Adversarial Events: CBRN

Overview[140]

The SNRA leveraged the 2011 DHS Integrated Terrorism Risk Assessment (ITRA) for likelihood and fatality, illness/injury, and economic loss estimates for the five CBRN national-level events. The ITRA is designed to generate customized reports to inform multiple decision contexts, including differing thresholds and splits or aggregations by specific agents or targets. For the purposes of the SNRA, the DHS Directorate of Science & Technology (S&T) provided data to the 2011 SNRA project corresponding to the scope of the five CBRN events as defined in the SNRA. Chemical and biological attacks on the food supply chain were split out from the ITRA chemical and biological attack events and combined into a single SNRA event.

All likelihood and impact estimates derived from the ITRA, the psychological distress estimates derived from the ITRA fatality and injury/illness data, and comparative risk judgments are classified at the SECRET//NOFORN level and may be found in the classified SNRA Technical Report. The methodology and analysis of the ITRA are described in detail in the technical reports of the ITRA and its three component assessments, the Biological Terrorism Risk Assessment (BTRA), the Chemical Terrorism Risk Assessment (CTRA), and the Radiological/Nuclear Terrorism Risk Assessment (RNTRA). The TRAs leverage a probabilistic risk assessment (PRA) methodology of substantial complexity and maturity which is difficult to treat fairly in a compact manner, and thus the methodological discussion for these events is limited to the key parameters needed for a reviewer with the appropriate clearances to replicate the SNRA's quantitative estimates from the ITRA computational engine. Detailed discussion of the PRA methodology and its adaptation for DHS's terrorist risk assessments may be found in the unclassified literature.[141]

The SNRA's social displacement and environmental impact estimates are unclassified and non-FOUO for all events and are included here in full. However, since the SNRA defines the *risk* corresponding to a measure of impact to be the product of these impacts with event frequencies, all of which are classified for adversarial events, risk judgments and visualizations comparing the adversarial events among themselves or with other events are classified at the SECRET or SECRET//NOFORN level and may be found in the classified SNRA Technical Report.

Nuclear Terrorism Attack

The SNRA leveraged the 2011 DHS Integrated Terrorism Risk Assessment (ITRA) to estimate the risk from nuclear terrorism attacks. Specifically, the SNRA included analysis of a nuclear attack in which a hostile non-state actor(s) acquires an improvised nuclear weapon through manufacture from fissile material, purchase, or theft, and detonates it. Nine U.S. cities were considered in calculating the frequency and impacts of the attack. The cities were chosen to sample a variety of locations and population densities and included New York, Washington, Houston, and Miami. Impacts of the attack were evaluated for four yields across the nine cities

[140] Additional discussion of the classified data sources of the SNRA is provided in Appendix L.

[141] See Ezell et al (2010, April), Probabilistic risk analysis and terrorism risk, *Risk Analysis* 30(4) 575-589; and pp 101-104, Gerstein, Daniel M. (2009), *Bioterror in the 21st Century: Emerging Threats in a New Global Environment*, Naval Institute Press, Annapolis MD. While somewhat dated, the most comprehensive and critical review remains National Research Council (2008), *Department of Homeland Security Bioterrorism Risk Assessment: a call for change*, National Academies Press, Washington DC.

and were evaluated 12 times throughout the year to sample atmospheric conditions at detonation.[142]

A successful nuclear attack would cause substantial fatalities, injuries, and infrastructure damage from the heat and blast of the explosion, and significant radiological consequences from both the initial nuclear radiation and the radioactive fallout that settles after the initial event. A nuclear detonation in a modern urban area would impact the medical system more than any disaster previously experienced by the Nation.[143] An electromagnetic pulse from the explosion could also disrupt telecommunications and power distribution. Significant economic, social, psychological, and environmental impacts would be expected.[144]

Nuclear explosions are classified by yield, or the amount of energy they produce, relative to how many tons of TNT would be needed to produce an equivalent explosive yield. Strategic nuclear weapon systems held by state actors deliver weapons with yields in the multi-hundred kilotons to megaton (1,000 kiloton) range. Generally, when considering nuclear explosion scenarios perpetrated by terrorists, experts assume a low-yield nuclear device detonated at ground level, where low yield in this context ranges from factions of a kiloton (kT) to 10 kT.[145] A terrorist attack could be carried out with an improvised nuclear device (IND), which is a crude nuclear device built from the components of a stolen weapon or from scratch using nuclear material (plutonium or highly enriched uranium).

The primary obstacle to a terrorist IND attack is limited access to weapon-grade nuclear materials: highly enriched uranium, plutonium, and stockpiled weapons are carefully inventoried and guarded. Nuclear attack is also impeded because:

1. Building nuclear weapons is difficult—general principles are available in open literature, but constructing a workable device requires advanced technical knowledge in areas such as nuclear physics and materials science.
2. Crude nuclear weapons are typically very heavy, ranging from a few hundred pounds to several tons, and are difficult to transport, especially by air. Specially designed small nuclear weapons, including the so-called "suitcase nuclear weapons" are much lighter, but they are difficult to acquire and to construct.[146]

Radiological Terrorism Attack

The SNRA leveraged the 2011 DHS Integrated Terrorism Risk Assessment (ITRA) to estimate the risk from radiological terrorism attacks. The analysis only included data for successful attacks (e.g. detonation of the device or successful spread into the food or water system). Failed attacks, whether from interdiction during the fabrication and assembly of the dispersal device, interdiction during travel to United States, or failure of the dispersal device, were not included in this analysis.

[142] U.S. Department of Homeland Security (2011, October 24). *2011 Radiological/Nuclear Terrorism Risk Assessment (RNTRA),* Vol. 1. (Reference is SECRET//NOFORN: Extracted information is UNCLASSIFIED.)
[143] National Security Staff Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (2010, June). *Planning Guidance for Response to a Nuclear Detonation* (2nd ed), p. 81.
[144] National Academies, U.S. Department of Homeland Security (2005). Nuclear attack. Fact sheet for the public (series, Communicating in a Crisis). Retrieved from http://www.dhs.gov/xlibrary/assets/prep_nuclear_fact_sheet.pdf via http://www.ready.gov (checked April 2015).
[145] It should be noted that if a state-built weapon were available to terrorists, the presumption of low yield may no longer hold. NSS (2010) *op cit.*, p. 15.
[146] National Academies & DHS (2004). Nuclear attack public fact sheet, *op. cit.*

Radiological devices used for terrorism may include radiological dispersal devices (RDD) and radiological exposure devices (RED). The principal type of RDD is a "dirty bomb" that combines a conventional explosive with radioactive material. A second type involves radioactive material dispersed in air or water by other mechanical means, such as a water spray truck, a crop duster, or manually spread. An RED may comprise a powerful radioactive source hidden in a public place, such as a trash receptacle in a busy train or subway station, to expose passers-by to a potentially significant dose of radiation.[147]

It is very difficult to design an RDD that would deliver radiation doses high enough to cause immediate health effects or fatalities in a large number of people. Most injuries from a dirty bomb would probably occur from the heat, debris, and force of the conventional explosion used to disperse the radioactive material, affecting individuals close to the site of the explosion. At the low radiation levels expected from an RDD, the immediate health effects from radiation exposure would likely be minimal.[148] Subsequent decontamination of the affected area could involve considerable time and expense. A dirty bomb could have significant psychological and economic effects.[149]

Most radiological devices would have very localized effects, ranging from less than a city block to several square miles. Factors determining the area of contamination would include the amount and type of radioactive material, the means of dispersal, the physical and chemical form of the radioactive material (for example, material dispersed in the form of fine particles may be carried by the wind over a relatively large area), local topography and location of buildings, and local weather conditions.[150]

Preparedness and effectiveness of response teams will play a significant role in mitigating the consequences caused by an RDD attack. Early identification of a radiological attack is important in determining whether or not to evacuate the area or shelter in place and the size of the area requiring cordoning.

Biological Terrorism Attack (non-food)

The SNRA leveraged the 2011 DHS Integrated Terrorism Risk Assessment (ITRA) in order to estimate risk from non-food biological terrorism attacks.

The SNRA considered the risk from a non-food biological attack in which a hostile non-state actor(s) acquires, weaponizes, and releases a biological agent against an outdoor, indoor, or water target with a concentration of people within the United States. Frequency estimates for this event only include data for successful attacks (e.g., detonation of a device or release of an agent). Examples of failed attacks not included in the SNRA include interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to the United States, or failure of the dissemination device.

Biological agents can be isolated from sources in nature, acquired from laboratories or a state bioweapons stockpile, or synthesized or genetically manipulated in a laboratory. Potential dissemination mechanisms of a biological agent by terrorists include aerosol dissemination from

[147] U.S. Environmental Protection Agency (2006, October). OSC Radiological Response Guidelines. Office of Solid Waste and Emergency Response, Office of Air and Radiation, U.S. EPA; at http://www.uscg.mil/hq/nsfweb/foscr/ASTFOSCRSeminar/References/EnvResponsePapersFactSheets/OSCRadResponseGuidelines.pdf (retrieved April 2013).
[148] National Academies and U.S. Department of Homeland Security (2004). Radiological attack: dirty bombs and other devices. Retrieved from http://www.dhs.gov/radiological-attack-fact-sheet via http://www.ready.gov.
[149] EPA (2006) OSC Radiological Response Guidelines, *op. cit.*
[150] Ibid.

sprayers or other devices outdoors or through the ventilation system of a building, subway, or airplane, human carriers, insects or other animal vectors, or physical distribution through the U.S. Mail or other means. Biological agents include transmissible agents that spread from person to person (e.g. smallpox, Ebola) or agents that may cause adverse effects in exposed individuals but which do not make these individuals contagious (e.g. anthrax, botulinium toxin).[151]

Unlike a nuclear or chemical attack, a biological attack may go undetected for hours, days, or potentially weeks (depending on the agent) until humans, animals, or plants show symptoms of disease. If there are no immediate signs of the attack as with the anthrax letters, a biological attack will probably first be detected by local health care workers observing a pattern of unusual illness, or by early warning systems that detect airborne pathogens. There may be uncertainties about crucial facts such as the exact location or extent of the initial release, the type of biological agent used, and likelihood of additional releases. The exact infectious dose (the number of organisms needed to make one sick, referred to as dose response) and the long-term health consequences for those who survive exposure are key scientific knowledge gaps for many biological agents: while approximate ranges and prognoses for humans have been extrapolated from animal studies, they comprise additional uncertainties which may complicate the public health response to a biological attack.[152]

Chemical Terrorism Attack (non-food)

The SNRA leveraged the 2011 DHS Integrated Terrorism Risk Assessment (ITRA) in order to estimate risk from non-food chemical terrorism attacks.

The SNRA considered the risk from a non-food chemical attack in which a hostile non-state actor(s) releases a chemical agent against an outdoor, indoor, or water target with a concentration of people within the United States. Frequency estimates for this event only include data for successful attacks (e.g. detonation of a device or release of an agent). Examples of failed attacks not included in the SNRA include interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to the United States, or failure of the dissemination device.

Chemical agents can be acquired from a variety of different sources (e.g., chlorine, mustard gas, sarin) and disseminated in various modes. Potential delivery mechanisms of a chemical agent by terrorists include building ventilation systems, misting or aerosolizing devices, passive release (container of chemical left open), explosives, improvised devices combining readily available chemicals to produce a dangerous chemical, or sabotage of industrial facilities or vehicles containing chemicals.[153]

According to the 2010 Chemical Terrorism Risk Assessment (CTRA), exposure to a chemical threat can result in health effects within a matter of minutes. This stands in contrast to many biological scenarios, and significantly impacts the risk reduction potential that exists in the chemical scenarios where casualties can occur rapidly after exposure. For chemicals with a delayed symptom onset, the 2010 CTRA identified related critical issues, including the timeliness of event detection and the logistics associated with successfully delivering medical countermeasures to exposed victims. These scenarios continue to be good candidates for risk

[151] National Academies and U.S. Department of Homeland Security (2004). Biological attack: human pathogens, biotoxins, and agricultural threats. Retrieved from http://www.dhs.gov/biological-attack-fact-sheet via http://www.ready.gov.
[152] Ibid.
[153] National Academies and U.S. Department of Homeland Security (2004). Chemical attack: warfare agents, industrial chemicals, and toxins. Retrieved from http://www.dhs.gov/chemical-attack-fact-sheet via http://www.ready.gov.

management effort because improvements in event detection time or in medical countermeasure delivery were assessed to have the potential to significantly reduce chemical terrorism risk.[154]

Chemical/Biological Food Contamination Terrorism Attack

The SNRA also examined a national-level event involving successful chemical/biological attacks targeting food within the U.S. supply chain. The DHS Science and Technology Directorate (S&T) extracted data from the 2011 DHS Integrated Terrorism Risk Assessment (ITRA)[155] for chemical and biological attacks on food and beverage targets for analysis as a national-level event in the SNRA distinct from attacks on non-food targets.[156]

Chemical and biological weapons differ in potential toxicity, specificity, speed of action, duration of effect, controllability, and residual effects.[157] Children, the elderly, pregnant women, and immune-compromised individuals are particularly susceptible to the adverse effects of a chemical/biological food contamination.[158]

A terrorist attack on the Nation's food supply chain using chemical or biological agents may initially be indistinguishable from an unintentional food contamination. Depending on the type of agent used in the attack, it could take several days for individuals to show symptoms and possibly weeks before public health, food, and medical authorities suspect terrorism as the source.[159] In 1984 members of the Rajneeshees, a religious community in an accelerating political dispute with the Oregon county where they had established their commune, deliberately contaminated salad bars at eight county restaurants with *Salmonella* bacteria, infecting or sickening 751 people and hospitalizing 45.[160] However, deliberate contamination was not identified until a year later, when the commune collapsed and criminal investigations into its other activities uncovered its clandestine biological laboratories.[161,162]

Population exposure can be limited with fast and accurate identification of the agent and vehicle (water, milk, lettuce, etc.) utilized to target the food supply system. A prepared public communications plan will assist in further limiting the spread while also mitigating the economic losses associated with falsely identifying the food contaminant.

[154] U.S. Department of Homeland Security (2010, May). *Chemical Terrorism Risk Assessment (CTRA): Full report.* (Reference is SECRET: Extracted information is UNCLASSIFIED.)

[155] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).

[156] The scope of the SNRA chemical/biological food contamination event (e.g. the portions of the ITRA event tree for which the event's data were calculated) included water products (i.e. bottled water) distributed through the food consumer supply chain, but all other attacks against water targets (e.g. piped water) were included with the chemical and biological non-food attacks.

Attacks on agriculture were excluded from all events. While intentional attacks on agriculture were prioritized for inclusion in the SNRA as a national-level event corresponding to the unintentional Animal Disease event, data comparability challenges prevented the use of ITRA data on agricultural targets in the first SNRA.

[157] United Nations (1970). Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, p. 12. Report of the Secretary-General, UN Publication no. E.69.I.24. Reprinted by Ballantine Books, 1970.

[158] FEMA (2008), *op. cit.*

[159] Federal Emergency Management Agency (August 2008), Food and Agricultural Incident Annex, p. 2, at http://www.fema.gov/pdf/emergency/nrf/nrf_FoodAgricultureIncidentAnnex.pdf (retrieved January 2015).

[160] This was to test a plan to poison the county water supply on Election Day, to suppress voter turnout and enable the group to take over the county board by electing their own candidates. Török et al (1997, August 6). A large community outbreak of Salmonellosis caused by intentional contamination of restaurant salad bars. *Journal of the American Medical Association (JAMA)* 278(5) 389-395; at http://www.cdc.gov/phlp/docs/forensic_epidemiology/Additional%20Materials/Articles/Torok%20et%20al.pdf (retrieved May 2014). Although unsuccessful in identifying deliberate action as the cause of the poisoning, CDC and FBI investigations following the incident may have deterred the group from carrying out their planned Election Day attack in November. Sobel et al (2002, March 9). Threat of a biological attack on the US food supply: the CDC perspective. *Lancet* 359(9309) 874-880.

[161] Török et al, *op cit.*

[162] Carus, W. Seth (2001, February). Bioterrorism and biocrimes: the illicit use of biological agents since 1900. Pages 50-58. National Defense University; at http://www.ndu.edu/centercounter/full_doc.pdf (retrieved March 2013). Agents experimented with included *Salmonella typhimurium*, the variant which was used in the salad bar attacks, *Salmonella typhi* which causes hepatitis and typhoid fever, *Giardia*, HIV, and multiple chemical and pharmaceutical poisons. *Giardia lamblia* was to be introduced into the county water supply via dead rats and beavers, which carry the parasite (p. 54).

Biological Terrorism Attack (non-food)

A hostile non-state actor(s) acquires, weaponizes, and releases a biological agent against an outdoor, indoor, or water target directed at a concentration of people within the U.S.

Data Summary

Category	Description	Metric	Low	Best	High
Health and Safety	Fatalities	Number of Fatalities	See classified data sheet		
	Injuries and Illnesses	Number of Injuries or Illnesses	See classified data sheet		
Economic	Direct Economic Loss	U.S. Dollars (2011)	See classified data sheet		
Social	Social Displacement	People Displaced from Home ≥ 2 Days	0	1,800	N/A
Psychological	Psychological Distress	Qualitative Bins	See classified data sheet		
Environmental	Environmental Impact	Qualitative Bins[1]	Low[2]		
LIKELIHOOD	Frequency of Events	Number of Events per Year	See classified data sheet		

(UNCLASSIFIED)

Event Background

The SNRA considered the risk from a non-food biological attack in which a hostile non-state actor(s) acquires, weaponizes, and releases a biological agent against an outdoor, indoor, or water target with a concentration of people within the United States. Frequency estimates for this event only include data for successful attacks (e.g., detonation of a device or release of an agent). Examples of failed attacks not included in the SNRA include interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to the United States, or failure of the dissemination device.

Biological agents can be isolated from sources in nature, acquired from laboratories or a state bioweapons stockpile, or synthesized or genetically manipulated in a laboratory. Potential dissemination mechanisms of a biological agent by terrorists include aerosol dissemination from sprayers or other devices outdoors or through the ventilation system of a building, subway, or airplane, human carriers, insects or other animal vectors, or physical distribution through the U.S. Mail or other means. Biological agents include transmissible agents that spread from person

[1] In 2011, the U. S. Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. The comments and rankings presented in this Risk Summary Sheet have not undergone review by the EPA and only represent the opinions of the group. Estimates pertain to the potential for adverse effects on living organisms associated with pollution of the environment; they are grouped into high, moderate, low, and de minimus (none) categories. Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[2] Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'Best' estimate.

to person (e.g. smallpox, Ebola) or agents that may cause adverse effects in exposed individuals but which do not make these individuals contagious (e.g. anthrax, botulinium toxin).[3]

Unlike a nuclear or chemical attack, a biological attack may go undetected for hours, days, or potentially weeks (depending on the agent) until humans, animals, or plants show symptoms of disease. If there are no immediate signs of the attack as with the anthrax letters, a biological attack will probably first be detected by local health care workers observing a pattern of unusual illness, or by early warning systems that detect airborne pathogens. There may be uncertainties about crucial facts such as the exact location or extent of the initial release, the type of biological agent used, and likelihood of additional releases. The exact infectious dose (the number of organisms needed to make one sick, referred to as dose response) and the long-term health consequences for those who survive exposure are key scientific knowledge gaps for many biological agents: while approximate ranges and prognoses for humans have been extrapolated from animal studies, they comprise additional uncertainties which may complicate the public health response to a biological attack.[4]

This National-Level Event focuses on non-food biological attacks. Note that the risks of intentional biological food contamination are considered in a separate National-Level Event in the SNRA and should not be considered for this event.

Assumptions

The SNRA leveraged classified data from the DHS/S&T 2011 Integrated Terrorism Risk Assessment (ITRA)[5] for quantitative frequency, fatality, illness/injury, and economic loss estimates for the biological (non-food) terrorism attack event. The data relies heavily on the Intelligence Community (IC) and other technical experts to develop scenarios and estimate the likelihoods of those scenarios for analysis. The DHS Science and Technology Directorate (S&T) extracted ITRA data for biological attacks on targets other than food and agriculture targets for the SNRA project to correspond to the scope of the SNRA biological (non-food) terrorism attack event.

SNRA analysis for this national-level event adopted the definition of a terrorist attack from the Homeland Security Act of 2002, which is any activity that:

- Involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources;
- Involves an act that is a violation of the criminal laws of the United States or any State or other subdivision of the United States;
- Appears to be intended to intimidate or coerce a civilian population;
- Appears to be intended to influence the policy of a government by intimidation or coercion; or
- Appears to be intended to affect the conduct of government by mass destruction, assassination, or kidnapping.

[3] National Academies and U.S. Department of Homeland Security (2004). Biological attack: human pathogens, biotoxins, and agricultural threats. Retrieved from http://www.dhs.gov/biological-attack-fact-sheet via http://www.ready.gov.
[4] Ibid.
[5] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).

In addition to this general definition, SNRA analysis considered the following categories of actors:

- International Terrorist Organizations: Terrorist organizations that operate both inside and outside of the U.S. that are not sponsored by a nation (e.g., al-Qaeda);
- State-Sponsored Terrorist Organizations: Terrorist organizations that operate inside and/or outside of the U.S. that are sponsored by a nation; sponsorship is defined as the provision of technical assistance, equipment, or chemical by a state program (e.g., Hezbollah);
- Domestic Terrorist Organizations: Terrorist organizations that operate only within the U.S. that are not sponsored by a nation (e.g., Animal Liberation Front and Rajneesh);
- Small Groups/Individuals Terrorist Organizations: Small groups (i.e., 2 to 3 members) or individuals that operate only within the U.S. that are not sponsored by a nation (e.g., the Unabomber and Timothy McVeigh).

Biological agents can be classified into different categories and disseminated in different modes (e.g., wet or dry aerosol). The SNRA considers the following categories of biological agents:

- Traditional Biological Agents: Includes bacterial, viral, toxin, and prion agents; these agents are most often considered in biological agent assessments;
- Enhanced Biological Agents: Refers to traditional agents that have been modified to increase the hazard associated with the agent, such as bacterial agents enhanced to be antibiotic resistant;
- Emerging Biological Agents: Includes organisms that were not previously considered significantly pathogenic but are currently recognized for that potential. The Severe Acute Respiratory Syndrome (SARS) is an example of such an agent.[6]

Frequency estimates for this National-level Event only include data for successful attacks, e.g., detonation of a device or release of an agent. Failed attacks are not considered during this assessment process. Examples of failed attacks include interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to United States, or failure of the dissemination device.

The SNRA project team used the definitions of direct, indirect, and induced economic costs given in Table 1 for economic loss estimates of this national-level event.

Table 1. Definitions for Direct, Indirect, and Induced Costs

Direct Costs include:
• **Decontamination, Disposal, and Physical Destruction:** DDP costs covered the repair, replacement and environmental clean-up which are considered expenditures by the government. It was assumed the government would recoup this spending through tax increases, causing a reduction of household spending of that same amount. However, this spending would be received as income by some sectors, such as waste management

[6] Bush, George W. (2001, January 31). Homeland Security Presidential Directive/HSPD-18 – Medical Countermeasures against Weapons of Mass Destruction: at http://fas.org/irp/offdocs/nspd/hspd-18.html. HSPD-18, the mandate for the Integrated CBRN Terrorism Risk Assessment (ITRA 2011) which the Biological Attack (non-food) national-level event leverages for its frequency, fatality, illness, and economic impact data, defined the traditional/enhanced/emerging/advanced agent classification used in characterizing biological terrorism agents.

and environmental consulting services. The increase in spending into the waste management and environmental consulting services is treated as increase in annual output for these sectors.

- **Business Interruption:** Business interruption impacts considered losses due to decreased output at the target area, along with other increases and decreases to related sectors due to behavioral changes resulting from the event.
- **Loss in Spending from Fatalities:** This SNRA project team estimated a loss of spending of $42,500 for each fatality. In addition, $6,000 is included in increased output for mortuary services for each fatality.
- **Medical Costs:** Costs of medical mitigation were considered to be borne through private spending and insurance companies, while the hospital sector received an offsetting increase in output.

Indirect Costs include:

- Costs incurred by the suppliers and vendors in the associated expenditure sectors for the industries impacted by the direct costs above.

Induced Costs include:

- The induced costs are those incurred due to reduced spending by households with members employed in any of the directly or indirectly affected industries. Induced costs can also include substitution effects or likely transfers of economic activity from one set of sectors to another set, such as avoidance of air or other travel or altered transportation mode preferences to other sectors following an attack on the commercial air transport sector.

Social Displacement

For the purposes of the SNRA, social displacement was defined as the number of people forced to leave home for a period of two days or longer. Note that there are limitations to this measure of social displacement, as the significant differences between temporary evacuations and permanent displacement due to property destruction are not captured.

- Low and best estimates of social displacement for the Biological Terrorism Attack (non-food) national-level event were provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (START).[7]
- The low estimate of 0 reflects assessed judgment of START subject matter experts. The best estimate of 1,800 represents the number of people evacuated in a historical outbreak of tuberculosis in East Timor in 1999, used as a proxy estimate for a small-scale but deliberate dissemination of a contagious agent.[8]
- A high estimate for social displacement was not determined for this event.

[7] START is a Department of Homeland Security University Center of Excellence that focuses on social and behavioral aspects of terrorism, natural disasters, and technological accidents, and the social, behavioral, cultural and economic factors influencing responses to and recovery from catastrophes.

[8] (Source: Connolly, Maire, 1999. "Communicable Disease Surveillance and Control in East Timor." World Health Organization.) Subject matter experts consulted for the SNRA noted that this estimate is arbitrary given the large range of potential biological attack scenarios; the high estimate could be significantly higher than the best estimate provided if there is a need to decontaminate a large area.

Psychological Distress

Psychological impacts for the SNRA focus on *significant distress* and *prolonged distress*, which can encompass a variety of outcomes serious enough to impair daily role functioning and quality of life. An index for significant distress was created that reflected empirical findings that the scope and severity of an event is more important than the type of event. The equation for this index uses the fatalities, injuries, and displacement associated with an event as primary inputs; a factor elicited from subject matter experts weights the index for differing psychological impact based on the type of event, but as a secondary input.[9] The numerical outputs of this index formula were used to assign events to bins of a risk matrix for a semi-quantitative analysis of psychological risk in the SNRA.

Environmental Impact

The United States Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. Estimates are based on the following assumptions:

- Experts were elicited to provide estimates in the environmental impact category based on assumptions. Actual environmental/ecological harm that occurs as a result of the events described in a given scenario may vary considerably, and will depend on numerous variables (e.g., chemical or biological agent, contamination extent, persistence, toxicity—both chronic and acute toxicity—and infectivity).
- EPA defined environmental consequence (impact)[10] as the potential for adverse effects on living organisms associated with pollution of the environment by effluents, emissions, wastes, or accidental chemical releases; energy use; or the depletion of natural resources.
- Experts identified the best estimate for environmental impacts as "Low." The environmental impact will vary on agent or persistence, but the highest potential would be an increase in animal disease. However, this potential is low given the focus on human diseases. Additionally, the disposal of contaminated waste could result in a higher risk for environmental impacts.

Potential Mitigating Factors

Viable human-health surveillance techniques, to include DHS Bio-Watch detection systems where available, should be employed in order to minimize the time window between attack and start of treatment. Emergency notification systems should be operational, with special care taken

[9] The Significant Distress Index is calculated from these inputs using a formula proposed by subject matter experts consulted for the SNRA project: $N_{SD} = C_{EF} \times (5\ Fat + Inj + \frac{1}{2}\ D)$, where N_{SD} represents the number of persons significantly distressed, C_{EF} is the expert assessed Event Familiarity Factor, *Fat* is the number of fatalities, *Inj* is the number of injuries and/or illnesses, and *D* is the number of persons displaced (Social Displacement). In words, this formula suggests that there are 5 significantly distressed persons for each life lost; 1 for each person injured; and 1 for each 2 people displaced. This formula was constructed to reflect the empirical finding that the most severe stressor of a disaster is losing a loved one, followed by injury, followed by displacement. Uncertainty was captured by applying the index formula to the low, best, and high estimates of these three human consequence metrics.

The Event Familiarity Factor is intended to capture the extent to which the event entails an ongoing threat with uncertainty regarding long term effects, is unfamiliar, or that people dread, exacerbating psychological consequences. This factor, ranging from 1.0 for familiar events to 1.3 for unfamiliar events, was provided by subject matter experts for each national-level event included in the SNRA: Biological Terrorism Attack (non-food) was given a C_{EF} of 1.3.

The numerical psychological distress estimates for this event and the complete semi-quantitative risk matrix may be found in Appendix G and the Findings sections, respectively, of the classified SNRA Technical Report.

[10] The 2011 SNRA referred to impacts as 'consequences' because of prior usage in quantitative risk assessment (Kaplan and Garrick [1981, March], On the quantitative definition of risk: *Risk Analysis* 1(1) 11-32). Except where it will cause confusion, 'impact' is used synonymously in this document because of pre-existing connotations of the word 'consequence' within FEMA.

to provide the most accurate and current information to hospitals that they may take steps to mitigate surge capacity problems and diagnose patients effectively. The appropriate Prevention/ Deterrence, Preparedness, Emergency Assessment/Diagnosis, Emergency Management/ Response, Hazard Mitigation, Evacuation/Shelter, Victim Care, Investigation/Apprehension and Recovery/Mediation mission areas should be activated to ensure a comprehensive, integrated response and minimize the impact of an attack.

Weather can have an ameliorating effect on biological agents as humidity, wind currents and ultraviolet radiation may decrease their potency. Therefore, agents are often most harmful when released in enclosed spaces.

Chemical Terrorism Attack (non-food)

A hostile non-state actor(s) acquires, weaponizes, and releases a chemical agent against an outdoor, indoor, or water target directed at a concentration of people, using an aerosol, ingestion, or dermal route of exposure.

Data Summary

Category	Description	Metric	Low	Best	High
Health and Safety	Fatalities	Number of Fatalities	See classified data sheet		
	Injuries and Illnesses	Number of Injuries or Illnesses	See classified data sheet		
Economic	Direct Economic Loss	U.S. Dollars (2011)	See classified data sheet		
Social	Social Displacement	People Displaced from Home ≥ 2 Days	0	100,000	700,000
Psychological	Psychological Distress	Qualitative Bins	See classified data sheet		
Environmental	Environmental Impact	Qualitative Bins[1]	Moderate[2]		
LIKELIHOOD	Frequency of Events	Number of Events per Year	See classified data sheet		

(UNCLASSIFIED)

Event Background

The Department of Homeland Security (DHS) and Federal Bureau of Investigation (FBI) define a chemical attack as follows:[3]

> A chemical attack is the spreading of chemicals with the intent to do harm. The Chemical Weapons Convention defines a chemical weapon as "any toxic chemical or its precursor that can cause death, injury, temporary incapacitation, or sensory irritation through its chemical action." A variety of chemicals could be used in an attack, to include toxic commercial and industrial chemicals and warfare agents developed for military use. The chemical could be used in various forms or states—such as gas, liquid, or solid. The toxicity of chemicals varies greatly; some are acutely toxic (causing immediate symptoms) in small doses, others are not toxic at all. Chemicals in liquid or vapor form generally create greater exposure than chemicals in solid form.

Chemical agents can be disseminated in various modes. Potential delivery mechanisms of a chemical agent by terrorists include building ventilation systems, misting or aerosolizing devices, passive release (container of chemical left open), explosives, improvised devices

[1] In 2011, the U. S. Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental consequences for this event. The comments and rankings presented in this Risk Summary Sheet have not undergone review by the EPA and only represent the opinions of the group. Estimates pertain to the potential for adverse effects on living organisms associated with pollution of the environment; they are grouped into high, moderate, low, and de minimus (none) categories. Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[2] Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[3] "Potential Terrorist Attack Methods: Joint Special Assessment", DHS & FBI, 23 April 2008, p. 15 (Reference is UNCLASSIFIED//FOR OFFICIAL USE ONLY: Extracted information is UNCLASSIFIED).

combining readily available chemicals to produce a dangerous chemical, or sabotage of industrial facilities or vehicles containing chemicals.[4]

This National-level Event focuses on non-food chemical attacks. Note that the risks of intentional chemical food contamination are considered in a separate National-level Event in the SNRA and should not be considered for this event.

Assumptions

The SNRA leveraged classified data from the DHS/S&T 2011 Integrated Terrorism Risk Assessment (ITRA)[5] for quantitative frequency, fatality, illness/injury, and economic loss estimates for the chemical (non-food) terrorism attack event. The data relies heavily on the Intelligence Community (IC) and other technical experts to develop scenarios and estimate the likelihoods of those scenarios for analysis. The DHS Science and Technology Directorate (S&T) extracted ITRA data for chemical attacks on non-food targets for the SNRA project, separate from attacks on food and beverage[6] targets, to correspond to the event structure of the SNRA.

The SNRA leveraged data for the classified risk summary sheet that assumed terrorist attack to include the following:

- Involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources.
- Involves an act that is a violation of the criminal laws of the United States or any State or other subdivision of the United States.
- Appears to be intended to intimidate or coerce a civilian population.
- Appears to be intended to influence the policy of a government by intimidation or coercion.
- Appears to be intended to affect the conduct of government by mass destruction, assassination, or kidnapping.

The SNRA only includes data for successful attacks for this national-level event (e.g., detonation of a device or release of an agent). Failed attacks (e.g., interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to United States, or failure of the dissemination device) are not considered during this assessment process.

The analysis used broad definitions of organizations that may initiate or represent potential chemical terrorism threats to the U.S., the categories of chemical agents that could be used for an attack, and the targets that may be selected for a chemical attack. The adopted criteria for general categories representing chemical terrorist threats to the U.S. are as follows:

- The International Terrorist Organization category is composed of terrorist organizations that operate both inside and outside of the U.S. that are not sponsored by a nation (e.g., al-Qaeda).
- The State-Sponsored Terrorist Organization category is composed of terrorist organizations that operate inside and/or outside of the U.S. that are sponsored by a nation. Sponsorship is

[4] National Academies and U.S. Department of Homeland Security (2004). Chemical attack: warfare agents, industrial chemicals, and toxins. Retrieved from http://www.dhs.gov/chemical-attack-fact-sheet via http://www.ready.gov.
[5] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).
[6] Water systems such as city and building water supplies are included in the non-food event; attacks using bottled water as a vector are included in the chemical-biological food contamination event.

defined as the provision of technical assistance, equipment, or chemical by a state program (e.g., Hezbollah).

- The Domestic Terrorist Organization category is composed of terrorist organizations that operate only within the U.S. that are not sponsored by a nation (e.g., Animal Liberation Front and Rajneesh).
- The Small Groups/Individuals Terrorist Organization category is composed of small groups (i.e., 2 to 3 members) or individuals that operate only within the U.S. that are not sponsored by a nation (e.g., the Unabomber and Timothy McVeigh).

Chemical agents can be acquired from a variety of different sources and disseminated in various modes. The analysis uses data that classifies chemical agents into the following categories:

- Toxic Industrial Materials (TIMs) and Toxic Industrial Chemicals (TICs): Includes toxic substances in solid, liquid, or gaseous form that are used or stored for use for military or commercial purposes. Chlorine is an example of this type of agent.
- Traditional Chemical Warfare Agents (CWAs): Encompasses the range of blood, blister, choking, nerve, and psychotropic agents historically developed for military use. Examples include: sulfur mustard, VX, and sarin. [7]

The SNRA project team used the definitions of direct, indirect, and induced economic costs given in Table 1 to estimate the economic losses for this national-level event.

Table 1. Definitions for Direct, Indirect, and Induced Costs

Direct Costs include:

- **Decontamination, Disposal, and Physical Destruction:** DDP costs covered the repair, replacement and environmental clean-up which are considered expenditures by the government. It was assumed the government would recoup this spending through tax increases, causing a reduction of household spending of that same amount. However, this spending would be received as income by some sectors, such as waste management and environmental consulting services. The increase in spending into the waste management and environmental consulting services is treated as increase in annual output for these sectors.
- **Business Interruption:** Business interruption impacts considered losses due to decreased output at the target area, along with other increases and decreases to related sectors due to behavioral changes resulting from the event.
- **Loss in Spending from Fatalities:** This SNRA project team estimated a loss of spending of $42,500 for each fatality. In addition, $6,000 is included in increased output for mortuary services for each fatality.
- **Medical Costs:** Costs of medical mitigation were considered to be borne through private spending and insurance companies, while the hospital sector received an offsetting increase in output.

[7] National Academies, DHS (2004), Chemical attack fact sheet, *op. cit.*

Indirect Costs include:

- Costs incurred by the suppliers and vendors in the associated expenditure sectors for the industries impacted by the direct costs above.

Induced Costs include:

- The induced costs are those incurred due to reduced spending by households with members employed in any of the directly or indirectly affected industries. Induced costs can also include substitution effects or likely transfers of economic activity from one set of sectors to another set, such as avoidance of air or other travel or altered transportation mode preferences to other sectors following an attack on the commercial air transport sector.

Social Displacement

For the purposes of the SNRA, social displacement was defined as the number of people forced to leave home for a period of two days or longer. Note that there are limitations to this measure of social displacement, as the significant differences between temporary evacuations and permanent displacement due to property destruction are not captured.

- Social displacement estimates for the Chemical Terrorism Attack (non-food) national-level event were provided by staff researchers and subject matter experts at the National Consortium for the Study of Terrorism and Responses to Terrorism (START).[8]
- The low estimate of 0 reflects assessed judgment of START subject matter experts. The best and high estimates of 100,000 and 700,000 respectively represent estimated evacuation and dispersal numbers in two modeled chemical attack scenarios in the literature: an attack with a blister agent aimed at a large gathering such as a football game (best), and a terrorist attack against a petroleum plant using explosives to cause a catastrophic release of toxic industrial chemicals (high).[9]

Psychological Distress

Psychological impacts for the SNRA focus on *significant distress* and *prolonged distress*, which can encompass a variety of outcomes serious enough to impair daily role functioning and quality of life. An index for significant distress was created that reflected empirical findings that the scope and severity of an event is more important than the type of event. The equation for this index uses the fatalities, injuries, and displacement associated with an event as primary inputs; a factor elicited from subject matter experts weights the index for differing psychological impact based on the type of event, but as a secondary input.[10] The numerical outputs of this index

[8] START is a Department of Homeland Security University Center of Excellence that focuses on social and behavioral aspects of terrorism, natural disasters, and technological accidents, and the social, behavioral, cultural and economic factors influencing responses to and recovery from catastrophes.

[9] Bea, Keith. 2005. "National Preparedness System: Issues in the 109th Congress." CRS Report for Congress. March 10, 2005.

[10] The Significant Distress Index is calculated from these inputs using a formula proposed by subject matter experts consulted for the SNRA project: $N_{SD} = C_{EF} \times (5\ Fat + Inj + \frac{1}{2}\ D)$, where N_{SD} represents the number of persons significantly distressed, C_{EF} is the expert assessed Event Familiarity Factor, *Fat* is the number of fatalities, *Inj* is the number of injuries and/or illnesses, and *D* is the number of persons displaced (Social Displacement). In words, this formula suggests that there are 5 significantly distressed persons for each life lost; 1 for each person injured; and 1 for each 2 people displaced. This formula was constructed to reflect the empirical finding that the most severe stressor of a disaster is losing a loved one, followed by injury, followed by displacement. Uncertainty was captured by applying the index formula to the low, best, and high estimates of these three human consequence metrics.

The Event Familiarity Factor is intended to capture the extent to which the event entails an ongoing threat with uncertainty regarding long term effects, is unfamiliar, or that people dread, exacerbating psychological consequences. This factor, ranging from 1.0 for familiar events to 1.3 for

formula were used to assign events to bins of a risk matrix for a semi-quantitative analysis of psychological risk in the SNRA.

Environmental Impact

The United States Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. Estimates are based on the following assumptions:

- Experts were elicited to provide estimates in the environmental impact category based on assumptions. Actual environmental/ecological harm that occurs as a result of the events described in a given scenario may vary considerably, and will depend on numerous variables (e.g., chemical or biological agent, contamination extent, persistence, toxicity—both chronic and acute toxicity—and infectivity).
- EPA defined environmental consequence (impact)[11] as the potential for adverse effects on living organisms associated with pollution of the environment by effluents, emissions, wastes, or accidental chemical releases; energy use; or the depletion of natural resources.
- The environmental assessment included effects resulting from terrorism threats, but did not include human health effects or effects in urban areas because these effects are already reflected in other impact measures.
- Experts identified the best estimate for environmental impacts as "Moderate." Experts indicated that the impacts will most likely be localized as effects will require direct exposure to the chemical. Aquatic runoff could disseminate certain chemicals and increase the impact on the environment. Defining variables that will determine whether or not the impacts are increased or decreased include toxicity, spread, and the persistence of the chemical agent used in the attack.

Potential Mitigating Factors

Hazardous Material (HazMat) Teams should be prepared to quickly dispatch to the target site and detect/identify the chemical agent deployed in the attack. This will determine the response steps necessary to mitigate consequences from a particular chemical agent. The hazard should be isolated and cordoned in order to prevent spreading the agent by fleeing victims. Additionally, the evacuation effort should include populations downwind from the explosion (chemical agent dependent) and emphasize at-risk or special populations in order to enhance mitigation efforts. Planners should note the importance of effective communication during the response effort to inform the public about evacuation routes, contaminated areas, and potential victims who may have experienced exposure to the chemical agent.

unfamiliar events, was provided by subject matter experts for each national-level event included in the SNRA: Chemical Terrorism Attack (non-food) was given a C_{EF} of 1.3.

The numerical psychological distress estimates for this event and the complete semi-quantitative risk matrix may be found in Appendix G and the Findings sections, respectively, of the classified SNRA Technical Report.

[11] The 2011 SNRA referred to impacts as 'consequences' because of prior usage in quantitative risk assessment (Kaplan and Garrick [1981, March], On the quantitative definition of risk: *Risk Analysis* 1(1) 11-32). Except where it will cause confusion, 'impact' is used synonymously in this document because of pre-existing connotations of the word 'consequence' within FEMA.

Additional Relevant Information

The severity of an attack is related to the toxicity of the chemical and its concentration when it reaches people. Many variables affect the concentration of a chemical, including the volatility of the chemical and environmental conditions.

The release of toxic chemicals in closed spaces, such as subways, airports, and financial centers, could deliver doses high enough to injure or kill a large number of people. A volatile chemical will disperse to fill the space. The smaller the space, the greater the concentration of the chemical.

In an open area, a toxic chemical cloud (plume) would become less concentrated as it spreads and would have to be released in large quantities to produce many casualties. The area affected would depend upon such factors as the type and amount of chemical agent, the means of dispersal, the local topography, and the local weather conditions. A toxic cloud would spread roughly with the speed and direction of the wind. For a highly toxic chemical, lethal or immediately life-threatening results could be seen close to the release point of the agent where its concentration is highest. However, the concentration of the chemical, and consequently its human health risk, would be greatly diminished at distances far from the source.[12]

[12] National Academies and U.S. Department of Homeland Security (2004), op. cit.

Chemical/Biological Food Contamination Terrorism Attack

A hostile non-state actor(s) acquires, weaponizes, and disperses a biological or chemical agent into food supplies within the U.S. supply chain.

Data Summary

Category	Description	Metric	Low	Best	High
Health and Safety	Fatalities	Number of Fatalities	See classified data sheet		
	Injuries and Illnesses	Number of Injuries or Illnesses	See classified data sheet		
Economic	Direct Economic Loss	U.S. Dollars (2011)	See classified data sheet		
Social	Social Displacement	People Displaced from Home ≥ 2 Days	0	N/A	N/A
Psychological	Psychological Distress	Qualitative Bins	See classified data sheet		
Environmental	Environmental Impact	Qualitative Bins[1]	Low[2]		
LIKELIHOOD	Frequency of Events	Number of Events per Year	See classified data sheet		

(UNCLASSIFIED)

Event Background

The SNRA considered biological and chemical attacks on the food supply chain in this event.

A terrorist attack on the Nation's food supply chain using chemical or biological agents may initially be indistinguishable from an unintentional food contamination. Depending on the type of agent used in the attack, it could take several days for individuals to show symptoms and possibly weeks before public health, food, and medical authorities suspect terrorism as the source.[3] In 1984 members of the Rajneeshees, a religious community in an accelerating political dispute with the Oregon county where they had established their commune, deliberately contaminated salad bars at eight county restaurants with *Salmonella* bacteria, infecting or sickening 751 people and hospitalizing 45.[4] However, deliberate contamination was not

[1] In 2011, the U. S. Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental consequences for this event. The comments and rankings presented in this Risk Summary Sheet have not undergone review by the EPA and only represent the opinions of the group. Estimates pertain to the potential for adverse effects on living organisms associated with pollution of the environment; they are grouped into high, moderate, low, and de minimus (none) categories. Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[2] Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[3] Federal Emergency Management Agency (August 2008), Food and Agricultural Incident Annex, p. 2, at http://www.fema.gov/pdf/emergency/nrf/nrf_FoodAgricultureIncidentAnnex.pdf (retrieved January 2015).

[4] This was to test a plan to poison the county water supply on Election Day, to suppress voter turnout and enable the group to take over the county board by electing their own candidates. Török et al (1997, August 6). A large community outbreak of Salmonellosis caused by intentional contamination of restaurant salad bars. *Journal of the American Medical Association (JAMA)* 278(5) 389-395; at http://www.cdc.gov/phlp/docs/forensic_epidemiology/Additional%20Materials/Articles/Torok%20et%20al.pdf (retrieved May 2014). Although unsuccessful in identifying deliberate action as the cause of the poisoning, CDC and FBI investigations following the incident may have deterred the group from carrying out their planned Election Day attack in November. Sobel et al (2002, March 9). Threat of a biological attack on the US food supply: the CDC perspective. *Lancet* 359(9309) 874-880.

identified until a year later, when the commune collapsed and criminal investigations into its other activities uncovered its clandestine biological laboratories.[5,6]

Chemical and biological weapons differ in potential toxicity, specificity, speed of action, duration of effect, controllability, and residual effects. Children, the elderly, pregnant women, and immune-compromised individuals are particularly susceptible to the adverse effects of a chemical/biological food contamination.[7,8]

This National-level Event focuses on chemical and biological attacks targeting food supplies within the U.S. supply chain. Note that the risks of chemical and biological attacks aimed at non-food targets are considered in separate National-level Events in the SNRA and should not be considered for this event.

Assumptions

The SNRA leveraged classified data from the DHS/S&T 2011 Integrated Terrorism Risk Assessment (ITRA)[9] for quantitative frequency, fatality, illness/injury, and economic loss estimates for the chemical/biological food contamination terrorism attack event. The data relies heavily on the Intelligence Community (IC) and other technical experts to develop scenarios and estimate the likelihoods of those scenarios for analysis. The DHS Science and Technology Directorate (S&T) extracted ITRA data for chemical and biological attacks on food and beverage targets to permit analysis of chemical-biological food attacks as a national-level event in the SNRA distinct from attacks on non-food targets.

The SNRA leveraged data for the classified risk summary sheet that assumed terrorist attack to include the following:

- Involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources;
- Involves an act that is a violation of the criminal laws of the United States or any State or other subdivision of the United States;
- Appears to be intended to intimidate or coerce a civilian population;
- Appears to be intended to influence the policy of a government by intimidation or coercion; or
- Appears to be intended to affect the conduct of government by mass destruction, assassination, or kidnapping.

The SNRA only includes data for successful attacks for this national-level event, e.g., detonation of a device or release of an agent. Failed attacks are not considered during this analysis (e.g., interdiction during the fabrication and assembly of the dissemination device, interdiction during travel to United States, or failure of the dissemination device).

[5] Török et al, *op cit.*
[6] Carus, W. Seth (2001, February). Bioterrorism and biocrimes: the illicit use of biological agents since 1900. Pages 50-58. National Defense University; at http://www.ndu.edu/centercounter/full_doc.pdf (retrieved March 2013). Agents experimented with included *Salmonella typhimurium*, the variant which was used in the salad bar attacks, *Salmonella typhi* which causes hepatitis and typhoid fever, *Giardia*, HIV, and multiple chemical and pharmaceutical poisons. *Giardia lamblia* was to be introduced into the county water supply via dead rats and beavers, which carry the parasite (p. 54).
[7] United Nations (1970). Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, p. 12. Report of the Secretary-General, UN Publication no. E.69.I.24. Reprinted by Ballantine Books, 1970.
[8] FEMA (2008), *op. cit.*
[9] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).

The analysis used broad definitions of organizations that may initiate or represent potential chemical or biological terrorism threats to the U.S. supply chain, the categories of chemical agents that could be used for an attack, and the targets that may be selected for a chemical attack. The adopted criteria for general categories representing chemical/biological food terrorist threats to the U.S. are as follows:

- The International Terrorist Organization category is composed of terrorist organizations that operate both inside and outside of the U.S. that are not sponsored by a nation (e.g., al-Qaeda).
- The State-Sponsored Terrorist Organization category is composed of terrorist organizations that operate inside and/or outside of the U.S. that are sponsored by a nation. Sponsorship is defined as the provision of technical assistance, equipment, or chemical by a state program (e.g., Hezbollah).
- The Domestic Terrorist Organization category is composed of terrorist organizations that operate only within the U.S. that are not sponsored by a nation (e.g., Animal Liberation Front and Rajneesh).
- The Small Groups/Individuals Terrorist Organization category is composed of small groups (i.e., 2 to 3 members) or individuals that operate only within the U.S. that are not sponsored by a nation (e.g., the Unabomber and Timothy McVeigh).

The SNRA project team used the following assumptions identified in Table 1 to estimate the economic losses for this national-level event.

Table 1. Definitions for Direct, Indirect, and Induced Costs

Direct Costs include: • **Decontamination, Disposal, and Physical Destruction:** DDP costs covered the repair, replacement and environmental clean-up which are considered expenditures by the government. It was assumed the government would recoup this spending through tax increases, causing a reduction of household spending of that same amount. However, this spending would be received as income by some sectors, such as waste management and environmental consulting services. The increase in spending into the waste management and environmental consulting services is treated as increase in annual output for these sectors. • **Business Interruption:** Business interruption impacts considered losses due to decreased output at the target area, along with other increases and decreases to related sectors due to behavioral changes resulting from the event. • **Loss in Spending from Fatalities:** This SNRA project team estimated a loss of spending of $42,500 for each fatality. In addition, $6,000 is included in increased output for mortuary services for each fatality. • **Medical Costs:** Costs of medical mitigation were considered to be borne through private spending and insurance companies, while the hospital sector received an offsetting increase in output.
Indirect Costs include: • Costs incurred by the suppliers and vendors in the associated expenditure sectors for the

industries impacted by the direct costs above.

Induced Costs include:

- The induced costs are those incurred due to reduced spending by households with members employed in any of the directly or indirectly affected industries. Induced costs can also include substitution effects or likely transfers of economic activity from one set of sectors to another set, such as avoidance of air or other travel or altered transportation mode preferences to other sectors following an attack on the commercial air transport sector.

Social Displacement

For the purposes of the SNRA, social displacement was defined as the number of people forced to leave home for a period of two days or longer. Note that there are limitations to this measure of social displacement, as the significant differences between temporary evacuations and permanent displacement due to property destruction are not captured.

- Subject matter experts from the National Consortium for the Study of Terrorism and Responses to Terrorism (START)[10] judged that although a terrorist chemical or biological attack against the food chain could sicken or kill many people, it was unlikely to force people to evacuate or leave their homes. Note that deaths and unplanned hospital stays are not considered social displacement for the purposes of the SNRA.

Psychological Distress

Psychological impacts for the SNRA focus on *significant distress* and *prolonged distress*, which can encompass a variety of outcomes serious enough to impair daily role functioning and quality of life. An index for significant distress was created that reflected empirical findings that the scope and severity of an event is more important than the type of event. The equation for this index uses the fatalities, injuries, and displacement associated with an event as primary inputs; a factor elicited from subject matter experts weights the index for differing psychological impact based on the type of event, but as a secondary input.[11] The numerical outputs of this index formula were used to assign events to bins of a risk matrix for a semi-quantitative analysis of psychological risk in the SNRA.

[10] START is a Department of Homeland Security University Center of Excellence that focuses on social and behavioral aspects of terrorism, natural disasters, and technological accidents, and the social, behavioral, cultural and economic factors influencing responses to and recovery from catastrophes.

[11] The Significant Distress Index is calculated from these inputs using a formula proposed by subject matter experts consulted for the SNRA project: $N_{SD} = C_{EF} \times (5\,Fat + Inj + \frac{1}{2}\,D)$, where N_{SD} represents the number of persons significantly distressed, C_{EF} is the expert assessed Event Familiarity Factor, *Fat* is the number of fatalities, *Inj* is the number of injuries and/or illnesses, and *D* is the number of persons displaced (Social Displacement). In words, this formula suggests that there are 5 significantly distressed persons for each life lost; 1 for each person injured; and 1 for each 2 people displaced. This formula was constructed to reflect the empirical finding that the most severe stressor of a disaster is losing a loved one, followed by injury, followed by displacement. Uncertainty was captured by applying the index formula to the low, best, and high estimates of these three human impact metrics.

The Event Familiarity Factor is intended to capture the extent to which the event entails an ongoing threat with uncertainty regarding long term effects, is unfamiliar, or that people dread, exacerbating psychological impacts. This factor, ranging from 1.0 for familiar events to 1.3 for unfamiliar events, was provided by subject matter experts for each national-level event included in the SNRA: Chemical/Biological Food Contamination Terrorism Attack was given a C_{EF} of 1.3.

The numerical psychological distress estimates for this event and the complete semi-quantitative risk matrix may be found in Appendix G and the Findings sections, respectively, of the classified SNRA Technical Report.

Environmental Impact

The United States Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. Estimates are based on the following assumptions:

- Experts were elicited to provide estimates in the environmental impact category based on assumptions. Actual environmental/ecological harm that occurs as a result of the events described in a given scenario may vary considerably, and will depend on numerous variables (e.g., chemical or biological agent, contamination extent, persistence, toxicity—both chronic and acute toxicity—and infectivity).
- EPA defined environmental consequence (impact)[12] as the potential for adverse effects on living organisms associated with pollution of the environment by effluents, emissions, wastes, or accidental chemical releases; energy use; or the depletion of natural resources.
- The environmental assessment included effects resulting from terrorism threats, but did not include human health effects or effects in urban areas because these effects are already reflected in other impact measures.
- Experts identified the best estimate for environmental impacts as "low." Experts indicated that this hazard is directed towards humans leading the environmental impacts to be minimal. If the agent is introduced into an agricultural setting, there could be consequences for the local ecosystem. Waste disposal is one of the primary concerns and depending on the volume of material this could lead to more significant environmental impacts.

Potential Mitigating Factors

Population exposure can be limited with fast and accurate identification of the agent and vehicle (water, milk, lettuce, etc.) utilized to target the food supply system. A prepared public communications plan will assist in further limiting the spread, while also mitigating the economic losses associated with falsely identifying the food supply contaminant.

Additional References

Khan et al (2001). Precautions against biological and chemical terrorism directed at food and water supplies. *Public Health Review* 116 (January-February 2001) 3-14.

Mohtadi et al (2009). Risk analysis of chemical, biological, or radionuclear threats: implications for food security. *Risk Analysis* 29(9) 1317-1335.

World Health Organization (2008, May). Terrorist threats to food: Guidance for establishing and strengthening prevention and response systems. At http://www.who.int/foodsafety/publications/fs_management/terrorism/en/ (checked April 2013).

[12] The 2011 SNRA referred to impacts as 'consequences' because of prior usage in quantitative risk assessment (Kaplan and Garrick [1981, March], On the quantitative definition of risk: *Risk Analysis* 1(1) 11-32). Except where it will cause confusion, 'impact' is used synonymously in this document because of pre-existing connotations of the word 'consequence' within FEMA.

Nuclear Terrorism Attack

A hostile non-state actor(s) acquires an improvised nuclear weapon through manufacture from fissile material, purchase, or theft, and detonates it within a major U.S. population center.

Data Summary

Category	Description	Metric	Low	Best	High
Health and Safety	Fatalities	Number of Fatalities	See classified data sheet		
	Injuries and Illnesses	Number of Injuries or Illnesses	See classified data sheet		
Economic	Direct Economic Loss	U.S. Dollars (2011)	See classified data sheet		
Social	Social Displacement	People Displaced from Home ≥ 2 Days	330,000	2 million	3 million
Psychological	Psychological Distress	Qualitative Bins	See classified data sheet		
Environmental	Environmental Impact	Qualitative Bins[1]	High[2]		
LIKELIHOOD	Frequency of Events	Number of Events per Year	See classified data sheet		

(UNCLASSIFIED)

Event Background

The Department of Homeland Security (DHS) and Federal Bureau of Investigation (FBI) define a nuclear attack as follows:

> A nuclear weapon is a device with explosive power resulting from the release of energy unleashed by the splitting of nuclei of a heavy chemical element, such as plutonium or uranium (fission), or by the fusing of nuclei from a light element, such as hydrogen (fusion). Fusion (thermonuclear) bombs can be significantly more powerful than fission bombs, but are at this point believed to be beyond the capability of terrorists to construct.[3]

A successful nuclear attack would cause substantial fatalities, injuries, and infrastructure damage from the heat and blast of the explosion, and significant radiological consequences from both the initial nuclear radiation and the radioactive fallout that settles after the initial event. A nuclear detonation in a modern urban area would impact the medical system more than any disaster previously experienced by the Nation.[4] An electromagnetic pulse from the explosion could also

[1] In 2011, the U. S. Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. The comments and rankings presented in this Risk Summary Sheet have not undergone review by the EPA and only represent the opinions of the group. Estimates pertain to the potential for adverse effects on living organisms associated with pollution of the environment; they are grouped into high, moderate, low, and de minimus (none) categories. Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[2] Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[3] "Potential Terrorist Attack Methods: Joint Special Assessment", DHS & FBI, 23 April 2008, p. 36. (Reference is (UNCLASSIFIED//FOR OFFICIAL USE ONLY): Extracted information is UNCLASSIFIED.)

[4] National Security Staff Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats.(2010, June), *Planning Guidance for Response to a Nuclear Detonation* (2nd ed), p. 81.

disrupt telecommunications and power distribution. Significant economic, social, psychological, and environmental impacts would be expected.[5]

Nuclear explosions are classified by yield, or the amount of energy they produce, relative to how many tons of TNT would be needed to produce an equivalent explosive yield. Strategic nuclear weapon systems held by state actors deliver weapons with yields in the multi-hundred kilotons to megaton (1,000 kiloton) range. Generally, when considering nuclear explosion scenarios perpetrated by terrorists, experts assume a low-yield nuclear device detonated at ground level, where low yield in this context ranges from factions of a kiloton (kT) to 10 kT.[6] This is still orders of magnitude greater than conventional explosives which may be used in a terrorist attack: for comparison, the 1995 Oklahoma City bombing was equivalent to 2 tons of TNT, or 0.002 kilotons.[7]

There are two general types of nuclear weapons a terrorist may acquire and use: illicitly acquired weapons produced by nation-states and improvised nuclear devices (INDs).

- The former are designed, constructed, and usually tested using the resources of a sovereign state. They are typically reliable, high-yield weapons designed for a delivery vehicle, such as an aircraft or missile.
- An IND, by contrast, would be a crude nuclear device built from components of a stolen weapon or from scratch using nuclear material. The primary obstacle to terrorists attempting to construct a viable IND is obtaining the weapons-grade fissile material—plutonium, highly enriched uranium, or a stolen state-manufactured weapon—needed to produce a nuclear explosion.
- Crude nuclear weapons are typically heavy, ranging from a few hundred pounds to several tons. Smaller, specially designed systems such as the so-called suitcase nuclear weapons are much lighter but more technically difficult to produce.[8]

Assumptions

The SNRA leveraged classified data from the DHS/S&T 2011 Integrated Terrorism Risk Assessment (ITRA)[9] for quantitative frequency, fatality, illness/injury, and economic loss estimates for the nuclear terrorism attack event. The data relies heavily on the Intelligence Community (IC) and other technical experts to develop scenarios and estimate the likelihoods of those scenarios for analysis. The DHS Science and Technology Directorate (S&T) extracted ITRA data for successful terrorist attacks corresponding to the five CBRN national-level events in the SNRA.

The SNRA leveraged data for the classified risk summary sheet that assumed terrorist attack to include the following:

- Involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources;

[5] National Academies, U.S. Department of Homeland Security (2005). Nuclear attack. Fact sheet for the public (series, Communicating in a Crisis). Retrieved from http://www.dhs.gov/xlibrary/assets/prep_nuclear_fact_sheet.pdf via http://www.ready.gov (checked April 2015).
[6] It should be noted that if a state-built weapon were available to terrorists, the presumption of low yield may no longer hold. NSS (2010) *op cit.,* p. 15.
[7] National Academies, DHS (2005), Nuclear attack public fact sheet, *op cit.;* p. 16, NSS 2010, *op cit.*
[8] National Academies, DHS (2005), Nuclear attack public fact sheet, *op cit.*
[9] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).

- Involves an act that is a violation of the criminal laws of the United States or any State or other subdivision of the United States;
- Appears to be intended to intimidate or coerce a civilian population;
- Appears to be intended to influence the policy of a government by intimidation or coercion;
- Appears to be intended to affect the conduct of government by mass destruction, assassination, or kidnapping.

Nine U.S. cities were considered in calculating the probabilities and impacts of the attack. The cities were chosen to sample a variety of locations and population densities and included New York, Washington, Houston, and Miami. Impacts of the attack were evaluated for four yields across the nine cities and were evaluated 12 times throughout the year to sample atmospheric conditions at detonation.

The SNRA project team used the following assumptions identified in Table 1 to estimate the economic losses for this national-level event.

Table 1. Definitions for Direct, Indirect, and Induced Costs

Direct Costs include: • **Decontamination, Disposal, and Physical Destruction:** DDP costs covered the repair, replacement and environmental clean-up which are considered expenditures by the government. It was assumed the government would recoup this spending through tax increases, causing a reduction of household spending of that same amount. However, this spending would be received as income by some sectors, such as waste management and environmental consulting services. The increase in spending into the waste management and environmental consulting services is treated as increase in annual output for these sectors. • **Business Interruption:** Business interruption impacts considered losses due to decreased output at the target area, along with other increases and decreases to related sectors due to behavioral changes resulting from the event. • **Loss in Spending from Fatalities:** This SNRA project team estimated a loss of spending of $42,500 for each fatality. In addition, $6,000 is included in increased output for mortuary services for each fatality. • **Medical Costs:** Costs of medical mitigation were considered to be borne through private spending and insurance companies, while the hospital sector received an offsetting increase in output.
Indirect Costs include: • Costs incurred by the suppliers and vendors in the associated expenditure sectors for the industries impacted by the direct costs above.
Induced Costs include: • The induced costs are those incurred due to reduced spending by households with members employed in any of the directly or indirectly affected industries. Induced costs can also include substitution effects or likely transfers of economic activity from one set

of sectors to another set, such as avoidance of air or other travel or altered transportation mode preferences to other sectors following an attack on the commercial air transport sector.

Social Displacement

For the purposes of the SNRA, social displacement was defined as the number of people forced to leave home for a period of two days or longer. Note that there are limitations to this measure of social displacement, as the significant differences between temporary evacuations and permanent displacement due to property destruction are not captured.

- Social displacement estimates for the Nuclear Terrorism Attack national-level event were provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (START).[10]
- The low, best, and high social displacement estimates of 330,000, 2 million, and 3 million for the Nuclear Terrorism Attack event reflect judgments from START subject matter experts, based on published evacuation/shelter-in-place estimates for a detonated 10 kiloton improvised nuclear device.[11]

Psychological Distress

Psychological impacts for the SNRA focus on *significant distress* and *prolonged distress*, which can encompass a variety of outcomes serious enough to impair daily role functioning and quality of life. An index for significant distress was created that reflected empirical findings that the scope and severity of an event is more important than the type of event. The equation for this index uses the fatalities, injuries, and displacement associated with an event as primary inputs; a factor elicited from subject matter experts weights the index for differing psychological impact based on the type of event, but as a secondary input.[12] The numerical outputs of this index formula were used to assign events to bins of a risk matrix for a semi-quantitative analysis of psychological risk in the SNRA.

Environmental Impact

The United States Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk,

[10] START is a Department of Homeland Security University Center of Excellence that focuses on social and behavioral aspects of terrorism, natural disasters, and technological accidents, and the social, behavioral, cultural and economic factors influencing responses to and recovery from catastrophes.

[11] Davis, Tracy C. 2007. "Stages of Emergency: Cold War Nuclear Civil Defense." Duke University Press.; Meade C, Molander R.C. Considering the Effects of a Catastrophic Terrorist Attack. Santa Monica, CA: RAND Center for Terrorism Risk Management Policy; 2006. http://www.rand.org/pubs/technical_reports/2006/RAND_TR391.pdf; National Security Staff Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats. Planning Guidance for Response to a Nuclear Detonation. 2nd Edition; 2010. http://www.remm.nlm.gov/PlanningGuidanceNuclearDetonation.pdf.

[12] The Significant Distress Index is calculated from these inputs using a formula proposed by subject matter experts consulted for the SNRA project: $N_{SD} = C_{EF} \times (5\ Fat + Inj + \frac{1}{2}\ D)$, where N_{SD} represents the number of persons significantly distressed, C_{EF} is the expert assessed Event Familiarity Factor, *Fat* is the number of fatalities, *Inj* is the number of injuries and/or illnesses, and *D* is the number of persons displaced (Social Displacement). In words, this formula suggests that there are 5 significantly distressed persons for each life lost; 1 for each person injured; and 1 for each 2 people displaced. This formula was constructed to reflect the empirical finding that the most severe stressor of a disaster is losing a loved one, followed by injury, followed by displacement. Uncertainty was captured by applying the index formula to the low, best, and high estimates of these three human impact metrics.

The Event Familiarity Factor is intended to capture the extent to which the event entails an ongoing threat with uncertainty regarding long term effects, is unfamiliar, or that people dread, exacerbating psychological impacts. This factor, ranging from 1.0 for familiar events to 1.3 for unfamiliar events, was provided by subject matter experts for each national-level event included in the SNRA: Nuclear Terrorism Attack was given a C_{EF} of 1.3.

The numerical psychological distress estimates for this event and the complete semi-quantitative risk matrix may be found in Appendix G and the Findings sections, respectively, of the classified SNRA Technical Report.

toxicology, and disaster field operations management to estimate environmental impacts for this event. Estimates are based on the following assumptions:

- Experts were elicited to provide estimates in the environmental impact category based on assumptions. Actual environmental/ecological harm that occurs as a result of the events described in a given scenario may vary considerably, and will depend on numerous variables (e.g., chemical or biological agent, contamination extent, persistence, toxicity—both chronic and acute toxicity—and infectivity).
- EPA defined environmental consequence (impact)[13] as the potential for adverse effects on living organisms associated with pollution of the environment by effluents, emissions, wastes, or accidental chemical releases; energy use; or the depletion of natural resources.
- The environmental assessment included effects resulting from terrorism threats, but did not include human health effects or effects in urban areas because these effects are already reflected in other impact measures.
- Experts identified the best estimate for environmental impacts as "High." Experts indicated that the environmental impacts would be high due to the size and effect of the fallout and the persistence of the material. The relative toxicity may be moderate, since isotopes could be remediated. Ultimately, the long-term impact to the environment could be more moderate, but the impact would be high for in the short and intermediate term (1 year or more).

Additional Relevant Information

The consequences of a nuclear attack would be determined by the following effects of a detonation:

- *Air blast:* As with a conventional explosive, a nuclear detonation produces a shock wave, or air blast wave.
- *Heat:* The second effect would be extreme heat, a fireball, with temperatures reaching to millions of degrees.
- *Initial radiation:* The initial radiation is produced in the first minute following detonation.
- *Ground shock:* Ground shocks roughly equivalent to a large localized earthquake would also occur. This could cause additional damage to buildings, communications, roads, utilities and other critical infrastructure.
- *Secondary radiation:* Secondary radiation exposure from fallout would occur primarily downwind from the blast, but changing weather conditions could spread radioactivity and enlarge the affected area.

A failed detonation is potentially hazardous to the extent that it results in a fizzle yield, which occurs if the fissile material mechanically disassembles before a significant yield is generated. Even a fizzle yield, however, can produce a fairly large explosion that could disperse radioactive material widely.

[13] The 2011 SNRA referred to impacts as 'consequences' because of prior usage in quantitative risk assessment (Kaplan and Garrick [1981, March], On the quantitative definition of risk: *Risk Analysis* 1(1) 11-32). Except where it will cause confusion, 'impact' is used synonymously in this document because of pre-existing connotations of the word 'consequence' within FEMA.

Radiological Dispersal Device Attack

A hostile non-state actor(s) acquires radiological materials and disperses them through explosive or other means or creates a radiation exposure device (RED).

Data Summary

Category	Description	Metric	Low	Best	High
Health and Safety	Fatalities	Number of Fatalities	See classified data sheet		
	Injuries and Illnesses	Number of Injuries or Illnesses	See classified data sheet		
Economic	Direct Economic Loss	U.S. Dollars (2011)	See classified data sheet		
Social	Social Displacement	People Displaced from Home ≥ 2 Days	25,000	50,000	100,000
Psychological	Psychological Distress	Qualitative Bins	See classified data sheet		
Environmental	Environmental Impact	Qualitative Bins[1]	Low[2]		
LIKELIHOOD	Frequency of Events	Number of Events per Year	See classified data sheet		

(UNCLASSIFIED)

Event Background

Radiological devices used for terrorism may include radiological dispersal devices (RDD) and radiological exposure devices (RED). The principal type of RDD is a "dirty bomb" that combines a conventional explosive with radioactive material. A second type involves radioactive material dispersed in air or water by other mechanical means, such as a water spray truck, a crop duster, or manually spread. An RED may comprise a powerful radioactive source hidden in a public place, such as a trash receptacle in a busy train or subway station, to expose passers-by to a potentially significant dose of radiation.[3]

It is very difficult to design an RDD that would deliver radiation doses high enough to cause immediate health effects or fatalities in a large number of people. Most injuries from a dirty bomb would probably occur from the heat, debris, and force of the conventional explosion used to disperse the radioactive material, affecting individuals close to the site of the explosion. At the low radiation levels expected from an RDD, the immediate health effects from radiation

[1] In 2011, the U. S. Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. The comments and rankings presented in this Risk Summary Sheet have not undergone review by the EPA and only represent the opinions of the group. Estimates pertain to the potential for adverse effects on living organisms associated with pollution of the environment; they are grouped into high, moderate, low, and de minimus (none) categories. Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[2] Experts provided both first and second choice categories, allowing the experts to express uncertainty in their judgments as well as reflect the range of potential effects that might result depending on the specifics of the event. The first choice represents the 'best' estimate.

[3] U.S. Environmental Protection Agency (2006, October). OSC Radiological Response Guidelines. Office of Solid Waste and Emergency Response, Office of Air and Radiation, U.S. EPA; at http://www.uscg.mil/hq/nsfweb/foscr/ASTFOSCRSeminar/References/EnvResponsePapersFactSheets/OSCRadResponseGuidelines.pdf (retrieved April 2013).

exposure would likely be minimal.[4] Subsequent decontamination of the affected area could involve considerable time and expense. A dirty bomb could have significant psychological and economic effects.[5]

Most radiological devices would have very localized effects, ranging from less than a city block to several square miles. Factors determining the area of contamination would include the amount and type of radioactive material, the means of dispersal, the physical and chemical form of the radioactive material (for example, material dispersed in the form of fine particles may be carried by the wind over a relatively large area), local topography and location of buildings, and local weather conditions.[6]

Preparedness and effectiveness of response teams will play a significant role in mitigating the impacts caused by an RDD attack. Early identification of a radiological attack is important in determining whether or not to evacuate the area or shelter in place and the size of the area requiring cordoning.

There is evidence indicating terrorist organizations have expressed interest in using RDDs, though experts disagree as to how attractive they are as a tactic due to the limited number of expected casualties and the challenges associated with acquiring and handling radiological material. However, others assert that the resulting psychological and economic impacts may be enough for terrorists to risk the difficulties in pursuing this as a method for attack.[7]

Assumptions

The SNRA leveraged classified data from the DHS/S&T 2011 Integrated Terrorism Risk Assessment (ITRA)[8] for quantitative frequency, fatality, illness/injury, and economic loss estimates for the radiological terrorism attack event. The data relies heavily on the Intelligence Community (IC) and other technical experts to develop scenarios and estimate the likelihoods of those scenarios for analysis. The DHS Science and Technology Directorate (S&T) extracted ITRA data for successful terrorist attacks corresponding to the five CBRN national-level events in the SNRA.

The SNRA leveraged data for the classified risk summary sheet that assumed the qualifiers for terrorist attack to include the following:

- Involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources;
- Involves an act that is a violation of the criminal laws of the United States or any State or other subdivision of the United States;
- Appears to be intended to intimidate or coerce a civilian population;
- Appears to be intended to influence the policy of a government by intimidation or coercion;
- Appears to be intended to affect the conduct of government by mass destruction, assassination, or kidnapping.

[4] National Academies and U.S. Department of Homeland Security (2005). Radiological attack: dirty bombs and other devices. Retrieved from http://www.dhs.gov/radiological-attack-fact-sheet via http://www.ready.gov.
[5] EPA (2006) OSC Radiological Response Guidelines, *op. cit.*.
[6] Ibid.
[7] Dana A. Shea, "Radiological Dispersal Devices: Select Issues in Consequence Management," Congressional Research Service for the Library of Congress (December 7, 2004).
[8] DHS Directorate of Science & Technology (2011), Integrated CBRN Terrorism Risk Assessment (reference is SECRET//NOFORN).

The analysis only included data for successful attacks for this national-level event, e.g. detonation of the device or successful spread into the food or water system. Failed attacks were not included in this analysis (e.g., interdiction during the fabrication and assembly of the dispersal device, interdiction during travel to United States, or failure of the dispersal device).

The analysis used broad definitions of organizations that may initiate or represent potential radiological terrorism threats to the U.S., the categories of radionuclides that could be used for an attack, and the targets that may be selected for a radiological attack. The adopted criteria for general categories representing radiological terrorist threats to the U.S. are as follows:

- The International Terrorist Organization category is composed of terrorist organizations that operate both inside and outside of the U.S. that are not sponsored by a nation (e.g., al-Qaeda).
- The Domestic Terrorist Organization category is composed of terrorist organizations that operate only within the U.S. that are not sponsored by a nation (e.g., Animal Liberation Front and Rajneesh).
- The Small Groups/Individuals Terrorist Organization category is composed of small groups (i.e., 2 to 3 members) or individuals that operate only within the U.S. that are not sponsored by a nation (e.g., the Unabomber and Timothy McVeigh).

The SNRA project team used the following assumptions identified in Table 1 to estimate the economic losses for this national-level event.

Table 1. Definitions for Direct, Indirect, and Induced Costs

Direct Costs include: • **Decontamination, Disposal, and Physical Destruction:** DDP costs covered the repair, replacement and environmental clean-up which are considered expenditures by the government. It was assumed the government would recoup this spending through tax increases, causing a reduction of household spending of that same amount. However, this spending would be received as income by some sectors, such as waste management and environmental consulting services. The increase in spending into the waste management and environmental consulting services is treated as increase in annual output for these sectors. • **Business Interruption:** Business interruption impacts considered losses due to decreased output at the target area, along with other increases and decreases to related sectors due to behavioral changes resulting from the event. • **Loss in Spending from Fatalities:** This SNRA project team estimated a loss of spending of $42,500 for each fatality. In addition, $6,000 is included in increased output for mortuary services for each fatality. • **Medical Costs:** Costs of medical mitigation were considered to be borne through private spending and insurance companies, while the hospital sector received an offsetting increase in output.
Indirect Costs include: • Costs incurred by the suppliers and vendors in the associated expenditure sectors for the industries impacted by the direct costs above.

Induced Costs include:

- The induced costs are those incurred due to reduced spending by households with members employed in any of the directly or indirectly affected industries. Induced costs can also include substitution effects or likely transfers of economic activity from one set of sectors to another set, such as avoidance of air or other travel or altered transportation mode preferences to other sectors following an attack on the commercial air transport sector.

Social Displacement

For the purposes of the SNRA, social displacement was defined as the number of people forced to leave home for a period of two days or longer. Note that there are limitations to this measure of social displacement, as the significant differences between temporary evacuations and permanent displacement due to property destruction are not captured.

- Social displacement estimates for the Radiological Terrorism Attack national-level event were provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (START).[9]
- The low, best, and high social displacement estimates of 25,000, 50,000, and 100,000 for the Radiological Terrorism Attack event reflect judgments from START subject matter experts, based on published evacuation/shelter-in-place estimates for radiological dispersal device (RDD) attack scenarios.[10]

Psychological Distress

Psychological impacts for the SNRA focus on *significant distress* and *prolonged distress*, which can encompass a variety of outcomes serious enough to impair daily role functioning and quality of life. An index for significant distress was created that reflected empirical findings that the scope and severity of an event is more important than the type of event. The equation for this index uses the fatalities, injuries, and displacement associated with an event as primary inputs; a factor elicited from subject matter experts weights the index for differing psychological impact based on the type of event, but as a secondary input.[11] The numerical outputs of this index formula were used to assign events to bins of a risk matrix for a semi-quantitative analysis of psychological risk in the SNRA.

[9] START is a Department of Homeland Security University Center of Excellence that focuses on social and behavioral aspects of terrorism, natural disasters, and technological accidents, and the social, behavioral, cultural and economic factors influencing responses to and recovery from catastrophes.

[10] Worcester, Maxim. "International Terrorism and the Threat of a Dirty Bomb." Institute Fur Strategies, Politik, Sicherheits, und Wirtschaftsberatung, Berlin.

[11] The Significant Distress Index is calculated from these inputs using a formula proposed by subject matter experts consulted for the SNRA project: $N_{SD} = C_{EF} \times (5\ Fat + Inj + \frac{1}{2}\ D)$, where N_{SD} represents the number of persons significantly distressed, C_{EF} is the expert assessed Event Familiarity Factor, *Fat* is the number of fatalities, *Inj* is the number of injuries and/or illnesses, and *D* is the number of persons displaced (Social Displacement). In words, this formula suggests that there are 5 significantly distressed persons for each life lost; 1 for each person injured; and 1 for each 2 people displaced. This formula was constructed to reflect the empirical finding that the most severe stressor of a disaster is losing a loved one, followed by injury, followed by displacement. Uncertainty was captured by applying the index formula to the low, best, and high estimates of these three human impact metrics.

The Event Familiarity Factor is intended to capture the extent to which the event entails an ongoing threat with uncertainty regarding long term effects, is unfamiliar, or that people dread, exacerbating psychological impacts. This factor, ranging from 1.0 for familiar events to 1.3 for unfamiliar events, was provided by subject matter experts for each national-level event included in the SNRA: Radiological Terrorism Attack was given a C_{EF} of 1.3.

The numerical psychological distress estimates for this event and the complete semi-quantitative risk matrix may be found in Appendix G and the Findings sections, respectively, of the classified SNRA Technical Report.

Environmental Impact

The United States Environmental Protection Agency (EPA) convened an ad hoc group of environmental experts representing the fields of environmental science, ecological risk, toxicology, and disaster field operations management to estimate environmental impacts for this event. Estimates are based on the following assumptions:

- Experts were elicited to provide estimates in the environmental impact category based on assumptions. Actual environmental/ecological harm that occurs as a result of the events described in a given scenario may vary considerably, and will depend on numerous variables (e.g., chemical or biological agents, contamination extent, persistence, toxicity—both chronic and acute toxicity—and infectivity).
- EPA defined environmental consequence (impact)[12] as the potential for adverse effects on living organisms associated with pollution of the environment by effluents, emissions, wastes, or accidental chemical releases; energy use; or the depletion of natural resources.
- The environmental assessment included effects resulting from terrorism threats, but did not include human health effects or effects in urban areas because these effects are already reflected in other impact measures
- Experts identified the best estimate for environmental impacts as "Low." Experts indicated that the environmental impact would be limited because: fallout would be restricted to an urban area, toxicity from likely materials would be relatively low, and the dispersion area could be relatively limited as well. Environmental impacts could be elevated to "Medium" depending on the specific scenario.

Potential Mitigating Factors

Though the effects of an RDD attack will vary by the size of the detonation device, the means of dispersal, weather conditions, and the selected radionuclide, the preparedness level and effectiveness of response teams will play a significant role in mitigating the consequences caused by an RDD attack. Those closest to the detonation site would likely sustain injuries from the explosion, but as the radioactive material spreads it becomes less concentrated and harmful.[13] Early identification of a radiological attack is important in determining whether or not to evacuate the area or shelter in place and the size of the area requiring cordoning. Additionally, the evacuation effort should include populations downwind from the explosion and also consider the needs of at-risk and special populations. Planners should note the importance of effective communication during the response effort to inform the public about evacuation routes and areas that are potentially contaminated.

In general, protection from radiation is afforded by utilizing the following principles:

- Minimizing the time exposed to radioactive materials;
- Maximizing the distance from the source of radiation; and
- Shielding from external exposure and inhaling radioactive material.[14]

[12] The 2011 SNRA referred to impacts as 'consequences' because of prior usage in quantitative risk assessment (Kaplan and Garrick [1981, March], On the quantitative definition of risk: *Risk Analysis* 1(1) 11-32). Except where it will cause confusion, 'impact' is used synonymously in this document because of pre-existing connotations of the word 'consequence' within FEMA.
[13] "Dirty Bombs: Backgrounder", United States Nuclear Regulatory Commission, May 2007.
[14] Ibid.

Appendix L: Data Sources in the Classified SNRA

Blue text indicates superseded information.

The 2011 SNRA natural hazard and technological hazard data was derived completely from unclassified data, with substantial reliance on historical records. Data within the assessment which addresses only natural hazards and technological hazards has been treated as unclassified. The following paragraphs describe the derivation of the For Official Use Only and classified SNRA data which may be found in the classified SNRA Technical Report.

Impacts

For the adversarial/human-caused events, some impact estimates were unclassified but marked For Official Use Only (U//FOUO) in accordance with DHS practice, while other impact estimates were classified by derivation.

- For the conventional attack events (Armed Assault, Explosives, and Aircraft as a Weapon) fatality and injury/illness estimates were derived from unclassified historical data, as detailed in the corresponding risk summary sheets (Appendix J, SNRA 2011 Unclassified Documentation of Findings).[1] Following DHS practice these estimates were marked as (U//FOUO). Direct economic impact estimates were calculated from (U//FOUO) models and data using the Risk Assessment Process for Informed Decision-Making (RAPID) engine.[2]
- Fatality, injury/illness, and economic impact data for the CBRN events were uniformly obtained from the DHS Directorate of Science & Technology (S&T) 2011 Integrated Terrorism Risk Assessment (ITRA). While these estimates are unclassified in their original form, the CBRN data provided by S&T to the SNRA team utilized weighted average consequences, which incorporate frequencies (the modelled relative likelihood that an attack, given occurrence, will result in consequences of a given magnitude). This calculation elevated the CBRN impact estimates provided to the SNRA project to the SECRET//NOFORN classification level of the incorporated frequency data.
- Quantitative impact data for the cyber attack events were not determined. Although the 2011 project successfully elicited quantitative frequency estimates from Intelligence Community and DHS cyber experts (see below), these experts could not reach agreement on the consequences of attacks corresponding to the estimated frequencies. The 2015 SNRA qualitatively identified a broader taxonomy of cyber events, but did not attempt to determine quantitative impact estimates.[3]

Social displacement and environmental impact estimates were unclassified for all events.

[1] The primary sources for the Aircraft as a Weapon historical fatality and injury data are the same as those in the present volume, with minor differences. The primary historical data source for the 2011 Armed Assault and Explosives Terrorism Attack events was the START Global Terrorism Database, retained as a supplementary data source for the 2015 risk summary sheets.

[2] The Risk Assessment Process for Informed Decision Making (RAPID) 2010 was a strategic level, DHS-wide process to assess risk and inform strategic planning priorities developed by the DHS Office of Risk Management & Analysis (National Protection & Programs Directorate). The RAPID engine is a suite of computational tools for calculating human and economic measures of risk and the relative effectiveness of different DHS programs in risk reduction. Like the SNRA it is a quantitative tool for calculating and comparing risks in the homeland security mission space with each other, but unlike the SNRA it is designed for additionally calculating the comparative effectiveness of different governmental programs in buying down risk.

[3] The 2015 SNRA did not attempt to elicit updated frequency estimates. Although the 2011 qualitative cyber attack risk summary sheets are included in this volume for completeness, the corresponding frequency estimates are no longer current because of the substantial evolution of the cyber risk environment since 2011.

Frequency

Quantitative estimates of the frequency with which an adversarial/human-caused attack may be initiated and successfully executed were used as measures of the likelihood of SNRA events. Where subject matter expert judgment was used to determine frequency of successful attacks, adversary intent and capability were considered implicitly by the experts, but were not explicitly quantified or characterized. Attack initiations may occur with higher frequency than the ranges provided.

Due to the short timeline imposed by the PPD-8 Implementation Plan, the 2011 SNRA project team made a concerted effort to rely on previously conducted analyses wherever possible. Appropriate prior analysis had been accomplished for the CBRN, aircraft-as-a-weapon, and explosives terrorism attack events. For these events, all frequency and impact data derive directly from previously conducted analysis. The 2011 project team conducted expert elicitations for the armed assault and cyber attack events which had not been previously studied within a methodology comparable to the SNRA.

Existing Frequency Data

A designated Intelligence Community (IC) agency reviewed and commented on the relative frequency of the adversarial/human-caused events for which data was derived from previous governmental risk assessments, including DHS/S&T's Integrated Terrorism Risk Assessment (ITRA) and DHS/NPPD/RMA's Risk Assessment Process for Informed Decision-making (RAPID). To accomplish this, the agency reviewed frequency data, including the 5th, mean, and 95th percentiles of the frequency distributions. The review was performed in the summer of 2011. The IC agency did not comment on the absolute values of the frequencies.[4]

Elicited Frequency Data

Within the adversarial/human-caused set of events, there were two event types, armed assault and cyber (affecting data and affecting physical infrastructure) for which appropriate frequency data sources could not be located. For these events, an elicitation protocol was developed and separate elicitations were conducted of IC experts.

For the cyber elicitation, representatives from DHS/NPPD/CS&C, ODNI, CIA, FBI, NSS, and NSA participated in a two part elicitation. All participants attended a half day working session to discuss the scope of the cyber events, identify event thresholds, and begin to provide frequency data. A subset of the participating agencies (ODNI, CIA, FBI, NSS) then completed the frequency elicitation tool and submitted it as input for consideration and review by the larger group.

- Elicitations for the cyber attack against data incorporated three specific target types (financial institution system, public health/emergency system, internet) and asked that the elicitees provide individual frequency judgments for each of these target types.
- Elicitations for the cyber attack against physical infrastructure incorporated five specified target types (dam failure, chemical release, electric grid failure, radiological release from a nuclear reactor, transportation system failure) and asked that the elicitees provide individual frequency judgments.

[4] The IC agency did not comment on the relative ordering of the frequencies for the two cyber events or armed assault, since those frequencies had not yet been elicited from the Intelligence Community SMEs within the SNRA project's structured elicitation process.

- As noted above, no consensus consequence estimates corresponding to these elicited frequency judgments were obtained for the cyber events.

For the armed assault elicitation, representatives from DHS/I&A, FBI, and NSS participated in a group elicitation. All participants attended a half day working session to discuss the scope of the armed assault event, identify event thresholds, and provide frequency data. All data was collected during this group session, with the exception of one domestic terrorism expert who was individually elicited to ensure that domestic terrorism perspectives were included. No specific target types were articulated by the group.

For all elicitations, elicitees were asked to assign a frequency range to the events leveraging structured bins. Elicitees identified whether the frequency of these events were more or less frequent than once per year. If more frequent, elicitees then assigned the events to one of four buckets, each of varying order of magnitude (1-10 events per year, 11-100 events per year, 101-400 events per year, or greater than 400 events per year). If less frequent than once per year, elicitees assigned the events to one of four probability ranges (1% or less probable per year, 10% probable per year, 25% probable per year, or 50% probable per year). Elicitee input was aggregated into a range, which is represented within the SNRA frequency data.

Detail

Five SNRA adversarial/human-caused events are discussed as a unit below because the data within the SNRA was uniformly obtained from the DHS/ Science & Technology (S&T) 2011 Integrated Terrorism Risk Assessment (ITRA).

SNRA Chemical, Biological, Radiological, and Nuclear Terrorism Attack Events

Events Covered

- Biological Terrorism Attack (non-food)
- Chemical/Biological Food Contamination Terrorism Attack
- Chemical Terrorism Attack (non-food)
- Nuclear Terrorism Attack
- Radiological Terrorism Attack

Data Source

DHS/Science & Technology (S&T) 2011 Integrated Terrorism Risk Assessment (ITRA)

Data Gathering Process[5]

The Integrated CBRN Terrorism Risk Assessment elicitations were conducted throughout May and June 2010. Experts were formally elicited on five topics: absolute frequency of CBR initiation, relative frequency of CBR selection, absolute frequency of IND acquisition, frequency of CBRN interdictions, and CTRA and BTRA terrorist organization category capabilities. From this data, absolute frequency of acquisition for CBRN and the absolute frequency of attack with CBRN were calculated. Elicitation methods used were based on the approach described in NUREG-1150.[6] Elicitation experts followed the below steps in obtaining probabilities from intelligence analysts:

1. Pre-elicitation meeting: The group discussed the purpose and approach and scope of the planned elicitations
2. Intelink Terrorism Risk Assessment Frequency of Initiation Intellipedia discussion: Elicitees continued on-line discussion of event definitions and scope, to ensure shared definitions
3. Dissemination of elicitation materials: Elicitation materials were shared electronically to allow the group to review the elicitation process and event definitions
4. Study period/individual formal elicitation meetings: Individual elicitations were conducted
5. Group review meeting: The full panel reviewed the final results and confirmed or updated responses
6. Dissemination of group review meeting follow-up document and reconciliation responses: The final results were circulated amongst the group for documentation purposes

Resultant probabilities were based on analysts' knowledge of the field and prior exposure to intelligence reporting, but probabilities were not expressly linked to specific reporting. Probability distributions resulting from the elicitations were classified as SECRET//NOFORN.

Participating Organizations

A combined panel of CBRN experts was convened for elicitation purposes, including analysts from:

- National Counterterrorism Center
- Defense Intelligence Agency
- National Security Agency
- Office of the Director of National Intelligence (ODNI)
- DHS Office of Intelligence & Analysis

Experts who were selected generally had significant expertise in at least one of the four CBRN terrorism threat areas, along with knowledge of the other threat areas.

[5] This process description is a summation of material contained in the DHS Science & Technology Directorate's 2011 Integrated CBRN Terrorism Risk Assessment, Chapter 3: Technical Approach (p. 3-149 – 3-155). (Reference is SECRET//NOFORN; Extracted information is UNCLASSIFIED.)

[6] NUREG-1150 is an elicitation methodology developed by the Nuclear Regulatory Commission (NRC) in 1991 to formalize the process by which subject matter experts may provide probabilistic assessments in areas where data is sparse.

Two of the adversarial/human-caused events had previously been assessed within the DHS National Protection and Programs Directorate's (NPPD) Risk Assessment Process for Informed Decision-making (RAPID), which provided a quantitative assessment of strategic risk facing the Nation. These events are discussed as a unit below.

SNRA Explosives and Aircraft-as-a-Weapon Events
Events Covered • Explosives Terrorism Attack • Aircraft as a Weapon
Data Source NPPD RAPID (2010)
Data Gathering Process The RAPID elicitations were conducted between October 2009 and January 2010. Eleven experts participated in the elicitation process. Following a modified NUREG-1150 expert elicitation process, RAPID II was able to obtain likelihood probabilities for the terrorism incident sets. Elicitation experts followed the below steps in obtaining probabilities from intelligence analysts: 1. Identification of issues: Elicitation topics were identified in alignment with the analytic fault trees provided 2. Selection of experts: RAPID team members identified appropriate experts within the intelligence community 3. Individual elicitations performed: Using R Project, the RAPID team worked with experts to interactively create probability distributions which represent the likelihood that an adversary will initiate an attack, and, if initiated, the relative likelihood of different types of attacks 4. Review by experts: Experts reviewed anonymous inputs of all participating experts, with the opportunity to make adjustments The resultant probability distributions identified the likelihood with which particular attack types would be initiated and the likelihood that a particular target class would be selected. Resultant probabilities were based on analysts' knowledge of the field and prior exposure to intelligence reporting, but probabilities were not expressly linked to specific reporting. Probability distributions resulting from the elicitations were classified as SECRET//NOFORN.
Participating Organizations All eleven experts were from the DHS Office of Intelligence & Analysis (I&A) or a DHS operational component. Experts were selected based on their knowledge of the research area.

Finally, the SNRA team conducted original subject matter elicitations for two adversarial/ human-caused events. These elicitations were conducted separately but are treated as a unit here because the same elicitation protocol was used.

SNRA Armed Assault and Cyber Events

Events Covered

- Armed Assault
- Cyber Attack against Data
- Cyber Attack against Physical Infrastructure

Data Source

Original frequency elicitations conducted in August 2011 to support the SNRA

Data Gathering Process

Following a modified NUREG-1150 expert elicitation process, SNRA was able to obtain likelihood probabilities for the terrorism incident sets. Elicitation experts followed the below steps in obtaining probabilities from intelligence analysts:

1. Selection of experts: The SNRA team worked with staff within the ODNI to identify appropriate participants
2. Identification of issues: On the day of the elicitation, the experts discussed and agreed upon the definition of the events. Note that for cyber, the broad categories of attacks against data and attacks against physical systems had been previously constructed
3. Group elicitations performed: Using a binning structure, each member of the group provided their probability estimate. Some information was collected via an in-person group discussion, while some information was received in electronic form after the meeting
4. Review by experts: Following the elicitation, the SNRA team compiled the inputs and provided final outcomes to participants for review and comment

The resultant probability distributions identified the likelihood with which each event types would be initiated and the likelihood that a particular target class would be selected. Resultant probabilities were based on analysts' knowledge of the field and prior exposure to intelligence reporting, but probabilities were not expressly linked to specific reporting. Probability distributions resulting from the elicitations were classified as SECRET//NOFORN.

Participating Organizations

Armed Assault

- National Counterterrorism Center
- Department of Homeland Security Intelligence & Analysis
- Federal Bureau of Investigation

Cyber Attacks (Infrastructure and Data)

- Office of the Director for National Intelligence
- Central Intelligence Agency
- Federal Bureau of Investigation
- National Security Agency
- National Security Staff
- Department of Homeland Security Cyber Security and Communications

Derivative Classification Sources for SNRA Data

The following references are derivative classification sources for the classified data of the SNRA, as noted in the data tables provided in Appendices B through E of the classified SNRA Technical Report.

Armed Assault SME: Subject matter expert elicitation session with representatives from the DHS Office of Intelligence & Analysis (I&A), Federal Bureau of Investigation (FBI), and National Security Staff (NSS) (2011, July 26). Classification level of discussion was SECRET; Derived from: Multiple Sources; Declassify on: 20360726.

Cyber SME: Subject matter expert elicitation session with representatives from DHS National Protection and Programs Directorate Office of Cyber Security and Communications (CS&C), Office of the Director of National Intelligence (ODNI), Central Intelligence Agency (CIA), Federal Bureau of Investigation (FBI), National Security Staff (NSS), and National Security Agency (NSA) (2011, July 25). Classification level of discussion was SECRET; Derived from: Multiple Sources; Declassify on: 20360725.

ITRA: Email correspondence from Program Manager, Integrated CBRN Terrorism Risk Assessment (ITRA), DHS Science & Technology Directorate (2011, September 28). Data file: '(SNF) 20110926 Uncertainty (U).zip'. Extracted information is SECRET//NOFORN; Derived from: Multiple Sources; Declassify on: 25X2.

ITRA – Nuclear Econ Update: Email correspondence from Battelle Memorial Institute Support Contractor, Integrated CBRN Terrorism Risk Assessment (ITRA) Program, DHS Science & Technology Directorate (2012, July 20). Data file: '(U) Histogram Bins Rad and Bio_files are SNF.zip'. Extracted information is SECRET//NOFORN; Derived from: Multiple Sources; Declassify on: 20370720.

RAPID: DHS Office of Risk Management & Analysis (RMA) Risk Assessment Process for Informed Decision-making (RAPID) Database. Accessed July 12, 2011. Extracted information is SECRET//NOFORN; Derived from: Multiple Sources; Declassify on: 20360712.

Additional detail is given in Appendix I of the classified SNRA Technical Report. Derivative classifications for narrative statements are noted as footnotes in the body of the classified SNRA Technical Report.