

## ENCLOSURE 2

M200042

### Response to RIS 2019-03 "Pre-Application Communication And Scheduling For Accident Tolerant Fuel Submittals"

#### Non-Proprietary Information

#### **IMPORTANT NOTICE**

This is a non-proprietary version of Enclosure 1, which has the proprietary information removed. Portions of the document that have been removed are indicated by white space with an open and closed bracket as shown here [[ ]].

### **GNF Responses to RIS 2019-03**

Global Nuclear Fuel, Americas (GNF-A) is pleased to provide this forecast of topical reports, and other regulatory aspects, associated with the GE Accident Tolerant Fuel (ATF) program in response to RIS 2019-03.

GNF is developing two (2) cladding technologies that provide improved oxidation resistance to high temperature steam associated with accident conditions: 1) ARMOR coated Zircaloy for retrofit to conventional reload fuel, and 2) iron-chromium-aluminum (FeCrAl) cladding referred to as GNF-IronClad as a replacement for Zircaloy. Additionally, GNF is making preparations to increase fuel enrichment above the current value of 5 w/o  $U^{235}$ , to as high as 8 w/o  $U^{235}$ , and referred to as LEU+, to support increasing fuel burnup by as much as 20% above current levels. The term High Assay Low Enriched Uranium (HALEU) is being reserved for enrichments  $> 10$  w/o  $U^{235}$  up to the limit for low enriched uranium of 20 w/o  $U^{235}$ . ARMOR coated Zircaloy, LEU+ and increased burnup are considered near term and the focus of this summary. GNF-IronClad is considered to be in a next phase of ATF development; however, GNF plans to apprise the Staff of IronClad development and performance.

The following responses to the questions contained in RIS 2019-03 represent GNF's best estimate of future submittals and are intended to align with broad industrial goals. It is noted that the HALEU and high burnup aspects are in the early stages & multi-dimensional and, therefore, have increased programmatic uncertainty.

*(1) What ATF concepts are you pursuing?*

- iii. ARMOR coating for application to BWR fuel rods
- iv. Iron-chromium-aluminum (GNF-IronClad) cladding

*(2) What lead test/lead use assembly campaigns do you plan to conduct or anticipate conducting?*

Lead test assemblies (LTAs) containing ARMOR coated lead test rods (LTRs) and LTAs containing an unfueled IronClad LTR were first installed into Plant Hatch in Cycle 29 that began operation in early 2018. These LTAs are described in:

NEDC-33883P, Revision 0, "GNF ARMOR Lead Test Assembly for Edwin I. Hatch Nuclear Plant, Unit 1," September 2017.

NEDC-33884P, Revision 0, "GNF FeCrAl ATF Lead Test Assembly For Edwin I. Hatch Nuclear Plant, Unit 1," October 2017.

Lead test assemblies containing ARMOR coated LTRs and lead test assemblies containing both fueled and unfueled GNF-IronClad LTRs were installed into the Clinton Power Station in late 2019. These LTAs are described in:

NEDC-33904P, Revision 0, "GNF ARMOR ATF Lead Test Assembly for Clinton Unit 1," November 2018.

NEDC-33903P, Revision 0, "GNF IronClad ATF Lead Test Assembly for Clinton Unit 1," November 2018.

There are no specific plans for additional ATF (i.e., ARMOR or IronClad) LTAs at this time. GNF plans to inform the NRC of poolside and hot cell PIE as results are generated and alert the Staff to any future ATF LTAs.

Additionally, GNF is preparing a proposed amendment to GESTAR II for submittal to the NRC that establishes High Burnup Lead Use Assemblies (HBLUAs) as a specific category of lead assembly. These HBLUAs are commercial reload fuel that are authorized to undergo extended irradiation beyond current regulatory limits governing exposure to provide for data collection in support of high exposure licensing if required. GNF is planning for HBLUAs to begin irradiation as soon as practical following NRC approval of the subject GESTAR II amendment.

(3) *What types of tests (e.g., material characterization, transient, ramp, loss-of-coolant accident, post-irradiation examination, criticality, fission product releases for applicable regulatory source terms) do you plan on conducting for the qualification of your ATF concepts, and what is your current schedule for such testing?*

E. This discussion is focused on ARMOR licensing. A complete array of material properties testing is being conducted on unirradiated material and will be described in a near term Topical Report. This testing is being conducted over a range of conditions spanning transport, normal operation, transient & accident conditions. Poolside surveillance has begun on the Hatch LTAs noted above and hot cell examinations are planned. GNF has been apprising the staff of ARMOR testing, test results and plans in periodic workshops and will continue to inform the Staff of ongoing data collection.

F. *When and how do you intend to engage with the NRC on these testing plans?*

As noted above, GNF has been informing the Staff as to our ongoing testing plans as well as Lead Assembly and test reactor programs in the periodic workshop setting. GNF plans to continue this practice through ARMOR licensing.

*G. Alternatively, do you intend to submit a draft ATF qualification plan for NRC review?*

GNF intends to submit a comprehensive Topical Report describing the performance of ARMOR coated fuel rods and the adequacy of engineering methods used in reload licensing. Additionally, GNF has been, and will continue to provide the Staff with detailed technical information that describes performance. GNF looks forward to NRC audits during the conduct of the ARMOR TR review to further supplement the Staff's understanding.

*H. If so, what is your estimated timeframe for completion of the draft qualification plan?*

GNF judges that the combination of the ARMOR Topical Report, pre-submittal workshops and post-submittal audits constitute regulatory qualification.

*(4) What topical reports or supplements do you plan on submitting to the NRC for review and approval to support ATF? What is your estimated timeframe for submitting those topical reports or supplements?*

See Table 1.

*(5) Do you plan to pursue ATFs with higher burnups than your currently approved values or enrichments greater than five (5) weight percent uranium-235 (U-235)? If so, what is the estimated timeframe for these submittals?*

Yes. GNF plans to pursue licensing authorizations to irradiate fuel to exposures as high as 20% above current regulatory limits. Concurrently, GNF has initiated a program to increase fuel enrichment to as high as 8 w/o U<sup>235</sup> to support the higher exposure targets. Topical Report submittals are summarized in Table 1.

*(6) Do you anticipate that your concepts will require rulemaking or an exemption to any regulations under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," or 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"?*

Increasing enrichments beyond the current 5 w/o U<sup>235</sup> value for LEU is understood to require either exemptions, or rulemaking.

- (7) Do you anticipate that your concepts will require modification of existing NRC guidance or creation of new guidance?*

GNF views that the existing regulatory guidance governing fuel as supplemented by ATF-ISG 2020-01, "Supplemental Guidance Regarding the Chromium-Coated Zirconium Alloy Fuel Cladding Accident Tolerant Fuel Concept - Interim Staff Guidance" is adequate to support licensing of the ARMOR coated fuel rod system under the existing safety basis.

- (8) Do you plan to submit a license application or license amendment for the production of ATF on either a lead test/lead use assembly scale or a production scale? If so, what is the estimated timeframe for such submittals?*

A license amendment is not required for the production of ARMOR coated fuel. A license amendment to GNF's SNM-1097 license is required (and has been submitted) to fabricate fuel at enrichments higher than 5 w/o U<sup>235</sup>.

- (9) Are there hazards that are not addressed in currently licensed fuel fabrication facilities such as enrichments greater than five (5) weight percent U-235 or new chemical or process hazards?*

There are no unaddressed hazards associated with the production of ARMOR coated fuel rod cladding tubes. The GNF-A fuel manufacturing facility will be modified to process >5 w/o feed material to conform to regulatory requirements governing nuclear safety.

#### **Fuel Vendors and Transportation/Storage System Certificate Holders**

- (1) Do you plan to submit an application for an amendment of a certificate of compliance (CoC) or a letter authorization for a transportation package for shipment of fresh (unirradiated) ATF on either a lead test/lead use assembly scale or a larger scale to support fresh fuel reloads?*

ARMOR coated GNF 10x10 fuel resides within the approved contents of the RAJ-II fresh fuel shipping container. A revision to the RAJ-II SAR is required to transport fuel with >5 w/o U<sup>235</sup> UO<sub>2</sub> fuel and an amendment is planned as indicated in Table 1.

- (2) Do you plan to submit an application for an amendment of a CoC of a transportation package for shipment of fresh fuel in pellet and/or powder forms? If so, what is the estimated timeframe for such submittals?*

GNF plans to submit a revision to the New Powder Container (NPC) SAR to support the transport of uranic solids, pellets etc. at enrichment >5 w/o U<sup>235</sup>. See Table 1 for the projected timing.

- (3) *Do you plan to fabricate ATF with enrichments greater than five (5) weight percent U-235 that will necessitate an amendment of a CoC of a transportation package (e.g., for the shipment of uranium hexafluoride (UF6) or other forms of uranium at an enrichment greater than five (5) weight percent U-235)? If so, what is the estimated timeframe for such submittals?*

As noted above, GNF plans to submit a revision to the RAJ-II SAR to support transport of GNF 10x10 fuel container >5 w/o U<sup>235</sup> UO<sub>2</sub>. See Table 1 for the projected timing.

- (4) *Do you plan to submit an application for an amendment of a CoC of a transportation package for shipment of spent ATF? Do you plan to submit an application for an amendment of a CoC of a dry storage system for spent ATF? If so, what is the estimated timeframe for such submittals? Do you expect new materials to be necessary for the fabrication of transportation packages and dry storage systems for use with spent ATF? If so, what are your plans for identifying additional needs (e.g., materials testing) for the fabrication of these designs?*

GNF has submitted a revision to the GE2000 SAR to provide for the transport of irradiated fuel material to support transport of rod segments for hot cell examination. Any subsequent SAR revision to support the transport of irradiated fuel at >5% U<sup>235</sup> initial enrichment and/or burnups in excess of current licensed values is outside the time horizon of this summary. Dry cask storage licensing is outside of GNF's domain; however, it is likely that GNF would support such licensing activities.

- (5) *Do you anticipate that your application for an amendment of a CoC of a transportation package or dry storage for fresh/spent ATF will require rulemaking or an exemption to any 10 CFR Part 71 or 10 CFR Part 72 regulations (e.g., maximum enrichment for use of moderator exclusion for UF6 packages in 10 CFR 71.55(g)(4))?*

Yes, associated with fresh fuel enrichment >5 w/o U<sup>235</sup>.

- (6) *Do you anticipate the need for modification of existing NRC guidance or the creation of new guidance for the safety review of your application for an amendment of a CoC for a transportation package or dry storage system for fresh/spent ATF?*

Existing NRC guidance is judged adequate.

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