Attachment 2

Vermont Yankee Nuclear Power Station
License No. DPR-28 (Docket No. 50-271)

GNF2 Lead Use Assembly for Vermont Yankee Plant
NEDC-33291 Revision 0
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(Non-Proprietary Version)

Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

NEDC-33291
Revision 0
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GNF2 Lead Use Assembly (LUA)

for

Vermont Yankee Plant

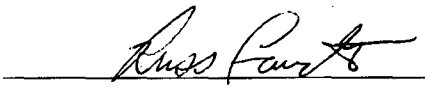
Document Title: **GNF2 Lead Use Assembly for Vermont Yankee Plant**

Abstract

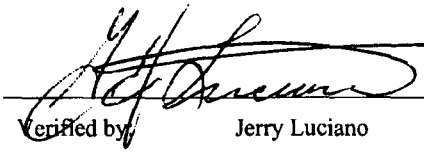
Entergy Nuclear Operations, Inc. plans to load four (4) Lead Use Assemblies as part of the Vermont Yankee Plant (VY) Reload 25 Cycle 26 during the 2007 refueling outage. These bundles, also referred to as GNF2 LUAs, are planned to be in operation as part of a joint program with Global Nuclear Fuel – Americas, LLC (GNF).

This report contains information that is to be provided to the Nuclear Regulatory Commission (NRC) to comply with the Reference 1 letter that provides guidelines to be followed to license LUAs. Included in this report are a description of the GNF2 LUAs, a discussion of the applicability of approved methods to the licensing analyses, a description of the objectives of the LUA program, and an outline of the kinds of measurements planned for the LUAs.

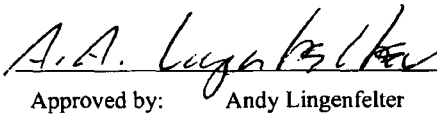
Signatures



Prepared by: Russ Fawcett Date **December, 2006**



Verified by: Jerry Luciano Date **December, 2006**



Approved by: Andy Lingenfelter Date **December, 2006**

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Revision Status

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1. Introduction

Entergy Nuclear Operations, Inc. plans to load four (4) Lead Use Assemblies as part of the Vermont Yankee Plant (VY) Reload 25 Cycle 26 during the 2007 refueling outage. These bundles, also referred to as GNF2 LUAs, are planned to be in operation as part of a joint program with Global Nuclear Fuel – Americas, LLC (GNF).

This report contains information that is to be provided to the Nuclear Regulatory Commission (NRC) to comply with the Reference 1 letter that provides guidelines to be followed to license LUAs. Included in this report are a description of the GNF2 LUAs, a discussion of the applicability of approved methods to the licensing analyses, a description of the objectives of the LUA program, and an outline of the kinds of measurements planned for the LUAs.

The GNF2 fuel design is described in Section 2. GNF2 is designed to be compatible with other GE fuel designs. The thermal hydraulic design closely matches the overall pressure drop of previous designs. The external envelope of the fuel assembly is virtually identical to the GE14 fuel assembly currently supplied to VY. The nuclear characteristics of these GNF2 LUAs are compatible with those of the current GE14 fuel being loaded into VY.

Section 3 describes the licensing analyses that will be performed and the objectives of the LUA program are stated in Section 4. The kinds of measurements planned as part of LUA surveillance are described in Section 5.

2. GNF2 Fuel Product Description

A GNF2 bundle schematic is shown in Figure 2-1. The GNF2 design consists of fuel rods and water rods contained in a 10x10 array. The water rods encompass fuel rod positions.

fuel rods are . The GNF2 lattice arrangement is shown in Figure 2-2. The rods are spaced and supported by the upper and lower tie plates and spacers over the length of the fuel rods. The GNF2 channel . The GNF2 . The material

The fuel rods consist of high-density ceramic uranium dioxide or urania-gadolinia fuel pellets stacked within Zircaloy cladding.

The cladding contains an inner zirconium liner provided for PCI resistance. The fuel rod is evacuated and backfilled with helium to atm. Fuel rod dimensions are given in Table 2-2.

2.1. New Design Features

GNF2 was designed for mechanical, nuclear, and thermal-hydraulic compatibility with previous GE fuel designs. The design includes many proven features of the GE10, GE11/13, GE12 and GE14 fuel designs including PCI resistant barrier cladding, part length rods (PLR), and a . New or improved features included in GNF2 are:

A discussion of each of these new design features is provided below.

2.2. Part-Length Rod Configuration

2.3. Fuel Rod Design

The high energy GNF2 fuel rod has the following characteristics

2.4. Cladding Material

Table 2-1. GNF Cladding Material Specifications

2.5. Channel Design

2.6. High Performance Spacers

2.7. Defender Debris Filter Lower Tie Plate

Table 2-2. GNF2 and GE14 Dimensions

Fuel Assembly	**GE14**	**GNF2**
Total number of fuel rods		
Number of Full length		
Number of Partial length		
Lattice Array		
Rod to rod pitch (cm)		
Number of water rods		
Typical Assembly Fuel weight (KgU)		
Typical Assembly active fuel length (mm)		
Full length		
Partial Length		
Fuel Rod		
Cladding material		
Cladding tube diameter, outer (mm)		
Cladding tube wall thickness (mm)		
Pellet diameter, outer (mm)		
Pellet stack density (g/cm^3)		
Pellet density with burnable absorber (g/cm^3)		
Water Rod		
Tube material		
Tube diameter, outer (mm)		
Tube wall thickness (mm)		
Spacer		
Number of spacers		
Axial locations		
Material		

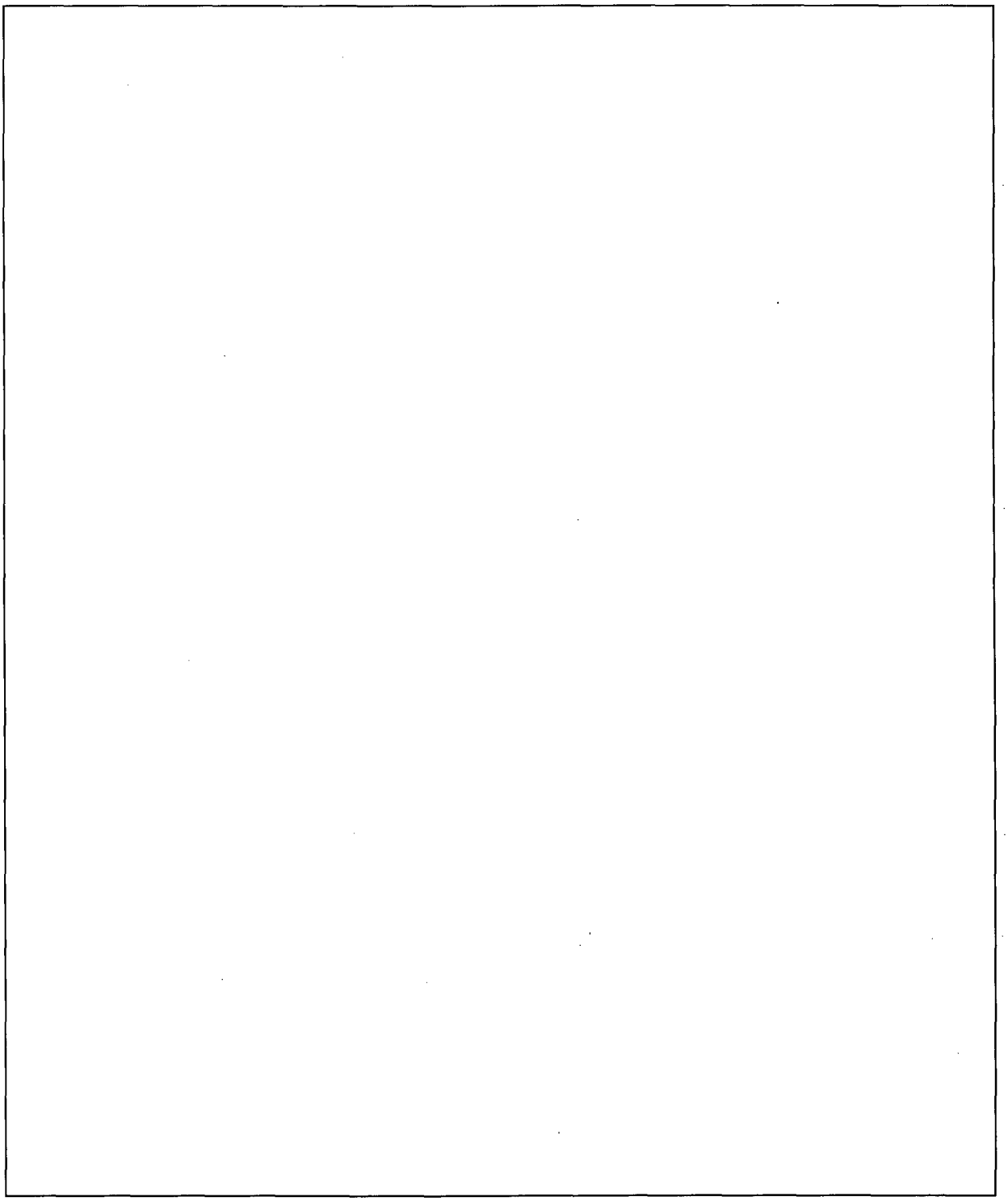


Figure 2-1. GNF2 Bundle Assembly

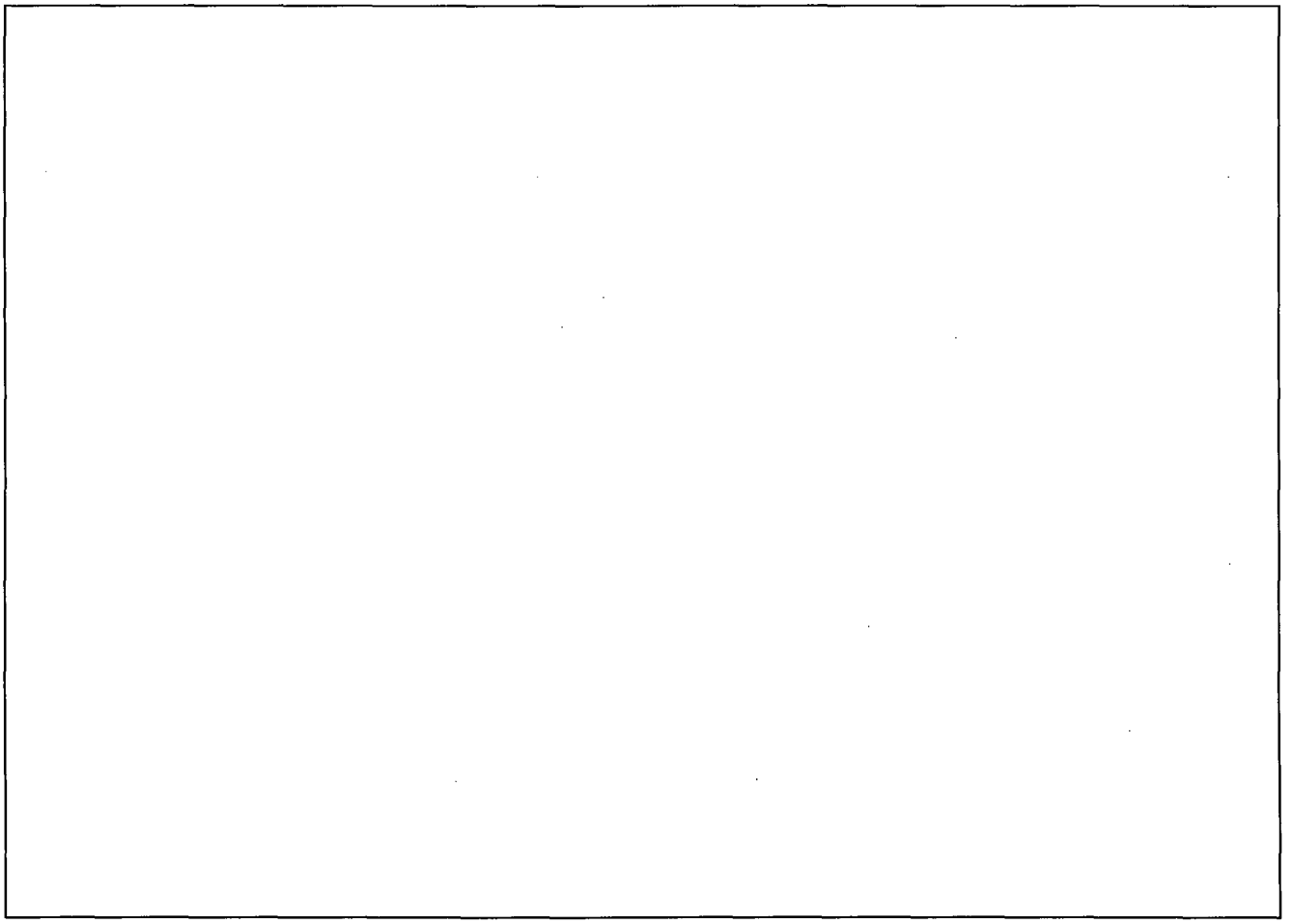


Figure 2-2 GNF2 Lattice Arrangement

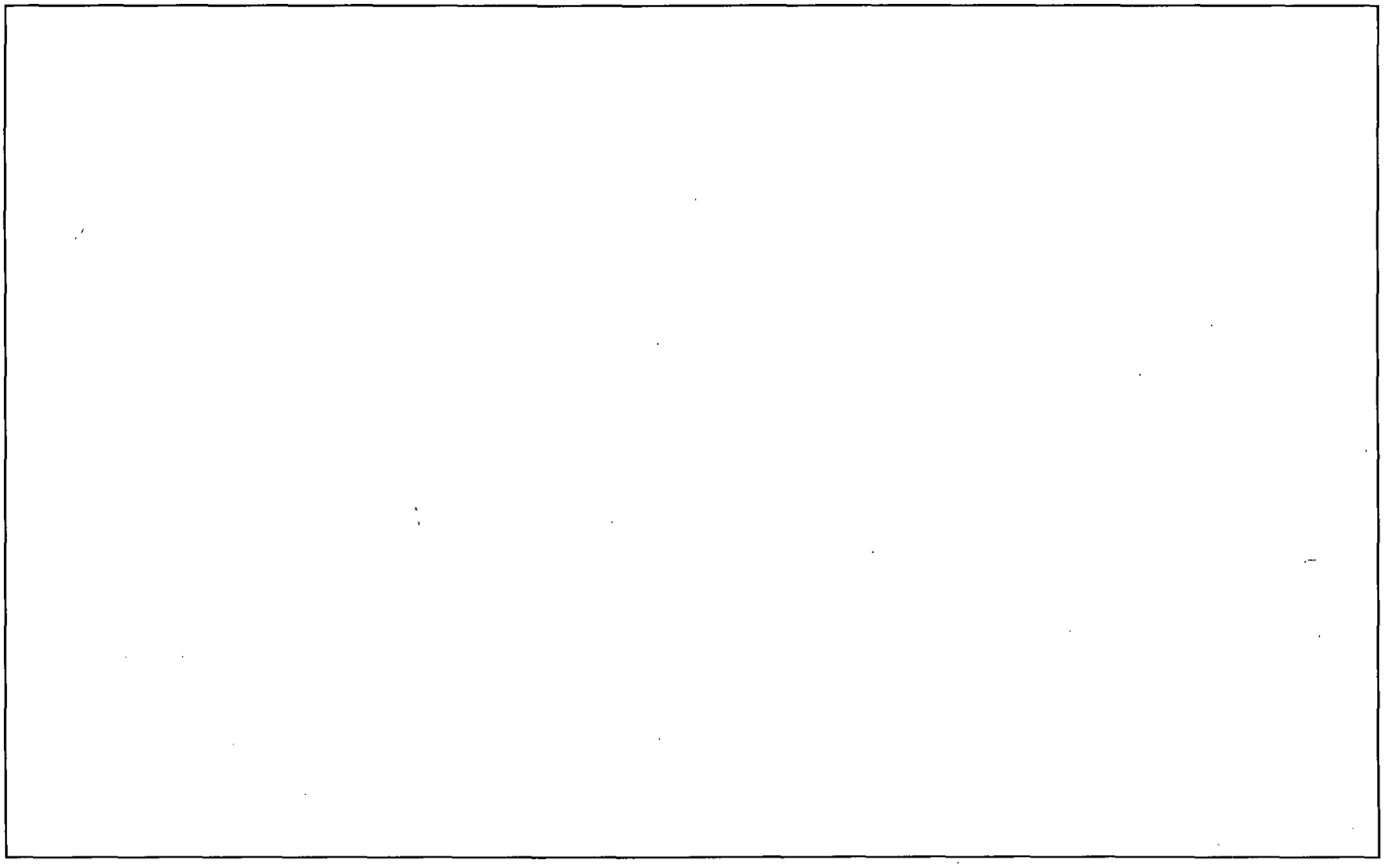


Figure 2-3 Defender Lower Tie Plate

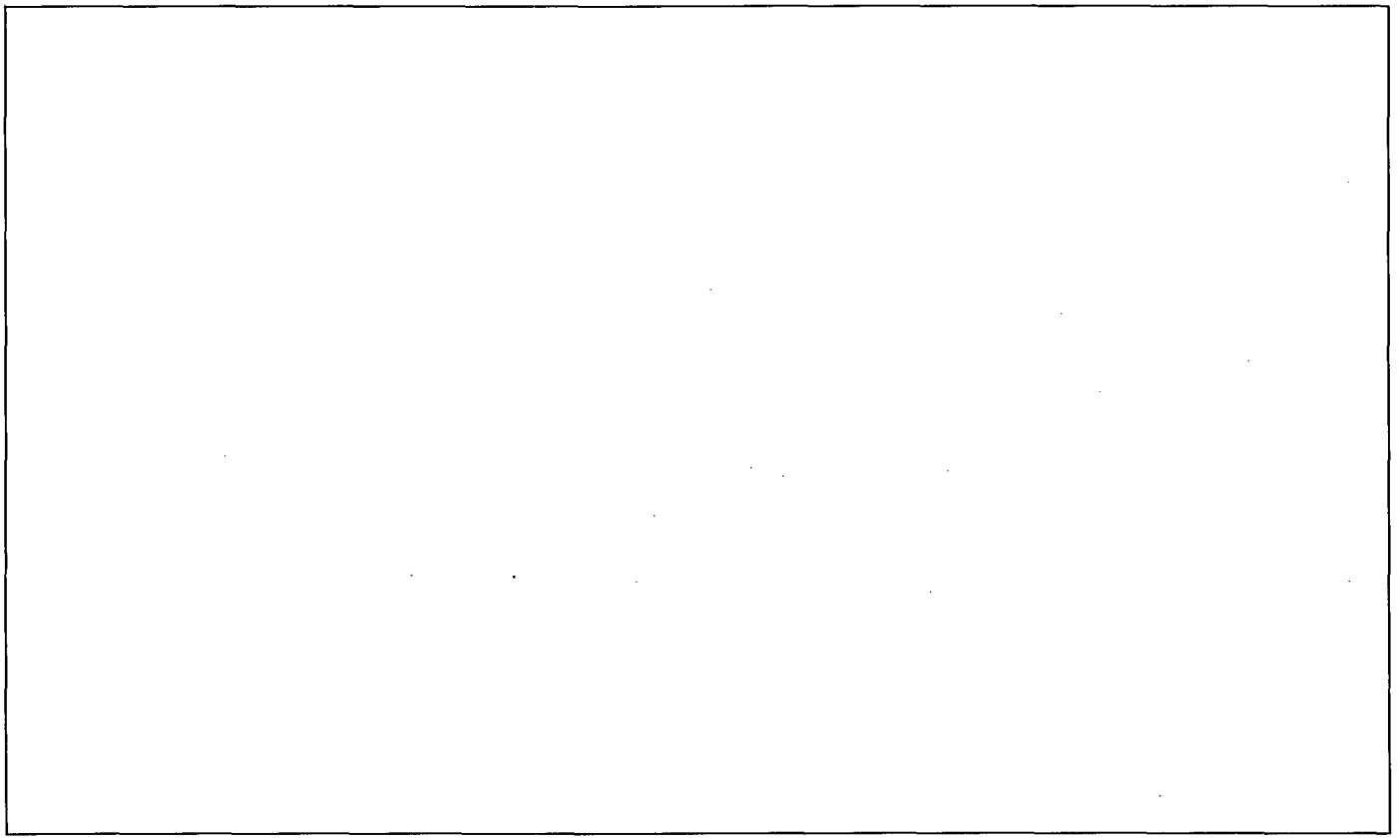
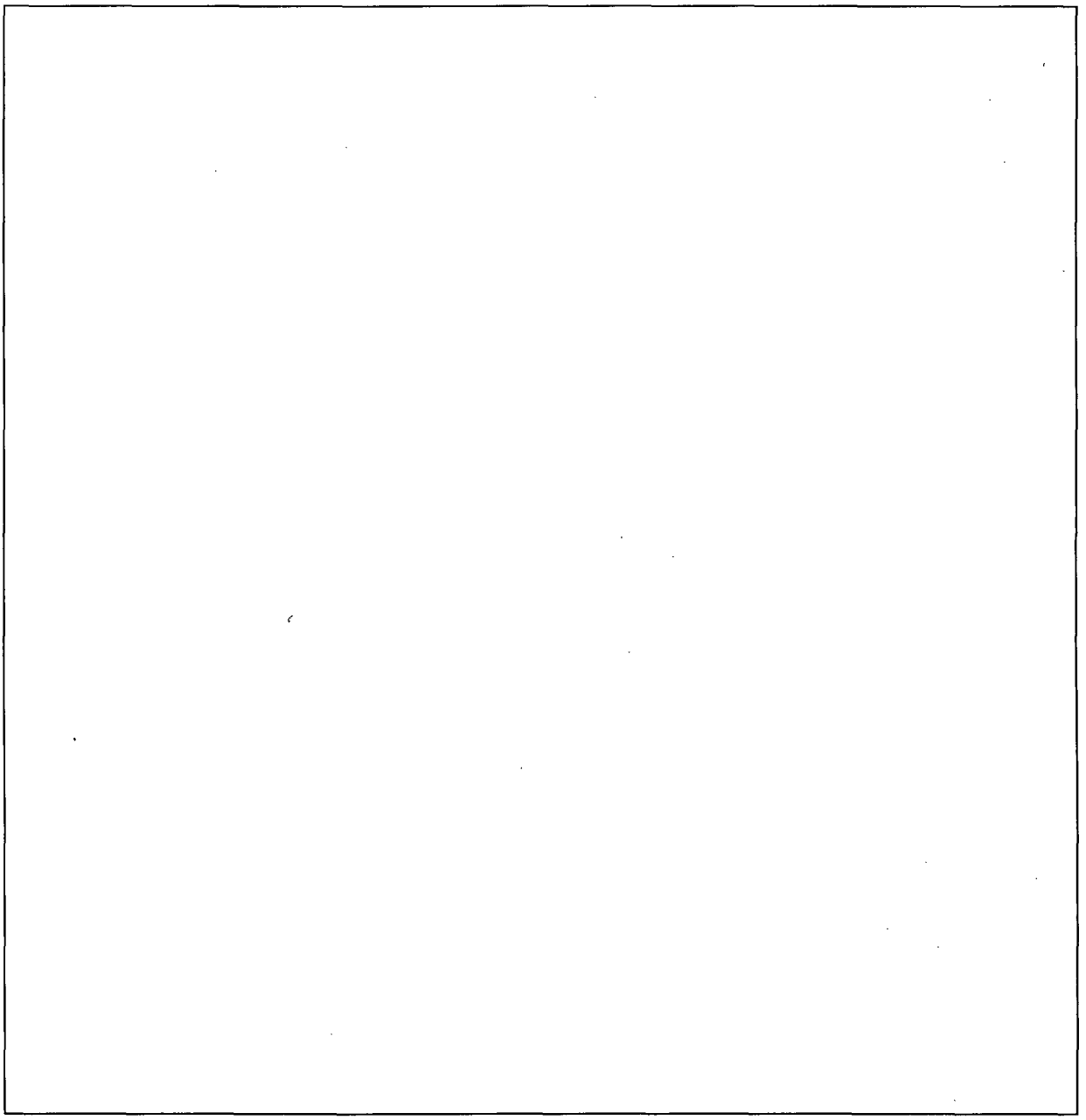


Figure 2-4 GNF2 Grid Spacer



Note that elevations correspond to the top of the lower tab attached to the spacer capture water rod.

Figure 2-5 GNF2 axial spacer pitch

3. Licensing Analyses

The GNF2 LUAs have been, or will be, analyzed using the NRC approved methods described in Reference 2. These methods are fully capable of analyzing all of the LUA features. Prior to loading of the LUAs, cycle-specific analyses will have been performed for VY Reload 25 Cycle 26 to establish fuel operating limits for the LUAs and to ensure that the core loading has been designed such that the LUAs will not be the most limiting fuel assemblies at any time during Cycle 26 with respect to compliance with LHGR, MAPLHGR and MCPR limits based on planned control rod patterns. Results of these analyses will be documented in the Supplemental Reload Licensing Report (SRLR). Furthermore, licensing analyses will be performed for the LUAs for each cycle of their operation, wherein the effect of the LUAs is considered for each of the appropriate licensing events and anticipated operational occurrences (AOOs) to establish appropriate reactor core thermal limits for operation.

Entergy intends to insert the GNF2 LUAs into VY and to operate Cycle 26 under the provisions of 10CFR50.59. However, cycle specific analyses to establish fuel operating limits are not yet complete. When the cycle specific analyses are complete, GNF will document the results in the Supplemental Reload Licensing Report and Entergy will update the VY Core Operating Limits Report accordingly.

The application of approved methods to analyze events and accidents whose results could be affected by the LUA's design is discussed below. Since the analysis of the LUAs using the approved methods meets, or will meet, the approved criteria, it is not anticipated that NRC approval is required prior to insertion.

3.1. Core Wide AOOs

Current approved methods described in Reference 2 are considered appropriate to determine the impact of core-wide AOOs on the LUAs. The GNF2 fuel rod(s) have been analyzed with GSTRM to establish steady state, and transient overpower, LHGR limits that ensure compliance with thermal mechanical licensing requirements as specified in Reference 2. Appropriate MCPR limits will be established to ensure safe operation of the LUAs based on these results. Note that GEXL14 is conservatively applied in the prediction of the onset of Boiling Transition for the LUAs. A conservative set of R-factor additive constants has been developed based on full-scale data that results in an overall conservative prediction of CPR for GNF2.

3.2. Localized AOOs

Approved methods are considered adequate to evaluate core response to a Rod Withdrawal Error (RWE), since the nuclear inputs are available to represent the LUAs

discretely. MCPR results will be based on the conservative application of GEXL14 and provided in the SRLR.

An evaluation was performed to estimate the effect on CPR of the Fuel Loading Error (Rotated Bundle). Preliminary results demonstrate that the change in CPR for this event is bounded by that used to establish the Operating Limit MCPR (OLMCPR) for the LUAs with significant margin, and therefore a Rotated Bundle Error will not result in violation of the OLMCPR. This will be confirmed by analysis prior to Cycle 26 startup.

3.3. Control Rod Drop Accident (CRDA)

Compliance with licensing limits governing CRDA is assured through adherence to the Banked Position Withdrawal Sequence (BPWS) as the associated analyses have generically demonstrated large margin to licensing limits governing acceptable enthalpy insertions. Due to the similarities in nuclear characteristics between the LUAs and approved GNF fuel designs, the Reference 2 methodology is applicable to the LUAs. Operation with the LUAs will not result in exceeding the CRDA acceptance criteria.

3.4. Loss of Coolant Accident and ECCS

The LUAs are to be loaded in non-limiting locations with respect to ECCS/LOCA MAPLHGR limits. An evaluation will be performed to assure that the LUAs will meet the PCT requirements in the event of a Design Basis Accident.

3.5. Refueling Accident

Based on the guidelines of Regulatory Guides 1.25 (RG 1.25) and 1.183 (RG 1.183), the fuel design related parameters that significantly impact the radiological consequence of a design basis fuel handling accident (FHA) are: 1) the number of fuel rods/bundles damaged during the accident, and 2) the radial power peaking factor of fuel bundle during operation.

For the GNF2 LUAs in VY, the assessed number of fuel rods damaged in an FHA is equivalent to 2.0 bundles. The radial power peaking is expected to be significantly less than 1.70. Compared to the safety analysis in the VY UFSAR, which assumed 2.1 damaged bundles with an analysis basis power peaking of 1.65, the radiological consequence of an FHA involving GNF2 is (1.7/1.65)*(2.0/2.1) or 0.98 times the UFSAR values. Therefore, the radiological consequences of a design basis fuel handling accident involving the GNF2 LUAs is bounded by the licensing basis analysis in the UFSAR.

3.6. Stability

The GNF2 LUAs will be explicitly modeled in VY C26 stability analyses as part of standard reload licensing. Option I-D licensing requirements governing stability will be assured and the results reported in the SRLR. The VY C26 reload core will be designed such that the LUAs will not be the most limiting bundles from a stability standpoint since these LUAs will operate with a large margin relative to the hot channel. In addition, a stability evaluation has been performed for GNF2 in support of GESTAR II New Fuel Licensing. The GNF2 core and channel decay ratios are less than those of the reference fuel design (P8x8R) and hence GNF2 conforms to GESTAR II requirements related to stability.

3.7. Shutdown Margin

The LUAs have been designed with approved methods to provide minimum cold shutdown margin with sufficient design margin to assure that all Technical Specification shutdown margin requirements are satisfied.

3.8. RAJ-II Shipping Container

Criticality safety analyses have been performed that confirm the adequacy of the RAJ-II shipping container to support the transportation of GNF2 fuel bundles. Regulatory approval to transport GNF2 fuel bundles in the RAJ-II container has been attained and this will be the second domestic shipment of GNF2 in an RAJ-II container.

4. LUA Program Objectives

The purpose of the GNF2 LUA Program is to obtain surveillance data to verify that fuel bundles with the design features described in Section 2 perform satisfactorily in service, prior to use of those features on a production basis.

5. LUA Measurements

As currently envisioned, measurements on the LUAs will consist of pre-irradiation characterization of fuel pellets, clad tubing, fuel rods, components and fuel bundles. At subsequent refueling outages, the scope of inspections consist of some, or all, of the following:

- Fuel bundle visual
- Channel bow and bulge measurements
- Fuel rod and bundle length measurements
- Rod integrity and profilometry measurements
- Corrosion thickness measurements

The extent of such measurement will be governed by the need to minimize the impact of these activities on the refueling outage critical path, the amount of inspections being performed on similar features at other reactor sites, and by the degree of technical interest in implementing the design changes demonstrated in the LUA.

Results obtained from this LUA Program will be summarized in a timely manner in GNF Fuel Experience Reports.

6. References

1. Letter, T.A. Ippolito (NRC) to R.E. Engel (GE), "Lead Test Assembly Licensing," September 23, 1981.

2. NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel," December 2005.

3. GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDC-32868P, Rev.1, September 2000.