

FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CORRECTION PAGES TO TOPICAL REPORT NEDC-32851P-A, REVISION 4

“GEXL14 CORRELATION FOR GE14 FUEL”

GLOBAL NUCLEAR FUEL

PROJECT NO. 712

1.0 INTRODUCTION AND BACKGROUND

By letter dated September 8, 2008 (Reference 1), Global Nuclear Fuel – Americas (GNF) submitted correction pages for Topical Report (TR) NEDC-32851P-A, Revision 4, “GEXL14 Correlation for GE14 Fuel,” to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. These pages were submitted to correct some errors that had been identified in the acceptance version of TR NEDC-32851P-A, Revision 4. The corrections are summarized in a revision status table and were identified by a revision bar in the right hand margin of the correction pages. The NRC staff has reviewed the correction pages and concluded that the proposed changes are acceptable based on the NRC staff findings as stated in this safety evaluation (SE).

TR NEDC-32851P-A, Revision 4 (Reference 2) presents the GEXL14 correlation development for determination of the minimum critical power ratio (MCPR) during normal operation and postulated transient events for GNF-fueled boiling water reactors (BWRs). The GEXL14 correlation is a critical quality and boiling length correlation used to predict the occurrence of boiling transition in BWR fuel designs. The test data used to support the development of the correlation include full-scale simulations of 7x7, 8x8, 9x9, and 10x10 fuel assemblies that were obtained at the General Electric (GE) ATLAS test facility in San Jose, California. The database supporting the basic GE critical quality - boiling length critical power correlation (GEXL) includes over 20,000 full-scale boiling transition data points and encompasses all of the fuel assembly designs and operating regions for BWRs. Testing has been performed in the ATLAS facility to demonstrate that the GEXL correlation can be used to predict the onset of boiling transition during postulated transient conditions that are analyzed in the safety analysis process.

2.0 REGULATORY EVALUATION

The regulation at Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34, “Contents of construction permit and operating license applications; technical information,” requires that Safety Analysis Reports be submitted that analyze the design and performance of structures, systems, and components provided for the prevention of accidents and the mitigation of the

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consequences of accidents. As part of the core reload design process, licensees (or vendors) perform reload SEs to ensure that their safety analyses remain bounding for the design cycle. To confirm that the analyses remain bounding, licensees confirm that key inputs to the safety analyses (such as the critical power ratio) are conservative with respect to the current design cycle. If key safety analysis parameters are not bounded, a re-analysis or re-evaluation of the affected transients or accidents is performed to ensure that the applicable acceptance criteria are satisfied.

The regulation at 10 CFR Part 50, Appendix A, General Design Criterion 10, "Reactor Design," is intended to ensure that reactor cores are designed with appropriate margin such that specified acceptable fuel design limits are not exceeded during normal operation or anticipated operational occurrences (AOOs).

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 4.4, "Thermal and Hydraulic Design," (Reference 3) specifies the review requirements for thermal and hydraulic design of the reactor core.

### 3.0 TECHNICAL EVALUATION

The GEXL correlation was developed to accurately predict the onset of boiling transition in BWR fuel assemblies during both steady-state and reactor transient conditions. The use of the GEXL correlation is necessary for determining the MCPR operating limits resulting from transient analyses, the MCPR safety limit analysis, and the core operating performance and design. The GEXL correlation is an integral part of the transient analysis methodology used by GNF. It is used to confirm the adequacy of the MCPR operating limit and can be used to determine the time of onset of boiling transition in the analysis of other events.

The GEXL correlation has been used in the safety analysis process for GE- or GNF-fueled BWRs since 1974. The GEXL correlation is based on the relationship of critical quality to boiling length. It expresses bundle average critical quality as a function of boiling length, thermal diameter, system pressure, lattice geometry, local rod peaking pattern (R-factor), mass flux, and annular flow length.

In the correction pages submitted with Reference 1, GNF provided a revision status table summarizing the proposed revisions to NEDC-32851P-A, Revision 4. The inclusion of these revisions in the subject TR will be designated NEDC-32851P, Revision 5. The revision status table identified the affected sections of the TR and a description of each of the corrections required. TR NEDC-32851P, Revision 5, captures and corrects several of the published additive constant values. Most of the corrections were of typographical errors or additive constant values that were documented incorrectly. In addition, TR NEDC-32851P, Revision 5, also corrects comparative statistics that were not documented correctly in Revision 4 of this TR.

The NRC staff reviewed each of the typographical errors and proposed corrections, and has determined that by revisiting the statistical methods, each correction is qualitatively and quantitatively technically correct. The minor changes to the statistics are deemed insignificant since the impact on the safety limit MCPR is in the 4<sup>th</sup> and 5<sup>th</sup> digit.

#### 4.0 CONCLUSION

The GEXL14 correlation has been validated against ATLAS data for cosine and inlet peaked axial power shapes and against Stern Laboratory data for inlet and outlet peaked axial power shapes. The proposed changes submitted with Reference 1 correct the minor errors found in TR NEDC-32851P-A, Revision 4. These errors and their corrections do not affect the correlation or the final correlation statistics to any significant degree. This SE supports the conclusion that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the NRC's regulations, and (3) the issuance of this revision will not be adverse to the common defense and security or to the health and safety of the public. Therefore, on the basis of the subject review and the justification provided above, the NRC staff concludes that the proposed minor corrections to the GEXL14 critical power correlation TR NEDC-32851P-A, Revision 4, are acceptable.

#### 5.0 REFERENCES

1. Lingenfelter, Andrew A., GNF Letter to Document Control Desk, NRC, FLN-2008-009, "Correction Pages for NEDC-32851P-A, Revision 4, "GEXL14 Correlation for GE14 Fuel,"" September 8, 2008, (ADAMS Package Accession No. ML082530507).
2. Lingenfelter, Andrew A., GNF Letter to Document Control Desk, NRC, FLN-2007-029, "Acceptance Version of Global Nuclear Fuel (GNF) Topical Report (TR) NEDC-32851P, Revision 2, "GEXL14 Correlation for GE14 Fuel,"" September 14, 2007, (ADAMS Package Accession No. ML072620192).
3. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 4.4, "Thermal and Hydraulic Design," March 27, 2007, (ADAMS Accession No. ML070550060).

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