

BENCHMARK PROBLEM ON VIRTUAL NPP BASED ON SOARCA PROJECT USING IXP ASSESSMENT TOOL

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The IXP results in this presentation are for demonstration purpose only and nothing else.



What's International eXchange Program?

- ❑ The IXP is a web-based system that provides rapid, three-dimensional, time-dependent [computer-model](#) predictions of the concentrations, doses, and health effects caused by atmospheric releases of radioactive and/or hazardous materials.
- ❑ Runs on NARAC (National Atmospheric Release Advisory Center) at Lawrence Livermore National Laboratory in Livermore, California, USA
- ❑ No special software needed
- ❑ Available 24/7 to all member states , currently [146 Member States](#) and the IAEA's [Incident and Emergency Centre \(IEC\)](#) in accordance with the [Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency](#) and registered with the IAEA's [Response Assistance Network \(RANET\)](#)



Running the IXP

□ General Information

- ▣ Name of run
- ▣ Description
- ▣ Response level
 - Test/drill (No NARAC staff support); Exercise/Emergency (with NARA staff support)
 - Phone number of the requested party

□ Release Time

- ▣ Reactor shutdown time (MM/DD/YYYY hh:mm timezone)
- ▣ Duration material held in containment vessel before release to atmosphere (days/hours/min) ~ 1 day
- ▣ Time duration of release of material to atmosphere (hours/minutes) ~ 23 hrs and 59 min



Running the IXP

- Release location
 - ▣ Site
 - World site
 - Requesting country
 - World NPP (country and NPP name)
 - ▣ Located at the point (lat,lon) and height above ground
 - Surry NPP in Virginia, USA
 - ▣ Downwind distance (extent, area of concern) ~ 200 km



Running the IXP

- Material properties
 - ▣ Material
 - All available / User-defined mixtures / As suggested (I-131 & Cs-137)
 - ▣ Strength type
 - Mass/mass rate/radioactivity/radioactivity rate
 - ▣ Strength



Running the IXP

- Model
 - ▣ NARAC (3D)
- Weather Data, to be obtained from
 - ▣ Use system default
 - ▣ I will provide it
 - ▣ Forecast model data



CONSEQUENCE REPORT

- ❑ SUMMARY
- ❑ PRODUCT
- ❑ SOURCE INFORMATION
- ❑ METEOROLOGY
- ❑ ASSUMPTION
- ❑ CONTACT INFORMATION
- ❑ DISCLAIMER



CONSEQUENCE REPORT

□ SUMMARY

- describes the health effect consequences associated by radioactive material release to the atmosphere;
- initial, automated NARAC product, not a final recommendation;
- initial predictions are for a limited time period and areas affected may change at later times;
- predictions should be confirmed and refined using in-situ measurements;



CONSEQUENCE REPORT

□ PRODUCT

- **Ground Exposure Dose Rate** (groundshine only) **at 12 hrs:**
Material: CS-137 + I-131
- **Early Phase Iodine Thyroid Blocking:** (Projected dose to the thyroid exceeding generic criteria)
Material: I-129 + I-130 + I-131 + I-132 + I-133 + I-134 + I-135 + I-136

This product identifies projected dose that exceeds the generic criteria of ____ mSv in the first 7 days to the thyroid (urgent) or ____ mSv in the 1st year. Take protective actions and other response actions early in the response.



CONSEQUENCE REPORT

□ PRODUCT

- **Early Phase Evacuation/Sheltering/Relocation/Food Restrictions :** (Projected Total Effective Dose Exceeding Generic Criteria)

Material: CS-137 + I-131

This product identifies projected dose that exceeds the generic criteria of ____ mSv in the first 7 days (urgent) or ____ mSv in the 1st year (early). Take protective actions and other response actions early in the response.



CONSEQUENCE REPORT

□ PRODUCT

- **Total Deposition**

Material: CS-137 + I-131

This product identifies the more highly contaminated areas due to **fallout** and **deposition** of the radioactive material.

This material, depending upon the type of radiation emitted, may continue to give doses to individuals in these areas through **inhalation** of resuspended radioactive material or from **direct external radiation**. These levels of deposited radioactivity should be confirmed by monitoring surveys.



CONSEQUENCE REPORT

□ PRODUCT

- **Longer Term Medical Screening :** (Total Effective Dose Received Exceeding Generic Criteria)

Material: CS-137 + I-131

This product identifies dose that has been received and exceeds the ____ mSv in a month generic criteria. Take longer term medical actions to detect and to effectively treat radiation induced health effects.



CONSEQUENCE REPORT

□ SOURCE INFORMATION

- Release Start Time: Mar 16, 2018 11:11 UTC
- Release Stop Time: Mar 17, 2018 11:10 UTC
- Release Location: (37.16560,-76.69780)
- Release Mechanism: Generic
- Source Material and Amount:
 - Ground Exposure Dose Rate at 12 hrs
 - Early Phase Evacuation/Sheltering/Relocation/Food Restrictions
 - Total Deposition
 - Longer Term Medical Screening



CONSEQUENCE REPORT

□ SOURCE INFORMATION

- Total Strength for the product(s) listed above = 3.085×10^{18} Bq
- 3.05×10^{17} Bq of CS-137 after a holdup of 1 day (100% respirable)
- 2.78×10^{18} Bq of I-131 after a holdup of 1 day (100% respirable)

Early Phase Iodine Thyroid Blocking

- Total Strength for the product(s) listed above = 2.78×10^{18} Bq I-131 after a holdup of 1 day (100% respirable)
- Source Geometry
 - Total Strength: 3.09×10^{18} Bq
 - Point released at 60 m
- Particle Size Distribution:
 - All particulate is in the respirable range from 0.1 to 10 microns



CONSEQUENCE REPORT

□ METEOROLOGY

- NAM12 Gridded Metdata from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC at 3 hr intervals were used in this calculation

□ ASSUMPTION

- ICRP60 series dose conversion factors were used for dose plots unless otherwise specified.

□ CONTACT INFORMATION

- Contact details of the person who requested calculation



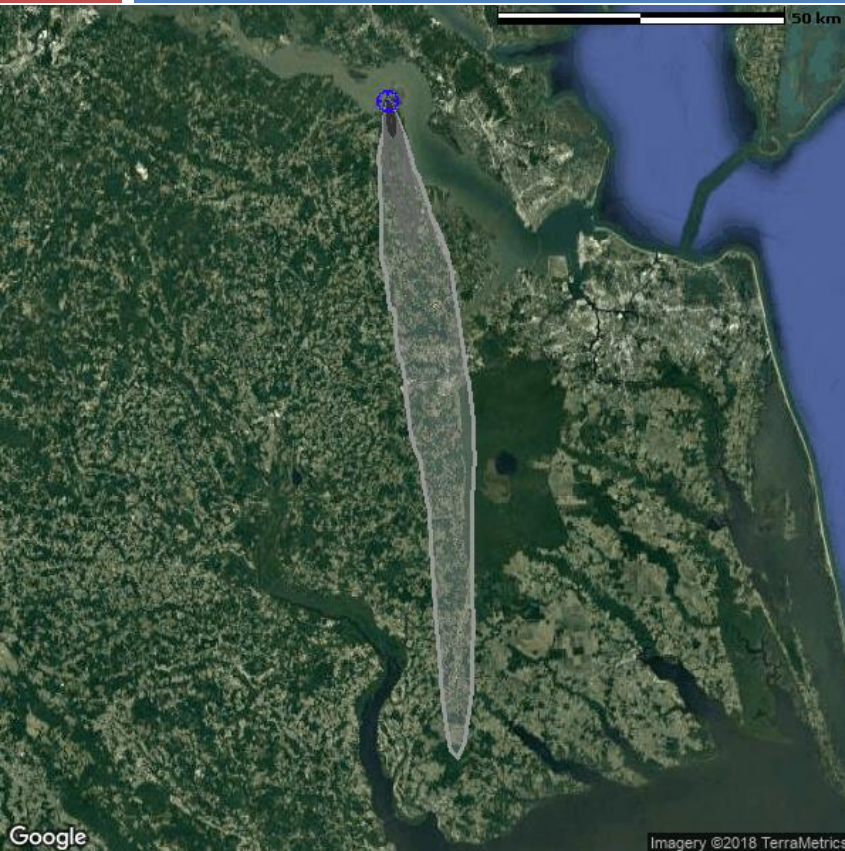
CONSEQUENCE REPORT

□ DISCLAIMER

- These model predictions are intended to be guidance, and are not final recommendations;
- The accuracy will be limited by the accuracy of the input data;
- Plume predictions may be for a limited time period, and may change at later times if new input data becomes available;
- Predictions should be confirmed and refined using field measurements;
- Air and ground concentration may be higher than predicted by this plume model simulation;
- Views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes.



Groundshine exposure dose rate at 12 hrs (Groundshine only) Jan 2018



Map size: 147 km x 147 km

Effects and Actions			
	Description	(mSv/hr) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10 5.7 km 3.7 km ²	180
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1 25.0 km 64.2 km ²	2,570
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>0.10 114 km 872 km ²	62,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination at January 14, 2018 16:15 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 04:22 UTC

Model: ADAPT/LODI

Comments:

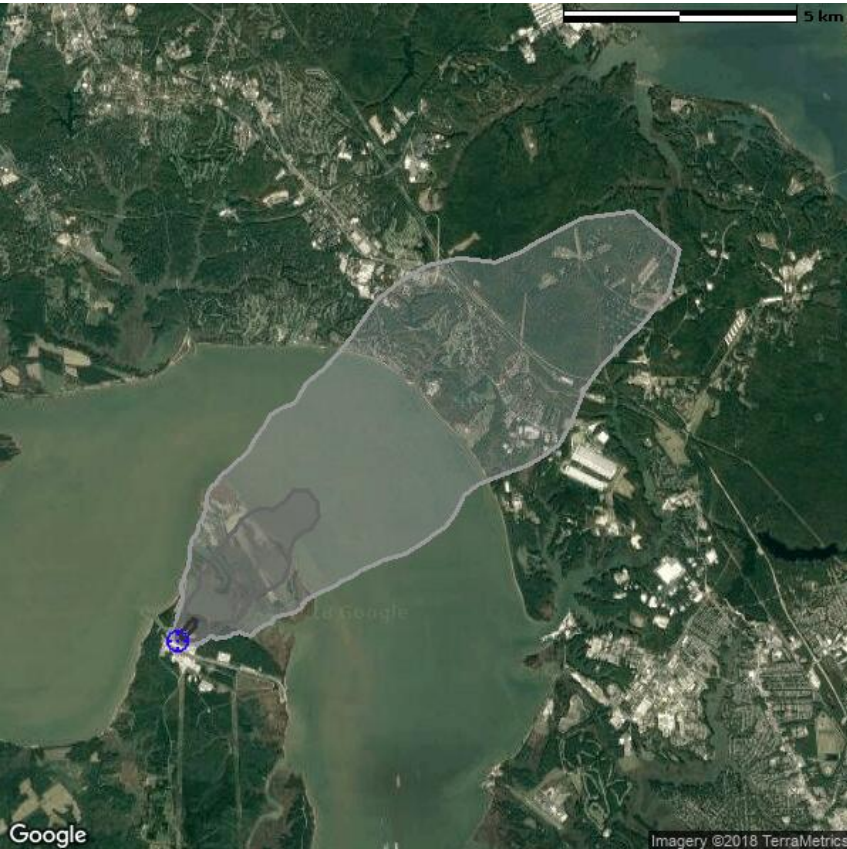
Release starting at 01/14/2018 04:15:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 01/14/2018 04:00:00 UTC to 01/15/2018 03:00:00 UTC



Groundshine exposure dose rate at 12 hrs

(Groundshine only) Feb 2018



Map size: 18.3 km x 18.3 km

Effects and Actions

	Description	(mSv/hr) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>100 0.6 km 0.07 km ²	10
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10 4.3 km 4.1 km ²	80
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1 13.7 km 43.4 km ²	3,850

Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.

Effects or contamination at February 14, 2018 23:26 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 06:31 UTC

Model: ADAPT/LODI

Comments:

Release starting at 02/14/2018 11:26:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 02/14/2018 11:00:00 UTC to 02/15/2018 10:00:00 UTC



Groundshine exposure dose rate at 12 hrs

(Groundshine only) 16 Mar 2018



Map size: 147 km x 147 km

Effects and Actions			
	Description	(mSv/hr) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10 4.6 km 2.6 km ²	90
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1 21.1 km 59.3 km ²	23,800
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>0.10 79.7 km 806 km ²	410,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination at March 16, 2018 23:11 UTC

Release Location: 37.165600 N, 76.697800 W

Material: CS-137 + I-131

Generated On: March 14, 2018 18:18 UTC

Model: ADAPT/LODI

Comments:

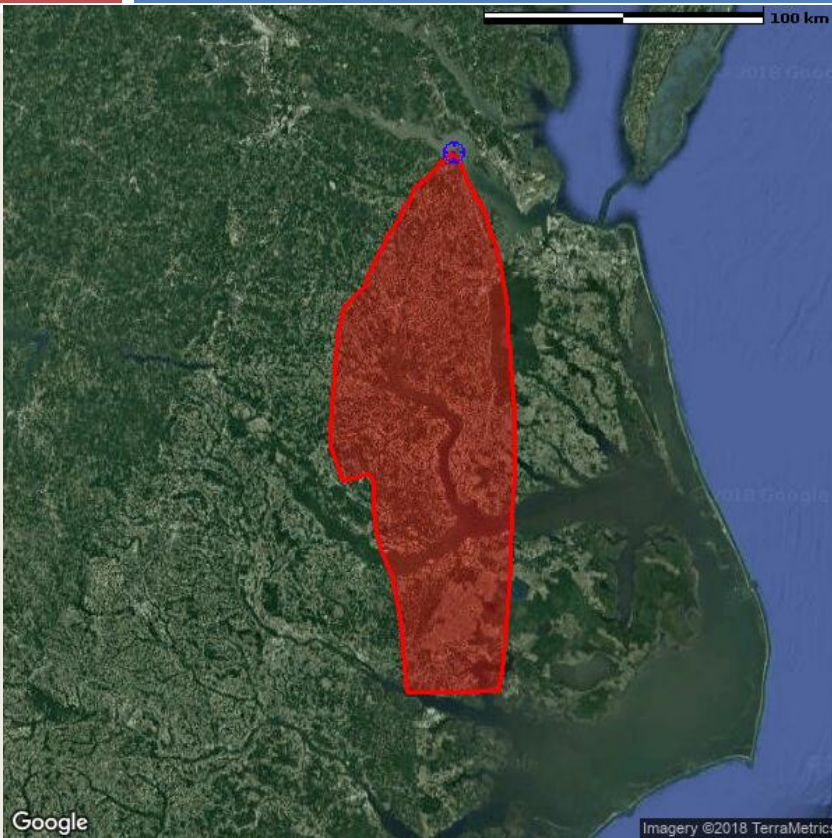
Release starting at 03/16/2018 11:11:00 UTC for 23 hr 59 min

gridded met at 3 hr intervals from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC



Early phase iodine thyroid blocking

(Projected dose to thyroid exceeding generic criteria) Jan 2018



Map size: 296 km x 296 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	50 mSv in 7 days - Iodine thyroid blocking (GSG-2, Table 3)	>50 192 km 8,859 km ²	195,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from January 14, 2018 04:15 UTC to January 21, 2018 04:15 UTC

Release Location: 37.166033 N, 76.697364 W

Material: I-129 + I-130 + I-131 + I-132 + I-133 + I-134 + I-135 + I-136

Generated On: March 13, 2018 04:22 UTC

Model: ADAPT/LODI

Comments:

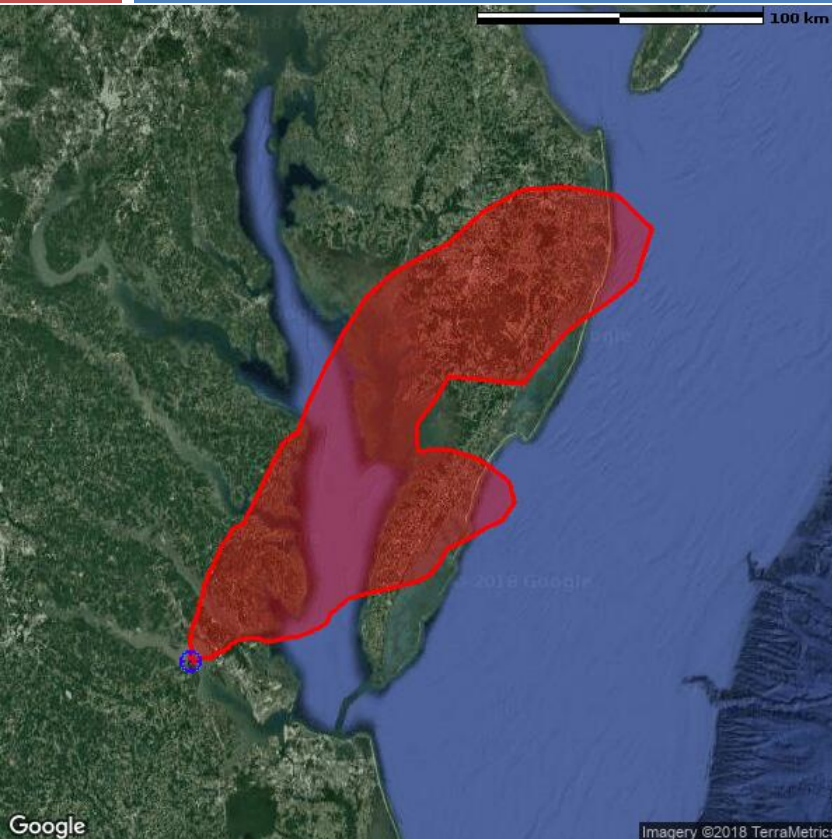
Hypothetical release starting at 01/14/2018 04:15:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 01/14/2018 04:00:00 UTC to 01/15/2018 03:00:00 UTC



Early phase iodine thyroid blocking

(Projected dose to thyroid exceeding generic criteria) Feb 2018



Map size 290 km x 290 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	50 mSv in 7 days - Iodine thyroid blocking (GSG-2, Table 3)	>50 218 km 10,413 km ²	333,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from February 14, 2018 11:26 UTC to February 21, 2018 11:26 UTC

Release Location: 37.166033 N, 76.697364 W

Material: I-129 + I-130 + I-131 + I-132 + I-133 + I-134 + I-135 + I-136

Generated On: March 13, 2018 06:31 UTC

Model: ADAPT/LODI

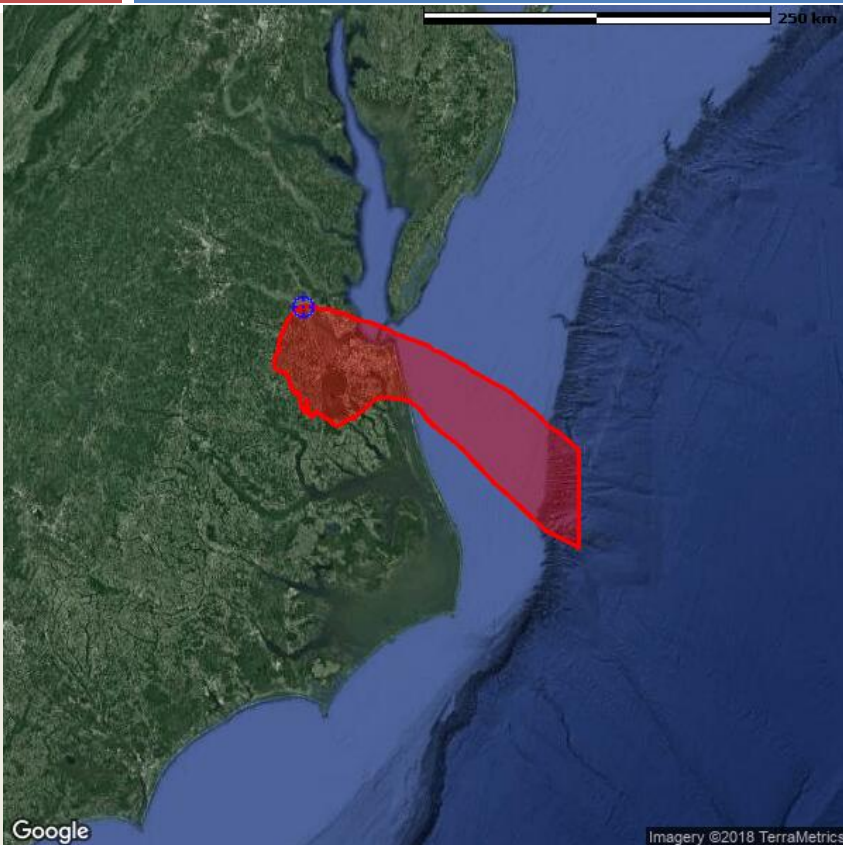
Comments:

Hypothetical release starting at 02/14/2018 11:26:00 UTC for 23 hr 59 min
met obs at 1 hr intervals from 02/14/2018 11:00:00 UTC to 02/15/2018 10:00:00 UTC



Early phase iodine thyroid blocking

(Projected dose to thyroid exceeding generic criteria) 16 Mar 2018



Map size 591 km x 591 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	50 mSv in 7 days - Iodine thyroid blocking (GSG-2, Table 3)	>50 255 km 13,818 km ²	1.45E6
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from March 16, 2018 11:11 UTC to March 23, 2018 11:11 UTC

Release Location: 37.165600 N, 76.697800 W

Material: I-129 + I-130 + I-131 + I-132 + I-133 + I-134 + I-135 + I-136

Generated On: March 14, 2018 18:18 UTC

Model: ADAPT/LODI

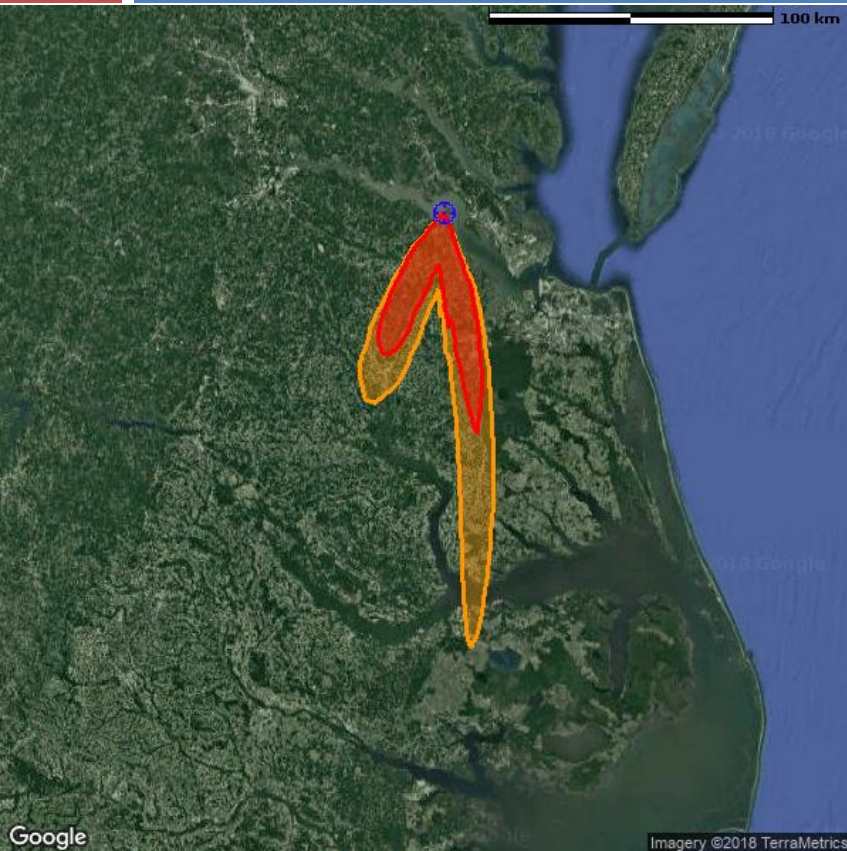
Comments:

Hypothetical release starting at 03/16/2018 11:11:00 UTC for 23 hr 59 min
gridded met at 3 hr intervals from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC



Early phase evacuation/sheltering/relocation/food restrictions

(Projected dose to thyroid exceeding generic criteria) Jan 2018



Map size: 295 km x 295 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in first 7 days - Sheltering, evacuation, decontamination; restriction of consumption of food, milk and water, contamination control, public reassurance (GSG-2, Table 3)	>100 76.7 km 908 km ²	53,600
	100 mSv in 1 year - Temporary relocation, decontamination, replacement of food, milk and water, public reassurance (GSG-2, Table 3)	>100 150 km 2,363 km ²	99,300

Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.

Effects or contamination from January 14, 2018 04:15 UTC to January 14, 2019 04:15 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 04:22 UTC

Model: ADAPT/LODI

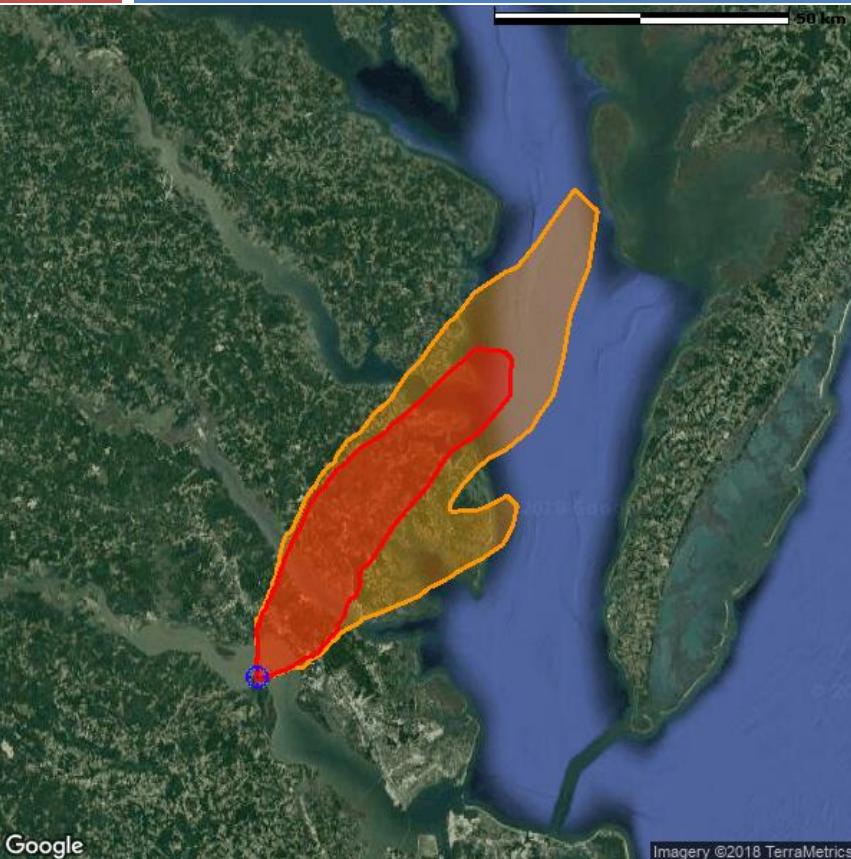
Comments:

Hypothetical release starting at 01/14/2018 04:15:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 01/14/2018 04:00:00 UTC to 01/15/2018 03:00:00 UTC



Early phase evacuation/sheltering/relocation/food restrictions (Projected dose to thyroid exceeding generic criteria) Feb 2018



Map size: 145 km x 145 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in first 7 days - Sheltering, evacuation, decontamination; restriction of consumption of food, milk and water, contamination control, public reassurance (GSG-2, Table 3)	>100 69.4 km 825 km ²	50,600
	100 mSv in 1 year - Temporary relocation, decontamination, replacement of food, milk and water, public reassurance (GSG-2, Table 3)	>100 98.6 km 1,725 km ²	65,200
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from February 14, 2018 11:26 UTC to February 14, 2019 11:26 UTC

Release Location: 37.166033 N, 140.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 06:31 UTC

Model: ADAPT/LODI

Comments:

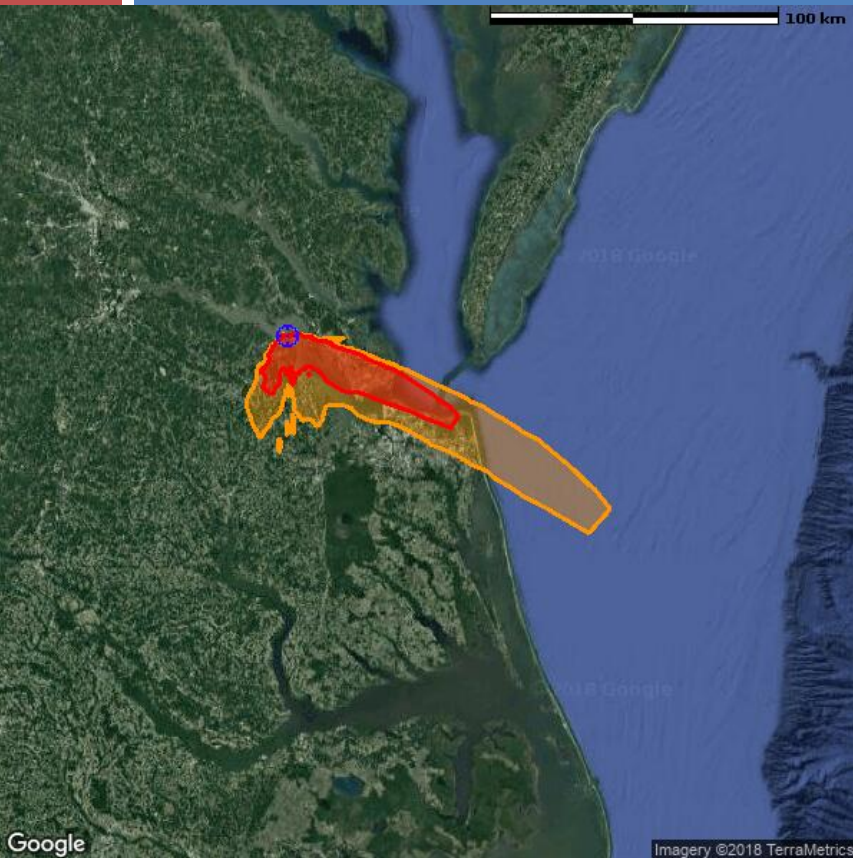
Hypothetical release starting at 02/14/2018 11:26:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 02/14/2018 11:00:00 UTC to 02/15/2018 10:00:00 UTC



Early phase evacuation/sheltering/relocation/food restrictions

(Projected dose to thyroid exceeding generic criteria) 16 Mar 2018



Map size: 294 km x 294 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in first 7 days - Sheltering, evacuation, decontamination; restriction of consumption of food, milk and water, contamination control, public reassurance (GSG-2, Table 3)	>100 64.5 km 794 km ²	329,000
	100 mSv in 1 year - Temporary relocation, decontamination, replacement of food, milk and water, public reassurance (GSG-2, Table 3)	>100 125 km 2,649 km ²	703,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects of contamination from March 16, 2018 11:11 UTC to March 16, 2019 11:11 UTC

Release Location: 37.165600 N, 76.697800 W

Material: CS-137 + I-131

Generated On: March 14, 2018 18:18 UTC

Model: ADAPT/LODI

Comments:

Hypothetical release starting at 03/16/2018 11:11:00 UTC for 23 hr 59 min
gridded met at 3 hr intervals from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC



Total deposition, Jan 2018



Map size: 147 km x 147 km

Effects and Actions			
	Description	(MBq/m2) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10,000 5.5 km 4.6 km2	240
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1,000 23.9 km 136 km2	2,800
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>100 112 km 1,459 km2	67,400
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination at January 15, 2018 04:15 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 04:22 UTC

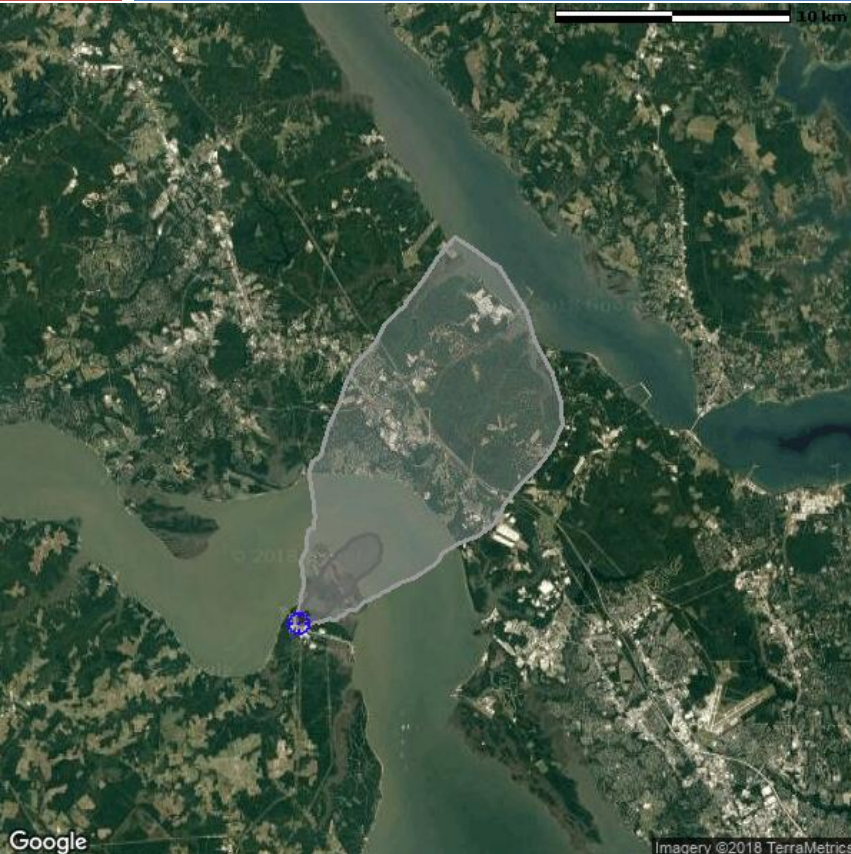
Model: ADAPT/LODI

Comments:

Hypothetical release starting at 01/14/2018 04:15:00 UTC for 23 hr 59 min
met obs at 1 hr intervals from 01/14/2018 04:00:00 UTC to 01/15/2018 03:00:00 UTC



Total deposition, Feb 2018



Map size: 36.5 km x 36.5 km

Effects and Actions

	Description	(MBq/m2) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>100,000 0.6 km 0.05 km2	10
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10,000 5.0 km 5.7 km2	80
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1,000 17.7 km 106 km2	18,200

Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.

Effects or contamination at February 15, 2018 11:26 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 06:31 UTC

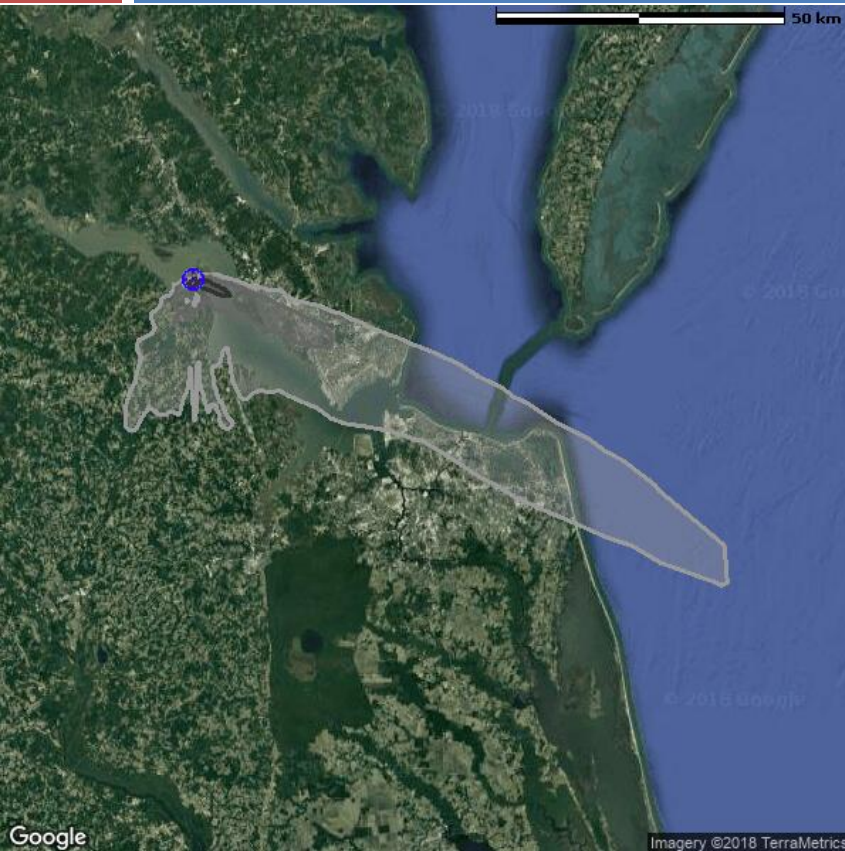
Model: ADAPT/LODI

Comments:

Hypothetical release starting at 02/14/2018 11:26:00 UTC for 23 hr 59 min
met obs at 1 hr intervals from 02/14/2018 11:00:00 UTC to 02/15/2018 10:00:00 UTC



Total deposition, 16 Mar 2018



Map size: 147 km x 147 km

Effects and Actions			
	Description	(MBq/m ²) Extent Area	Population
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>10,000 6.9 km 7.6 km ²	260
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1,000 26.0 km 124 km ²	58,400
	No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>100 106 km 1,718 km ²	549,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination at March 17, 2018 11:11 UTC

Release Location: 37.165600 N, 76.697800 W

Material: CS-137 + I-131

Generated On: March 14, 2018 18:18 UTC

Model: ADAPT/LODI

Comments:

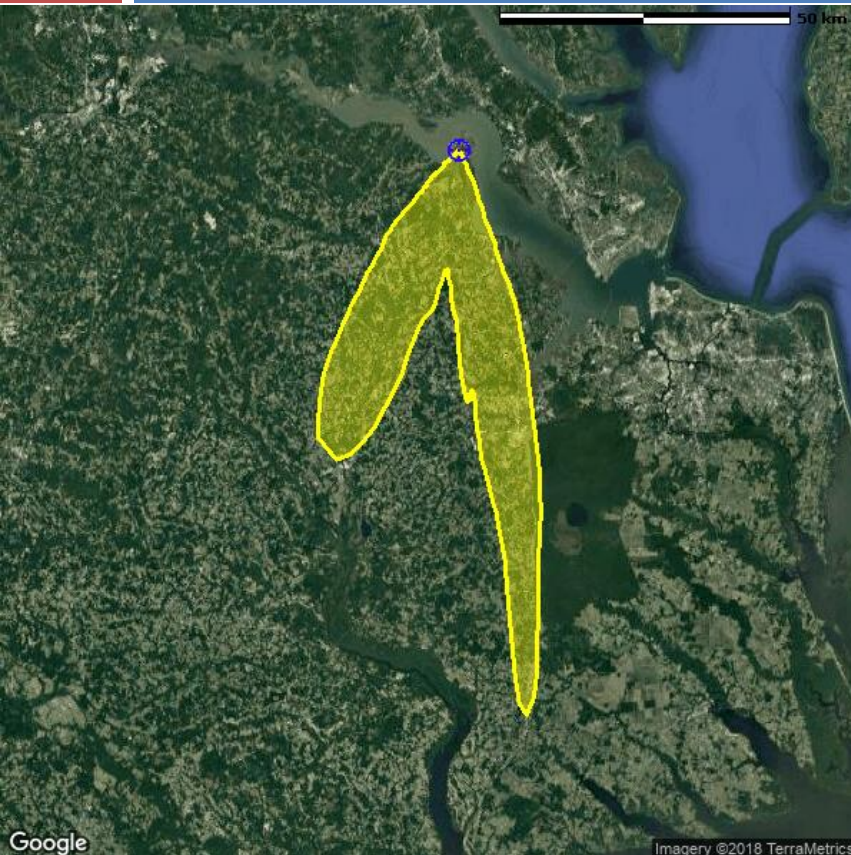
Hypothetical release starting at 03/16/2018 11:11:00 UTC for 23 hr 59 min

gridded met at 3 hr intervals from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC



Longer term medical screening

(Total effective dose received exceeding generic criteria) Jan 2018



Map size: 147 km x 147 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in 30 days - Screening based on equivalent doses to specific radiosensitive organs (as a basis for medical follow up), counseling (GSG-2, Table 3)	>100 97.4 km 1,213 km ²	61,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from January 14, 2018 04:15 UTC to February 13, 2018 04:15 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 04:22 UTC

Model: ADAPT/LODI

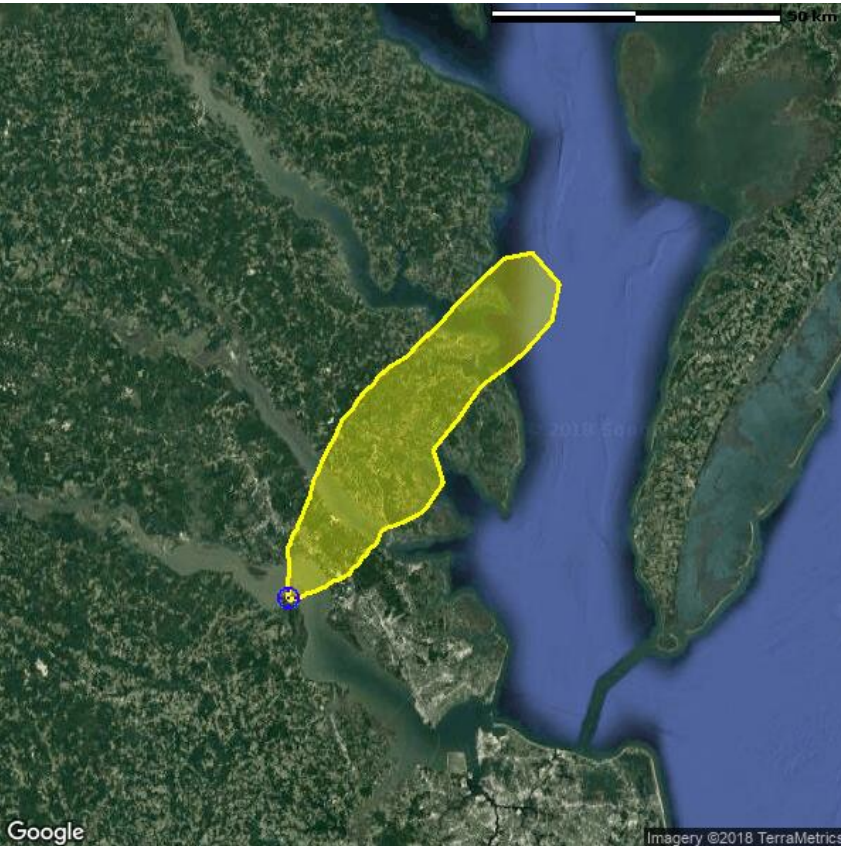
Comments:

Hypothetical release starting at 01/14/2018 04:15:00 UTC for 23 hr 59 min
met obs at 1 hr intervals from 01/14/2018 04:00:00 UTC to 01/15/2018 03:00:00 UTC



Longer term medical screening

(Total effective dose received exceeding generic criteria) Feb 2018



Map size: 146 km x 146 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in 30 days - Screening based on equivalent doses to specific radiosensitive organs (as a basis for medical follow up), counseling (GSG-2, Table 3)	>100 72.6 km 963 km ²	53,600
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from February 14, 2018 11:26 UTC to March 16, 2018 11:26 UTC

Release Location: 37.166033 N, 76.697364 W

Material: CS-137 + I-131

Generated On: March 13, 2018 06:31 UTC

Model: ADAPT/LODI

Comments:

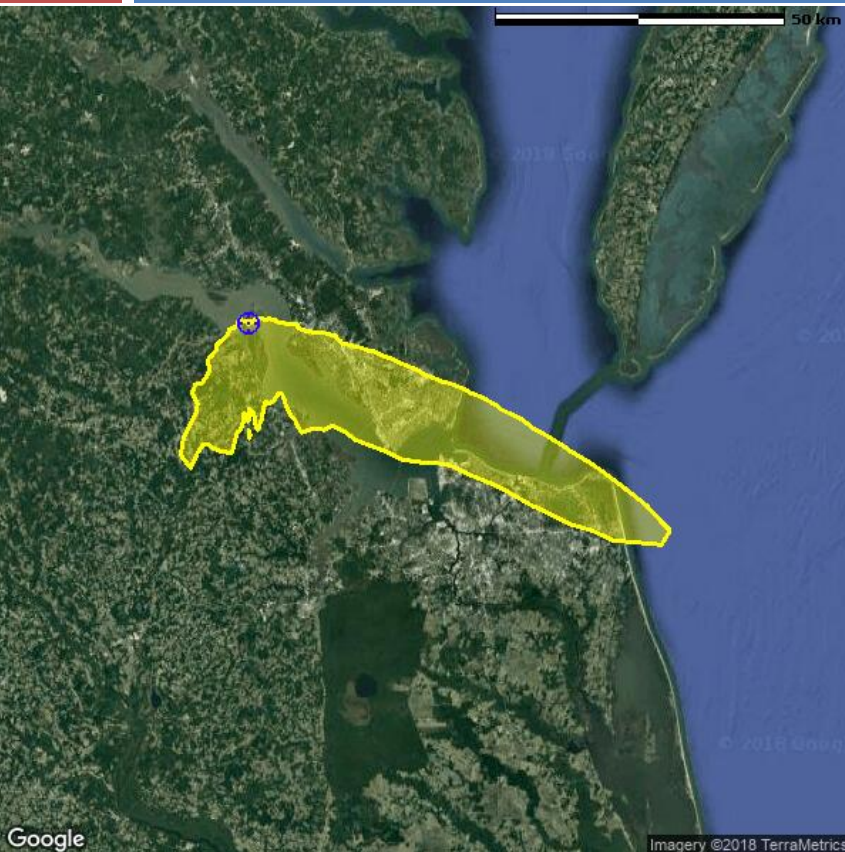
Hypothetical release starting at 02/14/2018 11:26:00 UTC for 23 hr 59 min

met obs at 1 hr intervals from 02/14/2018 11:00:00 UTC to 02/15/2018 10:00:00 UTC



Longer term medical screening

(Total effective dose received exceeding generic criteria) 16 Mar 2018



Map size: 147 km x 147 km

Actions and Long-Term Effects			
	Description	(mSv) Extent Area	Population
	100 mSv in 30 days - Screening based on equivalent doses to specific radiosensitive organs (as a basis for medical follow up), counseling (GSG-2, Table 3)	>100 80.6 km 1,121 km ²	432,000
Note: Areas and counts in the table are cumulative. Population Source = LandScan2010.			

Effects or contamination from March 16, 2018 11:11 UTC to April 15, 2018 11:11 UTC

Release Location: 37.165600 N, 76.697800 W

Material: CS-137 + I-131

Generated On: March 14, 2018 18:18 UTC

Model: ADAPT/LODI

Comments:

Hypothetical release starting at 03/16/2018 11:11:00 UTC for 23 hr 59 min

gridded met at 3 hr intervals from 03/16/2018 09:00:00 UTC to 03/17/2018 12:00:00 UTC



Closing Remarks

- ❑ The International eXchange Program (IXP) is an easy to use web-based tool for atmospheric dispersion and dose calculations on the NARAC system and is constantly available to support all IAEA Member States in the event of radiological & nuclear emergencies.
- ❑ There are many factors that affects the results of the model.
- ❑ The rapidly changing meteorology poses a significant modelling challenge.
- ❑ Accuracy of the model will depend on the accuracy of the input data.
- ❑ Predictions should be confirmed and refined using field measurements.

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END OF PRESENTATION

Thank you for your attention!