APPENDIX N
INTENTIONAL DESTRUCTIVE ACTS

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The purpose of this appendix is to evaluate the human health impacts of intentional destructive acts (IDAs) at the Western New York Nuclear Service Center. The term "IDA" is used to include intentional malevolent acts, intentional malicious acts, and acts of terrorism.

N.1 Introduction

In accordance with recent U.S. Department of Energy (DOE) National Environmental Policy Act (NEPA) guidance (DOE 2006), this appendix was developed to explicitly consider the potential impacts of intentional destructive acts (IDAs) in NEPA documents. A wide range of IDA scenarios involving the release of radiological or toxic chemical materials can be postulated for the Western New York Nuclear Service Center (WNYNSC). Each involves an action by intruders or insiders that affects existing inventories and their distribution at one of the waste management areas (WMAs) or during the transportation of radioactive waste packages from WNYNSC. The human health impacts of an IDA are directly related to the magnitude of radiological or chemical material available for dispersal, as well as the means of dispersing it to the environment. Other factors that affect impacts include population density, distance to the population, and meteorology. Appendix I of this *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center (Decommissioning and/or Long-Term Stewardship EIS)* identifies five locations at WNYNSC: high-level radioactive waste tanks in the Waste Tank Farm (WMA 3); the Main Plant Process Building (WMA 1); radioactive waste packages; the NRC [U.S. Nuclear Regulatory Commission]-Licensed Disposal Area (NDA) (WMA 7); and the State-Licensed Disposal Area (SDA) (WMA 8). These accident locations were evaluated for IDA scenarios.

IDA scenarios were selected based on the magnitude of radioactive or chemical materials at a facility or in a package. Other factors that were considered included the physical and chemical form of radioactive or chemical materials that made them more susceptible to environmental dispersion. For each onsite IDA scenario, a calculation of noninvolved worker, maximally exposed individual (MEI) member of the public, and population doses was performed, as appropriate, using the same computer codes and conservative modeling assumptions for accidents that were used for Appendices I and J of this environmental impact statement (EIS). The MACCS2 V1.13.1 computer code (NRC 1998) was used to calculate IDA radiological consequences from onsite airborne releases. The MACCS2 computer code is described in detail in Appendix I, which also provides detailed discussions of the methods used in calculating radiation doses and their human health effects. The GENII Version 2 computer code (PNNL 2007) was used to calculate radiological consequences from onsite aqueous releases. GENII Version 2 is described in detail in Appendix I. Human health impacts of IDAs relative to the transportation of radioactive waste packages from WNYNSC were also analyzed for each site waste management alternative. The RISKIND computer code (ANL 1995) was used to calculate radiation doses to the MEI and population from such an IDA. RISKIND, a code that has been extensively used in transportation accident analyses, is described in Appendix J of this EIS.

The radiological source term for each scenario was developed to represent the consequences of any carefully planned and executed IDA. Acute (short-term) and chronic (long-term) radiation doses were calculated, as was the likelihood of short-term and latent cancer fatalities from such doses. Health effects of acute exposure were assumed to appear within 1 year of exposure, and those of chronic exposure sometime later. As the frequency of success of these postulated IDA scenarios cannot be quantified, no annual risk was calculated.

N.2 Scenario Development

For onsite IDA scenarios, a group of outsiders is postulated to gain entrance to WNYNSC with the help of an inside employee. These outsiders are carrying weapons, backpacks containing high explosives, and associated detonation equipment. They overpower and eliminate security personnel and gain access to the high-level radioactive waste tanks, Main Plant Process Building, radioactive waste package storage area, NDA, or SDA. They attach the explosives to preselected locations that allow for the breach of any containment or confinement structure or container and cause release of the maximum possible radioactive source term in the form of respirable airborne particles.

The assumed target is the High-Level Waste Tank 8D-B in WMA 3, which has a larger radioisotope inventory than the Main Plant Process Building, the waste packages, or the licensed disposal areas. Tank 8D-B is a bounding composite of Tanks 8D-1 and 8D-2, which are described in Appendix I of this EIS. The explosive charge brought on site is designed, located, and timed to breach the wall of the tank and cylindrical concrete vault, thereby creating a Radiological Dispersal Device (RDD). An RDD usually consists of an explosive with associated detonation and timing equipment and radioactive material which would be dispersed after detonation of the explosive. In this scenario, the radioactive material in the tank constitutes the material for dispersal, so the intruders need only bring in the appropriate quantities and types of explosive and associated detonation and timing equipment.

No airborne release IDA scenarios were analyzed for the NDA and SDA, due to two factors: (1) the radioactive material is distributed over a large area with a concomitantly small density and (2) radioactive material is interspersed with soil and affixed to solids resulting in a relatively small respirable release fraction from any IDA scenario. Tank 8D-B IDA scenario consequences envelope NDA and SDA IDA scenario consequences. The detonation of high explosives on or near radioactive waste as it is being exhumed from the NDA, which has a higher radioactivity inventory than the SDA, would result in the airborne release of some of the radionuclide inventory. The NDA radioactive waste is distributed over 10,280 cubic meters (363,000 cubic feet) of disposal volume over an area of 22,300 square meters (240,000 square feet) in burial holes, trenches, and caissons (URS 2000). Assuming that the largest radionuclide inventory NDA burial site is targeted during exhumation and that the same fraction of material (0.1 percent) is released to the air as is assumed in the Tank 8D-B IDA scenario, the resulting source term would be 1 percent of that assumed for the Tank 8D-B IDA scenario. The total radionuclide inventory in the NDA and SDA is significantly smaller than that of the high-level radioactive waste tanks (see Appendix C of this EIS).

One IDA scenario involving liquid releases was analyzed for the NDA because of its close juxtaposition to Erdman Brook, which drains to Buttermilk Creek and Cattaraugus Creek. The attackers have inside knowledge regarding when the largest radioisotope inventory NDA burial is scheduled for exhumation. They use explosives to disperse this material into Erdman Brook where it releases radionuclides into the creek that are transported to Cattaraugus Creek, Lake Erie, and the Niagara River using the same models that are used in normal operations liquid releases in Appendix I, Section I.4, of this EIS. The liquid release conservatively assumes no cleanup or interception of the released material. In addition, the release is not assumed to be depleted by sediment deposition over the 64 kilometers (40 miles) of flow through Cattaraugus Creek. Furthermore, Erdman Brook is identified as an intermittent stream (Chapter 3, Section 3.6.1, of this EIS), but is assumed to be flowing to Buttermilk Creek at the time of the IDA event.

Another IDA scenario analyzed for human health consequences is the attack of a group of outsiders on a radioactive waste transport vehicle en route from WNYNSC to a waste repository. The attackers are postulated to eliminate all crew and use weapons to penetrate the radioactive waste package confinement, resulting in a release of respirable radionuclides to the environment. The waste package with the largest radionuclide inventory is the fuel and hardware drum, which is only transported for the Sitewide Removal Alternative, as shown in Appendix I of this EIS. Therefore, the transportation scenario assumes an attack on a vehicle transporting such drums. The attack and resulting radionuclide release occur when the vehicle is traveling through the area with the highest population density along its route, thus delivering the highest population dose.

The fuel and hardware drum is not transported for the Sitewide Close-In-Place, Phased Decisionmaking, or No Action Alternative. The same IDA scenario assumptions for transportation are analyzed for these alternatives, but the containers are different: a Greater-Than-Class C drum is used for the Sitewide Close-In-Place and Phased Decisionmaking Alternatives, and a Class A box for the No Action Alternative. For each of the alternatives, a transportation IDA involving these radioactive waste packages has the greatest MEI and population consequences.

Appendix I of this EIS identifies the bounding toxic chemical as the beryllium that is present in the Main Plant Process Building. Therefore, another IDA scenario was postulated in which outsiders, with assistance from an employee, carry in and set off explosive charges in and around that building, creating a Chemical Dispersal Device (CDD) to release the maximum respirable quantity of beryllium into the atmosphere. Although its effects would include the release of radioactivity present in the Main Plant Process Building, the radioactive source term and human health impacts would be lower than those of the high-level radioactive waste tank RDD scenario.

N.3 Scenarios Considered but Not Analyzed

Other IDA scenarios that were postulated but not analyzed for this appendix are: (1) a commercial or military aircraft crash into the high-level radioactive waste tanks or Main Plant Process Building; (2) vehicular bomb detonation next to the high-level radioactive waste tanks, Main Plant Process Building, licensed disposal areas, or radioactive waste storage area; (3) use of armor-piercing missiles on the high-level radioactive waste tanks, Main Plant Process Building, or radioactive waste storage facility; (4) detonation of high explosives in the proximity of radioactive waste storage packages; and (5) use of an improvised nuclear device.

Three factors affect the magnitude of a radioactive source term from a commercial or military aircraft crash into the high-level radioactive waste tanks or the Main Plant Process Building: (1) size of each facility; (2) underground location of some cells; and (3) structural design of the exterior walls and roof. The terrorist attacks of September 11, 2001 involved crashing commercial jets into the two World Trade Center towers which had an average height of 1,365 feet (416 meters) and the Pentagon, which occupies an area of 11.7 hectares (29 acres) with each side being 921 feet (281 meters) long (FEMA 2002, DoD 2009). In the case of the Pentagon, the aircraft impacted the ground in front of the building. In contrast, the area of the Main Plant Process Building is 0.3 hectares (0.8 acres) and that of the four high-level radioactive waste tanks comprises a conglomerate total of 0.1 hectares (0.25 acres). Moreover, the highest point of the Main Plant Process Building is 79 feet (24 meters) while that of the high-level radioactive waste tanks is 36 feet (11 meters). The area and height of these structures would make them a much more difficult target for an aircraft crash. Several cells within the Main Plant Process Building are located as much as 30 feet (9 meters) below the ground surface. This underground location offers additional protection from an impact and mitigation of any release. The Main Plant Process Building and the high-level radioactive waste tanks are constructed of or surrounded by reinforced concrete vaults, walls and roofs with a thickness of from 1 to 6 feet (0.3 to 1.8 meters). If an aircraft were to impact these structures, this reinforced concrete would either preclude or ameliorate the release of radioactivity by absorbing much of the impact energy. Even if structural failure were to occur, it would be expected to be localized and only affect a fraction of the radioactivity within these structures. The high-level waste tank IDA scenario that is analyzed assumes a composite of both tanks' radioactive inventory is affected and that the explosives used eliminate the entire concrete structure as presented in Section N.4 (WSMS 2008).

The aircraft crash was not analyzed because the radionuclide source term resulting from such a scenario at any of the locations that contain radionuclides would be enveloped by that assumed for the high-explosive detonation scenario analyzed for High-Level Radioactive Waste Tank 8D-B.

The vehicle bomb scenario was not analyzed because it may not fail the confinement structure of the high-level radioactive waste tanks, Main Plant Process Building, or radioactive waste packages and is not estimated to result in a source term greater than that assumed for the analyzed IDA event at Tank 8D-B.

Although armor-piercing missiles could fail confinement at the high-level radioactive waste tanks, Main Plant Process Building, or radioactive waste packages, the resulting source term would not be as high as that caused by the carefully designed and placed high explosives that are central to the IDA scenario for Tank 8D-B.

High explosives detonated next to high-level radioactive waste packages would fail their confinements and release a significant fraction of their radionuclide inventories. The effects, however, would be limited by the distance between the packages and that between the package and the explosive. (Explosive overpressure drops as the cube of the distance.) Thus, only a limited number of packages could fail and release radionuclides. Also limiting is the total radionuclide inventory of each package (see Appendix I of this EIS); between 23 and 2,500 packages would have to release their inventories to yield a source term equal to that assumed for the high-level radioactive waste tank IDA scenario. These limiting factors, in addition to the confinement integrity of each waste package, would not release a radiological source term equivalent to that of a failure of the high-level radioactive waste tanks.

The detonation of high explosives on or near the vitrified high-level radioactive waste stored at WNYNSC was not analyzed because the physical and chemical form of this waste would inherently restrict the release of respirable particles to the environment. Tests have shown that the vitrified high-level radioactive waste material, which is similar to glass, is very resistant to fracture into very small respirable particles. Explosives or fires would more likely result in segmentation of some of this waste into large, nonrespirable solid forms (DOE 1994, EPA 1992).

An improvised nuclear device requires access to a critical mass of either weapons-grade plutonium or highly enriched uranium, along with extremely sophisticated high explosives and electronic detonation equipment. None of these materials is expected to be present at WNYNSC. Any plutonium or uranium that is present exists in a distributed and diluted form in liquid and solid wastes—not the single, relatively pure mass required for an improvised nuclear device. Thus, intruders would have to construct such a device with components obtained outside of WNYNSC and purposefully bring it onto the site for detonation. The low population density in the area of WNYNSC also makes the site less desirable as a target for an improvised nuclear device or any other IDA scenario.

N.4 Source Terms

Calculations of the source terms for the high-level radioactive waste tank RDD, Main Plant Process Building CDD, and radioactive waste transportation IDA assume dispersal of a fraction of the entire waste inventory via a direct, open pathway to the atmosphere. The source term for the high-level radioactive waste tank RDD, presented as **Table N–1**, is based on a 0.1 percent (0.001) airborne respirable release fraction (DOE 1994) for the material at risk (MAR). Most of the radionuclide activity in Tank 8D-B (the same radionuclide activity assumed in Appendix I accident analyses) is fixed and in nonliquid form, making it more vulnerable to airborne release from the effects of an explosion. Also assumed (see Appendix I of this EIS) is a composite high-level radioactive waste tank, that is, a tank denoted as 8D-B that has the largest inventory of radioisotopes and, thus, one whose breach would result in the highest radiation dose.

Table N–1 High-Level Radioactive Waste Tank Radiological Dispersal Device Source Term

Radionuclide	*Source Term (curies)*
Carbon-14	0.000020
Strontium-90	34
Technetium-99	0.0054
Iodine-129	6.8×10^{-6}
Cesium-137	250
Uranium-232	0.00060
Uranium-233	0.00026
Uranium-234	0.00010
Uranium-235	3.4×10^{-6}
Uranium-238	0.000031
Neptunium-237	0.00050
Plutonium-238	0.15
Plutonium-239	0.036
Plutonium-240	0.026
Plutonium-241	0.74
Americium-241	0.38
Curium-243	0.0036
Curium-244	0.080
Total	285.4

Source: WVNSCO 2005.

The source term for the NDA liquid dispersal to Erdman Brook during exhumation of the most radioactive burial site is presented in **Table N–2**. The material with the largest amount of radioactivity in the NDA is spent nuclear fuel and its hardware (URS 2000); a liquid release fraction of 0.01 percent (0.0001) is assumed. This is identical to the airborne release fraction assumed for the fuel and hardware radioactive waste drum IDA. This source term also assumes that no emergency response actions are taken during the time period in which this source term would enter Erdman Brook.

Table N–2 NRC-Licensed Disposal Area Radiological Dispersal Device Liquid Release Source Term

Radionuclide	*Activity (curies)*	*Radionuclide*	*Activity (curies)*	*Radionuclide*	*Activity (curies)*
Tritium	1.4×10^{-3}	Niobium-94	1.5×10^{-3}	Uranium-235	4.8×10^{-6}
Carbon-14	5.2×10^{-2}	Antimony-125	3.9×10^{-3}	Uranium-238	6.4×10^{-5}
Iron-55	1.8×10^{-1}	Cesium-137	1.2	Neptunium-237	6.7×10^{-6}
Nickel-59	1.1×10^{-1}	Barium-137m	1.2	Plutonium-238	1.4×10^{-2}
Cobalt-60	8.1×10^{-1}	Promethium-147	1.6×10^{-3}	Plutonium-239	2.4×10^{-2}
Nickel-63	1.1×10^{1}	Samarium-151	2.0×10^{-2}	Plutonium-240	1.6×10^{-2}
Strontium-90	9.5×10^{-1}	Europium-154	8.0×10^{-3}	Plutonium-241	5.7×10^{-1}
Yttrium-90	9.5×10^{-1}	Uranium-233	3.8×10^{-4}	Americium-241	5.7×10^{-2}
Zirconium-93	1.2×10^{-3}	Uranium-234	2.0×10^{-5}	Total	17.1

NRC = U.S. Nuclear Regulatory Commission.
Source: URS 2000.

The source terms for the different packages that could be breached in a radioactive waste transportation IDA are presented in **Tables N–3, N–4,** and **N–5**. For the fuel and hardware drum, the source term is based on a 0.01 percent (0.0001) respirable release fraction; and for the Greater-Than-Class C drum and Class A box, a

0.1 percent (0.001) airborne respirable release fraction. The different respirable release fractions reflect the distinctive nature and radionuclide content of the waste packages (DOE 1994).

Table N–3 Fuel and Hardware Drum Intentional Destructive Act Source Term

Radionuclide	*Source Term (curies)*
Tritium	0.000311
Carbon-14	4.2×10^{-5}
Cobalt-60	0.0027
Strontium-90	0.133
Yttrium-90	0.133
Cesium-137	0.173
Thorium-234	0.0000131
Uranium-238	0.0000131
Plutonium-238	0.00105
Plutonium-239	0.00412
Plutonium-240	0.00221
Plutonium-241	0.0671
Americium-241	0.00799
Neptunium-237	7.94×10^{-7}
Curium-244	0.0000626
Total	0.56

Source: Karimi 2005.

Table N–4 Greater-Than-Class C Drum Intentional Destructive Act Source Term

Radionuclide	*Source Term (curies)*
Tritium	0.0020
Carbon-14	0.0000148
Iron-55	8.98×10^{-6}
Cobalt-60	0.000258
Nickel-63	0.000999
Strontium-90	0.00185
Yttrium-90	0.00185
Cesium-137	0.00235
Thorium-234	0.0000268
Uranium-238	9.28×10^{-6}
Plutonium-238	0.0267
Plutonium-239	0.0000363
Plutonium-240	0.000188
Plutonium-241	0.0105
Americium-241	0.000116
Total	0.047

Source: Karimi 2005.

Table N–5 Class A Box Intentional Destructive Act Source Term

Radionuclide	***Source Term (curies)***
Tritium	1.2×10^{-4}
Carbon-14	9.2×10^{-7}
Iron-55	5.6×10^{-7}
Cobalt-60	1.6×10^{-5}
Nickel-63	6.2×10^{-5}
Strontium-90	4.5×10^{-6}
Yttrium-90	4.5×10^{-6}
Cesium-137	4.4×10^{-5}
Thorium-234	5.8×10^{-7}
Uranium-238	5.8×10^{-7}
Plutonium-238	3.7×10^{-7}
Plutonium-239	5.5×10^{-7}
Plutonium-240	3.3×10^{-7}
Plutonium-241	1.2×10^{-5}
Americium-241	1.2×10^{-6}
Total	2.7×10^{-4}

Source: Karimi 2005.

The release plume for the waste transportation IDA is modeled for two different scenarios: a zero-energy, ground-level plume release and a plume with the energy of a fire created by combustion of the diesel fuel carried in the tanks of the transport truck. As in the case of the RDD, the plume energy assumptions for these two scenarios envelop both close and distant human health impacts.

N.5 Human Health Effects

Calculations by the MACCS2, GENII Version 2, and RISKIND computer codes and chemical dispersion modeling result in different human health impacts of the IDA scenarios discussed in Section N.2. Differences have been determined in radiological doses delivered to, and related latent cancer fatalities (LCFs)[1] for, the worker, the MEI, and the population at varying distances from the release site.

N.5.1 High-Level Radioactive Waste Tank Radiological Dispersal Device

The calculated radiation doses to the noninvolved worker, the MEI, and the population within 80, 160, 320, and 480 kilometers (50, 100, 200, and 300 miles) of an RDD-induced failure of the high-level radioactive waste tank are presented in **Table N–6**. Two plume models were assumed for this scenario: ground-level and elevated plume. The ground-level plume assumes that all the energy of the high explosives is expended in failing the tank confinement and in aerosolizing radioactive material. The elevated plume conversely assumes that all of the energy of the high explosives is available to the plume, resulting in an elevated release. These two diametrically opposite assumptions were used to calculate the range of close-in and distant human health consequences. Doses for the population beyond 80 kilometers (50 miles) were calculated to evaluate the public health impact of an elevated plume in comparison to a ground-level plume. The analysis assumed no emergency response such as evacuation or sheltering of the population. This assumption is very conservative for the population 320 to 480 kilometers (200 to 300 miles) away, because the plume would not reach these distances for at least 1 day. According to the 2000 U.S. census and the 2001 Canada census (DOC 2008, ESRI 2008, Statistics Canada 2008), the U.S. and Canadian populations within 80, 160, 320, and

[1] Since fatal cancer is the most probable serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities rather than cancer incidence are presented in this EIS. These effects are referred to as "latent" cancer fatalities (LCFs) because the cancer may take many years to develop.

480 kilometers (50, 100, 200, and 300 miles) are, respectively, 1.705 million, 7.872 million, 25 million, and 75.1 million.

Table N–6 Radiological Consequences of High-Level Radioactive Waste Tank Radiological Dispersal Device

Radiological Dispersal Device Scenario	*Ground-level Release*		*Elevated-plume Release*	
	Dose	*LCFs*	*Dose*	*LCFs*
Noninvolved worker (rem)	608 [a]	0.7	0.0177	0.000010
MEI member of the public (rem)	138	0.2	0.15	0.000090
50-mile population (person-rem)	3,600	2.2	5,860	3.5
100-mile population (person-rem)	4,610	2.8	8,240	4.9
200-mile population (person-rem)	5,240	3.1	9,620	5.8
300-mile population (person-rem)	5,890	3.5	10,700	6.4
Highest population average individual member [b] (rem)	0.0021	1.3×10^{-6}	0.0034	2.1×10^{-6}

LCFs = latent cancer fatalities, MEI = maximally exposed individual.

[a] This dose of 608 rem, equivalent to 0.7 LCFs, can cause a fatality from acute effects in more than 50 percent of humans, but this fatality may be ameliorated by immediate proper medical treatment (NRC 2008, PNNL 2005).

[b] Calculated by dividing the total population dose by the total population for each of the four distances; the highest average for the four distances is presented.

Note: LCFs calculated by multiplying dose by 0.0006 LCFs per rem (DOE 2002); an individual dose of 20 rem or greater is multiplied by twice the 0.0006 LCFs factor.

Table N–6 shows that the ground-level release results in higher noninvolved worker and MEI doses, whereas the elevated release results in a larger population dose. The largest noninvolved worker dose (608 rem) results in 0.7 LCFs, and the largest MEI dose (138 rem) in 0.2 LCFs. The elevated-plume model results in about a 60 to 80 percent larger population dose than the ground-level release model. The difference is due to the combined effect of dispersion, dilution, and differences in population distribution at distances from WNYNSC. Although population dose increases with distance, the change in population dose relative to the increase in population is slight. The highest average individual dose in the population (0.0034 rem) for the four distances analyzed occurs for the 80-kilometer (50-mile) population. The largest population consequence within 480 kilometers (300 miles) is 6.4 LCFs, assuming no emergency response, evacuation, or sheltering over this distance. The WNYNSC meteorological data used in the MACCS calculations include an average annual wind speed of 2.1 meters per second (4.7 miles per hour). At this wind speed, the plume would reach 80 kilometers (50 miles) 10.6 hours after its release. The time for the plume to travel 320 to 480 kilometers (200 to 300 miles) would be 43 to 64 hours. It is expected that emergency response actions, in the form of public evacuation and sheltering, could be taken during this time period, so that the population dose associated with these distances would be significantly lower.

N.5.2 NRC-Licensed Disposal Area Radiological Dispersal Device

The GENII Version 2 calculated radiation doses and likelihood of an LCF to the MEI and population of an RDD-induced liquid release from exhumed radioactive spent fuel and hardware at the NDA are presented in **Table N–7**. Workers were not assumed to survive an NDA exhumation liquid release RDD. The calculations were performed using the same GENII Version 2 model that was used for normal operations liquid releases in Appendix I of this EIS.

Table N–7 Radiological Consequences of NRC-Licensed Disposal Area Radiological Dispersal Device

Dose Receptor	*Dose*	*LCFs*
Individual on Cattaraugus Creek Near Site	0.019 rem	4.5×10^{-6}
Individual on Lower Reaches of Cattaraugus Creek	0.021 rem	5.6×10^{-6}
Lake Erie Downstream of Cattaraugus Creek Water Consumers [a]	5,500 person-rem	1.2
Niagara River Water Consumers [a]	90 person-rem	0.02

LCFs = latent cancer fatalities, NDA = NRC (U.S. Nuclear Regulatory Commission)-Licensed Disposal Area.
[a] Affected populations: Lake Erie Treatment Plants Downstream of Cattaraugus Creek, 565,000 consumers; Niagara River Treatment Plants, 386,000 consumers.

Table N–7 shows that the largest MEI member of the public dose (0.021 rem or 21 millirem) results in 5.6×10^{-6} LCFs and the total population dose to both Lake Erie and Niagara River water consumers of 5,590 person-rem results in 1.22 LCFs.

The calculated population dose assumes no actions to restrict water consumption during a 1-year time period following this IDA scenario. Unlike air releases, liquid releases require considerable time (i.e., days) to reach the large population of water consumers, and emergency water consumption restriction actions could be used to mitigate any radiological consequences. Therefore, the population dose calculated for this IDA scenario represents a conservative estimate with no ameliorating effect of emergency response actions.

N.5.3 Radioactive Waste Transportation Intentional Destructive Act

Workers were assumed not to survive a transportation IDA. The only dose receptors for this event are the MEI within 100 meters (328 feet) of the plume release and the population within 80 kilometers (50 miles). As in the case of the high-level radioactive waste tank RDD scenario, no emergency response, such as evacuation or sheltering of the population, is assumed within 80 kilometers (50 miles) of the IDA. The highest population density of the route is assumed so as to envelop the calculated population dose. Consequences for the three transportation IDA scenarios are presented in **Table N–8**. The low-energy plume assumes a release with no fire, while the high-energy plume assumes a fire occurring simultaneously with the release.

Table N–8 Transportation Intentional Destructive Act Radiological Consequences

Radiological Consequence	*Low-energy Plume*	*High-energy Plume*
Sitewide Removal Alternative: Fuel and Hardware Drum		
MEI dose, rem	9.65	0.00347
MEI LCFs	0.006	2.0×10^{-6}
50-mile population dose, person-rem	281	82.6
50-mile population LCFs	0.17	0.05
Sitewide Removal, Sitewide Close-In-Place, and Phased Decisionmaking Alternatives: Greater-Than-Class C Drum		
MEI dose, rem	13.9	0.0389
MEI LCFs	0.008	0.000020
50-mile population dose, person-rem	404	119
50-mile population LCFs	0.24	0.07
No Action Alternative: Class A Box		
MEI dose, rem	1.1×10^{-2}	9.1×10^{-5}
MEI LCFs	7.0×10^{-6}	6.0×10^{-6}
50-mile population dose, person-rem	3.49	3.46
50-mile population LCFs	2.1×10^{-3}	2.1×10^{-3}

LCFs = latent cancer fatalities, MEI = maximally exposed individual.
Note: LCFs calculated by multiplying dose by 0.0006 LCFs per rem (DOE 2002). To convert miles to kilometers, multiply by 1.6.

N.5.4 Chemical Dispersal Device

The CDD source term assumes that the entire inventory (5.1 kilograms [11.2 pounds]) of beryllium in the Main Plant Process Building is released as respirable particles, and that the release lasts for 10 minutes under average atmospheric conditions. The result is a respirable particle concentration of 0.00043 milligrams per cubic meter within 100 meters (328 feet) of the building, which is the location of the noninvolved worker. Such a concentration is a factor of more than 200 below (i.e., about 0.4 percent of) the Emergency Response Planning Guideline 3 (ERPG-3) value of 0.1 milligrams per cubic meter. If conservative atmospheric dispersion were assumed, the air concentration within the same distance from the release would be 0.0021 milligrams per cubic meter, still significantly below the ERPG-3 value, and even below the respective ERPG-2 and ERPG-1 values of 0.025 and 0.005 milligrams per cubic meter (DOE 2008). Air concentrations below the ERPG-1 level do not cause any serious health effects.

As the CDD-induced atmospheric concentration of beryllium at 100 meters (328 feet) from the release point is below the ERPG-3, ERPG-2, and ERPG-1 levels, similar results can be expected for all other toxic chemicals; concentrations should be significantly below their respective ERPGs. Accordingly, the risk to workers and the public due to the release of toxic chemicals to the atmosphere is very small. Nevertheless, a CDD is expected to result in toxic chemical deposition around the Main Plant Process Building area that will require cleanup, and workers within 100 meters (328 feet) of the CDD would presumably be injured from blast pressure and airborne debris associated with the explosion.

N.6 Summary of Intentional Destructive Acts Consequences

The IDA human health consequence analyses were performed for each IDA scenario and *Decommissioning and/or Long-Term Stewardship EIS* alternative. The same computer codes (MACCS and RISKIND), analytical methods, and site models were used for these IDA scenarios as for accidents analyzed in Appendices I and J of this EIS. Regardless of the alternative, the highest radiological source term for an IDA affecting onsite facilities is that associated with a breach of the high-level radioactive waste tank; the highest hazardous chemical source term, from damage to the Main Plant Process Building. For the three action alternatives, the radioactive waste transportation IDA scenario with the most significant human health consequences is that involving the Greater-Than-Class C Drum; for the No Action Alternative, it is failure of the Class A Box. **Table N–9** presents a summary of the human health consequences of onsite facility and offsite transportation IDA scenarios for the alternatives. As indicated, the only distinction in consequences between action and no action alternatives is that of the radioactive waste transportation IDA. Radioactive waste transportation IDA consequences are significantly lower for the No Action Alternative because only Class A waste is transported.

Another aspect of IDA consequences that can be evaluated is the vulnerable time period of each scenario. The vulnerable time periods of those scenarios are presented in **Table N–10** under each alternative. As indicated, the longest vulnerable time periods (i.e., highest consequences) occur with the high-level radioactive waste tank RDD scenario; the shortest vulnerable time periods (i.e., lowest consequences) occur with the Main Plant Process Building CDD and the No Action Alternative radioactive waste (i.e., specifically, Class A waste) transportation scenarios. The longest vulnerable time period for the high-level radioactive waste tank RDD occurs under the Sitewide Close-In-Place and No Action Alternatives; the longest for the radioactive waste package transportation scenario occurs under the Sitewide Removal Alternative. As the CDD consequences are not significant, the difference between the Main Plant Process Building vulnerable time periods under the alternatives is not considered a significant discriminator of IDA risk.

Table N–9 Range of Intentional Destructive Acts Human Health Consequences for the Alternatives

Onsite Radiological IDA		
Receptor	***All Alternatives***	
Noninvolved worker	Fatal [a] (tank ground-level release) to 0.00001 LCFs (tank elevated-plume release)	
MEI	0.2 LCF (tank ground-level release) to 4.5×10^{-6} LCFs (NDA liquid release)	
Population, airborne	2 LCF [b] (80 kilometer [50 mile] population, ground-level release) to 7 LCFs [b] (300 mile population, elevated-plume release)	
Population, liquid	1 LCF [b] (Lake Erie and Niagara River water consumer)	
Onsite Chemical IDA		
Receptor	***All Alternatives***	
Worker	No significant health impacts	
MEI	No significant health impacts	
Population	No significant health impacts	
Radioactive Waste Package Transportation IDA		
Receptor	***Action Alternatives***	***No Action***
Worker	Not applicable	
MEI	0.008 LCFs (low-energy plume) to 0.00002 LCFs (high-energy plume)	7.0×10^{-6} LCFs
Population	0.2 LCFs (low-energy plume) to 0.07 LCFs (high-energy plume)	2.1×10^{-3} LCFs

IDA = intentional destructive act, LCFs = latent cancer fatalities, MEI = maximally exposed individual.
[a] Dose of 608 rem, equivalent to 0.7 LCFs, may cause short-term fatality in more than 50 percent of humans, but may be ameliorated by immediate medical treatment.
[b] Lower consequences if there is emergency response such as sheltering or evacuation.

Table N–10 Intentional Destructive Act Scenario Vulnerable Time Period for Each Alternative

IDA Scenario	***Alternative***			
	Sitewide Removal	***Sitewide Close-In-Place***	***Phased Decisionmaking (Phase 1)***	***No Action***
High-level radioactive waste tanks	20 years	In perpetuity	Up to 30 years [a]	In perpetuity
Main Plant Process Building	11 years	7 years	5 years	In perpetuity
Radioactive waste transport	60 years	7 years	8 years	In perpetuity

IDA = intentional destructive act.
[a] The total vulnerable time period for the alternative will depend on the implementation decisions and schedule for Phase 2.
Sources: WSMS 2009a, 2009b, 2009c, 2009d.

The data in Table N–8 provide a basis for a qualitative comparison of the IDA risks for each alternative, which is presented in **Table N–11**. Specific attention is accorded on site, off site (waste transport), and overall IDA risks, taking into account the vulnerable time period for each scenario. The No Action Alternative is judged to have the highest IDA risk because vulnerable onsite facilities remain in place and periodic offsite transportation of radioactive waste packages is expected to continue in perpetuity. The three action alternatives have lower IDA risks because they involve the demolition of onsite facilities that would otherwise constitute potential targets for IDAs, and because the offsite transport of radioactive waste packages would occur during a finite period of time (albeit involving a higher radioactivity content than the No Action Alternative). The Sitewide Removal Alternative has a higher IDA risk than the other two action alternatives because it involves transport of the largest number of radioactive waste packages over the longest time period, and because removal of the Main Plant Process Building is deferred for longer than the Phased Decisionmaking (Phase 1) and Sitewide Close-In-Place Alternatives (12 versus 5 and 7 years, respectively).

Table N–11 Qualitative Comparison of Intentional Destructive Act Risks for Each Alternative [a]

Type of IDA Risk	*Alternative*			
	Sitewide Removal	*Sitewide Close-In-Place*	*Phased Decisionmaking (Phase 1)*	*No Action*
Onsite radiological	High	Very High	Very High	Highest
Onsite chemical	Medium	Low	Lowest	Highest
Radiological waste transportation	Highest	Medium	Medium	Lowest
Overall	High	Medium	Medium	Highest

IDA = intentional destructive act.
[a] A qualitative comparison of accident risks for each alternative is presented in Chapter 4, Table 4–23, and Appendix I, Table I–27, of this EIS.

N.7 Intentional Destructive Acts Emergency Planning, Response, and Security

DOE's strategy for environmental protection from extreme events, including IDAs or terrorism, has three distinct components: (1) prevent or reduce the probability of occurrence; (2) plan and provide a timely and adequate response to emergency situations; and (3) ensure progressive recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environment.

DOE sites and facilities produce, store, use, and dispose of many different hazardous substances, including radioactive materials, toxic chemicals, and biological agents and toxins. In managing these hazards, DOE considers the safety of workers and the public to be of paramount importance. Owing to high standards for facility design, conduct of operations, safety oversight, and personnel training, DOE activities consistently achieve accident and injury rates that compare very favorably with those of the private sector.

DOE employs a well-established system of engineered and administrative controls in key facilities to prevent or reduce the probability of occurrence of extreme events and to limit their potential impacts on the environment. This system has evolved over time and will continue to evolve as new environment, safety, and health requirements are identified; as new technologies become available; and as new engineering standards or best practices are developed. The framework and specific requirements for implementing this system of controls are embodied in the *Code of Federal Regulations* and DOE Orders. These are invoked as contractual requirements for DOE management and operating contractors. DOE safety requirements and quality assurance guidelines and controls cover all aspects of the life-cycle of key nuclear and nonnuclear facilities—design requirements, construction practices, startup and operational readiness reviews, and routine operations and maintenance. They also cover deactivation and disposal activities required at the end of a facility's useful service life. The contractor and Federal staff associated with these facilities receive screening for trustworthiness and reliability. Moreover, they are trained to operate the facilities safely and to recognize quickly, and respond appropriately to, departures from normal operating conditions. Workers with a potential for exposure to harmful substances or radiation are enrolled in monitoring programs to safeguard their health and welfare. In addition to the oversight provided by DOE, reviews and audits of key facilities by outside experts play a role in reducing the probability of occurrence of many potentially extreme events associated with facility design, condition, or operation.

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