Exelon Nuclear

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10 CFR 50.90

RS-07-097

July 10, 2007

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

Dresden Nuclear Power Station, Unit 2
Renewed Facility Operating License No. DPR-19
NRC Docket No. 50-237

Subject: Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) requests an amendment to Renewed Facility Operating License No. DPR-19 for Dresden Nuclear Power Station (DNPS), Unit 2. The proposed change revises the values of the safety limit minimum critical power ratio (SLMCPR) in Technical Specification (TS) Section 2.1.1, "Reactor Core SLs." Specifically, the proposed change would require that for Unit 2, the minimum critical power ratio (MCPR) shall be $\geq$ 1.12 for two recirculation loop operation, or $\geq$ 1.14 for single recirculation loop operation. This change is needed to support the next cycle of Unit 2 operation.

This request is subdivided as follows.

- Attachment 1 provides an evaluation supporting the proposed change.

- Attachment 2 contains the marked-up TS page, with the proposed change indicated.

- Attachment 3 provides a description of the SLMCPR evaluation for DNPS Unit 2 Cycle 21, as well as a summary of the Westinghouse establishment of a critical power ratio correlation for GNF GE14 fuel.

- Attachment 4 contains an affidavit and non-proprietary version of Attachment 3.

The proposed change has been reviewed by the DNPS Plant Operations Review Committee and approved by the Nuclear Safety Review Board in accordance with the requirements of the EGC Quality Assurance Program.

EGC requests approval of the proposed change by November 1, 2007, to support startup following the next refueling outage for Unit 2 (i.e., D2R20), which is scheduled to start in October 2007. Once approved, the amendment will be implemented prior to startup from D2R20. This implementation period will provide adequate time for the affected station documents to be revised using the appropriate change control mechanisms.

In accordance with 10 CFR 50.91(b), EGC is notifying the State of Illinois of this application for changes to the TS by transmitting a copy of this letter and its attachments to the designated State Official.

Attachment 3 contains information proprietary to Westinghouse Electric Company LLC; it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit, provided in Attachment 4, sets forth the basis on which the information may be withheld from public disclosure by the NRC and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Accordingly, it is requested that the information be withheld from public disclosure in accordance with 10 CFR 2.390. A non-proprietary version of the information contained in Attachment 3 is also provided in Attachment 4.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Mr. John L. Schrage at (630) 657- 2821.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 10th day of July 2007.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager - Licensing

Attachments:

- Attachment 1: Evaluation of Proposed Change
- Attachment 2: Markup of Proposed Technical Specifications Page
- Attachment 3: Dresden Unit 2 Cycle 21 SLMCPR (Proprietary)
- Attachment 4: Westinghouse Application for Withholding, Affidavit, and Non-Proprietary Version of Dresden Unit 2 Cycle 21 SLMCPR

ATTACHMENT 1
Evaluation of Proposed Change

ATTACHMENT 1
Evaluation of Proposed Change

1.0 DESCRIPTION

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) requests an amendment to Renewed Facility Operating License No. DPR-19 for Dresden Nuclear Power Station (DNPS), Unit 2. The proposed change revises the values of the safety limit minimum critical power ratio (SLMCPR) in Technical Specification (TS) Section 2.1.1, "Reactor Core SLs." Specifically, the proposed change would require that for Unit 2, the minimum critical power ratio (MCPR) shall be ≥ 1.12 for two recirculation loop operation, or ≥ 1.14 for single recirculation loop operation. This change is needed to support the next cycle of Unit 2 operation. The proposed change is described below.

2.0 PROPOSED CHANGE

TS Section 2.1.1.2 specifies the value for the SLMCPR. For DNPS Unit 2 and Unit 3, the current values specified are as follows.

> For Unit 2 two recirculation loop operation, MCPR shall be ≥ 1.11, or for single recirculation loop operation, MCPR shall be ≥ 1.12.
>
> For Unit 3 two recirculation loop operation, MCPR shall be ≥ 1.12, or for single recirculation loop operation, MCPR shall be ≥ 1.14.

The proposed change will revise TS Section 2.1.1.2 for Unit 2 to delete the Unit 2 SLMCPR specification and revise the Unit 3 SLMCPR specification to be applicable to both Unit 2 and Unit 3. The specification will read as follows:

> For two recirculation loop operation, MCPR shall be ≥ 1.12, or for single recirculation loop operation, MCPR shall be ≥ 1.14.

The deletion of the "Unit 3" from the specification is administrative, and does not change the current SLMCPR for DNPS Unit 3.

Attachment 2 provides the marked-up TS page indicating the proposed change.

3.0 BACKGROUND

The fuel cladding integrity SLMCPR is established to assure that at least 99.9% of the fuel rods in the core do not experience boiling transition during an anticipated operational occurrence (AOO). To determine the explicit value for the cycle specific safety limit, a full core statistical analysis is performed. The core model incorporates the uncertainty in the measurement of core operating parameters, critical power ratio (CPR) calculation uncertainties, and the statistical uncertainty associated with the fuel vendor's correlation. The number of rods that might experience boiling transition as a function of the nominal MCPR is calculated.

The GNF NRC-approved methodology (i.e., References 1 and 2) was used previously to determine the appropriate SLMCPR values for the current DNPS Unit 2 fuel cycle (i.e., Cycle 20). The Cycle 20 core contains all GNF GE14 fuel assemblies.

EGC will load Westinghouse SVEA-96 Optima2 fuel assemblies in DNPS Unit 2 for Cycle 21 with the result being a mixed core containing both GE14 and SVEA-96 Optima2 fuel assemblies. Therefore, the Westinghouse NRC-approved methodology (Reference 3) and further clarified in the EGC response to request for additional information (Reference 11) was used to determine the SLMCPR values for Cycle 21. Unlike the GNF methodology, the Westinghouse methodology generates a unique SLMCPR value for each fuel product line present in the core. However, based on previous discussions with the NRC related to the Westinghouse methodology, EGC will apply the more conservative SVEA-96 Optima2 fuel SLMCPR to all fuel types in DNPS Unit 2 Cycle 21 rather than establishing a unique SLMCPR for the GE14 fuel.

4.0 TECHNICAL ANALYSIS

In Reference 4, the NRC issued a license amendment for DNPS that, in part, revised TS Section 5.6.5 Core Operating Limits Report to allow Westinghouse methodologies, which have been generically approved by the NRC, to be used for core reload evaluations. The methodology used for SLMCPR evaluations is described in Reference 3, which was approved for use at DNPS as part of the Reference 4 license amendment.

Attachment 3 provides technical information to support the proposed change. A description of the SLMCPR evaluation for DNPS Unit 2 Cycle 21, as well as a summary of the Westinghouse establishment of a CPR correlation for GNF GE14 fuel, is provided in Attachment 3. The following information is also provided to support the proposed change. This information was requested in support of a previously approved amendment for Quad Cities Nuclear Power Station (QCNPS), Unit 2 (i.e., Reference 5).

<u>Unit 2 Cycle 21 Core Loading Pattern</u>

The DNPS Unit 2 Cycle 21 core loading pattern was developed via a design collaboration between EGC and Westinghouse. Both Westinghouse and EGC used NRC-approved lattice physics codes and three-dimensional simulator codes to perform bundle and core design calculations, respectively. The Westinghouse core reload design group performed design calculations using the PHOENIX lattice physics code and the POLCA7 three-dimensional simulator code, while the EGC Nuclear Fuels (NF) core reload design group used the CASM04 lattice physics code and MICROBURN-B2 three-dimensional simulator code.

The core loading pattern was developed, reviewed, and approved in accordance with the EGC core reload design process and procedures. Consistent with this, NF worked with DNPS to develop and document the design goals, constraints, and requirements for the reload cycle. Westinghouse design and manufacturing requirements were also incorporated. The Unit 2 Cycle 21 design criteria were approved by DNPS and NF management prior to the development and finalization of the core loading pattern.

Using the approved design criteria, Westinghouse and NF core reload design engineers performed numerous iterations on proposed SVEA-96 Optima2 bundle designs and core loading patterns. Designs were modeled and evaluated in both the Westinghouse POLCA7 core model and the NF MICROBURN-B2 core model. Engineers in both organizations reviewed proposed designs and collectively revised these designs until the design criteria were met. Based on a comparison of the results from both core models to the design criteria, the core

design was determined to ensure that cycle energy requirements, operating thermal margin goals, licensing requirements, and other design criteria were satisfied. In addition, the final bundle designs were reviewed to ensure that they comply with the Westinghouse SVEA-96 Optima2 fuel manufacturing criteria.

Since this is the second reload of Westinghouse SVEA-96 Optima2 fuel at DNPS, and the first reload at DNPS Unit 2, the DNPS Unit 2, Cycle 21 reload is considered a transition cycle. As such, there may be a relatively higher than normal uncertainty in the current prediction of the core reactivity and/or power distribution throughout the cycle. To account for this, thermal margins and cold shutdown margin were increased relative to recent DNPS cycles. In addition, in order to ensure that there will be sufficient operational flexibility, the core loading pattern was required to comply with the design thermal margin goals even if the core reactivity and operating control rod patterns are somewhat different than those that were developed based on the nominal hot core reactivity assumptions. This approach helped to ensure that the Cycle 21 core can be expected to operate at the targeted core thermal power levels with adequate thermal margins, even if the actual core reactivity and/or power distribution is somewhat different than predicted. In this way, sufficient operational flexibility and flexible control rod patterns were built into the design.

The prediction of the cycle energy capability for a given core design is dependent on the hot reactivity bias (i.e., hot target eigenvalue) that is assumed for the design cycle. This reactivity bias is also dependent on the three-dimensional core simulator code used to perform the design. Since the Unit 2 Cycle 21 core design was developed in collaboration between Westinghouse and NF using both the POLCA7 and MICROBURN-B2 core models, separate reactivity biases were established for use with each model. For POLCA7, Westinghouse used historical plant, bundle, and cycle operational data provided by NF to develop POLCA7 core models of recent DNPS cycles. Then, Westinghouse and NF reviewed the results of this POLCA7 benchmark and determined appropriate POLCA7 reactivity biases (i.e., hot and cold target eigenvalues) for use with the Unit 2 Cycle 21 core design. In a similar manner, MICROBURN-B2 eigenvalue trends from recent DNPS cycles were reviewed to determine appropriate MICROBURN-B2 hot and cold target eigenvalues.

USAG14 Correlation

The USAG14 correlation is the Westinghouse CPR correlation for GE14 fuel used in the Unit 2 Cycle 21 reload design and licensing analyses, and is the same correlation as that used to support the Reference 5 amendment for QCNPS, Unit 2 Cycle 19. As described in Reference 6, the USAG14 correlation sufficiently addresses the GNF Part 21 issue (i.e., Reference 7) with respect to critical power determination. The USAG14 correlation was generated based on GEXL14 CPR data that already reflected the GNF corrections to the GEXL14 CPR correlation that were made in response to the GNF Part 21 issue. Therefore, CPRs calculated with the USAG14 correlation match the values from the Part 21 corrected GEXL14 correlation (i.e., the GEXL14 correlation data revised by GNF to address the Part 21 issue).

The USAG14 correlation was developed using the NRC-approved methodology described in Reference 3. The USAG14 correlation, including a detailed description of the methodology used to develop the correlation, was submitted to the NRC in response to a request for additional information (i.e., response to NRC Request 8 in Attachment 2 of Reference 8) in

support of an amendment request to allow the transition to SVEA-96 Optima2 fuel at DNPS and QCNPS. The NRC approved that amendment for DNPS and QCNPS in Reference 4.

In Attachment 7 of Reference 9, EGC submitted information to the NRC to address the measures taken to ensure compliance with the limitations and conditions discussed in the NRC's safety evaluation for CENPD-300-P-A. Attachment 7 of Reference 9 also included a description of the methodology used to derive the conservative adder to the operating limit minimum critical power ratio (OLMCPR), as required by Condition/Limitation 7 of the NRC safety evaluation for CENPD-300-P-A.

Adjustment Factor

As described in Section 4 of Attachment 3, an adjustment factor is applied when using the USAG14 correlation. The adjustment factor applying to the USAG14 correlation is conservative. The adjustment factor is specifically applied to establish the GE14 fuel OLMCPR that satisfies the 95/95 statistical criterion. A description of the process in generating USAG14 was previously provided to the NRC in response to NRC Request 8 in Attachment 2 of Reference 8.

Core Flow Uncertainty

The total core flow uncertainty values for dual-loop and single-loop operations that were applied for the Unit 2 Cycle 21 SLMCPR calculation are the same as those used in SLMCPR calculations for recent DNPS cycles. These uncertainties are consistent with values provided in General Electric (GE) Nuclear Energy topical report NEDC-32601P-A (i.e., Reference 10), in which GE updated their methodology and the inputs to be used in SLMCPR evaluations. Reference 10 concluded that these core flow uncertainty values, which had also been previously approved for General Electric BWR Thermal Analysis Basis (GETAB) analyses, continued to be applicable and conservative. In Reference 1, the NRC approved NEDC-32601P.

The total core flow uncertainty values are based on system performance. There is no impact on the total core flow uncertainty values as a result of the mixed core, since the GE14 and SVEA-96 Optima2 fuel are hydraulically compatible.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) requests an amendment to Renewed Facility Operating License No. DPR-19 for Dresden Nuclear Power Station (DNPS), Unit 2. The proposed change revises the values of the safety limit minimum critical power ratio (SLMCPR) in Technical Specification (TS) Section 2.1.1, "Reactor Core SLs." Specifically, the proposed change would require that for Unit 2, the minimum critical power ratio (MCPR) shall be $\geq$ 1.12 for two recirculation loop operation, or $\geq$ 1.14 for single recirculation loop operation. This change is needed to support the next cycle of Unit 2 operation.

According to 10 CFR 50.92, "Issuance of amendment," paragraph (c), a proposed amendment to an operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Involve a significant reduction in a margin of safety.

EGC has evaluated the proposed change to the TS for DNPS, Unit 2, using the criteria in 10 CFR 50.92, and has determined that the proposed change does not involve a significant hazards consideration. The following information is provided to support a finding of no significant hazards consideration.

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The probability of an evaluated accident is derived from the probabilities of the individual precursors to that accident. The consequences of an evaluated accident are determined by the operability of plant systems designed to mitigate those consequences. Limits have been established consistent with NRC-approved methods to ensure that fuel performance during normal, transient, and accident conditions is acceptable. The proposed change conservatively establishes the SLMCPR for DNPS, Unit 2, Cycle 21 such that the fuel is protected during normal operation and during plant transients or anticipated operational occurrences (AOOs).

   Changing the SLMCPR does not increase the probability of an evaluated accident. The change does not require any physical plant modifications, physically affect any plant components, or entail changes in plant operation. Therefore, no individual precursors of an accident are affected.

   The proposed change revises the SLMCPR to protect the fuel during normal operation as well as during plant transients or AOOs. Operational limits will be established based on the proposed SLMCPR to ensure that the SLMCPR is not violated. This will ensure that the fuel design safety criterion (i.e., that at least 99.9% of the fuel rods do not experience transition boiling during normal operation and AOOs) is met. Since the proposed change does not affect operability of plant systems designed to mitigate any consequences of accidents, the consequences of an accident previously evaluated are not expected to increase.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   Creation of the possibility of a new or different kind of accident requires creating one or more new accident precursors. New accident precursors may be created by modifications of plant configuration, including changes in allowable modes of operation. The proposed change does not involve any plant configuration modifications or changes to allowable modes of operation. The proposed change to the SLMCPR assures that safety criteria are maintained for DNPS, Unit 2, Cycle 21.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No

   The SLMCPR provides a margin of safety by ensuring that at least 99.9% of the fuel rods do not experience transition boiling during normal operation and AOOs if the MCPR limit is not violated. The proposed change will ensure the current level of fuel protection is maintained by continuing to ensure that at least 99.9% of the fuel rods do not experience transition boiling during normal operation and AOOs if the MCPR limit is not violated. The proposed SLMCPR values were developed using NRC-approved methods. Additionally, operational limits will be established based on the proposed SLMCPR to ensure that the SLMCPR is not violated. This will ensure that the fuel design safety criterion (i.e., that no more than 0.1% of the rods are expected to be in boiling transition if the MCPR limit is not violated) is met.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based upon the above, EGC concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

5.2 Applicable Regulatory Requirements/Criteria

10 CFR 50.36, "Technical specifications," paragraph (c)(1), requires that power reactor facility TS include safety limits for process variables that protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. The fuel cladding integrity SLMCPR is established to assure that at least 99.9% of the fuel rods in the core do not experience boiling transition during normal operation and AOOs. Thus, SLMCPR is required to be contained in TS.

10 CFR 50, Appendix A, General Design Criterion (GDC) 10 requires that the reactor core and associated coolant, control, and protection systems be designed with

appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of AOOs. To ensure compliance with GDC 10, EGC has performed the plant-specific SLMCPR analyses using NRC-approved methodologies as prescribed in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 4.4. The SLMCPR ensures that sufficient conservatism exists in the operating limit MCPR such that, in the event of an AOO, there is a reasonable expectation that at least 99.9% of the fuel rods in the core will avoid boiling transition for the power distribution within the core including all uncertainties.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

EGC has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for Protection Against Radiation." However, the proposed amendment does not involve: (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," paragraph (c)(9). Therefore, pursuant to 10 CFR 51.22, paragraph (b), no environmental impact statement or environmental assessment needs be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. Letter from F. Akstulewicz (NRC) to G. A. Watford (GE), "Acceptance for Referencing of Licensing Topical Reports NEDC-32601P, 'Methodology and Uncertainties for Safety Limit MCPR Evaluations;' NEDC-32694P, 'Power Distribution Uncertainties for Safety Limit MCPR Evaluation;' and Amendment 25 to NEDE-24011-P-A on Cycle Specific Safety Limit MCPR (TAC Nos. M97490, M99069, and M97491)," dated March 11, 1999

2. NEDO-10958-A, "General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation, and Design Application," dated January 1977

3. CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel," dated July 1996

4. Letter from M. Banerjee (NRC) to C. M. Crane (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station,

Units 1 and 2 - Issuance of Amendments Re: Transition to Westinghouse Fuel and Minimum Critical Power Ratio Safety Limits (TAC. Nos. MC7323, MC7324, MC7325 and MC7326)," dated April 4, 2006

5. Letter from M. Banerjee (NRC) to C. M. Crane (Exelon Generation Company, LLC), "Quad Cities Nuclear Power Station, Unit 2 – Issuance of Amendment Re: Minimum Critical Power Ratio Safety Limit (TAC No. MC9243)," dated March 31, 2006

6. Letter from P. R. Simpson (Exelon Generation Company, LLC) to NRC, "Additional Information Supporting Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit," dated February 13, 2006

7. Letter from J. S. Post (GE Energy) to NRC, "Part 21 60 Day Interim Report Notification: Critical Power Determination for GE14 and GE12 Fuel With Zircaloy Spacers," dated June 24, 2005

8. Letter from P. R. Simpson (Exelon Generating Company, LLC) to NRC, "Additional Information Supporting Request for License Amendment Regarding Transition to Westinghouse Fuel," dated January 26, 2006

9. Letter from P. R. Simpson (Exelon Generation Company, LLC) to NRC, "Request for License Amendment Regarding Transition to Westinghouse Fuel," dated June 15, 2005

10. NEDC-32601P-A, "Methodology and Uncertainties for Safety Limit MCPR Evaluations," dated August 1999

11. Letter from D.M. Benyak (Exelon Generation Company, LLC) to NRC, "Additional Information Supporting Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit," dated October 19, 2006.

ATTACHMENT 2
Markup of Proposed Technical Specifications Page

DRESDEN NUCLEAR POWER STATION, UNIT 2

RENEWED FACILITY OPERATING LICENSE NO. DPR-19

<u>REVISED TECHNICAL SPECIFICATIONS PAGE</u>

2.0-1

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 785 psig or core flow < 10% rated core flow:

THERMAL POWER shall be ≤ 25% RTP.

2.1.1.2 With the reactor steam dome pressure ≥ 785 psig and core flow ≥ 10% rated core flow:

~~For Unit 2 two recirculation loop operation, MCPR shall be ≥ 1.11, or for single recirculation loop operation, MCPR shall be ≥ 1.12.~~

For ~~Unit 3~~ two recirculation loop operation, MCPR shall be ≥ 1.12, or for single recirculation loop operation, MCPR shall be ≥ 1.14.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be ≤ 1345 psig.

2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

ATTACHMENT 4

Westinghouse Application for Withholding, Affidavit, and Non-Proprietary Version of Dresden Unit 2 Cycle 21 SLMCPR

Westinghouse

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Our ref: CAW-07-2302

June 27, 2007

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: NF-BEX-07-125 P-Attachment, "Dresden Unit 2 Cycle 21 SLMCPR" (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-07-2302 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Exelon Generation.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-07-2302 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: J. Thompson/NRR

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared J. A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Sworn to and subscribed before
me this 27th day of June, 2007

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Sharon L. Markle, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Jan. 29, 2011
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory Compliance and Plant Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in NF-BEX-07-125 P-Attachment "Dresden Unit 2 Cycle 21 SLMCPR" (Proprietary), for review and approval, being transmitted by Exelon Nuclear letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse for "Dresden Unit 2 Cycle 21 SLMCPR" for review and approval.

This information is part of that which will enable Westinghouse to:

(a) Support Exelon's use of Westinghouse Fuel at Quad City and Dresden.

(b) Assist customer to obtain license change.

Further this information has substantial commercial value as follows:

(a) Westinghouse can use this information to further enhance their licensing position with their competitors.

(b) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar analyses and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

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Dresden Unit 2 Cycle 21 SLMCPR

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1.0 Introduction

This document contains a description of the Safety Limit Minimum Critical Power Ratio (SLMCPR) evaluation for Dresden 2 (DNPS2) Cycle 21, as well as identification of the Critical Power Ratio (CPR) correlation for Global Nuclear Fuel (GNF) GE14 legacy fuel, and the "conservative Adder" required by SER restriction 7 of Reference 3.

Dual (DLO) and single (SLO) recirculation loop SLMCPRs of 1.11 and 1.12, respectively, were established for the GE14 fuel by GNF for DNPS2 Cycle 20, [

]a,c As discussed in References 13 and 14, this conservative approach was also applied for DNPS3 Cycle 20, and Quad Cities Nuclear Power Station Unit 1 (QCNPS1) Cycle 20, respectively.

The GNF NRC-approved methodology (References 1 and 2) was used previously to determine the appropriate SLMCPR values for the currently operating DNPS2 Cycle 20, which contains GNF GE14 fuel assemblies. Consistent with the GNF methodology, the resulting Cycle 20 SLMCPRs apply to all fuel assemblies in the core, such that the same SLMCPRs are applied to all the GE14 fuel assemblies.

For DNPS2 Cycle 21, Exelon Generation Company, LLC (EGC) will load Westinghouse SVEA-96 Optima2 fuel. Therefore, the Westinghouse NRC-approved methodology described in Reference 3, and further clarified in the response to Request for Additional Information (RAI) D13 of Reference 4, was used to determine the SLMCPRs for Cycle 21. Further clarification of the Westinghouse SLMCPR methodology was also provided to the NRC in support of the transition to SVEA-96 Optima2 fuel in the Quad Cities and Dresden Units as follows:

> The response to NRC Request 19 in Reference 9 which supported the Licensing Amendment Request for transition to SVEA-96 Optima2 fuel in the Dresden and Quad Cities plants provided in Reference 8,
>
> The technical information supporting the Quad Cities 2 Technical Specification SLMCPR changes transmitted by Reference 10 as supplemented by the clarifying information in Reference 11.

The same SLMCPR methodology described in these references was followed to establish appropriate GE14 and SVEA-96 Optima2 SLMCPRs for DNPS2 Cycle 21. Unlike the GNF methodology, [

]a,c

[

]^{a,c}

The EGC proposed license amendment to use the Westinghouse methodology for core reload evaluations at the Dresden and Quad Cities units was submitted to the NRC in Reference 8. This submittal was approved by the NRC and supported the QC2 startup with a reload core containing SVEA-96 Optima2 fuel (i.e., Cycle 19). It also supports DNPS3 Cycle 20 and QCNPS1 Cycle 20 which are both operating with reload cores containing SVEA-96 Optima2 fuel and will support the operation of DNPS2 Cycle 21.

Condition 7 in the NRC safety evaluation for Reference 3 requires that a conservative factor applied to the GE14 Operating Limit Minimum Critical Power Ratio (OLMCPR) be identified in licensee applications. The value of this factor for DNPS2, Cycle 21, is [ ]^{a,c} which was also used for the QCNPS 2 Cycle 19, and DNPS3 Cycle 20, and QCNPS1 Cycle 20 licensing analyses.

2.0 GE14 SLMCPR for DNPS2 Cycle 21

Consistent with the Westinghouse methodology described in Reference 3, the treatment of the SLMCPR in mixed cores containing non-Westinghouse fuel [

]^{a,c} The Cycle 20 SLMCPR was determined by GNF based on plant- and cycle-specific analyses using GNF's NRC-approved methodology and uncertainties (References 1 and 2) as supplemented with DNPS2-specific uncertainties. The GNF evaluation used the GEXL14 correlation for GE14 fuel. The GNF evaluation confirmed that the DLO and SLO SLMCPRs of 1.11 and 1.12, respectively, in Reference 5 bounded the calculated Cycle 20 results and, therefore, continued to be appropriate for Cycle 20. [

]^{a,c}

[

]a,c

3.0 SVEA-96 Optima2 SLMCPR for Cycle 21

In establishing the SLMCPR for Westinghouse SVEA-96 Optima2 fuel assemblies, it is assumed that [

] a,c

The SVEA-96 Optima2 SLMCPR for DNPS2 Cycle 21 is based on a Reference Core design (SVEA-96 Optima2 bundle designs, core loading pattern and state point depletion strategy) that represents realistic current plans for the Cycle 21 loading and operation. The Reference Core loading pattern for DNPS2 Cycle 21 is shown in Figure 1. The Reference Core design was generated via collaboration between EGC and Westinghouse based on EGC's cycle assumptions and design goals. The Reference Core was designed to meet the cycle energy requirements, to satisfy all licensing requirements, to provide adequate thermal margins and operational flexibility, and to meet other design and manufacturing criteria established by EGC and Westinghouse.

In general, the calculated SLMCPR is dominated by the flatness of the assembly CPR distribution across the core, and the flatness of the relative pin CPR distribution based on the pin-by-pin power/R-factor distribution in each bundle. Greater flatness in either parameter yields more rods susceptible to boiling transition and thus a higher SLMCPR.

The calculation of the SLMCPR as a function of cycle exposure captures the interplay between the relative fuel assembly CPR and bundle relative pin-by-pin CPR distributions established from the power/R-factor distributions and allows a determination of the maximum (limiting) SLMCPR for the entire cycle. This limiting SLMCPR is applied throughout the entire cycle.

The SVEA-96 Optima2 SLMCPR for DNPS2 Cycle 21 was determined as a function of cycle exposure based on radial assembly power distributions at least as flat as the cycle exposure-dependent radial power distributions from [

] a,c

[

] a,c

Accordingly, the SVEA-96 Optima2 SLMCPR for dual recirculation loop (DLO) operation was calculated at 100% power and 100% flow at 12 cycle exposures throughout the cycle to assure that the limiting SLMCPR was identified. In addition, the dual recirculation loop SLMCPRs were calculated at 100% power at the minimum allowed core flow at rated power (95.3% flow), and a maximum core flow at rated power of 108% flow to confirm that a limiting SLMCPR had been established. Figure 3 shows a current DNPS2 power-flow map which is applicable to Cycle 21. While, as shown in Figure 3, DNPS2 Cycle 21 is not licensed for a maximum core flow of 108%, a flow window 95.3% to 108% of rated core flow was analyzed.

Single recirculation loop (SLO) SVEA-96 Optima2 SLMCPR calculations were also performed. These SLMCPR calculations were performed at [

] a,c The single loop calculations used the same procedure as the dual loop cases, except that the single loop cases applied a larger uncertainty for the core flow.

The SLMCPR results for Cycle 21 are plotted in Figure 4. As shown in Figure 4, the dual recirculation loop SLMCPR [

]a,c Since the uncertainties at each dual recirculation loop point are the same, this behavior is due to the interplay between the assembly relative CPRs and the relative fuel rod CPRs. In general, as the fraction of assembly or fuel rod CPRs in the vicinity of the minimum assembly or fuel rod CPR increases, the number of rods with a potential for experiencing dryout increases. Therefore, a larger SLMCPR is required to assure that less than 0.1% of the rods are in dryout.

While control rod patterns at individual state points required to maintain margins to thermal limits may perturb the trend, experience has shown that the assembly CPR distributions tend to become [

] a,c Consequently, the peak SLMCPR tends to occur when the assembly CPR and rod CPR distributions combine to place the maximum number of fuel rod CPRs close to the minimum CPR.

This behavior is shown for the DNPS2 Cycle 21 SLMCPR by the relative assembly CPR and relative fuel rod histograms shown in Figures 5 through 16 and 17 through 22, respectively. In Figures 5 through 16, assembly types DA21 and DB21 refer to the SVEA-96 Optima2 assembly types loaded in Cycle 21. Assembly type [ ] a,c

[

] a,c

Inspection of the DLO histograms in Figures 5 through 14 and the relative fuel rod CPR histograms in Figures 17 through 22 lead to the following observations, which explain the SLMCPR behavior in Figure 4:

1. [

] a,c

Therefore, the dual recirculation loop (DLO) SLMCPR results at rated conditions in Figure 4 can be explained in terms of [

] a,c

The continued adequacy of a dual recirculation loop SLMCPR of [

] a,c

[

] a,c

The single recirculation loop (SLO) results calculated at [

] a,c

The relative fuel rod CPRs in the SLMCPR calculations are [

] a,c

[

] a,c

In addition to the strong dependence on assembly CPR and relative fuel rod CPR distributions, the SLMCPR is strongly dependent on the distribution of assembly and relative fuel pin CPRs about their mean values leading to an overall distribution of fuel rod CPRs relative to their mean values. The wider these distributions, the higher the SLMCPR must be to prevent 0.1% of the fuel rods from experiencing boiling transition. The distributions of fuel rod CPRs relative to their mean values are determined by the uncertainties relative to the mean CPRs. Accordingly, the uncertainties used in establishing the SVEA-96 Optima2 SLMCPR for Cycle 21 are shown in Table 2.

4.0 Westinghouse CPR Correlation for GE14 Fuel

The Westinghouse CPR correlation for GE14 fuel used in the DNPS2 Cycle 21 reload design and licensing analyses is the same as that used for QCNPS12 Cycle 19, and described in the Response to NRC Request 8 in Reference 9. Further clarification of the correlation was provided in the response to NRC Request 2 in Reference 11 as well as in Reference 12. This correlation is also used in the reload analysis supporting DNPS3 Cycle 20 and QCNPS1, Cycle 20 operation as discussed in References 13 and 14. [

] a,c

[

] a,c The determination of this value was also based on EGC's plans to continue to monitor the CPR performance of GE14 fuel using the GNF GEXL14 correlation within the POWERPLEX-III online core monitoring system rather than the USAG14 correlation. This approach is consistent with Westinghouse's NRC-approved methodology per Reference 3.

5.0 References

1. Letter, Frank Akstulewicz (NRC) to Glen A. Watford (GE), "Acceptance for Referencing of Licensing Topical Reports NEDC-32601P, Methodology and Uncertainties for Safety Limit MCPR Evaluations; NEDC-32694P, Power Distribution Uncertainties for Safety Limit MCPR Evaluation; and Amendment 25 to NEDE-24011-P-A on Cycle Specific Safety Limit MCPR," (TAC Nos. M97490, M99069, and M97491), March 11, 1999.

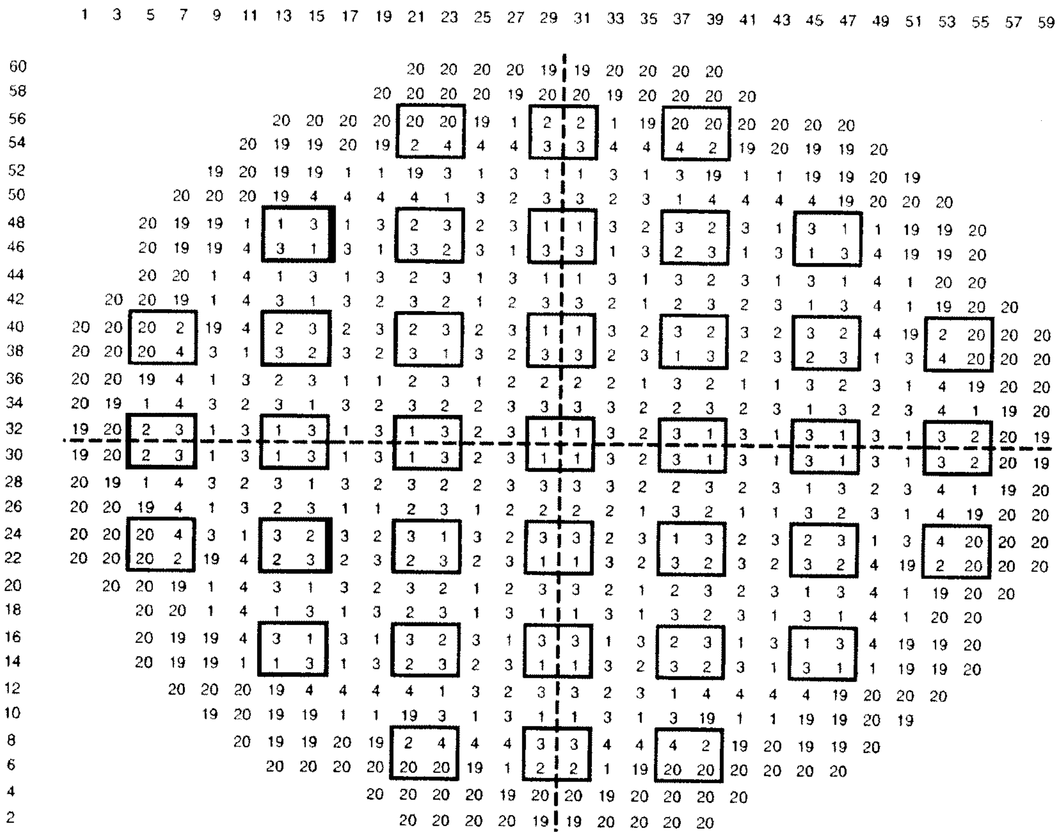
2. General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation, and Design Application, NEDO-10958-A, January 1977.
3. Licensing Topical Report, Reference Safety Report for Boiling Water Reactor Reload Fuel, CENPD-300-P-A, July 1996.
4. CENPD-389-P-A, 10x10 SVEA Fuel Critical Power Experiments and CPR Correlations: SVEA-96+, August 1999.
5. Dresden Technical Specifications, Section 2.1.1.2
6. WCAP-16081-P-A, 10x10 SVEA Fuel Critical Power Experiments and CPR Correlation: SVEA-96 Optima2, March 2005.
7. Letter, Jason S. Post (GE) to NRC, Part 21 60 Day Interim Report Notification: Critical Power Determination for GE14 and GE12 Fuel With Zircaloy Spacers, MFN 05-058 Rev 1, June 24, 2005, and GE Energy – Nuclear, 10 CFR Part 21 Communication, 60-Day Interim Report Notification and Transfer of Information, Critical Power Determination for GE14 and GE12 Fuel With Zircaloy Spacers, SC05-04 Rev 1, June 24, 2005.
8. Letter, Patrick R. Simpson (Exelon Generation Company, LLC) to NRC, Request for License Amendment Regarding Transition to Westinghouse Fuel, dated June 15, 2005.
9. RS-06-009, Additional Information Supporting Request for License Amendment Regarding Transition to Westinghouse Fuel, January 26, 2006.
10. Letter from Patrick R. Simpson, Exelon Nuclear, to U.S. NRC, "Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit", QCNPS, Unit 2, December 15, 2005.
11. RS-06-024, "Additional Information Supporting Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit", QCNPS, Unit 2, February 13, 2006.
12. RS-06-038, "Additional Information Supporting Request for Licensing Amendment Request Regarding Transition to Westinghouse Fuel and Request for Technical Specifications Change for Minimum Critical Power Ratio Safety Limit", March 3, 2006.
13. Letter from NRC (John Honcharik) to EXELON GENERATION COMPANY, LLC, dated November 7, 2006, *Dresden Nuclear Power Station, Unit 3- Issuance of Amendment RE: Minimum Critical Power Ratio Safety Limit* (TAC No. MD2706).
14. Letter from NRC (Joseph Williams) to EXELON GENERATION COMPANY, LLC, dated May 3, 2007, *Quad Cities Nuclear Power Station, Unit 1- Issuance of Amendment RE: Request for Technical Specification Change for Minimum Critical Power Ratio Safety Limit* (TAC No. MD4008).

Table 1 – Comparison of DNPS2 Cycle 20 and 21 Cores

Description	Dresden 2 Cycle 20	Dresden 2 Cycle 21
Number of Bundles in Core	724	724
Limiting Cycle Exposure Point	N/A (GNF proprietary)	Near EOC
Cycle Exposure at Limiting Point	N/A (GNF proprietary)	14.00 GWD/MTU (14205 EFPH)
Reload Fuel Type	GE14	SVEA-96 Optima2
Reload Batch Average Weight % Enrichment	3.93 w/o	3.99 w/o
Reload Batch Fraction (%)	34.80%	33.70%
Batch Fraction of SVEA-96 Optima2 Fuel	0.00%	33.70%
Batch Fraction of GNF GE14 Fuel	100.00%	66.30%
Core Average Weight % Enrichment	4.00 w/o	3.97 w/o
Licensing Analysis Safety Limit MCPR (DLO)	1.11 for all fuel types	[ ] a,c
Licensing Analysis Safety Limit MCPR (SLO)	1.12 for all fuel types	[ ] a,c

Table 2 – Uncertainties used in Dresden 2 Cycle 21 SVEA-96 Optima2 SLMCPR Determination

a,c



Fuel Type	Bundle Name	# Assem	ID Range	Cycle First Loaded
19	GE14-P10DNAB418-16GZ-100T-145-T6-2646	80	JLJ277-JLJ356	19
20	GE14-P10DNAB389-18GZ-100T-145-T6-2650	148	JLJ101-JLJ268	19
1	GE14-P10DNAB390-16GZ-100T-145-T6-2851	140	JLU501-JLU640	20
2	GE14-P10DNAB397-18GZ-100T-145-T6-2852	112	JLU641-JLU752	20
3	Opt2-3.97-11G8.00-4GZ8.00-3G6.00	188	DRA001-DRA188	21
4	Opt2-4.04-10G7.00-2GZ7.00-2G6.00	56	DRA189-DRA244	21

Figure 1 – Dresden 2 Cycle 21 – Reference Loading Pattern

	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59
60											17	16	16	16	16	16	16	16	16	17										
58										16	17	16	16	17	16	16	17	16	16	17	16									
56							17	17	16	17	16	19	19	19	20	20	19	19	19	16	17	16	17	17						
54						17	16	17	20	20	17	2	1	1	2	2	1	1	2	17	20	20	17	16	17					
52					17	17	16	19	20	19	19	1	19	1	20	20	1	19	1	19	19	20	19	16	17	17				
50				17	17	19	19	20	1	2	2	20	1	19	1	1	19	1	20	2	2	1	20	19	19	17	17			
48			17	16	16	19	17	2	20	2	20	1	20	1	20	20	1	20	1	20	2	20	2	17	19	16	16	17		
46			17	17	19	20	2	1	2	20	1	20	2	20	1	1	20	2	20	1	20	2	1	2	20	19	17	17		
44			16	20	20	1	20	2	20	1	20	2	20	2	17	17	2	20	2	20	1	20	2	20	1	20	20	16		
42		16	17	20	19	2	2	20	1	19	2	17	1	20	2	2	20	1	17	2	19	1	20	2	2	19	20	17	16	
40	17	17	16	17	19	2	20	1	20	2	20	2	17	2	16	16	2	17	2	20	2	20	1	20	2	19	17	16	17	17
38	16	16	19	2	1	20	1	20	2	17	2	20	1	17	1	1	17	1	20	2	17	2	20	1	20	1	2	19	16	16
36	16	16	19	1	19	1	20	2	20	1	17	1	20	1	20	20	1	20	1	17	1	20	2	20	1	19	1	19	16	16
34	16	17	19	1	1	19	1	20	2	20	2	17	1	20	1	1	20	1	17	2	20	2	20	1	19	1	1	19	17	16
32	16	16	20	2	20	1	20	1	17	2	16	1	20	1	20	20	1	20	1	16	2	17	1	20	1	20	2	20	16	16
30	16	16	20	2	20	1	20	1	17	2	16	1	20	1	20	20	1	20	1	16	2	17	1	20	1	20	2	20	16	16
28	16	17	19	1	1	19	1	20	2	20	2	17	1	20	1	1	20	1	17	2	20	2	20	1	19	1	1	19	17	16
26	16	16	19	1	19	1	20	2	20	1	17	1	20	1	20	20	1	20	1	17	1	20	2	20	1	19	1	19	16	16
24	16	16	19	2	1	20	1	20	2	17	2	20	1	17	1	1	17	1	20	2	17	2	20	1	20	1	2	19	16	16
22	17	17	16	17	19	2	20	1	20	2	20	2	17	2	16	16	2	17	2	20	2	20	1	20	2	19	17	16	17	17
20		16	17	20	19	2	2	20	1	19	2	17	1	20	2	2	20	1	17	2	19	1	20	2	2	19	20	17	16	
18			16	20	20	1	20	2	20	1	20	2	20	2	17	17	2	20	2	20	1	20	2	20	1	20	20	16		
16			17	17	19	20	2	1	2	20	1	20	2	20	1	1	20	2	20	1	20	2	1	2	20	19	17	17		
14			17	16	16	19	17	2	20	2	20	1	20	1	20	20	1	20	1	20	2	20	2	17	19	16	16	17		
12				17	17	19	19	20	1	2	2	20	1	19	1	1	19	1	20	2	2	1	20	19	19	17	17			
10					17	17	16	19	20	19	19	1	19	1	20	20	1	19	1	19	19	20	19	16	17	17				
8						17	16	17	20	20	17	2	1	1	2	2	1	1	2	17	20	20	17	16	17					
6							17	17	16	17	16	19	19	19	20	20	19	19	19	16	17	16	17	17						
4										16	17	16	16	17	16	16	17	16	16	17	16									
2											17	16	16	16	16	16	16	16	16	17										

Fuel Type	Bundle Name	# Assem	ID Range	Cycle First Loaded
16	GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484	104	JLA161-JLA280	18
17	GE14-P10HNAB408-16GZ-100T-145-T6-2483	120	JLA001-JLA160	18
19	GE14-P10DNAB418-16GZ-100T-145-T6-2646	80	JLJ277-JLJ356	19
20	GE14-P10DNAB389-18GZ-100T-145-T6-2650	168	JLJ101-JLJ268	19
1	GE14-P10DNAB390-16GZ-100T-145-T6-2851	140	JLU501-JLU640	20
2	GE14-P10DNAB397-18GZ-100T-145-T6-2852	112	JLU641-JLU752	20

Figure 2 – Dresden 2 Cycle 20 – Reference Loading Pattern

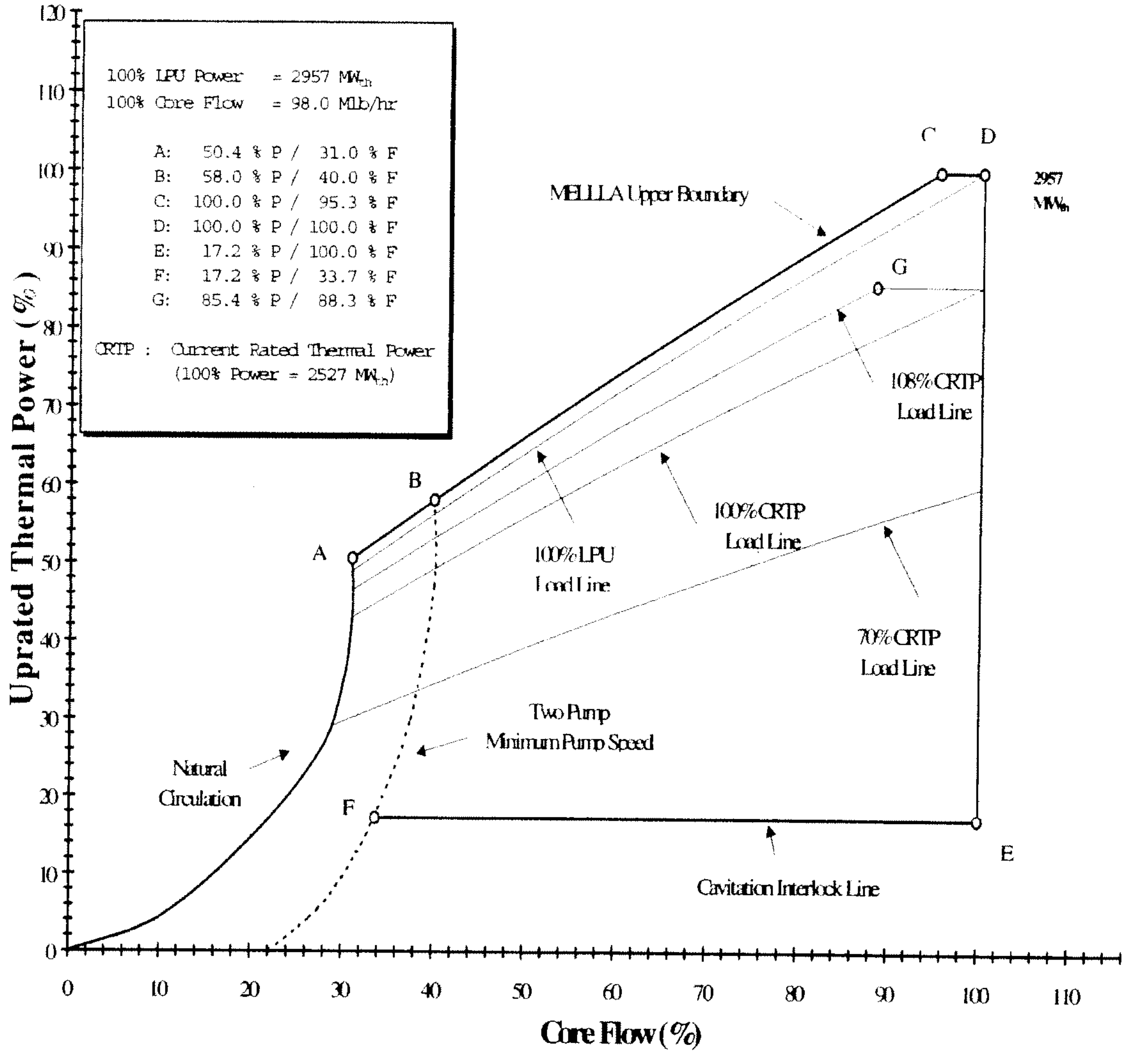


Figure 3 – DNPS Power Flow Map (Nominal Feedwater Temperature)

a,c

Figure 4 – Dresden 2 Cycle 21 SLMCPR Results for SVEA-96 Optima2 Fuel

Figure 5 – Assembly Histograms

a,c

Figure 6 – Assembly Histograms

a,c

Figure 7 – Assembly Histograms

a,c

Figure 8 – Assembly Histograms

a,c

Figure 9 – Assembly Histograms

a,c

Figure 10 – Assembly Histograms

a,c

Figure 11 – Assembly Histograms

a,c

Figure 12 – Assembly Histograms

a,c

Figure 13 – Assembly Histograms

a,c

Figure 14 – Assembly Histograms

a,c

Figure 15 – Assembly Histograms

a,c

Figure 16 – Assembly Histograms

a,c

Figure 17 – Relative Fuel Rod Histograms

a,c

Figure 18 – Relative Fuel Rod Histograms

a,c

Figure 19 – Relative Fuel Rod Histograms

a,c

Figure 20 – Relative Fuel Rod Histograms

a,c

Figure 21 – Relative Fuel Rod Histograms

a,c

Figure 22 – Relative Fuel Rod Histograms

a,c