



# NRC-RADTRAN – Introduction/ Exercise

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# Outline



- **Introduction**
- **NRC-RADTRAN Concepts**
- **NRC-RADTRAN Installation**
- **NRC-RADTRAN Use**
- **NRC-RADTRAN Demo**
- **Conclusions**

# Introduction

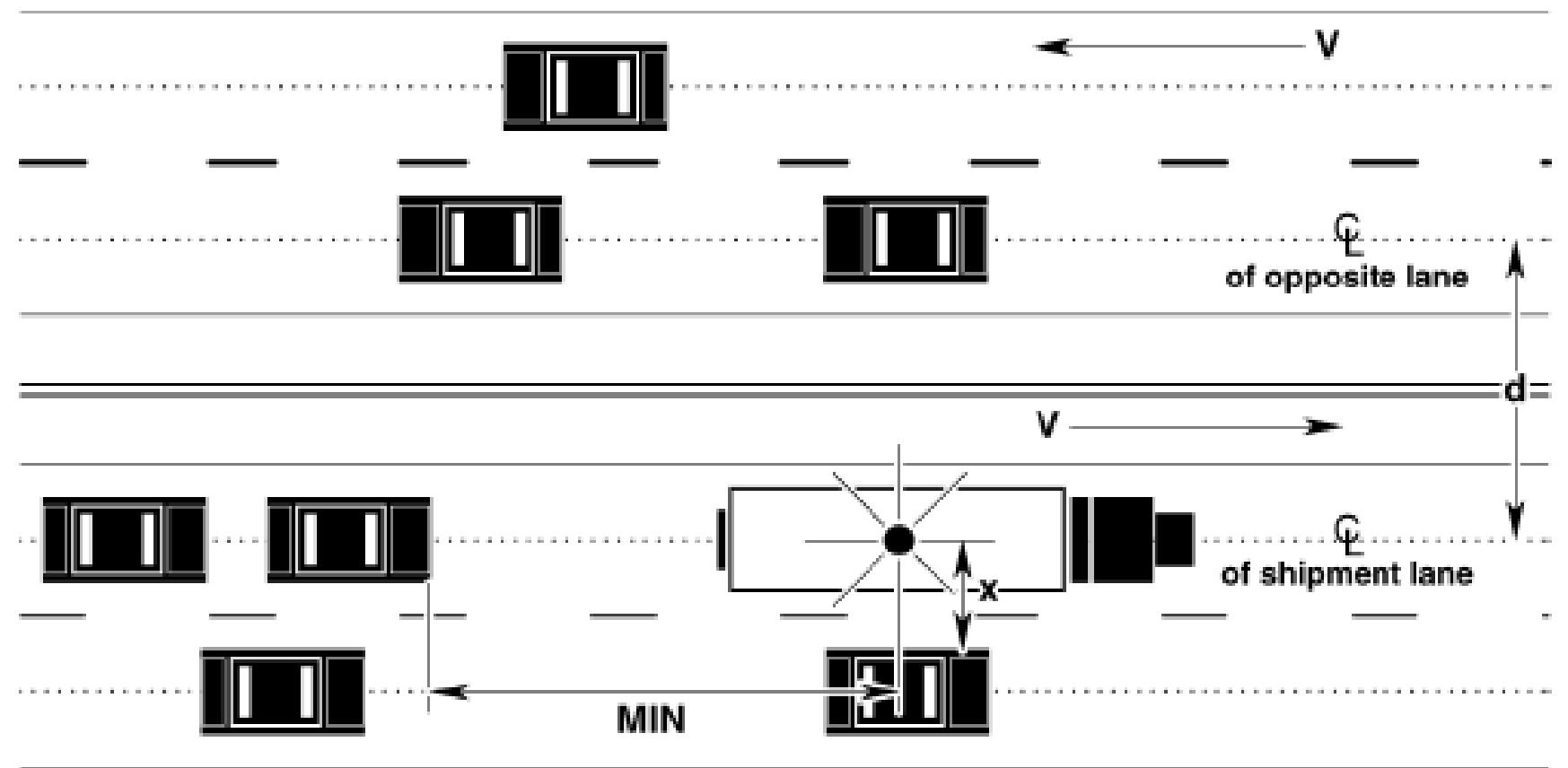


- NRC – Radioactive Material Transport (NRC-RADTRAN)
- Risk and consequence analysis of radioactive material (RAM) transportation
- Modes of transportation: rail, trucks, barge, aircraft
- First released in 1977 (SNL)
- 6 versions released to date
- GUI compatibility added to RADTRAN 6.02.1 → NRC-RADTRAN v1.0

# NRC-RADTRAN Concepts

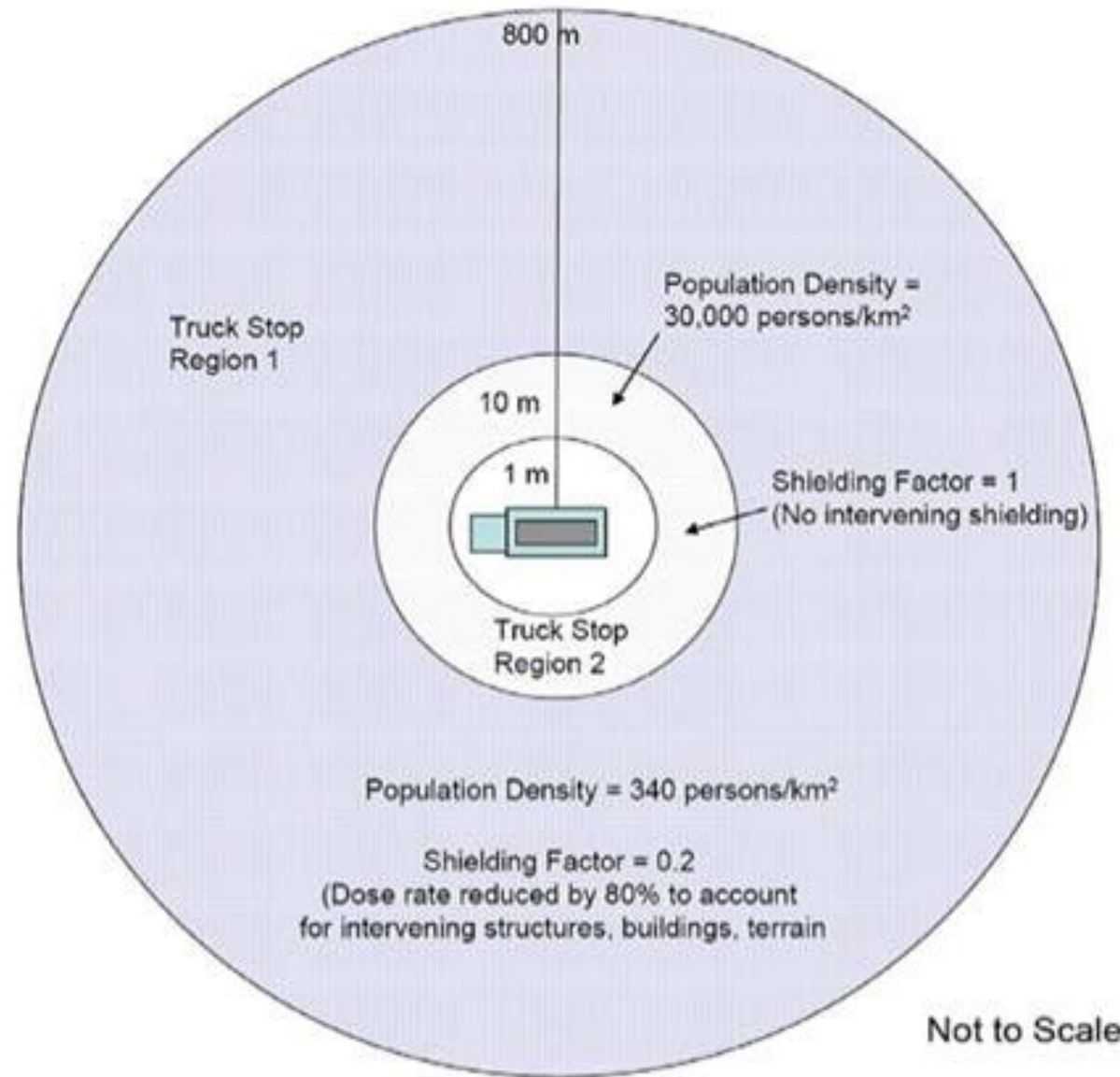


- Calculations
  - With traffic
  - Opposing traffic
  - Population
- Treats shipment as a stationary object
  - Relative velocity used for everything



Taken From RADTRAN 6 Technical Manual SAND2014-0780

# NRC-RADTRAN Concepts (cont.)



Example Truck Route Stop  
Figure from page 6-29 of U.S.  
NRC Environmental Impact  
Statement for an Early Site  
Permit (ESP) at the Clinch  
River Nuclear Site

NUREG-2226, Vol. 1

Figure 6-2 Illustration of the Truck Stop Model

# NRC-RADTRAN Concepts (cont.)



- Two types of exposures modeled:
  - Direct exposure from loss of shielding
  - Exposure associated with release of particulates, gases, volatiles, and crud; several pathways:
    - ✓ Inhalation
    - ✓ Cloudshine
    - ✓ Resuspension
    - ✓ Groundshine

# NRC-RADTRAN Concepts (cont.)



- Doses are calculated and summed for all appropriate exposure pathways for all isotopes in each material for the shipment(s) being analyzed and for all downwind isopleths for each accident severity to yield a consequence (total dose) per accident of each severity
- Probability of occurrence of each accident severity class is calculated from input values for accident rate, fractional occurrence, and distance traveled
- Total Dose is multiplied by probability of occurrence for each accident severity to yield Dose-Risk
- Results and intermediate calculations are included in the output file

# NRC-RADTRAN Concepts (cont.)



- Changes in RADTRAN 6
  - Command line is no longer used for any functionalities
  - RadCat is no longer maintained, distributed, or used
  - NRC-RADTRAN 1.0 is current version
    - ✓ Runs RADTRAN 6.02.1
    - ✓ New Graphic User Interface for Inputs
  - RADTRAN/RadCat 6 User Guide and Technical Manual are still valid references



# NRC-RADTRAN Installation



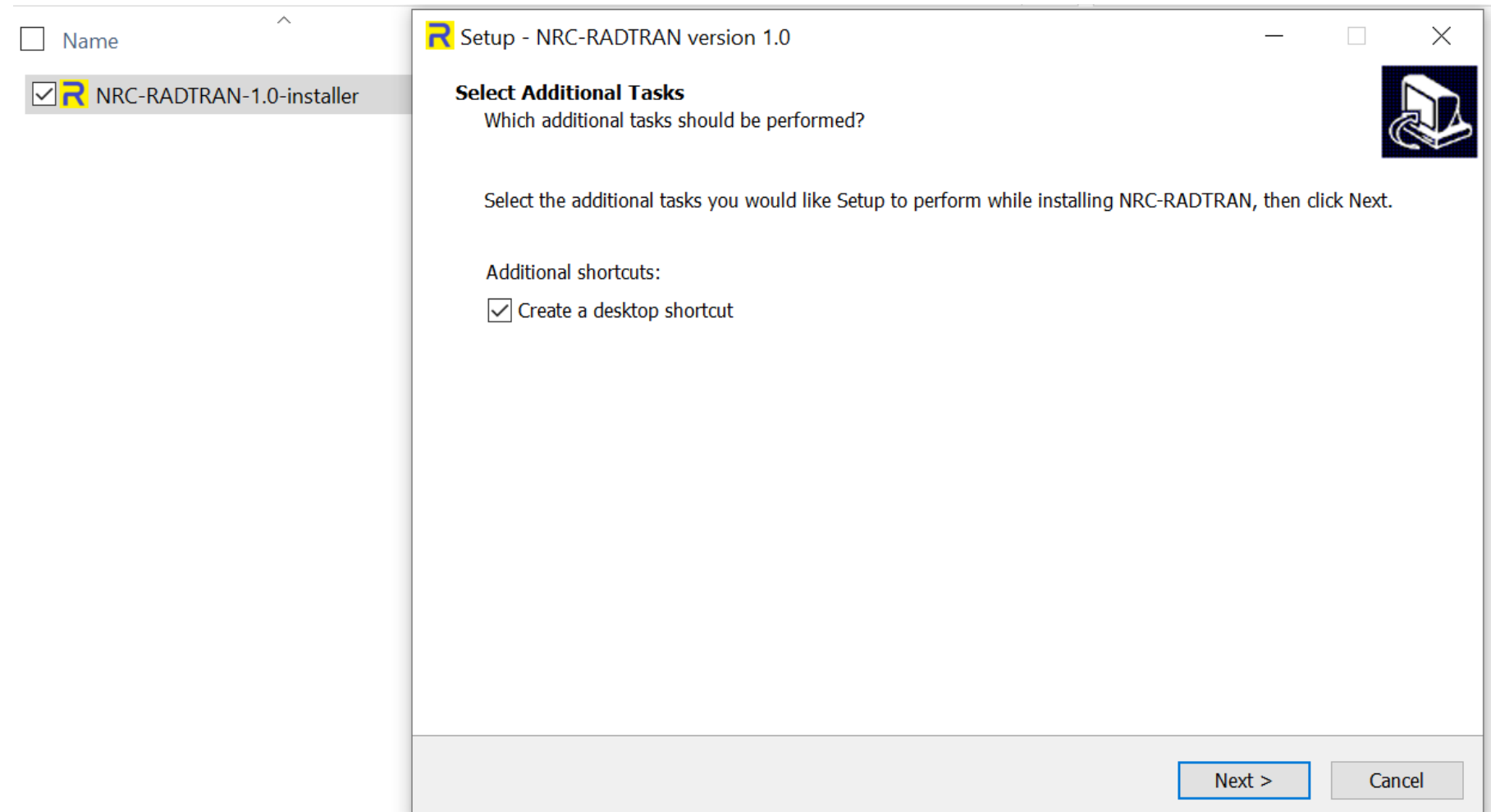
- Login to NRC-RAMP
  1. Codes
  2. NRC-RADTRAN
  3. Download

The screenshot shows the RAMP Website interface. At the top, a user profile for Harish Gadey is visible with options to view, edit, or log out. The main header includes the RAMP logo and the text "RAMP Website Radiation Protection Computer Code Analysis and Maintenance Program". A navigation menu contains "CODES +", "MEMBERSHIP +", "MEETINGS +", and "PARTNERS". A dropdown menu for "CODES" is open, listing various codes: ARCON, DandD, GALE, GENII, HABIT, IMBA, MILDOS, NRC-RADTRAN, NRCdose, PAVAN, PIMAL, Radiological Toolbox, RASCAL, RESRAD, SNAP/RADTRAD, Turbo FRMAC, VARSKIN, and VSP. The "NRC-RADTRAN" option is highlighted with a red box and a red "2.". Below the navigation, a "Code Menu" section is visible, with the "Download" option highlighted by a red box and a red "3.". Other options in the Code Menu include "NRC-RADTRAN Overview", "Documentation", and "Request Support".

# NRC-RADTRAN Installation (cont.)



- Double click on the downloaded file to install



# NRC-RADTRAN Use



## Defining the problem:

1. Type of Analysis
2. Units
  - Curies/ Rem
  - Bq/Sv
3. Item 1 selection dictates available input panels

NRC-RADTRAN

New Open Save Save As Close Undo (25) Redo (0) Options **Check** Run Help About

New file\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
 Vehicles: 0 ( 0 truck, 0 rail, 0 barge) Stops: 1 lasting 2 hrs  
 Packages: 1 containing 0 Ci Accident severities: 0  
 Links: 5 covering 722 km Release Groups: 0  
 WebTRAGIS Route: NE to WY (21 parts) Isopleths: 18

**Analysis Type**

Incident Free/Intact  
 Accidental Release  
 Both

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

**Vehicles**

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
Add Vehicle											

**3.**

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 Use (cont.)



- Basic functions: opening, closing, and saving files
- *Undo/ Redo*: maintains list of prior 99 actions
- *Options*: display, file, open/save, and other legacy options
- *Check*: Indicates any file errors (errors, warnings)
- *Help/ About*: opens the viewer and provides basic information about NRC-RADTRAN

Help Viewer

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

**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

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

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)	Crew Shielding Factor (1=None, 0=Fully shielded)	Number of Shipments
Add Vehicle											

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

TI at 1 meter from cask  
 0.5 CD = "Virtual" Cask Radius  
 Critical Dimension  
 r = Distance to Receptor

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.

**Help Viewer**  
 NRC-RADTRAN 1.0  
 Quick Start User's Guide  
 Try double-clicking a tab header or input label to jump to its section in this guide.  
 (Drag to resize help viewer)

**Contents**  
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# NRC-RADTRAN Use (cont.)



	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)	Crew Shielding Factor (1=None, 0=Fully shielded)	Number of Shipments
⊗	Vehicle_1	Rail	<input type="checkbox"/>	1	0	1	0	0	0	0	0	1

Add Vehicle

- *Transport Mode*: highway, rail, waterway
- *Size (CD)*: Largest dimension of package (max. 9 m)
- *Gamma/ Neutron Fraction*: split between gamma and neutron external package dose (must add to unity)
- *Crew Distance*: Average distance of crew to nearest radioactive package
- *Width Facing Crew*: largest dimension of the cargo facing crew
- *Crew Shielding Factor*: fraction of radiation exposed to the crew
- *Number of Shipments*: values calculated for single shipment and multiplied

# NRC-RADTRAN Use (cont.)



	Name	Vehicle	Mode	Length (km)	Speed (km/hr)	Adjacent Vehicle Occupants	Pop.Density People/km <sup>2</sup>	Traffic (vehicles /hr)	Accidents per km	Deaths per accident	Population Type	Farm fraction if rural
⊗	NE_Rural_H	Vehicle_1 ▾	NonRoad ▾	628.9	110.3	1	39.8	0	0	0	Rural ▾	0.5
⊗	NE_Subur_H	Vehicle_1 ▾	NonRoad ▾	21.14	115.5	1	1361.4	0	0	0	Suburban ▾	0
⊗	WY_Rural_H	Vehicle_1 ▾	NonRoad ▾	57.61	122.4	1	4.9	0	0	0	Rural ▾	0.5

- *Mode*: highway, secondary road/ non road. **Do not select unknown**
- *Adjacent Vehicle Occupants*: average number in vehicles
- *Traffic*: number of vehicles travelling per hour on the link
- *Traffic, Accidents per km, and Deaths per accident* are user defined
- *Population Type*: Either rural, suburban or urban. Affects shielding factors and dose to pedestrians
- *Farm fraction if rural*: fraction of surrounding area used for agriculture (only for rural)

# NRC-RADTRAN Use (cont.)



- Creation of Links using WebTRAGIS
  - Limited to contiguous 48 states
  - Requires US Government Sponsorship
  - Populations are not currently being updated
- Creation of Links in Google Earth
  - Requires population density files
- Manual Entry



# NRC-RADTRAN Use (cont.)



- WebTRAGIS information is intersection based
- Each link is the distance between two intersections
  - Uses known
    - ✓ Population density
    - ✓ Distance
    - ✓ Speed
    - ✓ Time of transit



Raw Route File Data

Segment ID	State	Rural Dist. (km)	Suburban Dist. (km)	Urban Dist. (km)	Rural Pop./km <sup>2</sup>	Suburban Pop./km <sup>2</sup>	Urban Pop./km <sup>2</sup>	Speed (km/hr)	Duration (hr)	X1	X2	Y1	Y2
31000007797	NE	2.8264033	4.7247969	0	14.311526	369.41164	0	151.02400	0.050000	-96.64	-96.715	40.896	40.862
31000007800	NE	0	3.2056443	0	0	821.170013	0	96.169325	0.033333	-96.715	-96.73	40.862	40.839
31000007816	NE	0	2.8434462	0	0	316.27792	0	85.303393	0.033333	-96.73	-96.75	40.839	40.817
31000007817	NE	28.228306	0.8998866	0	5.852835	254.36806	0	124.83511	0.233333	-96.75	-97.101	40.817	40.822
31000007812	NE	41.622199	0	0	2.0012392	0	0	118.92057	0.349999	-97.101	-97.59	40.822	40.821
31000007813	NE	33.619273	0	0	1.6860701	0	0	118.65624	0.283333	-97.59	-97.99	40.821	40.821
31000007814	NE	32.135462	0	0	1.6035867	0	0	120.50798	0.266666	-97.99	-98.37	40.821	40.820
31000007838	NE	62.165907	1.0555628	0	3.5758565	103.58322	0	122.36413	0.516666	-98.37	-99.08	40.820	40.669
31000007837	NE	24.3591311	0.6319524	0	4.0554827	92.303971	0	124.95538	0.200000	-99.08	-99.38	40.669	40.690
31000007835	NE	31.125923	0.5881252	0	1.9347366	99.471993	0	118.92768	0.266666	-99.38	-99.74	40.690	40.741
31000007828	NE	93.125263	3.17303911	0	3.2147720	159.50306	0	120.37288	0.799999	-99.74	-100.76	40.741	41.112
31000007780	NE	78.903204	1.95711837	0	1.7693489	129.63676	0	121.29046	0.666666	-100.76	-101.71	41.112	41.1150
31000007783	NE	38.479319	0	0	1.2944100	0	0	121.51357	0.316666	-101.71	-102.15	41.1150	41.026
31000007784	NE	68.228934	0.1666873	0	0.322960	67.267824	0	120.69817	0.566666	-102.15	-102.94	41.026	41.1131
31000007778	NE	0.1945772	1.8506766	0	33.157266	129.515910	0	122.71710	0.016666	-102.94	-102.97	41.1131	41.1132
31000007776	NE	5.2526765	0	0	5.9683196	0	0	105.05313	0.050000	-102.97	-103.03	41.1132	41.1263
31000007645	NE	55.501630	0	0	0.6387937	0	0	57.415477	0.966666	-103.03	-103.66	41.1263	41.2162
31000007762	NE	33.126976	0.0415692	0	0.8497031	62.170092	0	124.38216	0.266666	-103.66	-104.05	41.2162	41.1806



# NRC-RADTRAN Use (cont.)



- Summarized into three links per state
  - Rural
  - Urban
  - Suburban

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):

Name	Vehicle	Mode	Length (km)	Speed (km/hr)	Adjacent Vehicle Occupants	Pop. Density People/km <sup>2</sup>	Traffic (vehicles/hr)	Accidents per km	Deaths per accident	Population Type	Farm fraction if rural
⊗ NE_Rural_H	▼	PrimaryHighway ▼	628.9	110.3	1	39.8	0	0	0	Rural ▼	0.5
⊗ NE_Subur_H	▼	PrimaryHighway ▼	21.14	115.5	1	1361.4	0	0	0	Suburban ▼	0
⊗ WY_Rural_H	▼	PrimaryHighway ▼	57.61	122.4	1	4.9	0	0	0	Rural ▼	0.5
⊗ WY_Subur_H	▼	PrimaryHighway ▼	13.51	99.9	1	870.7	0	0	0	Suburban ▼	0
⊗ WY_Urban_H	▼	PrimaryHighway ▼	0.85	77.9	1	1501.6	0	0	0	Urban ▼	0

Highway route C:\Users\napi143\OneDrive - PNNL\Documents\NRC\RAMP\NRC-Tran\jonathan.napierdownload\highway\_route\_1\highway\_route\_1.kml

Embed WebTRAGIS Route in RADTRAN Input File

Raw Route File Data

# NRC-RADTRAN Use (cont.)



	Name	Vehicle	Pop.Density People/km <sup>2</sup>	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
⊗	Stop_1	Vehicle_1 ▾	2	1	2	0	0

Add Stop

- *Vehicle*: select any vehicle defined in the vehicles tab
- *Population Density*: the population density in # per km<sup>2</sup>
- *Inner Radius*: minimum distance from where dose to public is calculated
- *Outer Radius*: maximum distance till where dose to public is calculated
- *Shielding Factor*: used for dose calculations during a stop
- *Duration*: time period for a given stop in hours

# NRC-RADTRAN Use (cont.)



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

Add Package

## Vehicle Packages (determines radionuclides for accident analysis)

Enter the number of each type of package on each vehicle (leave blank for none).

Vehicle_1	Package_1
	<input type="text" value="1"/>

- Optional for incident free analysis
- Required for accident analysis
- Enter the critical dimension in meters
- Package Dimensions greater than 9 m should not be used

- Enter dose at 1 m from surface and gamma/neutron fraction
- Enter number of packages of given type in each vehicle

# NRC-RADTRAN Use (cont.)



**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 Lvl	Conditional Probability
<input checked="" type="checkbox"/>	1	0.5
<input checked="" type="checkbox"/>	2	0.3
<input checked="" type="checkbox"/>	3	0.2

**Mode**

Highway (1)  
 Rail (2)  
 Waterway (3)

**Population**

Rural (1)  
 Suburban (2)  
 Urban (3)

Del	Sev Lvl	Conditional Probability
<input checked="" type="checkbox"/>	1	0.3
<input checked="" type="checkbox"/>	2	0.4
<input checked="" type="checkbox"/>	3	0.3

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

**Group Name:** Group\_1

Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity
1	0.2	0.4	0.2	0.01 m/s
2	0.3	0.1	0.7	
3	0.1	0.6	0.8	

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

**Group Name:** Group\_2

Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity
1	0.4	0.2	0.5	0.03 m/s
2	0.2	0.3	0.7	
3	0.1	0.3	0.9	

- Optional for incident free analysis
- Required for accident analysis

- Enter dose at 1 m from surface and gamma/ neutron fraction
- Enter number of packages of given type in each vehicle





# NRC-RADTRAN Use (cont.)



Assign radionuclides to packages    Define new radionuclides

Assign isotopes to each package, from both the default isotope list (in the isotope Packages: (to add/remove packages use the Packages tab))

**Package\_1**

Isotope	Release Group	Inventory (Ci)
⊗ NA22 ▼	Group_1 ▼	40000
⊗ CS137 ▼	Group_2 ▼	200000

Add Isotope to Package\_1

Assign radionuclides to packages    Define new radionuclides

Add user-defined radionuclides here, including dose conversion factors.

Isotope	Half Life (days)	Gamma Energy (MeV)	Cloudshine DCF (rem-m <sup>3</sup> /Ci-s)	Groundshine DCF (rem-m <sup>2</sup> /Ci-day)	Effective Inhalation DCF (rem/Ci)	Gonad Inhalation DCF (rem/Ci)	Lung Inhalation DCF (rem/Ci)	Bone Marrow Inhalation DCF (rem/Ci)	Waste Limit (Ci/m <sup>3</sup> )
Add Radionuclide									

- Radionuclide inventory can be defined for package
- Isotope inventory assigned according to release group
- Each package has independent isotope inventory

- User-defined radionuclides can also be defined
- Half-lives, energies, and Dose Conversion Factors (DCFs) are required to be specified

# NRC-RADTRAN Use (cont.)



- *Conditional Probability* and *Fractional Loss* are defined
- Probability for all scenarios shall sum to unity
- Parameters for stop are defined

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 type="checkbox"/>	0.01	0.2
<input type="checkbox"/>	0.9	0.03
<input type="checkbox"/>	0.09	0.3

Suburban (NPOP=2)

	Conditional Probability	Fraction Lost
	0.03	0.02
	0.92	0.03
	0.05	0.05

Urban (NPOP=3)

	Conditional Probability	Fraction Lost
	0.06	0.03
	0.93	0.0001
	0.01	0.06

Add Loss of Shielding Probability

	Name	Vehicle	Pop.Density (People/km <sup>2</sup> )	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
<input type="checkbox"/>	Stop_2	Vehicle_1	2	1	2	0	0

Add Loss of Shielding Event

# NRC-RADTRAN Use (cont.)



- Values of “-1” mean NRC-RADTRAN defaults shall be used
- Potential user defined options include:
  - Residential shielding factors
  - Distance from radioactive packages
  - Dispersion options
  - Transfer coefficients
- REGCHECK: used to force regulatory limits for external dose and crew dose

### 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  Suburban  Urban

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 type="checkbox"/> Freeway	<input type="checkbox"/> City Street	<input type="checkbox"/> Other Road	<input type="checkbox"/> Rail	<input type="checkbox"/> Water
to pedestrians	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>
to right-of-way edge	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>
max exposure distance	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>
to vehicle going opposite direction	<input type="checkbox"/> <input type="text" value="-1"/>	<input type="checkbox"/> <input type="text" value="-1"/>	<input type="checkbox"/> <input type="text" value="-1"/>	<input type="checkbox"/> <input type="text" value="-1"/>	<input type="checkbox"/> <input type="text" value="-1"/>
to vehicle going same direction	<input type="checkbox"/> <input type="text" value="-1"/>				

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

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

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

Minimum small package dimension for handling (SMALLPKG):  m

Minimum perpendicular distance from package to bystander (MITDDIST):  m

Minimum vehicle speed (MITDVEL):  km/hr

Average breathing rate (BRATE):  m<sup>3</sup>/s

Cleanup Level (CULVL):  μCi/m<sup>2</sup>

Interdiction Threshold (INTERDICT):  Ci/mCi

Evacuation time for groundshine (EVACUATION):  days

Survey interval for groundshine (SURVEY):  days

Distance-dependent rail worker exposure factor (DDRWEF):  inspections/km

Latent cancer fatalities per person-REM (LCFCON) for Occupational:  Public:

Duration of shipping campaign (CAMPAIGN):  yr

REMs per Curie thyroid via inhalation (RPCTHYROID):  for

Dispersion option (IACC):  Gaussian (2)  No dispersion (1) - not recommended/no longer used

### Transfer coefficients

	Mu	A(1)	A(2)	A(3)	A(4)
<input type="checkbox"/> Gamma:	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>
<input type="checkbox"/> Neutron:	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>	<input type="text" value="-1"/>



# NRC-RADTRAN Use (cont.)



- *Check* button changes color based on potential Errors and Warnings
- Be certain to resolve errors/ warnings before running or saving
  - Some saved files may not be recoverable without editing the saved text files
- Default save location is not OneDrive

The screenshot shows the NRC-RADTRAN software interface. The main 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 'Check' button is highlighted in orange. The current file path is 'C:\Users\napi143\OneDrive - PNNL\Documents\NRC\RAMP\NRC-Tran\RAMP Test Case.input' and the output is 'Output - None'. The 'Input File Summary: Incident-Free' shows: Vehicles: 0 (0 truck, 0 rail, 0 barge), Packages: 0 containing 0 Ci, Links: 5 covering 722 km, WebTRAGIS Route: NE to WY (21 parts), Stops: 0 lasting 0 hrs, Accident severities: 0, Release Groups: 0, and Isoleths: 18. The 'Analysis Type' is set to 'Incident Free/Intact'. The 'Errors and Warnings' dialog box is open, displaying the following errors and warnings:

**Errors:**

- Error: Link NE\_Rural\_H has no vehicle assigned.
- Error: Link NE\_Subur\_H has no vehicle assigned.
- Error: Link WY\_Rural\_H has no vehicle assigned.
- Error: Link WY\_Subur\_H has no vehicle assigned.
- Error: Link WY\_Urban\_H has no vehicle assigned.

**Warnings:**

- Warning: No vehicles have been defined, so no doses can be calculated.

The left sidebar of the main window contains a list of analysis categories: Vehicles, Links, Stops, Handling, Packages, Accidents, Radionuclides, Loss of Shielding, and Economic Model.

# NRC-RADTRAN Use (cont.)



- Click the *Run* button
- Output window will populate
  - Input Echo – text version of all inputs into the GUI
  - NRC-RADTRAN Output – standard text output also viewable in spreadsheet form
    - ✓ Non-rad incident summary
    - ✓ Exposure Summary for links and Rural, Suburban, Urban transit zones
    - ✓ Input sensitivity analysis (effect of 1% change of input value)
- Automatically saves each run in a new output file

# NRC-RADTRAN Use (cont.)



**RADTRAN Output:**

Text Output

```

NON-RADIOLOGICAL DATA (ACCIDENTS and FATALITIES)
*****
                                HIGHWAY
                                VEHICLE_1

LINK      ACCIDENT RATE    ACCIDENTS    FATALITIES
NE_RURAL_H  1.00E-04      6.29E-02     6.29E-06
NE_SUBUR_H  1.00E-04      2.11E-03     2.11E-07
WY_RURAL_H  1.00E-04      5.76E-03     5.76E-07
WY_SUBUR_H  1.00E-04      1.35E-03     6.75E-07
WY_URBAN_H  1.00E-04      8.50E-05     8.50E-09

TOTALS:                7.22E-02     7.76E-06

                                REGULATORY CHECKS

                                INCIDENT-FREE SUMMARY
                                *****

IN-TRANSIT POPULATION EXPOSURE IN PERSON-REM

                                CREW    OFF LINK    ON LINK
NE_RURAL_H  5.17E-04  1.06E-05   5.52E-05
NE_SUBUR_H  1.66E-05  1.01E-05   2.54E-06
WY_RURAL_H  4.27E-05  1.08E-07   4.09E-06
WY_SUBUR_H  1.23E-05  4.79E-06   2.18E-06
WY_URBAN_H  9.90E-07  1.38E-08   3.04E-07

ZONE
RURAL      5.60E-04  1.07E-05   5.93E-05
SUBURB     2.89E-05  1.49E-05   4.71E-06
URBAN      9.90E-07  1.38E-08   3.04E-07

TOTALS:    5.90E-04  2.57E-05   6.43E-05

                                MAXIMUM INDIVIDUAL IN-TRANSIT DOSE
                                VEHICLE_1  8.60E-09 REM
    
```

**RADTRAN Output:**

Text Output

c1	c2	c3	c4
NON-RADIOLOGICAL DATA (ACCIDENTS and FATALITIES)			
*****			
HIGHWAY			
VEHICLE_1			
LINK	ACCIDENT RATE	ACCIDENTS	FATALITIES
NE_RURAL_H	1.00E-04	6.29E-02	6.29E-06
NE_SUBUR_H	1.00E-04	2.11E-03	2.11E-07
WY_RURAL_H	1.00E-04	5.76E-03	5.76E-07
WY_SUBUR_H	1.00E-04	1.35E-03	6.75E-07
WY_URBAN_H	1.00E-04	8.50E-05	8.50E-09
TOTALS:	-	7.22E-02	7.76E-06
REGULATORY CHECKS			
INCIDENT-FREE SUMMARY			
*****			
IN-TRANSIT POPULATION EXPOSURE IN PERSON-REM			
	CREW	OFF LINK	ON LINK
NE_RURAL_H	5.17E-04	1.06E-05	5.52E-05
NE_SUBUR_H	1.66E-05	1.01E-05	2.54E-06
WY_RURAL_H	4.27E-05	1.08E-07	4.09E-06
WY_SUBUR_H	1.23E-05	4.79E-06	2.18E-06
WY_URBAN_H	9.90E-07	1.38E-08	3.04E-07

# NRC-RADTRAN User Awareness



- Shielding Factors: two runs should be completed using 100% neutron or 100% gamma emissions and the results ratioed externally
- Incident-Free Off-Link Neutron Doses: hand-calculated MEI results do not match NRC-RADTRAN results. Until this issue is investigated and resolved, it is recommended that NRC-RADTRAN should be used to estimate incident-free off-link doses through gamma radiation only
- Rail Crew Doses: for the rail crew gamma and neutron doses calculating a stop with duration of transit will provide a more representative crew dose estimate
- MEI In-Transit Doses: the MEI in-transit doses estimated by NRC-RADTRAN cannot be duplicated using spreadsheet calculations. In addition, gamma and neutron MEI in-transit doses are estimated using the same equations. For this reason, it is recommended that the MEI in-transit doses not be used currently



# NRC-RADTRAN User Awareness



- The LOS model was developed for gamma radiation exposures and does not consider neutron radiation exposures
- The LOS model was based on modeling simulations performed for a generic 5.21-meter-long steel-lead-steel spent nuclear fuel truck transportation cask, and Dennis et al. (2009) states that the model should only be applied to truck transportation casks
- For the inhalation, resuspension, and immersion pathways, NRC-RADTRAN calculates doses using the geometric mean of the depleted atmospheric dilution factors ( $\chi/Q_s$ ). For the groundshine pathway, NRC-RADTRAN calculates doses using the depleted  $\chi/Q_s$ , not the geometric mean of the depleted  $\chi/Q_s$
- For accident risks, NRC-RADTRAN output does not provide totals for the expected values of population risks across all links, and users must sum these quantities externally

# NRC-RADTRAN Updates



- PNNL is actively working to identify solutions to previously noted
- These activities will be covered in the Friday presentation NRC-RADTRAN – Future Work

# Conclusion



- History of RADTRAN was explored
- High-level understanding of RADTRAN concepts were gained
- RADTRAN download and installation procedures covered
- Options and RADTRAN screens explored
- Incident Free and Accident Analysis were covered

**Break until 15:30 KST**



# **NRC-RADTRAN Demo – Incident Free and Accident Analysis**

# Spring RUG 2024 Demonstration



- Analysis Type
  - Both

- Model Inputs
  - Vehicles
  - Links
  - Stops
  - Handling
  - Packages
  - Accidents
  - Radionuclides
  - Loss of Shielding
  - Default Parameters

# Starting File



New Open Save Save As Close Undo (15) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Ppresentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**

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

**Analysis Type**

Incident Free/Intact  
 Accidental Release  
 Both

**Case Title:** April RUG Example 2024

**Output Units:** Becquerel/Sievert    **Text Output Size:** 3 (Full)

**Comments:** IF/Accident Example for Spring RUG Meeting in 2024

Vehicles	Vehicle parameters determine incident-free dose to the public, vehicle crew, and inspectors during transport of one or more radioactive packages.											
Links	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
Stops	Truck_1	Highway	<input type="checkbox"/>	3	12	1	0	2	3	3	0.4	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.

# Links



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

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Ppresentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
 Vehicles: 1 ( 1 truck, 0 rail, 0 barge) Stops: 2 lasting 4 hrs  
 Packages: 1 containing 0 Ci Accident severities: 3  
 Links: 5 covering 722 km Release Groups: 2  
 WebTRAGIS Route: NE to WY (21 parts) Isopleths: 18

**Analysis Type** Case Title: April RUG Example 2024

Incident Free/Intact Output Units: Becquerel/Sievert Text Output Size: 3 (Full)  
 Accidental Release  
 Both Comments: IF/Accident Example for Spring RUG Meeting in 2024

Vehicles

Links

Stops

Handling

Packages

Accidents

Radionuclides

Loss of Shielding

Economic Model

Default Parameters

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):

Name	Vehicle	Mode	Length (km)	Speed (km/hr)	Adjacent Vehicle Occupants	Pop.Density People/km <sup>2</sup>	Traffic (vehicles /hr)	Accidents per km	Deaths per accident	Population Type	Farm fraction if rural
⊗ NE_Rural_H	Truck_1	PrimaryHighway	628.9	110.3	2	39.8	0	1.55E-06	0.0353	Rural	0.5
⊗ NE_Subur_H	Truck_1	PrimaryHighway	21.14	115.5	2	1361.4	0	1.55E-06	0.0353	Suburban	0
⊗ WY_Rural_H	Truck_1	PrimaryHighway	57.61	122.4	2	4.9	0	2.04E-06	0.0353	Rural	0.5
⊗ WY_Subur_H	Truck_1	PrimaryHighway	13.51	99.9	2	870.7	0	4.78E-06	0.0353	Suburban	0
⊗ WY_Urban_H	Truck_1	PrimaryHighway	0.85	77.9	2	1501.6	0	9.58E-07	0.0353	Urban	0

Highway route C:\Users\napi143\OneDrive - PNNL\RADTRAN\KML Files\Lincoln to Cheyenne - Highway\highway\_route\_1.kml

Embed WebTRAGIS Route in RADTRAN Input File



# Stops



New Open Save Save As Close Undo (64) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
 Vehicles: 1 ( 1 truck, 0 rail, 0 barge)    Stops: 2 lasting 4 hrs  
 Packages: 0 containing 0 Ci                    Accident severities: 0  
 Links: 5 covering 722 km                        Release Groups: 0  
 WebTRAGIS Route: NE to WY (21 parts)    Isopleths: 18

**Analysis Type**

Incident Free/Intact

Accidental Release

Both

**Case Title:** April RUG Example 2024

**Output Units:** Becquerel/Sievert    **Text Output Size:** 3 (Full)

**Comments:** IF/Accident Example for Spring RUG Meeting in 2024

	Name	Vehicle	Pop.Density People/km <sup>2</sup>	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
(x)	Stop_1	Truck_1	9900	1	30	0.25	2
(x)	Stop_2	Truck_1	9900	30	800	0.25	2

Add Stop

**Example of a Stop configuration for a highway vehicle**

Vehicles

Links

Stops

Handling

Packages

Accidents

Radionuclides

Loss of Shielding

Economic Model

Default Parameters

# Handling



New Open Save Save As Close Undo (71) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Ppresentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

B (jonathan.napier@pnnl.gov) is signed in

**Accidental Release**  
 Vehicles: 1 ( 1 truck, 0 rail, 0 barge) Stops: 2 lasting 4 hrs  
 Packages: 0 containing 0 Ci Accident severities: 0  
 Links: 5 covering 722 km Release Groups: 0  
 WebTRAGIS Route: NE to WY (21 parts) Isopleths: 18

**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

**Case Title:** April RUG Example 2024  
**Output Units:** Becquerel/Sievert **Text Output Size:** 3 (Full)  
**Comments:** IF/Accident Example for Spring RUG Meeting in 2024

	Name	Vehicle	Persons	Distance (m)	Duration (hr)
<b>Vehicles</b>	Handling_1	Truck_1	2	1	1
<b>Links</b>	Handling_2	Truck_1	3	2	2

Add Handling

# Packages



New Open Save Save As Close Undo (82) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**

Vehicles: 1 ( 1 truck, 0 rail, 0 barge)    Stops: 2 lasting 4 hrs  
 Packages: 1 containing 0 Ci                Accident severities: 0  
 Links: 5 covering 722 km                 Release Groups: 0  
 WebTRAGIS Route: NE to WY (21 parts)    Isopleths: 18

**Analysis Type**

Incident Free/Intact  
 Accidental Release  
 Both

Case Title: April RUG Example 2024

Output Units: Becquerel/Sievert    Text Output Size: 3 (Full)

Comments: IF/Accident Example for Spring RUG Meeting in 2024

Vehicles	<p>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.</p> <p> <input type="button" value="Package_1"/> Largest (critical) dimension (m): <input type="text" value="3"/> Dose rate 1 m from surface (mrem/hr): <input type="text" value="12"/> Gamma fraction: <input type="text" value="1"/> Neutron fraction: <input type="text" value="0"/> </p> <p><input type="button" value="Add Package"/></p>						
Links							
Stops							
Handling							
Packages	<p><b>Vehicle Packages (determines radionuclides for accident analysis)</b></p> <p>Enter the number of each type of package on each vehicle (leave blank for none).</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"></td> <td style="width: 30%; text-align: center;">Package_1</td> <td style="width: 40%;"></td> </tr> <tr> <td style="text-align: center;">Truck_1</td> <td style="text-align: center;"><input type="text" value="1"/></td> <td></td> </tr> </table>		Package_1		Truck_1	<input type="text" value="1"/>	
	Package_1						
Truck_1	<input type="text" value="1"/>						
Accidents							
Radionuclides							
Loss of Shielding							
Economic Model							
Default Parameters							



# Accidents



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

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
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**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

Case Title: Apri  
 Output Units: Bec  
 Comments: IF/A

Vehicles	Severity Probabilities	Release Groups	Weather	Isopleths (Dispersion Areas)																								
Links	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.																											
Stops	<input checked="" type="checkbox"/> Use one set of probabilities for all groups																											
Handling	<table border="1"> <thead> <tr> <th>Mode</th> <th>Mode</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td><input checked="" type="radio"/> Highway (1)</td> <td><input checked="" type="radio"/> Highway (1)</td> <td><input checked="" type="radio"/> Highway (1)</td> </tr> <tr> <td><input type="radio"/> Rail (2)</td> <td><input type="radio"/> Rail (2)</td> <td><input type="radio"/> Rail (2)</td> </tr> <tr> <td><input type="radio"/> Waterway (3)</td> <td><input type="radio"/> Waterway (3)</td> <td><input type="radio"/> Waterway (3)</td> </tr> </tbody> </table>			Mode	Mode	Mode	<input checked="" type="radio"/> Highway (1)	<input checked="" type="radio"/> Highway (1)	<input checked="" type="radio"/> Highway (1)	<input type="radio"/> Rail (2)	<input type="radio"/> Rail (2)	<input type="radio"/> Rail (2)	<input type="radio"/> Waterway (3)	<input type="radio"/> Waterway (3)	<input type="radio"/> Waterway (3)													
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Packages	<table border="1"> <thead> <tr> <th>Population</th> <th>Population</th> <th>Population</th> </tr> </thead> <tbody> <tr> <td><input checked="" type="radio"/> Rural (1)</td> <td><input type="radio"/> Rural (1)</td> <td><input type="radio"/> Rural (1)</td> </tr> <tr> <td><input type="radio"/> Suburban (2)</td> <td><input checked="" type="radio"/> Suburban (2)</td> <td><input type="radio"/> Suburban (2)</td> </tr> <tr> <td><input type="radio"/> Urban (3)</td> <td><input type="radio"/> Urban (3)</td> <td><input checked="" type="radio"/> Urban (3)</td> </tr> </tbody> </table>			Population	Population	Population	<input checked="" type="radio"/> Rural (1)	<input type="radio"/> Rural (1)	<input type="radio"/> Rural (1)	<input type="radio"/> Suburban (2)	<input checked="" type="radio"/> Suburban (2)	<input type="radio"/> Suburban (2)	<input type="radio"/> Urban (3)	<input type="radio"/> Urban (3)	<input checked="" type="radio"/> Urban (3)													
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Accidents	<table border="1"> <thead> <tr> <th>Sev Del</th> <th>Conditional Probability</th> <th>Sev Del</th> <th>Conditional Probability</th> <th>Sev Del</th> <th>Conditional Probability</th> </tr> </thead> <tbody> <tr> <td><input checked="" type="checkbox"/> 1</td> <td>0.75</td> <td><input checked="" type="checkbox"/> 1</td> <td>0.75</td> <td><input checked="" type="checkbox"/> 1</td> <td>0.75</td> </tr> <tr> <td><input checked="" type="checkbox"/> 2</td> <td>0.2</td> <td><input checked="" type="checkbox"/> 2</td> <td>0.2</td> <td><input checked="" type="checkbox"/> 2</td> <td>0.2</td> </tr> <tr> <td><input checked="" type="checkbox"/> 3</td> <td>0.05</td> <td><input checked="" type="checkbox"/> 3</td> <td>0.05</td> <td><input checked="" type="checkbox"/> 3</td> <td>0.05</td> </tr> </tbody> </table>			Sev Del	Conditional Probability	Sev Del	Conditional Probability	Sev Del	Conditional Probability	<input checked="" type="checkbox"/> 1	0.75	<input checked="" type="checkbox"/> 1	0.75	<input checked="" type="checkbox"/> 1	0.75	<input checked="" type="checkbox"/> 2	0.2	<input checked="" type="checkbox"/> 2	0.2	<input checked="" type="checkbox"/> 2	0.2	<input checked="" type="checkbox"/> 3	0.05	<input checked="" type="checkbox"/> 3	0.05	<input checked="" type="checkbox"/> 3	0.05	
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Radionuclides	<div style="text-align: right;"> <input type="button" value="Add Group"/>  <input type="button" value="Remove Selected Group"/> </div>																											
Loss of Shielding																												
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New Open Save Save As Close Undo (99) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

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**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

Case Title: Apri  
 Output Units: Be  
 Comments: IF/A

Vehicles	Severity Probabilities	Release Groups	Weather	Isopleths (Dispersion Areas)																				
Links	<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>0.05</td> <td>0.01 m/s</td> </tr> <tr> <td>2</td> <td>0.05</td> <td>1</td> <td>0.05</td> <td></td> </tr> <tr> <td>3</td> <td>0.25</td> <td>1</td> <td>0.90</td> <td></td> </tr> </tbody> </table>				Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity	1	0	1	0.05	0.01 m/s	2	0.05	1	0.05		3	0.25	1	0.90	
Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity																				
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3	0.25	1	0.90																					
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Severity Level	Release Fraction	Aerosol Fraction	Respirable Fraction	Deposition Velocity																				
1	0	0	1	0 m/s																				
2	0.3	1	1																					
3	1	1	1																					
Handling	<div style="text-align: right;"> <input type="button" value="Add Group"/>  <input type="button" value="Remove Selected Group"/> </div>																							
Packages	<p>To add/remove rows (severity levels), use the Severity Probabilities tab.</p>																							
Accidents																								
Radionuclides																								
Loss of Shielding																								
Economic Model																								
Default Parameters																								

# Accidents



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

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
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**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

**Case Title** Output U Comment

Vehicles	Severity Probabilities	Release Groups	Weather	Isoleths (Dispersion Areas)																				
Links	<b>Weather option:</b> <input checked="" type="radio"/> National Average (0) <input type="radio"/> Pasquill Class (1) <input type="radio"/> User-defined (2) Pasquill Stability Class Fractions A -1 B -1 C -1 D -1 E -1 F -1																							
Stops	<b>User-Defined Weather Parameters</b> <table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>Release Height (m)</td><td>-1</td></tr> <tr><td>Heat Release (cal/sec)</td><td>-1</td></tr> <tr><td>Source Width (Cask Length) (m)</td><td>-1</td></tr> <tr><td>Source Height (Cask Radius) (m)</td><td>-1</td></tr> <tr><td>Wind Speed at Anemometer (m/s)</td><td>-1</td></tr> <tr><td>Anemometer Height (m)</td><td>-1</td></tr> <tr><td>Ambient Temperature (K)</td><td>-1</td></tr> <tr><td>Atmospheric Mixing Height (m)</td><td>-1</td></tr> <tr><td>Rainfall Rate (mm/hr)</td><td>-1</td></tr> </tbody> </table>				Parameter	Value	Release Height (m)	-1	Heat Release (cal/sec)	-1	Source Width (Cask Length) (m)	-1	Source Height (Cask Radius) (m)	-1	Wind Speed at Anemometer (m/s)	-1	Anemometer Height (m)	-1	Ambient Temperature (K)	-1	Atmospheric Mixing Height (m)	-1	Rainfall Rate (mm/hr)	-1
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Source Width (Cask Length) (m)	-1																							
Source Height (Cask Radius) (m)	-1																							
Wind Speed at Anemometer (m/s)	-1																							
Anemometer Height (m)	-1																							
Ambient Temperature (K)	-1																							
Atmospheric Mixing Height (m)	-1																							
Rainfall Rate (mm/hr)	-1																							
Handling	<b>Release point:</b> <input type="radio"/> (0) Allow elevated (preferred) <input type="radio"/> (1) Ground level (only if release height is less than 3m)																							
Packages	<b>Dispersion coefficients:</b> <input type="radio"/> (1) Pasquill-Gifford <input type="radio"/> (2) Briggs																							
Accidents	<b>Pasquill stability class:</b> <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E <input type="radio"/> F																							
Radionuclides	<b>Release location:</b> <input type="radio"/> (1) Rural <input type="radio"/> (2) Urban/Suburban																							
Loss of Shielding																								
Economic Model																								
Default Parameters																								

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

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**  
 Vehicles: 1 ( 1 truck, 0 rail, 0 barge) Stops: 2 lasting 4 hrs  
 Packages: 1 containing 0 Ci Accident severities: 3  
 Links: 5 covering 722 km Release Groups: 2  
 WebTRAGIS Route: NE to WY (21 parts) Isoleths: 18

**Analysis Type**  
 Incident Free/Intact  
 Accidental Release  
 Both

**Case Title** Output U Comment

Vehicles	Severity Probabilities	Release Groups	Weather	Isoleths (Dispersion Areas)						
Links	<b>Number of Isoleths: 18</b> <input type="button" value="Add Isoleth"/> <input type="button" value="Remove Isoleth"/>									
Stops	<b>Population Density (ISOPLETHP):</b> <input checked="" type="radio"/> From Links table <input type="radio"/> Custom									
Handling	<input type="checkbox"/> Edit isopleth information									
Packages	<table border="1"> <thead> <tr> <th>Area (m<sup>2</sup>)</th> <th>Centerline Distance (m)</th> <th>Dilution Factor (Ci-s/m<sup>3</sup>/Ci released)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Area (m <sup>2</sup> )	Centerline Distance (m)	Dilution Factor (Ci-s/m <sup>3</sup> /Ci released)			
Area (m <sup>2</sup> )	Centerline Distance (m)	Dilution Factor (Ci-s/m <sup>3</sup> /Ci released)								
Accidents										
Radionuclides										
Loss of Shielding										
Economic Model										
Default Parameters										



# Radionuclides



New Open Save Save As Close Undo (12) Redo (0) Options Check Run Help About

C:\Users\napi143\OneDrive - PNNL\RADTRAN\Ppresentations\Spring RUG 24\Example - IF & Accident.input\* Output - None

**Input File Summary: Incident-Free & Accidental Release**

Vehicles: 1 ( 1 truck, 0 rail, 0 barge)    Stops: 2 lasting 4 hrs  
 Packages: 1 containing 19 Ci                Accident severities: 3  
 Links: 5 covering 722 km                    Release Groups: 2  
 WebTRAGIS Route: NE to WY (21 parts)    Isopleths: 18

**Analysis Type**

Incident Free/Intact  
 Accidental Release  
 Both

**Case Title:** April RUG Example 2024  
**Output Units:** Becquerel/Sievert    **Text Output Size:** 3 (Full)  
**Comments:** IF/Accident Example for Spring RUG Meeting in 2024

Vehicles

---

Links

---

Stops

---

Handling

---

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)

**Package\_1**

	Isotope	Release Group	Inventory (Ci)
(x)	H3WTR ▼	GAS ▼	10
(x)	SR90 ▼	PART ▼	5
(x)	CS137 ▼	PART ▼	1
(x)	AM241 ▼	PART ▼	3

Add Isotope to Package\_1

# Loss of Shielding



C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input\*

Output - None

**Input File Summary: Incident-Free & Accidental Release**

Vehicles: 1 ( 1 truck, 0 rail, 0 barge) Stops: 2 lasting 4 hrs  
 Packages: 1 containing 39 Ci Accident severities: 3  
 Links: 5 covering 722 km Release Groups: 2  
 WebTRAGIS Route: NE to WY (21 parts) Isopleths: 18

**Analysis Type**

- Incident Free/Intact
- Accidental Release
- Both

Case Title: April RUG Example 2024

Output Units: Becquerel/Sievert

Text Output Size: 3 (Full)

Comments: IF/Accident Example for Spring RUG Meeting in 2024

- Vehicles
- Links
- Stops
- Handling
- 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
⊗	0.99	0
⊗	0.009	0.001
⊗	0.0009	0.1
⊗	9E-05	0.5
⊗	1E-06	1

**Suburban (NPOP=2)**

	Conditional Probability	Fraction Lost
	0.99	0
	0.009	0.001
	0.0009	0.1
	9E-05	0.5
	1E-06	1

**Urban (NPOP=3)**

	Conditional Probability	Fraction Lost
	0.99	0
	0.009	0.001
	0.0009	0.1
	9E-05	0.5
	1E-06	1

Add Loss of Shielding Probability

	Name	Vehicle	Pop.Density (People/km <sup>2</sup> )	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
⊗	LOS_1	Truck_1	2	30	800	1	10
⊗	LOS_2	Truck_1	2	30	800	0.01	10
⊗	LOS_3	Truck_1	2	1	30	1	10

Add Loss of Shielding Event

# Preparing to Run the Analysis



- Verify the Economic Model is NOT in use
- Verify the Default Parameters are -1
- Current Production Version uses -1 as the indicator for use of a default value
- Click the “Check” button to observe any Errors or Warnings
- Click the “Run”
- Outputs are automatically saved in C:\Users\XXX\NRCRADTRAN\Calculations
- XXX is your username on your computer
- Output is discussed outside of this presentation but will be identical if prepared using the inputs listed.

# Conclusion



- Incident Free and Accident Analysis were covered
- Included an active demonstration of Creating, Running, and understanding results reported by NRC-RADTRAN

**Questions?**





Thank you

