

Preliminary Analysis on the Economic Impact of a Nuclear Weapon Event in Vancouver

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Project Definition

CRTI-05-0043RTD - Economic Impact of Radiological Terrorist Events (ECIMORT)

- Calculate economic impacts associated with a Radiological Dispersal Device (RDD) event impacting Canadian territory (although the event may or may not occur in this country)
- Look at varying "cleanup levels" and the impacts of those levels on the cost to clean-up and recover from an RDD event
- Develop evaluation scenarios that span consequence spectrum:

- RDD sources (material quantity, type, and delivery method)
- Population centers (rural to high density urban)

ECIMORT addresses CRTI Investment Category H2:

- Scenario based review (technical, actuarial or otherwise) of the full spectrum of feasibility and impacts (i.e., economic) of CBRN events based on an analysis of CBRN scenarios developed under the CRTI Consolidated Risk Assessment.

Project Team:

- DRDC Ottawa - Dr. Tom Cousins, Dr. Lorne Erhardt, Dr. Dean Haslip
- Battelle/PNWD - Barbara Reichmuth
- CNSC - Chris Clement
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Recent Progress - Analysis of Nuclear Weapon Events in Vancouver

- Build upon methodology employed in U.S. to frame the economic consequences of a nuclear weapon event
 - U.S. methodology and assumptions utilized as proxy for similar event in Canada
 - Literature review yields numerous methodologies for economic evaluation. Data used in this analysis:
 - Federal Reserve Bank of New York Study¹ on effects of 9/11
 - Sandia National Lab RadTran V Economic Model (for cleanup cost)
- Focus on sensitivity analysis of a range of cleanup standards including the following:
 - Anything above a decontamination factor (DF) of 10 is assumed demolished and re-built
 - Assume that over 90% of the dose is received in the first year after a nuclear weapon event²

- Focus on five broad categories of cost (CAS2005):
 - Loss of productivity from earnings forgone
 - Indirect economic effects or multiplier
 - Loss and damage to building structures
 - Decontamination and decommissioning (D&D) cost (including disposal)
 - Evacuation cost
- Analysis does not cover the universe of all possible economic impacts
- Diversity of meteorological conditions not evaluated
- Cleanup initiated after 1 year

Prompt Effects 100kT

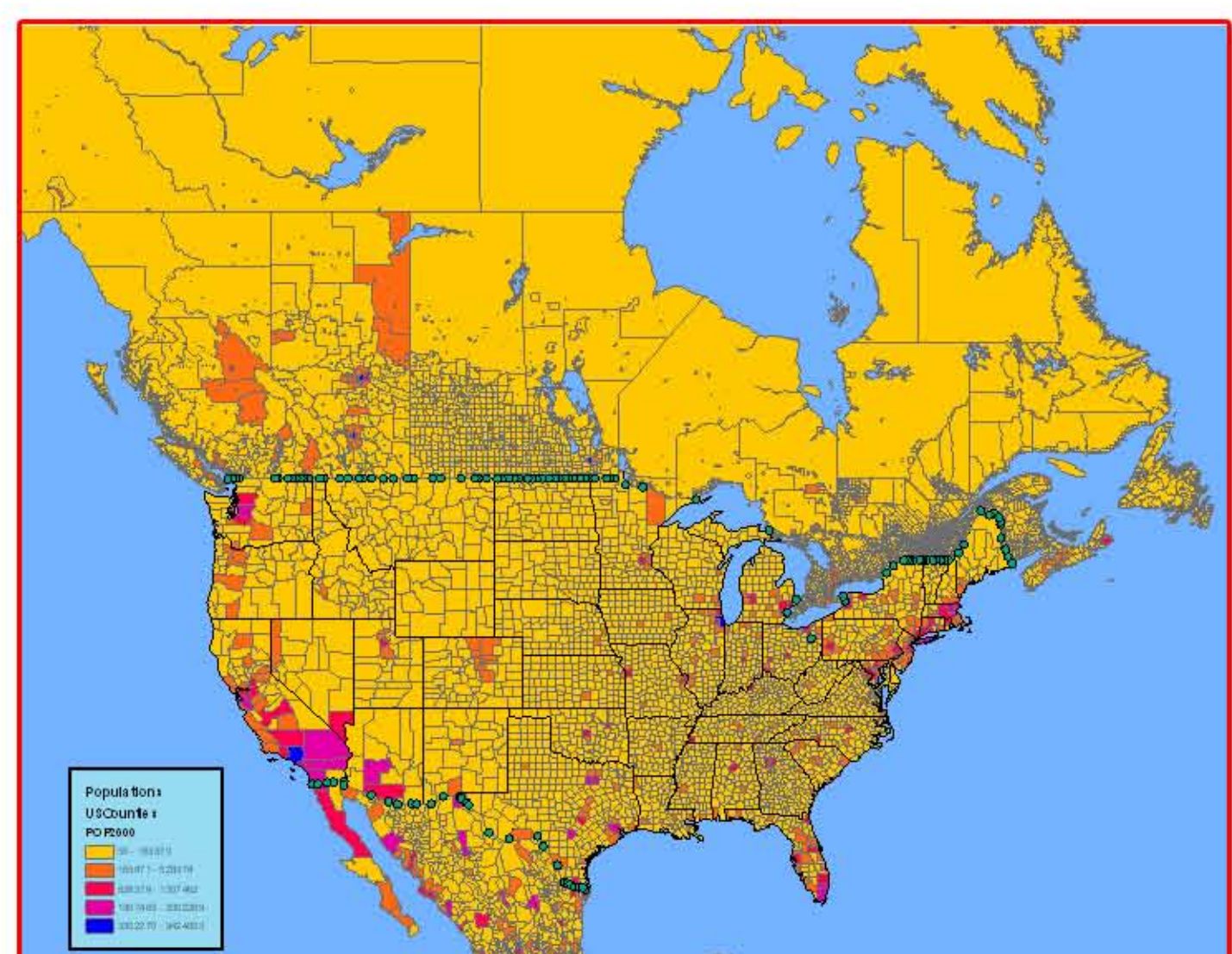


Potential Range of Cleanup Guidance for a Rad/Nuc Event - Which One Do We Use?	
15 mrem/yr	U.S. EPA, "Establishment of Cleanup Levels for CERCLA Sites With Radioactive Contamination"
30 mrem/yr	Proposed dose basis for the largest contaminated site remediation in Canada
100 mrem/yr	Note: 30 mrem/yr is the U.S. NRC, "Final Rule on Radiological Criteria for Source Term Permitting (40 CFR Part 20. Subpart B)"; Definition of contaminated land under the Nuclear Safety and Control Act
500 mrem/yr	Note: U.S. Health Physics Society Position Statement, "Guidance for Protective Actions Following a Radiological Event"; U.S. EPA, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," 400-R-02-001, "...doses in any single year after the first will not exceed 0.5 rem"
1 rem/yr	IAEA guidance on dose above which intervention is almost always justified



Problem Context

Terrorist Events Don't Have to Occur in Canada to Create Impacts



- Consideration of consequences serves to place in proper perspective the scale of preventive programs and measures that could minimize the likelihood of consequences being realized
- Exploration of costs poses worthwhile (and hard) questions about recovery and response
- Weapon characteristics provide the boundary conditions for the response:
 - How large is the affected area?
 - What actions need to be taken to protect the population?
- Nuclear weapon provides upper bound on terrorist induced damage
- Vancouver selected for scenario analysis; utilize U.S. methodology

Fallout Contours for 100-kT Event (0-365 days)



Fallout Contours for 100-kT Event (1-2 yrs)



Impact on Canada's CBRN Response

- Contamination contours correspond to the cleanup standards (15 mrem/yr, 30 mrem/yr, 100 mrem/yr, and 1 rem/yr)
- Most conservative standard (15 mrem/yr) is represented on the outermost contamination contour
- If cleanup were initiated in the first year, the land area impacted spans the width of Canada
- Waiting until after the first year to initiate cleanup dramatically reduces the area to be cleaned up, thereby reducing the time and cost to recover

Future Outlook

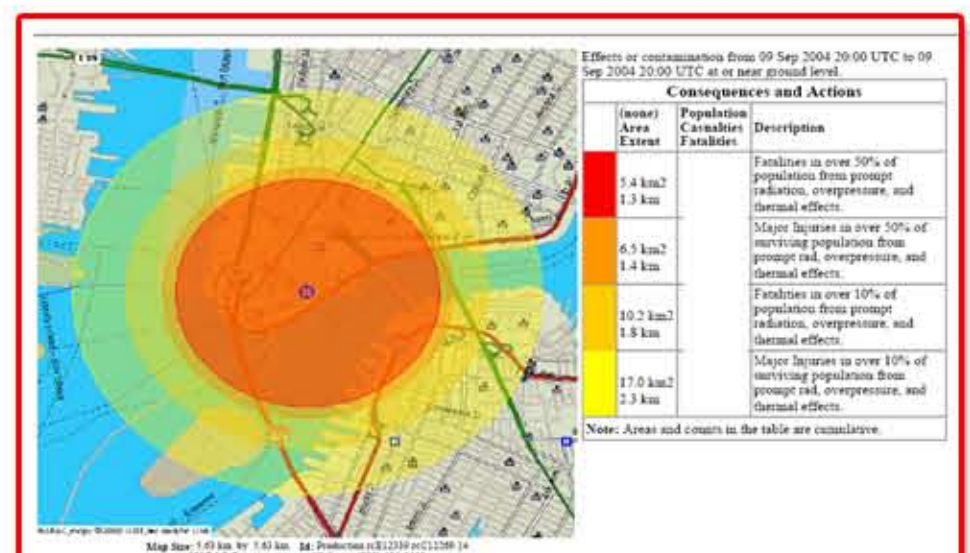
- Need to assess what aspects of typical emergency response and recovery are worthwhile and feasible following a large-scale WMD event
- Evaluations should focus on which emergency response actions have a high net payoff and could realistically be accomplished given:
 - Resource constraints,
 - Effects on infrastructure, and
 - Various degrees of federal involvement
- Classes of response (treatment of blast injuries, firefighting, facilitate evacuation, deny access to high rad zones, provision of shelter, provision of supplies to sheltered population, etc.) should be evaluated against losses from exposure of first responders.

- There are currently no cleanup standards specifically designed for radiological or nuclear terrorist events
- A risk-based approach to the development and application of cleanup standards for terrorist events is needed
- Policy implications of such a cleanup need to be fully evaluated
- Effects of terrorist attacks employing nuclear weapons need to be understood to balance investment in appropriate countermeasures and policy remedies

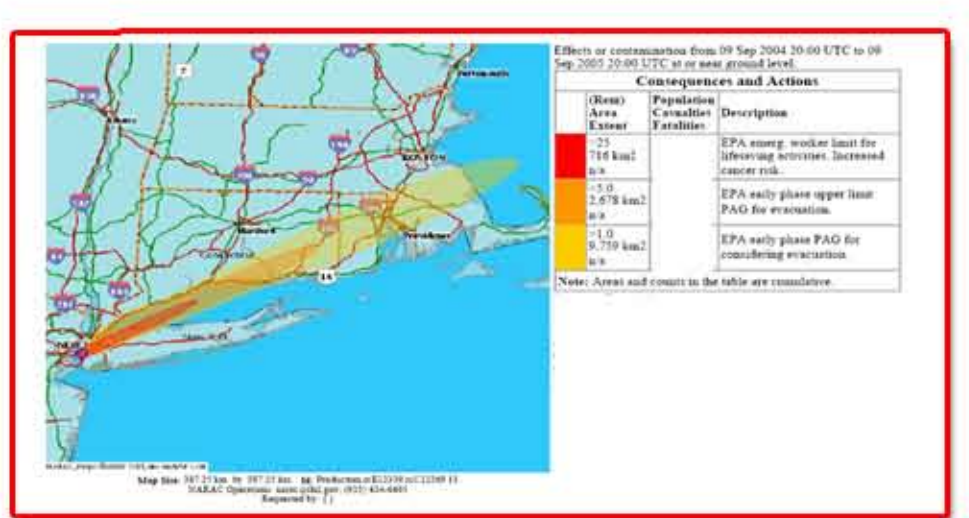
Conclusion

- Economic consequences of a nuclear event are highly dependent upon cleanup standards employed:
 - At the most conservative standard evaluated (U.S. EPA's 15 mrem/yr) total consequences exceed Canada's GDP of \$1.2 trillion for 2 of 3 weapon events in Vancouver
 - Cleanup cost and replacement value are the most significant cost components, dwarfing other dimensions across cleanup levels
 - Cleanup to the most conservative current standards (no matter what the class of weapon event) magnifies the consequences of the event
- Loss of use of productive assets can extend for long periods and generate significant economic loss
- Preliminary analysis is consistent with findings of U.S. analysis
- Further analysis utilizing Canadian-specific parameters should be conducted

A Nuclear Weapon Will Have Prompt and Fallout Effects



- Consequences depend upon:
- Weapon yield, height of burst, burst location, time of year, and surface type
 - Meteorological conditions (wind)
 - Geographic characteristics (topography)
 - Integrated time of population exposure to post-blast fallout
 - Radiation dose levels of concern



Fallout Effects Illustration