VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

March 6, 2007 10 CFR 50.90

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No.	07-0024
NL&OS/GDM	R1
Docket Nos.	50-280
	50-281
License Nos.	DPR-32
	DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
LICENSE AMENDMENT REQUEST
PROPOSED INCREASE IN THE LEAD ROD AVERAGE BURNUP LIMIT

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company (Dominion) requests an amendment to the licensing basis for Facility Operating License Numbers DPR-32 and DPR-37 for Surry Power Station Units 1 and 2. The proposed change will permit irradiation of the Surry fuel assemblies beginning with Surry Improved Fuel (SIF) assemblies with ZIRLO cladding (i.e., excluding older Surry assemblies with Zircaloy-4 cladding) to a lead rod average burnup of 62,000 MWD/MTU. The older fuel assemblies would continue to be limited to a lead rod average burnup of 60,000 MWD/MTU. The current lead rod average burnup limit of 60,000 MWD/MTU was imposed upon Dominion by NRC letters dated December 14, 1993, and April 20, 1994. The proposed increase in burnup will permit more effective fuel management. A discussion of the proposed license amendment request is provided in Attachment 1.

We have evaluated the proposed license amendment request and determined that the proposed increase in the lead rod average burnup does not involve a significant hazards consideration as defined in 10CFR50.92. The basis for this conclusion is provided in Attachment 1. The proposed license amendment and supporting evaluation have been reviewed and approved by the Station Nuclear Safety and Operating Committee.

Because the 60,000 MWD/MTU limit is not explicitly stated in the Surry Units 1 and 2 License Conditions or Technical Specifications, Dominion incorporated the limit into the Surry UFSAR to ensure the limit is not exceeded when reload design evaluations are performed. Upon approval of this request, the Surry UFSAR will be changed to indicate that the Surry cores are being designed to limit the lead rod average burnup to 62,000 MWD/MTU. The proposed UFSAR revision is provided in Attachment 2.

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It should be noted that Attachment 1 includes the following two enclosures:

1. Enclosure 1 (Proprietary), Westinghouse Design Criteria for Surry Units 1 and 2, and
2. Enclosure 2 (Non-Proprietary), Westinghouse Design Criteria for Surry Units 1 and 2 (Redacted)

As Enclosure 1 contains information proprietary to Westinghouse Electric Company LLC, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit 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 Section 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations.

Attachment 3 includes Westinghouse authorization letter, CAW-07-2233, accompanying affidavit, Proprietary Information Notice and Copyright Notice. Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse affidavit should reference CAW-07-2233 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.

Dominion requests approval of the license amendments by November 2007 with a 30-day implementation period to support core design efforts required for the Surry Unit 2 refueling outage currently scheduled for spring 2008.

If you have any questions or require additional information, please contact Mr. Gary D. Miller at (804) 273-2771.

Sincerely,

Gerald T. Bischof
Vice President – Nuclear Engineering

Commitments contained in this letter:

1. The lead rod average burnup limit for Surry fuel will be maintained in the Surry Units 1 and 2 Updated Final Safety Analysis Report.

Attachments:

1. Discussion of Change
   - Enclosure 1 (Proprietary), Westinghouse Design Criteria for Surry Units 1 and 2
   - Enclosure 2 (Non-Proprietary), Westinghouse Design Criteria for Surry Units 1 and 2 (Redacted)
2. Proposed UFSAR Change
3. Westinghouse Application for Withholding of Proprietary Information and Affidavit (CAW-07-2233), Proprietary Information Notice and Copyright Notice

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COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Gerald T. Bischof, who is the Vice President – Nuclear Engineering of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the forgoing document in behalf of that Company, and that the statements in the document are true and correct to the best of his knowledge, information, and belief.

Acknowledged before me this 6TH day of March, 2007.

My Commission Expires: 5-31-10

Vicki L. Hull
Notary Public

(SEAL)

ATTACHMENT 1

Discussion of Change

**Virginia Electric and Power Company
(Dominion)
Surry Power Station Units 1 and 2**

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DISCUSSION OF CHANGE

1.0 INTRODUCTION

Pursuant to 10 CFR 50.90, Virginia Electric and Power Company (Dominion) requests an amendment to the licensing basis for Facility Operating License Numbers DPR-32 and DPR-37 for Surry Power Station Units 1 and 2. The proposed change will permit irradiation of the Surry fuel assemblies beginning with Surry Improved Fuel (SIF) assemblies with ZIRLO cladding (i.e., excluding older Surry assemblies with Zircaloy-4 cladding) to a lead rod average burnup of 62,000 MWD/MTU. The older assemblies would continue to be limited to a lead rod average burnup of 60,000 MWD/MTU. This increase in burnup will permit more effective fuel management.

The proposed license amendment has been reviewed and it has been determined that no significant hazards consideration exists as defined in 10 CFR 50.92. In addition, the proposed change qualifies for categorical exclusion for an environmental assessment as set forth in 10 CFR 51.22(c)(9). Therefore, no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed change.

2.0 BACKGROUND

The NRC has imposed a lead rod average burnup restriction of 60,000 MWD/MTU on Surry fuel. This restriction has required Dominion to degrade recent reload patterns for Surry at an economic penalty to maintain the lead rod average burnup below 60,000 MWD/MTU. The burnup restriction at Surry resulted from a May 1980 request to increase the Surry maximum fuel enrichment to 4.1 weight percent U-235. It was recognized that this enrichment would allow an eventual increase in the discharge fuel burnups, and the NRC Safety Evaluation Report that allowed implementation of this change limited the fuel to a batch average burnup of 37,000 MWD/MTU. In late 1983, Dominion requested removal of this batch average burnup limit, citing a Westinghouse topical report supporting higher burnups (Reference 1). The NRC concluded that it was appropriate to increase the limit to 45,000 MWD/MTU, but not to remove the restriction entirely, as NRC review of the Westinghouse topical report was still in progress.

In 1992, citing the NRC's approval of the Westinghouse high burnup topical report, Dominion again requested that the NRC remove the batch average burnup restriction that had been imposed on the Surry units. Upon review of our request, the NRC increased the batch average burnup restriction to 50,000 MWD/MTU or above, provided that the maximum rod average burnup of any rod is no greater than 60,000 MWD/MTU (References 2 and 3). Because the burnup restriction is not explicitly stated in the Surry Unit 1 and 2 License Conditions or Technical Specifications, it was incorporated into Section 3.5.2.6.1 of the Surry UFSAR (Reference 4) to ensure that it is not exceeded when reload design evaluations are performed.

Since the lead rod average burnup restriction of 60,000 MWD/MTU was imposed upon Dominion in 1993, many programs have been conducted that have expanded the understanding of burnup on fuel properties. In addition, the NRC has approved the use of the Westinghouse fuel rod design codes to a burnup of 62,000 MWD/MTU (Reference 5), and the NRC has had an environmental study completed (Reference 6) that concludes that it is acceptable to burn fuel to 62,000 MWD/MTU. Also, the NRC has approved (Reference 7) the use of Westinghouse fuel products referencing WCAP 12610-P-A (Reference 8) or WCAP-10444-P-A (Reference 9) and evaluated with the PAD 4.0 code to a lead rod average burnup of 62,000 MWD/MTU.

The evolution of the SIF design is shown in Table 1. The key features of the current SIF product are the 15x15 Optimized Fuel Assembly (OFA) grids and ZIRLO cladding. Although Dominion still often refers to the current product as OFA because it retains the OFA mid-grid design, Westinghouse (Reference 10) classifies the product as VANTAGE+ (WCAP 12610-P-A) because of the ZIRLO cladding. ZIRLO cladding was first introduced into Surry in Batch 16 fuel for each unit. Dominion is requesting the NRC to approve a license amendment request for both Surry Unit 1 and Surry Unit 2 that will allow Dominion to irradiate Surry fuel assemblies to a lead rod average burnup of 62,000 MWD/MTU similar to other utilities utilizing Westinghouse fuel. The higher lead rod average burnup limit would apply to all recent Surry fuel, beginning with SIF assemblies with ZIRLO cladding. Older fuel assemblies in the spent fuel pool with Zircaloy-4 cladding, if used, would continue to be limited to a lead rod average burnup of 60,000 MWD/MTU. The lead rod average burnup limit will be maintained in the Surry UFSAR.

Table 1 SIF Product Evolution

Feature	***Batch First Used (Year)***	***Licensing Approach***	***Applicable Topical Report***
SIF: 15x15 OFA grids, guide tube diameter, hold down spring; VANTAGE 5 nozzle heights, guide tube length, removable top nozzle (RTN)	Surry 1 Batch 12 (1988) Surry 2 Batch 12 (1989)	License Amendment (No. 116)	WCAP-9500-A
Standardized high burnup assembly dimensions (guide tube length), debris filter bottom nozzle (DFBN)	Surry 1 Batch 13 (1990) Surry 2 Batch 13 (1991)	10 CFR 50.59	WCAP-9500-A
P-grid (and associated changes to fuel rod bottom end plug length and DFBN flow holes)	Surry 1 Batch 15 (1994) Surry 2 Batch 15 (1995)	10 CFR 50.59	WCAP-9500-A
ZIRLO clad, guide tubes, instrumentation tube, mid-grids	Surry 1 Batch 16 (1995) Surry 2 Batch 16 (1996)	License Amendment (No. 202)	WCAP-12610-P-A

ZIRLO+2 (assembly length increase, increase in rod length, increase in fuel rod bottom end plug length)	Surry 2 Batch 20 (2002) Surry 1 Batch 21 (2003)	10 CFR 50.59	WCAP-12610-P-A
Integral fuel burnable absorber (IFBA), annular 'blanket' pellets in IFBA rods	Surry 1 Batch 23 (2006) Surry 2 Batch 23 (2006)	10 CFR 50.59	WCAP-12610-P-A

3.0 PROPOSED CHANGE

A license amendment is being requested for Surry Units 1 and 2 to revise the licensing basis to permit irradiation of the Surry fuel assemblies beginning with SIF assemblies with ZIRLO cladding to a lead rod average burnup of 62,000 MWD/MTU.

4.0 TECHNICAL EVALUATION

4.1 Core Design

Dominion will use its standard reload methodology (References 11 and 12) to evaluate the cores up to a lead rod average burnup of 62,000 MWD/MTU. The nuclear design models currently being used by Dominion have been used to successfully model lead test assemblies to burnups of approximately 68,000 MWD/MTU. The Framatome lead test assemblies (LTAs) irradiated at North Anna were part of the benchmark dataset used to qualify the Reference 12 code system. The neutronics physics response is not impacted by the slightly higher burnup. Therefore, these models will accurately model reload fuel to 62,000 MWD/MTU.

4.2 Fuel Rod Design

The fuel rod design criteria (including rod internal pressure, clad corrosion, etc.) are evaluated each cycle to ensure that they are satisfied. This evaluation is done with the vendor fuel performance code (Reference 3) that has been approved to 62,000 MWD/MTU. There will be no change to current fuel rod design limits associated with operation of some fuel to 62,000 MWD/MTU. Enclosure 1 discusses the Westinghouse fuel rod design criteria, and lists the limits for the criteria along with typical reload design values for the SIF product. The SIF values are based on studies that were done for recent Surry cycles. Although the lead rod average burnup for these cycles was slightly less than 60,000 MWD/MTU, the margin to the design limits indicates that these limits would not be violated by extending the lead rod average burnup to 62,000 MWD/MTU. It should also be noted that these reload design values are typical and are not necessarily limiting. These values are re-calculated on a cycle by cycle basis.

4.3 Fuel Assembly Mechanical Design

Surry Improved Fuel is a Westinghouse VANTAGE+ fuel design, so the design bases and methodology for this fuel assembly and each of the assembly components are the same as those described for VANTAGE+ fuel in WCAP-12610-P-A. Westinghouse has confirmed that the fuel assembly growth and holddown spring force fuel mechanical design criteria remain satisfied for a burnup well in excess of 62,000 MWD/MTU. Enclosure 1 includes the design limits for these criteria along with typical values for Surry Improved Fuel. Westinghouse also indicated that the other mechanical design criteria regarding interface with the rod cluster control assemblies (RCCAs), core components, and handling equipment, as well as the criteria for the fuel assembly joints and connections are not affected by high burnups.

The fuel assembly is designed to maintain its structural integrity in response to seismic and LOCA loads. The fuel assembly deflection and grid impact force responses are incorporated into the site specific seismic and LOCA analyses to determine the reactor core response and also to verify that the core geometry remains coolable. These seismic and LOCA evaluations are based on unirradiated fuel properties, and so are unaffected by an increase in the allowable lead rod burnup to 62,000 MWD/MTU.

4.4 Safety Analyses

4.4.1 Core Kinetics Parameters

4.4.1.1 Moderator Temperature Coefficient (MTC)

WCAP-10125-P-A indicates that extended burnup fuel management leads to a more negative MTC at end of cycle (EOC). The limiting MTC values for recent Surry cycles were reviewed, and it was determined that sufficient margin exists to accommodate the effects of increasing the lead rod average burnup limit to 62,000 MWD/MTU without affecting the current Surry safety analyses.

4.4.1.2 Doppler Temperature Coefficient

WCAP-10125-P-A indicates that the Doppler coefficient is slightly more negative for extended burnup fuel cycles. A review of the results of recent cycle-specific calculations verified that sufficient margin exists between the reload specific values and those used in the current Surry safety analyses to accommodate the effects of an increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.1.3 Prompt Neutron Lifetime

The prompt neutron lifetime increases with increasing burnup. The reload limit for prompt neutron lifetime is satisfied by comparing the calculated prompt neutron lifetime, obtained from the SIMULATE core model, to the current limit of 26 E-06 seconds. The

SIMULATE cases are run at the cycle burnup limit, which will maximize the prompt neutron lifetime. Recent Surry reload calculations have shown the maximum prompt neutron lifetime to be less than or equal to 23.3 E-06 seconds at maximum batch average burnups of approximately 55,750 MWD/MTU. Therefore, there is enough margin in this parameter to accommodate the increase in lead rod burnup to 62,000 MWD/MTU.

4.4.1.4 Trip Reactivity

Shutdown Margin (SDM)

WCAP-10125-P-A indicates that increased burnup leads to a harder neutron spectrum due to larger plutonium and fission product concentrations. Harder spectrums tend to reduce control rod worth, although the changes are comparable to those for normal reload design variations. The variation in EOC control rod worth for recent Surry reload cycles has been sufficiently below the shutdown margin limit to accommodate the effects of an increase in the lead rod average burnup. There will be no adverse impact on the required shutdown margin used in the safety analysis.

Trip Reactivity

Minimum trip reactivity from both hot full power (HFP) and hot zero power (HZP) conditions shows considerably more margin to the reload safety analysis limits than the shutdown margin analysis. Therefore, the effects of increased burnup on trip reactivity are bounded by those for SDM.

4.4.2 Thermal-Hydraulic / Departure from Nucleate Boiling Ratio (DNBR)

4.4.2.1 Peaking Factors

Peaking factors are typically more limiting near beginning of cycle (BOC) conditions, and decrease with increasing burnups. Peaking is minimized through the use of burnable poisons. The use of burnable poisons will be continued for future reloads; therefore, the uncertainties in the power peak predictions will not be affected by the increased lead rod average burnup limit.

4.4.2.2 Overpower Evaluation

The design basis limit for fuel temperature assures that for Condition I and Condition II events, there is a 95% probability that fuel melt will not occur. The Westinghouse correlation for fuel melting temperature as stated in the UFSAR is:

$$\text{Melt temperature} = [5080 - 58*(\text{Burnup in MWD/MTU} / 10{,}000)]°\text{F}$$

A peak linear heat rate (kW/ft) limit corresponding to the fuel melt temperature limit is determined via a fuel pin thermal analysis. The linear heat rate limit is checked on a reload basis. Previous analyses have shown that fuel temperatures are limiting at beginning of life (BOL). Therefore, evaluation of fuel temperature limits is not impacted by extension of the burnup limit from 60,000 MWD/MTU to 62,000 MWD/MTU.

4.4.2.3 Maximum Spent Fuel Pool Heat Load

The heat load calculation is performed on a cycle by cycle basis. In general, any change that does not increase cycle length, increase core power, or reduce decay time will have an insignificant impact on refueling heat load. The models used in the calculation deal for the most part with sub-batches or entire batches of fuel. Nothing is modeled to the level of pin burnup. Increasing the lead rod average burnup limit to 62,000 MWD/MTU will not increase the batch burnups beyond those used in the heat load calculations.

4.4.3 Specific Accident Considerations

4.4.3.1 Boron Dilution

The limiting boron dilution event occurs at BOC, as reactivity insertion rates associated with boron dilution decrease with decreasing boron concentrations. Therefore, the current Boron Dilution Analysis of Record (AOR) and reload safety analysis parameters are unaffected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.2 Rod Withdrawal from Subcritical

The key input parameter for this transient is the Doppler Temperature Coefficient (DTC), where the current AOR employs a conservative least negative DTC, normalized at BOC HFP fuel temperature conditions. WCAP-10125-P-A states that the Doppler coefficient will become slightly more negative for extended fuel burnups. Therefore, the current Rod Withdrawal from Subcritical AOR and reload safety analysis parameters are unaffected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.3 Rod Withdrawal from Power

The current Rod Withdrawal from Power AOR indicates that the limiting results for both DNBR concerns and primary-side pressurization are obtained by modeling minimum reactivity feedback effects using the least negative BOC Doppler Temperature Coefficient. Since the Doppler coefficient will become slightly more negative for extended fuel burnups as discussed above, the current Rod Withdrawal from Power AOR and reload safety analysis parameters are unaffected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.4 Loss of Load

The minimum EOC delayed neutron fraction is evaluated each reload cycle, with the limiting value being based on the current Loss of External Electrical Load AOR. The reload specific value for this parameter, and thus the margin to the limiting value, has remained consistent through recent cycles. WCAP-10125-P-A indicates that the effective delayed neutron fraction would tend to be lower for extended fuel burnups, due to the larger fraction of fissions in plutonium. However, the change is expected to be small, and can be accommodated by the margin that has existed between recent reload specific values and the minimum value assumed for EOC delayed neutron fraction in the AOR. Therefore, the current Loss of External Electrical Load AOR will not be adversely affected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.5 Loss of Flow

The current Loss of Flow AOR indicates that the limiting results for DNBR concerns are obtained by modeling minimum reactivity feedback effects using the least negative BOC DTC. Since the Doppler coefficient will become slightly more negative for extended fuel burnups, the current Loss of Flow AOR and reload safety analysis parameters will be unaffected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.6 Locked Rotor

An acceptance criterion for the Locked Rotor event requires that the fuel cladding temperature remain below 2700°F to preclude cladding embrittlement and to maintain a coolable core geometry. This acceptance criterion is satisfied through the use of the Surry RETRAN Hot Spot Model, where conservatively high fuel temperatures (including uncertainties) at near-BOL conditions are employed, based on older more conservative Westinghouse models. Since fuel temperatures tend to decrease with burnup, and newer fuel performance models tend to predict lower fuel average temperatures, the Hot Spot Model analysis is not adversely affected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

The impact of increasing the lead rod average burnup limit to 62,000 MWD/MTU on the radiological consequences of this accident are discussed in Section 4.5 of this discussion.

4.4.3.7 Steam Generator Tube Rupture

The Steam Generator Tube Rupture event is relatively insensitive to reactor kinetics parameters, which may be affected by increased fuel burnup. There are no reload safety analysis parameters currently associated with the Steam Generator Tube Rupture AOR.

The impact of increasing the lead rod average burnup limit to 62,000 MWD/MTU on the radiological consequences of this accident are discussed in Section 4.5 of this discussion.

4.4.3.8 Main Steamline Break (MSLB)

The AOR for this event employs the reload safety analysis limit value for most negative EOC DTC to conservatively model reactivity feedback effects. As discussed above, the Doppler coefficient is slightly more negative for extended burnup fuel cycles. Based on the margin to this reload safety analysis parameter demonstrated in recent reloads, this reload safety analysis parameter will not be adversely affected by the increased lead rod average burnup limit of 62,000 MWD/MTU.

Reactivity insertion due to moderator temperature feedback may be potentially increased, as extended fuel burnup may lead to a more negative MTC at EOC as discussed above. The reactivity insertion due to the MSLB event is verified on a reload basis to ensure that the minimum shutdown margin criterion is met.

The impact of increasing the lead rod average burnup limit to 62,000 MWD/MTU on the radiological consequences of this accident is discussed in Section 4.5 of this discussion.

4.4.3.9 Control Rod Ejection

Burnup limits are not stated in the Rod Ejection Topical Report (VEP-NFE-2-A) (Reference 13) or the current Rod Ejection analysis of record. Fuel irradiation limits are implicitly imposed by the VEP-NFE-2-A acceptance criterion that the average hot spot fuel enthalpy remain below 200 cal/gm (360 BTU/lbm) for irradiated fuel. This acceptance criterion is conservative with respect to the current NRC criterion of 280 cal/gm cited in Regulatory Guide 1.77.

For Reactivity-Initiated Accidents such as Control Rod Ejection, fuel cladding failure and core coolability criteria are affected by fuel burnup. The observed burnup dependence of these parameters has occurred within the range of the current burnup limit, and is therefore not a new issue associated with the increased lead rod burnup limit of 62,000 MWD/MTU. These phenomena are currently being investigated by the NRC, and newly proposed acceptance criteria, as a function of burnup, have been drafted by the NRC's Office of Nuclear Reactor Regulation. The exact form of the new limits is the subject of current discussions between industry and the NRC. Pending new regulatory requirements from the NRC, the current fuel enthalpy acceptance criteria of VEP-NFE-2-A remain valid and conservative with respect to Regulatory Guide 1.77.

Hot Spot Model

The RETRAN Hot Spot model used in the Rod Ejection AOR employs fuel modeling assumptions consistent with zero burnup. This is consistent with Westinghouse

FACTRAN models used as a benchmark in the Rod Ejection Topical Report. Therefore, the Hot Spot Model assumptions and associated Rod Ejection results are not impacted by the increased lead rod average burnup limit of 62,000 MWD/MTU.

4.4.3.10 LOCA

The Large Break Loss of Coolant Accident (LBLOCA) analyses employ Westinghouse PAD 4.0 data for fuel average temperatures and rod internal pressures at near-BOL conditions. Fuel average temperatures are maximized at near-BOL conditions, which is conservative for LOCA analyses. The Small Break LOCA analyses use PAD 3.4 data. PAD 3.4 predicts conservatively higher fuel average temperatures than PAD 4.0. Westinghouse has employed the PAD 4.0 code on a forward fit basis. The increase in lead rod burnup to 62,000 MWD/MTU will not impact these LOCA input parameters.

The stack height reduction factor used in the LOCA analyses is verified on a reload basis. The increase in lead rod average burnup to 62,000 MWD/MTU could potentially increase predictions of fuel swelling, but ample margin exists between the reload specific value for recent cycles and the value used in the AOR to accommodate this effect.

The fuel rod stored energy is unaffected by the increased burnup limit. The value used in the AOR is based on PAD 3.4 data for Zircaloy-4 fuel, and used a conservative assumption to account for burned regions of fuel. For ZIRLO fuel, Westinghouse has taken credit for burned regions of fuel to offset the increased ZIRLO fuel temperatures. Fuel average temperatures decrease with burnup, and PAD 4.0 models now approved for use generally provide lower fuel average temperatures than the PAD 3.4 models used to generate input for the Surry AOR. The combination of PAD 4.0 and increased burnup credit generally results in lower fuel average temperatures, and therefore lower core stored energy.

4.4.3.11 Loss of Normal Feedwater

The total fuel rod stored energy for the Loss of Normal Feedwater analysis is unaffected by the increased burnup limit for reasons similar to those described above for the LOCA analysis.

4.4.3.12 Fuel Handling Accident

The impact of increasing the lead rod average burnup limit to 62,000 MWD/MTU on the radiological consequences of this accident are discussed in Section 4.5 of this discussion.

4.5 Radiological Consequences

Extending the burnup to 62,000 MWD/MTU at Surry will not affect normal plant effluents. The effects of high burnups on source terms and the associated doses have been discussed in a previous document (Reference 14). The evaluations determined that operation to high burnups increases the inventory of certain long lived fission products such as Cs-134 and Cs-137, but even with routine operation of entire reload batches to high burnup and no changes in the reactor coolant cleanup, there would be only a small increase in the annual release of these isotopes.

The accidents where the radiological consequences may be impacted by the presence of slightly higher burnup fuel fall into three categories: 1) the fuel handling accident, 2) accidents with cladding failure only, and 3) accidents with cladding failure and fuel melt.

The doses from the fuel handling accident are dependent upon the fuel rod gap fraction. Under the alternate source term methodology applied in the Surry fuel handling accident analysis, the fuel rod gap fraction is dependent upon the assembly average burnup and relative power distribution (RPD). This impact is evaluated on a cycle specific basis as part of the reload safety analysis checklist process.

For accidents such as the steam generator tube rupture (SGTR) and the main steam line break (MSLB), no fuel failures are predicted to occur as a consequence of the accident, and the calculated doses are based on failures that exist at the time of the accident. Specifically, the analyses of these accidents assume that the initial primary and secondary coolant activities are at the Technical Specifications limits for Dose Equivalent I-131. The case that assumes a pre-accident iodine spike assumes that the spike is at the limit defined in the Technical Specifications. The case that assumes a concurrent iodine spike uses an appearance rate specified by regulations. These limits are not sensitive to changes in burnup.

For Surry, analyses of loss of flow accidents show that the minimum DNBR does not decrease below the limit; therefore no cladding failure or release of fission products is predicted. For the current Surry locked rotor accident (LRA) NSSS thermal hydraulic analysis, no fuel rods are predicted to experience DNB. However, the offsite dose calculation for the LRA conservatively assumes failure and gap activity release for 1.4% of the fuel rods. In general, any failures during a LRA would likely occur in high power locations because high power rods are more likely to enter a boiling regime. The gap fraction used in the LRA analysis is valid to 62,000 MWD/MTU provided that the peak rod average linear heat rate is less than 6.3 kw/ft ($F\Delta H < 0.974$) for burnup greater than 54,000 MWD/MTU (Reference 15). Fuel rods with a burnup of 62,000 MWD/MTU would be operating at powers at or below the core average and would not fail for this accident scenario. The acceptability of the LRA analysis is evaluated on a cycle specific basis as part of the reload safety analysis checklist process by continuing to validate that the minimum DNBR does not decrease below the limit; therefore, no cladding failure or release of fission products is predicted.

The LBLOCA, SBLOCA, and rod ejection accident fall into a class of accidents that predict both cladding failure and some fuel melt. Dose calculations for these accidents are bounded by the evaluation of the LBLOCA, which conservatively assumes damage to the entire core. The Surry LBLOCA follows the guidelines of Reference 15, which requires the dose calculations be based on specific distributions of the core inventory of fission products. The core inventory modeled in the Surry LBLOCA is based on the ORIGEN2 code with 3 regions (batches) of fuel, where the batch average burnup for the 3^{rd} cycle batch of fuel is approximately 50,000 MWD/MTU. Normal variation of batch burnups will not impact the LOCA dose analysis since, as for most accidents, the doses are primarily due to short lived iodine and noble gas isotopes, and the core inventory of these isotopes is primarily a function of operating power rather than cumulative burnup. Extending lead rod average burnups to 62,000 MWD/MTU will not significantly change the EOC batch average burnup for the 3^{rd} cycle assemblies, and the LOCA dose analysis of record will remain applicable.

4.6 Industry Operating Events

4.6.1 Incomplete Rod Insertion

During the mid to late 1990s, the industry experienced several incomplete control rod insertion (IRI) events due to guide tube distortion in Westinghouse designed fuel assemblies. In response to these events, the NRC issued NRC Bulletin 96-01, "Control Rod Insertion Problems," requesting that the licensees determine the continued operability of control rods in their units and continue to collect data at higher burnups to determine the extent of the issue.

In response to this Bulletin, the industry provided significant data through the Westinghouse Owners Group. WCAP-15712 (Proprietary), "IRI Burnup Threshold Assessment Program," documents the results of the effort to collect data for Westinghouse twelve (12) foot fuel assemblies at burnups greater than 50,000 MWD/MTU (assembly average). Transmittal of this document completed the high burnup threshold assessment program. Based upon this project, the IRI burnup threshold for Westinghouse 15x15 fuel designs with ZIRLO guide tubes (both with and without Integral Flow Mixing (IFMs) grids) was set at 57,000 MWD/MTU (assembly average). If a rodded fuel assembly is projected to exceed this threshold burnup, a mechanical evaluation is performed to assess potential susceptibility to IRI.

The current fuel assembly design being used in the Surry reactors is Westinghouse 15x15 fuel with the Optimized Fuel Assembly (OFA) grid design and ZIRLO cladding and guide tubes, but without Integral Flow Mixing (IFM) grids. Therefore, the current burnup threshold for IRI in the Surry units is 57,000 MWD/MTU (assembly average). In past reload designs at Surry, no Surry Rod Cluster Control Assemblies (RCCAs) have been placed in assemblies that have exceeded an assembly average burnup of 57,000 MWD/MTU. Therefore, no specific IRI evaluations have had to be performed for past cycles.

Although the extension of the lead rod average burnup limit to 62,000 MWD/MTU may slightly raise the assembly average burnup for a few assemblies, the Surry reload designs will typically place RCCAs in assemblies that achieve a much lower burnup. However, if a reload design places an RCCA in an assembly that achieves an assembly average burnup greater than 57,000 MWD/MTU during the cycle, an evaluation will be performed to determine the acceptability of placing the RCCA in the assembly. If the calculation yields unacceptable results, the core will have to be redesigned.

5.0 REGULATORY SAFETY ASSESSMENT

5.1 No Significant Hazards Consideration

Virginia Electric and Power Company (Dominion) proposes to irradiate the fuel assemblies in the Surry Unit 1 and Unit 2 reactors to a lead rod average burnup of 62,000 MWD/MTU beginning with the Surry Improved Fuel assemblies with ZIRLO cladding.

Operation of the Surry cores with a limited number of fuel assemblies with some fuel rods irradiated to a lead rod average burnup of 62,000 MWD/MTU will not compromise the safe operation of the plants. Existing design criteria will remain applicable and will be satisfied for fuel operating to the higher burnup. No changes are required to the Operating Licenses or Technical Specifications; however, NRC approval of the license amendment request is required to increase the lead rod average burnup to 62,000 MWD/MTU because Dominion is currently limited to 60,000 MWD/MTU by References 2 and 3.

Irradiation of the standard production fuel at Surry to a lead rod average burnup of 62,000 MWD/MTU does not involve a significant hazards consideration as defined in 10 CFR 50.92. The basis for this determination is delineated below:

1. The probability of occurrence or the consequence of an accident previously evaluated is not significantly increased.

   The activity being evaluated is a slight increase in the lead rod average burnup limit for the fuel assemblies. No change in fuel design or fuel enrichment will be required to increase the lead rod average burnup. The fuel rods at the extended lead rod average burnup will continue to meet the design limits with respect to fuel rod growth, clad fatigue, rod internal pressure and corrosion. There will be no impact on the capability to engage the fuel assemblies with the handling tools. Therefore, it is concluded that the change will not result in an increase in the probability of occurrence of any accident previously evaluated in the UFSAR. The impact of extending the lead rod average burnup to 62,000 MWD/MTU from 60,000 MWD/MTU on the Core Kinetics Parameter, Core Thermal-Hydraulics/DNBR, Specific Accident Considerations, and Radiological Consequences was considered. Based on the evaluation of these considerations, it is concluded that increasing the lead rod average burnup limit to 62,000 MWD/MTU will not result in a significant increase in the consequences of the accidents previously evaluated in the Surry UFSAR.

2. The possibility for a new or different type of accident from any accident previously evaluated is not created.

   The fuel is the only component affected by the change in the burnup limit. The change does not affect the thermal hydraulic response to any transient or accident. The existing fuel rod design criteria continue to be met at the higher burnup limit. Thus, the change does not create the possibility of an accident of a different type.

3. The margin of safety as defined in the Bases to the Surry Technical Specifications is not significantly reduced.

   The operation of the Surry cores with a limited number of fuel assemblies with some fuel rods irradiated to a lead rod average burnup of 62,000 MWD/MTU will not change the performance requirements of any system or component such that any design criteria will be exceeded. The normal limits on core operation defined in the Surry Technical Specifications will remain applicable for the irradiation of the fuel to a lead rod average burnup of 62,000 MWD/MTU. Therefore, the margin of safety as defined in the Bases to the Surry Technical Specifications is not significantly reduced.

5.2 Environmental Assessment

The NRC has completed an environmental assessment of the effects of extending fuel burnup above 60,000 MWD/MTU (Reference NUREG/CR-6703, January 2001). The environmental effects of extending the Surry lead rod average burnup limit to 62,000 MWD/MTU are bounded by the NUREG.

6.0 CONCLUSION

The lead rod average burnup limit for the Surry units is currently limited to 60,000 MWD/MTU by References 2 and 3. Approval of the proposed amendment will allow Dominion to begin designing reloads to a lead rod average burnup limit of 62,000 MWD/MTU. Recent reload patterns have been degraded at an economic penalty to maintain the burnup below the existing limit.

The irradiation of a limited number of assemblies containing a few fuel rods that are irradiated to a lead rod average burnup limit of 62,000 MWD/MTU will not compromise the safe operation of the Surry units. Cycle specific reload calculations to confirm this conclusion will be performed and documented as part of the normal Reload Safety Evaluation. Preliminary evaluations discussed above indicate that assemblies containing rods irradiated to a lead rod average burnup of 62,000 MWD/MTU will remain acceptable from a fuel assembly and fuel rod mechanical standpoint. Core design and safety analysis limits will continue to be met.

If the cycle specific evaluations are unable to demonstrate that a design criterion will be satisfied or that the safety analyses of record remain bounding for a given loading pattern, an alternate reload pattern will be developed or the burnup will be limited to a value where all criteria remain satisfied.

7.0 REFERENCES

1. WCAP-10125-P,"Extended Burnup Evaluation of Westinghouse Fuel," December 1982.

2. Letter from the NRC (Mr. B. C. Buckley, Sr. and Mr. L. B. Engle) to Virginia Electric and Power Company (Mr. W. L. Stewart), "Surry, Units 1 and 2 and North Anna, Units 1 and 2 – Removal of 45,000 MWD/MTU Batch Average Burnup Restriction (TAC NOS. M87767, M87768, M87812, and M87813)," December 14, 1993.

3. Letter from the NRC (Mr. B. C. Buckley, Sr. and Mr. L. B. Engle) to Virginia Electric and Power Company (Mr. W. L. Stewart), "Surry, Units 1 and 2 and North Anna, Units 1 and 2 – Removal of 45,000 MWD/MTU Batch Average Burnup Restriction (TAC NOS. M87767, M87768, M87812, and M87813)," April 20, 1994.

4. Surry Updated Final Safety Analysis Report.

5. WCAP-15063-P-A, Revision 1, with Errata, "Westinghouse Improved Performance Analysis and Design Model (PAD 4.0)," July 2000.

6. NUREG/CR-6703, "Environmental Effects of Extending Fuel Burnup Above 60 GWD/MTU," January 2001.

7. Letter from U.S. Nuclear Regulatory Commission (J. D. Peralta), "Approval for Increase Licensing Burnup Limit To 62,000 MWD/MTU (TAC NO. MD1486)," May 25, 2006.

8. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995.

9. WCAP-10444-P-A, "Reference Core Report VANTAGE 5 Fuel Assembly," September 1985.

7.0 REFERENCES (cont'd)

10. Letter from Westinghouse (B. F. Mauer) to the U.S. Nuclear Regulatory Commission, "Clarification on 62,000 MWD/MTU Lead Rod Average Burnup (Proprietary, Non-Proprietary)," LTR-NRC-05-62, October 20, 2005.

11. Dominion Topical Report VEP-FRD-42 Rev.2.1-A, "Reload Nuclear Design Methodology," August 2003.

12. Dominion Topical Report VEP-NAF-1-Rev.0.0-P-A, "Qualification of the Studsvik Core Management System Reactor Physics Methods for Application to North Anna and Surry Power Stations," June 2003.

13. VEP-NFE-2-A, "VEPCO Evaluation of Control Rod Ejection Transient," September 26, 1984.

14. S. L. Davidson (Ed.) et al., "VANTAGE+ Fuel Assembly Reference Core Report," WCAP-14342-A (Non-Proprietary), April 1995.

15. NRC Regulatory Guide 1.183, Rev. 0, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," July 2000.

ATTACHMENT 3

Westinghouse Application for Withholding of Proprietary Information and Affidavit (CAW-07-2233), Proprietary Information Notice and Copyright Notice

Virginia Electric and Power Company
(Dominion)
Surry Power Station Units 1 and 2

Westinghouse

Westinghouse Electric Company
Nuclear Services
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Our ref: CAW-07-2233

January 24, 2007

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Virginia Electric and Power Company, Surry Power Station Units 1 and 2, License Amendment Request (Dominion Letter 07-0024), Proposed Increase in the Lead Rod Average Burnup Limit, Enclosure 1: Westinghouse Design Criteria for Surry Units 1 and 2 (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-07-2233 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 Dominion Generation and Virginia Electric and Power Company.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-07-2233 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,

[signature] for

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

Enclosures

cc: F. Akstulewicz/NRR
R. Landry/NRR
J. Thompson/NRR
G. Cranston/NRR

CAW-07-2233

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared B. F. Maurer, 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:

B. F. Maurer, Principal Engineer
Regulatory Compliance and Plant Licensing

Sworn to and subscribed before me
this 24th day of January, 2007

Sharon L. Fiori
Notary Public

Notarial Seal
Sharon L. Fiori, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires January 29, 2007
Member, Pennsylvania Association Of Notaries

(1) I am Principal Engineer, 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 "Virginia Electric and Power Company, Surry Power Station Units 1 and 2, License Amendment Request (Dominion Letter 07-0024), Proposed Increase in the Lead Rod Average Burnup Limit, Enclosure 1: Westinghouse Design Criteria for Surry Units 1 and 2 (Proprietary)", for review and approval, being transmitted by the Dominion Generation and Virginia Electric and Power Company letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse for Surry Power Station Units 1 and 2 is in support of their licensing amendment request.

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

(a) Provide technical information in support of fuel design criteria.

(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 Westinghouse fuel designs.

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.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

Copyright Notice

ENCLOSURE 2
(NON-PROPRIETARY)

Westinghouse Design Criteria for Surry Units 1 and 2 (REDACTED)

Virginia Electric and Power Company
(Dominion)
Surry Power Station Units 1 and 2

Westinghouse Design Criteria for Surry Units 1 and 2

The following design criteria definitions have been previously licensed by the U.S. NRC[(1)(2)(3)(4)(5)(6)] and are provided for information purposes only (i.e., not for review and approval). The reload design values provided in the subsequent table are typical values that are representative of both Surry Unit 1 and 2 and may vary from cycle to cycle. The reload fuel for Surry Unit 1 and 2 is the VANTAGE + fuel. Other parameters considered in these analyses are an enrichment of 4.30*, ZIRLO™** cladding, ZIRLO™ fabricated guide thimble tubes and instrumentation tube, ZIRLO™ fabricated mid-grids, annular axial blankets, IFBA, $F_Q = 2.32$, $F_{\Delta H}$ = 1.56 (statistical)/1.62 (non-statistical), average linear power = 6.47 kW/ft, CAOC ± 5%, coordinated pH chemistry control held constant at 7.1 pH with an allowed 3.5 ppm Lithium.

RIP - Gap Reopening: The rod internal pressure (RIP) limit is defined as the pressure where the sum of the thermal creep strain rate, irradiation creep strain rate, and growth strain rate exceeds the fuel pellet swelling rate. Rod internal pressure is dependent on the local power and burnup, but is primarily dependant on clad temperature.

RIP - DNB Propagation: The internal pressure of the lead rod in the reactor will be limited to a value below that which could cause extensive DNB propagation to occur.

Clad Corrosion: The fuel system will not be damaged due to excessive fuel clad oxidation. The fuel system will be operated to prevent significant degradation of mechanical properties of the clad at low temperatures, due to hydrogen embrittlement caused by formation of zirconium hydride platelets. The design limits applied to the clad oxidation evaluations are that calculated clad temperature (oxide to metal interface) shall be less than [ ] $^{a, c}$ during steady state operation, and for Condition II transients the metal to oxide interface temperature shall not exceed [ ] $^{a, c}$. The design limit for hydrogen pickup level shall be less

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* Maximum fuel enrichment limited to 4.3 w/o U^{235} per Technical Specification Section 5.3.A.3.

** ZIRLO™ trademark is property of Westinghouse Electric Company, LLC.

than or equal to [ ] [a, c] at the end of projected life. [ ] [a, c].

Clad Stress: The design limit for fuel rod cladding stress under Condition I and II modes of operation is that the volume average effective stress calculated with the von Mises equation, considering interference due to uniform cylindrical pellet-to-clad contact (caused by pellet thermal expansion and swelling, uniform clad creep, and fuel rod coolant system pressure differences), is less than the 0.2 percent offset yield stress with consideration of temperature and irradiation effects.

Clad Strain – Transient*:** The acceptance limit for fuel rod clad strain during Condition II events is that the total tensile strain due to uniform cylindrical pellet thermal expansion is less than 1% from the pre-transient value.

Clad Strain - Steady State*:** For steady-state operation the total plastic tensile creep strain due to uniform clad creep and uniform cylindrical fuel pellet expansion associated with fuel swelling and thermal expansion is less than 1% from unirradiated condition.

Clad Fatigue*:** The fatigue life usage factor shall be less than 1.0. That is for a given strain range, the number of strain fatigue cycles are less than those required for failure, considering a minimum safety factor of 2 on the stress amplitude or a minimum safety factor of 20 on the number of cycles, whichever is more conservative.

Plenum Clad Support*:** The fuel rod in the plenum region will not collapse during normal operating conditions for the fuel rod design lifetime. [ ] $^{a, c}$.

Clad Flattening*:** The fuel rod design shall preclude clad flattening during the projected exposure.

Clad Free Standing*:** The clad free standing criterion prevents the possible instantaneous collapse of the clad onto the fuel pellet or plenum spring due to the pressure differential across the clad wall. [ ] $^{a, c}$.

Fuel Centerline Temperature*:** The design limit for fuel temperature analyses during Condition I and Condition II events is that there is at least a 95% probability at a 95% confidence level that the peak kW/ft fuel rods will not exceed the UO_2 melting temperature. The melting temperature of unirradiated UO_2 is taken as 5080 °F, decreasing by 58 °F per 10,000 MWD/MTU exposure. [ ] $^{a, c}$.

Rod/Assembly Axial Growth*:** The space between the fuel rod end plug-to-end plug outer dimension and the lower nozzle-to-top adaptor plate inner dimension shall be sufficient to preclude interference of these members. The spacing between the fuel assembly outer dimension and the top and bottom core plate inner dimension shall be sufficient to preclude interference of these members.

Fretting Wear*:** The design basis for fuel rod fretting wear is that fuel rods shall be designed not to fail due to fretting wear during Condition I and II operation. This is met through the use of a general guide for wall thickness reduction [ ] $^{a, c}$ which is a percent of the original wall thickness.

Fuel Assembly Holddown*:** The fuel assembly holddown springs are designed to keep the fuel assemblies in contact with the lower core plate under all Condition I and II events with the exception of the turbine overspeed transient associated with a loss of external load. A turbine overspeed transient following loss-of-load may cause a fuel assembly lift for a short period of time. Such lifting is expected to be infrequent, but all fuel assembly holddown springs will accommodate the added deflection and function normally following the transient.

*** Typical, generic analysis which has been reviewed and audited by the U. S. NRC (Nuclear Performance and Code Review Branch) on numerous occasions, most recently April 10, 2006 (LTR-NRC-06-21, dated April 19, 2006).

References:

1. WCAP-10125-P-A, "Extended Burnup Evaluation of Westinghouse Fuel," December 1985.

2. WCAP-12488-A, "Westinghouse Fuel Criteria Evaluation Process," October 1994 and WCAP-12488-A, Addendum 1-A, Revision 1, "Addendum 1 to WCAP-12488-A Revision to Design Criteria," January 2002.

3. WCAP-10444-P-A, "Reference Core Report VANTAGE 5 Fuel Assembly," September 1985.

4. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995.

5. WCAP-13589-A, "Assessment of Clad Flattening and Densification Power Spike Factor Elimination in Westinghouse Nuclear Fuel," March 1995.

6. WCAP-8963-P-A, "Safety Analysis for the Revised Fuel Rod Internal Pressure Design Basis," August 1978.

Westinghouse Design Criteria for Surry Units 1 and 2

a. b. c

[ ]

* The design limit percentages are based on the plant specific transient analyses and address the corresponding dose analysis.

Westinghouse Design Criteria for Surry Units 1 and 2

a, b, c

[ ]

** Region aa and bb represent different fuel batches in their third operating cycle. Region cc represents fuel in its second cycle, and Region dd is representative of fuel in its first cycle of operation.

† Holddown force requirements are internal Westinghouse criteria, not licensed with the NRC.