# ENCLOSURE 5

# M220141

# 2022 Technology Update Presentation

# Non-Proprietary Information

## INFORMATION NOTICE

Enclosure 5 is a non-proprietary version of the 2022 Technology Update Presentations from Enclosure 4, which has the proprietary information removed. Portions that have been removed are indicated by open and closed double brackets as shown here [[ ]].

# August 10 - NRC Tech Update Agenda

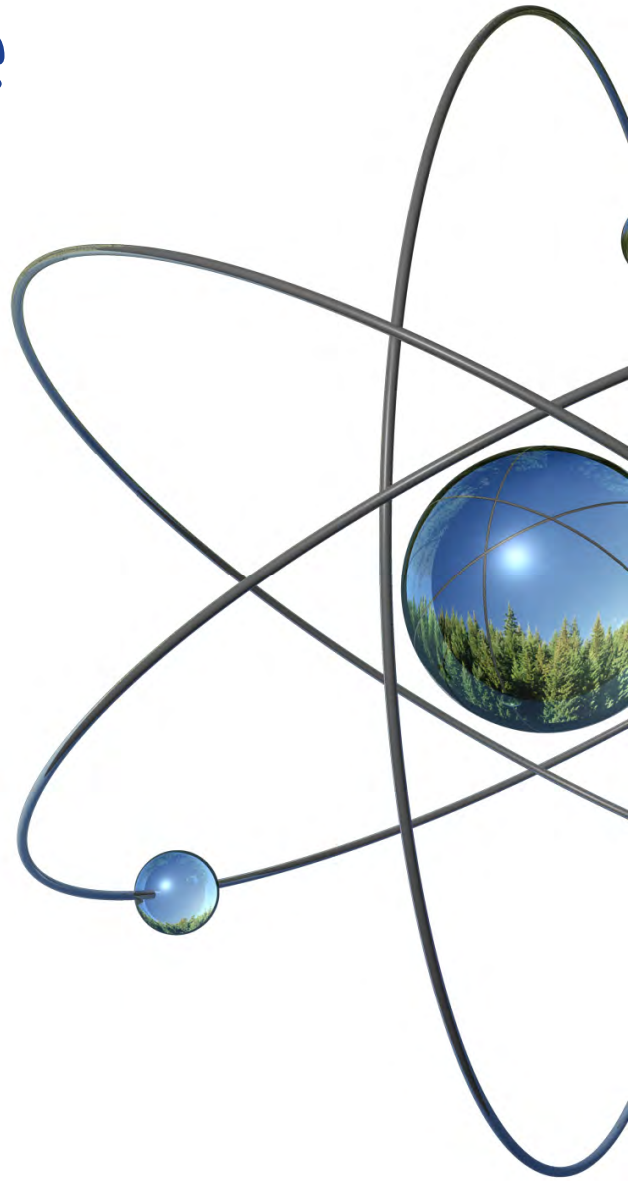
| Time | Subject | Presenter | Duration |
|---|---|---|---|
| 9:00a | Welcome/Safety Information/Introductions<br>NRC Comments | Brian Moore | 10 |
| 9:10a | Control Blade Inspection Update | Scott Nelson | 20 |
| 9:30a | Fuel Performance Update | Rob Schneider | 30 |
| 10:00a | ATF Program Update | Rich Augi | 20 |
| 10:20a | Break | | 10 |
| 10:30a | Increased Enrichment (LEU+) Update | Tyler Schweitzer | 30 |
| 11:00a | Burnup Extension LTR (FFRD Topics) | Kurshad Muftoglu | 60 |
| 12:00p | Lunch | | 60 |
| 1:00p | ARMOR 1.5 / 2.0 Updates | Samantha Michael / Sarah DeSilva | 30 |

GNF Global Nuclear Fuel

HITACHI

| Time | Subject | Presenter | Duration |
|---|---|---|---|
| 1:30p | LANCR Downstream Methods Plan | Dan Rock / Randy Jacobs | 30 |
| 2:00p | NSF Channel Annual Report | Dan Lutz | 30 |
| 2:30p | Break | | 10 |
| 2:40p | PRIME 7-Year Update & LEU+ | Ian Porter | 50 |
| 3:30p | BWRX-300 Technology Update | Charlie Heck | 60 |
| 4:30p | Licensing Update | Kent Halac | 10 |
| 4:40p | Closing Remarks | GNF / NRC | 20 |
| 5:00p | Adjourn | | |

# 2022 Technology Update for the US NRC August 10



Brian R. Moore
General Manager
Core & Fuel Engineering

Global Nuclear Fuel
A Joint Venture of GE, Toshiba, & Hitachi

HITACHI

# Thank You for Participating

- Safety Minute
- Introductions
- Why we are here… sharing technical performance and direction
- Don’t be bashful in Q&A periods
- NRC Opening Statements

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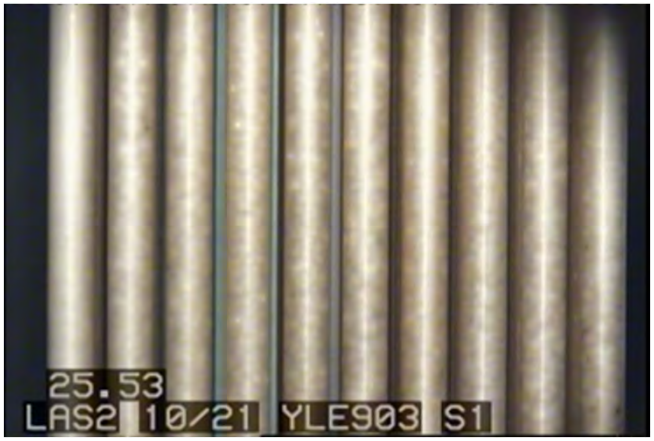
# 2022 Technology Update: US NRC






# Fuel Experience Update

Rob Schneider, GNF Fuel Reliability

Global Nuclear Fuel

# Agenda

- Fuel Experience Summary
  - Total, current designs
- Reliability Trend
  - historical, recent trends
- GNF2 experience details
- GNF3 experience details
- Details - recent fuel failures
- New Fuel Reload Surveillance Status
- LUA Surveillance Status & Objectives
  - GNF3
  - HBLUA
- Rod Gap Observations

# GNF Fuel Experience

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**Largest BWR Fuel Experience Base in the World**

# NRC requested formats for reliability data

## Fuel Performance formats

- Total Number of failed rods per year (not failed assemblies)

  provided in slide #9 and 10

- Failed rods per year broken down by failure mechanism

  provided in slide #11

- Failure Rate (failed rods per million manufactured) in US

  is provided in slide #5 by product line and #8 as function of time

# Fuel Experience Update (through July 2022, 10x10 fuel)

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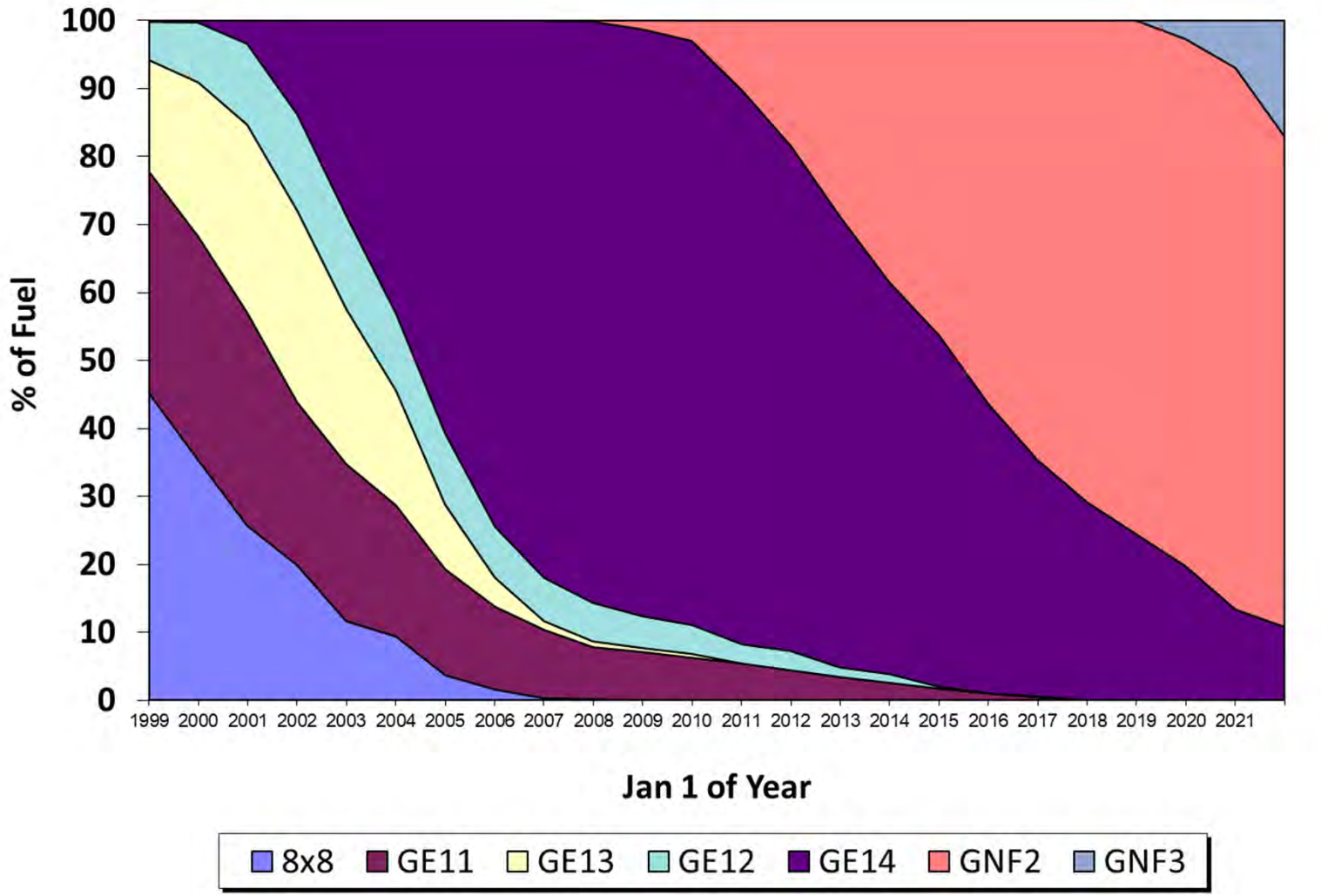
# Fuel Experience Update

**GNF-A, plus ENUSA/Europe, % of all bundles in-core/operating as of Jan 1 of calendar year**

- Currently only LV-1,-2 receiving GE14
- ~95% of all GE14 is discharged, ~60% of GNF2, including from plant S/D's (Pilgrim, Oyst Crk, KKM, DA, Gun-C past ~4 yrs)



# GNF2: Reloads & LUAs, Experience Summary

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# Historical Reliability Trends

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# GNF Fuel Failures per Year

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# GNF Fuel Failures per Year – International

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# Failed rods per year: by failure mechanism

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# Rod Gap Surveillance

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# Lead Assembly Surveillances

- GE14 LUAs Irradiations & Inspections complete
- GNF2 LUAs Irradiations & Inspections complete
    - New – GNF2_HBLUA inserted in ‘21
- GNF3 LUAs 2 sets of irradiations and inspections completed

# GNF2_HBLUA

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# GNF3 Inspection Plans

Poolside inspections

- Visual exams & COINs (oxide, crud profilometry/diameter) as outage schedules support
- Selected dimensional measurements

GNF3 is a variant on GNF2 – same fuel rod, pellet, cladding, materials

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# LaSalle-2 Oct 2021 Inspection

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# LaSalle-2 Oct 2021 Inspection

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Liftoff data added to PRIME Qualification database

# BWR/6 Inspections – no “dryout” indications

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# Summary

- **Fuel Experience:**
  - 10x10 experience base ~6.3 million rods
  - GNF2.02 and GNF3 have helped get to zero leakers
- **Reliability Trends**
  - First-ever BWR fleet zero leakers
  - Last US failure to occur ~ 16 months ago
- **GNF2 & GNF3 experience details**
  - Transition to GNF3 reloads started in ‘19
- **New Fuel Reload Surveillance Status**
  - Complete for legacy designs; extensive inspections.
- **LUA Surveillance Status & Objectives**
  - GNF3 LUA Inspections approaching completion
  - Detailed inspections Fall ‘21 after Feb ’21 discharge

Non-Proprietary Information

# 2022 Technology Update: US NRC

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## ATF Program Update

Rich Augi

Global Nuclear Fuel

# ARMOR Status & Plans

## ARMOR 1.0

- Inserted at Hatch (2018) and Clinton (2019)
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## ARMOR 1.5

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## ARMOR 2.0

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# IronClad – Maturing & Retiring Risks

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# Program Trajectory

Non-Proprietary Information

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# Acknowledgements

The financial support of GE Hitachi Nuclear and Global Nuclear Fuels is gratefully acknowledged. Part of the material presented is based upon work supported by the **Department of Energy [National Nuclear Security Administration]** and as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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# NRC Tech Update
# LEU+

August 2022

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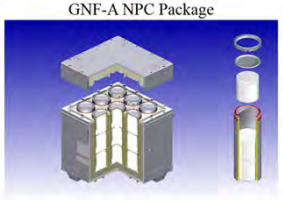
# Focus Areas for LEU+ & Higher Burnup

Enrichment Facilities

UF6 Transport

New Powder Container




Criticality Methods


Fabrication Facilities

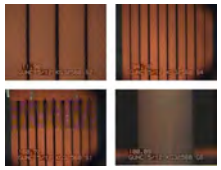
Front End (Dirt to Box)

RAJ-II Fresh Fuel Transport

Fuel Storage

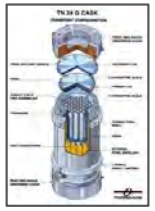
Engineering Methods


Fuel Performance



Licensing

Dry Cask Storage



In Service (Box to Cask)

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# Strategic Update

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**Accident Tolerant Fuel – ATF Program Level 1 Schedule – July 2022**

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# Target Timeline

- [[

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# LEU+ Engineering Methods

Nuclear methods

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Application Methods

- TRACG Qualification update to use LANCR based cross sections
- Downstream methods Implementation using LANCR/PANAC application and Methods C loss coefficients
  - Steady State Methods and SLMCPR
  - AOO/ATWS (TRACG and ODYN), Stability (TRACG and ODYSY), LOCA, CRDA, Fluence
- [[

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# LEU+ Engineering Methods

Fuel rod thermal mechanical method (PRIME03)

- Update PRIME to allow for LEU+
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# Transportation

Currently restricted to not more than 5.0 wt% U235

## RAJ-II Fresh Fuel (FF) Container

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## New Powder Container (NPC) fresh fuel shipping

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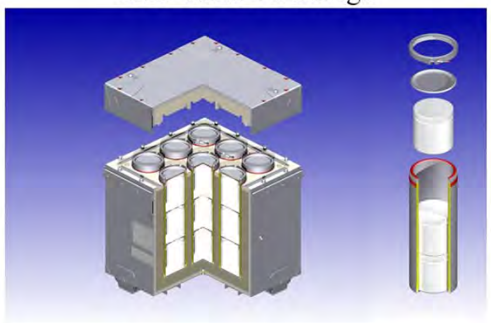
GNF-A NPC Package



## GE Model 2000 irradiated fuel shipping cask

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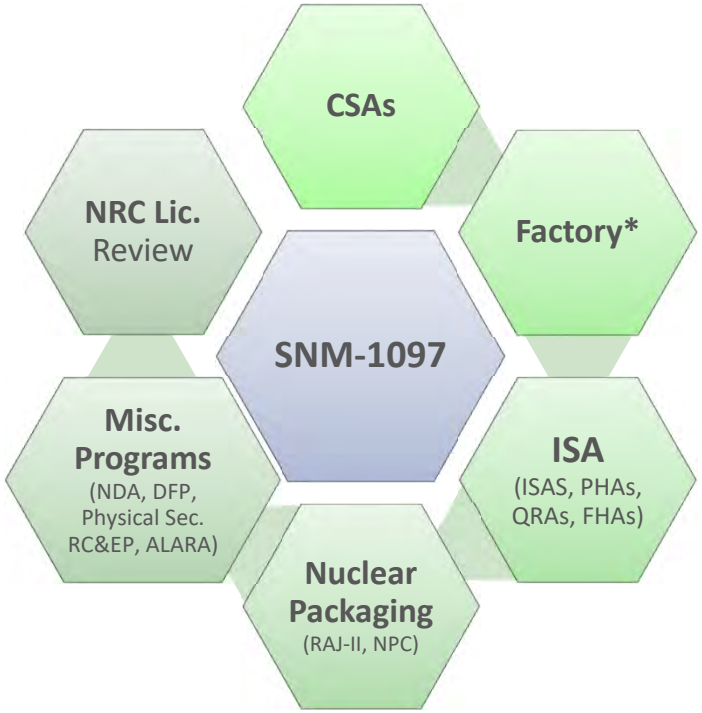
# GNF-A LEU+ Elements of Change in Facility




**SNM-1097 License Amendment (LA) approach for 8 wt. %**

* **Extent of factory changes depends on fuel form, enrichment limit**

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# 2022 Technology Update: US NRC

# ARMOR 1.5/2.0 Update

Sarah DeSilva/Samantha Michael

Global Nuclear Fuel

# Outline

- ARMOR 1.0 Re-Brief
- Coating Development Strategy
- ARMOR 1.5
- ARMOR 2.0

# Two Mechanisms

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# Hatch PIE ([[ ]] segment)

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# Transition to Mid-Term/Long-Term Activities

# Accelerated Corrosion Screening Tests

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# ARMOR 1.5

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# ARMOR 1.5

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# ARMOR 1.5

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# ARMOR 2.0: Parallel Concept Development

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# ARMOR 2.0: [[

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# ARMOR 2.0: [[

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# ARMOR 2.0: Exploratory Options

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# Conclusion

## ARMOR 1.5 Summary

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## ARMOR 2.0 Summary

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# Acknowledgement

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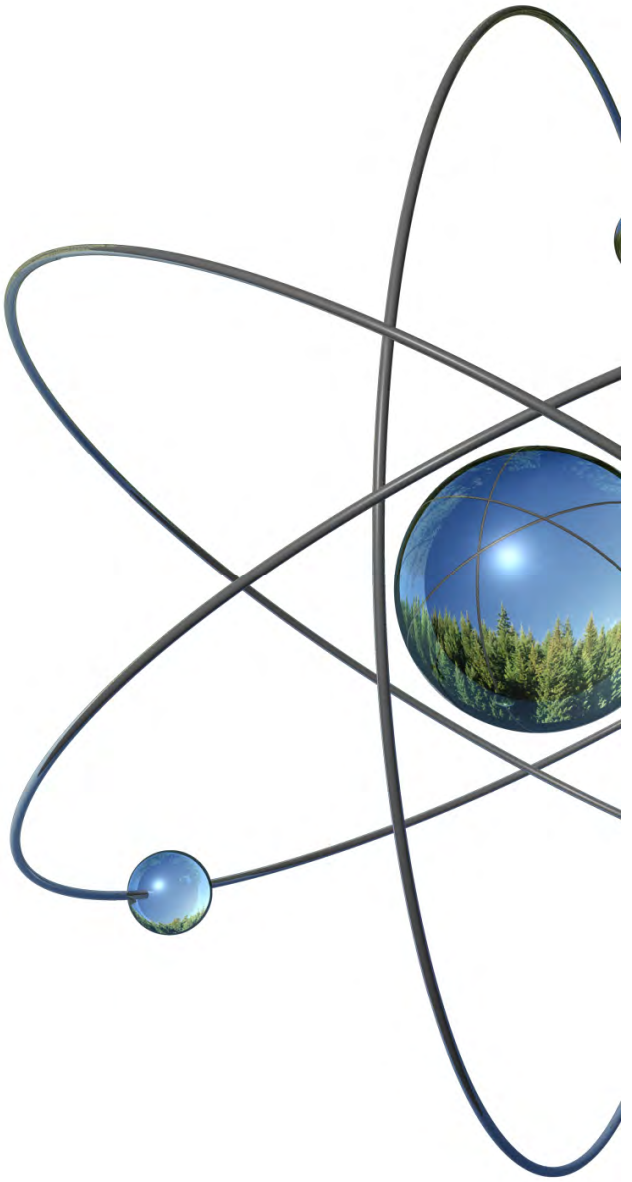
# LANCR02/PANAC11 Application Methodology TR

# Downstream Implementation



NRC Tech Update

August 2022

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# Agenda and Objective

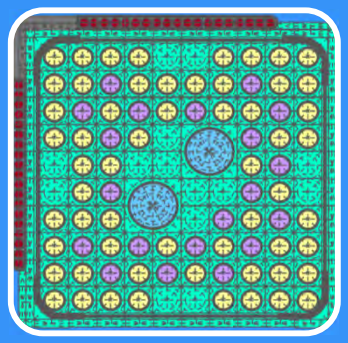
- Agenda
  - Summary of L02/P11 TR Downstream Impacts
  - Proposed Implementation Scope, Strategy, and Process Precedent
  - Downstream Method Impact Expectations
  - Logistics and Summary

- Objective
  - Introduce strategy for implementing LANCR02/PANAC11 in downstream methods and share expectations for the required scope/impact of changes

# Summary of L02/P11 TR Downstream Impacts

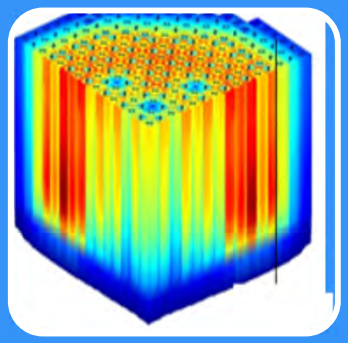
# Methods Licensing Overview

## Nuclear & Downstream Methods



### 2D Lattice Physics

- Nuclear Behavior of Fuel Rods Within Bundle
  - TGBLA06 – Approved Production Tool
  - LANCR02 – Model and Qualification TRs Approved



### 3D Core Simulation

- Nuclear + Thermal-Hydraulic Behavior of Bundles in Core
  - TGBLA6 + PANAC11 – Approved Production Tool
  - LANCR02 + PANAC11 (Currently in NRC Review)

Nuclear Methods

Models & Data

### Plant Simulation

- CRDA – (TRACG)
- AOOs – (ODYN & TRACG)
- Stability (ODYSY & TRACG)
- LOCA/ECCS (SAFER & TRACG)

Downstream Methods

# Overview of LANCR02 / PANAC11 Methods Changes

## Given the Method Change from TGBLA06/PANAC11 → LANCR02/PANAC11

Consistency between nuclear methods and downstream methods is necessary in areas of application and process interactions.

There are two models in LANCR02 / PANAC11 not in the existing downstream methods approval basis:

- The use of LANCR02 cross section data is not approved
- The Reynolds number and quality dependent local loss correlation 'Method C' is not approved.

## These Method Changes are Improvements Over the Current Methods

- LANCR02 more accurately predicts cross section data
- The Reynolds number and quality dependent local loss correlation 'Method C' is more accurate across a wider range of flow conditions, and better models contemporary axially varying fuel designs

# Proposed Implementation Scope, Strategy, and Process Precedent

# Topical Areas and Affected Topical Reports

| Methodology | Code | References |
|---|---|---|
| **Control Rod Drop Accident** | TRACG04 | NEDE-33885P-A R1 |
| **Fluence** | DORTG01 | NEDC-32983P-A R2 |
| **LOCA/ECCS (SAFER / TASC)** | SAFER04<br>TASC-03 | NEDE-23785-1-PA (Vols. 1-3)<br>NEDC-30996P-A (Vols. 1, 2)<br>NEDC-32084P-A |
| **LOCA/ECCS (TRACG)** | TRACG04 | NEDE-33005P-A R2 |
| **Safety Limit MCPR** | GESAM02 | NEDC-32601P-A<br>NEDC-32694P-A<br>TSTF-564 R2 |
| **Stability 1-D (ODYSY)** | ODYSY05 | NEDC-32339-P-A Supl. 1<br>NEDC–32992P–A<br>NEDE-33213P-A<br>NEDC-33075P-A<br>NEDE-32465 Supl. 1P-A<br>NEDE-33766P-A |
| **Stability 3-D (TRACG)** | TRACG04 | NEDC-33075P-A<br>NEDE-32465 Supl. 1P-A<br>NEDE-33766P-A<br>NEDE-33147P-A |
| **Transients 1-D (ODYN)** | ODYNM10, ODYNV09<br>TASC-03 | NEDO-24154-A (Vols. 1-4)<br>NEDC-32084P-A, R2 |
| **Transients 3-D (TRACG)** | TRACG04 | NEDO-24154-A (Vols. 1-4)<br>NEDC-32084P-A, R2<br>NEDE–32906P-A, Revision 3<br>NEDE-32906P Supplement 1-A, 2-A, 3-A |
| **TRACG Referential** | TRACG | NEDE-32176P<br>NEDE-32177P |

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# Implementation Strategy

## Outline of Strategy

1. GNF prepares single topical report outlining the implementation plan
   - Identify the scope of the changes to the downstream methods
   - Describe the implementation strategy for the changes
   - Describe the process for evaluating and documenting the significance of the changes resulting from implementation of the methods changes
   - Documents the necessary changes to GESTAR II
2. Plan submitted as Supplement 1 to NEDC-33935 currently under NRC review
3. NRC reviews / approves the plan for implementing & testing the methods changes
4. GNF executes to the plan, determining and documenting the significance of any methods changes considering the process for including uncertainties in the methodologies, and recommends a final application process in the various downstream methods.
5. NRC audits GNF and reviews the summary report, the successful conclusion of which would constitute approval for the use of the method changes in the downstream methods.

# Proposed Downstream Implementation Approach

## Similar Approach used in PRIME03 Downstream Implementation

- 7/10/2009 – GEH Submits to NRC: NEDO-33173, Supplement 4, "Implementation of PRIME Models and Data in Downstream Methods"
- 9/9/2011 – NRC Approved NEDO-33173
  - *SE States: At the conclusion of the code update and software testing process the NRC staff will audit the final documentation to ensure that the code updates were performed in accordance with the approved process described in Supplement 4.*
- 7/17 – 7/18/2012– NRC Audits PRIME Implementation Report
- 10/22/2012 – NRC Audit Letter Issued with the conclusion:
  - *The NRC staff's audit of GEH's PRIME implementation into downstream safety analysis analytical methods found that the NEDO-33173, Supplement 4 plan was correctly executed. The PRIME conductivity models were correctly encoded into downstream applications and test cases demonstrated that the impact of switching from GSTRM to PRIME models was as expected. There were no open items or negative audit findings*

# Downstream Method Impact Expectations

# Technology Code Considerations

## Updates to Nuclear Methods

- Implementation of LANCR02 cross section data occurs in PANAC11 and is largely transparent to downstream applications; very few modifications to codes or methods required.

## Updates to Thermal-Hydraulic Methods (Method C)

- The local loss formulations implemented in the downstream methods are generically encoded, and Method C losses can largely be implemented by providing the coefficients in code input ; very few modifications to codes or methods required.

**Technology codes not expected to change**

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**Analysis Results not expected to change much**

**(Note: Data shown is unverified)**

# Licensing Considerations

## What the TRs Say About Updates to Nuclear Methods

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## What the TRs Say About Updates to Thermal-Hydraulic Methods (Method C)

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# Logistics and Summary

# Anticipated Licensing Timeline

- LANCR02/PANAC11 Applications supporting DOE ATF program efforts to enable LEU+
- ATF Phase 2C runs from February 2021 – February 2025

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# Summary

- GNF has submitted NEDC-33935 Rev. 0 to the NRC for Approval to use LANCR02 and Method C as a 3D core simulator package.
- GNF is preparing an LTR to seek approval to use LANCR02 nuclear data and the Method C local loss formulation in the downstream methods to maintain consistency in the overall analysis and licensing basis.
- LANCR02 and Method C are improvements over the current models, and few if any changes will be required to the technology codes to implement them.
- GNF is using the same licensing strategy used in the PRIME03 Supplement 4 LTR which described a process for implementing changes into downstream codes and methods
- This licensing process worked very well, and was well received by the NRC.

# Backup Slides

# Propagation of Models and Data in Downstream Methods

**Licensing Approach: Follow Prior Precedent**

- **NEDO-33173 Supplement 4-A Implementing PRIME03 Models and Data into Downstream Methods**

By letter dated September 12, 2011 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML112440229), the U.S. Nuclear Regulatory Commission (NRC) staff issued its final Safety Evaluation (SE) approving GE-Hitachi Nuclear Energy Americas (GEH) Topical Report NEDO-33173, Supplement 4, "Implementation of PRIME Models and Data in Downstream Methods." By letter dated September 23, 2011 (ADAMS Accession No. ML112660155), GEH submitted the approved ("-A") version of this TR to the NRC, incorporating the NRC staff's final SE. Supplement 4 provided a detailed plan for implementation of PRIME fuel rod thermal-mechanical (T-M) models in downstream analysis codes. The PRIME T-M models would replace legacy models (e.g., GSTRM) within downstream analysis codes that do not account for fuel thermal conductivity degradation. In its review of NEDO-33173, Supplement 4, the NRC staff found the scope of the PRIME implementation plan acceptable. The NRC staff's SE for NEDO-33173, Supplement 4 included the following statement:

> At the conclusion of the code update and software testing process the NRC staff will audit the final documentation to ensure that the code updates were performed in accordance with the approved process described in Supplement 4.

Audit upon completion

# Overview of LANCR02 / PANAC11 Methods Changes

## Method Change Overview

| Approved Core Simulator TGBLA06/PANAC11 [1] | Under NRC Review LANCR02/PANAC11 [2] |
|---|---|
| Neutronic parameters used by PANACEA are obtained from the 2-D lattice physics code (TGBLA6) and parametrically are fitted as a function of moderator density, exposure, control and moderator density history for a given fuel type. | Neutronic parameters used by PANACEA are obtained from the 2-D lattice physics code (LANCER) and parametrically are fitted as a function of moderator density, exposure, control and moderator density history for a given fuel type [3,4]. |


1. *MFN-035-99, S. Richards (NRC) to G. Watford (GE), Amendment 26 to GE Licensing Topical Report NEDE-24011-P-A, "GESTAR II" – Implementing Improved GE Steady State Methods (TAC No. MA6481), November 10, 1999.*
2. *NEDC-33935P Rev 0 LANCR02/PANAC11 Application Methodology, November 2021.*
3. *NEDC-33376P Rev. 4, LANCR02 Physics Model Description, August 2021.*
4. *NEDC-33376P Rev. 4, LANCR02 Physics Model Qualification Report, August 2021.*

# Overview of LANCR02 / PANAC11 Methods Changes

## Downstream Methods Change Driver – “Method C” Introduction

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# NSF Channels Annual Report

Dan Lutz

August 10, 2022



Global Nuclear Fuel

# Outline

- NSF Background
- NSF LUCs and Inspection Status
- 2022 Annual NSF Channel Performance Report
- NSF Deployment Status

# NSF Channels

- NSF – 1% Nb, 1% Sn, 0.35% Fe, balance Zr
  - Effectively resistant to fluence bow
  - Reduced shadow corrosion-induced bow
- First LUCs inserted in 2002
- 8% LUC “mini-batch” approved in 2013
- NRC approved full reload batches in 2015
- First full reload inserted in 2016

# NSF SER Conditions and Limitations

- NRC set Conditions and Limitations for NSF reload licensing
  - EOL fast fluence < surrogate 70 GWD/MTU PPE
  - EOL ECBE < 55,000 inch-days
  - Continue application of SC11-05 until full NSF core in S-lattice plant does not have interference for 3 years
  - Complete NSF 8% mini batch LUC inspections
  - Annual experience report

# NSF LUC Mini-batch Inspection Scope (SER Requirements)

## For cycles prior to discharge

- Visual 5% of batch size (3-4)
- Length 5% of batch size (3-4)

## For cycles after discharge

- Visual 20% of batch size
- Length 20% of batch size
- Bow and bulge 50% of batch size
- Corrosion measurement of 20 channels (FSECT)

# NSF Lead-Use Channel Programs

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# NSF Channel Inspections

Required inspections for 5 of 6 US GNF2 mini-batch discharge inspections have been completed Nov-2020-July 2021

- Required corrosion measurements are complete
- Pilgrim D-lattice plant substitution for bow, bulge, and length, TBD

Bow, bulge, length for some 4-cycle GE14 LUCs also included in unmandated inspection scope

One small Reload inspection campaign Dec. 2021

Cofrentes TBD

Recent GNF2/GNF3 bulge data affecting 2020 and 2021 reports but will be included in 2022 (SIMCHAD tilt correction)

# NSF Channel SIMCHAD/Length Measurement Database

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# NSF Irradiation Growth Data

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# NSF 100T/T2 Channel SIMCHAD Creep Bulge Database

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# NSF 120T/T2 Channel SIMCHAD Creep Bulge Database

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# NSF 120T/T2 Channel SIMCHAD Creep Bulge Database

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Global Nuclear Fuel

# NSF Total Channel Bow

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# NSF Channel Shadow Bow

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# Typical Recent NSF Visual Exam Results

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# FSECT Channel Corrosion Measurements

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# NSF Channel Corrosion

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# NSF Deployment Status

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# Summary for 2022

Inspections required by SER are nearly done

Greatly expanded database continues to demonstrate excellent NSF performance

- Fluence and shadow bow resistant with much less variability than Zr-2 and without late life breakaway
- Acceptable bulge
- Acceptable corrosion

Exceptional operational experience to date

NSF is performing very well!

Non-Proprietary Information

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# NRC Tech Update

# PRIME Licensing for HBU & LEU+

August 2022

# PRIME Licensing – HBU & LEU+

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# PRIME LTR - Outline

The LTR will closely follow the NEDC-33256P-A and the NEDC-33258P-A reports.

A demonstration calculation will be provided with the GNF3 fuel product to show the impact of the new methodologies relative to current licensing bases

1. Introduction
   a. Background
   b. Summary of Changes
   c. Implementation
2. Model Updates
   a. Fuel Melting Correlation
3. Licensing Requirements
   a. Current Requirements
4. Design Analysis Procedure
   a. Rod Internal Pressure Limit
   b. Fuel Melting
   c. Cladding Strain Overpower Analysis
      i. Generic MOP
      ii. RWE
   d. Fatigue
5. GNF3 Demonstration
6. Conclusions

# PRIME Methodology Updates – [[ ]]

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# Method 1 – [[ ]]

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# Method 2 – [[ ]]

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# Method 3 – Current Methodology*

- For current and future TMOLs, the existing methodology may continue to be used for calculating the rod internal pressure (nominal and standard deviation).
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# Example Results - Recent ATF EQs

**Method 2** **Method 1**

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# PRIME Methodology Updates – [[ ]]

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# PRIME Methodology Updates – [[ ]]

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# PRIME Methodology Updates – Rod Withdrawal Error (RWE)

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# Generic Flexibility

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# PRIME Model Update – [[ ]]

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# PRIME Model Updates – HBU / LEU+

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# Summary

- PRIME Topical Report will be submitted in [[ ]]
- Several methodology updates will be made
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Non-Proprietary Information

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# NRC Tech Update

# PRIME 7-Year Update

August 2022

# Background

- As part of the PRIME approval in 2010, a limitation & condition (L&C) was put forth that requires “GNF to periodically demonstrate and document … the continued applicability of PRIME every five years starting in 2015”. This L&C was intended to ensure PRIME’s best-estimate predictions and applied uncertainties remain valid and applicable to current fuel designs and operations.
- The first 5-year update was provided in 2015, NEDC-33257P Supplement 1 Revision 0.
- During the PRIME Transient Topical Report review & approval (NEDC-33840P-A) in 2017, the reporting period was relaxed from every 5 years to every 7 years.
- GNF will submit the second supplement to NEDC-33257P [[ ]].
- These supplements are submitting for information only, not for approval.

# Supplement Requirements – per L&C4 of NEDC-33256P-A

a. In preparation of this letter, GNF must review available sources for applicable commercial and research reactor fuel performance data which may augment the existing PRIME qualification database (e.g., international research activities, pool-side examinations, hot-cell programs, power ramp programs).
b. In the letter, sources for new data should be clearly identified. If no new data for a particular model (e.g., FGR model) has been discovered, the letter should state this fact and identify which sources were investigated.
c. PRIME model predictions and uncertainties should be compared against the augmented database. New data should be easily differentiated on the plots. At a minimum, the letter should separately address the following model predictions and their respective uncertainties: (1) fuel temperature, (2) FGR, (3) fuel irradiation swelling, (4) cladding creep, (5) cladding strain (due to over power conditions), and (6) void volume/rod internal pressure.
d. Any data discarded from the augmented qualification database should be identified and dispositioned.
e. The letter should identify and disposition any bias on model predictions or increase in uncertainty.
f. Since the worst case methodology employed in the [[

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# Supplement Requirements – per L&C 1 & 2 of NEDC-33840P-A

1.b Periodic model validation requirement in L&C #4c expanded to include the effects of the augmented database on PRIME transient features.

2. The conservatism of [[ ]] described in Section 5.2.2 of NEDC-33840P must be periodically confirmed. The overall conservatism of this [[ ]], relative to a detailed PRIME transient analysis, may be impacted by changes to (1) fuel rod design, (2) PRIME models, (3) uncertainties and tolerances, (4) transient nuclear codes, and (5) plant operations and fuel utilization which may impact the sequence of events and accident progression for the fast AOOs. Results of the periodic confirmation should be added to the PRIME steady-state L&C #4 report, as augmented in L&C #1 above.

# New Data Sources - Overview

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# Qualification Updates

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All results presented are preliminary

# GNF3 – [[ ]]

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# GNF3 - [[ ]] [[

- Moderate power histories, typical of 3 cycle fuel

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# GNF3 - [[ ]] [[

- $UO_2$
- PLRL
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# GNF3 - [[ ]] [[

- 7wt% Gad
- FLR
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# [[ ]] Model Update

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# Transient [[ ]]

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Multiple types of transients (FWCF, LRNBP, TTNBP) and exposures were analyzed

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All results presented are preliminary

# Summary

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# Acknowledgements

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# Licensing Update

Kent Halac

Global Nuclear Fuel

# Licensing Interactions

Recently Approved

- N/A

Ongoing Review

- LANCR Qualification LTR for Increased Enrichment — Submitted Dec. 2021
- LANCR Model Description LTR for Increased Enrichment — Submitted Dec. 2021
- LANCR/PANAC Application LTR for Increased Enrichment — Submitted Dec. 2021

Near-Term Submittals

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# Licensing Interactions

NRC Engagement

- **GEXL98 for ATRIUM 10XM Fuel Audit**
  - Virtual Meeting – 1/18/22 through 1/20/22 (Rockville and Wilmington)
  - Josh Kaizer and Noushin Amini
- **GNF Plant Tour with ATF and PRIME Briefing**
  - In Person Meeting - 2/17/22 through 2/18/22 (Wilmington)
  - Andrea Kock, Paul Clifford, and Joseph Messina
- **Inspection of Safety Communications via Part 21 (Side Entry Orifice and Control Blades)**
  - In Person Meeting – 3/21/22 through 3/25/22 (Wilmington)
  - Yiu Law, Benjamin Parks, and Josh Kaizer
- **LANCR/PANAC Methods Audit**
  - Virtual Meeting – 7/28/22 through 7/30/22 (Rockville and Wilmington)
  - Mathew Panicker

# Methodology Update

ATF

- ARMOR 1.0 and IronClad LTAs operating in Clinton and Hatch.
- Limerick Unit 2 installed 8 HBLUA in Cycle 17 and are planning for [[
  ]].
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