ENCLOSURE 2

FLN-2007-024

GNF Presentations on GNF-Ziron and Additive Fuel, Draft Presentations

Non-Proprietary Information

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1 to FLN-2007-024, 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 [[ ]].

Pre-submittal Meeting

GNF-Ziron

July 25, 2007

GNF

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Agenda

- Introduction/Background on GNF-Ziron
- In-reactor Experience and Testing Data
- Licensing Plan
- Discussion

Scope

SER approval for:

GNF-Ziron as material for fuel rod and assembly components, within the operational limits defined for GNF fuel assembly designs.

- Fuel Rods, Water Rods, End Plugs, Spacers
- Within defined limits for licensed GNF fuel designs.

Why GNF-Ziron?

Issue:

- Hydrogen absorption at high exposures.

Solution:

- This alloy has lower end of life [H] pickup.

Change:

[[

[[

GNF Ziron

{3}]]

- **Requires licensing change to implement material**

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{3}]]

Composition Comparison (wt%)

	Zircaloy-2	**GNF-Ziron**
Zirconium	> 97	[[{3}]]
Tin	1.20 – 1.70	[[{3}]]
Iron	0.07 – 0.20 [[{3}]]	[[{3}]]
Chromium	0.05 – 0.15	[[{3}]]
Nickel	0.03 – 0.08	[[{3}]]

[[

{3}]]

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GNF-Ziron Background

[[

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GNF-Ziron Experience

[[

{3}]]

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GNF-Ziron – Lead Use Applications

[[

{3}]]

GNF-Ziron Properties Assessment

Physical properties not significantly affected [[
{3}]]

Main properties (corrosion and mechanical) similar or better than Zircaloy-2.
[[

{3}]]

-
- Mechanical properties
- Creep
- Cladding corrosion
- Water Rod Growth
- Simulated LOCA tests (weight gain and perforation stress)

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Hydrogen Uptake

[[

{3}]]

Room Temp. Tensile Properties

[[

{3}]]

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Tensile Strength

[[

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Creep Behavior

[[

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Corrosion

[[

{3}]]

Irradiation Growth Rates

[[

{3}]]

Simulated LOCA Oxidation Results

[[

{3}]]

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Simulated LOCA Test Results

[[

{3}]]

Simulated LOCA Test – additional tests

[[

{3}]]

GNF-Ziron Licensing Plan

- Phase 1

  [[➢ {3}]]

  ➢ LTR on GNF-Ziron (target September 2007)

  [[{3}]]

- Phase 2

  [[➢ {3}]]

  ➢ LTR submittal in future (TBD)

  [[{3}]]

- Will require exemption regarding "*zircaloy or ZIRLO cladding*" in 10CFR50.46

GNF-Ziron Licensing Technical Report

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GNF-Ziron Licensing Technical Report

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GNF-Ziron Licensing Technical Report

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GNF-Ziron Licensing Technical Report

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Pre-Submittal Meeting
Additive UO_2 and $(U,Gd)O_2$ Fuel

25 July 2007

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Overview

- The [[ ]] (additive) is an effective remedy for PCI failures
- Additive fuel is well characterized and has recently completed operation to bundle average exposures of [[ ]]
- Additive fuel properties are included in the computer models of GNF which have been approved or are being reviewed by the NRC; e.g., GSTRM, PRIME03, TRACG, TGBLA, . . .
- But, additive fuel is not explicitly addressed in GESTAR
- GNF wants to introduce additive fuel to gain additional margin to duty-related failure processes
- Need to review such an introduction with the NRC to
  - Identify areas of concern not already addressed by prior development work
  - Identify best process for submittal and review; e.g., administrative amendment to GESTAR supported by additive LTR or ?

Presentation Scope

- Present bases for applying an additive in BWR fuel
- Propose an approach for licensing additive UO_2 and $(U,Gd)O_2$ fuel
- Obtain comments from NRC regarding additional data needs and licensing approach

Additive Objectives

- Reasons for using additive
  - Defense in depth against duty-related cladding failures
    - o
    - o
  - Support industry initiative for zero leakers by 2010
- General approach
  -
  -

Additive Description

- Composition
  - Preferred:
  - Range:
    - o
    - o
- Concentration
  - Preferred:
  - Range:

Ternary Liquidus Phase Diagrams

[[

{3}]]

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UO_2-Additive Phase Diagrams

[[

{3}]]

[[As-Sintered Pellet Structure

{3}]]

Additive Structure

[[

{3}]]

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Additive Structure – Cont.

[[

{3}]]

Post-Irradiation Pellet Structure

LUA

[[

{3}]]

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Post-Irradiation Pellet Structure *Ramp Test*

[[

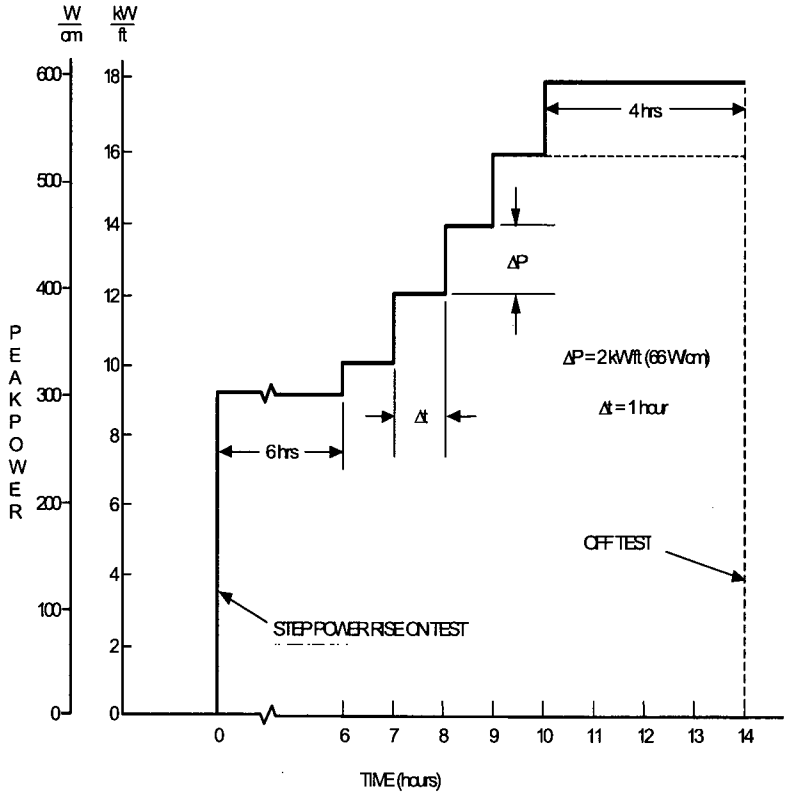
{3}]]

Post-Irradiation Structure *Ramp Test – Cont.*

[[

{3}]]

PCI Ramp Test Description



- Base irradiation in power reactor
- Transfer to test reactor
- Pre-conditioning at 9 kW/ft
- Power increased in steps, with a hold time of 1 hr at each stage, 4 hrs at peak target power
- Peak target power requested: 18 kW/ft
  Peak attained in test: 16 kW/ft
- Test terminated if rod fails or survives peak power for 4 hours

PCI Resistance

[[

{3}]]

Pellet Density

[[

{3}]]

Melting Temperature

[[

{3}]]

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Pellet Slump Temperature

[[

{3}]]

Thermal Diffusivity

[[

{3}]]

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Thermal Conductivity

[[

{3}]]

Pellet Centerline Temperature

[[

{3}]]

Fission Gas Release

[[

{3}]]

Densification and Swelling

[[

{3}]]

Stress-Strain Behavior

[[

{3}]]

Microstructure after Yielding

[[

{3}]]

Yield Stress

[[

{3}]]

Creep Rate

[[

{3}]]

RIA Behavior

[[

{3}]]

Properties Summary

[[

{3}]]

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Licensing Approach (Proposed)

- Additive LTR addressing
  - Properties
  - Behavior
  - Methods
  - Effects on licensing criteria
- Administrative amendment of GESTAR

LTR Topics (Proposed)

- Physical properties
- Thermal properties
- Mechanical properties
- Irradiation behavior
- Material models
- Regulatory requirements
  - Fuel melting
  - Gap conductance
  - Fuel rod internal pressure
  - Cladding strain
  - AOO
  - Core stability
  - LOCA
  - RIA

ENCLOSURE 3

FLN-2007-024

Affidavit

Global Nuclear Fuel – Americas

AFFIDAVIT

I, Jens G. M. Andersen, state as follows:

(1) I am Consulting Engineer, Thermal Hydraulic Methods, Global Nuclear Fuel – Americas, L.L.C. ("GNF-A"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of FLN-2007-024, Andrew A. Lingenfelter (GNF) to Document Control Desk (USNRC), GNF-*Ziron and Additive Fuel Pre-submittal Meeting, Draft Presentations,* dated July 12, 2007. The proprietary information in Enclosure 1, *GNF Presentations on GNF-Ziron and Additive Fuel, Draft Presentations,* is identified by [[double square brackets$^{\{3\}}$]]. Figures and other large objects are identified with double square brackets before and after the object. In each case, the superscript notation $^{\{3\}}$ refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GNF-A customer-funded development plans and programs, resulting in potential products to GNF-A;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A. Access to such documents within GNF-A is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology.

The development of the fuel design, along with the testing, development and approval of the supporting methodology was achieved at a significant cost, on the order of several million dollars, to GNF-A or its licensor.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 12th day of July 2007.

Jens G. M. Andersen
Consulting Engineer, Thermal Hydraulic Methods
Global Nuclear Fuel – Americas, L.L.C.