

## ENCLOSURE 2

MFN 13-074

Amendment 39 to 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 [[ ]].

## **GESTAR Amendment 39 for End-of-Cycle Coastdown for Reloads Analyzed with TRACG**

### **1.0 Background and Objective**

The current GESTAR II (Reference 1) Section 4.3.1.2.8 contains considerations for End-of-Cycle (EOC) coastdown operation. This section points to Reference 2, which determines that EOC coastdown operation is bounded by the normal reload analyses because Anticipated Operational Occurrence (AOO) margins increase during coastdown compared to the End-of-Rated (EOR) condition. The Reference 2 analyses and conclusions are specific to the ODYN/TASC AOO process. However, the behavior of the key parameters is expected to be the same for either approved AOO methodology. The analysis presented below examines the margin to limits for TRACG AOOs during EOC coastdown operation to support the same conclusion as for ODYN/TASC.

A statement for incorporation into GESTAR II is included in Section 4.

### **2.0 Approach**

Coastdown at the normal EOC is a useful means of cycle extension to gain increased operating flexibility and improved uranium utilization. Coastdown is accomplished by continued operation at the all-rods-out condition at full flow after the normal EOC. During coastdown operation, power decreases slowly due to fuel burnup. Coastdown operation down to 40% power has been examined for the ODYN/TASC AOO analysis process in Reference 2. The Reference 2 analysis concluded that coastdown to 40% power is bounded by the normal reload analyses because margin to the Safety Limit Minimum Critical Power Ratio (SLMCPR) and vessel pressure limit increase during coastdown to lower power levels.

The TRACG AOO analysis evaluates AOO margins to the SLMCPR and vessel pressure limit during typical coastdown conditions. TRACG calculations (both rated and off-rated) were performed for a typical BWR/4.

### **3.0 TRACG Transient Analysis Results**

The TRACG analysis includes the Turbine Trip without Bypass (TTNBP) and the Feedwater Controller Failure (FWCF) transients at the initial conditions from 100% to 40% Rated Thermal Power (RTP).

The results are summarized in Tables 1 and 2 for the TTNBP and FWCF events. Figures 1 through 3 present Minimum Critical Power Ratio (MCPR), peak Simulated Thermal Power (STP), and peak vessel pressure.

#### **3.1 MCPR**

With decreasing coastdown power, the Initial Critical Power Ratio (ICPR) increases steadily. While  $\Delta$ CPRs may increase with decreasing power, the MCPR reached during the limiting

events increases with decreasing power level. Thus, margin to the SLMCPR improves with decreasing power, as shown in Figure 1.

### **3.2 Peak Simulated Thermal Power**

Reference 2 examined peak heat flux during coastdown conditions. However, TRACG does not readily provide heat flux. Therefore, STP, which is essentially equivalent, is examined. As shown in Figure 2, the peak STP during the limiting events shows a decreasing trend with decreasing power. This is comparable to that observed in Reference 2.

### **3.3 Peak Vessel Pressure**

As shown in Figure 3, the peak vessel pressure decreases approximately linearly with decreasing power. This is comparable to that observed in Reference 2.

### **4.0 Conclusions**

The margin to the SLMCPR, as seen for potentially limiting events, is expected to increase with coastdown. Similarly, vessel pressure margin also increases. Therefore, coastdown operation is bounded by the normal reload analyses performed with TRACG and coastdown operation down to 40% power is considered acceptable for all BWRs analyzed with TRACG.

The following statement is provided for incorporation into GESTAR II Section 4.3.1.2.8:

Analyses with TRACG show the same trends as the evaluation in Reference 4-33, therefore, the same conclusion applies for TRACG based analyses.

### **5.0 References**

- 1 Global Nuclear Fuel, “General Electric Standard Application for Reactor Fuel (GESTAR II),” NEDE-24011-P-A-19, May 2012.
- 2 Letter from Ronald E. Engel (GE) to Thomas A. Ippolito (NRC), “End of Cycle Coastdown Analyzed with ODYN/TASC,” MFN-163-81, September 1981.

<b>Table 1 - TTNPB</b>						
<b>Power (% Rated)</b>	<b>Peak Neutron Flux (%)</b>	<b>Peak STP (%)</b>	<b>Peak Dome Pressure (psia)</b>	<b>Peak Vessel Pressure (psia)</b>	<b>Initial Critical Power Ratio</b>	<b>Minimum Critical Power Ratio</b>
100 (EOR)	[[					
90						
80						
70						
60						
50						
40						]]

<b>Table 2 - FWCF</b>						
<b>Power (% Rated)</b>	<b>Peak Neutron Flux (%)</b>	<b>Peak STP (%)</b>	<b>Peak Dome Pressure (psia)</b>	<b>Peak Vessel Pressure (psia)</b>	<b>Initial Critical Power Ratio</b>	<b>Minimum Critical Power Ratio</b>
100 (EOR)	[[					
90						
80						
70						
60						
50						
40						]]

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**Figure 1: MCPR vs. Power**

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**Figure 2: Peak STP vs. Power**

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**Figure 3: Peak Vessel Pressure vs. Power**