DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-050

SECTION A. Project Title: Development of LWR Fuels with Enhanced Accident Tolerance

SECTION B. Project Description:

GE Research (GRC), in collaboration with GE Hitachi Nuclear Energy (GEH), and Global Nuclear Fuel (GNF), proposes the continuation of the development of Accident Tolerant Fuels (ATF) by GE. There will be three main tasks, with the highest priority for the next phase of development being Task 1.

The Phase 2C work scope involves constructing & commissioning a facility to apply GNF's Abrasion Resistant, More Oxidation Resistant (ARMOR) coating to conventional Zircaloy fuel rod cladding (Task 1) and to upscale GNF-A's fuel factory to produce fuel at enrichments as high as 8 w/o U^{235} as compared to the current licensed limit of 5 w/o U^{235} (Task 2). The coating process will be performed in GNF-A's Fuel Components Operation (FCO) and the enrichment upscale will be retrofit to GNF-A's Fuel Manufacturing Operation (FMO). Both facilities reside on GNF-A's Wilmington, NC campus that is fully licensed and regulated by multiple agencies to produce commercial nuclear fuel.

Task 1: The continuation of the development and qualification of ATF concepts including manufacturing process and technologies in preparation for irradiation in a commercial light water reactor (LWR) to a level of readiness for batch reload implementation and subsequent commercialization and licensing efforts leading to full core implementation in commercial reactors. The subtasks included in Task 1 are as follows: Subtask 1.1: ARMOR performance, testing, licensing, and factory upscale; Subtask 1.2: Post-Irradiation Examination (PIE) of ARMOR (Plant) Hatch components; and Subtask 1.3: PIE of ARMOR ATR ATF-2 rodlets.

For ARMOR coating technology to be practical for commercial use, physical infrastructure items to support large-scale production as part of a normal nuclear fuel tube production line need to be designed, developed, and tested. This will be done as part of Subtask 1.1. Non-standard items from various sources will be integrated into one physical system as part of this effort. Specifically, the physical infrastructure activity entails developing a high bay coating area that can power and house large equipment for coating and fixturing nuclear fuel tubes in a safe, clean, and productive environment that keeps pace with a standard nuclear fuel tube production line. As part of this phase of the project, the team will develop the specialized physical infrastructure to meet these demanding requirements, in order to provide the technical basis for full scale production of ARMOR coating applied to full production in a standard nuclear fuel tubing shop

Task 2: The continuation of high-burnup high-enrichment research and testing. The subtasks included in Task 2 are as follows: Subtask 2.1: Phase 2 SNM-1097 (GNF's license) amendment for 8% U^{235} to NRC; Subtask 2.2: LEU+ Factory Readiness; Subtask 2.3: LEU+ Nuclear Methods Licensing; Subtask 2.4: LEU+ Fresh Fuel Transport and Storage; Subtask 2.5: High-Burnup (HBU) Licensing; Subtask 2.6: Fast Transients with Boiling Transition (FATBT); and Subtask 2.7: BWR AOO and Transient Dryout Testing.

Task 3: The continuation of pursuit of advanced concepts already under development at GE. The entire fuel cycle will be considered while pursuing Task 3 advanced concepts (coated Zircaloy, IronClad, and SiC CMCs) studies. That is, the newer ATF fuel concepts have to be able to be manufactured economically and then survive the residence in the reactor, the residence in the cooling pools, the residence in dry casks and finally be able to be reprocessed or disposed in a geologic repository. Due to anticipated reduced funding, some of the subtasks of Task 3 will be delayed and others will be prioritized. For example, research on fuel modification, ARMOR coating and selected IronClad activities will be prioritized while CMC (SiC) concepts may be delayed.

SECTION C. Environmental Aspects / Potential Sources of Impact

The industrial processes currently in use and planned at GNF's fuel manufacturing facility are highly regulated by state and federal agencies. The governing nuclear, industrial, and byproduct regulations are applicable and considered adequate for the subject projects. GNF has rigorous EHS programs to assure compliance with existing regulatory requirements.

Radioactive Material Use

Task 1 (ARMOR) – N/A as the ARMOR coating is not radioactive.

Task 2 (LEU+) – The GNF-A fuel fabrication facility produces low enriched uranium (LEU) nuclear fuel for boiling water reactors (BWRs) under Special Nuclear Material license (SNM-1097). Increasing the enrichment of the UF6 feed material from 5 w/o U^{235} to as high as 8 w/o U^{235} may require further ALARA considerations depending on overall average

enrichment through the factory; the GNF-A ALARA program is mature and capable of managing these changes. Nevertheless, GNF-A's fuel manufacturing processes shall comply with all governing state and federal regulations.

In summary, existing regulations are considered applicable & adequate, and GNF is expert at conforming to the governing regulatory requirements.

Radioactive Waste Generation
Task 1 (ARMOR) – N/A as the ARMOR coating is not radioactive.

Task 2 (LEU+) –
a) In order to support the LEU+ activities in the GNF shop areas, legacy contaminated equipment and associated piping/electrical/etc. material will need to be removed and disposed of to allow for the build-up of the radioactive waste processing area.
b) The solid, liquid, and gaseous radioactive waste streams are essentially the same as existing fuel fabrication process produces. Increased assay increases the specific activity of the waste uranium discharged; however, these effluents are already well below regulatory limits and are not expected to approach those limits. The unirradiated uranium bearing waste streams are radioactive and existing regulatory requirements (e.g., 10CFR20) are applicable & adequate. The liquid waste treatment system and select portions of the gaseous (HVAC) system employ favorable geometry as such will necessitate process equipment changes to accommodate the higher enrichment from a nuclear criticality safety perspective. The GNF Phase 2.C program includes installation and commissioning of select new process equipment.

Mixed Waste Generation
Task 1 (ARMOR) – N/A as the ARMOR coating is not radioactive.

Task 2 (LEU+) – The mixed (radioactive comingled with other hazardous components) wastes generated as part of the subject LEU+ project will be similar to the current generation of mixed wastes from current fuel manufacture (with an increase in the specific activity). The governing state & federal regulations are applicable & adequate.

Chemical Use/Storage
Task 1 (ARMOR) – No new chemicals in liquid form are introduced as part of the manufacturing process. Solid materials are governed normally by existing regulatory requirements that are understood to be applicable and adequate.

Task 2 (LEU+) – No new chemicals are introduced as part of increasing the feed enrichment into the fuel manufacturing process.

Chemical Waste Disposal
Task 1 (ARMOR) – The ARMOR coating is a commercially available industrial coating for specialized application and is being further developed for nuclear fuel application. The composition of the ARMOR coating remains a proprietary trade secret; however, there is general industrial experience in manufacturing processes applying the ARMOR coating. As such, existing state and federal regulations are applicable and adequate. GNF-A will rigorously and conservatively comply with all applicable regulations.

Task 2 (LEU+) – No impact – increasing the feed enrichment does not alter the overall chemical waste disposition for GNF-A's fuel manufacturing process.

Hazardous Waste Generation
Task 1 (ARMOR) – The ARMOR coating is a commercially available industrial coating for specialized application and is being further developed for nuclear fuel application. The composition of the ARMOR coating remains a proprietary trade secret; however, there is general industrial experience in manufacturing processes applying the ARMOR coating. As such, existing state and federal regulations are applicable and adequate. GNF-A will rigorously and conservatively comply with all applicable regulations.

Task 2 (LEU+) – No impact – increasing the feed enrichment does not alter the overall chemical waste disposition for GNF-A's fuel manufacturing process. Minor impact to LLRW is anticipated due to the increase in specific activity of non-combustible waste as a result of the higher enrichment. Incinerable waste is subject to uranium recovery and therefore no changes are anticipated to the basic transport and off-site processing methods. Existing nuclear package used to transport said waste will require new authorized content revision to permit transport of 8.0 wt.% U^{235} enriched waste forms pursuant to 10CFR71.

Industrial Waste Generation
Task 1 (ARMOR) – The ARMOR coating is a commercially available industrial coating for specialized application and is being further developed for nuclear fuel application. The composition of the ARMOR coating remains a proprietary trade secret; however, there is general industrial experience in manufacturing processes applying the ARMOR coating. As such, existing state and federal regulations are applicable and adequate. GNF-A will rigorously and conservatively comply with all applicable regulations.

Task 2 (LEU+) – No impact – increasing the feed enrichment does not alter the overall chemical waste disposition for GNF-A's fuel manufacturing process. Minor impact to LLRW is anticipated due to the increase in specific activity of non-combustible waste as a result of the higher enrichment, that may result in increased disposal expenses. Incinerable waste is subject to uranium recovery and therefore no changes anticipated to the basic transport and off-site processing methods. Existing nuclear package used to transport said waste will require new authorized content revision to permit transport of 8.0 wt.% U^{235} enriched waste forms pursuant to 10CFR71.

Air Emissions
Task 1 (ARMOR) – The ARMOR coating is a commercially available industrial coating for specialized application and is being further developed for nuclear fuel application. The composition of the ARMOR coating remains a proprietary trade secret; however, there is general industrial experience in manufacturing processes applying the ARMOR coating. As such, existing state and federal regulations are applicable and adequate. GNF-A will rigorously and conservatively comply with all applicable regulations.

Task 2 (LEU+) – Minor impact – increasing the feed enrichment is anticipated to only slightly increase the total activity of the air discharged from the exhaust stacks as a result of GNF-A's fuel manufacturing processes. Given historic monitored and reported exhaust stack effluent trends and the margin afforded, no regulatory limit challenges are expected to occur as a result of ATF fuel manufacture at material enrichments up to 8 wt% U^{235}.

Asbestos Emissions or Waste
The GNF-A fuel manufacturing facility has been in service for many decades and certain facilities have a stabilized legacy of asbestos. The GNF-A practice is to remediate asbestos as it is encountered in compliance with all state & federal regulations.

Soil Disturbance
Task 1 (ARMOR) – Process implementation will entail pouring of an outside concrete pad to house process utilities. The area is on a graded hill that will require some soil addition and redistribution to properly support the concrete pad. The associated manufacturing processes do not result in soil disturbance.

Task 2 (LEU+) – No impact.

Discharge of Wastewater
Non-hazardous small amount of chemicals (e.g., 100 g of sodium sulfate, sodium chloride, or zinc acetate) will be used to prepare aqueous solutions that will be used for testing of materials. After the tests, the waste electrolytes will be properly disposed.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B, give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not "connected" nor "related" (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). For purposes of this category, "demonstration actions" means actions that are undertaken at a scale to show whether a technology would be viable on a

larger scale and suitable for commercial deployment. Demonstration actions frequently follow research and development and pilot projects that are directed at establishing proof of concept.

B1.31 Installation or relocation and operation of machinery and equipment (including, but not limited to, laboratory equipment, electronic hardware, manufacturing machinery, maintenance equipment, and health and safety equipment), provided that uses of the installed or relocated items are consistent with the general missions of the receiving structure. Covered actions include modifications to an existing building, within or contiguous to a previously disturbed or developed area, that are necessary for equipment installation and relocation. Such modifications would not appreciably increase the footprint or height of the existing building or have the potential to cause significant changes to the type and magnitude of environmental impacts.

Justification: The activity consists of the pursuit to install by the mid-2020s the first reload of fuel clad in ARMOR coated Zircaloy-2 rods in a commercial US nuclear power plant and support the qualification of this fuel for use up to 68 GWD/MTU, with likely U^{-235} enrichment above 5%. Further development includes the qualification of the fuel to higher burnup on the order of 75 GWD/MTU.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer, on 08/26/2021.