APPENDIX E: IMPACT METHODOLOGY

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This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in the Site-wide Environmental Impact Statement for the Y-12 National Security Complex (Y-12 SWEIS). Included are impact assessment methods for land use, visual resources, site infrastructure, traffic and transportation, geology and soils, water resources, ecological resources, cultural resources, socioeconomics, environmental justice, human health and safety, waste management, and malevolent, terrorist, or intentional destructive acts.

E.1 INTRODUCTION

The following paragraphs are brief descriptions of the impact assessment approaches used in the Y-12 SWEIS for the Y-12 National Security Complex (Y-12), for addressing potential impacts of Y-12 operations under the No Action Alternative, Uranium Processing Facility (UPF) Alternative, Upgrade in-Place Alternative, Capability-sized UPF Alternative, and No Net Production/Capability-sized UPF Alternative.

E.2 IMPACT METHODOLOGY

Methodologies used for each resource area are discussed below to identify and, if possible, measure potential impacts.

E.2.1 Land Resources

To estimate possible impacts of the alternatives, the land resources analysis relied on information for current and planned land use on Y-12. A comparative methodology was used to determine land use impacts from the project alternatives in terms of function and acreage. Acreage disturbed were assessed for each project alternative. Facility operations and particularly any facility construction activities were examined and compared to existing land use conditions. Impacts, if any, were identified as they relate to changes in land use classifications as well as conflicting uses.

E.2.2 Visual Resources

The visual resources analysis looked at the impacts of the alternatives on the visual quality at Y-12 and the area surrounding Y-12. The analysis of visual impacts included a qualitative examination of potential changes to the viewsheds and viewpoints. Construction of new facilities, modification of existing facilities, and demolition of existing facilities associated with each alternative were examined, and any resulting changes were analyzed for potential impact to the existing visual environment. Analysis focused on site development or modification activities that would alter the visibility of Y-12 structures, obscure views of the surrounding landscape, or conflict with visual resources in the surrounding area.

E.2.3 Site Infrastructure

Incremental changes to utilities and energy use at Y-12 were assessed by comparing the support requirements of the alternatives to current site utility demands. The assessment focuses on the basic resource requirements of electrical power, fuel requirements, and water usage. These three resource requirements were judged to be the most effective measures of potential infrastructure impacts resulting from implementation of any of the alternatives.

E.2.4 Traffic and Transportation

National Nuclear Security Administration (NNSA) selected traffic congestion and collective radiation dose and latent cancer fatalities (LCFs) to the general population as analytical endpoints for the transportation analysis. Traffic congestion was determined by qualitatively comparing current traffic levels with projected employment changes for the various alternatives. Radiological doses from transport of radioactive materials and wastes were calculated by computer modeling. The radiological transportation analysis methodology is summarized below.

All transportation of radioactive materials was assumed to take place by truck. Y-12 identified origin-destination pairs for each shipment campaign. NNSA then used the Transportation Routing Analysis Geographic Information System (TRAGIS) computer code to determine the most suitable routing. TRAGIS was constrained to only provide routes consistent with the U.S. Department of Transportation's highway route-controlled quantity regulations. Besides identifying the route, TRAGIS provided useful inputs to the remainder of the modeling such as miles per population density category and population within 800 meters of the route for each state and population density category.

NNSA then used the U.S. Department of Energy (DOE) code, RADTRAN 4, to calculate incident-free radiological impacts (normal transport without any accident releasing radioactive materials) to a member of the public. RADTRAN 4 is a routinely used DOE computer model for calculating radiological exposures related to transportation issues. Members of the public are those residing within 800 meters of the route, those sharing the route in other vehicles, and those near the shipment at rest stops. Besides route length and demographics, the radiation dose 1 meter from the truck was the most important parameter. NNSA used a dose rate of 1 millirem per hour for shipments of special nuclear material and low-level waste (LLW) and 4 millirem per hour for transuranic (TRU) waste. RADTRAN 4 was used to calculate the collective dose for each type of material shipped between the various origin-destination pairs. The results were then multiplied by the numbers of shipments for each campaign.

For accidents, NNSA used RADTRAN 4 to calculate the collective dose should an accident occur. NNSA conservatively selected the highest consequence accident in the most populated area to report. Collective doses from incident-free and accident analyses were multiplied by the conversion factor for converting collective dose to numbers of LCFs. This factor is 6×10^{-4} LCFs per person-rem (DOE 2002a).

E.2.5 Geology and Soils

The geology and soils analysis looked at the effects of the construction and operation of facilities and of activities described for the alternatives. The analyses evaluated the amount of disturbance that might affect the geology and/or soils of areas at Y-12. Impacts could include erosion and effects to potential geologic economic resources, such as mineral and construction material resources and fossil locations. Impacts to soils were quantified as the amount of area disturbed by construction activities. The seismicity of the region was evaluated to provide perspective on the probability and severity of future earthquakes in the area. This information was used to provide input to the evaluation of accidents due to natural phenomena.

E.2.6 Air Quality and Noise

E.2.6.1 *Nonradiological Air Quality*

The primary activities that emit air pollutants, associated with current and continued laboratory operations, include fuel combustion, vehicular activity particularly with employees commuting to and from the site, and construction and maintenance activities. Air pollutant emission rates and potential impacts of these activities were assessed using standard methods endorsed by the U.S. Environmental Protection Agency (EPA) and local air pollution control agencies. As available, site-specific parameters developed by local air quality regulatory agencies were incorporated and conservative assumptions were used so as not to underestimate the potential impact.

Total emissions from project operations were compared to significance and conformity levels using the EPA-approved ISC3 model (EPA 1995b, DOE 2001a). Greenhouse gas emissions were also considered by assessing the amounts of carbon dioxide that would be emitted by each alternative. In addition to operational emissions, construction activities were considered, by comparing the emissions to past construction projects of similar magnitude. Experience has shown that there are a number of feasible control measures that can be reasonably implemented to significantly reduce particulate matter emissions from construction. The approach to analyses of construction impacts relative to significance levels is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

E.2.6.2 *Radiological Air Quality*

Routine radiological emissions from Y-12 facility operations were evaluated on the basis of dose to the site-wide maximally exposed individual (MEI) and collective dose to the general population within 50 miles of the site (population dose). The MEI evaluation was compared to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). NESHAP limits the radiation dose that a member of the public may receive from radiological material released to the atmosphere from normal operations to 10 millirems per year. Although there is no standard that governs population dose, it is compared with the population dose received from naturally occurring radiation.

The baseline year for radiological emissions was taken as 2004. The changes due to new facilities, upgraded facilities, or changes in releases on MEI dose and location was calculated using the EPA-approved *Clean Air Assessment Package* (CAP 88-PC 2000) *Version 3* computer model. CAP88-PC, used also in the NESHAP annual report, conservatively calculates radiological impacts extending up to 50 miles. Doses from both internal (e.g., inhalation, ingestion of foodstuffs) and external exposure (e.g., standing on ground contaminated with radioactive material) were considered. Spatial population distributions at each site were based on 2000 census data, which represents the best available data. Agricultural data used were for the State of Tennessee, as contained in the CAP88-PC database. It was assumed that the entire source of ingested vegetables and meat is grown within the affected area. No milk production was found in the area; all milk was assumed imported from outside the area.

The MEI is a hypothetical member of the public assumed to be located outdoors in a public area where the radiation dose from a particular source is highest. This individual is assumed to be exposed to the entire plume in an unshielded condition. The impacts on the MEI are therefore greater than the impacts that any member of the public can be expected to receive. The site-wide MEI is located where the composite dose from all site sources is greatest.

E.2.6.3 *Noise*

Various activities at Y-12 result in noise that may be heard in surrounding offsite locations. To understand the potential impact of planned or proposed activities, noise levels attributed to activities such as construction, demolition, and operating equipment were characterized in terms of decibel level and described in relation to comparative noise levels of activities commonly encountered in community settings and land use compatibility guidelines. For non-continuous sources, such as construction, demolition, and the unique impulse noise associated with explosives firings, activity levels were provided to give a sense of the amount of time that intermittent sources would be operated and contribute to ambient noise levels. Source location is also discussed where proximity to community receptors would result in a higher likelihood that a source would be heard in offsite areas.

E.2.7 Water

E.2.7.1 *Surface Water*

The affected environment discussion includes a description of local surface water resources at Y-12, flow characteristics and relationships, and existing water quality. Data used for impact assessments included rates of water consumption and wastewater discharge. The existing water supply was evaluated to determine if sufficient quantities were available to support an increased demand by comparing projected increases with the capacity of the supplier.

The water quality of potentially affected receiving waters was determined by reviewing current monitoring data for contaminants of concern. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System (NPDES) were examined for compliance with permit limits and requirements. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff addressed potential impacts to the receiving waters'

average flow during construction and operation. Suitable mitigation measures for potential impacts such as stream channel erosion, sedimentation, and stream bank flooding were identified. Floodplains were identified to determine whether any of the proposed facilities would be located within the 100-year and 500-year floodplains.

E.2.7.2 *Groundwater*

Groundwater resources were analyzed for effects on aquifers, groundwater use and storage, and groundwater quality within the regions. Groundwater resources were defined as the aquifers underlying the site and their extensions downgradient, including discharge points. The affected environment discussion included a description of the local hydrogeology, occurrence, flow, and quality. Groundwater usage was described and projections of future usage were made based on changing patterns of usage and anticipated growth patterns.

Available data on existing groundwater quality were compared to Federal and state groundwater quality standards, effluent limitations, and safe drinking water standards. Additionally, Federal and state permitting requirements for groundwater withdrawal and discharge were identified. Impacts of groundwater withdrawals on existing contaminant plumes due to construction and facility operations were assessed to determine the potential for changes in their rates of migration and the effects of any changes in the plumes on groundwater users. Impacts were assessed by evaluating local hydrogeology, groundwater quality, and groundwater availability.

E.2.8 Ecological Resources

A qualitative analysis addresses the impacts of the activities under each alternative to biological resources. The methodology focused on those biological resources with the potential to be appreciably affected, and for which analyses assessing alternative impacts were possible. Biological resources include vegetation, wildlife, protected and sensitive species, and wetlands that are present or use the Y-12 and contiguous areas. The potential sources of impacts from normal operations and security measures to biological resources that were considered include noise, outdoor tests, erosion, construction, demolition, and prescribed burns.

The biological data from earlier projects, wetlands surveys, and plant and animal inventories of portions of the Y-12 were reviewed to identify the locations of plant and animal species and wetlands. Lists of sensitive species potentially present on the Y-12 and areas designated as critical habitat were obtained from the U.S. Fish and Wildlife Service (USFWS). A similar request was made to the Tennessee Wildlife Resources Agency.

Activities and potential releases identified under the alternatives were reviewed for their potential to affect plants, animals, and the sensitive species under Federal and state laws and regulations. Potential beneficial and negative impacts to plants and animals were evaluated for gain, loss, disturbance, or displacement. Impacts to wetlands were evaluated to determine if their areal extent would change. Monitoring data on sensitive plants and animals were reviewed for impact to these resources.

E.2.9 Cultural Resources

Section 106 of the *National Historic Preservation Act* (NHPA) and its implementing regulations (36 *Code of Federal Regulations* [CFR] Part 800) state that an undertaking has an effect on a historic property when that undertaking may alter those characteristics of the property that qualify it for inclusion in the National Register of Historic Places (NRHP). An undertaking is considered to have an adverse effect on a historic property when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

Adverse effects include, but are not limited to:

- Physical destruction, damage, or alteration of all or part of the property;
- Isolation of the property or alteration of the character of the property's setting when that character contributes to the property's qualifications for the NRHP;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that alter its setting;
- Neglect of a property resulting in its deterioration or destruction;
- Transfer, lease, or sale of a property, without adequate provision to protect the property's historic integrity.

The analysis addressed potential impacts or effects to NRHP-eligible resources located within the boundaries of Y-12. Activities under the alternatives were reviewed to identify those that would cause ground disturbance, introduce visual or audible changes, or make changes to existing buildings and structures. The proposed activities were then analyzed to determine if they would cause adverse effects to NRHP-eligible resources.

The *Sitewide Programmatic Agreement Among the Department of Energy Oak Ridge Operations Office*, the *National Nuclear Security Administration, the Tennessee State Historic Preservation Office*, and the *Advisory Council on Historic Preservation Concerning the Management of Historical and Cultural Properties at the Y-12 Complex* provides implementing procedures to ensure the protection of the remaining 77 historic properties and structures at the Y-12 Complex. The Programmatic Agreement is a guideline for NNSA to comply with Section 106 for all present and future actions. In addition, the *National Historical Preservation Act* Historic Preservation Plan (Y/TS 2003) provides an effective approach to preserving the historically significant features of Y-12's historic buildings and structures. Both the plan and the Programmatic Agreement were reviewed by NNSA, DOE Oak Ridge Office (ORO), the Tennessee State Historic Preservation Officer (SHPO), and the advisory council in August 2003 and were approved in November 2003 (DOE 2004e). Provisions of the Programmatic Agreement would serve as components of mitigation measures.

E.2.10 Socioeconomics

The socioeconomic analysis measured the incremental effects from changes in employment and income associated with the alternatives at Y-12, as well as their overall effect on the region of influence (ROI). The ROI, as described in Chapter 4 of this Y-12 SWEIS, is a four-county area

surrounding Y-12 where more than 90 percent of Y-12 employees and their families live, spend their wages and salaries, and use their benefits.

Spending by Y-12 directly affects the ROI in terms of dollars of expenditures gained or lost for individuals and businesses, dollars of income gained or lost to households, and the number of jobs created or lost. Changes in employment at Y-12 directly affect the overall economic and social activities of the communities and people living in the ROI. These changes directly affect the amount of income received by individuals and businesses. Businesses and households in the ROI re-spend Y-12 money, which creates indirect socioeconomic effects from Y-12 operations. Every subsequent re-spending of money by businesses and households in the ROI is another tier of indirect and induced socioeconomic effects originating from Y-12 operations.

The analysis compared the magnitude of Y-12 employment changes to the future employment, population, and housing levels. Determination of impacts was based on the percentage of these future levels that are attributable to Y-12's influence. For construction activities, the analysis focuses on the peak year of construction, as this year would have the greatest impact.

Estimates of the geographic distribution of residences of potential new hires associated with the alternatives were based on the existing distribution of the workforce residences. This demographic pattern could change over the project period due to various economic and quality of life factors, as employees balance factors such as housing costs, commute times, and quality of schools. For purposes of this analysis, no change in the distribution was assumed. The community services analysis measured effects on local government support services: fire protection and emergency services, police protection and security services, and school services. The analysis evaluated the burden placed on each of these support services by changes in Y-12 demands under the various alternatives. For insignificant changes, no detailed analyses were required.

E.2.11 Environmental Justice

The potential for disproportionately high and adverse human health or environmental impacts from the alternatives on minority and low-income populations was examined in accordance with Executive Order (EO) 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629). Both the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997) and the *Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 1998) provide guidance for identifying minority and low-income populations and determining whether the human health and environmental effects on these populations are disproportionately high and adverse.

Demographic information from the U.S. Census Bureau was used to identify minority and low-income populations in the ROI. Information on locations and numbers of minority and low-income populations was obtained from the 2000 U.S. Census. Census data is reported on the level of census tracts.

Arc View Geographic Information Systems (GIS) layers were produced by identifying polygons from the 2000 census data which met the following criteria:

- Any block group with a minority population greater than 50 percent
- Had a median household income in 1999 less than 65 percent of the statewide median household
- Had an English proficiency of less than or equal to 75 percent
- Any block group with a foreign-born value of 25 percent or more

Areas meeting these criteria that fell within a 50-mile radius of Y-12 were identified as low-income or minority populations.

E.2.12 Human Health and Safety

Y-12 operations that could potentially impact human health and safety include radiological and nonradiological exposures and occupational injuries, illnesses, and fatalities resulting from normal, accident-free operations on site facilities. Impacts are given in LCFs, emergency response planning guideline (ERPG) values, injury and illness recordable cases, and lost/restricted workday cases. The following paragraphs discuss how each of these human health and safety issues is estimated. Impacts are estimated for involved workers, noninvolved workers, and the public.

E.2.12.1 *Nonradiological Health Impacts*

Occupational Safety. Occupational injuries and illnesses are those incidents that result during the performance of an individual's work assignment. Occupational injury, illness, and fatality estimates were evaluated using site-specific occupational incidence rates. Occupational injury, illness, and fatality categories used in this analysis were in accordance with Occupational Safety and Health Administration (OSHA) definitions.

Hazardous Air Pollutants. Health risks from hazardous chemical releases during normal operation will be assessed by evaluating facility chemical source term inventories and engineered facility safety features used to mitigate personnel exposures during normal (accident-free) operations. If required, site boundary concentrations, derived through modeling (i.e., ISCST or equivalent) will be used to develop hazard quotients for noncancer risks for comparison to reference concentration values, such as the EPA Integrated Risk Information System.

E.2.12.2 *Radiological Health Impacts*

Radiological health impacts from normal operations were evaluated in terms of the probability of a premature fatality. Such impacts were quantified by noting the probability that a given radiation exposure would result in an LCF to an individual. When evaluated over a population, the individual probabilities can be generalized to make a statement as to how many people (but not which people) in the population would be affected.

The DOE recommends a risk estimator of 6×10^{-4} excess (above those naturally occurring) fatal cancers per person-rem of dose in order to assess health effects to the public and to workers (DOE 2002a). Worker health effects from occupational exposure to radiation are projected based on recent experience with continuing operations and projections of specific additional operation impacts on involved workers. Radiological health impacts to the general population were calculated from radiation exposure to the site-wide MEI and the population as a whole. A similar calculation was performed for the noninvolved worker population dose. These doses were converted to health impacts using the dose to risk estimators. The air transport pathway currently results in almost all of the doses to the public from Y-12, either directly or through deposition and subsequent inhalation and ingestion.

The methodology for the accident analysis is presented in Appendix D.

E.2.13 Waste Management

The waste management analysis examines potential impacts associated with waste generation activities at Y-12, including LLW, mixed low-level waste (MLLW), hazardous waste, *Resource Conservation and Recovery Act* (RCRA) construction waste, decontamination and decommissioning (D&D) waste, municipal solid waste, and process (including domestic) wastewater. The ongoing waste management practices relating to generating, handling, treating, permits modifications, and storing wastes are described. The analysis also presents a summary of the regulatory framework as it applies to waste management and a summary of current and projected waste generation activities. The alternatives were analyzed by estimating the quantities of wastes that would be generated, comparing these amounts against the No Action Alternative, and assessing whether the existing Y-12 treatment, storage, and disposal were capable of managing the waste quantities. The analysis of potential impacts considered physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and treatment capacity.

For each alternative, the wastes projected represent the maximum possible waste generation level, and thus the bounding level of operation. This applies to all waste types including LLW, MLLW, and hazardous waste and all material types including radioactive, explosive, and chemical.

E.2.14 Malevolent, Terrorist, or Intentional Destructive Acts

Analyses of the potential impacts of terrorist attacks are in a classified appendix to this SWEIS. The impacts of some terrorist attacks would be similar to the accident impacts described earlier in this section, while others would have more severe impacts. This section describes the methodology NNSA uses to assess the vulnerability of its sites to terrorist attacks and then designs its systems to prevent and deter those threats.

E.2.14.1 *Assessment of Vulnerability to Terrorist Threats*

In accordance with DOE Order 470.3B, Graded Security Protection Policy (secret classification), and DOE Order 470.4A, Safeguards and Security Program, NNSA conducts vulnerability assessments and risk analyses of its facilities and sites to determine the physical protection

elements, technologies, and administrative controls NNSA should use to protect its assets, its workers, and the public. DOE Order 470.4A establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3B establishes requirements designed to prevent unauthorized access, theft, diversion, or sabotage of nuclear weapons, components, and special nuclear material controlled by NNSA.

Among other things, DOE Order 470.3B: (1) Specifies those national security assets that require protection; (2) Outlines threat considerations for safeguards and security programs to provide a basis for planning, designing, and constructing new facilities; and (3) Requires the development of credible scenarios of threats that are used to design and test safeguards and security systems. NNSA must also protect against espionage, sabotage, and theft of materials, classified matter, and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to:

- Deny adversaries access to nuclear weapons, nuclear test devices, and completed nuclear assemblies;
- Deny adversaries the opportunity to steal special nuclear materials (SNM), sabotage weapons or facilities, or produce an unauthorized nuclear yield (criticality) of SNM;
- Protect the public and employees from harm resulting from an adversary's use of radiological, chemical, or biological materials; and
- Protect classified information, classified matter, and designated critical facilities or activities from sabotage, espionage, and theft.

NNSA's vulnerability assessments employ a rigorous methodology based on guidance from the DOE Vulnerability Assessment Process Guide (September 2004), and the Vulnerability Assessment Certification course (DOE 2004f). Typically, a vulnerability assessment involves analyses by subject matter experts to determine the effectiveness of a safeguard and security system used to protect against an adversary with certain capabilities. Vulnerability assessments generally include the following activities:

Characterizing the threat. Threat characterization provides a detailed description of a physical threat by a malevolent adversary to a site's physical protection systems. Usually the description includes information about the types of potential adversaries, their motivations, objectives, actions, capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3B and the Adversary Capabilities List. The Department also issues site-specific guidance, to assist in this process.

Determining the target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests. Results of target determinations are used to help characterize potential threats and objectives, as well as, protective force and neutralization requirements.

Defining the scope. The scope of a vulnerability assessment is determined by subject matter experts and depends on the site vulnerabilities. In addition to defining the threat and possible terrorist objectives, the scope establishes the key assumptions and interpretations that will guide

the analyses, as well as the objectives, methods, and format for documenting the results of the vulnerability assessment.

Characterizing the facility or site. This activity requires defining and documenting every aspect of the facility or site to be assessed, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying strengths and weaknesses. Results are used as inputs to the pathway analyses, which DOE uses to develop representative scenarios for evaluating the security system. Facility and site characterization modeling tools include Analytical System and Software for Evaluating Safeguards and Security (ASSESS), Adversary Time-Line Analysis System (ATLAS), VISA, tabletop analysis, and others.

Characterizing the protective force. To assess a facility or site's vulnerability, analysts must accurately characterize protective force's capabilities against a defined threat and objective, particularly its ability to detect, assess, interrupt, and neutralize an adversary. Specific data used for this activity include special nuclear materials categorization; configuration, flow, and movement of special nuclear materials within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The protective force's equipment, weapons, size, and posts also are considered in the characterization. The characterization information is validated and verified via observation, alarm response assessments, performance tests, force-on-force exercises, joint conflict and tactical simulation (JCATS), and tabletop analyses. The JCATS software tool is used for training, analysis, planning, and mission rehearsal, as well as characterization of the protective force. It employs detailed graphics and models of buildings, natural terrain features, and roads to simulate realistic operations in urban and rural environments.

Analyzing adversary pathways. This activity identifies and analyzes adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. ASSESS and ATLAS are two primary tools that are used in this analysis. Analysts also conduct insider analysis as part of this activity.

Developing credible scenarios. Credible scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's objectives. As part of this activity, data from the adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to successfully achieve their objectives. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured and informal analysis of the strengths and weaknesses of potential adversaries.

Determining the probability of neutralization. The probability of neutralization is the probability that a protective force can prevent an adversary from achieving its objectives. The probability is derived from more than one source, one of which must be based on Joint Tactical Simulation, JCATS analysis, or force-on-force exercises.

Determining system effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multi-layered protection system. Analysis data derived from the

various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and effective upgrades are documented in the vulnerability analysis report.

Implementation. The culmination of the vulnerability assessment is development of a report documenting the analyses and results and a plan for implementing any necessary changes to security systems. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also oversees the implementation of security system upgrades.

E.2.14.2 *Terrorist Impacts Analysis*

Substantive details of the credible scenarios for terrorist attacks NNSA's countermeasures, and potential impacts of attacks are not released to the public because disclosure of this information could be exploited by terrorists and assist them in the planning of attacks. Depending on the intentionally destructive acts, impacts may be similar to or would exceed those of bounding accidents analyzed elsewhere in this SWEIS. A separate classified appendix to this SWEIS evaluates the impacts of an adversary achieving its objectives in one or more of the credible scenarios.

The classified appendix evaluates the potential impacts of the successful execution of credible scenarios for Y-12 and calculates consequences to a noninvolved worker, maximally exposed individual, and population in terms of direct effects, radiation dose, and LCFs. Risks are not calculated because the probability that an adversary could successfully execute the attack in a scenario cannot be quantified. The MACCS2 and RISKIND computer codes are used along with other manual methods to calculate human health effects of each credible scenario. The same site-specific meteorology and population distribution that is used in the accident analyses in this SWEIS are used in analyses of the impacts of an adversary achieving its objectives in the credible attack scenario.

E.2.14.3 *Mitigation of Impacts from Potential Terrorist Attacks*

The DOE strategy for the mitigation of environmental impacts resulting from a terrorist attack has three distinct components: (1) Prevent and deter terrorists form executing successful attacks; (2) Plan and provide timely and adequate response to emergency situations; and (3) Progressive recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environment.

E.2.14.4 *Actions to Prevent or Reduce the Probability of Successful Attacks*

NNSA employs a well-established system of engineered and administrative controls 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 security requirements are identified, as new technologies become available, and as new engineering standards or best practices are developed. The directing requirements and the framework for implementing this system of controls are embodied in the Code of Federal Regulations and in

DOE Orders. These are imposed as contractual requirements for DOE management and operating (M&O) contractors. The NNSA system of safety requirements and quality assurance guidelines and controls covers all aspects of key nuclear and non-nuclear facilities including design requirements, construction practices, start-up and operational readiness reviews, and routine operations and maintenance. The contractor and federal staff at these facilities are evaluated for trustworthiness and reliability.

E.2.14.5 *Plan for and Respond to Emergency Situations*

While NNSA has comprehensive security measures to prevent terrorist attacks, it is also necessary to have the capability for timely and adequate response to emergency situations. Therefore, in addition to the systems of workplace hazard controls and safeguards and security measures, the NNSA emergency management system imposes additional protections over operations involving dispersible hazardous materials in quantities that could harm people outside the immediate workplace. NNSA's comprehensive all-hazards approach to emergency management is established in DOE Order 151.1C, Comprehensive Emergency Management System. This Order provides a general structure and framework for responding to any emergency at an NNSA facility or for an NNSA activity and specific requirements to address protection of workers, the public, and the environment from the release of hazardous materials.

NNSA's comprehensive emergency management system is based on a three-tiered structure consisting of facility, site, or activity management; the Cognizant Field Element; and Headquarters, with each tier having specific roles and responsibilities during an emergency. Each organizational tier provides management, direction, and support of emergency response activities. Management personnel of a facility, site, or activity manage the tactical response to the emergency by directing the mitigative actions necessary to resolve the problem, protect the workforce, the public, and the environment; and return the facility, site, or activity to a safe condition. The Cognizant Field Element oversees the facility/site response and provides local assistance, guidance, and operational direction to the facility/site management. The Cognizant Field Element also coordinates the tactical response to the event with tribal, state, and local governments. NNSA Headquarters provides strategic direction to the response, provides assistance and guidance to the Cognizant Field Element, and evaluates the broad impacts of the emergency on the NNSA complex. Headquarters also coordinates with other Federal agencies on a national level, provides information to representatives of the executive and legislative branches of the Federal government, and responds to inquiries from the national media.

Each NNSA facility, site, or activity is required by DOE Order 151.1C to have an Operational Emergency Base Program, which provides the framework for responding to serious events or conditions that involve the health and safety of the workforce and the public, the environment, and safeguards and security. The objective of the Operational Emergency Base Program is to achieve an effective integration of emergency planning and preparedness requirements into an emergency management program that provides capabilities for all emergency responses through communication, coordination, and an efficient and effective use of resources, that is commensurate with the hazards present at that facility, site, or activity.

DOE Order 151.C requires that a Hazards Survey be prepared, maintained, and used for emergency planning purposes. The Order requires that emergency management efforts begin

with the identification and qualitative assessment of the facility- or site-specific hazards and the associated emergency conditions that may require response, and that the scope and extent of emergency planning and preparedness reflect these facility-specific hazards. Hazards Surveys are used to:

- identify the generic emergency conditions that apply to each facility;
- qualitatively describe the potential health, safety, or environmental impacts of the applicable emergencies;
- identify the applicable planning and preparedness requirements; and
- indicate the need for further evaluation of hazardous materials in an Emergency Planning Hazards Assessment (EPHA).

Some facilities have been analyzed as stand-alone facilities; however, several structures or component units with common or related purposes have been combined into a facility- or complex-wide hazards survey. Each facility- or complex-specific hazards survey clearly identifies the facility and describes the facility's mission, operations, and physical characteristics.

Using the knowledge and insights gained through the Hazards Survey and EPHA processes, the emergency management organization at each NNSA site or facility develops detailed plans and procedures and trains the staff to carry out response actions to reduce the severity of hazardous material release events and to minimize health impacts.

The Response Activities of the Emergency Management Program that would come into play should an operational emergency occur would include many of the following elements, depending on the specific circumstances:

Emergency Response Organization (ERO). The ERO is structured to enable it to assume overall responsibility for initial and ongoing site actions associated with the emergency response and mitigation. The ERO establishes effective control at the event/incident scene and integrates local agencies and organizations providing onsite response services.

Offsite response interfaces. DOE Order 151.1C requires coordination with tribal, state, and local agencies and organizations responsible for offsite emergency response. Interrelationships and interfaces for fire, hazardous materials expert, medical, and law enforcement and mutual assistance and support are pre-arranged and documented in various formal plans, agreements, and memoranda of understanding.

Emergency facilities and equipment. The EPHA is used to assist in determining the types and amounts of personal protective equipment, radiation monitoring, communications, and other equipment and supplies required to be maintained and operable for immediate use in responding to an operational emergency. Facilities established for either dedicated permanent use or on an ad hoc basis depending on the specific type and location of the operational emergency can include Emergency Operations Centers (EOCs), Command Centers, and Joint Information Centers. Departmental assets that may be required in the event of an operational emergency involving nuclear weapons, weapons components, or the dispersal of special nuclear materials include the Accident Response Group, Nuclear Emergency Search Team, Federal Radiological Monitoring and Assessment Center, Aerial Measuring System, Atmospheric Advisory

Capability, Radiological Emergency Assistance Center/Training Site, and the Radiological Assistance Program.

Emergency categorization and classification. DOE Order 151.1C and the associated Emergency Management Guide (DOE G 151.1-1A) require a DOE site or facility to declare an operational emergency when unplanned or abnormal events or conditions require time-urgent response from outside the immediate affected site, facility, or area of the incident. Events or conditions meeting the criteria for categorization as operational emergencies are those events or conditions that have the potential to cause: serious health or safety impacts to workers or the public; serious detrimental effects on the environment; direct harm to people or the environment as a result of degradation of security or safeguards conditions; direct harm to people or the environment as a result of a major degradation of safety systems, protocols, or practices involving hazardous biological agents or toxins; or loss of control over hazardous materials (for example, toxic chemicals or radioactive materials). NNSA sites or facilities are also required to classify an operational emergency that involves the loss of control over hazardous materials resulting in an actual or potential airborne release to the environment (outside a structure or enclosure on an NNSA facility or site) as either an Alert, Site Area Emergency, or General Emergency, in order of increasing severity.

Notifications and communications. The accurate, timely, and useful exchange of information during an emergency response is a key factor in understanding the scope of an emergency and providing proper response to limit its impacts. Emergency reporting includes initial notifications to onsite personnel, emergency response personnel, and offsite authorities including applicable NNSA elements; other Federal Agencies; and local, state, and tribal government organizations, and follow-on emergency status updates.

Consequence assessment. Consequence assessment includes all processes utilized to perform data collection and analysis necessary to support critical initial assessments and the continuing processes of refining the assessments as more information and additional resources become available. These can involve monitoring for specific indicators or field measurements and the integration of monitoring data with calculations and modeling capabilities. Consequence assessment is integrated with both event classification and protective action decision making and can include coordination with offsite entities including federal, state, local, and tribal organizations.

Protective actions and re-entry. Protective actions can be implemented either individually or in combination to reduce exposure of the workforce and the public to special nuclear materials or other hazardous materials. These can include:

- Controlling, monitoring, and maintaining records of personnel exposure to radiological and nonradiological hazardous materials;
- Sheltering or evaluation;
- Turning off heating, ventilation, and air conditioning systems during sheltering;
- Controlling access to contaminated areas and decontaminating personnel or equipment exiting the area;
- Controlling foodstuffs and water, or changing livestock and agricultural practices; and

- Developing and deploying for use in protective action decision making prepared Protective Action Guides and ERPG using DOE-approved guidance applicable to the actual or potential release of hazardous materials.

Planning and executing re-entry activities must include establishing adequate measures for the protection of response personnel from unnecessary exposure to hazardous materials or conditions either known or suspected to exist at the site of the accident or incident.

Emergency medical support. Emergency medical support includes providing various levels of treatment to those who may become injured or contaminated and arranging with offsite medical facilities to transport, accept, and treat contaminated, injured personnel. DOE Order 440.1A establishes requirements for facility and site medical programs required to meet the provisions of 10 CFR 851.210, *Occupational Medicine*, and addresses the medical organization, facilities and equipment, communications planning, and preparedness activities considered necessary for providing the medical treatment and access to medical services for mass casualty situations and medical response to an operational emergency involving contamination.

Emergency public information. The Emergency Public Information program plays a critical role in establishing and maintaining coordination with tribal, state, and local governments and the public. The program is expected to provide timely, candid, and accurate information to the workforce, the news media, and the public during an operational emergency. Providing accurate and factual health and safety information and security information helps to avoid and discourage speculation. The elements of an effective program can be pre-established by developing appropriate broadcast and print media interfaces, establishing a system for assembling and releasing emergency information that may include set-up of a Joint Information Center with representatives of offsite organizations, and conducting various drills and exercises that include exercising various Emergency Public Information program systems to educate the press and the public.

Termination and recovery. An operational emergency is terminated only after a predetermined set of criteria is met and in many scenarios, termination must be coordinated with various offsite agencies. The various pathways and timelines for recovery and resumption of normal operations must be developed to ensure the health and safety of the work force and the public. Actions may include the creation of a recovery organization to manage the conduct of recovery operations and to maintain communication and coordination with local, state, and tribal organizations, and other federal agencies providing support at the site. Specific recovery procedures may include dissemination of information to federal, state, tribal, and local organizations regarding the emergency and conditions required for the relaxation of public protection measures; planning and conducting decontamination actions; development and compliance with reporting requirements; and the creation of processes and procedures to guide the resumption of normal operations. Recovery also specifically includes the evaluation of the accident or incident and the response to identify lessons learned and develop potential means to mitigate the effects of future operational emergencies.

E.2.14.6 *Progressive Recovery Through Long Term Response*

The recovery phase of an operational emergency in which radioactive materials are dispersed over a wide area could require years to complete and might require an extended response by NNSA. The specific requirements for an extended response would be dictated by the circumstances. Requirements may include a continuing coordination with local authorities and various government agencies to continue protective actions and controls; long-term monitoring of the affected environment, population, or both for effects attributable to the operational emergency; providing medical support for affected individuals; maintaining public information and various technical and other response interfaces; and performing periodic reassessments and evaluations of progress in the recovery and return to more normal conditions.