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SOUTHERN COMPANY

OCT 2 9 2010

Docket Nos.: 52-025
52-026

ND-10-2091

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

Southern Nuclear Operating Company
Vogtle Electric Generating Plant Units 3 and 4 Combined License Application
Additional Response to Bellefonte Units 3 and 4 Safety Evaluation Report
Open Items for Chapter 15

Ladies and Gentlemen:

By letter dated March 28, 2008, Southern Nuclear Operating Company (SNC) submitted an application for combined licenses (COLs) for proposed Vogtle Electric Generating Plant (VEGP) Units 3 and 4 to the U.S. Nuclear Regulatory Commission (NRC) for two Westinghouse AP1000 reactor plants, in accordance with 10 CFR Part 52. As a result of the NRC's detailed review of the initial AP1000 Reference COL application (Bellefonte Units 3 and 4), the NRC has written a safety evaluation report (SER) with open items for the subject chapter. Since the VEGP Units 3 and 4 is the current AP1000 Reference COL application (R-COLA), SNC is addressing the subject SER open items in the enclosure to this letter. For completeness, each open item is identified but responses are provided only for the items impacting standard information or otherwise resulting in standard changes for the AP1000 COL applications. The open items identified as plant specific will be addressed on the Bellefonte Units 3 and 4 docket by the Tennessee Valley Authority.

This letter provides additional information to address the action items from the SER for the Caldon Technical Report Revision 8.

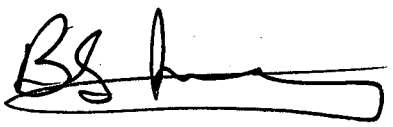
If you have any questions regarding this letter, please contact Mr. Wes Sparkman at (205) 992-5061 or Ms. Amy Aughtman at (205) 992-5805.

D092
NRO

Mr. B. L. Ivey states he is a Vice President of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY



B. L. Ivey

Sworn to and subscribed before me this 29 *day of* October, *2010*

Notary Public: Gloria H. Bice

My commission expires: 04/01/2013

BLI/BJS

Enclosure: Response to R-COLA SER with Open Items, Chapter 15

cc: Southern Nuclear Operating Company
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Mr. J. T. Gasser, Executive Vice President, Nuclear Operations (w/o enclosure)
Mr. D. H. Jones, Site Vice President, Vogtle 3 & 4 (w/o enclosure)
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Document Services RTYPE: COR0507-03
File AR.01.02.06

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Mr. K. T. Haynes, Director of Contracts and Regulatory Oversight

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Enclosure

Response to R-COLA SER with Open Items,

Chapter 15

Open Item	Response
15.00-01	Standard – See enclosed supplemented response
15.00-02	Plant-Specific – Bellefonte (not included)
15.04-01	Standard – See 1-22-10 response
15.07-01	Plant-Specific – Bellefonte (not included)
15.09-01	Plant-Specific – Bellefonte (not included)
15.09-02	Plant-Specific – Bellefonte (not included)
15.09-03	Plant-Specific – Bellefonte (not included)

Attachments / Enclosures	Pages Included
None	

eRAI Tracking No. 3951
NuStart Qb Tracking No. 4232
NRC SER OI Number 15.00-01:

AP1000 COL Information Item- Summary of Application

· COL 15.0-1

This COL information item was provided in a response to a request for additional information (RAI) related to the AP1000 design certification amendment review. Specifically, in its response dated May 6, 2009, (Agencywide Documents Access and Management System (ADAMS) Accession Number ML091310260) to NRC RAI AP1000 DCD RAI-SRP15.0-SRSB-02, Westinghouse proposed COL Information Item 15.0-1 to provide documentation of the plant calorimetric uncertainty methodology. It should be noted that the BLN applicant has not yet proposed this item. RAI-SRP15.0-SRSB-02 noted that the AP1000 DCD assumes a 2 percent power uncertainty for the initial condition for most accidents that are not departure from nucleate boiling limited. However, a 1 percent power uncertainty is assumed for the initial reactor power for the large-break loss-of-coolant accident (LOCA) in DCD Section 15.6.5.4A, as well as the mass and energy release calculation in DCD Sections 6.2.1.3 and 6.2.1.4. In response to this RAI, Westinghouse proposed a new COL information item to be included in the AP1000 DCD Section 15.0.15 (Revision 18). COL Information Item 15.0-1 states that:

> Following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters prior to fuel load, the Combined License holder will calculate the primary power calorimetric uncertainty. The calculations will be completed using an NRC acceptable method and confirm that the safety analysis primary power calorimetric uncertainty bounds the calculated values.

AP1000 COL Information Item - Technical Evaluation

· COL 15.0-1

Although Westinghouse has proposed COL Information Item 15.0-1, the BLN application does not address this item. Therefore, the staff cannot complete its evaluation until this information is provided. This is **Open Item 15.0-1.**

Supplemental Request:

As a follow-up item, the NRC requested that the four items from the Safety Evaluation Report for use of the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM) be addressed. The SER states:

"The ER recommended that each licensee will submit, as part of the power uprate package, a detailed accounting of the uncertainties applicable to the licensed facility, and will maintain, as part of the plant design documents, the LEFM calibration and other data justifying the proposed power uprate. In addition to the guidelines outlined in ER-80P and ER-157P, the following requirements shall be addressed by licensees referencing ER-157P in their request for a power uprate..."

These items are:

1. The licensee should discuss the maintenance and calibration procedures that will be implemented with the incorporation of the LEFM. These procedures should include processes and contingencies for an inoperable LEFM and the effect on thermal power measurement and plant operation.

2. For plants that currently have LEFM installed, the licensee should provide an evaluation of the operational and maintenance history of the installation and confirm that the installed instrumentation is representative of the LEFM system, and bounds the analysis and assumptions set forth in ER-80P.
3. The licensee should confirm that the methodology used to calculate the uncertainty of the LEFM in comparison to the current feed water instrumentation is based on accepted plant setpoint methodology (with regard to the development of instrument uncertainty). If an alternate methodology is used, the application should be justified and applied to both venturi and the LEFM for comparison.
4. Licensees for plant installations where the LEFM was not installed with flow elements calibrated to a site-specific piping configuration (flow profiles and meter factors not representative of the plant-specific installation), should provide additional justification for use. This justification should show either that the meter installation is independent of the plant-specific flow profile for the stated accuracy, or that the installation can be shown to be equivalent to known calibrations and the plant configuration for the specific installation, including the propagation of flow profile effects at higher Reynolds numbers. Additionally, for previously installed and calibrated LEFM, the licensee should confirm that the piping configuration remains bounding for the original LEFM installation and calibration assumptions.

SNC Response:

The measurement of the AP1000 reactor thermal power will be performed using a standard secondary side heat balance approach. This heat balance utilizes steam, feedwater, and steam generator blowdown enthalpies and flow rates as measured by plant process instrumentation. As a result, the AP1000 power measurement uncertainty will be based on the measurement of steamline pressure, feedwater pressure, feedwater temperature, feedwater flow, and steam generator blowdown flow. Industry experience with reactor power sensitivity studies has shown that the reactor power measurement uncertainty is significantly affected by the calculation of feedwater flow. Therefore, to facilitate measurement of reactor power with an uncertainty of 1%, the plant operating instrumentation selected for feedwater flow is the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM) ultrasonic flow measurement (UFM) instrumentation.

The Caldon CheckPlus™ LEFM system has been previously approved by the NRC for supporting the 1% power measurement uncertainty. See Caldon Engineering Report (ER)-80P, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM Check™ System," and the associated Safety Evaluation dated March 8, 1999 (ADAMS Accession No. 9903190065 – legacy library). ER-80P was supplemented by Caldon ER-157P, "Basis for a Power Uprate With the LEFM Check™ or LEFM CheckPlus™ System," and the associated NRC Safety Evaluation dated December 20, 2001 (ADAMS Accession No. ML013540256). The NRC reviewed and approved ER-80P and ER-157P again on July 5, 2006 (ADAMS Accession No. ML061700222), as part of its generic assessment of the hydraulic aspects of ultrasonic flow measurement application. (Note that Caldon, Inc. is now a part of the Measurement Systems Division of Cameron International Corporation ("Cameron"). The name "Caldon" continues to be used in describing their UFM instrumentation.) The four items from the Safety Evaluation Report for use of the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM) are repeated and addressed below.

A statement is added to FSAR subsection 15.0.3.2 to identify that the actual selected plant operating instrumentation uncertainties are documented to calculate a power calorimetric uncertainty and confirm that the uncertainty assumed for the initial reactor power in the safety analysis bounds the calculated calorimetric values, and to provide the appropriate administrative

controls. An ITAAC is proposed to confirm that the instrumentation indicated above has been installed in the plant and a License Condition is proposed to provide confirmation that the appropriate administrative controls are in place. Additionally, the new AP1000 COL information item is addressed as shown in the COL Application Revisions section below. The identified COLA revisions will be included in a future application revision.

Information to address the Safety Evaluation Report conditions for ER-157P Revision 5 regarding use of the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM)

Each of the four items from the Caldon SER is repeated below and addressed immediately following the item.

1. The licensee should discuss the maintenance and calibration procedures that will be implemented with the incorporation of the LEFM. These procedures should include processes and contingencies for an inoperable LEFM and the effect on thermal power measurement and plant operation.

AP1000 COL application

Implementation of the Leading Edge Flow Meter (LEFM) includes developing the necessary procedures and documents required for maintenance and calibration of the new Caldon LEFM CheckPlus™ System. Plant procedures are to be developed to incorporate Caldon's maintenance and calibration requirements prior to declaring the Caldon LEFM CheckPlus™ System operational. The incorporation of, and continued adherence to, these requirements provide proper maintenance and calibration of the Caldon LEFM CheckPlus™ System.

System maintenance and contingency plans for operation of the plant with the Caldon LEFM CheckPlus™ out of service are described below.

Maintenance Plans

Calibration and maintenance for the Caldon LEFM CheckPlus™ System hardware and instrumentation is performed using procedures based on appropriate Caldon LEFM CheckPlus™ technical manuals. Other calorimetric process instrumentation and computer points (e.g., flow coeffecients) are also maintained and periodically calibrated in accordance with procedures. Preventative maintenance (PM) tasks are periodically performed within the plant control system and support systems to provide continued reliability. The work is planned and executed in accordance with the plant work control processes and procedures.

The LEFM CheckPlus™ System software configuration is also maintained in accordance with plant procedures developed for that purpose. The plant control system software configuration is maintained in accordance with a change control process which includes verification and validation of changes to software configuration. Configuration of the hardware associated with the LEFM CheckPlus™ System and the calorimetric process instrumentation is maintained in accordance with plant configuration control processes.

Contingency Plans

Plant instrumentation that affects the power calorimetric, including the Caldon LEFM CheckPlus™ inputs, are monitored by plant system engineering personnel. These instruments are included in the plant PM program for periodic calibration. Problems that are detected are documented per the plant corrective action process and necessary resolution actions are

planned and implemented. Corrective action procedures, which provide compliance with the requirements of 10 CFR Part 50, Appendix B, include instructions for notification of deficiencies and error reporting.

In addition, an administrative control is provided for the operation of the plant at power with the device out-of-service. The controls provide for de-rating the plant output to power levels consistent with a 2% plant uncertainty. With the AP1000 operating at 100% load with 1% uncertainty, a de-rating to 99% would permit for a 2% safety margin to be maintained.

Monitoring of plant calorimetric power with the device out-of-service is supported by the use of the feedwater venturi elements installed in each feedwater line, as discussed in the AP1000 Design Control Document (DCD) Subsection 10.4.7.5.

A failure of an LEFM would not leave the plant in a condition where steady-state operation would be immediately compromised since it would not directly impact the calibration of the nuclear instrumentation utilized for power level related trips or safety system actuations. Thus, procedures require confirmation of the availability of alternate instrumentation (i.e., the feedwater venturi instrumentation) and initiation of the above described reduction in power within 48 hours. The LEFM out-of-service would result in a continuous de-rating of the unit until restored to service and thus, plant management would not allow this condition to exist for an extended period if restoration is possible. Note however, that once the plant is in a de-rated condition, continued steady-state operation in this condition (while not economically desired) would present no safety concern.

2. For plants that currently have LEFM installed, the licensee should provide an evaluation of the operational and maintenance history of the installation and confirm that the installed instrumentation is representative of the LEFM system, and bounds the analysis and assumptions set forth in ER-80P.

AP1000 COL application

This application represents construction of a new plant with no previously installed LEFM equipment. As such, this item is not applicable.

3. The licensee should confirm that the methodology used to calculate the uncertainty of the LEFM in comparison to the current feed water instrumentation is based on accepted plant setpoint methodology (with regard to the development of instrument uncertainty). If an alternate methodology is used, the application should be justified and applied to both venturi and the LEFM for comparison.

AP1000 COL application

The AP1000 is a new plant design and, as a result, the LEFM will not be installed with pre-existing feedwater instrumentation and associated setpoint methodology. Therefore, compliance with an existing plant setpoint methodology is not applicable. To meet this requirement, the AP1000 setpoint methodology includes power uncertainty values bounded by the licensing basis (Reference NRC Safety Evaluation August 2007 – ADAMS Accession No. ML072260620).

The uncertainty of the LEFM is bounded by the uncertainty input values used in the AP1000 plant setpoint methodology. The documentation of the AP1000 calorimetric power is consistent with the revised thermal design procedure (RTDP).

4. Licensees for plant installations where the LEFM was not installed with flow elements calibrated to a site-specific piping configuration (flow profiles and meter factors not representative of the plant-specific installation), should provide additional justification for use. This justification should show either that the meter installation is independent of the plant-specific flow profile for the stated accuracy, or that the installation can be shown to be equivalent to known calibrations and the plant configuration for the specific installation, including the propagation of flow profile effects at higher Reynolds numbers. Additionally, for previously installed and calibrated LEFM, the licensee should confirm that the piping configuration remains bounding for the original LEFM installation and calibration assumptions."

AP1000 COLA application

This application represents construction of a new plant with no previously installed flow metering equipment. The AP1000 main feedwater flow measurement instrumentation, consistent with the use of normalized flow meters, is required to be calibrated at a certified test laboratory in hydraulic model geometry consistent with AP1000 plant design. The LEFM commissioning process (i.e., installation acceptance testing) confirms that the actual instrument performance is consistent with the assumptions of the uncertainty calculation. Therefore, additional justification for use of the LEFM is not required.

Second Supplemental Request:

As a follow-up item, the NRC requested that the five items from the recent Safety Evaluation Report for use of the Caldon LEFM be addressed. The SER states:

"The NRC staff has found that Engineering Report ER-157P, Revision 8, is acceptable for referencing in licensing applications for a measurement uncertainty recapture application for power uprate using the leading edge flow meter (LEFM) Check or LEFM CheckPlus™ system for feedwater flow and temperature measurements to the extent specified and under the limitations delineated in the TR and in the enclosed final SE."

Information to address the Safety Evaluation Report conditions for ER-157P Revision 8 regarding use of the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM)

Each of the five items from the Caldon SER is repeated below and addressed immediately following the item.

1. Continued operation at the pre-failure power level for a pre-determined time and the decrease in power that must occur following that time are plant-specific and must be acceptably justified.

AP1000 COL application

The AP1000 obtains measurement of feedwater flow using two different instrumentation technologies installed in series; a UFM and an ASME PTC-19.5 compliant venturi, respectively. Failure of the UFM will result in the use of the feedwater venturi as the input into the calorimetric calculation.

Details concerning the reduction in plant power and time limitations are discussed in the response to item 1 of the Revision 5 SER criteria provided in the response above under the heading "Contingency Plans." The applicability and magnitude of the contingency actions are

justified based on the application of a venturi-based calorimetric uncertainty and experience with comparable LEFM installations that have been reviewed and approved by the NRC staff.

2. A CheckPlus operating with a single failure is not identical to an LEFM Check. Although the effect on hydraulic behavior is expected to be negligible, this must be acceptably quantified if a licensee wishes to operate using the degraded CheckPlus at an increased uncertainty.

AP1000 COL application

A degraded UFM resulting in an instrument uncertainty greater than the values assumed in the AP1000 calorimetric uncertainty calculation will be considered as failed and subject to compensatory actions as discussed in LEFM installation criteria #1 (see item 1 of the above section titled "Information to address the Safety Evaluation Report conditions for ER-157P Revision 5 regarding use of the Caldon CheckPlus™ Leading Edge Flow Meter (LEFM)."

3. An applicant with a comparable geometry can reference the above Section 3.2.1 finding to support a conclusion that downstream geometry does not have a significant influence on CheckPlus calibration. However, CheckPlus test results do not apply to a Check and downstream effects with use of a CheckPlus with disabled components that make the CheckPlus comparable to a Check must be addressed. An acceptable method is to conduct applicable Alden Laboratory tests.

AP1000 COL application

The AP1000 feedwater flow measurement instrumentation is located in piping with downstream geometry more favorable than the arrangements referenced in Section 3.2.1 of the SER. Therefore, the effects of downstream piping geometry are not considered to have a significant influence on the accuracy of the UFM.

Failure of a single plane of transducers shall be tested as part of the calibration process and documented in the calibration report to support the resolution of any identified Check vs. CheckPlus™ hydraulic effects.

4. An applicant that requests a MUR with the upstream flow straightener configuration discussed in Section 3.2.2 should provide justification for claimed CheckPlus uncertainty that extends the justification provided in Reference 17. Since the Reference 17 evaluation does not apply to the Check, a comparable evaluation must be accomplished if a Check is to be installed downstream of a tubular flow straightener.

AP1000 COL application

The AP1000 UFM instrumentation installation does not utilize an upstream flow straightener. Therefore, this conclusion is not applicable to the AP1000 design.

5. An applicant assuming large uncertainties in steam moisture content should have an engineering basis for the distribution of the uncertainties or, alternatively, should ensure that their calculations provide margin sufficient to cover the differences shown in Figure 1 of Reference 18.

AP1000 COL application

Topical Report ER-157P, Revision 8, contains justification for an overall power uncertainty of 0.4% with the use of a CheckPlus™ UFM. With this high accuracy, the use of an assumed steam separation/dryer performance will result in a large contribution to the overall power uncertainty.

However, it should be noted that this AP1000 application is for 1% overall power uncertainty. The result of this application of the LEFM at a lower accuracy is that the assumed steam separator/dryer performance becomes less of a relative contribution to the overall uncertainty. Furthermore, an engineering basis for the AP1000 moisture content assumption is contained in the calorimetric uncertainty calculation, which is documented to support the plant setpoint methodology as discussed in the response to LEFM installation criteria #3.

Also, note that the R-COLA submitted in August 2010 included revisions identified in the May 21, 2010 revision of this response. As such the Application Revisions section changes shown below are based on that version of the R-COLA Part 2 (Rev. 3) and Part 10 (Rev. 3), and supersede the revisions provided in Supplement 2 of this response on August 6, 2010.

This response is expected to be STANDARD for the S-COLAs.

Associated VEGP COL Application Revisions:

1. COLA Part 2 (Rev. 3), FSAR Chapter 15, Section 15.0.3.2, will be revised from:

   The actual selected plant operating instrumentation has documented instrumentation uncertainties to calculate a primary power calorimetric uncertainty that confirms the uncertainty assumed for the initial reactor power in the safety analysis bounds the calculated calorimetric values.

   To read:

   The plant operating instrumentation selected for feedwater flow measurement is a Caldon [Cameron] LEFM CheckPlus™ System (Reference 201). This selected plant operating instrumentation has documented instrumentation uncertainties to calculate a power calorimetric uncertainty that confirms the 1% uncertainty assumed for the initial reactor power in the safety analysis bounds the calculated calorimetric power measurement uncertainty values. This calculated calorimetric is done in accordance with a previously accepted Westinghouse methodology (Reference 202). Administrative controls implement maintenance and contingency activities related to the power calorimetric instrumentation.

2. COLA Part 2 (Rev. 3), FSAR Chapter 15, Section 15.0, will be revised to add the following new subsection:

   15.0.16 References

Add the following text to the end of DCD Subsection 15.0.16.

201. Final Safety Evaluation for Cameron Measurement Systems Engineering Report ER-157P, Revision 8, "Caldon Ultrasonics Engineering Report ER-157P, 'Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM Check or Checkplus™ System'," (TAC No. ME1321). August 16, 2010, ADAMS Accession No. ML102160694.

202. Final Safety Evaluation for Beaver Valley Power Station, Unit Nos. 1 and 2 (BVPS-1 and 2) – Issuance of Amendment re: 1.4-Percent Power Uprate and Revised BVPS-2 Heatup and Cooldown Curves. September 24, 2001, ADAMS Accession No. ML012490569.

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3. COLA Part 10 (Rev. 3), Proposed License Conditions, LC#2, COL Holder Items, COL Item No. 15.0-1, will be revised from:

15.0-1	Documentation of Plant Calorimetric Uncertainty Methodology	15.0.15.1	Prior to initial fuel load

Confirm the plant operating instrumentation installed for feedwater flow measurement is a Caldon [Cameron] LEFM CheckPlus™ System.

To read:

15.0-1	Documentation of Plant Calorimetric Uncertainty Methodology	15.0.15.1

Note - addressed by proposed ITAAC Table 2.5.4-2, item 4.

4. COLA Part 10, Proposed License Conditions, LC#6, Operational Program Readiness, will be revised to include a new line item for availability of documentation of plant calorimetric uncertainty methodology as follows (where # is the next appropriate letter designation):

#. the availability of documented instrumentation uncertainties to calculate a power calorimetric uncertainty, prior to initial fuel load.

#. the availability of administrative controls to implement maintenance and contingency activities related to the power calorimetric uncertainty instrumentation, prior to initial fuel load.

5. COLA Part 10, Appendix B, will be revised to include a new Plant-Specific ITAAC line item for COL item 15.0-1 as follows:

Add the following information to the information provided in the referenced DCD Tier 1 Section 2.5.4, as a new item 4 under the Design Description section:

4. The plant operating instrumentation installed for feedwater flow measurement is one that has been specifically approved by the NRC; the power calorimetric uncertainty calculation includes uncertainties for the associated instrumentation based on an NRC approved methodology; and the calculated calorimetric values are bounded by the uncertainty value assumed for the initial reactor power in the safety analysis.

6. COLA Part 10, Appendix B, will be revised to include a new Plant-Specific ITAAC line item for COL item 15.0-1 as follows:

Add the following information to the information provided in the referenced DCD Tier 1 Section 2.5.4, as a new, final line item in Table 2.5.4-2:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. The plant calorimetric uncertainty and plant instrumentation performance is bounded by the 1% calorimetric uncertainty value assumed for the initial reactor power in the safety analysis.	Inspection will be performed of the plant operating instrumentation installed for feedwater flow measurement, its associated power calorimetric uncertainty calculation, and the calculated calorimetric values.	a) The as-built system takes input for feedwater flow measurement from a Caldon [Cameron] LEFM CheckPlus™ System; b) the power calorimetric uncertainty calculation documented for that instrumentation is based on an accepted Westinghouse methodology and the uncertainty values for that instrumentation are not lower than those for the actual installed instrumentation; and c) the calculated calorimetric power uncertainty measurement values are bounded by the 1% uncertainty value assumed for the initial reactor power in the safety analysis.