# CHAPTER 5: ENVIRONMENTAL CONSEQUENCES

*Chapter 5 describes the environmental consequences of the Site-Wide Environmental Impact Statement (SWEIS) alternatives. The Chapter discusses the consequences of each alternative by resource area, in a format consistent with Chapter 4. Chapter 5 also describes the environmental impacts common to all alternatives. Where applicable, Chapter 5 also discusses potential mitigation measures that could be employed to reduce impacts.*

## 5.0 INTRODUCTION

In accordance with Council on Environmental Quality (CEQ) regulations, the environmental consequences discussions provide the analytical detail for comparisons of environmental impacts associated with the various Y-12 National Security Complex (Y-12) SWEIS alternatives. Discussions are provided for each environmental resource and relevant issues that could be affected. For each resource or issue in Chapter 5, the impacts of the No Action Alternative and the four action alternatives are presented. For comparison purposes, environmental concentrations of emissions and other potential environmental effects are presented with the appropriate regulatory standards or guidelines. However, compliance with regulatory standards is not necessarily an indication that the environmental impacts are not significant for purposes of the *National Environmental Policy Act* (NEPA).

Impacts of the SWEIS alternatives are assessed in the following resource areas: land use (Section 5.1); visual resources (Section 5.2); site infrastructure (Section 5.3); transportation and traffic (Section 5.4); geology and soils (Section 5.5); air quality and noise (Section 5.6); water resources (Section 5.7); ecological resources (Section 5.8); cultural resources (Section 5.9); socioeconomics (Section 5.10); environmental justice (Section 5.11); health and safety (Section 5.12); waste management (Section 5.13); and accidents (Section 5.14). Section 5.15 discusses impacts associated with the transportation and receipt of nuclear materials in support of the Global Threat Reduction Initiatives. Section 5.16 discusses decontamination and decommissioning impacts. The impacts presented in Sections 5.15 and 5.16 are applicable to each of the SWEIS alternatives. The impact analysis for this Y-12 SWEIS is based on the best data currently available. The methodology used to perform the impact assessments is described in Appendix E.

## 5.1 LAND USE

The land use resources analysis considers a region of influence (ROI) that includes the Y-12 area of responsibility, which covers approximately 5,400 acres, as well as the rest of the Oak Ridge Reservation (ORR) (approximately 35,000 acres) and the adjoining properties of the City of Oak Ridge. The land use impacts of all the alternatives are compared with existing land use patterns, plans and policies.

### 5.1.1 Alternative 1 – No Action Alternative

The main area of Y-12 (approximately 800 acres) is largely developed and classified as "industrial use" (Figure 5.1.1-1 illustrates the industrialized nature of Y-12). The land

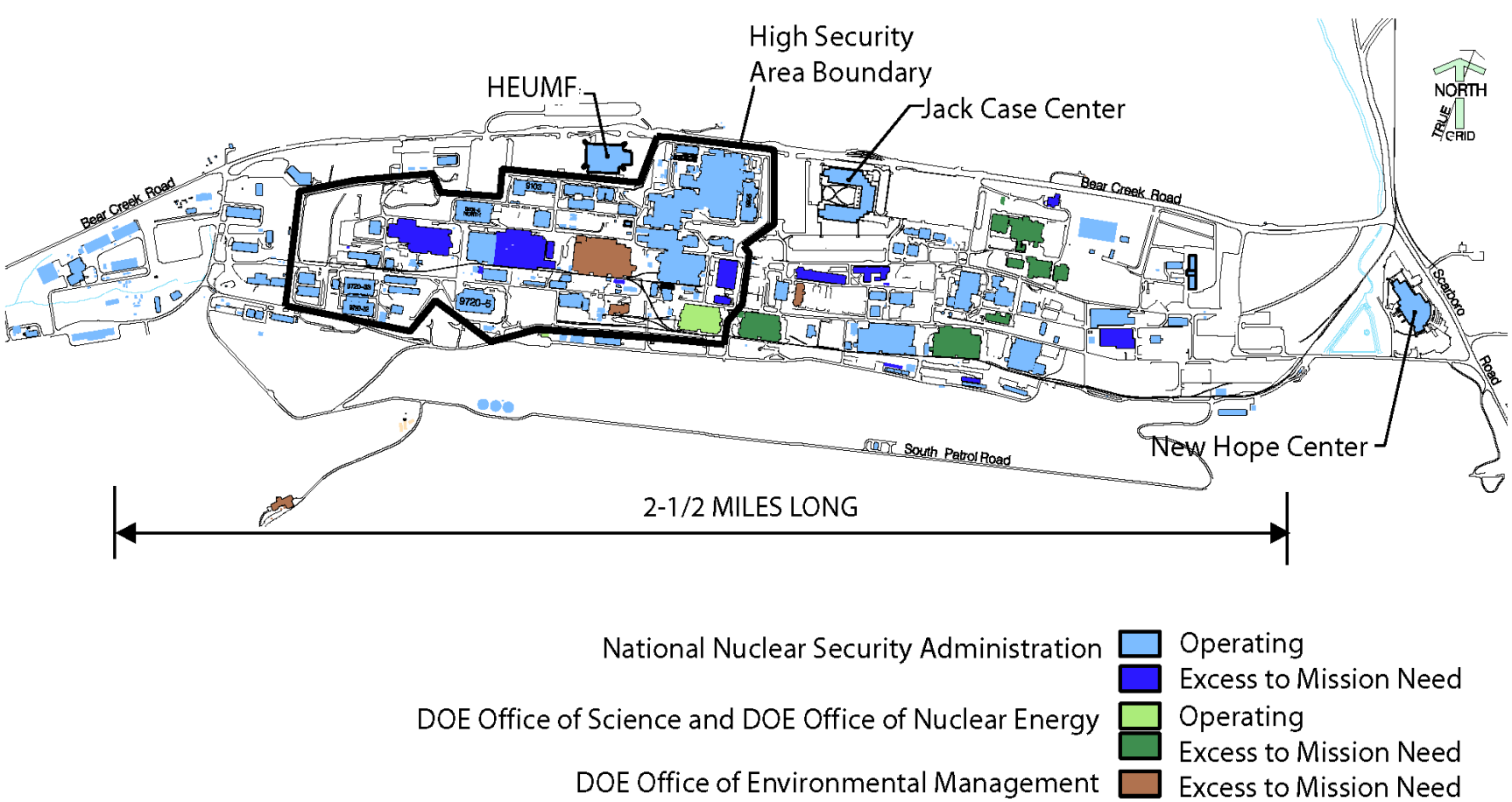
surrounding the main Y-12 area is used primarily for environmental restoration, waste management, and environmental field research activities. The No Action Alternative activities at Y-12 are consistent with current land use plans, classifications, and policies. Under the No Action Alternative, ongoing National Nuclear Security Administration (NNSA) and U.S. Department of Energy (DOE) activities would continue. Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for decontamination and decommissioning (D&D).

As discussed in Section 3.2.1 of this SWEIS, the long term plan for Y-12 is to consolidate operations and reduce the number of excess facilities. This is an ongoing mission that will continue for the foreseeable future. While specific land usage within Y-12 may change, the overall industrial use classification would likely remain the same. Because Y-12 would continue to require security and emergency response buffers, real estate associated with eliminating excess facilities would likely not be released for public use and there would be no local land use benefits. Impacts to land use adjacent to Y-12 are not expected.

### 5.1.2 Alternative 2 – Uranium Processing Facility Alternative

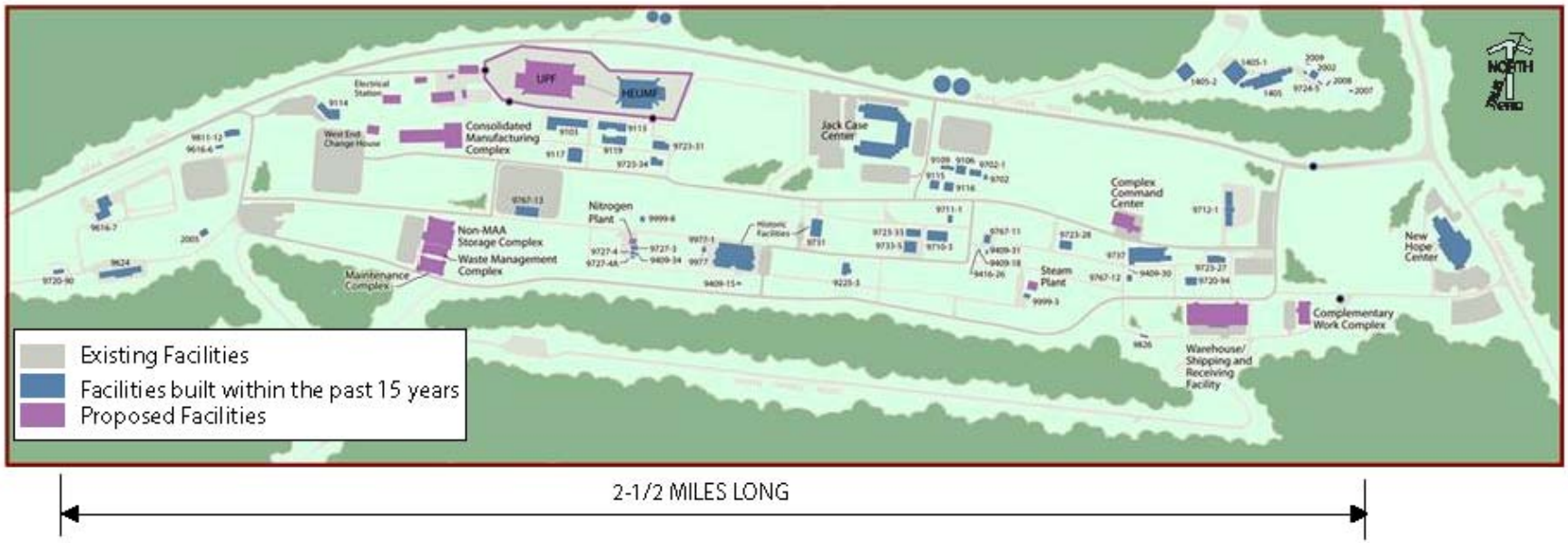
**Construction.** The new Uranium Processing Facility (UPF) and Complex Command Center (CCC), described in Section 3.2.2, would be compatible and consistent with the current land use at Y-12 and would not change the current industrial use classification that exists at the proposed location. Construction of and future operations at the UPF and CCC would be consistent with the Y-12 Ten Year Site Plan (TYSP) and would be a significant contribution to achieving an optimum configuration of Y-12 (see Figure 5.1.1-2). As shown by comparing Figures 5.1.1-1 and 5.1.1-2, the UPF would enable the enriched uranium (EU) operations to be consolidated into an area approximately 10 percent of the current size. The proposed UPF site is in the Pine Ridge and Bear Creek Parking Lots, collocated to the west of the Highly Enriched Uranium Materials Facility (HEUMF). This site is outside of, but adjacent to, the existing Perimeter Intrusion Detection and Assessment System (PIDAS). Figure 3.2.2-2, in Chapter 3 of this SWEIS, shows the location of the proposed UPF and CCC relative to other buildings at Y-12. The majority of the site for the UPF is presently a parking lot and represents a large level site with minimal site preparation requirements.

As shown on Figures 3.2.2-2 and 3.2.2-3, construction of the UPF would require approximately 35 acres of land, including land for a construction laydown area (four acres) and temporary parking. The construction laydown area for the UPF would be developed on the west side of the proposed UPF site. This area would be finished with an 8-inch-thick compacted, stabilized base for the construction phase. Interim employee parking lots would be developed west of the proposed construction laydown area. The site would be sufficiently graded and developed to accommodate a number of temporary construction trailers, storage buildings, and materials storage yards. The staging area would have electric power and potable water. Sanitary service would be provided by PVC double-wall collection tanks, which would be pumped out as needed. After construction of the UPF is complete, the construction office trailers would be removed and material laydown areas would be re-graded and seeded after removal of any soil that may have become contaminated with construction-related materials such as diesel fuel. Alternatively, it may be feasible to rework the laydown area to provide for additional parking.




Source: NNSA 2008a.

**Figure 5.1.1-1. Major Operational Facilities Currently Supporting Y-12 Missions.**




Source: NNSA 2008a, modified.

**Figure 5.1.1-2. The Proposed End State for the Modernization of Y-12.**

The UPF Project includes the construction of a Haul Road extension to link the UPF site construction/excavation activities with supporting infrastructure, i.e., a concrete batch plant, construction storage area, and a Wet Soils Disposal Area and West Borrow Area located west of Y-12 in the Bear Creek corridor (see Figure 2 in Appendix G). The road extension is required to accommodate the number and size of construction vehicles needed on site, as well as safely provide transportation away from occupied roadways. The designed alignment for the Haul Road extension follows the power line corridor and thus avoids forest habitat found to the north and south of the power line corridor. The Haul Road extension would require widening the existing power line corridor by approximately 12-15 feet. A minimal number of trees would be affected by this widening. In addition, there would be minimal clearing of vegetation within the existing power line corridor. The UPF footprint and the alignment of the new PIDAS would require Bear Creek Road to be closed to through traffic and re-routed slightly north of the existing road (see Appendix G, which refers to this re-routing as the "Site Access and Perimeter Modification Road"). Approximately 6 acres of land would be disturbed to construct the Haul Road extension and the Site Access and Perimeter Modification Road. The Wet Soils Disposal Area includes approximately 16.6 acres of property previously used for a controlled burn demonstration and pine reforestation project. The site is highly disturbed and would be used to disposition the wet and/or saturated soils that are expected to be encountered during initial site preparation and from the UPF foundation excavation. Wet soils would be placed at the site and graded according to the planned design for the area after necessary drying. The West Borrow Area is an 18.3 acre site that previously served as the source of clay for Y-12 landfill cap projects. This site would be utilized, as necessary, for the placement of excess soil from the UPF project with moisture content satisfactory for compaction (B&W 2010). Impacts to land use adjacent to Y-12 are not expected.

The CCC would be located in a previously developed area. The project would require excavation within the Y-12 industrial area for utility/communication lines. Excavation locations would be selected such that known *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) remediation areas of concern are avoided. Approximately 7 acres of land would be disturbed for the CCC.

**Operation.** The operational UPF would occupy about 8 acres of land. Upon completion of UPF construction, the PIDAS would be extended to surround the new facility. When the new PIDAS is completed, the existing EU operations would be relocated to the new facility, the current EU facilities could be declared surplus and evaluated for D&D, and the PIDAS surrounding the old EU facilities could be removed. D&D of the current EU facilities and removal of the PIDAS surrounding those facilities could not occur until after the UPF would become operational. Section 5.16 of this SWEIS provides a qualitative assessment of the types of impacts that might result from the D&D of these facilities. Although the ultimate disposition of these facilities would be determined by a separate NEPA review and determination in the future, when such actions are ripe for decisionmaking, this SWEIS acknowledges that approximately 633,000 square feet of facilities could become excess if the UPF is constructed. In the D&D of these facilities potential contamination could come from:

- Surface contamination on equipment, walls, ceilings, roof, floors, sinks, laboratory hoods, air ventilation ducts, etc;

- Solid and liquid contaminated waste from normal operations and off-normal and accident events; and
- Land contamination from normal and off-normal operations and accident events.

Ultimately, such D&D could result in the reuse of the land and facilities for activities not related to weapons production operations. While specific usage of this land may change, the overall industrial use classification would remain the same. Because Y-12 would continue to require security and emergency response buffers, no real estate associated with these facilities would likely be released for public use and there would be no local land use benefits. Once operational, the UPF would take up approximately eight acres, which represents a very small percentage of the land encompassed by the main area of Y-12 (approximately 800 acres). The UPF and new PIDAS would allow the Protected Area at Y-12 to be reduced from approximately 150 acres to about 15 acres.

The UPF footprint and the alignment of the new PIDAS would require Bear Creek Road to be closed to through traffic. Up to 1,200 parking spaces may be built to replace the parking spaces lost if the proposed UPF is constructed. Impacts to land use adjacent to Y-12 would not be expected to result from the construction of the proposed UPF and associated parking spaces.

Once operational, the CCC would occupy about 7 acres of land. Impacts to land use adjacent to Y-12 are not expected.

### 5.1.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would be both compatible and consistent with the current land use at Y-12 and would not change the current industrial use classification that exists. Construction activities would consist of internal modifications to existing facilities, as well as construction of the CCC, as described above. Overall, there would be no appreciable land use impacts or changes beyond those described for the No Action Alternative. Impacts to land use adjacent to Y-12 are not expected.

**Operation.** Operation of the upgraded facilities would have no impact on the current land use at Y-12 and would not change the current industrial use classification that exists at Y-12. Once operational, the CCC would occupy about 7 acres of land. Impacts to land use adjacent to Y-12 are not expected under the Upgrade in-Place Alternative.

### 5.1.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** The Capability-sized UPF Alternative, described in Section 3.2.4, would be compatible and consistent with the current land use at Y-12 and would not change the current industrial use classification that exists. The Capability-sized UPF would disturb no more than 32 acres of land during construction. The CCC would disturb 7 acres, as described above. The construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Standard construction mitigation techniques would be utilized and impacts to land use adjacent to Y-12 are not expected.

**Operation.** Under the Capability-sized UPF Alternative, operation of facilities would have no impact on the current land use at Y-12 and would not change the current industrial use classification that exists at Y-12. Consequently, the Capability-sized UPF Alternative would not entail any significant change to land use. Once operational, the CCC would occupy about 7 acres of land. Impacts to land use adjacent to Y-12 are not expected.

### 5.1.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** The No Net Production/Capability-sized UPF, described in section 3.2.5, would be compatible and consistent with the current land use at Y-12 and would not change the current industrial use classification that exists. The No Net Production/Capability-sized UPF would disturb no more than 32 acres of land during construction. The CCC would disturb 7 acres, as described above. The construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Standard construction mitigation techniques would be utilized and impacts to land use adjacent to Y-12 are not expected.

**Operation.** Under the No Net Production/Capability-sized UPF Alternative, operation of facilities would have no impact on the current land use at Y-12 and would not change the current industrial use classification that exists at Y-12. Consequently, the No Net Production/Capability-sized UPF Alternative would not entail any significant change to land use. Once operational, the CCC would occupy about 7 acres of land. Impacts to land use adjacent to Y-12 are not expected.

### 5.1.6 Potential Mitigation Measures

Because any construction would occur within the Y-12 industrial site, there would be no changes in land use at Y-12, and no conflicts with existing and approved future land uses. Therefore, no additional mitigation measures would be required.

### 5.1.7 Summary Comparison of Alternative Impacts for Land Use

**No Action Alternative.** Land uses at Y-12 would be compatible with the surrounding areas and with existing land use plans. There would be no change to existing land uses or total acreage of Y-12.

**UPF Alternative.** There would be a potential land disturbance of a total of approximately 83 acres (42 acres for the UPF and CCC, and 40.9 acres for the Haul Road extension and the Site Access and Perimeter Modification Road, the Wet Soils Disposal Area, and the West Borrow Area). Land uses at Y-12 would remain compatible with surrounding areas and with the existing land use plans.

**Upgrade in-Place Alternative.** Same as the No Action Alternative.

**Capability-sized UPF Alternative.** There would be a potential land disturbance of a total of approximately 80 acres of land (39 acres for the UPF and CCC, and 40.9 acres for the Haul Road

extension and the Site Access and Perimeter Modification Road, the Wet Soils Disposal Area, and the West Borrow Area). Land uses at Y-12 would remain compatible with surrounding areas and with the existing land use plans.

**No Net Production/Capability-sized UPF Alternative.** There would be a potential land disturbance of a total of approximately 80 acres of land (39 acres for the UPF and CCC, and 40.9 acres for the Haul Road extension and the Site Access and Perimeter Modification Road, the Wet Soils Disposal Area, and the West Borrow Area). Land uses at Y-12 would remain compatible with surrounding areas and with the existing land use plans.

## 5.2 VISUAL RESOURCES

The visual resources analysis considers a ROI that addresses the Y-12 area of responsibility, which covers approximately 5,400 acres. The impacts of the alternatives are evaluated for visual impacts.

### 5.2.1 Alternative 1 – No Action Alternative

As discussed in Section 4.2, the existing structures at Y-12 are mostly low-profile, reaching heights of three stories or less, and were built mainly in the 1940s and 1950s of masonry and concrete. Facilities at Y-12 are brightly lit at night, making them especially visible. Although there is no Bureau of Land Management (BLM) classification for Y-12, the level of development at Y-12 is consistent with Visual Resource Management (VRM) Class IV which is used to describe a highly developed area. Most of the land surrounding the Y-12 site would be consistent with VRM Class II and III (i.e., left to its natural state with little to moderate changes).

Under the No Action Alternative, ongoing activities associated with NNSA and DOE would continue. As discussed in Section 1.2 of this SWEIS, the long term plan for Y-12 is to consolidate operations and reduce the number of excess facilities. This is an ongoing mission that will continue for the foreseeable future. Although there would be some reduction in the density of industrial facilities as a result of such consolidation, Y-12 would still remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected. Figure 5.2.1-1 depicts many of the facilities that have been, or will be constructed at Y-12. As shown on that figure, these modern facilities are expected to improve the overall visual appearance of Y-12.

### 5.2.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** The new UPF and CCC described in Section 3.2.2 would be compatible and consistent with the current visual appearances at Y-12. The proposed UPF site is in the Pine Ridge and Bear Creek Parking Lot, located to the west of the HEUMF. This site is outside of, but adjacent to, the existing PIDAS. Figure 5.2.1-1 shows the location of the proposed UPF relative to other buildings at Y-12. The Pine Ridge and Bear Creek Parking Lot is close to the existing HEU processing complex and represents a large level site with minimal site preparation requirements. The proposed CCC site is in the eastern portion of Y-12 in a disturbed area near existing facilities.

Cranes used during construction of the UPF and CCC would create short-term visual impacts, but would not be out of character for an industrial site such as Y-12. The construction laydown areas, temporary parking, and temporary construction office trailers would also be typical for an industrial site. After construction of the facilities are complete, cranes and temporary construction office trailers would be removed, and construction laydown areas would be re-graded and seeded after removal of any soil that may have become contaminated with construction-related materials such as diesel fuel. Alternatively, the laydown areas could be used to provide for additional parking.

**Operation.** Upon completion of the UPF construction, the PIDAS would be extended to surround the new facility. When the new PIDAS is completed, the existing EU operations would be relocated to the new facility, the current EU facilities could be declared surplus, and evaluated for D&D. Although the ultimate disposition of these facilities would be determined by a separate NEPA review in the future, when such actions are ripe for decision-making, this SWEIS acknowledges that approximately 633,000 square feet of facilities could become excess if the UPF is constructed. Ultimately, this could improve the visual character of the site by reducing the density of industrial facilities. The CCC would be a one-story structure upon completion of construction (approximately 2012) and would not impact the visual character of Y-12. Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected.

### 5.2.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would consist mainly of internal upgrades to existing facilities and would not change the current visual impact of Y-12. Impacts of constructing the CCC would be the same as those described above under Alternative 2. Y-12 would still remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected.

**Operations.** Operation of the upgraded facilities and the CCC would have no impact on the current visual impact of Y-12. Upgrading existing facilities would not significantly reduce the density of industrial facilities in the protected area of Y-12.

### 5.2.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** The Capability-sized UPF Alternative would include construction of a 350,000 square foot UPF and the CCC. The Capability-sized UPF would be compatible and consistent with the current visual appearances at Y-12. It would be located at the same site as the UPF in Alternative 2, in the Y-12 Pine Ridge and Bear Creek Parking Lot, to the west of the HEUMF. The CCC would disturb 7 acres, as described above.

Cranes used during construction of the Capability-sized UPF and CCC would create short-term visual impacts, but would not be out of character for an industrial site such as Y-12. The

**Figure 5.2.1-1. New Facilities at Y-12.**

construction laydown areas, temporary parking, and temporary construction office trailers would also be typical for an industrial site. After construction of the facilities is complete, cranes and temporary construction office trailers would be removed, and construction laydown areas would be re-graded and seeded after removal of any soil that may have become contaminated with construction-related materials such as diesel fuel. Alternatively, the laydown areas could be used to provide for additional parking.

**Operation.** Upon completion of construction of the Capability-sized UPF, the PIDAS would be extended to surround the new facility. When the new PIDAS is completed, the existing EU operations would be relocated to the new facility. NNSA would need to maintain many of the current production facilities in a "ready-to-use" state in the event that changes were directed by the President. Therefore, there would be little change from the current visual appearance of Y-12. The CCC would be a one-story structure upon completion of construction (approximately 2012) and would not impact the visual character of Y-12. Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected. Consequently, the Capability-Sized UPF Alternative would not entail any significant change to visual resources.

### 5.2.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** The No Net Production/Capability-sized UPF Alternative would include construction of a 350,000 square foot UPF and the CCC. The No Net Production/Capability-sized UPF would be compatible and consistent with the current visual appearances at Y-12. It would be located at the same site as the UPF in Alternative 2, in the Pine Ridge and Bear Creek Parking Lot, to the west of the HEUMF. The CCC would disturb 7 acres, as described above.

Cranes used during construction of the No Net Production/Capability-sized UPF and CCC would create short-term visual impacts, but would not be out of character for an industrial site such as Y-12. The construction laydown areas, temporary parking, and temporary construction office trailers would also be typical for an industrial site. After construction of the facilities is complete, cranes and temporary construction office trailers would be removed, and construction laydown areas would be re-graded and seeded after removal of any soil that may have become contaminated with construction-related materials such as diesel fuel. Alternatively, the laydown areas could be used to provide for additional parking.

**Operation.** Upon completion of construction of the No Net Production/Capability-sized UPF, the PIDAS would be extended to surround the new facility. When the new PIDAS is completed, the existing EU operations would be relocated to the new facility. NNSA would need to maintain many of the current production facilities in a "ready-to-use" state in the event that changes were directed by the President. Therefore, there would be little change from the current visual appearance of Y-12. The CCC would be a one-story structure upon completion of construction (approximately 2012) and would not impact the visual character of Y-12. Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected. Consequently, the No Net Production/Capability-sized UPF Alternative would not entail any significant change to visual resources.

### 5.2.6 Potential Mitigation Measures

Under all alternatives, Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected. No mitigation measures would be required.

### 5.2.7 Summary Comparison of Alternative Impacts for Visual Resources

**No Action Alternative.** Y-12 would remain a highly developed area with an industrial appearance and with no change to VRM classification.

**UPF Alternative.** Cranes and other construction activities would create short-term visual impacts during construction of the UPF and CCC. Construction of the UPF would reduce the Protected Area from 150 acres to about 15 acres, resulting in a minor industrial density reduction. There would be no change to the VRM classification.

**Upgrade in-Place Alternative.** Cranes and other construction activities would create short term visual impacts during construction of the CCC.

**Capability-sized UPF Alternative.** Same as the UPF Alternative.

**No Net Production/Capability-sized UPF Alternative.** Same as the UPF Alternative.

## 5.3 SITE INFRASTRUCTURE

The site infrastructure impacts were assessed by comparing all the alternatives. 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. Projections of electricity availability, site development plans, and other Y-12 mid- and long-range planning documents were used to project site infrastructure conditions for the evaluated alternatives.

### 5.3.1 Alternative 1 – No Action Alternative

As discussed in Section 4.3, Y-12 maintains an extensive network of existing infrastructure. Site infrastructure at Y-12 includes; an extensive road and railroad system, electric power, natural gas, steam, water, sanitary sewer, industrial gases, and telecommunications.

As discussed in Section 3.2.1 under the No Action Alternative, ongoing NNSA and DOE activities would continue. The long-range plan for Y-12 is to consolidate operations and reduce the number of excess facilities, an ongoing mission that will continue for the foreseeable future. Table 5.3.1-1 presents the annual usage for electricity, steam, and water at Y-12 from 2006–2008. Activities under the No Action Alternative would cause minimal changes to the energy use and other infrastructure requirements at the site. As Y-12 continues to downsize and become more efficient, trends indicate that energy usage and most other infrastructure

requirements would be expected to continue reducing by approximately 2 to 5 percent per year. Although Table 5.3.1-1 illustrates rates of reduction different than this, a reduction rate of 2 to 5 percent per year is considered a reasonable long term estimate.

**Table 5.3.1-1. Annual Site Utility Usage for Years 2006–2008.**

| | Annual Power Usage (MWh) | Monthly Peak Power Usage (MW) | Annual Gross Steam Produced (1000 lb) | Potable Water Annual Consumption (1000 gal) |
|---|---|---|---|---|
| 2006 | 272,245 | 40 | 1,176,000 | 1,666,647 |
| 2007 | 260,730 | 35-40 | 1,131,000 | 806,190 |
| 2008 | 252,682 | 30-35 | 1,045,000 | 1,140,618 |

Source: B&W 2009.
Note: Available site electrical capacity is approximately 3,766,800 MWh/yr.

### 5.3.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** The new UPF and CCC described in Section 3.2.2 would require additional infrastructure demands during the construction phase above those for the No Action Alternative. During construction, the UPF would require a peak of approximately 2.2 megawatts (MW) per month of electric power, which is less than approximately 5 percent of the current peak power usage at Y-12 and less than one percent of available capacity. Water requirements during construction (4 million gallons) would be less than 1 percent of current site usage. Construction of the CCC would not impact current site water usage. Both Federal and DOE initiatives would require new construction to quantify and achieve energy savings.

**Operation.** During operations, the UPF would require approximately 14,000 megawatt hours (MWh) per month of electric power, which is less than 5 percent of available capacity. Additionally, the UPF would require an estimated 105 million gallons of water per year for operations. The UPF would not increase electricity or water demands at the site because EU operations would be phased out in existing facilities once the UPF becomes operational. Once operational, the UPF and CCC would not increase water use at Y-12, as compared to the No Action Alternative, as these facilities would replace existing facilities that perform similar functions. Operations under the UPF Alternative would reduce steam usage by at least 10 percent as inefficient facilities are closed.

### 5.3.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would involve internal upgrades to existing facilities, as well as construction of the CCC. Construction activities would have negligible energy and infrastructure requirements. Both Federal and DOE initiatives would require new construction to quantify and achieve energy savings.

**Operation.** Operations associated with the upgraded facilities and the CCC would not increase infrastructure demands beyond those of the No Action Alternative.

### 5.3.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** The Capability-sized UPF Alternative, described in Section 3.2.4, would involve construction of a 350,000 square foot UPF and the CCC. Infrastructure impacts resulting from construction of the Capability-sized UPF would be about 90 percent of those for the UPF in Alternative 2. The peak electrical energy requirement is estimated to be 1.9 megawatt electrical (MWe) per month and water usage 3.6 million gallons; both of these would be in addition to requirements under the No Action Alternative. Both Federal and DOE initiatives would require new construction to quantify and achieve energy savings.

**Operation.** Under the Capability-sized UPF Alternative, infrastructure requirements would be less than the No Action Alternative and the UPF Alternative. Electricity usage would be about 90 percent of the UPF usage (a 10 percent reduction) due to the reduced operations and smaller physical size of the facility. Water usage would be approximately 7 percent less than the UPF usage. Operation of the CCC would likely result in a reduction in infrastructure demands due to the consolidation of functions from a number of older facilities and compliance with modern-day energy efficiency and other conservation standards. The Capability-sized UPF and CCC would not entail any significant change to utilities or other site infrastructure.

### 5.3.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** The No Net Production/Capability-sized UPF, described in Section 3.2.5, would involve construction of a 350,000 square foot UPF and a CCC. Infrastructure impacts resulting from construction of the No Net Production/Capability-sized UPF would be about 90 percent of those for the UPF in Alternative 2. The peak electrical energy requirement is estimated to be 1.9 MWe per month and water usage 3.6 million gallons; both of these would be in addition to requirements under the No Action Alternative. Both Federal and DOE initiatives would require new construction to quantify and achieve energy savings.

**Operation.** Under the No Net Production/Capability-sized UPF Alternative, infrastructure requirements would be less than the No Action Alternative and the UPF Alternative. Electricity usage would be about 90 percent of the UPF usage (a 10 percent reduction). Water usage would be approximately 17 percent less than the UPF usage. Operation of the CCC would likely result in a reduction in infrastructure demands due to the consolidation of functions from a number of older facilities and compliance with modern-day energy efficiency and other conservation standards.

### 5.3.6 Potential Mitigation Measures

No mitigation measures for impacts to infrastructure are anticipated for the No Action, UPF, Upgrade in-Place, Capability-sized UPF, or No Net Production/Capability-sized UPF Alternatives.

### 5.3.7 Summary Comparison of Alternative Impacts for Site Infrastructure

**No Action Alternative.** As Y-12 continues to downsize, trends indicate that energy usage and most other infrastructure requirements will continue to decrease by approximately 2 to 5 percent per year.

**UPF Alternative.** There would be no expected increase in demand on site infrastructure. The UPF Alternative would use less than 5 percent of available electrical capacity and less than 1 percent of current site water usage.

**Upgrade in-Place Alternative.** Same as the No Action Alternative.

**Capability-sized UPF Alternative.** The Capability-Sized Alternative would reduce infrastructure demands by approximately 7-10 percent compared to the UPF Alternative.

**No Net Production/Capability-sized UPF Alternative.** Demands for electrical energy, water, and other utility services would be reduced by about 10-17 compared to the UPF Alternative.

## 5.4 TRANSPORTATION AND TRAFFIC

The traffic and transportation impacts were assessed by comparing all the alternatives. The analysis focuses on changes to traffic that may result from the alternatives. Additionally, this section analyzes the impacts associated with the transportation of radioactive material.

### 5.4.1 Nonradiological Transportation

#### 5.4.1.1 *Alternative 1 – No Action Alternative*

As discussed in Section 3.2.1 under the No Action Alternative, ongoing NNSA and DOE activities would continue at Y-12. The long-range plan for Y-12 is to consolidate operations and reduce the number of excess facilities required to continue the Y-12 mission for the foreseeable future. Primary roads on the Oak Ridge Reservation (ORR) serving Y-12 include Tennessee State Routes (TSRs) 95, 58, 62, and 170 (Bethel Valley Road). Bear Creek Road has restricted access around Y-12 and no longer is a public thoroughfare. The traffic statistics associated with the No Action Alternative missions are presented in Section 4.4, Table 4.4.4-1. Average daily traffic on ORR and roads serving Y-12 range from approximately 9,000 vehicles per day on Bethel Valley Road to approximately 31,000 vehicles per day on TSR 62. Major offsite area roads for long-distance transport of materials and waste include I-40, I-75, and I-81.

**Construction.** Construction activities under the No Action Alternative would not cause any significant change to the current workforce of approximately 6,500 and therefore to expected traffic volume. The Level-of-Service (LOS) on area roads would not change under the No Action Alternative.

**Operation.** Under the No Action Alternative, the Y-12 workforce is expected to remain relatively stable at approximately 6,500 workers. Consequently, the LOS on area roads would

not change due to operations under the No Action Alternative. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 6,500 person Y-12 workforce would travel approximately 65 million miles annually commuting to and from Y-12 for work (assuming a 40 mile roundtrip for each employee for 250 days per year). Statistically, approximately 0.8 fatalities would be expected annually.

#### 5.4.1.2 *Alternative 2 – Uranium Processing Facility Alternative*

**Construction.** Construction of the UPF and CCC would add a maximum of 950 worker vehicles per day to support construction during the peak year of construction. This increase would be similar to the increase that resulted from the HEUMF construction, which did not change the LOS on area roads. On-site transportation activities associated with excavation of the UPF site would add about 200 dump truck trips per shift along the Haul Road during the peak construction period. Transportation associated with concrete operations would add approximately 300 truck trips per shift between the proposed UPF site and the temporary batch plant.

**Operation.** Operations of the UPF and CCC would improve efficiency at Y-12 by consolidating operations and reducing the secure area. Approximately 750 existing workers might not be required under normal UPF operations. This would represent a workforce reduction of approximately 11 percent from the No Action Alternative, decreasing the vehicle traffic, but not changing the LOS. The UPF and CCC would reduce transportation impacts at Y-12 once operational, as these would replace existing facilities and the reduction in workers would lessen daily traffic volume. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 5,750 person Y-12 workforce would travel approximately 57.5 million miles annually commuting to and from Y-12 for work (assuming a 40 mile roundtrip for each employee for 250 days per year). Statistically, approximately 0.7 fatalities would be expected annually.

#### 5.4.1.3 *Alternative 3 – Upgrade in-Place Alternative*

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would require about 300 construction workers at the peak. Based on recent experience with construction of the HEUMF, which required a much larger workforce, this additional construction worker traffic would not adversely affect traffic at or in the vicinity of Y-12. Construction of the CCC would require only 50 workers and would not affect LOS on area roads, even if it were to occur at the same time as the upgrade of existing EU facilities.

**Operation.** Operations associated with the upgraded facilities would result in no additional work traffic since the existing workforce would be used. Operation of the CCC would also have no impact on site traffic because it would house functions currently being performed at Y-12 with no increase in the number of workers. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 6,500 person Y-12 workforce would travel approximately 65 million miles annually commuting to and from Y-12 for work (assuming a 40 mile roundtrip

for each employee for 250 days per year). Statistically, approximately 0.8 fatalities would be expected annually.

#### 5.4.1.4 *Alternative 4 – Capability-sized UPF Alternative*

**Construction.** Construction of the Capability-sized UPF would add a maximum of 850 worker vehicles per day to support construction during the peak year of construction. This increase would be less than the increase that resulted from the HEUMF construction, which did not change the LOS on area roads. Construction of the CCC would require only 50 workers and would not affect LOS on area roads, even if it were to occur at the same time as construction of the Capability-sized UPF. On-site transportation activities associated with excavation of the UPF site would add about 200 dump truck trips per shift along the Haul Road during the peak construction period. Transportation associated with concrete operations would add approximately 300 truck trips per shift between the proposed UPF site and the temporary batch plant.

**Operation.** Operations under the Capability-sized UPF Alternative would require a smaller workforce (about 1,825 monitored workers and 5,100 total Y-12 workers), once EU operations are transferred to the new facility. Additionally, most non-EU operations at Y-12 would be unaffected. This reduction would have a minimal positive impact on traffic and transportation, but would not change the LOS on area roads. Operation of the CCC would not affect LOS on area roads because it would consolidate functions currently being performed at Y-12 and would not result in an increase in the workforce or traffic volume. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 5,100 person Y-12 workforce would travel approximately 51 million miles annually commuting to and from Y-12 for work (assuming a 40 mile roundtrip for each employee for 250 days per year). Statistically, approximately 0.7 fatalities would be expected annually.

#### 5.4.1.5 *Alternative 5 – No Net Production/Capability-sized UPF Alternative*

**Construction.** Because the No Net Production/Capability-sized UPF Alternative would be the same physical size as the Capability-sized UPF Alternative and the CCC would also be part of this alternative, the impacts resulting from construction would be same as noted in section 5.4.1.4.

**Operation.** Operations under the No Net Production/Capability-sized UPF Alternative would require a smaller workforce (about 1,600 monitored workers and 4,500 total Y-12 workers) once EU operations are transferred to the new facility. Additionally, most non-EU operations at Y-12 would be unaffected. This reduction would have a minimal positive impact on traffic and transportation, but would not change the LOS on area roads. Operation of the CCC would not affect LOS on area roads because it would consolidate functions currently being performed at Y-12 and would not result in an increase in the workforce or traffic volume. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 4,500 person workforce would travel approximately 45 million miles annually commuting to and from Y-12

for work (assuming a 40 mile roundtrip for each employee for 250 days per year). Statistically, approximately 0.6 fatalities would be expected annually.

#### 5.4.1.6 *Potential Mitigation Measures*

The LOS on area roads is not anticipated to be impacted by any of the alternatives. Therefore no mitigation measures would be required.

### 5.4.2 Radiological Transportation

For this SWEIS, NNSA evaluated the transportation impacts associated with two material types (radioactive wastes and radioactive materials) transported to and from ORR and multiple offsite locations. Section A.5 provides details on the number of shipments analyzed, transportation routes, and methodology employed. As shown in Table 5.4.2-1 and Table 5.4.2-2, offsite radiological transportation would include transport of special nuclear materials to and from Pantex, and transport of radiological waste to the Nevada Test Site (NTS).

**Special Nuclear Materials Transportation.** The impacts of offsite radiological transportation would be the same under the No Action Alternative, UPF Alternative, and the Upgrade in-Place Alternative because there would be no significant change in the types of operations that are conducted at Y-12 or the amounts of radiological materials transported between ORR and other sites. As displayed in Table 5.4.2-1, impacts associated with radiological transportation would be insignificant (i.e., much less than one latent cancer fatality [LCF] annually).

**Table 5.4.2-1. Annual Radiological Transportation Impacts for No Action Alternative, UPF Alternative, and Upgrade in-Place Alternative.**

| Movement Description | Transportation Segment | Estimated Health Impacts (LCFs) | | |
|---|---|---|---|---|
| | | Accident | Incident-Free | Total |
| Canned Sub-assemblies | Handling | a | 0.0224 | 0.0224 |
| | Intersite Transportation | $1.51 \times 10^{-19}$ | 0.00145 | 0.00145 |
| | Stops | | $2.73 \times 10^{-9}$ | $2.73 \times 10^{-9}$ |
| | MEI | | $1.51 \times 10^{-9}$ | $1.51 \times 10^{-9}$ |

Source: NNSA 2008.
a – accident impacts associated with handling are included in the accident analyses for the Y-12 No Action Alternative.
Assumptions: All materials in metal form
ES-3100 or similar container used
Release and aerosol fractions based on West Valley Demonstration Project (WVDP) Waste Management EIS (DOE 2003c) values, which were determined to bound release fractions for pits and secondaries and cases.

For the Capability-Sized UPF and No Net Production/Capability-sized UPF Alternatives, radiological transportation impacts would be reduced relative to the other alternatives. Because of lower production rates, NNSA would ship fewer radioactive materials to and from Pantex, and Y-12 would generate less radioactive wastes. The impacts of transportation of radiological materials for the Capability-sized UPF Alternative would be approximately one-fourth as much as the impacts presented in Table 5.4.2-1, and for the No Net Production/Capability-sized UPF Alternative approximately one-twentieth as much.

With respect to accident impacts associated with transportation, RADTRAN (SNL 1992) calculates risks and consequences of potential accidents based on a number of input parameters including:

- Probability and severity fraction of accident types;
- Deposition velocity of the material;
- Release fraction from the container;
- Aerosol and respirable factors for the material; and
- Weather conditions.

DOE "Recommendations for Analyzing Accidents Under the National Environmental Policy Act," July 2002 (DOE 2002a), states that "it would be appropriate to estimate and present accident consequences for both median conditions and unfavorable conditions." Because of the lack of specific design information, this SWEIS uses a conservative approach and presents impacts for the unfavorable conditions. Additional analysis of median conditions would not have produced meaningful information to help make decisions based on this SWEIS.

The inputs for the materials, containers, and vehicles were adopted from industry standards. The probability and severity fractions were taken from the West Valley Demonstration Project Waste Management EIS (DOE 2003c). The weather conditions were based on Pasquill weather stability classes. Analyses were conducted in Stability Class D (most frequently occurring weather conditions) and Class F (stable weather conditions). All results presented in this chapter are for Stability Class F, which yields the more conservative (i.e., greater estimated impact) case.

The maximally exposed individual (MEI) results represent health impacts to a theoretical person that would receive the maximum exposure due to the proposed transportation. Often the MEI represents personnel associated with the material transport, such as a vehicle escort. Handling impacts reflect the sum total exposure impacts to crews involved in the storage, packaging, and loading/unloading of the material to be transported. The number of personnel, time spent handling the material, and the distance to the material are dependent on the individual transportation campaigns. The impact results at stops are presented for two theoretical receptor groups: the worker at the truck stop and residents that live within a half-mile radius of the truck stop. An average suburban population density is assumed for the area residents results.

Table 5.4.2-2 presents the estimated nonradiological impacts of transportation of radiological materials for the No Action Alternative, UPF Alternative, and Upgrade in-Place Alternative. The nonradiological impacts of transportation for the Capability-sized UPF Alternative would be approximately one-fourth as much as the impacts presented in Table 5.4.2-2 and approximately one-twentieth as much for the No Net Production/Capability-sized UPF Alternative.

**Table 5.4.2-2. Annual Nonradiological Transportation Impacts – No Action Alternative, UPF Alternative, and Upgrade in-Place Alternative.**

| Origin/ Destination Pair | Material Shipped | Total Mileage | Number of Accidents | Number of Accident Fatalities | Number of Nonradiological Emissions Fatalities[a] |
|---|---|---|---|---|---|
| Pantex/Y-12 | CSAs | 17,700 | $6.06 \times 10^{-3}$ | $2.93 \times 10^{-4}$ | $3.41 \times 10^{-5}$ |

Source: NNSA 2008.
a – Non-radiological impacts of routine transportation are the health effects that result from routine emissions of hydrocarbon pollutants and dust from the truck tractors used to transport materials. These impacts are not related to the radioactive nature of the shipments. They are calculated using a unit factor approach (that is, LCFs per mile) using data taken from Rao et al. (1982) that has been used in many past EISs.

**Low-level Radioactive Waste Transportation.** The radiological health impacts due to transportation of low-level radioactive waste (LLW) from Y-12 to NTS were estimated for three different hypothetical annual waste generation levels; 7,800 cubic yards, 12,300 cubic yards, and 24,000 cubic yards, which bound the annual LLW generation rates for any of the alternatives. It is assumed that Class A 55-gallon drums would be used to transport this waste. Considering this, the number of containers and shipments of LLW provided in Table 5.4.2-3 would be required to meet the generation levels.

**Table 5.4.2-3. Estimated Number of LLW Drums and Shipments.**

| Assumed Level of Annual Waste Generation ($yd^3$) | Number of Drums | Number of Shipments |
|---|---|---|
| 7,800 | 30,620 | 383 |
| 12,300 | 48,300 | 604 |
| 24,000 | 94,200 | 1178 |

Source: NNSA 2008.

For this analysis, waste inventories were assumed to be similar to those provided in the West Valley Demonstration Project Waste Management (WVDP WM) EIS (DOE 2003c). Accident conditional probabilities and release fractions were also used based on WVDP WM EIS values for Class A LLW and drum containers. The estimated human health impacts for accidents and incident-free transportation of LLW in LCFs are provided in Table 5.4.2-4. Nonradiological impacts are presented in Table 5.4.2-5.

**Table 5.4.2-4. Estimated Health Impacts Due to LLW Transportation (in LCF).**

| | Level of Annual Waste Generation ($yd^3$) | | |
|---|---|---|---|
| | 7,800 | 12,300 | 24,000 |
| Handling | 0.662 | 0.826 | 1.61 |
| Incident-Free | 0.05680599 | 0.09456 | 0.184 |
| In-Transit Exposure | | | |
| Truck Stop Personnel | $4.57\ 82 \times 10^{-9}$ | $7.21\ 60 \times 10^{-9}$ | $1.40\ 48 \times 10^{-8}$ |
| Resident Near Stop | $6.14\ 48 \times 10^{-8}$ | $1.029.68 \times 10^{-7}$ | $1.89\ 99 \times 10^{-7}$ |
| Accident Exposure | $4.122.69 \times 10^{-8}$ | $6.504.24 \times 10^{-8}$ | $1.278.27 \times 10^{-8}$ |

Source: NNSA 2008.

**Table 5.4.2-5. Estimated Nonradiological Health Impacts Due to LLW Transportation.**

| Assumed Level of Annual Waste Generation ($yd^3$) | Total Mileage | Number of Accidents | Number of Accident Fatalities | Number of Nonradiological Emissions Fatalities[a] |
|---|---|---|---|---|
| 7,800 | 837,000 | 0.258 | 0.01340152 | 0.00129 |
| 12,300 | 1,320,000 | 0.408 | 0.02110240 | 0.00204 |
| 24,000 | 2,572,000 | 0.0794 | 0.04110467 | 0.00397 |

Source: NNSA 2008.
a – Non-radiological impacts of routine transportation are the health effects that result from routine emissions of hydrocarbon pollutants and dust from the truck tractors used to transport materials. These impacts are not related to the radioactive nature of the shipments. They are calculated using a unit factor approach (that is, LCFs per mile) using data taken from Rao et al. (1982) that has been used in many past EISs

#### 5.4.2.1 *Commercial / Military Air Transportation*

The Y-12 Site would periodically ship domestic and foreign materials utilizing commercial airlines and military flights. Shipments would primarily move through the McGhee-Tyson airport located in Knoxville, Tennessee. Additional shipments may be routed through other domestic and foreign airports such as Atlanta, Canada, France, Korea, Argentina and other airports, as logistics warrant. Mission sensitivity may not allow for full disclosure but all shipments would be executed in strict compliance with DOE/NNSA requirements and Department of Transportation, Nuclear Regulatory Commission, and Federal Aviation Administration (FAA) regulations. Section 5.15 provides a more detailed discussion of the potential impacts of shipments in support of global threat reduction initiatives.

#### 5.4.2.2 *Sea Transportation*

Periodic shipments may be transported by sea. U.S. ports may include Charleston on the east coast and San Francisco/Oakland on the west coast. International entry/exit points may be located in Europe, Japan, and Australia. Ports would be used on an as needed basis as required by the mission. All shipments would be made in strict accordance with all shipping regulations and maritime laws. Section 5.15 provides a more detailed discussion of the potential impacts of shipments in support of global threat reduction initiatives.

#### 5.4.2.3 *Potential Mitigation Measures*

Per Table 5.4.2-1, the impacts of offsite radiological transportation would be small (less than one fatality) for all alternatives. Therefore, no additional mitigation measures would be required.

### 5.4.3 Summary Comparison of Alternative Impacts for Transportation and Traffic

**No Action Alternative.** Because there would be no significant change to the current workforce of approximately 6,500 or to the normal hours of employment, the LOS on area roads would not be expected to change.

**UPF Alternative.** Construction-related traffic would add an additional maximum of 950 worker vehicles per day to existing traffic. Increased traffic would be similar to that of the HEUMF

construction, which has not significantly changed the LOS on area roads. Operations of the UPF and CCC would improve efficiency at Y-12 by consolidating operations and reducing the secure area. Approximately 750 existing workers might not be required under normal UPF operations. This would represent a workforce reduction of approximately 11 percent from the No Action Alternative, decreasing the vehicle traffic, but not changing the LOS.

**Upgrade in-Place Alternative.** Construction-related traffic would add an additional maximum of 300 worker vehicles per day to the existing traffic. Increased traffic would be less than that of the HEUMF construction, which did not significantly change the LOS on area roads.

**Capability sized UPF Alternative.** Construction-related traffic would add an additional maximum of 850 worker vehicles per day. Increased traffic would be similar to that of the HEUMF construction, which did not significantly change the LOS on area roads. During operations, reduction of the Y-12 workforce by approximately 1,400 would reduce traffic volume in the area around Y-12 but would not be expected to significantly change the LOS on area roads.

**No Net Production/Capability-sized UPF Alternative.** Construction-related traffic would add an additional maximum of 850 worker vehicles per day. Increased traffic would be similar to that of the HEUMF construction, which did not significantly change the LOS on area roads. During operations, reduction of the Y-12 workforce by approximately 2,000 would reduce traffic volume in the area around Y-12 but would not be expected to significantly change the LOS on area roads.

## 5.5 GEOLOGY AND SOILS

The geology and soils analysis considers a ROI that includes the Y-12 area of analysis as well as the rest of ORR. Impacts to these resource areas were determined by assessing potential changes in existing geology and soils that could result from construction activities and operations under each of the alternatives. The impacts of the all alternatives are evaluated for geological impacts.

### 5.5.1 Alternative 1 – No Action Alternative

Y-12 is located within Bear Creek Valley, which is underlain by Middle to Late Cambrian strata of the Conasauga Group in the site area. The Conasauga Group consists primarily of highly fractured and jointed shale, siltstone, calcareous siltstone, and limestone in the Site area. The bedrock at Y-12 is overlain by alluvium, colluvium, man-made fill, fine-grained residuum from the weathering of the bedrock, saprolite, and weathered bedrock. The overall thickness of these materials in the Y-12 area is typically less than 40 feet.

Bear Creek Valley lies on well to moderately-well-drained soils underlain by shale, siltstone, and silty limestone. Y-12 lies on soils of the Armuchee-Montevallo-Hamblen, the Fullerton-Claiborne-Bodine, and the Lewhew-Armuchee-Muskinghum associations (DOE 2001a). Soil erosion due to past land use has ranged from slight to severe. Wind erosion is slight and shrink-swell potential is low to moderate.

The Oak Ridge area lies at the boundary between seismic Zones 1 and 2 of the Uniform Building Code, indicating that minor to moderate damage could typically be expected from an earthquake. Y-12 is cut by many inactive faults formed during the late Paleozoic Era (DOE 1996e). There is no evidence of capable faults in the immediate area of Oak Ridge, (surface movement within the past 35,000 years or movement of a recurring nature within the past 500,000 years) as defined by the Nuclear Regulatory Commission's (NRC's) "Reactor Site Criteria" (10 *Code of Federal Regulations* [CFR] Part 100). The nearest capable faults are approximately 300 miles west of ORR in the New Madrid Fault zone. No changes in seismic related impacts are expected.

Under the No Action Alternative, infrastructure reduction activities would continue to consolidate the industrialized footprint at Y-12, resulting in less runoff and less potential for soil erosion. Geological features (e.g., bedrock outcrops) at Y-12 would be unaffected by ongoing consolidation activities.

### 5.5.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** Although it would affect about 42 acres of land, construction of a UPF and CCC would have no impact on undisturbed geological resources (e.g., bedrock outcrops), and the hazards posed by geological conditions are expected to be minor. Slopes and underlying foundation materials are generally stable at Y-12. Landslides or other non-tectonic events are unlikely to affect the construction sites. Sinkholes are present in the Knox Dolomite, but it is unlikely that they would impact the project, as the Knox Dolomite is not present in the Y-12 area.

The construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. Widening the Haul Road extension by approximately 12-15 feet would be accomplished using soils excavated from the UPF site. Excess soils from the UPF excavation would be disposed of at the Wet Soils Disposal Area west of Y-12 in the Bear Creek corridor. The Wet Soils Disposal Area includes approximately 16.6 acres of property previously used for a controlled burn demonstration and pine reforestation project. Wet soils would be placed at the site and graded according to the planned design for the area after necessary drying. The West Borrow Area is an 18.3 acre site that previously served as the source of clay for Y-12 landfill cap projects. This site would be utilized, as necessary, for the placement of excess soil from the UPF project with moisture content satisfactory for compaction (B&W 2010).

Based on the seismic history of the area, a moderate seismic risk exists at Y-12. This should not impact the construction and operation of the UPF, or other new facilities. Past earthquake events in this area have not resulted in liquefaction of foundation soils. All new facilities and building expansions would be designed to withstand the maximum expected earthquake-generated ground acceleration in accordance with DOE Order 420.1B, *Facility Safety*, and accompanying safety guidelines.

During construction activities, excavation of soil, limestone, and shale bedrock would occur. There is sufficient capacity to either stockpile these materials or dispose of them during the construction at the sites. Soil disturbance from new construction would occur at building,

parking, and construction laydown areas, and lead to a possible temporary increase in erosion as a result of storm water runoff and wind action. Soil loss would depend on the frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of ground disturbance; and the duration of time the soil is bare. A small volume of soil, limestone, and shale bedrock may be excavated during the construction process. However, this material could be stockpiled for use as fill.

The potential for additional soil contamination from project activities at the UPF and CCC sites would be minimized by complying with waste management procedures DOE Order 435.1, Radioactive Waste Management, and DOE Order 450.1A, Environmental Protection Programs.

**Operation.** During operation, minor soil erosion impacts are expected, but detention basins, runoff control ditches, and cell design components would minimize impacts. The UPF, CCC, and other new facilities would have no added impact on geology or soils during operation because of site design and engineered control measures.

### 5.5.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would involve internal upgrades to existing facilities, as well as construction of the CCC, which would affect about seven acres of previously disturbed soil and other geological media. Overall, the Upgrade in-Place Alternative would not change the current geological or soil impacts at Y-12.

**Operation.** Operation of upgraded facilities and CCC would have no impact on undisturbed geological or soil resources at Y-12.

### 5.5.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** The Capability-sized UPF Alternative, described in Section 3.2.4, would include construction of an approximately 350,000 square foot UPF and the CCC, affecting about 39 acres of previously disturbed land. The construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Construction of this smaller UPF would have smaller albeit similar impacts to geologic and soil resources than those for the UPF in Alternative 2. The potential for additional soil contamination from project activities at the Capability-sized UPF site would be minimized by complying with DOE Order 435.1 and DOE Order 450.1 waste management procedures.

**Operation.** Under the Capability-sized UPF Alternative, Y-12 operations would be similar to operations under the No Action Alternative, with the addition of a 350,000 square foot UPF and the CCC. Operation of the Capability-sized UPF would be similar to, but significantly lower in intensity than operations of the UPF in Alternative 2. During operation of the Capability-sized UPF and CCC, minor soil erosion impacts are expected, but detention basins, runoff control ditches, and cell design components would minimize impacts. The Capability-sized UPF and CCC would have no added impact on undisturbed geology or soils during operation because of site design and engineered control measures.

### 5.5.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** The No Net Production/Capability-sized UPF Alternative, described in Section 3.2.5, would include construction of an approximately 350,000 square foot UPF and the CCC. Construction of this smaller UPF would have smaller albeit similar impacts to geological and soil resources than those for the UPF in Alternative 2. The potential for additional soil contamination from project activities at the No Net Production/Capability-sized UPF and CCC sites would be minimized by complying with DOE Order 435.1 and DOE Order 450.1 waste management procedures.

**Operation.** Under the No Net Production/Capability-sized UPF Alternative, Y-12 operations would be similar to operations under the No Action Alternative, with the addition of a 350,000 square foot UPF and the CCC. Operation of the Capability-sized UPF would be similar to, but significantly lower in intensity than operations of the UPF in Alternative 2. During operation of the No Net Production/Capability-sized UPF and CCC, minor soil erosion impacts are expected, but detention basins, runoff control ditches, and cell design components would minimize impacts. The No Net Production/Capability-sized UPF and CCC would have no added impact on undisturbed geology or soils during operation because of site design and engineered control measures.

### 5.5.6 Potential Mitigation Measures

Given control measures such as use of barriers, watering to minimize fugitive dust emissions, water retention systems, and other techniques to minimize soil and geologic disturbance which would be taken by NNSA during design, construction, and operational phases, any potential impacts to geology and soils would be minimized under all alternatives. New facilities would be designed to withstand reasonably anticipated geological hazards, such as earthquakes, slope failure, etc. No additional mitigation measures would be required.

### 5.5.7 Summary Comparison of Alternative Impacts for Geology and Soils

**No Action Alternative.** No significant disturbance to geology or soils other than those resulting from ongoing environmental remediation activities.

**UPF Alternative.** The UPF and CCC Alternative would disturb approximately 42 acres of previously disturbed land. Additionally, the construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Appropriate mitigation measures would be employed to minimize soil erosion and other impacts to geology and soils.

**Upgrade in-Place Alternative.** Construction of the CCC would affect about 7 acres of previously disturbed land but otherwise impacts to geological media would be similar to the No Action Alternative

**Capability-sized UPF Alternative.** The Capability-sized UPF and CCC would disturb approximately 39 acres of previously disturbed land. Additionally, the construction of a Haul

Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Appropriate mitigation measures would be employed to minimize soil erosion and other impacts associated with geology and soils.

**No Net Production/Capability-sized UPF Alternative.** The No Net Production/Capability-sized UPF and CCC would disturb approximately 39 acres of previously disturbed land. Additionally, the construction of a Haul Road extension and the Site Access and Perimeter Modification Road would also disturb approximately 6 acres of land. The Wet Soils Disposal Area and West Borrow Area would disturb an additional 34.9 acres of land. Appropriate mitigation measures would be employed to minimize soil erosion and other impacts associated with geology and soils.

## 5.6 AIR QUALITY AND NOISE

The air quality and noise analysis considers a ROI that addresses the Y-12 area of responsibility, covering approximately 5,400 acres, as well as the rest of ORR (approximately 35,000 acres) and the adjoining properties of the city of Oak Ridge. The impacts of all the alternatives are evaluated for air quality and noise impacts. Nonradiological air quality impacts are presented in Section 5.6.1, radiological air quality impacts are presented in Section 5.6.2, and noise impacts are presented in Section 5.6.3.

### 5.6.1 Nonradiological Air Quality

The assessment of nonradiological air emissions at Y-12 is used to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) and the rules of the Tennessee Department of Environment and Conservation (TDEC) for criteria pollutants and guidelines for chemical concentrations (TDEC 1999a). Nonradiological air quality impacts were determined by assessing site emissions of criteria and chemical pollutants from the applicable Y-12 facility operations. Nonradiological airborne discharges from Y-12 facilities consist of those criteria and chemical pollutant emissions from the Y-12 steam plant and chemical emissions that are specific to the alternative under consideration.

**Criteria Pollutants.** Y-12 is classified as a Major Source having the potential to emit 100 tons per year or more of regulated air pollutants in accordance with *Rules of the TDEC* Chapter 1200-3-9-.02(11)(b)(14)(ii). Allowable emissions at the Y-12 steam plant are greater than 100 tons per year of regulated air pollutants for particulates, sulfur oxides, and nitrogen oxides.

Maximum concentrations of the six criteria pollutants included in the primary and secondary NAAQS (40 CFR Part 50) were assessed, including carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), particles with an aerodynamic diameter less than or equal to 10 micrometers ($PM_{10}$), sulfur dioxide ($SO_2$), and ozone. Gaseous fluorides such as hydrogen fluoride (HF), included in the *Rules of TDEC*, were also assessed. Ambient air monitoring data were used to supplement modeled pollutant concentrations for those pollutants for which no emission data were available.

**Chemical Emissions.** In accordance with *Rules of the TDEC* Chapter 1200-3-9.02(11)(b)(14)(i), Y-12 is classified as a major source under Section 112 of the *Clean Air Act* (CAA) (42 U.S.C. 7401); that is, Y-12 has a potential to emit 10 tons per year or more of a hazardous air pollutant (HAP) which has been listed in Section 112(b) of the CAA, or 25 tons or more of combined HAPs. For example, Y-12 emits greater than 10 tons per year of methanol and hydrochloric acid. Additional HAPs are emitted in much smaller amounts such as HF (hydrofluoric acid), acetonitrile, and beryllium (DOE 2001a).

Chemical pollutant concentrations were compared with human health guidelines derived from occupational exposure limits and concentrations corresponding to cancer risks of $10^{-8}$ risk levels in lieu of established regulatory ambient air quality standards. The chemicals were categorized into two groups, non-carcinogenic chemicals and carcinogenic chemicals, to address the differences in health effects. Each group was evaluated using a screening technique comparing each chemical's estimated emission rate to a health-risk based Threshold Emission Value (TEV). Consistent with the human health impacts assessment methodology, appropriate health risk values were used in the chemical process to derive chemical-specific TEVs. Because of different health effects (non-carcinogenic and carcinogenic), two methods were applied to derive chemical-specific TEVs. Chemicals that failed the screening process were assessed in greater detail. This approach is consistent with U.S. Environmental Protection Agency (EPA) guidance and focuses detailed analyses only on those chemicals of concern that have the potential to cause adverse health effects.

#### 5.6.1.1 *Alternative 1 – No Action Alternative*

As discussed in Section 3.2.1, under the No Action Alternative, ongoing activities associated with NNSA and DOE would continue. The long term plan for Y-12 is to consolidate operations and reduce the number of excess facilities, an ongoing mission that will continue for the foreseeable future. Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA, the TDEC Division of Air Pollution Control, and DOE Orders. Each ORR facility has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne discharges meet all regulatory requirements and therefore do not adversely affect ambient air quality.

The release of nonradiological contaminants into the atmosphere at Y-12 occurs as a result of site production, maintenance, and waste management operations as well as steam generation. In October 2004, the TDEC personnel issued Y-12 its first-ever Major Source (Title V) Operating Air Permit. The permit covers 35 air emission sources and over 100 air emission points. Other emission sources at Y-12 are categorized as being insignificant and exempt from air permitting. The allowable level of air pollutant emissions from emission sources in 2005 was about 10,033 tons per year of regulated pollutants. Actual emissions are much lower than the allowable emissions (DOE 2005d). In order to evaluate the potential air quality impacts, the modeling analysis conducted for the 2001 SWEIS was reviewed for validity and application to the current No Action Alternative operations. As discussed below, the air quality modeling performed for the 2001 SWEIS remains valid and conservative, and serves as the framework for the analysis in this section.

**Criteria Pollutants.** The nonradiological air quality for criteria pollutants at Y-12 under the No Action Alternative is represented by the Y-12 steam plant emissions as a baseline. This is due to the fact that more than 90 percent of the criteria pollutants from Y-12 can be attributed to the operation of the Y-12 steam plant (DOE 2001a and DOE 2008). Although the No Action Alternative provides for Y-12 to operate at planned mission and workload levels, the steam plant replacement, addressed in *Environmental Assessment for the Y-12 Steam Plant Life Extension Project-Steam Plant Replacement Subproject* (DOE/EA-1593) (YSO 2007), which became operational in June 2010, will lower criteria pollutant emissions significantly, as discussed below.

Table 5.6.1.1-0 displays a comparison of historic Y-12 steam plant emissions, current emission limits, and estimated emissions from the new steam plant. As shown, the emissions associated with the new steam plant are expected to be significantly lower for total particulate matter, sulfur dioxide, and nitrogen oxides. In addition, both metal and non-metal hazardous air pollutant emissions associated with the combustion of coal, such as mercury, sulfur dioxide, and nitrogen oxides have been eliminated. Actual emissions under worst case fuel conditions are expected to be slightly higher, by 2 to 5 tons per year, for volatile organic compounds (VOCs). Carbon monoxide emissions are expected to be 82 tons higher with the new steam plant. Increased carbon monoxide emissions are due to the large amount of natural gas burned along with No. 2 fuel oil during natural gas curtailment, but would not violate air permits. None of the projected emission increases are considered significant for the purposes of non-attainment New Source Review or Prevention of Significant Deterioration permitting (YSO 2007).

Emissions from the Y-12 steam plant vary throughout the year depending on the demand for steam. To assess the maximum impact to air quality from operation of the Y-12 steam plant, the emission rates associated with operation of the facility at the calculated heat input capacity of 522 million British thermal units per hour was used as input to the ISC3 model (EPA 1995b, DOE 2001a). The calculated criteria pollutant emissions based upon this Y-12 steam plant operation are assumed to represent a reasonable upper limit for estimating criteria pollutant concentrations at or beyond the site boundary.

**Table 5.6.1.1-0. Air Emissions of Existing Y-12 Steam Plant and New Steam Plant.**

| Pollutant | Existing Y-12 Steam Plant (Boilers) | | | New Steam Plant | |
|---|---|---|---|---|---|
| | CY 2006 Emissions (tons/yr) | | Concentration Allowable (permit) | Worst Case Fuel Scenario Emissions (tons/yr) | |
| | Actual | Allowable | (lb/MM Btu) | Projected Actual | Maximum |
| Particulate | 32 | 945 | 0.174 | 10 | 14 |
| Sulfur Dioxide | 2,286 | 20,803 | 4 | 13 | 31 |
| Nitrogen Oxides[a] | 654 | 5,905 | – | 42 | 60 |
| Nitrogen Oxides (ozone season only)[b] | 153.4 | 232 | 232 tpy | – | – |
| Volatile Organic Compounds[a] | 2.3 | 41 | – | 7 | 9 |
| Carbon Monoxide[a] | 20 | 543 | – | 102 | 136 |

Source: YSO 2007.
Btu = British thermal unit.
a – When there is no applicable standard or enforceable permit condition for some pollutants, the allowable emissions are based on the maximum actual emissions calculation as defined in Tennessee Department of Environment and Conservation Rule 1200-3-26-.02(2)(d)3 (maximum design capacity for 8,760 hours/year). The emissions for both the actual and allowable emissions were calculated based on the latest EPA compilation of air pollutant emission factors. (EPA 1995a and 1998 *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources*. Environmental Protection Agency, Research Triangle Park, N.C. January 1995 and September 1998.)
b – Monitored emissions.
Note: The expected emissions from the new steam plant are calculated based on a maximum heat input of 99 million Btu/hr, and the projected actual emissions are based on a projected heat input of 75 million Btu/hr.

Maximum background concentrations of criteria pollutants from Tennessee air quality monitors located in Anderson, Knox, and Roane counties are presented in Table 5.6.1.1-1. These background concentrations represent concentrations from all nearby sources including the Y-12 steam plant. The modeled pollutant concentrations from the old Y-12 steam plant emissions (which generally bound emissions from the new steam plant) were added to the background concentrations for the respective pollutant to calculate the percent of standard. The maximum modeled criteria pollutant concentrations do not occur at the location of the monitor for which background concentrations are presented. Therefore, not only do the background concentrations contain contributions from the Y-12 steam plant, but the maximum modeled and background concentrations occur at different locations. The sum of the modeled and background concentrations therefore overestimates the cumulative pollutant concentrations resulting from the background and modeled Y-12 steam plant concentrations. This conservative approach bounds the potential impacts on regional air quality resulting from Y-12 activities.

As shown in Table 5.6.1.1–1, all criteria pollutant concentrations are below the national and TDEC standards, with the exception of the 8-hour ozone concentration. The 8-hour ozone concentration exceedance is not a result of ORR-specific activities. Instead, as described in Section 4.6.2.1, the EPA has designated Anderson County as a basic non-attainment area for the 8-hour ozone standard, as part of the larger Knoxville basic 8-hour ozone non-attainment area that encompasses several counties. As discussed above, the criteria pollutant concentrations listed in Table 5.6.1.1–1 represent a conservative bounding case for the No Action Alternative. DOE therefore believes that no adverse direct or indirect air quality impacts are expected for criteria pollutants from activities associated with the continuation of Y-12 missions under the No Action Alternative.

**Table 5.6.1.1-1. Criteria Pollutant Concentrations – No Action Alternative Operations.**

| Pollutant | Averaging Time | Maximum standard (µg/m$^3$) | Background Concentration (µg/m$^3$) | Maximum Modeled Concentration [b] (µg/m$^3$) | Percent of Standard |
|---|---|---|---|---|---|
| $SO_2$ | 3-hr | 1,300 | 398 [a] | 523.8 | 71 |
| | 24-hr | 365 | 47.1 [b] | 174.6 | 61 |
| | Annual | 80 | 10.5 [b] | 20.7 | 39 |
| $PM_{10}$ | Annual [a] | 50 | 25.4 [b] | 0.2 | 51 |
| | 24-hr [b] | 150 | 77 [a] | 1.5 | 52 |
| $PM_{2.5}$ | Annual [a] | 15 | No Data | N/A | N/A |
| | 24-hr [b] | 65 | 48.2 [a] | N/A | 74 |
| CO | 1-hr | 40,000 | 12,712 | 4.30 | 32 |
| | 8-hr | 10,000 | 4,466 [b] | 2.52 | 44 |
| Ozone | 1-hr | 235 | 225 [a] | N/A | 96 |
| | 8-hr | 157 | 188.4 [a] | N/A | 120 |
| $NO_2$ | Annual | 100 | 15.1 [a] | 9.1 | 24 |
| Lead | Calendar quarterly mean | 1.5 | 0.009 [a] | N/A | N/A |
| Gaseous Fluorides (as HF) | 30-day | 1.2 | No Data | N/A | N/A |
| | 7-day | 1.6 | 0.114 [a] | N/A | 7 |
| | 24-hr | 2.9 | No Data | 0.72 | 25 |
| | 12-hr | 3.7 | No Data | N/A | N/A |

a – Source: TDEC 2005c.
b – Source: DOE 2001a.

**Chemical Emissions.** No non-carcinogenic contaminants exceeded the preliminary air quality screening of Y-12 steam plant emissions data (DOE 2001a). As such, no non-carcinogenic chemicals were included in the evaluation of public exposures. The carcinogenic contaminants and their associated excess cancer risks resulting from old Y-12 steam plant emissions (which generally bound emissions from the new steam plant) are presented in Table 5.6.1.1-2. No excess cancer risks were determined to fall within the EPA's range of concern. Thus, no non-carcinogenic or carcinogenic contaminants of concern were determined to be associated with Y-12 steam plant emissions.

The observed concentrations of mercury vapor at Y-12 under the No Action Alternative are well below the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value of 25 micrograms per cubic meter ($\mu g/m^3$). The average mercury vapor concentrations at Y-12 monitoring stations have declined significantly since monitoring began. Annual average mercury concentrations during 2007 at the Y-12 east and west boundary monitoring stations are comparable to reference levels measured on Chestnut Ridge in 1988 and 1989 and approach values reported for continental background (DOE 2008). These concentrations are well below current environmental and occupational health standards for inhalation exposure to mercury vapor (DOE 2005d).

**Table 5.6.1.1-2. Y-12 Steam Plant Maximum Boundary Hazardous Air Pollutant Carcinogenic Chemical Concentrations.**

| Chemical | Maximum Boundary Concentration ($\mu g/m^3$) | Inhalation Unit Risk $(mg/m^3)^{-1}$ [a] | Excess Cancer Risk |
|---|---|---|---|
| Arsenic | $3.40 \times 10^{-5}$ | $0.43 \times 10^{1}$ | $1.46 \times 10^{-7}$ |
| Beryllium | $5.1 \times 10^{-6}$ | $0.24 \times 10^{1}$ | $1.22 \times 10^{-8}$ |
| Nickel | $8.14 \times 10^{-5}$ | b | c |

Source: DOE 2001a.
a – Toxicity values were obtained from the EPA's Integrated Risk Information System.
b – Toxicity values are not currently available.
c – Not calculated due to lack of toxicity values.

### 5.6.1.2 *Alternative 2 – Uranium Processing Facility Alternative*

**Construction.** Construction of the UPF and CCC would result in temporary increases in air quality impacts from construction equipment, trucks, employee vehicles, excavation activities, and construction of the Haul Road extension. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, particulate matter, total suspended particulates, and carbon monoxide. Fugitive dust generated during the clearing, grading, and other earth moving operations would also cause short-term impacts to air quality, predominantly to total suspended particulates. As shown on Table 5.6.1.1-1, the maximum modeled concentrations of these pollutants are currently well below maximum standards and would be expected to remain below maximum standards. The UPF construction would be similar in size and duration to the HEUMF construction that was recently completed at Y-12. Modeling of air quality impacts from the HEUMF construction showed that releases of sulfur dioxide, nitrogen oxide, particulate matter, total suspended particulates, and carbon monoxide impacts would not cause any significant impact to air quality at Y-12 (DOE 2001a). This conclusion would also apply to construction of the UPF.

Effective control measures commonly used to reduce fugitive dust emissions include wet suppression, wind speed reduction using barriers, vehicle speed limits, and chemical stabilization. Chemical stabilization alone could reduce emissions by up to 80 percent (DOE 2001a). Necessary control measures would be applied to ensure that $PM_{10}$ concentrations remain below applicable standards. The temporary increases in pollutant emissions due to construction activities are too small to result in exceeding the NAAQS beyond the Y-12 boundary. Therefore, air quality impacts resulting from construction of the UPF and CCC would be small.

**Operation.** No significant new quantities of criteria or toxic pollutants would be generated from operation of the UPF or CCC. Once operational, the UPF Alternative would reduce steam usage by at least 10 percent as inefficient facilities are closed. Emissions under Alternative 2, including the heating requirements for the new UPF, would not exceed the level of emissions estimated for the No Action Alternative. In fact, it is expected that emissions from the newer more efficient UPF would be less. Any releases of nitrogen and argon, which are used to maintain inert atmospheres for glovebox operations in the UPF, would be less than current releases from existing EU operations. No new hazardous air emissions would result from the facility operation of the UPF or CCC.

#### 5.6.1.3 *Alternative 3 – Upgrade in-Place Alternative*

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would involve mainly internal upgrades to existing facilities, and thus, minimal impact to air quality at Y-12. Minor quantities of fugitive dust would be generated from CCC construction. Temporary emissions from construction equipment, trucks, and employee vehicles would be much less than the UPF Alternative presented above, due to the significantly smaller workforce (i.e., 300 versus 950) required for the upgrades.

**Operation.** Although there would likely be measurable reductions in air quality impacts associated with improvements to facilities and processes, because specific plans are not available, it is assumed that operation of the upgraded facilities would not change air quality impacts beyond those presented for the No Action Alternative because there would be no significant change in the operating requirements of the facilities.

#### 5.6.1.4 *Alternative 4 – Capability-sized UPF Alternative*

**Construction.** The Capability-sized UPF Alternative would include construction of a 350,000 square foot UPF and the CCC. The Capability-sized UPF would be about 10 percent smaller than the UPF in Alternative 2 and would require a smaller workforce for construction (850 versus 950). For this reason, the emissions to the air from construction of the Capability-sized UPF would be similar in character but about 10 percent lower in quantity than those of the larger facility described in Section 5.6.1.2.

**Operation.** Under the Capability-sized UPF Alternative, no significant new quantities of criteria or toxic pollutants would be generated from the UPF. Emissions from the Y-12 steam plant related to providing heating for the Capability-sized UPF would likely be about 60 percent of current emission levels and would remain well within NAAQS for all criteria pollutants, with the exception of the 8- hour ozone concentrations. Reductions in EU operations are also expected to result in the reduction of carcinogenic HAPs. However, the maximum concentrations of these HAPs are small and do not have significant impacts (see Table 5.6.1.1-2). Despite these potential reductions in emissions, because there is no design information for the Capability-sized UPF, for purposes of this SWEIS, NNSA assumes the impacts to nonradiological air emissions would be the same as for the UPF in Alternative 2. Any releases of nitrogen and argon, which are used to maintain inert atmospheres for glovebox operations in the Capability-sized UPF, would be less than current releases from existing EU operations. No new hazardous air emissions would result from operations in the Capability-sized UPF.

#### 5.6.1.5 *Alternative 5 – No Net Production/Capability-sized UPF Alternative*

**Construction.** The No Net Production/Capability-sized UPF Alternative would include construction of a 350,000 square foot UPF and the CCC as described in section 5.6.1.4. Therefore, the potential impacts to non-radiological air quality resulting from construction of the No Net Production/Capability-sized UPF Alternative would be the same as for the Capability-sized UPF Alternative.

**Operation.** Under the No Net Production/Capability-sized UPF Alternative, no significant new quantities of criteria or toxic pollutants would be generated from the UPF. Emissions from the Y-12 steam plant related to providing heating for the No Net Production/Capability-sized UPF Alternative would likely be about 53 percent of current emission levels (due to lower levels of operation) and would remain well within NAAQS for all criteria pollutants, with the exception of the 8- hour ozone concentrations. Reductions in EU operations are also expected to result in the reduction of carcinogenic HAPs. However, the maximum concentrations of these HAPs are small and do not have significant impacts (see Table 5.6.1.1-2). Despite these potential reductions in emissions, because there is no design information for the No Net Production/Capability-sized UPF Alternative, for purposes of this SWEIS, NNSA assumes the impacts to nonradiological air emissions would be the same as for the UPF in Alternative 2. Any releases of nitrogen and argon, which are used to maintain inert atmospheres for glovebox operations in the No Net Production/Capability-sized UPF Alternative, would be less than current releases from existing EU operations. No new hazardous air emissions would result from operations in the No Net Production/Capability-sized UPF Alternative.

#### 5.6.1.6 *General Conformity*

The conformity process begins with an applicability review which requires the Federal agency to identify, analyze, and quantify emissions associated with the proposed action. A conformity determination is required for any action that is federally funded, licensed, permitted, or approved where the total direct and indirect emissions of one or more criteria pollutants in a non-attainment or maintenance area exceed rates specified in TDEC 1200-3-34-.02, or if the pollutant emissions are regionally significant.

Alternative 2 would cause the greatest land disturbance at Y-12, require the largest construction workforce, and contribute the largest vehicular emissions quantities. However, these temporary activities would increase pollutant emissions only in the near term. In the long term, when the bulk of construction and D&D efforts are complete, pollutant emissions would be substantially reduced, and heated building space at Y-12 would drop from about 633,000 square feet to 388,000 square feet.

Planned construction and demolition projects would potentially have an impact on the local area due to fugitive dust emissions (airborne particulate matter that escapes from a construction site). Effective engineered control measures are available to reduce fugitive dust emissions. These methods include the application of water or chemical dust suppressants, the use of barriers for wind speed reduction, reduced vehicle speed, chemical stabilization, and seeding of soil piles and exposed soils. Necessary control measures would be applied at the construction and demolition sites to minimize fugitive dust emissions. Near source capture of dust emissions by surface cover and forested areas would also reduce offsite fugitive dust concentrations.

Future demolition activities, including those under Integrated Facility Disposition Project (IFDP) and *American Recovery and Reinvestment Act* (ARRA) of 2009, would involve only small-scale projects. These projects are typically performed one at a time by small business enterprises and generally include no more than one or two medium-size bull dozers, a loader, one or two dump trucks, a small truck for errands, and no more than 20 workers that commute to the site.

Emissions associated with these activities are clearly below the NAAQS threshold of 100 tons per year and would be far below the level of regional significance. In addition, each demolished facility represents an emissions reduction associated with heat and electric power that would otherwise be required.

Construction plans for each of the alternatives are insufficiently developed to quantify emissions, and therefore do not satisfy the Tennessee Code definition of reasonably foreseeable. For this reason, a complete General Conformity Review cannot be included in the SWEIS. When the construction plans are sufficiently developed to estimate NAAQS emissions, a General Conformity Review must be performed before future planned construction activities can proceed. If there are no additional emissions for the selected alternative (above existing emissions at the site), then a General Conformity Review is not required.

#### 5.6.1.7 *Potential Mitigation Measures*

Short-term construction impacts are expected from fugitive dust emissions. Effective engineered control measures are available to reduce fugitive dust emissions. These methods include the application of water or EPA-approved chemical dust suppressants, the use of barriers for wind speed reduction, reduced vehicle speed, chemical stabilization, and seeding of soil piles and exposed soils. Necessary control measures would be applied at the construction and demolition sites to minimize fugitive dust emissions. Near source capture of dust emissions by surface cover and forested areas would also reduce offsite fugitive dust concentrations. Air quality impacts from operation would not be regionally significant. Therefore, no additional mitigation measures are required.

#### 5.6.1.8 *Greenhouse Gas Analysis*

Actions associated with each of the alternatives would generate greenhouse gases, and specifically carbon dioxide ($CO_2$). The majority of the $CO_2$ emissions at Y-12 have been associated with operation of the steam plant and vehicle operations. Over the past 15 years, energy management has been an ongoing and comprehensive effort that contains a key strategy of implementing guidelines to reduce the consumption of energy and fuel (including gasoline, diesel fuel, electricity, and natural gas). Energy consumption over the past several years has continued a steady downward trend. By 2006, Y-12 achieved an overall energy usage reduction of approximately 44 percent from the previously existing 1985 baseline (DOE 2008). Improvements at the steam plant reduced $CO_2$-equivalent greenhouse gas emissions by approximately 27 percent over the same time period (DOE 2007b). To estimate the greenhouse gases associated with each alternative, the analysis below focuses on three areas: (1) steam plant operations; (2) electric power usage; and (3) vehicle operations.

**Steam Plant.** The purpose of the Steam Plant Replacement Project is to replace the existing coal fired boiler Y-12 steam plant with a new centralized steam plant using natural gas fired, packaged boiler systems. Since becoming operational in June 2010, the new steam plant is expected to reduce greenhouse gases even further because the burning of natural gas generates only approximately 52 to 57 percent as much greenhouse gas emissions as the burning of coal (depending upon the type of coal, anthracite having the highest emissions and bituminous the lowest) (EIA 2009).

The new steam plant operates on natural gas with a fuel oil back-up. It will incorporate four package water-tube boilers with a total energy input not to exceed 100 million Btu per hour (YSO 2007). Combustion of natural gas produces 117.08 pounds of $CO_2$ per 1 million Btu (EIA 2009). Given a maximum Btu input of 100 million per hour, the new steam plant emits 11,708 pounds of $CO_2$ per hour at full capacity. During periods when it is necessary to burn fuel oil in the boilers, the hourly $CO_2$ emissions would be 16,138.6 pounds. This is a bounding worst case analysis. The actual energy input for the new steam plant would most likely be somewhat less than 100 million Btu because the steam plant is not expected to operate at full capacity very often. As a comparison, if the same energy input were made with bituminous coal, the $CO_2$ per million Btu would be 205.3 pounds (EIA 2009), or 20,530 pounds per hour.

With respect to greenhouse gas emissions associated with the steam plant, there would not be significant operational differences among the No Action Alternative, UPF Alternative, and Upgrade in-Place Alternative, as each of these alternatives would require operation of the steam plant and would utilize motor vehicles at similar levels. The Capability-sized UPF and No Net Production/Capability-sized UPF Alternatives would operate at substantially lower levels and the steam plant is expected to operate at reduced levels. It is estimated that for the Capability-sized UPF Alternative and No Net Production/Capability-sized UPF Alternative, the steam plant would generate approximately 40 to 50 percent less greenhouse gases than the other alternatives. Table 5.6.1.8-1 provides a comparison of estimated annual $CO_2$ emissions for the alternatives from Y-12 steam plant operation.

**Electrical Use.** Y-12 electrical power is supplied by TVA. Approximately 60 percent of TVA electricity is generated by coal, while nuclear and hydroelectric generate 30 and 10 percent, respectively (TVA 2009). There are no greenhouse gas emissions from nuclear or hydroelectric generation (EIA 2009), so only 60 percent of electrical use at Y-12 would be attributed to greenhouse gas emissions. In 2008, Y-12 used approximately 252,682 MWh of electricity, or 28.9 MWe per hour, which would equal about 98,676,910 Btu. Sixty percent of this—the amount of electricity used at Y-12 coming from coal—would be 59,206,146 Btu. The average heat content of a ton of U.S. coal in 2008 was 19,988,000 million Btu (EIA 2009a). It therefore required about 2.96 tons of coal to provide one hour of electrical power for Y-12 during 2008. Assuming an average $CO_2$ emission coefficient of 215 pounds of $CO_2$ per million Btu, the amount of $CO_2$ emission to provide electricity at Y-12 for one hour during 2008 was 6.4 tons.

With respect to greenhouse gas emissions associated with electricity use, there would not be any significant operational differences among the No Action Alternative, UPF Alternative, and Upgrade-in-Place Alternative, as each of these alternatives would use essentially the same amount of electricity. The Capability-Sized UPF Alternative and No Net Production/Capability-sized UPF Alternative would operate at substantially lower levels and would use approximately 40 to 50 percent less electricity, respectively, than the No Action Alternative, UPF Alternative, and Upgrade in-Place Alternative. Table 5.6.1.8-1 provides a comparison of estimated annual $CO_2$ emissions from the alternatives from electricity use.

**Vehicle Operations.** Increasing the use of alternative fuels and replacing gasoline-fueled vehicles with E-85–fueled vehicles will occur as funding permits. Additional fuel savings were achieved in FY 2007 as follows:

- vehicle utilization and the budget available were carefully analyzed, and 78 of 588 vehicles were removed from service;
- diesel fuel procurements were changed from No. 2 diesel fuel to a B20 (20 percent biofuel/80 percent petroleum diesel) biodiesel mix alternative fuel. Biodiesel reduces $CO_2$ emissions and petroleum consumption when used in place of petroleum diesel (Radich 2004, NBB 2009);
- all flex fuel-capable vehicles were operated on E85 ethanol alternative fuel. Use of ethanol can reduce greenhouse gas emissions in flex-fuel vehicles. Combustion of ethanol produces approximately 22 to 60 percent less greenhouse gas emissions than unleaded gasoline in flex-fuel vehicles (Wang 2002);
- of all motor vehicle fuel consumed in FY 2007, 29 percent was alternative fuel;
- unleaded fuel consumed in FY 2007 was reduced 7 percent below the amount consumed in FY 2006;
- diesel fuel consumed in FY 2007 was reduced 10 percent below the amount consumed in FY 2006; and
- use of E85 ethanol was increased 55 percent above the amount consumed in FY 2006 (DOE 2008).

In addition to greenhouse gas emissions reduction from these measures affecting the Y-12 vehicle fleet, the reduction in number of employees that would accompany implementation of the UPF, Capability-sized UPF, and No Net Production/Capability-sized UPF Alternatives would also produce a reduction in employee vehicle miles and subsequent greenhouse gas emissions. The U.S. EPA estimates that each gallon of gasoline produces 19.4 pounds of $CO_2$ emissions (EPA 2009) and EIA estimates 19.564 pounds of $CO_2$ emission per gallon (EIA 2009). For this analysis it is assumed that combustion of a gallon of gasoline produces about 19.5 pounds of $CO_2$ emissions and that each Y-12 worker drives 30 miles roundtrip to work in a vehicle with a fuel economy rating of 20 miles per gallon of gasoline. Each Y-12 worker would then generate 29.25 pounds of $CO_2$ in their daily commute to work. Assuming a five-day workweek and 50 working weeks per year, the annual amount of $CO_2$ emissions by each worker would be 7,313 pounds (about 3.66 tons). Because there are differences in number of employees among the alternatives, the total $CO_2$ emissions for employees commuting under each of the alternatives would be as follows:

- **No Action Alternative:** 6,500 workers × 7,313 / 2,000 = 23,767 tons
- **UPF Alternative:** 5,750 workers × 7,313 / 2,000 = 21,025 tons
- **Upgrade in-Place Alternative:** 6,500 workers × 7,313 / 2,000 = 23,767 tons
- **Capability-sized UPF Alternative:** 5,100 workers × 7,313 / 2,000 = 18,648 tons
- **Capability-sized/No Net Production UPF:** 4,500 workers × 7,313/2,000 = 16,454 tons

Table 5.6.1.8-1 provides a comparison of the estimated potential $CO_2$ emissions for all of the alternatives addressed in the SWEIS.

**Table 5.6.1.8-1. Estimated Annual $CO_2$ Emissions from Y-12 Operations (tons).**

| | No Action | UPF | Upgrade in-Place | Capability-sized UPF | No Net Production/ Capability-sized UPF |
|---|---|---|---|---|---|
| Steam Plant [a] | 51,281 | 51,281 | 51,281 | 30,769 | 25,641 |
| Electricity Use | 55,757 | 55,757 | 55,757 | 33,454 | 27,879 |
| Employee Commute | 23,767 | 21,025 | 23,767 | 18,648 | 16,454 |
| Total | 130,805 | 128,063 | 130,805 | 82,871 | 69,974 |

a – Estimated worst case for the new steam plant; actual emissions would likely be a fraction of these estimates.

Because of the reduced level of operations and reduction in size of the operational footprint at Y-12, the Capability-sized UPF and No Net Production/Capability-sized UPF Alternatives would have significantly lower $CO_2$ emissions than the No Action, UPF, and Upgrade in-Place Alternatives. However, even the highest levels of $CO_2$ emissions (No Action and Upgrade in-Place Alternatives) would be relatively small compared to the state-wide $CO_2$ emissions in Tennessee. From 1990 through 2005, $CO_2$ emissions in the state of Tennessee ranged from a low of 109.9 million tons in 1991 to a high of 138.8 million tons in 2005 (EIA 2009b). At its maximum $CO_2$ emission rate under the No Action and Upgrade in-Place Alternatives, Y-12 would contribute only 0.094 to 0.12 percent of the statewide $CO_2$ emissions in Tennessee. Each of the other alternatives would contribute proportionally less to statewide $CO_2$ emissions: UPF Alternative, 0.092 to 0.117 percent; Capability-sized UPF Alternative, 0.059 to 0.075 percent; and Capability-sized/No Net Production UPF Alternative, 0.050 to 0.064 percent.

As noted above, Y-12 has been taking steps to reduce its carbon footprint, such as replacing the coal-fired steam plant with a more efficient natural gas fired plant, reducing its use of electricity, and the vehicle fleet, and increasing the use of E85 gasoline and biodiesel. By reducing the amount of time the new steam plant must operate on fuel oil instead of natural gas, Y-12 will be able to maximize $CO_2$ reduction from that source. Expanding the use of E85 fuel and flex-fueled vehicles will also reduce $CO_2$ emissions at Y-12. Maximizing the use of a four-day workweek and allowing some employees to tele-commute one or more days each week would reduce $CO_2$ emissions from employee vehicle use for commuting to work. NNSA will evaluate these and other means of reducing the carbon footprint of Y-12 and implement those that are determined to be feasible and cost-effective.

### 5.6.1.9 Diesel Emissions

Because the combustion of diesel fuel produces relatively large amounts of particulates, particularly $PM_{2.5}$, EPA issued guidance to assist federal agencies in analyzing diesel emissions (EPA 2009a). Diesel exhaust is a complex mixture of thousands of gases and fine particles emitted by a diesel-fueled internal combustion engine. The gaseous fraction of diesel exhaust is composed primarily of typical combustion gases such as nitrogen, oxygen, carbon dioxide, and water vapor but also includes air pollutants such as carbon monoxide (CO), sulfur oxides (SOx) nitrogen oxides (NOx), volatile hydrocarbons, and low-molecular weight polycyclic aromatic hydrocarbons and their derivatives (CARB 1998).

One of the main characteristics of diesel exhaust is the release of particles at a relative rate of about 20 times greater than from gasoline-fueled vehicles, on an equivalent energy basis.

Almost all of the diesel exhaust particle mass (about 98 percent) is in the fine particle range of 10 microns or less in diameter ($PM_{10}$). Further, about 94 percent of the diesel exhaust particle mass is 2.5 microns or smaller ($PM_{2.5}$) (CARB 1998). Because of their small size, these particles can be inhaled and eventually trapped into the bronchial and alveolar regions of the lung.

Y-12 uses 43 stationary and portable diesel fueled emergency and/or standby generators ranging in horsepower from 19 to 235 (Johnson 2009). Emissions from these generators were calculated using AP-42 emission factors (EPA 1995). The emissions estimates were calculated by multiplying the horsepower of each generator by the AP-42 appropriate AP-42 emission factor then multiplying by hours of operations, which yields pounds of a pollutant per period of operation. The emissions for each generator were summed for each pollutant then divided by 2,000 to determine total tons of each pollutant. The calculations are based on an assumed 500 hours of operation per year for each generator. These emission estimates are already incorporated into the emissions reported for Y-12 in Table 5.6.1.1-1. Table 5.6.1.9-1 shows the results of the emission calculations for the Y-12 diesel-fueled generators. These emissions are representative of the emissions associated with diesel sources for Alternatives 1-3. While Alternatives 4 and 5 should have reduced diesel emissions, due to reduced operations, the reduction cannot be quantified.

**Table 5.6.1.9-1. Estimated Emission from Diesel-fueled Sources at Y-12.**

| Pollutant | NOx | $SO_2$ | CO | $PM_{10}$ | $PM_{2.5}$ | Total Organic Compounds | Aldehydes |
|---|---|---|---|---|---|---|---|
| **Estimated Emissions (tons)** | 5.87 | 2.42 | 7.87 | 2.59 | 2.48 [a] | 2.91 | 0.55 |

a – Based on $PM_{2.5}$ being 94 percent of total particle mass in diesel exhaust.

### 5.6.2 Radiological Air Impacts

Radiological discharges to the atmosphere would occur as a result of the operation of facilities at Y-12. To analyze the impacts of these emissions by alternative, NNSA identified the facilities with the potential for radiological emissions and then estimated the amount of emissions that could result based on the projected use of the facilities. As described in Section 5.6.1.1 (for non-radiological air impacts), the results of this analysis are considered to be a bounding case.

After determining the emissions rates, the CAP88 computer code (EPA 2008) was used to estimate radiological doses to the MEI, the populations surrounding Y-12, and Y-12 workers. The CAP88 code is a Gaussian plume dispersion model used to demonstrate compliance with the radionuclide National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). Subpart H of 40 CFR Part 61 specifically addresses emissions of radionuclides other than radon from DOE facilities. Y-12-specific parameters including meteorological data, source characteristics, and population data were used to estimate the radiological doses. Detailed information on the CAP88 dispersion modeling is presented in Appendix D.

In the United States, the average person is exposed to an effective dose of approximately 360 millirem (mrem) (whole-body exposure) per year from all sources (EPA 2009). For more information, see “Radiation Basics” and “Average Annual Radiation Dose from Natural and Manmade Sources” text boxes. The potential risks to human health associated with the radiation

dose, from Y-12 operations under all of the alternatives considered in the SWEIS are addressed in the Occupational and Public Health and Safety (Section 5.12).

#### 5.6.2.1 *Alternative 1 – No Action Alternative*

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 under the No Action Alternative occurs almost exclusively as a result of Y-12 production, maintenance, and waste management activities. An estimated 0.01 Curies (Ci) of uranium was released into the atmosphere in 2007 as a result of Y-12 activities (DOE 2008).

The total dose received by the hypothetical MEI for Y-12 under the No Action Alternative was calculated to be 0.15 mrem based on both monitored and estimated effluent data. This is approximately 1.5 percent of the 10 mrem per year NESHAP standard. This individual is postulated to be located about 7,579 feet northeast of Y-12 (DOE 2008). Statistically, an annual dose of 0.15 mrem would result in a LCF risk of $9.0\times10^{-8}$. The total dose to the population residing within 50 miles of ORR from Y-12 emissions under the No Action Alternative was calculated to be approximately 1.5 person-rem (DOE 2008). Statistically, a dose of 1.5 person-rem would result in 0.0009 LCFs annually.

#### 5.6.2.2 *Alternative 2 – Uranium Processing Facility Alternative*

**Construction.** Construction of the UPF and CCC would not result in the release of any radiological emissions and there would be no associated impacts.

**Operation.** Operation of the UPF would result in some radiological airborne emissions. The current design calls for appropriately sized filtered heating, ventilating, and air conditioning (HVAC) systems (see Section 3.2.2). Under normal operations, radiological airborne emissions would be less than radiological airborne emissions from the existing EU facilities due to the incorporation of newer technology into the facility design.

## Radiation Basics

**What is radiation?** Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

**What is radioactivity?** Radioactivity is produced by the process of unstable (radioactive) atoms trying to become stable. Radiation is emitted in the process. In the United States radioactivity is measured in units of curies (Ci). Smaller fractions of the curie are the millicurie (1mCi = 1/1,000 Ci), the microcurie (μCi = 1/1,000,000 Ci), and the picocurie (1pCi = 1/1,000,000,000,000 Ci).

**What is radioactive material?** Radioactive material is any material containing unstable atoms that emits radiation.

**What are the four basic types of ionizing radiation?**

**Alpha (α)** – Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.

**Beta (β)** – Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper but may be stopped by a thin sheet of aluminum foil or glass.

**Gamma (γ)** – Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.

**Neutrons (n)** – A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

**Not all radioactive materials emit all four types of ionizing radiation.**

**What are the sources of radiation?**

**Natural sources of radiation** – 1) Cosmic radiation from the sun and outer space; 2) natural radioactive elements in the earth's crust; 3) natural radioactive elements in the human body; and 4) radon gas from the radioactive decay of uranium naturally present in the soil.

**Man-made sources of radiation** – Medical radiation (x-rays, medical isotopes), consumer products (TVs, luminous dial watches, smoke detectors), nuclear technology (nuclear power plants, industrial x-ray machines), and fallout from past worldwide nuclear weapons tests or accidents (Chernobyl).

**What is radiation dose?** Radiation dose is the amount of energy of ionizing radiation absorbed per unit mass of any material. For people, radiation dose is the amount of energy absorbed in human tissue. In the United States, radiation dose is measured in units of rad or rem. Smaller fractions of the rem are the millirem (1mrem = 1/1,000 rem) and the microrem (1μrem = 1/1,000,000 rem).

**Average Annual Radiation Dose from Natural and Manmade Sources**

Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, granite countertops, and materials released from nuclear and coal-fired power plants. The following table shows average annual radiation in the United States.

| Source | Average Annual Dose (mrem) |
|---|---|
| **Cosmic Radiation** (from outer space) | |
| If you live at sea level your cosmic radiation dose is | 26 |
| If you live above sea level your dose must be adjusted by the addition of the following amounts: | |
| Elevation up to 1,000 ft | 2 |
| Elevation 1,000 to 2,000 ft | 5 |
| Elevation 2,000 to 3,000 ft | 9 |
| Elevation 3,000 to 4,000 ft | 15 |
| Elevation 4,000 to 5,000 ft | 21 |
| Elevation 5,000 to 6,000 ft | 29 |
| Elevation 6,000 to 7,000 ft | 40 |
| Elevation 7,000 to 8,000 ft | 53 |
| Elevation above 8,000 ft | 70 |
| **Terrestrial radiation** (from the ground; varies by location): | |
| Gulf States or Atlantic Coast regions | 23 |
| Colorado Plateau | 90 |
| Elsewhere in the United States | 46 |
| **Internal radiation** (in your body) | |
| From food and water (e.g., potassium) | 40 |
| From air (radon) | 200 |
| Plutonium-powered pacemaker | 100 |
| Porcelain crowns or false teeth | 0.07 |
| **Travel-related sources** | |
| For each 1,000 miles traveled by jet: | 1 |
| **Miscellaneous sources** | |
| Nuclear weapons test fallout (global) | 1 |
| Brick, stone, or concrete home construction | 7 |
| Luminous wrist watch | 0.06 |
| Watching television | 1 |
| Computer use | 0.1 |
| Home smoke detector | 0.08 |
| Each medical x-ray | 40 |
| Each nuclear medicine procedure | 14 |
| Living within 50 miles of a nuclear power plant | 0.009 |
| Living within 50 miles of a coal-fired power plant | 0.03 |

Note: The amount of radiation exposure is usually expressed in millirem (mrem). In the United States the average person is exposed to an effective dose of approximately 360 mrem (whole-body exposure) per year from all sources (NCRP Report # 93). These doses are based on the American Nuclear Society's brochure, "Personal Radiation Dose Chart." The primary sources of information are the National Council on Radiation Protection and Measurements Reports #92-#95, and #100. Values in the table are general averages and do not provide data for precise individual dose calculations.

Source: EPA 2010

NNSA estimates that the uranium emissions from the UPF would decrease from 0.01 Ci to approximately 0.007 Ci. This approximately 30 percent reduction in uranium emissions would reduce the MEI dose to 0.1 mrem would result in an LCF risk of $6.0\times10^{-8}$. The total dose to the population residing within 50 miles of ORR from Y-12 emissions was calculated to be approximately 1.0 person-rem. Statistically, a dose of 1.0 person-rem would result in 0.0006 LCFs annually. Operation of the CCC would not produce radiological air emissions.

#### 5.6.2.3 *Alternative 3 – Upgrade in-Place Alternative*

**Construction.** Construction activities associated with the Upgrade in-Place Alternative would not result in the release of any radiological emissions and there would be no associated impacts.

**Operation.** Under normal operations, radiological airborne emissions would be no greater than radiological airborne emissions from the existing EU facilities, and would likely be less due to the incorporation of newer technology into the facility design. Because detailed design information does not yet exist for upgrading EU facilities, reductions in emissions cannot be quantified. As a result, for purposes of this SWEIS analysis, the radiological airborne emissions and resulting impacts from upgraded EU facilities would remain unchanged from the No Action Alternative.

#### 5.6.2.4 *Alternative 4 – Capability-sized UPF Alternative*

**Construction.** Construction of the Capability-sized UPF would not result in the release of any radiological emissions and there would be no associated impacts.

**Operation.** Under the Capability-sized UPF Alternative, operation of the UPF would result in reduced radiological airborne emissions compared to Alternatives 1, 2, or 3. NNSA estimates that the uranium emissions from the Capability-sized UPF would decrease from 0.01 Ci to approximately 0.006 Ci. This approximately 40 percent reduction in uranium emissions would reduce the MEI dose to 0.09 mrem would result in an LCF risk of $5.0\times10^{-8}$. The total dose to the population residing within 50 miles of ORR from Y-12 emissions was calculated to be approximately 0.9 person-rem. Statistically, a dose of 0.9 person-rem would result in 0.0005 LCFs annually.

#### 5.6.2.5 *Alternative 5 – No Net Production/Capability-sized UPF Alternative*

**Construction.** Construction of the No Net Production/Capability-sized UPF Alternative would not result in the release of any radiological emissions and there would be no associated impacts.

**Operation.** Under the No Net Production/Capability-sized UPF Alternative, operation of the UPF would result in reduced radiological airborne emissions compared to the other alternatives considered in the SWEIS. NNSA estimates that the uranium emissions from the No Net Production/Capability-sized UPF Alternative would decrease from 0.01 Ci to approximately 0.005 Ci. This approximately 50 percent reduction in uranium emissions would reduce the MEI dose to 0.08 mrem would result in an LCF risk of $4.0\times10^{-8}$. The total dose to the population

residing within 50 miles of ORR from Y-12 emissions was calculated to be approximately 0.8 person-rem. Statistically, a dose of 0.8 person-rem would result in 0.0005 LCFs annually.

#### 5.6.2.6 *Potential Mitigation Measures*

DOE standards for construction and operation of radiological facilities incorporate engineered and administrative controls to reduce potential releases of radioactive materials to the extent practicable. Because the potential impacts of radioactive impacts under all of the alternatives would be well below all applicable standards, no further mitigation measures would be necessary.

#### 5.6.2.7 *Summary Comparison of Alternative Impacts for Air Quality*

**No Action Alternative.** The steam plant would continue to be the primary source of criteria pollutants. All criteria pollutant concentrations would be expected to remain below national and TDEC standards, except 8-hour ozone and $PM_{2.5}$, which exceed standards throughout the region. Radiological air emissions under the No Action Alternative would remain relatively constant at approximately 0.01 Ci of uranium per year.

**UPF Alternative.** Temporary increases in criteria air pollutants would result from the use of construction equipment, trucks, and employee vehicles; emissions would be expected to be less than one-half of regulatory thresholds for all criteria pollutants. No significant new quantities of criteria or toxic pollutants would be expected to be generated during operations. Compared to the No Action Alternative, radiological air emissions would decrease by approximately 30 percent to approximately 0.007 Ci of uranium per year.

**Upgrade in-Place Alternative.** Same as No Action Alternative.

**Capability-sized UPF Alternative.** Temporary increases in pollutants would result from the use of construction equipment, trucks, and employee vehicles; emissions would be expected to be less than one-half of regulatory thresholds for all criteria pollutants. No significant new quantities of criteria or toxic pollutants would be expected to be generated during operations. Compared to the No Action Alternative, radiological air emissions would decrease by approximately 40 percent to approximately 0.006 Ci of uranium per year.

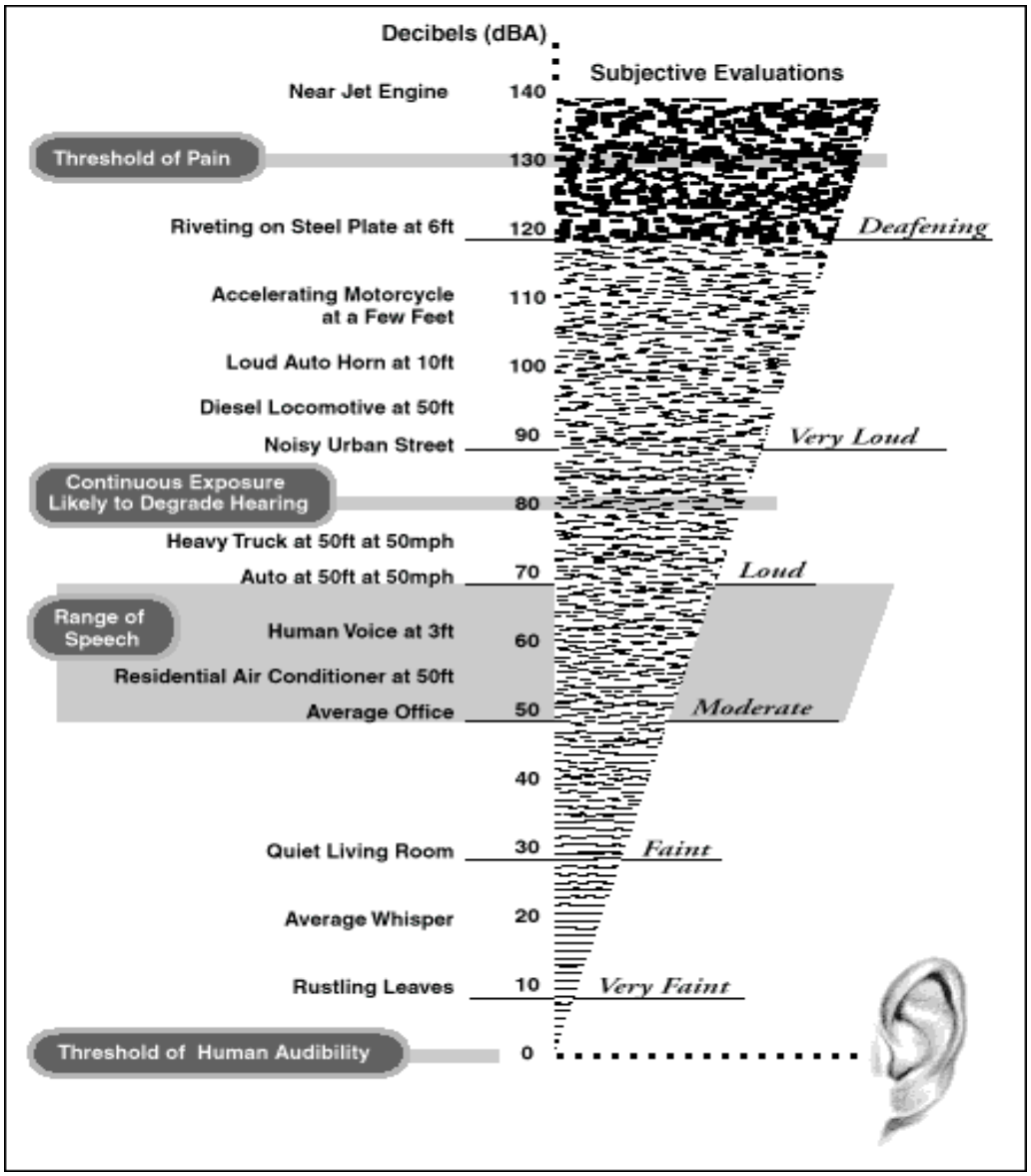
**No Net Production/Capability-sized UPF Alternative.** Temporary increases in pollutants would result from the use of construction equipment, trucks, and employee vehicles; emissions would be expected to be less than one-half of regulatory thresholds for all criteria pollutants. No significant new quantities of criteria or toxic pollutants would be expected to be generated during operations. Compared to the No Action Alternative, radiological air emissions would decrease by approximately 50 percent to approximately 0.005 Ci of uranium per year.

### 5.6.3 Noise

The process of quantifying the effects of sound begins with establishing a unit of measure that accurately compares sound levels. The physical unit most commonly used is the decibel (dB).

The decibel represents a relative measure or ratio to a reference pressure. The reference pressure is a sound approximating the weakest sound that a person with very good hearing can hear in an extremely quiet room. The reference pressure is 20 micropascals, which is equal to 0 (zero) decibels (dB).

A-weighted sound levels (dBA) are typically used to account for the response of the human ear. A-weighted sound levels represent adjusted sound levels that are made according to the frequency content of the sound. Figure 5.6.3-1 presents a comparison of decibel levels of everyday events with the threshold of human audibility.




Source: DOE 2001a.

**Figure 5.6.3-1. Decibel Levels Compared to the Threshold of Human Audibility.**

### 5.6.3.1 *Alternative 1 – No Action Alternative*

Major noise emission sources within Y-12 include various industrial facilities, equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources would not be distinguishable from background noise levels.

Industrial and construction activities are another source of noise. Some of these activities could affect the occupational health of Y-12 personnel, but measures are in effect to ensure that hearing damage to personnel does not occur. These measures include regulations contained within the *Noise Control Act* of 1972 (42 *United States Code* [U.S.C.] §4901), *Contractor Industrial Hygiene Program* (DOE Order 5480.10), and *Occupational Noise Exposure* (29 CFR Part 1910.95).

For Y-12 personnel, protection against effects of noise exposure is provided when the sound levels exceed those shown in Table 5.6.3.1-1. When employees are subjected to sound exceeding those listed in Table 5.6.3.1-1, feasible administrative or engineered controls are used. If such controls fail to reduce sound levels to within the levels of the table, personal protective equipment (e.g., ear plugs) is provided and used to reduce sound levels to within the levels of the table.

**Table 5.6.3.1-1. Permissible Noise Exposure.**

| Duration Per Day, hours | Sound Level dBA Slow Response |
|---|---|
| 8.0 | 90 |
| 6.0 | 92 |
| 4.0 | 95 |
| 3.0 | 97 |
| 2.0 | 100 |
| 1.5 | 102 |
| 1.0 | 105 |
| 0.5 | 110 |
| 0.25 or less | 115 |

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Continued compliance measures would be taken to ensure that hearing damage to personnel does not occur. Noise from traffic sources in and around Y-12 would continue unchanged under the No Action Alternative.

The acoustic environment along ORR site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with the day-average sound level in the range of 35 to 50 dBA. Areas near the site within the city of Oak Ridge are typical of a suburban area, with the average day-night sound level in the range of 53 to 62 dBA. The primary source of noise at the site boundary and at residences located near roads is traffic. No change in noise impacts is expected during the 10-year planning period under the No Action Alternative.

### 5.6.3.2 *Alternative 2 – Uranium Processing Facility Alternative*

**Construction.** The onsite and offsite acoustical environments may be impacted during construction of the proposed UPF and CCC. Construction activities would generate noise produced by heavy construction equipment, trucks, power tools, and percussion from pile drivers, hammers, and dropped objects. In addition, traffic and construction noise is expected to increase during construction onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site. The levels of noise would be representative of levels at large-scale building sites. Table 5.6.3.2-1 describes peak attenuated noise levels expected from operation of construction equipment.

Relatively high and continuous levels of noise in the range of 89 to 108 dBA would be produced by heavy equipment operations during the site preparation phase of construction. However, after this time, heavy equipment noise would become more sporadic and brief in duration. The noise from trucks, power tools, and percussion would be sustained through most of the building construction and equipment installation activities on the proposed facility site. As construction activities reach their conclusion, sound levels on the proposed facility site would decrease to levels typical of daily facility operations (50 to 70 dBA). These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels.

The site for the UPF is approximately 1,700 feet from the Y-12 Site boundary. The proposed site for the CCC is even farther from the Y-12 site boundary. Peak attenuated noise levels from construction of the UPF would be below background noise levels (53 to 62 dBA) at offsite locations within the city of Oak Ridge, as shown in Table 5.6.3.2–1.

**Operation.** Operation of the UPF and CCC would generate some noise, caused particularly by site traffic and mechanical systems associated with operation of the facility (e.g., cooling systems, transformers, engines, pumps, paging systems, and materials-handling equipment). In general, sound levels are expected to be characteristic of a light industrial setting within the range of 50 to 70 dBA and would be within existing No Action levels. Effects upon residential areas would be attenuated by the distance from the facility, topography, and by a vegetated buffer zone.

**Table 5.6.3.2-1. Peak Attenuated Noise Levels (in dBA) Expected from Operation of Construction Equipment.**

| Source | Peak Noise Level | Distance from Source | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 15 m (50 ft) | 30 m (100 ft) | 61 m (200 ft) | 100 m (400 ft) | 305 m (1,000 ft) | 518 m (1,700 ft) | 762 m (2,500 ft) |
| Heavy trucks | 95 | 84-89 | 78-83 | 72-77 | 66-71 | 58-63 | 54-59 | 50-55 |
| Dump trucks | 108 | 88 | 82 | 76 | 70 | 62 | 58 | 54 |
| Concrete mixer | 108 | 85 | 79 | 73 | 67 | 59 | 55 | 51 |
| Jackhammer | 108 | 88 | 82 | 76 | 70 | 62 | 58 | 54 |
| Scraper | 93 | 80-89 | 74-82 | 68-77 | 60-71 | 54-63 | 50-59 | 46-55 |
| Bulldozer | 107 | 87-102 | 81-96 | 75-90 | 69-84 | 61-76 | 57-72 | 53-68 |
| Generator | 96 | 76 | 70 | 64 | 58 | 50 | 46 | 42 |
| Crane | 104 | 75-88 | 69-82 | 63-76 | 55-70 | 49-62 | 45-48 | 41-54 |
| Loader | 104 | 73-86 | 67-80 | 61-74 | 55-68 | 47-60 | 43-56 | 39-52 |
| Grader | 108 | 88-91 | 82-85 | 76-79 | 70-73 | 62-65 | 58-61 | 54-57 |
| Dragline | 105 | 85 | 79 | 73 | 67 | 59 | 55 | 51 |
| Pile driver | 105 | 95 | 89 | 83 | 77 | 69 | 65 | 61 |
| Forklift | 100 | 95 | 89 | 83 | 77 | 69 | 65 | 61 |

Source: Golden et al. 1980.
Note: 1ft = 0.305 m.

### 5.6.3.3 *Alternative 3 – Upgrade in-Place Alternative*

**Construction.** The onsite and offsite acoustical environments may be impacted during upgrades to existing EU facilities and construction of the CCC. Construction activities would generate noise produced by heavy construction equipment, trucks, power tools, and percussion from hammers, and dropped objects. In addition, traffic and construction noise is expected to increase during construction onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site. The levels of noise would be representative of levels at large-scale building sites. In general, activities associated with the Upgrade in-Place Alternative would cause less noise impacts than the UPF Alternative because construction would take place within the facilities, and the facilities are slightly further from the site boundary than the UPF site.

**Operation.** Operation of the upgraded EU facilities would continue to generate the same types and intensities of noises that currently occur under the No Action Alternative.

### 5.6.3.4 *Alternative 4 – Capability-Sized UPF Alternative*

**Construction.** The onsite and offsite acoustical environments may be impacted during construction of an approximately 350,000 square foot UPF and the CCC. Construction activities would generate noise produced by heavy construction equipment, trucks, power tools, and percussion from pile drivers, hammers, and dropped objects. In addition, traffic and construction noise is expected to increase during construction onsite and along offsite local and regional transportation routes used to bring construction material and workers to the site. The levels of noise would be representative of levels at large-scale building sites. Table 5.6.3.2-1 describes peak attenuated noise levels expected from operation of construction equipment.

Relatively high and continuous levels of noise in the range of 89 to 108 dBA would be produced by heavy equipment operations during the site preparation phase of construction. However, after this time, heavy equipment noise would become more sporadic and brief in duration. The noise from trucks, power tools, and percussion would be sustained through most of the building construction and equipment installation activities on the proposed facility site. As construction activities reach their conclusion, sound levels on the proposed facility site would decrease to levels typical of daily facility operations (50 to 70 dBA). These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels.

The site for the Capability-sized UPF is approximately 1,700 feet from the Y-12 site boundary. The proposed site for the CCC is even farther from the Y-12 site boundary. Peak attenuated noise levels from construction of the Capability-sized UPF would be below background noise levels (53 to 62 dBA) at offsite locations within the city of Oak Ridge as shown in Table 5.6.3.2-1.

**Operation.** Under the Capability-sized UPF Alternative, operation of the UPF would generate some noise, caused particularly by site traffic and mechanical systems associated with operation of the facility (e.g., cooling systems, transformers, engines, pumps, paging systems, and materials-handling equipment). In general, sound levels are expected to be characteristic of a light industrial setting within the range of 50 to 70 dBA and would be within existing No Action levels. Effects upon residential areas would be attenuated by the distance from the facility, topography, and by a vegetated buffer zone.

#### 5.6.3.5 *Alternative 5 – No Net Production/Capability-sized UPF Alternative*

**Construction.** Noise impacts resulting from construction activities under the No Net Production/Capability-sized UPF Alternative would be the same as under the Capability-sized UPF Alternative.

**Operation.** Noise impacts resulting from operations under the No Net Production/Capability-sized UPF Alternative would be essentially the same as under the Capability-sized UPF Alternative

#### 5.6.3.6 *Potential Mitigation Measures*

Noise-generating activity levels and conditions for Alternatives 2, 3, 4, and 5 are not expected to be significantly different from the No Action Alternative. With the relatively large spatial area and perimeter buffer zone, noise from most activities would not be expected to be discernible in offsite areas. Noise levels are not expected to conflict with land use guidelines or adversely impact the offsite community. Workers are required to comply with applicable hearing protection standards to reduce impacts from noise in the workplace. No additional mitigation measures would be required.

#### 5.6.3.7 *Summary Comparison of Alternative Impacts for Noise*

**No Action Alternative.** Most Y-12 facilities are at sufficient distance from the site boundary so that noise levels are not distinguishable from background noise levels.

**UPF Alternative.** Activities and additional traffic associated with construction of the UPF and the CCC would generate temporary increases in noise. These noise levels would be representative of typical, large-scale building sites. Due to the distance to the site boundary, noise levels for both proposed projects would be expected to be at or below background noise levels at offsite locations within the city of Oak Ridge.

**Upgrade in-Place Alternative.** Minor additional noise impacts would be expected as a result of the construction taking place within facilities which are slightly further from the site boundaries than the UPF site. Construction of the CCC would generate temporary increases in noise but would not likely be noticeable offsite.

**Capability-sized UPF Alternative.** Construction activities and additional traffic associated with the Capability-sized UPF and the CCC would be expected to generate temporary increases in noise. These noise levels would be representative of typical large-scale building sites. Noise levels would be expected to be at or below background noise levels at offsite locations within the city of Oak Ridge.

**No Net Production/Capability-sized UPF Alternative.** Construction activities and additional traffic associated with the No Net Production/Capability-sized UPF and the CCC would be expected to generate temporary increases in noise. These noise levels would be representative of typical large-scale building sites. Noise levels would be expected to be at or below background noise levels at offsite locations within the city of Oak Ridge.

## 5.7 WATER RESOURCES

This section analyzes the impacts to water resources associated with the No Action and action alternatives.

### 5.7.1 Alternative 1 – No Action Alternative

Under the No Action Alternative there would be no change in current plans, including approved projects, at Y-12. Under this alternative, Y-12 would continue to support major DOE and NNSA programs.

#### 5.7.1.1 *Groundwater*

This analysis focuses on the Upper East Fork Poplar Creek (UEFPC) groundwater regime because it is considered the most relevant to Y-12 operations. Under the No Action Alternative, overall groundwater quality should continue to improve from ongoing remediation at treatment facilities. Groundwater monitoring data collected to date indicate that volatile organic compounds (VOCs) are the primary class of contaminants that are migrating through the exit pathways in the UEFPC regime. The compounds are migrating at depths of almost 500 feet. The

deep fractures and solution channels that constitute the flow paths appear to be well connected, resulting in contaminant migration for substantial distances off ORR into Union Valley to the east of the complex.

In addition to the intermediate to deep pathways monitored, shallow groundwater within the water table interval near the UEFPC, New Hope Pond, and Lake Reality is also monitored. Observed concentrations of VOCs at the New Hope Pond distribution channel remain low. This may be because of the continued operation of the groundwater plume capture system which may be reducing the levels of VOCs in the area.

The plume capture system pumps groundwater from the intermediate bedrock depth to mitigate offsite migration of volatile organic compounds. Groundwater is continuously pumped and passes through a treatment system to remove the VOCs, and then discharges to the UEFPC.

Three other wells, located in Pine Ridge through which the UEFPC exits Y-12, are also used to monitor shallow, intermediate, and deep groundwater intervals. Continued monitoring of the wells since 1990 has not shown that any contaminants are moving via this exit pathway. Monitoring of wells indicates that operation of the plume capture system is decreasing VOCs (DOE 2005a).

Since the initiation of remedial action, concentrations of VOCs directly downgradient of pumping wells have fallen from approximately 500 to 110 micrograms per liter (µg/L). In shallower intervals, VOC concentrations have remained similar to remediation baseline levels. A plume of contaminated groundwater that extends from the UEFPC through Union Valley, where it discharges to springs in the Scarboro Creek headwaters has shown continued detections of VOCs in groundwater. However, data shows a downward trend for signature VOCs (ORR 2003).

As described in Section 3.2.1, some minor construction would occur under the No Action Alternative. Although this construction could have an adverse impact on groundwater due to contaminant releases, previous NEPA studies for the construction activities do not indicate any significant impacts would result. Contaminant sources include construction material (e.g. concrete and asphalt), spills of oil and diesel fuel, and releases from transportation or waste handling accidents. Compliance with approved erosion and sedimentation control plans and a spill prevention, control, and countermeasures plan would mitigate potential impacts from surface spills. Y-12 would follow prevention and mitigation steps in the event of a hazardous material spill. Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade groundwater quality by contaminant releases similar to those from construction, mentioned above. However, successful D&D of surplus facilities could also reduce some potential sources of groundwater contamination (see Section 5.16 for additional information related to D&D).

#### 5.7.1.2 *Surface Water*

Y-12's primary water source is the Clinch River, which borders Y-12 to the south and west. Waters in the Clinch and Tennessee Rivers are used for water supply, industrial processes, fishing and recreation, irrigation, generation of electric power, and navigation. The Clinch River

watershed comprises 11 percent of the Tennessee River watershed. Total water withdrawals from the Tennessee River watershed are approximately 12 billion gallons per day. Of this water withdrawn, approximately 96 percent is returned to the watershed (TVA 2004). The Clinch River is Y-12's primary source of water. Y-12 withdraws approximately 2 billion gallons/year, which is well below 1 percent of the water withdrawn from the Tennessee River watershed. Treated water from the Clinch River is used to supply water for fire protection, process operations, sanitary sewage requirement, and boiler feed at the steam plant. The TDEC Division of Water Supply Water Resources Information Program collects information on the withdrawal and use of water within Tennessee. The information is used to identify water uses and resources that may require management at critical times, especially drought conditions. The purpose of the program is to protect the water resources of Tennessee from over-utilization.

The water quality of surface water in the vicinity of Y-12 is affected by current and past operations. Among the three hydrogeologic regimes at Y-12, the UEFPC regime contains most of the known and potential sources of surface water contamination with mercury discharge being the leading contaminant. The UEFPC is the primary surface water exit pathway and exits Y-12 at Station 17. The natural flow path was altered during construction of the plant site, including rerouting of the natural streams, development of the underground utility system, and building of the dewatering sumps.

Cleanup actions that addressed a number of waste sources and contaminated media in the UEFPC under CERCLA and other authorities have been completed or are ongoing. Principal actions include:

- National Pollutant Discharge Elimination System (NPDES) Permit Compliance Program Phase 1 Actions
- NPDES Permit Compliance Program Phase 2 Actions
- UEFPC Stream Bank Stabilization Study
- Flow Management
- Basin 9822 Early Action
- Firing Range Early Action
- Union Valley Interim Action
- East End VOC Plume Early Action
- Record of Decision (ROD) for Phase I Interim Source Control Actions

In addition, two "no further action" decisions and one removal action have been accomplished within the UEFPC:

- Plating Shop Container Areas
- Abandoned Nitric Acid Pipeline
- Building 9201-4 Exterior Process Piping Removal Action

These actions have contributed to the removal or reduction of many point sources of mercury (>90 percent) since the early 1990s resulting in reducing mercury loading to the UEFPC (ROD for Phase II Interim Remedial Actions 2005) (DOE 2005f). Average water usage and treated water use is expected to remain the same under the No Action Alternative. Under the No Action

Alternative, surface water monitoring would continue in accordance with DOE's NPDES Permit TN0002968 (DOE 2008).

Y-12 maintains a good record for compliance with respect to its NPDES Permit. Y-12 was issued a NPDES Permit from TDEC on March 13, 2006, with an effective date of May 1, 2006, which was renewed in December 2008. Certain provisions of this permit were appealed by the Department of Energy. The appeal primarily affected permit limitations set for legacy contaminants such as mercury and PCBs which are to be addressed through the CERCLA programs. Resolution of some issues has been completed, while others are being negotiated.

A number of contaminants are present and monitored in East Fork Poplar Creek (EFPC). Levels of mercury do remain above ambient water quality criteria in the EFPC. Nickel levels were well below the Tennessee General Water Quality Criteria. In 2003, the maximum nickel concentration was below the detection level of 0.05 milligrams per liter (mg/L), and the current maximum criteria for fish and aquatic life is 0.470 mg/L. Thallium is consistently below the analytical detection level of 0.2 mg/L. While the current water quality criteria for recreation for thallium is 0.0017 mg/L, this level is below the detection limit so the data does not indicate whether this parameter is either above or below this criterion. VOC concentrations have not been routinely measured since 1991, because the levels were consistently below analytical detection limits (B&W 2006b).

Discharges to surface water allowed under the NPDES permit include storm drainage, cooling water, cooling tower blowdown, steam condensate, and treated process wastewaters, including effluents from wastewater treatment facilities. Groundwater inflow into sumps in building basements and infiltration to the storm drain system are also permitted for discharge to the creek. The monitoring data collected by the sampling and analysis of permitted discharges are compared with NPDES limits if a limit exists for each parameter. Some parameters, defined as "monitor only," have no specified limits (DOE 2008).

The water quality of surface streams in the vicinity of the Y-12 Complex is affected by current and historical legacy operations. Discharges from the Y-12 Complex processes flow into EFPC before the water exits the Y-12 Complex. EFPC eventually flows through the city of Oak Ridge to Poplar Creek and into the Clinch River. Bear Creek water quality is affected by area source runoff and groundwater discharges. The NPDES permit requires regular monitoring and storm water characterization in Bear Creek and several of its tributaries. Requirements of the NPDES permit have been satisfied and monitoring of outfalls and instream locations have indicated excellent compliance. Data obtained as part of the NPDES program are provided in a monthly report to the TDEC. The percentage of compliance to the permit for 2007 was greater than 99.9 percent. The only NPDES permit excursion for 2007 occurred on February 12, 2007, when a computer software program being used to run analysis of an oil and grease sample failed to save the data result. The sample taken from outfall 200 was consumed in the analysis (hexane extractable material) and no data could be reported for the required weekly sample. Analytical laboratory personnel evaluated the situation, and corrective actions were put into place to avoid a recurrence (DOE 2008).

Y-12 is required to operate in compliance with DOE Order 5400.5, which contains requirements for control of residual radioactive material (Section II.5 and Chapter IV). The purpose of the order is to "…establish standards and requirements for operations of the DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation." The order contains derived concentration guidelines (DCG's). These guidelines are defined as, "…the concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an effective dose of 100 mrem." The DCG's are provided as reference values for conducting radiological environmental protection programs at operational DOE facilities and sites. Technetium-99 (Tc-99) and uranium isotope values at Station 17 during 2003 were well below the applicable guideline. The maximum Tc-99 value was 24.0 picocuries per liter (pCi/L) while the DCG is 100,000 pCi/L. The maximum value for U-234 was 3.3 pCi/L compared to a DCG of 500 pCi/L. The maximum value for U-235 was 0.22 pCi/L with a guideline of 600 pCi/L, the U-236 maximum was 0.18 pCi/L with a guideline of 500 pCi/L, and the U-238 maximum was 11.0 pCi/L with a guideline of 600 pCi/L (B&W 2006b).

Mercury and other legacy contamination are to be addressed under the authority of CERCLA. Remedies for mercury contamination focus on source removal to restore surface water in EFPC to risk based human health values. This process has set a performance value of 0.0002 mg/L in EFPC at monitoring location Station 17. Long term trends over ten or more years indicate steadily decreasing mercury levels (B&W 2006b). Waterborne mercury concentrations in the upper reaches of EFPC decreased substantially following the 2005 start-up of the Big Spring Treatment System at a mercury-contaminated spring; however, mercury concentrations in fish have not yet decreased in response (DOE 2008).

The CERCLA remediation process under the Phase I ROD (*Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*), Interim Source Control, has completed several actions including the construction and operation of several mercury water treatment facilities (Central Mercury and East End Mercury), stream stabilization in the upper reaches of EFPC, and construction of the Big Spring Water Treatment Facility. This facility began operation in the fall of 2005 and treats mercury contaminated water from a spring also known as Outfall 51 on the present permit. Plans are to incorporate basement sump water from Building 9201-2 into this new treatment facility. Other actions planned under the Phase I ROD include, asphalt caps over mercury runoff areas, flush of contaminated sediment from storm drains and reline as needed, removal of contaminated sediments/soil in UEFPC and Lake Reality, and continued monitoring to evaluate reductions in mercury (B&W 2006b).

Under the No Action Alternative, surface water quality could be degraded by contaminant releases during construction and could include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. DOE/NNSA goes to great lengths to minimize such occurrences through aggressive vehicle and machinery maintenance, worker training and enforcement of safe construction practice requirements. Storm water pollution prevention plans have been devised to identify pollutant sources that could affect the quality of industrial stormwater discharges and to describe implementation practices to

reduce pollutants in these discharges. In the event of a hazardous spill, necessary equipment to implement cleanup is available, and personnel are trained in proper response, containment, and cleanup of spills. Compliance with an approved erosion and sedimentation control plan during construction would also prevent impacts to surface water from construction-induced erosion. Prior to any new construction activities, any suspect areas of soil contamination that may contain sufficient mass to be a continuing source to surface water contamination would be assessed and action taken (i.e. soil removal) (DOE 2005f). Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade surface water quality by contaminant releases similar to those from construction. However, successful D&D of surplus facilities could also reduce some potential sources of surface water contamination (see Section 5.16 for additional information related to D&D).

No facilities would be located in either the 100-year or 500-year floodplain; therefore, no impact from flooding would be expected. No additional adverse impacts to surface water are expected under the No Action Alternative.

### 5.7.2 Alternative 2 – Uranium Processing Facility Alternative

This alternative includes the No Action Alternative and the construction and operation of a modern UPF sized to support the smaller nuclear stockpiles of the future and construction and operation of a new CCC. The proposed UPF site is located in the Y-12 Pine Ridge and Bear Creek Parking Lot adjacent to the HEUMF and the proposed CCC site is located on the eastern end of Y-12.

#### 5.7.2.1 *Groundwater*

**Construction.** Impacts to groundwater from construction activities under Alternative 2 would be similar to those described under the No Action Alternative in Section 5.7.1.1. Some groundwater may be extracted during construction activities to remove water from excavations. Appropriate construction techniques would be implemented to minimize the seepage of groundwater into excavation sites. No impact on groundwater direction or flow would be expected during construction activities of the UPF or CCC.

Minimal impacts to groundwater quality are expected because extracted groundwater would be collected and treated in onsite treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water. To limit further contamination of the UEFPC, utility and sanitary wastewater would be treated prior to discharge in accordance with the applicable permits. Additional impacts from construction activities would not be beyond impacts described for the No Action Alternative. Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade groundwater quality by contaminant releases similar to those from construction. However, successful D&D of surplus facilities could also reduce some potential sources of groundwater contamination

**Operation.** Impacts to groundwater from operation activities under Alternative 2 would be similar to those described under the No Action Alternative in Section 5.7.1.1. Minimal impacts to groundwater quality are expected from the operation of the UPF or CCC because all contaminated water would be collected and treated in onsite treatment facilities to meet the discharge limits of the NPDES permit prior to release to surface water. Utility and sanitary wastewater would be treated prior to discharge in accordance with the applicable permits. Additional impacts would not be beyond impacts described for the No Action Alternative.

#### 5.7.2.2 *Surface Water*

**Construction.** Y-12 surface water withdrawals and discharges would not increase substantially during construction of the UPF. Construction water requirements for the UPF and other new facilities (approximately 4 million gallons per year) would not raise the average annual water use for Y-12. Until the UPF is operational, Y-12 would continue to use an average of approximately 2 billion gallons per year. The Haul Road would necessarily cross some headwater areas of small unnamed tributaries to Bear Creek (see Section 5.8.2 for a discussion of these potential impacts). The proposed sites for new facilities are not located within either the 100-year or 500-year floodplains.

Federal, state and local governments have passed laws and regulations to address the problem of polluted runoff, especially from construction. Phase I EPA storm water regulations (40 CFR 122.26) initiated a national storm water permitting program in 1990, that applied to industrial activities, to construction sites of five acres or more and to urban runoff from larger cities. Phase II regulations in 1999 (64 FR 68722) addressed additional urbanized areas, certain cities with population over 10,000, and construction activities of one to five acres. The Tennessee Department of Environment and Conservation, Division of Water Pollution Control implements the EPA Phase I and Phase II regulations in Tennessee.

Surface water quality could be degraded by construction activities. In order to avoid this, storm water control and erosion control measures would be implemented to minimize soil erosion and transport to the UEFPC. This would include control of surface water runoff from any new parking lots and any lay down areas. Actions described in Section 5.7.1.2 could also contribute to the continued mitigation of mercury discharge to the UEFPC. Prior to the construction of any new facility, any suspect areas of soil contamination that may be a source of surface water contamination would be removed. Analysis conducted in the *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek*, dated August 9, 2005 (DOE 2005f) indicated that the proposed site of the UPF is not in an area of soil remediation. Therefore, it is not anticipated that the construction of the UPF would degrade surface water quality.

Construction activities would not appreciably raise the average annual water use for Y-12. No impact from flooding would be expected. No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with permits issued by the TDEC and the Storm Water Pollution Prevention Plan, and minimized by actions described in Section 5.7.1.2. Additional impacts to surface water from construction activities would be similar to those described for the No Action Alternative. Ongoing downsizing

of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade surface water quality by contaminant releases similar to those from construction. However, successful D&D of surplus facilities could also reduce some potential sources of surface water contamination.

**Operation.** UPF operation would require an estimated 105 million gallons per year. Once operational, the average annual water use at Y-12 is expected to decrease to from 2 billion gallons per year to approximately 1.3 billion gallons per year. No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with NPDES permit limits and minimized by actions described in Section 5.7.1.2. Although reduced withdrawals and discharges would increase stream flow in EFPC, this effect is not expected to be significant since the change in the volume of water would be insignificant (less than 1 percent) compared to the existing flows in this body of water.[1]

### 5.7.3 Alternative 3 – Upgrade in-Place Alternative

Under this alternative, NNSA would continue the No Action Alternative and upgrade the existing EU and nonnuclear processing facilities to contemporary environmental, safety, and security standards to the extent possible within the limitations of the existing structures and without prolonged interruptions of manufacturing operations.

#### 5.7.3.1 *Groundwater*

**Construction.** Construction water requirements for the Upgrade in-Place Alternative would be minimal because construction activities would consist mainly of internal facility modifications, as well as construction of the CCC. The water requirements would not raise the average annual water use for Y-12 (approximately 2 billion gallons per year), or cause any appreciable water resource impacts or changes beyond those described for the No Action Alternative. Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade groundwater quality by contaminant releases similar to those from construction. However, successful D&D of surplus facilities could also reduce some potential sources of groundwater contamination.

**Operation.** Operation of the upgraded EU and other processing facilities and the CCC would not change current water usage (approximately 2 billion gallons per year). Operation of the new and upgraded EU facilities would not impact groundwater quality beyond current conditions because there would be no appreciable increase in output of upgraded facilities. No adverse impacts to groundwater resources are expected because all discharges would be maintained to comply with NPDES permit limits and minimized by actions described in Section 5.7.1.2. Additional impacts would not be beyond impacts described for the No Action Alternative.

[1] The average flow in EFPC is approximately 4,500 cubic feet/second, which equates to approximately 1,060 billion gallons/year (USGS 2010). An increase in flow of 0.7 billion would be insignificant.

#### 5.7.3.2 *Surface Water*

**Construction.** Construction water requirements for the Upgrade in-Place Alternative would be minimal because activities would consist mainly of internal facility modifications, as well as construction of the CCC. Water requirements would not raise the average annual water use for Y-12 (approximately 2 billion gallons per year), nor cause any appreciable water resource impacts or changes beyond those described for the No Action Alternative. Ongoing downsizing of Y-12 would result in more facilities being declared surplus and recommended for D&D. D&D of such facilities would have the potential to degrade surface water quality by contaminant releases similar to those from construction. However, successful D&D of surplus facilities could also reduce some potential sources of surface water contamination.

**Operation.** Operation of the upgraded facilities and CCC would not change current water usage; therefore operation of the upgraded facilities would not raise the average annual water use for Y-12. Operation of the upgraded facilities would not impact surface water quality beyond current conditions because there would be no appreciable increase in output of facilities. No adverse impacts to surface water resources or surface water quality are expected because all discharges would be maintained to comply with NPDES permit limits and minimized by actions described in Section 5.7.1.2. Additional impacts would not be beyond impacts described for the No Action Alternative.

### 5.7.4 Alternative 4 – Capability-sized UPF Alternative

Under this alternative, NNSA would construct a Capability-sized UPF and the CCC. The Capability-sized UPF would be constructed at the same location as the UPF in Alternative 2. This would result in the transfer of activities currently conducted in existing EU facilities to the UPF and other functions from other areas of Y-12 to the CCC. All other activities under this alternative would be similar to No Action.

#### 5.7.4.1 *Groundwater*

**Construction.** The Capability-sized UPF would be about 10 percent smaller than the UPF in Alternative 2 and would likely have proportionately less impact on groundwater. However, because the design for the smaller facility has not been completed, it is not possible to accurately project the impacts of its construction on groundwater. Therefore, for purposes of this SWEIS, the impacts projected under Alternative 2 for the UPF are used to assess the impact of the Capability-sized UPF.

**Operation.** For the reasons cited in the preceding paragraph, for purposes of this SWEIS, the groundwater impacts projected under Alternative 2 for the UPF are used to assess the impact of the Capability-sized UPF.

#### 5.7.4.2 *Surface Water*

**Construction.** The Capability-sized UPF would likely be about 350,000 square feet, or about 10 percent smaller than the UPF in Alternative 2 and its construction would likely have

proportionately less impact on surface water quantity and quality. Because the design for the smaller facility has not been completed, however, it is not possible to precisely project the impacts its construction could have on surface water. Therefore, for purposes of this SWEIS, the impacts projected under Alternative 2 for the UPF in Alternative 2 are used to assess the impact of the Capability-sized UPF.

**Operation.** The reduced operations associated with the Capability-sized UPF would reduce water use at Y-12. Water requirements would decrease from approximately 2 billion gallons per year to approximately 1.2 billion gallons per year.

### 5.7.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

Under this alternative, NNSA would construct a No Net Production/Capability-sized UPF and the CCC. The No Net Production/Capability-sized UPF would be constructed at the same location as the UPF in Alternative 2. The No Net Production/Capability-sized UPF would be the same size as the Capability-sized UPF (Alternative 3). Implementation of this alternative would result in the transfer of activities currently conducted in existing EU facilities to the UPF and other functions from other areas of Y-12 to the CCC. All other activities under this alternative would be similar to No Action.

#### 5.7.5.1 *Groundwater*

**Construction.** Construction activities under the No Net Production/Capability-sized UPF Alternative would be the same as those for Alternative 4. For this reason and those cited in Section 5.7.4.1, for purposes of this SWEIS, the impacts to groundwater projected under Alternative 2 for the UPF are used to assess the impact of the No Net Production/Capability-sized UPF Alternative.

**Operation.** For the reasons cited in the preceding paragraph, for purposes of this SWEIS, the groundwater impacts to groundwater projected under Alternative 2 for the UPF are used to assess the impact of the No Net Production/Capability-sized UPF Alternative.

#### 5.7.5.2 *Surface Water*

**Construction.** Construction activities under the No Net Production/Capability-sized UPF Alternative would be the same as those for Alternative 4. For this reason and those cited in Section 5.7.4.1, for purposes of this SWEIS, the impacts to surface water projected under Alternative 2 for the UPF are used to assess the impact of the No Net Production/Capability-sized UPF Alternative.

**Operation.** The reduced operations associated with the No Net Production/Capability-sized UPF Alternative would reduce water use at Y-12. Water requirements would decrease from approximately 2 billion gallons per year to approximately 1.08 billion gallons per year.

### 5.7.6 Potential Mitigation Measures

Water resources could be degraded by contaminant releases during construction of some facilities. Contaminant sources include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste handling accidents. If a spill occurred, Y-12 stormwater pollution prevention plans are in place to identify pollutant sources that affect the quality of industrial stormwater discharges and to describe implementation practices to reduce pollutants in the discharges. Stormwater management techniques, such as silt fences and runoff diversion ditches, would be used to prevent erosion and potential water pollutants from being washed from the construction site during rainfall events. Y-12 will continue to remove contaminants from ground and surface water through a series of treatment facilities at Y-12.

### 5.7.7 Summary Comparison of Alternative Impacts for Water Resources

**No Action Alternative.** Current water usage of 2 billion gallons per year would be expected to continue. Discharges would be expected to be within NPDES requirements. Ongoing stormwater runoff and erosion control management would continue. No additional impacts to groundwater would be expected.

**UPF Alternative.** An increased water usage of approximately 4.0 million gallons would result during the construction of the UPF. Once operational, the UPF would reduce average annual water usage from 2 billion gallons per year to 1.3 billion gallons per year.

**Upgrade in-Place Alternative.** Same as the No Action Alternative.

**Capability-sized UPF Alternative.** An increased water usage of approximately 3.6 million gallons would result during the construction of the UPF. Once operational, the UPF would reduce average annual water usage from 2 billion gallons per year to 1.2 billion gallons per year.

**No Net Production/Capability-sized UPF Alternative.** An increased water usage of approximately 3.6 million gallons would result during the construction of the UPF. Once operational, the UPF would reduce average annual water usage from 2 billion gallons per year to 1.08 billion gallons per year.

## 5.8 ECOLOGICAL RESOURCES

This analysis focuses on Y-12 and the area within this SWEIS study area boundary. Ecological resources at ORR include terrestrial and aquatic resources, threatened and endangered (T&E) species, state species of concern, and floodplains and wetlands. Potential impacts are assessed based on the degree to which various habitats or species could be affected by Y-12 proposed actions and alternatives. Where possible, impacts are evaluated with respect to Federal and state protection regulations and standards.

Impacts to wildlife are evaluated in terms of disturbance, displacement, or loss of wildlife. Impacts to wetlands are assessed based on their proximity to Y-12 current mission operations, the proposed construction and operation of new facilities, and any related discharge. A list of

species potentially present at Y-12 was obtained from the U.S. Fish and Wildlife Service (USFWS) and used in the process of assessing whether Y-12 current mission operations or proposed new facilities would impact any plant or animal under Section 7 of the *Endangered Species Act* (USFWS 2006) and has been included in the Final SWEIS. For a full discussion of Federal- and state-listed threatened, endangered, and animal species of concern that may occur at ORR, see Section 4.8.1. A detailed Wetlands Assessment was prepared in accordance with 10 CFR 1022 for the purpose of fulfilling NNSA's responsibilities under Executive Order 11990. The Wetlands Assessment is contained in Appendix G.

### 5.8.1 Alternative 1 – No Action Alternative

The main area of Y-12 (approximately 800 acres) is a fenced area, which is largely developed, paved, cleared, and landscaped. Buildings and parking lots dominate the landscape in Y-12, with limited vegetation present. The land surrounding the main area of Y-12 is used in part to conserve ecological resources. Under the No Action Alternative, continued implementation of planned modernization actions announced in the 2002 ROD would continue. The Y-12 Site has been categorized as industrial and contains no suitable habitat for species. However, conservation easements exist and will continue in order to protect, restore, and enhance wildlife and suitable habitat.

Within the fenced, developed portion of Y-12, grassy and de-vegetated areas surround the entire facility. Fauna within the Y-12 area is limited by the lack of large areas of natural habitat. Impacts on terrestrial resources are minimal under the No Action Alternative.

At ORR, DOE has set aside large tracts of land for conservation, including approximately 3,000 acres set aside in April 2005. This conservation land is located on the western end of ORR and features mature forests, wetlands, river bluffs, cliffs and caves and is home to several rare species. Another conservation easement is Parcel G which contains a palustrine emergent/scrub-shrub wetland system totaling approximately 3.4 acres. Under the No Action Alternative, conservation activities on large portions of ORR would continue. Although wetlands have been identified on Y-12 in the vicinity of the Haul Road extension corridor (see Appendix G), no wetlands would be affected under the No Action Alternative

Under the No Action Alternative, fish and other organisms in local waterways in Y-12, including EFPC, would continue to be monitored as an indicator of the health of the ecosystem and the efficacy of Y-12's pollution prevention measures. Overall trends to date suggest a measurable improvement in fish health. However, fish would continue to have higher levels of contaminants than those found in reference streams, and bioaccumulation is still a concern. Mercury levels in Largemouth bass (*Micropterus salmoides*) and other species collected from UEFPC indicate that Y-12, even under the No Action Alternative, would continue to remain a source of mercury and PCB contamination in the local fauna.

A Biological Monitoring and Abatement Program (BMAP) was established in conjunction with the NPDES permit issued to Y-12 in 1995. The Environmental Monitoring and Compliance program is overseen by TDEC. The program includes toxicity monitoring, bioaccumulation studies, biological indicator studies, and ecological surveys (TDEC 2005a).

**Threatened and Endangered Species.** As described in Section 4.8.1, twenty Federal- and state-listed threatened, endangered, and other special status species have been identified on ORR. The gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalist)* are the only Federally-listed endangered animal species that are known to occur at ORR. There are no federally-listed T&E plant species. Under the No Action Alternative, impacts to T&E species or special status species would continue to be minimal on Y-12. Monitoring to assure that T&E species and other special status species, such as the gray bat and Indiana bat, which have been observed on ORR (but not on Y-12) would continue.

### 5.8.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** Under Alternative 2, most ecological impacts at the Y-12 site would remain the same as in the No Action Alternative. However, there could be some short-term impacts due to construction of new facilities.

The UPF and CCC would be constructed on approximately 42 acres of land, which include laydown areas and a temporary parking lot. In addition, the Haul Road extension, Site Access and Perimeter Modification Road, Wet Soils Disposal Area, and West Borrow Area would disturb approximately 41 acres of land. There would be some disturbance to terrestrial biotic resources due to associated utility hook-ups and rerouting, site access by construction vehicles, and parking lot relocations. Some dislocation of small urban type species (i.e., rodents) could be expected. Large animals would be largely excluded from controlled areas. However, because the areas on which these facilities would be constructed are largely developed and paved, terrestrial biotic impacts would be few.

Rain events occurring during construction could cause erosion and transport of soil and other materials from the construction site. NNSA would utilize appropriate stormwater management techniques to prevent pollutants from entering local waterways, and thus aquatic resources should not be negatively impacted beyond what is discussed in the No Action Alternative. The BMAP described above, would continue to monitor effects in both wetlands and waterways from the construction of UPF and other Y-12 activities. In addition, mitigation measures discussed in Section 5.8.6 are intended to minimize the impacts to ecological resources that might occur during construction activities associated with this alternative. A Haul Road extension would be constructed to link UPF site construction/excavation activities with supporting infrastructure located west of the proposed UPF site in the Bear Creek corridor. The road extension would accommodate the number and size of construction vehicles needed on site, as well as safely provide transportation away from occupied roadways. The designed alignment for the Haul Road extension follows the existing power line corridor and thus avoids forest habitat found to the north and south of the power line. The Haul Road would necessarily cross some headwater areas of small unnamed tributaries to Bear Creek, some of which contain wetlands. The Site Access and Perimeter Modification Road would disturb mowed areas, wetlands, limited early successional old field, and some forest. The greatest acreage potentially affected would be mowed turf grasses. It is anticipated that the Haul Road extension and the Site Access and Perimeter Modification Road would result in the loss of one acre of wetlands, and place two small stream segments [approximately 300 feet (total) of unnamed tributaries to Bear Creek] within culverts. A total of approximately three acres of wetland would be created as part of

proposed action. The mitigation wetlands would include expansion of some existing wetlands "upstream" and adjacent to the Haul Road extension, as well as creating additional wetlands in the Bear Creek watershed. A detailed Wetlands Assessment is included in Appendix G of this SWEIS.

As mitigation for the loss of stream segments, a section of Bear Creek would be restored and relocated to a more natural channel course. The restoration of Bear Creek would focus on the stream section near the confluence of the unnamed tributaries and Bear Creek. The restoration of this previously disturbed portion of Bear Creek would re-establish natural stream conditions and diversity of fish species, particularly the Tennessee Dace (*Phoxinus tennesseensis*), which the State of Tennessee classifies as "in need of management." Wetland and stream mitigations would be conducted in accordance with the requirements of the U.S. Army Corps of Engineers and the TDEC. An approved Aquatic Resource Alteration Permit was received from TDEC on June 10, 2010 (TDEC 2010). A final Section 404 Permit from the U.S. Army Corps of Engineers was received on September 2, 2010 (USACE 2010).

**Operation.** Impacts to terrestrial biotic resources from the operation of UPF and other new facilities would be similar to those currently observed under the No Action Alternative. The proposed UPF site is developed and paved and the proposed CCC would be located in a previously developed area, and thus if the facilities become operational, similar impacts would be seen as those discussed in the No Action Alternative. The BMAP would continue and would be used to ascertain any impacts from the UPF and CCC on local biota. In addition, mitigation measures discussed in Section 5.8.6 are intended to minimize the impacts to ecological resources that might occur during operational activities associated with this alternative.

**Threatened and Endangered Species.** Impacts to T&E species and special status species would be the same as in the No Action Alternative. The land to be used for UPF and CCC is already developed and is accessible via existing roads. Monitoring to assure that T&E species and other special status species, such as the gray bat and Indiana bat, which have been observed on ORR (but not on Y-12) would continue as in the No Action Alternative.

On January 19, 2007, NNSA conducted consultations with the USFWS to discuss the potential impacts of the UPF on the Indiana bat and gray bat. As a result of that consultation, NNSA agreed to prepare a biological assessment (BA) to specifically address the potential impacts to the habitats of these bats. A BA was completed and is included in Appendix C of this SWEIS. Based on the information presented in the BA, the actions proposed in this SWEIS are not likely to adversely affect the Indiana bat or gray bat (Stair 2008). The BA was submitted to the USFWS for review and concurrence. Following review, the USFWS had no comments and NNSA has determined that no further consultation with the USFWS is required regarding that BA. The USFWS also reviewed the Haul Road extension activities and determined that, "based on the best information available at this time, we believe that the requirements of section 7 of the Endangered Species Act of 1973, as amended, are fulfilled" (USFWS 2010).

### 5.8.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** Under this alternative, ecological impacts at the Y-12 site would be the same as those described under the No Action Alternative, and the CCC above. Construction activities would consist of internal modifications to existing facilities, as well as the CCC. No impacts to ecological resources from the Upgrade in-Place Alternative are expected because land disturbance would be minimal (7 acres) and areas associated with the Upgrade in-Place Alternative have been previously disturbed.

**Operation.** Operation of the CCC and upgraded facilities would have no impact on the current ecological resources at Y-12, as there would be no significant change to facility operations compared to the No Action Alternative.

**Threatened and Endangered Species.** Impacts to T&E species and other special status species would be the same as in the No Action Alternative, as modifications would be mainly internal to structures on Y-12 and no changes in operation would be expected. As discussed in Section 5.8.2, NNSA has determined that no further consultation with the USFWS is required regarding that BA.

### 5.8.4 Alternative 4 – Capability-sized UPF Alternative

Under this alternative, NNSA would construct and operate a Capability-sized UPF and the CCC at the same locations as proposed in Alternative 2. Construction and operation impacts from the Capability-sized UPF would be similar, if not slightly less than for the UPF in Alternative 2. Under the Capability-Sized UPF Alternative, ecological monitoring would continue to assess levels of pollutants in soil, waterways, and wildlife.

**Threatened and Endangered Species.** With the Capability-sized Alternative, impacts to federally- and state-listed T&E species and other special status species would be expected to be essentially the same as for Alternative 2. As discussed in Section 5.8.2, NNSA has determined that no further consultation with the USFWS is required regarding that BA. The USFWS also reviewed the Haul Road extension activities and determined that, "based on the best information available at this time, we believe that the requirements of section 7 of the Endangered Species Act of 1973, as amended, are fulfilled" (USFWS 2010).

### 5.8.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

Under this alternative, NNSA would construct and operate a No Net Production/Capability-sized UPF and the CCC at the same locations as proposed in Alternative 2. Construction and operation impacts from the No Net Production/Capability-sized UPF Alternative would be similar, if not slightly less than for the UPF in Alternative 2. Under the No Net Production/Capability-sized UPF Alternative, ecological monitoring would continue to assess levels of pollutants in soil, waterways, and wildlife.

**Threatened and Endangered Species.** With the No Net Production/Capability-sized UPF Alternative, impacts to federally- and state-listed T&E species and other special status species would be expected to be essentially the same as for Alternative 2. As discussed in Section 5.8.2,

NNSA has determined that no further consultation with the USFWS is required regarding that BA. The USFWS also reviewed the Haul Road extension activities and determined that, "based on the best information available at this time, we believe that the requirements of section 7 of the Endangered Species Act of 1973, as amended, are fulfilled" (USFWS 2010).

### 5.8.6 Potential Mitigation Measures

For any of the alternatives discussed above, potential impacts to terrestrial plant and animal species and wetland areas would be mitigated to avoid or minimize potential impacts. Proposed construction sites would be surveyed for the presence of special status species before construction begins, and mitigation actions would be developed. Appropriate runoff and siltation controls would be implemented to minimize potential impacts to adjacent wetland areas during construction and operation. Following construction, temporary structures would be removed and the sites reclaimed. However, no T&E or species of concern have been identified at Y-12. In addition, the developed portions of Y-12 do not contain suitable species habitat. Conservation easements exist at Y-12 and will continue in order to protect, restore, and enhance wildlife and suitable habitat.

### 5.8.7 Summary Comparison of Alternative Impacts for Ecological Resources

**No Action Alternative.** The existing Y-12 Site is highly developed, consisting mainly of disturbed habitat. Wildlife diversity is low. Continued minor impacts to terrestrial resources would be expected due to continued operations and human activities.

**UPF Alternative.** Construction would not be expected to significantly impact ecological resources because new facilities would be sited on previously disturbed land. The Haul Road extension, Site Access and Perimeter Modification Road, Wet Soils Disposal Area, and West Borrow Area would disturb approximately 41 acres of land. Operations of the new facilities would not impact ecological resources because activities would generally be located in previously disturbed or heavily industrialized portions of Y-12 that do not contain habitat sufficient to support a biologically diverse species mix.

**Upgrade in-Place Alternative.** Impacts to ecological resources beyond those for the No Action Alternative would not be expected because construction activities would consist mostly of internal building modifications in areas previously disturbed that do not contain habitat sufficient to support ecological resources.

**Capability-sized UPF Alternative.** Impacts would be essentially the same as for Alternative 2.

**No Net Production/Capability-sized UPF Alternative.** Impacts would be essentially the same as for Alternative 2.

## 5.9 CULTURAL RESOURCES

Potential impacts to cultural resources are assessed by applying the criteria of adverse effect as defined in 36 CFR Part 800.5[a]. An adverse effect is found when an action may alter the characteristics of a historic property that qualifies it for inclusion in the National Register of

Historic Places (NRHP) in a manner that would diminish the integrity of the property's location, design, setting, workmanship, feeling, or association. Some examples of adverse effect to cultural resources include: physical destruction or damage; alterations not consistent with the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (DOI 1990); relocation of a property; isolation and restriction of access; introduction of visible, audible, or atmospheric elements out of character with the resource; neglect resulting in deterioration; or transfer, lease or sale of historic properties without adequate protections. Adverse effects may include reasonably foreseeable effects caused by the action that may occur later in time, be farther removed in distance, or be cumulative. Activities conducted under the alternatives considered are measured against the criteria of adverse effect to determine the potential for, and intensity of, impacts to cultural resources.

While DOE, as the Federal agency, makes the determination of adverse effect, consultation with the State Historic Preservation Officer (SHPO) and other parties is required regarding the application of the criteria of adverse effect and in mitigation efforts to avoid or reduce any impacts. For certain activities specifically outlined in the Cultural Resources Management Plan (CRMP), DOE Oak Ridge Office (DOE-ORO) may apply the criteria of adverse effect without consultation, but if there is an adverse effect, it must be resolved via consultation with the SHPO (36 CFR Part 800.6, Souza et al. 1997).

Ancestors of the Cherokee Nation of Oklahoma may be culturally affiliated with the prehistoric use of the Y-12 area. No Native American traditional use areas or religious sites are known to be present on the Y-12 site. Also, no artifacts of Native American religious significance are known to exist or to have been removed from Y-12 (DOE 2001a).

### 5.9.1 Alternative 1 – No Action Alternative

Y-12 currently has 76 existing historic properties (NNSA 2005c). These 76 properties are also contributing elements to the proposed Y-12 Plant Historic District for their historical association with the Manhattan Project. The Y-12 National Security Complex *National Historic Preservation Act Historic Preservation Plan* details the historic significance of these properties and their contribution to the proposed historic district. Preservation of cultural resources at Y-12, including these historic buildings, would continue under the No Action Alternative. As discussed in Section 4.9.4, any alterations to these historic buildings would be in accordance with the Historic Preservation Plan and Programmatic Agreement.

### 5.9.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** Alternative 2, described in Section 3.2.2, would be compatible and consistent with the current status of cultural resources at Y-12. Construction activities for new facilities would take place in areas outside of the proposed historic district and there would be no appreciable impacts or changes beyond those described for the No Action Alternative. Should suspected cultural artifacts be encountered during the construction process, all construction activities would cease and the situation would be resolved via consultation with the SHPO (36 CFR Part 800.6, Souza 1997).

**Operation.** Operation of any of the UPF Alternatives and CCC would have no impact on the current cultural resources at Y-12.

### 5.9.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would be compatible and consistent with the current status of cultural resources at Y-12. Activities would consist of internal modifications to existing facilities, as well as construction of the CCC. There would be no appreciable impacts or changes to cultural or historic resources.

**Operation.** Operation of the CCC and upgraded facilities would not have any additional impact on the current cultural resources at Y-12, as all operations under Alternative 3 would be similar to existing operations.

### 5.9.4 Alternative 4 – Capability-sized UPF Alternative

Under this alternative, NNSA would include construction and operation of a Capability-sized UPF and the CCC at the same locations as Alternative 2. Impacts to significant cultural resources from the Capability-sized UPF Alternative would be appreciably the same as Alternative 2. Should suspected cultural artifacts be encountered during the construction process, all construction activities would cease and the situation would be resolved via consultation with the SHPO (36 CFR Part 800.6, Souza et al. 1997).

### 5.9.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

Under this alternative, NNSA would include construction and operation of a No Net Production/Capability-sized UPF and the CCC at the same locations as Alternative 2. Impacts to significant cultural resources from the No Net Production/Capability-sized Alternative would be appreciably the same as Alternative 2. Should suspected cultural artifacts be encountered during the construction process, all construction activities would cease and the situation would be resolved via consultation with the SHPO (36 CFR Part 800.6, Souza et al. 1997).

### 5.9.6 Potential Mitigation Measures

If adverse impacts to NRHP-eligible sites were to be expected and could not be avoided through project design or siting, a Memorandum of Agreement would need to be negotiated among DOE, the Tennessee SHPO, and the Advisory Council on Historic Preservation. The Memorandum of Agreement would formalize mitigation measures agreed to by these consulting parties. Mitigation measures could include describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. No Native American resources were identified at Y-12.

### 5.9.7 Summary Comparison of Alternative Impacts for Cultural Resources

Y-12 currently has a proposed National Register Historic District comprised of historic buildings associated with the Manhattan Project that are eligible for listing in the NRHP. Preservation of

cultural resources at Y-12, including the buildings in this proposed historic district, would continue under all alternatives. None of the alternatives would impact significant cultural resources at Y-12.

## 5.10 SOCIOECONOMICS

The socioeconomic analysis considers a ROI where more than 90 percent of ORR workforce resides. The ROI is a four-county area in Tennessee comprised of Anderson, Knox, Loudon, and Roane Counties. The socioeconomic impacts of all the alternatives are addressed in terms of both direct and indirect impacts.

### 5.10.1 Alternative 1 – No Action Alternative

Section 4.10 describes the existing socioeconomic characteristics of the ROI. Although there have been fluctuations in these estimates, the ROI labor force grew by approximately 11 percent from 280,986 in 2000 to 312,211 in 2007 (BLS 2007).

The 2010 unemployment rate in the ROI varies from a low of approximately 7.0 percent in Knox County to a high of approximately 8.8 percent in Anderson County. The unemployment rate in Tennessee is approximately 10.6 percent (BLS 2010).

The average per capita income in the ROI was $31,493 in 2006, a 21.7 percent increase from the 2001 level of $25,880. Per capita income in 2006 in the ROI ranged from a low of $29,074 in Roane County to a high of $33,963 in Knox County. The per capita income in Tennessee was $32,172 in 2006 (BEA 2007).

Y-12 employs approximately 6,500 workers, including DOE employees and multiple contractors (NNSA 2005c). This represents approximately 3.1 percent of area employment. DOE has a significant impact on the economies both of the ROI and of Tennessee. As a whole, DOE employees and contractors number more than 11,900 individuals in Tennessee, primarily in the ROI. These jobs have an average salary of approximately $54,800 in comparison to the statewide average of approximately $32,900 (UTenn 2005, BEA 2007). The total spending generated in Tennessee as a result of DOE operations supported a total of more than 62,000 jobs in the state, most in the ROI. This means that for every direct DOE-related job, an additional 3.2 jobs were supported in other sectors of the state's economy. This relatively high implied employment multiplier reflects, in part, the high average annual salary of DOE-related employees in the state (UTenn 2005, BEA 2007). Under the No Action Alternative, the workforce at Y-12 is projected to remain at a relatively stable level over the next ten years (NNSA 2005c).

From 2000 to 2007, the population of the ROI increased 3 percent from 544,358 to 596,192 in 2007. Loudon County experienced the largest population growth within the ROI between 2000 and 2007 with an increase of 16 percent. Roane County experienced the lowest growth rate with an increase of 2.9 percent (USCB 2007).

Knox County is the largest county in the ROI with a 2007 population of 423,874. Knox County includes the city of Knoxville, the largest city in the ROI. Loudon County is the smallest county

in the ROI with a total population of 45,448 in 2007. The city of Oak Ridge and ORR are located in both Roane and Anderson Counties which had 2003 populations of 53,399 and 73,471, respectively (USCB 2007). In 2000, the total number of housing units in the ROI was 244,537 with 224,796 occupied (91.9 percent). There were 156,219 owner-occupied housing units and 68,577 rental units. The median value of owner-occupied units in Loudon County was the greatest of the counties in the Y-12 ROI ($97,300). The vacancy rate was the lowest in Loudon County (7.7 percent) and the highest in Roane County (9.3 percent) (USCB 2007).

There would be no appreciable changes in the regional socioeconomic characteristics over the 10-year planning period resulting from continuation of the No Action Alternative.

### 5.10.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** The construction of the new UPF and other new facilities, described in Section 3.2.2, would require approximately 1,350 workers during the peak year of construction (see Table 3.2.2.1-1). A total of 5,670 additional jobs (1,350 direct and 4,320 indirect, using the multiplier of 3.2 indirect jobs for every DOE-related direct job) would be created in the ROI during the peak year of construction. The total new jobs would represent an increase of less than 1 percent in ROI employment. The number of direct jobs at Y-12 could increase by approximately 20 percent during the peak year of construction. Overall, these changes would be temporary, lasting only through the construction duration of the CCC and UPF, and would be similar in magnitude to the socioeconomic impacts that were experienced at Y-12 with construction of the HEUMF. Similar to the HEUMF, the existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services utilized in the ROI.

Based on the ROI average earnings of $26,100 for the construction industry, direct income would increase by approximately $25 million annually. This would also generate additional indirect income in supporting industries (this analysis uses the average ROI earnings of $31,493 for other indirect jobs). The total impact to the ROI income would be approximately $171 million ($35 million direct and $136 million indirect). Table 5.10.2-1 illustrates the impacts to socioeconomic resources from construction under Alternative 2.

**Table 5.10.2-1. Socioeconomic Impacts from Construction under Alternatives 2, 3, 4 and 5.**

| Socioeconomic Resource | Alternative 2 | Alternative 3 | Alternatives 4 and 5 |
|---|---|---|---|
| Peak Workers | 1,350 | 700 | 1,250 |
| Indirect Jobs Created | 4,320 | 2,240 | 4,000 |
| Total Jobs Created | 5,670 | 2,940 | 5,250 |
| ROI Average Earning (direct) | $26,100 | $26,100 | $26,100 |
| ROI Average Earning (indirect) | $31,493 | $31,493 | $31,493 |
| Direct Income Increase | $35,235,000 | $18,270,000 | $32,625,000 |
| Indirect Income Increase | $136,050,000 | $70,544,000 | $125,972,000 |
| Total Impact to the ROI | $171,285,000 | $88,814,000 | $158,597,000 |

**Operation.** Upon completion of all new construction, the operational workforce for the UPF is expected to be smaller than the existing EU workforce due to efficiencies associated with the new facility. NNSA estimates that the total workforce reduction could be approximately 750 workers, which is approximately 11 percent of the total Y-12 workforce. These reductions are expected to be met through normal attrition/retirements since 50 percent of the work force at Y-12 is eligible to retire within the next 5 years. The change from baseline Y-12 employment would be minor and no noticeable impacts to ROI employment, income, population, housing, or community services would be expected.

Once the UPF is operational, the current EU facilities may be declared excess and evaluated for D&D. Section 5.16 of this SWEIS provides a qualitative assessment of the types of impacts that might result from the D&D of these facilities. Although the ultimate disposition of these facilities would be determined by a NEPA proposal and determination in the future, when such actions are ready for decisionmaking, this SWEIS acknowledges that approximately 633,000 square feet of facilities could require D&D, which could result in socioeconomic impacts to include impacts on employment and population in the ROI. Y-12 is a CERCLA Superfund listed site. D&D and site clean-up will be done according to CERCLA requirements which include input from state and Federal regulators and the public. The impacts from these actions would occur in 2018 or beyond, which is outside of the planning period for this SWEIS, analysis of these impacts, at this time, would be premature.

### 5.10.3 Alternative 3 – Upgrade in-Place Alternative

**Construction.** The Upgrade in-Place Alternative, described in Section 3.2.3, would require approximately 700 workers (see Table 5.10.2-1), generating a total of 2,940 jobs (700 direct and 2,240 indirect, using the multiplier of 3.2 indirect jobs for every DOE-related direct job) in the ROI during the peak year of construction. The total jobs would represent an increase of less than 1 percent in ROI employment, while the direct jobs would increase the employment at Y-12 by approximately 10 percent. These changes would be temporary, lasting only the duration of the construction period, and would be much less in magnitude than the socioeconomic impacts that were experienced at Y-12 with construction of the HEUMF. The existing ROI labor force could likely fill all of the jobs generated by the increased employment and expenditures. Therefore, there would be no impacts to the ROI's population or housing sector. Because there would be no change in the ROI population, there would be no change to the level of community services provided in the ROI.

Based on the ROI average earnings of $26,100 for the construction industry, direct income would increase by approximately $18 million annually. This would also generate additional indirect income in supporting industries (this analysis uses the average ROI earnings of $31,493 for other indirect jobs). The total impact to the ROI income would be approximately $88 million ($18 million direct and $70 million indirect). Table 5.10.2-1 illustrates the impacts to socioeconomic resources from construction under Alternative 3.

**Operation.** Upon completion of the upgrades and any new construction, operation of the upgraded facilities would not result in any significant change in Y-12 workforce requirements and the facilities would be staffed by the existing Y-12 workforce. Therefore, there would be no

change from the baseline employment, and no impacts to ROI employment, income, population, housing, or community services. Upgrading the existing facilities would not allow the Protected Area at Y-12 to be reduced from approximately 150 acres to about 15 acres, and would not reduce security force requirements.

### 5.10.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** As described in Section 3.2.4, NNSA would construct and operate a 350,000 square foot UPF and the CCC under the Capability-sized UPF Alternative. The socioeconomic impacts associated with construction would likely be similar to, although slightly less than, those discussed for Alternative 2 in Section 5.10.2 and shown in Table 5.10.2-1.

**Operation.** Operations under the Capability-sized UPF Alternative would require a smaller workforce compared to Alternative 2. NNSA estimates that the site employment could decrease to approximately 5,100 workers.[2] This would represent a decrease of approximately 1,400 jobs; a reduction of approximately 20 percent compared to the No Action Alternative baseline. Combined with the indirect jobs that could be lost, the ROI employment could be reduced by approximately 5,880 total jobs, or approximately 1.9 percent.

### 5.10.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** As described in Section 3.2.5, NNSA would construct and operate a 350,000 square foot UPF and the CCC under the No Net Production/Capability-sized UPF Alternative. The socioeconomic impacts associated with construction would likely be similar to, although slightly less than, those discussed for Alternative 2 in Section 5.10.2 and shown in Table 5.10.2-1.

**Operation.** Operations under the No Net Production/Capability-sized UPF Alternative would require a smaller workforce compared to Alternative 2. NNSA estimates that the site employment could decrease to approximately 4,500 workers. This would represent a decrease of approximately 2,000 jobs; a reduction of approximately 30 percent compared to the No Action Alternative baseline. Combined with the indirect jobs that could be lost, the ROI employment could be reduced by approximately 8,400 total jobs, or approximately 2.7 percent.

### 5.10.6 Potential Mitigation Measures

Construction and operation under the alternatives analyzed would cause changes to employment, however, changes would generally be short-term. For the Capability-sized UPF and No Net Production/Capability-sized UPF Alternatives, NNSA would minimize socioeconomic impacts by attempting to meet employment goals through normal attrition and workforce retraining.

[2] In the Draft Y-12 SWEIS, the Y-12 site employment number for Alternatives 4 and 5 were 3,900 and 3,400 workers, respectively, and were taken from the Capability-Based Alternative in the Complex Transformation SPEIS (published in October 2008) which was programmatic in nature and provided bounding estimates based on information available at that time. NNSA has prepared the current site employment estimates for Alternatives 4 and 5 based on better defined UPF information, program requirements, and required capacities that are now available. Therefore, NNSA has estimated that the Y-12 site employment levels for Alternatives 4 and 5 would be 5,100 and 4,500, respectively. No change is required in the total number of Y-12 monitored workers from the Draft SWEIS to the Final SWEIS because that number was originally estimated for the SWEIS and was based on currently available information.

Outsourcing resources would be established for workers. Such resources would include counseling, up-to-date job listings for the ROI, resume assistance, and office space with telephones and word processors. Early retirement packages and offers could be instituted to lessen the severity of forced job losses and priority hiring for positions elsewhere at other NNSA facilities could be instituted. In addition, D&D activities could be started earlier and workers losing their positions at the Y-12 production facilities could be given priority hiring opportunities for jobs associated with the D&D of phased out facilities.

### 5.10.7 Summary Comparison of Alternative Impacts for Socioeconomics

**No Action Alternative.** The operational workforce at Y-12 would be expected to remain stable with no significant increase or decrease. No appreciable changes in the regional socioeconomic characteristics over the 10-year planning period would be expected.

**UPF Alternative.** There would be an increase of 1,350 construction workers during the peak year of construction. A total of 5,670 jobs (1,350 direct and 4,320 indirect) would be created in the ROI, which would affect present employment levels by less than a 3 percent increase. An 11 percent decrease in the current operational workforce level could be expected due to more efficient operations of the UPF and reduced security requirements resulting from a decrease in the footprint of facilities requiring high level security.

**Upgrade in-Place Alternative.** There would be an increase in 700 workers during the peak year of construction. A total of 2,940 jobs (700 direct and 2,240 indirect) would be created in the ROI, which would be expected to increase current employment levels in the ROI by less than 1 percent. There would be no expected changes to the current level of the operational workforce.

**Capability-sized UPF Alternative.** There would be an increase in 1,250 workers during the peak year of construction. A total of 5,250 jobs (1,250 direct and 4,000 indirect) would be created in the ROI by construction work, which would be expected to increase current employment levels by less than 2 percent. The operational workforce could be expected to decrease by about 1,400 jobs, which could result in the number of indirect jobs decreasing by about 4,480 in the ROI.

**No Net Production/Capability-sized UPF Alternative.** There would be an increase in 850 workers during the peak year of construction. A total of 3,570 jobs (850 direct and 2,720 indirect) would be created in the ROI by construction work, which would be expected to increase current employment levels by less than 2 percent. The operational workforce could be expected to decrease by about 2,000 jobs, which could result in the number of indirect jobs decreasing by about 6,400 in the ROI.

## 5.11 ENVIRONMENTAL JUSTICE

Section 4.11 describes the existing environmental justice characteristics of the ROI, including census tracts for minority, low-income populations, and American Indian groups with a cultural affiliation with the Y-12 area. For each of the alternatives, the offsite health and safety impacts

described in Section 5.12 do not differ significantly. As such, the analysis in this section discusses potential environmental justice impacts for all of the alternatives.

In 2000, minority populations comprised 7.4 percent of the ROI population surrounding Y-12. In 2000, minorities comprised 30.9 percent of the population nationally and 20.8 percent of the population in Tennessee. The percentage of persons within the ROI below the poverty level at the time of the 2000 Census was 13.4 percent, which is higher than the 2000 national average of 12.4 percent, but slightly lower than the statewide figure of 13.5 percent.

Based on the analysis of impacts for resource areas, no significant adverse effects are expected from construction and operation activities at Y-12 under any of the alternatives. For those impacts that would occur, NNSA expects the impacts to affect all populations in the area equally. There would be no discernable adverse impacts to land uses, visual resources, noise, water, air quality, geology and soils, biological resources, socioeconomic resources, or cultural and archeological resources. As shown in Section 5.12, Occupational Public Safety and Health, it is not expected that there would be large adverse impacts to any populations.

**Construction.** The short-term socioeconomic impacts during any construction activities would be positive and not result in any disproportionately high and adverse effects on minority populations, low-income, or American Indian populations. With respect to human health, occupational impacts during construction would be expected (see Health and Safety, 5.12), but would not be significant (i.e., statistically, no fatal injuries during construction, and no more than 27 non-fatal occupational injuries). Therefore, no disproportionately high and adverse effects on minority populations, low-income, or American Indian populations would be expected during construction for any alternative.

**Operation.** None of the proposed alternatives would pose significant health risks to the public and radiological emissions would remain below the annual dose limit of 10 mrem (the maximum MEI dose is 0.15 mrem per year). Results from ORR ambient air monitoring program show that the hypothetical dose received within the Scarboro Community (a small urban minority community which is the nearest residential community to active DOE operations or property at ORR) is typically similar to, or lower than, other monitoring stations of Y-12 (DOE 2005a). Consequently, there are no special circumstances that would result in any greater impact on minority, low-income or American Indian populations than the population as a whole. As discussed in Section 4.11, an EPA study has concluded that residents of Scarboro Community are not currently being exposed to substances that pose an unreasonable risk to health or the environment (EPA 2003). None of the alternatives would be expected to change that conclusion.

### 5.11.1 Potential Mitigation Measures

There would be no negative, disproportionately high or adverse effects to minority populations or low-income populations; therefore, no mitigation measures are identified.

### 5.11.2 Summary Comparison of Alternative Impacts for Environmental Justice

Under all alternatives, no significant health risks to the public would be expected. The radiological dose to the MEI would remain well below the annual dose limit of 10 mrem. Results from the monitoring program and modeling show that the maximum exposed individual would not be located in a minority or low-income population area. No special circumstances that would result in greater impact on minority, low-income, or American Indian populations than the population as a whole, would be expected.

## 5.12 OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

This section describes potential human health impacts associated with radiation exposures, chemical exposures, and worker safety issues due to Y-12 operations under each of the alternatives. A comprehensive evaluation of the potential risks associated with human exposure to environmental media (air, surface water, soil, sediment, and groundwater) was conducted.

### 5.12.1 Radiological Impacts

#### 5.12.1.1 *Public Health*

The release of radioactive materials and the potential level of radiation doses to workers and the public are regulated by DOE for its facilities. Environmental radiation protection is currently regulated by DOE Order 5400.5. This Order sets annual dose standards to members of the public from routine DOE operations of 100 mrem through all exposure pathways. The Order requires that no member of the public receives an effective dose (ED) in a year greater than 10 mrem from airborne emissions of radionuclides and 4 mrem from ingestion of drinking water. In addition, the dose requirements in the *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities* (40 CFR Part 61, Subpart H) limit exposure to the MEI of the public from all air emissions to 10 mrem per year.

The dose received by the hypothetical MEI for Y-12 under the No Action Alternative was calculated to be 0.15 mrem based on both monitored and estimated emissions data (DOE 2008). This dose would be well below the NESHAP standard of 10 mrem for protection of the public (DOE 2008). The major radionuclide emissions from Y-12 are U-234, U-235, U-236, and U-238. The total dose to the population residing within 50 miles of ORR during 2007 (approximately 1,040,041 people) from Y-12 air emissions under the No Action Alternative was calculated to be about 1.5 person-rem (DOE 2008). For the Upgrade in-Place Alternative, the radiological airborne emissions and resulting impacts from upgraded EU facilities would remain unchanged from the No Action Alternative.

Although the design for a UPF is not completed, it is anticipated that implementation of the UPF Alternative would reduce the airborne emissions concentrations for Y-12 from those under the No Action Alternative and Upgrade-in Place Alternative. NNSA has estimated that uranium emissions from the UPF would be reduced by approximately 30 percent compared to the No Action Alternative. Under the Capability-sized UPF Alternative and the No Net Production/Capability-sized UPF Alternative, activities that release radiological emissions would

be reduced, resulting in lower emission levels relative to the No Action Alternative. NNSA estimates that uranium emissions would decrease by approximately 40 percent for the Capability-sized UPF Alternative and approximately 50 percent for the No Net Production/Capability-sized UPF Alternative. The potential radiological doses and impacts to the MEI of the public and the population within 50 miles from Y-12 air emissions for all alternatives are presented in Tables 5.12.1.1–1 and 5.12.1.1-2.

**Table 5.12.1.1-1. Annual Radiation Doses from Y-12 Air Emissions.**

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | No Action | UPF | Upgrade in-Place | Capability-sized UPF | No Net Production/ Capability-sized UPF |
| Dose to the MEI (mrem/year) | 0.15 | 0.1 | 0.15 | 0.09 | 0.08 |
| Offsite Population Dose (person-rem/year) [ab] | 1.5 | 1.0 | 1.5 | 1.0 | 0.8 |

a – Population residing within 50 miles of ORR

b – Based on total of airborne emissions and liquid effluents

**Table 5.12.1.1-2. Annual Radiation Health Impacts from Y-12 Air Emissions.**

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | No Action | UPF | Upgrade in-Place | Capability-sized UPF | No Net Production/ Capability-sized UPF |
| Latent Cancer Fatality to the MEI | $9.0\times10^{-8}$ | $6.0\times10^{-8}$ | $9.0\times10^{-8}$ | $5.0\times10^{-8}$ | $4.0\times10^{-8}$ |
| Latent Cancer Fatalities in the Offsite Population [ab] | 0.0009 | 0.0006 | 0.0009 | 0.0005 | 0.0005 |

a – Population residing within 50 miles of ORR.

b – Based on total of airborne emissions and liquid effluents

For liquid effluents, the MEI dose to a member of the public from consumption of fish, drinking water, and participation in other water uses from the Clinch River would not be expected to change for all alternatives. For liquid effluents, the MEI dose to a member of the public would be approximately 0.006 mrem per year (DOE 2008). Statistically, an annual dose of 0.006 mrem would result in a latent cancer fatality (LCF) risk of $4.0\times10^{-9}$. The committed collective EDE to the population residing within a 50-mile radius of ORR from liquid effluents would be about 6.3 person-rem per year (DOE 2008). Statistically, a dose of 6.3 person-rem would result in 0.004 LCFs annually.

### 5.12.1.2 *Y-12 Worker Health Impacts*

Occupational radiation protection is regulated by the Occupational Radiation Protection Rule (10 CFR Part 835), which limits the occupational dose for an individual worker at 5,000 mrem per year. DOE/NNSA has set administrative exposure guidelines at a fraction of this exposure limit to help enforce the goal to manage and control worker exposure to radiation and radioactive material "as low as reasonably achievable" (ALARA). The worker radiation dose projected in this SWEIS is the total effective dose incurred by workers as a result of routine operations. This dose is the sum of the external whole body dose as monitored by personnel dosimeters, including dose from both photons and neutrons, and internal dose, as required by 10 CFR Part 835.

The projected health impacts to workers for major production operations under the No Action Alternative are presented in Table 5.12.1.2–1. These doses are based on the most recent data available (NNSA 2008b) and expected to be representative of doses for these operations under the No Action Alternative.

Y-12 personnel received a total internal dose of 49 person-rem in 2009. Statistically, this would result in 0.03 annual LCFs under the No Action Alternative. The Y-12 internal dose is spread across approximately 2,450 workers. About 10 percent of those workers account for about half the total exposure, mainly hands-on production and maintenance workers. None of the internal exposures exceeded the site's 1.0 rem administrative limit. The exposures ranged from 0 to 0.823 rem (Oliver 2010).

The implementation of the UPF Alternative would decrease the number of radiation workers due to more efficient operations. NNSA has estimated that approximately 900 operating and maintenance (O&M) personnel would be required to conduct UPF operations, which represents a reduction of approximately 350 radiation workers (approximately 35 percent) compared to the current workforce. Operations in the UPF are also expected to improve worker radiation protection and NNSA estimates that the total dose to workers associated with the UPF operations would be approximately 20.5 person-rem. Statistically, a total dose of 20.5 person-rem would result in 0.013 annual LCFs to the UPF workforce (see Table 5.12.1.2-1).

For the Upgrade in-Place Alternative, there would be no change in either the number of radiation workers at Y-12 or the radiation dose compared to the No Action Alternative because the level and type of work is expected to be similar to current activities. All work would be conducted in full compliance with applicable health, safety, and environmental protection standards. Consequently, the potential health impacts for the Upgrade in-Place Alternative would be the same as the No Action Alternative.

Under the Capability-sized UPF Alternative, the number of radiation workers at Y-12 and the radiation dose would decrease with reduced workload. NNSA estimates that the monitored workforce at Y-12 would be 1,825 under this alternative. The total dose to the Y-12 monitored workforce would be 18.2 person-rem, which would equate to approximately 0.01 LCFs annually. The resulting radiation doses and projected health effects for all alternatives are presented in Table 5.12.1.2-1.

**Table 5.12.1.2-1. Annual Radiation Doses and Health Impact to the Total Monitored Workers at Y-12 for the Alternatives.**

| | No Action Alternative | UPF Alternative | Upgrade in-Place Alternative | Capability-sized UPF Alternative | No Net Production/ Capability-sized UPF Alternative |
|---|---|---|---|---|---|
| Y-12 Monitored Workers | 2,450 | 2,050 [a] | 2,450 | 1,825[c] | 1,600[d] |
| Average Individual Worker Dose (mrem) | 19.9 | 10.0 [b] | 19.9 | 10.0 | 10.0 |
| Collective Worker Dose (person-rem) | 49.0 | 20.5 [e] | 49.0 | 18.2 [e] | 16.0 [e] |
| Latent Cancer Fatalities | 0.03 | 0.01 | 0.03 | 0.01 | 0.009 |

Source: Oliver 2010, Gorman 2009.
a - The total number of monitored workers at Y-12 for the UPF Alternative was derived by reducing the No Action Alternative workforce to reflect more efficient operations in the UPF and other reductions, including the consolidation of the Protected Area from 150 acres to 15 acres. As a result of these reductions, there would be 400 fewer monitored workers.
b - Average dose for UPF assumes the internal dose is reduced by 50 percent.
c – Capability-sized UPF Alternative assumes an approximately 25 percent reduction in UPF personnel, which would reduce the total Y-12 monitored workers to 1,825 (see Section 3.2.4).
d – No Net Production/Capability-sized UPF Alternative assumes an approximately 33 percent reduction in UPF personnel, which would reduce the total Y-12 monitored workers to 1,600 (see Section 3.2.5).
e – After UPF becomes operational, NNSA has estimated that the total dose associated with Y-12 operations could be reduced to approximately 2 person-rem (Gorman 2009). For the bounding analysis, this SWEIS assumes the average worker dose would be reduced by 50 percent, but acknowledges that the dose could be even smaller.

Under the No Net Production/Capability-sized UPF Alternative, the number of radiation workers at Y-12 and the radiation dose would decrease with reduced workload. NNSA estimates that the monitored workforce at Y-12 would be 1,600 under this alternative. The total dose to the Y-12 monitored workforce would be 16.0 person-rem, which would equate to approximately 0.009 LCFs annually. The resulting radiation doses and projected health effects for all alternatives are presented in Table 5.12.1.2-1.

### 5.12.2 Non-radiological Hazardous Chemical Impacts

Airborne emissions of chemicals used at Y-12 occur as a result of plant production, maintenance, waste management operations, and steam generation. Most process operations are served by ventilation systems that remove air contaminants from the workplace. Non-radionuclide emissions at Y-12 include chemical processing aids (hydrochloric and nitric acids), cleaning and cooling aids (methanol), refrigerants (Freon 11, 12, 22, 13, and 502), and emissions from the Y-12 steam plant (particulates, $SO_2$, carbon monoxide, VOCs, and $NO_2$). More than 90 percent of the pollutants emitted from Y-12 have been the result of historic Y-12 steam plant operations. With the new Y-12 steam plant now operational, the emissions for all criteria pollutants except for VOCs and carbon monoxide are expected to decrease significantly from past levels. Chemical use at Y-12 would not vary significantly under any of the alternatives being considered in the SWEIS. Implementation of the Capability-sized UPF or No Net Production/Capability-sized UPF Alternatives would result in reduced production of canned assemblies and other work currently conducted in existing EU facilities and therefore some reduction in chemical usage

associated with those processes. Although there would be some reduction in chemical use under the Capability-sized UPF and No Net Production/Capability-sized UPF Alternatives, the majority of the chemicals are used due to the production and daily clean-up resulting from the production of the first unit and the rest of the chemical usage is directly proportional to number of the units produced.

#### 5.12.2.1 *Impacts to Workers*

**Mercury.** A study of mortality patterns of all workers employed at least 5 months at Y-12 between January 1, 1953, and April 30, 1958 was published in 1984 (Cragle et al. 1984). Mercury was used during this timeframe to produce enriched lithium. The group was divided into mercury-exposed and non-mercury-exposed by results of urinalysis supplied by the site. Vital status follow-up was complete through the end of 1978 and standard mortality ratios (SMRs) were calculated. There were no differences in mortality patterns for the mercury-exposed, when compared to the non-mercury exposed. Excesses of lung cancer mortality were observed in both groups of workers and were not related to the mercury exposure (exposed SMR=1.34; 42 observed, 31.36 expected; non-exposed SMR=1.34, 71 observed, 52.9 expected). The authors stated that mortality is not the optimal end point to assess mercury-related health effects.

Another study of mercury workers (Albers et al. 1988) assessed neurological function and mercury exposure. The clinical study examined 502 Y-12 workers, 247 of whom worked in the mercury process 20 to 35 years prior to the examination. Several correlations between increasing mercury exposure and declining neurological function were discovered. An exposure assessment was determined for each mercury worker during the time of employment in the mercury process. Workers with at least one urinalysis equal to or greater than 0.6 mg/L of mercury showed decreased strength, coordination, and sensation along with increased tremor and prevalence of Babinski and snout reflexes when compared to the 255 non-exposed workers. Clinical polyneuropathy was associated with the level of the highest exposure but not with the duration of exposure.

Under any of the alternatives considered in this SWEIS, exposure of Y-12 workers to mercury would remain at levels below those described above. Workplace controls would continue to be employed to further control the exposures to levels that comply with all applicable regulatory limits. Therefore, there would be no adverse impacts to Y-12 workers from exposure to mercury under any of the alternatives.

**Beryllium.** Because of the heightened sensitivity and awareness associated with worker exposure to beryllium, a detailed evaluation of the impact of exposure to beryllium is presented below.

Since the 1950s, processing beryllium metals and alloys has been an important part of the Y-12 mission. Beryllium materials have been used for research and development (R&D), testing, and manufacturing operations at multiple locations throughout the plant. Included in the beryllium operations have been melting and molding, grinding, and machine tooling of parts. Recent studies and experience with the manufacture of beryllium-containing compounds indicated a

potential significant hazard to employees. As such, much emphasis has been placed on evaluating, communicating, and mitigating the health effects of occupational exposure to ensure worker protection and public safety.

Beryllium and beryllium compounds enter the environment as a result of the release and/or disposal of beryllium contaminated wastewater, dust, or a solid waste component. Once beryllium has been released to the environment, exposure to beryllium can occur by breathing air, eating food, or drinking water that contains beryllium. Dermal contact with metal containing beryllium or water containing dissolved beryllium salts will result in only a small fraction of the beryllium actually entering the body. A portion of beryllium dust breathed into the lungs will dissolve and eventually result in the transfer of the beryllium into the bloodstream; some may be transferred to the mouth then swallowed, and the rest will remain in the lungs for a long time. Of the beryllium ingested via contaminated foodstuffs or water, or swallowed subsequent to inhalation, about 1 percent will pass from the stomach and intestines into the bloodstream. Therefore, most of the beryllium that is swallowed leaves the body through the feces without entering the bloodstream. Of the beryllium that enters the bloodstream, some is routed to the kidneys and is eliminated from the body in urine. Some beryllium can also be carried by the blood to the liver and bones where it may remain for a long period of time. If beryllium is swallowed, it leaves the body in a few days. However, if beryllium is inhaled, it may take months to years before the body rids itself of beryllium.

As with any contaminant, the health effects resulting from exposure to beryllium are dependent on the exposure concentration, frequency and duration. Inhalation of large amounts of soluble beryllium compounds can result in acute beryllium disease. Acute beryllium disease results in lung damage that resembles pneumonia with reddening and swelling of the lungs. Lung damage may heal provided exposure does not continue, or the exposed individual may become sensitive to beryllium. The increased sensitivity of some individuals to beryllium results in an immune or inflammatory reaction when subsequent low level exposures occur. This condition is called chronic beryllium disease. This disease can occur long after exposure to either the soluble or the insoluble forms of beryllium. Studies linking exposure to beryllium or beryllium compounds with an increased incidence of cancer (in particular, lung cancer) have been performed on laboratory animals. However, these studies are not considered reliable predictors of human health effects and ongoing efforts are currently underway to evaluate workers who have been known to be exposed.

In 1997, DOE initiated an Interim Chronic Beryllium Disease Prevention Program. The purpose of the program was to enhance, supplement, and integrate a worker protection program to reduce the number of current workers exposed, minimize the levels of beryllium exposure and the potential for exposure to beryllium, and to establish medical surveillance protocols to ensure early detection of disease. In December of 1999, DOE published a final rule to establish the chronic beryllium disease prevention program that became effective on January 7, 2000 (10 CFR Part 850). The final rule establishes:

- An airborne beryllium concentration action level as 0.2 μg/m$^3$
- A requirement for employers to ensure that workers use respirators in areas where the concentration of beryllium is at or above the action level and to provide a respirator to any employee who requests one regardless of the concentration of airborne beryllium
- Criteria and requirements governing the release of beryllium-contaminated equipment and other items at DOE sites for use by other DOE facilities or the public
- Requirements for offering medical surveillance to any "beryllium-associated worker"
- Medical removal protection and multiple physician review provisions

Under any of the alternatives considered in this EIS, these requirements would continue to be employed to minimize the levels of beryllium exposure and the potential for exposure to beryllium. Therefore, adverse impacts to Y-12 workers from exposure to beryllium under any of the alternatives would be minimized to the extent practicable.

#### 5.12.2.2 *Impacts to Members of the Public*

**Mercury.** The Y-12 ambient air monitoring program for mercury was established in 1986 as a best management practice. The objectives of the program have been to maintain a database of mercury concentration in ambient air, to identify long term spatial and temporal trends in ambient mercury vapor, and to demonstrate protection of the environment and human health from releases of mercury at Y-12 to the atmosphere. Originally, four monitoring stations were operated at Y-12, including two within the former mercury- use area. The two atmospheric mercury monitoring stations currently operating at Y-12 are located near the east and west boundaries of the complex, respectively. Since their establishment in 1986, these stations have monitored mercury in ambient air continuously with the exception of short periods of downtime because of electrical or equipment outages.

At the two monitoring sites, airborne mercury vapor is collected by pulling ambient air through a sampling train consisting of a Teflon filter, a flow-limiting orifice, and an iodated charcoal-filled sampling trap. The average concentration of mercury vapor in the ambient air for each 7-day sampling period is calculated by dividing the total quantity of mercury collected on the charcoal by the total volume of air pulled through the charcoal trap.

Table 5.12.2.2-1 summarizes the 2007 mercury results and the results from the 1986 through 1988 period for comparison. Annual average mercury concentrations during 2007 at the Y-12 east and west boundary monitoring stations are comparable to reference levels measured on Chestnut Ridge in 1988 and 1989 and approach values reported for continental background (DOE 2008). These concentrations are well below current environmental and occupational health standards for inhalation exposure to mercury vapor; for example, the National Institute for Occupational Safety and Health recommended exposure limit of 50 μg/m$^3$ (time weighted average for an 8-hour workday), the American Conference of Governmental Industrial Hygienists workplace threshold limit value of 25 μg/m$^3$ (time-weighted average for an 8- hour workday and 40-hour work week), the Agency for Toxic Substances and Disease Registry minimal risk level for inhalation exposure (0.2 μg/m$^3$), and the current EPA reference concentration for elemental mercury for daily inhalation exposure without appreciable risk of harmful effects during a lifetime (0.3 μg/m$^3$). Table 5.12.2.2-2 presents the hazard quotients (HQ), the ratio of the estimated exposure (e.g., daily intake rate) to be expected to have no

adverse effects, calculated for each location and demonstrates that the measured concentrations are below (i.e., HQ < 1.0) both the threshold for continuous public and occupational exposure.

Although there would likely be some differences in the levels of mercury emissions among the alternatives, it is anticipated that these measured concentrations would continue to be consistently much lower than all applicable standards under any of the alternatives.

**Table 5.12.2.2-1. Summary Results for the Y-12 Mercury in Ambient Air Monitoring Program during 2004.**

| | Mercury Vapor Concentration (μg/m$^3$) | | | |
|---|---|---|---|---|
| **Ambient air monitoring stations** | **2007 Average** | **2007 Maximum** | **2007 Minimum** | **1986–1988[a] Average** |
| AAS2 (east end of Y-12) | 0.0036 | 0.0066 | 0.0010 | 0.010 |
| AAS8 (west end of Y-12) | 0.0057 | 0.0143 | 0.0017 | 0.033 |
| Reference Site, Rain Gauge No.2 (1988[b]) | N/A | N/A | N/A | 0.006 |
| Reference Site, Rain Gauge No.2 (1988[c]) | N/A | N/A | N/A | 0.005 |

Source: DOE 2008.
a – Period in late-80s with elevated ambient air Hg levels.
b – Data for period from February 9 through December 31, 1988.
c – Data for period from January 1 through October 31, 1989.

**Table 5.12.2.2-2. Y-12 Maximum Boundary Chemical Hazard Quotients for Mercury.**

| Location | Maximum Vapor Concentration (μg/m$^3$) | Inhalation RfD – Chronic (μg/m$^3$) | Hazard Quotient |
|---|---|---|---|
| AAS2 (east end of Y-12) | 0.0066 | 0.3 | 0.02 |
| AAS8 (west end of Y-12) | 0.0143 | 0.3 | 0.048 |

**Fluorides.** State of Tennessee regulation 1200-3-3-.01 does not define primary standards (affecting public health) for hydrogen fluoride. However, secondary standards (affecting public welfare, i.e., vegetation, aesthetics) are defined in 1200-3-3-.02 for gaseous fluorides expressed as hydrogen fluoride. In anticipation of the startup of the hydrogen fluoride system in EU Building during 2005, arrangements were made to monitor the community adjacent to Y-12 for the presence of fluorides. This monitoring capability, which began in November 2004, was added to the already existent Oak Ridge National Laboratory (ORNL) monitoring station used in NESHAP radionuclide monitoring for ORR.

Table 5.12.2.2-3 presents the annual maximum measured concentrations of HF in the Scarboro Community from the beginning of the monitoring program in November 2004 through 2007. The table also presents the regulatory secondary standard for the seven-day average (1.6 μg/m$^3$) and the hazard quotients calculated for the maximum concentrations. The hazard quotients demonstrate that the measured concentrations are below (i.e., Hazard Quotient <1.0) the thresholds for both continuous public and occupational exposures. It is anticipated that the measured concentrations would remain consistently low under any of the alternatives.

**Table 5.12.2.2-3. Annual Maximum HF Measured as Fluorides (7-day average) in the Scarboro Community, 2004 through 2007.**

| Year | Maximum Measured Concentration (µg/m$^3$) | Standard (µg/m$^3$) | Hazard Quotient |
|---|---|---|---|
| 2004 | 0.114[ab] | 1.6 | 0.053 |
| 2005 | 0.102[a] | 1.6 | 0.064 |
| 2006 | 0.048 [a] | 1.6 | 0.030 |
| 2007 | 0.048 [a] | 1.6 | 0.030 |

a – Source: ORR Annual Site Environmental Reports for 2004 (DOE 2005a), 2005 (DOE 2006c), 2006 (DOE 2007b), and 2007 (DOE 2008).
b – Monitoring began in November 2004. This result is based on a partial annual sampling cycle (8 weeks).

**Beryllium.** On September 16, 1996, Y-12 initiated a request to DOE to discontinue beryllium stack sampling on the basis that continuous sampling was not required for regulatory compliance at Y-12. The regulations required that the combined beryllium emissions for all beryllium sources be less than 10 grams over a 24-hour period. In addition, the regulations required that stack tests be conducted to determine emissions. This requirement was fulfilled for Y-12 in 1990 and 1991 when EPA Method 104 sampling, the regulatory required sampling, was conducted. Since that time and through 1996, beryllium stack sampling was conducted at Y-12 as a Best Management Practice (BMP). The BMP data indicated that combined emissions from monitored beryllium sources were less than one gram per year. With DOE concurrence, BMP sampling for the beryllium stacks was discontinued on October 1, 1996 (NNSA 2006b). A previous study of the potential human health effects of beryllium emissions from Y-12 showed that no adverse health impacts are associated with normal beryllium operations (DOE 2001a).

**Other Chemicals.** To evaluate the drinking water pathway, risk estimates for carcinogens (HQs) were estimated upstream and downstream of ORR discharge points. HQs were less than one for detected chemical analytes for which there are reference doses or maximum contaminant levels. Acceptable risk levels for carcinogens typically range from $10^{-4}$ to $10^{-6}$. Chemicals in water can be accumulated by aquatic organisms that may be consumed by humans. To evaluate the potential health effects from the fish consumption pathway, HQs were estimated for the consumption of non-carcinogens, and risk values were estimated for the consumption of carcinogens detected in sunfish and catfish collected both upstream and downstream of ORR discharge points. For consumption of sunfish and catfish, HQ values of less than one were calculated for all detected analytes except for Aroclor-1260 at all three locations. For carcinogens in sunfish and catfish, risk values greater than $10^{-5}$ were calculated for the intake of arsenic and Aroclor-1260 collected at all three locations. TDEC issued a fish advisory for East Tennessee (see Table 5.12.2.2-4) (TDEC 2006).

**Table 5.12.2.2-4. Current Fish Advisories.**

| Stream | County | Portion | Pollutant | Comments |
|---|---|---|---|---|
| **East Tennessee** | | | | |
| Boone Reservoir | Sullivan, Washington | Entirety (4,400 acres) | PCB's chlordane | Precautionary advisory for carp and catfish. |
| Chattanooga Creek | Hamilton | Mouth to GA line (11.9 miles) | PCBs, chlordane | Fish should not be eaten. Avoid contact with water also. |
| E. Fork of Poplar Creek, incl. Poplar Creek embayment | Anderson, Roane | Mouth to New Hope Pond (Mile 15.0) | Mercury, PCBs | Fish should not be eaten. Avoid contact with water also. |
| Fort Loudon Reservoir | Loudon, Knox, Blount | Entirety (14,600 acres) | PCBs | Commercial fishing for catfish prohibited by TWRA. Catfish, largemouth bass over two pounds, or any largemouth bass from the Little River embayment should not be eaten. Do not eat largemouth bass from the Little River embayment. |
| Melton Hill Resrvoir | Knox, Anderson | Entirety (5,690 acres) | PCBs | Catfish should not be eaten. |
| Nickajack Reservoir | Hamilton, Marion | Entirety (10,370 acres) | PCBs | Precautionary advisory for catfish. |
| N.Fork Holston River | Sullivan, Hawkins | Mile 0.0-6.2 | Mercury | Fish should not be eaten. Advisory goes to TN/VA line. |
| Tellico Reservoir | Loudon | Entirety (16,500 acres) | PCBs | Catfish should not be eaten. |
| Watts Bar Reservoir | Roaner, Meigs Rhea, Loudon | TN River portion (38,000 acres) | PCBs | Catfish, striped bass, and hybrid striped bass should not be eaten. Precautionary advisory for sauger, carp, smallmouth buffalo, white bass, and largemouth bass. |
| Watts Bar Reservoir | Roane, Anderson | Clinch River arm (1,000 acres) | PCBs | Striped bass should not be eaten. Precautionary advisory for catfish and sauger. |

Source: DOE 2008.

### 5.12.3 Worker Safety

The Y-12 worker non-fatal injury/illness rates for Federal, management and operating (M&O) contractor, site security, and subcontractor personnel were used to calculate the 4-year average (2005–2008) injury/illness rate per 100 workers (or 200,000 hours). These 4-year averages are expressed in terms of Total Recordable Cases (TRCs) and Days Away, Restricted or on Job Transfer (DART) (formerly Lost Workdays [LWDs]). At Y-12, from 2005 through 2008, there was an average of almost 116 TRCs and 3,571 DARTs each year (DOE 2009a). Dividing the TRCs each year by the total number hours worked and then multiplying by 200,000, the TRC

rate was obtained for each year and then the average TRC rate was derived for the 4-year period. The average TRC rate for Y-12 is 2.02; which means that 2.02 TRCs may be expected per 100 workers each year. Using a similar calculation for DARTs, the average DART rate for Y-12 from 2005 through 2008 is 63.18 per 100 workers each year.

The 4-year average injury/illness rate was used to calculate the total number of Y-12 worker non-fatal injury/illness per year, assuming the 4-year average rate would remain constant. Table 5.12.3-1 presents the recordable cases of injuries that would be expected for the entire Y-12 workforce under each of the alternatives during operations.

During the 4-year averaging period there were no fatalities at Y-12, although there was one fatality reported for Oak Ridge Operations, which includes Y-12 (DOE 2009a). So, while the calculated annual fatality rate per 100 workers at Y-12 is zero, the calculated rate for Oak Ridge Operations is 0.00035 fatalities per year per 100 workers. Because there is always the potential for a worker fatality, Table 5.12.3-1 shows less than one worker fatality per year.

**Table 5.12.3-1. Annual Calculated Nonfatal TRCs and DART for the Y-12 Workforce During Operations.**

| | No Action Alternative | UPF Alternative | Upgrade in-Place Alternative | Capability-sized UPF Alternative | No Net Production/ Capability-sized UPF Alternative |
|---|---|---|---|---|---|
| **Number of Workers** | 6,500 | 5,950 | 6,500 | 5,100 | 4,500 |
| **Total Recordable Cases** | 131 | 120 | 131 | 103 | 90 |
| **DART** | 4,107 | 3,759 | 4,107 | 3,222 | 2,843 |
| **Fatalities** | <1 | <1 | <1 | <1 | <1 |

During construction, the UPF would have the highest potential for occupational injuries due to the fact that the UPF would require the greatest construction workforce. The TRC rate for construction in the state of Tennessee during 2007 was 5.2 and the DART rate was 2.7 (BLS 2009). The worker fatality rate for construction in Tennessee during 2007 was 10.5 per 100,000 workers (BLS 2009a); that would be equivalent to 0.011 fatalities per 100 workers. Table 5.12.3-2 presents the TRC, DART, and worker fatality rates that would be expected based on statewide statistics during construction based on the largest applicable workforce for each alternative. It should be noted that the worker fatality record for Y-12 for construction is significantly better than for the state as a whole, given that there have been no construction-related fatalities during construction of the HEUMF.

**Table 5.12.3-2. Annual Calculated Nonfatal TRCs and DART for the Y-12 Construction Workforce.**

| | No Action Alternative | UPF Alternative | Upgrade in-Place Alternative | Capability-sized UPF Alternative | No Net Production/ Capability-sized UPF Alternative |
|---|---|---|---|---|---|
| **Number of Workers** [a] | 0 | 1,350 | 700 | 1,250 | 1,250 |
| **Total Recordable Cases** [b] | 0 | 70 | 37 | 65 | 65 |
| **DART** [b] | 0 | 34 | 19 | 34 | 34 |
| **Fatalities** [b] | 0 | 0.15 | 0.08 | 0.14 | 0.14 |

a – The number of construction workers for Alternatives 2-5 also includes the CCC construction workers.
b – TRC, DART, and fatalities rates for construction in the state of Tennessee in 2007 were 5.2, 2.7, and 0.011, respectively (BLS 2009, BLS 2009a)

### 5.12.4 Potential Mitigation Measures

Radioactive and chemical airborne emissions to the general population and onsite exposures to workers could be reduced by using improved technologies related to process and design improvements. Each of the alternatives addressed in this SWEIS would provide varying opportunities to implement this mitigation. Under the No Action Alternative, implementing these technologies would be pursued within the limitations of existing facilities and other infrastructure. Implementation of the Upgrade in-Place Alternative would provide an opportunity for NNSA to make changes to facilities and infrastructure to use the majority of the latest technology for process and design improvements but would be somewhat limited by the use of existing, albeit upgraded, facilities. The UPF, Capability-sized UPF, and No Net Production/Capability-sized UPF Alternatives would allow full implementation of the latest technology for process and design improvements.

### 5.12.5 Summary Comparison of Alternative Impacts for Health and Safety

Under all of the alternatives there would be no adverse impacts to Y-12 workers from exposure to mercury and impacts from beryllium would be minimized. Although there would likely be some differences in the levels of mercury emissions among the alternatives, it is anticipated that these measured concentrations would continue to be consistently much lower than all applicable standards under any of the alternatives and there would be no impacts to members of the public. Based on the demonstrated hazard quotients for HF (i.e., Hazard Quotient <1.0) it is anticipated that the measured concentrations would remain consistently low under any of the alternatives and there would be no adverse impacts to the public.

**No Action Alternative.** Radiological impacts to workers and the public would occur. All radiation doses from normal operations would be below regulatory standards with no statistically significant impact on the health and safety of workers or public. The MEI dose would be expected to be 0.15 mrem per year ($9.0\times10^{-8}$ LCFs). The population dose would be expected to be 25.8 person-rem per year (0.015 LCFs). The total worker dose would be expected to be 49 person-rem per year (0.03 LCFs). Worker safety impacts would likely continue at their

current rates, i.e., 131 TRCs, 4,107 DARTs, and significantly less than one fatality each year. There would be no worker safety impacts for new construction under the No Action Alternative.

**UPF Alternative.** MEI and Population dose would be same as No Action Alternative. There would be an expected reduction in radiological impacts to workers due to more efficient operations in a modern facility. The total worker dose would be expected to be 21.1 person-rem per year (0.013 LCFs). Worker safety impacts would be expected to be less than the No Action Alternative, i.e., 120 TRCs, 3,759 DARTs, and significantly less than one fatality per year. In addition, construction of the UPF and CCC would likely result in about 49 TRCs, 26 DARTs, and 0.105 fatalities during the peak year of construction.

**Upgrade in-Place Alternative.** Radiological and worker safety impacts would be about the same as the No Action Alternative. Construction under the Upgrade in-Place Alternative would result in about 16 TRCs, 8 DARTs, and 0.033 worker fatalities during the peak year of construction.

**Capability-sized UPF Alternative.** There would be an expected 50 percent reduction in radiological emissions, which would reduce MEI and population dose. The MEI dose would be expected to be 0.08 mrem per year ($5\times10^{-8}$ LCFs). The population dose would be expected to be 10 person-rem per year ($6.0 \times10^{-3}$ LCFs). The total worker dose would be expected to be 18.8 person-rem per year (0.01 LCFs). Worker safety impacts would be expected to be less than under either the No Action, UPF, or Upgrade in-Place Alternatives. Under the Capability-sized UPF Alternative, operations at Y-12 would be expected to result in about 103 TRCs, 3,222 DARTS, and significantly less than one worker fatality per year. Construction of the Capability-sized UPF and CCC would result in about 44 TRCs, 23 DARTs, and 0.093 worker fatalities during the peak year of construction.

**No Net Production/Capability-sized UPF Alternative.** There would be an expected 80 percent reduction in radiological emissions, which would reduce MEI and population dose. The MEI dose would be expected to be 0.0016 mrem per year ($1\times10^{-8}$ LCFs). The population dose would be expected to be 2 person-rem per year ($1.2 \times10^{-3}$ LCFs). The total worker dose would be expected to be 16.5 person-rem per year (0.009 LCFs). Operations under the No Net Production/Capability-sized UPF Alternative would be expected to result in lower worker safety impacts than any of the other alternatives. Operational worker safety impacts would be about 90 TRCs, 2,843 DARTs, and significantly less than one worker fatality per year. Worker safety impacts from construction of the No Net Production/Capability-sized UPF and CCC would be the same as the Capability-sized UPF Alternative.

## 5.13 WASTE MANAGEMENT

Waste streams currently generated at Y-12 may be broadly grouped to include: LLW, mixed-LLW (MLLW), hazardous waste, and sanitary/industrial (nonhazardous) waste. These waste streams would continue to be generated by implementation of each of the alternatives, however, quantities and relative proportions of the waste would vary by alternative. Wastes generated during routine operations are discussed for all the alternatives. Table 5.13-1 provides a comparison of the waste volumes anticipated to be generated by the alternatives during

construction and Table 5.13-2 provides a comparison of estimated Y-12 annual waste volumes during routine operations.

**Table 5.13-1. Summary of Annual Waste Generation during Construction at Y-12 by Alternative.**

| Waste Type | No Action | UPF | Upgrade in-Place | Capability-sized UPF | No Net Production/ Capability-sized UPF |
|---|---|---|---|---|---|
| **LLW Liquid (gal.)** | None | None | None | None | None |
| **LLW Solid ($yd^3$)** | None | 70 | None | 63 | 63 |
| **Mixed LLW Liquid (gal)** | None | None | None | None | None |
| **Mixed LLW Solid ($yd^3$)** | None | None | None | None | None |
| **Hazardous (tons)** | None | 4 | None | 3.6 | 3.6 |
| **Nonhazardous Sanitary (tons)** | None | 800 | 400 | 720 | 720 |

Source: Jackson 2008.

**Table 5.13-2. Summary of Annual Waste Generation during Routine Operations at Y-12 by Alternative.**

| Waste Type | No Action | UPF | Upgrade in-Place | Capability-sized UPF | No Net Production/ Capability-sized UPF |
|---|---|---|---|---|---|
| **LLW Liquid (gal)** | 713 | 476 | 713 | 428 | 403 |
| **LLW Solid ($yd^3$)** | 9,405 | 5,943 | 9,405 | 5,643 | 5,314 |
| **Mixed LLW Liquid (gal)** | 1,096 | 679 | 1,096 | 640 | 619 |
| **Mixed LLW Solid ($yd^3$)** | 126 | 81 | 126 | 76 | 71 |
| **Hazardous (tons)** | 12 | 12 | 12 | 7.2 | 7.2 |
| **Nonhazardous Sanitary (tons)** | 10,374 | 9,337 | 10,374 | 8,140 | 7,182 |

Source: Jackson 2008.

Some wastes generated by Y-12 activities are not specifically assessed in the analysis in this section. For example, as part of the environmental cleanup strategic planning, DOE and NNSA are developing an IFDP. The IFDP is a strategic plan for disposing of legacy materials and facilities at ORNL and Y-12 that uses an integrated approach. Under the IFDP, the D&D of approximately 112 facilities at ORNL and 19 facilities at Y-12, and the remediation of soil and groundwater contamination at Y-12, would occur over the next 30 to 40 years. Per agreement among DOE, the State of Tennessee and the EPA, D&D of facilities on ORR will be primarily addressed as removal actions through the CERCLA process because facilities are often contaminated and present a risk to human health and the environment. This agreement allows DOE and the regulators to prioritize D&D of these facilities based on the level of risk posed by the facility and available funding. Waste generated by D&D of these surplus facilities is addressed through the CERCLA process. CERCLA waste streams are included in a discussion of cumulative impacts in Chapter 6.

As discussed in Section 4.13.5, wastes containing residual radioactive materials below approved authorized limits are currently disposed of at the onsite sanitary/industrial landfill and construction/demolition landfills. Potential radiological impacts to onsite workers and offsite

members of the public must be evaluated during the development of such authorized limits per DOE Order 5400.5 and associated guidance. Requirements for the approval of authorized limits for any specified waste stream at these facilities include analyses demonstrating that: (1) the potential radiation dose to workers or the public would be as far below 25 mrem per year as reasonably achievable (and typically below 1 mrem per year); (2) groundwater would be protected in accordance with the Site Groundwater Protection Program and applicable Federal and state regulations (40 CFR Part 131.11 and Rules of the TDEC Chapter 1200-4-3); and (3) any future release of the landfill property would not be expected to require future remediation under DOE Order 5400.5 requirements. These requirements are designed to provide reasonable assurance that potential radiological impacts from residual radioactive materials below authorized limits at these facilities would be negligible.

Implementation of any alternative could result in the potential for future D&D impacts. The potential impacts from D&D are addressed in Section 5.16 of this SWEIS. D&D can range from performing a simple radiological survey to completely dismantling and removing a radioactively contaminated facility. The potential reuse of a facility or the outcome of its disposition must be known to predict waste volumes for its D&D, but could be conservatively bounded by a demolition scenario and discussed on a relative basis.

### 5.13.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, Y-12 would continue to generate and manage wastes, at levels similar to those in 2007 (see Table 5.13-1). MLLW and LLW in solid form are currently stored onsite pending treatment and storage. Disposal of radioactive waste generated at Y-12 has been restricted by either a lack of onsite facilities or by administrative barriers to approval of transporting and disposing of radioactive waste off site since onsite disposal ceased in the 1980s. As a result, significant quantities of LLW and MLLW have accumulated in storage at Y-12. Quantities of accumulated, legacy MLLW and LLW are being shipped off site for treatment and disposal because some approvals have been obtained to use existing DOE or licensed-commercial facilities. As of June 2005, the inventory of legacy LLW on ORR was about 7,455 cubic yards. Since the beginning of FY 2005, DOE has reduced its legacy LLW inventory by about 80 percent. During FY 2003, over 150 metric tons of depleted uranium-alloyed metal waste was shipped to the NTS for disposal. An additional 300 metric tons of depleted uranium was shipped during FY 2004 (NNSA 2005c). DOE must meet milestones to disposition MLLW as set forth in an ORR Site Treatment Plan for Mixed Waste as mandated by a State Commissioner's Order and to comply with the Federal Facilities Compliance Act (FFCA). Liquid LLW and MLLW are either treated on site and disposed of, or treated and subsequently managed as solids.

DOE issued a ROD covering treatment and disposal of MLLW and LLW (65 FR 10061, February 25, 2000) as one of a series of RODs for the Waste Management PEIS. In the ROD, DOE decided to continue minimum treatment of LLW generated at ORR onsite and dispose of the LLW at the NTS. For management of MLLW, DOE decided to treat the MLLW generated at ORR onsite and dispose of the mixed LLW at the NTS. Adverse impacts related to storage of legacy MLLW and LLW are expected to be reduced as the goals for legacy waste set forth under the Site Treatment Plan and the ROD are met.

No new adverse impacts to the environment are anticipated from the generation of hazardous and sanitary/industrial waste by continuing current operations at No Action levels. RCRA-permitted units for the storage and treatment of hazardous waste would continue to operate in support of routine operations at Y-12. Adequate permitted and approved offsite facilities are available to meet any additional treatment requirements and for disposal of the hazardous waste. Sanitary and process waste liquids would continue to be treated by the city of Oak Ridge sewage treatment plant or Y-12 treatment facilities. Current facilities have a combined capacity to handle approximately 10 times the waste volumes generated by current operations. The resultant solids would be disposed of with other nonhazardous waste in existing, permitted landfills with an adequate capacity to handle projected waste volumes. Landfill V, a sanitary/industrial landfill at Y-12, would continue to accept general refuse and asbestos, medical (non-infectious), and other special waste as approved on a case-by-case basis by the state regulatory authorities. Landfill VII is permitted for disposal of construction and demolition waste and has ample disposal capacity for well beyond the 10-year planning period.

### 5.13.2 Alternative 2 – Uranium Processing Facility Alternative

**Construction.** Under the UPF Alternative, waste generated during construction would be minimal with respect to the waste production of the entire Y-12. During the construction phase period, LLW would increase by a total of 70 cubic yards per year, which is less than 1 percent of the LLW currently generated annually at Y-12. There would be no increase in MLLW. Hazardous wastes would increase by approximately four tons or 34 percent per year during construction, but would not exceed waste disposal capabilities. Nonhazardous sanitary wastes would increase by approximately 800 tons, or about 7 percent, as a result of the additional construction workforce required for the UPF. Sanitary wastes would continue to be treated by the city of Oak Ridge sewage treatment plant or Y-12 treatment facilities. The current facilities have a combined capacity to handle approximately 10 times the waste volumes generated by current operations.

**Operation.** Under the UPF Alternative, waste generation would be reduced compared to the No Action Alternative operations, as shown in Table 5.13-2. This is due to the increased efficiency associated with UPF operations in a modern facility. Because employment would decrease by approximately 10 percent once the UPF becomes operational, nonhazardous sanitary wastes would be expected to decrease from 10,374 tons per year by approximately 10 percent to 9,337 tons per year.

### 5.13.3 Alternative 3 – Upgrade in-Place Alternative

Under this alternative, NNSA would upgrade the existing EU and other processing facilities to contemporary environmental, safety, and security standards to the extent possible within the limitations of the existing structures and without prolonged interruptions of manufacturing operations. NNSA would also construct the CCC. Compared to the No Action Alternative, no significant changes in waste quantities are expected from these upgrades, either during construction or operation, except for non-hazardous sanitary waste, which would increase by 400 tons per year during the construction phase.

### 5.13.4 Alternative 4 – Capability-sized UPF Alternative

**Construction.** The Capability-sized UPF Alternative, described in Section 3.2.4, would include construction and operation of a UPF and the CCC. The Capability-sized UPF would be about 10 percent smaller than the UPF described in Alternative 2. Therefore, for purposes of this SWEIS, waste generated during construction of the Capability-sized UPF would be expected to be about 10 percent less than the UPF in Alternative 2, as shown in Table 5.13-1.

**Operations.** During operation of the Capability-sized UPF and the CCC under this alternative, generation of LLW and MLLW would decrease compared to the No Action Alternative due to the reduction in operations. Annual volumes of solid LLW generation would be about 5,643 cubic yards, a decrease of 3,762 cubic yards from the No Action Alternative. Liquid LLW volumes would be about 285 gallons less each year. Generation of solid MLLW would decline by about 50 cubic yards and liquid mixed LLW would decline by about 456 gallons per year. Comparable decreases in other waste streams are also expected due to reduced operations and reduced employment under the Capability-Sized UPF Alternative.

### 5.13.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

**Construction.** Waste Generation during construction of the No Net Production/Capability-sized UPF and the CCC, would be the same as the Capability-sized UPF.

**Operations.** During operation of the No Net Production/Capability-sized UPF and the CCC LLW and MLLW would decrease compared to the No Action Alternative. Annual volumes of solid LLW would be about 5,314 cubic yards or 4,091 cubic yards less each year than the No Action Alternative. Liquid LLW volumes would be about 310 gallons less each year. Solid MLLW generation would be about 71 cubic yards, a decrease of 55 cubic yards. Liquid mixed LLW would decline by about 477 gallons per year. Comparable decreases in other waste streams are also expected due to reduced operations and reduced employment under the No Net Production/Capability-sized UPF Alternative.

### 5.13.6 Potential Mitigation Measures

Waste generation projects would not exceed waste treatment and disposal capacities for any alternative. To minimize wastes, Y-12 would continue to implement pollution prevention and waste minimization initiatives, as discussed in Section 4.13.6.

### 5.13.7 Summary Comparison of Alternative Impacts for Waste Management

**No Action Alternative.** Although the volume of any waste type generation may vary from year to year, it is estimated for purposes of this SWEIS that future waste generation at Y-12 under the No Action Alternative would continue to approximate the 2007 baseline displayed in Table 5.13-1.

**UPF Alternative.** Under the UPF Alternative, during construction of the UPF and CCC there would be modest increases in annual generation of solid LLW (70 cubic yards), hazardous waste

(4 tons), and nonhazardous sanitary waste (800 tons). Once the UPF became operational nonhazardous sanitary waste generation at Y-12 would be somewhat lower than under No Action. Generation of all other waste types would also be less than No Action.

**Upgrade in-Place Alternative.** During construction, under the Upgrade in-Place Alternative, only nonhazardous sanitary waste generation would increase by about 400 tons. Generation of all categories of waste would be the same as the No Action Alternative once the upgraded facilities become operational.

**Capability–sized UPF Alternative.** Construction of the Capability-sized UPF would cause a slightly smaller increase than the UPF Alternative in the generation at Y-12 of solid LLW (63 cubic yards), hazardous waste (3.6 tons), and nonhazardous sanitary waste (720 tons). Operation of the Capability-sized UPF would result in total Y-12 waste volumes being substantially less than under the No Action Alternative i.e., solid LLW 5,643 cubic yards, liquid LLW 428 gallons, solid mixed LLW 76 cubic yards, liquid mixed LLW 640 gallons, hazardous waste 7.2 tons, and nonhazardous sanitary waste 8,140 tons.

**No Net Production/Capability-sized UPF Alternative.** Under this alternative, generation of waste during construction would be the same as the Capability-sized UPF Alternative. Waste generation at Y-12 would be slightly less for the No Net Production/Capability-sized UPF during operations than for the Capability-sized UPF i.e., solid LLW 5,314 cubic yards, liquid LLW 403 gallons, solid mixed LLW 71 cubic yards, liquid mixed LLW 619 gallons, hazardous waste 7.2 tons, and nonhazardous sanitary waste 7,182 tons.

## 5.14 ACCIDENTS

NEPA requires that an agency evaluate reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement. This section of the SWEIS informs the decision maker and the public about the chances that reasonably foreseeable accidents associated with the proposed action and alternatives could occur, and their potential adverse consequences. An accident is considered bounding if no reasonably foreseeable accident can be found with greater consequences. An accident is reasonably foreseeable if the analysis of occurrence is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason (40 CFR Part 1502.22[b][4]).

This section presents the potential impacts on workers (both involved and noninvolved) and the public due to potential accidents associated with operation of Y-12. Additional details supporting the information presented here are provided in Appendix D.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictates the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.
- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.
- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Natural phenomena can cause accidents to, and within, facilities and compound the progression of an accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the adverse effects of the accident because of their proximity. The non-involved workers and the offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, NNSA predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury.

Most of the accidents analyzed in this SWEIS do not vary by alternative because the same facilities are potentially involved in the accidents and subsequent consequences; therefore, this SWEIS presents first the accident analysis that pertains to all the alternatives. A section is also included which discusses the consideration of accidents unique to the other alternatives compared to the No Action Alternative.

## 5.14.1 Radiological Accident Scenarios

### 5.14.1.1 *Methodology*

**Selection Process.** The selection process for radiological accident scenarios used a multistep screening process to identify bounding events. For accidents associated with specific Y-12 facilities, the screening process began with a review of all Y-12 facilities with emphasis on building hazard classification, radionuclide inventories, including type, quantity, and physical form, and storage and use conditions.

For each of these facilities, the next step was to identify the most current documentation describing and quantifying the risks associated with its operation. Current safety documentation was obtained for all of these facilities. From these documents, the next step was to identify

potential accident scenarios and source terms (release rates and frequencies) associated with those facilities. Table D.9.3-1 in Appendix D lists the results of this process and serves as the basis for the subsequent consequence analysis described below.

**Consequence Analysis.** Consequences of accidental radiological releases were determined using the MELCOR Accident Consequence Code Systems 2 (MACCS2) computer code (Chanin and Young 1998). MACCS2 is a DOE/Nuclear Regulatory Commission (NRC)-sponsored computer code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and in support of safety and NEPA documentation for facilities throughout the DOE complex. The MACCS2 computer code includes as part of the analysis groundshine and food pathway exposures.

Because of assumptions used in this SWEIS analysis, not all of the code's capabilities were used. It was conservatively assumed that no special actions would be taken to avoid or mitigate exposure to the general population following an accidental release of radionuclides. For example, there would be no evacuation or protection of the surrounding population nor would there be interdiction to prevent ingestion of food grown downwind of the release. Another conservative assumption was that wet and dry depositions of all radioactive material were set to zero for individual receptors (maximally exposed individual and non-involved worker). These receptors are exposed for the duration of the release; suppressing deposition increases inhalation dose (increasing negative health effects) by keeping the radioactive material airborne (rather than depleting the plume by deposition) and available for inhalation.

NNSA estimated radiological impacts to three receptors: (1) the maximally exposed individual at the Y-12 boundary, (2) a non-involved worker approximately 3,300 feet from the accident location, and (3) the offsite population within 50 miles of Y-12. Because all alternatives would perform similar operations, bounding results are presented for all alternatives. Section 5.14.3 discusses qualitative differences among the alternatives.

DOE "Recommendations for Analyzing Accidents Under the National Environmental Policy Act," July 2002 (DOE 2002a), states that "it would be appropriate to estimate and present accident consequences for both median conditions and unfavorable conditions." Because of the lack of specific design information for new facilities, this SWEIS uses a conservative approach and presents impacts for the unfavorable conditions. Additional analysis of median conditions would not have produced meaningful information to help make decisions based on this SWEIS.

**Results.** The accident with the highest potential consequences to the offsite population (see Table 5.14.1-1) is the aircraft crash into the EU facilities (HEUMF and UPF). Approximately 0.4 LCFs in the offsite population could result from such an accident in the absence of mitigation. An offsite MEI would receive a maximum dose of 0.3 rem. Statistically, this MEI would have a $2 \times 10^{-4}$ chance of developing an LCF, or about 1 in 5,000. This accident has a probability of occurring approximately once every 100,000 years. When probabilities are taken into account (see Table 5.14.1-2), the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be $4.4 \times 10^{-7}$, or about 1 in 2 million. For the population, the LCF risk would be $4.0 \times 10^{-4}$, or about 1 in 2,500.

**Table 5.14.1-1. Radiological Accident Frequency and Consequences: All Alternatives.**

| Accident | | Maximally Exposed Individual [a] | | Offsite Population [b] | | Noninvolved Worker [c] | |
|---|---|---|---|---|---|---|---|
| | Frequency (per year) | Dose (rem) | Latent Cancer Fatalities[d] | Dose (Person-rem) | Latent Cancer Fatalities[d] | Dose (rem) | Latent Cancer Fatalities[d] |
| Major fire | $10^{-4}$ – $10^{-6}$ | 0.59 | 0.00036 | 520 | 0.31 | 16.3 | 0.0098 |
| Explosion | $10^{-4}$ – $10^{-6}$ | 0.058 | 0.000035 | 51.2 | 0.031 | 1.18 | 0.00071 |
| Fire in EU Warehouse | $10^{-4}$ – $10^{-6}$ | 0.69 | 0.00041 | 608 | 0.36 | 17.4 | 0.010 |
| Design-basis fires for HEU Storage [e] | $10^{-2}$ – $10^{-4}$ | 0.073 | 0.000044 | 66.1 | 0.04 | 1.08 | 0.00065 |
| Aircraft crash | $10^{-4}$ – $10^{-6}$ | 0.3 | 0.0002 | 665 | 0.4 | 0.39 | 0.00023 |

Source: Tetra Tech 2008.
a – At site boundary, approximately 1.3 miles from release.
b – Based on a projected future population (year 2030) of approximately 1,548,207 persons residing within 50 miles of Y-12 location.
c – At approximately 3,300 feet from release.
d – The conversion factor used for dose to latent cancer fatalities is 0.0006; any discrepancies are due to rounding.
e – The accident analysis includes accidents for all major facilities/operations at Y-12. Impacts are addressed for UPF, HEUMF, EU processing facilities, and other facilities (see Appendix D (Section D.9.3). A design basis fire in EU facilities (including the UPF) is included in Table D.9.3-1. However, the source term for this accident is less than that of the HEU Storage Facility, which is presented in the table above.
Note 1: On March 15, 2010, NNSA received a letter from the Defense Nuclear Facilities Safety Board (DNFSB) regarding seismic issues related to the design of the UPF (see Section 3.2.2.1.1), as well as one comment regarding potential internal blast effects. The UPF is currently in the preliminary design process and more detailed design activities would occur following the Y-12 SWEIS ROD. NNSA will consider the DNFSB comments regarding internal blast effects in the UPF design process and will work with DNFSB to ensure this issue is appropriately addressed. NNSA's goal is to eliminate potential internal explosions in the UPF design process. The impacts of accidents presented in Table 5.14.1-1 would bound any potential impacts from explosions and internal blast effects that cannot be eliminated through the design process.

**Table 5.14.1-2. Annual Cancer Risks: All Alternatives.**

| Accident | Maximally Exposed Individual [a] | Offsite Population[b] | Noninvolved Worker [c] |
|---|---|---|---|
| Major fire | $3.6 \times 10^{-8}$ | $3.1 \times 10^{-5}$ | $9.8 \times 10^{-7}$ |
| Explosion | $3.5 \times 10^{-9}$ | $3.1 \times 10^{-6}$ | $7.1 \times 10^{-8}$ |
| Fire in EU Warehouse | $4.1 \times 10^{-8}$ | $3.6 \times 10^{-5}$ | $1.0 \times 10^{-6}$ |
| Design-basis fires for HEU Storage [d] | $4.4 \times 10^{-7}$ | $4.0 \times 10^{-4}$ | $6.5 \times 10^{-6}$ |
| Aircraft crash | $2.0 \times 10^{-8}$ | $4.0 \times 10^{-5}$ | $2.3 \times 10^{-8}$ |

Source: Tetra Tech 2008.
a – At site boundary, approximately 1.3 miles from release.
b – Based on a projected future population (year 2030) of approximately 1,548,207 persons residing within 50 miles of Y-12 location.
c – At approximately 3,300 feet from release.
d – The accident analysis includes accidents for all major facilities/operations at Y-12. Impacts are addressed for UPF, HEUMF, EU processing facilities, and other facilities (see Appendix D (Section D.9.3). A design basis fire in EU facilities (including the UPF) is included; however, the source term for this accident is less than that of the HEU Storage Facility, which is presented in the table above.

### 5.14.2 Chemical Accident Scenarios

Under all alternatives, Y-12 would store and use a variety of hazardous chemicals. The quantities of chemicals vary, ranging from small amounts in individual laboratories to bulk amounts in processes and specially designed storage areas. In addition, the effects of chemical exposure on personnel would depend upon its characteristics and could range from minor to fatal. Minor accidents within a laboratory room, such as a spill, could result in injury to workers in the immediate vicinity. A catastrophic accident such as a large uncontrolled fire, explosion, earthquake, or aircraft crash could have the potential for more serious impacts to workers and the public.

The adverse effects of exposure vary greatly among chemicals. They range from physical discomfort and skin irritation to respiratory tract tissue damage and, at the extreme, death. For this reason, allowable exposure levels differ from substance to substance. For this analysis, Emergency Response Planning Guideline (ERPG) values are used to develop hazard indices for chemical exposures. ERPG definitions are provided below.

**ERPG DEFINITIONS**

***ERPG-1*** *is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.*

***ERPG-2*** *is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.*

***ERPG-3*** *is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.*

As required by DOE Order 151.1B, NNSA estimated the impacts of the potential releases of the most hazardous chemicals used at Y-12. Potential chemical accidents used in this SWEIS were obtained from review of the Y-12 chemical accident scenarios reported in previous NEPA documents. A chemical's vapor pressure, acceptable concentration (ERPG-2), and quantity available for release are factors used to rank a chemical's hazard. Determination of a chemical's hazardous ranking takes into account quantities available for release, protective concentration limits (ERPG-2) and evaporation rate. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch in depth in the area around the point of release. The chemical analyzed for release was nitric acid.

DOE "Recommendations for Analyzing Accidents Under the National Environmental Policy Act," July 2002 (DOE 2002a), states that "it would be appropriate to estimate and present accident consequences for both median conditions and unfavorable conditions." Because of the lack of specific design information for new facilities, this SWEIS uses a conservative approach and presents impacts for the unfavorable conditions. Additional analysis of median conditions would not have produced meaningful information to help make decisions based on this SWEIS.

Both Gaussian Plume and Aerial Locations of Hazardous Atmospheres (ALOHA) methodologies were used to evaluate the potential consequences associated with a release of each chemical in an accident situation. Table 5.14.2-1 shows the consequences of the dominant loss of containment accident scenario. The impacts of a nitric acid release are measured in terms of ERPG-2 protective concentration limits given in ppm. The distances at which the limit is reached are also provided for the ERPG-2 limit. The concentration of the chemical at approximately 3,300 feet from the accident is shown for comparison with the concentration limit for ERPG-2. The distance to the site boundary and the concentration at the site boundary are also shown for comparison with the ERPG-2 concentration limits and for determining if the limits are exceeded offsite. Conservative modeling of a chemical release over the period of one-hour was developed based on accident analysis used for the Complex Transformation SPEIS. This model was based on a spill and a subsequent pool with evaporation and the resulting down-wind concentrations calculated.

**Table 5.14.2-1. Chemical Accident Frequency and Consequences: All Alternatives.**

| Chemical Released | Quantity Released (lbs) | ERPG-2 | | Concentration | | Frequency |
|---|---|---|---|---|---|---|
| | | Limit (ppm) | Distance to Limit (ft) | At 3,300 ft (ppm) | At Site Boundary (ppm) [a] | |
| Nitric acid | 23,148 | 6 | 919 | 0.5 | 0.01 | $10^{-4}$ |

Source: Tetra Tech 2008.
a – Site boundary is at a distance of approximately 1.3 miles.

### 5.14.3 Accidents for the UPF Alternative, Upgrade in-Place Alternative, Capability-sized UPF Alternative and No Net Production/Capability-sized UPF Alternative Compared to the No Action Alternative

The UPF Alternative would decrease the overall Y-12 facility accident risks presented above. This is because many of the operations and materials in the existing Y-12 nuclear facilities would be consolidated into the UPF, reducing the accident risks associated with those older facilities. However, detailed design descriptions for the UPF are not available. Without these detailed descriptions, this reduction in accident risks cannot be quantified. New facilities such as the UPF would be constructed to current building design standards and would be designed and built to withstand higher seismic accelerations and thus would be more resistant to earthquake damage. These new facilities would experience damage from earthquakes and other external initiators less frequently. Also, controls would be incorporated into the design of new Y-12 facilities to reduce the frequency and consequence of internally initiated accidents. Therefore, the risks presented above for the current Y-12 facilities (both individually and additive) would be bounding for the UPF.

Under the Upgrade in-Place Alternative, the overall Y-12 facility accident risks would also decrease. This is because the existing enriched uranium and nonnuclear processing facilities would be upgraded to contemporary environmental, safety, and security standards to the extent possible. The upgrade projects would include upgrade of a number of building structures to comply with current natural phenomena criteria. Existing fire protection systems for many of the enriched uranium facilities would also be replaced. All of these actions would have the effect of reducing the frequency and consequences of the accident scenarios presented above.

Under the Capability-sized UPF, and No Net Production/Capability-sized UPF Alternatives, the discussion pertaining to the UPF Alternative would also be applicable. In addition, operations of some Y-12 facilities would be reduced under these two alternatives. As a result, accident consequences and risks associated with some operations could decrease. However, since facilities would not be de-inventoried (i.e., the amount of material present in the facilities might not change), many of the accidents and their consequences would still be valid under reduced operations.

### 5.14.4 Malevolent, Terrorist, or Intentional Destructive Acts

NNSA has prepared a classified appendix to this SWEIS that evaluates the potential impacts of malevolent, terrorist, or intentional destructive acts. Substantive details of terrorist attack scenarios, security countermeasures, and potential impacts are not released to the public because

disclosure of this information could be exploited by terrorists to plan attacks. Appendix E (Section E.2.14) discusses the methodology used to evaluate potential impacts associated with a terrorist threat and the methodology by which NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems. As discussed in that section, NNSA's strategy for the mitigation of environmental impacts resulting from extreme events, including intentional destructive acts, has three distinct components: (1) prevent or deter 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.

Depending on the intentional destructive acts, impacts would be similar to or exceed the impacts of accidents analyzed in the SWEIS. These analyses provide NNSA with information upon which to base, in part, decisions regarding transformation of the Complex. The classified appendix evaluates several scenarios involving intentional destructive acts for alternatives at Y-12 and calculates consequences to the noninvolved worker, MEI, and population in terms of physical injuries, radiation doses, and LCFs. Although the results of the analyses cannot be disclosed, the following general conclusion can be drawn: the potential consequences of intentional destructive acts are highly dependent upon distance to the site boundary and size of the surrounding population, the closer and higher the surrounding population, the higher the consequences. In addition, it is generally easier and more cost-effective to protect new facilities, as new security features can be incorporated into their design. In other words, protection forces needed to defend new facilities may be smaller due to the inherent security features of a new facility. New facilities can, as a result of design features, better prevent attacks and reduce the impacts of attacks.

### 5.14.5 Summary Comparison of Alternative Impacts Facility Accidents

**No Action Alternative.** For consequences, the bounding accident is an aircraft crash into the EU facilities. Approximately 0.4 LCFs in the offsite population could result from such an accident. The MEI dose from such an accident would be expected to be 0.3 rem. The MEI LCF risk would be expected to be a $2 \times 10^{-4}$ chance of developing a LCF, or about 1 in 5,000. When probabilities are taken into consideration, the accident with the highest risk is the design-basis fire for HEU storage. For this accident, the maximum LCF risk to the MEI would be expected to be $4.4 \times 10^{-7}$, or about 1 in 2 million. For the population, the LCF risk would be $3.97 \times 10^{-4}$, or about 1 in 2,500.

**UPF Alternative.** No greater impacts than the No Action Alternative would be expected. Accident risks would likely decrease compared to the No Action Alternative, because many of the operations and materials in the existing Y-12 nuclear facilities would be consolidated into the UPF. This consolidation would reduce the accident risks associated with these older facilities.

**Upgrade in-Place Alternative.** No greater impacts than the No Action Alternative would be expected. Accident risks would likely decrease compared to the No Action Alternative because the existing EU facilities would be upgraded to contemporary environmental, safety, and security standards, to the extent possible.

**Capability-sized UPF Alternative and No Net Production/Capability-sized UPF Alternative.** No greater impacts than the No Action Alternative would be expected. Because facilities would not be de-inventoried (i.e., the amount of material present in the facilities might not change), many of the accidents and their consequences for the No Action Alternative would still be valid.

## 5.15 ENVIRONMENTAL IMPACTS OF CONTINUED RECEIPT AND TRANSPORTATION OF NUCLEAR MATERIALS IN SUPPORT OF GLOBAL THREAT REDUCTION INITIATIVES

As described in Section 2.1.2.2 under the "Global Threat Reduction Initiative," Y-12 is expected to continue to receive nuclear material from both foreign and domestic sources and to provide safe and secure storage for such material. Such a mission is independent of the alternatives in this SWEIS (i.e., under all alternatives, Y-12 would continue to receive and store nuclear materials). This section describes the basic environmental impacts that are expected from continuing this receipt and storage mission. The continued mission to receive and store nuclear materials requires a certain amount of flexibility. Although the GTRI program has a list of possible future shipments, it is not possible to know with any degree of certainty: (1) the locations from where all future nuclear materials would come; (2) the exact quantities of future nuclear materials; and (3) the specific radionuclides of the future nuclear materials. Because of these uncertainties, the environmental analysis in this section summarizes the information in recent relevant environmental analyses to provide an environmental baseline of continuing this mission. In the future, prior to the receipt and storage of any new nuclear materials, proposals would be compared against this baseline to determine whether additional NEPA documentation would be required or to provide an indication of what level document may need to be prepared.

DOE/NNSA has prepared many NEPA documents, some of which are classified, related to the transportation and storage of nuclear materials at Y-12. These documents include the following:

1. *Environmental Assessment for the Interim Storage of Highly Enriched Uranium at the Y-12 Plant, Oak Ridge, Tennessee Acquired from Kazakhstan by the United States and Finding of No Significant Impact* (FONSI) (also known as the *Project Sapphire Environmental Assessment* (EA) (DOE/EA-1006, May 1995) (DOE 1995), which assessed transporting a large quantity of enriched uranium (1,245 pounds) from the Republic of Kazakhstan to the United States for interim storage and processing to low enriched uranium for use as commercial nuclear fuel.

2. *Environmental Assessment for the Transportation of Highly Enriched Uranium from the Russian Federation to the Y-12 National Security Complex and Finding of No Significant Impact* (DOE/EA-1471, January 2004) (DOE 2004d). DOE/NNSA prepared this EA to evaluate the environmental impacts of transporting HEU from Russia to Y-12 for safe, secure storage. The amount of HEU to be transferred under the proposed action would be, on average, approximately 366 pounds per year over a period of 10 years. The HEU would eventually be sent to a facility in Lynchburg, Virginia, where it would be fabricated into reactor fuel. The analysis in the EA shows that the proposed transfer of HEU from Russia to the United States entails little or no risk to the quality of the environment or to human health. A FONSI confirmed this conclusion.

3. *Environmental Assessment for the Transportation of Unirradiated Uranium in Research Reactor Fuel from Argentina, Belgium, Japan and the Republic of Korea to the Y-12 National Security Complex* (DOE/EA-1529, June 2005) (DOE 2005h). DOE/NNSA prepared this EA to evaluate the environmental impacts of transporting uranium from various foreign countries to Y-12 for safe, secure storage. The uranium would eventually be sent to a facility in Lynchburg, Virginia, where it would be fabricated into reactor fuel. The analysis in the EA shows that the proposed transfer of uranium from the various foreign countries to the United States entails little or no risk to the quality of the environment or to human health. A FONSI confirmed this conclusion.

In reviewing these and other relevant documents, the following general conclusions can be supported:

The potential environmental impacts associated with the transportation of nuclear materials over the global commons (i.e., oceans) can be accomplished in specific cases with the appropriate safety and security measures without causing significant adverse impacts. However, two types of impacts can occur: nonradiological and radiological. Nonradiological impacts associated with such transportation are insignificant when compared to the normal transportation of all other goods across the global commons. Radiological impacts associated with such transportation generally involve small doses to aircraft (or ship's crew for surface transport), which are well below any regulatory standards. For example, the *Project Sapphire EA*, which assessed the transportation of a relatively large amount of enriched uranium (1,245 pounds) compared to the other NEPA documents identified above, concluded that a collective dose of 0.34 person-rem would result to 30 crew. Statistically, this would result in an associated latent cancer fatality probability of $1.4 \times 10^{-4}$, which would not be significant since not a single crew member would be expected to die from a latent cancer (DOE 1995).

Potential impacts from accidents are also possible. As documented in the *Project Sapphire EA*, in-flight accidents would have a higher probability of container breach than landing/stall accidents. Further, for the global commons, only in-flight accidents probabilities are applicable because no landings would occur in the commons. The bounding accident scenario assumes the containers would breech and the enriched uranium would be released. Depending upon the specific body of water, the volume of water and the well-mixed conditions in the shallow sea would likely disperse the uranium such that effects would be localized and short-term, although there may be some fatalities to marine species in the localized area of the accident (DOE 1995).

In an accident scenario, only the crew and the global commons would be affected. There would be no exposure to the public. The *Project Sapphire EA* examines an accident scenario for a large quantity (1,245 pounds) of enriched uranium. For Project Sapphire, the probability of the accident occurring in-flight was estimated to be $6.7 \times 10^{-10}$. This is a bounding conservative probability (overestimation) based on a severe case accident where the impact forces exceed standards and fire engulfs the plane for more than 30 minutes causing 70 percent of the packages to fail. The *Project Sapphire EA* FONSI concludes there may be some loss of life to marine organisms directly exposed to the enriched uranium in this hypothetical bounding case scenario. However, as a result of the large volumes of water, the mixing mechanisms within it, the existing background concentrations of uranium, the radiation-resistance of aquatic organisms, and the

radiological and toxicological impact of a very low probability accident would be localized and of short duration (DOE 1995).

## 5.16 DECONTAMINATION AND DECOMMISSIONING IMPACTS

Eventually, any facility used for EU operations would be subject to the process of D&D. Depending upon the decisions made as a result of this SWEIS, D&D could be required for the UPF, the Capability-sized UPF, the No Net Production/Capability-sized UPF, for EU facilities replaced by the UPF, or for existing and/or upgraded EU facilities. The primary D&D goal would be to decontaminate any facility to the extent that its residual radioactivity would be at an acceptable level. The facility decontamination would be conducted in accordance with all applicable regulations and requirements and in a manner which would minimize potential impacts to the health and safety of workers, the general public, and the environment. The facility decontamination would be executed in accordance with the decommissioning plan prepared by the facility operator (a DOE contractor) and approved by DOE.

Under the Y-12 modernization program, over 1.3 million square feet of floor space in non-process contaminated facilities has already been demolished. Future D&D activities specific to Y-12 are included in the IFDP Program (see Section 3.3).

Prior to the initiation of D&D activities, the facility operator would have to prepare a detailed D&D plan. The D&D plan would contain a detailed description of the site-specific D&D activities to be performed and would be sufficient to allow an independent reviewer to assess the appropriateness of the decommissioning activities; the potential impacts on the health and safety of workers, the public, and the environment; and the adequacy of the actions to protect health and safety and the environment. All buildings and systems would require regulatory planning, document preparation, and characterization and deactivation before any D&D activities would be allowed to commence. Facilities would be characterized to identify waste types (e.g., radiological and chemical waste), construction material types (e.g., steel, roofing, concrete, etc.), presence of equipment, levels of contamination, expected waste volumes, and other information that will be used to support safe demolition and clarify requirements for developing facility-specific plans. Active systems (e.g., electric, steam, water, gas, telecom) would be identified and deactivated, as appropriate. Adaptive reuse of such infrastructure would be considered and recyclable materials would be sorted and managed separately, to the extent practicable (YSO 2007a).

The IFDP is planning to start CD-2 approval and budget to initiate the D&D process within the next three to five years, although some D&D has been accelerated through the use of funding from the American Recovery and Reinvestment Act of 2009. CD-1 documentation was completed in June 2008 and approved in November 2008. Because the entire ORR has already been determined to be a Superfund Site, the D&D of heavily contaminated facilities at Y-12 will be performed under the provisions of CERCLA and the Federal Facility Agreement (FFA) among EPA, DOE and the State of Tennessee. The CERCLA process will require extensive documentation, approvals by EPA and the TDEC and will assure NEPA values are addressed in the design process. A significant advantage of performing the D&D activities under the terms of CERCLA would be the maximum use of an onsite CERCLA disposal cell, greatly reducing

transportation costs and risk. Milestones for the proposed IFDP implementation would be subject to agreement among EPA, DOE and TDEC and would then be added to the existing ORR FFA (YSO 2007a).

Although IFDP D&D activities are expected to commence within the next three to five years, the major IFDP D&D activities would not take place for many years (e.g., most likely any D&D activities associated with the action alternatives in this SWEIS would not take place prior to approximately 2018). As such, the major D&D activities are to be resolved under the provisions of CERCLA and are beyond the planning basis for this SWEIS. This SWEIS includes the following qualitative assessment of the D&D impacts that might result from each of the SWEIS alternatives.

### 5.16.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, the UPF would not be constructed, and existing EU facilities would continue to be operated. At the end-of-life (EOL) for these facilities (assumed to be 50 years from now), the existing facilities would undergo D&D. Because the operations in those facilities involve mainly EU, potential residual contamination could include:

- Surface contamination on equipment, walls, ceilings, roof, floors, sinks, laboratory hoods, air ventilation ducts, etc;
- Solid and liquid contaminated waste from normal operations and off-normal and accident events; and
- Land contamination from normal and off-normal operations and accident events.

It is expected that most surface contamination would be easily removed and reduced to acceptable levels. Any wastes from such decontamination would be classified, in accordance with the *Low-Level Radioactive Waste Policy Act Amendments Act* of 1985 (42 U.S.C. 2021b), as LLW, since they would not be high level waste, spent nuclear fuel, or byproduct material as defined by the *Atomic Energy Act* of 1954.

The extent and amount of D&D associated with the No Action Alternative cannot be estimated without a detailed assessment of the facilities, which would not be conducted until the EOL is reached. However, this SWEIS acknowledges that the No Action Alternative could involve D&D of approximately 633,000 square feet of EU facilities once those facilities reach EOL. Additionally, approximately 50,000-80,000 square feet of facilities could become excess if the CCC were constructed. Such D&D would likely generate large quantities of low-level waste and non-radioactive waste. The LLW would be disposed at NTS, Envirocare of Utah, Environmental Management Waste Management Facility, or other appropriate permitted disposal facility, while non-radioactive waste would likely be disposed of at landfills within ORR.

D&D activities would also cause health and safety impacts to workers (occupational and radiological), as well as potential health impacts to the public through the release of radiological materials. While D&D activities would also produce socioeconomic impacts, it would be speculative to quantify the number of jobs that would be created; however, it is noted that D&D activities at the East Tennessee Technology Park and other DOE sites have created a significant

number of jobs relative to the number of operational jobs that were lost when a facility ceased operations.

### 5.16.2 Alternative 2 – Uranium Processing Facility Alternative

D&D actions associated with the UPF would be the same as discussed under the No Action Alternative (except such D&D would likely occur in the 2018 timeframe, after EU operations would begin in the UPF), but would also include the eventual D&D of the UPF in approximately 50 years. As such, this alternative would involve D&D of more than 1 million square feet (633,000 square feet of existing EU facilities and 388,000 square feet of the UPF). The types of impacts that would occur for this alternative would be expected to be similar to the impacts described for the No Action Alternative.

### 5.16.3 Alternative 3 – Upgrade in-Place Alternative

The Upgrade in-Place Alternative would involve essentially the same D&D actions as discussed under the No Action Alternative. The types and magnitudes of impacts that would occur for this alternative would be expected to be similar to the impacts described for the No Action Alternative.

### 5.16.4 Alternative 4 – Capability-sized UPF Alternative

The Capability-sized UPF Alternative would involve essentially the same D&D actions as discussed under Alternative 2, UPF Alternative. The types and magnitudes of impacts that would occur for this alternative would be expected to be similar to the impacts described for that alternative.

### 5.16.5 Alternative 5 – No Net Production/Capability-sized UPF Alternative

The No Net Production/Capability-sized UPF Alternative would involve essentially the same D&D actions as discussed under Alternative 2, UPF Alternative. The types and magnitudes of impacts that would occur for this alternative would be expected to be similar to the impacts described for that alternative.

## 5.17 SENSITIVITY ANALYSIS OF ALTERNATIVES 1 AND 3 AT SMALLER OPERATIONAL LEVELS

The environmental impact analysis of Alternatives 1-3 is based upon an operational level that would support approximately 125 secondaries and cases per year. Because the impacts of new production bound those associated with other types of operations that could be supported (e.g., life extension programs, processing uranium materials and parts, dismantling nuclear weapons secondaries and cases, and providing special production support to NNSA weapons laboratories and to other NNSA programs), the analysis also covers these operations. NNSA has also evaluated the environmental impacts associated with a smaller UPF that would support smaller operational levels: Alternative 4 would support approximately 80 secondaries and cases per year and Alternative 5 would support approximately 10 secondaries and cases per year. The purpose

of this section is to provide an assessment of Alternative 1 (No Action Alternative) and Alternative 3 (Upgrade in-Place Alternative) in supporting an operational level of approximately 80 secondaries and cases per year. As discussed below, the potential impacts associated with both construction and operation are addressed.

In order to prepare this analysis, NNSA utilized information for the UPF capacity alternatives to determine the percentage by which key operational parameters (i.e., utility usage, operations personnel, waste quantities, etc.) would decrease when the operational level is decreased. Although these data were associated with UPF operations, they provide the best estimate of how key operational parameters would decrease when only the operational level decreases. NNSA applied the percentage of change to the values associated with the No Action Alternative and Upgrade in-Place Alternative to determine the values used in the analysis below (see Table 1.4.6-1 for these values). While NNSA acknowledges that there could be differences that are not quantified, the analysis below has been prepared using the best information available, and provides a reasonable analysis of the No Action Alternative and Upgrade in-Place Alternative for supporting a reduced operational level.

It is noteworthy that the operational impacts of the No Action Alternative and the Upgrade in-Place Alternative are the same. This is due to the fact that both alternatives operate essentially the same facilities and processes. Although the facilities associated with the Upgrade in-Place Alternative would be improved compared with the No Action Alternative, as described in Section 3.2.3, the improvements are related to structural upgrades, fire protection upgrades, utility upgrades, and roofing. Consequently, the Upgrade in-Place Alternative would not result in any measurable efficiency gains, but might stem the escalation of aging to enable continued operations longer than under the No Action Alternative.

**Construction.** No construction activities are proposed under the No Action Alternative; consequently, there are no impacts associated with construction for this alternative. For the Upgrade in-Place Alternative, the proposed construction activities described in Section 3.2.3 are independent of the operational level. Consequently, the impacts associated with construction for the Upgrade in-Place Alternative would not change compared to those impacts presented in Sections 5.1 through 5.17 of this SWEIS.

**Operations.** Potential impacts associated with land use, visual resources, geology and soils, noise, ecological resources, cultural resources, and environmental justice would be unaffected by a change in the operational level. As such, these resource areas are not further discussed. Potential changes to other resources are discussed below.

Site Infrastructure. Electrical energy usage, water usage, and steam production at Y-12 would be reduced in order to support approximately 80 secondaries and cases per year compared to supporting approximately 125 secondaries and cases per year. Electrical energy usage would be reduced by a maximum of approximately 10 percent compared to present usage. Site-wide water usage would only be reduced by approximately 150 million gallons per year, which would represent a seven percent reduction compared to the water usage associated with supporting approximately 125 secondaries and cases per year. Steam production would be reduced from

approximately 1.5 billion pounds per year to approximately 1.35 billion pounds per year. The existing Y-12 infrastructure would be more than adequate to support these reduced requirements.

Transportation and Traffic. Reduced operational level would result in a reduced workforce and lesser transportation and traffic impacts. The Y-12 workforce could be reduced by approximately 750 existing workers (from 6,500 workers to 5,750 workers), which would represent a workforce reduction of approximately 11 percent compared to the workforce that would be needed to support approximately 125 secondaries and cases per year. The reduction in workforce would decrease vehicle traffic, but would not change the level of service on existing roads. Based on the most recent National Highway Traffic Safety Administration statistics, approximately 1.25 traffic fatalities are expected for every 100 million miles traveled (NHTSA 2010). The 5,750 person Y-12 workforce would travel approximately 57.5 million miles annually commuting to and from Y-12 for work (assuming a 40 mile roundtrip for each employee for 250 days per year). Statistically, approximately 0.7 fatalities would be expected annually.

Radiological transportation impacts would also be reduced. Because of lower operational levels, NNSA would ship fewer radioactive materials to and from Pantex, and Y-12 would generate less radioactive wastes. The impacts of transporting radiological materials would be less than 0.02 latent cancer fatalities annually.

Air Quality. As discussed in Section 5.6.1.1, more than 90 percent of the criteria pollutants from Y-12 have been attributed to the operation of the Y-12 steam plant. Under the reduced operational level, steam production would be reduced from approximately 1.5 billion pounds per year to approximately 1.35 billion pounds per year. This would reduce criteria pollutants from the Y-12 steam plant by approximately 10 percent. All criteria pollutant concentrations would be expected to remain below the national and TDEC standards, with the exception of the 8-hour ozone concentration. The 8-hour ozone concentration exceedance is not a result of ORR-specific activities. Instead, as described in Section 4.6.2.1, the EPA has designated Anderson County as a basic non-attainment area for the 8-hour ozone standard, as part of the larger Knoxville basic 8-hour ozone non-attainment area that encompasses several counties.

Greenhouse gas emissions would also be smaller due to reduced operations of the Y-12 steam plant, less electrical usage, and reduced transportation. From 1990 through 2005, $CO_2$ emissions in the state of Tennessee ranged from a low of 109.9 million tons in 1991 to a high of 138.8 million tons in 2005 (EIA 2009b). $CO_2$ emission rates from Y-12 would remain below 0.09 percent of the statewide $CO_2$ emissions in Tennessee.

Radiological air emissions would be reduced by approximately 14 percent, from approximately 0.01 curies/year to 0.0086 curies/year. The potential impacts to human health are presented in the occupational and public health and safety discussion below.

Socioeconomics. The Y-12 workforce could be reduced by approximately 750 existing workers (from 6,500 workers to 5,750 workers), which would represent a workforce reduction of approximately 11 percent compared to the workforce that would be needed to support approximately 125 secondaries and cases per year. These reductions are expected to be met through normal attrition/retirements since 50 percent of the work force at Y-12 is eligible to

retire within the next 5 years. The change from baseline Y-12 employment would be minor and no noticeable impacts to ROI employment, income, population, housing, or community services would be expected.

Occupational and Public Health and Safety. Reducing radiological air emissions by approximately 14 percent would reduce the offsite population dose from 1.5 person-rem/year to approximately 1.3 person-rem/year. Statistically, this would reduce the annual latent cancer fatalities in the offsite population from 0.0009 to 0.0008. Worker dose would also be reduced. It is expected that the number of monitored workers would be reduced by approximately 11 percent, from 2,450 to approximately 2,180. Although the average worker dose (19.9 mrem/year) would not be expected to change, the reduction in workforce would reduce the total worker dose from 49.0 person-rem/year to 43.4 person-rem/year. Statistically, this would reduce the annual latent cancer fatalities from 0.03 to 0.026.

Waste Management. Radiological and non-radiological wastes would be reduced by approximately 5 to 10 percent compared to the wastes associated with supporting approximately 125 secondaries and cases per year. Wastes generated would be as follows:

- Low level liquid waste: 635 gallons/year
- Low level solid waste: 8,935 cubic yards/year
- Mixed low level liquid: 1,035 gallons/year
- Mixed low level solid: 118 cubic yards/year
- Hazardous: 7.2 tons/year
- Nonhazardous Sanitary: 9,177 tons/year

These quantities are well below the capacities of the existing waste management facilities at Y-12.

Accidents. The bounding accident presented in Section 5.14.5, which is the aircraft crash into the enriched uranium facilities, would not change due to reduced operational levels because the potential material at risk and the potential source term associated with a release would not change. As such, the impacts presented in Section 5.14.5 for the bounding accident would remain applicable to reduced operations. For other accidents that were analyzed, the overall Y-12 facility accident risks would decrease under the Upgrade in-Place Alternative. This is because the existing enriched uranium and nonnuclear processing facilities would be upgraded to contemporary environmental, safety, and security standards to the extent possible. The upgrade projects would include upgrade of a number of building structures to comply with current natural phenomena criteria. Existing fire protection systems for many of the enriched uranium facilities would also be replaced. These actions would have the effect of reducing the frequency and consequences of the accident scenarios.