# 4.0 ENVIRONMENTAL IMPACTS

This section describes the impacts for each resource described in Section 3.0, *Description of the Affected Environment*. These impacts (e.g., direct, indirect, and cumulative) consider normal operational events as well as reasonably foreseeable accidents (e.g., credible consequence events for 10 CFR 70 licensees). As noted in Section 1.2, the No-Action Alternative is the only alternative considered in this ER besides the proposed action, and for which environmental impacts are described. The No-Action Alternative is defined as continued CFFF operations for the remainder of the existing 20-year license (expires 2027), without any significant changes in the existing facility.

## 4.1 Land Use Impacts

### 4.1.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing facilities would be constructed. Land uses at the CFFF plant site (see Section 3.1) would not change significantly, because no new buildings or major external modifications would be built as a result of operating under the current license. **4.1.2 Proposed Action Alternative—40 Year License Renewal**

Under the proposed action of a 40-year license renewal, manufacturing capacity would remain the same as the current manufacturing capacity of 1,500 MTU/year. As a result, no new manufacturing facilities would be necessary.

Land uses mentioned in Section 3.1 of this report would not change significantly as a result of a 40 year renewal because no new buildings or major external modifications would be made. The UF6 storage pad extension would occur on land already developed and owned by Westinghouse, therefore having no effect on other land use types. Similarly increasing the calcium fluoride release limit would also have no impact on land use types.

### 4.1.3 Mitigation

None required for either alternative.

## 4.2 Transportation Impacts

### 4.1.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing facilities would be constructed and capacity would remain the same; therefore, no changes would occur in operations that would affect transportation. Current transportation quantities and frequency of incoming and outgoing materials from CFFF operations are identified in Appendix B, Table B-2. As noted in Table B-2, the total shipments of chemicals and radioactive materials to or from the site under the No-Action alternative would be an estimated 1342 shipments of all types per year. Since each shipment involves entry to and departure from the site, the total shipment-related traffic on local roads would be 7.4 vehicles per day (i.e., = [2 x 1342]/365).

The employment level at the CFFF under the No-Action alternative would be approximately 1,100 employees. Assuming that a given worker works five days per week and 50 weeks per year, then the annual average daily work force is 755 (i.e., = [50/52] x [5/7] x 1100). Assuming one worker per vehicle (maximum traffic estimate), then the total number of worker vehicles on local roads would be 1,510 per day (i.e., = 2 x 755).

The primary highway supporting traffic into and out of the site is SC 48. The South Carolina Department of Transportation (SC-DOT) provides annual average daily traffic (AADT) counts by highway and highway segment (SC-DOT, 2008). The AADT count during 2007 for the that portion of SC 48 between Secondary State Highways (S) 87 and S 734 (along which is the site) was 4,400 vehicles per day. Based on the information presented above, CFFF-related traffic of all types (worker and shipments) during operation under the No-Action alternative would comprise an estimated 34 percent (i.e., 100 x [7.4 + 1510] / 4,400) of the local traffic on SC 48 near the site on a daily basis, dominated by worker traffic.

The CFFF has been in operation since 1968 with current facility-related traffic levels indicated above. For this reason, no significant impacts to transportation are anticipated under the No-Action alternative.

### 4.2.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action of a 40-year license renewal, manufacturing capacity would remain the same as the current manufacturing capacity and therefore would have no additional impact to the environment versus the No-Action Alternative. However, should the $^{235}U$ possession limit be increased as proposed in the amendment, the transportation of $UF_6$ cylinders on-site will increase, slightly increasing the number of trucks entering the site on a monthly basis. The overall environmental impact would be minimal. Increasing the calcium fluoride release limit will have no effect on transportation and therefore no environmental impact.

### 4.2.3 Mitigation

All shipments of nuclear materials, chemicals and wastes would be carried out in conformance with NRC, DOT, and SC requirements, including truck placarding to identify contents, and manifests. Trucks used for transport would be of the design and size deemed appropriate by the applicable regulations, and subject to the necessary inspections and maintenance to ensure safe transport. Site access roads and loading areas would be paved, minimizing the potential for fugitive dust generation by truck traffic. These mitigation methods would apply to both alternatives, regardless of the one approved by the NRC.

## 4.3 Geology and Soils Impacts

### 4.3.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing facilities would be constructed; therefore site geology and soils would not be significantly impacted.

### 4.3.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action of a 40-year license renewal, no new manufacturing facilities would be constructed, however the $UF_6$ storage pad size would be increased, should the aforementioned amendment to the existing license be approved. The proposed modification would be insignificant, as the area for expansion is already accounted for in the disturbed land area for Westinghouse. Increasing the calcium fluoride release limit has no additional impact to geology and soils. Under the existing license, calcium fluoride is collected and stored on site in an outdoor mound on a concrete pad. The pad is equipped with runoff collection, as to not affect the surrounding area. To date, no geological effects such as erosion, landslides, or subsidence have been observed.

### 4.3.3 Mitigation

None required for either alternative.

## 4.4 Water Resources Impacts

### 4.4.1 No-Action Alternative

The liquid effluents associated with CFFF operations under the No-Action alternative have been described in Section 2.1.1.4. Potential surface water impacts associated with operations at the CFFF site include some degradation of water quality in the Congaree River due to contaminated effluent discharges. This potential impact is minimized by Westinghouse's compliance with the discharge limits outlined in its NPDES permit. Current effluent quality characteristics are well within the permit limitations (NRC, 2007a). It is not expected that liquid effluent discharges would result in the deterioration of recreational uses of water bodies. The discharge volume is miniscule compared to the flow rate and volume of the river. The temperature of the discharge is close to ambient, and solids contents are sufficiently low to preclude collection of sediments.

Potential groundwater impacts include the degradation of groundwater quality due to contamination caused by leaks or spills of material into the soil. This potential impact is minimized by implementation of the CFFF Chemical Safety Program and other procedures designed to ensure safe storage and handling of materials. Remediation is currently underway to address past groundwater contamination with volatile organic compounds (VOCs), but continued operations at the CFFF site should not result in additional negative impacts on the local groundwater system. In addition, groundwater monitoring wells are being sampled for various water quality parameters as specified in the NPDES permit. The groundwater is confined in a shallow geologic unit that has little or no potential of being an underground source of drinking water and discharges or will discharge to surface water.

Groundwater around the CFFF is routinely monitored and evaluated, as described in Section 6.0. Observation of an upward trend in groundwater contamination initiates investigation and corrective action as appropriate. Additional details regarding groundwater impacts under the No-Action alternative are presented below, in terms of groundwater quality by contaminant of potential concern (Westinghouse, 2006a and 2007d):

<u>Volatile Organic Compounds (VOCs)</u>:

A groundwater contamination event was noted at the site following an EPA site screening inspection at the facility in February 1989. Following this screening, an evaluation indicated that organic compounds were detected in the groundwater. Westinghouse confirmed in 1993 that chlorinated volatile organic compounds (VOCs, including perchloroethylene and PCE degradation products) were detected in the groundwater. Subsequently, Westinghouse performed a detailed site inspection assessment in 1994 documenting VOC contamination west southwest of the plant extending 300 m (1000 ft) from the old oil house to Sunset Lake. The perchloroethlyene contamination was estimated to have occurred due to temporary storage of leaking drums outside the oil house prior to passage of regulations requiring more prescriptive methods of handling hazardous materials and waste.

After further evaluation and consultation with SC-DHEC, Westinghouse installed a groundwater remediation system consisting of air sparging and soil vapor extraction (AS/SVE) system in 1998 as a preventive barrier to prevent VOCs (perchloroethylene and degradation products) from reaching the deeper groundwater aquifers and surface water (e.g., Sunset Lake). The objective of this approach is to contain the plume and prevent further migration.

Initially, wells were sampled and found to contain approximately 0-3000 µg/L VOCs (1995-98). The maximum noted in the 2004 report was 569 µg/L. Processes have been implemented to ensure that raw materials or waste VOC containing materials do not leak or contaminate groundwater. Based on data review, the above efforts appear to have been successful in containing the VOC plume and preventing additional contamination.

The primary VOCs at the site are tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and vinyl chloride (VC). TCE, cis-1,2-DCE and vinyl chloride are potential breakdown products of PCE. Over years of the air sparge system operation, removal of DCE and VC is most evident and effective, where VC was only detected at well W-45 (2.2 µg/L) in December 2001 since the AS/SVE operation began. The current performance monitoring program demonstrates the stabilization of PCE and TCE plumes with no sign of plume expansion or shrinkage, except that PCE and TCE levels have gradually increased over time at wells RW-2R and W-33. The operation of the AS/SVE system has controlled the migration of PCE and TCE plumes; however, the overall performance is less evident and less effective on PCE and TCE compared to VC and DCE.

During investigations to detect groundwater contamination, multiple soil geoprobe penetrations were completed in locations affected by past spills of chlorinated solvents. Soil samples were taken at depths from 0.9 to 3.4 m (3 to 11 ft). One sample was noted to contain Total VOC's equal to 4.5 mg/kg; and nineteen other samples indicated Total VOC's less than 0.3 mg/kg. No management program was necessary specifically to manage the soil. Programs were implemented to manage the groundwater in the shallow surficial aquifer beneath the soil.

The soil impacted by chlorinated solvent contamination would be leached by rainwater, the surface aquifer, and then be attenuated by reaction with soil bacteria. No requirements were established by SC-DHEC to remove soil at the low documented levels of contamination.

Westinghouse continued with implementation of the chlorinated solvent remediation project by operation of the air sparge soil vapor extraction system in calendar year 2010. This process has effectively operated to remove VOC's and perchloroethylene contamination in

the shallow surficial aquifer identified west southwest of the oil house. In December 2010, the air sparge soil vapor extraction system was turned off, as agreed by SC-DHEC (Westinghouse, 2011b). The system may remain off, provided that quarterly ground water samples show no rebound in VOC levels. Sampling of VOCs in the groundwater is continuing, and confirms that remains the case (Westinghouse, 2012d).

Fluoride:

Fluoride has a maximum contaminant level (MCL) of 4 mg/L. Several wells show the fluoride concentrations above MCL and these wells are generally consistent throughout the years of monitoring. During June 2007, 9 of 14 wells sampled for fluoride were at times above the MCL. The affected wells are those around wells W-7A, -10, -15, -16 and -30.

Although the footprint of fluoride plume does not change over time, several wells do demonstrate the attenuation of fluoride. For example, the highest fluoride concentration in June 2007 is 18 mg/L at well W-30, which is significantly lower than the maximum detected concentration of 125 mg/L at well W-28 in June 2001.

Continued investigation and monitoring indicated that that fluoride (and nitrate) concentrations in groundwater remain at levels exceeding the MCLs in the vicinity of well W-30 in the wastewater treatment area. See "Nitrate" discussion below for information on the follow up.

Nitrate:

Nitrate has a MCL of 10 mg/L. For the subject site, the highest nitrate concentration of 520 mg/L was detected at well W-30 in June 2006 compared to the highest concentration of 350 mg/L in June 2007 at well W-30. Nitrate concentrations at other wells are significantly lower (all below 100 mg/L except 127 mg/L at RW-2R). Although well W-30 contains elevated levels of nitrate, a nitrate source in the W-30 area is not anticipated and the concentrations at W-30 have shown a consistent decreasing trend. Well RW-2R, which indicated 127 mg/L of nitrate in June 2007, formerly contained 510mg/L of nitrate in December 2005. This well also demonstrated a consistent decreasing trend since December 2005.

Continued investigation and monitoring after 2007 indicated that that nitrate (and fluoride) concentrations in groundwater remain at levels exceeding the MCLs in the vicinity of well W-30 in the wastewater treatment area. In 2010 Westinghouse undertook a source investigation in the vicinity of the wastewater treatment area consisting of direct push borings to collect groundwater samples for analysis of fluoride and nitrate concentrations. Groundwater borings in May 2011 indicated the North and South Lagoons to be source of nitrate contamination. As a result, Westinghouse relined the site lagoons in January to February 2012.

Ammonia:

An ammonia groundwater contamination event was noted in 1980 involving contamination south-southwest of the facility as a result of leaks at waste treatment and product storage. The effects of the ammonia contamination at the initial most elevated location appear to have been corrected from a concentration of 1000 mg/L to current levels of approximately 55 mg/L by remedial actions and attenuation of the source.

The highest ammonia (76 mg/L) was detected at well W-7A in December 2000 compared to the highest concentration of 59 mg/L at well W-32 in June 2007 (see Section 6.1.4 for identification of well locations). Ammonia concentrations fluctuate at wells showing ammonia detections across the site. This fluctuation in ammonia is expected because ammonia in the subsurface is thermodynamically unstable and would be oxidized to nitrate under the proper geochemical conditions. Nitrate is typically more thermodynamically stable than ammonia in groundwater.

Although the ammonia data fluctuated at each individual well because of its physicochemical characteristics in groundwater, it is apparent that the ammonia plume is stable with no evidence of expanding. Wells W-48 and W-26 upgradient from the Mill Creek did not indicate ammonia over the years and ammonia concentrations at wells W-10 and W-15 located upgradient from wells W-48 and W-26 are stable with no sign of increase in concentrations.

Due to the little to no migration of the ammonia plume, the plume occurs and will only occur on the property with little to no possibility of groundwater withdrawals to create drawdown such that contaminants would flow off-site. In addition, ammonia is not considered dangerously toxic, mobile or persistent based on the historical site data and natural attenuation of ammonia is expected.

Gross Alpha and Beta:

Well water analysis is required as an NRC license commitment on ten surficial aquifer wells. A third investigation was noted in 1998 related to three identified NRC well sampling sites exceeding 50 pCi/L Gross Beta investigation limit (Well 17, Well 32, and Well 13). Corrective actions implemented at the cylinder recertification building and hydrostatic test operation in 1998 appeared to have been effective in eliminating the source of elevated beta activity. Also, alarms have been installed on to minimize overflow potential.

In 2010, however, two identified NRC sampling well sites exceeded the 50 pCi/L Gross Beta investigation limit (Westinghouse, 2011b). Well 7 averaged 193 pCi/l Gross Beta, and Well 32 averaged 234 pCi/l Gross Beta. Four other wells (W10, W15, W18, W22,) which are not on the NRC sampling list, also exceeded the 50 pCi/l Gross Beta limit. This elevated Gross Beta content was identified and confirmed as technicium-99 (Tc-99). The investigation evaluated potential causes from lagoon leaks, K-40 natural contamination, sampling errors, the cylinder recertification building, and adjacent surface water contamination from the concrete pad. The cylinder recertification building liquid from the hydrostatic test process appeared to have the highest potential of being a major contributor since this liquid (from remnants of activity in the cleaned cylinders) could contain elevated uranium daughter beta, Tc-99 beta, and low alpha concentrations. Monitoring of these wells on a routine basis will continue, and further sampling and investigation of Tc-99 in groundwater was initiated in 2011.

Overall Groundwater Impacts:

Based on the information presented above, the groundwater impacts of the No-Action alternative are not significant. The groundwater is confined in a shallow geologic unit that has little or no potential of being an underground source of drinking water and discharges or will

discharge to surface water. Any contaminated plumes detected (e.g., VOCs, fluoride, nitrate and ammonia) are confined to the property, with little to no possibility of groundwater withdrawals to create drawdown such that contaminants would flow off-site.

### 4.4.2 Proposed Action Alternative—40 Year License Renewal

As stated in the groundwater impacts for the No-Action Alternative, any contamination that might be detected by periodic monitoring would be confined to the property, with little or no possibility of groundwater withdrawals to create drawdown for flow off-site. Because of this, impacts on groundwater as a result of the proposed 40-year license renewal are not significant. In addition, impacts on groundwater as a result of increasing the $^{235}U$ possession limit and calcium fluoride release limit are not significant.

### 4.4.3 Mitigation

The primary Westinghouse approach to minimizing potential environmental impacts to water resources would be through 1) careful process control, 2) proper management of liquid effluents leading to and from the six lagoons, 3) conduct of the environmental monitoring program as described in Section 6.0, and 4) assessment of any abnormally high concentrations of liquid effluent constituents in surface waters and groundwater. These mitigation methods would apply to both alternatives, regardless of the one approved by the NRC.

Liquid effluent monitoring requirements at the CFFF are in accordance with the permit, as described in Section 6.0. Groundwater around the CFFF is routinely monitored and evaluated, as described in Section 6.0. Observation of an upward trend initiates investigation and corrective action if necessary.

Westinghouse has continued with groundwater remediation through the chlorinated solvent remediation project. This is done by assuring continuous operation of the AS/SVE system since its installation through 2010. This process has effectively operated to remove VOC's and perchloroethylene contamination in the shallow surficial aquifer identified west southwest of the oil house. In December 2010, the air sparge soil vapor extraction system was turned off, as agreed by SC-DHEC (Westinghouse, 2011b). The system may remain off, provided that quarterly ground water samples show no rebound in VOC levels. Sampling of VOCs in the groundwater is continuing, and confirms that remains the case (Westinghouse, 2012d).

Continued investigation and monitoring after 2007 indicated that that nitrate (and fluoride) concentrations in groundwater remain at levels exceeding the MCLs in the vicinity of well W-30 in the wastewater treatment area. In 2010 Westinghouse undertook a source investigation in the vicinity of the wastewater treatment area consisting of direct push borings to collect groundwater samples for analysis of fluoride and nitrate concentrations (AECOM 2011). Groundwater borings in May 2011 indicated the North and South Lagoons to be source of nitrate contamination. As a result, Westinghouse relined the site lagoons in January to February 2012 (Westinghouse 2012e).

Following identification of Tc-99 in the groundwater and liquid effluents in 2010, monitoring of Tc-99 continued and is included in the annual ALARA report with other radiological analysis

## 4.5 Ecological Resources Impacts

### 4.5.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing facilities would be constructed. No effects would occur on ecological resources.

### 4.5.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action of a 40-year license renewal, no new manufacturing facilities would be constructed; therefore ecological resources would not be significantly impacted. In addition, impacts on ecological resources as a result of increasing the $^{235}U$ possession limit and calcium fluoride release limit are not significant.

### 4.5.3 Mitigation

The environmental monitoring program described in Section 6.0 is designed to identify any unexpected buildup of radioactive and chemical concentrations in environmental media that could impact ecological resources. Additionally, the CFFF has voluntarily partnered with the South Carolina Department of Natural Resources (SCDNR) as a Wildlife and Industry Together (W.A.I.T.) site. Members of the CFFF W.A.I.T. Team establish conservation, biodiversity, and education goals that are implemented to maintain and improve wildlife health on the site and certification with SCDNR.

## 4.6 Air Quality Impacts

### 4.6.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. No changes to air quality in the vicinity of the CFFF would result. Airborne effluents under the No-Action alternative have been described in Section 2.1.4 and Section 2.2.

Agricultural use of nearby land could potentially be affected by fluoride and ammonia emissions on crops, pasture grasses, and cattle. However, analysis of past projected fluoride emissions indicates that there will be no significant or observable impacts (NRC, 1985).

Although ammonia is a plant nutrient and is used in fertilizers, a very high atmospheric concentration of ammonia can adversely affect vegetation. Ammonia emissions from the plant should not present a hazard to domestic or wild animals or to public health. For significant impacts to occur on domestic animals and on land uses involving these animals, concentrations of ammonia would have to be much higher than the suggested guidelines for the protection of human health. Because the predicted ammonia concentrations at and beyond the nearest site boundary are below applicable criteria, no impact should occur (NRC, 1985).

### 4.6.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action of a 40-year license renewal, no new manufacturing facilities would be constructed; therefore air quality would not be significantly impacted as compared to the no-action alternative. In addition, impacts on air quality as a result of increasing the $^{235}U$ possession limit and calcium fluoride release limit are not significant.

### 4.6.3 Mitigation

Control of airborne effluents is described in Section 2.1.1.4. The NESHAPs regulates airborne releases of hazardous materials. Nonradiological emissions at CFFF are regulated by the SC-DHEC under permit number 1900-0050 (effective May 12, 2003) (Westinghouse, 2006c). The CFFF permit addresses NAAQS pollutants, nitric acid, and opacity. The permit does not require monitoring. Instead, operating permit limits are based on process throughputs at rated capacities as outlined by the SC-DHEC in SC Air Quality Control Regulation 61-62.

Radiological emissions are regulated by NRC under 10 CFR Part 20 and by the U.S. Environmental Protection Agency under 40 CFR Part 61. Westinghouse monitors radiological airborne discharges from 47 stacks and calculates an offsite dose from the combined emissions. As part of the environmental monitoring program, Westinghouse also monitors for the presence of radioactive material in ambient air at four onsite locations.

## 4.7 Noise Impacts

The CFFF currently generates levels of noise commensurate with a large manufacturing facility. As noted in Sec. 3.7, noise from the CFFF is not detectable at the site boundary (Westinghouse, 2006c).

### 4.7.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. Ambient noise levels associated with existing manufacturing activities would remain relatively the same, and no impacts are anticipated.

### 4.7.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action of a 40 year license renewal, no new manufacturing activities would be constructed. Ambient noise levels associated with existing manufacturing activities would remain relatively the same, and no impacts are anticipated.

### 4.7.3 Mitigation

None required for either alternative.

## 4.8 Historic and Cultural Resources Impacts

The nearest historic and cultural resource, the Denley Cemetery, is located on the site, as described in Section 3.8. The cemetery is maintained in good condition and fenced.

### 4.8.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. No changes would occur to historic or cultural resources.

### 4.8.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action, no new manufacturing activities would be constructed. No changes would occur to historic or cultural resources.

### 4.8.3 Mitigation

None required for either alternative.

## 4.9 Visual/Scenic Resources Impacts

### 4.9.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. No changes would occur to nearby visual/scenic resources.

### 4.9.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action, no new manufacturing activities would be constructed. No changes would occur nearby visual/scenic resources.

### 4.9.3 Mitigation

None required for either alternative.

## 4.10 Socioeconomic Impacts

### 4.10.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. There would be no changes to the regional economy and population, and no socioeconomic changes would occur.

The CFFF provides significant local employment, provides tax revenues, is partnered with local schools (i.e., Mill Creek Elementary), is active in the community, is a major supporter of the United Way, as well as provides training and support to local emergency response organizations.

The number of persons expected to be employed by Westinghouse is not expected to increase significantly over current employment levels. In the long term, the CFFF operations would continue to have a beneficial socioeconomic impact on the nearby community.

### 4.10.2 Proposed Action Alternative—40 Year License Renewal

Under the Proposed Action, no new manufacturing activities would be constructed. There would be no changes to the regional economy and population, and no socioeconomic changes would occur.

The CFFF provides significant local employment, provides tax revenues, is partnered with local schools (i.e., Mill Creek Elementary), is active in the community, is a major supporter of the United Way, as well as provides training and support to local emergency response organizations.

The number of persons expected to be employed by Westinghouse is not expected to increase significantly over current employment levels. However, an approved license extension could offer economic stability to the local and state economy as well as Westinghouse employees for an additional 40 years. In the long term, the CFFF operations would continue to have a beneficial socioeconomic impact on the nearby community.

### 4.10.3 Mitigation

None required for either alternative.

## 4.11 Environmental Justice

The evaluation of environmental justice impacts is predicated on the identification of high and adverse impacts in surrounding areas, followed by a determination if those impacts would affect minority and low-income populations disproportionately. Previous analyses of impacts from operating the CFFF facility do not indicate high and adverse impacts for any of surrounding areas. It must be noted, however, that the CFFF exists in a section of Richland County (Census Tract 118) that has higher levels of minority and/or low-income populations compared with Richland County as a whole, and SC. Therefore, the nearest human receptors (other than occupational exposures) of any radiological or nonradiological impacts resulting from operational or accidental releases from CFFF operations would likely be to minority and/or low-income populations.

### 4.11.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. There would be no changes to the regional economy and population. No socioeconomic-related changes would occur, and there would be no changes to existing environmental conditions. Therefore, the No-Action alternative would not result in any environmental justice impacts.

### 4.11.2 Proposed Action Alternative—40 Year License Renewal

Under the proposed action, no new manufacturing activities would be constructed. There would be no changes to the regional economy and population. No socioeconomic-related changes would occur, and there would be no changes to existing environmental conditions. Therefore, the proposed action would not result in any environmental justice impacts.

### 4.11.3 Mitigation

Mitigation measures to minimize radiological and non-radiological emissions including monitoring are expected to result in emissions from the CFFF that are "As Low As Reasonably Achievable" (ALARA). No additional mitigation measures are required to protect against environmental justice impacts.

## 4.12 Public and Occupational Health Impacts

### 4.12.1 No-Action Alternative

Under the No-Action alternative, no new manufacturing activities would be constructed. There would be no changes to environmental conditions at the CFFF that have potential public and/or occupational health hazards.

#### 4.12.1.1 Nonradiological Impacts

For the workforce, industrial accidents can occur, as is the case in all work environments. In 2000, about 5,200 people in the U.S. were killed in accidents while at work, and approximately 39 million disabling work-related injuries were reported. The Occupational Safety and Health Act of 1970 provides OSHA the authority to prescribe and enforce standards and regulations affecting the occupational safety and health of private- sector employees. The CFFF operates in compliance with OSHA regulations, and has an aggressive worker safety management program in place. There has never been a death or a serious injury to a worker at the CFFF site. Statistics as of the end of 2005 reflect a yearly Total Recordable Incident Rate of 1.16 and a Days Away Case Rate of 0.09. Although all work activities are conducted in as safe a manner as possible, there is a chance that workers could be accidentally killed or injured under the No-Action alternative, unrelated to any radiation or chemical exposures.

#### 4.12.1.2 Radiological Impacts

##### 4.12.1.2.1 Pathway Assessment

Potential health impacts to members of the general public could occur if material released from the CFFF entered the environment and was transported from the site through the air, surface water, or groundwater. Off-site releases of uranium, because of the low specific activity of uranium, would be expected to be small (Westinghouse, 2006b).

#### 4.12.1.2.2 Public and Occupational Exposure

Calculated radiological doses to the public from the CFFF operations are primarily from the air emissions. Over 99 percent of the offsite dose originates from the airborne pathway (Westinghouse, 2012). CFFF stack emissions would result in a total effective dose of less than 0.16 mrem to a hypothetical exposed individual living at the site boundary (Westinghouse 2013). This dose is less than the ALARA goal in NRC Regulatory Guide 8.37 and the SC-DHEC Licensing Guide, "ALARA Levels for Effluents from Materials Facilities" (10 mrem/year); less than the "dose constraint" level in 10 CFR 20.1101(d), and less than the investigation level in Westinghouse procedures of 1 mrem/yr. Air emissions from the CFFF are routinely monitored, the results are trended, and corrective actions are taken if necessary to ensure that emissions remain ALARA.

Radiological Exposures to the public from CFFF operations are primarily via air emissions results of which are described above. Based on using the TEDE compliance option, the contribution of dose from the liquid discharges will be negligible at the present liquid discharge levels (less than approximately 0.0002 mrem/year). Control of liquid discharges is based on adherence with ALARA principles and compliance with Westinghouse Procedures and NRC Regulatory Guide 8.37. Note that the liquid effluent dose is not the major pathway in individual off-site dose calculations. Approximately 99 percent of the off-site dose originates from the airborne pathway.

### 4.12.1.3 Potential Impacts of Accidents

In accordance with 10 CFR Part 70, Subpart H, Westinghouse performed an Integrated Safety Analysis (ISA) (Westinghouse 2012a). An ISA is defined in 10 CFR 70.4 as "a systematic analysis to identify facility and external hazards and their potential for initiating accident sequences, the potential accident sequences, their likelihood and consequences, and the items relied on for safety." Items relied on for safety are structures, systems, equipment, components, and activities of personnel that prevent potential accidents that could exceed the performance requirements in 10 CFR 70.61.

Accidents that could occur at the CFFF under the No-Action alternative are both radiological and nonradiological in nature. The fabrication of fuel for nuclear reactors involves the chemical processing of low-enriched uranium. Significant radioactive materials present at the fuel fabrication facility are the $UO_2$ pellets for fuel rod fabrication and the $UF_6$ stored in cylinders. The 4.5 to 5 percent enriched uranium that is used has a low specific activity of 2.4 pCi/g. Thus, with the exception of a criticality accident and the potential rupture of $UF_6$ cylinders, the environmental impacts which would result from postulated accidents at CFFF would be similar to the impacts of a manufacturing plant in which nonradioactive chemicals are stored. The radiological environmental impacts of the more probable postulated accidents are insignificant at this facility.

The hazards posed by these materials are evaluated in the ISA for the associated systems or process operations. The bounding maximum consequence basis accidents for the CFFF are:

- Liquid System Criticality
- Dry System Criticality
- Soluble Uranium Release
- Insoluble Uranium Release
- Aqueous Ammonia Release
- Hydrofluoric Acid Release
- Nitric Acid Release

- Chlorine Release
- Hydrogen Explosion
- Fuel Oil Fire
- Natural Phenomena Hazards

The NRC prepared a Safety Evaluation Report (SER) regarding the CFFF to evaluate the potential adverse impacts of continued operation of the facility to the worker and public health and safety, under both normal operating and accident conditions (NRC, 2007b). The review also considered physical protection of SNM, material control and accounting of SNM, and the management organization, administrative programs, and financial qualification proved to ensure the safe design and operation of the facility. The NRC staff concluded in the SER that "the licensee's [Westinghouse] descriptions, specifications, and analyses provide an adequate basis for the safety and safeguards of facility operations, and that continued operation of the facility does not pose an undue risk to worker and public health and safety."

Use of anhydrous ammonia at CFFF was eliminated in August 2011, and replaced by aqueous ammonium hydroxide (Westinghouse 2012a). This resulted in a reduction in chemical hazard risk.

For the purpose of the ER, additional information regarding potential accidents is provided in the remainder of this section. A spectrum of possible accidents related to the operation of CFFF and their potential consequences are presented in Table 4.12-1 (NRC, 1985). Accident severity is classified into three categories. Category 1 accidents are those most likely to occur during normal plant operations, and have the least environmental impacts of the three. Category 2 events, which would occur infrequently during the plant's operating life, could release concentrations of radiological and nonradiological pollutants to the onsite (and possibly offsite) environment that would exceed normal effluent releases and could cause significant impacts, if not controlled or mitigated. Category 3 accidents are those not expected to occur during the life of the plant but which could result in significant releases of radioactive or toxic pollutants to the onsite and offsite environment. Westinghouse (1975 and 1983) has analyzed the radiological and nonradiological consequences of several accident scenarios, both inside the manufacturing plant and outside the plant (e.g., storage areas, lagoons, etc.).

#### 4.12.1.3.1 Radiological Accidents

Although several minor accidents are likely to happen during the life of the plant (e.g., a small leak in a pipeline or a small spill), most will not result in a significant release of uranium to the environment. Therefore, the accident analysis in support of this assessment is limited to the consideration of severe, low-probability accidents that could potentially result in the release of large quantities of radioactivity, a $UF_6$ release or a criticality accident. The radiological

**Table 4.12-1 Potential CFFF Accidents**

| Area and Material Involved | Typical Accidents | Severity Class | Release(s) of Concern |
|---|---|---|---|
| **Tank farm**<br>Ammonium hydroxide<br>Sodium hydroxide<br>Nitric acid | Pipeline or tank leak; rupture, spills, fire | 1, 2 | Ammonia<br>Nitrate<br>Caustic and acid solutions |
| **Lagoons**<br>Ammonium nitrate<br>Calcium fluoride<br>Uranium | Leak, massive dike/liner failure, flooding | 1, 2 | Ammonia<br>Nitrate<br>Fluoride<br>Uranium |
| **Outside-storage/inside-vaporization area**<br>Uranium hexafluoride<br>(solid, liquid, vapor)<br>Uranyl nitrate | Ruptured cylinder, vapor release<br>Ruptured drum | 1, 2<br>2 | Uranium, hydrogen fluoride<br>Uranium<br>Nitrate |
| **Chemical and manufacturing areas**<br>Uranium<br>Uranium dioxide<br>Ammonium diuranate<br>Hydrogen fluoride<br>Hydrogen | Pipeline or container rupture, spills, explosions, fires, filter failure criticality<br>Explosion | 1, 2, 3<br>3 | Uranium<br>Ammonia<br>Fluoride<br>Uranium |
| **Transportation** | Container rupture, spills | 1, 2 | Uranium<br>Miscellaneous chemicals |

Source: NRC, 1985

consequences of a major fire and a transportation accident are also evaluated. The dose estimates presented below are based on information presented in Westinghouse 1975, 1983; and NRC 1985.

<u>$UF_6$ Release</u>

Shipping cylinders of $UF_6$ (2.27 MT [2.5 tons]) are stored inside the manufacturing building or in a secured outdoor area. The $UF_6$ is a solid at ambient temperatures (sublimes at 56° C [132°F]) and is only heated and vaporized inside the CFFF Chemical Area. Therefore, the possibility of an outdoor release of liquid $UF_6$ is extremely remote. If a cylinder of solid $UF_6$ were to fail outside, for any reason, the $UF_6$ would vaporize very slowly. Because $UF_6$ reacts with atmospheric moisture to form uranyl fluoride ($UO_2F_2$), which is a nonvolatile solid, such a leak would tend to be self-sealing. Therefore, the quantity of material released from such an accident involving a cylinder of solid $UF_6$ would not contribute significantly to the plant's normal emissions, and the potential offsite consequences would hot be a concern.

Although very unlikely, an accident resulting in a massive outdoor release of $UF_6$ was postulated as the maximum credible $UF_6$ accident. Such an accident would involve a fire in the $UF_6$ outside storage area when a truck crashes there and ruptures two of the $UF_6$ cylinders. A fire results when the truck's fuel tank is ruptured by the crash. The resulting release of $UF_6$ is estimated to

be about 1260 kg (2,778 lb) over a one-hour period, assuming no remedial action is taken. This equates to a total release of 860 kg (1,896 lb) of low-enriched (<5 wt-% $^{235}U$) uranium.

The $UF_6$ gas volatilized by the fire would react with water vapor in the air to form hydrogen fluoride (HF) gas, and uranyl fluoride ($UO_2F_2$) particulates. The resultant cloud would rise at least 30 m (100 ft) above the site, primarily driven by the thermal expansion of heated air and combustion products from the burning truck fuel (Klett 1975). The accident is assumed to occur under adverse meteorological conditions including an F type of atmospheric stability and a light wind blowing at 1 m/s. With a ground-level release and a dilution effect caused by building wake turbulence, the $\chi/Q$ at the nearest residence (1000 m to the northeast) is $2.33 \times 10^{-4}$ s/m$^3$. Under these atmospheric conditions, $UO_2F_2$ and HF could move downwind in a narrow, unwavering plume. The plume would be a dense white cloud which would be highly visible at the nearest residence during the day. The average concentration of uranium and HF as the plume passes through this location would be about 60 mg/m$^3$ and 20 mg/m$^3$, respectively.

HF is a corrosive vapor, and exposure to concentrations of 25 mg/m$^3$ for several minutes is known to cause respiratory discomfort (NAS, 1971). Brief exposure to 40 mg/m$^3$ of HF is dangerous to life; exposure to 100 mg/m$^3$ of HF for 1 minute is considered epidemiologically significant (Sunshine, 1972). Therefore, the calculated HF concentration at the nearest residence may cause some respiratory discomfort (prompting a person to flee), but would not be life-threatening.

If an adult at the nearest residence stood in the plume and endured this discomfort for an entire hour, there would be an intake of soluble uranium of approximately 50 mg. The chemical toxicity of this intake would likely cause kidney injury (Eve, 1964) but would be well below the potentially fatal uranium intake of 160 mg (Luessenhop, 1958). The radiation dose associated with this intake would be insignificant.

Criticality Accident

The effects of a postulated criticality accident have been considered, although the possibility of such an accident is remote. Historically, no accident of this kind has ever occurred in a low-enrichment fuel fabrication facility. Achievement of criticality with low-enrichment uranium requires carefully controlled conditions and is not likely to happen accidentally. In addition, at the CFFF, programs of design, review, procedural control, engineered safeguards, and audits are implemented routinely to prevent a criticality accident of this kind.

The postulated criticality accident has the following characteristics (NRC Regulatory Guide 3.34, Rev. 1):

- The accident results in $10^{19}$ fissions produced in a series of pulses within a supercritical liquid system over an 8-h period.
- The accident releases only the volatile fission products produced by the above number of fissions. At this time, radioactive decay begins.

In addition, it was assumed that 25 percent of the halogens and 100 percent of the noble gases were released from the manufacturing building. No credit for removal of radionuclides was given for the existing filters, scrubber, or other installed controls. Furthermore, the accident was assumed to occur under adverse meteorological conditions (an F-type atmospheric stability and a wind speed of 1 m/s). Given these conditions, and considering a building wake effect, the X/Q

at the nearest residence would be $2.33 \times 10^{-4}$ s/m$^3$. The offsite consequences from this accident at the nearest residence are shown in Table 4.12-2 (NRC, 1985). The doses also are well below recommended protective action guides (1 to 5 rem for total body and 5 to 25 rem for thyroid) given by the EPA (EPA, 1980).

**Table 4.12-2 Maximum 50-year Dose Commitment to the Nearest Resident from a Criticality Accident[1, 2]**

| Exposure type | Dose (mrem) | |
|---|---|---|
| | TEDE | Thyroid |
| Airborne radioactivity | 102 | 950 |
| Prompt gamma | 3.8 | 3.8 |
| Prompt neutron | 1.6 | 1.6 |
| Total | 107.4 | 955.4 |

1 Nearest resident is 1000 m from the accident site.

2 Accident parameters and calculations are based on information in NRC Regulatory Guide 3.34, Rev. 1.

Source: NRC, 1985

Transportation Accidents

Transportation of special nuclear materials is strictly regulated by the DOT (NRC, 1977a and 10 CFR 50 and 71), and package design and specifications must be approved by the NRC. Containers must be designed to withstand hypothetical accident conditions applied sequentially in an order specified in the regulations to determine the cumulative effect on the container being tested. Criteria include free drops, punctures, thermal stress, and water immersion tests. These tests, which are more severe than any expected transportation accidents, make the probability of release of contents or accidental criticality very small. In addition, to ensure that all packages are properly prepared for shipment, the applicant must establish, maintain, and execute a quality assurance program (10 CFR 71) that satisfies applicable criteria (10 CFR 50). The special nuclear materials are transported in dedicated vehicles specifically designed for the purpose of assuring nuclear safety and material accountability and security.

The environmental effects of transportation accidents involving properly packaged radioactive materials have been analyzed and documented (NRC, 1975 and 1977b). These analyses show that the radiological risk from transportation accidents involving radioactive materials does not contribute appreciably to the accident consequences.

Major Fire

A major fire would involve complete burning of operational HEPA filters servicing exhaust from conversion and scrap recovery processes. The filters are housed in wooden boxes and located on the roof of the manufacturing building. On the basis of the estimated release rate of 47.4 µCi/week (NRC, 1985), a filtering efficiency of 99.97 percent, and a maximum time between filter changes of 26 weeks, the maximum uranium activity accumulated in these filters would be 1.4 Ci. NRC provides a release fraction of various radioactive materials in unsealed form for

accidental source terms in case of a major fire (NRC, 1984). The assigned release fractions for different materials are based on studies conducted by Battelle Northwest Laboratory (Mishima et al., 1968; Sutter and Mishima, 1981; Mishima and Schwendiman, 1973). For uranium in an unsealed form, the assigned release fraction is 0.001 (NRC, 1984). The general rationale for this assigned fraction is that the material is not a volatile powder; a small fraction of the powder (a few percent) is of respirable-size, and experiments conducted usually found releases of respirable size particles of about 0.001 or less. Therefore, the total quantity released during a fire lasting one hour would be $3.9 \times 10^{1}$ μCi/s. Using a conservative X/Q of $2.3 \times 10^{-4}$ s/m$^3$ for accident situations (NRC, 1979), the average uranium concentration at the nearest residence would be $9.1 \times 10^{-5}$ μCi/m$^3$. An adult at this location exposed to the plume for one hour would receive, through the inhalation pathway, an effective whole body dose commitment of about $9 \times 10^{-3}$ rem. This value is well below the EPA's Protective Action Guide of 1 to 5 rem for emergency preparedness (EPA, 1980). No evaluation of this same accident on the basis of chemical toxicity was performed, because the fire would convert any soluble uranium to the insoluble, biologically non-dispersible form.

#### 4.12.1.3.2 Nonradiological Accidents

Environmental impacts that may occur at a low-level-enrichment nuclear fuel fabrication plant would most likely result from possible accidents associated with potentially harmful chemicals rather than from radioactive materials. Thus, the CFFF under the No-Action alternative can be considered in the same class as any other manufacturing plant where significant quantities of nonradioactive chemicals are processed. A summary of the location and quantity of chemicals stored onsite is included in Appendix B, Table B-1.

Category 1. Category 1 accidents within the manufacturing building in the chemical processing area would be typified by minor liquid spills (i.e., 40 L [10 gal] or less) of acids, ammonium diuranate, uranyl nitrate, and oil. Operators can quickly detect these spills and take corrective action (such as isolation of the leaking section). The spilled liquids would be quickly cleaned up and transferred to appropriate waste containers or, if appropriate, returned to the process for recovery. No floor drains are present in the chemical processing area of the main plant building; therefore, there would be no release to the environment through either airborne or liquid pathways.

Category 1 accidents external to the manufacturing building that are likely to happen during the life of the plant include minor process-equipment leaks or small spills (200 L [50 gal] or less). A leak of this type would be located rapidly by operators, and corrective action would be implemented. Another Category 1 accident could result from the release of chemicals by a leak in the liner of a waste-holding lagoon. Such a release would contaminate underlying soil and groundwater. The contaminated groundwater would discharge into Sunset Lake and the small onsite pond. Depending on the magnitude of the release and the contaminants present, concentrations could rise to levels that are hazardous to aquatic life.

Category 2. Category 2 accidents occurring in the chemical storage areas outside the manufacturing building could result in complete or partial emptying of a bulk chemical storage tank. Such a release is considered very unlikely because storage vessels are designed using good engineering practices and are filled according to safe operating procedures. To experience a rupture or failure, some unforeseen catastrophic disaster would have to occur, or all current safety systems would have to deteriorate simultaneously. Nevertheless, the most conceivable release scenarios involve 1) exposure of the storage vessels to an intense, prolonged fire with

subsequent release of vapors through pressure relief valves and 2) tank rupture caused by a projectile from an adjacent explosion.

In 1975, protective dikes that could contain approximately 136,000 L (36,000 gal) of a liquid release in the event of complete tank failure were placed around the chemical tank farm. The dikes were further upgraded in 1982 to assure that leaks do not reach the groundwater. Any overflow would run through the storm drainage ditch to Upper Sunset Lake, where it would mix and flow into Lower Sunset Lake via a causeway. Lower Sunset Lake drains into Mill Creek, which eventually enters the Congaree River via a meandering route of about 11 km (7 miles). In the event of a major spill, the upper lake can be closed off at the causeway and then diluted by increasing the diverted flow of incoming Mill Creek water. The continuous chemical monitoring and prompt dilution of these waters can prevent significant liquid releases to the offsite environment.

Airborne concentrations of vapors in the release area could be excessive, but after dispersion in the atmosphere, concentrations at the site boundary would not likely require isolation of offsite areas or temporary evacuation of residents. Some of the potential vapors, such as ammonia and hydrogen fluoride, have pungent suffocating odors which would force people away and aid in limiting offsite exposures.

Category 3. These accidents are catastrophic in magnitude and are not expected in the plant's lifetime. All are extremely unlikely; they would involve either container rupture, failure, explosion, fire, natural disaster, or an extremely improbable criticality-type accident. The potential consequences of such accidents have been discussed previously.

### 4.12.2 Proposed Action Alternative—40 Year License Renewal

Under the Proposed Action, no new manufacturing activities would be constructed. Because the 40-year renewal is an extension of time of the existing permit, the radiological, nonradiological, and accident impacts all addressed in the No-Action Alternative apply to the Proposed Action as well. Consequently, there would be no changes to environmental conditions at the CFFF that have potential public and/or occupational health hazards.

Should a cylinder of solid $UF_6$ leak, the quantity of material would not contribute significantly to the plant's normal emissions, and the potential offsite consequences would hot be a concern. Therefore the proposed increase in the $UF_6$ storage pad would not result in a negative environmental impact.

Regarding Calcium Fluoride, per CN-SB-12-018 Rev 0, calculations performed using RESRAD to the maximally exposed individual are shown to be less than 10 mrem/yr. Long term exposures continue to be less than10 mrem/year. The results are based on the industrial worker scenario considering direct exposure to calcium fluoride. Inhalation risks remain below10 mrem/year although will be lower with the use of respiratory equipment while working directly with calcium fluoride in the brick or cement manufacturing process. Dose exposures will be significantly lower due to lower concentrations of calcium fluoride needed in bricks or cement products. Shielding provided by the products is a factor for low dose. Considering the selected pathways in RESRAD 6.5 all doses remain below 10 mrem per year. No environmental risks are expected. Stabilized CaF2 material will not support plant growth and, as a result, pathways such as plant growth and use, food pathways, and animal plant consumption are not reasonable.

### 4.12.3 Mitigation

Under both the No-Action alternative and the Proposed Alternative, controls would be in place to limit airborne, liquid and solid waste effluents to below applicable regulatory limits. The environmental monitoring program described in Section 6.0 would be continued to ensure concentrations of hazardous materials in the environment remain below acceptable levels to protect public and occupational health. Should abnormal increases in any concentrations be detected, the conditions contributing to such increases would be evaluated and the appropriate mitigation measures taken.

## 4.13 Waste Management Impacts

### 4.13.1 No-Action Alternative

Under the No-action alternative, no new manufacturing activities would be constructed. There would be no changes to levels of wastes generated at the CFFF and, therefore, no effects on waste management at the CFFF.

### 4.13.2 Proposed Action Alternative—40 Year License Renewal

Under the No-action alternative, no new manufacturing activities would be constructed. There would be no changes to levels of wastes generated at the CFFF and, therefore, no effects on waste management at the CFFF.

Neither the possession limit increase nor the calcium fluoride limit increase would have an impact on the waste management of CFFF.

### 4.13.3 Mitigation

Waste management under the both alternatives would be in accordance with applicable state and Federal regulations. Low-level radioactive wastes designated for disposal are packaged in DOT-approved 208-L (55-gal) metal drums or in metal boxes. Wastes consigned to disposal are shipped to a licensed disposal facility. Shipments are made in compliance with all applicable NRC, DOT, EPA and State regulations; and, in conformance to disposal site criteria.

Hazardous wastes such as degreasing solvents, lubricating and cutting oils, and spent plating solutions are generated at CFFF. These wastes are regulated under 40 CFR Part 261, Identification and Listing of Hazardous Waste; 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste; and South Carolina Hazardous Waste Regulations R61-79.261. Hazardous Waste Generation Reports are provided quarterly and the waste is disposed of offsite through permitted contractors.