

NRC-RADTRAN

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NRC-RADTRAN

Presentation Overview

- Introduction to RADTRAN
- Overview of recent RADTRAN updates
- Introduction to new NRC-RADTRAN GUI
 - Example 1: Installation & simple incident-free transport scenario
 - Example 2: Basic accident scenario for medical isotope transport
 - Example 3: Realistic spent fuel transport with WebTRAGIS route
 - Possibilities for future development
- Selected RADTRAN modeling topics
- User Q&A

Introduction to RADTRAN

- Risks and consequences assessment for transport of radioactive material
- Developed at Sandia National Laboratories starting with NUREG-0170 (1977)
 - RADTRAN 6.02 (last public version with full documentation) released 2014
- User provides input file describing:
 - Vehicle(s) used—road, rail, and water
 - Route to be traveled (links) and stops along the way
 - Type, quantity, and properties of radioactive materials
- RADTRAN calculates:
 - Consequences for each link and stop
 - Accident probabilities for each link
 - Uncertainties

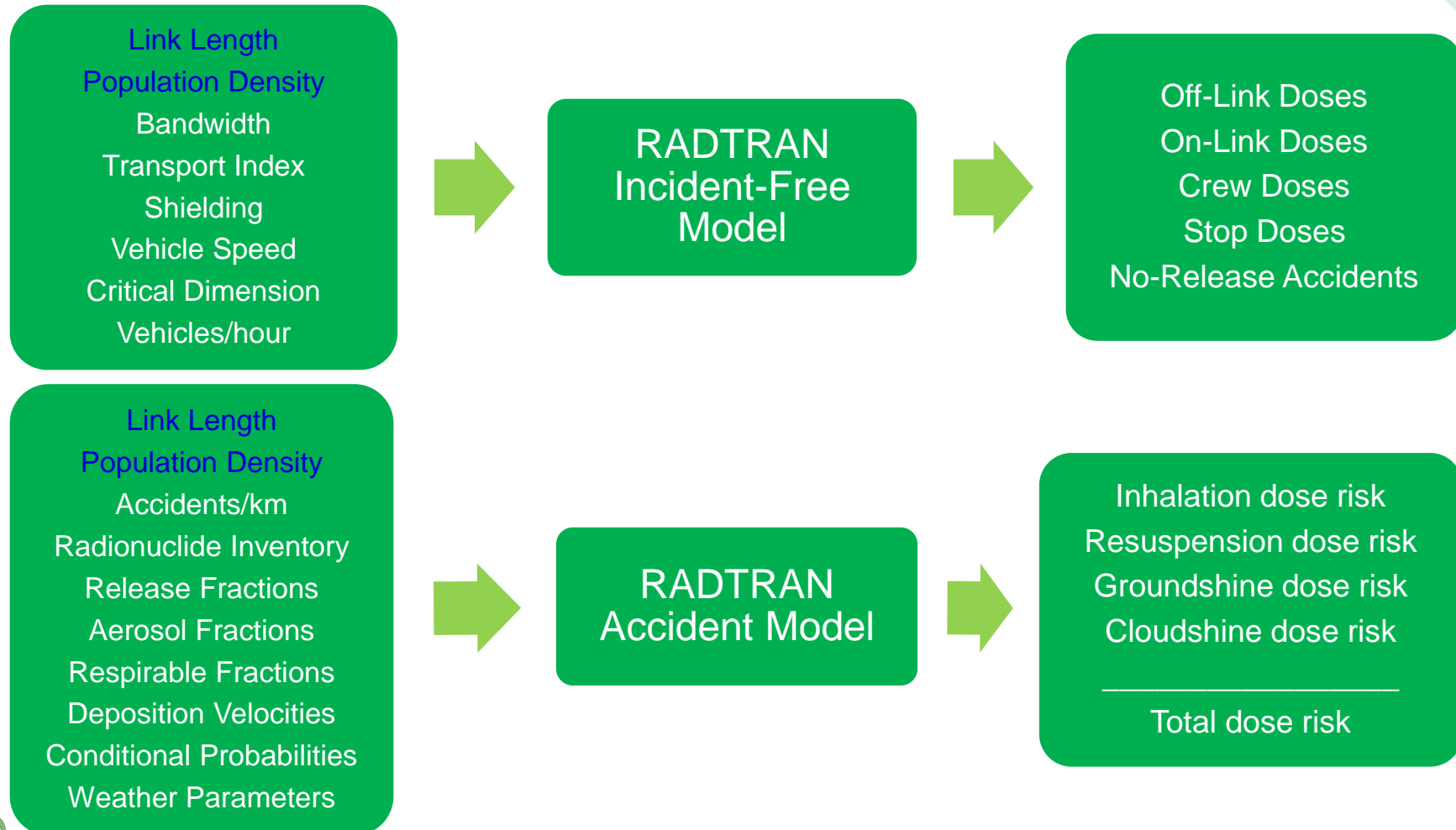
Introduction to RADTRAN:

Analysis Types

- Two types of risk calculation
 - Routine, incident-free transportation
 - Radioactive material package stays intact
 - Exposure to radiation from the surface of the vehicle can affect crew, handlers, and the public
 - Deterministic
 - Accident
 - Radioactive material may be released in a crash and disperse into the environment
 - Probabilistic (probability and consequences)
- Inputs for these two types are mostly separate
 - Certain route info is used for both

Introduction to RADTRAN

Inputs and Outputs by Analysis Type



Recent RADTRAN Updates

- Goals:
 - Make a modern, NRC-maintained version of RADTRAN available to the public
 - Develop a new, user-friendly interface and corresponding documentation
- Development by Energy Research, Inc (ERI) on behalf of NRC
 - No longer associated with Sandia or DoE
- Acknowledgments:
 - Ruth Weiner
 - Daniel Hinojosa (RadCat developer)
 - NRC Staff

Recent RADTRAN Updates

- RADTRAN code changes (version 6.02.1)
 - Time restrictions removed
 - Output size 4 is no longer available
 - Obsolete, but some 6.02 executables still allowed it
 - No modeling changes
 - Calculation methods are identical to previously released RADTRAN 6.02
- NRC-RADTRAN Graphical User Interface (GUI)
 - Primary focus of the new development efforts
 - Windows application for creating/editing RADTRAN input files, running RADTRAN, and viewing output
- NRC-RADTRAN 1.0 available soon on RAMP

Resources

NRC-RADTRAN Help Email: NRCRADTRAN_Help.Resource@nrc.gov

“NRC-RADTRAN 1.0 Quick Start User’s Guide,” E. Ball and M. Zavisca, ERI/NRC 20-208, 2020 (included with NRC-RADTRAN).

“RADTRAN 6 Technical Manual,” R. Weiner et. al, SAND2014-0780, 2014. ([RAMP website](#)).

“RADTRAN 6/RadCat 6 User Guide,” R. Weiner et. al, SAND2013-8095, 2013. ([RAMP website](#)).

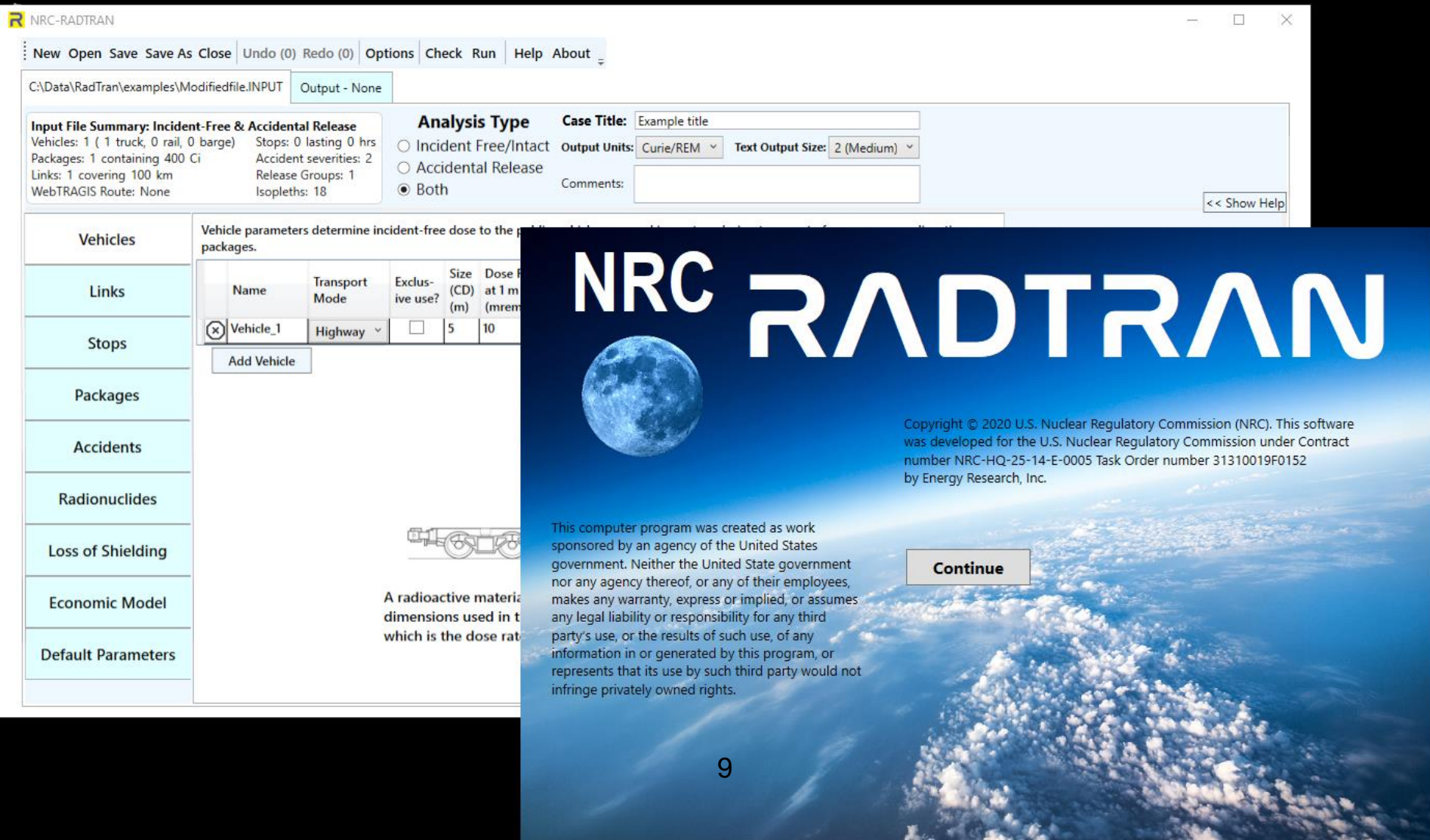
“Spent Fuel Transportation Risk Assessment,” U.S. Nuclear Regulatory Commission, NUREG-2125, January 2014. ([RAMP website](#)).

“WebTRAGIS: Transportation Routing Analysis Geographic System User’s Guide,” S. Peterson, ORNL/TM-2018/856, 2018. ([RAMP website](#)).

“An Economic Model for RADTRAN,” D. Osborn et. al, SAND2007-7120, 2007 (included with NRC-RADTRAN).

“Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes,” U.S. Nuclear Regulatory Commission, NUREG-0170, December 1977. ([NRC website](#)).

Intro to NRC-RADTRAN GUI



The screenshot displays the NRC-RADTRAN software interface. The top menu bar includes options like New, Open, Save, Save As, Close, Undo, Redo, Options, Check, Run, Help, and About. The main window is divided into several sections:

- Input File Summary: Incident-Free & Accidental Release**
 - Vehicles: 1 (1 truck, 0 rail, 0 barge)
 - Packages: 1 containing 400 Ci
 - Links: 1 covering 100 km
 - WebTRAGIS Route: None
 - Stops: 0 lasting 0 hrs
 - Accident severities: 2
 - Release Groups: 1
 - Isopleths: 18
- Analysis Type**
 - ☐ Incident Free/Intact
 - ☐ Accidental Release
 - ☒ Both
- Case Title:** Example title
- Output Units:** Curie/REM
- Text Output Size:** 2 (Medium)
- Comments:**
- << Show Help**

On the left, a sidebar lists various parameters: Vehicles, Links, Stops, Packages, Accidents, Radionuclides, Loss of Shielding, Economic Model, and Default Parameters. The main area shows a table for vehicle parameters:

Name	Transport Mode	Exclus-ive use?	Size (CD) (m)	Dose at 1 m (mrem)
Vehicle_1	Highway	<input type="checkbox"/>	5	10

Below the table is an "Add Vehicle" button. To the right, a large blue banner features the text "NRC RADTRAN" and a moon image. Below this, a copyright notice states: "Copyright © 2020 U.S. Nuclear Regulatory Commission (NRC). This software was developed for the U.S. Nuclear Regulatory Commission under Contract number NRC-HQ-25-14-E-0005 Task Order number 31310019F0152 by Energy Research, Inc."

A disclaimer text reads: "This computer program was created as work sponsored by an agency of the United States government. Neither the United State government nor any agency thereof, or any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any information in or generated by this program, or represents that its use by such third party would not infringe privately owned rights."

A "Continue" button is located at the bottom right of the banner area.

Intro to NRC-RADTRAN GUI

- Using RADTRAN 6.02.1 separately is unnecessary
 - All RADTRAN features are accessible through the GUI
- User interface philosophy
 - Self-explanatory controls (labels, tooltips, error and warning messages)
 - Program guides the user to appropriate sections of the documentation (double-click labels to navigate help)
- Consists of two functional components
 - Backend for reading and writing RADTRAN input/output text files
 - Graphical input file editor and output viewer
- Written in C# with Windows Presentation Foundation (WPF)

Intro to NRC-RADTRAN GUI

Replacing RadCat

- RadCat (previous RADTRAN GUI) will not be maintained or released in the future

Parameter	Value
Shielding factor for rural residents	1.00E00
Shielding factor for suburban residents	8.70E-01
Shielding factor for urban residents	1.80E-02
Fraction of outside air in urban buildings	5.00E-02
Fraction of urban population occupying the sidewalk	4.80E-01
Fraction of urban population inside buildings	5.20E-01
Ratio of pedestrians/km² to residential population/km²	6.00E00
Minimum small package dimension for handling (m)	5.00E-01
Distance from shipment for maximum exposure (m)	3.00E01
Vehicle speed for maximum exposure (km/hr)	2.40E01
Imposed regulatory limit on vehicle external dose	Yes
Average breathing rate (m³/sec)	3.30E-04
Cleanup Level (microcuries/m²)	2.00E-01
Interdiction Threshold (Ci/mCi)	4.00E01
Evacuation time for groundshine (days)	1.00E00
Survey interval for groundshine (days)	1.00E01
Occupational latent cancer fatalities per person-rem	6.00E-04
Public latent cancer fatalities per person-rem	6.00E-04
Campaign (year)	8.33E-02
Iodine	1.31
Rem per curie thyroid via inhalation (Rem/Ci)	1.27E06
Distance of freeway vehicle carrying radioactive cargo to pede...	3.00E01
Distance of freeway vehicle carrying radioactive cargo to right...	3.00E01
Distance of freeway vehicle carrying radioactive cargo to maxi...	8.00E02
Distance of non-freeway vehicle carrying radioactive cargo to p...	2.70E01
Distance of non-freeway vehicle carrying radioactive cargo to ri...	3.00E01
Distance of non-freeway vehicle carrying radioactive cargo to ...	8.00E02
Distance of city street vehicle carrying radioactive cargo to ped...	5.00E00
Distance of city street vehicle carrying radioactive cargo to righ...	8.00E00
Distance of city street vehicle carrying radioactive cargo to ma...	8.00E02
Perpendicular distance to freeway vehicle going in opposite dire...	1.50E01
Perpendicular distance to non-freeway vehicle going in opposit...	3.00E00
Perpendicular distance to city vehicle going in opposite direction...	3.00E00
Perpendicular distance to all vehicles going in same direction (m)	4.00E00

Intro to NRC-RADTRAN GUI

- New GUI is a native Windows application
 - Runs on Windows 7 and 10 (no Java required)

The screenshot displays the NRC-RADTRAN GUI interface. The title bar reads "NRC-RADTRAN". The menu bar includes "New", "Open", "Save", "Save As", "Close", "Undo (0)", "Redo (0)", "Options", "Check", "Run", "Help", and "About". The status bar shows the file path "C:\Data\RadTran\PSEG7-4_YM_SNF_R1_USAPWR.dat" and "Output - None".

Input File Summary: Incident-Free & Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 2 lasting 12 hrs
Packages: 1 containing 7.931E+05 Ci Accident severities: 19
Links: 36 covering 4474.1 km Release Groups: 5
WebTRAGIS Route: None Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: Calc. 2009-06944: Irradiated Fuel to Yucca Mountain (US-APWR)
Output Units: Becquerel/Sievert
Text Output Size: 3 (Full)
Comments:

Optional Parameters (-1 means RADTRAN default will be used)
☐ Treat input units as SI (Bq/Sv) instead of Ci/REM (SI_INPUT). Warning: changing this option will not convert previously-entered numbers.

Residential shielding option (IUOPT): ☐ Total (1) ☒ Default (2) ☐ None (3)
☒ Residential shielding factors (RR, RS, RU): Rural 1 Suburban 0.87 Urban 0.018

Rail option (ITRAIN): ☐ General freight/common carrier (1) ☐ Dedicated freight (2)

REGCHECK: ☒ Force vehicle external dose and crew dose to comply with regulatory limit. May override dose rates and/or dimensions.

MODSTD Inputs:
Distance from radioactive package, m (DISTOFF/DISTON)

If package/vehicle is on:	Freeway	City Street	Other Road	Rail	Water
to pedestrians	30	5	27	-1	-1
to right-of-way edge	30	8	30	-1	-1
max exposure distance	800	800	800	-1	-1
to vehicle going opposite direction	<input checked="" type="checkbox"/> 15	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 3	<input type="checkbox"/> -1	<input type="checkbox"/> -1
<input checked="" type="checkbox"/> to vehicle going same direction	4				

☒ Fraction of aerosols that get into urban buildings (BDF): 0.05
Fraction of urban area/people in ☒ sidewalks (USWF): 0.48 ☒ buildings (UBF): 0.52
☒ Ratio of pedestrian density near roads to residential population density (RPD): 6
☒ Minimum small package dimension for handling (SMALLPKG): 0.5 m

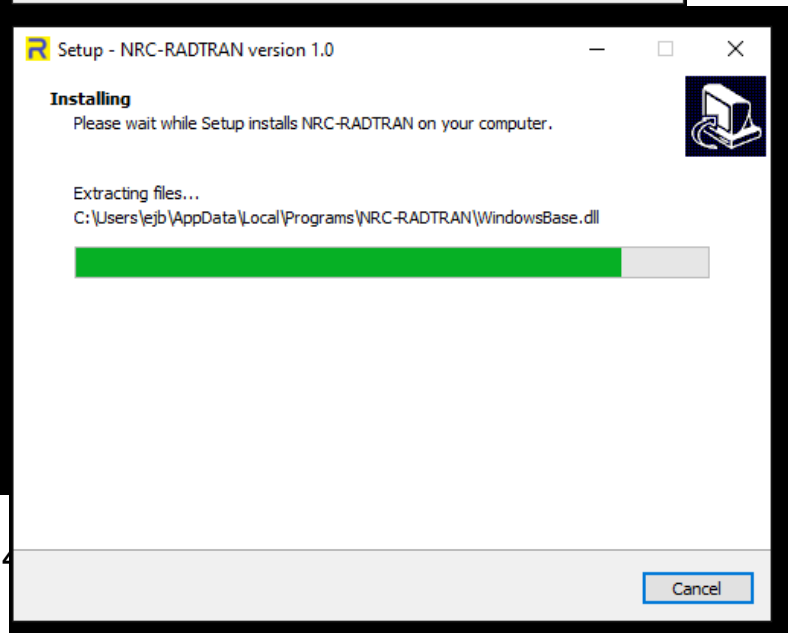
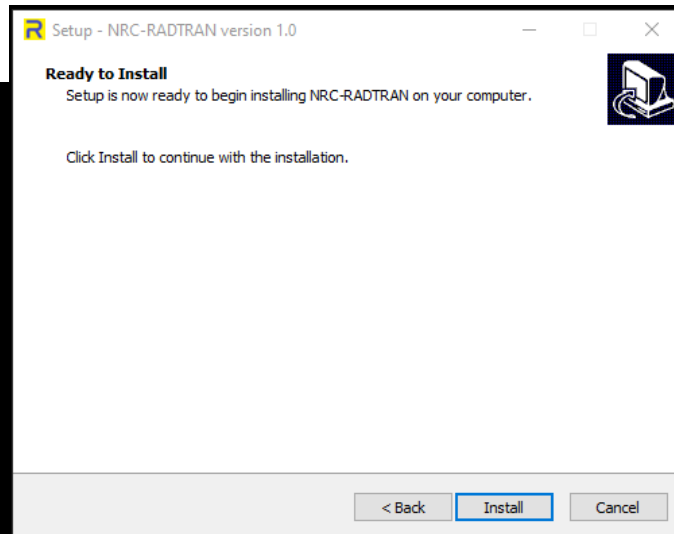
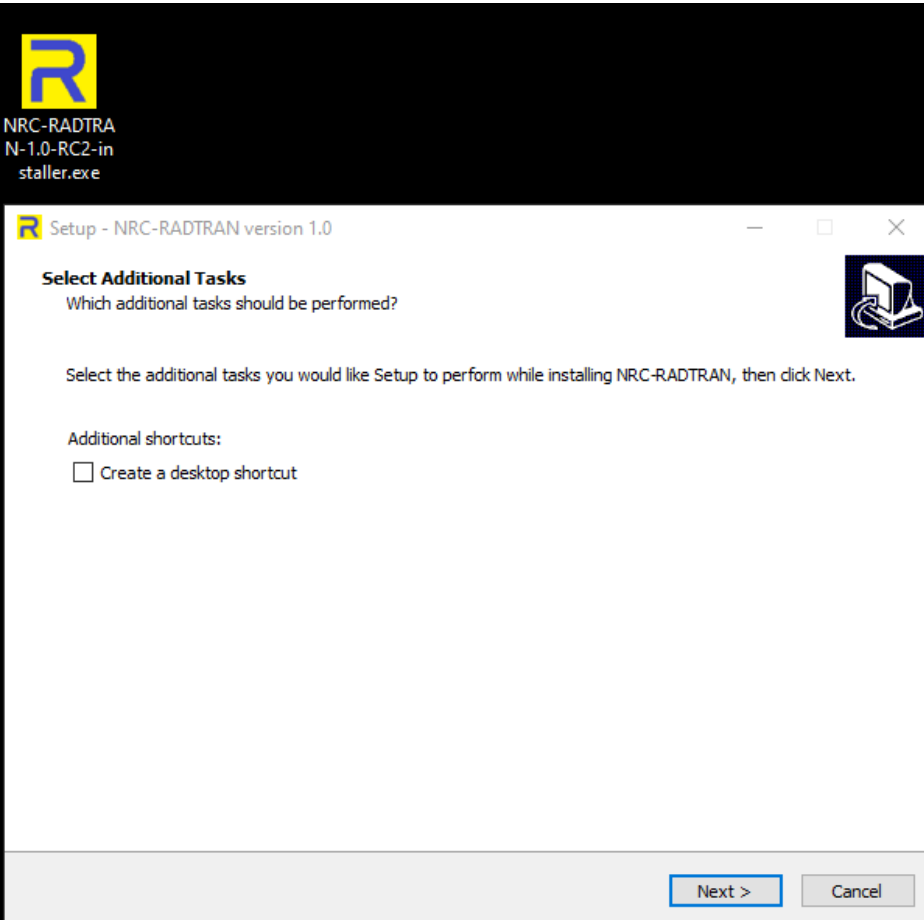
Default Parameters Tab
This tab includes a large number of inputs, all of which are optional. Most of these belong to the MODSTD block of the RADTRAN text input file. For these, the user may choose whether to include them by checking the checkbox to the left of the option. Four of the options on this tab (IUOPT, ITRAIN, REGCHECK, and IACC) are part of the FLAGS block in the text input file, and two are stand-alone options (SI_INPUT and TRANSFER). These are discussed individually below.

- SI Input Option
Selecting the SI Input option sets keyword SI_INPUT to 1 in the text input file. This causes RADTRAN to interpret its inputs using SI radiation units (Sv/Bq) rather than

Example 1: Installation and simple incident-free scenario

- NRC-RADTRAN features to cover:
 - Overview of interface
 - Toolbar (open/save/close, undo/redo, run)
 - Summary pane
 - Analysis type
 - Title and comments fields
 - Error checking function
 - Running a new (empty) file
 - Input echo viewer and output viewer
 - Manual entry of vehicles and links
 - Basic meaning of vehicle and link input fields
 - Integrated help viewer

Example 1: Installation



Example 1: Interface basics

The screenshot displays the NRC-RADTRAN software interface. The main window has a menu bar with options: New, Open, Save, Save As, Close, Undo (0), Redo (0), Options, Check, Run, Help, and About. Below the menu bar is a toolbar with icons for file operations. The main area is divided into several sections:

- Input File Summary: Incident-Free**
Vehicles: 0 (0 truck, 0 rail, 0 barge)
Packages: 0 containing 0 Ci
Links: 0 covering 0 km
WebTRAGIS Route: None
- Analysis Type**
☒ Incident Free/Intact
☐ Accidental Release
☐ Both
- Case Title:** [Empty text box]
Output Units: Curie/REM
Text Output Size: 3 (Full)
- Comments:** [Empty text box]

On the left side, there is a sidebar with a list of categories: Vehicles, Links, Stops, Packages, Accidents, Radionuclides, Loss of Shielding, Economic Model, and Default Parameters. The 'Vehicles' category is selected, and a table of vehicle parameters is displayed. The table has columns: Name, Transport Mode, Exclusive use?, Size (CD) (m), Dose Rate at 1 m (mrem/hr), Gamma Fraction, Neutron Fraction, Crew Size, Crew Distance (m), Width Facing Crew (m), and Crew Shield Factor (1=0=Fully sh). Below the table is an 'Add Vehicle' button.

At the bottom of the main window, there is a section for 'Errors and Warnings'. It contains a list of errors and a list of warnings. The warning section shows a message: 'Warning: No vehicles have been defined, so no doses can be calculated.'

On the right side, there is a help viewer window titled 'NRC-RADTRAN 1.0 Quick Start User's Guide'. It contains a table of contents with links to various sections: Introduction, File Toolbar, Opening and Saving Input Files, Check Button, Undo/Redo, Options, Help Button, About Button, Input File Editor, General Inputs/Summary Area, Case Title, and Analysis Type.

Example 1: Blank output

The screenshot displays the NRC-RADTRAN software interface. The window title is "NRC-RADTRAN". The menu bar includes "New", "Open", "Save", "Save As", "Close", "Undo (0)", "Redo (0)", "Options", "Check", "Run", "Help", and "About". The status bar shows "New file" and "Output - - RUN DATE: [10-18-2020 AT 17:58]".

The main window is divided into two panes. The left pane, titled "Input Echo and Input Edit:", contains the following text:

```
TITLE
INPUT STANDARD
OUTPUT CI_REM
FORM UNIT

*& # OF SEVERITIES, # OF LOS PROBABILITIES, # OF ISOPLETHS
DIMEN 0 0 18

*& ECON, ANALYSIS TYPE, VERBOSITY, WEATHER
PARM 0 1 2 0

FLAGS
IACC 2      *& DISPERSION OPTION
EOF

*& LINKS SECTION:
EOF

END OF INPUT EDIT
```

The right pane, titled "RADTRAN Output:", contains the following text:

```

RADTRAN 6.02.1 Build AC  October 23, 2019

RUN DATE: [ 10-18-2020  AT 17:58 ]

NON-RADIOLOGICAL DATA (ACCIDENTS and FATALITIES)
*****

TOTALS:                0.00E+00      0.00E+00

REGULATORY CHECKS HAVE BEEN DISABLED
*****

INCIDENT-FREE SUMMARY
*****

IN-TRANSIT POPULATION EXPOSURE IN PERSON-REM

      CREW    OFF LINK    ON LINK
ZONE
RURAL  0.00E+00  0.00E+00  0.00E+00
SUBURB 0.00E+00  0.00E+00  0.00E+00
URBAN  0.00E+00  0.00E+00  0.00E+00
TOTALS: 0.00E+00  0.00E+00  0.00E+00
```


Example 1: Integrated Help Viewer

NRC-RADTRAN

New Open Save Save As Close Undo (4) Redo (0) Options Check Run Help About

New file* Output - None

Analysis Type Case Title:

g 0 hrs
ities: 0
s: 0

☒ Incident Free/Intact
☐ Accidental Release
☐ Both

Output Units: Curie/REM Text Output Size: 2 (Medium)

Comments:

mine incident-free dose to the public, vehicle crew, and inspectors during transport of one or more radioactive

Transport Mode	Exclusive use?	Size (CD) (m)	Dose Rate at 1 m (mrem/hr)	Gamma Fraction	Neutron Fraction	Crew Size	Crew Distance (m)	Width Facing Crew (m)	Crew Factor (0=F)
Highway	<input type="checkbox"/>	1	0	1	0	0	0	0	0

A radioactive material package on a vehicle (railcar) showing dimensions used in the incident-free model. TI is Transport Index, which is the dose rate 1 m from the surface in mrem/hr.

Introduction
File Toolbar
- Opening and Saving I
- Check Button
- Undo/Redo
- Options
- Help Button
- About Button
Input File Editor
General Inputs/Summar
- Case Title
- Analysis Type
- Consequence Format
- Output Units
- Output Size
- Comments
- Input File Summary Bc
Vehicles Tab
- Vehicles Table

Vehicles Tab

The Vehicles tab allows the user to create vehicles, delete existing vehicles, and modify the individual vehicle inputs in the vehicle

table. At least one vehicle must be defined for RADTRAN to calculate incident-free or accident doses.

- Vehicles Table

Each row in the Vehicles Table corresponds to the entries following the VEHICLE keyword in the text input file. On the left is a button for deleting the vehicle, followed by

Type text to find...

Example 1: Vehicle Input

NRC-RADTRAN

New

Open

Save

Save As

Close

Undo (10)

Redo (0)

Options

Check

Run

Help

About

New file*

Output - - RUN DATE: [10-18-2020 AT 17:58]

Input File Summary: Incident-Free

Vehicles: 1 (0 truck, 1 rail, 0 barge)

Packages: 0 containing 0 Ci

Links: 0 covering 0 km

WebTRAGIS Route: None

Stops: 0 lasting 0 hrs

Accident severities: 0

Release Groups: 0

Isopleths: 18

Analysis Type

☒ Incident Free/Intact

☐ Accidental Release

☐ Both

Case Title:

Output Units:

Curie/REM

Text Output Size:

2 (Medium)

Comments:

<< Show Help

Vehicles

Links

Stops

Packages

Accidents

Radionuclides

Loss of Shielding

Economic Model

Default Parameters

Vehicle parameters determine incident-free dose to the public, vehicle crew, and inspectors during transport of one or more radioactive packages.

Name	Transport Mode	Exclus-ive use?	Size (CD) (m)	Dose Rate at 1 m (mrem/hr)	Gamma Fraction	Neutron Fraction	Crew Size	Crew Distance (m)	Width Facing Crew (m)	Crew Shielding Factor (1=None, 0=Fully shielded)	Number of Shipments
<input checked="" type="checkbox"/> Vehicle_1	Rail	<input checked="" type="checkbox"/>	5	13	1	0	5	30	2	0.2	1

Add Vehicle

A radioactive material package on a vehicle (railcar) showing dimensions used in the incident-free model. TI is Transport Index, which is the dose rate 1 m from the surface in mrem/hr.

NRC-RADTRAN

New Open Save Save As Close Undo (19) Redo (0) Options Check Run Help About

New file* Output - - RUN DATE: [10-19-2020 AT 00:54]

Input File Summary: Incident-Free

Vehicles: 1 (0 truck, 1 rail, 0 barge)

Packages: 0 containing 0 Ci

Links: 1 covering 1000 km

WebTRAGIS Route: None

Analysis Type

☒ Incident Free/Intact
☐ Accidental Release
☐ Both

Case Title: _____

Output Units: Curie/REM **Text Output Size:** 2 (Medium)

Comments: _____

<< Show Help

Vehicles	To specify the transport route, you can create links manually and/or import a route from a WebTRAGIS output file.											
	Name	Vehicle	Mode	Length (km)	Speed (km/hr)	Adjacent Vehicle Occupants	Pop.Density People/km ²	Traffic (vehicles /hr)	Accidents per km	Deaths per accident	Population Type	Farm fraction if rural
Links	(x) Link_1	Vehicle_1 ▾	NonRoad ▾	1000	80	0	500	0	1E-08	0.5	Rural ▾	0
Stops												
Packages												
Accidents												
Radionuclides												
Loss of Shielding												
Economic Model												
Default Parameters												

Add Link
Import from WebTRAGIS ?

The map displays a black line representing a transport route across the central and southern United States. The route begins in California near Los Angeles, travels east through Arizona and New Mexico, crosses into Oklahoma and Arkansas, and continues through Tennessee towards Nashville. Major cities like Las Vegas, Santa Fe, Phoenix, Wichita, Memphis, and Birmingham are labeled. State boundaries for IIA, ARIZONA, NEW MEXICO, OKLAHOMA, ARKANSAS, TENNESSEE, and KENTUCKY are shown. Orange dots mark specific locations along the route.

<< Show Help

Example 1: Incident-Free Output

NRC-RADTRAN

New Open Save Save As Close Undo (19) Redo (0) Options Check Run Help About

New file* Output - - RUN DATE: [10-19-2020 AT 00:54]

RUN DATE: [10-19-2020 AT 00:54]
RADTRAN 6.02.1 Build AC October 23, 2019
SUCCESSFUL COMPLETION

Input Echo and Input Edit:

```
TITLE
INPUT STANDARD
OUTPUT CI_REM
FORM UNIT

=& # OF SEVERITIES, # OF LOS PROBABILITIES, # OF ISOPLETHS
DIMEN 0 0 18

=& ECON, ANALYSIS TYPE, VERBOSITY, WEATHER
PARM 0 1 2 0

=& VEHICLE:MODE,NAME,DOSE RT,GAMMA FRAC,NEUTRON FRAC,SIZE,#SHIPMENTS,#CREW,CREWDIST,SHLDG,CREW
=&
(NEGATIVE MODE = EXCLUSIVE USE)
VEHICLE -2 VEHICLE_1 13 1 0 5 1 5 30 0.2 2

FLAGS
IACC 2      =& DISPERSION OPTION
EOF

=& LINKS SECTION:

=& LINK NAME,VEHICLE,LENGTH,SPD,#CREW,POP DENS,VEH RATE,ACC RATE,FATAL RATE,R/S/U,MODE,FARM FR
LINK LINK_1 VEHICLE_1 1000 80 0 500 0 1E-08 0.5 R 3 0
EOF

END OF INPUT EDIT
```

Open Calculation Folder

RADTRAN Output: Save Output as CSV

Text Output Spreadsheet

```
RUN DATE: [ 10-19-2020 AT 00:54 ]

NON-RADIOLOGICAL DATA (ACCIDENTS and FATALITIES)
*****

GENERAL FREIGHT
VEHICLE_1

LINK ACCIDENT RATE ACCIDENTS FATALITIES
LINK_1 1.00E-08 1.00E-05 5.00E-06

TOTALS: 1.00E-05 5.00E-06

REGULATORY CHECKS HAVE BEEN DISABLED
*****

INCIDENT-FREE SUMMARY
*****

IN-TRANSIT POPULATION EXPOSURE IN PERSON-REM

LINK CREW YARD OFF LINK ON LINK
LINK_1 1.96E-03 1.31E-02 1.82E-02 0.00E+00

ZONE
RURAL 1.96E-03 1.31E-02 1.82E-02 0.00E+00
SUBURB 0.00E+00 0.00E+00 0.00E+00 0.00E+00
URBAN 0.00E+00 0.00E+00 0.00E+00 0.00E+00

VEHICLE_1 CLASSIFICATION-NONLINK 1.45E-02
TOTALS: 1.96E-03 2.76E-02 1.82E-02 0.00E+00

MAXIMUM INDIVIDUAL IN-TRANSIT DOSE
VEHICLE_1 5.36E-07 REM

EOI
```


Example 2: Basic accident scenario (medical isotope transport)

- NRC-RADTRAN features to cover:
 - Accident severity levels
 - Release groups
 - Adding package radionuclides
 - Saving output as a CSV
 - Structure and naming of the calculation folder
 - Overview of the Options tab
 - Display settings
 - Auxiliary input and output files
 - Legacy input options
- Questions?

Example 2: Open from file browser

The screenshot displays the NRC-RADTRAN software interface. A file browser window is open, showing the directory structure: This PC > Local Disk (C:) > Data > RadTran > examples. The file 'Example2.dat' is selected, with a date modified of 10/19/2020 6:38 AM and a type of NRC-RADTRAN Input File.

The NRC-RADTRAN application window is open, showing the 'Input File Summary: Accidental Release' for 'Example2.dat'. The summary includes:

- Vehicles: 1 (1 truck, 0 rail, 0 barge)
- Packages: 0 containing 0 Ci
- Links: 0 covering 0 km
- WebTRAGIS Route: None
- Stops: 0 lasting 0 hrs
- Accident severities: 0
- Release Groups: 0
- Isopleths: 18


The 'Vehicles' section shows a table with columns: Name, Transport Mode, and Exclusive use? The table contains one entry: 'Vehicle_1' with 'Highway' as the transport mode. An 'Add Vehicle' button is visible below the table.

The main application window features a large blue header with the text 'NRC RADTRAN' and a moon image. Below the header, a copyright notice states: 'Copyright © 2020 U.S. Nuclear Regulatory Commission (NRC). This software was developed for the U.S. Nuclear Regulatory Commission under Contract number NRC-HQ-25-14-E-0005 Task Order number 31310019F0152 by Energy Research, Inc.'

A disclaimer text is displayed: 'This computer program was created as work sponsored by an agency of the United States government. Neither the United State government nor any agency thereof, or any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any information in or generated by this program, or represents that its use by such third party would not infringe privately owned rights.'

A 'Continue' button is present. At the bottom right, there is a dropdown menu for 'Analysis Type' set to '27' and a search bar labeled 'Type text to find...'.

Example 2: Package input

 NRC-RADTRAN

New Open Save Save As Close Undo (0) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example2completed.dat Output - None

Input File Summary: Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge)
Packages: 1 containing 0 Ci
Links: 2 covering 1200 km
WebTRAGIS Route: None

Analysis Type
☐ Incident Free/Intact
☒ Accidental Release
☐ Both

Case Title: Example 2: Basic accident scenario
Output Units: Curie/REM
Text Output Size: 3 (Full)
Comments: This example represents transport of a medical device containing cobalt-60.

<< Show Help

Vehicles

Links

Stops

Packages

Accidents

Radionuclides

Loss of Shielding

Economic Model

Default Parameters

Add packages/casks here (optional for incident-free analysis, required for accidental release).
The parameters in each package row determine the incident-free dose to handlers. If there is only one package on the vehicle, then package parameters (length, dose rate, gamma/neutron fractions) should match the vehicle.
Package radionuclides (for accident dose) are entered on the Radionuclides tab.


☒ Medical Largest (critical) dimension (m): 1 Dose rate 1 m from surface (mrem/hr): 0 Gamma fraction: 1 Neutron fraction: 0

Add Package

Vehicle Packages (determines radionuclides for accident analysis)
Enter the number of each type of package on each vehicle (leave blank for none).

	Medical
Vehicle_1	2

Example 2: Severity Levels

 NRC-RADTRAN

New Open Save Save As Close Undo (0) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example2completed.dat Output - None

Input File Summary: Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 0 lasting 0 hrs
Packages: 1 containing 0 Ci Accident severities: 2
Links: 2 covering 1200 km Release Groups: 1
WebTRAGIS Route: None Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☒ Accidental Release
☐ Both

Case Title: Example 2: Basic accident scenario
Output Units: Curie/REM **Text Output Size:** 3 (Full)
Comments: This example represents transport of a medical device containing cobalt-60.

<< Show Help

Vehicles
Links
Stops
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters

Severity Probabilities
The Probabilities tab specifies the conditional probability of an accident of a particular severity, given that a vehicle accident happens. These are also referred to as "severity fractions". One row is typically the probability of an accident not affecting the package; the others correspond to releases of radioactive material. Probabilities may depend on transportation mode and rural/suburban/urban.
☒ Use one set of probabilities for all groups
Mode
☒ Highway (1)
☐ Rail (2)
☐ Waterway (3)
Population
☒ Rural (1)
☐ Suburban (2)
☐ Urban (3)

	Sev	Conditional
Del	Lvl	Probability
<input checked="" type="checkbox"/>	1	0.99
<input checked="" type="checkbox"/>	2	0.01

Add Severity Level

Release Groups
Add Group
Remove Selected Group

Weather

Isopleths (Dispersion Areas)

Example 2: Release Groups

NRC-RADTRAN

New Open Save Save As Close Undo (0) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example2completed.dat Output - None

Input File Summary: Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 0 lasting 0 hrs
Packages: 1 containing 0 Ci Accident severities: 2
Links: 2 covering 1200 km Release Groups: 1
WebTRAGIS Route: None Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☒ Accidental Release
☐ Both

Case Title: Example 2: Basic accident scenario

Output Units: Curie/REM **Text Output Size:** 3 (Full)

Comments: This example represents transport of a medical device containing cobalt-60.

<< Show Help

Vehicles **Links** **Stops** **Packages** **Accidents** **Radionuclides** **Loss of Shielding** **Economic Model** **Default Parameters**

Severity Probabilities **Release Groups** **Weather** **Isopleths (Dispersion Areas)**

Group Name: Cobalt

Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity
1	0	0	0	0.01 m/s
2	0.01	1	1	

Add Group

Remove Selected Group

To add/remove rows (severity levels), use the Severity Probabilities tab.

Example 2: Radionuclides

NRC-RADTRAN

New Open Save Save As Close Undo (6) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example2completed.dat Output - Example 2: Basic accident scenario - RUN DATE: [10-19-2020 AT 07:28]

Input File Summary: Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 0 lasting 0 hrs
Packages: 1 containing 400 Ci Accident severities: 2
Links: 2 covering 1200 km Release Groups: 1
WebTRAGIS Route: None Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☒ Accidental Release
☐ Both

Case Title: Example 2: Basic accident scenario
Output Units: Curie/REM **Text Output Size:** 3 (Full)
Comments: This example represents transport of a medical device containing cobalt-60.

<< Show Help

Vehicles
Links
Stops
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters

Assign radionuclides to packages **Define new radionuclides**

Assign isotopes to each package, from both the default isotope list (in the isotope file) and any user-defined radionuclides.
Packages: (to add/remove packages use the Packages tab)

Medical

Isotope	Release Group	Inventory (Ci)
CO60	Cobalt	400

CO60
NI63
ZN65
GA67
KR85
RB86
RB87
SR89
SR90
Y90
Y91
ZR93
ZR95
NB94
NB95M
NB95
MO99
TC99

Example 2: Saving as CSV

NRC-RADTRAN

File Edit View Options Check Run Help About

C:\Data\RadTran\examples\Example2completed.dat Output - Example 2: Basic accident scenario - RUN DATE: [10-19-2020 AT 07:43]

RUN DATE: [10-19-2020 AT 07:43]
 RADTRAN 6.02.1 Build AC October 23, 2019
 SUCCESSFUL COMPLETION

Open Calculation Folder

RADTRAN Output: Save Output as CSV

Text Output Spreadsheet

1.02E+03	1.32E-02	7.91E-04	2.73E-03	1.12E-04	2.24E+00
1.63E+03	6.23E-03	3.74E-04	1.29E-03	5.30E-05	1.06E+00
2.31E+03	2.90E-03	1.74E-04	6.02E-04	2.47E-05	4.93E-01
4.27E+03	1.09E-03	6.58E-05	2.27E-04	9.32E-06	1.86E-01
5.47E+03	4.99E-04	3.00E-05	1.04E-04	4.24E-06	8.49E-02
1.11E+04	2.37E-04	1.42E-05	4.92E-05	2.01E-06	4.03E-02
1.31E+04	8.75E-05	5.26E-06	1.82E-05	7.45E-07	1.49E-02

Input Echo and Input Edit:

```

TITLE EXAMPLE 2: BASIC ACCIDENT SCENARIO
&& THIS EXAMPLE REPRESENTS TRANSPORT OF A MEDICAL DEVICE CONTAINING COBALT-60.
INPUT STANDARD
OUTPUT CI_REM
FORM UNIT

*& # OF SEVERITIES, # OF LOS PROBABILITIES, # OF ISOPLETHS
DIMEN 2 0 18

*& ECON, ANALYSIS TYPE, VERBOSITY, WEATHER
PARM 0 2 3 0

SEVERITY *& LIST CONDITIONAL PROBABILITIES OF
NPOP=1 *& RURAL
NMODE=1 *& HIGHWAY
0.99 0.01

RELEASE *& DEFINE CHEMICAL/PHYSICAL GROUPS FOR
GROUP=COBALT
RFRAC *& FRACTION OF THIS GROUP THAT
0 0.01
AERSOL *& FRACTION OF THIS GROUP THAT
0 1
RESP *& FRACTION OF THIS GROUP THAT I
0 1
DEPVEL 0.01 *& DEPOSITION VELOCITY FOR T

*& PACKAGE: NAME, DOSE RATE, GAMMA FRAC, NEUTRON
PACKAGE MEDICAL 0 1 0 1
*& ISOTOPE, INVENTORY, RELEASE GROUP
CO60 400 COBALT
END

*& VEHICLE:MODE,NAME,DOSE RT,GAMMA FRAC,NEUTRON FRAC,SIZE,#SHIPMENTS,#CREW,CREWD
(NEGATIVE MODE = EXCLUSIVE USE)
VEHICLE 1 VEHICLE_1 0 1 0 1 1 2 0 0 0
MEDICAL 2

FLAGS
IACC 2 *& DISPERSION OPTION
EOF

*& LINKS SECTION:
  
```

Example2_completed.dat

File Home Share View

< > << ejb > NRCRADTRAN > Calculations > Example2_completed.dat

Name	Date modified	Type	Size
output2020_10_19_07_43_50.csv	10/19/2020 7:45 AM	Microsoft Excel C...	
RADTRAN2020_10_19_07_43_50.INPUT	10/19/2020 7:43 AM	INPUT File	
RADTRAN2020_10_19_07_43_50.OUTPUT	10/19/2020 7:43 AM	OUTPUT File	

1.11E+04	4.92E-05	3.15E-11	1.88E-06	3.02E-05	8.13E-05	5.35E-04	1.52E-04
1.31E+04	1.82E-05	4.30E-12	6.94E-07	1.12E-05	3.00E-05	1.98E-04	5.63E-05
2.13E+04	8.57E-06	9.55E-13	3.27E-07	5.27E-06	1.42E-05	9.33E-05	2.65E-05
4.05E+04	3.92E-06	1.99E-13	1.49E-07	2.41E-06	6.47E-06	4.26E-05	1.21E-05
7.00E+04	2.09E-06	5.69E-14	7.98E-08	1.28E-06	3.46E-06	2.28E-05	6.47E-06
8.99E+04	1.28E-06	2.12E-14	4.87E-08	7.84E-07	2.11E-06	1.39E-05	3.95E-06
1.21E+05	8.34E-07	9.05E-15	3.18E-08	5.13E-07	1.38E-06	9.08E-06	2.58E-06

ACCIDENT SUMMARY

NRC-RADTRAN GUI

Writes Input Files in a Standard Format

- Text input file written by user vs. NRC-RADTRAN
 - Opening and then saving a file will change the format

RADTRAN 6

TITLE Example title

INPUT STANDARD OUTPUT CI_REM FORM
UNIT

DIMEN 2 0 18

&& Dimensions for various arrays

PARM 0 3 2 1

&& No econ. Verbosity medium. Pasquill weather.

RELEASE

GROUP = Group_1

RFRAC 0.0 0.10

DEPVEL 1.0e-2

PSPROB 2.0e-1 3.0e-1 2.0e-1 1.0e-1 1.0e-1 1.0e-1

SEVERITY

NPOP=1 NMODE=1 9.99e-1 1.0e-3

RADTRAN 6 NRC-RADTRAN 2020

TITLE Example title

&& Dimensions for various arrays

&& No econ. Verbosity medium. Pasquill weather.

INPUT STANDARD

OUTPUT CI_REM

FORM UNIT

*& # of severities, # of LOS probabilities, # of isopleths

DIMEN 2 0 18

*& econ, analysis type, verbosity, weather

PARM 0 3 2 1

SEVERITY *& List conditional probabilities of different severity levels in a vehicle accident

NPOP=1 *& Rural

NMODE=1 *& Highway

0.999 0.001

RELEASE *& Define chemical/physical groups for radionuclide behavior

GROUP=Group_1

RFRAC *& Fraction of this group that is released in each accident severity level

0 0.1

AERSOL *& Fraction of this group that is aerosolized

0 0

RESP *& Fraction of this group that is respirable

0 0

DEPVEL 0.01 *& Deposition velocity for this rel group

PSPROB *& Weather: Pasquill stability class fractions A-F

0.2 0.3 0.2 0.1 0.1 0.1



Example 3: Spent Fuel Transport

- NRC-RADTRAN features to cover:
 - Importing a WebTRAGIS route
 - Stops
 - Weather
 - Isopleths
 - User-defined radionuclides
 - Economic model
 - Loss of Lead Shielding
 - Modifying default parameters
 - SI input units option (set first)
 - DISTOFF/DISTON parameters and their physical meaning
 - REGCHECK option

Example 3: WebTRAGIS

NRC-RADTRAN

New Open Save Save As Close Undo (32) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example3.input Output - None Options

Input File Summary: Incident-Free & Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 20 lasting 89.2 hrs
Packages: 1 containing 4.138E+05 Ci Accident severities: 6
Links: 5 covering 607.1 km Release Groups: 4
WebTRAGIS Route: AZ to NV (20 parts) Isoleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: TVA SPENT_FUEL
Output Units: Curie/REM **Text Output Size:** 3 (Full)
Comments:

<< Show Help

Vehicles

To specify the transport route, you can create links manually and/or import a route from a WebTRAGIS output file.
Title of link section (optional):

Links

Name	Vehicle	Mode	Length (km)	Speed (km/hr)	Adjacent Vehicle Occupants	Pop.Density People/km ²	Traffic (vehicles /hr)	Accidents per km	Deaths per accident	Population Type	Farm fraction if rural
<input checked="" type="checkbox"/> AZ_Rural_H	SPENT_FUEL	PrimaryHighway	536.2	85.2	2	47.1	0	0	0	Rural	0.5
<input checked="" type="checkbox"/> AZ_Subur_H	SPENT_FUEL	PrimaryHighway	49.95	95.8	2	3008.4	0	0	0	Suburban	0
<input checked="" type="checkbox"/> AZ_Urban_H	SPENT_FUEL	PrimaryHighway	4.65	124.4	2	3097.3	0	0	0	Urban	0
<input checked="" type="checkbox"/> NV_Rural_H	SPENT_FUEL	PrimaryHighway	9.45	82.9	2	17.9	0	0	0	Rural	0.5
<input checked="" type="checkbox"/> NV_Subur_H	SPENT_FUEL	PrimaryHighway	6.8	79.2	2	649.3	0	0	0	Suburban	0

Add Link Import from WebTRAGIS ?

Radionuclides
Highway route C:\Data\RadTran\examples\Highway 101912081512\Highway 101912081512.kml
☒ Embed WebTRAGIS Route in RADTRAN Input File

Loss of Shielding

Economic Model

Default Parameters

UNITED STATES

30

Raw Route File Data

Segment ID	State	Rural Dist. (km)	Suburban Dist. (km)	Urban Dist. (km)	Rural Pop./km ²	Suburban Pop./km ²	Urban Pop./km ²	Speed (km/hr)	Duration (hr)	X1	X2	Y1	Y2
------------	-------	------------------	---------------------	------------------	----------------------------	-------------------------------	----------------------------	---------------	---------------	----	----	----	----

Example 3: Stops

NRC-RADTRAN

New Open Save Save As Close Undo (53) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example3.input Output - None

Input File Summary: Incident-Free & Accidental Release
 Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 5 lasting 8 hrs
 Packages: 1 containing 4.138E+05 Ci Accident severities: 6
 Links: 5 covering 607.1 km Release Groups: 4
 WebTRAGIS Route: AZ to NV (20 parts) Isoleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: TVA SPENT_FUEL
Output Units: Curie/REM **Text Output Size:** 3 (Full)
 Comments:

<< Show Help

Vehicles	Name	Vehicle	Pop.Density People/km ²	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
Links	⊗ AZINSP1606	SPENT_FUEL	267.3	30	800	0.87	0.17
	⊗ AZFUEL1727	SPENT_FUEL	492	30	800	0.87	0.83
Stops	⊗ NVFUEL2255	SPENT_FUEL	165	30	800	0.87	0.83
	⊗ CREWTOTAL	SPENT_FUEL	1	1	1	1	2.89
Packages	⊗ SHARINGSTOP	SPENT_FUEL	9805	1	15	1	3.32

Add Stop

Example of a Stop configuration for a highway vehicle

Example 3: Severity Levels

NRC-RADTRAN

New Open Save Save As Close Undo (97) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example3.input Output - None

Input File Summary: Incident-Free & Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 5 lasting 8 hrs
Packages: 1 containing 4.138E+05 Ci Accident severities: 6
Links: 5 covering 607.1 km Release Groups: 4
WebTRAGIS Route: AZ to NV (20 parts) Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: Arizona-Nevada SPENT_FUEL
Output Units: Curie/REM **Text Output Size:** 3 (Full)
Comments:

<< Show Help

Vehicles
Links
Stops
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters

Severity Probabilities **Release Groups** **Weather** **Isopleths (Dispersion Areas)**

The Probabilities tab specifies the conditional probability of an accident of a particular severity, given that a vehicle accident happens. These are also referred to as "severity fractions". One row is typically the probability of an accident not affecting the package; the others correspond to releases of radioactive material. Probabilities may depend on transportation mode and rural/suburban/urban.

☒ Use one set of probabilities for all groups

Mode
☒ Highway (1)
☐ Rail (2)
☐ Waterway (3)

Population
☒ Rural (1)
☐ Suburban (2)
☐ Urban (3)

Del	Sev	Conditional Probability
(X)	1	0.99993
(X)	2	6.06E-05
(X)	3	5.86E-06
(X)	4	4.95E-07
(X)	5	7.49E-08
(X)	6	3E-10

Mode
☒ Highway (1)
☐ Rail (2)
☐ Waterway (3)

Population
☐ Rural (1)
☒ Suburban (2)
☐ Urban (3)

Del	Sev	Conditional Probability
(X)	1	0.99993
(X)	2	6.06E-05
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(X)	6	3E-10

Mode
☒ Highway (1)
☐ Rail (2)
☐ Waterway (3)

Population
☐ Rural (1)
☐ Suburban (2)
☒ Urban (3)

Del	Sev	Conditional Probability
(X)	1	0.99993
(X)	2	6.06E-05
(X)	3	5.86E-06
(X)	4	4.95E-07
(X)	5	7.49E-08
(X)	6	3E-10

Add Group
Remove Selected Group
Add Severity Level

Example 3: Release Groups

Vehicles	Severity Probabilities	Release Groups	Weather	Isopleths (Dispersion Areas)																																			
Links	<p>Group Name: <input type="text" value="PARTIC"/></p> <table border="1"> <thead> <tr> <th>Severity Level</th> <th>Release Fraction</th> <th>Aerosol Fraction</th> <th>Respirable Fraction</th> <th>Deposition Velocity</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0.01 m/s</td></tr> <tr><td>2</td><td>0.7</td><td>1</td><td>1</td><td></td></tr> <tr><td>3</td><td>0.7</td><td>1</td><td>1</td><td></td></tr> <tr><td>4</td><td>0.7</td><td>1</td><td>1</td><td></td></tr> <tr><td>5</td><td>0.7</td><td>1</td><td>1</td><td></td></tr> <tr><td>6</td><td>0.64</td><td>1</td><td>1</td><td></td></tr> </tbody> </table>				Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity	1	0	1	1	0.01 m/s	2	0.7	1	1		3	0.7	1	1		4	0.7	1	1		5	0.7	1	1		6	0.64	1	1	
Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity																																			
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Packages	<p>Group Name: <input type="text" value="GAS"/></p> <table border="1"> <thead> <tr> <th>Severity Level</th> <th>Release Fraction</th> <th>Aerosol Fraction</th> <th>Respirable Fraction</th> <th>Deposition Velocity</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0 m/s</td></tr> <tr><td>2</td><td>0.8</td><td>1</td><td>1</td><td></td></tr> <tr><td>3</td><td>0.8</td><td>1</td><td>1</td><td></td></tr> <tr><td>4</td><td>0.8</td><td>1</td><td>1</td><td></td></tr> <tr><td>5</td><td>0.8</td><td>1</td><td>1</td><td></td></tr> <tr><td>6</td><td>0.8</td><td>1</td><td>1</td><td></td></tr> </tbody> </table>				Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity	1	0	1	1	0 m/s	2	0.8	1	1		3	0.8	1	1		4	0.8	1	1		5	0.8	1	1		6	0.8	1	1	
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5	0.8	1	1																																				
6	0.8	1	1																																				
Accidents	<p>Group Name: <input type="text" value="CRUD"/></p> <table border="1"> <thead> <tr> <th>Severity Level</th> <th>Release Fraction</th> <th>Aerosol Fraction</th> <th>Respirable Fraction</th> <th>Deposition Velocity</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0.01 m/s</td></tr> <tr><td>2</td><td>0.001</td><td>1</td><td>1</td><td></td></tr> <tr><td>3</td><td>0.001</td><td>1</td><td>1</td><td></td></tr> <tr><td>4</td><td>0.001</td><td>1</td><td>1</td><td></td></tr> <tr><td>5</td><td>0.001</td><td>1</td><td>1</td><td></td></tr> <tr><td>6</td><td>0.001</td><td>1</td><td>1</td><td></td></tr> </tbody> </table>				Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity	1	0	1	1	0.01 m/s	2	0.001	1	1		3	0.001	1	1		4	0.001	1	1		5	0.001	1	1		6	0.001	1	1	
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5	0.001	1	1																																				
6	0.001	1	1																																				
Radionuclides	<p>Buttons: Add Group, Remove Selected Group</p> <p>To add/remove rows (severity levels), use the Severity Probabilities tab.</p>																																						
Loss of Shielding																																							
Economic Model																																							
Default Parameters																																							

Example 3: Radionuclides

Vehicles
Links
Stops
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters

Assign radionuclides to packages

Define new radionuclides

Assign isotopes to each package, from both the default isotope list (in the isotope file)

Packages: (to add/remove packages use the Packages tab)

SPENT_FUEL

	Isotope	Release Group	Inventory (Ci)
(X)	AM241 ▼	PARTIC ▼	727
(X)	AM242M ▼	PARTIC ▼	13.1
(X)	AM243 ▼	PARTIC ▼	33.4
(X)	CE144 ▼	PARTIC ▼	8870
(X)	CM242 ▼	PARTIC ▼	28.3
(X)	CM243 ▼	PARTIC ▼	30.7
(X)	CM244 ▼	PARTIC ▼	7750
(X)	CM245 ▼	PARTIC ▼	1.21
(X)	EU154 ▼	PARTIC ▼	9130
(X)	EU155 ▼	PARTIC ▼	4.62
(X)	II29 ▼	VOL ▼	0.0465
(X)	KR85 ▼	GAS ▼	8900
(X)	PM147 ▼	PARTIC ▼	17600
(X)	PU238 ▼	PARTIC ▼	6070
(X)	PU239 ▼	PARTIC ▼	255
(X)	PU240 ▼	PARTIC ▼	543
(X)	PU241 ▼	PARTIC ▼	69600
(X)	PU242 ▼	PARTIC ▼	1.82
(X)	RU106 ▼	VOL ▼	15500
(X)	SB125 ▼	PARTIC ▼	3830
(X)	SR90 ▼	PARTIC ▼	61900
(X)	Y90 ▼	PARTIC ▼	61900
(X)	CO60 ▼	CRUD	4.09
(X)	CS134 ▼	VOL	48000
(X)	CS137 ▼	VOL	93100

Example 3: Loss of Shielding

NRC-RADTRAN

New Open Save Save As Close Undo (99) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example3.input Output - None

Input File Summary: Incident-Free & Accidental Release
 Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 5 lasting 8 hrs
 Packages: 1 containing 4.138E+05 Ci Accident severities: 6
 Links: 5 covering 607.1 km Release Groups: 4
 WebTRAGIS Route: AZ to NV (20 parts) Isoleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: Arizona-Nevada SPENT_FUEL
Output Units: Curie/REM **Text Output Size:** 3 (Full)
 Comments:

<< Show Help

Vehicles

Links

Stops

Packages

Accidents

Radionuclides

Loss of Shielding

Economic Model

Default Parameters

These three tables can list the probability of various degrees of shielding loss when an accident occurs.

Rural (NPOP=1)

	Conditional Probability	Fraction Lost
<input checked="" type="checkbox"/>	0.99	0
<input checked="" type="checkbox"/>	0.01	0.5

Suburban (NPOP=2)

	Conditional Probability	Fraction Lost
	0.99	0
	0.01	0.5

Urban (NPOP=3)

	Conditional Probability	Fraction Lost
	0.99	0
	0.01	0.5

Add Loss of Shielding Probability

	Name	Vehicle	Pop.Density (People/km ²)	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
<input checked="" type="checkbox"/>	Stop_1	SPENT_FUEL	500	5	25	0.8	10

Add Loss of Shielding Event

Example 3: Default Parameters

NRC-RADTRAN

New Open Save Save As Close Undo (99) Redo (0) Options Check Run Help About

C:\Data\RadTran\examples\Example3.input Output - None

Input File Summary: Incident-Free & Accidental Release
Vehicles: 1 (1 truck, 0 rail, 0 barge) Stops: 5 lasting 8 hrs
Packages: 1 containing 4.138E+05 Ci Accident severities: 6
Links: 5 covering 607.1 km Release Groups: 4
WebTRAGIS Route: AZ to NV (20 parts) Isopleths: 18

Analysis Type
☐ Incident Free/Intact
☐ Accidental Release
☒ Both

Case Title: Arizona-Nevada SPENT_FUEL
Output Units: Curie/REM **Text Output Size:** 3 (Full)
Comments:

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Economic Model

Default Parameters

Optional Parameters (-1 means RADTRAN default will be used)
☐ Treat input units as SI (Bq/Sv) instead of Ci/REM (SI_INPUT). Warning: changing this option will not convert previously-entered numbers.

Residential shielding option (IUOPT): ☐ Total (1) ☒ Default (2) ☐ None (3)
☒ Residential shielding factors (RR, RS, RU): Rural 1 Suburban 0.87 Urban 0.018

Rail option (ITRAIN): ☐ General freight/common carrier (1) ☐ Dedicated freight (2)

REGCHECK: ☐ Force vehicle external dose and crew dose to comply with regulatory limit. May override dose rates and/or dimensions.

MODSTD Inputs:
Distance from radioactive package, m (DISTOFF/DISTON)

If package/vehicle is on:	<input checked="" type="checkbox"/> Freeway	<input checked="" type="checkbox"/> City Street	<input checked="" type="checkbox"/> Other Road	<input type="checkbox"/> Rail	<input type="checkbox"/> Water
to pedestrians	30	5	27	-1	-1
to right-of-way edge	30	8	30	-1	-1
max exposure distance	800	800	800	-1	-1
to vehicle going opposite direction	<input checked="" type="checkbox"/> 15	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 3	<input type="checkbox"/> -1	<input type="checkbox"/> -1
<input checked="" type="checkbox"/> to vehicle going same direction	4				

☒ Fraction of aerosols that get into urban buildings (BDF): 0.05

Fraction of urban area/people in ☒ sidewalks (USWF): 0.48 ☒ buildings (UBF): 0.52

☒ Ratio of pedestrian density near roads to residential population density (RPD): 6

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RADTRAN Modeling

- Dose risk
 - The risk triplet normally separates probability from consequences
 - Dose risk multiplies them together to provide an overall risk measurement
- Loss of Shielding
 - Applies only to lead shielding that may be used on highly radioactive packages (mainly spent fuel)
 - Slump fraction abstracts the effect of shifting or thinning
 - Damage to steel or depleted uranium shielding unlikely

Truck Event Tree

ACCIDENT	TYPE	OBJECT STRUCK	SPEED DISTRIBUTION	SURFACE STRUCK	PROBABILITY
Large truck accident on interstate highway	Collision with non-fixed object 0.820	Train	Train grade crossing		0.00082
		0.001	accident speeds		
		Gasoline tanker truck			0.00246
		0.003			
		Other vehicles (motorcycles, cars, other Trucks)			0.76916
		0.938			
		Other smaller non-fixed objects (cones, animals, pedestrians)			0.04756
		0.058			
				Hard rock	3.45E-06
				0.050	
				Soft rock, rocky soul	3.18E-06
				0.046	
				Other soils, clay, silt	5.65E-05
				0.817	
				Railbed, roadbed	5.39E-06
			0.078		
			Water	6.22E-07	
			0.009		
				0.00010	
				0.00329	
				0.00054	
				0.00014	
				0.00012	
			0.00222		
			0.00630		
			0.11970		



NRC-RADTRAN GUI

Potential Future Improvements

- RAMP is constantly seeking to improve our codes based on user needs.
- If you identify any future improvements or user needs you would like to see integrated into the code, send them the NRC-RADTRAN help resource email given below
- Send user feedback on the GUI to NRCRADTRAN_Help.Resource@nrc.gov

NRC-RADTRAN GUI

Potential Future Improvements

- Alternate routing software
 - WebTRAGIS limitations
 - Contiguous 48 states only
 - Requires US government sponsorship
 - Population density data no longer being updated
 - Possibly Google Earth or Google Maps could be added
 - Requires separate population density database



Questions?

NRC RADTRAN



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