Overview of Briefing Products
Part 1: Radiological/Nuclear

October 2020

Technical Lead: Kristen Yu
Contributors: John Nasstrom and Brenda Pobanz

Lawrence Livermore National Laboratory

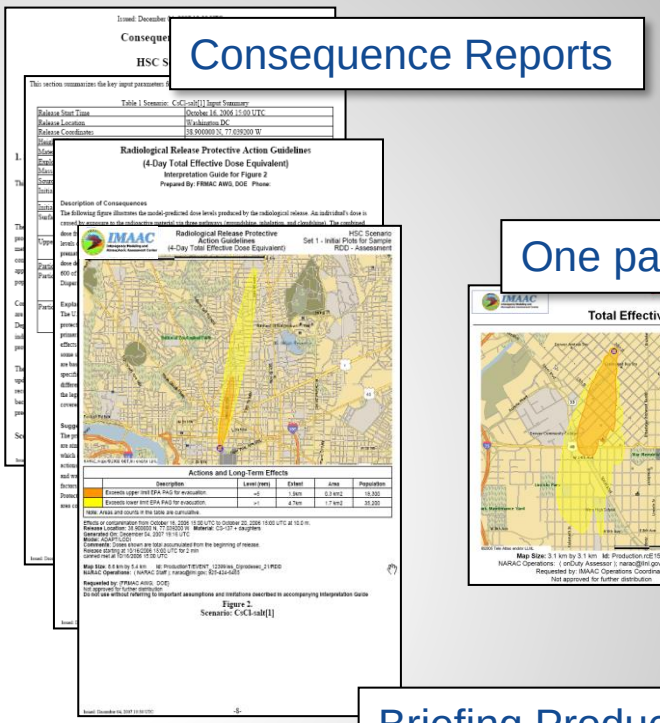
National Atmospheric Release Advisory Center
NARAC

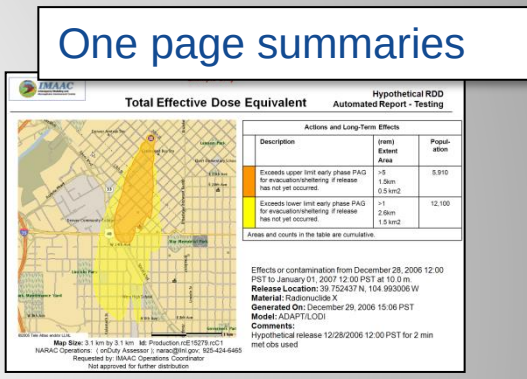
LLNL-PRES-817613

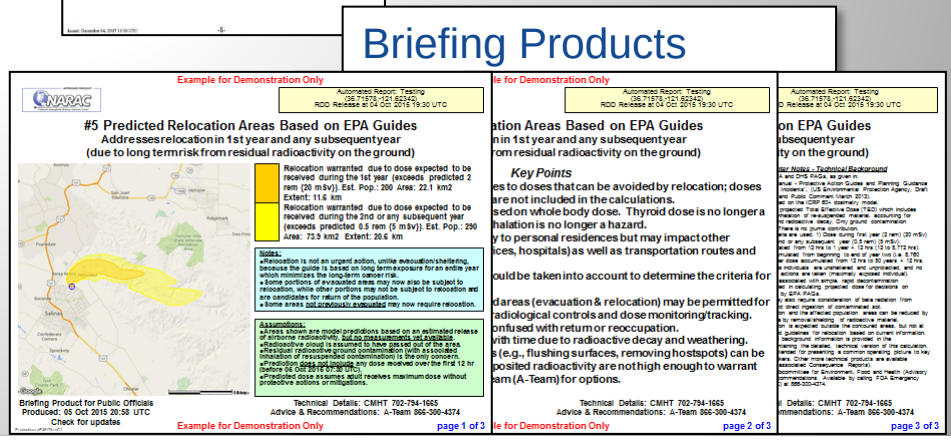
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. The Department of Homeland Security sponsored part of the production of this material.

Products Inform Decisions on Evacuation, Sheltering, Relocation, Worker Protection, and Sampling Plans

- Standard plot sets
  - Plume hazard areas
  - Affected population numbers
  - Expected health effects
  - Protective action guide levels
  - Geographical information
- One-page map summary plots
- Multi-page consequence reports
  - Expanded descriptions
  - Input data and assumptions
  - Interpretation guides
- Briefing Products
  - Focus on actions and decisions that need to be considered
  - RDD, IND, nuclear power plants, chemicals, and biological agents
  - Developed with interagency consensus







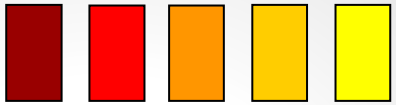
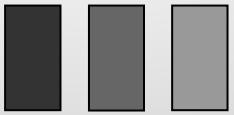
Standard Plots Are Derived From Interagency Input and Consensus

- Plot standards are developed with user input and agency consensus
  - Standard plot format and color schemes
  - Standard plot types and contamination/dose levels of concern
  - Consequence reports documenting model inputs and assumptions and providing interpretational guidance
  - Maps showing areas reaching health effect levels, and protective action guides from DHS/EPA, if available
- Default plots produced automatically when a model request is made
  - Web users may directly initiate a modeling request
  - NARAC Operations can produce and share results with designated users
- NARAC Operations provides reach-back support to:
  - Develop additional event-specific plots
  - Refine predictions based on field data and event information
  - Provide subject matter expertise on plots and analyses

A Standard Default Plot Set is Provided For Each Type of Release Developed with Interagency Input

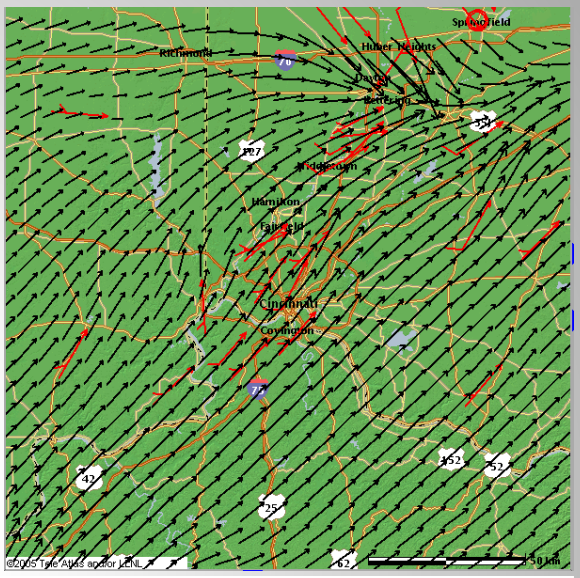
Release Type	*Default Plot Type*
Unknown source material	Hourly average air concentration Deposition if particulate is used
Industrial chemical	*"Peak"* average air concentration, deposition
Chemical agent	*"Peak"* average air concentration, deposition
Biological agent	Time-integrated air concentration, deposition
Explosive	Health effects from blast overpressure
Radiological	Dose, dose rate, deposition
Nuclear	Prompt effects, dose, dose rate

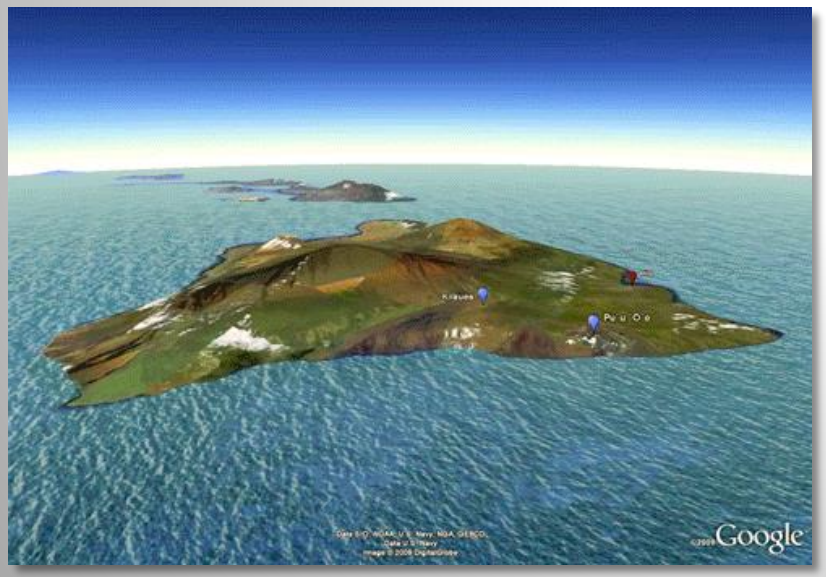
Standard Product Contour Level and Color Schemes are Used for Ease of Interpretation

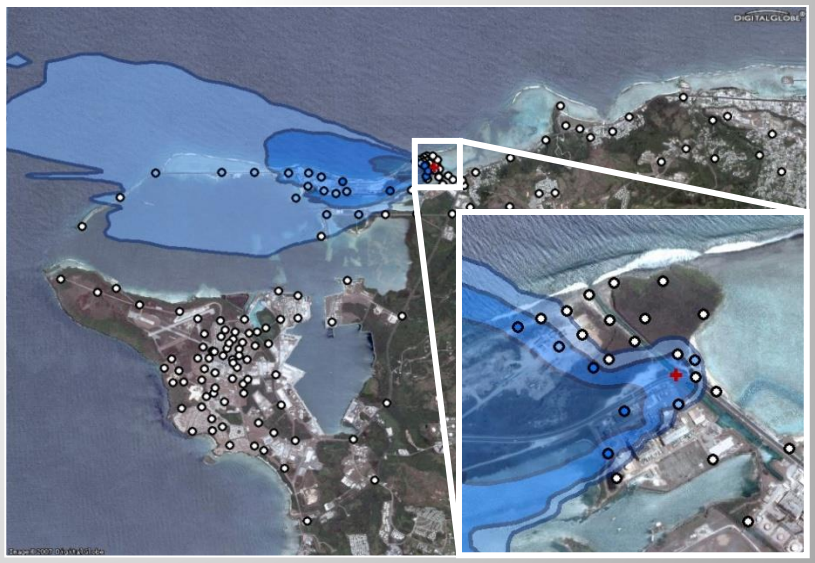
Model Contour Levels	Have levels been reached?	Contour Colors	Description Wording
Acute/Chronic exposure/dose or protective action guideline levels exist in the NARAC database (release amount assumed to be known)	Yes		Consistent with EPA, NRC, FDA or other guidance.
	No		Values below health effect or PAG levels. Possibly contaminated area. Confirm with monitoring surveys.
Customer specified levels	Yes		Customer specified levels.
	No		Values are below customer specified levels.
No levels exist in NARAC database (or no release amount known)			No guidelines specified. Possibly contaminated area.

Auxiliary Analyses Are Provided For Situational Awareness

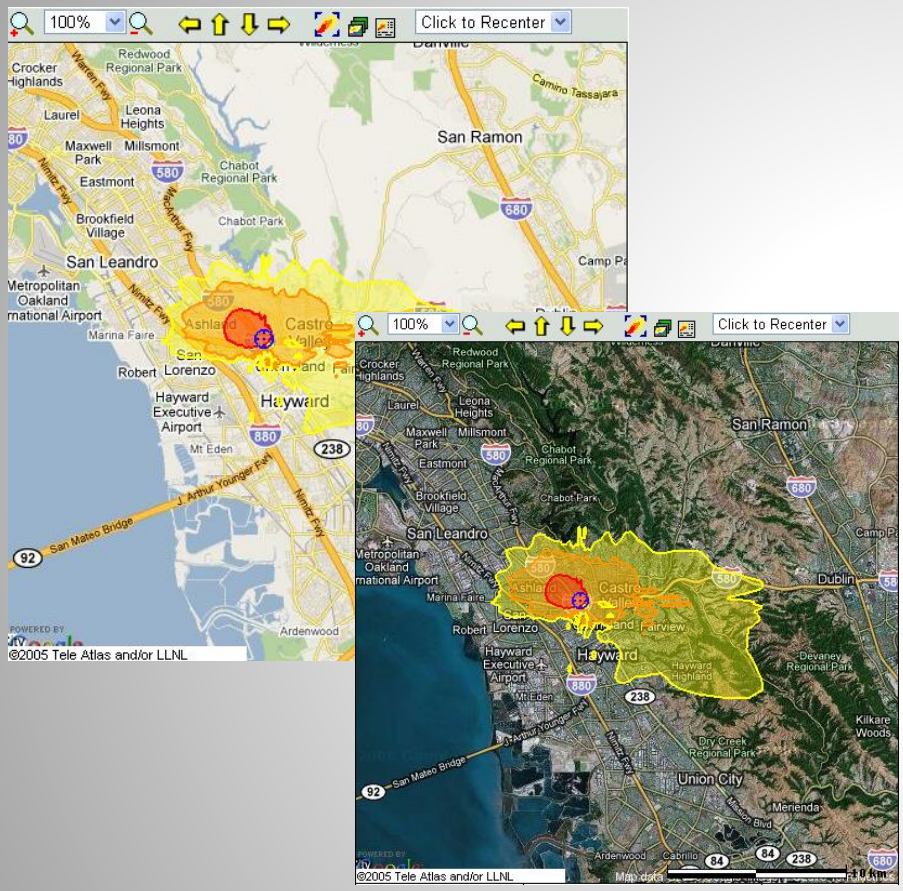
- Wind observations and fields
- Numerical weather prediction forecasts
- Field measurement data
- Deposition
- Time series, particle, or plume animations



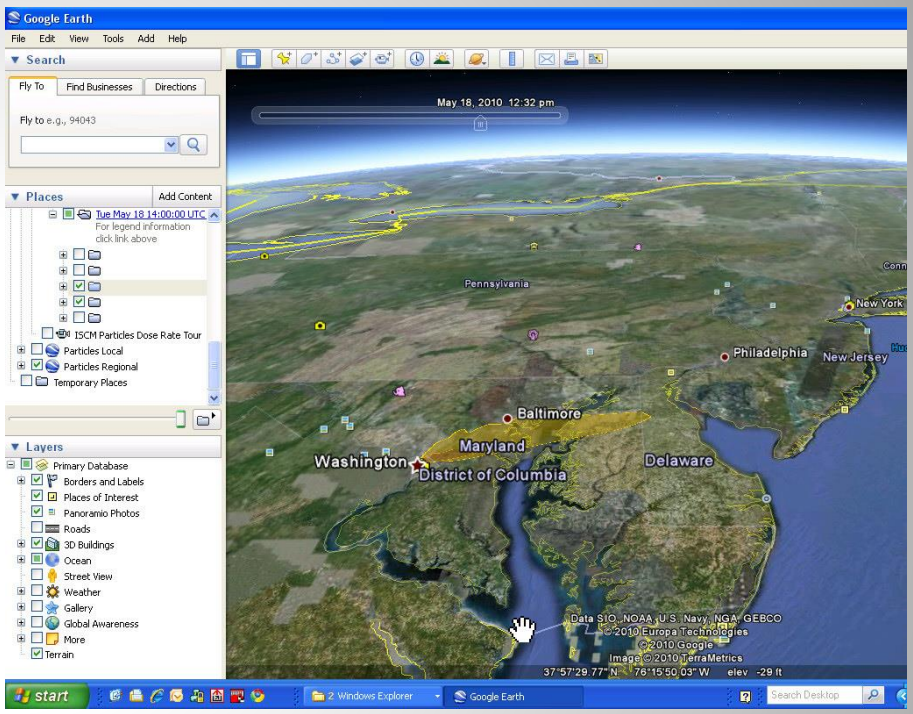




Products and Map Layers are Provided in Multiple Formats (PDF, ESRI, Google)



Worldwide Google Street and satellite displays



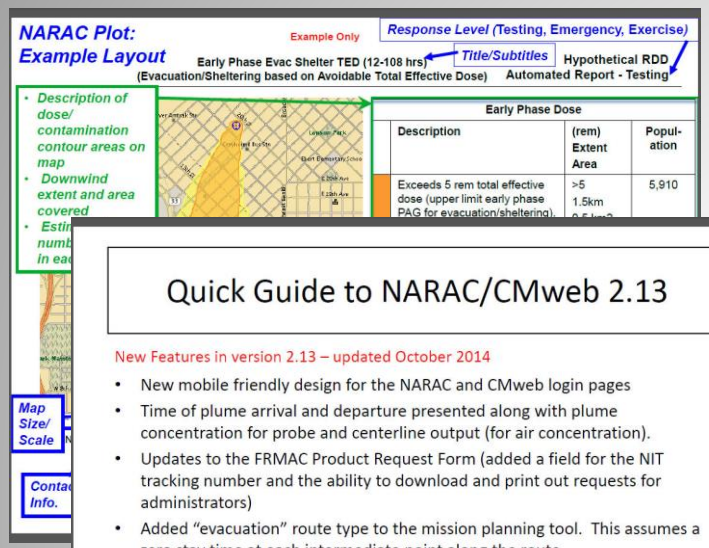
Export plumes to *Google Earth* (FEMA)

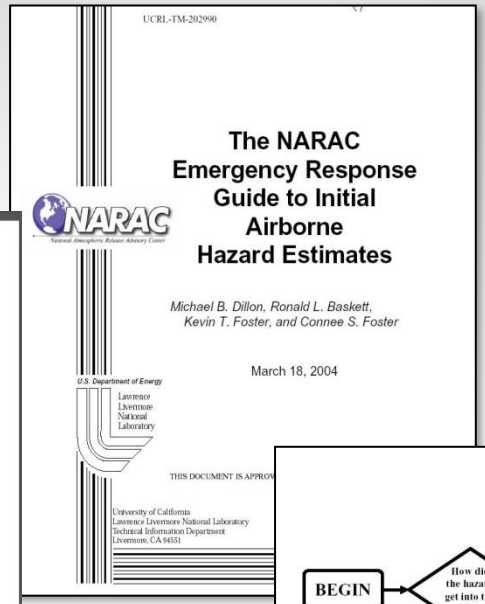
Available on NARAC/CM Web

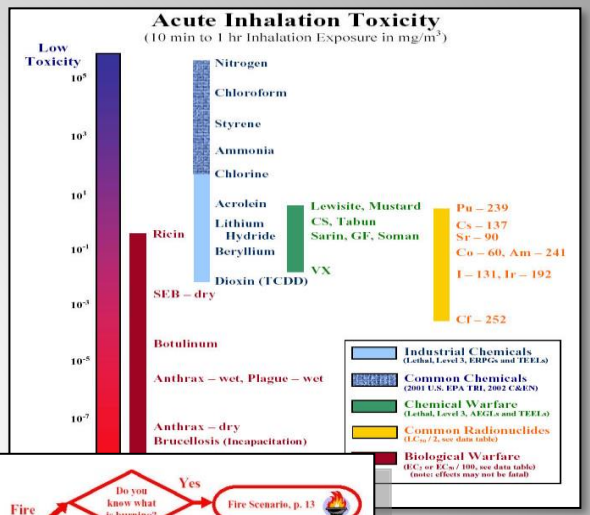
PDF, PowerPoint, HTML/XML, JPG/PNG graphics,

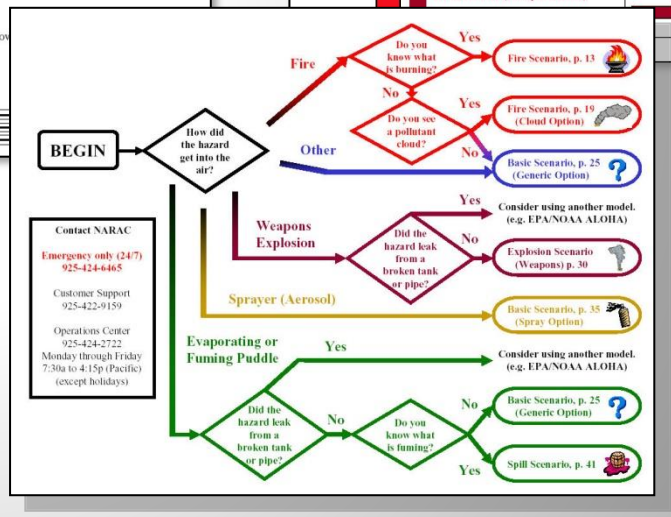
ESRI Shape and Google Earth KMZ GIS files with plume areas

Extensive User Documentation Includes User Guides and Web-Based Training









- Technical manuals
- Web-based training
- Step-by-step guide to software use
- Guide books for determining model inputs from known information

Summary of NARAC/IMAAC Briefing Products

Lawrence Livermore National Laboratory

National Atmospheric Release Advisory Center

NARAC

LLNL-PRES-817613

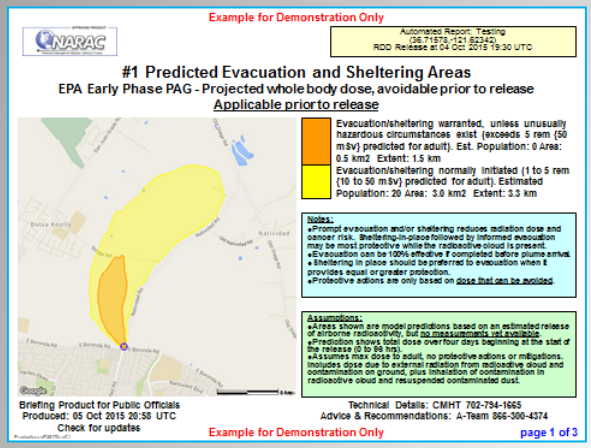
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. The Department of Homeland Security sponsored part of the production of this material.

Interagency Briefing Products Are Used to Communicate Key Information to Decision Makers

- Homeland Security Council tasked DOE / DHS to produce hazard area graphics targeted at officials, decision makers, and public affairs officers
  - Present information on effects in plain, non-technical language
  - Explain actions that need to be considered and why (e.g., sheltering, evacuation, relocation, worker protection, agricultural embargoes)
  - List assumptions and limitations
- Based on existing pertinent agency-published documents for guidance
- Developed with extensive interagency input with on-going updates based on interagency feedback and recommendations
- Designed for Subject Matter Experts to use in briefing officials and responders (not intended for direct briefing of the general public)

The development of Briefing Products has been sponsored by DOE/NNSA and DHS, and involved a collaboration of LLNL, RSL, Sandia, EPA, DHS, NRC, and HHS/CDC

Briefing Products Use a Standard Three Slide Format With Information Developed Via Interagency Consensus


Example for Demonstration Only

Automated Report: Testing
(36.71875,-121.92342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas
EPA Early Phase PAG - Projected whole body dose, avoidable prior to release
Applicable prior to release

Evacuation/sheltering warranted, unless unusually hazardous circumstances exist (exceeds 5 rem (50 mSv) predicted for adult). Est. Population: 0 Area: 0.5 km2 Extent: 1.5 km
Evacuation/sheltering normally initiated (1 to 5 rem (10 to 50 mSv) predicted for adult). Estimated Population: 20 Area: 3.0 km2 Extent: 3.3 km

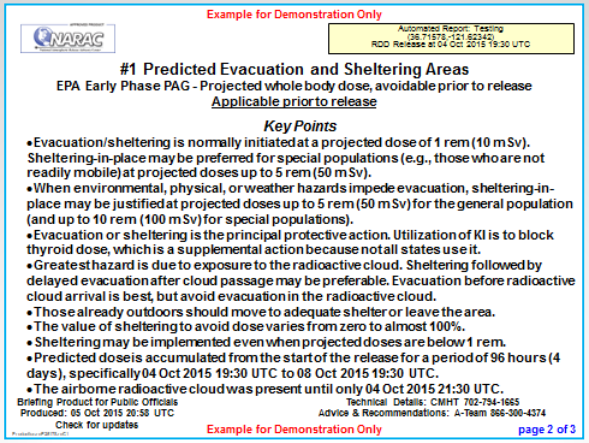
Notes:
•Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering-in-place followed by informed evacuation may be most protective while the radioactive cloud is present.
•Evacuation can be 100% effective if completed before plume arrival.
•Sheltering in place should be preferred to evacuation when it provides equal or greater protection.
•Protective actions are only based on dose that can be avoided.

Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Predictions shows total dose over four days beginning at the start of the release (0 to 96 hrs).
•Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Example for Demonstration Only
page 1 of 3


Example for Demonstration Only

Automated Report: Testing
(36.71875,-121.92342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas
EPA Early Phase PAG - Projected whole body dose, avoidable prior to release
Applicable prior to release

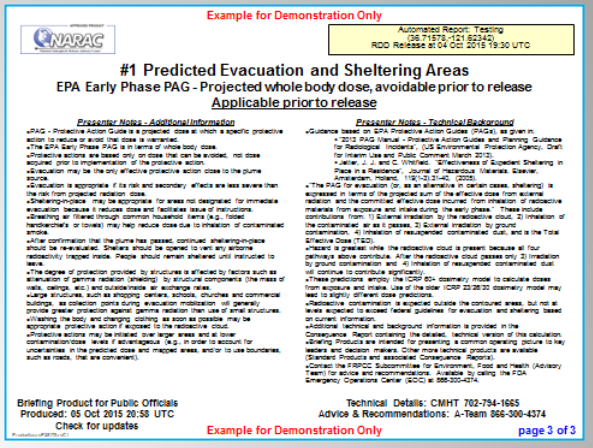
Key Points

- Evacuation/sheltering is normally initiated at a projected dose of 1 rem (10 mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).
- When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).
- Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.
- Greatest hazard is due to exposure to the radioactive cloud. Sheltering followed by delayed evacuation after cloud passage may be preferable. Evacuation before radioactive cloud arrival is best, but avoid evacuation in the radioactive cloud.
- Those already outdoors should move to adequate shelter or leave the area.
- The value of sheltering to avoid dose varies from zero to almost 100%.
- Sheltering may be implemented even when projected doses are below 1 rem.
- Predicted dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 04 Oct 2015 19:30 UTC to 08 Oct 2015 19:30 UTC.
- The airborne radioactive cloud was present until only 04 Oct 2015 21:30 UTC.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Example for Demonstration Only
page 2 of 3


Example for Demonstration Only

Automated Report: Testing
(36.71875,-121.92342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas
EPA Early Phase PAG - Projected whole body dose, avoidable prior to release
Applicable prior to release

Presenter Notes - Additional Information

•PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
•The EPA Early Phase PAG is in terms of whole body dose.
•Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
•Evacuation may be the only effective protective action close to the plume source.
•Evacuation is appropriate if its risk and secondary effects are less severe than the risk from projected radiation dose.
•Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
•Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce dose due to inhalation of contaminated smoke.
•After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
•The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
•Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation from use of small structures.
•Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
•Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted doses and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

•Guidance based on EPA Protective Action Guides (PAGs), as given in:
  • 2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents" (US Environmental Protection Agency), Draft for Interim Use and Public Comment March 2013).
  • Jaller, J. J. and C. Whitfield, "Effectiveness of Expedient Sheltering in Place in a Residence," Journal of Hazardous Materials, Elsevier, Amsterdam, Holland, 152(1-3):37-40, (2008).
•The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred, from inhalation of radioactive materials from exposure and intake during the early phase." These include contributions from: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of resuspended contaminated dust, and is the Total Effective Dose (TED).
•Hazard is greatest while the radioactive cloud is present, because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute significantly.
•These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
•Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
•Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
•Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
•Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Example for Demonstration Only
page 3 of 3

Slide 1. Plot

- Map of the areas of concern
- Plot legend (associated with actionable guidance)
- Important notes, assumptions, and limitations

Slide 2. Key Points

- Expanded list of key information concerning relevant actions for consideration (evacuation, sheltering, relocation, worker protection)
- Highlights key points to present

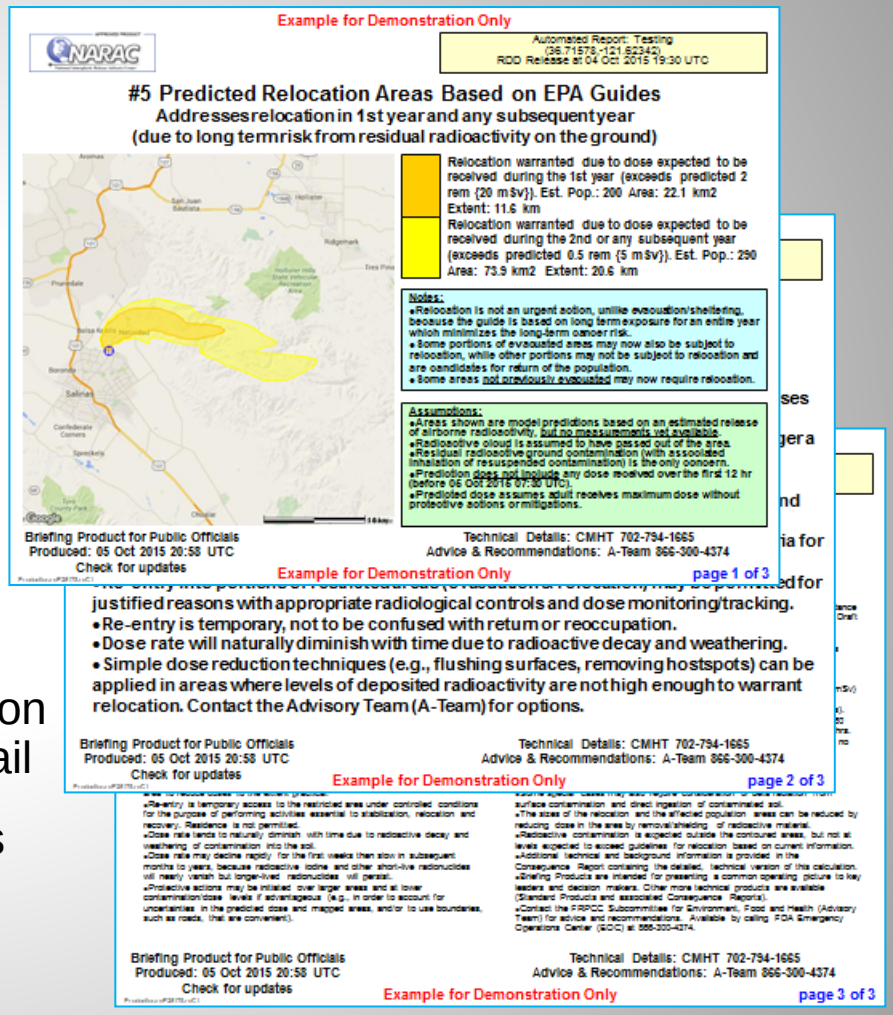
Slide 3. Presenter Notes

- Background and technical
- Intended for use by the presenter (not for display)

All slides include product titles and sub-titles, short scenario description, product creation date/time, and contact phone numbers for technical details and advice (e.g., NARAC/IMAAC, CMHT/FRMAC or Federal Advisory Team for Environment, Food and Health for radiological advice, EPA for chemical advice)

NARAC Automated Software Allows Users to Quickly Generate Briefing Products

- NARAC software can generate Briefing Products for these scenarios:
  - Nuclear detonations (e.g., Improvised Nuclear Device [IND])
  - Radiological Dispersion Device (RDD)
  - Nuclear Power Plant (NPP) accidents
  - Chemicals (toxic industrial materials/chemicals and chemical agents)
  - Biological agents
- LLNL NARAC software can quickly produce briefing products for distribution on CMweb/NARAC Web, HSIN, ECN or email
- Briefing Products available in two formats
  - PowerPoint
  - PDF

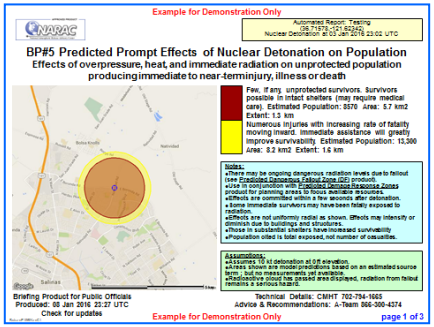
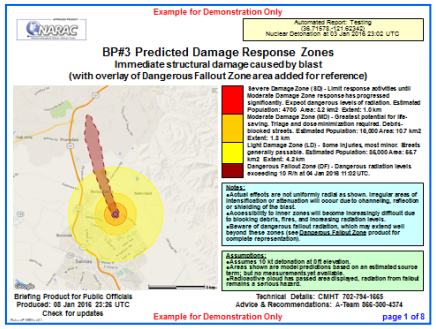


Comparison of Technical and Briefing Products

Characteristic	**Technical Products**	**Briefing Products**
User and purpose	For use by subject matter experts to support the decision-making process	To assist subject matter experts in the communication of consequences and guidance to decision-making officials
Language	Technical terminology	Plain language
Content	Complex: Includes data used to develop products such as source term, meteorology, measurements	Streamlined: Includes only essential details and focuses on explaining results
Protective action criteria and guidelines	Use established agency guidelines for standard default products, but may have information specified by subject matter experts for a special purpose	Use established agency guidelines to focus user's attention on potential actions for consideration
Training needed to use products	Requires a technical background and training before using	Each product includes two pages of key notes and background information, but training is still strongly suggested.

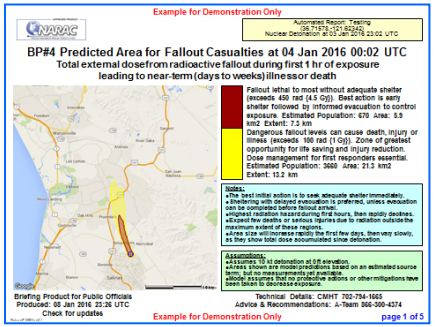
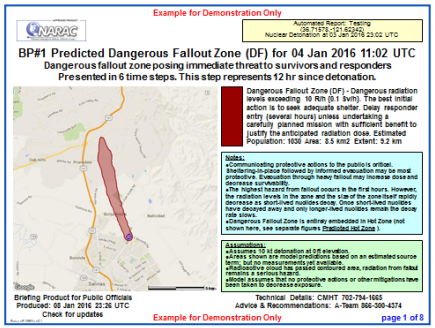
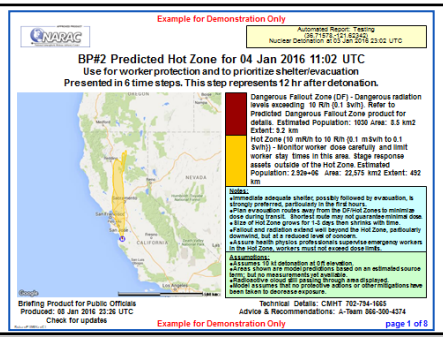
Neither type of product is intended for distribution or presentation to the general public

Nuclear Detonation Briefing Products – Prompt Effects: Summary

Time Phase	Product		Purpose
Early (minutes)	Predicted Prompt Effects on Population		• Estimate areas with immediate near-term injury, illness or death • Prioritize rescue
	Predicted Damage Response Zones		• Estimate immediate structural damage and related consequences • Inform search & rescue • Time-varying dangerous fallout zone included

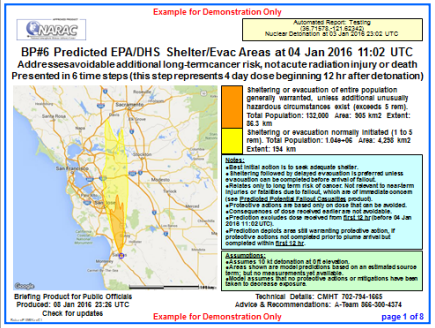
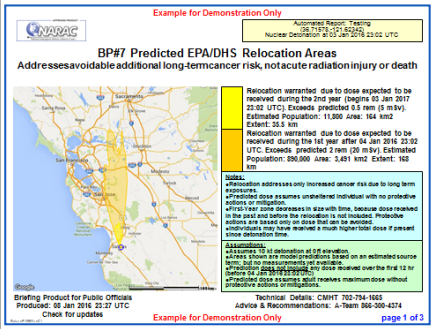
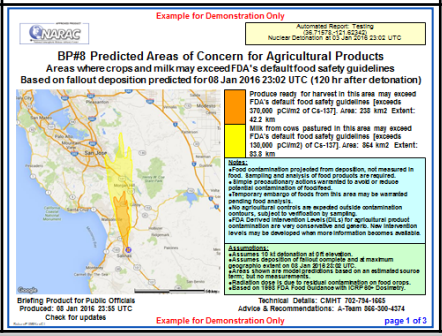
Nuclear Detonation Briefing Products – Fallout: Summary (1)

Multiple Times Shown Due to Rapid Fallout Decay

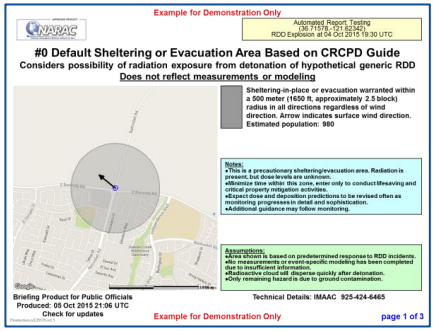
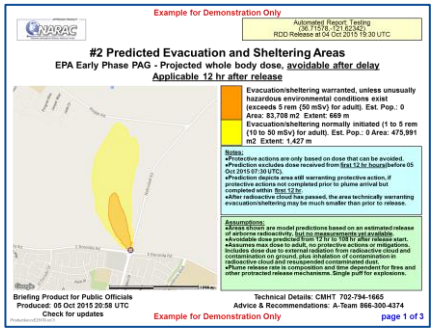
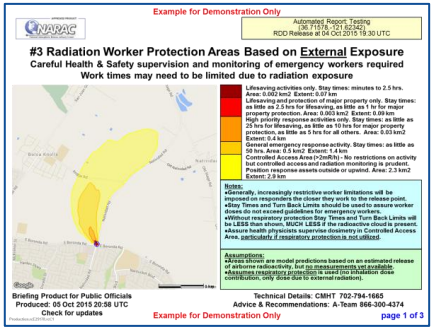
Time Phase	Product		Purpose
Early (minutes)	Predicted Area for Potential Fallout Casualties		• Estimate total fallout casualties/ injuries • Estimate external groundshine dose from radioactive fallout during first hours to days of exposure leading to near-term (days to weeks) health effects • Presented for multiple times
	Predicted Dangerous Fallout Zone		• Estimate high dose fallout zone posing immediate fatality threat to survivors and responders • >10 R/h • Presented for multiple times
	Predicted Hot Zone /Worker Protection Areas		• Use for worker protection and stay time guidance • Determine access control area • > 10 mR/hr • Presented for multiple times

Nuclear Detonation Briefing Products – Fallout: Summary (2)

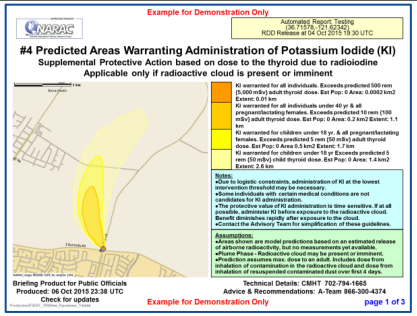
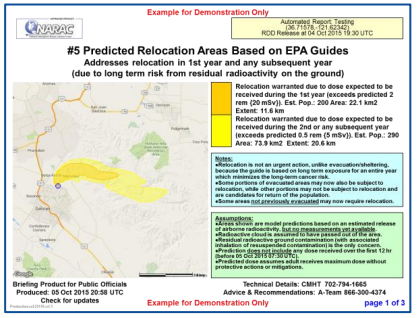
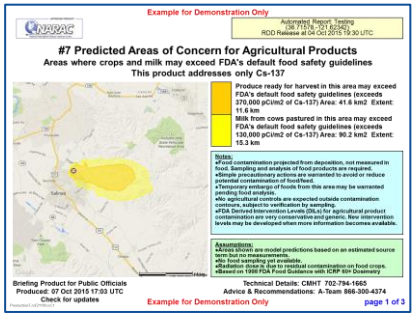
Multiple Times Shown Due to Rapid Fallout Decay

Time Phase	Product		Purpose
Early (hours to days)	Predicted EPA/DHS Sheltering/ Evacuation Areas		• Guide sheltering and evacuation decisions • Assess avoidable additional long-term cancer risk, not acute radiation injury or death (1-5 Rem and >5 Rem in 4 days) • Presented for multiple times
Intermediate (days to months)	Predicted EPA/DHS Relocation Areas		• Guide population relocation decisions • Assess avoidable additional long-term cancer risk, not acute radiation injury or death (2 Rem in first year and 0.5 Rem in subsequent or later year)
Late Phases (days to years)	Predicted Areas of Concern for Agricultural Products		• Guide crop sampling • Guide crop/food control decisions • Predict areas where crops and milk may exceed FDA's food safety guidelines based on fallout

RDD Briefing Products: Summary (1)

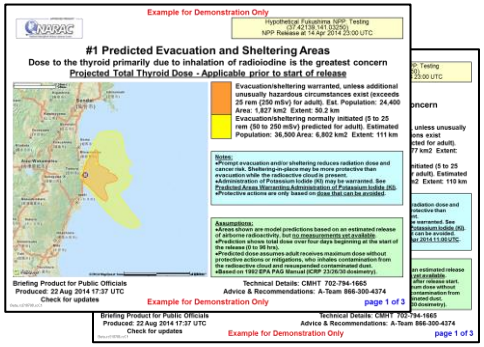
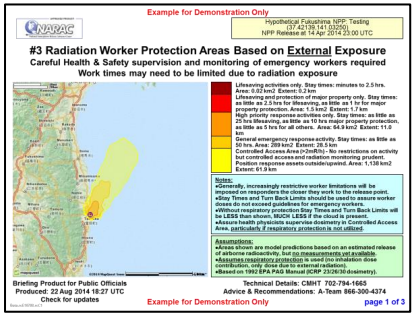
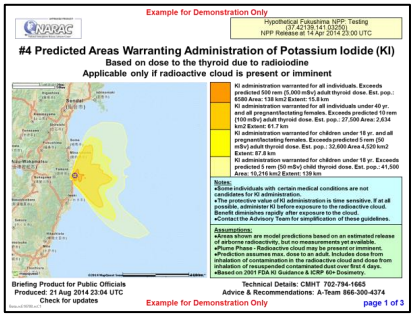
Time Phase	Product		Purpose
Early (minutes)	Default Evacuation or Sheltering Area		• Guide precautionary sheltering and evacuation decision • Guide access control and monitoring
Early (hours to days)	Predicted EPA/DHS Sheltering/ Evacuation Areas (TED)		• Update guide for sheltering and evacuation decisions • Assess avoidable additional long-term cancer risk • Uses 4-day Whole-body Total Effective Dose [TED] of 5 Rem and 1-5 Rem
	Predicted Worker Protection Areas		• Use for worker protection and stay time guidance • Determine access control area

RDD Briefing Products: Summary (2)

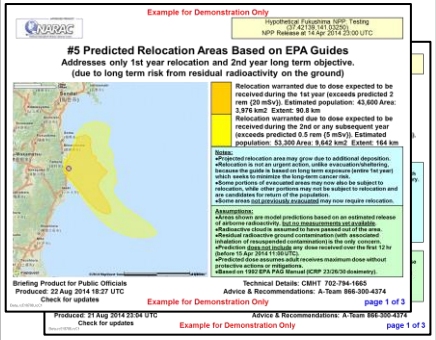
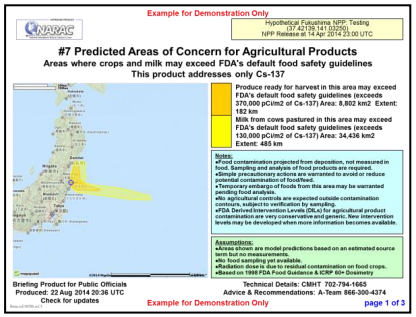
Time Phase	Product	Sample	Purpose
Early (hours to days)	Predicted Potassium Iodide Administration Areas		• Guidance for potassium iodide administration to reduce thyroid dose and long-term cancer risk from inhaled radioactive iodine • Based on FDA 2001 (age-dependent dose levels) publications
Intermediate (days to months) and Late Phases (months to years)	Predicted EPA/DHS Relocation and Recovery Areas		• Guide population relocation decisions • Assess avoidable additional long-term cancer risk, not acute radiation injury or death (2 Rem in first year, 0.5 Rem in second or later year and 5 rem over 50 years)
	Predicted Areas of Concern for Agricultural Products		• Guide crop sampling • Guide crop/food control decisions • Predict areas where crops and milk may exceed FDA's food safety guidelines based on ground contamination

Note: ICRP60 dose conversion factors are used for radiological dispersal device products

NPP Briefing Products: Summary (1)

Time Phase	Product	Sample	Purpose
Early (hours to days)	Predicted EPA/DHS Sheltering/ Evacuation Areas (TED or Thyroid CDE)		• Guide for sheltering and evacuation decisions based on most-limiting organ dose criteria • Assess avoidable additional long-term cancer risk (4-day Total Effective Dose Equivalent: 1-5 Rem and >5 Rem levels; or Adult Thyroid Committed Dose Equivalent: >25 Rem and 5-25 Rem levels)
	Predicted Worker Protection Areas		• Use for worker protection and stay time guidance • Determine access control area
	Predicted Potassium Iodide Administration Areas		• Guidance for potassium iodide administration to reduce thyroid dose and long-term cancer risk from inhaled radioactive iodine • Customer-specific guidance based on FDA 2001 (age-dependent dose levels) publications

NPP Briefing Products: Summary (2)

Time Phase	Product	Sample	Purpose
Intermediate (days to months) and Late Phases (months to years)	Predicted EPA/DHS Relocation Areas		• Guide population relocation decisions • Assess avoidable additional long-term cancer risk (2 rem in first year, 0.5 rem in subsequent or later year and 5 rem over 50 years)
	Predicted Areas of Concern for Agricultural Products		• Guide for areas to sample crops • Guide crop/food control decisions • Predict areas where crops and milk may exceed FDA's food safety guidelines based on ground contamination

Note: ICRP26/30 dose conversion factors are currently used for nuclear reactor release products, apart from the FDA 2001 potassium iodide administration and agricultural products which are based on ICRP 60

National Atmospheric Release Advisory Center
NARAC

Layout of Briefing Products (1)

[Product Set #:] [Event Name]
[Location Name and/or Coordinates]
[Event Type] at [Date/Time]

Italicized text describes type of information that will appear hear, and varies from product to product

Product Title
Product Sub-Title 1
Product Sub-Title 2

Blue text is substituted in the actual product with appropriate text based on response-, scenario- or material-dependent information

Non-Italicized text shows text as it is displayed in the actual product

One or more shaded contoured areas overlaid onto a geographic map of the affected area

Contour Legend Area: one or more color-coded areas with associated descriptive text applicable to the area covered by the contour. This text preferably reflects appropriate actions for consideration by the decision-maker.

Notes
- *A list of bulleted key items of interest concerning this product, the area it covers, and/or relevant actions for consideration.*

Assumptions:
- *A statement of whether this product is based only on estimated source term, or if initial source term assumptions have been modified to better match available measurement data.*
- *A statement of whether the airborne plume is still expected to be present in the area, or if the initial plume has passed.*

Briefing Product for Public Officials
Produced: [insert time and date]
Check for updates

Technical Details: [phone number of technical contact]
Federal POC for Advice: [phone number of advice contact]

National Atmospheric Release Advisory Center
NARAC

Layout of Briefing Products (2)

[Product Set #:] [Event Name]
[Location Name and/or Coordinates]
[Event Type] at [Date/Time]

Product Title

Product Sub-Title 1

Product Sub-Title 2

Key Points

- *An expanded list of bulleted key items of interest concerning this product, the area it covers, and/or relevant actions for consideration. Some of these points may repeat Notes from slide one.*

National Atmospheric Release Advisory Center
NARAC

Layout of Briefing Products (3)

[Product Set #:] [Event Name]
[Location Name and/or Coordinates]
[Event Type] at [Date/Time]

Product Title

Product Sub-Title 1

Product Sub-Title 2

Presenter Notes – Additional Information:

- *A bulleted list of background information items relevant to briefing this product. These items are meant to provide context and reference for the presenter, and not for display to the audience*.

Presenter Notes - Technical Background:

- *A bulleted list of more technically-oriented background information items relevant to briefing this product. These items are meant to provide context and optional reference for the presenter, and not for display to the audience*.

NARAC/IMAAC Briefing Products for a Nuclear Detonation

Kristen Yu

Lawrence Livermore National Laboratory

National Atmospheric Release Advisory Center

NARAC

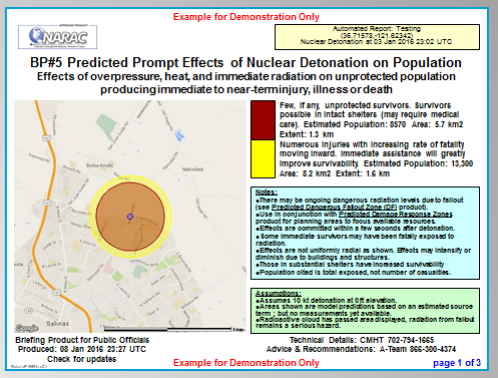
LLNL-PRES-817613

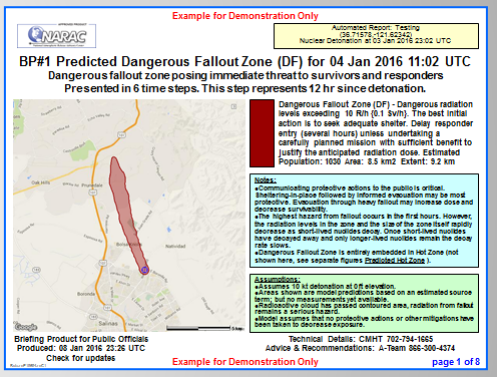
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. The Department of Homeland Security sponsored part of the production of this material.

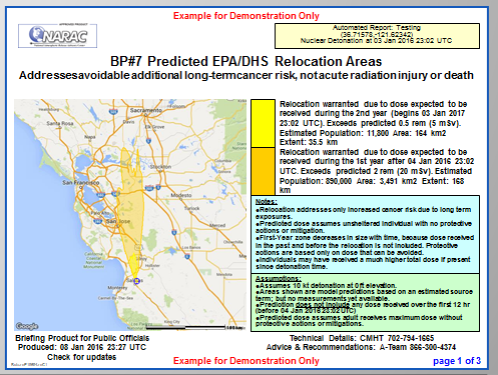
Released-LLNL-TR-454371

Nuclear Detonation Briefing Product Set

- **Early Phase (minutes)**
  - Prompt Effects on Population (single time only)
  - Predicted Damage Response Zones (with Dangerous Fallout Zone)
  - Predicted Dangerous Fallout Zone
  - Predicted Hot Zone /Worker Protection Areas
  - Predicted Area for Potential Fallout Casualties
- **Early Phase (hours to days)**
  - Predicted EPA/DHS Sheltering/ Evacuation Areas
- **Intermediate Phase (days to months)**
  - Predicted EPA/DHS Relocation Areas
- **Late Phase (days to years)**
  - Predicted Areas of Concern for Agricultural Products







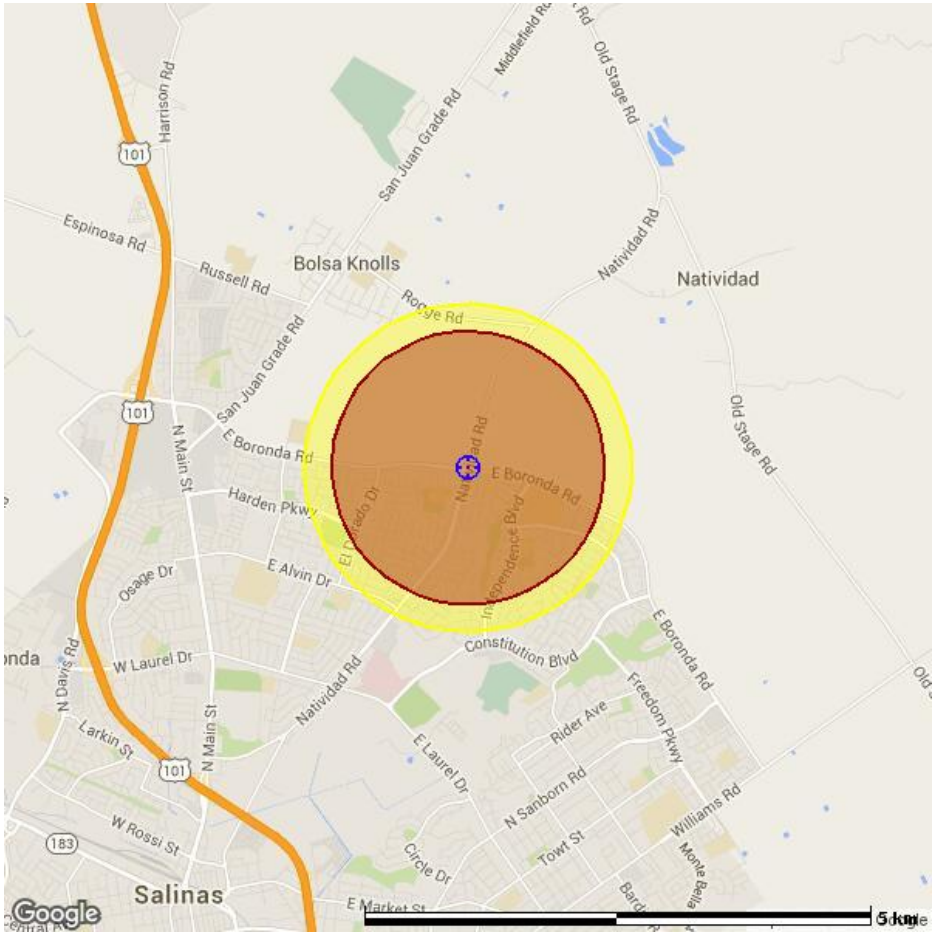
All plots apart from the Prompt Effects product may be shown for multiple times due to the rapid changes in impacts resulting from radioactive decay

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#5 Predicted Prompt Effects of Nuclear Detonation on Population

Effects of overpressure, heat, and immediate radiation on unprotected population producing immediate to near-term injury, illness or death



Few, if any, unprotected survivors. Survivors possible in intact shelters (may require medical care). Estimated Population: 8570 Area: 5.7 km2 Extent: 1.3 km

Numerous injuries with increasing rate of fatality moving inward. Immediate assistance will greatly improve survivability. Estimated Population: 13,300 Area: 8.2 km2 Extent: 1.6 km

Notes:

- **There may be ongoing dangerous radiation levels due to fallout (see Predicted Dangerous Fallout Zone (DF) product).**
- **Use in conjunction with Predicted Damage Response Zones product for planning areas to focus available resources.**
- **Effects are committed within a few seconds after detonation.**
- **Some immediate survivors may have been fatally exposed to radiation.**
- **Effects are not uniformly radial as shown. Effects may intensify or diminish due to buildings and structures.**
- **Those in substantial shelters have increased survivability**
- **Population cited is total exposed, not number of casualties.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term ; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#5 Predicted Prompt Effects of Nuclear Detonation on Population

Effects of overpressure, heat, and immediate radiation on unprotected population producing immediate to near-term injury, illness or death

Key Points

- Number of casualties will depend on many factors (e.g. sheltering at time of detonation, construction quality, etc.). Expect a mix of fatalities, major injuries, and minor injuries.
- Most prompt casualties will lie within the predicted Moderate and Severe Damage Response Zones (see Predicted Damage Response Zones product).
- Expect greater than 90% fatality rate for unprotected individuals inside the red area. Survival for some may be possible, if shelter adequate.
- Expect declining fatality rate in the yellow area with few fatalities and as little as only 10% of the population suffering major injuries at its outer boundary.
- Levels of radiation dangerous to first responders and survivors can be expected in portions of the affected area, (see Predicted Dangerous Fallout Zone (DF) product).
- Outside radiation levels may be too dangerous for immediate escape/evacuation.
- Life-saving efforts have greatest potential value in the outer ring, except in the DF Zone.
- Injuries will include a spectrum of blast, radiation, and thermal effects (separately or in combination). Some victims, and areas displayed, are contaminated with fallout.
- Special victim triage procedures may be necessary. Some relatively uninjured victims may have severe or lethal radiation exposures and/or be contaminated by fallout.
- Treatment of serious or life-threatening injuries takes precedent over decontamination.

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#5 Predicted Prompt Effects of Nuclear Detonation on Population

Effects of overpressure, heat, and immediate radiation on unprotected population producing immediate to near-term injury, illness or death

Presenter Notes - Additional Information

- This product estimates the total casualties by sequentially applying the health effects of each hazard, one hazard at a time, associated with the prompt heat, blast (overpressure) and radiation consequences. These estimates do not include any additional compounding of health effects which may occur from simultaneous exposure to combinations of the individual effects, which would be expected to increase casualties by an unknown amount.
- This product only considers effects committed at the moment of detonation. It does not include effects of radioactive fallout.
- While these prompt effects are committed in the few moments following detonation, some fatalities may be delayed until much later.
- The size of these prompt effects zones are determined immediately after detonation and do not change with time.
- Subsequent sheltering or evacuation of the affected population will not alter these effects, but will reduce additional health effects caused by radioactive material deposited onto the surface (fallout).
- Some individuals in uncontaminated areas of the regions shown will have substantial, if not severe, radiation exposures during the instant of detonation.
- Dangerous levels of radioactive contamination (fallout) will be present. A cloud of visible radioactive dust will surround the detonation site (base surge cloud). This radioactive dust will be carried downwind for miles (fallout). The most dangerous fallout will be visible as dust and fine particles.
- Most contamination can be removed by changing into uncontaminated clothes and washing exposed skin. At a minimum, brush off radioactive dust or remove contaminated clothes.
- Initial triage will be based in part on the victim's post-detonation location history, physical examination, and dosimetry predictions from initial models.
- Initial triage (or sorting) should not replace follow-on clinical triage for more specific medical management.
- Because of probable damage to infrastructure, the limited availability of resources, and the presence of radiation, paramedics and clinicians will have to bypass conventional clinical standards of care in order to maximize the overall preservation of life.

Presenter Notes - Technical Background

- Guidance based on:
  - "Planning Guidance for Response to a Nuclear Detonation", Second Edition, June, 2010. Developed by the Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats.
- Area where unprotected survivors are unlikely is defined where 90% or more of those in the open (i.e. not sheltered) are expected to receive fatal injuries.
- Area where numerous injuries and some fatalities occur is defined as where expected effects experienced by unsheltered population range from 10% major injuries to 90% fatal injuries.
- Overpressure, thermal, and radiation injuries in combination are likely, and may result in fatalities above those estimated.
- The "Estimated Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:27 UTC
Check for updates

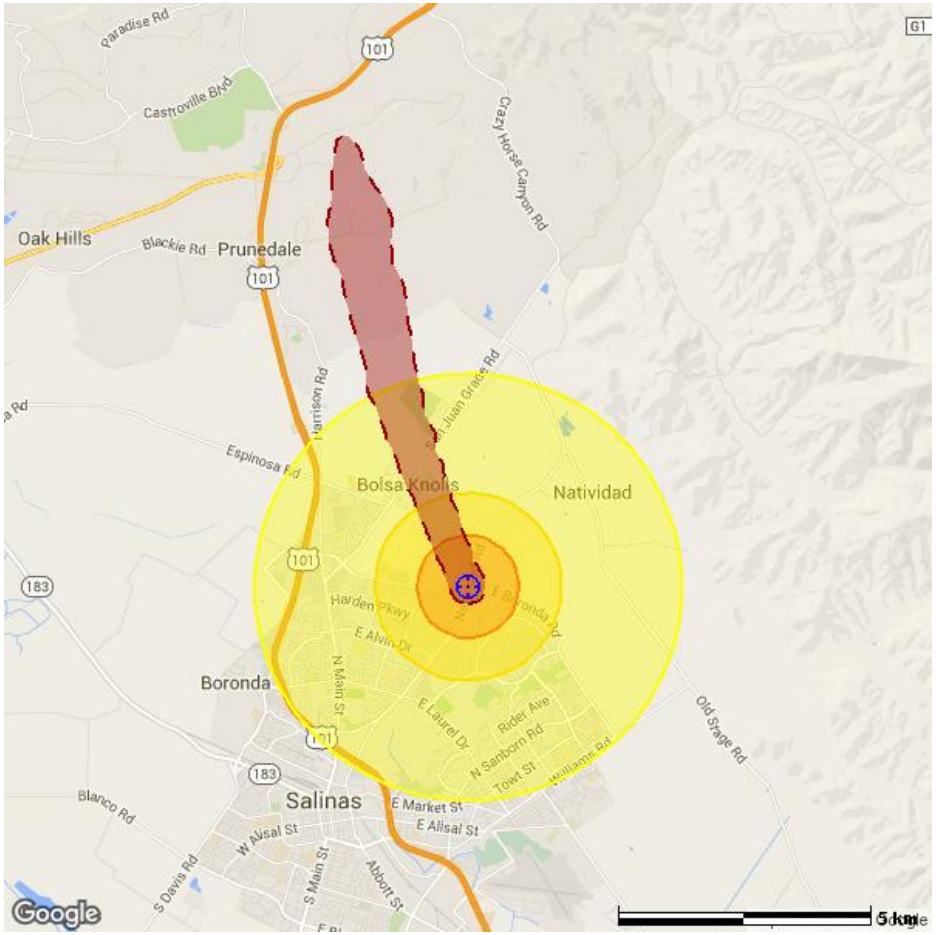
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 04 Jan 2016 11:02 UTC.

Notes:

- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

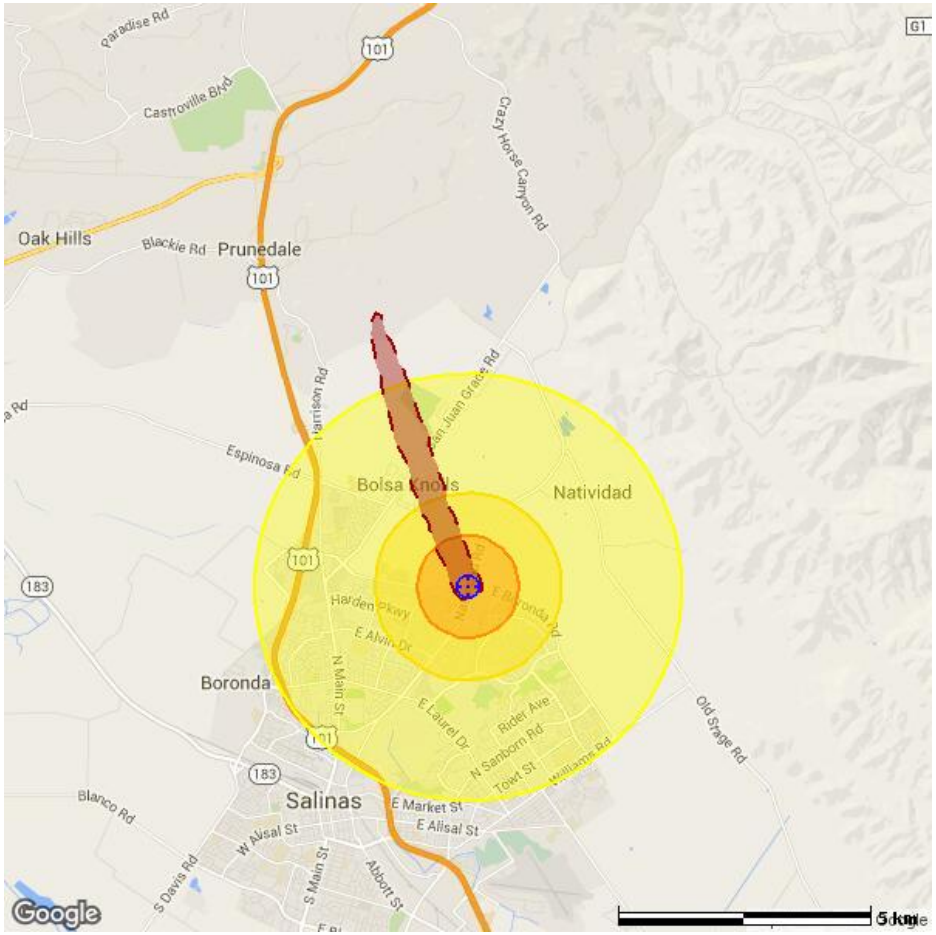
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 04 Jan 2016 23:02 UTC.

Notes:
- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

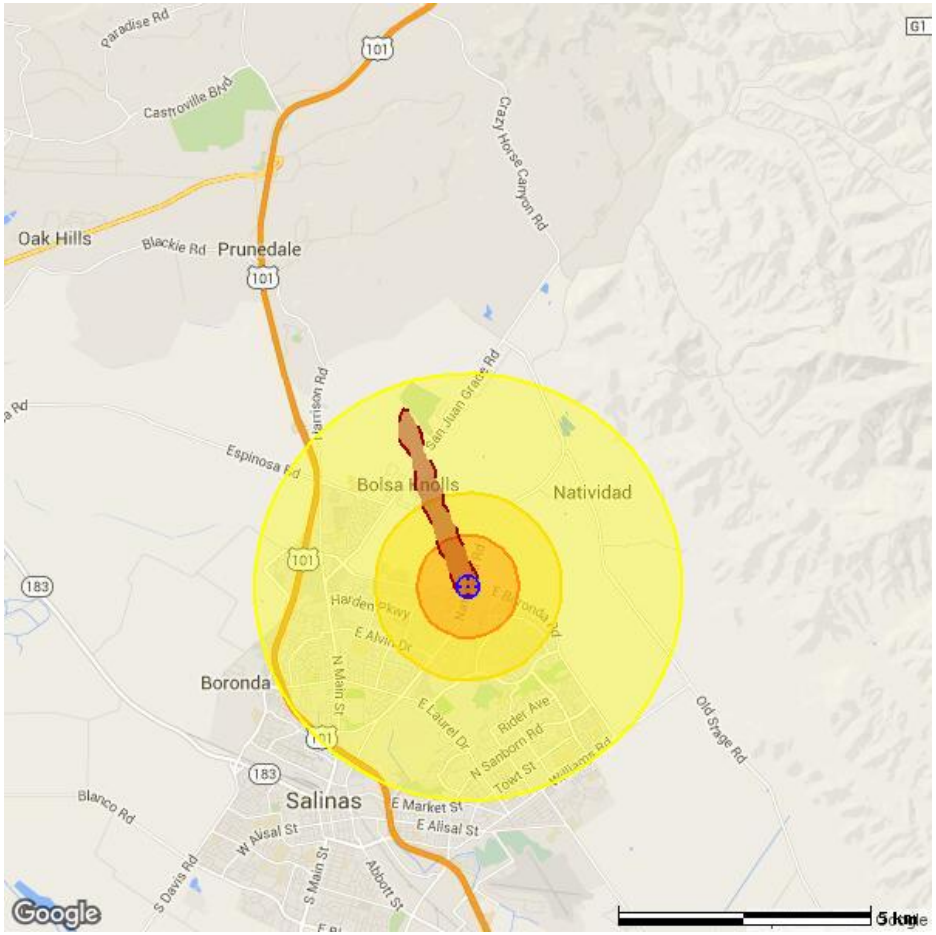
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 05 Jan 2016 11:02 UTC.

Notes:
- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

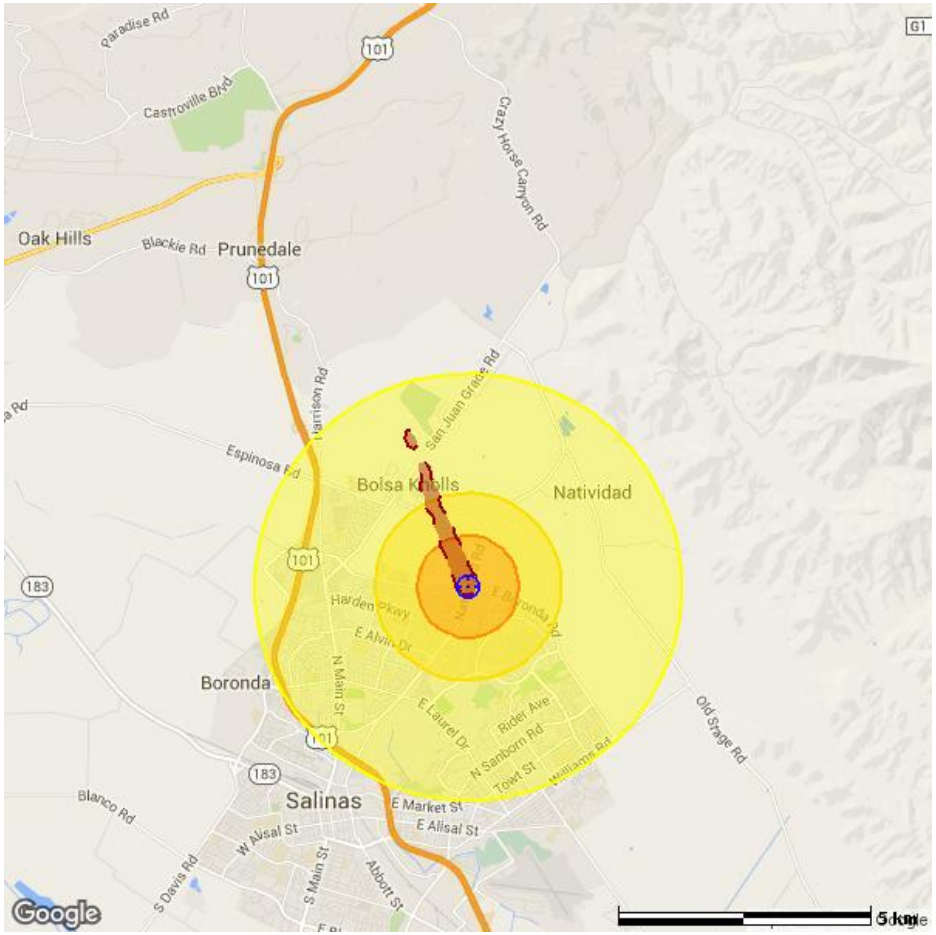
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 05 Jan 2016 23:02 UTC.

Notes:

- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

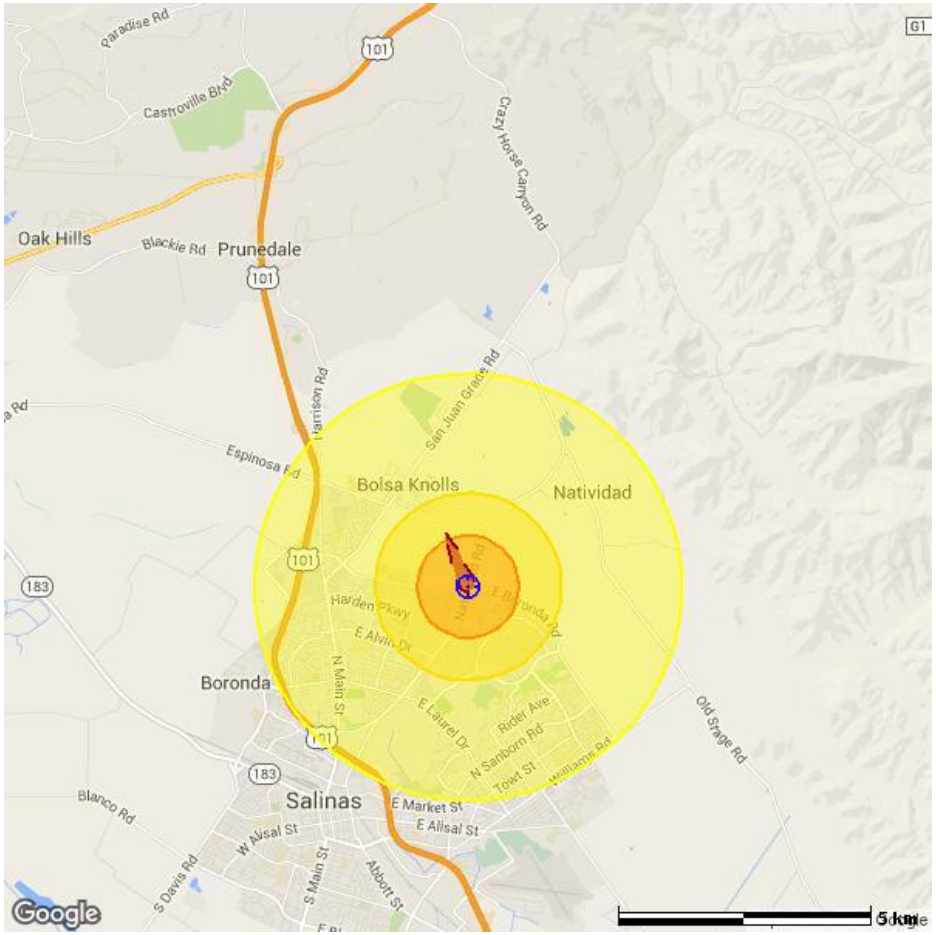
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 06 Jan 2016 23:02 UTC.

Notes:
- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

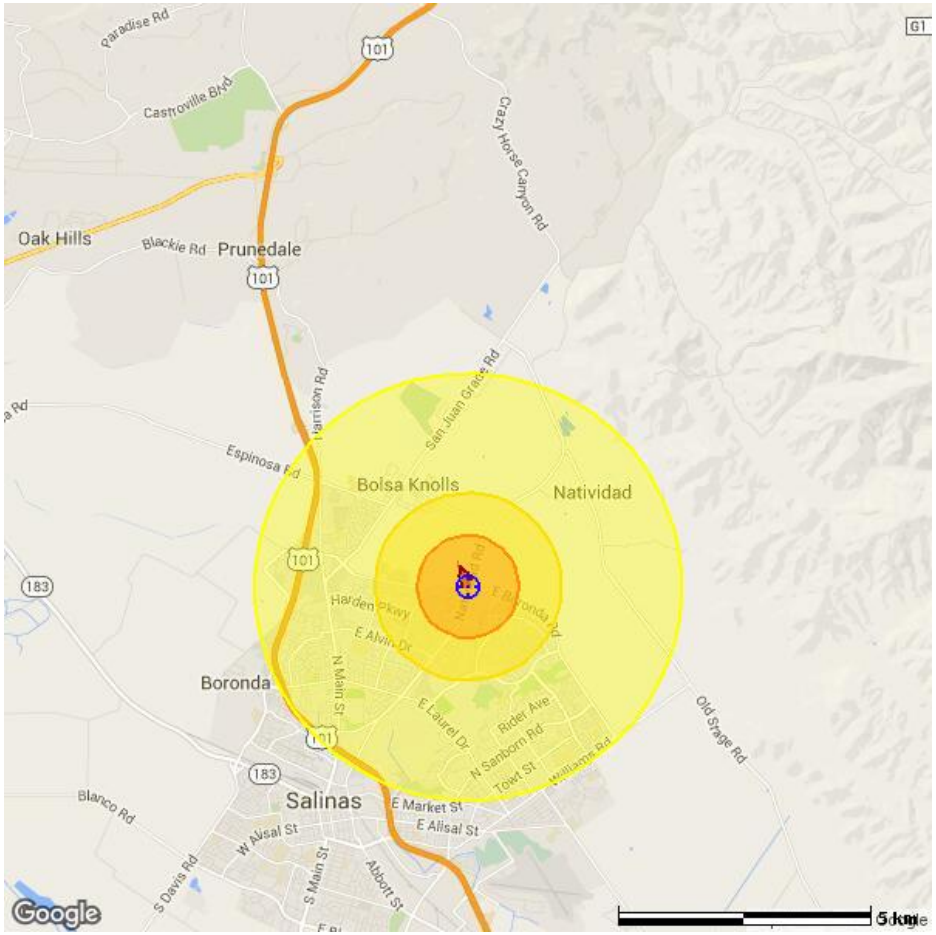
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)



Severe Damage Zone (SD) - Limit response activities until Moderate Damage Zone response has progressed significantly. Expect dangerous levels of radiation. Estimated Population: 4700 Area: 3.2 km2 Extent: 1.0 km

Moderate Damage Zone (MD) - Greatest potential for life-saving. Triage and dose minimization required. Debris-blocked streets. Estimated Population: 16,000 Area: 10.7 km2 Extent: 1.8 km

Light Damage Zone (LD) - Some injuries, most minor. Streets generally passable. Estimated Population: 85,000 Area: 55.7 km2 Extent: 4.2 km

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h at 07 Jan 2016 23:02 UTC.

Notes:
- **Actual effects are not uniformly radial as shown. Irregular areas of intensification or attenuation will occur due to channeling, reflection or shielding of the blast.**
- **Accessibility to inner zones will become increasingly difficult due to blocking debris, fires, and increasing radiation levels.**
- **Beware of dangerous fallout radiation, which may extend well beyond these zones (see Dangerous Fallout Zone product for complete representation).**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed area displayed, radiation from fallout remains a serious hazard.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)

Key Points

- This map shows blast damage, and at least part of the area of high radiation hazard. There is dangerous fallout in this area and possibly beyond (see Dangerous Fallout Zone product for a complete representation).
- Dangerous fallout may be carried in directions other than expected by surface winds.
- The actual damage areas are not circular, but irregularly shaped, due to the effect of buildings on the blast.
- Severe Damage Zone (formerly No-Go Zone): Practically all structures severely damaged or collapsed. Rubble will make streets and roads impassable. Some survivors possible in stable structures. Adequate shelter (e.g., tunnels or basements) required to survive prompt radiation and effects of radioactive fallout (see Dangerous Fallout Zone product).
- Moderate Damage Zone: Substantial damage to most light structures, minor damage to heavily-reinforced structures, most single-family dwellings destroyed. Rubble and disabled vehicles will make use of streets difficult to impossible. Many casualties due to flying debris/glass, burns, building collapse and accidents. Urgent medical care required.
- Light Damage Zone: Glass breakage and distorted window/door frames, little to no damage to reinforced structures. Stalled/crashed vehicles will slow movement of emergency vehicles. Mostly non-life threatening injuries requiring self/out-patient care.

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#3 Predicted Damage Response Zones

Immediate structural damage caused by blast
(with overlay of Dangerous Fallout Zone area added for reference)

Presenter Notes - Additional Information

- Dangerous fallout may be present, particularly in the Severe Damage Zone and in the Dangerous Fallout Zone downwind of the detonation site (see Dangerous Fallout Zone product).
- Response in the Severe Damage Zone should be avoided, if possible, until radiation levels decline.
- Serious, although lower, radiation levels (up to 10 R/hr) may be encountered in the area surrounding the Dangerous Fallout Zone, particularly downwind of the blast site.
- Early life-saving operations should focus on the Moderate Damage Zone, because that is where the greatest benefit can be achieved.
- Response within the Moderate Damage Zone requires preparation for elevated radiation levels, unstable buildings and other structures, downed power lines, ruptured gas lines, hazardous chemicals, sharp metal objects, broken glass, and fires.
- Light Damage Zone - Encourage those with minor injuries to shelter in safe locations to expedite access to the severely injured.
- Treatment of life threatening injuries takes precedence over decontamination of patients or equipment.
- Some surviving individuals in uncontaminated (from fallout) areas of the regions shown may have already received substantial, if not severe, radiation exposures during the instant of detonation.
- Predicted Damage Response Zones are defined in terms of blast overpressure for which characteristic degrees of structural damage can be expected for yields of 1 to 100kT.
- Overpressure levels for the zones shown chosen as:
  - Severe Damage Zone = exceeds 5 psi (35kPa) overpressure
  - Moderate Damage Zone = exceeds 2 psi (14 kPa) overpressure
  - Light Damage Zone = exceeds 0.5 psi (3.5 kPa) overpressure
- Modeled size and shape only depend on yield and burst height and do not reflect effects of buildings, subsequent damage or restoration work.

Presenter Notes - Technical Background

- Guidance based on:
  - "Planning Guidance for Response to a Nuclear Detonation", Second Edition, June, 2010. Developed by the Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats.
- Severe Damage Zone (SD, formerly No-Go Zone) - Region in which structural damage is severe, survival prospects are very poor and hazards to responders are extreme. Damage in this zone is characteristic of overpressures exceeding 5 to 8 psi (35 to 55 kPa). Even heavily constructed buildings are destroyed inside the inner half of the SD Zone, but most should survive to some degree in the outer half of the SD Zone. Approximately 50% of light structures will suffer moderate damage at the boundary. Rubble piles may reach as much as 30 feet (9 meters) in height.
- Moderate Damage Zone (MD) - Significant building damage to light structures (minor damage to heavily-reinforced structures) characteristic of overpressures exceeding 2 to 3 psi (14 to 21 kPa).
- Light Damage Zone (LD) - A relatively large zone in which damage is primarily broken windows and crushed doors due to over pressures at about 0.5 psi (3.5 kPa). Expect approximately 25% of the windows broken at the outer boundary of the LD Zone. Injuries are generally minor, requiring only self or out-patient treatment.
- The "Total Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

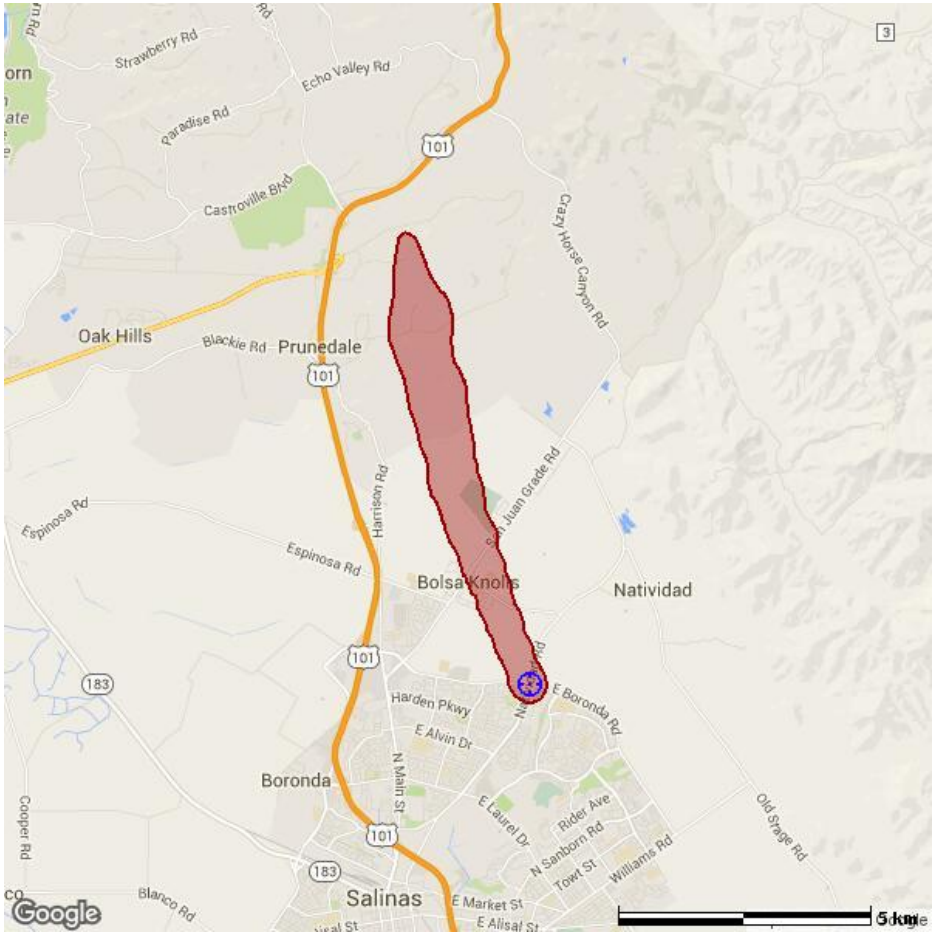
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 04 Jan 2016 11:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 12 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 1030 Area: 8.5 km2 Extent: 9.2 km

Notes:

- Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.
- The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.
- Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).

Assumptions:

- Assumes 10 kt detonation at 0 ft elevation.
- Areas shown are model predictions based on an estimated source term; but no measurements yet available.
- Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.
- Model assumes that no protective actions or other mitigations have been taken to decrease exposure.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

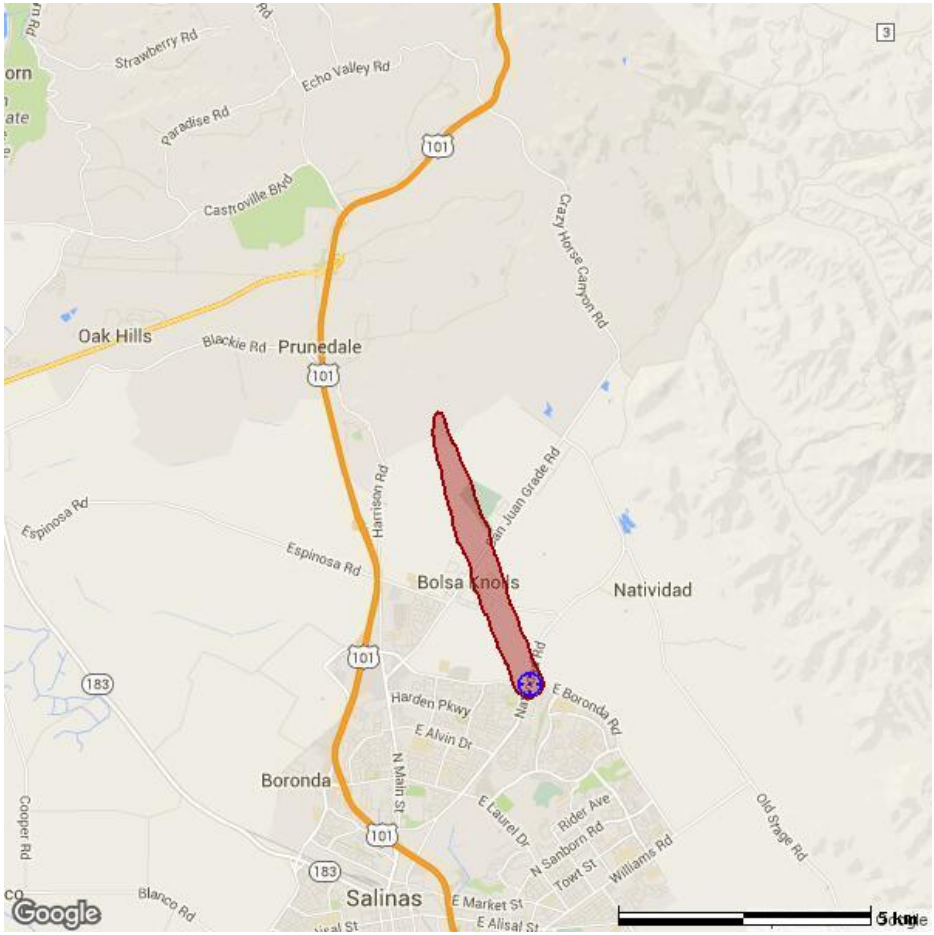
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 04 Jan 2016 23:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 24 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 420 Area: 3.0 km2 Extent: 5.7 km

Notes:

- **Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.**
- **The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.**
- **Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

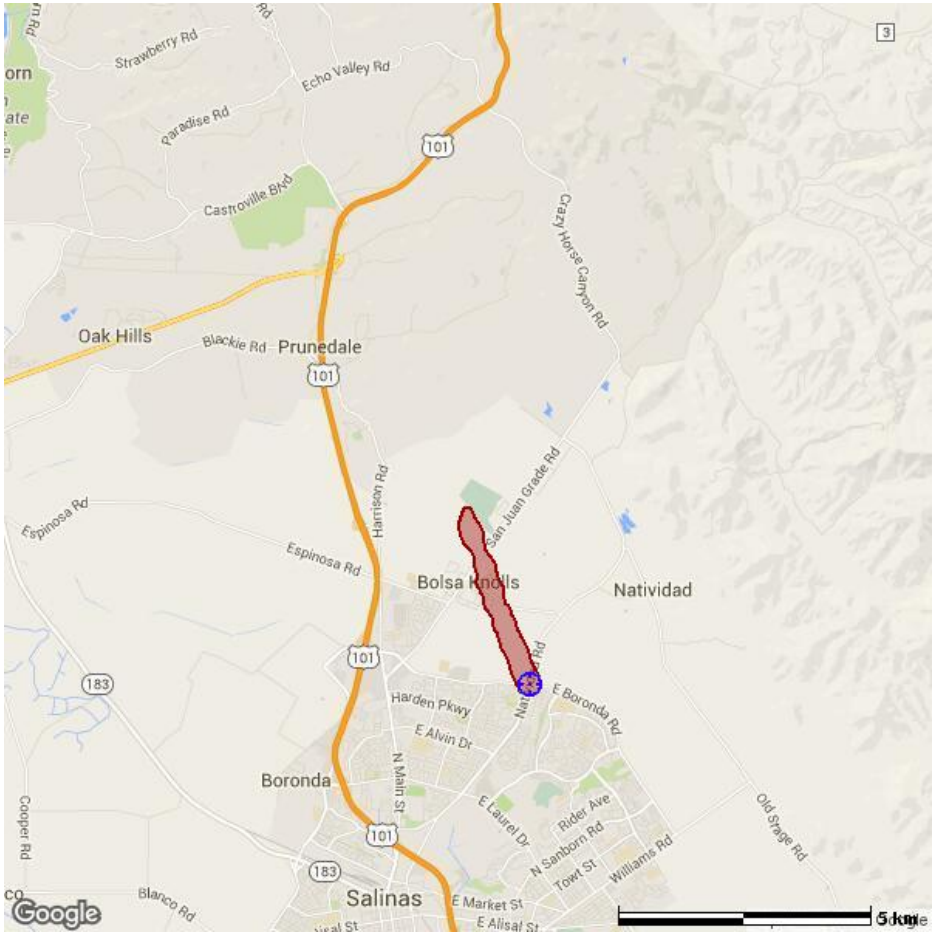
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 05 Jan 2016 11:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 36 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 270 Area: 1.5 km2 Extent: 3.7 km

Notes:

- Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.
- The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.
- Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).

Assumptions:

- Assumes 10 kt detonation at 0 ft elevation.
- Areas shown are model predictions based on an estimated source term; but no measurements yet available.
- Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.
- Model assumes that no protective actions or other mitigations have been taken to decrease exposure.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

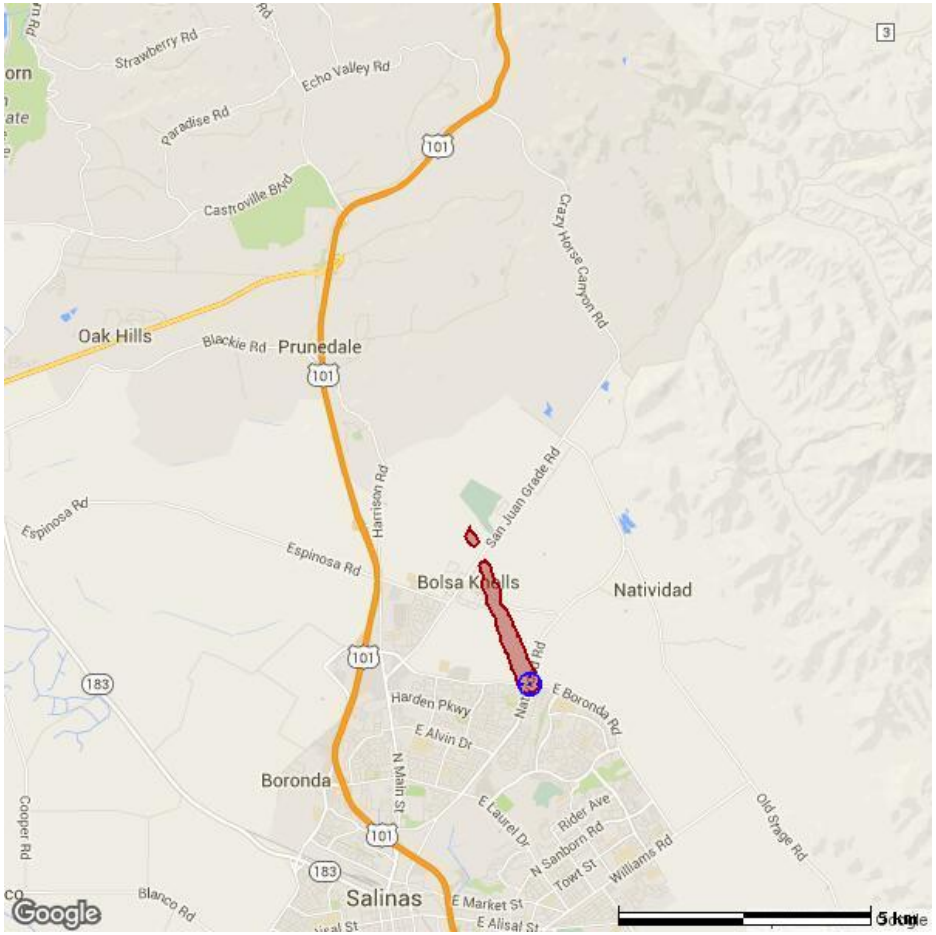
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 05 Jan 2016 23:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 48 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 90 Area: 0.9 km2 Extent: 3.3 km

Notes:

- **Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.**
- **The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.**
- **Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

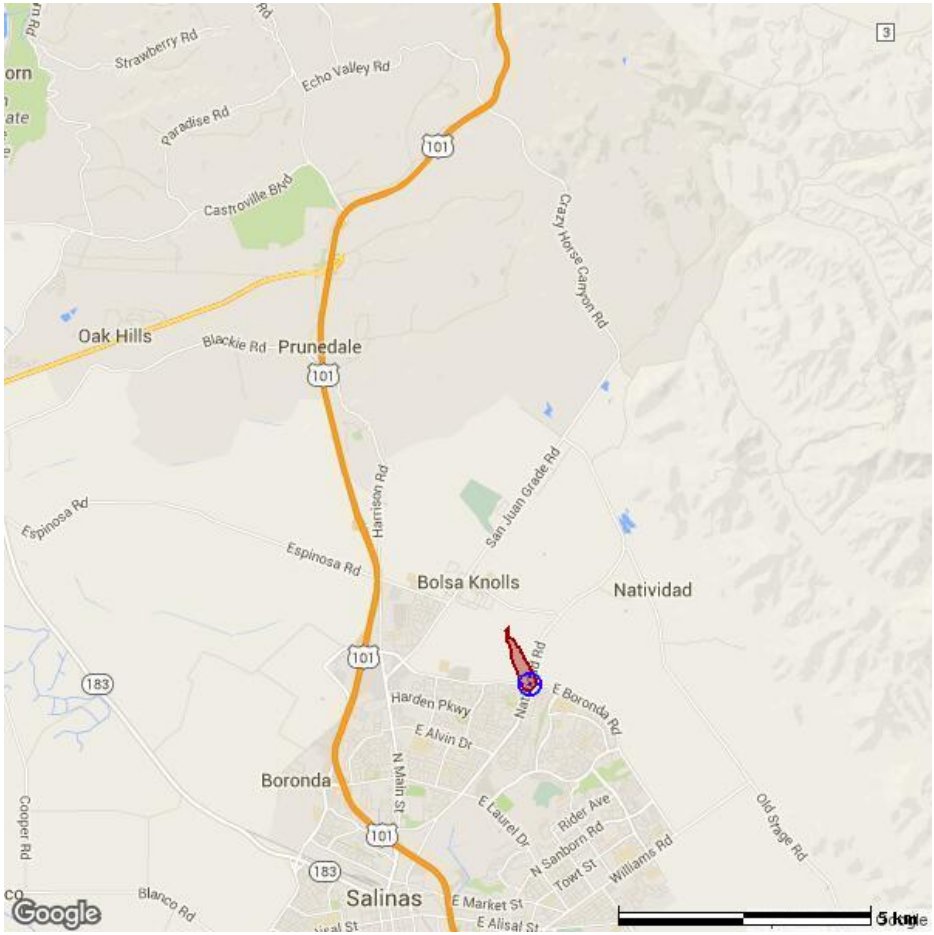
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 06 Jan 2016 23:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 72 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 0 Area: 0.3 km2 Extent: 1.2 km

Notes:

- **Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.**
- **The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.**
- **Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

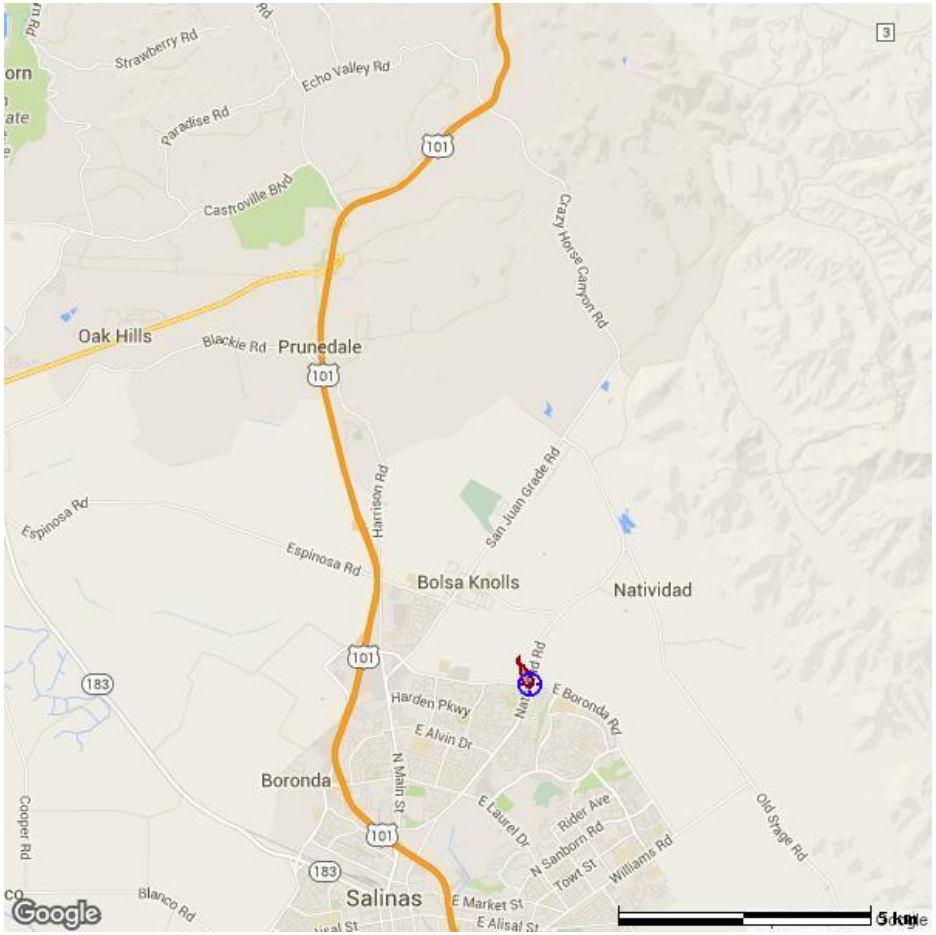
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF) for 07 Jan 2016 23:02 UTC

Dangerous fallout zone posing immediate threat to survivors and responders

Presented in 6 time steps. This step represents 96 hr since detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. The best initial action is to seek adequate shelter. Delay responder entry (several hours) unless undertaking a carefully planned mission with sufficient benefit to justify the anticipated radiation dose. Estimated Population: 0 Area: 0.1 km2 Extent: 0.6 km

Notes:

- **Communicating protective actions to the public is critical. Sheltering-in-place followed by informed evacuation may be most protective. Evacuation through heavy fallout may increase dose and decrease survivability.**
- **The highest hazard from fallout occurs in the first hours. However, the radiation levels in the zone and the size of the zone itself rapidly decrease as short-lived nuclides decay. Once short-lived nuclides have decayed away and only longer-lived nuclides remain the decay rate slows.**
- **Dangerous Fallout Zone is entirely embedded in Hot Zone (not shown here, see separate figures Predicted Hot Zone).**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area, radiation from fallout remains a serious hazard.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF)

Dangerous fallout zone posing immediate threat to survivors and responders

Key Points

- The best initial action is to seek adequate shelter before fallout arrives.
- Delayed evacuation is the preferred protective action, except for those lacking adequate shelter. Sheltering time depends on shelter quality and cloud arrival time. Adequate shelter means being significantly shielded from radiation (intact basements, thick walls, etc).
- Allowing time for fallout to decay significantly reduces exposure during evacuation.
- Communicating protective actions to the public in the DF Zone is generally more important than immediate attempts at lifesaving, decontamination of people or protection of critical infrastructure and key resources.
- DF Zone generally reaches maximum size in 1-3 hours and then decreases (rapidly at first). DF Zone radiation levels can reach 1,000s of R/h and be quickly fatal or injurious.
- Fallout at lower levels extends well beyond this zone, particularly downwind.
- Responders must have personal dosimetry and alarming dosimeters, plus instruments that can measure radiation levels up to 1000 R/h (10 Sv/h). Supervisors must monitor responder doses and adjust mission tasks accordingly.

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#1 Predicted Dangerous Fallout Zone (DF)

Dangerous fallout zone posing immediate threat to survivors and responders

Presenter Notes - Additional Information

- Seeking and remaining in adequate shelter is critical to reducing radiation dose and improving survival. It is good practice even at lower radiation levels.
- The DF Zone normally overlaps much of the Severe Damage Zone (SD) and portions of the Moderate Damage (MD) and Light Damage (LD) Zones (which are defined by varying levels of structural blast damage). The Dangerous Fallout (DF) Zone will shrink over time due to radioactive decay.
- The highest radiation hazard occurs in the first few hours.
- Plan to shelter for a few hours to a day or more before attempting evacuation.
- Evacuation egress may be much slower than expected due to rubble, injuries and traffic congestion.
- Fallout will primarily occur downwind along the path of upper level winds (not surface winds), but surface winds may significantly widen the fallout footprint.
- Visible fallout (dust and fine particles) is strong evidence for dangerous fallout radiation levels. Fallout may not be visible on rough or dirty surfaces.
- Lack of visible fallout does not indicate the absence of fallout. Appropriate radiation measurements are required.
- Most fallout contamination can be eliminated by a change of clothes and washing exposed skin. Even simple brushing reduces contamination.
- Measured radiation levels of 10 R/h suggest that much higher radiation levels may be close by.
- Treatment of life threatening injuries takes precedence over decontamination of patients or equipment.
- Careful supervision and monitoring of emergency workers required. Assure health physics professionals are involved in worker safety oversight.
- Total radiation dose accumulated by responders must be monitored frequently and work assignments adjusted to avoid over exposure.
- Radiation detection equipment and dosimetry is essential for responders.
- Radiation dose is cumulative hour-by-hour and day-by-day.
- Emergency dose limits attempt to balance risk from radiation against benefit of an activity.
    - Limits vary depending on activity (lifesaving, protection of major property, general response work).
    - Turn back limits may be at levels other than 10 R/h (100 mSv/h).
    - Plan work to minimize exposure time, avoid high exposure rate areas.

Presenter Notes - Technical Background

- Guidance based on:
    - "Planning Guidance for Response to a Nuclear Detonation", Second Edition, June, 2010. Developed by the Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats.
    - "Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19", 2005, National Council on Radiation Protection and Measurements.
    - "Key Response Planning Factors for the aftermath of Nuclear Terrorism", LLNL-TR-410067, 2009, Lawrence Livermore National Laboratory.
- Threshold for death and/or serious injury due to radiation is approximately 100 R. Exposures exceeding 450 R are usually lethal.
- Lifesaving dose limit is 25 rem (250 mSv) for responders over the course of the entire response, assuring exposures will not provide acute health effects.
- Protection of valuable property dose limit is 10 rem (100 mSv) for the event.
- Occupational dose limit of 5 rem (50 mSv) per year applies to all other work.
- Stay Times may be established to limit work times due to radiation exposure.
- Turn Back limits are criteria for responders to recognize when radiation levels are too high to proceed and they should retreat. The mission may resume after additional control measures are put in place or after sufficient radioactive decay occurs such that the Turn Back limit is no longer exceeded.
- External exposure greatly dominates total radiation dose. Inhalation is not included in this product. This exposure is related to acute health effects by assuming 0.7 rad midline body dose =1R (Roentgen) external exposure, and is related to risk of future cancer induction by assuming 1 rem = 1 R.
- The "Total Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 04 Jan 2016 11:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 12 hr after detonation.

Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 1030 Area: 8.5 km2 Extent: 9.2 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 2.92e+06 Area: 22,575 km2 Extent: 492 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud still passing through area displayed.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

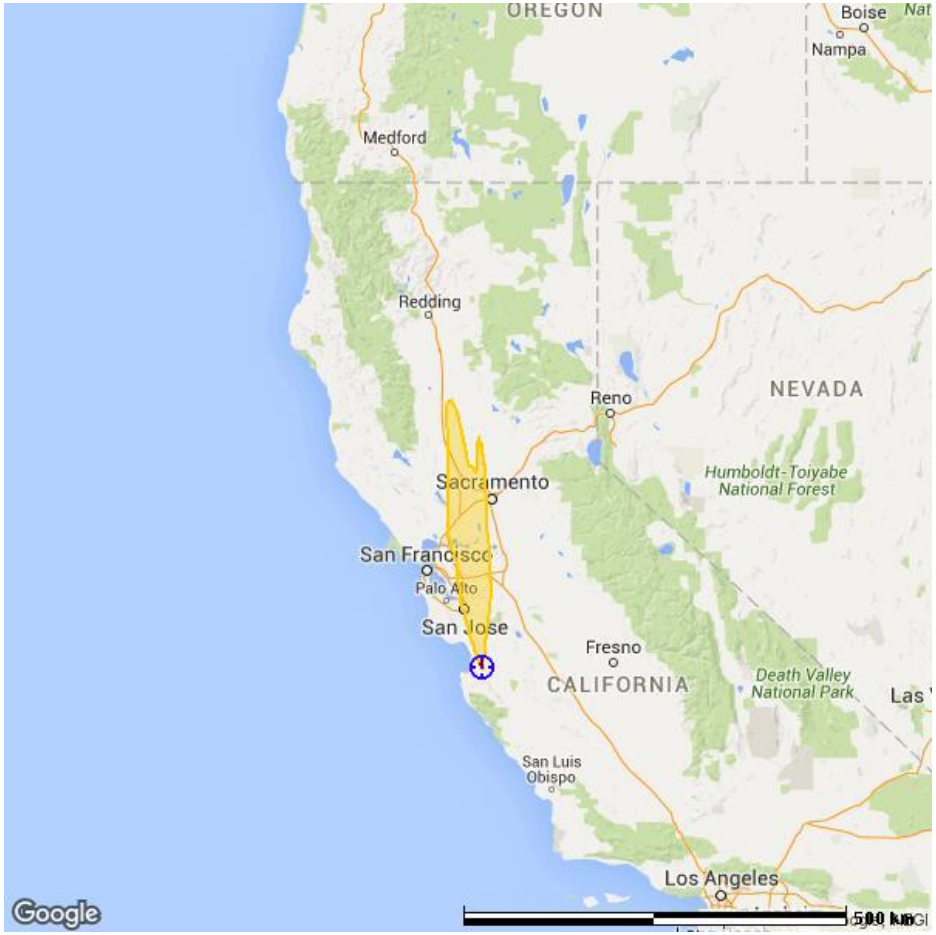
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 04 Jan 2016 23:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 24 hr after detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 420 Area: 3.0 km2 Extent: 5.7 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 1.92e+06 Area: 10,680 km2 Extent: 330 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud still passing through area displayed.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

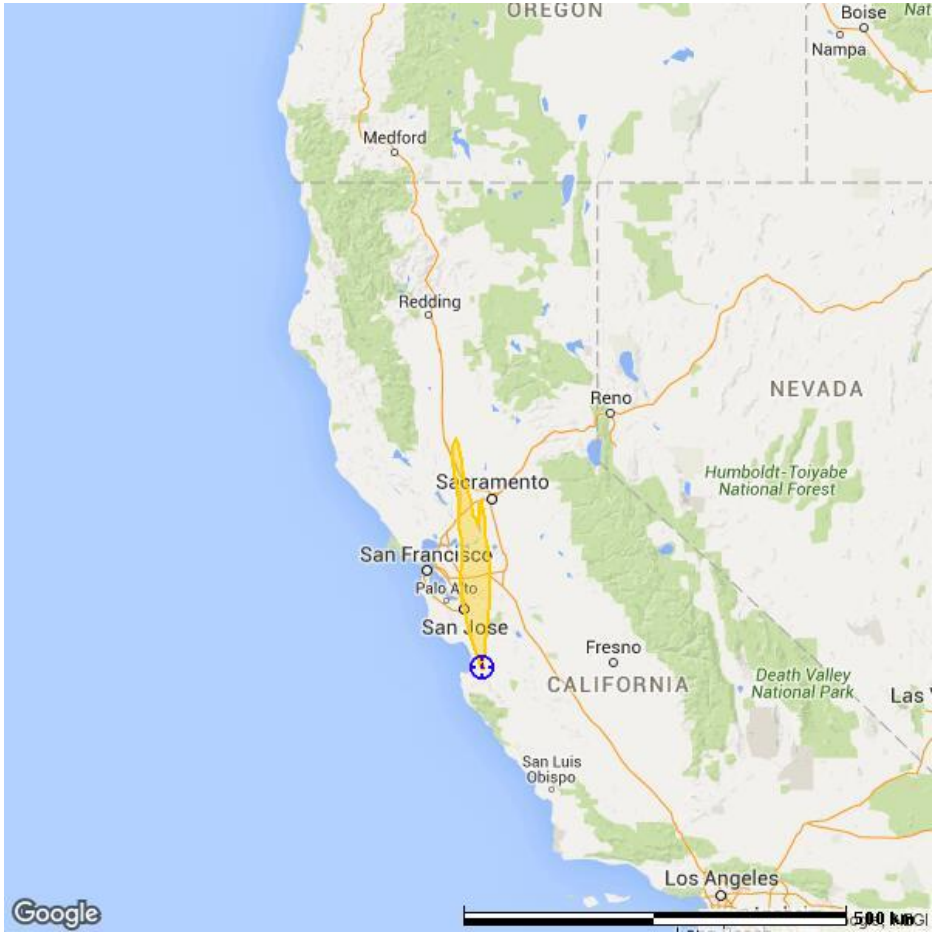
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 05 Jan 2016 11:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 36 hr after detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 270 Area: 1.5 km2 Extent: 3.7 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 1.27e+06 Area: 6,299 km2 Extent: 284 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

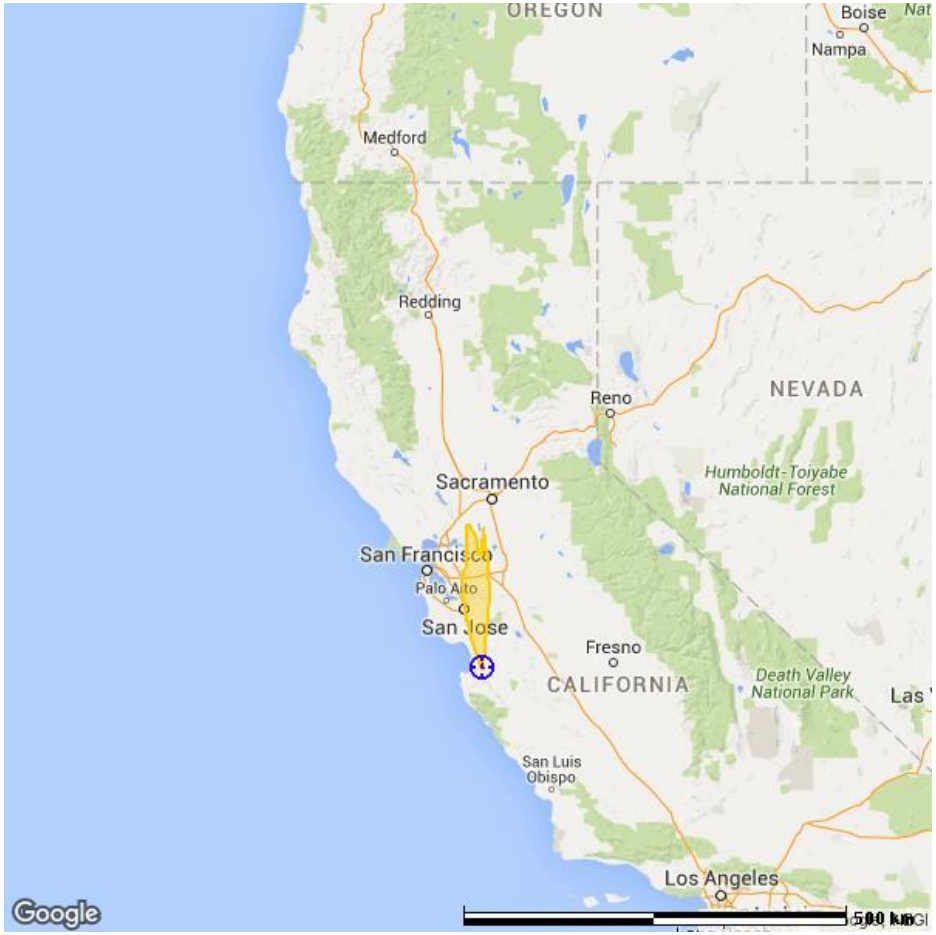
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 05 Jan 2016 23:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 48 hr after detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 90 Area: 0.9 km2 Extent: 3.3 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 933,000 Area: 3,807 km2 Extent: 176 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

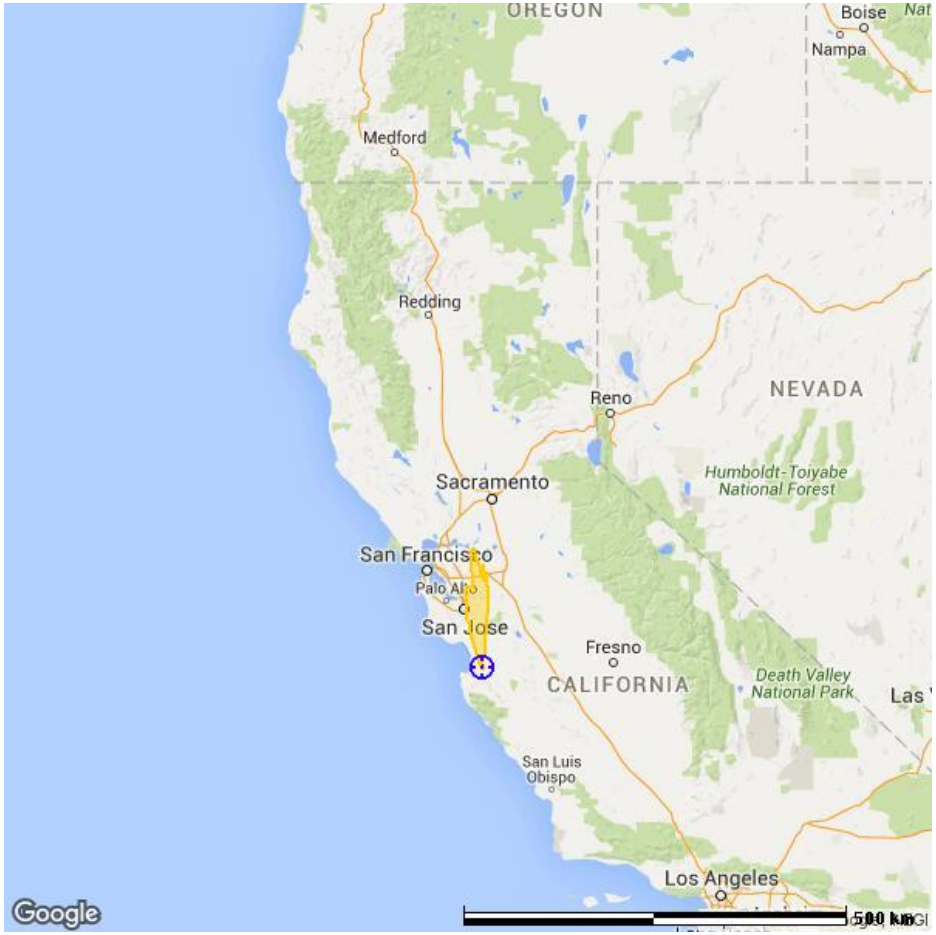
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 06 Jan 2016 23:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 72 hr after detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 0 Area: 0.3 km2 Extent: 1.2 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 553,000 Area: 2,416 km2 Extent: 146 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

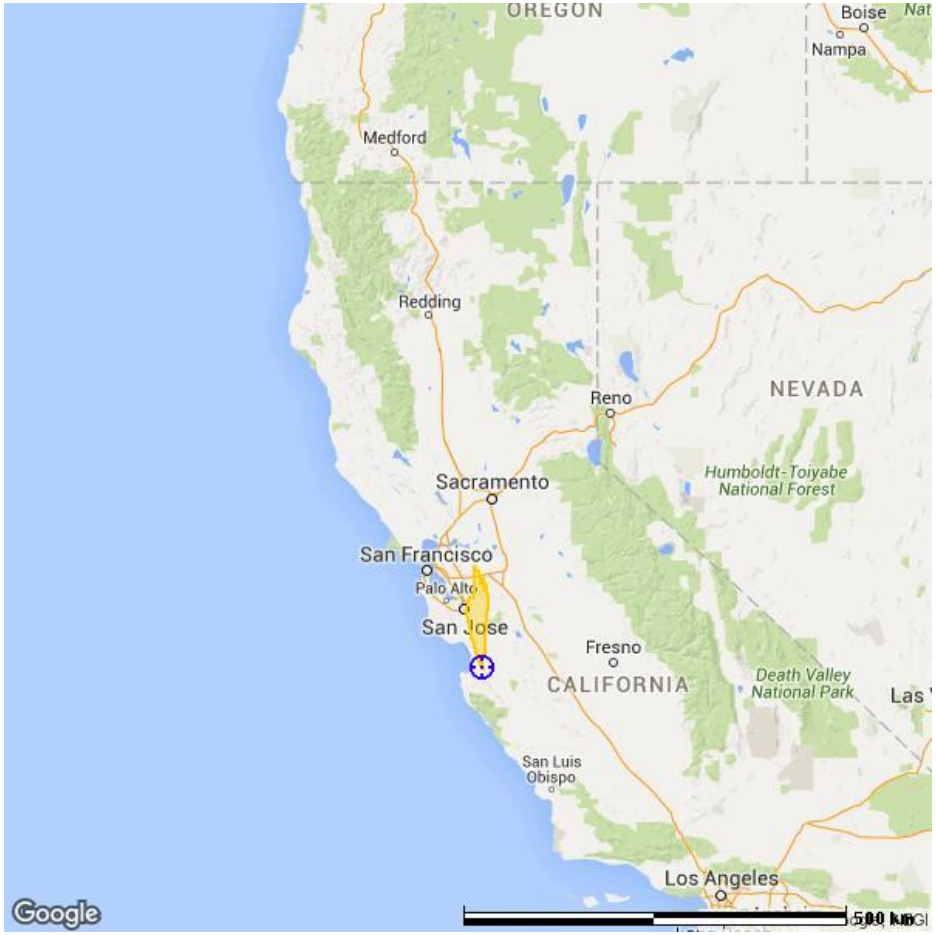
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone for 07 Jan 2016 23:02 UTC

Use for worker protection and to prioritize shelter/evacuation

Presented in 6 time steps. This step represents 96 hr after detonation.



Dangerous Fallout Zone (DF) - Dangerous radiation levels exceeding 10 R/h {0.1 Sv/h}. Refer to Predicted Dangerous Fallout Zone product for details. Estimated Population: 0 Area: 0.1 km2 Extent: 0.6 km

Hot Zone (10 mR/h to 10 R/h {0.1 mSv/h to 0.1 Sv/h}) - Monitor worker dose carefully and limit worker stay times in this area. Stage response assets outside of the Hot Zone. Estimated Population: 385,000 Area: 1,811 km2 Extent: 126 km

Notes:

- **Immediate adequate shelter, possibly followed by evacuation, is strongly preferred, particularly in the first hours.**
- **Plan evacuation routes away from the DF/Hot Zones to minimize dose during transit. Shortest route may not guarantee minimal dose.**
- **Size of Hot Zone grows for 1-3 days then shrinks with time.**
- **Fallout and radiation extend well beyond the Hot Zone, particularly downwind, but at a reduced level of concern.**
- **Assure health physics professionals supervise emergency workers in the Hot Zone, workers must not exceed dose limits.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Radioactive cloud has passed contoured area.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone

Use for worker protection and to prioritize shelter/evacuation

Key Points

- Immediate adequate sheltering preferred in Hot Zone, possibly followed by a planned evacuation via the most expedient route after a period of substantial radioactive decay.
- The size of the Hot Zone will grow at first, reaching maximum size in 1-3 days as fallout is deposited downwind. After the radioactive cloud leaves the area, radioactive decay will cause radiation levels to decline and the footprint to shrink.
- Lower levels of radiation and fallout extend well beyond the Hot Zone.
- Stage response assets outside Hot Zone, but do not expect "background" levels nearby.
- Equipment and supplies taken into the Hot Zone may be contaminated such that they cannot be taken out of this zone.
- Occupational limits do not apply to emergencies. Instead, dose guidelines are provided for emergency response. Different guidelines apply to 1) lifesaving, 2) protection of major property and 3) any other emergency response work. Avoid exceeding guidelines.
- Radiation doses to emergency workers are voluntary and require informed consent.
- For purposes of limiting worker radiation dose, doses accumulate day-by-day.
- Strive to keep worker exposures As-Low-As-Reasonably-Achievable (ALARA).
- Engage assistance of health physics professionals for specific guidance ASAP.

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#2 Predicted Hot Zone

Use for worker protection and to prioritize shelter/evacuation

Presenter Notes - Additional Information

●Visible fallout (dust and fine particles) is strong evidence for dangerous fallout radiation levels. Fallout may not be visible on rough or dirty surfaces. Lack of visible fallout does not indicate the absence of fallout. Appropriate radiation measurements are required.
●Most contamination can be eliminated by a change of clothes and washing exposed skin. Even simple brushing reduces contamination.
●Treatment of life threatening injuries takes precedence over decontamination of patients or equipment.
●Substantial radiological safety measures are required inside the Hot Zone. Assure health physics professionals are involved in worker safety oversight.
●Various dose limits are used depending on the nature of the emergency response activity. These various limits attempt to balance risk from radiation against benefit of an activity.
●All radiation exposures require informed consent, particularly those exceeding routine occupational limits (5 rem {50mSv}), such as for lifesaving or protection of valuable property activities.
●An individual's radiation dose is a cumulative total of their dose received each day or work period.
●Plan activities to make exposures As-Low-As-Reasonably-Achievable (ALARA).
- ◆Plan work to minimize exposure time,
- ◆Implement Stay Times and Turn Back Limits,
- ◆Avoid lingering in areas with radiation levels over 10 mR/h (0.1 mSv/h),
- ◆Position assets outside the Hot Zone and upwind if possible,
- ◆Take advantage of available shelter and shielding (buildings,walls, etc).

●Radiation detection equipment and dosimetry is essential for responders. If sufficient dosimeters, alarming dosimeters or radiation measuring instruments are not available for each responder in the Hot Zone, then equip each responder team instead.
●Evaluate necessity of respiratory protection because it can actually increase dose if its use slows work and results in longer exposure times. External dose normally dominates inhalation dose.

Presenter Notes - Technical Background

●Guidance based on:
- ◆"Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", (EPA 400-R-92-001, May 1992).
- ◆"Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19", 2005, National Council on Radiation Protection and Measurements.
- ◆"Key Response Planning Factors for the aftermath of Nuclear Terrorism", LLNL-TR-410067, 2009, Lawrence Livermore National Laboratory.
- ◆"Handbook for Responding to a Radiological Dispersal Device", CRCPD Pub. 06-6.

●DF Zone is shown to provide comparison of relative size. See Predicted Dangerous Fallout Zone product for detailed view and discussion.
●The Hot Zone perimeter is the same area as the NCRP Commentary 19 "Outer Perimeter", the CRCPD "Low Radiation Boundary", and the "Safe Area" cited in "Key Response Planning Factors."
●The dose guideline for lifesaving is 25 rem (250 mSv) for the event, which assures exposures will not produce acute health effects.
●The dose guideline for protection of critical infrastructure or valuable property is 10 rem (100 mSv) for the event.
●An occupational dose guideline of 5 rem (50 mSv) per year applies to all other general emergency response work.
●Emergency dose guidelines apply to emergency response workers. Lower dose guidelines apply to the general public.
●The "Estimated Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
●Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
●Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

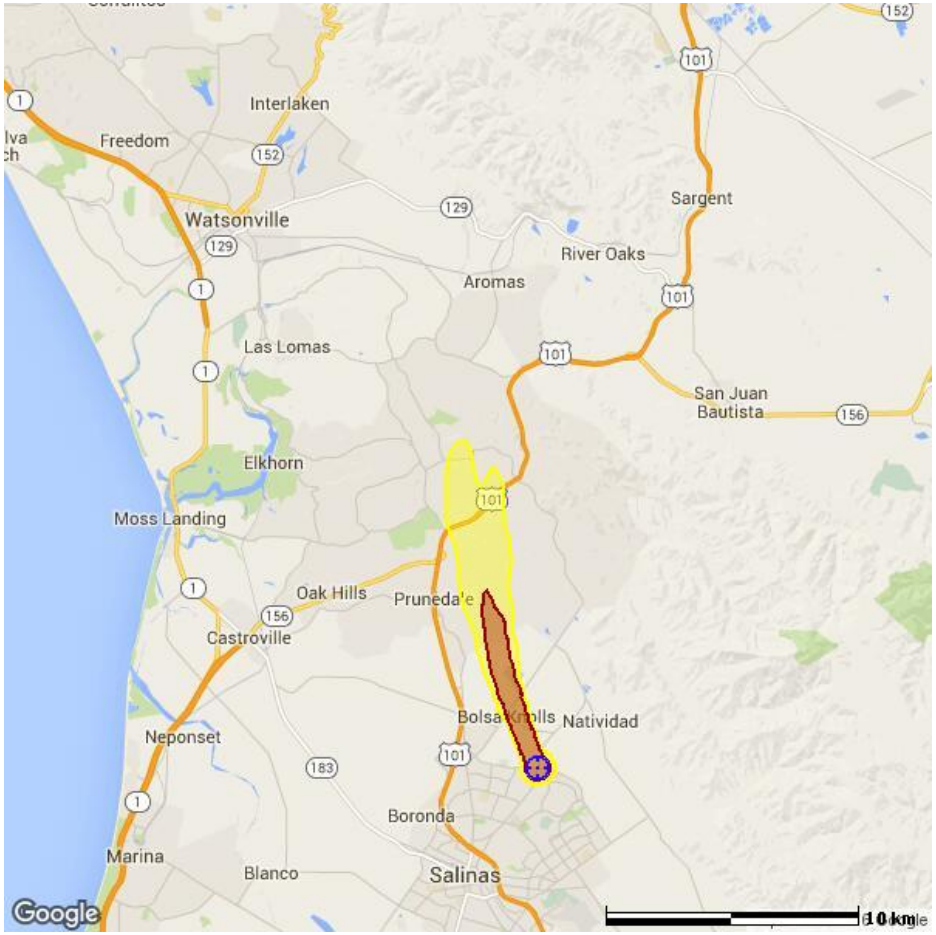
Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Fallout Casualties at 04 Jan 2016 00:02 UTC

Total external dose from radioactive fallout during first 1 hr of exposure leading to near-term (days to weeks) illness or death



Fallout lethal to most without adequate shelter (exceeds 450 rad {4.5 Gy}). Best action is early shelter followed by informed evacuation to control exposure. Estimated Population: 670 Area: 5.9 km2 Extent: 7.3 km

Dangerous fallout levels can cause death, injury or illness (exceeds 100 rad {1 Gy}). Zone of greatest opportunity for life saving and injury reduction. Dose management for first responders essential. Estimated Population: 3660 Area: 21.3 km2 Extent: 13.2 km

Notes:
- **The best initial action is to seek adequate shelter immediately.**
- **Sheltering with delayed evacuation is preferred, unless evacuation can be completed before fallout arrival.**
- **Highest radiation hazard during first hours, then rapidly declines.**
- **Expect few deaths or serious injuries due to radiation outside the maximum extent of these regions.**
- **Area size will increase rapidly the first few days, then vary slowly, as they show total dose accumulated since detonation.**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

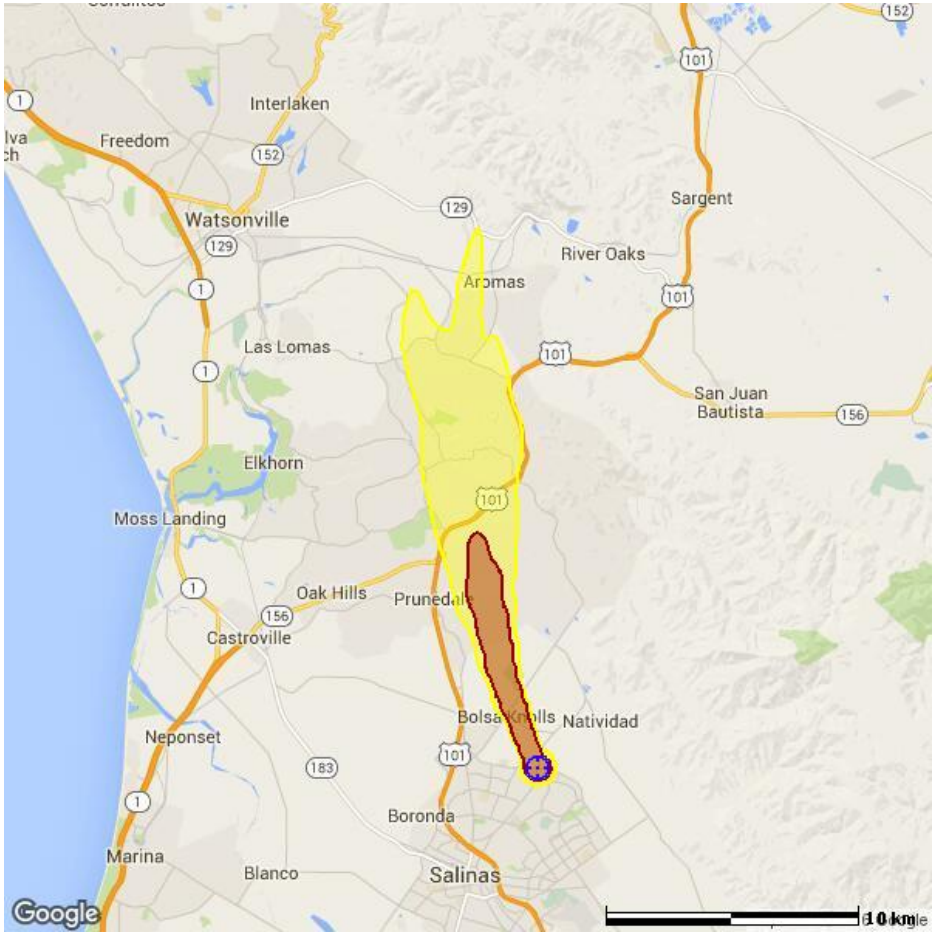
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Fallout Casualties at 04 Jan 2016 11:02 UTC

Total external dose from radioactive fallout during first 12 hr of exposure leading to near-term (days to weeks) illness or death



Fallout lethal to most without adequate shelter (exceeds 450 rad {4.5 Gy}). Best action is early shelter followed by informed evacuation to control exposure. Estimated Population: 1230 Area: 10.2 km2 Extent: 9.6 km

Dangerous fallout levels can cause death, injury or illness (exceeds 100 rad {1 Gy}). Zone of greatest opportunity for life saving and injury reduction. Dose management for first responders essential. Estimated Population: 7380 Area: 52.3 km2 Extent: 21.4 km

Notes:
- **The best initial action is to seek adequate shelter immediately.**
- **Sheltering with delayed evacuation is preferred, unless evacuation can be completed before fallout arrival.**
- **Highest radiation hazard during first hours, then rapidly declines.**
- **Expect few deaths or serious injuries due to radiation outside the maximum extent of these regions.**
- **Area size will increase rapidly the first few days, then vary slowly, as they show total dose accumulated since detonation.**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

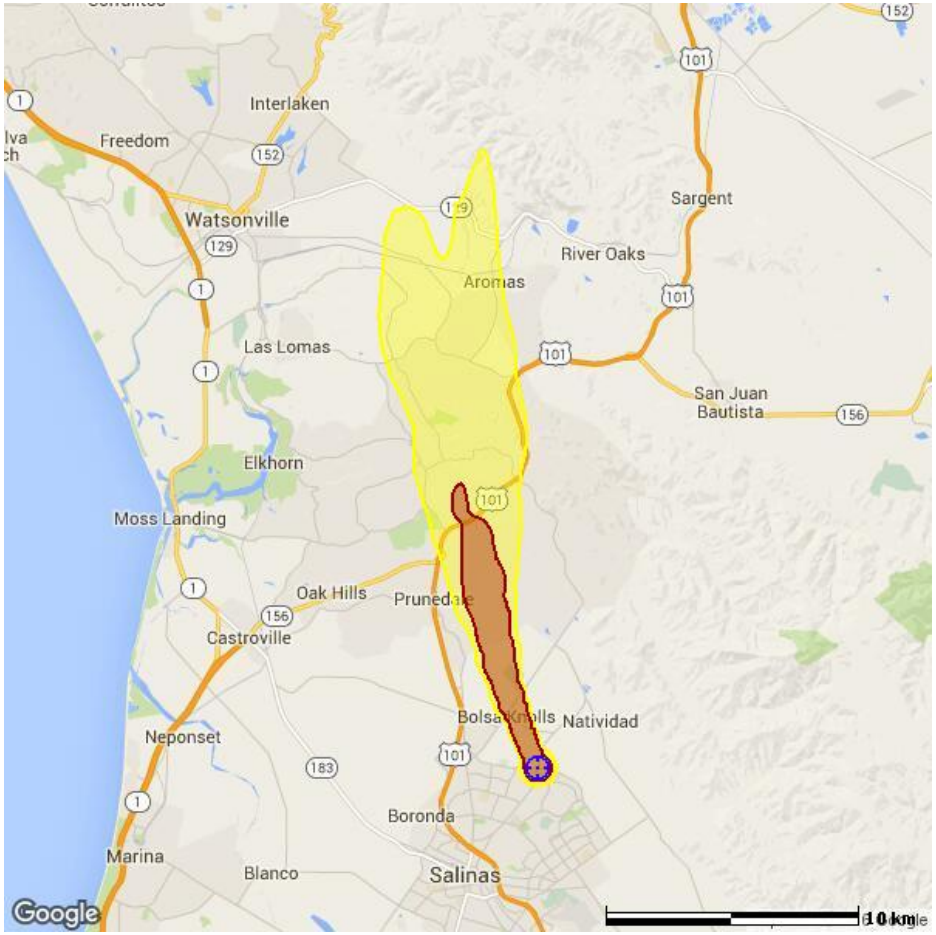
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Fallout Casualties at 11 Jan 2016 23:02 UTC

Total external dose from radioactive fallout during first 192 hr of exposure leading to near-term (days to weeks) illness or death



Fallout lethal to most without adequate shelter (exceeds 450 rad {4.5 Gy}). Best action is early shelter followed by informed evacuation to control exposure. Estimated Population: 1830 Area: 13.0 km2 Extent: 11.6 km

Dangerous fallout levels can cause death, injury or illness (exceeds 100 rad {1 Gy}). Zone of greatest opportunity for life saving and injury reduction. Dose management for first responders essential. Estimated Population: 9410 Area: 75.9 km2 Extent: 24.4 km

Notes:
- **The best initial action is to seek adequate shelter immediately.**
- **Sheltering with delayed evacuation is preferred, unless evacuation can be completed before fallout arrival.**
- **Highest radiation hazard during first hours, then rapidly declines.**
- **Expect few deaths or serious injuries due to radiation outside the maximum extent of these regions.**
- **Area size will increase rapidly the first few days, then vary slowly, as they show total dose accumulated since detonation.**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Potential Fallout Casualties

Total external dose from radioactive fallout leading to near-term (days to weeks) illness or death

Key Points

- Prompt communication of protective action orders to the public is critical.
- Generally, the best initial action is sheltering in the nearest safe building and await instructions. Evacuate after a period for decay to reduce fallout radiation levels.
- Health effects may be greatly reduced for those in the areas shown if sheltered in large multi-story structures or underground areas (basements, parking garages, tunnels, etc.)
- Single-story wood frame houses without basements provide only minimal shelter.
- Decisions to evacuate must be based on event-specific factors such as fallout pattern, radiation intensity, availability of adequate shelter, impending hazards (e.g. fire), etc.
- Early evacuation should be considered for individuals who are threatened by fire or building collapse and for those that lack adequate shelter in the fallout area within 10 miles of the detonation.
- Potential evacuation routes should be established only after the fallout pattern and intensity are well-estimated, and should not obstruct ongoing life-saving missions.
- If possible, when evacuating travel at right angles to the estimated fallout plume and away from the plume centerline.
- Long-term induced cancer rates will be increased in areas beyond those shown here (refer to Predicted EPA/DHS Sheltering/Evacuation Areas product).

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Potential Fallout Casualties

Total external dose from radioactive fallout leading to near-term (days to weeks) illness or death

Presenter Notes - Additional Information

- This product estimates radiation effects of the total dose delivered by fallout since detonation for three time periods.
- The two principal actions to protect the public from fallout are: 1) taking shelter and 2) evacuation. No single action will be adequate for all locations and times.
- Generally, the preferred action is to take immediate shelter in the most robust, readily available shelter, then await instructions for an orderly evacuation along the safest routes.
- Duration of shelter primarily depends on adequacy of shelter. Short shelter times (hours) are indicated for those with poor shelter. A day or more may be indicated for those with good shelter and supplies.
- Generally, initial recommendations should be issued as soon as possible after the incident, which will be likely based on little or no incident data.
- Follow-up recommendations should be issued once additional data become available, and may include continued shelter and/or evacuation instructions.
- Adequate shelter significantly reduces radiation dose to occupants during an extended period (e.g. safe underground structures such as basements, parking garages, etc.). Shelter must be structurally stable and otherwise safe to occupy.
- Consider supporting those who are able to spontaneously self-evacuate, by providing information on when to leave and where to go.
- Most of dose is received within the first hours of exposure, 98% in first year.

Time After Detonation	Percent of Total Dose	Time After Detonation	Percent of Total Dose
1 hour	55%	4 hours	68%
12 hours	75%	24 hours	80%

- The highest hazard from fallout occurs within the first few hours and will continue to drop relatively quickly as the radioactive fission products decay.
- Visible fallout (dust and fine particles) is strong evidence for dangerous fallout radiation levels. Fallout may not be visible on rough or dirty surfaces. Lack of visible fallout does not indicate the absence of fallout. Appropriate radiation measurements are required.
- Decontamination of persons is generally not a lifesaving issue. Changing from contaminated to uncontaminated clothes and washing exposed skin is preferred. Simply brushing off outer garments is useful until more thorough decontamination can be accomplished.

Presenter Notes - Technical Background

- Guidance based on:
  - "Planning Guidance for Response to a Nuclear Detonation", Second Edition, June, 2010. Developed by the Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats.
  - "Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19", 2005, National Council on Radiation Protection and Measurements.
  - "Key Response Planning Factors for the aftermath of Nuclear Terrorism", LLNL-TR-410067, 2009, Lawrence Livermore National Laboratory.
  - "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", (EPA 400-R-92-001, May 1992).
- This total dose is estimated by integrating the external exposure over the exposure time (assuming 0.7 rad mid-line body dose per 1 Roentgen exposure). It does not include additional doses due to inhalation, ingestion or skin contamination, which are minor contributors.
- Inner Contour (450 rad) - Expect fatalities exceeding 90% for those lacking shelter inside this zone. Some of these fatalities will be delayed by days or weeks.
- Outer Contour (100 rad) - Expect fatality and radiation injury rate to rapidly decline further out in this zone. Few, if any, fatalities are expected outside this zone. Less than 10% suffer radiation injury at the outer boundary.
- The "Total Exposed Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

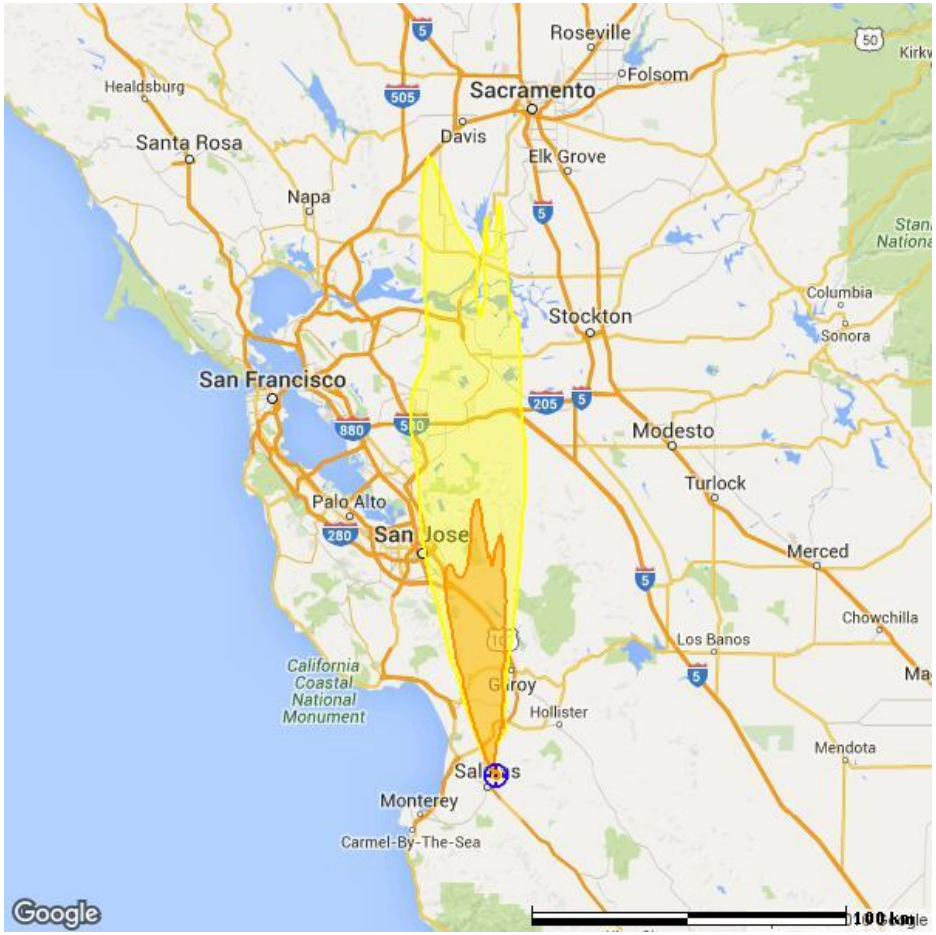
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 04 Jan 2016 11:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 12 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 132,000 Area: 905 km2 Extent: 86.3 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 1.04e+06 Area: 4,298 km2 Extent: 194 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 12 hr (before 04 Jan 2016 11:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 12 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

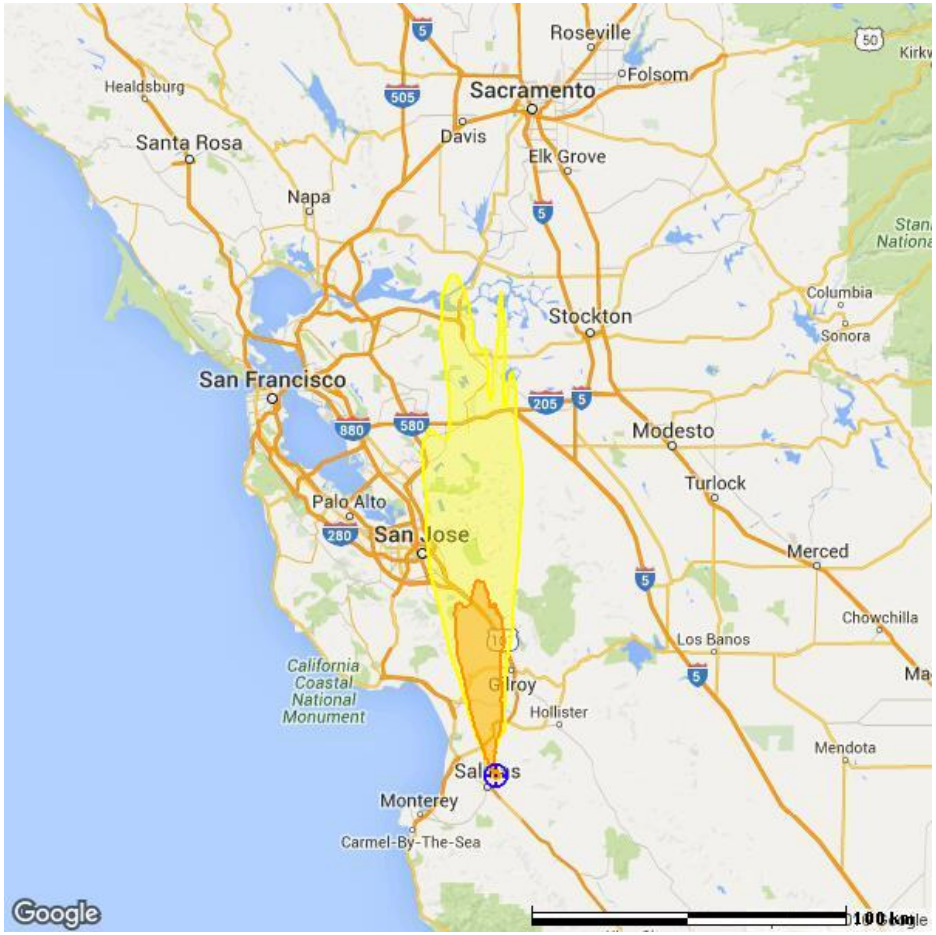
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 04 Jan 2016 23:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 24 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 61,100 Area: 549 km2 Extent: 61.2 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 727,000 Area: 2,935 km2 Extent: 157 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 24 hr (before 04 Jan 2016 23:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 24 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

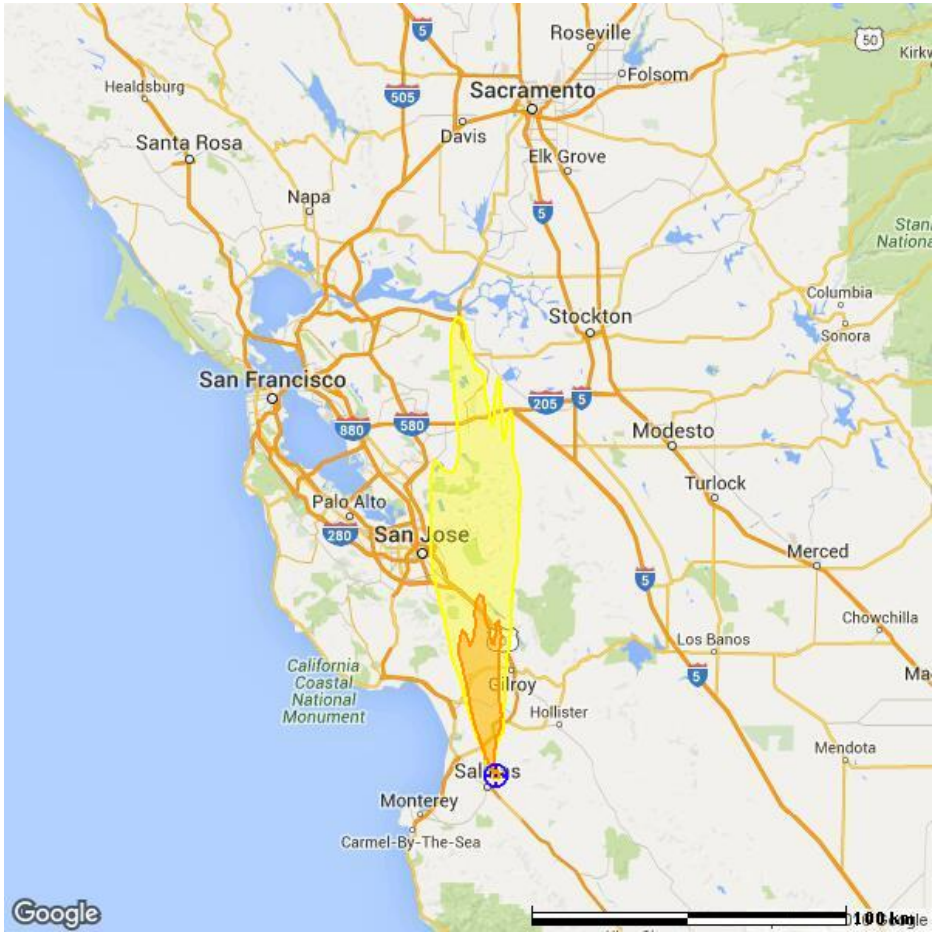
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 05 Jan 2016 11:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 36 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 37,300 Area: 408 km2 Extent: 56.5 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 523,000 Area: 2,325 km2 Extent: 144 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 36 hr (before 05 Jan 2016 11:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 36 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

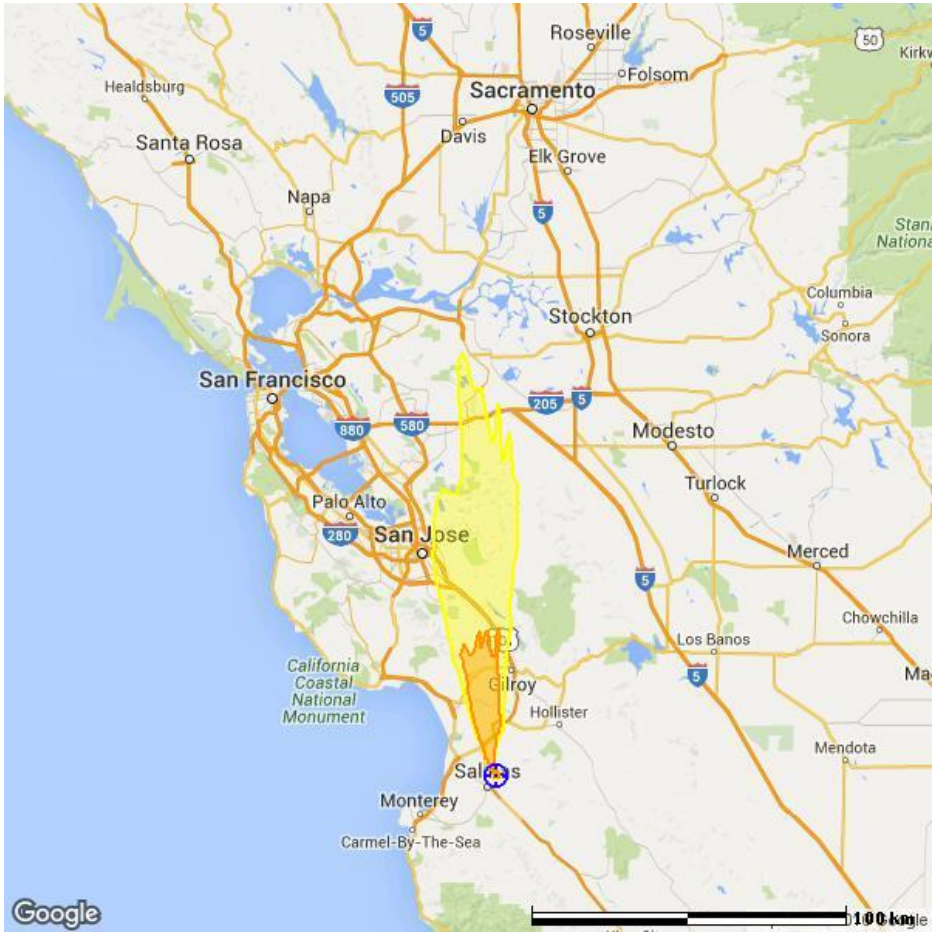
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 05 Jan 2016 23:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 48 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 18,700 Area: 307 km2 Extent: 45.8 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 473,000 Area: 1,991 km2 Extent: 132 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 48 hr (before 05 Jan 2016 23:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 48 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

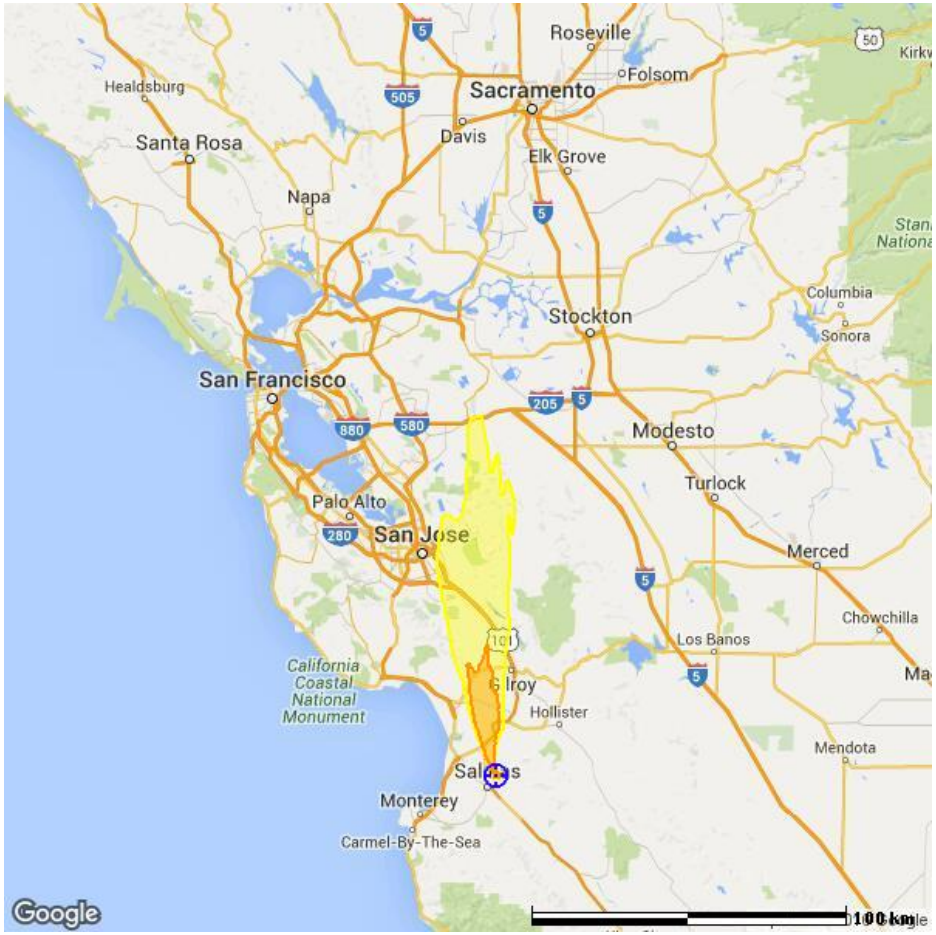
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 06 Jan 2016 23:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 72 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 13,100 Area: 209 km2 Extent: 41.0 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 333,000 Area: 1,539 km2 Extent: 112 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 72 hr (before 06 Jan 2016 23:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 72 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

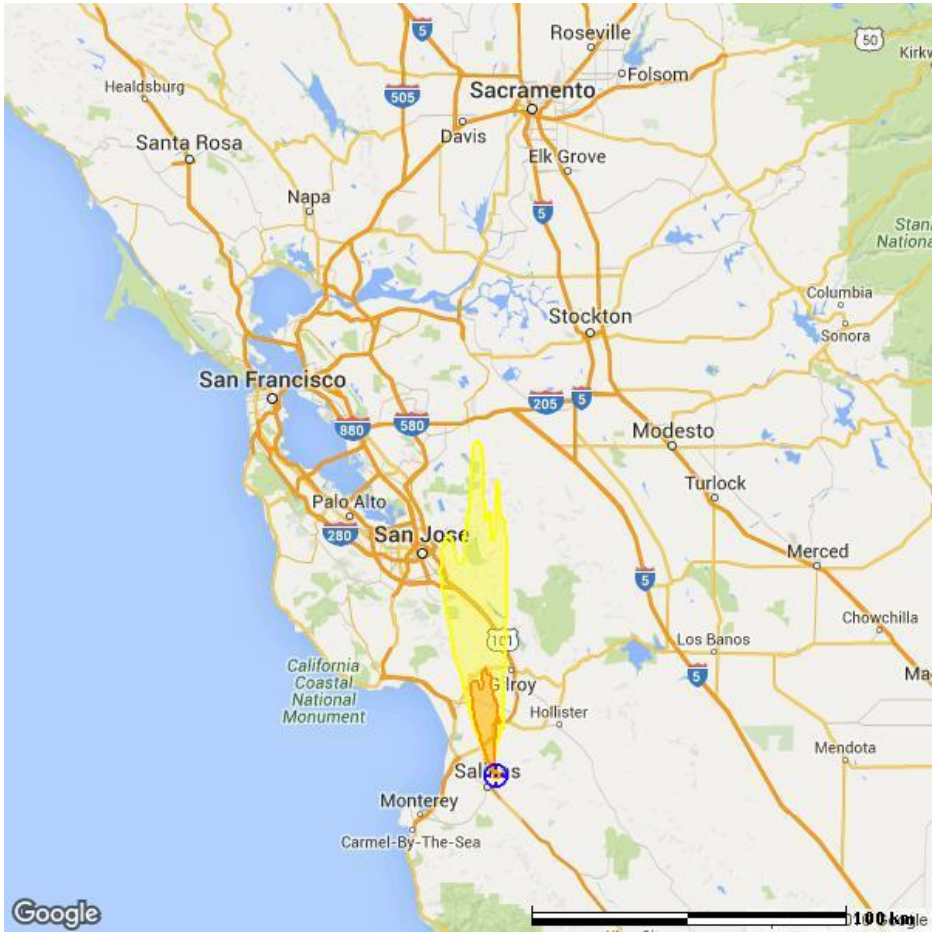
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evac Areas at 07 Jan 2016 23:02 UTC

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presented in 6 time steps (this step represents 4 day dose beginning 96 hr after detonation)



Sheltering or evacuation of entire population generally warranted, unless additional unusually hazardous circumstances exist (exceeds 5 rem). Total Population: 11,500 Area: 148 km2 Extent: 34.1 km

Sheltering or evacuation normally initiated (1 to 5 rem). Total Population: 242,000 Area: 1,185 km2 Extent: 105 km

Notes:

- **Best initial action is to seek adequate shelter.**
- **Sheltering followed by delayed evacuation is preferred unless evacuation can be completed before arrival of fallout.**
- **Relates only to long term risk of cancer. Not relevant to near-term injuries or fatalities due to fallout, which are of immediate concern (see Predicted Potential Fallout Casualties product).**
- **Protective actions are based only on dose that can be avoided.**
- **Consequences of dose received earlier are not avoidable.**
- **Prediction excludes dose received from first 96 hr (before 07 Jan 2016 23:02 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 96 hr.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evacuation Areas

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Key Points

- **The best initial action following a nuclear explosion is to seek shelter.**
- **Sheltering with adequate shielding from radiation, possibly with a delayed evacuation, is the preferred action unless evacuation can be completed before fallout arrival.**
- **Sheltering alone may be adequate for those in the outermost portion of the yellow zone.**
- **The size of the Sheltering and Evacuation zones will shrink as radioactive decay causes radiation levels in these areas to decline.**
- **The cancer risks addressed by these Protective Action Guides (PAGs) are secondary concerns compared to the immediate radiation-induced injuries and deaths.**
- **The zone of greatest opportunity for life saving and injury reduction (exceeds 100 rad) is indicated on the Potential Fallout Casualties product.**
- **Cancer risk increases by less than one percent at the outer perimeter of the sheltering/evacuation zones.**
- **Protective actions are based on dose that can be avoided. Areas shown do not include dose received before the date and time shown on each figure.**
- **Predicted dose is accumulated for four days after the date/time shown on each figure.**
- **Predicted dose assumes individuals are unsheltered and unprotected for four full days.**

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#6 Predicted EPA/DHS Shelter/Evacuation Areas

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presenter Notes - Additional Information

- PAG - Protective Action Guide, defined as the projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Reduce radiation exposure to minimize long-term cancer risk. Evacuation and sheltering reduce radiation exposure.
- Sheltering, possibly followed by a delayed evacuation is strongly preferred, even at long distances downwind, unless shelter is inadequate.
- Preference for sheltering over evacuation is opposite to the norm for nuclear power plant accidents, because a nuclear explosion delivers most of the radiation dose in the first day, while a nuclear power plant accident may have substantial pre-release warning and persist for days.
- Most of dose is received within the first hours of exposure, 98% in first year.

Time After Detonation	Percent of Total Dose	Time After Detonation	Percent of Total Dose
1 hour	55%	4 hours	68%
12 hours	75%	24 hours	80%

- Dose accumulates more slowly as time passes.
- Evacuation and shelter guidance based on EPA/DHS Early Phase Guidelines
  - "Evacuation (or, for some situations, sheltering-in-place) should be initiated when projected dose is 1 rem (10 mSv)."
  - "Both sheltering and evacuation may be implemented during the same response in different areas or timeframes."
  - "Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) as a protective action at projected doses of up to 5 rem (50 mSv) over four days."
  - "When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations)."

Presenter Notes - Technical Background

- Guidance based on EPA and DHS PAGs, as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents", (Federal Register, Vol. 73, No. 149, Aug. 1, 2008, pg 45029).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." Note that in this case however, committed inhalation dose is not included in the predicted doses.
- Predicted dose is known as Total Effective Dose (TED), which in this case is only due to external irradiation by ground contamination.
- Predicted dose is accumulated over 4 days following date/time shown on each of the figures.
- Predicted dose assumes unsheltered population, but only considers dose that can be avoided by protective actions. Doses received prior to this point in time are not considered.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- The "Estimated Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

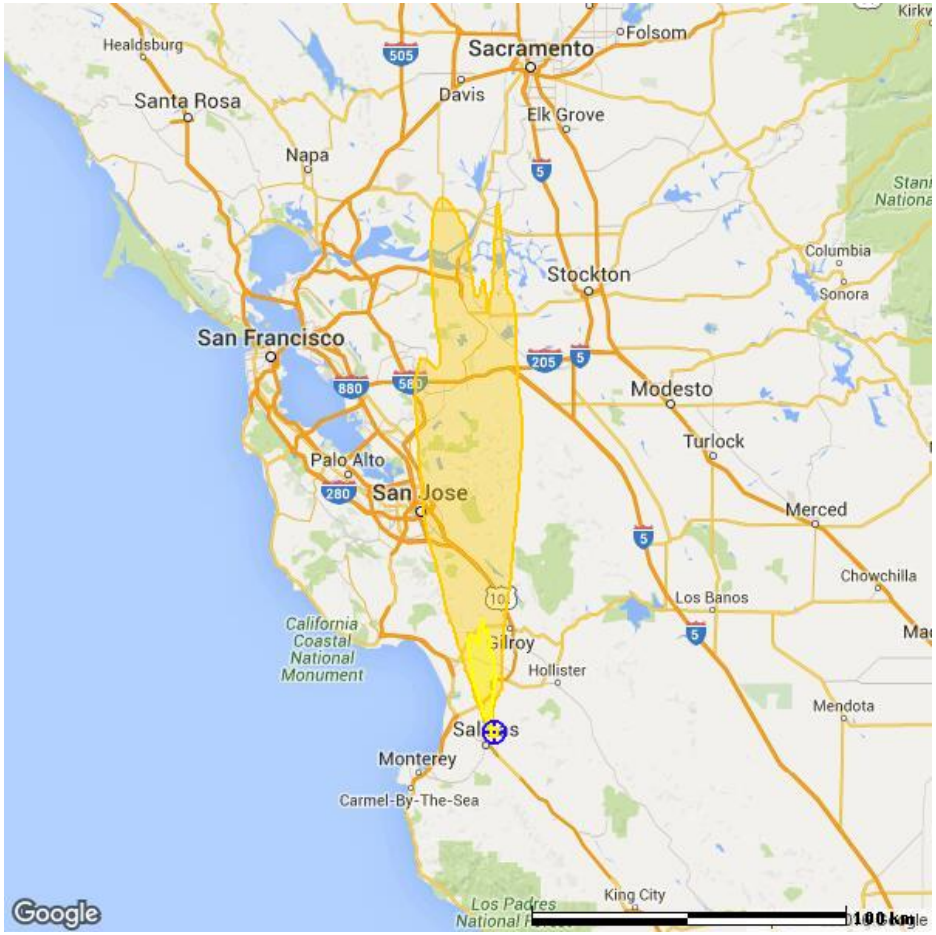
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#7 Predicted EPA/DHS Relocation Areas

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death



Relocation warranted due to dose expected to be received during the 2nd year (begins 03 Jan 2017 23:02 UTC). Exceeds predicted 0.5 rem (5 mSv). Estimated Population: 11,800 Area: 164 km2 Extent: 35.5 km

Relocation warranted due to dose expected to be received during the 1st year after 04 Jan 2016 23:02 UTC. Exceeds predicted 2 rem (20 mSv). Estimated Population: 890,000 Area: 3,491 km2 Extent: 168 km

Notes:

- **Relocation addresses only increased cancer risk due to long term exposures.**
- **Predicted dose assumes unsheltered individual with no protective actions or mitigation.**
- **First-Year zone decreases in size with time, because dose received in the past and before the relocation is not included. Protective actions are based only on dose that can be avoided.**
- **Individuals may have received a much higher total dose if present since detonation time.**

Assumptions:

- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Prediction does not include any dose received over the first 12 hr (before 04 Jan 2016 23:02 UTC)**
- **Predicted dose assumes adult receives maximum dose without protective actions or mitigations.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#7 Predicted EPA/DHS Relocation Areas

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Key Points

- **Relocation is not urgent. Protective Action Guidelines (PAGs) are based on long term exposure and cancer risk.**
- **The PAG level for relocation applies to doses that can be avoided by relocation; doses already incured prior to relocation are not included in the calculations.**
- **Areas shown do not include dose received before 04 Jan 2016 23:02 UTC.**
- **Size of First-Year Relocation area decreases as time passes because the dose received before the Relocation is ignored.**
- **Some groups not previously evacuated may require relocation.**
- **Re-entry into portions of restricted areas (evacuation & relocation) may be permitted for justified reasons with appropriate radiological controls and dose monitoring/tracking.**
- **There are separate guidelines for dose during first year and dose during any subsequent year (second year dose will be the highest and is shown on plot).**
- **Only ground contamination contributes to dose.**
- **Dose rate tends to naturally diminish with time as fallout decays.**
- **Simple dose reduction techniques (e.g., flushing surfaces, removing hotspots) can be applied in areas where levels of deposited radioactivity are not high enough to warrant relocation. Contact the Advisory Team (A-Team) for options.**

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#7 Predicted EPA/DHS Relocation Areas

Addresses avoidable additional long-term cancer risk, not acute radiation injury or death

Presenter Notes - Additional Information

- PAG - Protective Action Guide, defined as projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- Relocation PAG applies only to dose that can be avoided during the first year and any subsequent year.
- Following the early phase response it may be necessary to temporarily relocate the public from areas until decontamination has taken place.
- Areas shown do not include dose received before 04 Jan 2016 23:02 UTC .
- In contrast to the situation during the early phase, when decisions usually must be made and implemented quickly, many relocation decisions and actions during the intermediate phase can be delayed until adequate resources are in place.
- PAGs are guidance only. During an incident, due to unanticipated local conditions and constraints, professional judgment will be required. Situations can be envisaged in which relocation of the public, based on the recommended PAGs, would be impractical. Conversely, under some conditions relocation may be practical at doses below the PAGs.
- Some groups not previously evacuated may require relocation.
- Informed judgment must be exercised to prioritize protection for individuals in areas having the highest exposure rates.
- Contamination below PAG levels extends beyond the relocation area. Monitoring and simple dose reduction efforts are recommended in this area to reduce doses to the extent practical.
- Simple dose reduction efforts are recommended for areas outside the relocation area to reduce doses to the extent pratical.
- Re-entry into relocated areas may be permitted with appropriate controls.
- Re-entry is temporary access to the restricted area under controlled conditions for the purpose of performing activities essential to stabilization, relocation and recovery. Residence is not permitted.
- Dose rates will diminish with time due to decay of fallout.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA and DHS PAGs, as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents", (Federal Register, Vol. 73, No. 149, Aug. 1, 2008, pg 45029).
- Predicted dose is the projected Total Effective Dose (TED) which in this case includes only external irradiation, accounting for weathering of material and radioactive decay. Only ground contamination contributes to the dose. There is no plume contribution.
- Two separate dose criteria are used: 1) Dose during the first year (2 rem {20 mSv}), 2) Dose during the second or any subsequent year (0.5 rem {5 mSv}).
- Projected dose assumes individuals are unsheltered and unprotected, and no mitigation or remediation actions are taken (maximally exposed individual).
- Dose reduction factors associated with simple, rapid decontamination techniques are not included in calculating projected dose for decisions on relocation, as prescribed by EPA PAGs.
- Dose reducing actions may reduce the size of the relocation area and the size of the affected population.
- Dose rate naturally diminishes with time due to radioactive decay and weathering of contamination into the soil.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed guidelines for relocation based on current information.
- The "Estimated Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

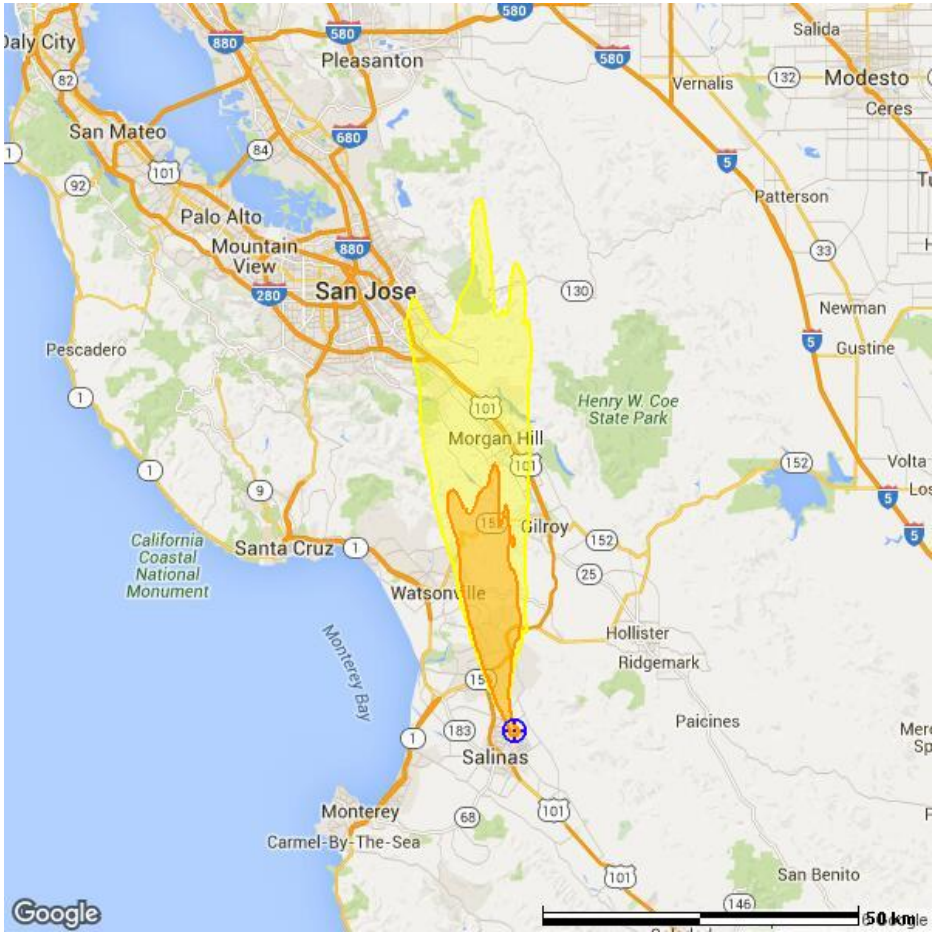
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#8 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

Based on fallout deposition predicted for 08 Jan 2016 23:02 UTC (120 hr after detonation)



Produce ready for harvest in this area may exceed FDA's default food safety guidelines [exceeds 370,000 pCi/m2 of Cs-137]. Area: 238 km2 Extent: 42.2 km

Milk from cows pastured in this area may exceed FDA's default food safety guidelines [exceeds 130,000 pCi/m2) of Cs-137]. Area: 864 km2 Extent: 83.8 km

Notes:

- Food contamination projected from deposition, not measured in food. Sampling and analysis of food products are required.
- Simple precautionary actions warranted to avoid or reduce potential contamination of food/feed.
- Temporary embargo of foods from this area may be warranted pending food analysis.
- No agricultural controls are expected outside contamination contours, subject to verification by sampling.
- FDA Derived Intervention Levels (DILs) for agricultural product contamination are very conservative and generic. New intervention levels may be developed when more information becomes available.

Assumptions:

- Assumes 10 kt detonation at 0 ft elevation.
- Assumes deposition of fallout complete and at maximum geographic extent on 08 Jan 2016 23:02 UTC.
- Areas shown are model predictions based on an estimated source term; but no measurements.
- Radiation dose is due to residual contamination on food crops.
- Based on 1998 FDA Food Guidance with ICRP 60+ Dosimetry.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:55 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#8 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

Based on fallout deposition predicted for 08 Jan 2016 23:02 UTC (120 hr after detonation)

Key Points

- FDA guidance applies to concentration of radioactivity in foods as prepared for eating.
- This product is based on projection of food concentration from expected and/or measured environmental deposition, not measured food concentration. Assumes no reduction of contamination by washing, peeling, cooking or other processing.
- Extensive, time consuming sampling and analysis required to properly assess food contamination.
- FDA recommends consultation with the FDA on: 1) simple precautions to avoid/reduce contamination of food/feed, and 2) use of temporary food embargoes to prevent introduction of contaminated food into commerce.
  - Precautions include covering exposed products, moving animals to shelter and corralling livestock plus providing uncontaminated (or clean) feed and water.
  - The temporary embargo permits opportunity for monitoring and sampling to be performed as the basis of future protective actions.
- Food products not yet ready for harvest will require analysis prior to harvest.
- Food and beverages packaged before the accident are generally not affected.
- FDA guidance assumes 30% of all food eaten is contaminated (very conservative).
- Drinking water concerns are not addressed by this product.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:55 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#8 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

Based on fallout deposition predicted for 08 Jan 2016 23:02 UTC (120 hr after detonation)

Presenter Notes - Additional Information

- This is a preliminary assessment based on predicted radioactivity levels in the environment, not concentration of radioactivity in foods. FDA food safety guidance is based on concentration in foods as prepared for consumption.
- This preliminary assessment pertains only to food products that are ready for immediate consumption, not foods to be harvested at a future date or foods grown underground or indoors.
- No food sampling has taken place. Confidence and accuracy will be improved once results of food sampling are obtained.
- "Protective actions can be taken before the release or arrival of contamination if there is advance knowledge that radionuclides may accidentally contaminate the environment."*
- "Protective actions which can be taken within the area likely to be affected and prior to confirmation of contamination consist of:
  - simple precautionary actions to avoid or reduce the potential for contamination of food and animal feeds, and
  - temporary embargoes to prevent the introduction into commerce of food which is likely to be contaminated."*
- "Protective actions which should be implemented when the contamination in food equals or exceeds the DILs consist of:
  - temporary embargoes to prevent the contaminated food from being introduced into commerce,
  - normal food production and processing actions that reduce the amount of contamination in or on food to below the DILs."*
- "Normal food production and processing procedures that could reduce the amount of radioactive contamination in or on the food could be simple, (such as holding to allow for radioactive decay, or removal of surface contamination by brushing, washing, or peeling)..."*
- Food products that are not yet ready for harvest should be analyzed at a later time before consumption to determine if they are suitable for consumption.
- Pre-packaged food and beverages in these areas are generally not affected.
- This map is valid for only this growing season.

*"Guidance on Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies", (Federal Register, Vol. 71, No. 1, Jan. 3, 2006, pg 174).

Presenter Notes - Technical Background

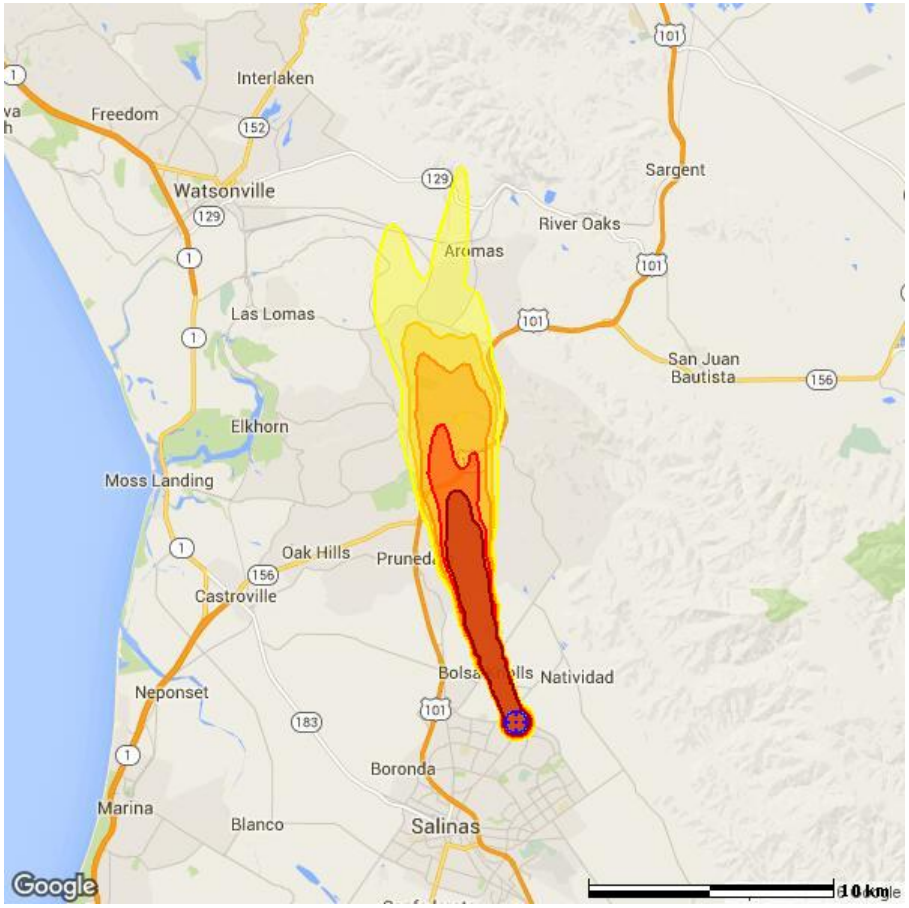
- Guidance based on EPA and DHS PAGs, as given in:
  - "Guidance on Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies", (Federal Register, Vol. 63, No. 156, Aug. 3, 1998, pg 43402).
  - "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents", (Federal Register, Vol. 73, No. 149, Aug. 1, 2008, pg 45029).
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- This assessment is based on the ICRP 60+ dosimetry model.
- Preliminary assessment based on FDA's food safety guidelines, termed Derived Intervention Levels (DILs), expressed as activity per unit mass of food. These food guidelines have been projected to obtain limits for deposition of radioactivity in the environment, which can be easily predicted and quickly measured. These are termed Derived Response Levels (DRLs).
- DRLs for the current growing season consider the amount of radioactivity deposited ON the plant (e.g., on leaves and fruit).
- DRLs for future growing seasons also consider uptake of radioactivity by roots from soil and INTO the plant (e.g., in leaves and fruit). This is a slow process.
- FDA DILs limit the radiation dose due to consumption of contaminated food to a predicted 0.5 rem (0.5 cSV) for the effective whole body or 5 rem (5 cSv) to any one organ. They are computed for the most sensitive age group.
- Drinking water is protected by separate EPA drinking water DRLs, which limit the radiation dose due to consumption of contaminated water.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines based on current information.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:55 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

EXAMPLE COMPARISON OF A NUCLEAR DETONATION TECHNICAL AND BRIEFING PRODUCTS

Early Fallout Casualties
(1-Day Groundshine Dose)



Map Size: 36.7 km by 36.7 km **Id:** Beta.rcE19694.rcC1
NARAC Operations: (NARAC Staff); narac@llnl.gov; 925-424-6465
Requested by: {NARAC Staff; NARAC -- Operations; 925.422.0708}
Approved by: {NARAC Operations; NARAC}

Acute (Short-Term) Effects

	Description	(rad) Extent Area	Population Fatalities Casualties
	Fatalities in over 90% of Population.	>450 9.7km 10.8 km2	1,330 1,320 1,330
	Fatalities in over 50% of Population.	>300 12.4km 16.8 km2	2,750 2,290 2,750
	Fatalities in over 10% of Population.	>200 15.4km 29.8 km2	5,130 2,940 5,000
	Non-Fatal Injuries/Effects in over 50% of Surviving Population.	>150 16.8km 38.2 km2	5,950 2,970 5,550
	Non-Fatal Injuries/Effects in over 10% of Surviving Population.	>100 22.6km 59.7 km2	7,930 2,980 6,070

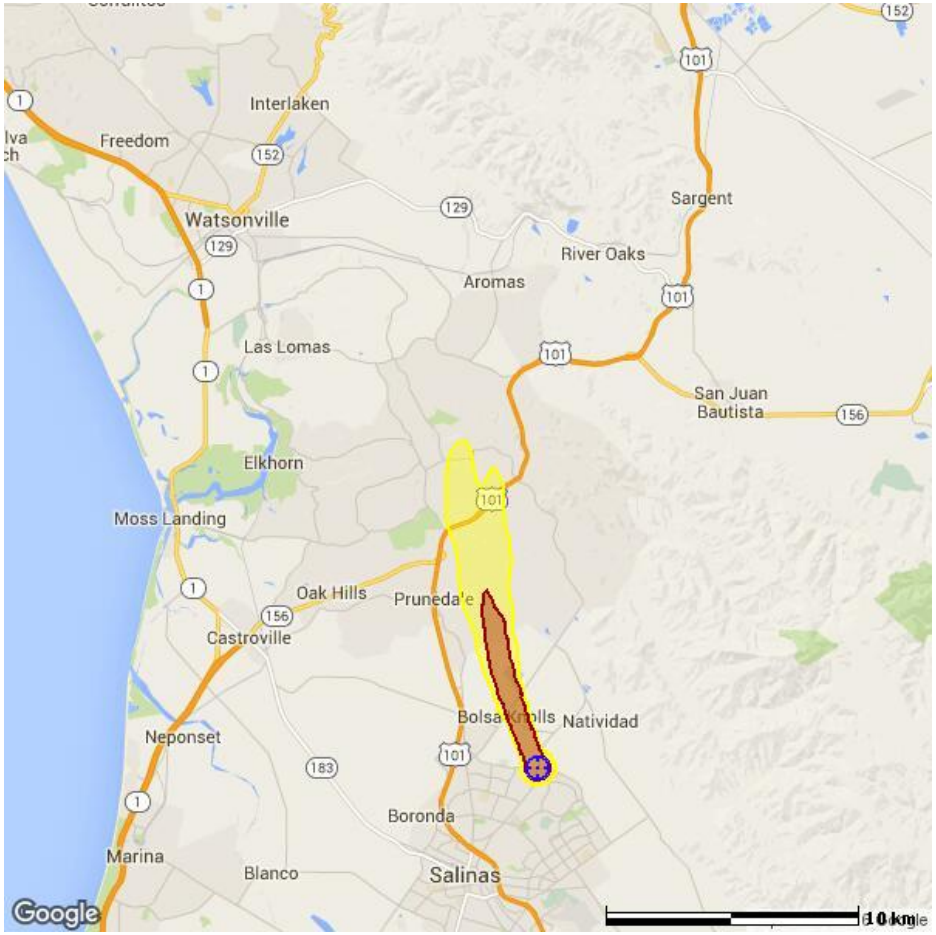
Areas and counts in the table are cumulative. Casualties include both Fatal and Non-Fatal effects. Population Source = LandScan2010.

Effects or contamination from January 03, 2016 23:02 UTC to January 04, 2016 23:02 UTC
Release Location: 36.715775 N, 121.623420 W
Material: Nuclear Detonation Radioactive Debris
Generated On: January 08, 2016 23:08 UTC
Model: ADAPT/LODI
Comments: Population counts have been reduced by Prompt Effect Fatalities
Hypothetical release starting at 01/03/2016 23:02:00 UTC for unknown gridded met at 1 hr intervals from 01/03/2016 23:00:00 UTC to 01/04/2016 22:00:00 UTC

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Fallout Casualties at 04 Jan 2016 00:02 UTC

Total external dose from radioactive fallout during first 1 hr of exposure leading to near-term (days to weeks) illness or death



Fallout lethal to most without adequate shelter (exceeds 450 rad {4.5 Gy}). Best action is early shelter followed by informed evacuation to control exposure. Estimated Population: 670 Area: 5.9 km2 Extent: 7.3 km

Dangerous fallout levels can cause death, injury or illness (exceeds 100 rad {1 Gy}). Zone of greatest opportunity for life saving and injury reduction. Dose management for first responders essential. Estimated Population: 3660 Area: 21.3 km2 Extent: 13.2 km

Notes:
- **The best initial action is to seek adequate shelter immediately.**
- **Sheltering with delayed evacuation is preferred, unless evacuation can be completed before fallout arrival.**
- **Highest radiation hazard during first hours, then rapidly declines.**
- **Expect few deaths or serious injuries due to radiation outside the maximum extent of these regions.**
- **Area size will increase rapidly the first few days, then vary slowly, as they show total dose accumulated since detonation.**

Assumptions:
- **Assumes 10 kt detonation at 0 ft elevation.**
- **Areas shown are model predictions based on an estimated source term; but no measurements yet available.**
- **Model assumes that no protective actions or other mitigations have been taken to decrease exposure.**

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Potential Fallout Casualties

Total external dose from radioactive fallout leading to near-term (days to weeks) illness or death

Key Points

- Prompt communication of protective action orders to the public is critical.
- Generally, the best initial action is sheltering in the nearest safe building and await instructions. Evacuate after a period for decay to reduce fallout radiation levels.
- Health effects may be greatly reduced for those in the areas shown if sheltered in large multi-story structures or underground areas (basements, parking garages, tunnels, etc.)
- Single-story wood frame houses without basements provide only minimal shelter.
- Decisions to evacuate must be based on event-specific factors such as fallout pattern, radiation intensity, availability of adequate shelter, impending hazards (e.g. fire), etc.
- Early evacuation should be considered for individuals who are threatened by fire or building collapse and for those that lack adequate shelter in the fallout area within 10 miles of the detonation.
- Potential evacuation routes should be established only after the fallout pattern and intensity are well-estimated, and should not obstruct ongoing life-saving missions.
- If possible, when evacuating travel at right angles to the estimated fallout plume and away from the plume centerline.
- Long-term induced cancer rates will be increased in areas beyond those shown here (refer to Predicted EPA/DHS Sheltering/Evacuation Areas product).

Automated Report: Testing
(36.71578,-121.62342)
Nuclear Detonation at 03 Jan 2016 23:02 UTC

BP#4 Predicted Area for Potential Fallout Casualties

Total external dose from radioactive fallout leading to near-term (days to weeks) illness or death

Presenter Notes - Additional Information

- This product estimates radiation effects of the total dose delivered by fallout since detonation for three time periods.
- The two principal actions to protect the public from fallout are: 1) taking shelter and 2) evacuation. No single action will be adequate for all locations and times.
- Generally, the preferred action is to take immediate shelter in the most robust, readily available shelter, then await instructions for an orderly evacuation along the safest routes.
- Duration of shelter primarily depends on adequacy of shelter. Short shelter times (hours) are indicated for those with poor shelter. A day or more may be indicated for those with good shelter and supplies.
- Generally, initial recommendations should be issued as soon as possible after the incident, which will be likely based on little or no incident data.
- Follow-up recommendations should be issued once additional data become available, and may include continued shelter and/or evacuation instructions.
- Adequate shelter significantly reduces radiation dose to occupants during an extended period (e.g. safe underground structures such as basements, parking garages, etc.). Shelter must be structurally stable and otherwise safe to occupy.
- Consider supporting those who are able to spontaneously self-evacuate, by providing information on when to leave and where to go.
- Most of dose is received within the first hours of exposure, 98% in first year.

Time After Detonation	Percent of Total Dose	Time After Detonation	Percent of Total Dose
1 hour	55%	4 hours	68%
12 hours	75%	24 hours	80%

- The highest hazard from fallout occurs within the first few hours and will continue to drop relatively quickly as the radioactive fission products decay.
- Visible fallout (dust and fine particles) is strong evidence for dangerous fallout radiation levels. Fallout may not be visible on rough or dirty surfaces. Lack of visible fallout does not indicate the absence of fallout. Appropriate radiation measurements are required.
- Decontamination of persons is generally not a lifesaving issue. Changing from contaminated to uncontaminated clothes and washing exposed skin is preferred. Simply brushing off outer garments is useful until more thorough decontamination can be accomplished.

Presenter Notes - Technical Background

- Guidance based on:
  - "Planning Guidance for Response to a Nuclear Detonation", Second Edition, June, 2010. Developed by the Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats.
  - "Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, Commentary No. 19", 2005, National Council on Radiation Protection and Measurements.
  - "Key Response Planning Factors for the aftermath of Nuclear Terrorism", LLNL-TR-410067, 2009, Lawrence Livermore National Laboratory.
  - "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", (EPA 400-R-92-001, May 1992).
- This total dose is estimated by integrating the external exposure over the exposure time (assuming 0.7 rad mid-line body dose per 1 Roentgen exposure). It does not include additional doses due to inhalation, ingestion or skin contamination, which are minor contributors.
- Inner Contour (450 rad) - Expect fatalities exceeding 90% for those lacking shelter inside this zone. Some of these fatalities will be delayed by days or weeks.
- Outer Contour (100 rad) - Expect fatality and radiation injury rate to rapidly decline further out in this zone. Few, if any, fatalities are expected outside this zone. Less than 10% suffer radiation injury at the outer boundary.
- The "Total Exposed Population" is the total estimated population in the zone adjusted for day/night variations due to commuting based on "Landscan" data.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 08 Jan 2016 23:26 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

NARAC/IMAAC Briefing Products for a Radiological Material Dispersal

Kristen Yu

Lawrence Livermore National Laboratory

National Atmospheric Release Advisory Center

NARAC

LLNL-PRES-817613

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. The Department of Homeland Security sponsored part of the production of this material.

Radiological Dispersal Device (RDD) Briefing Product Set

RDD Briefing Product Set contains seven products for three phases of an incident:

Early Phase:

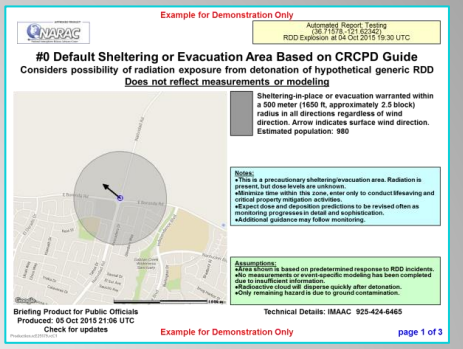
1. Default Evacuation or Sheltering Area Based on CRCPD Guide
2. Evacuation/Sheltering Areas Based on EPA/DHS Guides (cloud present/passed)
3. Worker Protection Areas
4. Potassium Iodide Administration Areas (for releases involving radioactive iodine)

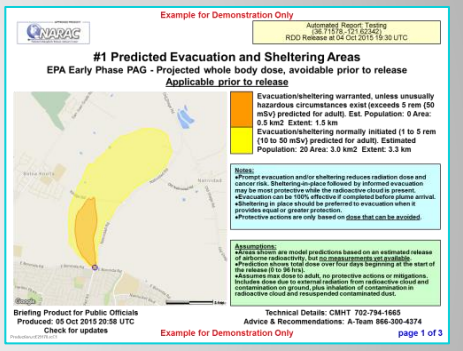
Intermediate Phase:

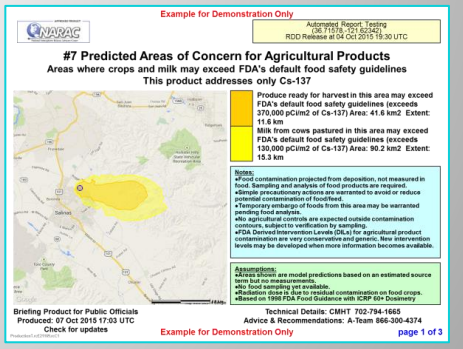
5. Relocation areas based on EPA Guide
6. Predicted Area of Concern for Long Term Recovery

Late Phase:

7. Areas of Concern for Agricultural Products





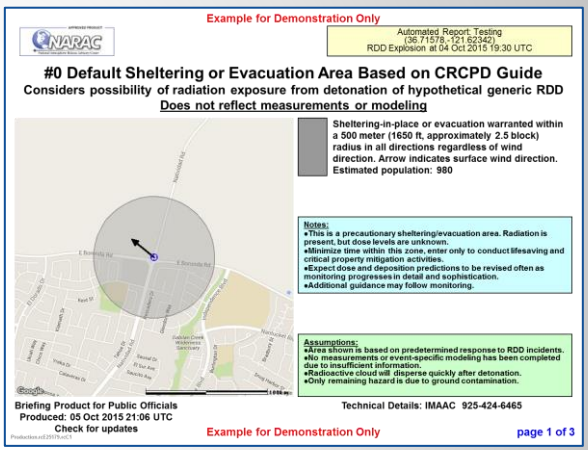


RDD Briefing Product sponsorship: DOE funded format/content design of briefing products (in collaboration with RSL) and implementation in FY08-FY09. DHS-hosted review by IMAAC Interagency Working Group and representatives of the National Emergency Management Association (NEMA). FEMA-funded revisions in FY15.

EARLY PHASE

Default Evacuation or Sheltering Area Based on CRCPD Guide

- This is a precautionary evacuation/sheltering area (radiation is present, but dose levels are unknown)
- Default Evacuation or Sheltering Area based on “Handbook for Responding to a Radiological Dispersal Device", CRCPD Pub. 06-6
- Does not reflect measurements or modeling
- Single arrow at the center indicates surface wind direction (as part of the technical product set, NARAC produces relative air and ground contamination plots that more completely illustrates the meteorological situation)



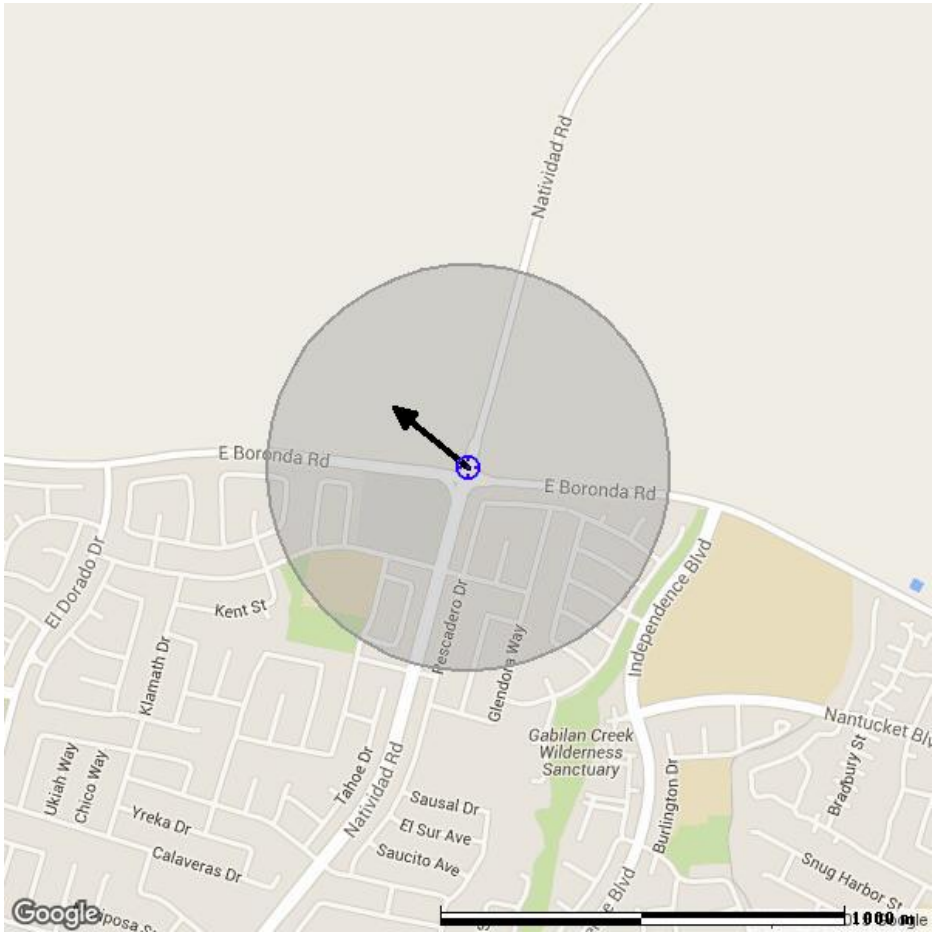
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Explosion at 04 Oct 2015 19:30 UTC

#0 Default Sheltering or Evacuation Area Based on CRCPD Guide

Considers possibility of radiation exposure from detonation of hypothetical generic RDD

Does not reflect measurements or modeling



Sheltering-in-place or evacuation warranted within a 500 meter (1650 ft, approximately 2.5 block) radius in all directions regardless of wind direction. Arrow indicates surface wind direction. Estimated population: 980

Notes:
- This is a precautionary sheltering/evacuation area. Radiation is present, but dose levels are unknown.
- Minimize time within this zone, enter only to conduct lifesaving and critical property mitigation activities.
- Expect dose and deposition predictions to be revised often as monitoring progresses in detail and sophistication.
- Additional guidance may follow monitoring.

Assumptions:
- Area shown is based on predetermined response to RDD incidents.
- No measurements or event-specific modeling has been completed due to insufficient information.
- Radioactive cloud will disperse quickly after detonation.
- Only remaining hazard is due to ground contamination.

Briefing Product for Public Officials
Produced: 05 Oct 2015 21:06 UTC
Check for updates

Technical Details: CMHT 702-794-1665

Automated Report: Testing
(36.71578,-121.62342)
RDD Explosion at 04 Oct 2015 19:30 UTC

#0 Default Sheltering or Evacuation Area Based on CRCPD Guide

Considers possibility of radiation exposure from detonation of hypothetical generic RDD

Does not reflect measurements or modeling

Key Points

- **Sheltering is generally preferred to evacuation while the radioactive cloud is present.**
- **Treat life-threatening injuries immediately, victim's contamination is secondary.**
- **Rescue all injured persons, move upwind of the immediate blast area.**
- **Evacuation/sheltering warranted to minimize potential acute effects and long-term cancer risk.**
- **Default protocol recommended by CRCPD is as follows:**
  - **Evacuate all non-essential personnel within a 500 m (1650 ft) radius.**
  - **Monitor evacuees for contamination and collect information to evaluate exposure.**
  - **Stage response assets upwind, if possible. Place assets where radiation levels are less than 2 mR/h or less than 1,000 cpm as measured by "pancake probe".**
  - **Set-up access control perimeter based on measurements.**
- **Sheltering-in-place may be preferable to evacuation in some situations**
- **Radiological monitoring urgently needed to determine magnitude and extent of ground contamination.**
- **Extreme caution necessary where radiation exceeds 10,000 mR/h.**
- **Consult standard technical product set for more detail.**

Briefing Product for Public Officials
Produced: 05 Oct 2015 21:06 UTC
Check for updates

Technical Details: CMHT 702-794-1665

Automated Report: Testing
(36.71578,-121.62342)
RDD Explosion at 04 Oct 2015 19:30 UTC

#0 Default Sheltering or Evacuation Area Based on CRCPD Guide

Considers possibility of radiation exposure from detonation of hypothetical generic RDD

Does not reflect measurements or modeling

Presenter Notes - Additional Information

- Blast presents the highest hazard. Exposure to the radioactive cloud is secondary hazard. The radioactive cloud disperses quickly, leaving only ground contamination, which is a lesser but persistent radiological hazard.
- Contamination of victims is a secondary concern compared to medical care for life threatening injuries. Transport and care should not be delayed to decontaminate those severely injured.
- Area shown is based on a default radius for a generic RDD, determined through experiments and modeling. Area does not reflect measurements or event-specific modeling, because information about the RDD is insufficient.
- Arrow shows direction surface winds will carry contamination. Buildings may also channel winds and some contamination other directions.
- In the absence of device-specific or measurement information, default protocol recommended by the Conference of Radiation Control Program Directors (CRCPD) is as follows:
  - Rescue all injured persons, moving personnel, as feasible, upwind of the immediate blast area (or away from movement of the dust and debris cloud, if visible).
  - Evacuate all other non-essential personnel within a 500 m (1650 ft or about 2.5 city blocks) radius.
  - Monitor evacuees for contamination and collect information needed to evaluate exposure.
  - Stage response assets upwind, if possible. Place assets where radiation levels are less than 2 mR/h or less than 1,000 cpm as measured by "pancake probe".
- Sheltering-in-place may be preferable to evacuation in some situations
  - Certain populations may need special consideration (hospitals, nursing homes, prisoners, etc.)
  - Severe weather, competing disasters, impediments to evacuation
- Updated calculations will be performed whenever, and as soon as, additional information becomes available.

Presenter Notes - Technical Background

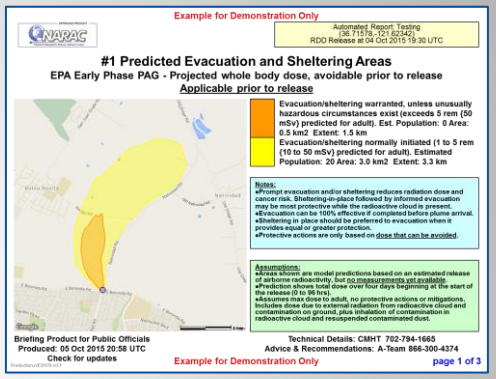
- Guidance based on a technical analysis of the consequences of hypothetical RDDs, as given in:
  - "Handbook for Responding to a Radiological Dispersal Device", CRCPD Pub. 06-6, www.crcpd.org/RDD.htm
  - "Realistic radiological dispersal device hazard boundaries and ramifications for early consequence management decisions", Harper, Musolino, Wente. Health Phys. July 2007
  - "Updated Emergency Response Guidance for the First 48 H After the Outdoor Detonation of an Explosive Radiological Dispersal Device," Musolino, Harper, Buddemeir, Brown & Schlueck. Health Phys. July 2013.
- The precautionary evacuation or sheltering area is based on potential exposure to ionizing radiation and seeks to minimize possible acute health effects and long term cancer risks.
- Predetermined area is defined as the area of highest concern for the more probable scenarios, and is the area in which acute effects, a lifetime inhalation dose of 100 rem, or a 5 rem groundshine (5-hour exposure) dose might occur.
- Knowledge of the type and quantity of radiological material is required to model radiological dispersal and potential impact to the environment. Therefore, measurements are required.
- Once the source term has been better defined, expect updated guidance regarding evacuation, sheltering, relocation and agricultural intervention.
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-43740.
- Consult standard technical product set for qualitative visualization of plume footprint.
- "Updated studies suggest 1) immediate shelter to avoid acute exposure to the radioactive cloud with evacuation, 2) moving from outdoors or "smokey" buildings to clear intact buildings, 3) delayed evacuation until directed to an uncontaminated evacuation route, and 4) extension of sheltering out to 2,000 m (1.25 mi.) downwind.

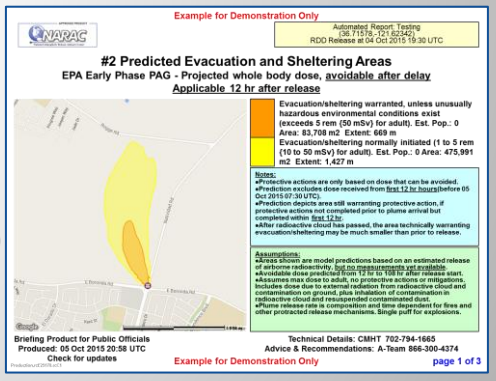
Briefing Product for Public Officials
Produced: 05 Oct 2015 21:06 UTC
Check for updates

Technical Details: CMHT 702-794-1665

Predicted Evacuation and Sheltering Areas Based on EPA/DHS Guides

- This product may be used to refine initial default Evacuation and Sheltering decisions
- Contours area displayed are the EPA or DHS PAGs (Protective Action Guidelines)
- Contours depict areas of dose that may be avoided by evacuation and/or sheltering
- Plume footprint may change with each update, indicating an updated prediction of avoidable dose
- Product indicates whether the radioactive cloud is still present or has passed
  - May include all plume passage 4-day dose (0-96 hours) or only avoidable dose (default avoidable dose period is 12-108 hours)
  - Only dose from ground contamination is considered if the plume has passed
- May reflect measurements (if indicated in the green box)





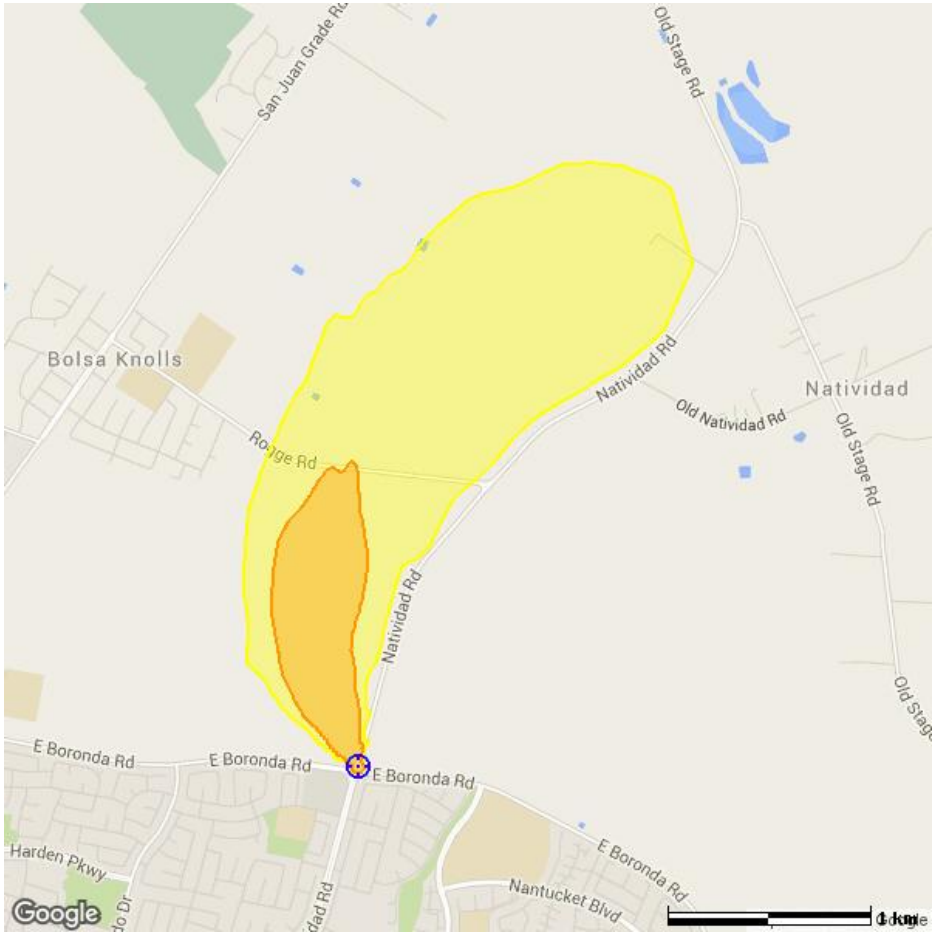
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release



Evacuation/sheltering warranted, unless unusually hazardous circumstances exist (exceeds 5 rem {50 mSv} predicted for adult). Est. Population: 0 Area: 0.5 km2 Extent: 1.5 km

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} predicted for adult). Estimated Population: 20 Area: 3.0 km2 Extent: 3.3 km

Notes:

- **Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering-in-place followed by informed evacuation may be most protective while the radioactive cloud is present.**
- **Evacuation can be 100% effective if completed before plume arrival.**
- **Sheltering in place should be preferred to evacuation when it provides equal or greater protection.**
- **Protective actions are only based on dose that can be avoided.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release

Key Points

- **Evacuation/sheltering is normally initiated at a projected dose of 1 rem (10 mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.**
- **Greatest hazard is due to exposure to the radioactive cloud. Sheltering followed by delayed evacuation after cloud passage may be preferable. Evacuation before radioactive cloud arrival is best, but avoid evacuation in the radioactive cloud.**
- **Those already outdoors should move to adequate shelter or leave the area.**
- **The value of sheltering to avoid dose varies from zero to almost 100%.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 04 Oct 2015 19:30 UTC to 08 Oct 2015 19:30 UTC.**
- **The airborne radioactive cloud was present until only 04 Oct 2015 21:30 UTC.**

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source.
- Evacuation is appropriate if its risk and secondary effects are less severe than the risk from projected radiation dose.
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce dose due to inhalation of contaminated smoke.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - Jetter, J. J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include contributions from: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of resuspended contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute significantly.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

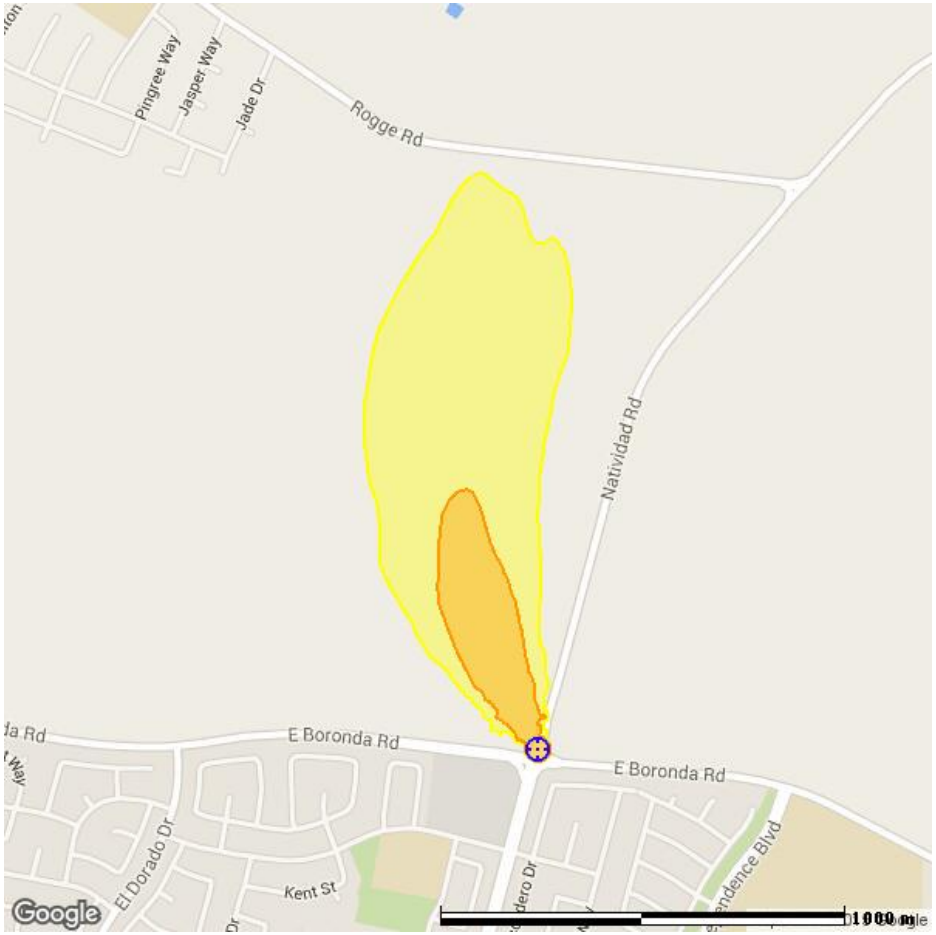
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after release



Evacuation/sheltering warranted, unless unusually hazardous environmental conditions exist (exceeds 5 rem {50 mSv} for adult). Est. Pop.: 0 Area: 83,708 m2 Extent: 669 m

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} for adult). Est. Pop.: 0 Area: 475,991 m2 Extent: 1,427 m

Notes:

- **Protective actions are only based on dose that can be avoided.**
- **Prediction excludes dose received from first 12 hr hours(before 05 Oct 2015 07:30 UTC).**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 12 hr.**
- **After radioactive cloud has passed, the area technically warranting evacuation/sheltering may be much smaller than prior to release.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Avoidable dose predicted from 12 hr to 108 hr after release start.**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**
- **Plume release rate is composition and time dependent for fires and other protracted release mechanisms. Single puff for explosions.**

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after release

Key Points

- **T+12 hr period predicts the remaining future dose due to resuspension or contamination and because it may not be practical to complete protective actions by that time.**
- **Evacuation and or sheltering is normally initiated at a projected dose of 1 rem (10mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action.**
- **Sheltering-in-place followed by informed evacuation may be most protective.**
- **The value of sheltering to avoid dose varies from zero to almost 100%. As time passes, the protective value of shletering-in-place may diminish.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from 12 hr after the start of the release for a period of 96 hours (4 days), specifically 05 Oct 2015 07:30 UTC to 09 Oct 2015 07:30 UTC.**
- **The airborne radioactive cloud has already passed and does not contribute to this prediction.**

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of a whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source (incident site).
- Sheltering may be the preferred protective action when it will provide protection equal to or greater than evacuation (example: evacuation through a plume).
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce dose due to inhalation of contaminated smoke.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

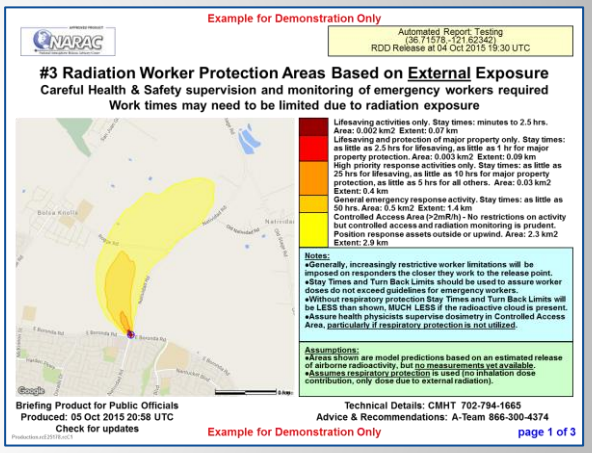
- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment march 2013).
  - Jetter, J.J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute.
- Hazard has been significantly reduced because the radioactive cloud passed. This prediction utilizes only external irradiation by ground contamination and inhalation of resuspended contaminated dust.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Worker Protection Areas Determined From Exposure Rates

- This product is used by dose assessment personnel to plan the tasks of Emergency Workers
  - Product displays an exposure rate at a specific time
  - Emergency Worker Stay Times are predicted based on that exposure rate
  - Note: if the radiation involved is decaying rapidly, this product will change significantly over time
- Contours displayed are the EPA or DHS worker guidelines and CRCPD guidance
- Product also may be used to estimate the ongoing dose received by the unsheltered general population
- May reflect measurements (indicated in the green box)



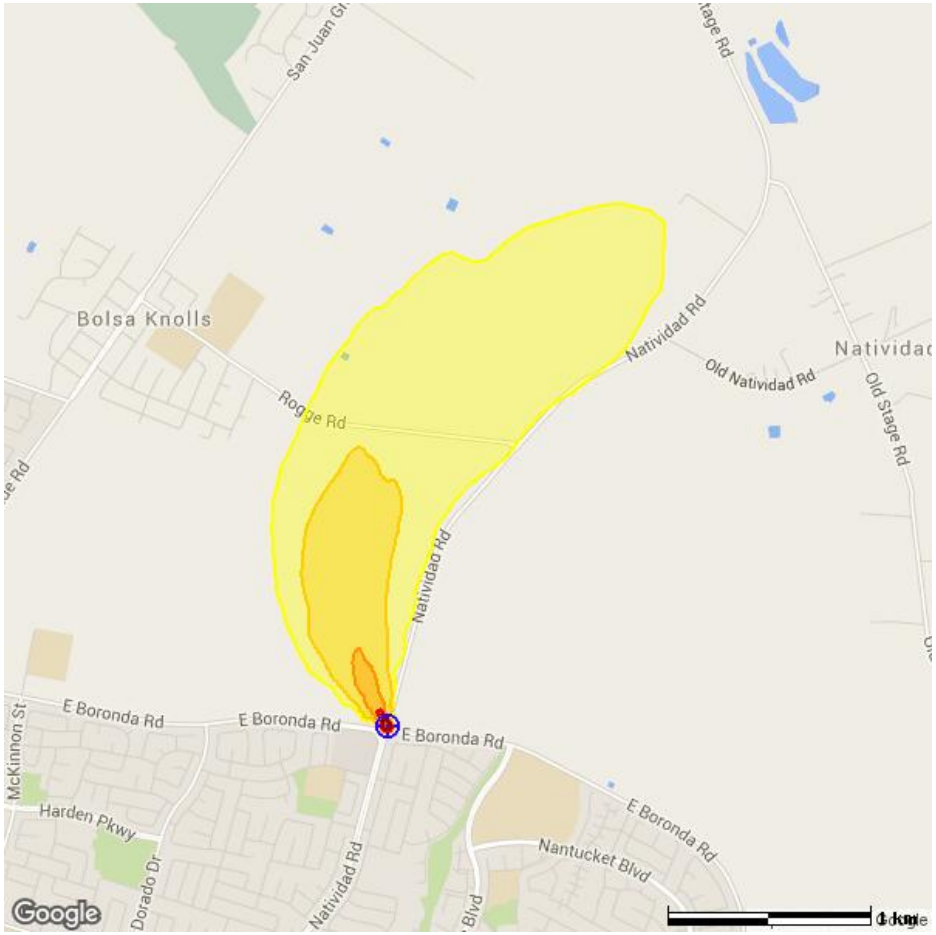
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required

Work times may need to be limited due to radiation exposure



Lifesaving activities only. Stay times: minutes to 2.5 hrs. Area: 0.002 km2 Extent: 0.07 km

Lifesaving and protection of major property only. Stay times: as little as 2.5 hrs for lifesaving, as little as 1 hr for major property protection. Area: 0.003 km2 Extent: 0.09 km

High priority response activities only. Stay times: as little as 25 hrs for lifesaving, as little as 10 hrs for major property protection, as little as 5 hrs for all others. Area: 0.03 km2 Extent: 0.4 km

General emergency response activity. Stay times: as little as 50 hrs. Area: 0.5 km2 Extent: 1.4 km

Controlled Access Area (>2mR/h) - No restrictions on activity but controlled access and radiation monitoring is prudent. Position response assets outside or upwind. Area: 2.3 km2 Extent: 2.9 km

Notes:

- Generally, increasingly restrictive worker limitations will be imposed on responders the closer they work to the release point.
- Stay Times and Turn Back Limits should be used to assure worker doses do not exceed guidelines for emergency workers.
- Without respiratory protection Stay Times and Turn Back Limits will be LESS than shown, MUCH LESS if the radioactive cloud is present.
- Assure health physicists supervise dosimetry in Controlled Access Area, particularly if respiratory protection is not utilized.

Assumptions:

- Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
- Assumes respiratory protection is used (no inhalation dose contribution, only dose due to external radiation).

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required
Work times may need to be limited due to radiation exposure

Key Points

- **Product portrays areas where responder work times may be limited to protect workers.**
- **Occupational limits do not apply to emergencies. Instead, dose guidelines are provided for emergency response. Different guidelines apply to 1) lifesaving, 2) protection of major property and 3) any other emergency response work. Avoid exceeding guidelines.**
- **Radiation doses to emergency workers are voluntary and require informed consent.**
- **Emergency workers do not "burn out" if the guideline is exceeded, but must consent to additional radiation exposure/dose to continue work in a radiation area.**
- **Response activities must be prioritized and carefully planned to obtain the maximum benefit from the least amount of worker exposure.**
- **Work controls may limit time in radiation area (Stay Time) and require stop work and retreat in high radiation areas (Turn Back Limits).**
- **Map assumes respiratory protection is used to prevent dose due to inhalation of radioactivity in the radioactive cloud or in contaminated dust.**
- **For purposes of limiting worker radiation dose, doses accumulate day-by-day.**
- **Strive to keep exposures As-Low-As-Reasonably-Achievable (ALARA).**
- **Engage assistance of health physics professionals for specific guidance ASAP.**
- **This map product is valid at 05 Oct 2015 07:30 UTC .**

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required

Work times may need to be limited due to radiation exposure

Presenter Notes - Additional Information

- Map assumes external exposure rate is essentially equivalent to total dose rate (1 mrem/h = 1 mR/h = 0.01mSv/h), because utilization of respiratory protection is assumed.
- The total dose may be up to 100 times greater than the external exposure indicated on a personal dosimeter, if respiratory protection is not used while the radioactive cloud is present.
- Even if the cloud has passed the multiplier can still be significant due to resuspended material/contamination.
- CMHT can provide this exposure rate to total dose multiplier (conversion factor).
- All radiation exposures require informed consent, particularly those exceeding routine occupational limits (5 rem {50mSv}), such as for lifesaving or protection of valuable property activities.
- An individual's radiation dose is a cumulative total of their dose received each day or work period.
- These guidelines apply to doses incurred over the duration of an emergency and are assumed to be once in a lifetime.
- Plan activities to make exposures As-Low-As-Reasonably-Achievable (ALARA).
  - Plan work to minimize exposure time
  - Avoid lingering in areas with radiation levels over 2 mR/h (0.02 mSv/h)
  - Take advantage of available shielding (trucks, walls...)
  - Position assets outside the Controlled Access Area boundary and upwind if possible
  - Use respiratory protection, until demonstrated as unnecessary
  - Avoid, or minimize, eating or drinking in radiation areas to the extent practical.
- Assure health physics professionals are involved in worker safety oversight.
- The CMHT can provide predictions of total dose rate for those without respiratory protection. This includes guidance for use of Electronic Personal Dosimeters (EPDs).

Presenter Notes - Technical Background

- Guidance based on EPA/DHS PAGs as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- This assessment is based on the ICRP 60+ dosimetry model.
- The dose guideline for lifesaving is 25 rem (250 mSv) for the event, which assures exposures will not produce acute health effects.
- The dose guideline for protection of critical infrastructure or valuable property (e.g., a nuclear power plant) is 10 rem for the event.
- An occupational dose guideline of 5 rem per year applies to all other general emergency response work.
- Emergency responders without radiological worker training or monitoring should remain outside the 2 mR/h (0.02 mSv/h) boundary, if possible.
- Contour levels correspond to predicted exposure rate levels of:
  10,000 mR/h, 1,000 mR/h, 100 mR/h, 10 mR/h, 2mR/h
  {100 mSv/h, 10 mSv/h, 1 mSv/h, 0.1 mSv/h, 0.02 mSv/h}

Fewer than five contours may be shown if some of these higher thresholds are not reached.

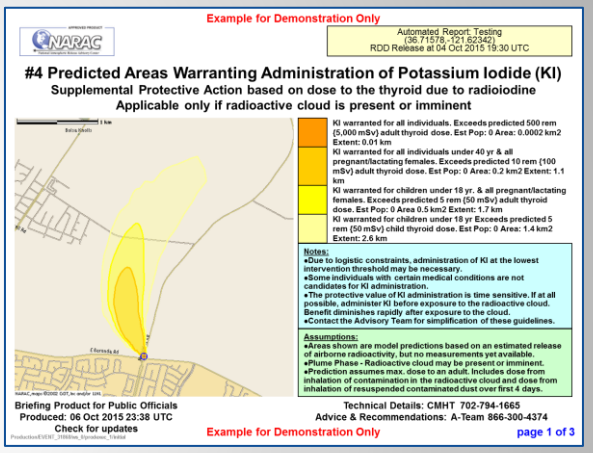
- EPA's emergency dose guidelines apply to emergency response workers. However, not all organizations use these EPA limits.
- Lower dose guidelines apply to the general public.
- Consult a health physics professional to evaluate the benefit and added risk of various types of PPE.
- Radioactive contamination is expected outside the contoured areas, but not at levels currently expected to exceed federal guidelines.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Predicted Areas Warranting Administration of Potassium Iodide (KI)

- This product is provided for cases in which radioactive iodine is released
- Product is used to determine whether administration of potassium Iodide (KI) may be warranted to protect against the risk of thyroid cancer
- Product is based on predicted dose from inhalation of the radioactive cloud during plume passage and resuspended dust from ground contamination over the first four days
- Contours displayed are based on the 2001 Food and Drug Administration Protective Action Guide, which considers the thyroid dose for different age groups and special cases
- Use of KI may be an effective alternative to evacuation for cases involving radioiodine releases

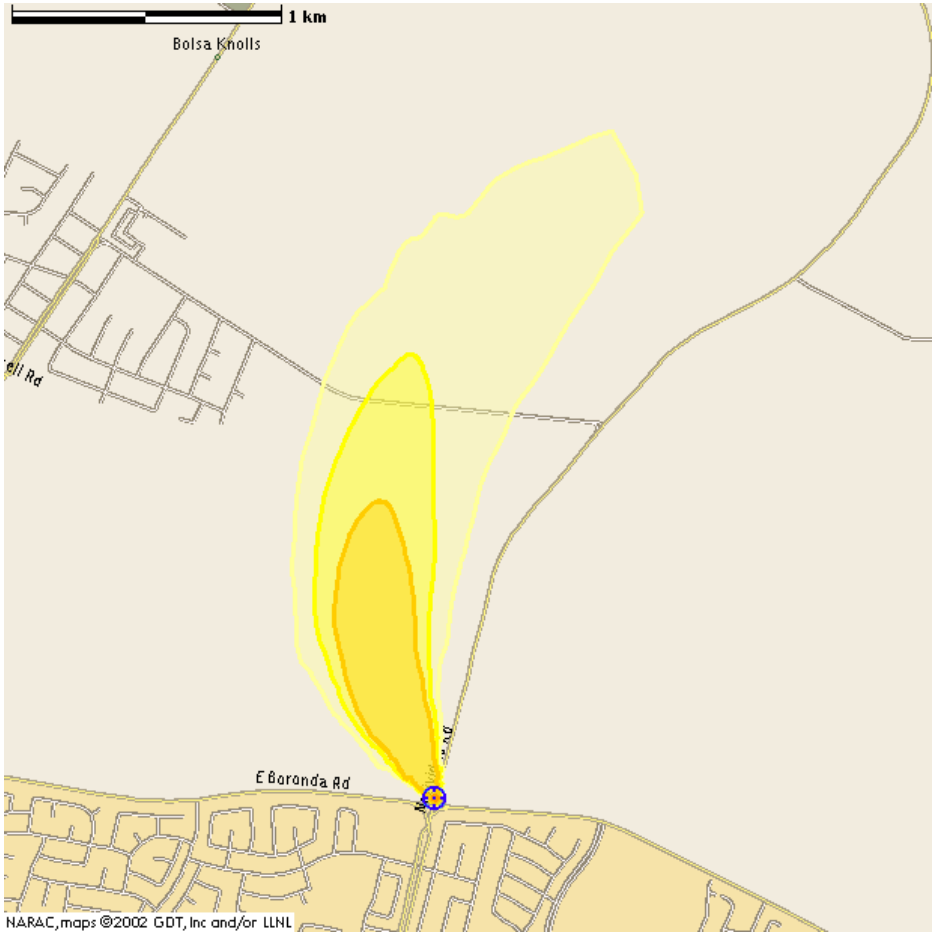


Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine

Applicable only if radioactive cloud is present or imminent



KI warranted for all individuals. Exceeds predicted 500 rem {5,000 mSv} adult thyroid dose. Est Pop: 0 Area: 0.0002 km2 Extent: 0.01 km

KI warranted for all individuals under 40 yr & all pregnant/lactating females. Exceeds predicted 10 rem {100 mSv} adult thyroid dose. Est Pop: 0 Area: 0.2 km2 Extent: 1.1 km

KI warranted for children under 18 yr. & all pregnant/lactating females. Exceeds predicted 5 rem {50 mSv} adult thyroid dose. Est Pop: 0 Area 0.5 km2 Extent: 1.7 km

KI warranted for children under 18 yr Exceeds predicted 5 rem {50 mSv} child thyroid dose. Est Pop: 0 Area: 1.4 km2 Extent: 2.6 km

Notes:

- **Due to logistic constraints, administration of KI at the lowest intervention threshold may be necessary.**
- **Some individuals with certain medical conditions are not candidates for KI administration.**
- **The protective value of KI administration is time sensitive. If at all possible, administer KI before exposure to the radioactive cloud. Benefit diminishes rapidly after exposure to the cloud.**
- **Contact the Advisory Team for simplification of these guidelines.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Plume Phase - Radioactive cloud may be present or imminent.**
- **Prediction assumes max. dose to an adult. Includes dose from inhalation of contamination in the radioactive cloud and dose from inhalation of resuspended contaminated dust over first 4 days.**

Briefing Product for Public Officials
Produced: 06 Oct 2015 23:38 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine
Applicable only if radioactive cloud is present or imminent

Key Points

- **Utilization of KI is a supplemental action because not all communities use it. Evacuation is the primary protective action.**
- **Use of KI may be an effective alternative to evacuation in cases involving radioiodine releases, if evacuation cannot be implemented or exposure occurs during evacuation. See Predicted Evacuation and Sheltering Areas products for evacuation/shelter guidance.**
- **Leaving shelter to seek KI may result in increased radiation dose.**
- **FDA recommends that KI be administered to all age groups at the lowest intervention threshold, because the multiple thresholds may be logistically impractical to implement.**
- **Potassium Iodide only protects the thyroid from radioiodine. It has not protective value for other radionuclides or for any other organ.**
- **Radiation dose to the thyroid increases the risk of thyroid cancer.**
- **KI is most effective when administered immediately prior to exposure to the plume, but significant protection can be provided even if administration is delayed 3 or 4 hours after initial exposure.**
- **Predicted thyroid dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 04 Oct 2015 19:30 UTC to 0 hr.**

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine

Applicable only if radioactive cloud is present or imminent

Presenter Notes - Additional Information

- This product is based on the 2001 FDA KI administration guidance.
- Radiation dose to the thyroid increases the risk of thyroid cancer.
- Radioiodine inhalation is the strongest contributor to thyroid dose.
- Potassium Iodide blocks most of the absorption of radioiodine by the thyroid.
- The area on the graphic describing KI administration to children under 18 is actually for the most limiting child age group (1 year-old infant).
- The FDA guide reports:
  - "The protective effects of KI last approximately 24 hours. For optimal prophylaxis, KI should therefore be dosed daily, until a risk of significant exposure to radioiodines by either inhalation or ingestion no longer exists."
  - "The overall benefits of KI far exceed the risks of overdosing, especially in children, though we continue to emphasize particular attention to dose in infants."
  - "KI may still have a substantial protective effect even if taken 3 or 4 hours after exposure" (the older EPA guide says 1 or 2 hours).
- Age specific dosages are established. Contact medical and radiation health professionals for radiation guidance.
- Prolonged radioiodine exposure may require subsequent administration of KI. Repeat dosing should be avoided for newborns, pregnant and lactating women. Consult medical professionals.

Presenter Notes - Technical Background

- Guidance based on the new FDA KI PAG as given in:
  - "Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies", (U.S. Department of Health and Human Services Food and Drug Administration, Center for Drug Evaluation and Research (CDER), December 2001, Procedural)
- This prediction employs the updated ICRP 60+ dosimetry model and dose factors.
- A simplified approach to KI administration is under consideration, which would provide KI to the entire public if the projected child thyroid dose exceeds 5 rem (50 mSv).
- Potassium Iodide (KI) preferentially deposits in the thyroid whether inhaled or ingested. Inhalation of contaminated air is the concern while the cloud is present. Inhalation of radioiodine is a particularly large contributor to thyroid dose.
- The FDA KI guide recommends these KI dosages if the following potential thyroid doses are exceeded:

Group	Potential Thyroid Dose		KI Dosage
Adults over 40	> or =	500 rem {5,000 mSv}	130 mg
Adults 18 to 40	> or =	10 rem {100 mSv}	130 mg
Pregnant/lactating women	> or =	5 rem {50mSv}	130 mg
Adolescents 12 to 18	> or =	5 rem {50mSv}	65 mg
Children 3 to 12	> or =	5 rem {50mSv}	65 mg
Infant 1 mo to 3 yr	> or =	5 rem {50 mSv}	32 mg
Infant birth to 1 mo	> or =	5 rem {50 mSv}	16 mg

- Contaminated air will be found outside contoured areas, but not at levels expected to exceed FDA guidelines for KI administration.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

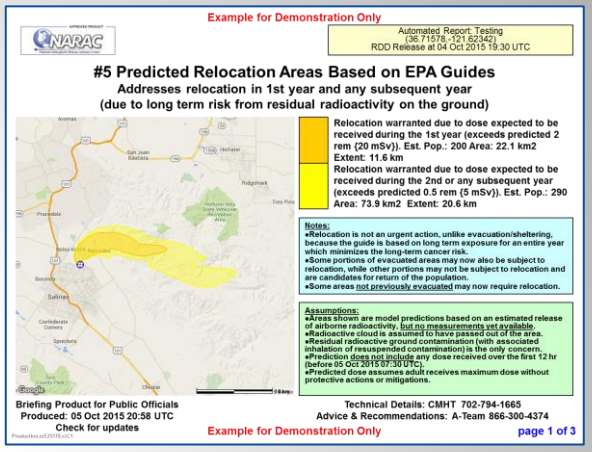
Briefing Product for Public Officials
Produced: 06 Oct 2015 23:38 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

INTERMEDIATE PHASE

Predicted Relocation Areas Based on EPA/DHS Guides

- These products are used to determine the dose that may be avoided in the long term (1 to 2 years or 50 years) if the population is relocated
- Contours displayed are the EPA or DHS PAGs (Protective Action Guides)
- By this time, the plume will most likely have passed and the dose received will be from ground contamination, either by direct exposure or via inhalation of resuspended material
- May reflect measurements (as indicated in the green box)


Example for Demonstration Only

NARAC

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#5 Predicted Relocation Areas Based on EPA Guides
Addresses relocation in 1st year and any subsequent year
(due to long term risk from residual radioactivity on the ground)

Relocation warranted due to dose expected to be received during the 1st year (exceeds predicted 2 rem (20 mSv)). Est. Pop.: 200 Area: 22.1 km2 Extent: 11.6 km

Relocation warranted due to dose expected to be received during the 2nd or any subsequent year (exceeds predicted 0.5 rem (5 mSv)). Est. Pop.: 290 Area: 73.9 km2 Extent: 20.6 km

Notes:
•Relocation is not an urgent action, unlike evacuation/sheltering, because the guide is based on long term exposure for an entire year which minimizes the long-term cancer risk.
•Some portions of evacuated areas may now also be subject to relocation, while other portions may not be subject to relocation and are candidates for return of the population.
•Some areas not previously evacuated may now require relocation.

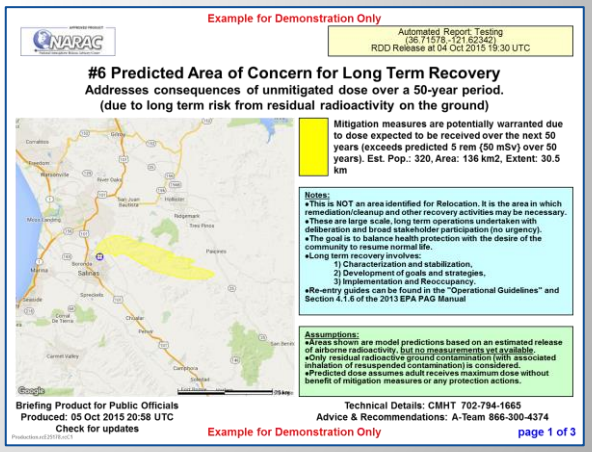
Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Radioactive cloud is assumed to have passed out of the area.
•Residual radioactive ground contamination (with associated inhalation of resuspended contamination) is the only concern.
•Prediction does not include any dose received over the first 12 hr (before 05 Oct 2015 07:30 UTC).
•Predicted dose assumes adult receives maximum dose without protective actions or mitigations.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Example for Demonstration Only

page 1 of 3


Example for Demonstration Only

NARAC

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#6 Predicted Area of Concern for Long Term Recovery
Addresses consequences of unmitigated dose over a 50-year period.
(due to long term risk from residual radioactivity on the ground)

Mitigation measures are potentially warranted due to dose expected to be received over the next 50 years (exceeds predicted 5 rem (50 mSv) over 50 years). Est. Pop.: 320, Area: 136 km2, Extent: 30.5 km

Notes:
•This is NOT an area identified for Relocation. It is the area in which remediation/cleanup and other recovery activities may be necessary.
•These are large scale, long term operations undertaken with deliberation and broad stakeholder participation (no urgency).
•The goal is to balance health protection with the desire of the community to resume normal life.
•Long term recovery involves:
1) Characterization and stabilization,
2) Development of goals and strategies,
3) Implementation and Reoccupancy.
•Re-entry guides can be found in the "Operational Guidelines" and Section 4.1.6 of the 2013 EPA PAG Manual

Assumptions:
•Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
•Only residual radioactive ground contamination (with associated inhalation of resuspended contamination) is considered.
•Predicted dose assumes adult receives maximum dose without benefit of mitigation measures or any protection actions.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Example for Demonstration Only

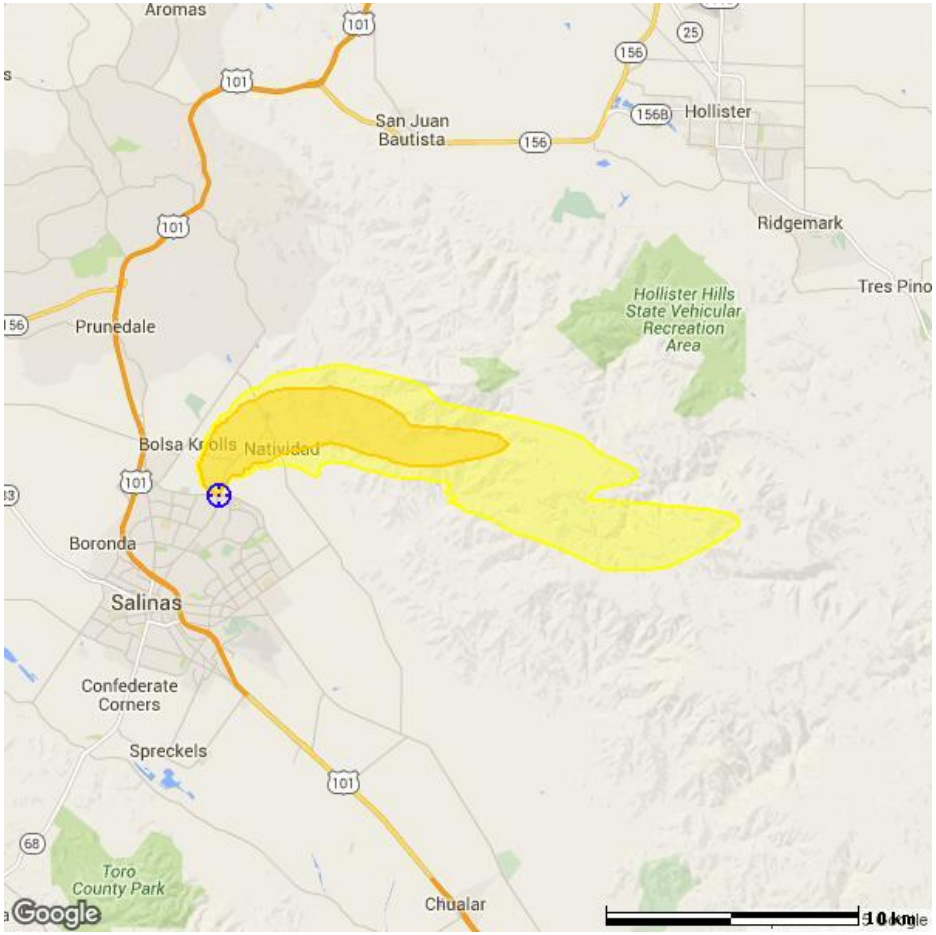
page 1 of 3

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year (due to long term risk from residual radioactivity on the ground)



Relocation warranted due to dose expected to be received during the 1st year (exceeds predicted 2 rem {20 mSv}). Est. Pop.: 200 Area: 22.1 km2 Extent: 11.6 km

Relocation warranted due to dose expected to be received during the 2nd or any subsequent year (exceeds predicted 0.5 rem {5 mSv}). Est. Pop.: 290 Area: 73.9 km2 Extent: 20.6 km

Notes:

- **Relocation is not an urgent action, unlike evacuation/sheltering, because the guide is based on long term exposure for an entire year which minimizes the long-term cancer risk.**
- **Some portions of evacuated areas may now also be subject to relocation, while other portions may not be subject to relocation and are candidates for return of the population.**
- **Some areas not previously evacuated may now require relocation.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Radioactive cloud is assumed to have passed out of the area.**
- **Residual radioactive ground contamination (with associated inhalation of resuspended contamination) is the only concern.**
- **Prediction does not include any dose received over the first 12 hr (before 05 Oct 2015 07:30 UTC).**
- **Predicted dose assumes adult receives maximum dose without protective actions or mitigations.**

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year
(due to long term risk from residual radioactivity on the ground)

Key Points

- **The PAG level for relocation applies to doses that can be avoided by relocation; doses already incured prior to relocation are not included in the calculations.**
- **Relocation recommendation is based on whole body dose. Thyroid dose is no longer a primary concern because plume inhalation is no longer a hazard.**
- **Relocation PAG applies principally to personal residences but may impact other facilities as well (e.g., factories, offices, hospitals) as well as transportation routes and facilities.**
- **Occupancy time of individuals should be taken into account to determine the criteria for using a facility or area.**
- **Re-entry into portions of restricted areas (evacuation & relocation) may be permitted for justified reasons with appropriate radiological controls and dose monitoring/tracking.**
- **Re-entry is temporary, not to be confused with return or reoccupation.**
- **Dose rate will naturally diminish with time due to radioactive decay and weathering.**
- **Simple dose reduction techniques (e.g., flushing surfaces, removing hostspots) can be applied in areas where levels of deposited radioactivity are not high enough to warrant relocation. Contact the Advisory Team (A-Team) for options.**

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year (due to long term risk from residual radioactivity on the ground)

Presenter Notes - Additional Information

- PAG - Protective Action Guideline, projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- Relocation PAG applies only to dose that can be avoided during the first year and any subsequent year.
- Following early phase response it may be necessary to temporarily relocate the public from areas until decontamination has taken place.
- Areas shown do not include dose received before 05 Oct 2015 07:30 UTC.
- In contrast to the situation during the early phase, when decisions usually must be made and implemented quickly, many relocation decisions and actions during the intermediate phase can be delayed until adequate resources are in place.
- Some groups not previously evacuated may require relocation.
- PAGs are guidance only. During an incident, due to unanticipated local conditions and constraints, professional judgment will be required. Situations can be envisaged in which relocation of the public, based on the recommended PAGs, would be impractical. Conversely, under some conditions relocation may be quite practical at doses below the PAGs.
- Informed judgment must be exercised to prioritize protection for individuals in areas having the highest exposure rates.
- Simple dose reduction efforts are recommended for areas outside the relocation area to reduce doses to the extent practical.
- Re-entry is temporary access to the restricted area under controlled conditions for the purpose of performing activities essential to stabilization, relocation and recovery. Residence is not permitted.
- Dose rate tends to naturally diminish with time due to radioactive decay and weathering of contamination into the soil.
- Dose rate may decline rapidly for the first weeks then slow in subsequent months to years, because radioactive iodine and other short-live radionuclides will nearly vanish but longer-lived radionuclides will persist.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA and DHS PAGs, as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- This assessment is based on the ICRP 60+ dosimetry model.
- Dose considered is the projected Total Effective Dose (TED) which includes external irradiation and inhalation of re-suspended material, accounting for weathering of material and radioactive decay. Only ground contamination contributes to the dose. There is no plume contribution.
- Two separate dose criteria are used: 1) Dose during first year (2 rem) {20 mSv} and 2) Dose during second or any subsequent year (0.5 rem) {5 mSv}.
- First year dose accumulated from 12 hrs to 1 year + 12 hrs (12 to 8,772 hrs).
- Second year dose accumulated from beginning to end of year two (i.e. 8,760 hrs to 17,520 hrs). 50 year dose accumulated from 12 hrs to 50 years + 12 hrs.
- Projected dose assumes individuals are unsheltered and unprotected, and no mitigation or remediation actions are taken (maximally exposed individual).
- Dose reduction factors associated with simple, rapid decontamination techniques are not included in calculating projected dose for decisions on relocation, as prescribed by EPA PAGs.
- Some special cases may also require consideration of beta radiation from surface contamination and direct ingestion of contaminated soil.
- The sizes of the relocation and the affected population areas can be reduced by reducing dose in the area by removal/shielding of radioactive material.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed guidelines for relocation based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

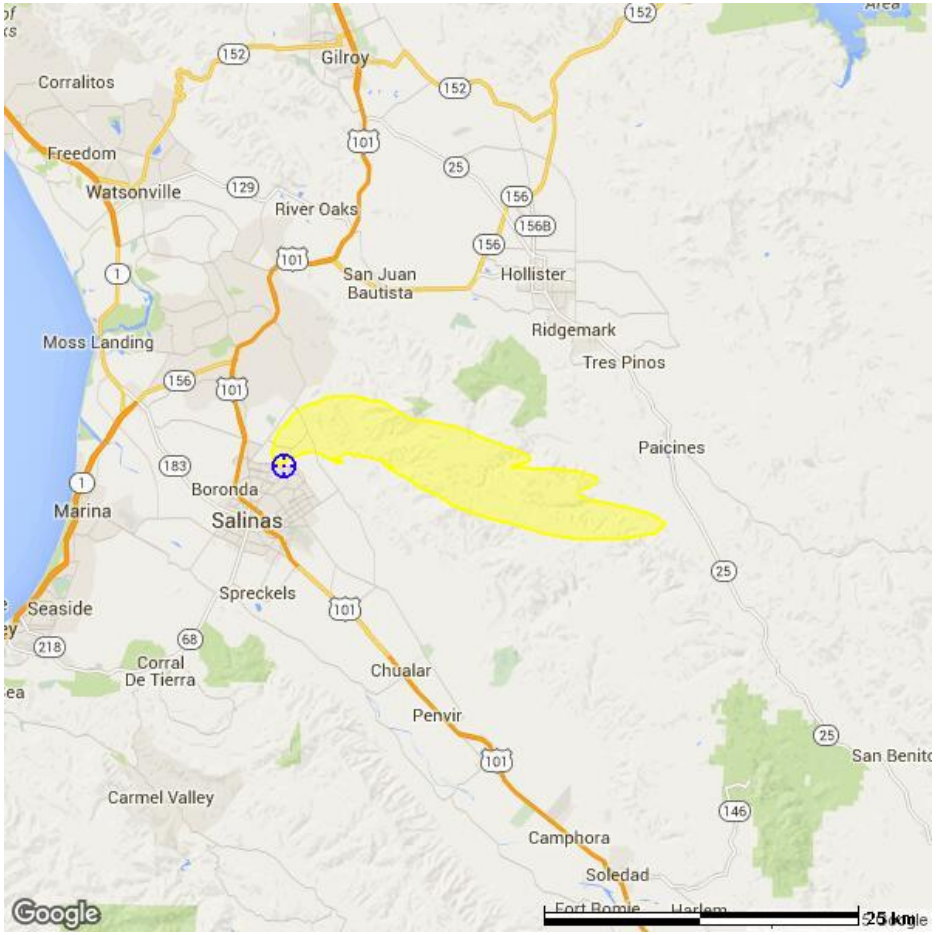
Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period. (due to long term risk from residual radioactivity on the ground)



Mitigation measures are potentially warranted due to dose expected to be received over the next 50 years (exceeds predicted 5 rem {50 mSv} over 50 years). Est. Pop.: 320, Area: 136 km2, Extent: 30.5 km

Notes:

- This is NOT an area identified for Relocation. It is the area in which remediation/cleanup and other recovery activities may be necessary.
- These are large scale, long term operations undertaken with deliberation and broad stakeholder participation (no urgency).
- The goal is to balance health protection with the desire of the community to resume normal life.
- Long term recovery involves:
  1) Characterization and stabilization,
  2) Development of goals and strategies,
  3) Implementation and Reoccupancy.
- Re-entry guides can be found in the "Operational Guidelines" and Section 4.1.6 of the 2013 EPA PAG Manual

Assumptions:

- Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
- Only residual radioactive ground contamination (with associated inhalation of resuspended contamination) is considered.
- Predicted dose assumes adult receives maximum dose without benefit of mitigation measures or any protection actions.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period.
(due to long term risk from residual radioactivity on the ground)

Key Points

- **The Briefing Product is based on the now defunct 5 rem in 50 years Relocation PAG found in the 1992 EPA PAG Manual. It may inform planning for long term recovery.**
- **Recovery seeks best path to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community.**
- **Recovery considerations include 1) Mitigation/cleanup measures, 2) Permanent housing solutions, 3) Restoring infrastructure, and 4) Revitalizing business/agriculture.**
- **Priority shifts from supporting protective actions to characterizing the nature and extent of contamination to facilitate stabilization and cleanup.**
- **Earliest considerations must address:**
  - **Stabilization and mitigation actions to prevent further damage/loss,**
  - **Return and reoccupation by population, plus recovery of critical infrastructure and key resources (CI/KR).**
- **The "Operational Guidelines" offer criteria to facilitate initial infrastructure and business recovery, reentry and use of transit.**
- **Contact Advisory Team (A-Team) for additional information regarding Recovery.**

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period. (due to long term risk from residual radioactivity on the ground)

Presenter Notes - Additional Information

●The 50-year long term objective (5 rem {50 mSv} accumulated over 50 years) is focused on dose that can be avoided in the future. Therefore, it does not include any dose received from plume passage or dose from ground contamination during the first 12 hours (received before 05 Oct 2015 07:30 UTC).
●Numeric PAG levels will not be used to guide restoration and recovery of areas impacted by a radiological incident; rather, a process that involves stakeholders in setting priorities and determining actions will be developed that is adaptable to a given situation.
●Informed judgment must be exercised to prioritize recovery for individuals in areas having the highest exposure rates.
●Reoccupying households and businesses should be considered in balance with progress made in reducing radiation risks through decontamination, radioactive decay and managing contaminated waste.
●Exposure limits in a range of one in a population of ten thousand (10-4) to one in a population of one million (10-6) excess lifetime cancer incidence outcomes are generally considered protective, though this may not be achievable after a large radiological incident.
●Recovery can include a combination of cleanups and use restrictions
●Disposal of large volumes of radioactively contaminated waste will be a problem, because it would likely overwhelm existing radioactive waste disposal capacity in the U.S.
●Criteria for free release of personal property may be an issue.
●Dose rate tends to naturally diminish with time due to radioactive decay and weathering of contamination into the soil. The rate of decline will decline rapidly for the first weeks then slow in subsequent months to years, because radioactive iodine and other short-live radionuclides will nearly vanish but longer-lived radionuclides will persist.

Presenter Notes - Technical Background

●Guidance based on EPA and DHS PAGs, as given in:
- "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- "Preliminary Report on Operation Guidelines Developed for Use in Emergency Preparedness and Response to a Radiological Dispersal Device Incident", (DOE/HS-0001: ANL/EVS/TM/09-1).
- "National Disaster Recovery Framework", (FEMA, Sept 2011)

●This assessment is based on the ICRP 60+ dosimetry model (2013 EPA PAG Manual).
●Dose considered is the projected Total Effective Dose (TED) which includes external irradiation and inhalation of re-suspended material, accounting for weathering of material and radioactive decay. Only ground contamination contributes to the dose. There is no plume contribution.
●Projected dose assumes individuals are unsheltered and unprotected, and no mitigation or remediation actions are taken (maximally exposed individual).
●Dose reduction factors associated with simple, rapid decontamination techniques are not included in calculating projected dose for decisions on relocation, as prescribed by EPA PAGs.
●The sizes of the relocation and the affected population areas can be reduced by reducing dose in the area by removal/shielding of radioactive material.
●Radioactive contamination is expected outside the contoured areas at very low levels based on current information.
●Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
●Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
●Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

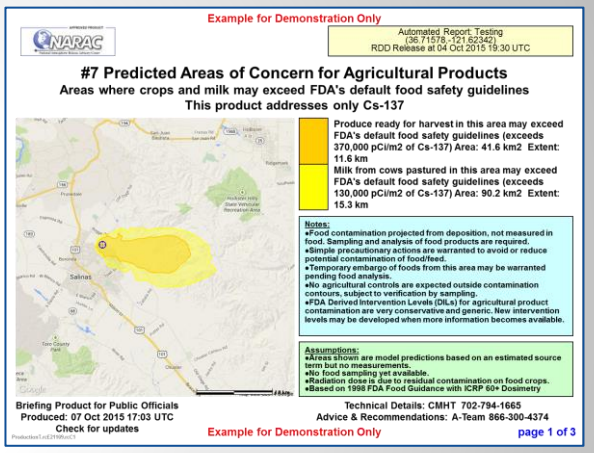
Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

LATE PHASE

Predicted Areas of Concern for Agricultural Products

- This product is used to determine where there is the potential to exceed food safety guidelines and may be used to guide crop sampling efforts
- Contours displayed are DRLs (Derived Response Levels) corresponding to FDA DILs (Derived Intervention Levels)
- Levels displayed on this product are very low and are difficult to measure directly
- May reflect measurements (indicated in the green box)



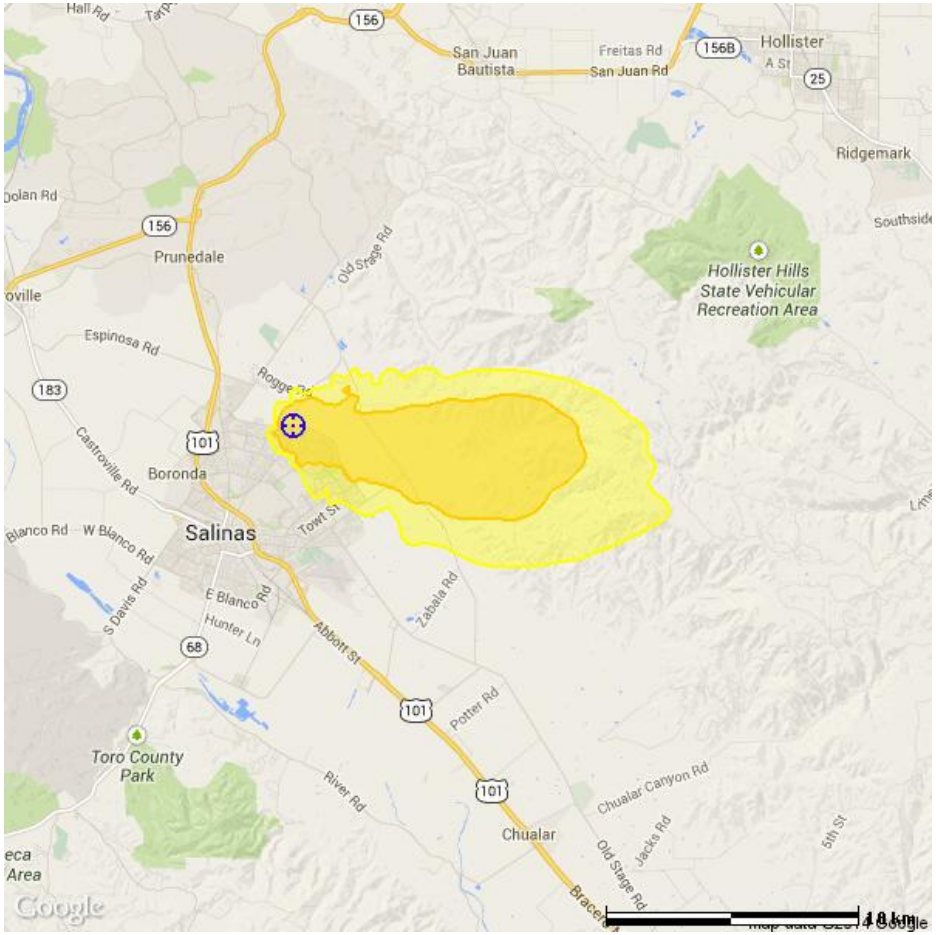
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only Cs-137



Produce ready for harvest in this area may exceed FDA's default food safety guidelines (exceeds 370,000 pCi/m2 of Cs-137) Area: 41.6 km2 Extent: 11.6 km

Milk from cows pastured in this area may exceed FDA's default food safety guidelines (exceeds 130,000 pCi/m2 of Cs-137) Area: 90.2 km2 Extent: 15.3 km

Notes:

- **Food contamination projected from deposition, not measured in food. Sampling and analysis of food products are required.**
- **Simple precautionary actions are warranted to avoid or reduce potential contamination of food/feed.**
- **Temporary embargo of foods from this area may be warranted pending food analysis.**
- **No agricultural controls are expected outside contamination contours, subject to verification by sampling.**
- **FDA Derived Intervention Levels (DILs) for agricultural product contamination are very conservative and generic. New intervention levels may be developed when more information becomes available.**

Assumptions:

- **Areas shown are model predictions based on an estimated source term but no measurements.**
- **No food sampling yet available.**
- **Radiation dose is due to residual contamination on food crops.**
- **Based on 1998 FDA Food Guidance with ICRP 60+ Dosimetry**

Briefing Product for Public Officials
Produced: 07 Oct 2015 17:03 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT NARAC National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only RDD Cs-137 Russian Seed Irradiator

Key Points

- FDA guidance applies to concentration of radioactivity in foods as prepared for eating.
- This product is based on projection of food concentration from expected and/or measured environmental deposition, not measured food concentration. Assumes no reduction of contamination by washing, peeling, cooking or other processing.
- Extensive, time consuming sampling and analysis will be required to properly assess food contamination.
- FDA recommends consultation with the FDA on: 1) simple precautions to avoid/reduce contamination of food/feed and 2) use of temporary food embargoes to prevent introduction of contaminated food into commerce.
  - Precautions include covering exposed products, moving animals to shelter and corralling livestock plus providing uncontaminated (or clean) feed and water.
  - The temporary embargo permits opportunity for monitoring and sampling to be performed as the basis of future protective actions.
- Food products not yet ready for harvest will require analysis prior to harvest.
- Food and beverages packaged before the accident are generally not affected.
- FDA guidance assumes 30% of all food eaten is contaminated (very conservative).
- Drinking water concerns are not addressed by this product.

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only RDD Cs-137 Russian Seed Irradiator

Presenter Notes - Additional Information

- This is a preliminary assessment based on predicted radioactivity levels in the environment, not concentration of radioactivity in foods. FDA food safety guidance is based on concentration in foods as prepared for consumption.
- This preliminary assessment pertains only to food products that are ready for immediate consumption, not foods to be harvested at a future date, or to foods grown underground or indoors.
- No food sampling has taken place. Confidence and accuracy will be improved once results of food sampling are obtained.
- "Protective actions can be taken before the release or arrival of contamination if there is advance knowledge that radionuclides may accidentally contaminate the environment."
- "Protective actions which can be taken within the area likely to be affected and prior to confirmation of contamination consist of:
  - simple precautionary actions to avoid or reduce the potential for contamination of food and animal feeds, and
  - temporary embargoes to prevent the introduction into commerce of food which is likely to be contaminated."
- "Protective actions which should be implemented when the contamination in food equals or exceeds the DILs consist of:
  - temporary embargoes to prevent the contaminated food from being introduced into commerce,
  - normal food production and processing actions that reduce the amount of contamination in or on food to below the DILs."
- "Normal food production and processing procedures that could reduce the amount of radioactive contamination in or on the food could be simple, (such as holding to allow for radioactive decay, or removal of surface contamination by brushing, washing, or peeling)..."
- Food products that are not yet ready for harvest should be analyzed at a later time before consumption to determine if they are suitable for consumption.
- Pre-packaged food and beverages in these areas are not affected.
- This map is valid for only this growing season.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

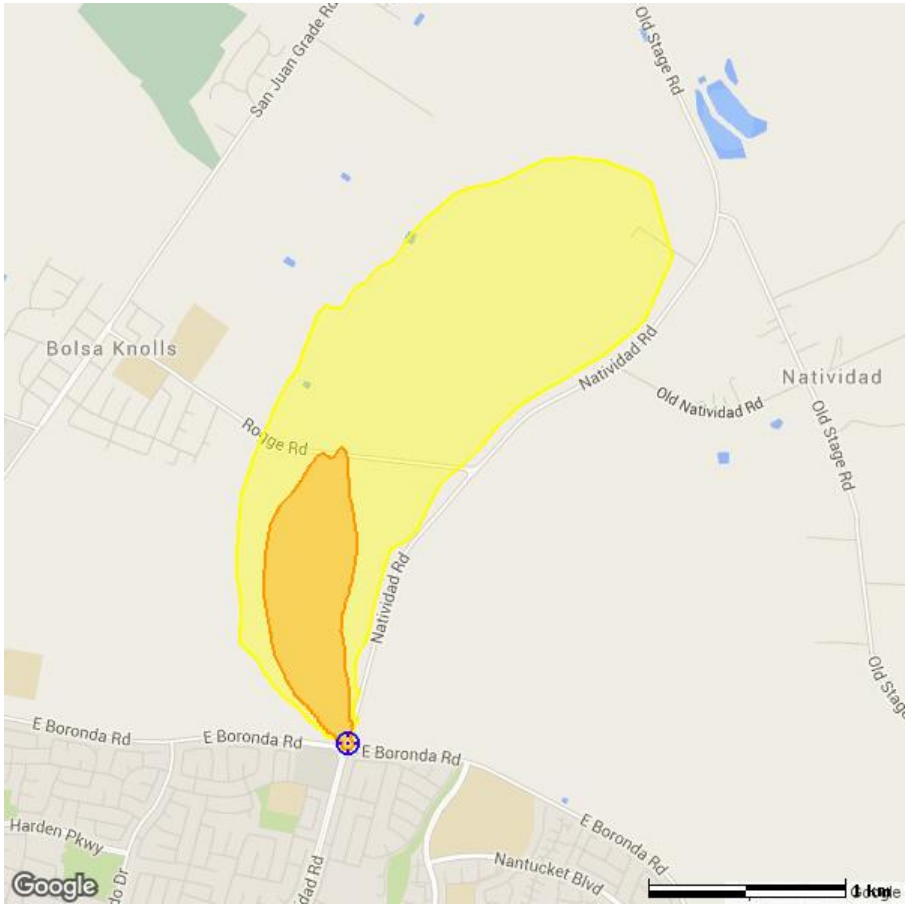
- Guidance based on EPA and DHS PAGs, as given in:
  - "Guidance on Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies", (Federal Register, Vol. 63, No. 156, Aug. 3, 1998, pg 43402).
- This prediction employs the updated ICRP 60+ dosimetry model and dose factors.
- Preliminary assessment based on FDA's food safety guidelines, termed Derived Intervention Levels (DILs), expressed as activity per unit mass of food. These food guidelines have been projected to obtain limits for deposition of radioactivity in the environment, which can be easily predicted and quickly measured. These are termed Derived Response Levels (DRLs).
- DRLs for the current growing season consider the amount of radioactivity deposited ON the plant (e.g., on leaves and fruit).
- DRLs for future growing seasons also consider uptake of radioactivity by roots from soil and INTO the plant (e.g., in leaves and fruit). This is a slow process.
- FDA DILs limit the radiation dose due to consumption of contaminated food to a predicted 0.5 rem {0.5 cSv} for the effective whole body or predicted 5 rem {5 cSv} to any one organ. They are computed for the most sensitive age group.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines based on current information.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 07 Oct 2015 17:03 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

EXAMPLE COMPARISON OF RDD TECHNICAL AND BRIEFING PRODUCT

Early Phase TED (0-96 hrs)
(Total Effective Dose Including Plume Passage)



Map Size: 4.6 km by 4.6 km **Id:** Production.rcE25178.rcC1
NARAC Operations: (NARAC Staff); narac@llnl.gov; 925-424-6465
Requested by: {NARAC Staff; NARAC -- Operations; 925.422.0708}
Approved by: {NARAC Operations; NARAC}

Early Phase Dose

	Description	(rem) Extent Area	Population
	Exceeds 5 rem total effective dose.	>5 1.5km 0.5 km2	0
	Exceeds 1 rem total effective dose.	>1 3.3km 3.0 km2	20

Areas and counts in the table are cumulative. Population Source = LandScan USA V1.0.

Effects or contamination from October 04, 2015 19:30 UTC to October 08, 2015 19:30 UTC
Release Location: 36.715775 N, 121.623420 W
Material: RDD Cs-137 Russian Seed Irradiator
Generated On: October 05, 2015 20:58 UTC
Model: ADAPT/PUFF/LODI
Comments: Doses shown are total accumulated from the beginning of release.
Hypothetical release starting at 10/04/2015 19:30:00 UTC for 1 sec
met obs at 1 hr intervals from 10/04/2015 19:00:00 UTC to 10/05/2015 18:00:00 UTC

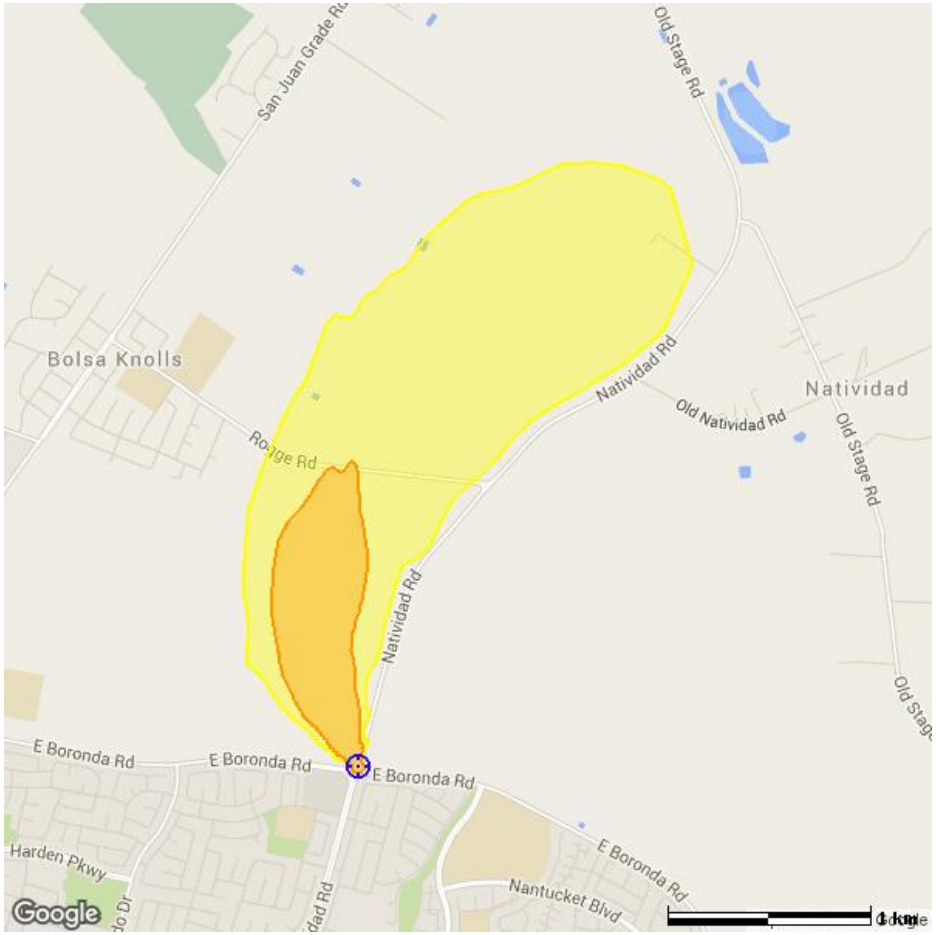
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release



Evacuation/sheltering warranted, unless unusually hazardous circumstances exist (exceeds 5 rem {50 mSv} predicted for adult). Est. Population: 0 Area: 0.5 km2 Extent: 1.5 km

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} predicted for adult). Estimated Population: 20 Area: 3.0 km2 Extent: 3.3 km

Notes:

- **Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering-in-place followed by informed evacuation may be most protective while the radioactive cloud is present.**
- **Evacuation can be 100% effective if completed before plume arrival.**
- **Sheltering in place should be preferred to evacuation when it provides equal or greater protection.**
- **Protective actions are only based on dose that can be avoided.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release

Key Points

- **Evacuation/sheltering is normally initiated at a projected dose of 1 rem (10 mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.**
- **Greatest hazard is due to exposure to the radioactive cloud. Sheltering followed by delayed evacuation after cloud passage may be preferable. Evacuation before radioactive cloud arrival is best, but avoid evacuation in the radioactive cloud.**
- **Those already outdoors should move to adequate shelter or leave the area.**
- **The value of sheltering to avoid dose varies from zero to almost 100%.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 04 Oct 2015 19:30 UTC to 08 Oct 2015 19:30 UTC.**
- **The airborne radioactive cloud was present until only 04 Oct 2015 21:30 UTC.**

Automated Report: Testing
(36.71578,-121.62342)
RDD Release at 04 Oct 2015 19:30 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source.
- Evacuation is appropriate if its risk and secondary effects are less severe than the risk from projected radiation dose.
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce dose due to inhalation of contaminated smoke.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - Jetter, J. J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include contributions from: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of resuspended contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute significantly.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 05 Oct 2015 20:58 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

NARAC/IMAAC Briefing Products for Nuclear Power Plant Accidents

Kristen Yu

Lawrence Livermore National Laboratory

National Atmospheric Release Advisory Center

NARAC

LLNL-PRES-817613

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. The Department of Homeland Security sponsored part of the production of this material.

Nuclear Power Plant (NPP) Accident Briefing Product Set

NPP Briefing Product Set contains six products for three phases of an incident:

Early Phase:

1. Evacuation/Sheltering Areas Based on EPA/DHS Guides (cloud present/passed)
2. Worker Protection Areas
3. Potassium Iodide Administration Areas (for releases involving radioactive iodine)

Intermediate Phase:

4. Relocation areas based on EPA/DHS Guide
5. Recovery areas based on EPA/DHS Guide

Late Phase:

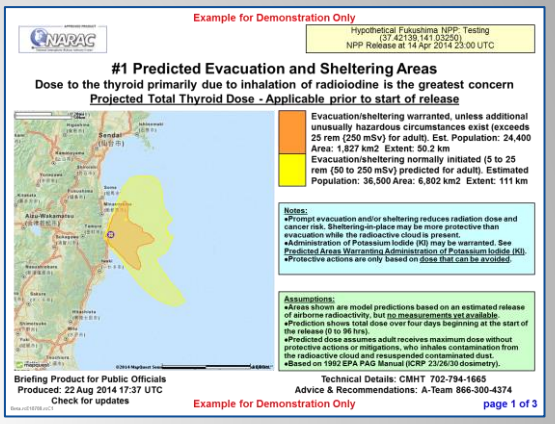
6. Areas of Concern for Agricultural Products

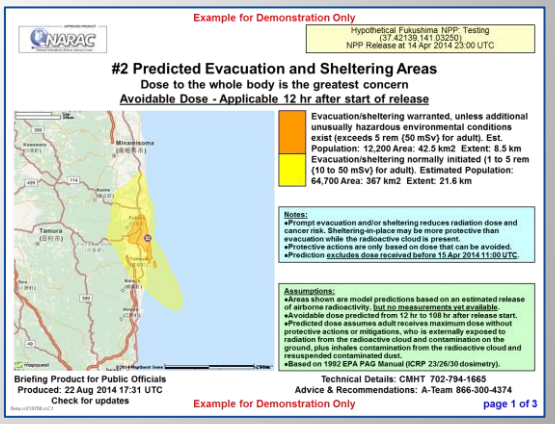
NPP Briefing Product sponsorship: DOE funded format/content design of briefing products and implementation in FY08-FY09; FEMA supported FY14 revision in collaboration with RSL.

EARLY PHASE

Predicted Evacuation and Sheltering Areas Based on EPA/DHS Guides

- This product may be used to refine initial default Evacuation and Sheltering decisions
- Contours area displayed are the EPA or DHS PAGs (Protective Action Guidelines)
- Contours depict areas of dose that may be avoided by evacuation and/or sheltering
- Plume footprint may shrink with each update, indicating an updated prediction of avoidable dose
- Product indicates whether the radioactive cloud is still present or has passed
  - May include all plume passage 4-day dose (0-96 hours) or only avoidable dose (default avoidable dose period is 12-108 hours)
  - Considers only dose from ground contamination is considered if the plume has passed
- May reflect measurements (if indicated in the green box)





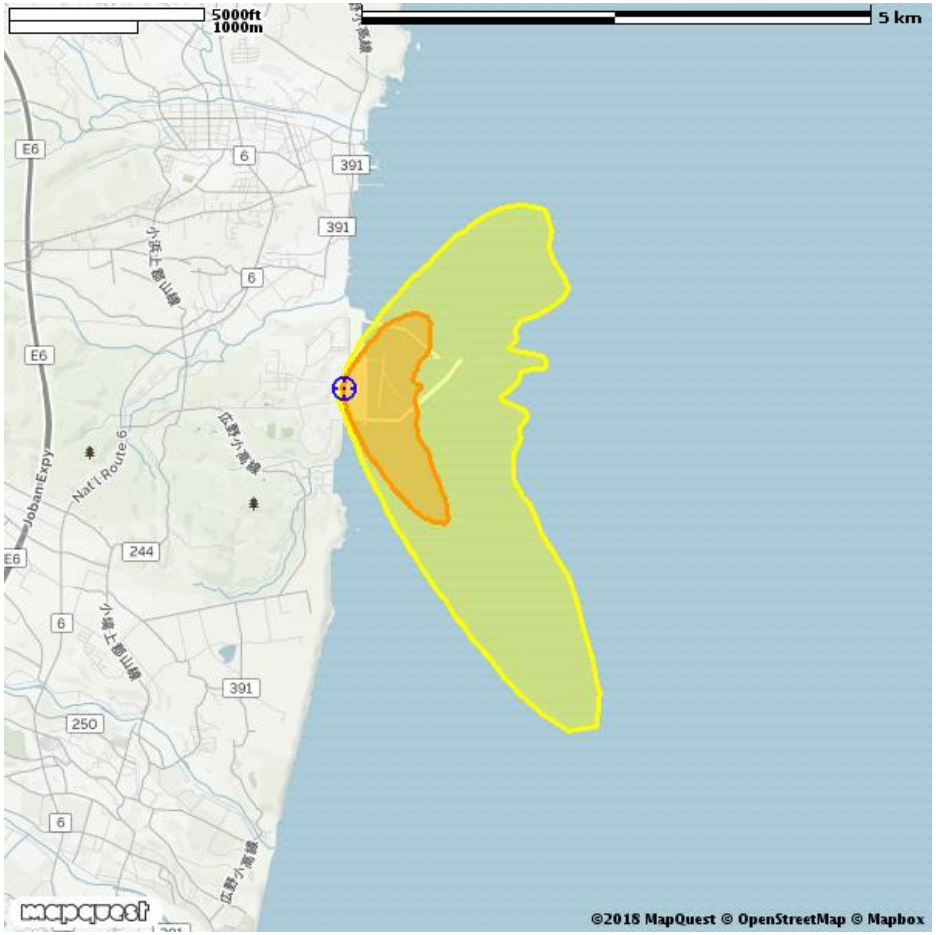
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release



Evacuation/sheltering warranted, unless unusually hazardous circumstances exist (exceeds 5 rem {50 mSv} predicted for adult). Est. Population: 10 Area: 1.1 km2 Extent: 1.6 km

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} predicted for adult). Estimated Population: 10 Area: 6.6 km2 Extent: 4.1 km

Notes:

- **Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering-in-place followed by informed evacuation may be most protective while the radioactive cloud is present.**
- **Evacuation can be 100% effective if completed before plume arrival.**
- **Sheltering in place should be preferred to evacuation when it provides equal or greater protection.**
- **Administration of Potassium Iodide (KI) may be warranted. See Predicted Areas Warranting Administration of Potassium Iodide (KI).**
- **Protective actions are only based on dose that can be avoided.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**
- **Assumed plume composition and release rate is time dependent.**

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release

Key Points

- **Evacuation/sheltering is normally initiated at a projected dose of 1 rem (10 mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.**
- **Greatest hazard is due to exposure to the radioactive cloud. Sheltering followed by delayed evacuation after cloud passage may be preferable. Evacuation before radioactive cloud arrival is best, but avoid evacuation in the radioactive cloud.**
- **Those already outdoors should move to adequate shelter or leave the area.**
- **The value of sheltering to avoid dose varies from zero to almost 100%.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 03 May 2018 03:00 UTC to 07 May 2018 03:00 UTC.**
- **The airborne radioactive cloud was present until only 03 May 2018 07:45 UTC.**

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source.
- Evacuation is appropriate if its risk and secondary effects are less severe than the risk from projected radiation dose.
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- If a major release of radioiodine or particulate materials occurs, inhalation dose may be a controlling criterion for protective actions. Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce exposures.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - Jetter, J. J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include contributions from: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of resuspended contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute significantly.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

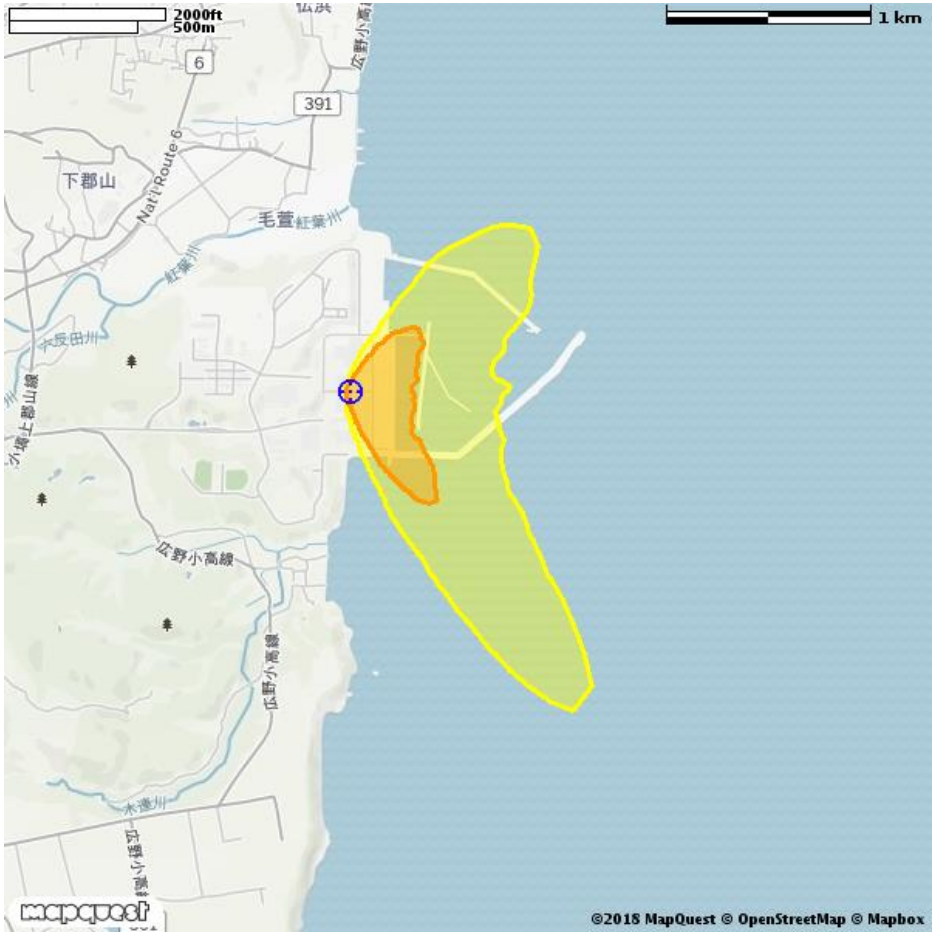
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after start of release



Evacuation/sheltering warranted, unless unusually hazardous environmental conditions exist (exceeds 5 rem {50 mSv} for adult). Est. Pop.: 0 Area: 0.2 km2 Extent: 0.7 km

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} for adult). Est. Pop.: 10 Area: 1.4 km2 Extent: 1.9 km

Notes:

- **Protective actions are only based on dose that can be avoided.**
- **Prediction excludes dose received from first 12 hr hours.**
- **Prediction depicts area still warranting protective action, if protective actions not completed prior to plume arrival but completed within first 12 hr.**
- **After radioactive cloud has passed, the area technically warranting evacuation/sheltering may be much smaller than prior to release.**
- **Evacuation during plume passage may increase dose but may be unavoidable. Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce dose.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Avoidable dose predicted from 12 hr to 108 hr after release start.**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**
- **Assumed plume composition and release rate is time dependent.**

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after start of release

Key Points

- **T+12 hr period predicts the remaining future dose because it may not be practical to implement or complete protective actions by that time.**
- **Evacuation and or sheltering is normally initiated at a projected dose of 1 rem (10mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.**
- **Sheltering-in-place followed by informed evacuation may be most protective.**
- **The value of sheltering to avoid dose varies from zero to almost 100%. As time passes, the protective value of sheltering-in-place may diminish.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from 12 hr after the start of the release for a period of 96 hours (4 days), specifically 03 May 2018 15:00 UTC to 07 May 2018 15:00 UTC.**
- **The airborne radioactive cloud has already passed and does not contribute to this prediction.**

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#2 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable after delay

Applicable 12 hr after start of release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of a whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source.
- Sheltering may be the preferred protective action when it will provide protection equal to or greater than evacuation (example: evacuation through a plume).
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- If a major release of radioiodine or particulate material occurs, inhalation dose may be a controlling criterion for protective actions. Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce exposure.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

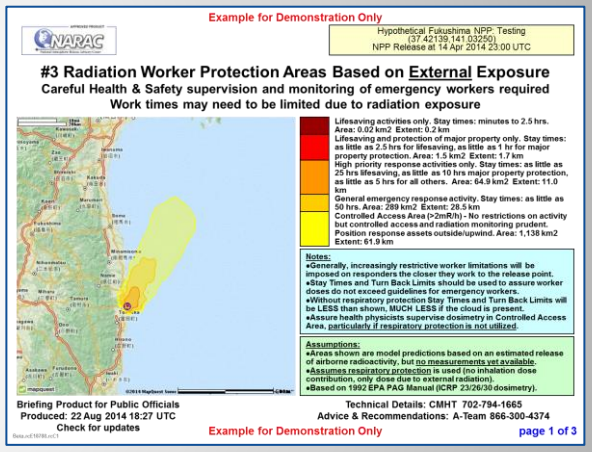
- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment march 2013).
  - Jetter, J.J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute.
- Hazard has been significantly reduced because the radioactive cloud passed. This prediction utilizes only external irradiation by ground contamination and inhalation of resuspended contaminated dust.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Worker Protection Areas Determined From Exposure Rates

- This product is used by dose assessment personnel to plan the tasks of Emergency Workers
  - Product displays an exposure rate at a specific time
  - Emergency Worker Stay Times are predicted based on that exposure rate
  - Note: if the radiation involved is decaying rapidly, this product will change significantly over time
- Contours displayed are the EPA or DHS worker guidelines and CRCPD guidance
- Product also may be used to estimate the ongoing dose received by the unsheltered general population
- May reflect measurements (indicated in the green box)



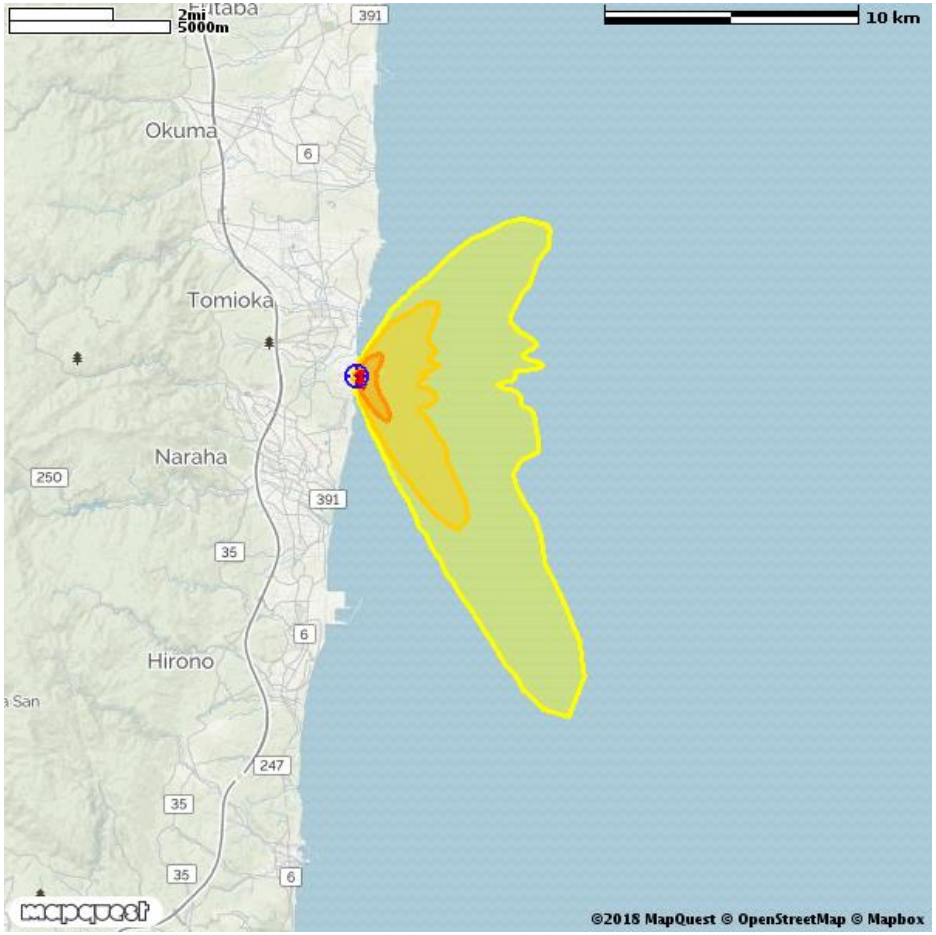
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required

Work times may need to be limited due to radiation exposure



Lifesaving activities only. Stay times: minutes to 2.5 hrs. Area: 0.003 km2 Extent: 0.08 km

Lifesaving and protection of major property only. Stay times: as little as 2.5 hrs for lifesaving, as little as 1 hr for major property protection. Area: 0.1 km2 Extent: 0.5 km

High priority response activities only. Stay times: as little as 25 hrs for lifesaving, as little as 10 hrs for major property protection, as little as 5 hrs for all others. Area: 1.6 km2 Extent: 2.1 km

General emergency response activity. Stay times: as little as 50 hrs. Area: 18.0 km2 Extent: 7.2 km

Controlled Access Area (>2mR/h) - No restrictions on activity but controlled access and radiation monitoring prudent. Position response assets outside/upwind. Area: 84.2 km2 Extent: 15.7 km

Notes:

- **Generally, increasingly restrictive worker limitations will be imposed on responders the closer they work to the release point.**
- **Stay Times and Turn Back Limits should be used to assure worker doses do not exceed guidelines for emergency workers.**
- **Without respiratory protection Stay Times and Turn Back Limits will be LESS than shown, MUCH LESS if the radioactive cloud is present.**
- **Assure health physicists supervise dosimetry in Controlled Access Area, particularly if respiratory protection is not utilized.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Assumes respiratory protection is used (no inhalation dose contribution, only dose due to external radiation).**

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required
Work times may need to be limited due to radiation exposure

Key Points

- Product portrays areas where responder work times may be limited to protect workers.
- Occupational limits do not apply to emergencies. Instead, dose guidelines are provided for emergency response. Different guidelines apply to 1) lifesaving, 2) protection of major property and 3) any other emergency response work. Avoid exceeding guidelines.
- Radiation doses to emergency workers are voluntary and require informed consent.
- Emergency workers do not "burn out" if the guideline is exceeded, but must consent to additional radiation exposure/dose to continue work in a radiation area.
- Response activities must be prioritized and carefully planned to obtain the maximum benefit from the least amount of worker exposure.
- Work controls may limit time in radiation area (Stay Time) and require stop work and retreat in high radiation areas (Turn Back Limits).
- Map assumes respiratory protection is used to prevent dose due to inhalation of radioactivity in the radioactive cloud or in contaminated dust.
- For purposes of limiting worker radiation dose, doses accumulate day-by-day.
- Strive to keep exposures As-Low-As-Reasonably-Achievable (ALARA).
- Engage assistance of health physics professionals for specific guidance ASAP.
- This map product is valid at 03 May 2018 15:00 UTC .

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#3 Radiation Worker Protection Areas Based on External Exposure

Careful Health & Safety supervision and monitoring of emergency workers required

Work times may need to be limited due to radiation exposure

Presenter Notes - Additional Information

- Map assumes external exposure rate is essentially equivalent to total dose rate (1 mrem/h = 1 mR/h = 0.01mSv/h), because utilization of respiratory protection is assumed.
- The total dose may be up to 100 times greater than the external exposure indicated on a personal dosimeter, if respiratory protection is not used while the radioactive cloud is present.
- Even if the cloud has passed the multiplier can still be significant due to resuspended material/contamination.
- CMHT can provide this exposure rate to total dose multiplier (conversion factor).
- If radioiodine is present in the radioactive cloud, then the use of Potassium Iodid (KI) may be indicated. Seek advice of health physics professionals.
- All radiation exposures require informed consent, particularly those exceeding routine occupational limits (5 rem {50mSv}), such as for lifesaving or protection of valuable property activities.
- An individual's radiation dose is a cumulative total of their dose received each day or work period.
- These guidelines apply to doses incurred over the duration of an emergency and are assumed to be once in a lifetime.
- Plan activities to make exposures As-Low-As-Reasonably-Achievable (ALARA).
  - Plan work to minimize exposure time
  - Avoid lingering in areas with radiation levels over 2 mR/h (0.02 mSv/h)
  - Take advantage of available shielding (trucks, walls...)
  - Position assets outside the Controlled Access Area boundary and upwind if possible
  - Use respiratory protection, until demonstrated as unnecessary
  - Avoid, or minimize, eating or drinking in radiation areas to the extent practical.
- Assure health physics professionals are involved in worker safety oversight.
- The CMHT can provide predictions of total dose rate for those without respiratory protection. This includes guidance for use of Electronic Personal Dosimeters (EPDs).

Presenter Notes - Technical Background

- Guidance based on EPA/DHS PAGs as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- This assessment is based on the ICRP 60+ dosimetry model.
- The dose guideline for lifesaving is 25 rem (250 mSv) for the event, which assures exposures will not produce acute health effects.
- The dose guideline for protection of critical infrastructure or valuable property (e.g., a nuclear power plant) is 10 rem for the event.
- An occupational dose guideline of 5 rem per year applies to all other general emergency response work.
- Emergency responders without radiological worker training or monitoring should remain outside the 2 mR/h (0.02 mSv/h) boundary, if possible.
- Contour levels correspond to predicted exposure rate levels of:
  10,000 mR/h, 1,000 mR/h, 100 mR/h, 10 mR/h, 2mR/h
  {100 mSv/h, 10 mSv/h, 1 mSv/h, 0.1 mSv/h, 0.02 mSv/h}

Fewer than five contours may be shown if some of these higher thresholds are not reached.

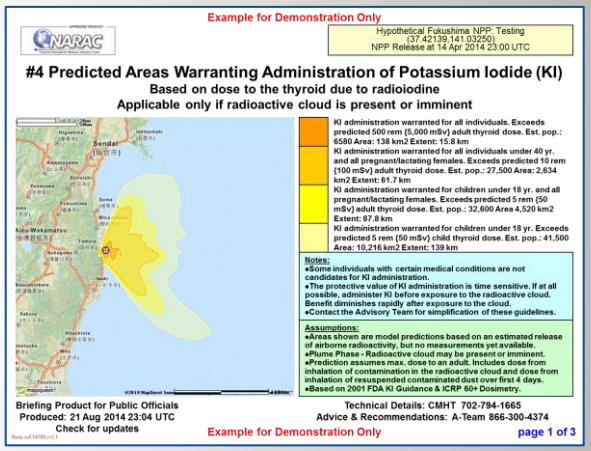
- EPA's emergency dose guidelines apply to emergency response workers. However, not all organizations use these EPA limits.
- Lower dose guidelines apply to the general public.
- Consult a health physics professional to evaluate the benefit and added risk of various types of PPE.
- Radioactive contamination is expected outside the contoured areas, but not at levels currently expected to exceed federal guidelines.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Predicted Areas Warranting Administration of Potassium Iodide (KI)

- This product is provided for cases in which radioactive iodine is released
- Product is used to determine whether administration of potassium Iodide (KI) may be warranted to protect against the risk of thyroid cancer
- Product is based on predicted dose from inhalation of the radioactive cloud during plume passage and resuspended dust from ground contamination over the first four days
- Contours displayed are based on the 2001 Food and Drug Administration Protective Action Guide, which considers the thyroid dose for different age groups and special cases
- Use of KI may be an effective alternative to evacuation for cases involving radioiodine releases



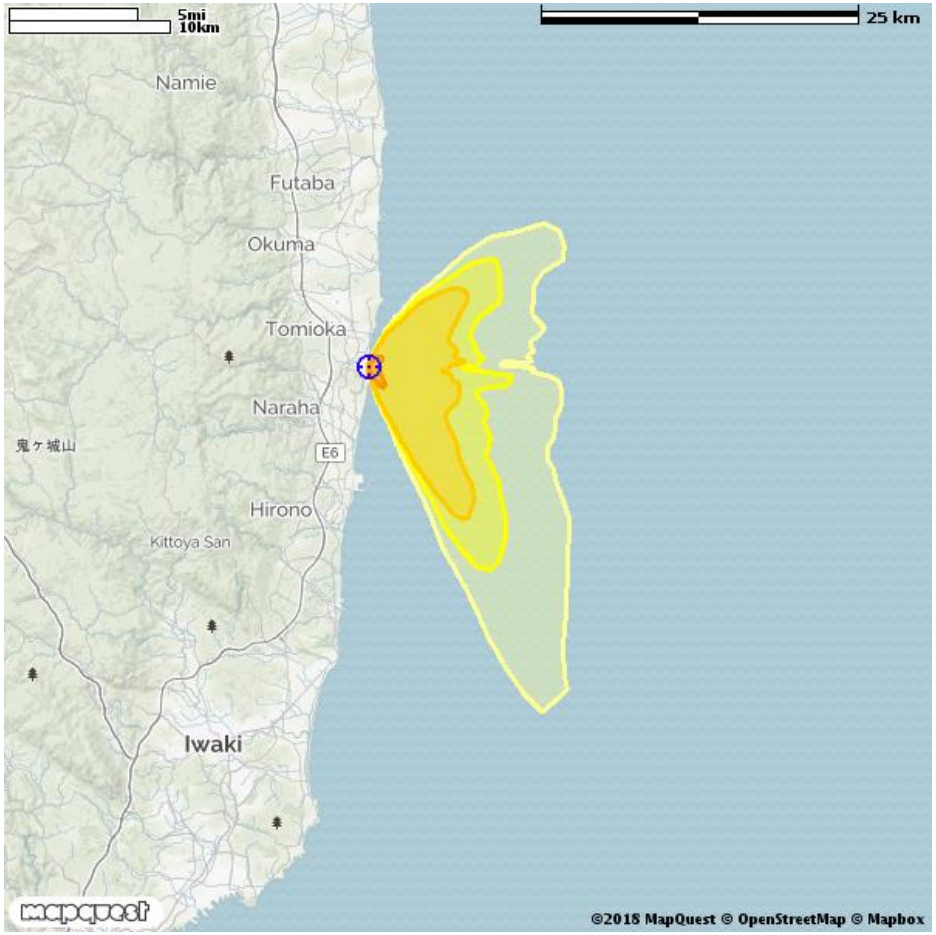
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine

Applicable only if radioactive cloud is present or imminent



KI administration warranted for all individuals. Exceeds predicted 500 rem {5,000 mSv} adult thyroid dose. Est. pop.: 10 Area: 1.6 km2 Extent: 1.9 km

KI administration warranted for all individuals under 40 yr. and all pregnant/lactating females. Exceeds predicted 10 rem {100 mSv} adult thyroid dose. Est. pop.: 10 Area: 79.2 km2 Extent: 14.1 km

KI administration warranted for children under 18 yr. and all pregnant/lactating females. Exceeds predicted 5 rem {50 mSv} adult thyroid dose. Est. pop.: 10 Area 147 km2 Extent: 18.5 km

KI administration warranted for children under 18 yr. Exceeds predicted 5 rem {50 mSv} child thyroid dose. Est. pop.: 10 Area: 355 km2 Extent: 30.3 km

Notes:

- **Due to logistic constraints, administration of KI at the lowest intervention threshold may be necessary.**
- **Some individuals with certain medical conditions are not candidates for KI administration.**
- **The protective value of KI administration is time sensitive. If at all possible, administer KI before exposure to the radioactive cloud. Benefit diminishes rapidly after exposure to the cloud.**
- **Contact the Advisory Team for simplification of these guidelines.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Plume Phase - Radioactive cloud may be present or imminent.**
- **Prediction assumes max. dose to an adult. Includes dose from inhalation of contamination in the radioactive cloud and dose from inhalation of resuspended contaminated dust over first 4 days.**

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine
Applicable only if radioactive cloud is present or imminent

Key Points

- **Utilization of KI is a supplemental action because not all communities use it. Evacuation is the primary protective action.**
- **Use of KI may be an effective alternative to evacuation in cases involving radioiodine releases, if evacuation cannot be implemented or exposure occurs during evacuation. See Predicted Evacuation and Sheltering Areas products for evacuation/shelter guidance.**
- **Leaving shelter to seek KI may result in increased radiation dose.**
- **FDA recommends that KI be administered to all age groups at the lowest intervention threshold, because the multiple thresholds may be logistically impractical to implement.**
- **Potassium Iodide only protects the thyroid from radioiodine. It has not protective value for other radionuclides or for any other organ.**
- **Radiation dose to the thyroid increases the risk of thyroid cancer.**
- **KI is most effective when administered immediately prior to exposure to the plume, but significant protection can be provided even if administration is delayed 3 or 4 hours after initial exposure.**
- **Predicted thyroid dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 03 May 2018 03:00 UTC to 0 hr.**

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#4 Predicted Areas Warranting Administration of Potassium Iodide (KI)

Supplemental Protective Action based on dose to the thyroid due to radioiodine

Applicable only if radioactive cloud is present or imminent

Presenter Notes - Additional Information

- This product is based on the 2001 FDA KI administration guidance.
- Radiation dose to the thyroid increases the risk of thyroid cancer.
- Radioiodine inhalation is the strongest contributor to thyroid dose.
- Potassium Iodide blocks most of the absorption of radioiodine by the thyroid.
- The area on the graphic describing KI administration to children under 18 is actually for the most limiting child age group (1 year-old infant).
- The FDA guide reports:
  - "The protective effects of KI last approximately 24 hours. For optimal prophylaxis, KI should therefore be dosed daily, until a risk of significant exposure to radioiodines by either inhalation or ingestion no longer exists."
  - "The overall benefits of KI far exceed the risks of overdosing, especially in children, though we continue to emphasize particular attention to dose in infants."
  - "KI may still have a substantial protective effect even if taken 3 or 4 hours after exposure" (the older EPA guide says 1 or 2 hours).
- Age specific dosages are established. Contact medical and radiation health professionals for radiation guidance.
- Prolonged radioiodine exposure may require subsequent administration of KI. Repeat dosing should be avoided for newborns, pregnant and lactating women. Consult medical professionals.

Presenter Notes - Technical Background

- Guidance based on the new FDA KI PAG as given in:
  - "Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies", (U.S. Department of Health and Human Services Food and Drug Administration, Center for Drug Evaluation and Research (CDER), December 2001, Procedural)
- This prediction employs the updated ICRP 60+ dosimetry model and dose factors.
- A simplified approach to KI administration is under consideration, which would provide KI to the entire public if the projected child thyroid dose exceeds 5 rem (50 mSv).
- Potassium Iodide (KI) preferentially deposits in the thyroid whether inhaled or ingested. Inhalation of contaminated air is the concern while the cloud is present. Inhalation of radioiodine is a particularly large contributor to thyroid dose.
- The FDA KI guide recommends these KI dosages if the following potential thyroid doses are exceeded:

Group	Potential Thyroid Dose		KI Dosage
Adults over 40	> or =	500 rem {5,000 mSv}	130 mg
Adults 18 to 40	> or =	10 rem {100 mSv}	130 mg
Pregnant/lactating women	> or =	5 rem {50mSv}	130 mg
Adolescents 12 to 18	> or =	5 rem {50mSv}	65 mg
Children 3 to 12	> or =	5 rem {50mSv}	65 mg
Infant 1 mo to 3 yr	> or =	5 rem {50 mSv}	32 mg
Infant birth to 1 mo	> or =	5 rem {50 mSv}	16 mg

- Contaminated air will be found outside contoured areas, but not at levels expected to exceed FDA guidelines for KI administration.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

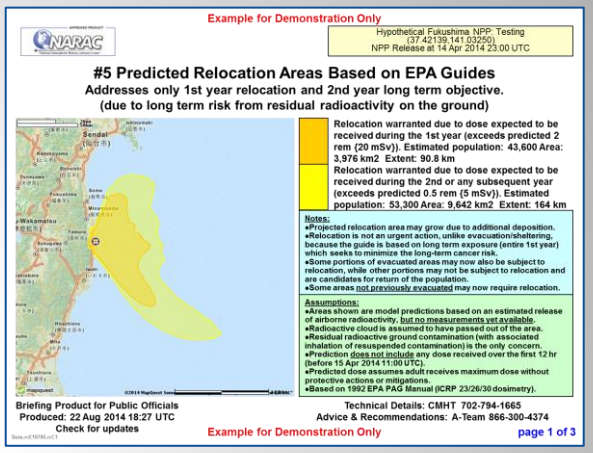
Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

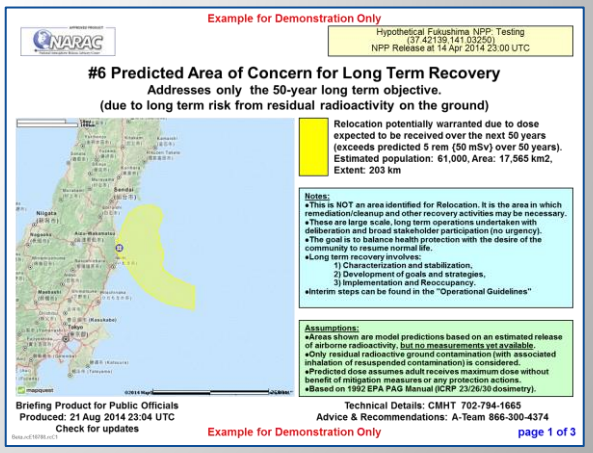
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

INTERMEDIATE PHASE

Predicted Relocation Areas Based on EPA/DHS Guides

- These products are used to determine the dose that may be avoided in the long term (1 to 2 years or 50 years) if the population is relocated
- Contours displayed are the EPA or DHS PAGs (Protective Action Guides)
- By this time, the plume will most likely have passed and the dose received will be from ground contamination, either by direct exposure or via inhalation of resuspended material
- May reflect measurements (as indicated in the green box)



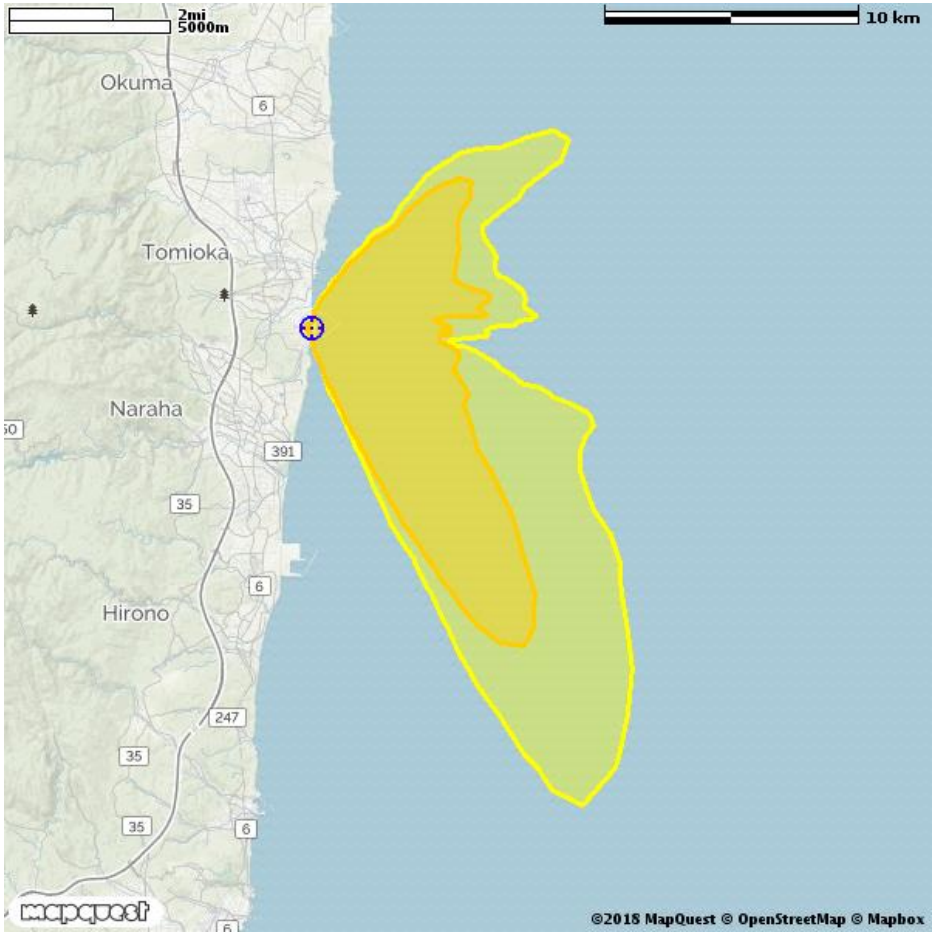


APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year (due to long term risk from residual radioactivity on the ground)



Relocation warranted due to dose expected to be received during the 1st year (exceeds predicted 2 rem {20 mSv}). Est. Pop.: 10 Area: 74.2 km2 Extent: 15.0 km

Relocation warranted due to dose expected to be received during the 2nd or any subsequent year (exceeds predicted 0.5 rem {5 mSv}). Est. Pop.: 10 Area: 168 km2 Extent: 21.5 km

Notes:

- **Projected relocation area may grow due to additional deposition.**
- **Relocation is not an urgent action, unlike evacuation/sheltering, because the guide is based on long term exposure for an entire year which minimizes the long-term cancer risk.**
- **Some portions of evacuated areas may now also be subject to relocation, while other portions may not be subject to relocation and are candidates for return of the population.**
- **Some areas not previously evacuated may now require relocation.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Radioactive cloud is assumed to have passed out of the area.**
- **Residual radioactive ground contamination (with associated inhalation of resuspended contamination) is the only concern.**
- **Prediction does not include any dose received over the first 12 hr (before 03 May 2018 15:00 UTC).**
- **Predicted dose assumes adult receives maximum dose without protective actions or mitigations.**

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year
(due to long term risk from residual radioactivity on the ground)

Key Points

- **The PAG level for relocation applies to doses that can be avoided by relocation; doses already incured prior to relocation are not included in the calculations.**
- **Relocation recommendation is based on whole body dose. Thyroid dose is no longer a primary concern because plume inhalation is no longer a hazard.**
- **Relocation PAG applies principally to personal residences but may impact other facilities as well (e.g., factories, offices, hospitals) as well as transportation routes and facilities.**
- **Occupancy time of individuals should be taken into account to determine the criteria for using a facility or area.**
- **Re-entry into portions of restricted areas (evacuation & relocation) may be permitted for justified reasons with appropriate radiological controls and dose monitoring/tracking.**
- **Re-entry is temporary, not to be confused with return or reoccupation.**
- **Dose rate will naturally diminish with time due to radioactive decay and weathering.**
- **Simple dose reduction techniques (e.g., flushing surfaces, removing hostspots) can be applied in areas where levels of deposited radioactivity are not high enough to warrant relocation. Contact the Advisory Team (A-Team) for options.**

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#5 Predicted Relocation Areas Based on EPA Guides

Addresses relocation in 1st year and any subsequent year (due to long term risk from residual radioactivity on the ground)

Presenter Notes - Additional Information

- PAG - Protective Action Guideline, projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- Relocation PAG applies only to dose that can be avoided during the first year and any subsequent year.
- Following early phase response it may be necessary to temporarily relocate the public from areas until decontamination has taken place.
- Areas shown do not include dose received before 03 May 2018 15:00 UTC.
- In contrast to the situation during the early phase, when decisions usually must be made and implemented quickly, many relocation decisions and actions during the intermediate phase can be delayed until adequate resources are in place.
- Some groups not previously evacuated may require relocation.
- PAGs are guidance only. During an incident, due to unanticipated local conditions and constraints, professional judgment will be required. Situations can be envisaged in which relocation of the public, based on the recommended PAGs, would be impractical. Conversely, under some conditions relocation may be quite practical at doses below the PAGs.
- Informed judgment must be exercised to prioritize protection for individuals in areas having the highest exposure rates.
- Simple dose reduction efforts are recommended for areas outside the relocation area to reduce doses to the extent practical.
- Re-entry is temporary access to the restricted area under controlled conditions for the purpose of performing activities essential to stabilization, relocation and recovery. Residence is not permitted.
- Dose rate tends to naturally diminish with time due to radioactive decay and weathering of contamination into the soil.
- Dose rate may decline rapidly for the first weeks then slow in subsequent months to years, because radioactive iodine and other short-live radionuclides will nearly vanish but longer-lived radionuclides will persist.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA and DHS PAGs, as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- This assessment is based on the ICRP 60+ dosimetry model.
- Dose considered is the projected Total Effective Dose (TED) which includes external irradiation and inhalation of re-suspended material, accounting for weathering of material and radioactive decay. Only ground contamination contributes to the dose. There is no plume contribution.
- Two separate dose criteria are used: 1) Dose during first year (2 rem) {20 mSv} and 2) Dose during second or any subsequent year (0.5 rem) {5 mSv}.
- First year dose accumulated from 12 hrs to 1 year + 12 hrs (12 to 8,772 hrs).
- Second year dose accumulated from beginning to end of year two (i.e. 8,760 hrs to 17,520 hrs). 50 year dose accumulated from 12 hrs to 50 years + 12 hrs.
- Projected dose assumes individuals are unsheltered and unprotected, and no mitigation or remediation actions are taken (maximally exposed individual).
- Dose reduction factors associated with simple, rapid decontamination techniques are not included in calculating projected dose for decisions on relocation, as prescribed by EPA PAGs.
- Some special cases may also require consideration of beta radiation from surface contamination and direct ingestion of contaminated soil.
- The sizes of the relocation and the affected population areas can be reduced by reducing dose in the area by removal/shielding of radioactive material.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed guidelines for relocation based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

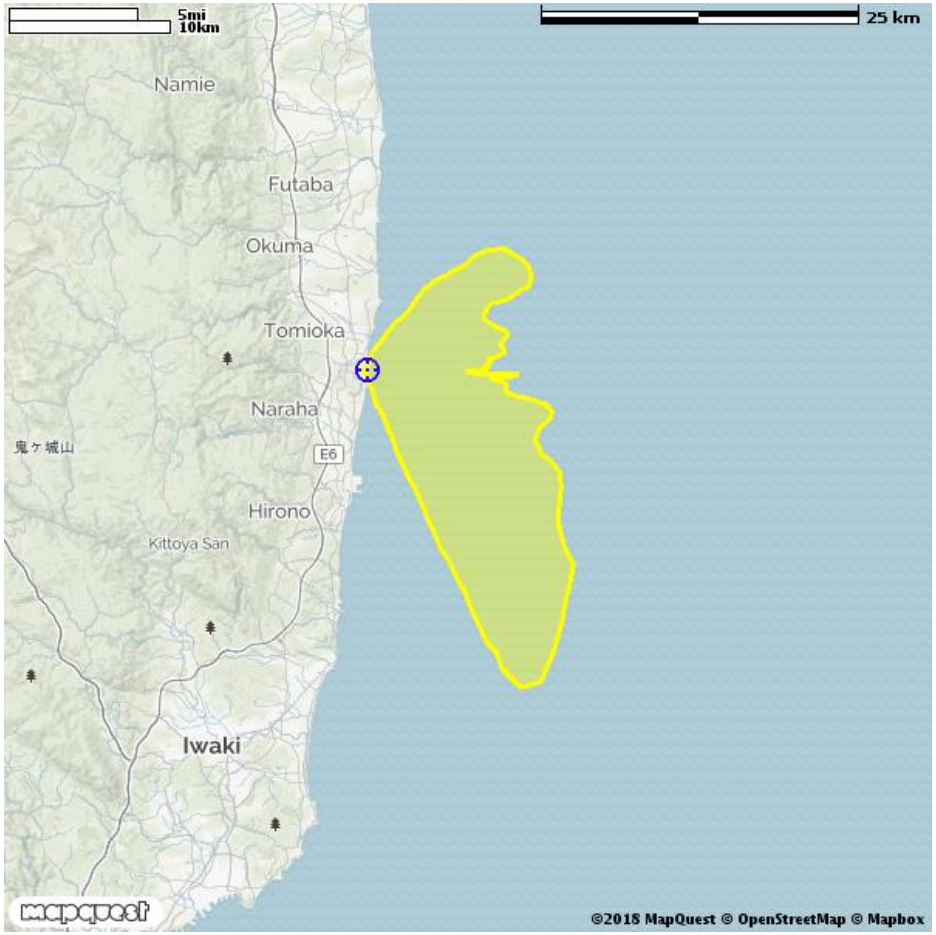
Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period. (due to long term risk from residual radioactivity on the ground)



Mitigation measures are potentially warranted due to dose expected to be received over the next 50 years (exceeds predicted 5 rem {50 nSv} over 50 years). Est. Pop.: 10, Area: 290 km2, Extent: 28.0 km

Notes:

- This is NOT an area identified for Relocation. It is the area in which remediation/cleanup and other recovery activities may be necessary.
- These are large scale, long term operations undertaken with deliberation and broad stakeholder participation (no urgency).
- The goal is to balance health protection with the desire of the community to resume normal life.
- Long term recovery involves:
  1) Characterization and stabilization,
  2) Development of goals and strategies,
  3) Implementation and Reoccupancy.
- Re-entry guides can be found in the "Operational Guidelines" and Section 4.1.6 of the 2013 EPA PAG Manual

Assumptions:

- Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.
- Only residual radioactive ground contamination (with associated inhalation of resuspended contamination) is considered.
- Predicted dose assumes adult receives maximum dose without benefit of mitigation measures or any protection actions.

Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period.
(due to long term risk from residual radioactivity on the ground)

Key Points

- **The Briefing Product is based on the now defunct 5 rem in 50 years Relocation PAG found in the 1992 EPA PAG Manual. It may inform planning for long term recovery.**
- **Recovery seeks best path to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community.**
- **Recovery considerations include 1) Mitigation/cleanup measures, 2) Permanent housing solutions, 3) Restoring infrastructure, and 4) Revitalizing business/agriculture.**
- **Priority shifts from supporting protective actions to characterizing the nature and extent of contamination to facilitate stabilization and cleanup.**
- **Earliest considerations must address:**
  - **Stabilization and mitigation actions to prevent further damage/loss,**
  - **Return and reoccupation by population, plus recovery of critical infrastructure and key resources (CI/KR).**
- **The "Operational Guidelines" offer criteria to facilitate initial infrastructure and business recovery, reentry and use of transit.**
- **Contact Advisory Team (A-Team) for additional information regarding Recovery.**

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#6 Predicted Area of Concern for Long Term Recovery

Addresses consequences of unmitigated dose over a 50-year period. (due to long term risk from residual radioactivity on the ground)

Presenter Notes - Additional Information

●The 50-year long term objective (5 rem {50 mSv} accumulated over 50 years) is focused on dose that can be avoided in the future. Therefore, it does not include any dose received from plume passage or dose from ground contamination during the first 12 hours (received before 03 May 2018 15:00 UTC).
●Numeric PAG levels will not be used to guide restoration and recovery of areas impacted by a radiological incident; rather, a process that involves stakeholders in setting priorities and determining actions will be developed that is adaptable to a given situation.
●Informed judgment must be exercised to prioritize recovery for individuals in areas having the highest exposure rates.
●Reoccupying households and businesses should be considered in balance with progress made in reducing radiation risks through decontamination, radioactive decay and managing contaminated waste.
●Exposure limits in a range of one in a population of ten thousand (10-4) to one in a population of one million (10-6) excess lifetime cancer incidence outcomes are generally considered protective, though this may not be achievable after a large radiological incident.
●Recovery can include a combination of cleanups and use restrictions
●Disposal of large volumes of radioactively contaminated waste will be a problem, because it would likely overwhelm existing radioactive waste disposal capacity in the U.S.
●Criteria for free release of personal property may be an issue.
●Dose rate tends to naturally diminish with time due to radioactive decay and weathering of contamination into the soil. The rate of decline will decline rapidly for the first weeks then slow in subsequent months to years, because radioactive iodine and other short-live radionuclides will nearly vanish but longer-lived radionuclides will persist.

Presenter Notes - Technical Background

●Guidance based on EPA and DHS PAGs, as given in:
- "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
- "Preliminary Report on Operation Guidelines Developed for Use in Emergency Preparedness and Response to a Radiological Dispersal Device Incident", (DOE/HS-0001: ANL/EVS/TM/09-1).
- "National Disaster Recovery Framework", (FEMA, Sept 2011)

●This assessment is based on the ICRP 60+ dosimetry model (2013 EPA PAG Manual).
●Dose considered is the projected Total Effective Dose (TED) which includes external irradiation and inhalation of re-suspended material, accounting for weathering of material and radioactive decay. Only ground contamination contributes to the dose. There is no plume contribution.
●Projected dose assumes individuals are unsheltered and unprotected, and no mitigation or remediation actions are taken (maximally exposed individual).
●Dose reduction factors associated with simple, rapid decontamination techniques are not included in calculating projected dose for decisions on relocation, as prescribed by EPA PAGs.
●The sizes of the relocation and the affected population areas can be reduced by reducing dose in the area by removal/shielding of radioactive material.
●Radioactive contamination is expected outside the contoured areas at very low levels based on current information.
●Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
●Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
●Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

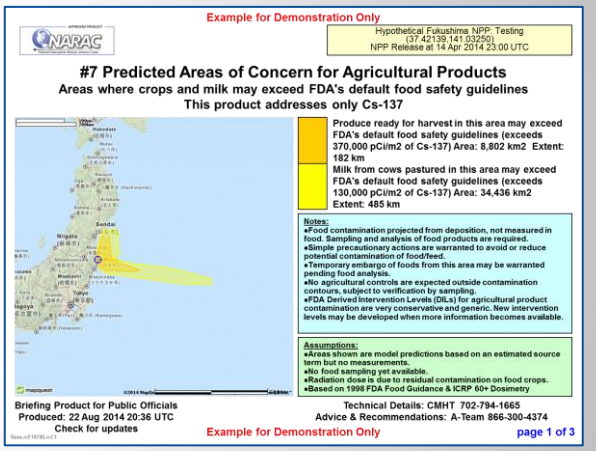
Briefing Product for Public Officials
Produced: 14 Dec 2018 23:05 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

LATE PHASE

Predicted Areas of Concern for Agricultural Products

- This product is used to determine where there is the potential to exceed food safety guidelines and may be used to guide crop sampling efforts
- Contours displayed are DRLs (Derived Response Levels) corresponding to FDA DILs (Derived Intervention Levels)
- Levels displayed on this product are very low and are difficult to measure directly
- May reflect measurements (indicated in the green box)



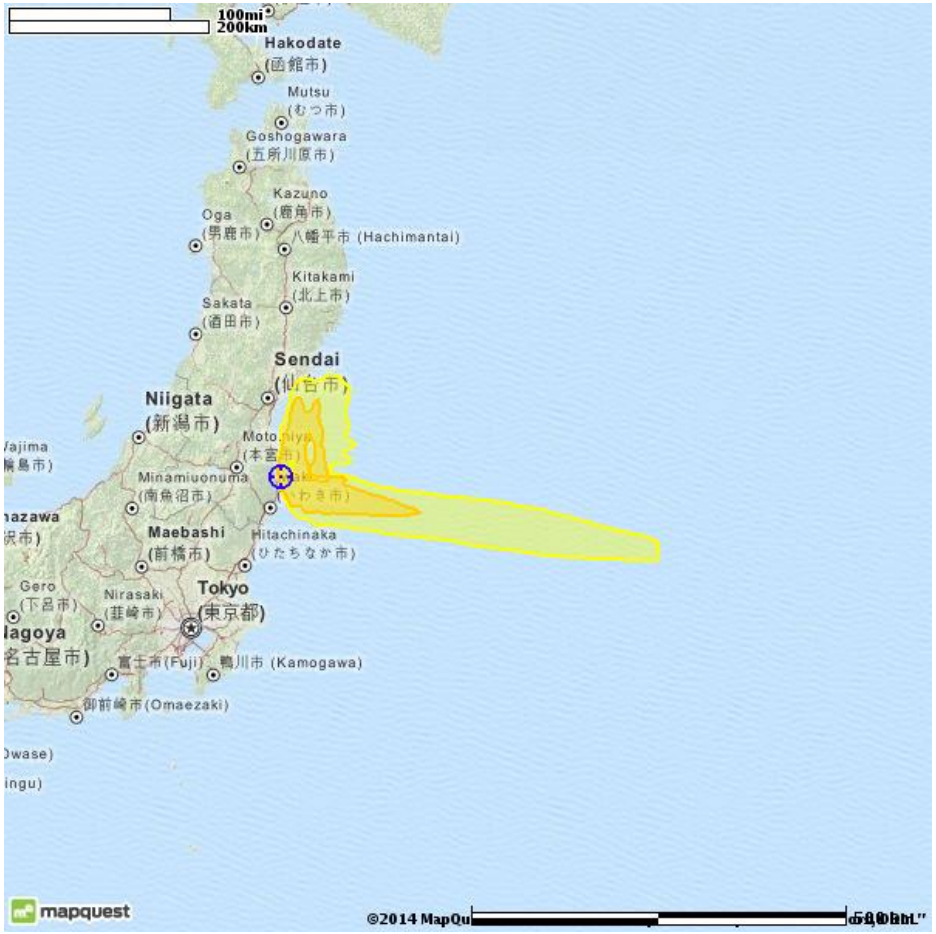
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical Fukushima NPP: Testing
(37.42139,141.03250)
NPP Release at 14 Apr 2014 23:00 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only Cs-137



Produce ready for harvest in this area may exceed FDA's default food safety guidelines (exceeds 370,000 pCi/m2 of Cs-137) Area: 8,802 km2 Extent: 182 km

Milk from cows pastured in this area may exceed FDA's default food safety guidelines (exceeds 130,000 pCi/m2 of Cs-137) Area: 34,436 km2 Extent: 485 km

Notes:

- **Food contamination projected from deposition, not measured in food. Sampling and analysis of food products are required.**
- **Simple precautionary actions are warranted to avoid or reduce potential contamination of food/feed.**
- **Temporary embargo of foods from this area may be warranted pending food analysis.**
- **No agricultural controls are expected outside contamination contours, subject to verification by sampling.**
- **FDA Derived Intervention Levels (DILs) for agricultural product contamination are very conservative and generic. New intervention levels may be developed when more information becomes available.**

Assumptions:

- **Areas shown are model predictions based on an estimated source term but no measurements.**
- **No food sampling yet available.**
- **Radiation dose is due to residual contamination on food crops.**
- **Based on 1998 FDA Food Guidance & ICRP 60+ Dosimetry**

Briefing Product for Public Officials
Produced: 22 Aug 2014 20:36 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Hypothetical Fukushima NPP: Testing
(37.42139,141.03250)
NPP Release at 14 Apr 2014 23:00 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only Cs-137

Key Points

- FDA guidance applies to concentration of radioactivity in foods as prepared for eating.
- This product is based on projection of food concentration from expected and/or measured environmental deposition, not measured food concentration. Assumes no reduction of contamination by washing, peeling, cooking or other processing.
- Extensive, time consuming sampling and analysis will be required to properly assess food contamination.
- FDA recommends consultation with the FDA on: 1) simple precautions to avoid/reduce contamination of food/feed and 2) use of temporary food embargoes to prevent introduction of contaminated food into commerce.
  - Precautions include covering exposed products, moving animals to shelter and corralling livestock plus providing uncontaminated (or clean) feed and water.
  - The temporary embargo permits opportunity for monitoring and sampling to be performed as the basis of future protective actions.
- Food products not yet ready for harvest will require analysis prior to harvest.
- Food and beverages packaged before the accident are generally not affected.
- FDA guidance assumes 30% of all food eaten is contaminated (very conservative).
- Drinking water concerns are not addressed by this product.

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical Fukushima NPP: Testing
(37.42139,141.03250)
NPP Release at 14 Apr 2014 23:00 UTC

#7 Predicted Areas of Concern for Agricultural Products

Areas where crops and milk may exceed FDA's default food safety guidelines

This product addresses only Cs-137

Presenter Notes - Additional Information

- This is a preliminary assessment based on predicted radioactivity levels in the environment, not concentration of radioactivity in foods. FDA food safety guidance is based on concentration in foods as prepared for consumption.
- This preliminary assessment pertains only to food products that are ready for immediate consumption, not foods to be harvested at a future date, or to foods grown underground or indoors.
- No food sampling has taken place. Confidence and accuracy will be improved once results of food sampling are obtained.
- "Protective actions can be taken before the release or arrival of contamination if there is advance knowledge that radionuclides may accidentally contaminate the environment."
- "Protective actions which can be taken within the area likely to be affected and prior to confirmation of contamination consist of:
  - simple precautionary actions to avoid or reduce the potential for contamination of food and animal feeds, and
  - temporary embargoes to prevent the introduction into commerce of food which is likely to be contaminated."
- "Protective actions which should be implemented when the contamination in food equals or exceeds the DILs consist of:
  - temporary embargoes to prevent the contaminated food from being introduced into commerce,
  - normal food production and processing actions that reduce the amount of contamination in or on food to below the DILs."
- "Normal food production and processing procedures that could reduce the amount of radioactive contamination in or on the food could be simple, (such as holding to allow for radioactive decay, or removal of surface contamination by brushing, washing, or peeling)..."
- Food products that are not yet ready for harvest should be analyzed at a later time before consumption to determine if they are suitable for consumption.
- Pre-packaged food and beverages in these areas are not affected.
- This map is valid for only this growing season.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA and DHS PAGs, as given in:
  - "Guidance on Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies", (Federal Register, Vol. 63, No. 156, Aug. 3, 1998, pg 43402).
- This prediction employs the updated ICRP 60+ dosimetry model and dose factors.
- Preliminary assessment based on FDA's food safety guidelines, termed Derived Intervention Levels (DILs), expressed as activity per unit mass of food. These food guidelines have been projected to obtain limits for deposition of radioactivity in the environment, which can be easily predicted and quickly measured. These are termed Derived Response Levels (DRLs).
- DRLs for the current growing season consider the amount of radioactivity deposited ON the plant (e.g., on leaves and fruit).
- DRLs for future growing seasons also consider uptake of radioactivity by roots from soil and INTO the plant (e.g., in leaves and fruit). This is a slow process.
- FDA DILs limit the radiation dose due to consumption of contaminated food to a predicted 0.5 rem {0.5 cSv} for the effective whole body or predicted 5 rem {5 cSv} to any one organ. They are computed for the most sensitive age group.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines based on current information.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling FDA Emergency Operations Center (EOC) at 866-300-4374.

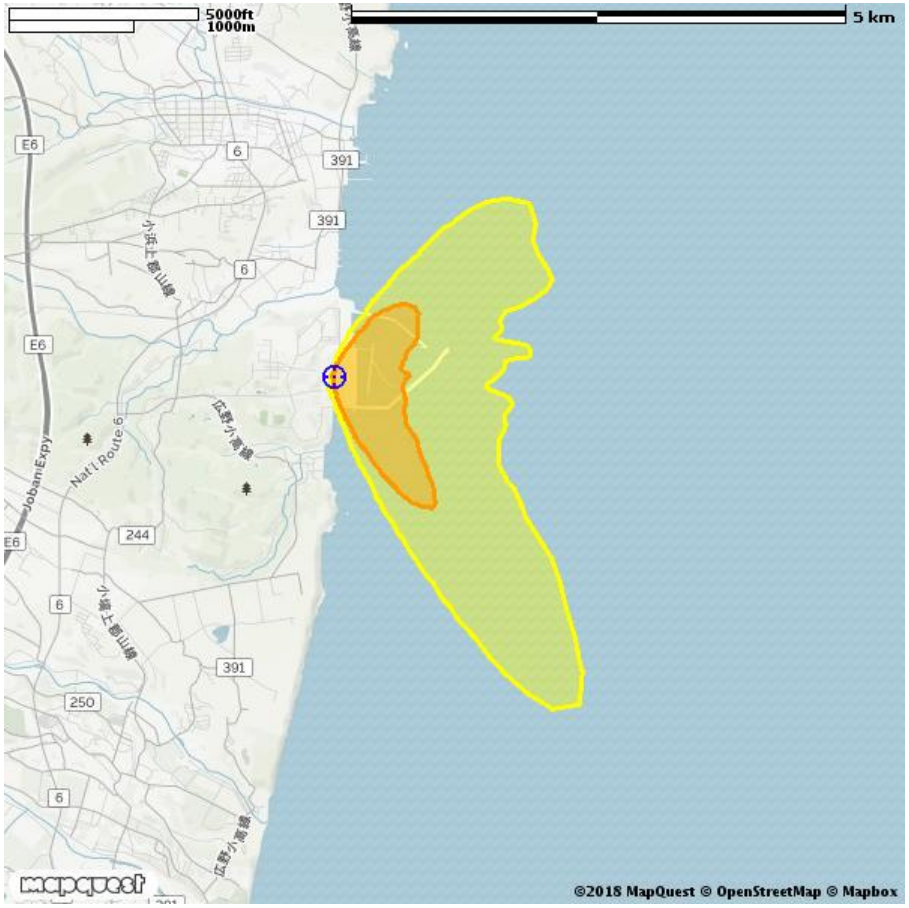
Briefing Product for Public Officials
Produced: 22 Aug 2014 20:36 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

EXAMPLE COMPARISON OF NPP TECHNICAL AND BRIEFING PRODUCT

TECHNICAL PRODUCTS INCLUDE BOTH TED AND CDE CALCULATION
BRIEFING PRODUCT IS BASED ON THE TED

Early Phase TED (0-96 hrs)
(Total Effective Dose Including Plume Passage)



Map Size: 9.1 km by 9.1 km **Id:** Production3.rcE25721.rcC1
NARAC Operations: (NARAC Staff); narac@llnl.gov; 925-424-6465
Approved by: {NARAC Operations; NARAC}

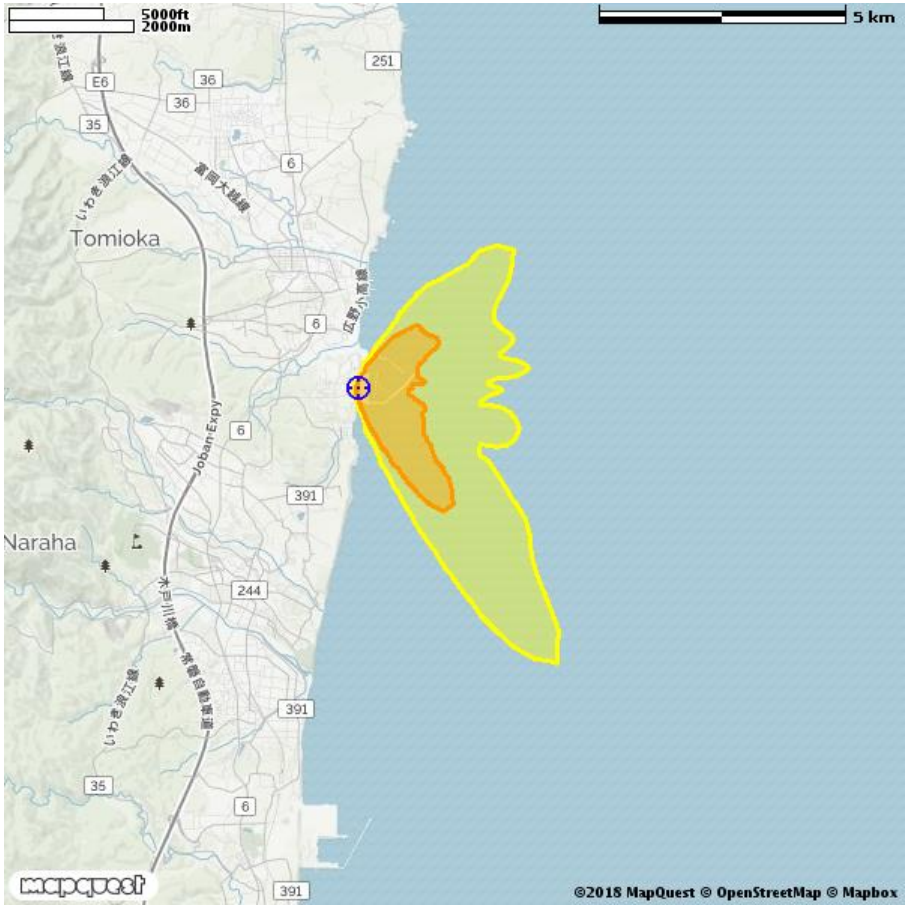
Early Phase Dose

	Description	(rem) Extent Area	Population
	Exceeds 5 rem total effective dose.	>5 1.6km 1.1 km2	10
	Exceeds 1 rem total effective dose.	>1 4.1km 6.6 km2	10

Areas and counts in the table are cumulative. Population Source = LandScanGlobal2015.

Effects or contamination from May 03, 2018 03:00 UTC to May 07, 2018 03:00 UTC
Release Location: 37.316389 N, 141.025560 E
Material: CS-137 + I-131 + XE-133
Generated On: December 14, 2018 22:27 UTC
Model: ADAPT/LODI
Comments: Doses shown are total accumulated from the beginning of release.
Hypothetical release starting at 05/03/2018 03:00:00 UTC for 4 hr
gridded met at 1 hr intervals from 05/03/2018 03:00:00 UTC to 05/04/2018 02:00:00 UTC

Early Phase Thyroid CDE (0-96 hrs)
(Thyroid Committed Dose Equivalent Including Plume Passage)



Map Size: 18.2 km by 18.2 km **Id:** Production3.rcE25721.rcC1
NARAC Operations: (NARAC Staff); narac@llnl.gov; 925-424-6465
Approved by: {NARAC Operations; NARAC}

Early Phase Dose

	Description	(rem) Extent Area	Population
	Exceeds 25 rem thyroid dose.	>25 3.0km 3.5 km2	10
	Exceeds 5 rem thyroid dose.	>5 6.8km 17.2 km2	10

Areas and counts in the table are cumulative. Population Source = LandScanGlobal2015.

Effects or contamination from May 03, 2018 03:00 UTC to May 07, 2018 03:00 UTC
Release Location: 37.316389 N, 141.025560 E
Material: CS-137 + I-131
Generated On: December 14, 2018 22:27 UTC
Model: ADAPT/LODI
Comments: Doses shown are total accumulated from the beginning of release.
Hypothetical release starting at 05/03/2018 03:00:00 UTC for 4 hr
gridded met at 1 hr intervals from 05/03/2018 03:00:00 UTC to 05/04/2018 02:00:00 UTC

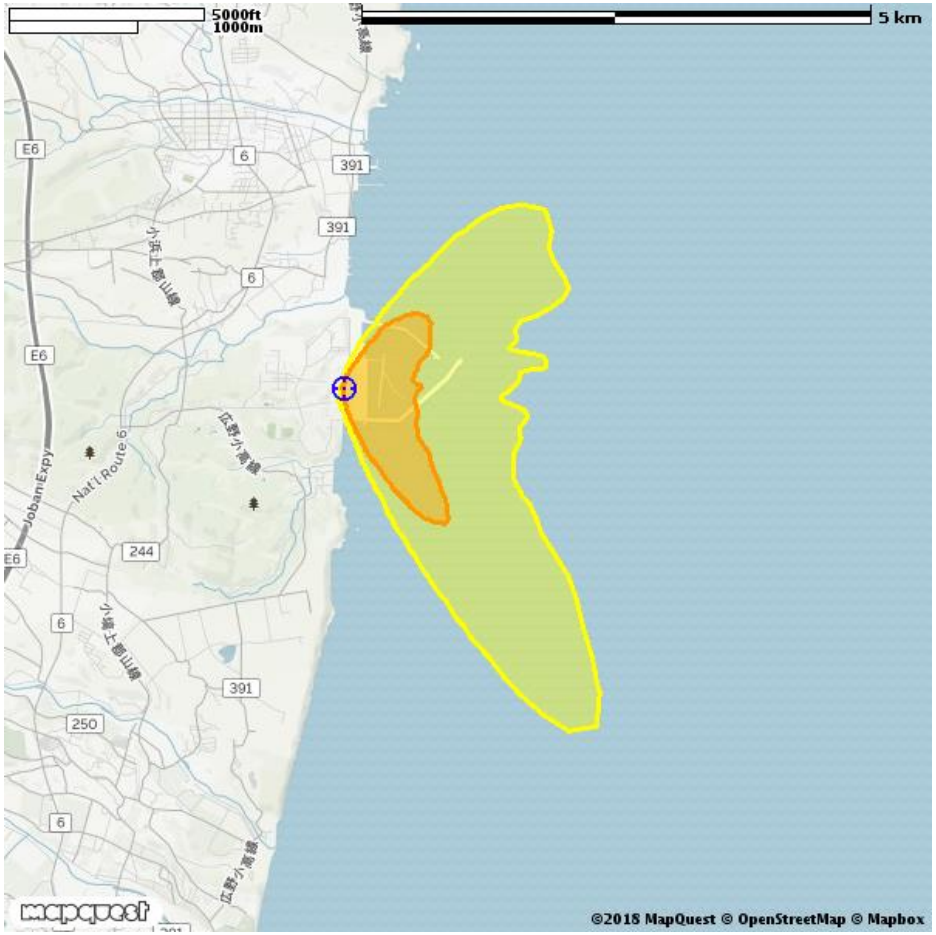
APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release



Evacuation/sheltering warranted, unless unusually hazardous circumstances exist (exceeds 5 rem {50 mSv} predicted for adult). Est. Population: 10 Area: 1.1 km2 Extent: 1.6 km

Evacuation/sheltering normally initiated (1 to 5 rem {10 to 50 mSv} predicted for adult). Estimated Population: 10 Area: 6.6 km2 Extent: 4.1 km

Notes:

- **Prompt evacuation and/or sheltering reduces radiation dose and cancer risk. Sheltering-in-place followed by informed evacuation may be most protective while the radioactive cloud is present.**
- **Evacuation can be 100% effective if completed before plume arrival.**
- **Sheltering in place should be preferred to evacuation when it provides equal or greater protection.**
- **Administration of Potassium Iodide (KI) may be warranted. See Predicted Areas Warranting Administration of Potassium Iodide (KI).**
- **Protective actions are only based on dose that can be avoided.**

Assumptions:

- **Areas shown are model predictions based on an estimated release of airborne radioactivity, but no measurements yet available.**
- **Prediction shows total dose over four days beginning at the start of the release (0 to 96 hrs).**
- **Assumes max dose to adult, no protective actions or mitigations. Includes dose due to external radiation from radioactive cloud and contamination on ground, plus inhalation of contamination in radioactive cloud and resuspended contaminated dust.**
- **Assumed plume composition and release rate is time dependent.**

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release

Key Points

- **Evacuation/sheltering is normally initiated at a projected dose of 1 rem (10 mSv). Sheltering-in-place may be preferred for special populations (e.g., those who are not readily mobile) at projected doses up to 5 rem (50 mSv).**
- **When environmental, physical, or weather hazards impede evacuation, sheltering-in-place may be justified at projected doses up to 5 rem (50 mSv) for the general population (and up to 10 rem (100 mSv) for special populations).**
- **Evacuation or sheltering is the principal protective action. Utilization of KI is to block thyroid dose, which is a supplemental action because not all states use it.**
- **Greatest hazard is due to exposure to the radioactive cloud. Sheltering followed by delayed evacuation after cloud passage may be preferable. Evacuation before radioactive cloud arrival is best, but avoid evacuation in the radioactive cloud.**
- **Those already outdoors should move to adequate shelter or leave the area.**
- **The value of sheltering to avoid dose varies from zero to almost 100%.**
- **Sheltering may be implemented even when projected doses are below 1 rem.**
- **Predicted dose is accumulated from the start of the release for a period of 96 hours (4 days), specifically 03 May 2018 03:00 UTC to 07 May 2018 03:00 UTC.**
- **The airborne radioactive cloud was present until only 03 May 2018 07:45 UTC.**

APPROVED PRODUCT
NARAC
National Atmospheric Release Advisory Center

Hypothetical NPP: Testing
(37.31639,141.02556)
NPP Release at 03 May 2018 03:00 UTC

#1 Predicted Evacuation and Sheltering Areas

EPA Early Phase PAG - Projected whole body dose, avoidable prior to release

Applicable prior to start of release

Presenter Notes - Additional Information

- PAG - Protective Action Guide is a projected dose at which a specific protective action to reduce or avoid that dose is warranted.
- The EPA Early Phase PAG is in terms of whole body dose.
- Protective actions are based only on dose that can be avoided, not dose acquired prior to implementation of the protective action.
- Evacuation may be the only effective protective action close to the plume source.
- Evacuation is appropriate if its risk and secondary effects are less severe than the risk from projected radiation dose.
- Sheltering-in-place may be appropriate for areas not designated for immediate evacuation because it reduces dose and facilitates issue of instructions.
- If a major release of radioiodine or particulate materials occurs, inhalation dose may be a controlling criterion for protective actions. Breathing air filtered through common household items (e.g., folded handkerchiefs or towels) may help reduce exposures.
- After confirmation that the plume has passed, continued sheltering-in-place should be re-evaluated. Shelters should be opened to vent any airborne radioactivity trapped inside. People should remain sheltered until instructed to leave.
- The degree of protection provided by structures is affected by factors such as attenuation of gamma radiation (shielding) by structural components (the mass of walls, ceilings, etc.) and outside/inside air exchange rates.
- Large structures, such as shopping centers, schools, churches and commercial buildings, as collection points during evacuation mobilization will generally provide greater protection against gamma radiation than use of small structures.
- Washing the body and changing clothing as soon as possible may be appropriate protective action if exposed to the radioactive cloud.
- Protective actions may be initiated over larger areas and at lower contamination/dose levels if advantageous (e.g., in order to account for uncertainties in the predicted dose and mapped areas, and/or to use boundaries, such as roads, that are convenient).

Presenter Notes - Technical Background

- Guidance based on EPA Protective Action Guides (PAGs), as given in:
  - "2013 PAG Manual - Protective Action Guides and Planning Guidance for Radiological Incidents", (US Environmental Protection Agency, Draft for Interim Use and Public Comment March 2013).
  - Jetter, J. J. and C. Whitfield. "Effectiveness of Expedient Sheltering in Place in a Residence", Journal of Hazardous Materials. Elsevier, Amsterdam, Holland, 119(1-3):31-40, (2005).
- "The PAG for evacuation (or, as an alternative in certain cases, sheltering) is expressed in terms of the projected sum of the effective dose from external radiation and the committed effective dose incurred from inhalation of radioactive materials from exposure and intake during the early phase." These include contributions from: 1) External irradiation by the radioactive cloud, 2) Inhalation of the contaminated air as it passes, 3) External irradiation by ground contamination, 4) Inhalation of resuspended contaminated dust, and is the Total Effective Dose (TED).
- Hazard is greatest while the radioactive cloud is present because all four pathways above contribute. After the radioactive cloud passes only 3) Irradiation by ground contamination and 4) Inhalation of resuspended contaminated dust will continue to contribute significantly.
- These predictions employ the ICRP 60+ dosimetry model to calculate doses from exposure and intake. Use of the older ICRP 23/26/30 dosimetry model may lead to slightly different dose predictions.
- Radioactive contamination is expected outside the contoured areas, but not at levels expected to exceed federal guidelines for evacuation and sheltering based on current information.
- Additional technical and background information is provided in the Consequence Report containing the detailed, technical version of this calculation.
- Briefing Products are intended for presenting a common operating picture to key leaders and decision makers. Other more technical products are available (Standard Products and associated Consequence Reports).
- Contact the FRPCC Subcommittee for Environment, Food and Health (Advisory Team) for advice and recommendations. Available by calling the FDA Emergency Operations Center (EOC) at 866-300-4374.

Briefing Product for Public Officials
Produced: 14 Dec 2018 22:27 UTC
Check for updates

Technical Details: CMHT 702-794-1665
Advice & Recommendations: A-Team 866-300-4374

Additional Information

Web: narac.llnl.gov
Email: narac@llnl.gov

Lawrence Livermore National Laboratory

National Atmospheric Release Advisory Center
NARAC