NRC-RADTRAN – Introduction/ Exercise

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Outline

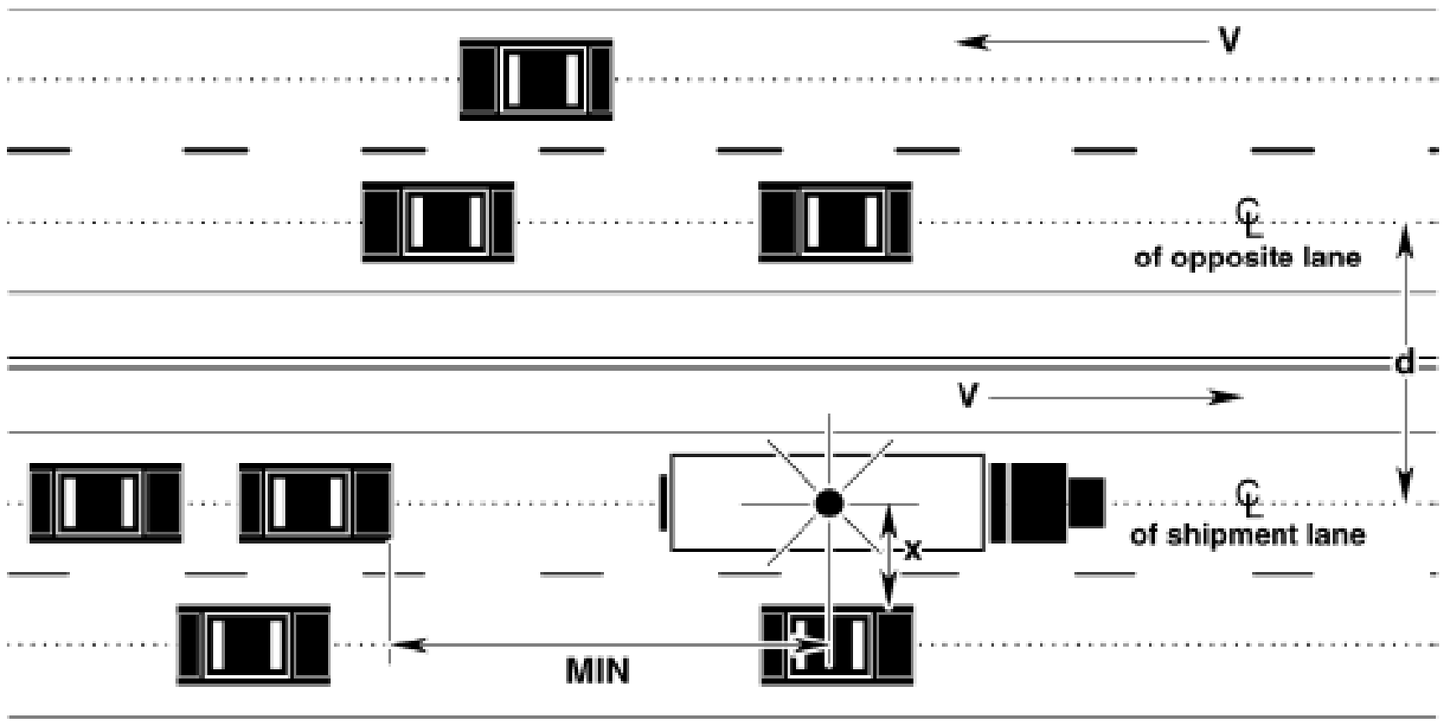
- Introduction
- NRC-RADTRAN Concepts
- NRC-RADTRAN Installation
- NRC-RADTRAN Use
- NRC-RADTRAN Demo
- Conclusions

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.)

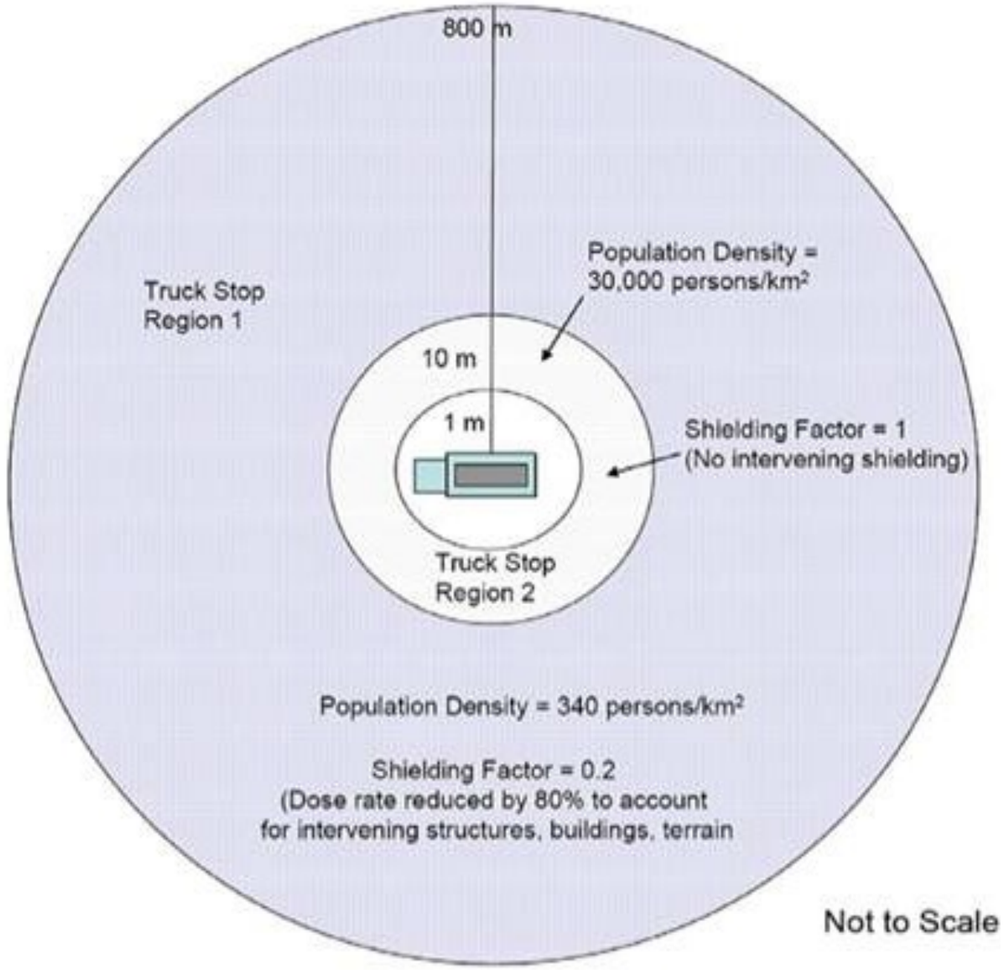


Figure 6-2 Illustration of the Truck Stop Model

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

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.)

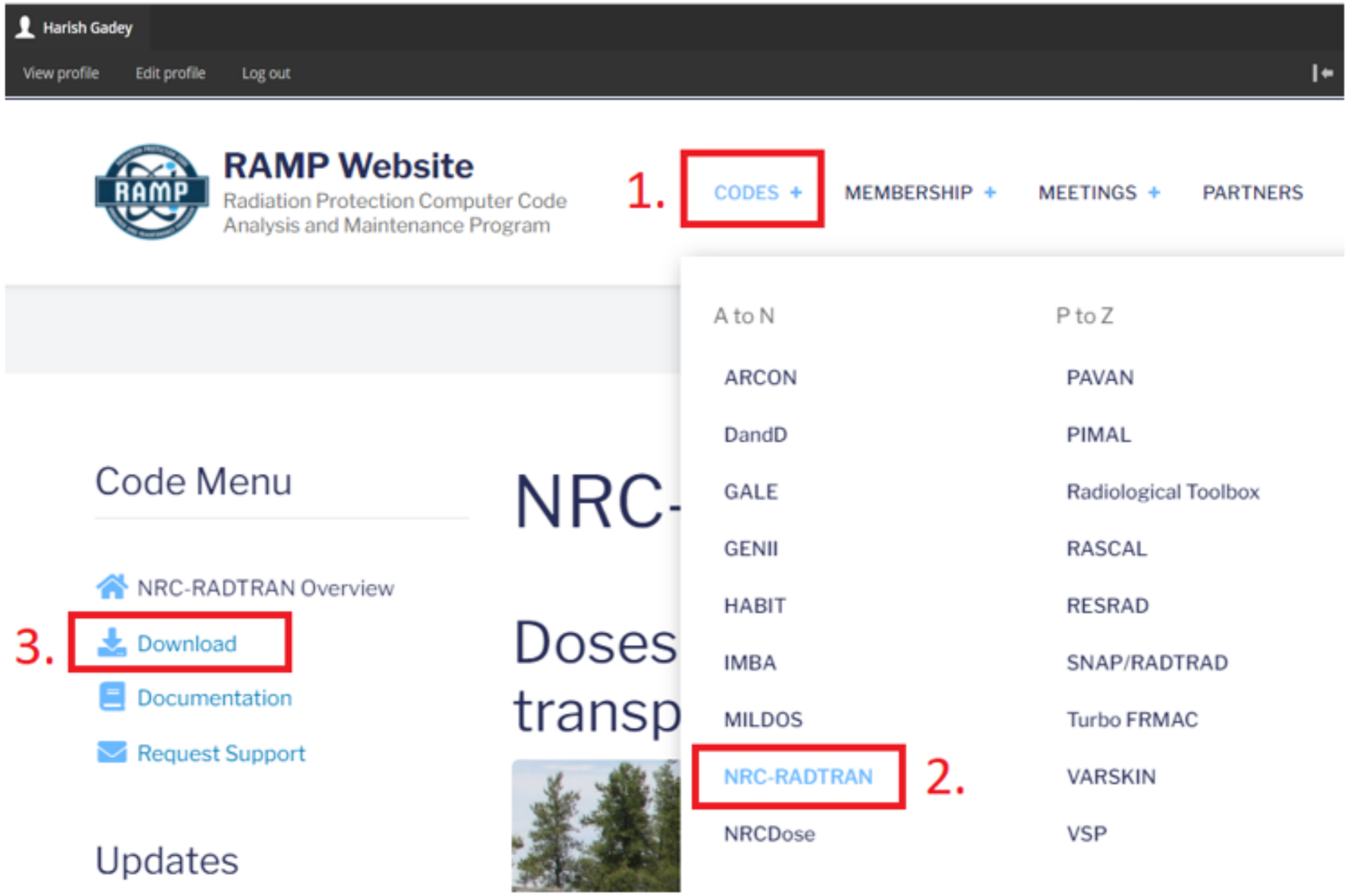
- Doses are calculated and summed for all appropriate exposure pathways for all isotopes in each material for the shipment(s) being analyzed and for all downwind isopleths for each accident severity to yield a consequence (total dose) per accident of each severity
- Probability of occurrence of each 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

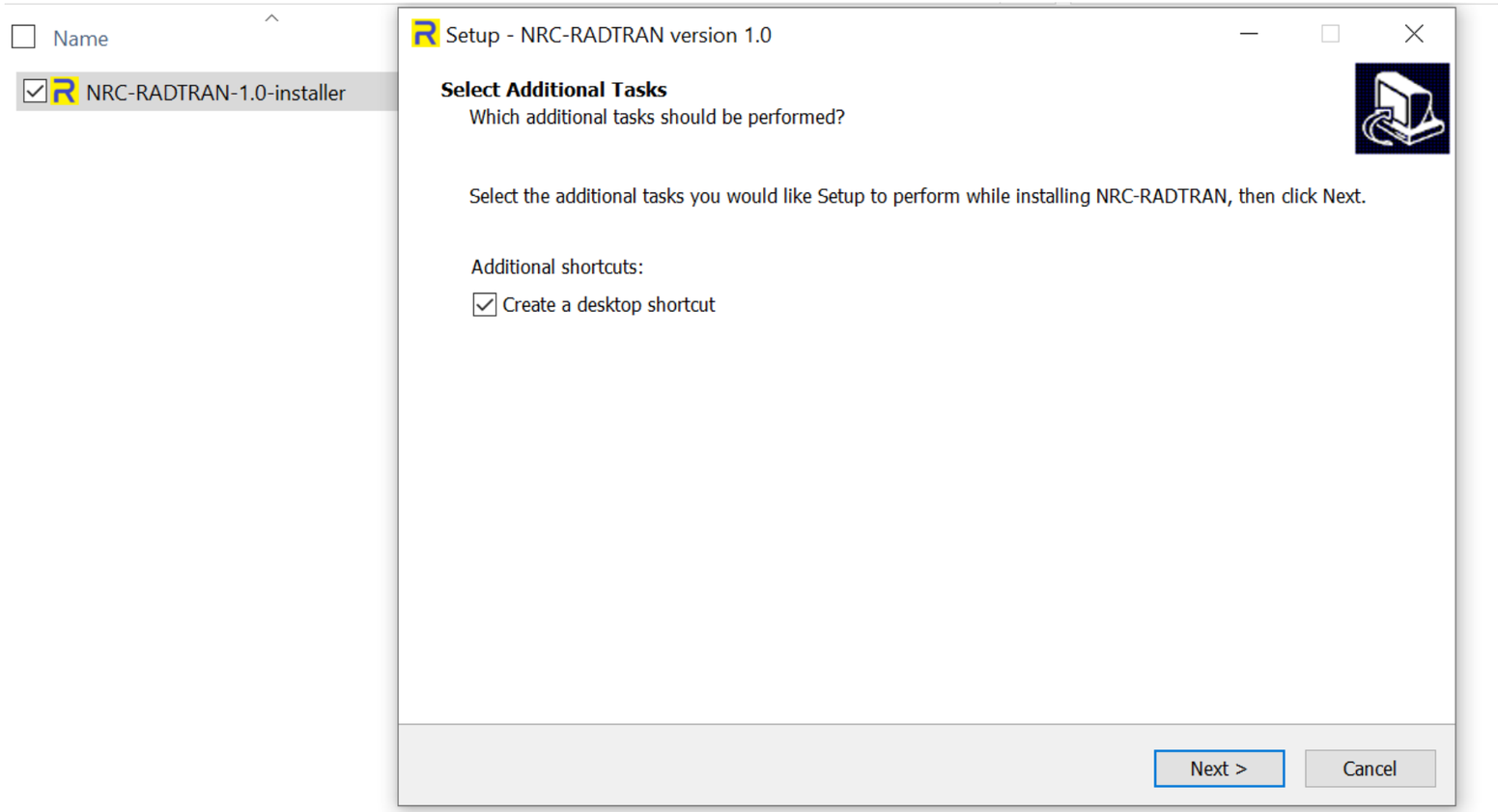
NRC-RADTRAN Installation

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



NRC-RADTRAN Installation (cont.)

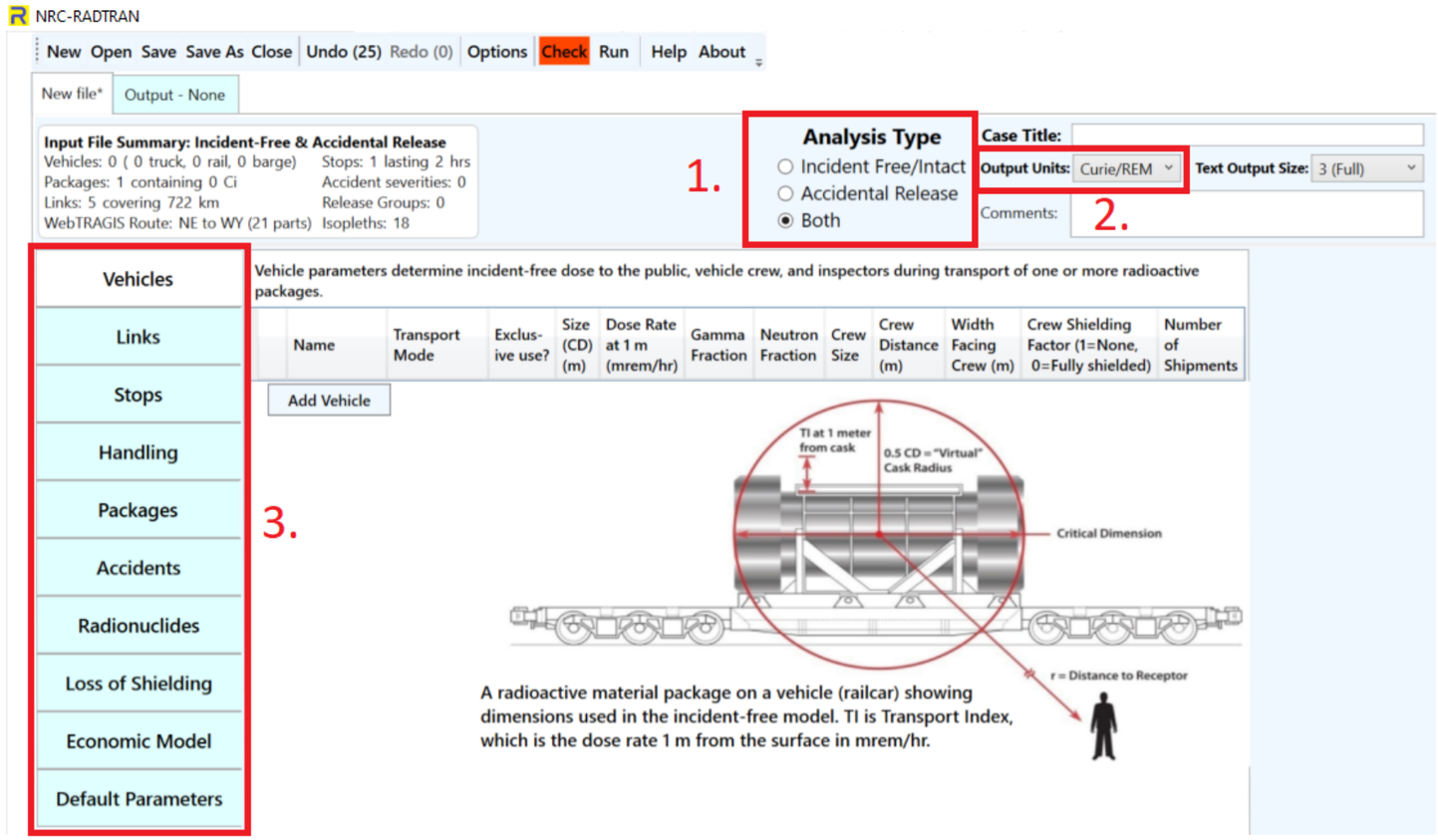
- Double click on the downloaded file to install



NRC-RADTRAN Use

Defining the problem:

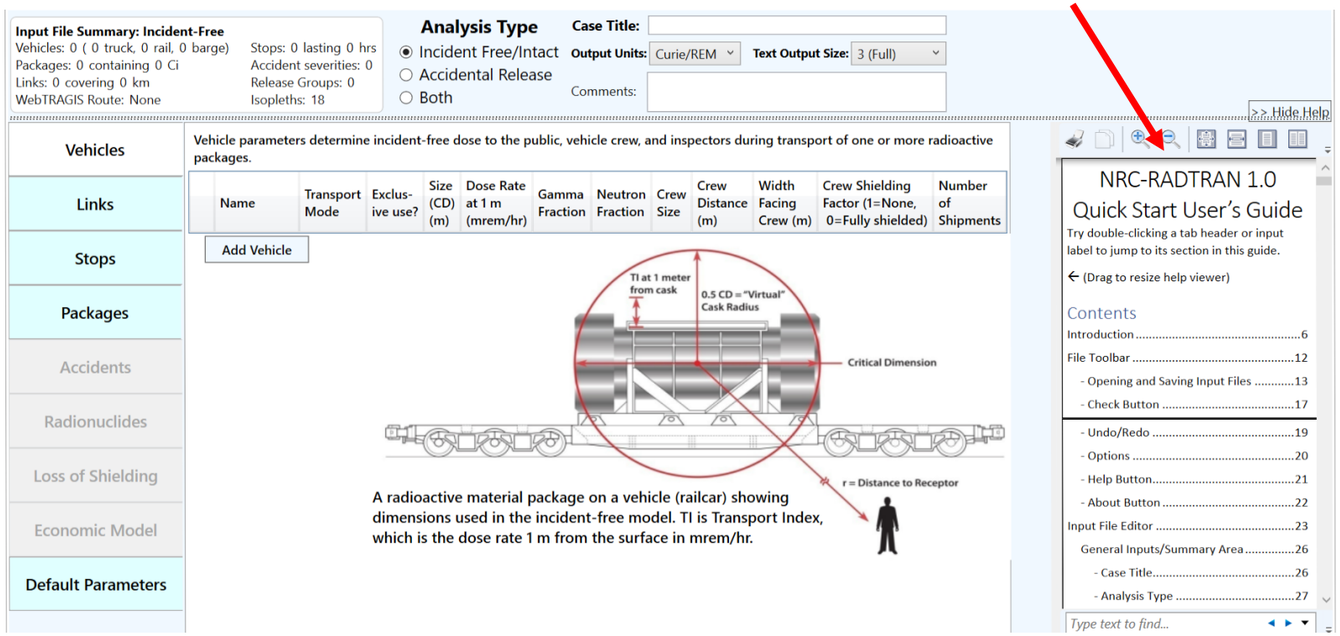
1. Type of Analysis
2. Units
   - Curies/ Rem
   - Bq/Sv
3. Item 1 selection dictates available input panels



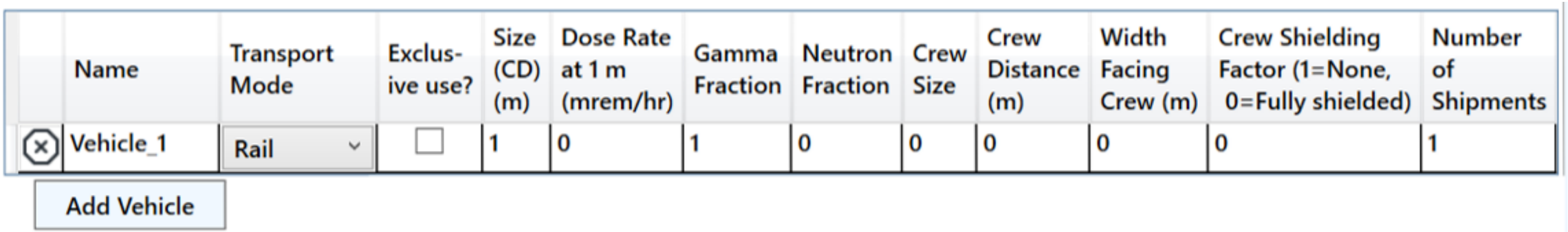
NRC-RADTRAN Use (cont.)

- 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



NRC-RADTRAN Use (cont.)



	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
⊗	Vehicle_1	Rail	☐	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^2	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.)

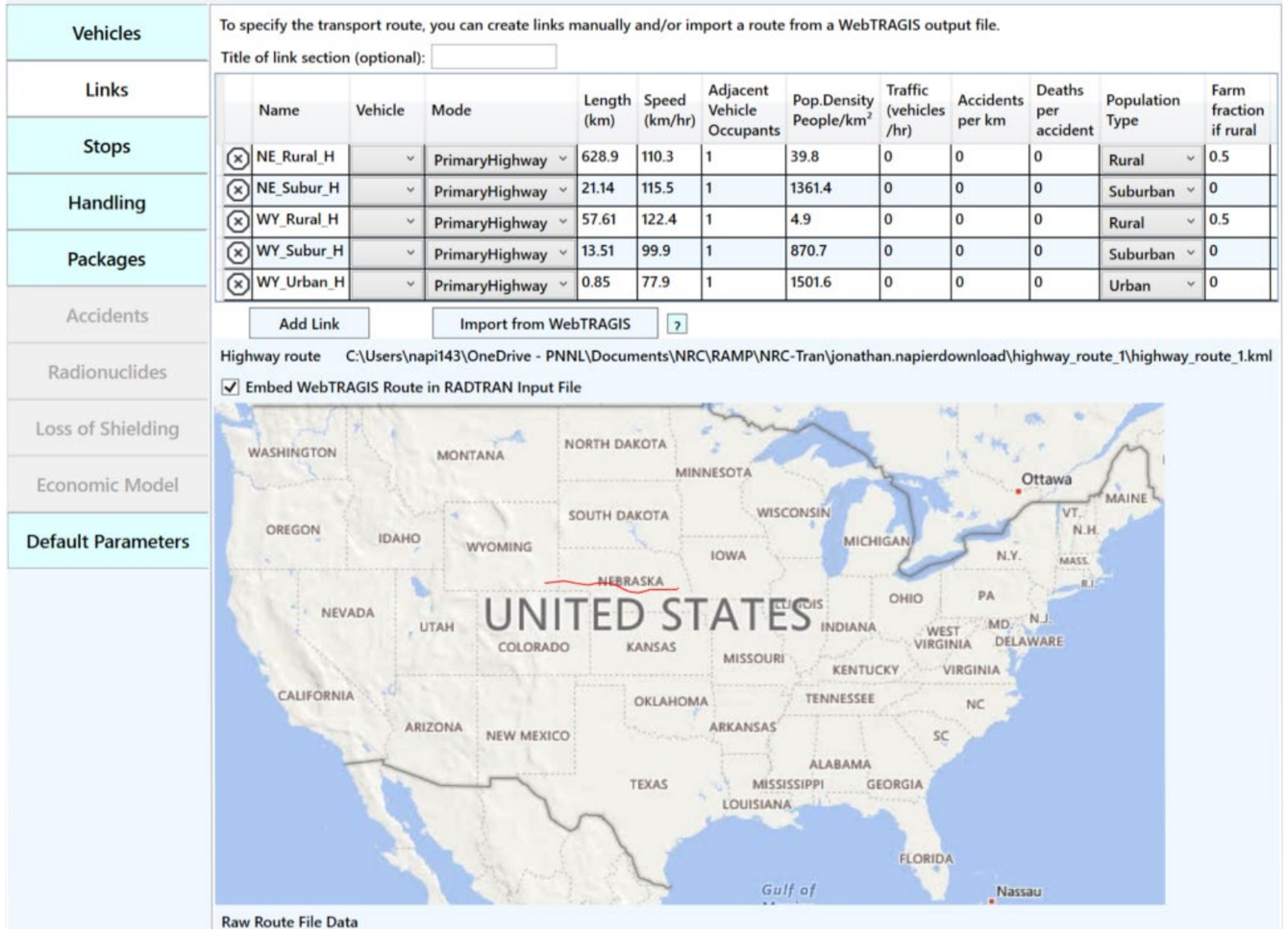
- WebTRAGIS information is intersection based
- Each link is the distance between two intersections
  - Uses known
    - ✓Population density
    - ✓Distance
    - ✓Speed
    - ✓Time of transit

Raw Route File Data

Segment ID	State	Rural Dist. (km)	Suburban Dist. (km)	Urban Dist. (km)	Rural Pop./km²	Suburban Pop./km²	Urban Pop./km²	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	85.30339	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	-97.597	40.822	40.821
31000007813	NE	33.619273	0	0	1.6860701	0	0	118.65624	0.283333	-97.597	-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	-99.085	40.820	40.669
31000007837	NE	24.3591311	0.6319524	0	4.0554827	92.303971	0	124.95538	0.200000	-99.085	-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	41.111
31000007780	NE	78.903204	1.95711837	0	1.7693489	129.63676	0	121.29046	0.666666	-100.76	-101.71	41.111	41.115
31000007783	NE	38.479319	0	0	1.2944100	0	0	121.51357	0.316666	-101.71	-102.15	41.115	41.026
31000007784	NE	68.228934	0.1666873	0	0.322960	67.267824	0	120.69817	0.566666	-102.15	-102.94	41.026	41.113
31000007778	NE	0.1945772	1.8506766	0	33.157266	129.51591	0	122.71710	0.016666	-102.94	-102.97	41.113	41.113
31000007776	NE	5.2526765	0	0	5.9683196	0	0	105.05313	0.050000	-102.97	-103.03	41.113	41.126
31000007645	NE	55.501630	0	0	0.6387937	0	0	57.415477	0.966666	-103.03	-103.66	41.126	41.216
31000007762	NE	33.126976	0.0415692	0	0.8497031	62.170092	0	124.38216	0.266666	-103.66	-104.05	41.216	41.180

NRC-RADTRAN Use (cont.)

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



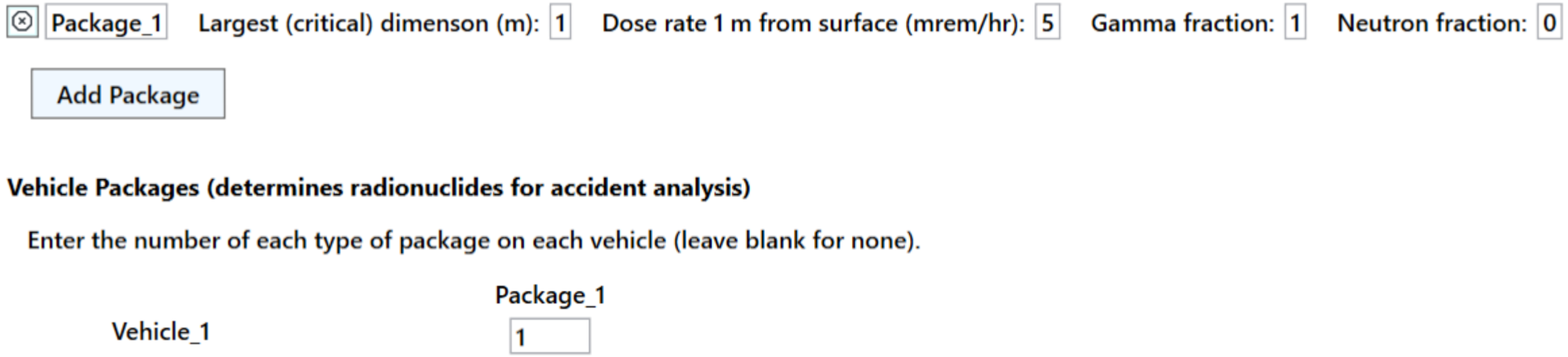
NRC-RADTRAN Use (cont.)

	Name	Vehicle	Pop.Density People/km^2	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^2
- *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

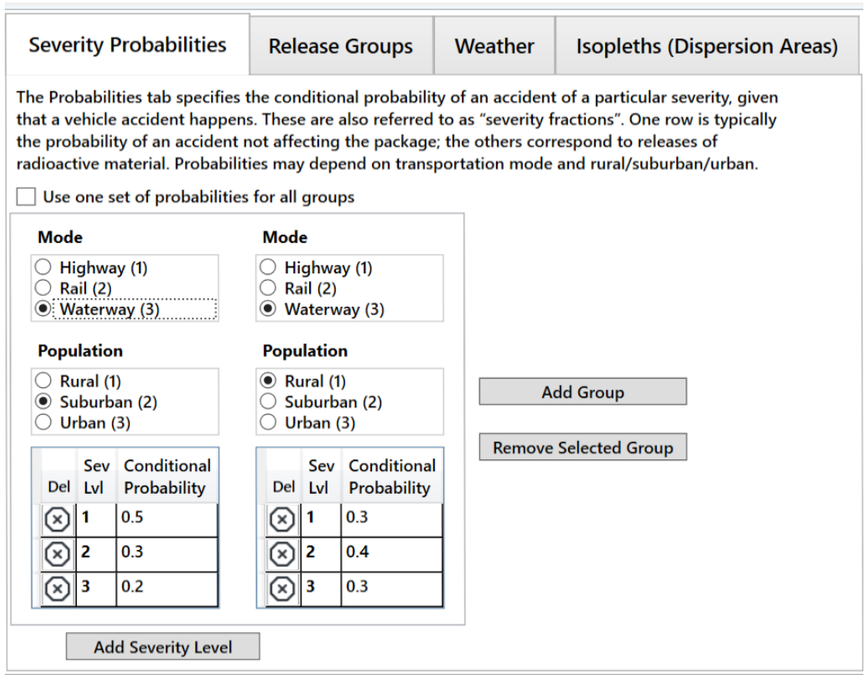
NRC-RADTRAN Use (cont.)

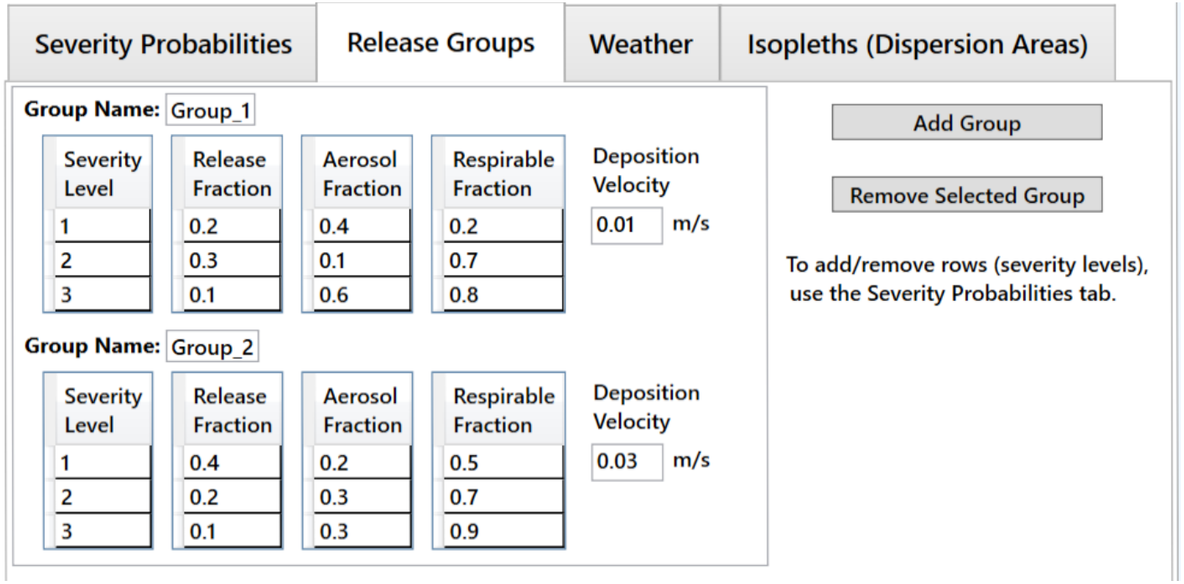


- Optional for incident free analysis
- Required for accident analysis
- Enter the critical dimension in meters
- Package Dimensions greater than 9 m should not be used

- 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.)





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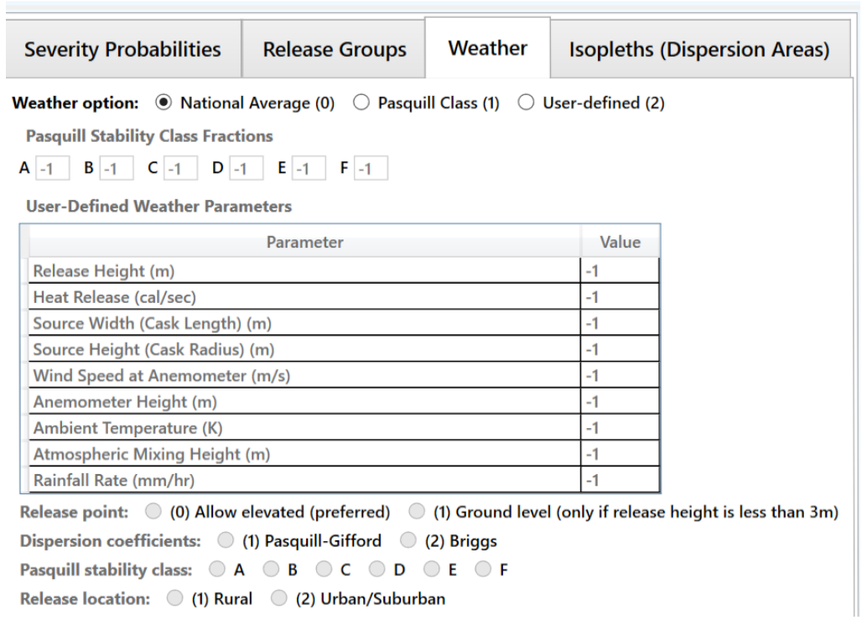
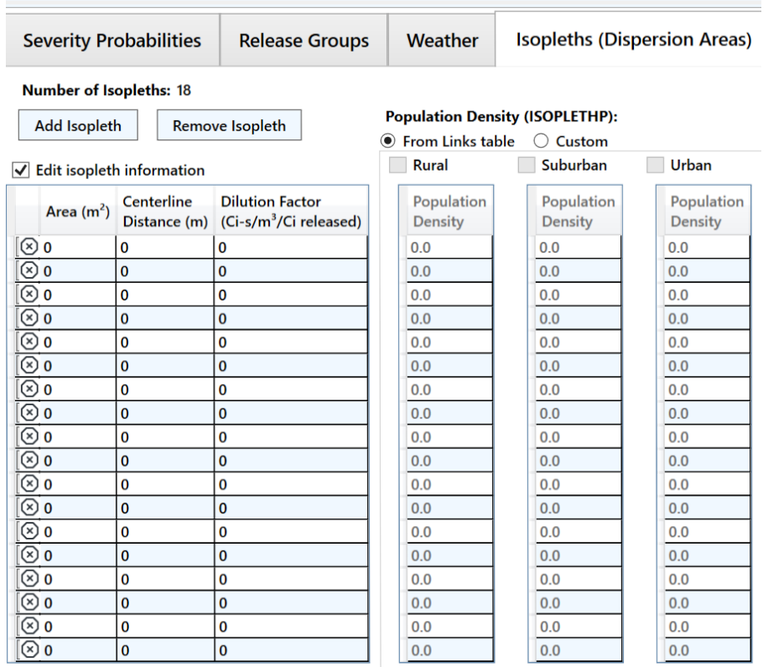
NRC-RADTRAN Use (cont.)

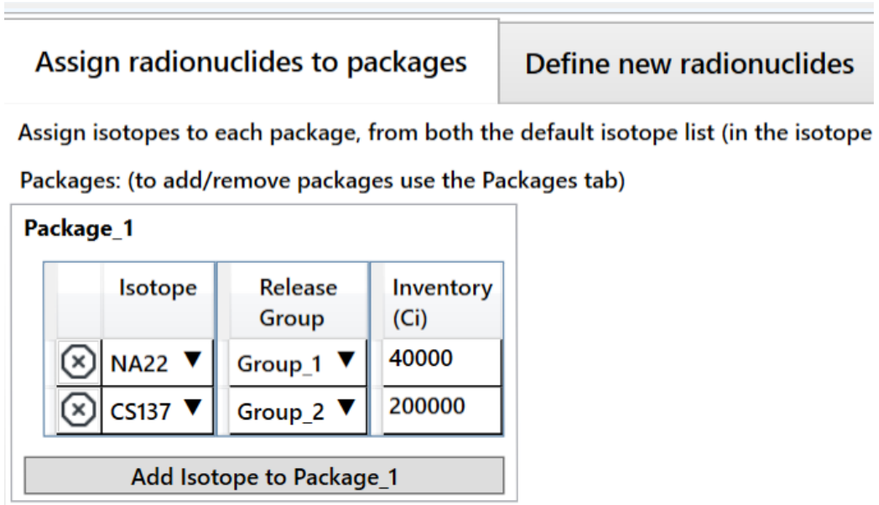


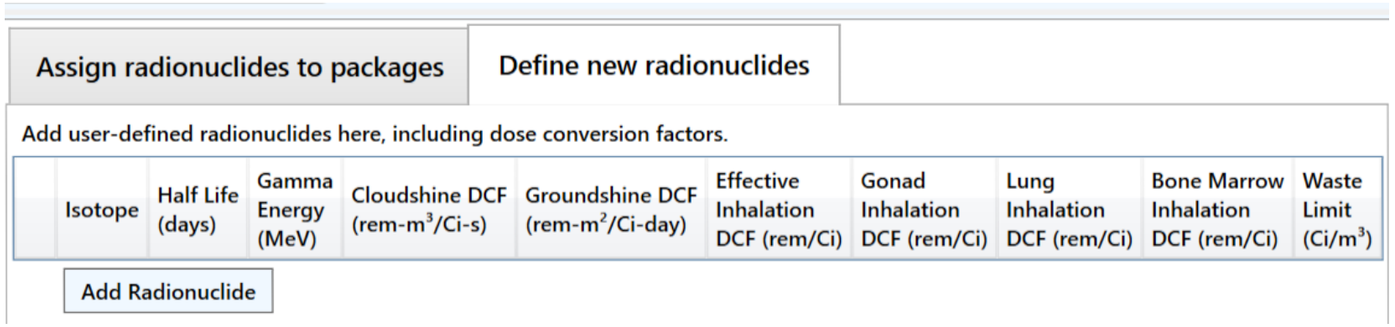


- *National Average (0)*: simplest and requires no inputs
- *Pasquill Class (1)*: requires values for each Pasquill stability class
- *User-Defined (2)*: allows more detailed analysis

- Define area, centerline distance, and dilution factor of each isopleth (max. number of isopleths: 18)
- NOTE: if population density is being used, first two isopleths shall have same population density

NRC-RADTRAN Use (cont.)





- 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
⊗	0.01	0.2
⊗	0.9	0.03
⊗	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

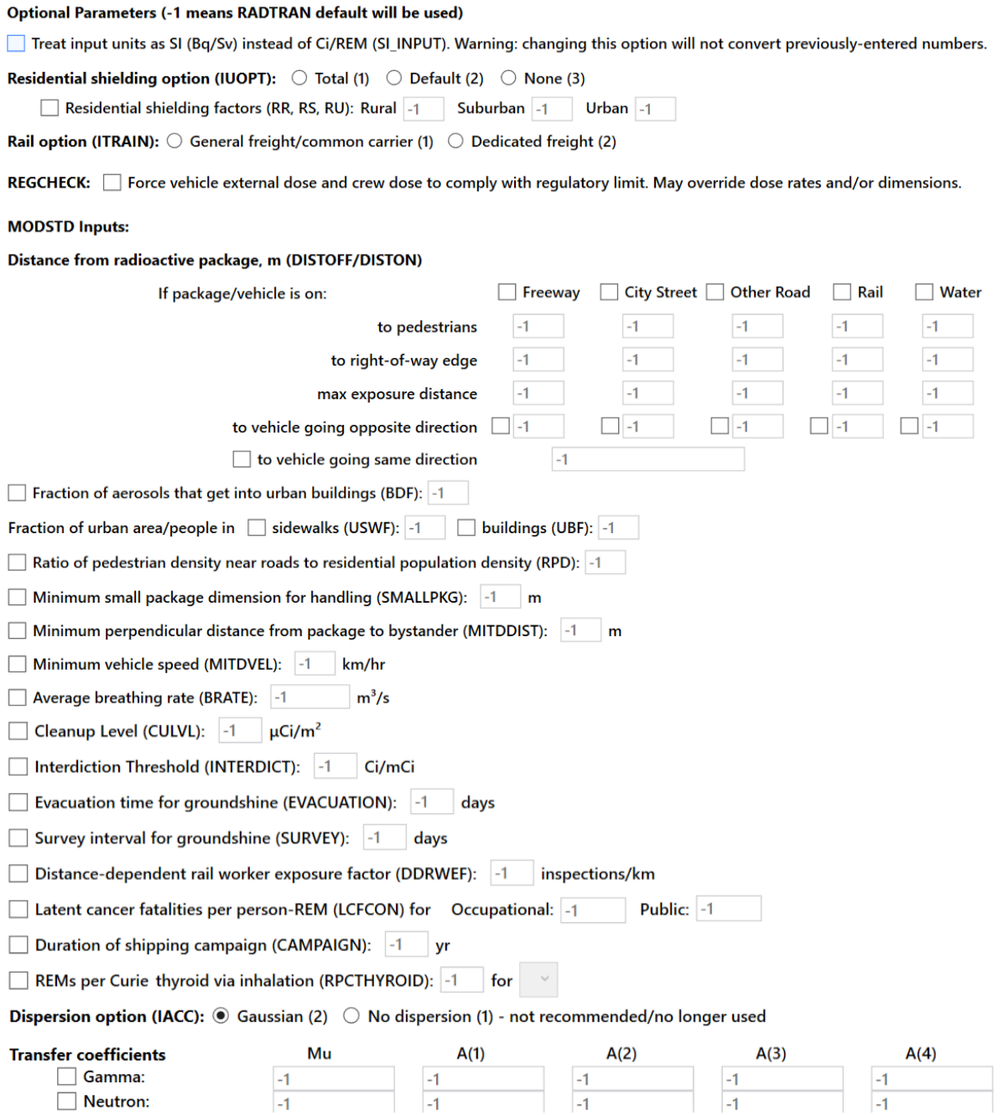
Add Loss of Shielding Probability

	Name	Vehicle	Pop.Density (People/km^2)	Inner Radius (m)	Outer Radius (m)	Shielding Factor (1.0 = none, 0 = fully shielded)	Duration (hr)
⊗	Stop_2	Vehicle_1	2	1	2	0	0

Add Loss of Shielding Event

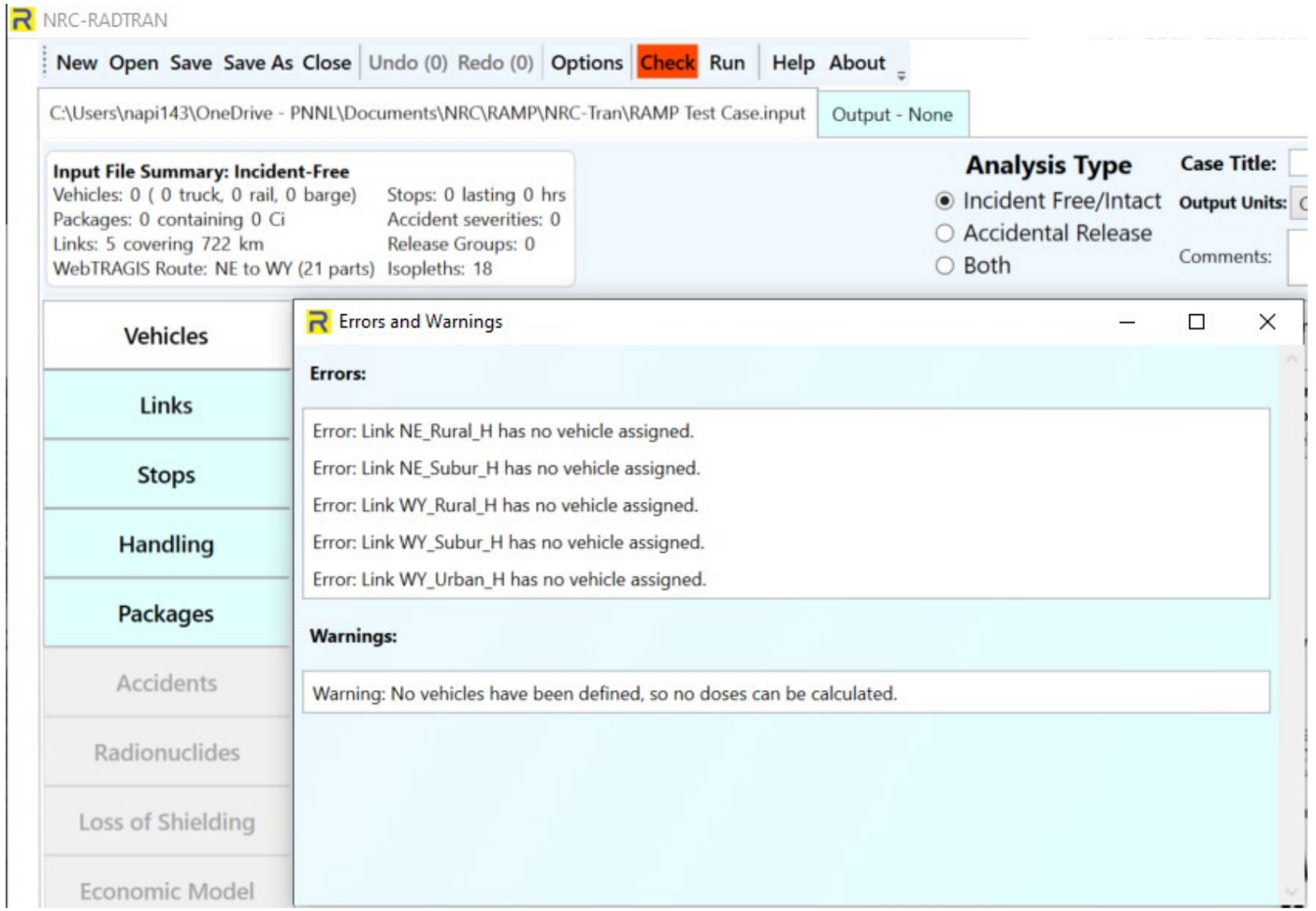
NRC-RADTRAN Use (cont.)

- 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



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



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: Save Output as CSV

Text Output | Spreadsheet

```
                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: Save Output as CSV

Text Output | Spreadsheet

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 (χ/Qs). For the groundshine pathway, NRC-RADTRAN calculates doses using the depleted χ/Qs, not the geometric mean of the depleted χ/Qs
- 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

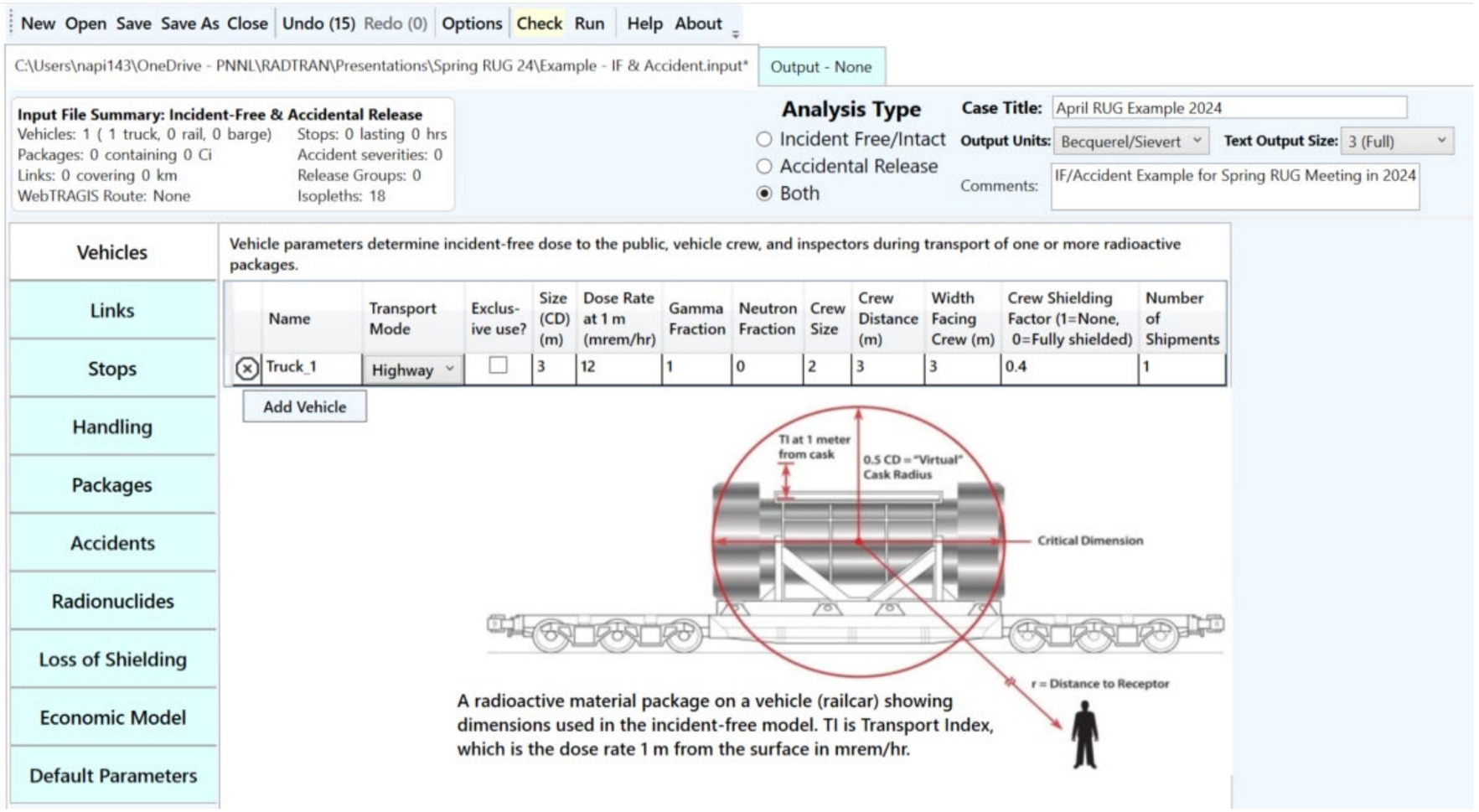
NRC-RADTRAN Demo – Incident Free and Accident Analysis

Spring RUG 2024 Demonstration

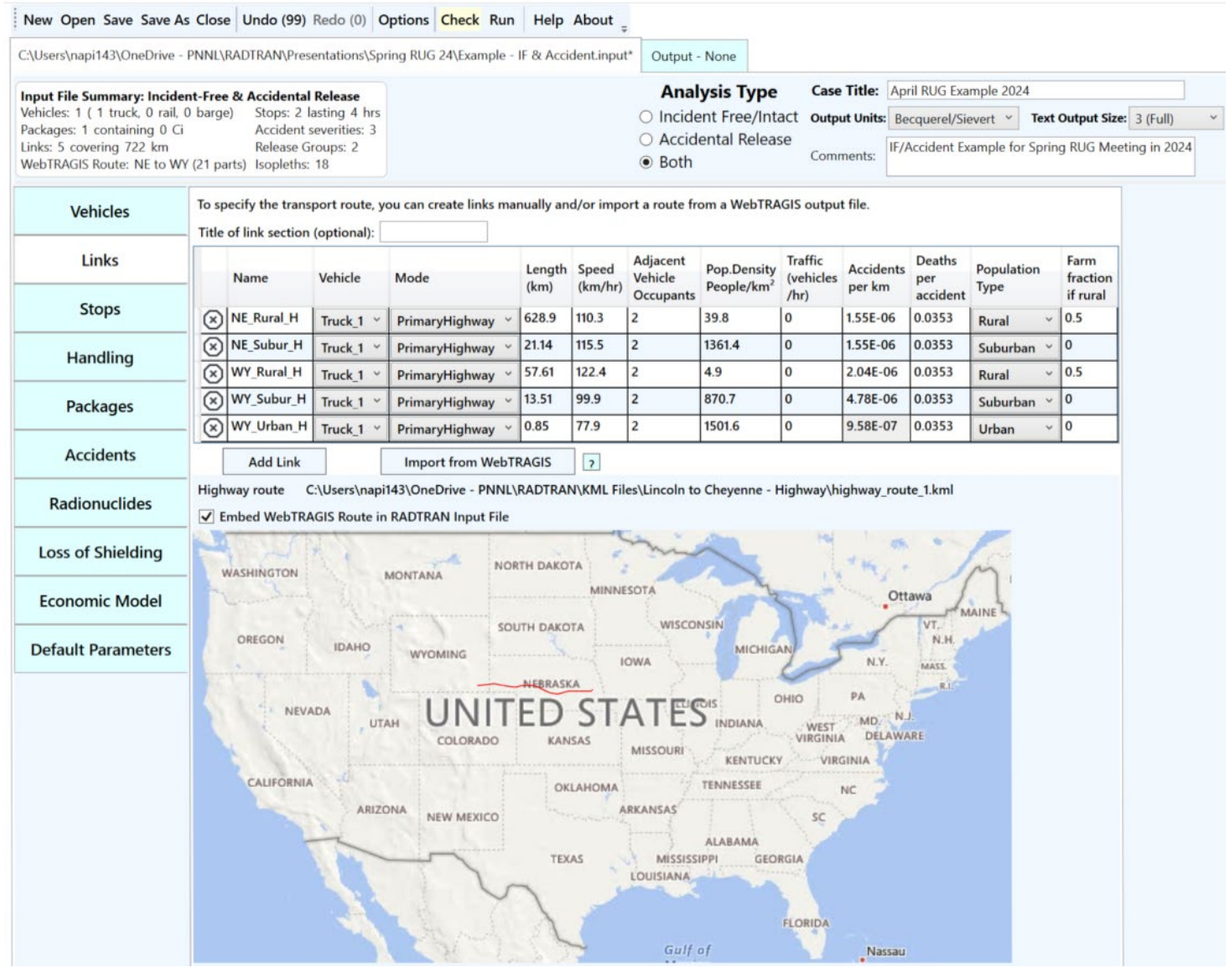
- Analysis Type
  - Both

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

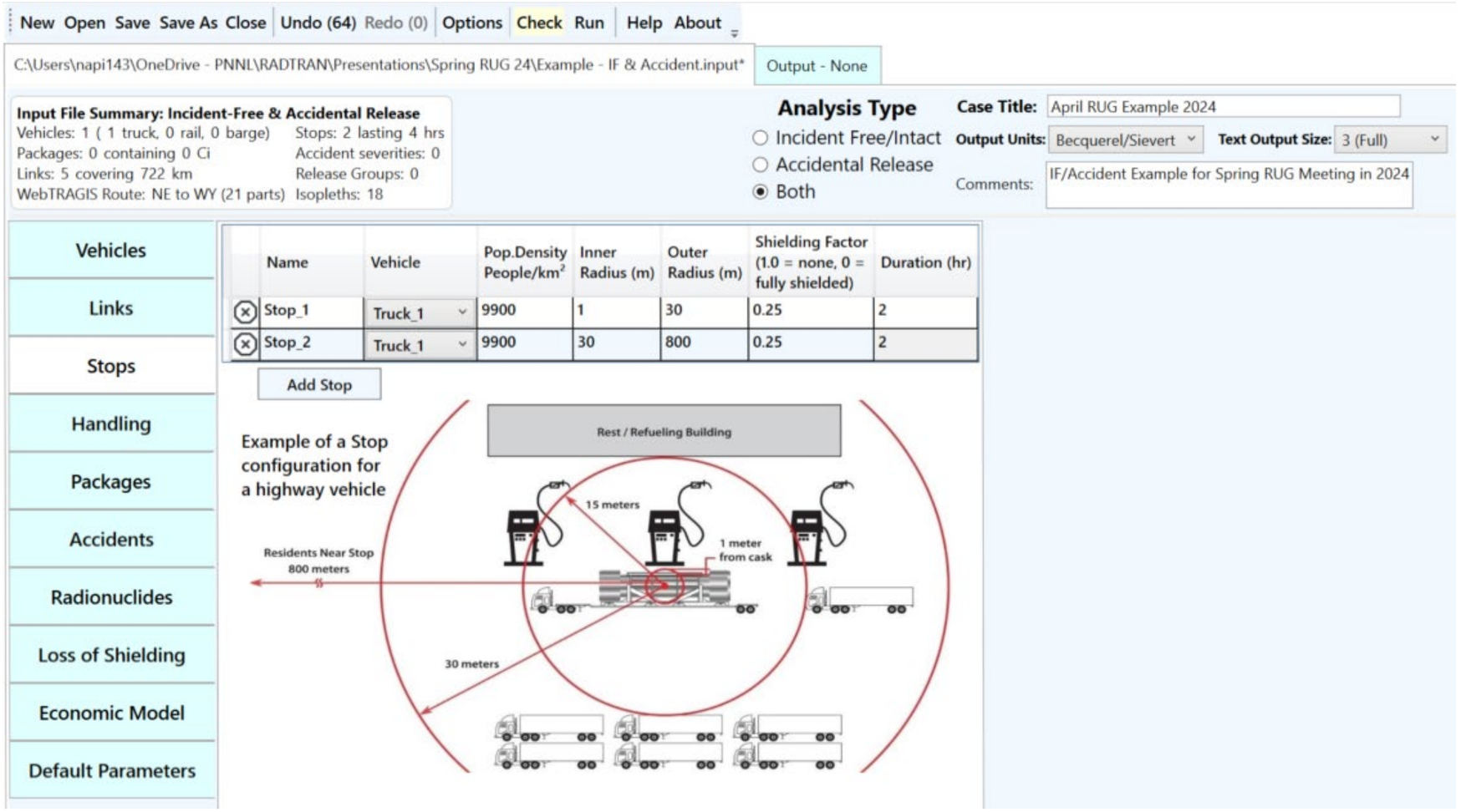
Starting File



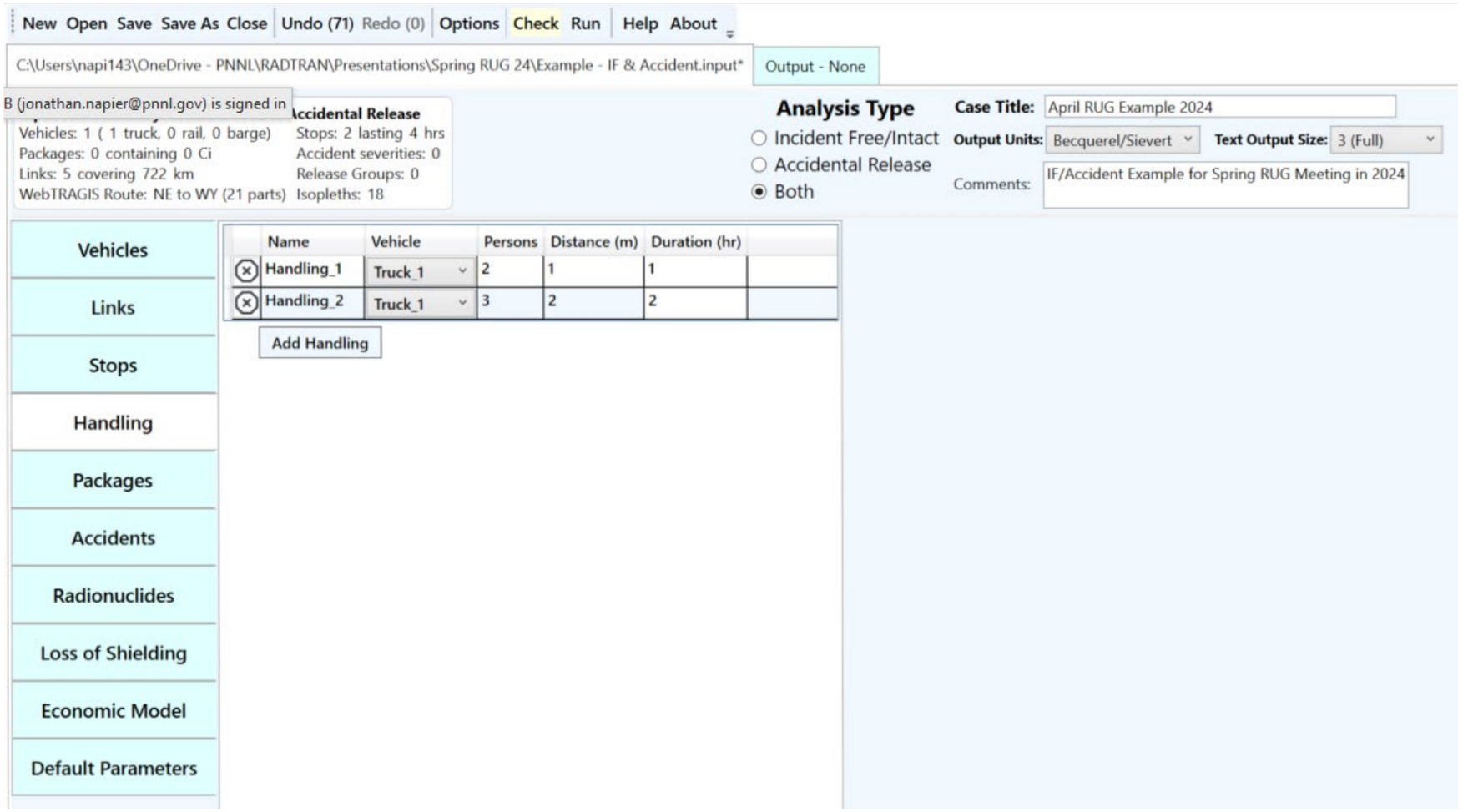
Links


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
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
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
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/km² | 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
Add Link
Import from WebTRAGIS
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
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
Ottawa
MAINE
OREGON
IDAHO
WYOMING
SOUTH DAKOTA
WISCONSIN
MICHIGAN
IOWA
NEBRASKA
NEVADA
UTAH
COLORADO
KANSAS
UNITED STATES
OHIO
INDIANA
MISSOURI
KENTUCKY
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
TENNESSEE
ARKANSAS
TEXAS
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
FLORIDA
Nassau

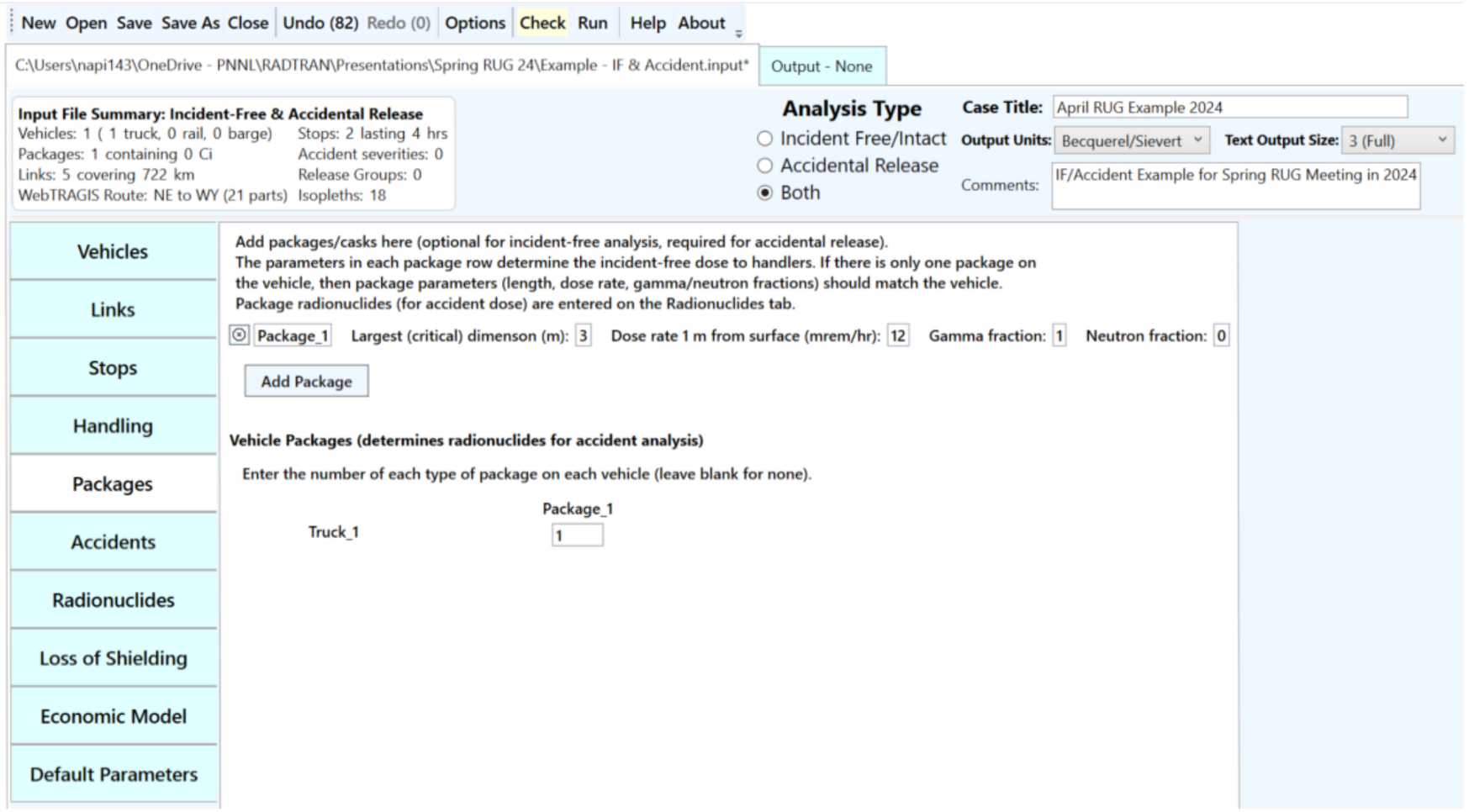
Stops


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
Vehicles
Links
Stops
Handling
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters
Name
Vehicle
Pop.Density People/km²
Inner Radius (m)
Outer Radius (m)
Shielding Factor (1.0 = none, 0 = fully shielded)
Duration (hr)
Stop_1
Truck_1
9900
1
30
0.25
2
Stop_2
Truck_1
9900
30
800
0.25
2
Add Stop
Example of a Stop configuration for a highway vehicle
Rest / Refueling Building
15 meters
1 meter from cask
Residents Near Stop 800 meters
30 meters

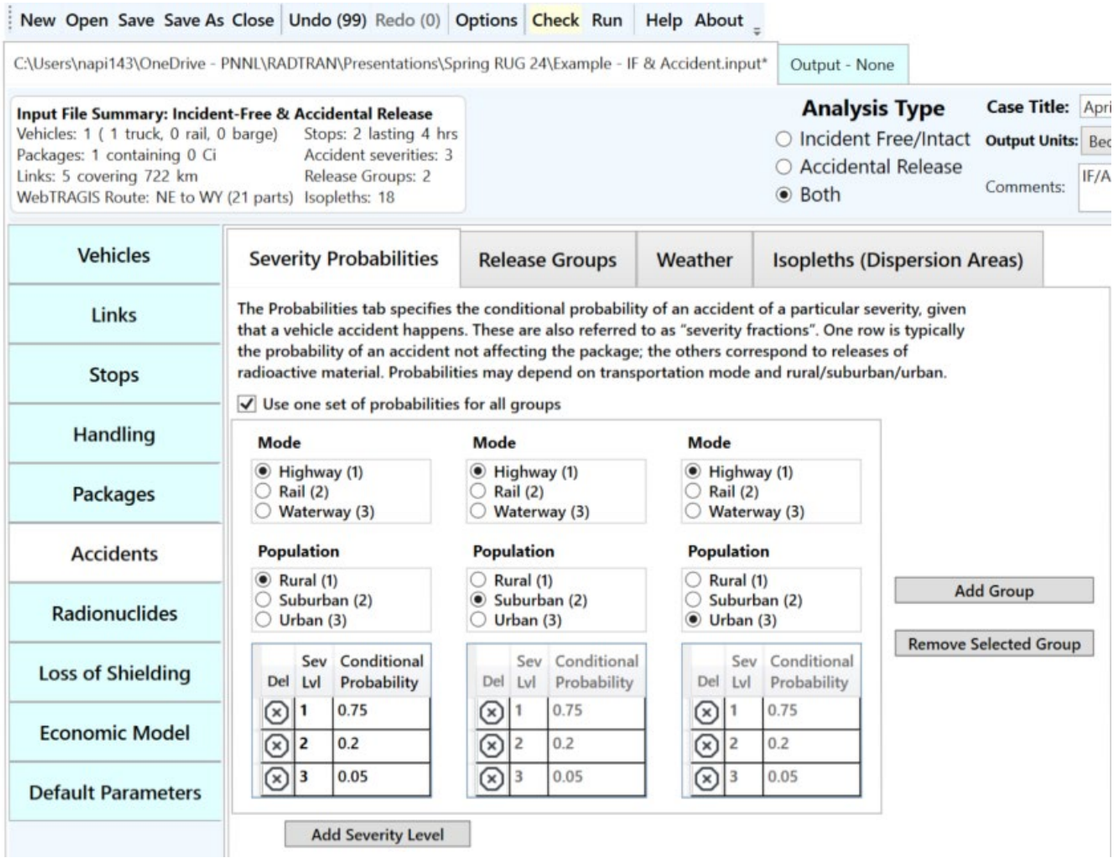
Handling


New Open Save Save As Close Undo (71) Redo (0) Options Check Run Help About
C:\Users\napi143\OneDrive - PNNL\RADTRAN\Presentations\Spring RUG 24\Example - IF & Accident.input*
Output - None
B (jonathan.napier@pnnl.gov) is signed in
Vehicles: 1 (1 truck, 0 rail, 0 barge)
Packages: 0 containing 0 Ci
Links: 5 covering 722 km
WebTRAGIS Route: NE to WY (21 parts)
Stops: 2 lasting 4 hrs
Accident severities: 0
Release Groups: 0
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
Name
Vehicle
Persons
Distance (m)
Duration (hr)
Handling_1
Truck_1
2
1
1
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
Links
Stops
Handling
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.
Package_1 Largest (critical) dimenson (m): 3 Dose rate 1 m from surface (mrem/hr): 12 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).
Package_1
Truck_1
1

Accidents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WebTRAGIS Route: NE to WY (21 parts)
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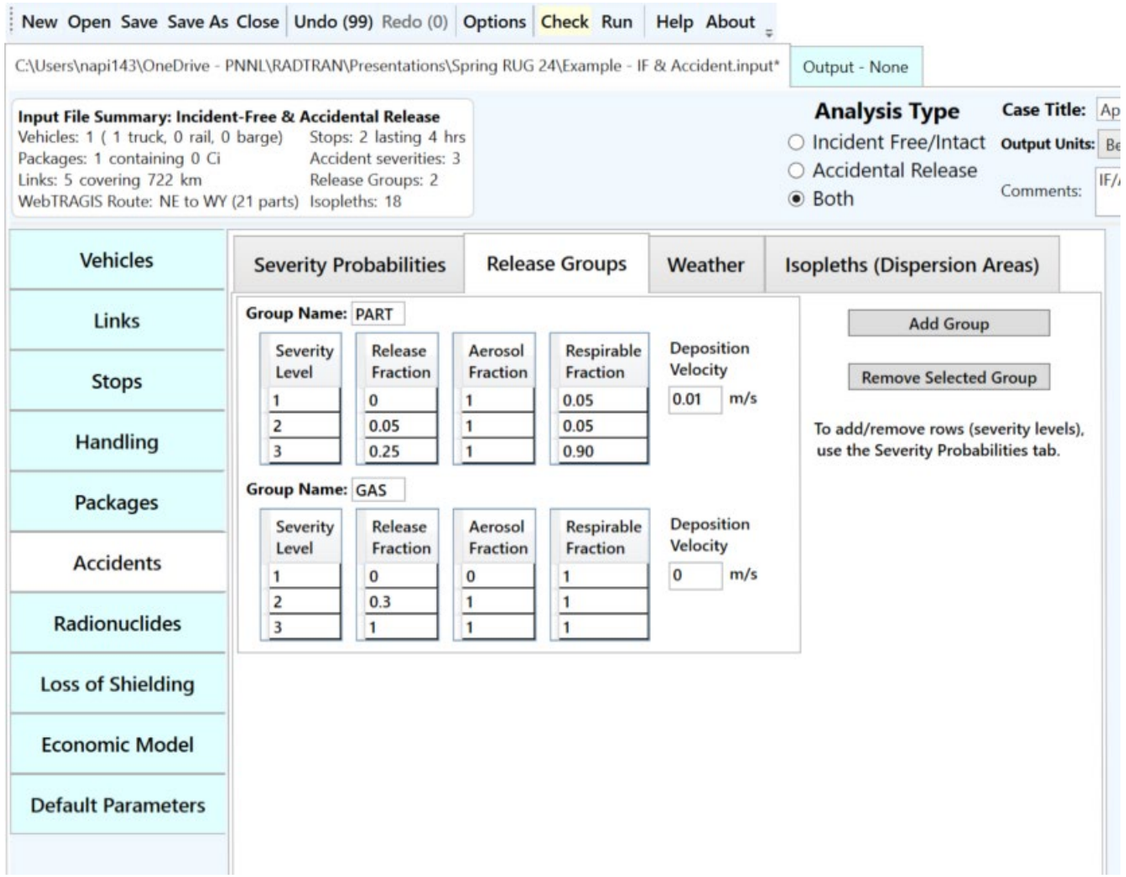
Analysis Type
Incident Free/Intact
Accidental Release
Both
Case Title:
Output Units:
Comments:
Vehicles
Links
Stops
Handling
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters
Severity Probabilities
Release Groups
Weather
Isopleths (Dispersion Areas)
The Probabilities 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 Lvl
Conditional Probability
1 0.75
2 0.2
3 0.05
Add Group
Remove Selected Group
Add Severity Level


New Open Save Save As Close Undo (99) Redo (0) Options Check Run Help About
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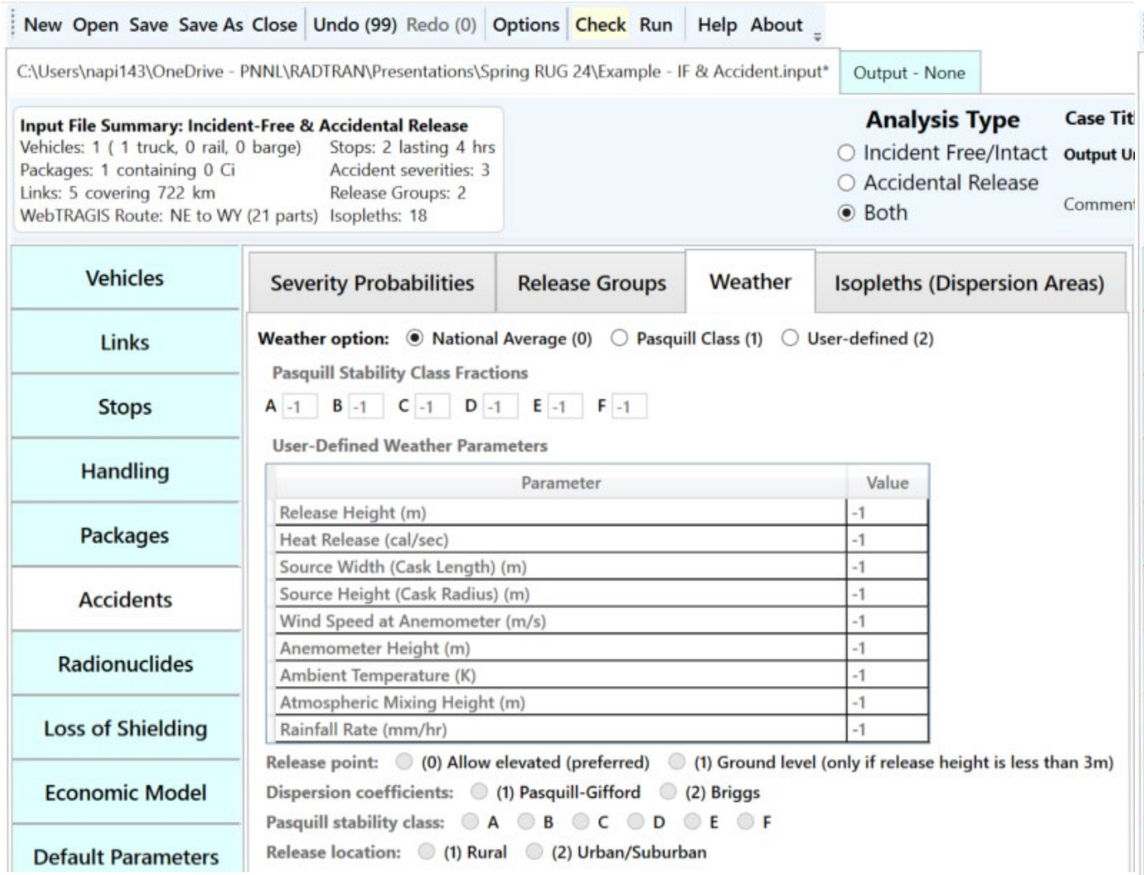
Stops: 2 lasting 4 hrs
Packages: 1 containing 0 Ci
Accident severities: 3
Links: 5 covering 722 km
Release Groups: 2
WebTRAGIS Route: NE to WY (21 parts)
Isopleths: 18
Analysis Type
Incident Free/Intact
Accidental Release
Both
Case Title:
Output Units:
Comments:
Vehicles
Links
Stops
Handling
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters
Severity Probabilities
Release Groups
Weather
Isopleths (Dispersion Areas)
Group Name: PART
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
Group Name: GAS
1 0 0 1 0 m/s
2 0.3 1 1
3 1 1 1
Add Group
Remove Selected Group
To add/remove rows (severity levels), use the Severity Probabilities tab.

Accidents


New Open Save Save As Close Undo (99) Redo (0) Options Check Run Help About
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Accidental Release
Both
Vehicles
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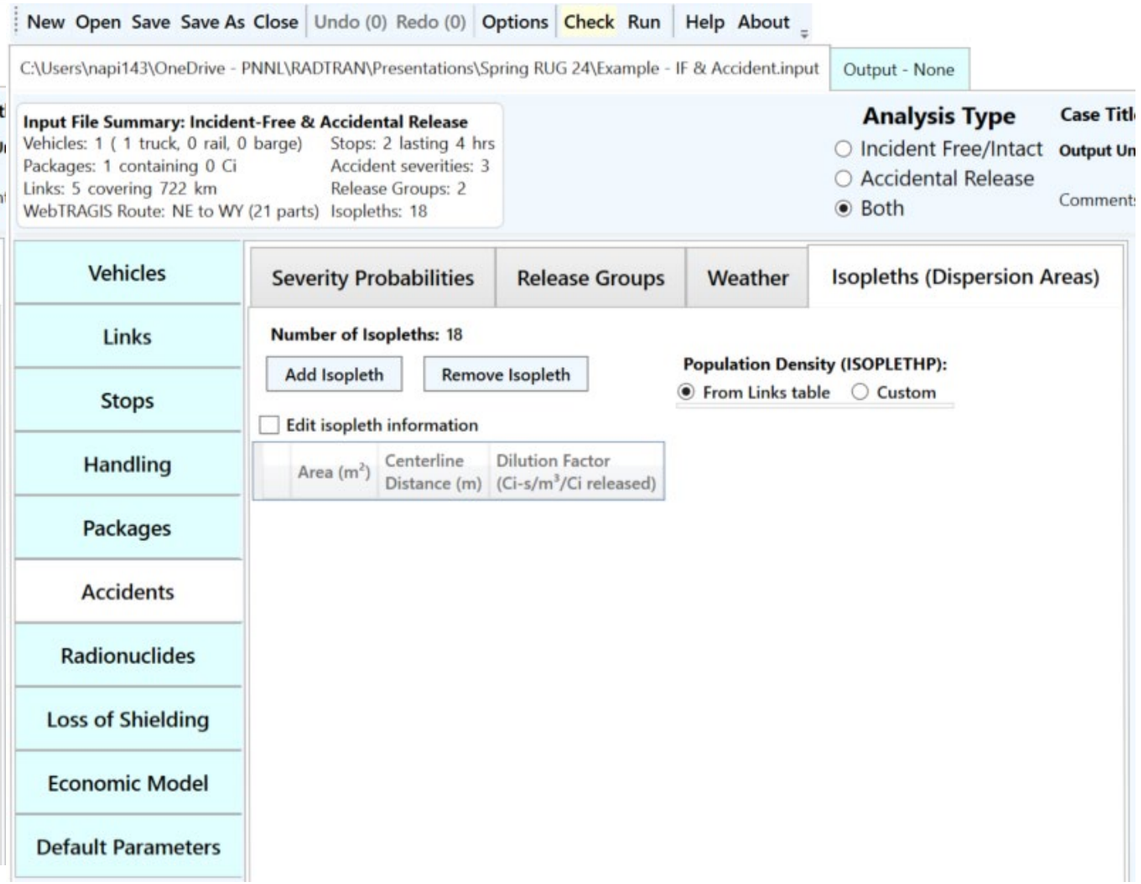
Packages
Accidents
Radionuclides
Loss of Shielding
Economic Model
Default Parameters
Severity Probabilities
Release Groups
Weather
Isopleths (Dispersion Areas)
Weather option: National Average (0) Pasquill Class (1) User-defined (2)
Pasquill Stability Class Fractions
A -1 B -1 C -1 D -1 E -1 F -1
User-Defined Weather Parameters
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
Release point: (0) Allow elevated (preferred) (1) Ground level (only if release height is less than 3m)
Dispersion coefficients: (1) Pasquill-Gifford (2) Briggs
Pasquill stability class: A B C D E F
Release location: (1) Rural (2) Urban/Suburban


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
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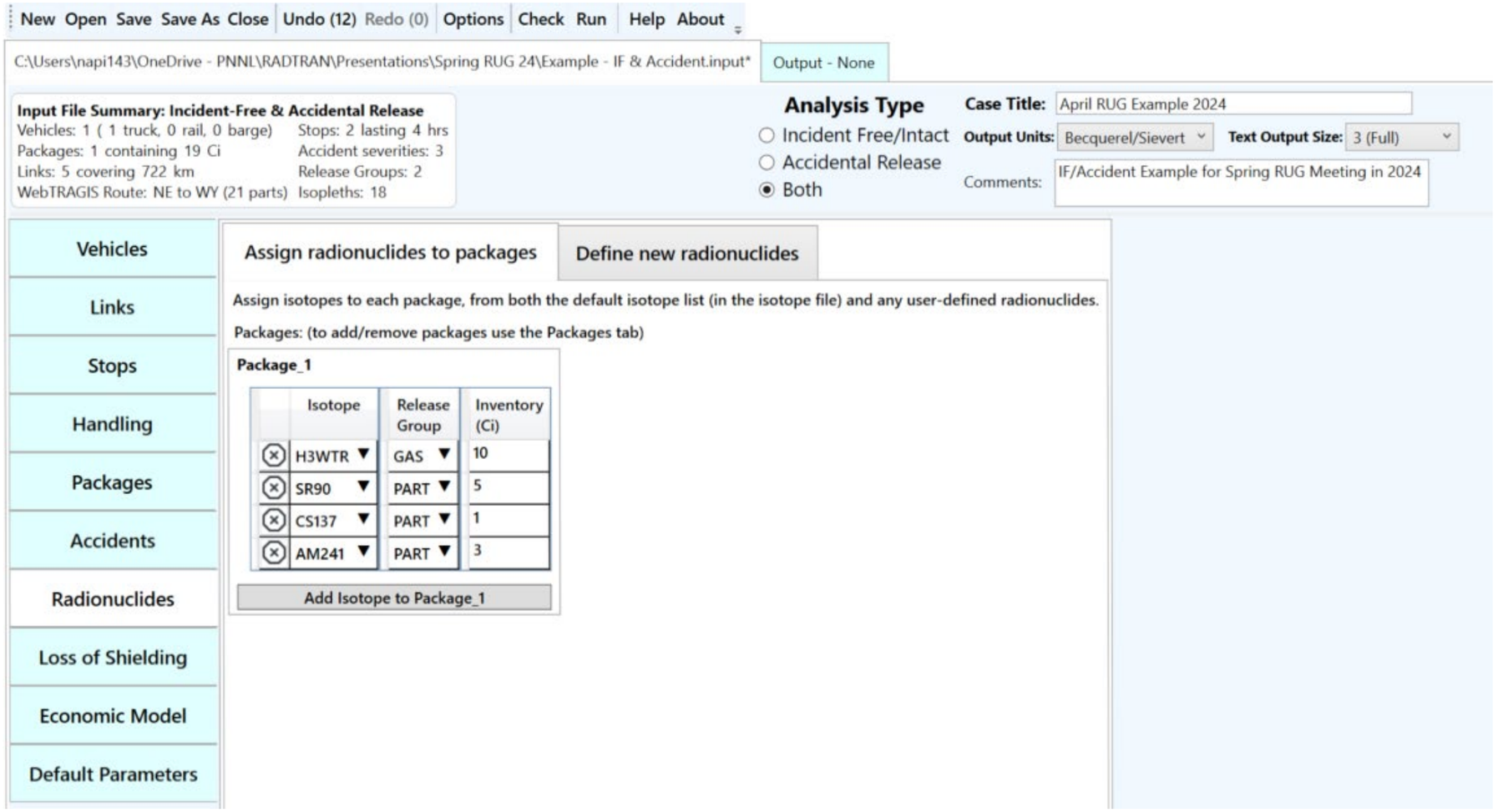
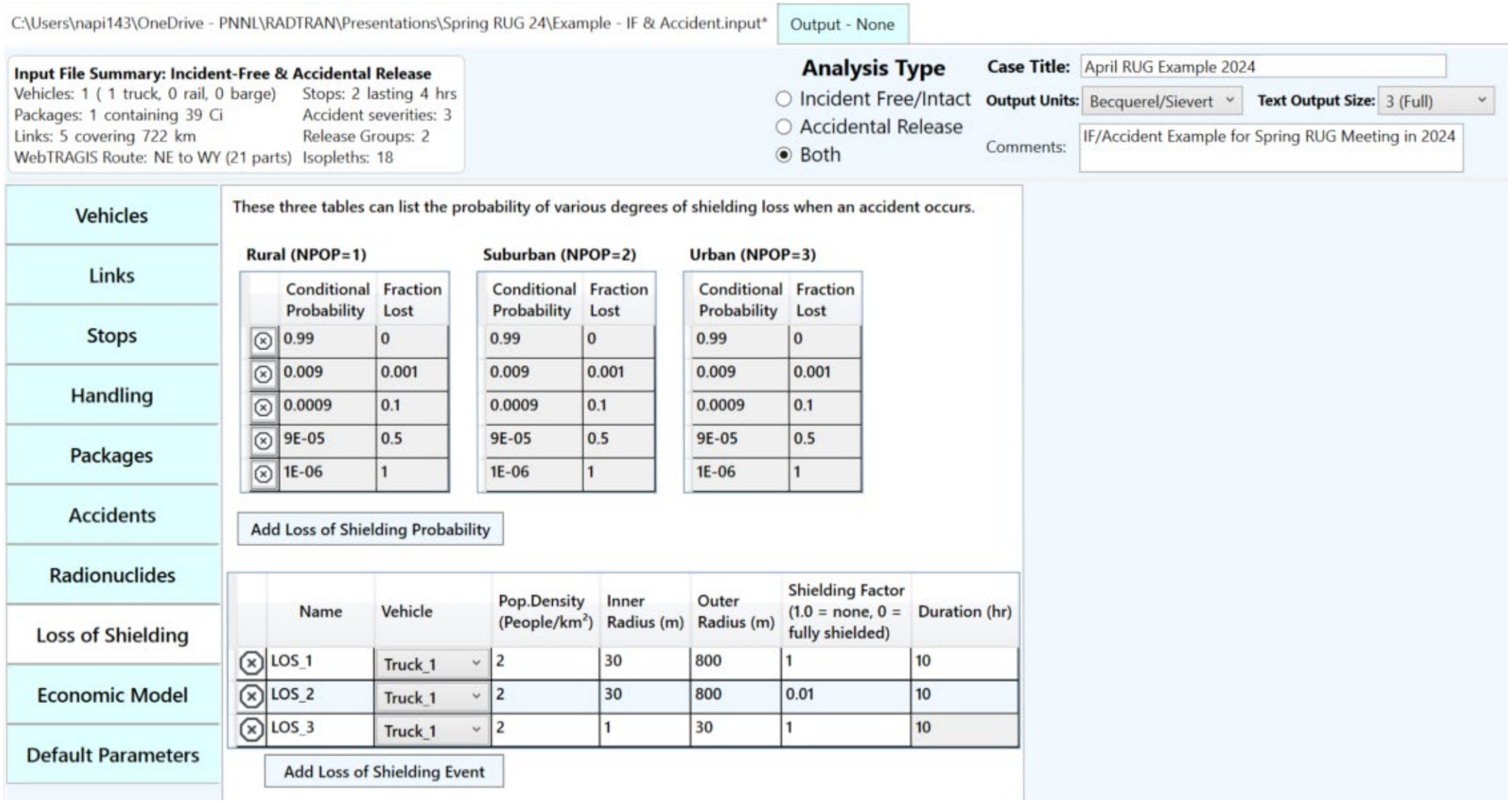
Loss of Shielding
Economic Model
Default Parameters
Severity Probabilities
Release Groups
Weather
Isopleths (Dispersion Areas)
Number of Isopleths: 18
Add Isopleth
Remove Isopleth
Population Density (ISOPLETHP):
From Links table
Custom
Edit isopleth information
Area (m²)
Centerline Distance (m)
Dilution Factor (Ci-s/m³/Ci released)

Radionuclides



Loss of Shielding



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