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FRAMATOME ANP
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RODEX2 - Additional V&V and Consolidation of Approved Versions

- Ref.: 1. Letter, J. H. Nordahl (SPC) to Director, Office of Enforcement (NRC), "Siemens Power Corporation-Nuclear Division Responses to the Demand for Information, Notice of Nonconformance, and Unresolved Items (Inspection Report 9990081/97-01), February 24, 1998.
- Ref.: 2. XN-NF-81-58(P)(A) Revision 2 Supplements 1 & 2(P)(A) Revision 2, *RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model*, Siemens Power Corporation, March 1984.
- Ref.: 3. ANF-81-58 (P)(A) Revision 2 Supplements 3&4, *RODEX2 Fuel Rod Thermal Mechanical Response Evaluation Model*, Siemens Power Corporation, April 1990.
- Ref.: 4. XN-NF-85-74(P)(A) *RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model*, Siemens Power Corporation, October 1994.
- Ref.: 5. EMF-85-74(P) Revision 0 Supplement 1(P)(A) and Supplement 2(P)(A), *RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Models*, Siemens Power Corporation, February 1998.
- Ref.: 6. Letter, Suzanne C. Black, Chief Quality Assurance, Vendor Inspection, and Maintenance Branch, Division of Reactor Controls and Human Factors, Office of Nuclear Reactor Regulation to Chris M. Powers, Vice President Quality and Regulatory Affairs, Siemens Power Corporation - Nuclear Division, "NRC Inspection Report No. 99900081/98-01," September 4, 1998.

The purpose of this letter is to inform the NRC of recent activities with respect to the Framatome ANP RODEX2 fuel rod code.

In Reference 1 Framatome ANP (formerly Siemens Power Corporation) committed to perform additional V&V and to update or create users manuals, theory manuals, and programmers manuals for Framatome ANP's primary codes. Specifically, the pertinent commitments in Reference 1 are numbers 24 and 25. Three of the primary codes identified

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were RODEX2, RODEX2-2A and RDX2LSE. The work on these three codes has been completed. RODEX2-2A has two modes: RODEX2 and RODEX2A. The RODEX2 mode is used for PWR mechanical analyses and the RODEX2A mode is used for BWR mechanical analyses. The code RDX2LSE is a separate code which implements the RODEX2 mode for use in BWR and PWR safety analyses. The code RODEX2 was approved by the NRC for use in BWR and PWR analysis (mechanical and safety) in References 2 and 3. The code RODEX2A was approved by the NRC for use in BWR mechanical analysis in References 4 and 5.

The NRC had expressed concern in the Reference 6 inspection about maintaining multiple versions of an NRC-approved code. However, the NRC concluded that the user guidance for both versions of the code clearly distinguished which options are to be used for specific analyses and were consistent with the SER for RODEX2. Subsequently, Framatome ANP decided to merge the RODEX2 code versions into a single code.

While performing the additional V&V, two errors were identified that are described below.

Documentation Error

Reference 2 states that 75 percent of the pellet dish volume is assumed to be available to accommodate gaseous swelling, but the version of RODEX2 used for mechanical analyses actually uses a smaller fraction. This error dates back to the mid-1980s and involves a mistake in a RODEX2 equation that resulted in 57 percent of the actual dish volume being available to accommodate swelling.

This error in RODEX2 was corrected and the assumption of the pellet dish volume available to accommodate gaseous swelling was reduced from 75 to 57 percent in order to maintain agreement with the value implicitly used for the benchmark data. The Reference 2 document should therefore state that 57 percent of the pellet dish volume is assumed to be available to accommodate gaseous swelling.

Code Error

The mistake discussed above was not corrected in the RDX2LSE version (which is used in safety analysis) at the time it was corrected in the version of RODEX2 used for mechanical analysis. In RDX2LSE, the error caused the model to become overly sensitive to the number of radial nodes (NRD) used to model the central dished part of the pellet.

The underestimate of the volume allocated for swelling becomes magnified as NRD is reduced. The reduced volume directly affects the calculated temperatures and gap conductances.

BWR safety analyses are performed with the maximum value of NRD and are not affected by this sensitivity, whereas PWR analyses use a smaller value of NRD, and the results could be in error.

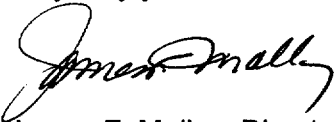
Correcting the error and merging the two codes has been shown to have negligible effect on the safety and mechanical analyses. The effect on PCT from the LOCA analyses shows an impact of less than one degree F.

The following actions were taken on the RODEX2 codes:

- The portion of the pellet dish that is assumed to be available to accommodate swelling (as described in Reference 2) was made consistent; it should be 57 percent instead of 75 percent.
- The error in RDX2LSE has been corrected.
- The various versions of RODEX2 were merged into a single code.
- The results from the new code were verified against the original benchmark results submitted to the NRC in References 2, 3, 4, and 5.
- The new code was assessed for any impact on safety and mechanical analyses, and the results show negligible differences.
- LOCA analyses were assessed for any PCT differences, and the results show less than one degree F impact.
- These PCT estimates have been provided to customers for evaluation for reporting in accordance with 10 CFR 50.46.

The information in this letter is provided to keep the NRC informed of Framatome ANP's activities in completing the V&V on RODEX2. No specific NRC action is requested.

Very truly yours,



James F. Mallay, Director
Regulatory Affairs

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cc: N. Kalyanam
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