ENCLOSURE 2

MFN 16-057

GNF Response to RAIs

Non-Proprietary Information – Class I (Public)

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 [[ ]].

SNPB RAI 1

Enclosure 1 of MFN 16-011 (Amendment 42 to GESTAR II) indicates that there will be improvements in cyber security, consistency with modern functionalities and expectations. Please provide justifications for the following claims and specifications associated with this amendment:

(a) GNF-A indicates that it is "*in the process of updating its core monitoring system for compatibility with Windows-based computer platforms and operating systems, and to streamline the cybersecurity aspects of core monitoring.*" Please provide justification to your statement that there will be improvements in cybersecurity aspects of the software when the computing platform is switched from a Virtual Memory System (VMS)-based core simulator to a Windows-based platform.

(b) With the change in computing platform from a VMS-based system to a Windows-based system for the core monitoring function, is/are the licensee(s) capable of continuing to comply with Appendix B to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," specifically with respect to Section XVII, "*Quality Assurance Records.*"

(c) Explain what is meant by "*consistency with modern functionalities and expectations*" with the transformation from a VMS-based platform to Windows-based platform for GE's core monitoring system.

GNF Response:

(a) The ACUMEN core monitoring system on the Windows-based computer platform meets the cybersecurity requirements through the ACUMEN system design and by supplemental information supplied to the customers to fulfil their cybersecurity plan for core monitoring. With the obsolescence of the VMS platform and with Windows being a modern widely used platform, the cybersecurity aspects are streamlined for the Windows based ACUMEN system. This package addresses over [[ ]] from the NEI 08-09 guidelines to assist customers in meeting their cybersecurity requirements. Providing the supplemental information to the customer facilitates the Cyber Security Assessment Team review of the product and saves customers many hours of preparation and system design.

The ACUMEN supplemental information includes information such as:

- User Account Management including Account Types, Groups, and Policies
- File and Database Permission Management
- Network Communication / Configuration and Firewall Configurations and Administration
- System Logging and Event Management
- Privileged Functions in ACUMEN and Windows

- Process Scheduling and Prioritization
- Encryption
- Malicious Code, Virus, and Malware

The cyber security aspects of the Windows platform do not change the functionality or the technical equivalence of the ACUMEN and the 3D-MONICORE nuclear kernel.

(b) The change in computing platform does not affect the capability for continued compliance (i.e., the licensee(s) are capable of continuing to comply with Appendix B Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," specifically with respect to Section XVII, "*Quality Assurance Records"* on the Windows platform similar to the VMS platform).

(c) The VMS system is considered obsolete. The modern state-of-the-art (hardware and software) systems are Windows based and are expected by GNF customers to be in line with industry information technology (IT) standards. The ACUMEN features consistent with modern functionalities and expectations include:

- Customer Service: The ACUMEN database provides data transfer and enables quick diagnosis and engineering assistance in support of reactor engineering needs.
- Modern User Interface: ACUMEN provides user configuration, which facilitates workspace optimization, customization and efficiency.
- Database: The ACUMEN system employs a relational database with a Structured Query Language (SQL) server for both long term and short term information as well as configuration data and core simulator output data. It provides the flexibility for historical trending and analysis, including multiple fuel cycles.
- Operating System: The ACUMEN operating system runs on the Microsoft Windows platform providing increased control, availability, and flexibility of data center and desktop infrastructure.
- Reporting: ACUMEN's database infrastructure provides reactor engineers with increased analysis and reporting capabilities.
- Human Performance: ACUMEN provides intuitive software tools that reduce human performance errors. Better features for fuel conditioning analysis, Local Power Range Monitor (LPRM) drift analysis, core viewer to inspect core and nodal data are available.

SNPB RAI 2

Describe the impact of the change of computing platforms for the 3D-MONICORE (3DM) core monitoring system on the following operating parameters that are monitored and their related uncertainties:

(a) Safety limit minimum critical power ratio (SLMCPR)

(b) Linear heat generation rates (LHGR), and

(c) Maximum planar LHGR (MAPLHGR)

GNF Response:

(a) When simulations are run to eliminate the variability of the Monte Carlo SLMCPR methodology, the bias in SLMCPR due the platform related changes is [[ ]] with a standard deviation of [[ ]]. These numbers are insignificant. The power distribution uncertainties are not affected by a platform change since they are an artifact of elements such as plant instrumentation and gamma scan data that are outside the influence of a computing platform change.

(b) and (c) The bias in limiting LHGR due to the platform related changes is [[ ]] with a standard deviation of [[ ]]. The bias in maximum planar LHGR is [[ ]] with a standard deviation of [[ ]]. These differences are insignificant based on the perspective of industry core monitoring operational experience.

SNPB RAI 3

Enclosure 1 of letter MFN 16-011 shows the comparison of ACUMEN and 3D-MONICORE outputs when the same input data is fed to both the systems. The ACUMEN monitoring system was installed at the Global Nuclear Fuel facility in Wilmington, NC. The test data file was created from one set of plant process data taken at rated power and was the basis for all data entered into ACUMEN and 3DM. Parameters in the test data file were manually changed to simulate different plant power and flow conditions allowing calculated thermal margin comparison between the respective core monitoring systems in a typical power maneuver situation.

Enclosure 1 of letter MFN-16-011 has summarized a comparison of two thermal margin calculations from the core monitoring system, mainly, fraction of limiting critical power ratio (CPRRAT) - related to fuel bundle power) and fraction of limiting power density (FLPD) – related to fuel pin local power. The NRC staff recognizes the fact that the minimum and maximum CPRRAT and FLPD differences from Table 1 are acceptable. However, the staff would like to examine the accuracy of other core operating parameters, either automatic or on demand, such as, control rod positions, plant heat balance results, core average axial relative power, core average radial power distribution, and any other significant operational parameters that are monitored by the core monitoring system.

GNF Response:

The supporting discussion in MFN 16-011 Enclosure 1 for Attachment 1 for thermal margin comparisons CPRRAT and FLPD is most relevant and applicable to demonstrating the equivalency of the two core monitoring systems ACUMEN and 3DM. Because the observable thermal margins CPRRAT and FLPD are representative of the fuel bundle and nodal power distribution, respectively, the associated uncertainties applied in the design methodologies are unchanged. The CPRRAT and FLPD comparisons reflect performance of plant heat balance, core average axial power, and core average radial power distribution, and the accuracy of the specific data requested is essentially the same between the two systems.

[[ ]], a customer expecting to be an early adopter of ACUMEN, has evaluated parallel operation of ACUMEN and 3DM core monitors during a [[ ]] control rod sequence exchange. A sequence exchange covers wide changes in core operating parameters and is a good case to use for comparison of the two core monitoring systems. Figures 3-1 thru 3-5 show the comparison for maximum fraction of limiting critical power ratio (MFLCPR), core flow, maximum planar average linear heat generation rate ratio (MAPRAT), ratio of nodal power to the fuel conditioned power (PCRAT), and maximum fraction of limiting power density (MFLPD), respectively. The following information has been provided by the customer:

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Figure 3-1: Comparison of MFLCPR During Sequence Exchange

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Figure 3-2: Comparison of Core Flow During Sequence Exchange

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Figure 3-3: Comparison of MAPRAT During Sequence Exchange

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Figure 3-4: Comparison of PCRAT During Sequence Exchange

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Figure 3-5: Comparison of MFLPD During Sequence Exchange

SNPB RAI 4

Enclosure 2 to letter MFN 16-011 provides texts that will be inserted in GESTAR II Amendment 42 for Sections 3.2.2.2 and S.5.2. Review of S.5.2 in the GESTAR II US supplement for the Amendment 42 and the text for S.5.2 in GESTAR II Amendment 37 (currently under review) (NEDE-24011-P-Draft-US), shows that the references listed in Amendment 42 text have different numbers from reference numbers in the text for Amendment 37 for the same section. Please explain how this discrepancy in the numbering of the references will be resolved.

GNF Response:

The expectation is that Amendment 42 is approved before Amendment 37, in which case the reference numbers as included in the current revision to GESTAR II (NEDE-24011-P-A-22) and in the Amendment 42 submittal will remain the same. When Amendment 37 is approved the reference numbers will be changed. In the new content proposed in Amendment 42, the citation of reference numbers S-101, S-108, and S-109 will be consistent with the changes noted in Amendment 37. In other words, S-101 will become S-53, S-108 will become S-54, and S-109 will become S-55. However, there will be no change to the citation of Reference numbers 3-4, 3-5, 3-16, 3-17, and 3-18 since Amendment 37 did not modify those reference numbers.