NUCLEAR ACCIDENT ABOARD A NAVAL VESSEL HOMEPORTED AT STATEN ISLAND, NEW YORK

Quantitative Analysis of a Hypothetical Accident Scenario

by

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III. EXECUTIVE SUMMARY

This paper describes a quantitative, site-specific analysis of a hypothetical nuclear accident scenario aboard a military vessel homeported at the Stapleton-Fort Wadsworth Complex, Staten Island, New York. Conventional methodology used by the U. S. Nuclear Regulatory Commission (NRC) to regulate the U. S. civilian nuclear industry is applied to evaluate the consequences of an accident involving incineration of a single nuclear weapon containing 5 kg of plutonium-239 in a three-hour shipboard fire. Bracketing assumptions (i. e., assumptions that lead to accident consequences that are likely to encompass those of a real accident) are used to assess the impact of the accident on the environment, human health and on the economy of New York City. Conclusions and Recommendations of this report are contained in section VII (pp. 57 to 61). The reader is encouraged to review this section in particular.

Such an accident would produce a radioactive cloud containing particulate and aerosolized plutonium-239. The commonest wind direction at the site (Figure 1) would carry the radioactive cloud northeast in the form of a plume, directly over downtown Manhattan (Figure 2). First landfall would occur 9 km (approximately 5.5 miles) from the accident site, at the southern tip of Manhattan. The centerline of the plume would pass through the financial district (Wall Street), and bisect the World Trade Center. The path of the plume would then coincide approximately with the Avenue of the Americas, pass adjacent to the Empire State Building, through the Rockefeller Center, and into Central Park. The centerline of the radioactive plume would continue northward through Harlem, into the Bronx, and beyond.

The lateral boundaries of the plume were calculated for the two boundary conditions, namely the most stable (narrowest plume) and the least stable (widest plume) atmosphere. In the former case the plume would encompass Broadway, Park Ave. and Madison Ave. on its eastern edge, and Eighth Ave. and Central Park West on its western edge. Thus, the narrowest possible plume would nonetheless engulf the major section of downtown Manhattan, assuming the most common wind direction. The widest possible plume would engulf all of Manhattan, cross the Hudson on the west, the western portion of Queens, and most of the Bronx on the east (Figures 2 and 3).

As the hypothetical radioactive plume travels northward from the Bronx, its centerline would pass through Yonkers and Mt. Vernon, Eastchester, White Plains, past the western corner of Connecticut and directly across the Kensico reservoir, a major water supply for New York City. The centerline would then pass through the western portion of Connecticut and into the western sector of Massachusetts. Lateral boundaries of the plume would extend into New Jersey on the west, and nearly to Long Island Sound on the east (Figures 4 and 5). As will be summarized below, significant radiological impact would occur up to approximately 200 km (122 miles) from the site of the accident at Staten Island, i.e, well into Massachusetts.

The concentration of plutonium-239 in the plume was calculated for two extremes of accident conditions: no initial thermal loft, and 100 m (328 feet) of thermal loft by the heat of the fire (Figures 8 and 9). Calculations were carried out both for the most stable atmosphere (Pasquill category F) and the least stable atmosphere (Pasquill category A). These calculations indicate that the plutonium concentration in the plume would exceed existing federal limits by up to ten thousand times near the scene of the accident. Under the worst conditions (stable atmosphere and 100 m thermal loft), plutonium concentration in the air would exceed federal limits by approximately five-hundred times throughout Manhattan and into Yonkers. The air concentration would under these conditions remain above federal limits out to approximately 100 km (61 miles) from the accident site—well beyond New York City and into rural regions to the north.

As the hypothetical radioactive cloud is transported downwind, plutonium contained within it would deposit on all exposed surfaces in the form of "fallout". The calculated deposition would exceed federal limits by as much as one million times near the scene of the accident. Surface deposition would exceed federal limits by nearly ten thousand times throughout Manhattan for the case of 100 m (328 feet) of thermal loft and the most stable atmospheric conditions (Figure 10 and 11).

Persons in the path of the radioactive cloud would be exposed to the plutonium-239 primarily by inhalation. Exposure by other pathways has been ignored in the present analysis, under the conservative assumption that persons in the path of the cloud will evacuate shortly after the accident and food and water will be quarantined immediately. For the worst conditions (thermal loft of 100 m combined with the most stable atmospheric conditions), inhalation exposure from breathing plutonium is approximately one thousand times higher than federal guidelines and two hundred thousand times above background levels up to approximately 20 km (12.2 miles) from the accident site, i. e., for most of Manhattan (Figures 12 and 13). Exposure levels remain above federal guidelines up to 105 km (approximately 63 miles) from the scene of the accident—the farthest distance included in this analysis.

Casualties from the above inhalation exposure include latent cancer fatalities (LCFs; i. e., cancers that are induced by the accident, but occur from a few to several years later) and severe genetic defects. The latter are not calculated in the present analysis. Casualties are calculated for the workforce population in addition to the residential population. For the most stable atmospheric conditions and the highest dose-conversion factors (Figures 15 - 18), latent cancer fatalities may be expected for up to 30,442 people.

The commonest wind direction would carry the radioactive plume over the Croton watershed that supplies much of New York City's water supply and over the Kensico Reservoir. Significant short-term and long-term contamination of the water supply with plutonium would be expected for the least favorable accident conditions.

Economic impacts from such an accident include those associated with evacuation and decontamination, as well as "indirect" losses from the interruption of the New York City economy and the resultant ripple effects on the national economy. Although these costs are difficult to estimate accurately, U. S. government studies suggest that the cost of decontamination alone, assuming it were feasible, could run into several tens of billions of dollars.

The risk of such an accident is the product of the consequences (described above) and the probability of occurrence. Although some consequences, such as LCFs, can be estimated with some precision, calculating the probability of such an accident requires information that the military has been unwilling to provide. In the absence of this information, the risks (probability × consequences) associated with the hypothetical accident modeled cannot be calculated. The military itself has contingency plans to deal with an accident of this type (although not of this scope), suggesting that it views the risk as finite.

The following recommendations stem from the results of this study.

- RECOMMENDATION # 1: *The environmental impacts of possible nuclear accidents consequent to homeporting nuclear capable vessels in New York Harbor should be analyzed in detail. Included in such analyses should be the impacts of such accidents on the terrestrial and aquatic environments, and on the water supply to New York City.*

- RECOMMENDATION # 2: *The full resources of the City of New York and the U. S. Navy should be brought to bear in producing an exhaustive analysis of nuclear accident scenarios and their medical consequences before further consideration of homeporting nuclear capable vessels in New York Harbor.*

• RECOMMENDATION # 3: *The City of New York, together with State and Federal Agencies that are responsible, should determine whether an effective emergency evacuation plan can be developed for the city in the event of a severe nuclear accident aboard a homeported naval vessel.*

• RECOMMENDATION # 4: *Any such emergency evacuation plan should be rehearsed periodically to demonstrate and develop its effectiveness.*

• RECOMMENDATION # 5: *City, State and Federal officials and agencies should work with the military to develop a realistic plutonium decontamination plan. Included in such plan should be assignment of responsibilities, cost and duration, and answers to questions of legal liability and indemnity.*

• RECOMMENDATION # 6: *Economic analyses of the possible impacts of nuclear accidents in New York Harbor should be undertaken in connection with the homeporting proposal. Linkages with the national and international economy should be taken into account in this analysis.*

• RECOMMENDATION # 7: *City and State authorities should insist on obtaining from the military sufficient data to assess accurately the probability of an accident like the one modeled here. Such accidents should be taken into account in arriving at an informed policy regarding homeporting nuclear capable vessels in densely populated urban centers such as New York City.*