DUKE ENERGY®

Scott L. Batson
Vice President
Oconee Nuclear Station

Duke Energy
ON01VP | 7800 Rochester Hwy
Seneca, SC 29672

o: 864.873.3274
f: 864.873. 4208
Scott.Batson@duke-energy.com

10 CFR 50.54 (f)

ONS-2014-024

February 27, 2014

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station (ONS), Unit Nos. 1, 2, and 3
Docket Nos. 50-269, 50-270, and 50-287
Renewed License Nos. DPR-38, DPR-47, and DPR-55

Subject: Oconee Closure Option 1 Response for Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance" in resolution of final Issues related to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

By letter dated February 29, 2008 (ADAMS accession number ML080710159), Duke Energy submitted a supplemental response to the NRC regarding the status of GL 2004-02 Requests for Additional Information (RAI) and inspection questions. Included in this letter was a commitment to "Evaluate and Respond to NRC Conditions and Limitations of WCAP 16793-NP, rev. 0, 90 days after receipt of final NRC Conditions and Limitations." By letter dated July 1, 2008 (ADAMS accession number ML081750635), the NRC issued a response to Duke Energy's February 29, 2008, summary of the GL 2004-02 program. In this letter, the NRC stated:

> "We have no further questions at this time regarding your completion of corrective actions for Generic Letter (GL) 2004-02. In large part this conclusion is based on the very low potential debris loading at Oconee, as discussed in your supplemental response."

In a subsequent paragraph, the July 1, 2008, letter from the NRC stated the following:

> "As you may be aware, we have not yet issued a final safety evaluation (SE) on WCAP 16793 NP. "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." We believe that the likelihood of unacceptable in-vessel debris impact for Oconee is very low because of the low debris loading. However, because your GL 2004-02 response refers to and relies on this topical report, we plan to defer issuance of a closure letter to Oconee for the GL until uncertainties regarding the remaining issues with WCAP-16793 are reduced. You may

A116
NRR

> wait for the issue to be resolved through the WCAP process or may demonstrate that in-vessel downstream effects issues are resolved for Oconee by demonstrating without reference to WCAP-16793 or the NRC staff SE that in-vessel downstream effects have been addressed at Oconee."

On April 8, 2013, the NRC issued a safety evaluation relating to WCAP-16793-NP, Revision 2, "Evaluation of Long Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid" (ADAMS accession number ML13084A154). On May 15, 2013, Duke Energy submitted a letter revising its commitment to address WCAP 16973-NP and associated NRC safety evaluation by July 31, 2013 (ADAMS accession number ML13137A047). On July 31, 2013, Duke Energy submitted a letter (ADAMS accession number ML13219A110) indicating that strainer fiber bypass testing performed in 2006 was found to not meet the bypass test requirements in WCAP 16793-NP and that Duke Energy was evaluating options for utilizing strainer fiber bypass testing from other plants with strainers supplied by Control Components Inc. (CCI). The letter also extended the commitment date for addressing WCAP 16793-NP to December 15, 2013. This date was subsequently revised to February 27, 2014, based on docketed email correspondence between Robert Meixell (Duke Energy) and Richard Guzman (NRC NRR) on December 6, 2013 (ADAMS accession number ML13339A789).

The enclosure to this letter documents successful completion of the in-vessel downstream effects analysis performed in accordance with WCAP 16793-NP, Revision 2 and the associated NRC safety evaluation. This demonstrates compliance with 10 CFR 50.46 and satisfies the final outstanding GSI-191 commitment for Oconee Nuclear Station.

There are no new regulatory commitments contained in this letter.

Please address any comments or questions regarding this matter to Bob Meixell, Oconee Regulatory Affairs, at (864) 873-3279.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 25, 2014.

Sincerely,

Scott L. Batson
Vice President
Oconee Nuclear Station

Enclosure

xc (w/enclosure):

Mr. Victor McCree, Regional Administrator
U.S. Nuclear Regulatory Commission – Region II
Marquis One Tower
245 Peachtree Center Ave., NE Suite 1200
Atlanta, Georgia 30303-1257

Mr. Richard Guzman, Project Manager (ONS)
(by electronic mail only)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop O-8C2
Rockville, MD 20852

Mr. Eddy Crowe
NRC Senior Resident Inspector
Oconee Nuclear Station

Enclosure
[12 pages plus cover]

Oconee Nuclear Station
Generic Letter 2004-02 Supplemental Response

WCAP 16793-NP-Revision 2
Evaluation Response for Oconee

February 27, 2014

Letters dated November 19, 2007, December 18, 2007, and December 19, 2007, December 28, 2007, and December 22, 2008 (ADAMS accession numbers ML073300021, 073580178, 073580168, 073550011 and 083650288), document commitments and associated date changes regarding modifications to resolve issues identified in the Oconee downstream effects evaluation. The scope of these modifications involved replacement of High Pressure Injection (HPI) pumps to utilize more durable wear parts, replacement of seal flush orifices and cyclone separators for High Pressure Injection, Low Pressure Injection (LPI), and Reactor Building Spray (BS) pumps, and to review and, if needed, provided procedural guidance for operator recognition of and response to HPI, LPI, or BS pump seal failures or HPI pump wear-related failure. In its letter dated February 29, 2008, Duke Energy made three additional commitments. The scope of these commitments was to (1) evaluate and respond to NRC Conditions and Limitations on WCAP 16793-NP, (2) revise Site Directive (SD) 1.3.9 to ensure evaluation of metal scaffolding left in Reactor Building (RB), and (3) update the Oconee UFSAR to capture new emergency sump licensing basis.

By NRC letter dated July 1, 2008, the following item is the only open item for Oconee Nuclear Station regarding GL 2004-02:

> We have no further questions at this time regarding your completion of corrective actions for Generic Letter (GL) 2004-02. In large part this conclusion is based on the very low potential debris loading at Oconee, as discussed in your supplemental response.
>
> As you may be aware, we have not yet issued a final safety evaluation (SE) on WCAP 16793 NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." We believe that the likelihood of unacceptable in-vessel debris impact for Oconee is very low because of the low debris loading. However, because your GL 2004-02 response refers to and relies on this topical report, we plan to defer issuance of a closure letter to Oconee for the GL until uncertainties regarding the remaining issues with WCAP-16793 are reduced. You may wait for the issue to be resolved through the WCAP process or may demonstrate that in-vessel downstream effects issues are resolved for Oconee by demonstrating without reference to WCAP-16793 or the NRC staff SE that in-vessel downstream effects have-been addressed at Oconee. We are developing a Regulatory Issue Summary to inform the industry of our expectations and plans regarding resolution of this remaining aspect of GSI-191.

<u>Oconee Response</u>

With the submission of this letter, the above open item is considered complete.

In accordance with Duke Energy Letter dated July 31, 2013, Oconee Nuclear Station elected to pursue GSI-191 Closure Option 1 since Units 1, 2 and 3 meet the requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," based on approved models for analyses, strainer head loss testing, and in-vessel; downstream effects. As the WCAP-16793-NP, Revision 2 methodology represents an NRC-approved model, successful completion of the analysis in accordance with the associated SE shows compliance with 10 CFR 50.46 as it relates to in-vessel downstream effects, and resolves this final outstanding item for Oconee Nuclear Station.

Compliance with WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical debris in the Recirculating Fluid," Revision 2 and associated NRC Safety Evaluation issued on April 8, 2013 (ADAMS accession number ML13084A154), can be demonstrated by examining Emergency Core Cooling System (ECCS) strainer bypass testing results, scaling the results to overall debris quantities predicted to be transported to the reactor vessel, evaluation of in-core response based on application of LOCADM models, and successful application of the limitations and conditions imposed in the Safety Evaluation issued by the staff.

Background

By letter dated July 31, 2013, Duke Energy informed the NRC of plans for Oconee to utilize testing from other nuclear sites that utilize the same sump strainer supplier, Control Components Inc. (CCI). Limitations and Conditions 11 from Safety Evaluation (SE) for WCAP 16793-NP Revision 2 states:

> "Licensee may determine the quantity of debris that passes through their strainers by (1) performing strainer bypass testing using the plant strainer design, plant specific debris loads, and plant specific flow velocities, (2) relying on strainer bypass values developed through strainer bypass testing of the same vendor and same perforation size, prorate to the licensee's plant specific strainer area; approach velocity; debris types, and debris quantities, or (3) assuming that the entire quantity of fiber transported to the sump strainer passes through the sump strainer."

Oconee has utilized information from the docketed responses for Salem Nuclear Station and applied them to meet WCAP-16793-NP Reactor Building Emergency Sump (RBES) strainer bypass testing for Oconee. RAI responses from Salem dated April 27, 2012 (ADAMS accession number ML121290536), and April 22, 2013 (ADAMS accession number ML13114A048), and the Salem GL 2004-02 In-Vessel Downstream Effects Resolution response dated July 11, 2013 (ADAMS Accession number ML13192A417), were the source documents for the Salem information. The second option of Limitations and Conditions item number 11 from the SE for WCAP 16793-NP Revision 2, states the parameters (here forth referenced to as Critical Parameters) that must be included in an evaluation of sump strainers. Table 1-Critical Parameter Review contains the Oconee and Salem critical parameters and the supporting evaluation.

Table 1 – Critical Parameter Review

<table>
<tr><th>Parameter</th><th>Salem Value</th><th colspan="3">Oconee Value</th><th>Evaluation</th></tr>
<tr><td>Strainer Manufacturer</td><td>Control Components Inc. (CCI)</td><td colspan="3">Control Components Inc. (CCI)</td><td rowspan="2">Strainer design is by CCI for both Salem and Oconee. Same design and same strainer hole size. Evaluation conclusion is the strainer for both Oconee and Salem share the same form, fit and function.</td></tr>
<tr><td>Strainer Hole Diameter</td><td>1/12 inch</td><td colspan="3">1/12 inch</td></tr>
<tr><td rowspan="3">Strainer Area</td><td rowspan="3">Unit 1 4854 ft^2
Unit 2 4656 ft^2</td><td>Unit</td><td>Actual Area (ft^2)</td><td>Effective Area (ft^2)</td><td rowspan="3">Both Salem and Oconee have similar size strainers. Effective Area for Oconee includes 325 ft^2 reduction in strainer surface area due to tags, labels and other misc. debris in containment. Both plant's strainers are two sided and are completely submerged during a LOCA. Salem's methodology computes fiber bypass quantity based on strainer area and not simply a percentage of total fiber load. Thus, differences in strainer area are accounted for automatically.</td></tr>
<tr><td>1</td><td>4867.67</td><td>4542.67</td></tr>
<tr><td>2/3</td><td>5191.09</td><td>4866.09</td></tr>
<tr><td>RBES flow rate</td><td>Units 1 & 2 maximum flow 8850 gpm</td><td colspan="3">Units 1, 2 & 3 maximum flow 7400 gpm</td><td>Note: These figures are total ECCS and Containment Spray system flow rates per unit. ONS RBES flow rate is less than the Salem maximum RBES flow rate. Observations from bypass testing indicate that higher flow rates translate to higher strainer bypass flow for the same strainer design, same strainer areas and same debris types and quantities. Thus, Salem's strainer test results can be considered conservative when compared to Oconee's flow rates.</td></tr>
<tr><td>Debris types and quantities</td><td>30 lb_m of NUKON fiber</td><td colspan="3">Nuclear Instrumentation
(NI) Cable fiber: 0.75 ft^3
Latent fiber: 6.825 ft^3
Total Fiber: 7.575 ft^3

Fiber Density: 2.4 lb_m/ft^3

Total Fiber Mass: 18.18 lb_m</td><td>Salem 2008 Bypass Test 3 was performed with a debris load equivalent to 30 lb_m of NUKON fiber in the RBES. This case bounds the Oconee potential strainer fiber quantity of 18.18 lb_m. For additional conservatism, Oconee, like Salem, used the higher strainer fiber bypass quantity values from Salem 2008 Bypass Test 1 for fuel evaluations.</td></tr>
<tr><td>Approach Velocity</td><td>0.0042 ft/sec</td><td colspan="3">0.0036 ft/sec</td><td>ONS RBES approach velocity is less than Salem's approach velocity. Based on Salem's April 27, 2012 RAI response, higher velocity results in higher fiber bypass.</td></tr>
</table>

ECCS Sump Strainer Bypass Testing

- Test Flume Design

CCI performed debris bypass testing for the Salem replacement strainers. From the Salem RAI response dated April 27, 2012, fiber bypass testing performed in 2008 used a two-sided strainer module in the test loop with strainer submergence. The Oconee strainer is a two-sided strainer that is submerged during an accident. As discussed in Table 1, the Oconee RBES flow rates and strainer design are similar to or are bounded by the Salem strainer parameters and RBES flow rates. In addition, the two-sided design of the strainer used in Salem's bypass test is similar to Oconee's installed two-sided strainer. Therefore, since the strainers and ECCS flow rates for Salem and Oconee are similar or the Salem parameters conservatively bound equivalent Oconee parameters, Salem's test flume design provides a similar and/or conservative design for obtaining test results applicable to Oconee.

- Test Flowrate

From the bypass test results in the Salem RAI response dated April 22, 2013, it is shown that higher penetration/approach velocities produce more debris bypass. As seen in Table 1, the ECCS and Building Spray flow rates for Salem are higher than those for Oconee. Likewise, the approach velocities for Salem are higher than those for Oconee. In addition, the area of the strainer available for flow was based on the smallest designed strainer reduced by a sacrificial strainer area predicted to be lost due to miscellaneous latent debris (e.g., tags, labels). Therefore, since the strainer surface area for Oconee and Salem are similar and the strainer flow rates are higher for Salem, the Salem test for bypass will bound Oconee's test cases.

- Fibrous Debris Preparation

The April 27, 2012, Salem RAI response describes how the fibrous debris is prepared. NUKON is utilized as a surrogate for latent fiber. Utilizing NUKON as a surrogate for latent fiber is consistent with the SE for NEI 04-07, which also states that a bulk density of 2.4 lb_m/ft^3 can be assumed. In the Salem testing, the NUKON fibers were conservatively prepared as fines. The fibers were baked at 250 degrees C for 24 hours. The fibers were cut into pieces approximately 50 mm by 50 mm. The fibers were divided into batches of 0.1 to 0.14 ft^3. Then the fibers were soaked into water until saturated. Finally each fiber batch was decomposed in a high pressure water jet for 4 minutes. Observations of industry testing indicate that preparation of fiber as fines is conservative because fines create higher bypass values.

- Fibrous Debris Introduction and Transport Efficiency

From the Salem RAI response dated April 27, 2012, fibrous debris introduction for the Salem test was added in a slurry form in batches as noted in the debris preparation above. Action was taken to ensure the fiber batch in the slurry had not settled. The debris was added 1.5 meters from the strainer at the sparger to promote mixing. All debris was added very slowly to the test loop water surface with attention given to avoid clumping. After each fiber batch was added, the test loop was checked for sedimentation and agitated as necessary. The above method of adding fiber and agitating as necessary ensures the fiber does not settle and is transferred to the strainer. Since bypass was calculated based on the difference between the mass of fiber added to the loop and the mass of fiber collected downstream of the strainer, settled fiber would reduce the apparent strainer bypass quantities. Also, fiber clumps would be less likely to bypass than individual fibers.

- Capture/Quantification of Bypass Debris

  From the Salem RAI response dated April 27, 2012, the Salem bypass testing ran for 6 hours. The approximate test loop turnover time was 2.5 to 3 minutes. So, the test run was long enough to perform over 100 pool turnovers. A bypass screen was installed downstream of the strainer and designed to capture fiber fines. The bypass screen was weighed before and after the test to determine bypass mass (after correcting for drying the fiber on the bypass screen).

- Bypass Test Results

  Salem, in Section 3f.4.2.2.1 of their April 27, 2012 RAI response, draws three conclusions concerning fiber bypass (quoted below).
  - Once the strainer becomes saturated with fiber, an increase in the upstream fiber quantity does not result in a higher amount of fiber bypass. Therefore, the quantity of fiber bypass is not proportional to the amount of upstream fiber and bypass cannot be characterized as a percentage of upstream material.
  - The bypass volume is proportional to the penetration velocity and each penetration velocity has its own bypass value. The bypass quantity increases with the flow rate / penetration velocity.
  - The bypass volume is proportional to the strainer area.

  Based on these stated conclusions, Oconee reviewed the Salem bypass test data, specifically the 2008 testing done with the two-sided strainer test assembly for reasons previously discussed. As stated in Table 1, the Salem bypass test that is closest to the Oconee fiber debris load is 2008 Bypass Test 3. This test, which had the lowest fiber load of the three bypass tests, had a fiber load of 30 lb_m and resulted in a fiber bypass quantity of 0.68 lb_m / 1000 ft^2 (i.e. mass of fiber per 1000 ft^2 of overall strainer surface area). Based on the surface area of Salem's strainers (4854 ft^2 and 4656 ft^2), 2008 Bypass Test Case 3 represents a potential fiber load on the Salem strainer ranging from 6.18 to 6.44 lb_m / 1000 ft^2. By comparison, the 18.18 lb_m of fiber currently postulated to transport to the Oconee strainer, along with the range of Oconee strainer areas (4542.67 ft^2 to 5191.09 ft^2) represents a potential strainer fiber load of 3.50 to 4.00 lb_m / 1000 ft^2. Since all the Salem 2008 bypass test cases had fiber loads higher than the Oconee fiber load, both in terms of actual quantity and fiber load per 1000 ft^2 of strainer area, combined with the fiber bypass conclusions drawn previously by Salem (as quoted above), the Salem fiber bypass test data is considered to provide fiber bypass results that would bound potential fiber bypass for the Oconee strainers.

Table 2 – Summary of Salem 2-Sided Strainer Bypass Test Results

Test Case	Total Fiber Load lb_m (Note 1)	Fiber Bypass $lb_m/1000\ ft^2$ (Note 2)	Percentage of Fibers ≤ 1.5mm in Length (Note 3)
2008 Bypass Test 1	1184.06	0.85	93%
2008 Bypass Test 2	497.06	0.51	93%
2008 Bypass Test 3	30.0	0.68	95%

Note 1: Total Fiber Load data from Salem's April 27, 2012, RAI response, Table 3f.4.1.6.4-1.
Note 2: Fiber Bypass data from Salem's April 22, 2013, RAI response, Table 9-2.
Note 3: Percentage of Fibers ≤ 1.5mm in Length data from Salem's April 27, 2012, RAI response, Table 3f.4.2.2.2-2.

Analysis of In-Vessel Downstream Effects

In their April 22, 2013, RAI response (Question 9), Salem stated that they used the results from 2008 Bypass Test 1 for their fuel deposition evaluation, as that case had the highest fiber bypass quantity (0.85 lb_m / 1000 ft^2) out of the bypass tests performed with the two-sided strainer test setup. The fiber load for that test was 1184.06 lb_m whereas the total fiber currently assumed to transport to the RBES during an Oconee LOCA is 18.18 lb_m. As previously noted, Salem concluded that once the strainer becomes saturated with fiber, an increase in the upstream fiber quantity does not result in a higher amount of fiber bypass. Therefore, the quantity of fiber bypass is not proportional to the amount of upstream fiber and bypass. Based on this, bypass results (in terms of amount of bypass, not necessarily percentage of bypass) from tests high fiber loads are expected to bound fiber bypass quantities for low fiber loads. However, using the same fiber bypass quantity as Salem (0.85 lb_m / 1000 ft^2) along with the largest actual (not effective) strainer area of the three Oconee strainers (Units 2 and 3 at 5191.09 ft^2) results in an a fiber load for the fuel deposition analysis of 11.3 g/Fuel Assembly (FA).

Fiber/FA = (Strainer Area)*(Fiber Bypass) / (No. Fuel Assemblies)
= (5191.09 ft^2)(0.85 lb_m/1000 ft^2) / (177 FA) * 453.592 g/lb_m
= 11.3 g/FA

If the Salem 2008 Bypass Test 3 results were used instead (0.68 lb_m / 1000 ft^2), the resulting fiber load for the fuel deposition analysis would be reduced to 9.0 g/FA (using the above calculation).

The Pressurized Water Reactor Owners Group (PWROG) has developed a methodology for the evaluating the effect of debris and chemical products on Long Term Core Cooling (LTCC) for PWRs, as documented in WCAP 16793-NP, Revision 2. Oconee has committed to utilize this WCAP methodology to show LTCC. Thus far, the information contained within this response has addressed one of three success criterion (Fibrous debris in the core) outlined in the NRC Safety Evaluation.

The remainder of the acceptance criteria associated with WCAP 16793-NP, Revision 2 are met by the use of the LOCA Deposition Model (LOCADM) contained in the WCAP. This model predicts the scale thickness due to deposition of bypass debris on the fuel rod surfaces and then evaluates the resulting peak fuel cladding temperatures. The resulting scale thickness is combined with the thickness of existing fuel cladding oxidation and crud build-up to calculate the total deposition thickness.

The results of the WCAP 16793-NP, Revision 2 evaluation conclude the accumulation and deposition of fibrous and chemical precipitate debris at the reactor core will not challenge the ability to maintain post-LOCA LTCC at Oconee.

- Application of bypass testing at Salem performed specifically for CCI strainers was used to determine potential fiber bypass in terms of fiber bypass mass per 1000 ft^2 of strainer area rather than as simple percentage of the total fiber load in the RBES. Oconee has performed a comparison of key parameters and has utilized bypass test results that conservatively bound the potential fiber load at Oconee. This results in a postulated fibrous debris load for Oconee of 11.3 grams per fuel assembly (g/FA). This debris load is smaller than the 15 g/FA limit required in the WCAP and subsequent Safety Evaluation. Therefore, accumulation of fibrous debris at the reactor fuel inlet will not inhibit LTCC.

- Utilizing the methodology outlined in WCAP 16793-NP, LOCADM runs were performed for two different cases: minimum initial RBES sump volume (Case 1) and maximum initial RBES sump volume (Case 2). Table 3 summarizes the results (peak cladding temperature, scale thickness and deposition thickness) of the two cases.

Table 3 – Oconee LOCADM Model Results

Case	Peak Cladding Temperature (°F)		Deposition Thickness (mils)	
	Results	Acceptance Criterion	Results	Acceptance Criterion
1: Minimum Initial RBES Pool Volume	331	< 800	23.8	< 50
2: Maximum Initial RBES Pool Volume	331		23.4	

For either case, the Peak Cladding Temperature (PCT) is much lower than the acceptance criterion of 800°F, and the Deposition Thickness (DT) value is well within the acceptance criterion of 50 thousandths of an inch (mils). Therefore, deposition of post-LOCA debris and chemical precipitate product on the fuel rods will not block the LTCC flow through the reactor core or create unacceptable local hot spots on the fuel cladding surfaces.

<u>Compliance with Limitations and Conditions</u>

The NRC Safety Evaluation dated April 8, 2013, provides analysis and recommendations on the usage of WCAP 16793-NP Revision 2 evaluations. Specifically, the Safety Evaluation points out 14 Limitations and Conditions that must be addressed when applying the WCAP methodology. These 14 Limitations and Conditions are addressed for Oconee Nuclear Station below.

1. **Assure the plant fuel type, inlet filter configuration, and ECCS flow rate are bounded by those used in the** [Fuel Assembly] **FA testing outlined in Appendix G of the WCAP. If the 15 g/FA acceptance criterion is used, determine the available driving head for a** [Hot Leg] **HL break and compare it to the debris head loss measured during the FA testing. Compare the fiber bypass amounts with the acceptance criterion given in the WCAP.**

   Response:

   Utilizing the methodology identified in RAI #18 of PWROG letter OG 10-253, "PWROG Response to Request for Additional Information Regarding PWROG Topical Report WCAP 16793-NP, Revision 1, dated August 2010, the available driving head for a Oconee HL break is 12.9 psi. The maximum head loss of the AREVA testing is 2.7 psi which is much lower than the available driving head shown above. Therefore, the driving head for Oconee is favorably higher for both the AREVA and Westinghouse fuels in the fuel assembly testing.

   For ONS, the maximum ECCS flow rate for a HL or Cold Leg (CL) break is 4297 gpm by combining the flow rates of injected flow and spill flow. Using the total ECCS flow rate of 4297 gpm is conservative because this approach assumes that all the ECCS flow travels through the reactor core while a portion of the flow may actually travel through alternate flow paths or spill from the break location. Therefore, the maximum flow rate per FA for ONS is determined to be 24.3 gpm/FA which is within the bounds of the FA testing flow rate of 44.7 gpm/FA.

   The ONS fuel type (AREVA 15×15, Mark-B-HTP-1) and inlet filter configuration (AREVA FuelGuard) are covered by the FA testing program in Appendix G of the WCAP. Although the FA testing utilizes the AREVA 17×17, Mark-BW fuel design, the FA testing applies to the specified ONS fuel type and filter configuration.

   As determined earlier, the amount of fiber bypass at Oconee translates to 11.3 g/FA, which is within the bounds of the 15 g/FA acceptance criteria identified in the Safety Evaluation for WCAP 16793-NP-Revision 2.

2. **Each licensee's GL 2004-02 submittal to the NRC should state the available driving head for a HL break, ECCS flow rates, LOCADM results, type of fuel and inlet filter, and amount of fiber bypass.**

   Response:

   For the available HL break driving head, ECCS flow rate, type of fuel and inlet filter, and amount of fiber bypass, see the response to the first limitation and condition.

3. **If a licensee credits alternate flow paths in the reactor vessel in their LTCC evaluations, justification is required through testing or analysis.**

   Response:

   Oconee is not crediting alternate flow paths. Therefore no additional justification is required.

4. **The numerical analysis discussed in Section 3.2 and 3.3 of the WCAP should not be relied upon to demonstrate adequate LTCC.**

   Response:

   Oconee does not use any of the conclusions drawn based on the fuel blockage modeling discussed in Section 3.2 and 3.3 of the WCAP report. Instead, the amount of fiber bypass transported to the fuel inlet at Oconee (11.3 g/FA) is compared with the fibrous debris acceptance criterion established from the FA testing to show that the debris will not form impenetrable blockage at the reactor core spacer grid, thereby demonstrating adequate LTCC.

5. **Assure the plant meets the 15 g/FA fiber bypass acceptance criteria.**

   Response:

   The analysis documented in this enclosure determined a fiber loading value of 11.3 g/FA for the Oconee reactor cores. This bypass quantity meets the 15 g/FA acceptance criteria limit identified in the SE.

6. **The debris acceptance criterion can only be applied to fuel types and inlet filter configurations evaluated in the WCAP FA testing.**

   Response:

   As stated in the response to the first limitation and condition, ONS's fuel type and inlet filter configuration are covered by the Westinghouse FA testing (AREVA 15×15, Mark-B-HTP-1). Therefore, the fibrous debris acceptance criterion given in the WCAP is applicable to the ONS fuel type and inlet filter configuration.

7. **Each licensee's GL 2004-02 submittal to the NRC should compare the PCT from LOCADM with the acceptance criterion of 800°F.**

   Response:

   The ONS PCT is determined to be 331°F which is well within the acceptance criterion of 800°F.

8. **When utilizing LOCADM to determine PCT and DT, the aluminum release rate must be doubled to more accurately predict aluminum concentrations in the sump pool in the initial days following a LOCA.**

   Response:

   The appropriate modeling methodology was followed, including the doubling of the aluminum release rate, in the LOCADM analysis.

9. **If refinements specific to the plant are made to the LOCADM to reduce conservatisms, the licensee should demonstrate that the results still adequately bound chemical product generation.**

   Response:

   The Oconee LOCADM runs credit phosphate inhibition because the aluminum corrosion rate decreases after exposure to Trisodium Phosphate (TSP) due to formation of a film on the surface of the aluminum. This phenomena was confirmed for the aluminum alloys utilized at Oconee in corrosion tests performed by Duke Energy for ONS post-LOCA containment conditions (see Enclosure 2 of Oconee GSI-191 RAI response, dated February 29, 2008). The refinement for reducing the amounts of sodium aluminum silicate and aluminum oxide hydroxide precipitates is utilized. However, it can be shown for Oconee that changing the values to zero in the cell in the "Switches" spreadsheet does not affect the scale thickness or any other calculated outputs.

10. **The recommended value for scale thermal conductivity of 0.11 BTU/(h-ft-°F) should be used for LTCC evaluations.**

    Response:

    The scale deposit thermal conductivity is assumed to be 0.2 W/m-K. As stated in Appendix E of WCAP-16793-NP, the recommended thermal conductivity of 0.11 BTU/(h-ft-°F) can be converted to 0.2 W/m-K, which is used in this calculation.

11. **The licensee's submittals should include the means used to determine the amount of debris that bypasses the ECCS sump strainer and the fiber loading at the fuel inlet expected for the HL and CL break scenarios. Licensees should provide the debris loads, calculated on a fuel assembly basis, for both the HL and CL break cases in their GL 2004-02 responses.**

    Response:

    Oconee assumes all debris generated by the LOCA is transferred to the recirculation pool and the debris transfers to the RBES. This approach is very conservative in that it maximizes the debris at the RBES strainer. See the ECCS Sump Strainer Bypass testing section of this RAI response for discussion of the plant specific strainer bypass testing that was performed for Oconee. The amount of fiber bypass transported to the fuel inlet at ONS is assumed to be 11.3 g/FA. This is less than the 15 g/FA limit given in the WCAP report which is bounding for both HL and CL breaks.

12. **Plants that can qualify a higher fiber load based on the absence of chemical deposits should ensure that tests for their conditions determine limiting head losses using particulate and fiber loads that maximize the head loss with no chemical precipitates included in the tests. In this case, licensees must also evaluate the other considerations discussed in the first limitation and condition.**

    Response:

    As stated previously, Oconee uses the fibrous debris acceptance criterion of 15 g/FA established by the Westinghouse FA testing. Therefore, no additional justification is required.

13. **The size distribution of the debris used in the FA testing must represent the size distribution of fibrous debris expected to pass through the ECCS sump strainer at the plant.**

    Response:

    In regards to strainer bypass testing and results, Oconee credits the testing and results performed by Salem. The following is from the Salem July 11, 2013, response regarding GL 2004-02 In-Vessel Downstream Effects Resolution. Specifically, the following is Salem's response to Limitations and Condition 13 regarding debris size distribution:

    > The bypass fiber size distribution at Salem was compared to the fiber size distribution in WCAP 16793-NP, Revision 2. The PWROG fuel assembly testing used a blender to produce fibers with lengths representative of bypassed fibers. The Salem plant specific testing at the vendor facility (CCI) used a high pressure washer to produce fibers with lengths representative of fibers upstream of the strainer.
    >
    > The blender method is known to result in larger amounts of smaller fibers. However, the methodology used to prepare the fiber insulation at Salem is consistent with NEI's recommended procedure (ADAMS ML120481052 & 120481057-NEI ZOI Fibrous Debris Preparation: Processing, Storage and Handling) and is expected to produce a representative fiber bypass size distribution. Based on the comparison between the Salem and PWROG testing, the bypass fiber sizes for Salem are slightly larger than those tested by the PWROG but are comparable. Therefore, the size of fibrous debris which bypasses the strainer is comparable to the fiber sizes used in the fuel assembly testing in WCAP 16793-NP, Revision 2.

14. Each licensee's GL 2004-02 submittal to the NRC should not utilize the "Margin Calculator" as it has not been reviewed by the NRC.

Response:

The Oconee in-vessel downstream effects evaluation does not use the "Margin Calculator."