Global Nuclear Fuel

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Global Nuclear Fuel

M230095

July 28, 2023

Samantha Lav, Chief
Fuel Facility Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attn: Document Control Desk

Subject: GNF-A Response to NRC Request for Additional Information

References:
1) NRC License SNM-1097, Docket 70-1113
2) GNF-A License Amendment Request for 8 wt.% U235 (LEU+), 6/24/22
3) Letter, from S. Lav (NRC) to S. P. Murray (GNF-A) Request for Additional Information Regarding GNF-A License Amendment Request, 7/3/23, (Enterprise Project ID L-2022- LLA-0065)

Dear Ms. Lav:

The Global Nuclear Fuel – Americas L.L.C. (GNF-A) facility in Wilmington, North Carolina hereby provides the requested information in support of our fuel manufacturing license amendment request (Reference 2). This information is being provided in response to your request dated July 3, 2023 (Reference 3).

Please contact me on (910) 819-5950 if you have any questions or would like to discuss this matter further.

Sincerely,

Scott Murray, Manager,
Facility Licensing

Attachment: GNF-A Response to NRC Request for Additional Information

Cc: J. Rowley, USNRC/DFM/FFLB
J. Rivera, USNRC/RII/DFFI
SPM 23-028

GNF-A RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING 8 WT % LICENSE AMENDMENT REQUEST

(NRC Request dated 07/03/23)

NCS-1

Regulatory Basis

Title 10 of the *Code of Federal Regulations* (10 CFR) 70.61(d) requires, in part, the risk of nuclear criticality accidents be limited by assuring that under normal and credible abnormal. conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety.

NUREG-1520 provides guidance for demonstrating compliance with this requirement. Section 5.3.B.2 of NUREG-1520, "Standard Review Plan for Fuel Cycle Facilities License Applications," Revision 2, states that the NRC staff reviews should include any portions of the integrated safety analysis (ISA) summary affected by the requested changes, including process descriptions, new or changed assumptions, controlled parameters, safety limits, controls, or safety margin, as well as new or changed criticality accident sequences and items relied on for safety.

Section 5.3.B.5 of NUREG-1520, "Standard Review Plan for Fuel Cycle Facilities License Applications," Revision 2, states that the NRC staff reviews should include the justification for the requested changes, including revised criticality safety basis documents (process hazards analyses, criticality safety evaluations, calculations, and other supporting technical documents) that are needed to demonstrate adequate protection against the risk of accidental criticality.

Description of Issue

In its request dated June 24, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22175A069), Global Nuclear Fuel – Americas LLC (GNF-A) stated that its criticality safety function evaluated the proposed amendment and concluded that the request to increase enrichments up to 8.0 weight percent uranium-235 (U235) will result in modifications to select nuclear criticality safety controls as documented in supporting Criticality Safety Analyses (CSAs).

Information Needed

To facilitate the staff's review of the requested amendment, provide the following criticality safety basis documents:

- CSA 206.00.100 for the Dry Conversion Process (DCP) Blend, Pre-Compact, and Granulate Process;
- CSA 407.00.100 for Rod Processing;
- CSA 801.00.100 for General Can Storage; and
- CSA 702H.00.100 for the 8.0 weight percent Liquid Radioactive Waste System

GNF-A Response:

The SNM-1097 License Amendment Request 2022 reading room criticality safety analysis folder has been populated with each of the above requested documented [nodal] criticality safety analysis (CSAs) per request to evaluate changes necessary to process material enrichments up to 8.0 wt.% U235.This set of 4 represents a representative subset of the 45 total nodal analyses completed. Required control changes are identified in section 6 of each documented CSA. Changes to Items Relied on for Safety (IROFS) are likewise identified in a separate GNF CALC-900-012, Summary of ISA Modifications Required for Increasing Fuel Enrichment from 5 wt% to 8 wt%, Rev. 1, February 2023. This CALC-900-012 document has also been added to the reading room integrated safety analysis folder to aid the review.

NCS-2

Regulatory Basis
The regulation in 10 CFR 70.61(d) requires, in part, the risk of nuclear criticality accidents be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety.

NUREG-1520 provides guidance for demonstrating compliance with this requirement. Section 5.3.B.2 of NUREG-1520, “Standard Review Plan for Fuel Cycle Facilities License Applications,” Revision 2, states that the NRC staff reviews should include any portions of the ISA summary affected by the requested changes, including process descriptions, new or changed assumptions, controlled parameters, safety limits, controls, or safety margin, as well as new or changed criticality accident sequences and items relied on for safety.

Section 5.3.B.5 of NUREG-1520, “Standard Review Plan for Fuel Cycle Facilities License Applications,” Revision 2, states that the NRC staff reviews should include the justification for the requested changes, including revised criticality safety basis documents (process hazards analyses, criticality safety evaluations, calculations, and other supporting technical documents) that are needed to demonstrate adequate protection against the risk of accidental criticality.

Description of Issue
It is the staff’s understanding based that GNF-A does not intend to take credit for neutron absorbers added to in-process fuel, such as gadolinia, for enrichments greater than 5.0 weight percent U235. However, Section 5.4.4.5 of the SNM-1097 license application states that credit may be taken for neutron absorbers added to in-process fuel, and no changes have been made to the SNM-1097 license application that would limit this practice to enrichments of 5.0 weight U235 or less. Furthermore, in its request dated June 24, 2022 (ADAMS Accession No. ML22175A069), GNF-A stated that GNF-A does not have plans for segmentation of the fuel fabrication facility based on enrichment and that the entire fuel fabrication facility will be approved and controlled to safely process material enrichments up to 8.0 weight percent U235.

Information Needed
State whether GNF-A intends to take credit for neutron absorbers added to in-process fuel for enrichments greater than 5.0 weight percent U235. If GNF-A no longer intends to take credit for neutron absorbers added to in-process fuel, provide changes to the SNM-1097 license. application.

GNF-A Response:

As stated, SNM 1097 8% LAR section 5.4.4.5 does permit use of neutron absorbers during in-process fuel fabrication (e.g., gadolinia powder, Gd_2O_3, a burnable absorber). Though we currently do not take credit for neutron absorbers in “in-process” material, we may in the future. Therefore, no change to the license commitments on credible neutron absorbers in “in-process” are being proposed.

Per section 5.4.4.5 Neutron Absorber - Neutron absorbing materials may be utilized to provide a method for nuclear criticality safety control for a process, vessel or container. Stable compounds such as boron carbide fixed in a matrix such as aluminum or polyester resin; elemental cadmium clad in appropriate material; elemental boron alloyed stainless steel, or other solid neutron absorbing materials with an established dimensional relationship to the fissionable material are recommended. The use of neutron absorbers in this manner is defined as part of a passive engineered control. Credit may also be taken for neutron absorbers added to fuel, such as gadolinia. For fixed neutron absorbers used as part of a geometry control, the following requirements apply:

The composition of the absorber is measured and documented prior to first use.
Periodic verification of the integrity of the neutron absorber system subsequent to installation is performed on a scheduled basis approved by the criticality safety function. The method of verification may take the form of traceability (e.g., serial number, QA documentation, etc.), visual inspection or direct measurement, as appropriate for the application.

For crediting neutron absorbers added to the fuel, such as gadolinia, the following requirements apply:

For in-process fuel (e.g., mechanical mixing of gadolinia powder with uranium oxide powder), the continued presence of the absorber in the fuel, its distribution, and its concentration is verified using an appropriate method. The system design should include factors such as process conditions, hazards, and human errors for potential degradation of the neutron absorber. Acquisition, storage, preparation, and use of the neutron absorbers should conform to the established quality program.

For fuel bundles, the presence of the gadolinia absorber in completed fuel rods is documented and verified using non-destructive testing; and the placement of rods in completed fuel bundles is documented in accordance. with established quality control practices.

The nodal CSAs governing the gadolinia product line currently take no credit for the presence of the neutron absorber during the upstream “in-process” manufacturing of the fuel rod itself. For downstream bundle processing nodal CSA, credit is taken for the presence of the gadolinium present in the rod; as this credit is required and necessary for both a) transport in the RAJ-II Type B nuclear package and b) in-core reactivity control at the reactor utility to meet fuel cycle energy requirements (core design basis for the lattice). CSA 603.00.100, Bundle Processing, Rev. 1, September 2021 includes the following administrative control requirements (excerpts shown):

AC: Inner Bundle Container Storage Array – Safe Geometry: The safety function of this control is to prevent improper storage of loaded RAJ-II inners. This configuration is based on GNF3 design parameters (bounding of GNF2, GE14/12, GE11/9) and the design parameters of the RAJ-II inner 5 wt% U235 enrichment: Loaded RAJ-II inner containers shall be stacked no more than 2-high (otherwise unlimited in the x, y plane).

8 wt% U235 enrichment: Loaded RAJ-II inner containers shall not be stacked (1 high only; otherwise, unlimited in the x, y plane).

AC: Fuel Bundle – Minimum Gadolinium Content: The safety function of this control is to assure the minimum fixed neutron absorber (gadolinium) content is met prior to loading completed BWR fuel bundle into the RAJ-II inner container. This is a dependent control linked to Inner Bundle Container Storage Array – Safe Geometry.
Each gad rod shall be measured using MAPS to confirm required gadolinium content meets the minimum content of at least 2 wt. %.
Each 10x10 lattice shall conform to the current design bases document and meet the minimum gad loading requirements specified in the current RAJ-II certificate of compliance [22].

The SNM-1097 License Amendment Request 2022 reading room has also been populated with the nodal CSA 603.00.100 to provide a more complete description of the crediting of the neutron absorber, Gadolinium, in support of our bundle processing for materials enrichments up to 8.0 wt.% U235.

NCS-3

Regulatory Basis
The regulation in 10 CFR 70.24 requires, in part, each licensee authorized to possess special nuclear material in a quantity exceeding 700 grams of contained U235, 520 grams of U-233, 450 grams of plutonium, 1,500 grams of contained U235 if no uranium enriched to more than 4 percent by weight of U235 is present, 450 grams of any combination thereof, or one-half such quantities if massive moderators or reflectors made of graphite, heavy water or beryllium may be present, maintain in each area in which such licensed special nuclear material is handled, used, or stored, a monitoring system meeting the requirements of either paragraph (a)(1) or (a)(2), as appropriate, and using gamma- or neutron-sensitive radiation detectors which will energize clearly audible alarm signals if accidental criticality occurs.

NUREG-1520 provides guidance for demonstrating compliance with this requirement. Section 5.3.B.3 of NUREG-1520, “Standard Review Plan for Fuel Cycle Facilities License Applications,” Revision 2, states that the NRC staff reviews should include any portions of the license application and ISA Summary pertaining to the licensee’s criticality accident alarm system and emergency response measures affected by the change, and that staff reviews should verify that the applicant still complies with the requirements of 10 CFR 70.24, “Criticality accident requirements.”

Description of Issue
The current SNM-1097 grants an exemption from the requirements of 10 CFR 70.24 in areas where the licensee has demonstrated that a criticality accident is not credible and there is not more than 1) a safe batch of finished reactor fuel rods, or 2) the quantity of uranium authorized for delivery to a carrier when fully packaged for transport according to a valid the NRC authorization for such packages without limit on the number of packages, provided storage

locations preclude mechanical damage and flooding. However, the basis for granting this exemption relied on the assumption that special nuclear material would be limited to an enrichment of 5.0 weight percent U235.

Information Needed
State which areas of the facility GNF-A intends to be exempt from the requirements of 10 CFR 70.24. For each such area, provide information that demonstrates that the current exemption from the requirements of 10 CFR 70.24 remains valid for enrichments up to 8.0 weight percent U235. Alternatively, submit a request for exemption from the requirements of 10 CFR 70.24 for each such area and provide a justification that demonstrates that criticality is not credible for enrichments up to 8.0 weight percent U235.

GNF-A Response:

Per SNM-1097, Section 1.3.11, the existing CAAS exemption program commitments remain unchanged (excerpt shown below). The approval of this exemption request language was approved by the USNRC as documented in the Safety Evaluation Report, GLOBAL NUCLEAR FUEL - AMERICAS – EXEMPTION TO CRITICALITY MONITORING SYSTEM REQUIREMENTS LICENSE AMENDMENT REQUEST AND AMENDMENT 12 (COST ACTIVITY CODE L33401), dated February 23, 2016 (ML16048A160).

> 1.3.11 EXEMPTION TO CRITICALITY MONITORING SYSTEM REQUIREMENTS
> Authorization that it is not necessary to maintain the criticality accident monitoring system requirements of 10 CFR 70.24 when it is demonstrated that a credible criticality risk does not exist for:
> 1.3.11.1 A quantity of finished reactor fuel rods equal to or less than 45% of a minimum critical number under conditions in which double batching is credible, or equal to or less than 75% of a minimum critical number under conditions in which double batching is not credible, or
> 1.3.11.2 The quantity of uranium authorized for delivery to a carrier when fully packaged as
> for transport according to a valid NRC authorization for such packages without limit on the number of such packages, provided storage locations preclude mechanical damage and flooding, or
> 1.3.11.3 Individual areas where there is negligible risk of criticality due to the amount or configuration of fissile material.
> In these areas, an evaluation has determined the risk of criticality is very low such that no credible accident sequence can be identified that results in criticality.

The existing CAAS detector placement analysis evaluates the CIDAS MkXI detector [cluster] coverage for credible accident source terms throughout Zone 1 and Zone 2 governing the GNF-A fuel manufacturing and support operations. The prior analysis was revised accordingly to evaluate and document the impact of changing the source terms with material enrichment of 8 wt.% U235. MCNP5 general-purpose Monte Carlo N-Particle transport code developed by Los Alamos Nation Laboratory is used. MCNP5 uses continuous-energy nuclear and atomic data libraries. ENDF/B-V neutron and photon data libraries are utilized. Nuclear data tables exist for neutron interactions, neutron-induced photons, photon interactions, neutron dosimetry or activation, and thermal neutron scattering S(α,β). This re-evaluation of the FMO/FMO-X building, DCP, shipping warehouse, and outside fuel support process areas is documented separately and can be made available for staff review:

- GNF PLM #001N7915, Analysis of criticality Accident Alarm System Coverage in GNF-A Fuel Manufacturing Facilities, Rev. 1, May 2022.

The recommended existing detector locations provide a complete and effective coverage of the FMO/FMO-X building, DCP, shipping warehouse and outside fuel support process areas by the gamma dose rate detection with an alarm trigger level of 100 mR/hr in soft tissue, if a criticality accident is capable of delivering an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of two meters from the reacting material within one minute.

The current 10CFR70.24 exemptions pursuant to SNM-1097, Section 1.3.11.3 (shown above) include the following CAAS needs evaluations which justify no credible criticality accident sequence exists for these select process areas of our fuel manufacturing facility for processing material enrichments up to 8.0 wt.% U235.

- CSA 101.01.100, 30B UF6 cylinder Storage CAAS Needs Evaluation, rev. 1, June 2021.
  - SCOPE: 30B cylinder storage areas where the risk of a criticality accident is negligible due to design of the container and the nature of handling and transportation process

- CSA 700.00.101, CAAS Needs Evaluation: Zone 3 CAAS, rev. 1, May 2022.
  - SCOPE: pH Adjustment Tank, the Aeration Basin, and Process Lagoons

- CSA 703.00.100, CAAS Needs Evaluation: Criticality Warning System DAM 20, rev. 1, May 2021.
  - SCOPE: WT HF Neutralization process/equipment, WT Central Lagoon, remediated fluoride/nitrate lagoon, URLS, maintenance boneyard, empty trailer storage

- CSA 706.00.100, Outside Storage Pads CAAS Needs Evaluation, rev. 1, May 2021.
  - SCOPE: Combustible / non-combustible waste box storage, waste box 3 or 5-gallon can standards, waste oil drum storage, waste oil 55-gallon drum standards, and storage of empty/contaminated containers

GNF-A Response: The SNM-1097 License Amendment Request 2022 reading room has been populated with each of the above documented CAAS needs evaluations as a reviewer supplement which justify no impact to prior “crit not credible” conclusions (for these select activities) as a result of processing material enrichments up to 8.0 wt.% U235.

Environmental RAIs

Regulatory Basis

The regulation in 10 CFR 51.60, “Environmental report – materials licenses,” and the guidance in NUREG-1748, “Environmental Review Guidance for Licensing Actions Associated with NMSS Programs,” outline the information that should be provided by the licensee for the NRC staff to assess the environmental impacts of the proposed action and prepare an Environmental Assessment (EA).

Description of Issue
The licensee should provide publicly available information in order for the NRC staff to complete its environmental review of the proposed license amendment request (LAR). The proposed increased enrichment may require some necessary changes for safe handling of material. For each of the items mentioned in the "Information Needed" section below, provide the requested details so that the NRC can evaluate the impacts of the requested action.

Information Needed

Enviro-1
Please explain what changes would occur due to use of uranium enriched to 8.0 weight percent U235 at the GNF-A fuel fabrication facility.

GNF-A Responses shown in bold

a. Would the same type and size 30-B cylinder be used with the higher enrichment, or a different model cylinder be used? **(The same type and size 30B cylinder will be used)**

b. Would the process for receipt, handling and temporary storage change due to increased enrichment? If no changes are necessary, please state this. **(The current process for cylinder receipt, handling, and storage will not change)**

c. Would the cylinder pad storage change to accommodate the increased enrichment. If no changes are necessary, please state this. **(The current process for cylinder pad storage will not change)**

d. Would the number of enriched uranium shipments change, increase, or decrease? If so, by how many and what would be the annual total? If no changes are expected in the shipping amount, please state this and indicate how many shipments are expected in a given year. **(The current number of enriched uranium shipments per year will not change. However, the number of shipments per year is considered sensitive proprietary information and is not publicly available)**

Enviro-2
Discuss the reduction in dosimetry at the fence line since physically relocating the 30B cylinder storage pad. In your October 2022 response to the NRC's Request for Supplemental Information (RSI), you indicated that the dose at the fence line was 22 mRem in 2021 and that the storage pad was moved away from the fence line as a result of the potential elevated dose.

GNF-A Responses shown in bold

a. Explain the process followed to relocate the cylinders, **(The existing GNF-A configuration management change control process described in the NRC SNM License application was followed including review and approval to pave an existing uranium storage pad. The cylinders were moved using an existing facility cylinder move procedure)**

b. Describe where the storage pad is currently located and, **(The cylinder storage pad was relocated approximately 1100 feet to the west/northwest of the previous location and approximately 580 feet north of the closest property line.**

c. Discuss the current dose at the fence. **(Fence line dosimetry in this area now indicates facility related dose at a non-detectable level).**

Enviro-3

In your October 2022 response to the NRC's RSI, in reference to the public and occupational dose, you indicated that the 2007 environmental report and the 2009 EA remain valid or bounding. You further state that "Over the past Decade there have been additional reductions in many of these results." Please describe the reductions and what produced the reductions in dose.

GNF-A Response:

The NRC annual public dose limit is 100 mRem with constraint limits of 25 mRem from all operations and 10 mRem from air emissions.

Per 10 CFR 70.59, GNF-A is required to send NRC semi-annual effluent monitoring reports for both gaseous and liquid effluents. A review of these reports from 2007 through 2022 indicates that the highest calculated potential radiological dose to the public from GNF-A air emissions in past fifteen years was 0.149 mRem during the first half of 2016. For comparison, during the second half of 2022, the highest calculated public dose from air emissions was 0.026 mRem.

Similarly, the total NRC licensed radioactivity in liquid effluents released to the environment in 2007 averaged approximately 21.6 mCi. In 2022, total radioactivity in liquid effluents released to the environment averaged approximately 5.4 mCi.

The reductions in both air and liquid emission radioactivity were caused by several factors including improved filtration and treatment. Since 2007, the liquid effluent volume was also reduced by approximately 30 % using additional water conservation and recycle methods.

In addition, in 2021 the facility related fence line dose rate near a storage pad was slightly more than 20 mRem/yr. Facility changes were initiated in the third quarter 2021 to significantly reduce this dose rate. A cylinder storage pad located approximately 90 feet north of the closest property line was physically relocated approximately 1100 feet to the west/northwest of the prior location and approximately 580 feet north of the closest property line. Cylinder moves were completed in the first quarter 2022. The GNF-A fence line dosimetry for the 2022 year indicates the facility related dose at this location has been reduced to a non-detectable level.

MCA-1

Regulatory Basis

In accordance with 10 CFR 70.22(b), an application must contain a full description of the program for control and accounting of special nuclear material that will be in the applicant's possession under license to show how compliance with the requirements of 10 CFR 74.31, 74.33, 74.41, or 74.51, as applicable, will be accomplished.

Description of Issue
In the submittal letter under “Material Control and Accounting,” the licensee states that “the Material Control and Accountability (MC&A) function has evaluated the proposed amendment and commits that changes to the policies, procedures, and controls to support the proposed amendment will be implemented consistent with the existing MC&A program.” However, the submittal provides no information regarding the specific impacts to the MC&A program or what changes to the program or fundamental nuclear material control plan (FNMCP) are anticipated. Although 10 CFR 70.32(c) allows, without prior NRC approval, for changes that would not decrease the effectiveness of the MC&A program, the NRC must make a determination that the MC&A controls related to the proposed license amendment are adequate in accordance with 10 CFR 70.23(a)(6).

Information Needed
Please provide information on the impacts to the MC&A controls applicable to the proposed amendment, anticipated changes to the MC&A program or FNMCP associated with the proposed amendment, and justification for any determination made in accordance with 10 CFR 70.32(c).

GNF-A Response:

No changes are required to the FNMCP or our MC&A Program to go to 8% since it is still considered LEU material.

Below is the opening paragraph of the current GNF-A FNMCP that allows up to 10 weight percent U235.

> This Fundamental Nuclear Material Control Plan (FNMCP) is submitted by Global Nuclear Fuel - Americas, L.L.C., Wilmington, North Carolina, (hereafter called GNF-A) to the U.S. Nuclear Regulatory Commission (NRC) to satisfy the requirements of 10 CFR 74.31. The information in the Plan demonstrates the adequacy of the compliance program for fulfilling the requirements of 10 CFR 74.31 with regard to the licensing to possess and use special nuclear material of low strategic significance referenced as low enriched (less than 10 weight percent U235) uranium (LEU). LEU is used throughout the Plan to include both uranium and the U235 isotope.

Minor software changes will be needed to internally track and report LEU quantities up to 8 weight percent U235.