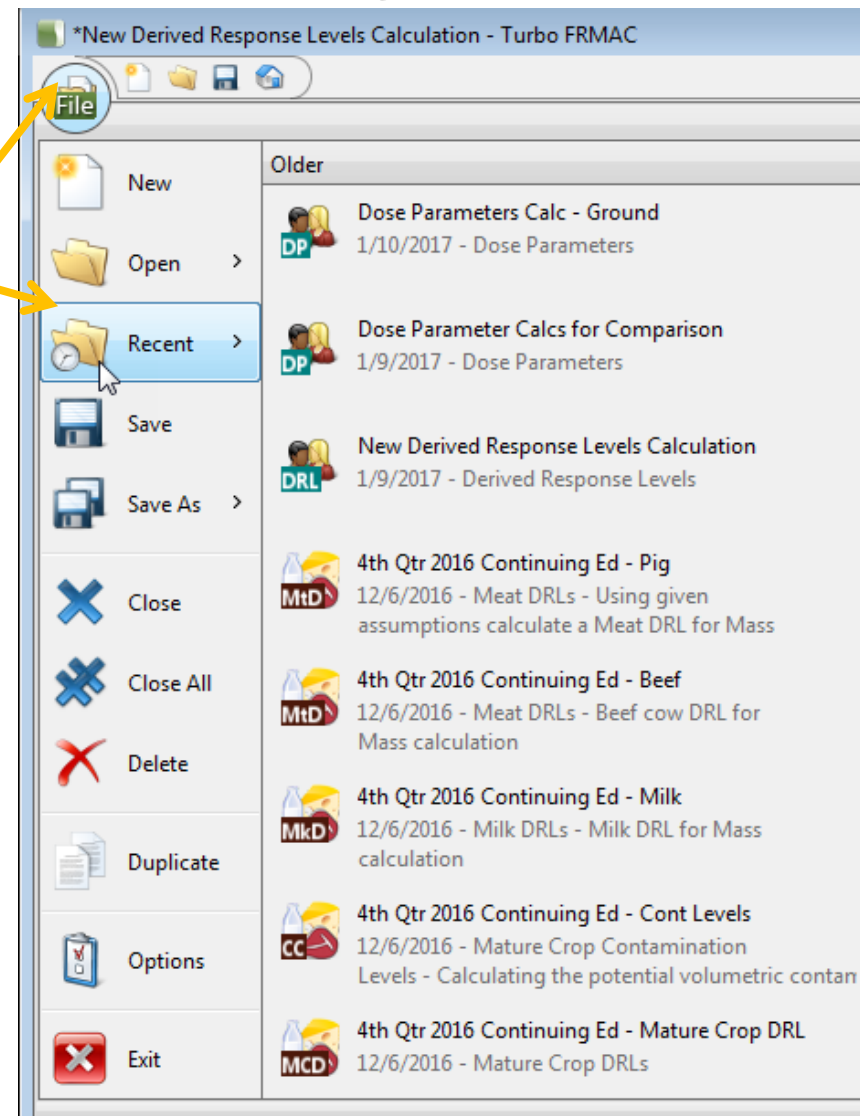




Turbo FRMAC General Layout

Drop Down Menu

- Emulates Microsoft layouts
- Provides easy access to many commands

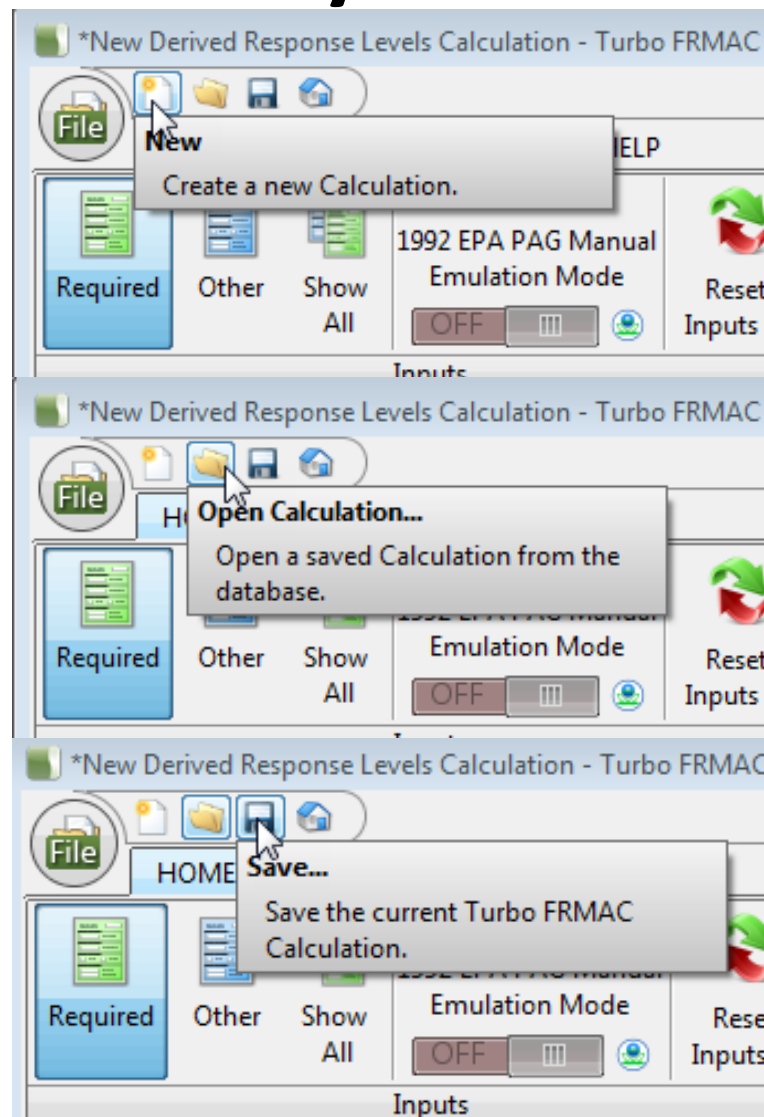
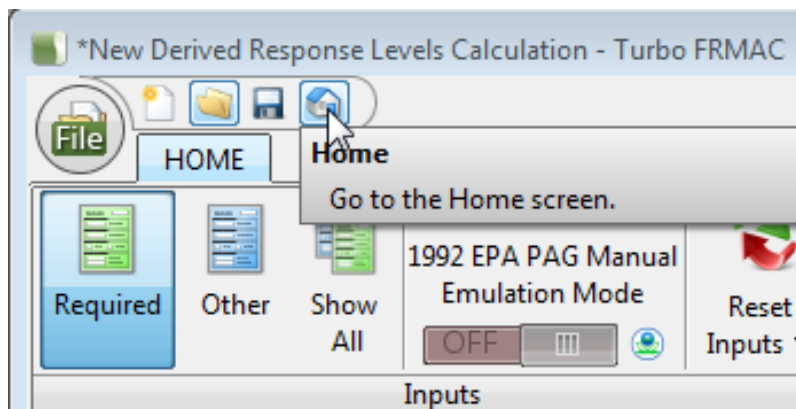




Turbo FRMAC General Layout

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

The screenshot displays the Turbo FRMAC software interface. The main window is titled "New Derived Response Levels Calculation - Turbo FRMAC". It features a menu bar with "File", "HOME", "SHARE", "TOOLS", and "HELP". Below the menu bar is a toolbar with icons for "Required", "Other", "Show All", "1992 EPA PAG Manual Emulation Mode", "Reset Inputs", "Dose and Exposure", "Deposition", "Integrated Air", "Dose Parameters", "Age Group", "Organ", "Dose Rollup Tool", "Collapse All", "Expand All", "Search", "Details", "Switch Calculations", and "Window".

The main content area is divided into two sections. The top section, "Derived Response Levels", contains a message: "Radionuclide Mixture: The Mixture must contain 1 or more Radionuclides. Add Radionuclides or Import a Mixture." Below this is a tabbed interface with the following tabs: "Name and Description", "Time Settings", "Radionuclide Mixture" (which is currently selected), "ICRP Settings", and "Protective Action Guides (PAGs)".

The "Radionuclide Mixture" panel includes a "Name" field (set to "Unknown") and a "Description" field. It also has a "Type of Measurement" section with a "Generic" dropdown and radio buttons for "Activity per Area" (selected) and "Mass per Area". A note states: "The Mixture's Physical Form partitioning and Deposition Velocities will be adjusted for the selected Mixture Type." To the right, there is a "Known Mixture Values" section with the question "What values do you know for the Mixture?" and radio buttons for "Activity per Area" (selected), "Integrated Air Concentration", and "Both". A note below these states: "'Integrated Air Concentration' values will be calculated using the 'Deposition Velocity'."

Below the "Type of Measurement" section is an "Add Radionuclide" section with a search bar and buttons for "Import", "Export & Email", "Fill", and "Scale". At the bottom, there are tabs for "Physical Form", "Radionuclide", "Activity per Area", "Integrated Air Concentration", "Deposition Velocity", and "Particle Size Distribution". The "Radionuclide" tab is currently selected, showing a table with columns for "Radionuclide", "Activity per Area", "Integrated Air Concentration", "Deposition Velocity", and "Particle Size Distribution". The table is currently empty, showing "0 parents, 0 daughters, 0 total".

At the bottom of the panel, there are units for "Activity per Area" ($\mu\text{Ci} / \text{m}^2$), "Integrated Air Concentration" ($(\mu\text{Ci} \cdot \text{s}) / \text{m}^3$), and "Deposition Velocity" (m / s). The ranges for these units are: $[-4.86\text{E}303, 4.86\text{E}303]$, $[-4.86\text{E}303, 4.86\text{E}303]$, and $[-\infty, \infty]$ respectively.

A red error message at the bottom of the panel states: "The Mixture must contain 1 or more Radionuclides. Add Radionuclides or Import a Mixture."



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

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: **m³** / **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: **m³** / **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

☒ 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

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

0 parents, 0 daughters, 0 total

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

☒ 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

Age

Scale

View

2015 ICRP 60

per Area

Integrated Air Concentration

Deposition Velocity

Particle Size Distribution

total forms

$\mu\text{Ci} / \text{m}^2$

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

m / s

Truncation: ON Equilibrium: ON

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

Add Radionuclide:

Search...    Import  Export & Email  Ma

Form	Radionucli...	Activity per Area	Integrated Air Concentrat


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

μCi / m^2 (μCi • s

Mixture and Measurement Type

Mixture Properties

Specify the Type of Measurement and the Mixture Type.

 Generic ☒ Activity per Area ☐ Mass per Area

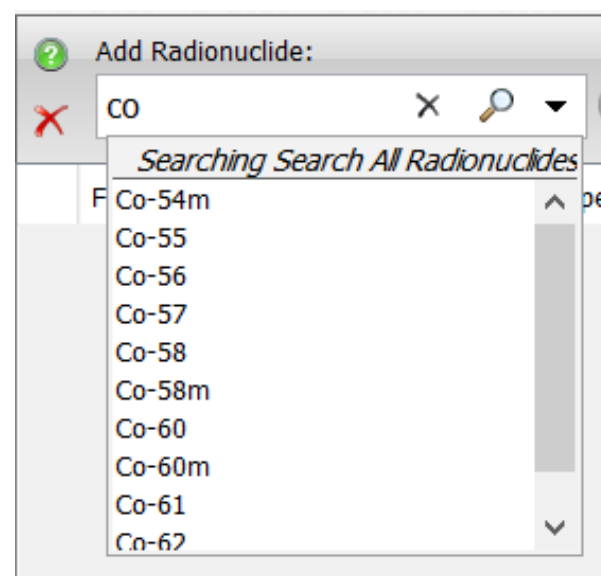
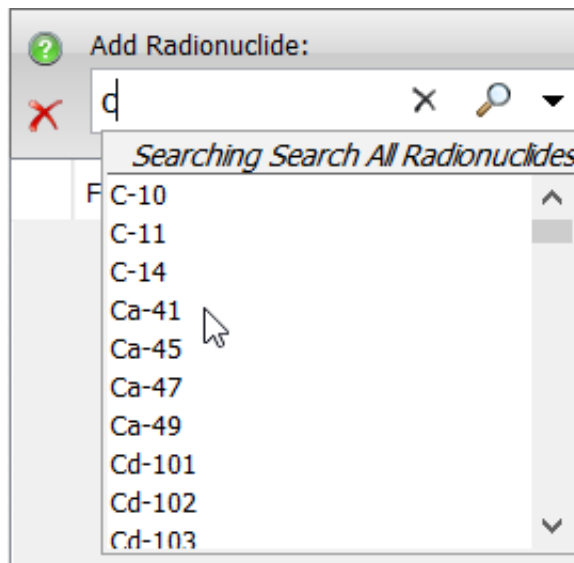
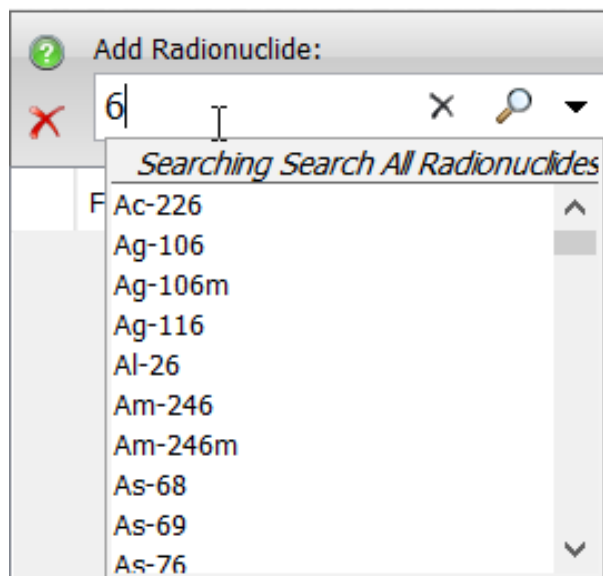
- Generic
- Uranium Enriched
- Plutonium
- Nuclear Power Plant
- Nuclear Weapon
- Aged Fission Product
- Radiological Thermal Generator
- Nuclear Detonation
- Nuclear Power Plant Coolant**
- Criticality Accident
- Nuclear Power Plant Monitored Mixture



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

Mixture and Measurement Type

 Generic

☒ Activity per Area
☐ Mass per Area

What Values are Known 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

 Manage Daughters

 Age

 Scale

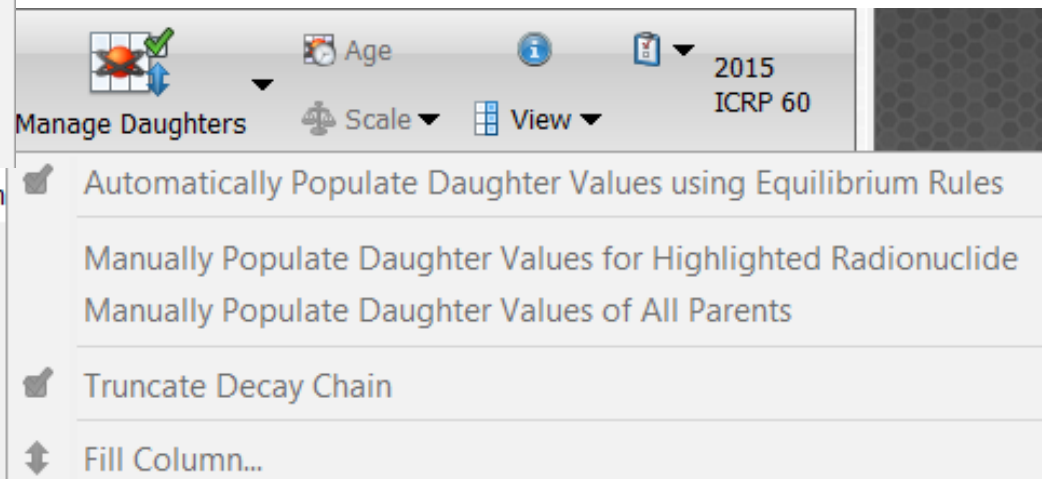
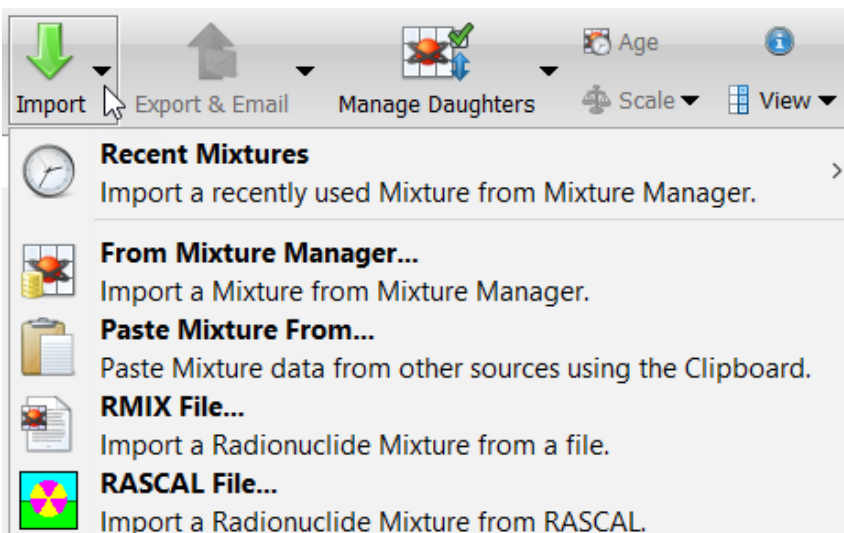
 View

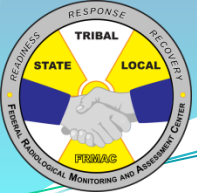
2015 ICRP 60



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

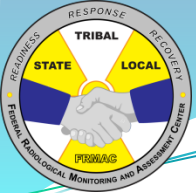
Instrument Thresholds

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

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

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

1 parent, 1 daughter, 2 total

μCi / m² (μCi · s) / m³ 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 ON Reset Inputs

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

Dose Rollup Tool Collapse All Expand All Search Details Switch Calculations

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

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

Radionuclide-Specific DRLs

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

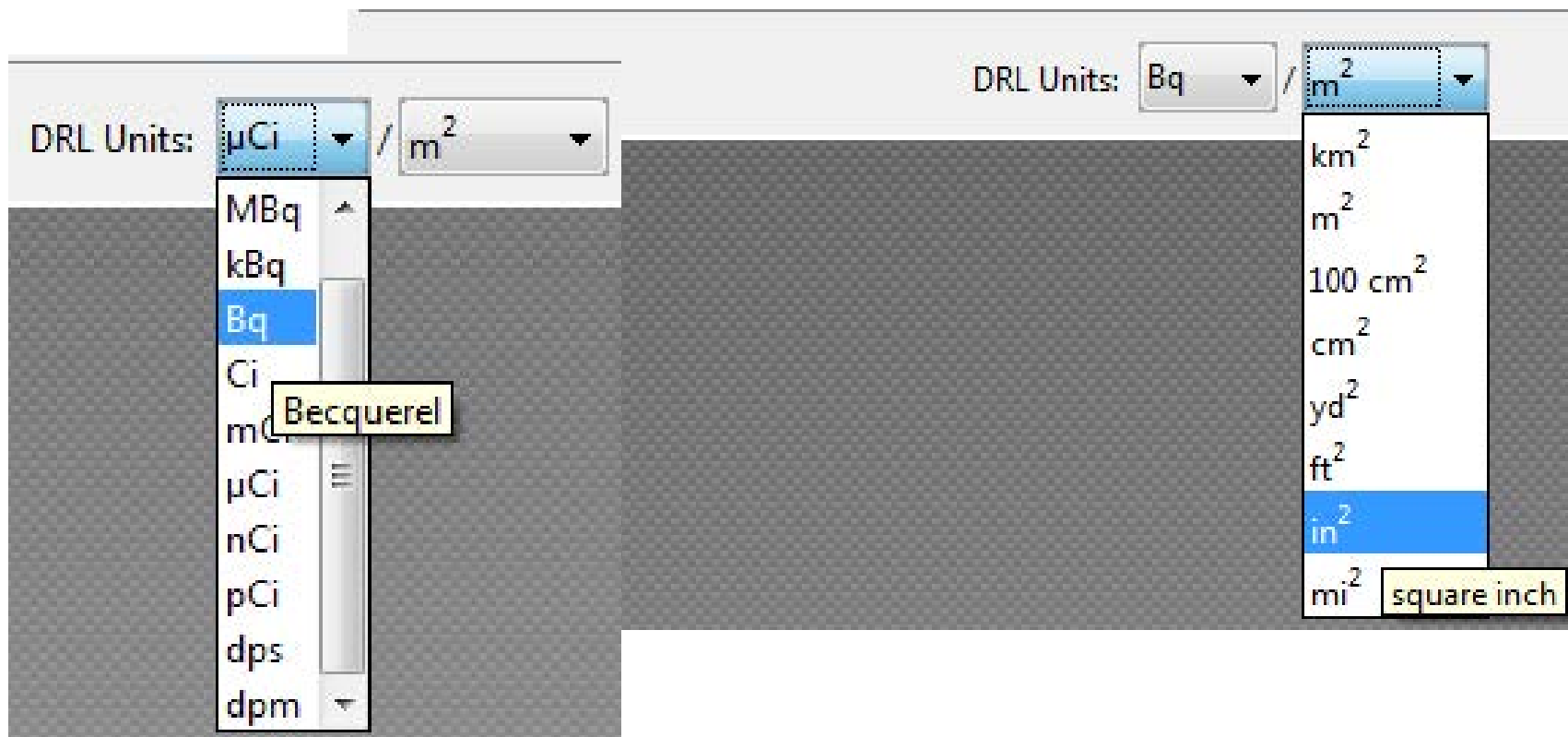
Radionuclide	Physical Form	Early Phase	First Year	Second Year	Fifty Year	User Defined
$^{137\text{m}}\text{Ba}$	P	1.38E3	39.4	11.8	6.22	1.62E4
^{137}Cs	P	1.46E3	41.6	12.5	6.57	1.72E4

12/11/2020



Features → Results

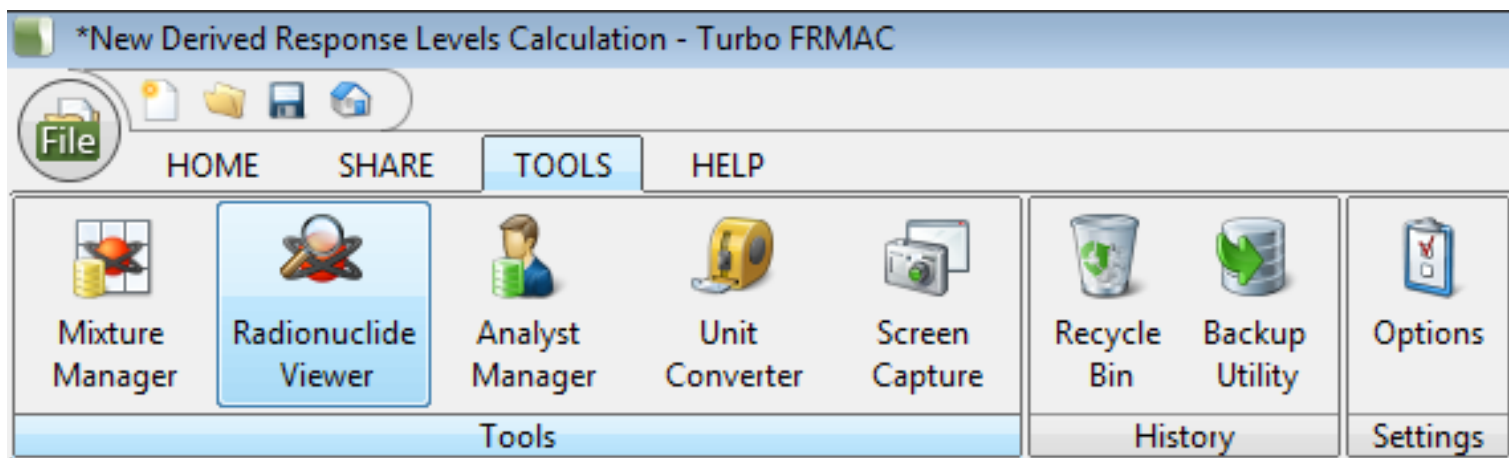
Units can be converted as needed





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: ICRP 60...

Age: Adult

Commitment Period: Chronic

Instrument Threshold: 70 keV...

Select Radionuclide

Filter: Show All

Search: cs

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 Cs	1.10E4 B-		6.33E-5	N/A	8.71E10	1.00E-2	0.0	1.87E2	0.0
^{137m} Ba	1.77E-3 IT		3.91E2	0.946	5.38E17	1.00E-2	0.0	65.1	0.596

d

d⁻¹

Fraction

μCi

kg

Fraction

MeV

keV

MeV

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

mrem / μCi

ICRP Guidance: ICRP 60

Age: Adult

Commitment Period: Chronic

View Particle Sizes for:

☒ Compound Distribution

☐ Vapor or Gas

Compound Distribution

View/Edit Distributions...

Distribution Summary:

1 Monodispersed

Lung Clearance Type

Maximum

Fast (F) - ICRP Recommended

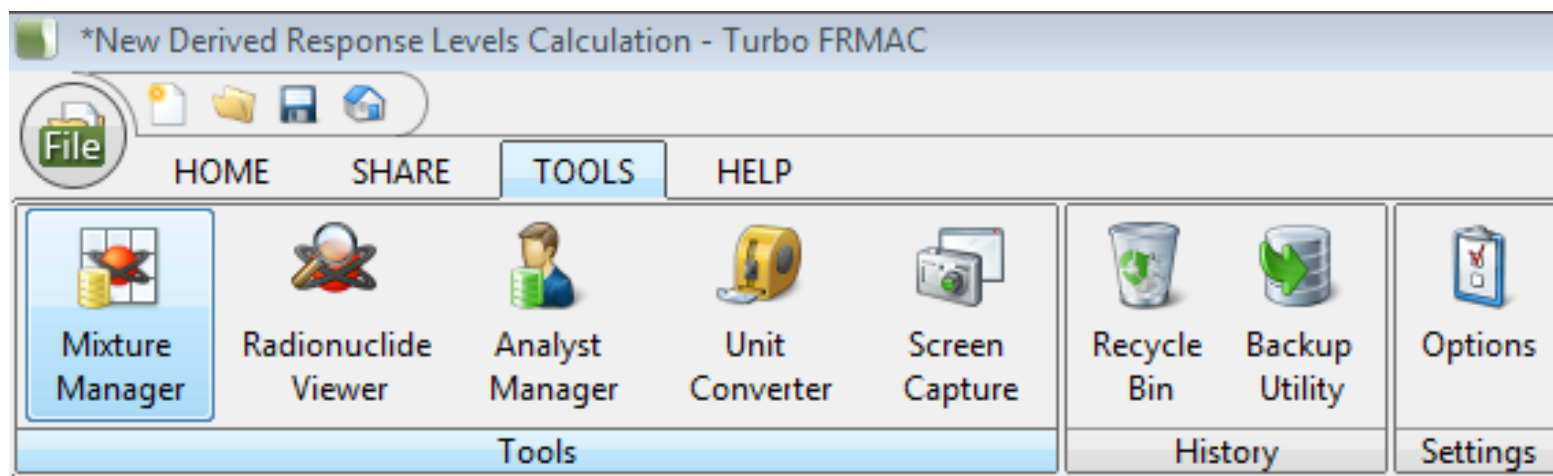
Medium (M)

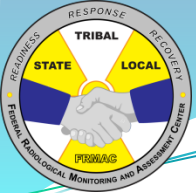
Slow (S)



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?

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