

## ENCLOSURE 2

MFN 13-008 Sup 2

Markup of GESTAR II

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 [[ ]].

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**2.2.1.6.3 Evaluations**

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**2.2.1.7 Hydraulic Loads**

**2.2.1.7.1 Bases**

The fuel assembly is evaluated to ensure that interference sufficient to prevent control blade insertion will not occur.

**2.2.1.7.2 Limits**

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**2.2.1.7.3 Evaluations**

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Two separate aspects of channel box deflection are considered: channel bulge and channel bow. Channel bulge is addressed in Reference 2-4. In response to an NRC question on initial cores, Reference 2-12 provides supplementary information to Reference 2-4, and also contains a discussion of the program GE recommends to utilities obtaining an operating license after May 1982. Channel bow effects on thermal margins are included in Reference 2-16. References 2-4, 2-12 and 2-16 apply only to channels supplied by General Electric.

**Channel bow and bulge are material dependent phenomenon. In addition to the standard alloys Zircaloy-2 and Zircaloy-4, GNF also fabricates channels made of fully recrystallized Zr-Sn-Nb-Fe alloy called NSF. The NRC approved NSF for use in channels and the accepted version of the Topical Report (TR) is included as Reference 2-23. The key difference between the NSF material and the Zircaloy-2 or Zircaloy-4 alloy is the reduction in both fluence and shadow corrosion induced bow. No changes in the channel design requirements or processes are necessary as result of the change to NSF.**

**The NSF channel bow effects on thermal margins are addressed in the Reference 2-23 TR. The bow inputs for NSF channels, as well as for the transition cycles, were approved in accordance with the Safety Evaluation (SE) included in Reference 2-23.**

**2.2.1.8 Control Rod Reactivity**

Control rod reactivity limits are discussed in Subsections 3.1 and 3.2.4.

**2.2.2 Fuel Rod Failure**

Subsections 2.2.2.1 through 2.2.2.3 apply to normal operation; Subsections 2.2.2.4, 2.2.2.5 and 2.2.2.7 apply to anticipated operational occurrences; and Subsections 2.2.2.6, 2.2.2.8 and 2.2.2.9 apply to postulated accidents.

**2.2.2.1 Hydriding**

Hydriding is discussed in Subsection 2.2.1.4.2 of this document.

**2.2.2.2 Cladding Collapse**

**2.2.2.2.1 Bases**

The fuel rod is evaluated to ensure that fuel rod failure due to cladding collapse into a fuel column axial gap will not occur.

**2.2.2.2.2 Limits**

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**2.2.2.2.3 Evaluations**

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## 2.4 References

- 2-1 Letter from J. S. Charnley (GE) to R. Lobel (NRC), *Implementation of GESTR-M*, April 24, 1984.
- 2-2 *General Electric Fuel Bundle Designs*, NEDE-31152P, Revision 9, May 2007.
- 2-3 *General Electric Fuel Bundle Designs Evaluated with TEXICO/CLAM Analyses Bases*, April 1986 (NEDE-31151-P).
- 2-4 *BWR Fuel Channel Mechanical Design and Deflection*, NEDE-21354-2-P (Proprietary) and NEDO-21354-2, July 1977.
- 2-5 American National Standard for Light Water Reactors Fuel Assembly Mechanical Design and Evaluation, American Nuclear Society Standards Committee Working Group ANS 57.5, ANSI/ANS-57.5-1981.
- 2-6 W. G. Jameson, Jr., *Fuel Assembly Evaluation of Shipping and Handling Loadings*, NEDE-23542-P (Proprietary), March 1977.
- 2-7 *Fuel Assembly Evaluation of Combined Safe Shutdown Earthquake (SSE) and Loss-of-Coolant Accident (LOCA) Loadings (Amendment No. 3)*, NEDE-21175-3-P-A (Proprietary) and NEDO-21175-3-A, October 1984.
- 2-8 Letter from J. S. Charnley (GE) to M. S. Dunenfeld (NRC), *1984 Fuel Experience Report*, October 14, 1985.
- 2-9 K. W. Hill, et al., *Effect of a Rod Bowed to Contact on Critical Heat Flux in Pressurized Water Reactor Rod Bundles*, American Society of Mechanical Engineers Publication 75-WA/HT-77.
- 2-10 E. S. Markowski, et al., *Effect of Rod Bowing on CHF in PWR Fuel Assemblies*, American Society of Mechanical Engineers Publication 77-HT-91.
- 2-11 Letter from R. L. Gridley (GE) to D. G. Eisenhut (NRC), *Evaluation of Potential Fuel Bundle Lift at Operating Reactors*, July 11, 1977.

- 2-12 Letter from G. G. Sherwood (GE) to D. G. Eisenhut (NRC), *In the Matter of 238 Nuclear Island General Electric Standard Safety Analysis Report (GESSAR II) Docket No. 50-447*, February 2, 1983.
- 2-13 *Creep Collapse Analysis of BWR Fuel Using SAFE-COLAPS Model*, NEDO-20606A and NEDE-20606-PA (Proprietary), August 1976.
- 2-14 Memo from L. S. Rubenstein (NRC) to R.L. Tedesco (NRC), *SER Input for WNP-2*, February 24, 1982.
- 2-15 *Nuclear Energy Business Group BWR Quality Assurance Program Description*, NEDO-11209-04A, March 1978.
- 2-16 Letter, J. S. Charnley (GE) to R. C. Jones, Jr. (NRC), *Fuel Channel Bow Assessment*, MFN086-89, November 15, 1989.
- 2-17 *GE11 Critical Power Test with Rod Bow to Contact*, NEDE-31829P, April 1990.
- 2-18 Robert A. Rand, *Cladding Creep Collapse Licensing Topical Report*, NEDC-33139P-A, July 2005.
- 2-19 GNF Licensing Topical Report, *The PRIME Model for Analysis of Fuel Rod Thermal – Mechanical Performance*, Technical Bases - NEDC-33256P-A, Qualification - NEDC-33257P-A, and Application Methodology - NEDC-33258P-A, September 2010.
- 2-20 Letter from AA Lingenfelter (GNF) to Document Control Desk (NRC), Subject: *Amendment 32 To NEDE-24011-P, General Electric Standard Application For Reactor Fuel (GESTAR II)*, FLN-2008-011, October 15, 2008, and Letter from TB Blount (NRC) to AA Lingenfelter (GNF), Subject: *Final Safety Evaluation for Amendment 32 to Global Nuclear Fuel Topical Report NEDE-24011-P General Electric Standard Application for Reload (TAC NO. MD9939)*, July 30, 2009.
- 2-21 *Implementation of PRIME Models and Data in Downstream Methods*, NEDO-33173 Supplement 4-A, Revision 0, September 2011.
- 2-22 Letter from JC Kinsey (GEH) to Document Control Desk (NRC), Subject: *Response to Portion of NRC Request for Additional Information Letter No. 110 - Related to ESBWR Design Certification Application - RAI Numbers 4.2-2 Supplement 3, 4.2-4 Supplement 2 and 4.8-6 Supplement 1*, MFN 08-347, May 9, 2008.
- 2-23 *Application of NSF to GNF Fuel Channel Designs, NEDE-33798P-A, Revision 1, date TBD.***