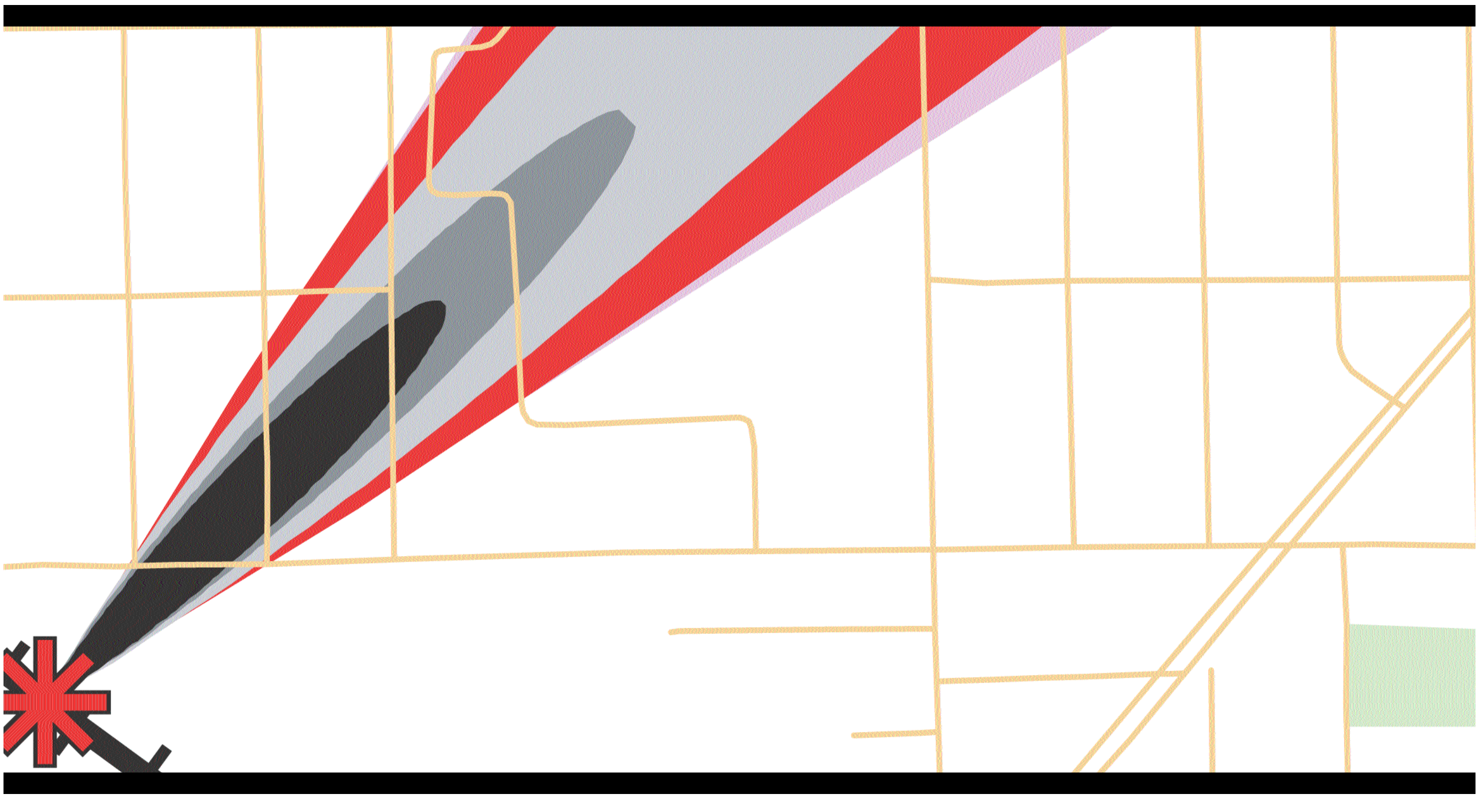
What if...



A nuclear waste accident scenario in Pittsburgh, PA

ENVIRONMENTAL WORKING GROUP

Nuclear Waste Route Maps

Richard Wiles
James R. Cox

June 27, 2002
www.MapScience.org

Summary

Everyone agrees that there will be accidents if nuclear waste is transported by train and truck through 45 states for 38 years to the repository at Yucca Mountain in Nevada. The Department of Energy (DOE) predicts that there will be about 100 accidents over the life of the project. The State of Nevada predicts about 400 accidents during the same time period. To date, however, the public has not been provided meaningful information about the potential effects of a serious nuclear waste accident in any of the heavily populated metropolitan areas through which Nevada-bound radioactive waste would travel. This report is the first attempt to utilize government data and computer models in order to describe the consequences of a serious, but plausible accident involving the release of high-level radioactive waste in major cities along the DOE proposed nuclear waste transport routes.

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The DOE has developed a series of computer models at its Lawrence Livermore, Sandia, and Argonne National Laboratories, in order to predict the consequences of accidents involving shipments of nuclear materials. These models, known as HOTSPOT, RISKIND, and RADTRAN, among others, are designed to allow anyone to model the radiation plume that would arise from accidents of varying severity, involving different amounts and types of radioactive material, under different weather conditions.

The primary model used in this analysis, HOTSPOT, was developed by Lawrence Livermore National Laboratory and is available online at:

http://www.llnl.gov/nai/technologies/hotspot/

For people who live along the Department of Energy's proposed nuclear waste transport route in Pittsburgh, the question is: What if there is a nuclear waste accident in Pittsburgh that involves the release of radiation?

The maps presented here by Environmental Working Group are the first attempt to provide the public with answers to this question. We use government models and government assumptions as outlined below and presented in more detail in our national report. *The maps describe the* *consequences of an accident of moderate severity, not a worst case scenario*. We did not model the impact of an attack on a nuclear waste shipment that penetrates or explodes the casks or results in a severe prolonged fire, events that would disperse a far greater amount of lethal radiation over a much larger area.

Appendix J — the original DOE documentation, is available online at: http://www.mapscience.org/doe_eis_maps.php

The DOE has not published a detailed analysis of the impact of a terrorist attack on a nuclear waste shipment. Instead, the DOE has produced a generic, one-size-fits-all estimate of the number of fatalities from a serious accident, and conducted complex and lengthy probability analyses designed to show that such an accident is very unlikely to occur. The DOE analysis was an abstract exercise. It did not situate the modeled event in any actual community.

Given the unanimous agreement that train or truck accidents are inevitable during the tens of thousands of radioactive waste shipments to Yucca Mountain, we believe people have a right to know what would happen if one of those accidents led to a release of radioactive materials in their town.

Assessing the Risks

In order to assess what could happen if there were an accident involving a nuclear waste shipment in a major metropolitan area, Environmental Working Group used the following data and computer models:

- The government radiation plume models (HOTSPOT) developed at the Lawrence Livermore National Laboratory (http://www.llnl.gov/nai/technologies/hotspot/
- Accident scenarios and data on the radioactive composition of nuclear waste shipments developed by the Department of Energy;

- The most recent “cancer potency factor” for a given radiation exposure level published by the National Academy of Sciences, BEIR V.

The results presented here describe the radiation released from a train wreck with the following characteristics:

- The accident occurs at a speed of between 30 to 60 miles per hour;
- The wreck occurs under average weather conditions (median winds) during the day in each of the metropolitan areas modeled;
- Radiation, primarily in the form of Cesium, escapes as a result of a broken seal in the shipping cask and a subsequent modest fire. Again, this is not a “worst case” scenario involving puncture or penetration of the cask, a severe and prolonged fire, or a major explosion that could disperse portions of the spent fuel.

Cesium will be the primary radionuclide released in a nuclear waste accident. It is a highly reactive metal and even a small break in the seal will release significant amounts of it. Cesium burns spontaneously in air, and will explode when exposed to water.

Cesium will be the primary radionuclide released in a nuclear waste accident because it is present in what is called the fuel clad gap. This gap is the space between the fuel pellets and the inside wall of the metal tube that contains the fuel. This "gap cesium" can be released in any event where the cladding is breached. Cesium is a highly reactive metal and even a small break in the seal will release significant amounts of it. Cesium burns spontaneously in air, and will explode when exposed to water. In a severe transportation incident, isotopes of Cesium would create a plume of radioactive particulates that would be inhaled and ingested by those downwind from the accident site. In the body, Cesium compounds collect in the gonads, breast milk and muscle tissue. Following an incident, cesium particulates would also settle to the earth and expose residents and cleanup personnel to external gamma radiation.

Different weather conditions would produce different dispersion patterns and exposures, some greater, some lesser. A more serious breach of the cask could release more radiation than assumed here.

Extreme Radiation Exposure

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The number of people exposed to unsafe doses of radiation is entirely dependent on the timing and location of the accident or attack. If an accident occurs near a city center during the middle of a work day, the number of exposed individuals would be very high. If the accident occurs at night in the city center the number of people exposed could be relatively low. These eventualities are impossible to predict. Based on our assumptions of average weather in Pittsburgh and a moderately severe train wreck, we found that:

> Within two minutes of an accident a zone of radiation equal to an average of 5,500 X-rays – or 3,667 times the EPA's *annual* radiation exposure limit – would extend about a quarter mile, or two to four blocks from the crash site (Map 1). EPA's acceptable one-year radiation dose is 15 millirem, or about 1.5 chest X-rays. In less than ten minutes, contamination plumes equal to average exposures of 750 and 300 X-rays would extend about 0.4 miles and 1 mile from the wreck respectively.
>
> A zone of exposure equal to about 55 X-rays would extend from 1 mile to 4.6 miles form the crash site, and a zone with average exposure of about 5 X-rays would extend from 4.6 miles to 25.4 miles from the site.
>
> Based on the average residential population in Pittsburgh, 4 people, closest to the crash would suffer the effects of severe radiation exposures equivalent to 30,000 X-rays or greater. Slightly farther away from the accident, 41 people would be exposed to the equivalent of 5,500 X-rays within two or three minutes of the crash. Another 52 would be exposed to an

average of 750 X-rays within another five minutes, and about five minutes after that 512 people would receive a dose averaging 300 X-rays. In less than one hour after the accident, 9,764 people would be exposed to a 55 X-ray dose of radiation, and by the end of the day another 122,218 people would be exposed to an average of about 5 X-rays.

First responders or others approaching the accident site in the minutes after the crash could be exposed to a radiation dose equal to about 30,000 X-rays or perhaps even greater. There is a very high risk of fatality for rescue, police or medical staff if they must come close to the accident scene instead of securing and evacuating the immediate area.

Latent Cancer Fatalities

Future suffering and deaths from cancer caused by radiation exposure would extend far beyond the immediate zone of highest exposure and would be significantly influenced by longer term radiation exposure – called groundshine – from contamination of the area.

The greatest exposure would occur in the immediate aftermath of the crash, when a cloud of radioactive cesium gas would waft over an area down wind from the accident site. The primary health risk is the elevated, long-term risk of cancer from these exposures. Future suffering and deaths from cancer caused by radiation exposure, however, would extend far beyond the immediate zone of highest exposure and would be significantly influenced by longer term radiation exposure – called groundshine – from contamination of the area. Using cancer potency factors from the National Academy of Sciences' ongoing analyses of cancer rates among World War II atomic bomb survivors and population densities projected for 2020 in Pittsburgh based on U.S. census data, we estimate that:

In Pittsburgh, 494 people would suffer and die from "latent fatal cancers" caused by one year of exposure to radiation from a moderately serious train wreck involving nuclear waste headed for Yucca Mountain. This estimate assumes that all people in the 1,000 X-ray zone are evacuated on the day of the wreck and receive no additional exposure. The Department of

Energy assumes that all people remain in the zone and are exposed to radiation for an entire year.

A larger release from a more serious crash or attack on the cask could produce more latent fatalities. If a disproportionate number of children were exposed to the radiation, there would be more latent cancers because children have a greater susceptibility to radiation-induced cancer. If a disproportionate number of elderly were exposed, there would be fewer cancer incidences and fatalities.

Areas farther from the accident scene are the least likely to be cleaned up and the most likely to produce longer radiation exposures for the population living there, leading to a high number of latent cancer fatalities miles from the actual crash site.

The rate of fatal cancers per exposed person declines significantly with distance from the accident. This lower exposure, however, is offset by the greater number of exposed individuals, producing significant numbers of fatalities at locations miles from the crash. Areas farther from the accident scene are the least likely to be cleaned up and the most likely to produce longer radiation exposures for the population living there, leading to a high number of latent cancer fatalities miles from the actual crash site.

Recommendations

The accident scenario analyzed here represents a wreck where the cask is cracked, seals are broken and a radioactive cloud of cesium particulates is released downwind from the crash site into the community. This is nowhere near a worst-case analysis where the cask is penetrated by an explosive devise, or where weather conditions create a more concentrated dose of radiation for a greater number of people. Even so, it is apparent from this analysis that hundreds or even thousands of lives are at risk in the event of a serious accident or terrorist attack on a shipment of nuclear waste in a major city.

Economic disruption from such a contamination event would be enormous. Estimates run from 10 to 150 billion in clean-up costs. Predicting costs to the local and regional economy is nearly impossible, but costs could be astronomical if primary interstate highways or rail lines were disrupted for weeks, months, or even years.

Given these risks, we recommend that the U.S. Senate vote against an override of Nevada Gov. Kenny Guinn's veto of DOE's recommendation to proceed with development of Yucca Mountain as a national nuclear waste repository.

Voting "no" on Yucca Mountain now would not eliminate the possibility of considering Yucca Mountain, or other locations, for use as a repository in the future. Nor would a "no" vote on Yucca Mountain present a waste storage crisis for the nuclear industry or any added risk to the public, according to the Nuclear Regulatory Commission.

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A vote in opposition to proceeding with the Nevada repository would allow much needed time to develop a thorough transportation security plan, as well as full public notification and comment on a repository and its transportation implications, *before* its final selection.

A delay would also provide an opportunity for the public to weigh the implications of a national waste repository in the context of vital state and local concerns about the continued, long-term presence of operating nuclear reactors and the associated long-term, on-site storage of nuclear waste that will be required even if the Yucca Mountain repository is developed.

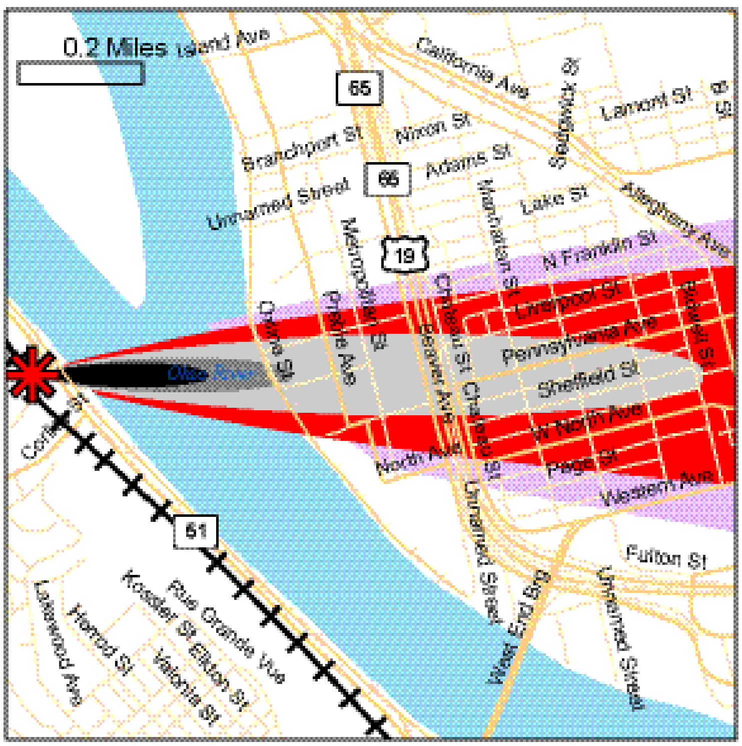
Pittsburgh Rail Accident Scenario

SCENARIO PARAMETERS

- Train travelling between 30 and 60 miles per hour;
- A crash into a hard surface causes a fire and leaks in the seals of the cask, releasing cesium. The fire is not hot enough to melt the cask.
- The cask is not penetrated, punctured, or exploded;
- Almost all radiation exposure comes from a cloud of cesium that drifts downwind from the crash.

MAP 1: LARGE SCALE VIEW

- In less than 10 minutes, a radiation plume equal to 100 - 500 x-rays would extend 1 mile from the crash site.



MAP KEY:

- DOE's Proposed Route
- 1 to 10 X-rays
- 10 to 100 X-rays
- 100 to 500 X-rays
- 500 to 1,000 X-rays
- Over 1,000 X-rays

These dosages are based on exposure to a radioactive cesium cloud as it passes through the area.

DOE HOTSPOT AND RISKIND MODEL RESULTS: PITTSBURGH

						Totals
Dose Range (Rems - 1 day)*	10-500	5-10	1-5	0.1-1	0.01-0.1	
Dose Range (x-rays - 1 day)*	1000-50,000	500-1000	100-500	10-100	1-10	
Distance to Outer Limit of Range (ft. || mi.)	1,480	2,200	1.0	4.6	25.4	
Area (ft2 || mi2)	215,280	247,572	0.09	1.7	31	
Persons Within Area	45	52	512	9,764	122,218	132,591
Instantaneously Induced Fatal Cancers**	4	0	2	5	7	18
1-yr. Latent Fatal Cancers***	4†	14	54	188	235	494

* Dosage contained within the initial particulate cloud

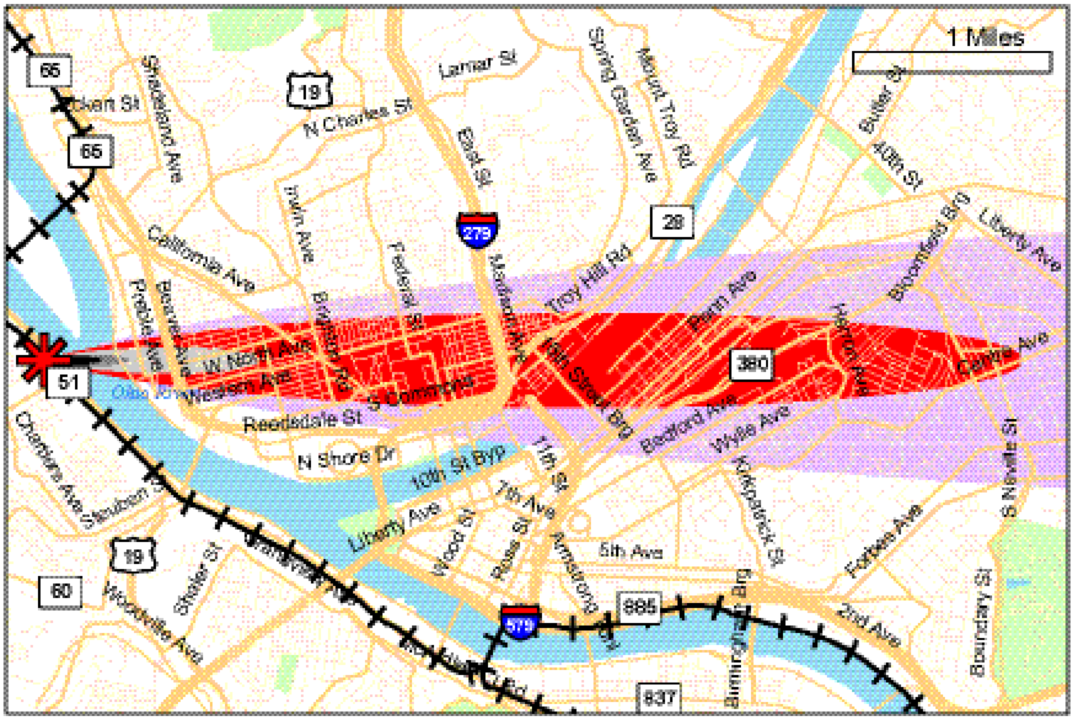
** Latent fatal cancers induced instantaneously by the particulate "cloud"

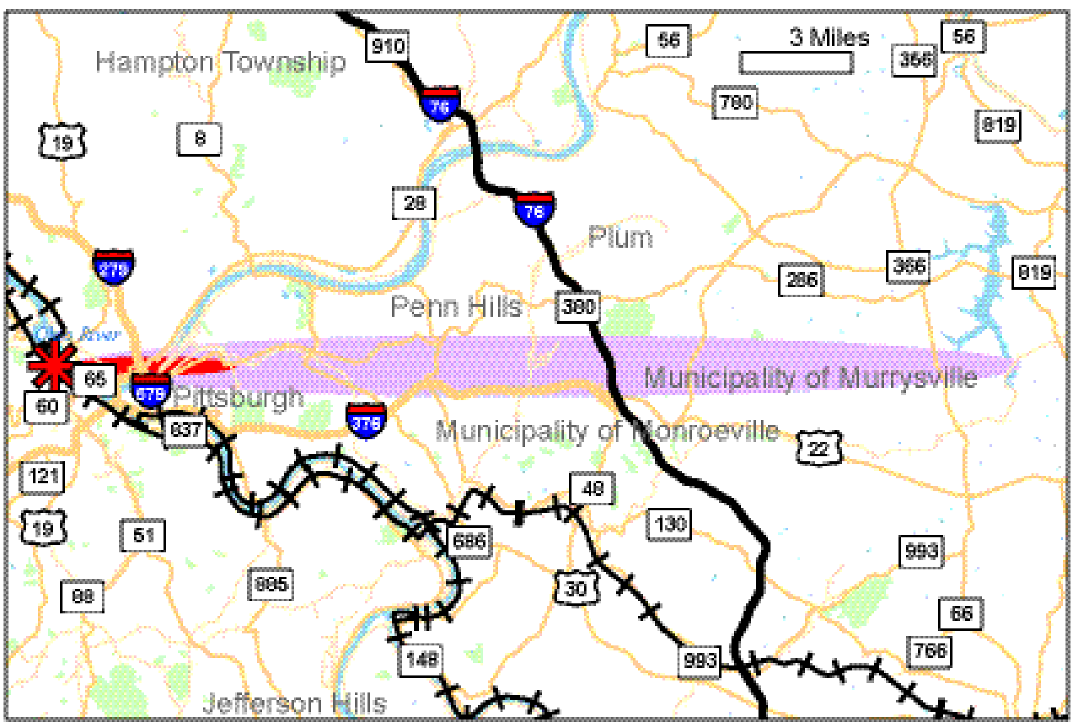
***Latent fatal cancers induced by one year's exposure to residual radioactivity in the contaminated area

† Assumes people in this area are evacuated after one day

MAPS 2 AND 3: MID-RANGE & SMALL SCALE VIEWS

People miles downwind from the accident would face an elevated risk of radiation-induced cancer.





How fatal cancers are calculated

- The amount of radiation in the cask and the amount released are based on a DOE model (RISKIND);

- The plume shape, size, and radiation doses are predicted by Department of Energy model (HOTSPOT). It depicts a cloud of cesium gas carried over the community by average winds blowing in the dominant direction during the day.

- Populations exposed are based on people living under the shaded areas from the 2000 census, projected to the year 2020. People working in or traveling through the exposed area are not counted.

- Cancer potency (the amount of radiation needed to cause a fatal cancer), is from the National Academy of Sciences, BEIR V.

- Fatal cancer projections are a function of total radiation delivered to the population exposed. We assume that it takes 1,000 person/rems to cause a fatal cancer.