ATTACHMENT 2

MILLSTONE UNIT 2 CYCLE 21 PEAKING FACTOR UNCERTAINTY ANALYSIS FOR ICI DETECTOR MISALIGNMENT (NON-PROPRIETARY)

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

AREVA

CALCULATION SUMMARY SHEET (CSS)

Document No. 32 - 9149958 - 001 Safety Related: ☒ Yes ☐ No

Title Millstone Unit 2 Cycle 21 Peaking Factor Uncertainty Analysis for ICI Detector Misalignment

PURPOSE AND SUMMARY OF RESULTS:

Per References 2 and 10, forty-five (45) ICI (Incore Instrumentation) guide tubes were replaced during refueling outage 2R19 in preparation of the startup of Cycle 20. Twenty-six (26) guide tubes were cut 1.375" too short. The location of the 26 shortened guide tubes is identified in Reference 2, PDF page 27 of 27 total. As a result of the guide tubes being cut too short, the ICI's in these locations will have interference which prevents the ICI from reaching its normal height (i.e. the rhodium detector string will bottom out in the tube).

NOTE: This document is the non-proprietary version of 32-9149958-001.

The purpose of this analysis is to evaluate the expected impact on INPAX-II based measured $F_{\Delta H}$ and F_Q due to the resultant detector string offset of +1.375 inches for 26 of 45 total detector locations. The resultant bias/penalty will be appropriately combined with the measurement uncertainties previously derived for $F_{\Delta H}$ and F_Q in order to determine if the total uncertainties bound [ ] respectively (Reference 3, Table 5.2).

This evaluation is based upon the Cycle 21 core design, thus the peaking factor uncertainties listed below are only valid for Cycle 21 operation.

The total uncertainty on $F_{\Delta H}$, including the impact of the offset ICI detector strings, remains bounded by the criteria of [ ] documented in Reference 3, Table 5.2.

Assuming the incore monitoring software for Cycle 21 operation will already include a [ ], uncertainty on the measured F_Q, an additional conservative penalty of 1.0025 will be applied for Cycle 21 operation.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
See Section 3.3	

THE DOCUMENT CONTAINS ASSUMPTIONS THAT SHALL BE VERIFIED PRIOR TO USE

☐ YES
☒ NO

Review Method: ☒ Design Review (Detailed Check)
☐ Alternate Calculation

Signature Block

[redacted]

Note: P/R/A designates Preparer (P), Reviewer (R), Approver (A);
LP/LR designates Lead Preparer (LP), Lead Reviewer (LR)

[redacted]

Record of Revision

[

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None

1.0 PURPOSE

Per References 2 and 10, forty-five (45) ICI (Incore Instrumentation) guide tubes were replaced during refueling outage 2R19 in preparation of the startup of Cycle 20. Twenty-six (26) guide tubes were cut 1.375" too short. The location of the 26 shortened guide tubes is identified in Reference 2, PDF page 27 of 27 total. As a result of the guide tubes being cut too short, the ICI's in these locations will have interference which prevents the ICI from reaching its normal height (i.e. the rhodium detector string will bottom out in the tube).

The purpose of this analysis is to evaluate the expected impact on INPAX-II based measured $F_{\Delta H}$ and F_Q due to the resultant detector string offset of +1.375 inches for 26 of 45 total detector locations. The resultant uncertainty/bias will be appropriately combined with the measurement uncertainties previously derived for $F_{\Delta H}$ and F_Q in order to determine if the total uncertainties bound [ ] respectively (Reference 3, Table 5.2).

2.0 SUMMARY OF KEY RESULTS

Per References 2 and 10, forty-five (45) ICI (Incore Instrumentation) guide tubes were replaced during refueling outage 2R19 in preparation of the startup of Cycle 20. Twenty-six (26) guide tubes were cut 1.375" too short. The location of the 26 shortened guide tubes is identified in Reference 2, PDF page 27 of 27 total. As a result of the guide tubes being cut too short, the ICI's in these locations will have interference which prevents the ICI from reaching its normal height (i.e. the rhodium detector string will bottom out in the tube).

The purpose of this analysis was to evaluate the expected impact on INPAX-II based measured $F_{\Delta H}$ and F_Q due to the resultant detector string offset of +1.375 inches for 26 of 45 total detector locations.

Total Uncertainty on $F_{\Delta H}$ (Including impact of offset ICI Detector Strings):

From Section 5.4.2, the maximum error in average assembly power (i.e. assembly power under-prediction) was calculated to be [ ]. From Reference 7, PDF page 37, the current one-sided, 95/95, total $F_{\Delta H}$ uncertainty for Millstone Unit 2 is [ ] (rounded up to [ ]. Hence, the **total uncertainty** on $F_{\Delta H}$, including the impact of the offset ICI detector strings is: [ ] or [ ]. **The total uncertainty on $F_{\Delta H}$, including the impact of the offset ICI detector strings, remains bounded by the criteria of [ ] documented in Reference 3, Table 5.2.**

Total Uncertainty on F_Q (Including impact of offset ICI Detector Strings):

From Reference 7, PDF page 37, the Millstone Unit 2 specific, one-sided, 95/95, total F_Q uncertainty for Millstone Unit 2 is [ ] and is bounded by [ ] in Reference 3, Table 5.2. Hence, [ ] margin exists to the criteria.

From Section 5.4.2, incorporating the impact of the offset ICI detector strings results in a maximum error in nodal power (i.e. nodal power under-prediction) of [ ] for Cycle 21 operation. Because this analysis was performed using "best-estimate" model for Cycle 21 operation, this under-prediction must be treated as a "bias" (or penalty) to the current total F_Q uncertainty. Classifying the under-prediction as a "bias" is a direct result of the under-prediction in nodal power occurring in "limiting" core locations.

[

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3.0 ANALYTICAL METHODOLOGY

3.1 Methodology

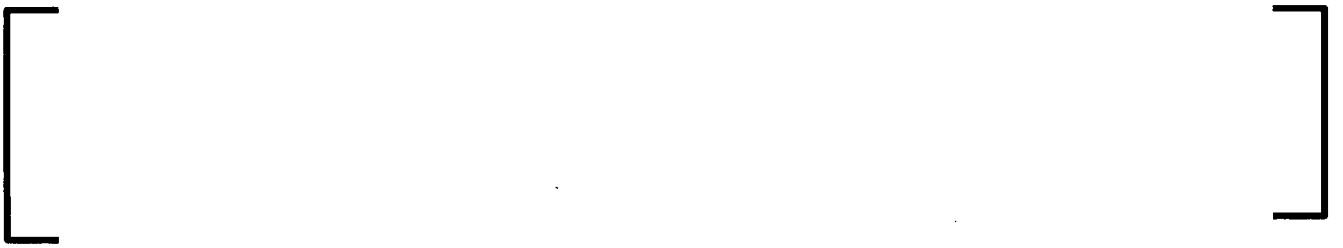
This analysis was performed consistent with the methodology prescribed in:

[ ]

The methodology is briefly summarized below:

[

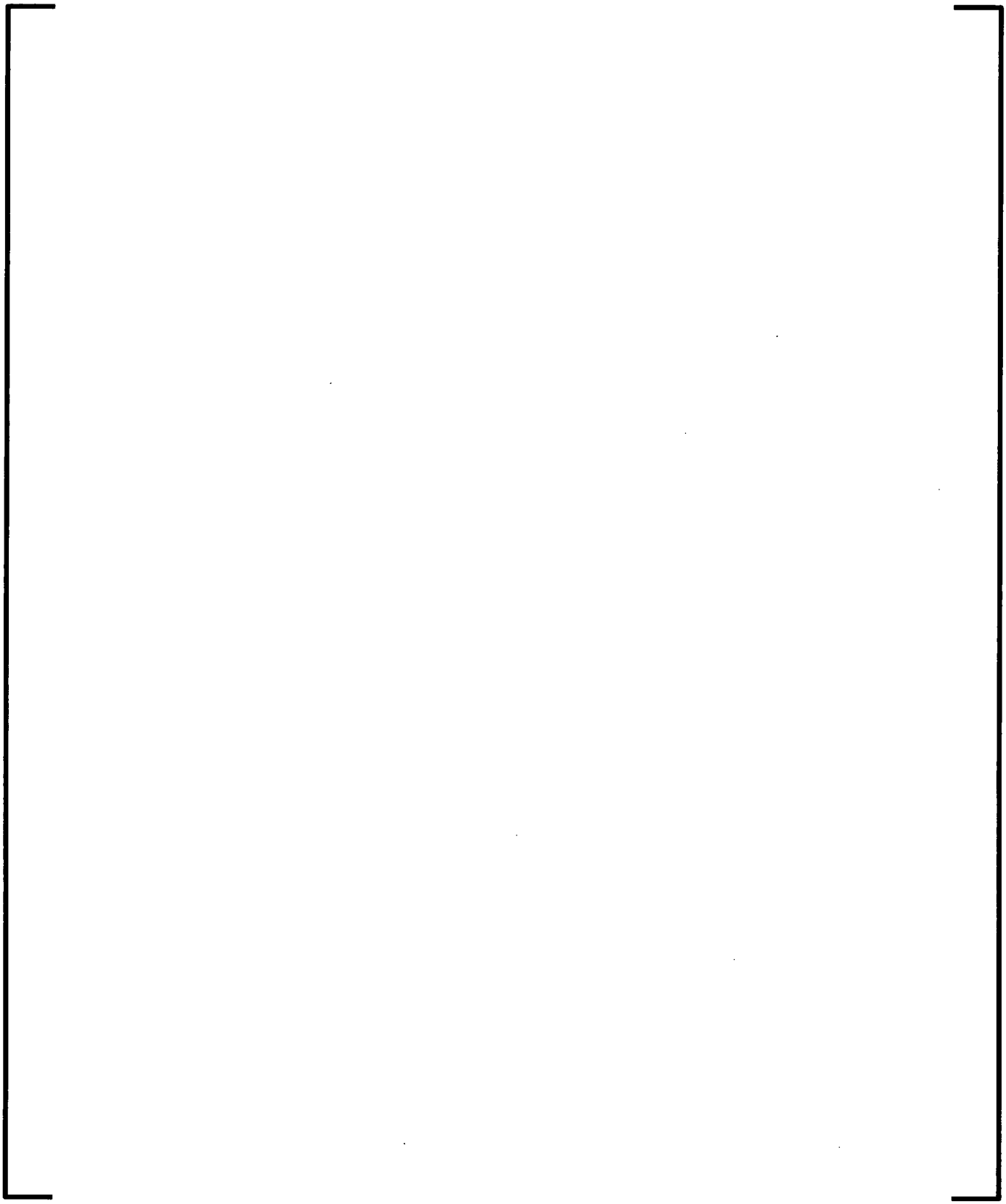
]

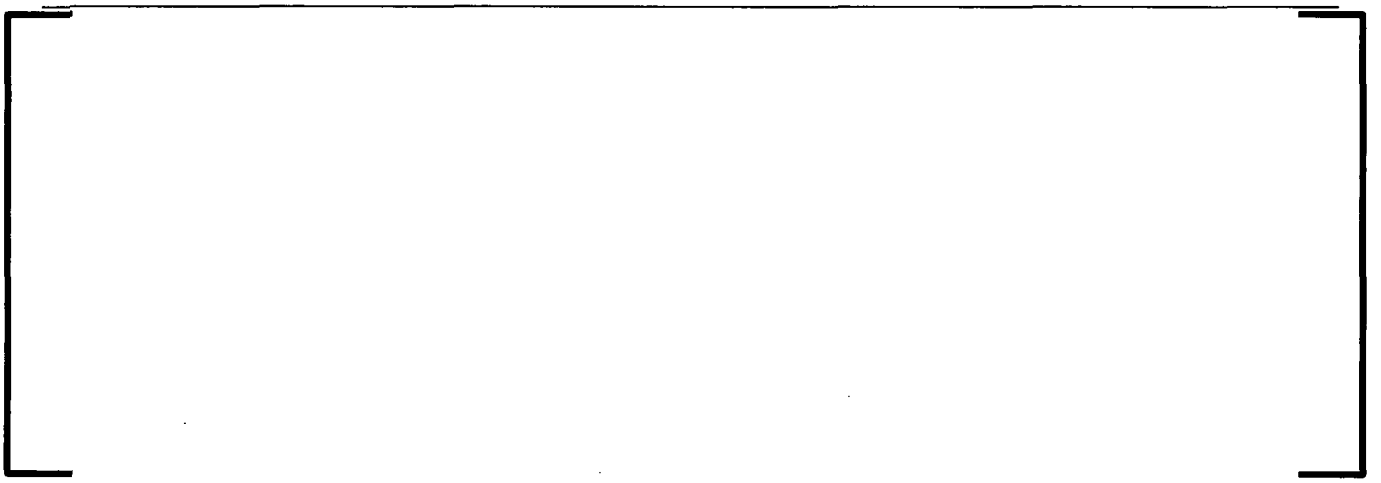


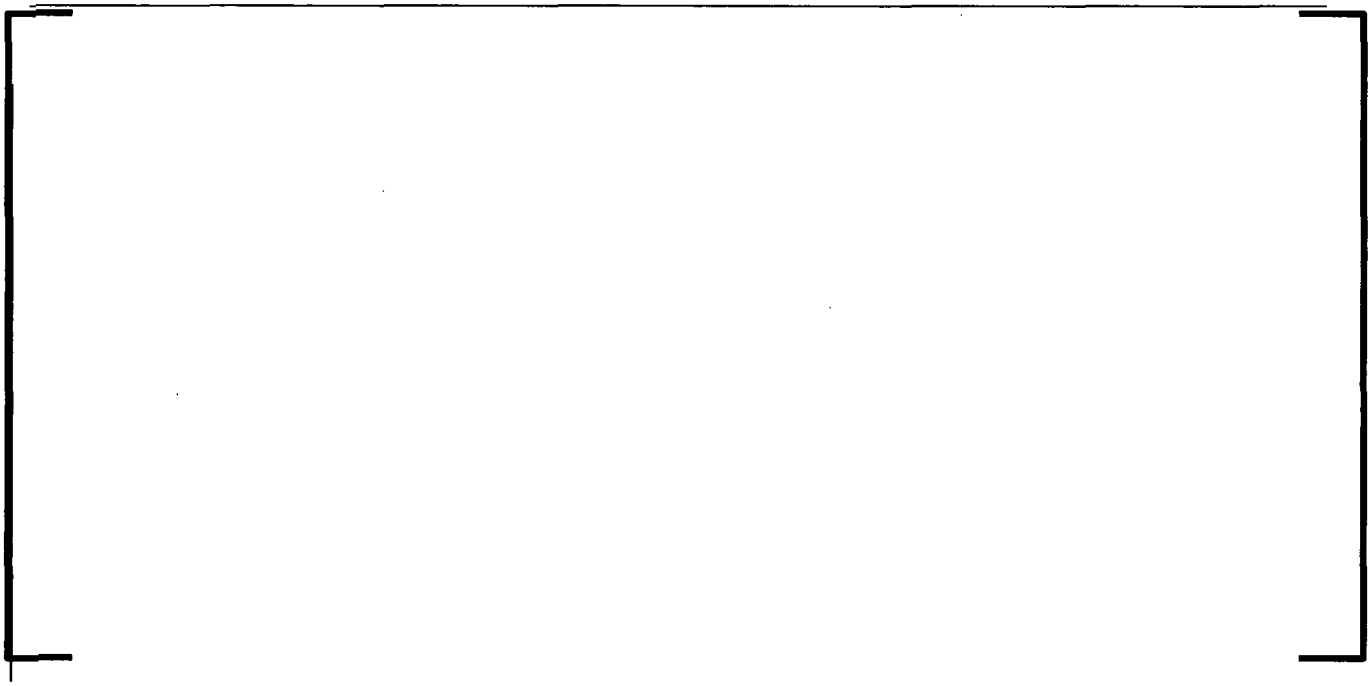
4.0 KEY ASSUMPTIONS

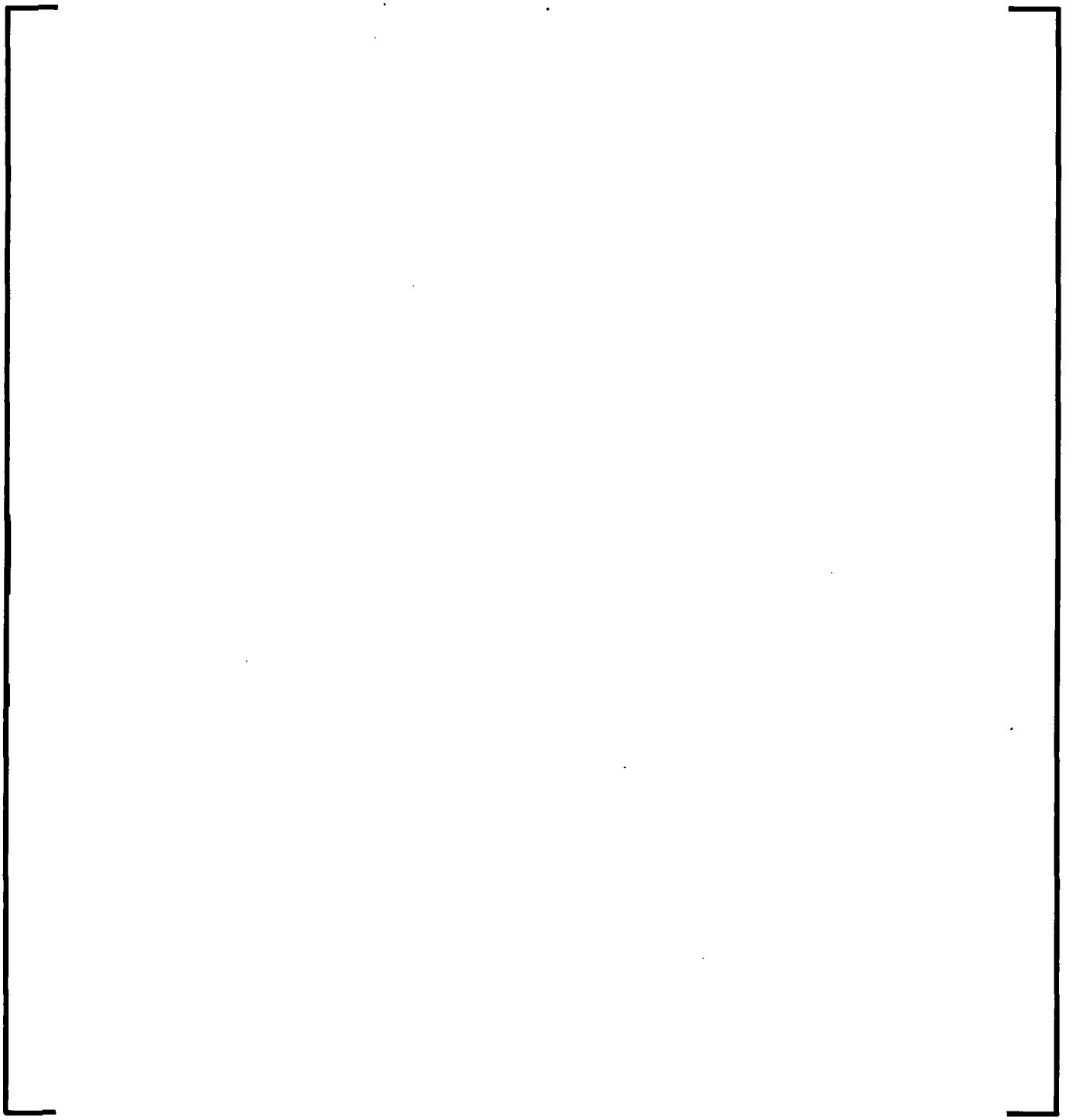
[redacted]

5.0 CALCULATIONS

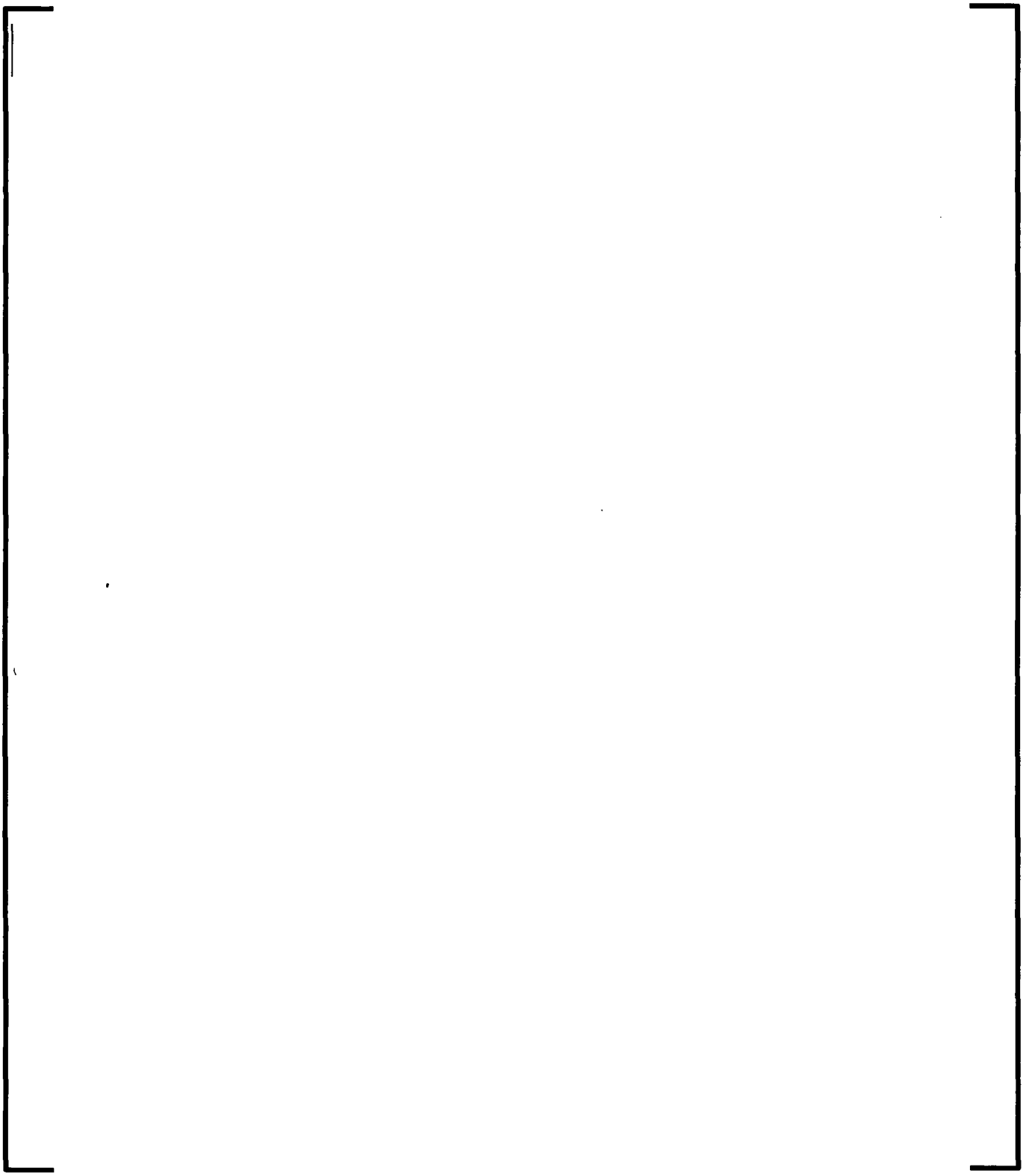


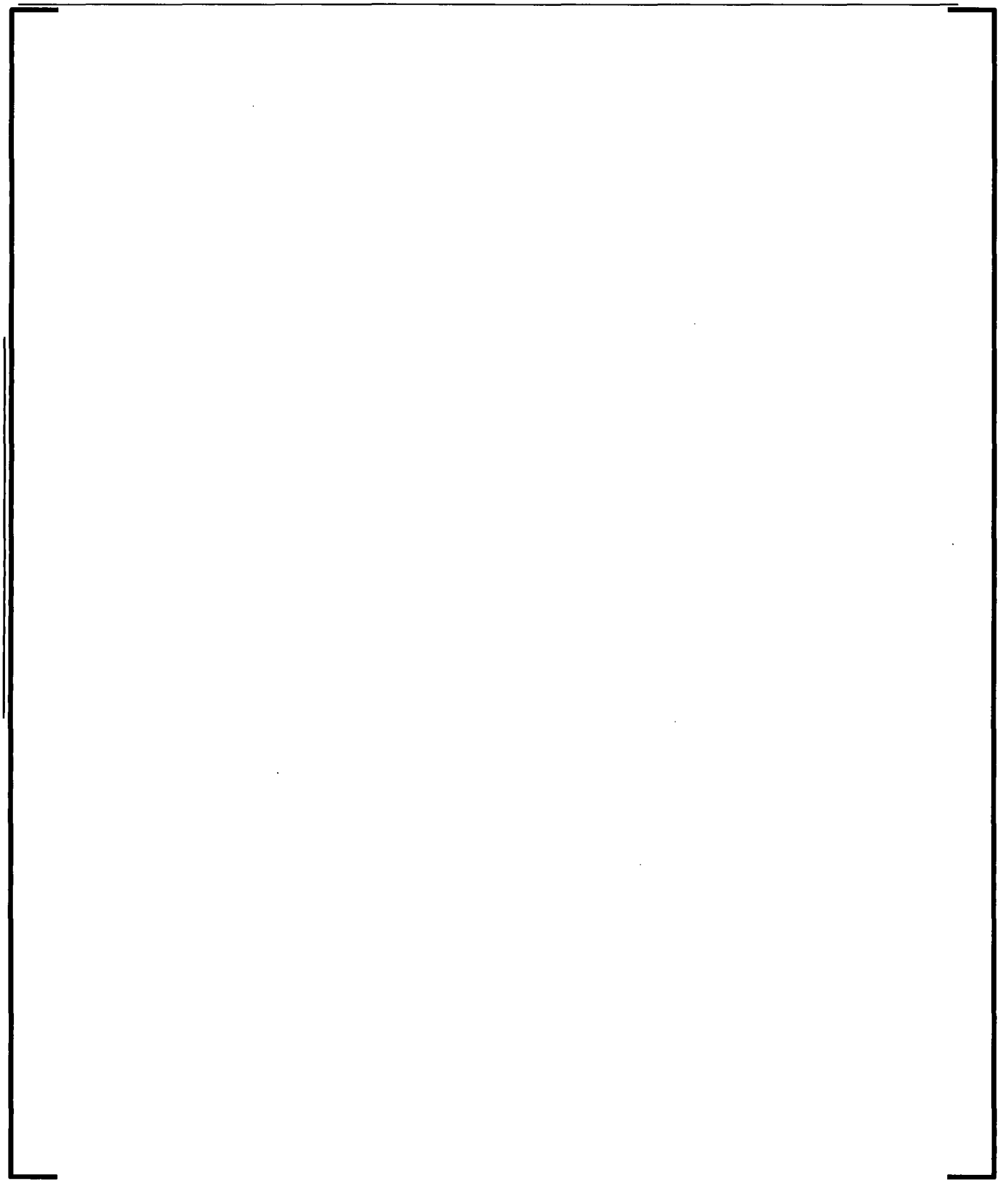


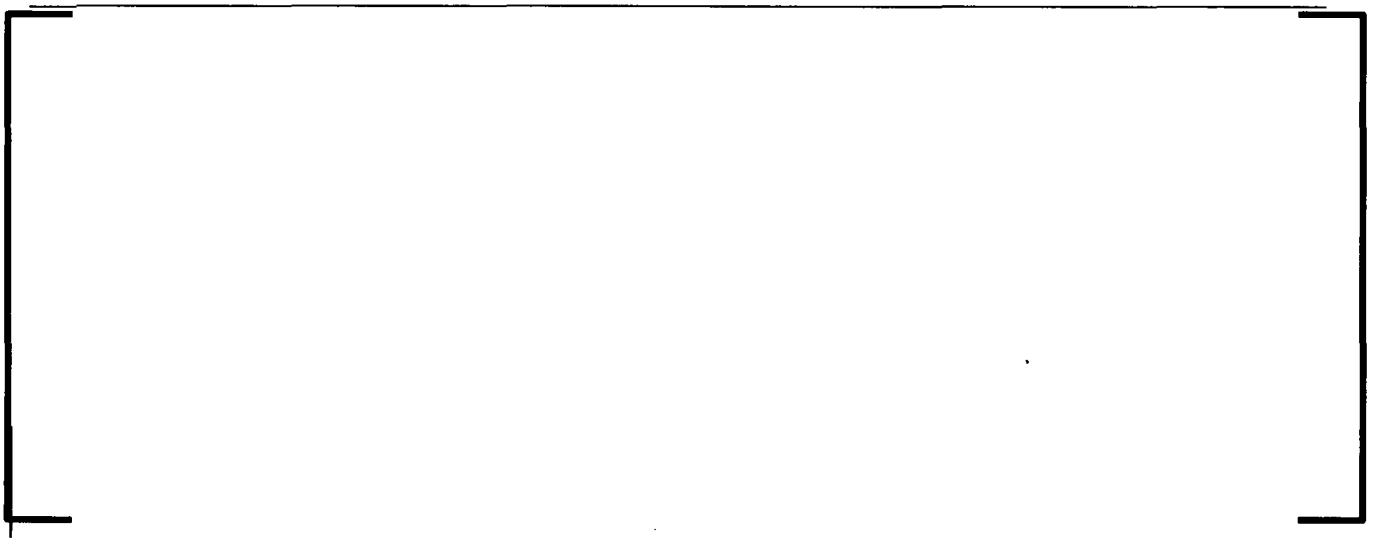




[ ]







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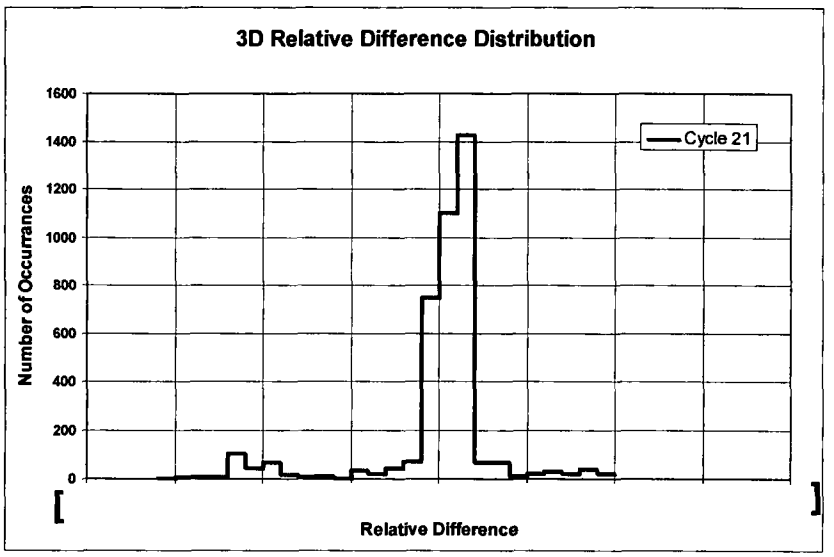
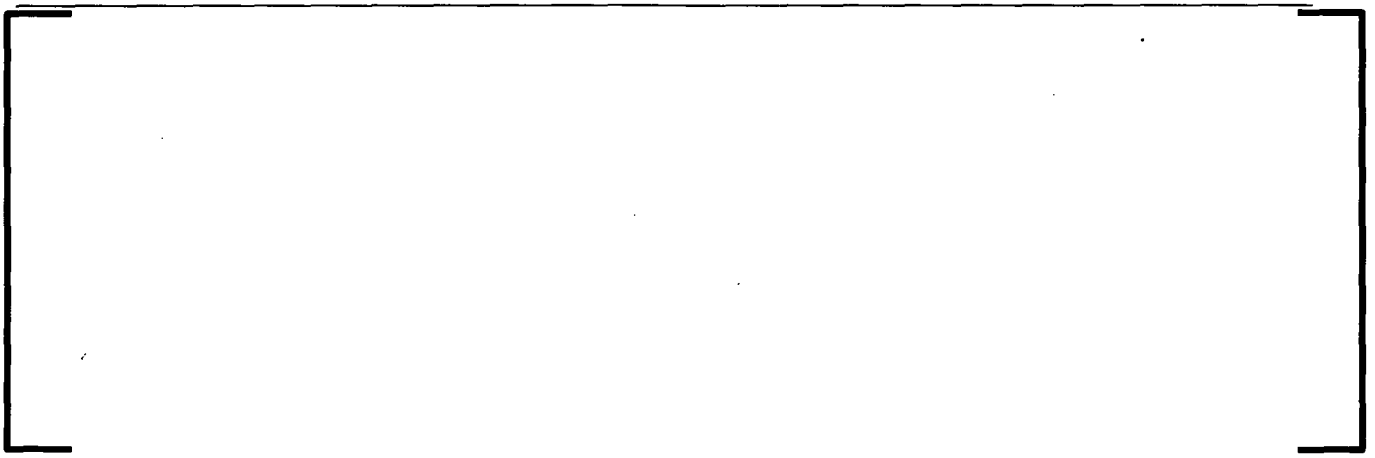
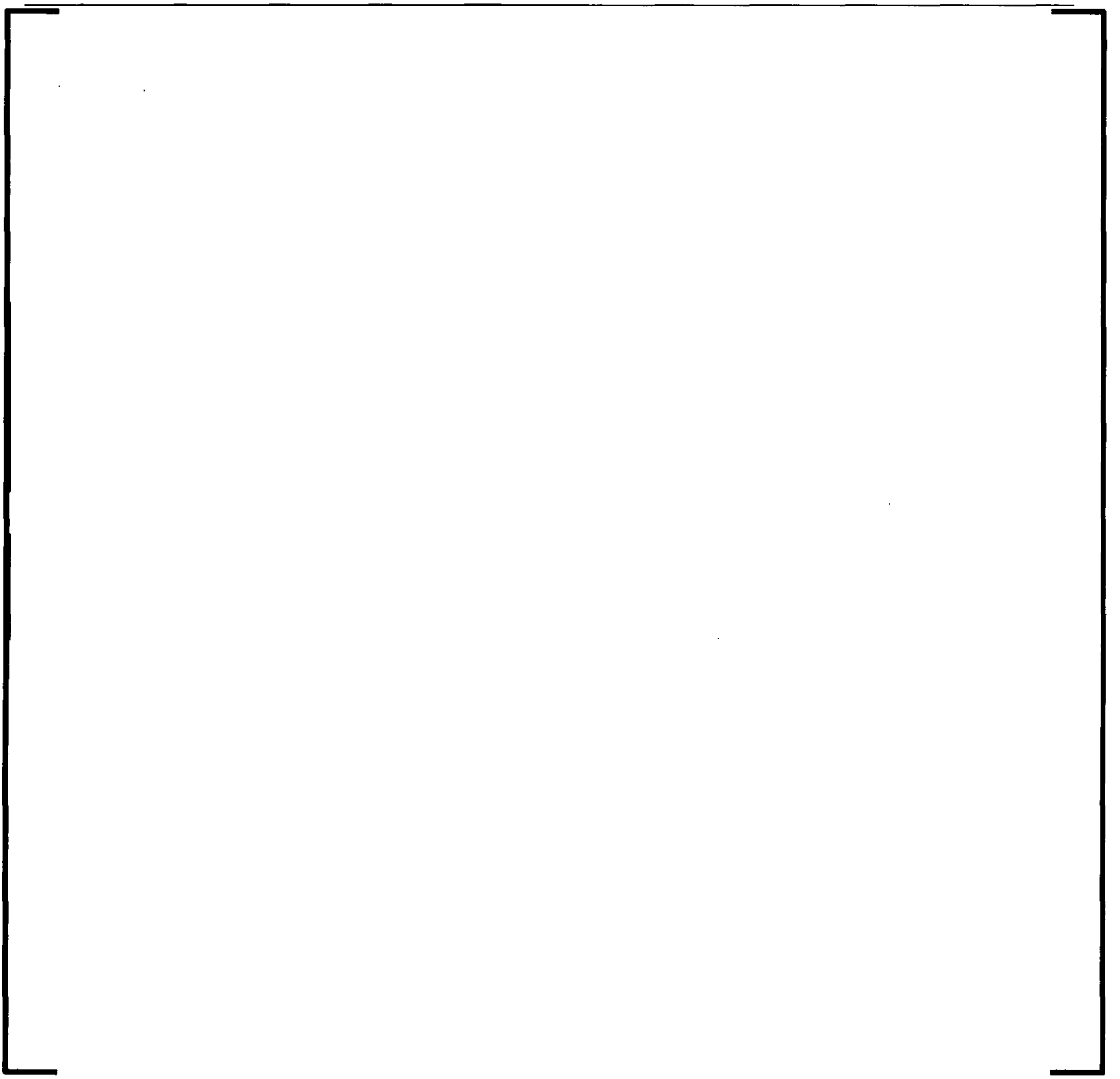
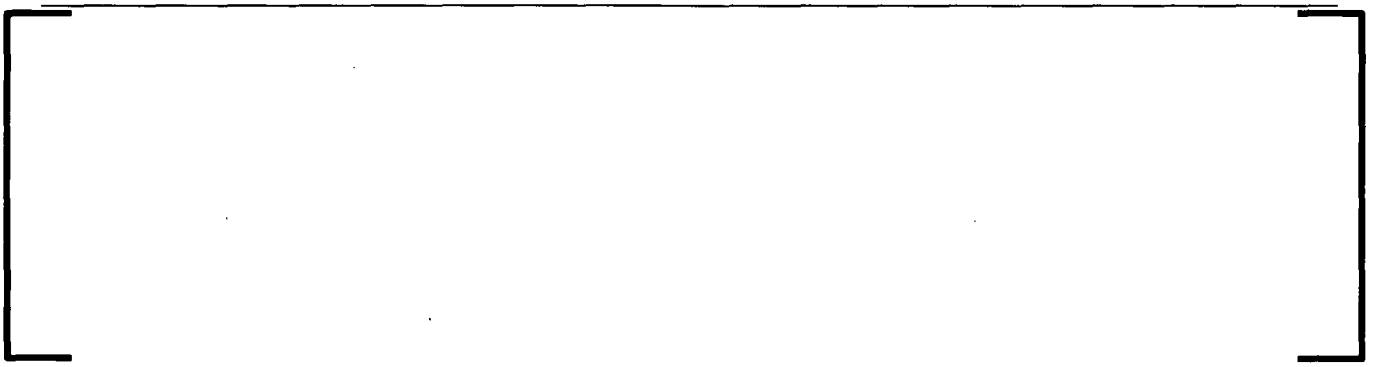

3D Relative Difference Distribution
Cycle 21
Number of Occurrances
1600
1400
1200
1000
800
600
400
200
0
Relative Difference

]



6.0 COMPUTER RUN INDEX





9.0 REFERENCES

1. [ ]

2. 38-9149924-000, Transmission of CORRES-OUT-AREVA-20100061, Confirmation of Thimble Locations and Assumptions to Support the Millstone Unit 2 ICI Misalignment Evaluation.

3. EMF-96-029(P)(A), Volume 1, 2 and Attachment, Reactor Analysis System for PWRs, Volume 1 – Methodology Description and Volume 2 – Benchmarking Results, January 1997.

4. [

5.

]

10. 38-9126165-000, Transmission of CORRES-OUT-AREVA- 20090060, Rev 0, Add 0, Information Related to Millstone Unit 2 2R19 / Cycle 20 ICI Thimble Tube Evaluation – SUPERSEDES CORRES-OUT-AREVA-20090059-0-0.

11. [

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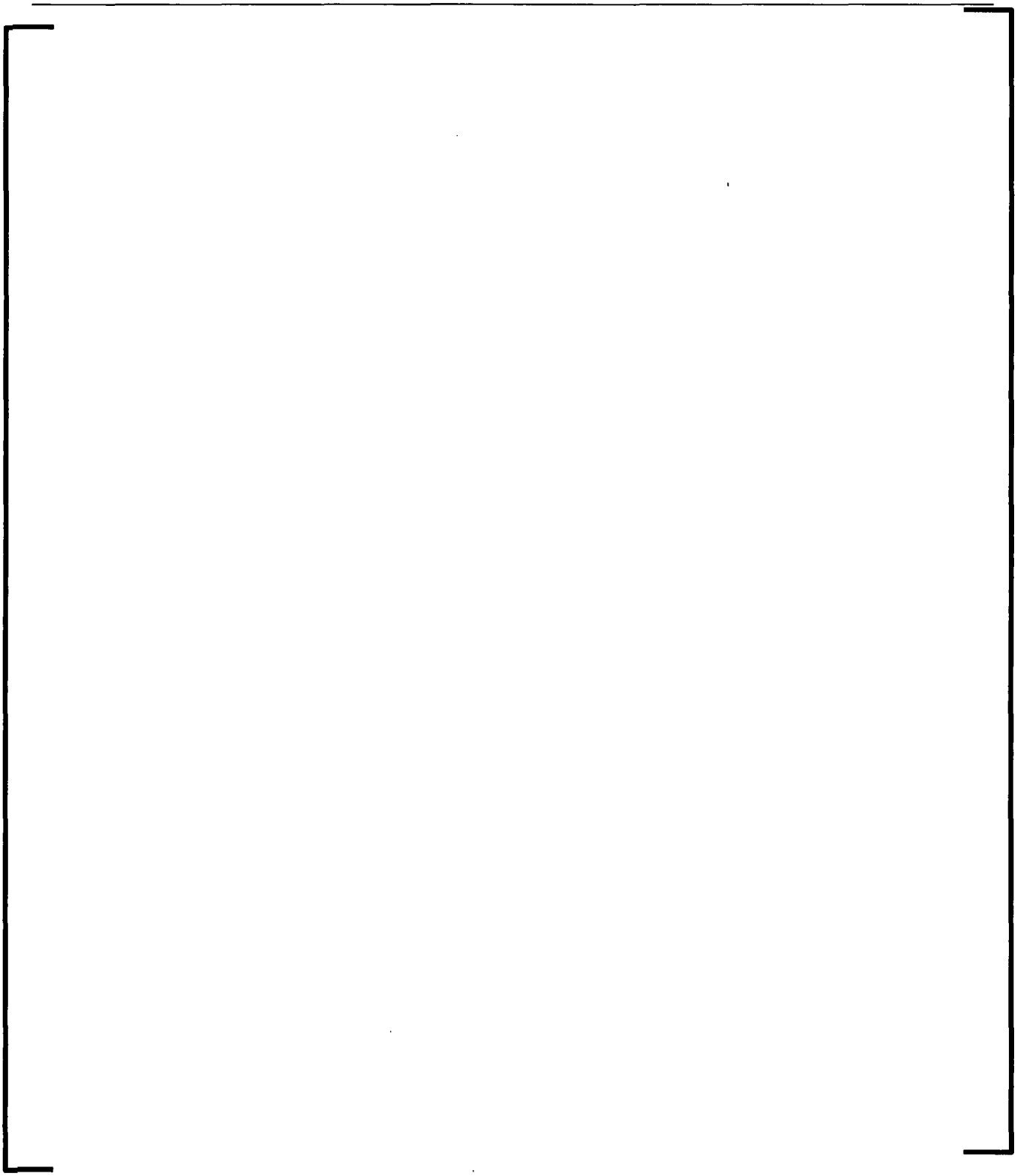
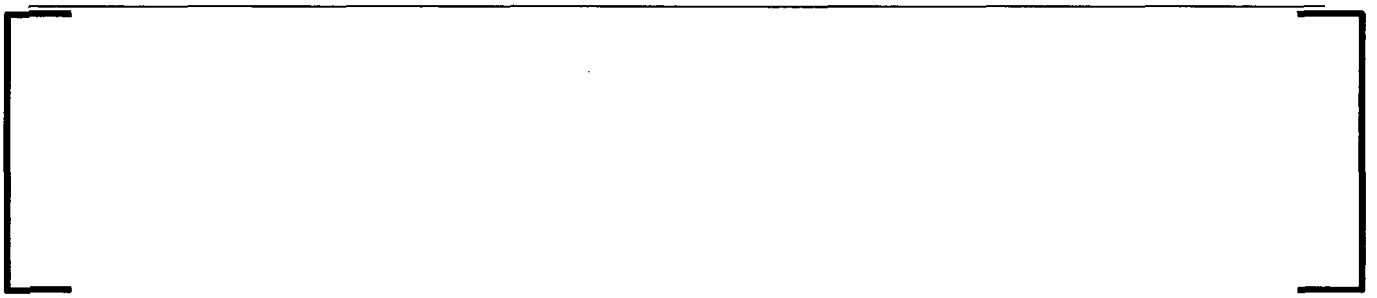
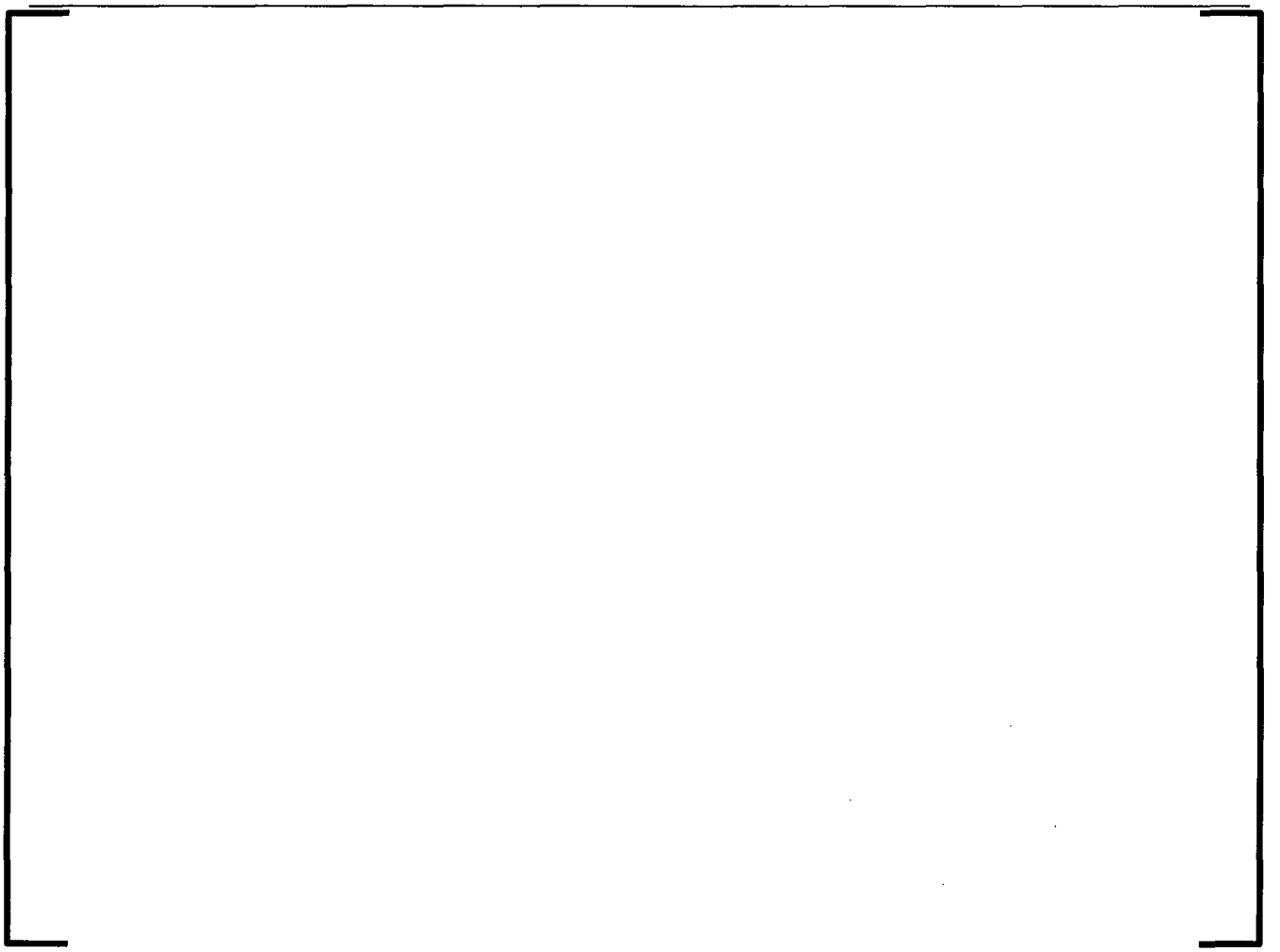
Appendix A



Appendix B



Appendix C



ATTACHMENT 3

AREVA NP AFFIDAVIT

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

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 Calculation Summary Sheet (CSS) 32-9149958-001, "Millstone Unit 2 Cycle 21 Peaking Factor Uncertainty Analysis for ICI Detector Misalignment," 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.

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 the Document is considered proprietary for the reasons set forth in paragraph 6(c) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document have 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 21st day of November, 2011.

Danita R. Kidd
NOTARY PUBLIC, STATE OF VIRGINIA
MY COMMISSION EXPIRES: 12/31/12
Reg. # 205569

DANITA R. KIDD COMMONWEALTH OF VIRGINIA NOTARY PUBLIC