Environmental Report Supplement for Global Nuclear Fuel—Americas, LLC Natrium Fuel Fabrication Facility

Prepared for

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Acronyms and Abbreviations

ALARA	as low as reasonably achievable
ARF	airborne release fraction
CATEX	categorical exclusion
cc	cubic centimeter
CEDE	committed effective dose equivalent
CFR	*Code of Federal Regulations*
Ci	curie
DU	depleted uranium
EA	environmental assessment
EIS	environmental impact statement
ER	environmental report
ft	foot
g	gram
GEH	GE Hitachi Nuclear Energy
GLE	Global Laser Enrichment Project
GNF-A	Global Nuclear Fuel—Americas, LLC
HALEU	high-assay, low-enriched uranium
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air conditioning
kg	kilogram
LEU	low-enriched uranium
µCi	microcurie
µg	microgram
MGD	million gallons per day
mrem	millirem
MTU	metric tons of uranium
Natrium OTR	Natrium out-of-core thermal reactor
NCDENR	North Carolina Department of Environment and Natural Resources
NEPA	National Environmental Policy Act
NFFF	Natrium Fuel Fabrication Facility
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act

RF	respirable fraction
SWMP	stormwater management plan
U	uranium
U10Zr	uranium-zirconium alloy metal (90 percent uranium, 10 percent zirconium)
USCB	U.S. Census Bureau
WMPO	Wilmington Urban Area Metropolitan Planning Organization
wt%	weight percent
yr	year

1 INTRODUCTION

1.1 Background

GE Hitachi Nuclear Energy (GEH) and TerraPower, LLC, are developing the Natrium technology. GEH, TerraPower, and Global Nuclear Fuel—Americas, LLC (GNF-A), have also partnered on a project to produce advanced nuclear reactor fuel technologies with enrichment limits up to 20 weight percent (wt%) uranium (U)-235 supporting TerraPower's award under the U.S. Department of Energy's Advanced Reactor Demonstration Program (Cooperative Agreement No. DE-NE0009054).

The Natrium technology features a 345-megawatt electric reactor combined with a gigawatt-scale thermal energy storage system, sometimes referred to as the Natrium out-of-core thermal reactor or Natrium OTR. The Natrium reactor creates heat that can be used to generate electricity immediately or that can be contained in thermal storage reserves. The stored heat can later be turned into electricity upon demand from the grid when need peaks or renewables are unavailable. The Natrium reactor uses high-assay, low-enriched uranium (HALEU) metallic fuel. HALEU, by definition, can have a candidate enrichment of up to 20 wt% U-235. HALEU metal would be shipped to GNF-A, which would fabricate the HALEU into Natrium fuel rods and assemblies.

As a part of this effort, GNF-A plans to design, license, and construct a standalone Category II fuel fabrication facility, the Natrium Fuel Fabrication Facility (NFFF), for the Natrium demonstration reactor within an existing controlled access area at its facility in Wilmington, North Carolina. Currently, a U.S. Nuclear Regulatory Commission (NRC)-licensed uranium fuel fabrication facility at the proposed site of the Category II HALEU facility is authorized to process uranium with an enrichment of up to 5 wt% U-235 (NRC License No. SNM-1097).

GNF-A will request a license amendment to permit nuclear fuel fabrication at enrichments of up to 20.0 wt% U-235 and authorize operation of the NFFF. This environmental report (ER) supplement provides information to enable the NRC to efficiently complete its environmental review responsibilities under the National Environmental Policy Act (NEPA) for the proposed license amendment.

1.2 Prior Environmental Review

In May 2009, the NRC issued an environmental assessment (EA) for the renewal of NRC License No. SNM-1097 for GNF-A's Wilmington, North Carolina, fuel fabrication facility (NRC 2009). This EA was prepared in accordance with NRC regulations as established in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions"; applicable NRC guidance from NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards Programs," issued August 2003 (NRC 2003); and other relevant NEPA implementing regulations, including Council on Environmental Quality regulations (40 CFR Parts 1500–1508).

The NRC's 2009 EA was based, in part, on GNF-A's application for renewal of NRC License No. SNM-1097 and an associated ER provided by GNF-A (GNF-A 2007). Based on the EA, NRC concluded that the renewal of NRC License No. SNM-1097 involving the continued operation of the GNF-A site in Wilmington, North Carolina, will not cause significant additional impact on the environment.

1.3 Scope and Approach of This Environmental Report Supplement

This ER supplement was prepared pursuant to 10 CFR 51.45, "Environmental report," and NUREG-1748. This ER supplement examines potential changes in environmental impacts, including cumulative impacts, of operations at GNF-A's Wilmington, North Carolina, facility that may result from the proposed new license amendment.

The baseline for this analysis is the NRC's 2009 EA, which is hereby incorporated by reference. The facility description and potential environmental impacts described in the NRC's 2009 EA would be essentially unchanged except as noted in this ER supplement. This ER supplement also references relevant analyses in the NRC environmental impact statement (EIS), NUREG-1938, "Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina," issued February 2012 (NRC 2012).

Due to the evolving nature of the facility's design, some of the documents referenced in this report are in their "draft" stage. As the design matures, these documents will be finalized. GNF-A commits to monitoring these draft reports to ensure that their final versions do not invalidate any of this report's conclusions.

In accordance with 10 CFR 51.45(b)(1) and NUREG-1748, this ER supplement describes potential environmental consequences in proportion to their significance, focusing primarily on those environmental resource areas or issues that would be affected by the license renewal and providing a greater level of detail for them. In addition, a greater level of detail is provided in the analysis of the four criteria in 10 CFR 51.22(c)(11), described in section 1.4.

1.4 Relevant NRC NEPA Requirements

In 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," the NRC identifies licensing and regulatory actions that are eligible for categorical exclusion (CATEX). One class of action under 10 CFR 51.22(c)(11) appears to encompass the proposed standalone Category II HALEU fuel facility. This CATEX states the following:

> Issuance of amendments to licenses for fuel cycle plants and radioactive waste disposal sites and amendments to materials licenses identified in § 51.60(b)(1) which are administrative, organizational, or procedural in nature, or which result in a change in process operations or equipment, provided that:
>
> (i) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite,
>
> (ii) there is no significant increase in individual or cumulative occupational radiation exposure,
>
> (iii) there is no significant construction impact, and
>
> (iv) there is no significant increase in the potential for or consequences from radiological accidents.

1.5 Report Organization

Section 2 of this ER supplement describes the NFFF, activities that would be authorized under the proposed license amendment, and the chemical, physical, and radiological similarities and differences between low-enriched uranium (LEU) and HALEU.

Section 3 analyzes the potential impacts of the proposed facility with respect to the four criteria of CATEX 10 CFR 51.22(c)(11) discussed in section 1.4.

Section 4 analyzes a range of other environmental issues and factors for which potential impacts may differ from those analyzed in the 2009 NRC EA. This analysis is intended to inform a conclusion about whether the proposed new activities would alter the previously evaluated environmental impacts associated with the licensed operations, and whether there are any "special" or "extraordinary" circumstances present that would preclude the application of a CATEX.

Section 5 summarizes the findings of this ER supplement, including key findings that arguably support the case for a potential CATEX classification ultimately determined by the NRC for the proposed action.

2 FACILITY DESCRIPTION AND OVERVIEW OF OPERATIONS

2.1 Physical Description

The conceptual design report prepared by Jacobs Engineering Group Inc. (Jacobs 2022) provides a detailed description of the facility, as summarized in this section.

The NFFF would be located in the northeast sector of the controlled access area of the GNF-A campus near the electrical substation (see figure 1). The site had been used previously in the manufacturing process but has since been vacated. The site is bounded by Centennial Drive to the east, a steam line to the north, a storage area to the west, and a service road to the south. The site area for the proposed facility is approximately 4 hectares [10 acres].

The NFFF would be composed of a main process facility building with direct adjacent supporting ancillary functions. The 14,273 gross-square-meter [153,630 gross-square-foot (ft)] main processing building would be located at the northwest corner of the intersection of a service road running east/west with Centennial Drive. The predominately one-story process building would include a second story providing utility support activities. Ancillary facilities include a 465 square-meter [5,000 square-ft] process waste storage building and outdoor areas. Outdoor areas include pads for bottled gases, electrical/power infrastructure, and heating, ventilation, and air-conditioning (HVAC) equipment yards.

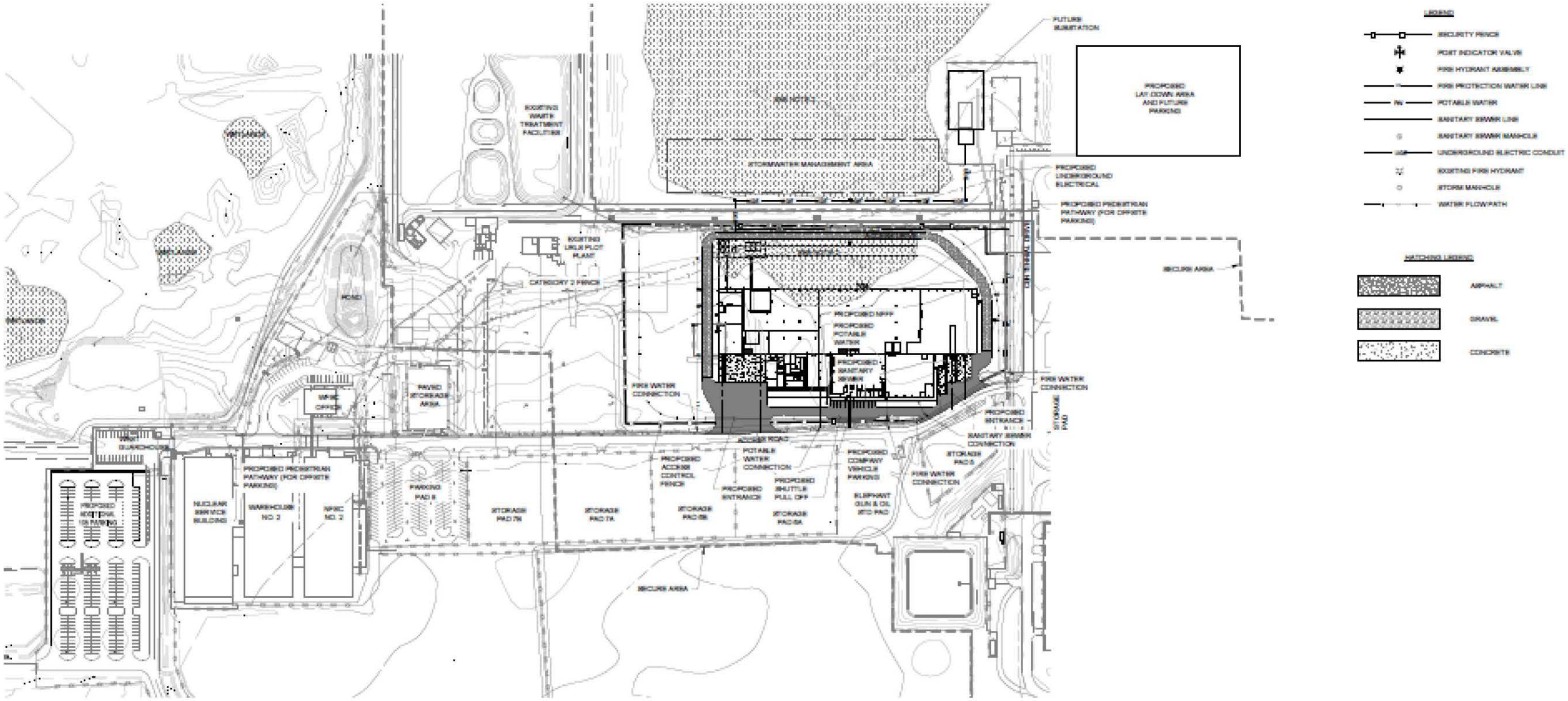

Figure 1 Proposed site location

In addition, GNF-A proposes to design and install a new 15/20/25 megavolt-ampere transformer with redundant switchgear to provide the new 3.5 megawatts of planned load increases associated with operation of the NFFF. A new substation could be built in the open area immediately to the west of the existing substation. A new access road could be built to separate the two stations and facilitate the full separation of facility loads at the site. A wooded area near the planned new substation location is proposed to be cleared to allow sufficient space for a laydown yard as requested by site operations staff. However, this area must be surveyed to determine whether wetlands are present. If they are, the area may need to be avoided and an alternative laydown location chosen.

2.2 Stormwater Management

Although the NFFF footprint would not directly impact surface water resources such as streams, surface impoundments, or wetlands, a stormwater management plan (SWMP) would be developed to ensure water resources are protected during construction and operation.

Stormwater discharges from the current GNF-A facility are regulated under National Pollutant Discharge Elimination System (NPDES) Stormwater Permit NC000022, issued by the North Carolina Department of Environment and Natural Resources (NCDENR). This permit requires monitoring to ensure compliance with a prescribed set of effluent standards and calls for development and implementation of a stormwater pollutant prevention plan.

The NFFF conceptual design report (Jacobs 2022) states that an SWMP for the new facility would be designed in accordance with the New Hanover County Stormwater Design Manual, issued September 2022 (New Hanover County 2022). This design manual seeks to minimize flooding, water quality impacts, and erosion; prevent offsite sedimentation; and manage stormwater runoff. The SWMP would include supporting documentation consisting of site plans with required certifications, a stormwater report, design data and calculations, a downstream assessment, information regarding other permits required for the development of the site, and other such material as may be required by the county to review the stormwater permit application for a project. Stormwater runoff from the site would be collected in either catch basins or drainage swales dispersed around the facility. Once collected, the runoff would be conveyed through a combination of culverts and swales to a detention facility on the north side of the building. As the stormwater is conveyed, it would go through a series of treatments to improve the quality of discharges from the site. These treatments would be based on the North Carolina Department of Environmental Quality best management practices. These may include bioretention cells, treatment swales, dry ponds, and various other techniques required to meet the county and State standards.

2.3 Facility Operations

2.3.1 Overview of Operations

GNF-A will request a license amendment to permit nuclear fuel fabrication at enrichments up to 20.0 wt% U-235, and to authorize operation of the NFFF. The NFFF would produce metallic nuclear fuel assemblies to power the Natrium reactor. The fuel consists of a uranium-zirconium alloy metal (90 percent uranium, 10 percent zirconium, called U10Zr). Sodium metal would be included inside the fuel pins to provide superior heat transfer characteristics. The throughput rate for the current fuel manufacturing facility at the site is approximately 1,200 metric tons of uranium (MTU) per year (yr). Natrium production will not reduce any of the existing effluent streams at the site but would only add very small quantities to the existing streams. The anticipated average Natrium fabrication throughput rate is estimated to be 18 MTU/yr (inclusive of both HALEU and depleted uranium [DU] processing contributions), which would be approximately a 1.5 percent increase over existing operations.

The NFFF would process HALEU and DU metal within a contamination-controlled area. The HALEU and DU would be derived from natural uranium ore and would principally consist of the constituent isotopes U-235 and U-238.

The NFFF design would incorporate an area for incoming materials, a uranium processing area with nuclear-grade ventilation, an industrial processing area for handling encapsulated uranium (inside fuel pins for example), product inspection and storage areas, and a product shipping area. The siting of the facility within the existing GNF-A contamination-controlled area would be optimized for personnel access, shipping/receiving, and minimum impacts to ongoing production activities. The processes and equipment expected to be used in the NFFF are based on historical sodium fast reactor metal fuel production technologies developed at Idaho National Laboratory.

2.3.2 Radiological Aspects of HALEU Fuel

As alluded to in section 2.3.1, the NFFF would process HALEU and DU metal within a contamination-controlled area. The HALEU and DU would be derived from natural uranium ore with potential allowance for *minimal* contamination from reprocessed uranium. The proposed HALEU and DU material specifications limit the inclusion of any minor uranium isotopes to less than 0.0001 microgram (µg) U-232 per gram of uranium, less than 12,500 µg U-234 per gram of U-235, and less than 250 µg U-236 per gram of uranium. No measurable transuranic (e.g., plutonium) or measurable fission product quantities would be allowed in the uranium feedstock throughout the NFFF's operational campaign.

As for the feedstock's primary isotopic characterization, based on the empirical equation from Rich, et al. (1988), the specific activity of uranium increases as the weight percentage of U-235 increases, as depicted in figure 2.

Not only does the uranium-specific activity increase, but the mix of uranium isotopes also changes as the U-235 weight percentage increases. Figure 3 shows the U-234, U-235, and U-238 alpha activity percentages as a function of the U-235 weight percentage.

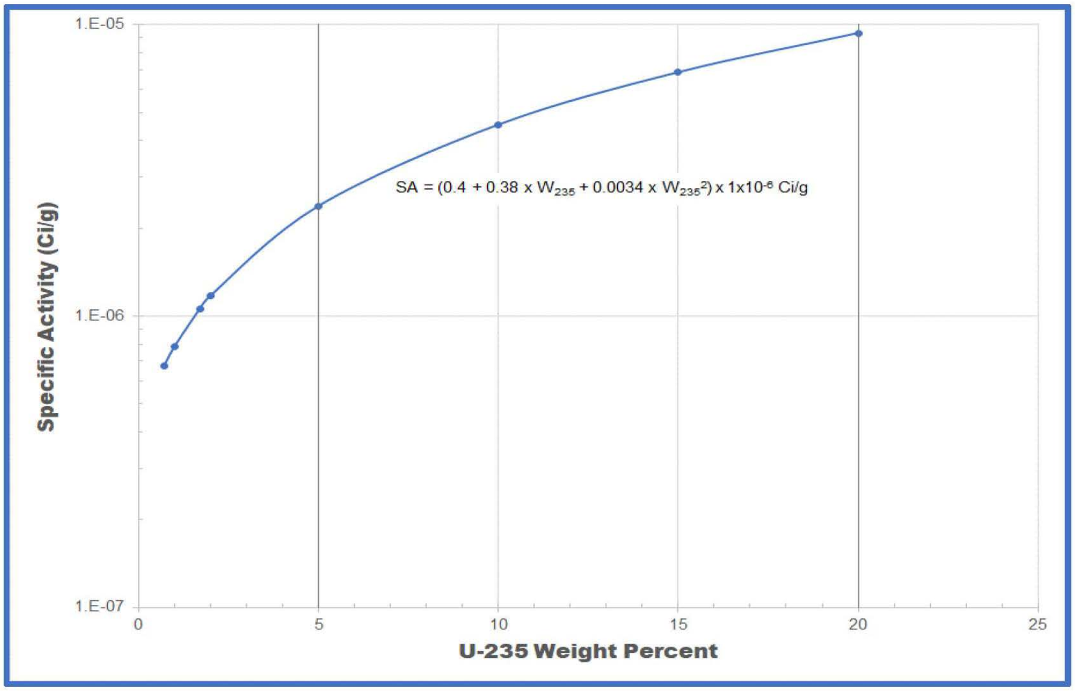

Figure 2 Uranium-specific activity

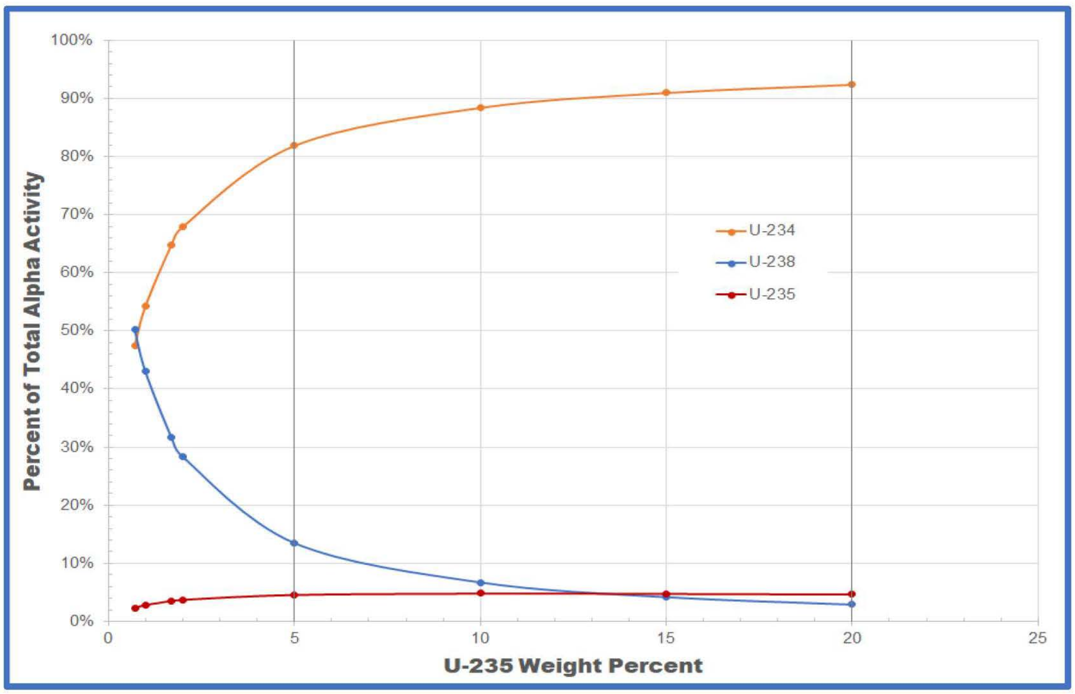

Figure 3 Percent U-234, U-235, and U-238 alpha activity

Using the information in figures 2 and 3, table 1 compares the uranium radiological characteristics of 5 wt% and 20 wt% U-235 fuel (i.e., LEU and HALEU, respectively).

Table 1 Uranium Isotope Concentrations

U-235 (wt%)	Concentration (Ci/g)			
	U-235	U-234	U-238	Total
5 (LEU)	1.10E-07	1.95E-06	3.23E-07	2.39E-06
20 (HALEU)	4.40E-07	9.83E-06	2.71E-07	1.05E-05

Table 1 compares the U-235, U-234, and U-238 concentrations at 5 and 20 wt% U-235. Obviously, at 20 wt%, the U-235 concentration is exactly 4 times what it is at 5 wt%, while the U-234 concentration at U-235 20 wt% is approximately 5 times what it is at 5 wt% U-235, and the U-238 concentration at U-235 20 wt% decreases slightly to 0.84 times what it is at 5 wt% U-235. These differences in the uranium isotopic mix could theoretically result in slightly different effluent streams and occupational exposures from processing U-235 fuel of 20 wt% versus 5 wt%.

The information provided in table 1 was used to draw the associated conclusions discussed in sections 3.1 and 3.2 with regard to (any) expected discernible deltas for radiological effluents and occupational radiation exposures, respectively, associated with the proposed new standalone Category II HALEU fuel fabrication facility. Projected deltas were compared to historically reported effluents and worker exposures of the existing operating GNF-A Wilmington facility in order to determine whether or not any such changes/increases are significant.

3 EVALUATION WITH RESPECT TO THE FOUR CRITERIA IN 10 CFR 51.22(C)(11)

3.1 There is no significant change in the types or significant increase in the amounts of any effluents that may be released off site.

3.1.1 Radiological Releases

Semiannually, GNF-A is required to report its gaseous and liquid effluents to the NRC as required by 10 CFR 70.59, “Effluent monitoring requirements.” To serve as a baseline for prototypical releases from present site operations, four of those semiannual reports have been randomly selected for analysis: January 2022–June 2022, January 2019–June 2019, July 2019–December 2019, and July 2018–December 2018 (GNF-A 2022, 2019b, 2020, 2019a, respectively). The reports include information on activity released, offsite concentrations, and public exposures for U-234, U-235, and U-238.

In support of this ER supplement’s analysis for estimating anticipated radiological release quantities from proposed NFFF operations, historically released U-234, U-235, and U-238 activities associated with previous LEU fuel processing at the site were first converted to mass releases, with the total uranium mass release then subsequently calculated. The isotopic mix of the total calculated uranium mass release was then adjusted to be proportionally representative of what would be expected isotopically for HALEU 20 wt% U-235 fuel, with the resulting uranium isotopic ratioed quantities then evaluated as hypothetical releases from the NFFF (i.e., predicted NFFF source terms). The 20 wt% U-235 uranium isotopic release quantity estimates were then consequently converted into activity-based quantities as a final step. Table 2 provides the complete series of calculations.

Table 2 Estimated U-235 20 wt% Radiological Releases from NFFF Operations (based on a normalized 1,200 MTU/yr throughput)

Uranium Isotope	GASEOUS EFFLUENT—PARTICULATE (Ci)				GASEOUS EFFLUENT—PARTICULATE (g)			
	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018
	As historically reported for 5% LEU				Calculated (historical 5% LEU)			
U-234	7.86E-06	7.14E-06	7.81E-06	3.65E-06	1.25E-03	1.13E-03	1.24E-03	5.79E-04
U-235	3.33E-07	2.97E-07	3.45E-07	1.47E-06	1.51E-01	1.35E-01	1.57E-01	6.68E-01
U-238	1.22E-06	9.93E-07	1.21E-06	5.03E-06	3.59E+00	2.92E+00	3.56E+00	1.48E+01
TOTAL	9.41E-06	8.43E-06	9.37E-06	1.02E-05	3.74E+00	3.06E+00	3.72E+00	1.55E+01
	Adjusted to U-235 20 wt%				Adjusted to U-235 20 wt%			
U-234	3.68E-05	3.00E-05	3.65E-05	1.52E-04	5.84E-03	4.77E-03	5.80E-03	2.41E-02
U-235	1.65E-06	1.34E-06	1.64E-06	6.80E-06	7.48E-01	6.11E-01	7.43E-01	3.09E+00
U-238	1.02E-06	8.30E-07	1.01E-06	4.20E-06	2.99E+00	2.44E+00	2.97E+00	1.23E+01
TOTAL	3.94E-05	3.22E-05	3.92E-05	1.63E-04	3.74E+00	3.06E+00	3.72E+00	1.55E+01
Uranium Isotope	LIQUID EFFLUENT (Ci)				LIQUID EFFLUENT (g)			
	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018
	As historically reported for 5% LEU				Calculated (historical 5% LEU)			
U-234	3.40E-03	6.96E-03	9.22E-03	1.64E-03	5.40E-01	1.10E+00	1.46E+00	2.60E-01
U-235	1.44E-04	2.89E-04	4.07E-04	6.60E-04	6.55E+01	1.31E+02	1.85E+02	3.00E+02
U-238	5.28E-04	9.68E-04	1.43E-03	2.26E-03	1.55E+03	2.85E+03	4.21E+03	6.65E+03
TOTAL	4.07E-03	8.22E-03	1.11E-02	4.56E-03	1.62E+03	2.98E+03	4.39E+03	6.95E+03
	Adjusted to U-235 20 wt%				Adjusted to U-235 20 wt%			
U-234	1.59E-02	2.93E-02	4.32E-02	6.83E-02	2.53E+00	4.65E+00	6.85E+00	1.08E+01
U-235	7.12E-04	1.31E-03	1.93E-03	3.06E-03	3.24E+02	5.96E+02	8.78E+02	1.39E+03
U-238	4.39E-04	8.09E-04	1.19E-03	1.89E-03	1.29E+03	2.38E+03	3.51E+03	5.55E+03
TOTAL	1.71E-02	3.14E-02	4.63E-02	7.32E-02	1.62E+03	2.98E+03	4.39E+03	6.95E+03

The offsite concentrations for both gaseous and liquid effluents were next calculated by multiplying the reported concentrations by the isotopic ratios, and the U-235 20 wt% concentrations were then compared to the limits in columns 1 and 2 in table 2 in Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," to 10 CFR Part 20, "Standards for Protection Against Radiation. Table 3 shows this series of calculations and that the Appendix B limits would not be exceeded by the processing of U-235 20 wt% fuel during NFFF operations.

Table 3 Estimated U-235 20 wt% Offsite Concentrations Resulting from NFFF Operations (based on a normalized 1,200 MTU/yr throughput)

Uranium Isotope	GASEOUS EFFLUENT—Concentration (µCi/cc)				GASEOUS EFFLUENT—% of Limit			
	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018
	As historically reported for 5% LEU				As historically reported for 5% LEU			
U-234	4.39E-15	3.93E-15	4.28E-15	2.05E-15	0.09%	0.08%	0.09%	0.04%
U-235	1.86E-16	1.63E-16	1.89E-16	8.26E-16	0.00%	0.00%	0.00%	0.01%
U-238	6.82E-16	5.46E-16	6.64E-16	2.82E-15	0.01%	0.01%	0.01%	0.05%
	Adjusted to U-235 20 wt%				Adjusted to U-235 20 wt%			
U-234	2.05E-14	1.84E-14	2.00E-14	9.59E-15	0.41%	0.37%	0.40%	0.19%
U-235	9.19E-16	8.06E-16	9.34E-16	4.08E-15	0.02%	0.01%	0.02%	0.07%
U-238	5.68E-16	4.54E-16	5.53E-16	2.35E-15	0.01%	0.01%	0.01%	0.04%
	LIQUID EFFLUENT—Concentration (µCi/cc)				LIQUID EFFLUENT—% of Limit			
	As historically reported for 5% LEU				As historically reported for 5% LEU			
U-234	1.82E-08	3.46E-08	4.47E-08	7.78E-09	6.07%	11.53%	14.90%	2.59%
U-235	7.71E-10	1.44E-09	1.97E-09	3.13E-09	0.26%	0.48%	0.66%	1.04%
U-238	2.83E-09	4.81E-09	6.92E-09	1.07E-08	0.94%	1.60%	2.31%	3.57%
	Adjusted to U-235 20 wt%				Adjusted to U-235 20 wt%			
U-234	8.52E-08	1.62E-07	2.09E-07	3.64E-08	28.39%	53.97%	69.73%	12.14%
U-235	3.81E-09	7.12E-09	9.75E-09	1.55E-08	1.27%	2.37%	3.25%	5.16%
U-238	2.36E-09	4.00E-09	5.76E-09	8.91E-09	0.79%	1.33%	1.92%	2.97%

In the final series of calculations presented below, historically reported committed effective dose equivalent (CEDE) doses (per specific isotope) to the public were adjusted by accordingly multiplying these doses by the ratio of estimated U-235 20 wt% releases to previously reported releases (per isotope). Table 4 shows this series of calculations and that the processing of U-235 20 wt% fuel at the NFFF would not result in any offsite exposure above one-half (since these are semiannual releases) the 10 CFR 20.1301(a)(1) dose limit of 100 millirem (mrem)/yr for individual members of the public, and it also would be in compliance with the 10 CFR 20.1101(d) as low as reasonably achievable (ALARA) constraint of 10 mrem/yr. It is moreover noteworthy to emphasize that the total estimated annual CEDE to a maximally exposed member of the public from projected NFFF operations at a hypothetically identical throughput level that LEU is processed at (i.e., 1,200 MTU/yr) would be significantly less than both of the above-described compliance levels (essentially on the order of 0.2 mrem/yr) and would generally be expected to be a factor of about 4 times greater than the essentially de minimis historical annual CEDEs associated with typical LEU processing operations at the site. However, since HALEU operations are only expected to process an average throughput of 18 MTU/yr, the aforementioned 0.2 mrem/yr value (mathematically correlated to a throughput of 1,200 MTU/yr) would actually be expected to be about a factor of 67 lower, which would therefore equate to an estimated annual CEDE of 0.003 mrem/yr. As a result of this reduced dose estimate based on the much lower anticipated throughput of HALEU fuel versus historical LEU processing rates, the actual delta in public dose from the addition of operations at the

NFFF would only be expected to result in about a 6 percent net increase (i.e., ~0.05 mrem/yr to ~0.053 mrem/yr).

Table 4 U-235 20 wt% Offsite Doses (based on a normalized 1,200 MTU/yr throughput)

Uranium Isotope	GASEOUS EFFLUENT—CEDE (mrem)				GASEOUS EFFLUENT—CEDE (Lung) (mrem)			
	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018	January 2022–June 2022	January 2019–June 2019	July 2019–December 2019	July 2018–December 2018
	As reported				As reported			
U-234	2.20E-02	1.96E-02	2.14E-02	1.03E-02	1.84E-01	1.65E-01	1.80E-01	8.61E-02
U-235	7.81E-04	6.86E-04	7.94E-04	3.47E-03	6.51E-03	5.71E-03	6.62E-03	2.89E-02
U-238	2.86E-03	2.29E-03	2.79E-03	1.19E-02	2.39E-02	1.91E-02	2.32E-02	9.88E-02
Total	2.56E-02	2.26E-02	2.50E-02	2.57E-02	2.14E-01	1.90E-01	2.10E-01	2.14E-01
	Calculated at U-235 20 wt% (mrem)				Calculated at U-235 20 wt% (mrem)			
U-234	1.03E-01	9.17E-02	1.00E-01	4.82E-02	8.61E-01	7.72E-01	8.42E-01	4.03E-01
U-235	3.86E-03	3.39E-03	3.92E-03	1.72E-02	3.22E-02	2.82E-02	3.27E-02	1.43E-01
U-238	2.38E-03	1.91E-03	2.32E-03	9.91E-03	1.99E-02	1.59E-02	1.93E-02	8.22E-02
Total	1.09E-01	9.70E-02	1.06E-01	7.52E-02	9.13E-01	8.16E-01	8.94E-01	6.28E-01
	LIQUID EFFLUENT—CEDE (mrem)				LIQUID EFFLUENT—CEDE (Bone Surface) (mrem)			
	As reported				As reported			
U-234	1.33E-06	2.52E-06	3.26E-06	5.68E-07	1.93E-05	3.66E-05	4.73E-05	8.24E-06
U-235	8.02E-08	1.50E-07	2.05E-07	3.26E-07	1.16E-06	2.17E-06	2.97E-06	4.72E-06
U-238	1.87E-07	3.18E-07	4.57E-07	7.07E-07	2.71E-06	4.61E-06	6.62E-06	1.02E-05
Total	1.60E-06	2.99E-06	3.92E-06	1.60E-06	2.32E-05	4.34E-05	5.69E-05	2.32E-05
	Calculated at U-235 20 wt% (mrem)				Calculated at U-235 20 wt% (mrem)			
U-234	6.22E-06	1.18E-05	1.53E-05	2.66E-06	9.03E-05	1.71E-04	2.21E-04	3.86E-05
U-235	3.97E-07	7.42E-07	1.01E-06	1.61E-06	5.74E-06	1.07E-05	1.47E-05	2.33E-05
U-238	1.56E-07	2.65E-07	3.80E-07	5.88E-07	2.26E-06	3.84E-06	5.51E-06	8.49E-06
Total	6.78E-06	1.28E-05	1.67E-05	4.86E-06	9.83E-05	1.86E-04	2.42E-04	7.04E-05

Based on the above analysis, there is no significant change in the types or amounts of any radiological effluents that may be released off site. An increase of 6 percent from 0.05 mrem/yr to a total annual CEDE of 0.053 mrem/yr is considered de minimis.

3.1.2 Nonradiological Releases

The fabrication of HALEU fuel would be essentially the same as current fuel fabrication, except for the HALEU fuel's higher U-235 content. Therefore, on a uranium mass processing basis, there would be no significant change in the types or amounts of any nonradiological effluents that may be released off site. The discussion in sections 3.1.3, 3.1.4, and 3.1.5 expands further on this conclusion.

3.1.3 Solid Waste Streams

Proposed operations in the NFFF would generate a variety of solid waste streams, including radiological, hazardous, and mixed wastes (wastes with both radiological and Resource Conservation and Recovery Act [RCRA] hazardous constituents). Solid wastes would be managed in accordance with all applicable requirements.

None of the solid wastes are effluents that would be released off site. They are presented here with the discussion of effluents to provide a more complete picture of waste streams and an overall context of the scope and nature of the proposed new facilities in comparison with current licensed operations.

The report "Process Design Description for Waste Treatment," Revision 0, issued February 2023 (GNF-A and TerraPower 2023), identifies solid waste streams that would be generated and discusses how they would be managed, including plans for collection, treatment, and disposition. For some types of waste for which final disposition plans remain under development, the draft report discusses options. An overview of information from that report is summarized in sections 3.1.3.1, 3.1.3.2, 3.1.4, and 3.1.5.

In general, solid wastes anticipated from the proposed NFFF would be similar in nature to wastes from existing fuel fabrication operations under NRC License No. SNM-1097. Based on the smaller uranium throughput of the NFFF (18 MTU/yr) in comparison with current fuel manufacturing operations (1,200 MTU/yr), waste quantities from the new facilities would be substantially less and, taken together, cumulative impacts related to solid waste management would be essentially the same.

3.1.3.1 Solid Waste Overview

An assumed value of 5 percent of the HALEU fuel processed within the NFFF is anticipated to be waste. For 18 MTU, that is equivalent to 900 kilograms (kg) of HALEU. GNF-A is exploring ways to minimize HALEU waste in each process step to reduce costs. At current estimates of $10,000 to $20,000 per kg of HALEU, this corresponds to $9.0 million to $18 million in nonrecycled fuel plus the additional high costs of disposal, providing an incentive for waste minimization. Although current plans would ensure that all of the wastes are managed safely and in an environmentally sound manner, additional waste minimization would further reduce any potential safety or environmental risks as well as reduce costs.

Most of the waste would be generated during the injection casting process. The remainder would be realized primarily from laboratory samples, cleanup, HVAC/hood/radiological ventilation filters, and effluent streams. Some other wastes would be generated in the NFFF, including general, hazardous, and mixed wastes. Wastes would be categorized as a solid, liquid, or gaseous stream and either contaminated (radiologically) or noncontaminated. Chemical waste disposal would follow all applicable State/Federal RCRA regulations as well as disposal requirements for potential mixed waste as applicable under NRC License No. SNM-1097.

Expected solid waste streams include high-value U10Zr alloy (in various forms) and sodium metal (and reaction products). Contaminated molds (quartz tubing) from the injection casting process are another major (contaminated) solid waste stream. Other solid waste streams include failed equipment (and components), HVAC filters, radiological ventilation filters, rejected pin components, graphite crucibles, crucible refurbishment fines, and various components and tools. These items may be contaminated with uranium or reacted sodium compounds, or both.

High-uranium-content scrap material would be handled separately from contaminated wastes with lower uranium content. This includes alloy dross from the induction melting process and alloy rejected for high chemical impurities that cannot be melt-refined in the plant or diluted to meet impurity specification limits. These materials would be consolidated and stored in the uranium storage area. GNF-A plans to develop a purification process for specific nonconforming impurities. Other options for disposition include packaging into an approved shipping container for shipment to an offsite facility for reclamation or other disposition. A specific offsite reclamation/disposition path has not yet been identified.

Contaminated quartz molds (up to 2.1 cubic meters/yr [75 cubic ft/yr]) and contaminated graphite crucibles (up to 1 cubic meter/yr [37 cubic ft/yr]) would be consolidated into containers and stored in the waste storage area. Options for disposition of the above materials include further processing or offsite disposal.

Contaminated general solid waste (up to 181 cubic meters/yr [6,400 cubic ft/yr]) would be packaged in waste containers and placed into waste storage, pending disposition. General solid wastes include pin components, equipment components, preprocessed filters (roughing and high-efficiency particulate air [HEPA] filters), maintenance items, and personal protective equipment.

Hazardous waste such as lightbulbs and batteries would be collected, processed, and segregated. Where possible, in order to reduce the volume of mixed waste items, they would be disassembled, decontaminated, surveyed for release from the contamination-controlled area, and packaged in approved containers for disposal.

Mixed waste items that cannot be decontaminated would be packaged in approved hazardous containers for disposal as low-level mixed waste.

3.1.3.2 Sodium-Bearing Waste

One type of waste that would be generated at the NFFF, sodium-bearing waste, is not generated at the existing fuel manufacturing facility. Sodium-bearing waste management is described in GNF-A and TerraPower (2023) and summarized below.

Sodium metal would be used in the pin fabrication process. The maximum expected quantity to be processed is 720 kg/yr. Noncontaminated sodium waste (oxidized) in the original container (less than 15 kg sodium) would be packaged and sent back to the sodium supplier for purification or disposal. This is expected to occur intermittently and would not be a regular steady volume of waste.

Sodium-bearing waste would be segregated from all other waste streams to minimize the hazards associated with sodium. GNF-A is exploring whether recycling is a viable option for this material.

Potentially contaminated solid sodium would be produced as scrap during the pin fabrication and recycle processes. Although the precise amount of sodium that would be produced as scrap during the pin fabrication process is uncertain, it is assumed that 2 percent of the pins would be rejected and need to be recycled. The bulk of the sodium will be melted and removed from the pin. This portion of the contaminated sodium waste represents 14 kg of sodium metal/yr. Contaminated sodium scrap would be put in a container under inert mineral oil and sealed.

Ethanol would be used in the pin recycle process to remove residual sodium from the pin components. Contaminated ethanol solutions that contain sodium hydroxide would be produced during the pin recycle process. Pin components generated during the pin recycle process would be placed in a pure ethanol bath to react and remove elemental residual sodium. The resulting solution would contain sodium hydroxide and excess ethanol and would be potentially contaminated with uranium. These wastes would be treated as appropriate to enable disposal.

Overall, there would be no change from previously analyzed environmental impacts related to solid waste management activities at the GNF-A site, which would remain small.

3.1.4 Liquid Waste Streams

At the existing GNF-A facility, liquid effluents from the process and sanitary waste systems are treated and discharged into the Northeast Cape Fear River in accordance with NPDES Permit NC0001228 and 10 CFR Part 20 requirements. Although the NPDES permit expired on January 31, 2022, GNF-A submitted a timely application for renewal to NCDENR and is operating in substantial compliance with the permit.

Under the NPDES permit, GNF-A is authorized to discharge up to 1.8 million gallons per day (MGD) of process wastewater, and 0.075 MGD of sanitary wastewater. Process and sanitary wastewater streams are monitored and discharged through separate outfalls (001 and 002, respectively; see figure 4) in accordance with the NPDES permit.

Treated process wastewater flows through a system of lagoons before discharge. Monthly discharge monitoring reports for the 12-month period through October 2022 show substantial compliance, with no reported excursions. During this period, monthly process flow rates averaged 0.2 MGD with a daily maximum of 0.45 MGD, well below the permit limit of 1.8 MGD, indicating substantial capacity to accommodate additional wastewater flows.

Similarly, GNF-A's treatment system for sanitary wastewater has adequate capacity for additional flows. In accordance with the NPDES permit, GNF-A operates a water reclamation and distribution system under which sanitary wastewater is treated and recycled for internal users at the GNF-A facility, and no sanitary wastewater was discharged to the permitted outfall during the past year.

Liquid wastewater that would be generated from the proposed NFFF is described in GNF-A and TerraPower (2023) and summarized below. An estimated 10 gallons per minute of liquid wastewater would be generated from a variety of sources, including liquid laboratory wastes, cleaning liquid wastes, slug recycle cleaning liquids, and general wastewater.

General wastewater from the uranium processing areas (i.e., HVAC condensate, scrubber water, laundry, lab effluents) would be monitored continuously for uranium content by a pipe detector system to ensure it meets discharge limits or, if necessary, is processed through a wastewater treatment system to remove uranium through flocculation and filtration. After processing, another pipe detector system would monitor the wastewater continuously for uranium content to ensure it meets discharge limits. Wastewater that does meet discharge limits would be pH-adjusted and discharged to the existing GNF-A site aeration basins and lagoons, which has adequate capacity to accommodate this waste stream in accordance with NPDES permit requirements.

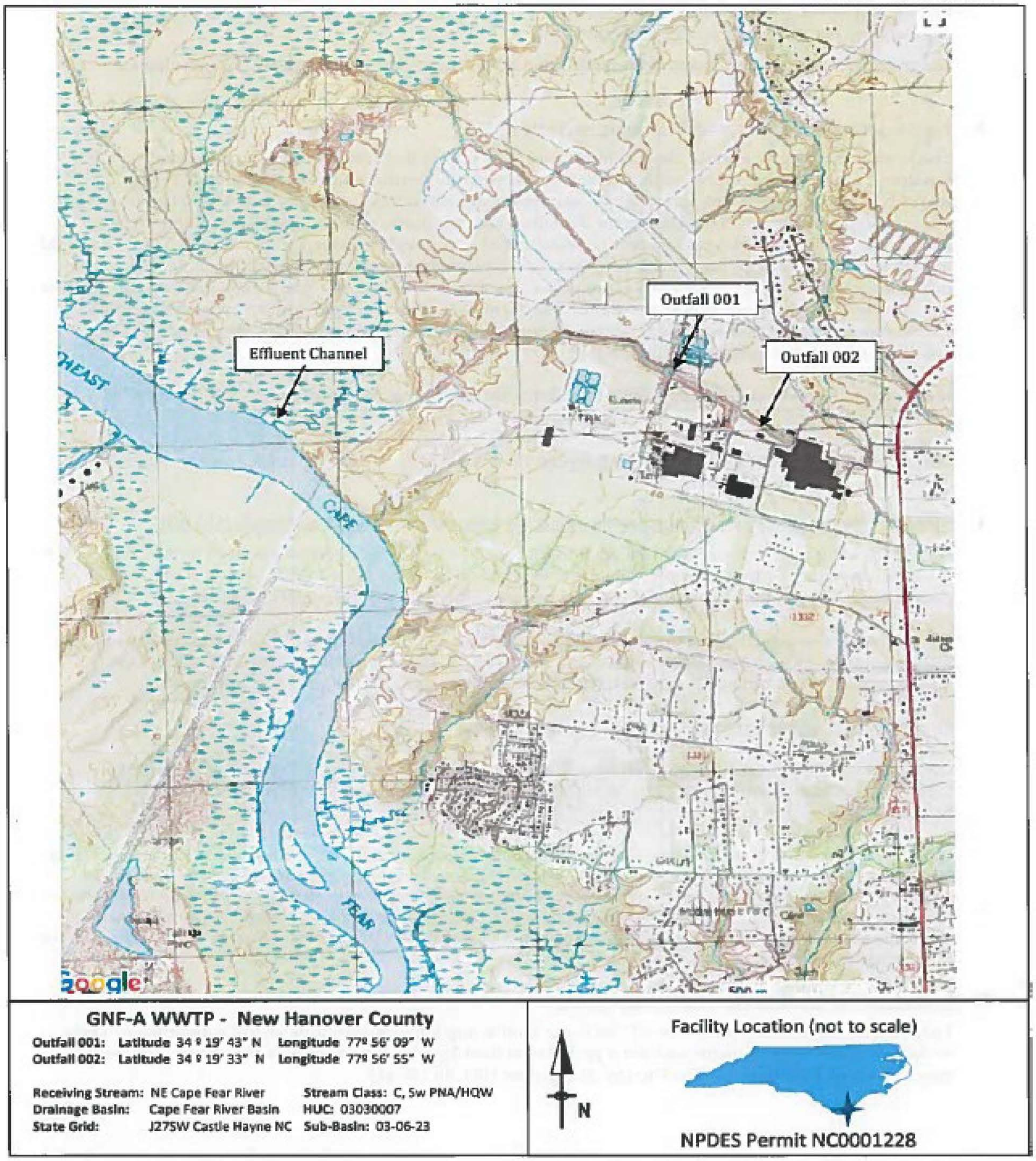

Figure 4 NPDES permit discharge locations

Sanitary wastewater from up to 125 employees at the NFFF would be segregated from all other wastewater and processed through the existing facility's treatment system, which has adequate capacity to accommodate this waste stream.

Other liquids, such as contaminated oil-based wastes (e.g., vacuum pump oil and lubricants), are expected to be generated by maintenance activities. The materials would be collected in a safe geometry slab tank, sampled for uranium content, and eventually transferred into containers for final disposition. The maximum expected volume is 1,041 liters/yr [275 gallons/yr]. GNF is exploring options for disposition of these liquid wastes.

Overall, there would be no significant increase in the amounts of liquid effluents that would be released off site, and no change in effluent quality.

3.1.5 Gaseous Waste Streams

In the 2009 EA, the NRC found the GNF-A radioactive emission concentrations from the existing facility to be low, that the direct dose impact to the public was well below the limit listed in 10 CFR 20.1101(d), and that potential impacts from nonradiological airborne effluents are minimized by compliance with permit limits that the NCDENR Division of Air Quality regulates. The 2009 EA states that the NRC considers the short-term, direct, and indirect environmental impacts on air quality from continued operations at GNF-A to be SMALL, and that, if the concentrations of radiological constituents and the amounts of nonradiological constituents continue to remain low as operational history has shown, the NRC staff finds the long-term environmental impact on air quality to be SMALL.

Currently, air emissions from a variety of emission sources at the existing GNF-A facility are in substantial compliance with the current NCDENR Division of Air Quality Air Permit No. 01756R23, which was issued on May 12, 2022, and expires on April 30, 2030. New source(s) may require a modification to the air permit.

Air emissions from the proposed NFFF would be of essentially the same character as emissions from the existing facility and would not have the potential to result in significant impacts to air quality. Potential gaseous effluents from the NFFF are described in GNF-A and TerraPower (2023) and summarized below.

Potential gaseous effluents include those from process gas, evolved gas, entrained particulates, and acid fumes. Process gas sources may include argon and helium inert gases as well nitrogen gas from liquid nitrogen used in the fuel fabrication processes. Evolved gas may include hydrogen gas produced as a byproduct of the reaction of residual sodium metal with ethanol. The process design would keep the hydrogen content safely below the lower explosive limit. These gases would enter the process ventilation system locally and would ultimately exit the exhaust stack. The exhaust stack flow is continuously sampled and analyzed weekly for any alpha or beta activity. Acid fumes (nitric and hydrofluoric) would be produced in the analytical laboratory for the dissolution of process samples for production quality measurements. These fumes would be removed by a wet scrubber before exiting an exhaust stack. Entrained particulates can be swept up in the process ventilation flows but would be removed by HEPA filtration.

The proposed action does not include any change to the facility or processes that would increase the site’s overall radionuclide emission concentrations or source terms.

3.2 There is no significant increase in individual or cumulative occupational radiation exposure.

The upper portion of table 5 shows the GNF-A collective and average worker doses (total effective dose equivalents) for the 5-year period from 2016 through 2020 as reported in NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," Volumes 38 through 42 (NRC 2018, NRC 2019, NRC 2020a, NRC 2022a, NRC 2022b). While NUREG-0713 does not directly report maximum individual doses, for a number of dose ranges, it does report the number of workers who received doses within each range. For the purposes of this ER supplement, the displayed maximum dose estimates for each calendar year (rightmost column) were thus selected "as less than the upper end" of the highest NUREG-0713 dose range containing one or more workers.

Table 5 U-235 20 wt% Collective and Individual Scaled Occupational Dose Estimates

	Collective Dose (person-rem)	Average Dose (mrem)	Max Dose (rem)
	As appears in NUREG-0713 (recent 5% LEU operations)		
2020	46.847	85	<0.75
2019	49.22	96	<1.0
2018	40.08	84	<1.0
2017	36.785	79	<0.75
2016	34.877	77	<0.50
Average	***41.562***	***84.2***	***<1.0***
	Scaled to U-235 20 wt% HALEU Operational Estimates		
2020	115.657	279.8	<2.5
2019	127.803	301.0	<3.1
2018	105.903	265.1	<3.2
2017	101.617	246.5	<2.3
2016	95.649	241.0	<1.6
Average	***109.326***	***266.7***	***<3.2***

For this analysis, the fact that, in accordance with Federal Guidance Report No. 13, "Cancer Risk Coefficients for Environmental Exposure to Radionuclides," issued September 1999 (EPA 1999), dose conversion factors for U-234, U-235, and U-238 are all nearly identical leads to a conclusion that dose generally relies more on total uranium activity than it does on the mix of uranium isotopes. To estimate bounding occupational exposures for the processing of 20 wt% U-235, doses were thus essentially multiplied by the 20 wt% to 5 wt% total-activity-ratio from table 1. Using this approach, the calculated 20 wt% U-235 occupational doses are shown in the bottom portion of table 5. As table 5 indicates, none of these conservatively estimated occupational exposures for HALEU fuel processing would exceed the occupational dose limit of 5 rem/yr in 10 CFR 20.1201, "Occupational dose limits for adults."

Additionally, GNF-A's standard of care for occupationally exposed individuals is to maintain exposures below the limits established by the NRC. Beyond this standard of care, GNF-A's radiation protection staff has a commitment to establish, maintain, and implement an effective radiation protection program. This includes a program commitment to maintain employee exposures ALARA, which is delineated by documented radiation protection program practices and procedures.

The provided conservative estimates of occupational exposure from the proposed processing of 20 wt% U-235 uranium are generally based on two implicit assumptions: (1) the processing “activities” of 20 wt% fuel would be essentially the same as the processing “activities” of 5 wt% fuel, and (2) the annual throughput of 20 wt% fuel would be essentially the same as the 5 wt% annual throughput. Any information that would either support or modify those assumptions (likely to the lesser side for either throughput rate or processing activity complexity) would strengthen the case that processing 20 wt% U-235 fuel would not result in a significant increase in individual or cumulative occupational radiation exposures. For example, if the 20 wt% throughput is expected to be only half of the 5 wt% throughput (which is likely a very high-sided assumption considering that only 18 metric tons HALEU is to be processed per year as opposed to the estimated continued 1,200 MTU/yr for LEU processing), then the dose estimates for 20 wt% in table 5 could easily be reduced by a factor of 2 or greater under such circumstances. Furthermore, if 5 wt% fuel processing theoretically contains a unique step where high exposures typically manifest, and that step is not part of the 20 wt% fuel processing procedures, then this could also likewise result in a potential scenario whereby 20 wt% exposures could further decrease relative to historically recorded 5 wt% values. As such, any subsequent information made available (specifically quantitative estimates) that compares Natrium fuel fabrication to current LEU fuel fabrication would help to further substantiate the above conclusions.

In summary, there are no new operational steps or gross material-at-risk quantities associated with HALEU fuel processing that are inherently different than those conventionally associated with the site’s existing LEU fuel fabrication processes, to the extent that new exposure modes or pathways are created that could potentially result in any substantial increase to typical worker dose rates historically seen at the site. For the NFFF, it is estimated 50 engineers and 75 operators will support the facility directly. Hence, the proposed Natrium facility would not discernibly increase the potential for radiological dose consequences to site workforces.

3.3 There is no significant construction impact.

This analysis of potential construction impacts is derived from information in the facility conceptual design report (Jacobs 2022).

Although the approximately 14,273 square-meter [153,630-square-ft] NFFF would be a robust structure, with infrastructure to support its intended mission and use, from a construction perspective the facility poses no unique environmental or safety issues, and the potential environmental impacts of construction would be typical of those for a large warehouse or commercial structure. Potential construction impacts would be essentially the same as those considered for the laser enrichment facility analyzed in the NRC’s 2012 EIS.

Adverse impacts from noise, dust, and traffic are anticipated. These impacts would be temporary and minimized through best construction management practices. In the 2012 EIS, the NRC concluded that although construction impacts could be small to moderate, the impacts would primarily affect residents in the immediate vicinity.

GNF-A estimates that the construction of the NFFF would last about 2 years, followed by a 1-year period for equipment installation and startup. Approximately 150 temporary workers would be on the site during construction; the current facility has approximately 650 employees. Impacts on local traffic from commuting workers are anticipated to be minor. Construction jobs would represent a beneficial economic impact.

The location of the NFFF footprint in a previously disturbed and industrialized contamination-controlled access area minimizes the potential for impacts from ground-disturbing activities. For example, the site location avoids surface water resources, which would be protected as described in section 2.2. No impacts to historic/cultural or biological resources, including special status species, would be expected because such resources are not known to be present within the controlled access area. This expectation would be confirmed for the proposed laydown yard area described in section 2.1 before any construction activity would be allowed to occur there.

Soils excavated during construction would be sampled and maintained on site until sample results confirm an appropriate disposition path.

3.4 There is no significant increase in the potential for or consequences from radiological accidents.

The summary in this section is based on information in the revised accident analysis comparison report (Christensen 2023). The potential dose and associated risk to relevant human receptors (site workers and the public, associated with the increased potential for or consequences from a radiological accident) is the product of both the radiotoxicity of the isotopes involved and the available mass of those isotopes. The source material (i.e., "material-at-risk") to be used at the Natrium facility does have a higher net radiotoxicity level than that presently used for LEU processing operations at the site. The overall dose conversion factor for the Natrium facility's material-at-risk would be more hazardous on a per-gram basis (about 4 times greater) than that for the existing fuel manufacturing operation. However, the mass of isotopes used in the existing fuel manufacturing operation (i.e., throughput) is approximately 50–100 times that which would be processed in the Natrium facility. Consequently, the risk of the Natrium facility relative to that of the existing fuel manufacturing operation would therefore only be on the order of one-tenth if the upper estimate of radiotoxicity and the lower bound of mass are used. Hence, increasing the overall sitewide accident risk by only 10 percent does not constitute a "significant" increase over risk levels associated with present-day LEU processing operations.

The airborne release fractions (ARFs) and respirable fractions (RFs) for the two facilities are assumed to be essentially equivalent, despite the introduction of the metal form of source material for the Natrium facility, which generally has a lower ARF × RF than oxides or fluorides. A comparison between facilities of potential worst case radiological releases shows that a new accident type created by the Natrium facility (i.e., a molten-metal explosion) is comparable to the previously analyzed "hot cylinder scenario" for the existing facility and has approximately equal associated radiological risks, overall, based on the uranium mass and nature of the material used in subject processes.

These factors, taken in combination, show that the overall risk of radiological release for the Natrium facility will be at most equal to, if not lower than, that of the existing LEU fuel manufacturing operation. Therefore, the proposed Natrium facility does not significantly increase the potential for or consequences from radiological accidents.

4 OTHER ENVIRONMENTAL RESOURCE AREAS AND ISSUES

This section briefly summarizes the potential impacts on the relevant resource areas listed in the NRC's CATEX checklist, contained in Appendix B.3, "Checklist to Support an Environmental Finding of Categorical Exclusion," to NRC LIC-203, Revision 4, "Procedural Guidance for

Preparing Categorical Exclusions, Environmental Assessments, and Considering Environmental Issues," effective July 13, 2020 (NRC 2020b).

4.1 Socioeconomic Impacts

As discussed, GNF-A currently employs 650 employees at its Wilmington facility. GNF-A estimates construction of the NFFF would add 150 temporary jobs. In addition, over the next 5 years, GNF-A anticipates adding 500 new full-time employees at its Wilmington campus, including 125 employees for the Natrium facility.

These jobs represent a positive socioeconomic impact. As described in the 2009 EA, employees at GNF-A's Wilmington facilities would likely live in the counties of New Hanover, Brunswick, and Pender and contribute to the local economy and tax base. For context, in its planning report adopted in November 2020, "Cape Fear Moving Forward 2045, Metropolitan Transportation Plan," the Wilmington Urban Area Metropolitan Planning Organization (WMPO) projects that the number of jobs in the New Hanover, Brunswick, and Pender County region will increase from 144,808 (2015 estimate) to 158,681 by 2045.

The new GNF-A employees would contribute incrementally to a trend of rapid continued regional growth. Such growth poses a potential for adverse impacts on transportation (traffic congestion) and a potential strain on community services. For perspective, WMPO (2020) reported that U.S. Census data show that, between 2010 and 2018, New Hanover and Pender counties were the 12th and 4th fastest growing counties in North Carolina, respectively. Brunswick County was the fastest growing county overall. Each grew significantly more than the State's total population increase of 8 percent during that same period. WMPO further reported that the population of New Hanover County grew by 14.6 percent between 2010 and 2018, while Pender County grew by 19.1 percent, and Brunswick County grew by 27.3 percent.

As described in the WMPO plan (WMPO 2020), according to the WMPO Travel Demand Model, the population within the WMPO planning boundary is projected to increase from the current estimate of 280,000 people to approximately 422,748 by 2045. The WMPO planning boundary encompasses all of New Hanover County and portions of Brunswick and Pender counties. Census data show that most residents of the region commute to work in a single-occupancy vehicle with an average commute time of 24 minutes.

Based on 2021-2022 U.S. Census Bureau data (USCB 2022), North Carolina had an estimated statewide population of 10,698,973 in 2022, with associated county population estimates for 2021 (latest available) of 229,018, 62,815, and 144,215 for New Hanover County, Pender County, and Brunswick County, respectively. The 2021 three-county area total was thus estimated as the sum of the three (436,048). These values correspond well with 2021–2022 interpolative estimates derived from the 2009 EA.

Moreover, U.S. Census Bureau data for 2020 (USCB 2022) show a total North Carolina statewide population density of 214.7 persons per square mile, with associated county population densities for the same year of 1,174.0, 69.1, and 160.8 persons per square mile for New Hanover County, Pender County, and Brunswick County, respectively. These values correspond well with 2020 interpolative estimates derived from the 2009 EA.

WMPO (2020) reported that the economy in the Wilmington urban area has grown significantly in recent years, and that the largest industries in the region, in terms of number of employees, include education and health services; professional and business services; public administration; information services; trade, transportation, and utilities; manufacturing; and finance. Approximately 11,170 employer establishments are presently located in Brunswick, New Hanover, and Pender counties.

In this context, the projected increase in the number of new GNF-A employees is small in comparison to the number of employees projected in the region. Therefore GNF-A's incremental contributions to potential adverse impacts on transportation/traffic and community services in the region would be correspondingly small.

Traffic mitigation measures are being developed for the region, as described in WMPO (2020). WMPO has developed a congestion management process and proposed approximately 79 roadway projects to mitigate adverse traffic impacts in the region. WMPO also proposed additional projects to improve public transportation by rail, bicycle, air, and water. WMPO developed and adopted its congestion management process in 2014 and prepares biennial reports to monitor and track congestion on 30 critical transportation corridors in the region. The reports analyze congestion-related metrics such as travel time and delay, safety, and multimodal usage.

Overall, the proposed NFFF would result in beneficial socioeconomic impacts from the creation of new jobs. The proposed NFFF would contribute incrementally to a regional trend of rapid population growth, with potential adverse impacts on traffic congestion and community services. However, the incremental contributions attributable to the NFFF would be small.

4.2 Noise

As described in section 3.3, temporary impacts from construction noise are anticipated. Such impacts would be essentially the same as those analyzed in the NRC's 2012 EIS, which found that potential construction noise impacts on an adjacent residential subdivision would be moderate, but temporary, and that during construction, vehicular traffic would generate intermittent noise that would be limited to the immediate vicinity and would be minor in comparison to other continuous sources.

Similarly, during operations, noise impacts would be essentially the same as those previously analyzed in the 2012 EIS. The EIS concluded that, during operations, noise sources would be primarily enclosed within buildings, and other sources would include vehicular traffic. Noise levels at the site boundary closest to the adjacent residential subdivision were estimated to be below the day and night equivalent sound level in compliance with the local noise ordinance and U.S. Environmental Protection Agency noise guidelines.

4.3 Transportation

No change in previously evaluated impacts associated with the transportation of personnel, wastes, and materials at the site under routine operations is anticipated.

4.4 Biotic Communities

No impacts are anticipated for biotic communities. There is a potential for the small loss of habitat if trees are removed for a proposed laydown area.

4.5 Special Status Species and Habitats

No effects are anticipated related to special status species and habitats.

4.6 Water Resources

As described in section 2.2, stormwater management measures would protect surface water resources, and there would be no change in impacts from process and sanitary wastewater discharges, which would be expected to continue to meet all NPDES permit requirements.

No impact on ground water quality is anticipated from proposed NFFF operations. GNF-A maintains a comprehensive ground water well sampling program that includes wells near the proposed NFFF. GNF-A will consult with the contractor that performs prescribed sampling of ground water wells to determine whether additional wells and analysis specific to the NFFF are needed.

4.7 Hazardous Materials

Some new hazardous material or waste streams would be generated, as described in section 3.1.3. No adverse impacts are expected.

4.8 Air Quality

As described in section 3.1.5, no change in previously evaluated impacts for air quality is anticipated.

4.9 Compatible Land Use

No change in land use would occur.

4.10 Special Land Use Designations

No impacts related to special land use designations are anticipated.

4.11 Parks, Refuges, Recreational Resources

No change in previously analyzed effects for parks, refuges, and recreational resources are anticipated.

4.12 Historic Properties

No impacts to historic properties included in or eligible for the National Park Service's National Register of Historic Places or a State or local register of historic places are anticipated.

4.13 Historic and Cultural Resources

No impacts to historic and cultural resources of Federal, Tribal, State, or local significance are anticipated. Most construction would take place on ground previously disturbed. No construction activities are planned in a portion of the Wilmington site where historic and cultural resources are known to exist.

4.14 Environmental Justice

Because no adverse impacts on human health or the environment from facility operations have been identified, no disproportionately high and adverse impacts on minority or low-income populations from operations would occur.

As described in section 3.3, construction activities could result in temporary impacts. These impacts would be essentially the same as those previously evaluated in the NRC's 2012 EIS. In the EIS, the NRC concluded that although construction impacts could be small to moderate, the impacts would not be disproportionately high and adverse for minority or low-income populations. The majority of environmental impacts would be mitigated and would primarily affect residents in the immediate vicinity. The neighborhood immediately surrounding the site includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Because impacts on the general population would be small to moderate, and because the greatest impact would be expected to occur in the immediate vicinity (and in an area with a mix of ethnicities and income levels), impacts from construction, operation, and eventual decommissioning would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents.

4.15 Accidents

As described in section 3.4, there would be no significant increase in the potential for or consequences from radiological accidents.

4.16 Effluents

As described in section 3.1, there would be no significant change in the types or significant increase in the amounts of any effluents that may be released off site.

4.17 Human Health

There would be no change in impacts to public human health from those described in the 2009 EA. As described in section 3.2, there would also be no significant increase in individual or cumulative occupational radiation exposure.

4.18 Cumulative Impacts

As described in section 3.1, potential environmental impacts from emissions and wastes resulting from the proposed new NFFF would be small. In combination with those of the existing licensed fuel manufacturing operations, potential cumulative impacts from emissions and wastes would be essentially the same as previously analyzed impacts, which were found to be small.

The 2009 EA indicated a potential for cumulative impacts of the licensed operations together with those from additional facilities, such as a laser enrichment facility planned to share resources with GNF-A. As described on the NRC's Global Laser Enrichment Facility Licensing page on its website (https://www.nrc.gov/materials/fuel-cycle-fac/laser.html), this facility, known as the Global Laser Enrichment (GLE) Project, was to be conducted in multiple phases. For phase one, a test loop was built at GEH's nuclear fuel fabrication facility in Wilmington, North Carolina, to advance the performance and reliability of the processes and equipment to be used for commercial laser enrichment. The test loop is licensed under GNF-A's fuel fabrication license (NRC License No. SNM-1097). For phase two, GLE submitted a license application in June 2009 for a full-scale commercial facility at GEH's Wilmington, North Carolina, campus. In February 2012, the NRC issued a final EIS (NUREG-1938) for the proposed facility. On September 25, 2012, the NRC issued a construction and operating license for the facility (NRC License No. SNM-2019). In April 2016, GEH announced the desire to exit the GLE Project, due to changes in business priorities and the existing difficult uranium market conditions. On January 5, 2021, the NRC terminated NRC License No. SNM-2019 for the GEH GLE facility. Accordingly, no cumulative impacts from the GLE project are foreseeable.

Although future variations in NFFF operations or HALEU formulations might be considered, GNF-A does not have any current specific proposals for such variations, and cumulative impacts from such projects are not anticipated. Future proposals for projects that could contribute to cumulative impacts would require appropriate further environmental review.

As discussed under socioeconomic impacts (section 4.1), new jobs associated with the NFFF and operations at existing Wilmington, North Carolina, facilities would contribute incrementally to a trend of rapid continued regional growth. Associated cumulative impacts would be both beneficial (jobs and contribution to the local economy and tax base) as well as adverse (traffic congestion, strain on community services). Incremental contributions to adverse cumulative impacts, however, would be small. Planning authorities have proposed projects that could mitigate regional impacts.

4.19 Uncertainty

The location of the proposed facility in a previously disturbed and well-surveyed area substantially eliminates uncertainties about potential impacts of ground-disturbing activities on sensitive resources. As noted in section 2.1, an additional survey of a small, proposed laydown area to determine whether wetlands are present would be conducted. Although treatment and disposition pathways for some waste streams have not been finalized, environmentally sound options exist for all of them. Overall, the level of uncertainty about the impacts of the proposed action is low.

4.20 Controversy

The GNF-A facilities have not been the subject of significant controversy or opposition. For example, public comments on the 2012 draft EIS did not indicate substantial controversy on environmental issues or general opposition; a number of commenters expressed support for the project in view of expectations of beneficial socioeconomic impacts. The facility and its potential expansion would benefit the local community economically, and nuclear products from this facility would have a positive impact on climate change.

5 SUMMARY OF FINDINGS

Analysis shows that the proposed license amendment to permit nuclear fuel fabrication at enrichments up to 20.0 wt% U-235 and authorize operation of the NFFF would not change the scope or nature of the licensed activities at the GNF-A Wilmington campus. Previously analyzed environmental impacts for licensed operations would remain essentially the same.

Analysis further shows that there would be no significant change in the types or significant increase in the amounts of any effluents that may be released off site, no significant increase in individual or cumulative occupational radiation exposure, no significant construction impacts, and no significant increase in the potential for or consequences from radiological accidents.

There are no known special or extraordinary circumstances relevant to environmental concerns.

As a result, the action meets the exclusion criteria in 10 CFR 51.22(c)(11).

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