UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 26, 2018

Site Vice President
Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR USE OF THE TRANFLOW CODE FOR DETERMINING PRESSURE DROPS ACROSS THE STEAM GENERATOR SECONDARY SIDE INTERNAL COMPONENTS (EPID L-2018-LLA-0112)

Dear Sir or Madam:

By letter dated April 12, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18106A074), Entergy Operations, Inc. (the licensee) submitted a license amendment request to revise the Waterford Steam Electric Station, Unit 3 (Waterford 3) Updated Final Safety Analysis Report (UFSAR) Section 3.9 to incorporate the TRANFLOW computer code. By letter dated June 1, 2018 (ADAMS Accession No. ML18145A265), the U.S. Nuclear Regulatory Commission (NRC) requested supplemental information to the application. The licensee provided a response to the request for supplemental information by letter dated June 13, 2018 (ADAMS Accession No. ML18169A275).

Specifically, the license amendment would delete subsection 3.9.1.2.2.1.28 of the UFSAR, which describes that the computer code CEFLASH-4A is used to calculate internal loadings following a postulated main steam line break. The deletion of this subsection would clarify that the pressure drops across the steam generator secondary side due to a steam line break accident are calculated by the TRANFLOW code.

After reviewing your request, the NRC staff has determined that additional information is required to complete the review. The additional information needed to complete the review is delineated in the enclosure to this letter.

During a closed public teleconference which was held with Maria Zamber of your staff on November 15, 2018, it was agreed that a response would be provided by 60 days after the date of this letter. Please note that if you do not respond to this letter by the agreed-upon date or provide an acceptable alternate date in writing, we may deny your application for amendment under the provisions of Title 10 of the *Code of Federal Regulations*, Section 2.108.

If you have any questions, please contact me at 301-415-1390 or via e-mail at April.Pulvirenti@nrc.gov.

Sincerely,

April L. Pulvirenti

April L. Pulvirenti, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:
Request for Additional Information

cc: Listserv

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST REGARDING THE

REVISION OF UFSAR SECTION 3.9

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

In its application dated April 12, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18106A074), Entergy Operations, Inc. (the licensee) stated that TRANFLOW was used to determine a detailed distribution of fluid temperatures and heat transfer coefficients on the secondary side of the steam generator, as well as the dynamic loading on components on the secondary side of the steam generator resulting from a postulated rupture of the main steam line. The calculated values for the dynamic loadings on secondary-side components are used as inputs into the structural analysis of the steam generator components. The structural analysis must be performed to the standard of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III.

The U.S. Nuclear Regulatory Commission (NRC) staff must therefore make a determination that TRANFLOW is capable of providing acceptable results for use as inputs in the ASME Code, Section III analysis. The review guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (SRP) Section 15.0.2, "Review of Transient and Accident Analysis Methods," specifies that the NRC staff should conduct a review of seven areas pertinent to the Code. Section III.5 of SRP 15.0.2 notes that application of the full review process described in the SRP may not be needed when the new evaluation model is a change to or extension of an existing evaluation model. This is the case for this particular use of TRANFLOW at Waterford Steam Electric Station, Unit 3 (Waterford 3), because TRANFLOW is an extension of the NRC-approved TRANFLO code used in determining main steam line break flow quality. For the review of TRANFLOW, the NRC staff is reviewing the areas of documentation, evaluation model, code assessment, and quality assurance.

1. To make its determination, the NRC staff requires additional information regarding drift-flux models. The supplement to the application dated June 13, 2018 (ADAMS Accession No. ML18169A275), indicated that TRANFLO received a major update in 1980 that implemented a drift-flux model (as compared to the homogeneous model employed in the original version). Provide additional information and documentation regarding the drift-flux model implemented in TRANFLOW. Documentation should specifically be provided on:

    a. The conservation equations (mass, momentum, and energy)
    b. Void-quality relations
    c. Heat transfer models (including boiling models)
    d. Pressure drop models (including skin friction, form losses, and expansion models)

e. Any new models used in the Waterford 3 analysis added following NRC approval of TRANFLO.

2. Explain whether countercurrent flow limitation or condensation models are included in the version of TRANFLOW used at Waterford 3. Discuss whether it is conservative or not conservative to use such models in the evaluation of steam generator internals pressure drop.

3. Describe the implementation of heat storage in and heat transfer to and from the steam generator metal mass, which is included in TRANFLOW as used at Waterford 3 (based on the supplement dated June 13, 2018) but does not appear to be in the NRC-approved version of TRANFLO.

4. Table 1 of the original submittal dated April 12, 2018, showed that pressure drop caused by crossflow over the steam generator tube U-bend was included in the original steam generator design basis calculations but not in the TRANFLOW calculations. Explain why this pressure drop was not included in the replacement steam generator analysis.

5. The NRC staff's original approval of TRANFLO indicated that data was passed back and forth between TRANFLO and MARVEL, a thermal-hydraulic systems analysis code, to determine both the primary and secondary system responses. However, the response to Sufficiency Item No. 2 in the supplement dated June 13, 2018, states that the primary side volumes were characterized in TRANFLOW as "constant pressure nodes with nodal temperature determined from the energy equation." Given that a full reactor simulation of the main steam line break would indicate that the primary system cools and depressurizes over the course of the transient, justify this assumption.

6. The June 1, 2018, request for supplemental information included a request for information regarding the input biases applied in the TRANFLOW analysis and a discussion of how the input biases would produce conservative results. The response dated June 13, 2018, stated that hot standby conditions were considered to be conservative, as they would result in the highest initial steam generator pressure. The response also included a study that demonstrated that it was most conservative to assume the initial water level in the steam generators to be at the top tube support plate. The response, however, did not discuss the assumptions related to the characteristics of the steam line break, such as the break size or discharge coefficient. Describe the break conditions assumed in the analysis, and how are they known to be limiting.

7. Explain whether main steam line flow restrictors were modeled in the TRANFLOW analysis.

8. Discuss how the primary steam separators are modeled in the Waterford 3 steam line break analysis performed with TRANFLOW.

9. Westinghouse letter LTR-SGMP-17-107 NP-Attachment, "Acceptability of the TRANFLOW Computer Code for Steam Line Break Internal Pressure Loads for the Waterford Unit 3 Replacement Steam Generators," Rev. 0, was included as attachment 4 to the licensee's supplemental information letter. (A publicly available version of this letter is included in the supplement dated June 13, 2018 (ADAMS Accession No. ML18169A275)). Section 3.3 of Appendix A of this document provides qualification of TRANFLOW versus test data, as requested by the NRC. However, the

plots provided throughout this section to provide comparisons between measurement and prediction appear to be excerpted from the original TRANFLO topical report. Please explain if the validation in Section 3.3 was performed with the revised version of TRANFLOW. If not, justify why such validation against test data is not needed for the version of TRANFLOW used in the Waterford 3 analysis, which appears to have implemented completely different versions of the conservation equations and constitutive relations from that approved by the NRC.

10. Section 3.1 of LTR-SGMP-17-107 NP-Attachment provides a benchmark of TRANFLOW to RELAP5. Table 3.1-1 demonstrates that pressure drops on the tube support plates calculated by TRANFLOW tend to differ from the pressure drops calculated by RELAP5. Please provide further discussion on why this difference exists and is acceptable, considering RELAP5 contains newer, higher fidelity models than TRANFLOW.

11. Westinghouse Letter LTR-SGMP-18-20 NP-Attachment, "Responses to Waterford Unit 3 TRANFLOW License Amendment Request, Non-Accept Sufficiency Items," Rev. 1, was included as Attachment 1 to the licensee's supplemental information letter. (A publicly available version of this letter is included in the supplement dated June 13, 2018 (ADAMS Accession No. ML18169A275)). The Westinghouse Letter LTR-SGMP-18-20 states, in part, that

> The TRANFLOW calculated values of thermal-hydraulic (TH) parameters: pressures, pressure loads (ΔPs), flow rates, flow loads (ρV2), bulk fluid temperatures, metal surface temperatures and film heat transfer coefficients are used in the downstream structural, fatigue and non-ductile failure analyses in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Power Plant Components.

Moreover, it is stated that,

> TRANFLOW is a one-dimensional, two-phase, thermal-hydraulic code used for calculating the thermodynamic and fluid (hydraulic) behavior of steam generators subject to prescribed transient conditions. The code calculates pressures, temperatures, flow rates, and heat transfer coefficients, which are used as inputs for structural analyses. TRANFLOW uses an elemental volume approach in which the spatial solution is achieved by dividing the system into a discrete number of control volumes having uniform thermal and hydraulic conditions.

One-dimensional TH analyses typically use significant course nodalization compared to three-dimensional (3D) finite element analysis (FEA) models used to analyze stresses for Section III. Describe how the TRANFLOW results are interpolated and what is assumed (i.e., asymmetry) when using them as inputs to 3D FEA models to assess fatigue and non-ductile failure analyses in accordance with Section III. Specifically, please provide information on how the nodal time history temperature and pressure information is applied to a finite element model to generate stresses and vibratory responses in the steam generator for the following components, where applicable:

a. Tube sheets
b. Tube to tube sheet welds
c. Lower shell, transition cone and upper shell
d. Primary separator assembly

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ADAMS Accession No. ML18320A090 ***by email dated**

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