AREVA

November 2, 2012
NRC:12:056

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

Response to an RAI on Topical Report ANP-10301(P), Revision 0, "Statistical Universal Power Reconstruction with Fixed Margin Technical Specifications"

Ref. 1: Letter, Ronnie L. Gardner (AREVA NP Inc.) to Document Control Desk (NRC), "Request for Review and Approval of ANP-10301(P), 'Statistical Universal Power Reconstruction with Fixed Margin Technical Specifications'," NRC:09:096, September 15, 2009.

AREVA NP Inc. (AREVA NP) requested the NRC's review and approval of the topical report ANP-10301(P) Revision 0, in Reference 1. During an NRC meeting on the topical report on August 7, 2012, the NRC provided a Request for Additional Information (RAI) regarding the report. The complete responses to the RAI are enclosed with this letter as Attachment A.

AREVA NP considers some of the material contained in the attachment to be proprietary. As required by 10 CFR 2.390(b), an affidavit is enclosed to support the withholding of the information from public disclosure. Proprietary and non-proprietary versions of the attached are provided.

If you have any questions related to this submittal, please contact Ms. Gayle F. Elliott, Product Licensing Manager. She may be reached by telephone at 434-832-3347 or by e-mail at gayle.elliott@areva.com.

Sincerely,

Pedro Salas
Director, Regulatory Affairs
AREVA NP Inc.

Enclosures

cc: J.G. Rowley
Project 728

T007
NRR

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for AREVA NP Inc. (AREVA NP) and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in the attachment to a letter to the NRC from Pedro Salas (AREVA NP) to Document Control Desk (NRC) entitled "Response to an RAI on Topical Report ANP-10301(P), Revision 0, 'Statistical Universal Power Reconstruction with Fixed Margin Technical Specifications'," dated November 2, 2012 and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information. The proprietary information is identified by its enclosure within pairs of brackets ("[ ]").

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be

withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in this Document is considered proprietary for the reasons set forth in paragraphs 6(b) and 6(c) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me this 2nd

day of November 2012.

Kathleen A. Bennett

Kathleen Ann Bennett
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 8/31/15
Reg. # 110864

KATHLEEN ANN BENNETT
Notary Public
Commonwealth of Virginia
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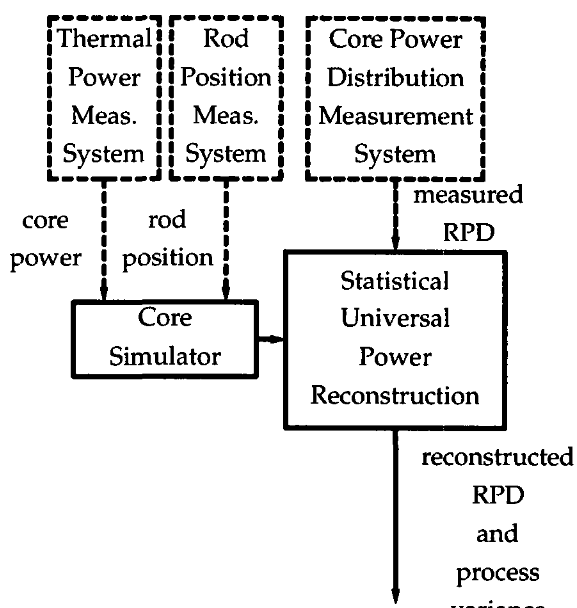
My Commission Expires Aug 31, 2015

SUPR-FMTS Additional Information

1 What further work is required for implementation in a particular plant?

One or more currently approved core relative power distribution (RPD) measurement systems will be used to provide periodic power distribution measurements to the SUPR-FMTS system [1]. These must be systems with prior approval, including a quantified measurement uncertainty. Examples of currently existing systems include Movable Incore Detector (MIDs) and Fixed Incore Detectors (FICs). The methods and software to process the detector signals to produce the measured RPDs in instrumented locations are previously approved. The SUPR-FMTS system also uses other measured plant parameters such as thermal power level and control rod position, as shown in Figure 1.

Figure 1 — The Statistical Universal Power Reconstruction Portion of the SUPR-FMTS System



For the case where the core power distribution is infrequently measured, such as with Movable Incore Detectors, the excore flux detector and fuel assembly exit thermocouple measurements are compared with the values estimated by the SUPR system to obtain a local power penalty. This process is called the RPD Check methodology. This will provide for operation without flux maps for periods beyond the current 31 day Technical Specification limit.

The final portion of the SUPR-FMTS System is the Fixed Margin Technical Specification methodology. This methodology was previously approved [2] for use as part of the Technical Specifications for B&W-designed plants to ensure that the LCO core power distribution design limits are maintained during operation of the plant. This approval includes Technical Specification methods to deal with computer and software system failure. These methods have been incorporated into the example Standard Technical Specifications provided in Appendix B of the Topical Report and expanded to apply to B&W, Westinghouse, and CE-designed plants. The total SUPR-FMTS System is depicted in Figure 2.

To implement SUPR-FMTS for a given plant, an LAR must be submitted and approved which contains the quantification of the total SUPR-FMTS system uncertainty for that specific core and instrumentation geometry. Since incore detectors can fail during operation, the uncertainty quantification will cover a sufficient range of failures to support continued monitoring in anticipated conditions. [ ] Any associated spatial limits on failures, such as having no detectors within a certain distance of every limiting node in the core, will be specified as system operational requirements to assure that the total system uncertainty, which is quantified before the cycle begins operation, will provide the required protection. On the other hand, if more than one incore RPD measurement system, such as a partial incore system, is used at the same time, any improvement in RPD monitoring will be reflected in the SUPR-FMTS System total system uncertainty, which will be documented in the LAR.

The measurement systems required for SUPR-FMTS implementation are those above the dotted line in Figure 2 and listed in Table 1.

Table 1 — Measurement Systems Required by SUPR-FMTS

System	Examples
Frequent Incore Flux Measurement	Fixed Self-Powered Neutron Detectors
or	
Infrequent Incore Flux Measurement	Movable Incore Detectors
and	
Fuel Assembly Exit Thermocouples	—
and Excore Flux Detectors	
and Partial FIC (optional)	
Core Power Level	Core Thermal Power
Control Rod Position	Control Rod Position Indicators

It is noted that all of the measurements are derived from systems that either are previously approved for use or are justified in the LAR and that their uncertainties are quantified. These quantified uncertainties, along with the specific geometries and anticipated fuel loadings are used in the Monte Carlo code which models the SUPR-FMTS System, as described in the Topical Report, to quantify the total system uncertainty. [

] The results will be displayed to the plant operator in a manner that makes any corrective action that is required to keep the local powers within limits intuitive. This will be done through operator displays, which have been presented in the previously approved FMTS Topical Report [2] and which will be presented in the LAR. In addition, the detailed reconstructed RPDs and variances will be available to the operators and Reactor Engineers.

Finally, several cycles of similar operation will be evaluated with the SUPR-FMTS System to demonstrate that it provides adequate monitoring and also does not negatively impact operation. In summary, the LAR will contain the information listed in Table 2.

Table 2 — Components of the LAR Required for Implementation of SUPR-FMTS

LAR Item	Description
Uncertainty Analysis	Based on Monte Carlo analysis using methodology described in Chapter 6 of ANP-10301P using system uncertainties listed in Table 1.
Measurement System Uncertainties	Uncertainties for the systems listed in Table 1, either previously approved for the specific plant or the justification for newly derived uncertainties.
SUPR-FMTS Total System Uncertainty	This will be provided as a function of incore flux detector failures with upper limits on the amount and/or geometric configuration of the operable detectors.
Proof of Concept	The results of simulating the operation of multiple fuel cycles with the SUPR-FMTS will be provided to verify operation.
Topical Report Modifications or Corrections	Any modifications or corrections to the Topical Report will be provided and justified.

2 Explain the RPD Check Methodology in More Detail.

With core RPD measurement systems that provide infrequent measurements, such as the MID system, the historical approach has been to allow operation for up to 31 days until the next flux map is required. These systems, being mechanical in nature, can be susceptible to mechanical problems. Because of this, and to avoid wear on the system, the plant operators desire to be able to justify operation beyond this 31 day requirement.

The RPD Check methodology uses the measurements from the excore flux detectors and the fuel assembly exit thermocouples, which are measured on a frequent basis, to provide information that can be used to justify such continued operation. The change in the excore flux detector imbalance is an indication of a change in the power peaking in the core. However, these detectors are mainly directly responsive to the peripheral fuel assemblies. The thermocouples provide information that can produce a radial power map. It was judged that constructing a three-dimensional power distribution from the excore and thermocouple data would lead to large uncertainties. Therefore, the method that was chosen is to estimate the excore and thermocouple readings from the reconstructed RPDs and variances and then to compare them to the measured values. This approach provides frequently measured information about both axial and radial changes to the power distribution with only infrequent use of the MIDs. [

]

This approach is considered to provide adequate penalty for the following reasons. First, the change in local power peaking is presently adequately correlated to the incore imbalance (using what have been called flyspeck plots) to establish all of the incore- and excore-imbalance-based Technical Specification Limits. This is necessary to ensure the applicability of the excore-based Technical Specification limits and trip setpoints. Since these gain factors ensure that the excore-indicated imbalance is always adequately calibrated with the incore-indicated imbalance, they ensure that [

] This then ensures that the adjusted reconstructed RPDs will be equal to or greater than the actual RPDs. Second, any local phenomena, such as rod mis-alignment, which may cause more local power peaking increase than is indicated by a flux detector which is one or more fuel assemblies distant from the peaking anomaly, is quantified in the analysis of the SUPR-FMTS total system uncertainty and is therefore addressed by that uncertainty factor. Third, thermocouple failures are modeled in the uncertainty analysis so that any required additional penalty is quantified.

This methodology will be tested for the specific plant core, instrument geometry, and fuel cycle loadings and will be reported in the LAR. This will confirm that the methodology is adequate to provide the required protection for a specific plant type geometry, fuel loading, and measurement system. The testing will consist of using operational data from previous cycles and comparing the results of the cycle flux map data with results generated assuming that no flux map data is available to show that the RPD Check methodology provides the required protection.

In actual operation, as time passes since the last incore flux map, if the required adjustment increases, the power peaking will increase and become closer to the limiting power peaking criteria. The operator will then take a flux map, which may re-normalize the SUPR-FMTS system to the actual core power peaking. If this does not resolve the problem, however, the cause of the anomaly can be determined and eliminated. In the unlikely event that none of these measures resolves the problem, the power will then be reduced to increase the distance to the power peaking limiting criteria.

References

1. R. Kochendarfer, "Statistical Universal Power Reconstruction with Fixed Margin Technical Specifications," ANP-10301P, AREVA, Inc. (September 2009).
2. R.A. Kochendarfer, C.T. Rombough, and A.Y. Cheng, "Fixed Margin Technical Specifications," BAW-10158P-A, Babcock and Wilcox (August 1986).