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U.S. Nuclear Regulatory Commission Attention: Document Control Desk Washington, DC 20555



10 CFR 50.46

19-246 Serial No.: NRA/GDM: R0 · Docket Nos.: 50-336/423 50-338/339 50-280/281

License Nos.: DPR-65/NPF-49 NPF-4/7 DPR-32/37

DOMINION ENERGY NUCLEAR CONNECTICUT, INCORPORATED (INC.) VIRGINIA ELECTRIC AND POWER COMPANY MILLSTONE POWER STATION UNITS 2 AND 3 NORTH ANNA POWER STATION UNITS 1 AND 2 SURRY POWER STATION UNITS 1 AND 2 2018 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

In accordance with 10 CFR 50.46(a)(3)(ii), Dominion Energy Nuclear Connecticut, Inc. (DENC) and Virginia Electric and Power Company (Dominion Energy Virginia) hereby submit the annual summary of permanent changes to the ECCS evaluation models (EMs) for Millstone Power Station (MPS) Units 2 and 3, North Anna Power Station (NAPS) Units 1 and 2, and Surry Power Station (SPS) Units 1 and 2, respectively.

Attachment 1 to this letter provides a report describing plant-specific EM changes associated with the Westinghouse and Framatome Small Break Loss of Coolant Accident (SBLOCA) and Large Break Loss of Coolant Accident (LBLOCA) ECCS EMs for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2, as applicable.

Information regarding the effect of the ECCS EM changes upon the reported SBLOCA and LBLOCA analyses of record results is provided for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 in Attachments 2, 3, and 4, respectively. The calculated Peak Cladding Temperatures (PCT) for the SBLOCA and LBLOCA analyses for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are summarized below:

Small Break - Framatome EM:	1714°F
Large Break - Framatome EM (Zr4 fuel):	1845°F
Large Break - Framatome EM (M5 fuel):	1615°F
Small Break - Westinghouse EM:	1193°F
Large Break - Westinghouse EM:	1933°F
Small Break - Westinghouse EM:	1834.1°F
Large Break - Westinghouse EM:	1982°F
Small Break - Westinghouse EM:	2012°F
Large Break - Westinghouse EM:	2071°F
	Small Break - Framatome EM: Large Break - Framatome EM (Zr4 fuel): Large Break - Framatome EM (M5 fuel): Small Break - Westinghouse EM: Large Break - Westinghouse EM: Small Break - Westinghouse EM: Small Break - Westinghouse EM: Small Break - Westinghouse EM: Large Break - Westinghouse EM:

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The LOCA results for MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are confirmed to have sufficient margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements.

The information contained herein satisfies the 2018 annual reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any questions regarding this submittal, please contact Mr. Gary D. Miller at (804) 273-2771.

Respectfully,

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Mark D. Sartain Vice President - Nuclear Engineering and Fleet Support Dominion Energy Nuclear Connecticut, Inc. Virginia Electric and Power Company

Commitments made in this letter: None

Attachments:

- 1. Report of Changes in Framatome and Westinghouse ECCS Evaluation Models
- 2. 2018 Annual Reporting of 10 CFR 50.46 Margin Utilization Millstone Power Station Units 2 and 3
- 3. 2018 Annual Reporting of 10 CFR 50.46 Margin Utilization North Anna Power Station Units 1 and 2
- 4. 2018 Annual Reporting of 10 CFR 50.46 Margin Utilization Surry Power Station Units 1 and 2

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cc: U. S. Nuclear Regulatory Commission, Region I Regional Administrator 2100 Renaissance Blvd., Suite 100 King of Prussia, PA 19406-2713

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Attachment 1

2018 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

REPORT OF CHANGES IN FRAMATOME AND WESTINGHOUSE ECCS EVALUATION MODELS

DOMINION ENERGY NUCLEAR CONNECTICUT, INC. VIRGINIA ELECTRIC AND POWER COMPANY MILLSTONE POWER STATION UNITS 2 AND 3 NORTH ANNA POWER STATION UNITS 1 AND 2 SURRY POWER STATION UNITS 1 AND 2

REPORT OF CHANGES IN FRAMATOME AND WESTINGHOUSE ECCS EVALUATION MODELS

Millstone Power Station Unit 2

- 1. Framatome identified no changes or errors applicable to the EMF-2328(P)(A), Revision 0, with Supplement 1 evaluation model for Small Break LOCA (SBLOCA) for Millstone Unit 2 during 2018.
- 2. Framatome identified no changes or errors applicable to the SEM/PWR-98 evaluation model for Large Break LOCA (LBLOCA) for Millstone Unit 2 during 2018. This evaluation model is applicable to the Millstone Unit 2 fuel with Zr-4 cladding.
- 3. On January 24, 2017, a new LBLOCA analysis was approved by the NRC, based upon the EMF-2103(P)(A), Revision 3, "Realistic Large Break LOCA (RLBLOCA) Methodology for Pressurized Water Reactors." The new analysis is applicable to the Framatome Standard CE14 HTP fuel product with the M5[™] fuel rod cladding.

Framatome identified no changes or errors applicable to the EMF-2103(P)(A), Revision 3, evaluation model for RLBLOCA for Millstone Unit 2 during 2018.

Millstone Power Station Unit 3

- 1. Westinghouse identified the following change and error applicable to the 1985 Westinghouse SBLOCA Evaluation Model (EM) with NOTRUMP for Millstone Unit 3 during 2018:
 - <u>UO2 FUEL PELLET HEAT CAPACITY.</u> A typographical error was discovered in the implementation of the UO2 fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA EMs. The erroneous formulation results in an overprediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. The small overprediction in UO2 fuel pellet heat capacity has been evaluated to have a negligible effect on existing Large and Small Break LOCA analysis results, due to the small magnitude of the change, leading to an estimated Peak Clad Temperature (PCT) impact of 0°F.
- 2. Westinghouse identified the following changes and errors applicable to the 2004 Westinghouse Best Estimate (BE) LBLOCA EM using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for Millstone Unit 3 during 2018:
 - <u>VAPOR TEMPERATURE RESETTING.</u> In the WCOBRA/TRAC and WCOBRA/TRAC-TF2 codes, when the vapor temperature is greater than the wall temperature and several other conditions are met, the vapor temperature is

reset to the saturation temperature for heat transfer calculations. It was discovered that this vapor temperature resetting logic results in an inconsistency between the conduction solution and the hydraulic solution, such that energy is not conserved between the two solutions. Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations leading to an estimated peak cladding temperature impact of 0°F.

 <u>MILLSTONE UNIT 3 CYCLE 20 PBOT/PMID VIOLATIONS.</u> The Millstone Unit 3 Cycle 20 reload core design resulted in violations of the PBOT/PMID box used in the LBLOCA analysis. These violations were evaluated for Millstone Unit 3 Cycle 20 operation. This item represents a change in plant configuration or associated set points, distinguished from an EM change in Section 4 of WCAP-13451. The PCT impact of the PBOT/PMID violations for Millstone Unit 3 Cycle 20 was determined via a plant-specific evaluation to be 0°F.

Cycle 20 operation began in spring 2019, and thus the evaluation is included as a planned modification in Attachment 2.

North Anna Power Station Units 1 and 2

- 1. Westinghouse identified the following change and error applicable to the 1985 Westinghouse SBLOCA EM with NOTRUMP for North Anna Units 1 and 2 during 2018:
 - <u>UO2 FUEL PELLET HEAT CAPACITY.</u> A typographical error was discovered in the implementation of the UO2 fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA EMs. The erroneous formulation results in an overprediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. The small over-prediction in UO2 fuel pellet heat capacity has been evaluated to have a negligible effect on existing Large Break and Small Break LOCA analysis results due to the small magnitude of the change, leading to an estimated PCT impact of 0°F.
- 2. Westinghouse identified the following change and error applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for North Anna Units 1 and 2 during 2018:
 - <u>VAPOR TEMPERATURE RESETTING.</u> In the WCOBRA/TRAC and WCOBRA/TRAC-TF2 codes, when the vapor temperature is greater than the wall temperature, and several other conditions are met, the vapor temperature is reset to the saturation temperature for heat transfer calculations. It was discovered that this vapor temperature resetting logic results in an

inconsistency between the conduction solution and the hydraulic solution, such that energy is not conserved between the two solutions. Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations leading to an estimated peak cladding temperature impact of 0°F.

Surry Power Station Units 1 and 2

- 1. Westinghouse identified the following change and error applicable to the 1985 Westinghouse SBLOCA EM with NOTRUMP for Surry Units 1 and 2 during 2018:
 - <u>UO2 FUEL PELLET HEAT CAPACITY.</u> A typographical error was discovered in the implementation of the UO2 fuel pellet heat capacity as described by Equation C-4 of WCAP-8301 [1] for fuel rod heat-up calculations within the Appendix K Large Break and Small Break LOCA EMs. The erroneous formulation results in an overprediction of heat capacity that increases with fuel temperature. The corrected formulation results in a maximum decrease in heat capacity on the order of approximately 1.2% for existing analyses of record. The small overprediction in UO2 fuel pellet heat capacity has been evaluated to have a negligible effect on existing Large Break and Small Break LOCA analysis results due to the small magnitude of the change leading to an estimated PCT impact of 0°F.
- 2. Westinghouse identified the following change and error applicable to the 2004 Westinghouse BE LBLOCA EM using ASTRUM for Surry Units 1 and 2 during 2018:
 - <u>VAPOR TEMPERATURE RESETTING.</u> In the WCOBRA/TRAC and WCOBRA/TRAC-TF2 codes, when the vapor temperature is greater than the wall temperature, and several other conditions are met, the vapor temperature is reset to the saturation temperature for heat transfer calculations. It was discovered that this vapor temperature resetting logic results in an inconsistency between the conduction solution and the hydraulic solution, such that energy is not conserved between the two solutions. Engineering judgement supported by sensitivity calculations showed that correcting this error had minimal impact on LOCA transient calculations leading to an estimated peak cladding temperature impact of 0°F.

Conclusion

The LOCA results for Millstone Units 2 and 3, North Anna Units 1 and 2, and Surry Units 1 and 2 are confirmed in the PCT rackup tables, Attachments 2 through 4, to have margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements. Reporting of this information is required per 10 CFR 50.46(a)(3)(ii),

which obligates each licensee to report the effect upon calculated temperature of any change or error in EMs or their application on an annual basis.

This information satisfies the annual reporting requirements of 10 CFR 50.46(a)(3)(ii) for calendar year 2018.

Reference:

[1] WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis," June 1974.

Attachment 2

2018 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2018 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

DOMINION ENERGY NUCLEAR CONNECTICUT, INC. MILLSTONE POWER STATION UNITS 2 AND 3

10 CFR	50.46 MARGIN UTILIZATION - SMALL BREA	K LOCA
Plant N	Millstone Power Station, Unit 2	
Utility	Name: Dominion Energy Nuclear Connec	cticut, Inc.
Analys	is Information	
EM:	2015, Supp. 1, SBLOCA, S-RELAP5 Based	Limiting Break Size: 3.78 Inches
Analys	is Date: April 2015	
Vendo	r: Framatome	
Peak L	inear Power: 15.1 kW/ft	
Notes:	None	
		<u>Clad Temp (°F)</u>
LICEN	ISING BASIS	
	Analysis of Record PCT	1707
PCT A	SSESSMENTS (Delta PCT)	
А.	Prior ECCS Model Assessments	
	1. Zirc-4 Product Penalty	4
	2. M5 LOCA Swelling and Rupture	0
	3. S-RELAP5 Oxidation Calculations	3
B.	Planned Plant Modification Evaluations	
_	1. None	0
C.	2018 ECCS Model Assessments	Y
	1. None	0
D.	Other	
	1. None	0
LICEN	ISING BASIS PCT + PCT ASSESSMENTS	PCT = 1714

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10 CF	<u>R 50.46</u>	MAR	GIN UTILIZATION - LARGE BREAK LOCA		
Plant l	Name:		Millstone Power Station, Unit 2		
Utility	Name:		Dominion Energy Nuclear Connecticut, Inc.		
Analys	sis Info	rmatio	<u>1</u>	•	
EM:	-		SEM/PWR-98 Limiting Break Siz	e: 1.0 DE	ECLG
Analys	sis Date	:	November 1998		
Vendo	or:		Framatome		
Peak I	Linear I	Power:	15.1 kW/ft		
Notes:			None		
				Clad T	<u>emp (°F)</u>
LICE	NSING	BASIS			
	Analys	is of Re	ecord PCT	1	814
PCT A	SSESS	MENT	'S (Delta PCT)		
A.	Prior I	ECCS I	Vodel Assessments		
	1.	Correc	ted Corrosion Enhancement Factor	-	1
	2.	ICECC	ON Coding Errors	C)
	3.	Setting	RFPAC Fuel Temperatures at Start of Reflood	-	2
	4.	SISPU	NCH/ujun98 Code Error	C)
	5.	Error i	n Flow Blockage Model in TOODEE2	C)
	6.	Change	e in TOODEE2-Calculation of OMAX	C)
	7.	Change	e in Gadolinia Modeling	Č)
	8.	PWR I	BLOCA Split Break Modeling	ĺ.)
	9.	TEOB	Y Calculation Error	Č)
	10.	Inappr	opriate Heat Transfer in TOODEE2	()
	11.	End-of	-Bypass Prediction by TEOBY	()
	12.	R4SS (Overwrite of Junction Inertia	C)
	13.	Incorre	ect Junction Inertia Multipliers	1	
	14.	Errors	Discovered During RODEX2 V&V	Č)
	15.	Error i	n Broken Loop SG Tube Exit Junction Inertia	C)
	16.	RFPA	C Refill and Reflood Calculation Code Errors	1	6
	17.	Incorre	ect Pump Junction Area Used in RELAP4	Č)
	18.	Error in	n TOODEE2 Clad Thermal Expansion	_	1
	19.	Accum	ulator Line Loss Error	-	1
	20.	Incons	istent Loss Coefficients Used for Robinson LBLOC	CA C)
	21.	Pump]	Head Adjustment for Pressure Balance Initialization	1 -	3
	22.	ICECC	N Code Errors	C)
	23.	Contai	nment Sump Modification and Replacement PZR	2	
	24.	Non-C	onservative RODEX Fuel Pellet Temperature	2	20
	25.	Array 3	ndex Issues in the RELAP4 Code	C)
D	Dlanna	d Dlam	t Modification Evoluctions		
D,	1	Milleto	ne Unit 3 Cycle 20 PBOT/PMID Violations	0	1
	1.	winisit		U	,
C.	2018 E	CCS M	Iodel Assessments		
	1. None	e		0)

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D. Other

1. None

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LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1845	
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Plant	Name:	Millstone Power Station, Unit 2 (M5 Fuel)					
Utility	/ Name:	Dominion Energy Nuclea	Dominion Energy Nuclear Connecticut, Inc.				
Analy	sis Information	-					
EM:		EMF-2103	Limiting Break Siz	ze: 1.0 DEGB			
Analy	sis Date:	January 2017					
Vende	or:	Framatome					
Peak	Linear Power	15.1 kW/ft					
Notes	:	None					
				Clad Temp (°F)			
LICE	NSING BASI	5		· · ·			
	Analysis of R	ecord PCT		1615			
	•						
PCT A	ASSESSMEN'	ΓS (Delta PCT)					
А.	Prior ECCS	Model Assessments					
	1. Place	nent of Hot Leg Piping For	m Loss Coefficient	0			
	2. M5 L	OCA Swelling and Rupture	2	0			
	3. S-RE	LAP5 Oxidation Calculatio	ns	0			
R	Planned Play	nt Modification Evaluatio	ns				
D .	1. None			0			
C.	2018 ECCS]	Model Assessments					
0.	1. None			0			
D.	Other						
	1. None			0			
LICE	NSING BASI	S PCT + PCT ASSESSMI	ENTS PCT =	= 1615			

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Serial Number 19-246 Docket Nos. 50-336/423 Attachment 2

10 CI	FR 50.4	MARGIN UTILIZATION - S	SMALL BREAK	LOCA	
Plant	Name:	Millstone Power Station	n, Unit 3		
Utilit	y Name	Dominion Energy Nucle	ear Connecticut, In	c.	
Analy	vsis Info	rmation			
EM:		NOTRUMP	Limiting Break	Size:	4 inches
Analy	ysis Dat	e: 02/07/07	-		
Vend	or:	Westinghouse			
FQ:		2.6	FdH:	1.65	
Fuel:		RFA-2	SGTP (%):	10	
Notes	s:	None			
		······································			Clad Temp (°F)
LICE	INSING	BASIS			
2102	Analy	sis of Record PCT			1193
РСТ	ASSES	SMENTS (Delta PCT)			
Δ	Prior	ECCS Model Assessments			
2 8.	1	Errors in Reactor Vessel Lower	r Plenum Surface A	Irea	
	1.	Calculations		neu	· 0
	2	Discrepancy in Metal Masses I	Ised From Drawin	ng	0 0
	2.	Urania-Gadolinia Pellet Therm	al Conductivity Ca	lculation	0
	<u></u> . Л	Pellet Crack and Dish Volume	Calculation	liculation	0
	т. 5	Treatment of Vessel Average T	Calculation Semperature Uncer	tainty	0
	5.	Maximum Fuel Rod Time Sten		lanny	0
	0. 7	Rediction Heat Transfer Logic	Logic		0
	/.	NOTDING ENGLISHER LOGIC	Truel Dellet Theorem	-1	0
	δ.	NOTRUMP-EM Evaluation of	Fuel Pellet Therm	al	0
	0	Conductivity Degradation			0
	9.	SBLOCIA Cladding Strain Re	quirement for Fuel		0
	10	Rod Burst			0
	10.	Fuel Rod Gap Conductance Err	or		0
	11.	Radiation Heat Transfer Model	Error		0
	12.	SBLOCTA Pre-DNB Cladding	Heat Transfer		0
		Coefficient Calculation			
	13.	Insertion of AXIOM TM Claddir	ng LTAs		0
	14.	Vessel Average Temperature U	Incertainty		0
	15.	Error in the Upper Plenum Flui	d Volume Calcula	tion	0
В.	Plann	ed Plant Modification Evaluat	ions		
	1.	None			
C.	2018	ECCS Model Assessments			
	1.	UO ₂ Fuel Pellet Heat Capacity			0
D.	Other				
	1.	None			0
LICE		BASIS PCT + PCT ASSESSM	IENTS	PCT =	1193

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10 CFI	R 50.46	MARGIN UTILIZA	TION - LARC	GE BREAK L	OCA	· · ·
Plant N	Name:	Millstone Pov	ver Station, Uni	t 3		
Utility	Name:	Dominion En	ergy Nuclear Co	onnecticut, Inc		
Analys	is Info	mation				······································
EM:		ASTRUM (20)04) Lir	niting Break	Size:	Guillotine
Analys	is Date	: 04/17/07	,	<u> </u>		
Vendo	r:	Westinghouse	e			
FQ:		2.6	Fd	H:	1.65	
Fuel:		RFA-2	SG	TP (%):	10	
Notes:		None				
						Clad Temp (°F)
LICEN	SING	BASIS				
	Analys	is of Record PCT				1781
PCT A	SSESS	MENTS (Delta PCT)			
А.	Prior I	ECCS Model Assess	nents			
	1.	HOTSPOT Burst Ter	nperature Logic	e Errors		0
	2.	CCFL Global Volum	e Error			0
	3.	HOTSPOT Gap Heat	Transfer Logic	;		0
	4.	Discrepancy in Metal	Masses Used F	From Drawings	5	0
	5.	Error in ASTRUM P	rocessing of Av	erage Rod Bur	nup	<u>_</u>
	-	and Rod Internal Pres	ssure	T T	•	0
	6.	Treatment of Vessel .	Average Tempe	rature Uncerta	inty	0
	7.	PBOT and PMID Ev	aluation			0
	8.	Evaluation of Fuel Pe	ellet Thermal Co	onductivity		222
	9	HOTSPOT Burst Ter	nnerature Calcu	lation		0
).	for ZIRLO Cladding	inperature Calet	nation		0
	10	Rod Internal Pressure	Calculation			0
	11	HOTSPOT Iteration	Algorithm for (Calculating the		ů 0
		Initial Fuel Pellet Av	verage Tempera	ture		Ū
	12	WCOBRA/TRAC Th	ermal-Hydraul	ic History File		0
	121	Dimension used in H	SDRIVER Bac	kground		Ŭ
	13.	WCOBRA/TRAC A	utomated Restar	rt Process Logi	c Error	0
	14.	Initial Fuel Pellet Av	erage Temperat	ure Uncertaint	v	0
		Calculation	0 1		5	
	15.	Elevations for Heat S	lab Temperatur	e Initialization	L	0
	16.	Heat Transfer Model	Error Correctio	ons		0
	17.	Correction to Heat Tr	ansfer Node In:	itialization		0
	18.	Mass Conservation E	rror Fix			0
	19.	Correction to Split C	hannel Moment	um Equation		0
	20.	Heat Transfer Logic	Correction for F	Rod Burst Calc	ulation	0
``	21.	Changes to Vessel Su	perheated Stear	m Properties		0
	22.	Update to Metal Den	sity Reference 7	remperatures		0
	23.	Decay Heat Model E	rror Corrections	3		0
	24.	Correction to the Pipe	e Exit Pressure	Drop Error		0
	25.	WCOBRA/TRAC Û	19 File Dimensi	on Error Corre	ection	0
	26.	Revised Heat Transfe	er Multiplier Dis	stributions		-91

	27.	HUISPUI Burst Strain Error Correction	21
	20. 20	Grid Heat Transfer Enhancement Calculation	0
	29.	Burst Elevation Selection	0
	30. 21	Errors in Decay Group Uncertainty Factors	0
	21.	Errors in Support Date, Core Barrel, and Vessel Wall	0
	32.	Unheated Conductor	0
	33.	Error in Oxidation Calculations	0
	34.	Error in use of ASME Steam Tables	0
	35.	Insertion of AXIOM [™] Cladding LTAs	0
	36.	Vessel Average Temperature Uncertainty	0
	37.	Inconsistent Application of Numerical Ramp Applied	0
		to the Entrained Liquid / Vapor Interfacial Drag Coefficient	
	38.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
	39.	Steady-State Fuel Temperature Calibration Method	0
B.	Plan	ned Plant Modification Evaluations	
2.	1.	None	
C	2010	ECCS Model Assessments	
C.	2018	ECCS Model Assessments	
	1.	vapor Temperature Resetting	0
D.	Othe	er	
	1.	None	0
LIC	ENSIN	G BASIS PCT + PCT ASSESSMENTS PCT =	1933

Attachment 3

2018 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2018 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION ENERGY VIRGINIA) NORTH ANNA POWER STATION UNITS 1 AND 2

Serial Number 19-246 Docket Nos. 50-338/339 Attachment 3

Plant	Name:	North Anna Power	North Anna Power Station, Unit 1				
Utility	y Name	Virginia Electric ar	Virginia Electric and Power Company				
Analy	sis Info	<u>rmation</u>					
EM:		NOTRUMP	Limiting Break	Size:	2.75 inches		
Analy	sis Date	e: 12/20/2010					
Vend	or:	Westinghouse					
FQ:		2.32	F∆H:	1.65			
Fuel:		RFA-2	SGTP (%):	7			
Notes	:	None					
					Clad Temp (°F)		
LICE	NSING	BASIS					
	Analys	sis of Record PCT			1834.1		
PCT A	ASSESS	SMENTS (Delta PCT)					
A.	Prior	ECCS Model Assessments			_		
	1.	NOTRUMP-EM Evaluatio	n of Fuel Pellet Therma	al	0		
	_	Conductivity Degradation			_		
	2.	SBLOCA Cladding Strain	Requirement for Fuel		0		
	•	Rod Burst	-				
	3.	Fuel Rod Gap Conductance	e Error		0		
	4.	Radiation Heat Transfer M	odel Error		0		
	5.	SBLOCTA Pre-DNB Clad	ding Heat Transfer		0		
	~	Coefficient Calculation					
	6.	Error in the Upper Plenum	Fluid Volume Calculat	ion	0 ·		
P	Plann	ad Plant Madification Eva	luations				
D ,	1	None ·	luations		0		
	1.	INOLIC			0		
C.	2018 F	CCS Model Assessments					
	1.	UO2 Fuel Pellet Heat Capa	icity		0		
		· · · · · · · · · · · · · · · · · · ·	2		-		
D.	Other						
	1.	None			0		

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1834.1

Serial Number 19-246 Docket Nos. 50-338/339 Attachment 3

10 CFF	R 50.46 I	MARGIN UTILIZATION - WESTI	INGHOUSE LAR	GE BRJ	EAK LOCA
Plant I	Name:	North Anna Power Station	, Unit 1		
Utility	Name:	Virginia Electric and Powe	er Company		
Analys	sis Info	rmation			
EM:		ASTRUM (2004)	Limiting Break	Size:	DEGB
Analys	sis Date	: 8/25/2010			
Vendo	r:	Westinghouse			
FQ:		2.32	F∆H:	1.65	
Fuel:		RFA-2	SGTP (%):	7	
Notes:	Core Pow	$ver \le 100\%$ of 2951 MWt; SG Model 54F; 17	x17 RFA-2 Fuel with Z	IRLO® or	· Optimized ZIRLO™
cladding,	Non-IFB	A of IFBA, IFMS			Clad Town (°F)
LICEN	ISINC	RASIS			<u>Clau Temp (T)</u>
LICE	Analys	is of Record PCT			1852
	7 mary 5				1052
PCT A	SSESS	MENTS (Delta PCT)			
A.	Prior I	ECCS Model Assessments			
	1.	Evaluation of Fuel Pellet Thermal	Conductivity		135
		Degradation	,		
	2.	HOTSPOT Burst Temperature Ca	lculation		0
		for ZIRLO Cladding			
	3.	Rod Internal Pressure Calculation			0
	4.	HOTSPOT Iteration Algorithm fo	r Calculating the		0
		Initial Fuel Pellet Average Tempe	erature		
	5.	WCOBRA/TRAC Thermal-Hydra	aulic History File		0
		Dimension used in HSDRIVER B	ackground		
	6.	WCOBRA/TRAC Automated Res	start Process Logi	c Error	0
	7.	Initial Fuel Pellet Average Tempe	rature Uncertaint	У	1
		Calculation			<u>,</u>
	8.	Elevations for Heat Slab Tempera	ture Initialization		0
	9.	Heat Transfer Model Error Correc	tions		0
	10.	Correction to Heat Transfer Node	Initialization		0 .
	11.	Mass Conservation Error Fix	antum Equation		0
	12.	Uset Transfer Logic Correction for	entum Equation	vlation	0
	13.	Changes to Vessel Superheated St	or Rou Burst Calc	ulation	0
	14.	Undate to Metal Density Reference	a Temperatures		0
	15. 16	Decay Heat Model Error Correction			0
	10.	Correction to the Pipe Exit Pressu	re Dron Frror		0
	17.	WCOBRA/TRAC 1119 File Dime	nsion Error Corre	ection	0
	19.	Revised Heat Transfer Multiplier	Distributions		-2.7
	20.	HOTSPOT Burst Strain Error Cor	rection		21
	21.	Changes to Grid Blockage Ratio a	nd Porosity		0
	22.	Grid Heat Transfer Enhancement	Calculation		0
	23.	Vessel Section 7 Mid-Level Eleva	tion Modeling		0

24.	Burst Elevation Selection	0
25.	Errors in Decay Group Uncertainty Factors	0
26.	Error in Oxidation Calculations	0
27.	Error in use of ASME Steam Tables	0
28.	Support Column Core Barrel Unheated Conductor Errors0	0
29.	Inconsistent Application of Numerical Ramp Applied	0
	to the Entrained Liquid / Vapor Interfacial Drag Coefficient	
30.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
31.	Steady-State Fuel Temperature Calibration Method	0
32.	Correction to Fuel Pellet TCD Assessment	0
Plan	and Plant Modification Evaluations	
1	Nono	Δ
1.	None	0
2018	BECCS Model Assessments	
1.	Vapor Temperature Resetting	0
	· · · · · · · · · · · · · · · · · · ·	
Oth	er	
1.	None	

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1982

B.

C.

D.

Serial Number 19-246 Docket Nos. 50-338/339 Attachment 3

Plant	Name:	North Anna Powe	r Station. Unit 2		
Utilit	y Name	: Virginia Electric a	and Power Company		
Anal	ysis Info	rmation			
EM:		NOTRUMP	Limiting Break	Size:	2.75 inches
Anal	ysis Dat	e: 12/20/2010	C C		,
Vend	lor:	Westinghouse			
FQ:		2.32	F Δ H :	1.65	
Fuel:		RFA-2	SGTP (%):	7	
Notes	8:	None			
		· · · •			Clad Temp (°F)
LICE	ENSING	BASIS			
	Analy	sis of Record PCT			1834.1
РСТ	ASSES	SMENTS (Delta PCT)			
A.	Prior	ECCS Model Assessment	S		
	1.	NOTRUMP-EM Evaluati	on of Fuel Pellet Therma	1	0
		Conductivity Degradation	1		
	2.	SBLOCTA Cladding Stra	in Requirement for Fuel		0
		Rod Burst	_		
	3.	Fuel Rod Gap Conductan	ce Error		0
	4.	Radiation Heat Transfer N	Aodel Error		0
	5.	SBLOCTA Pre-DNB Cla	dding Heat Transfer		0
	<i>c</i>	Coefficient Calculation			0
	6.	Error in the Upper Plenun	n Fluid Volume Calculati	on	0
D	Dlaws	ad Dland Madification F-	a]		
D.	1 r lann	Nono	aluations		0
	1.	NOILE			0
C	2018 1	CCS Model Assessments			
C .	1	1102 Fuel Pellet Heat Car	nacity		0
	1.	002 Tuer Tenet Tieat Cap	Jucity		U
D.	Other				
	1.	None			0
					Č.
	INSINC	DASIS DOT + DOT ASS	FSEMENTS	PCT -	. 192/1

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:		North Anna Power Station, Unit 2	North Anna Power Station, Unit 2				
Utility Name:		e: Virginia Electric and Power Company					
Analy	ysis Inf	ormation					
EM:		ASTRUM (2004) Limiting Break Size:	DEGB				
Analy	ysis Da	te: 8/25/2010					
Vend	or:	Westinghouse					
FQ:		2.32 FΔH: 1.6	5				
Fuel:		RFA-2 SGTP (%): 7					
Notes claddin	S: Core Po g, Non-IF	ower \leq 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO BA or IFBA, IFMs	® or Optimized ZIRLO™				
			Clad Temp (°F)				
LICE	ENSIN	G BASIS					
Analysis of R		vsis of Record PCT	1852				
	-						
PCT	ASSES	SMENTS (Delta PCT)					
А.	Prior	· ECCS Model Assessments					
	1.	Evaluation of Fuel Pellet Thermal Conductivity	135				
		Degradation					
	2.	HOTSPOT Burst Temperature Calculation	0				
		for ZIRLO Cladding					
	3.	Rod Internal Pressure Calculation	0				
	4.	HOTSPOT Iteration Algorithm for Calculating the	0				
		Initial Fuel Pellet Average Temperature					
	5.	WCOBRA/TRAC Thermal-Hydraulic History File	0				
		Dimension used in HSDRIVER Background					
	6.	WCOBRA/TRAC Automated Restart Process Logic Err	ror 0				
	7.	Initial Fuel Pellet Average Temperature Uncertainty	1				
		Calculation					
	8.	Elevations for Heat Slab Temperature Initialization	0				
	9.	Heat Transfer Model Error Corrections	0				
	10.	Correction to Heat Transfer Node Initialization	0				
	11.	Mass Conservation Error Fix	0				
	12.	Correction to Split Channel Momentum Equation	0				
	13.	Heat Transfer Logic Correction for Rod Burst Calculati	on 0				
•	14.	Changes to Vessel Superheated Steam Properties	0				
	15.	Update to Metal Density Reference Temperatures	0				
	16.	Decay Heat Model Error Corrections	0				
	17.	Correction to the Pipe Exit Pressure Drop Error	0				
	18.	WCOBRA/TRAC U19 File Dimension Error Correction	n 0				
	19.	Revised Heat Transfer Multiplier Distributions	-27				
	20.	HOTSPOT Burst Strain Error Correction	21				
	21.	Changes to Grid Blockage Ratio and Porosity	0				
	22.	Grid Heat Transfer Enhancement Calculation	0				

Serial Number 19-246 Docket Nos. 50-338/339 Attachment 3

urst Elevation Selection rrors in Decay Group Uncertainty Factors rror in Oxidation Calculations rror in use of ASME Steam Tables upport Column Core Barrel Unheated Conductor Errors consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0 0 0 0 0 0
rrors in Decay Group Uncertainty Factors rror in Oxidation Calculations rror in use of ASME Steam Tables upport Column Core Barrel Unheated Conductor Errors consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0 0 0 0
rror in Oxidation Calculations rror in use of ASME Steam Tables upport Column Core Barrel Unheated Conductor Errors consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0 0 0
rror in use of ASME Steam Tables upport Column Core Barrel Unheated Conductor Errors consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0 0 0
upport Column Core Barrel Unheated Conductor Errors consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0 0
consistent Application of Numerical Ramp Applied the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0
the Entrained Liquid / Vapor Interfacial Drag Coefficient appropriate Resetting of Transverse Liquid Mass Flow	0
appropriate Resetting of Transverse Liquid Mass Flow	Δ
	0
eady-State Fuel Temperature Calibration Method	0
orrection to Fuel Pellet TCD Assessment	0
Plant Modification Evaluations	
	0
	Ū
CS Model Assessments	
apor Temperature Resetting	0
	orrection to Fuel Pellet TCD Assessment Plant Modification Evaluations one CS Model Assessments apor Temperature Resetting

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B.

C.

D.

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LICENSING	BASIS PCT + PC	T ASSESSMENTS	PCT =	1982	

Attachment 4

2018 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2018 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION ENERGY VIRGINIA) SURRY POWER STATION UNITS 1 AND 2

Serial Number 19-246 Docket Nos. 50-280/281 Attachment 4

Plant]	Name:	Surry Power Station, Unit 1					
Utility	Name	Virginia Electric and Power	Virginia Electric and Power Company				
Analy	sis Info	rmation					
EM:		NOTRUMP Li	miting Break Size:	2.75 inches			
Analy	sis Dat	: 5/7/2009	5/7/2009				
Vendo	r:	Westinghouse					
FO:		2.5 FA	H: 1.7				
Fuel:		Upgrade SC	SGTP (%): 7				
Notes:		None					
		······	· · · · ·	Clad Temp (°F)			
LICE	NSING	BASIS					
	Analy	sis of Record PCT		2012			
PCT A	ASSES	SMENTS (Delta PCT)					
Α.	Prior	ECCS Model Assessments					
	1.	Urania-Gadolinia Pellet Thermal Co	nductivity Calculation	n. 0			
	2.	Pellet Crack and Dish Volume Calcu	ulation.	0			
	3.	Treatment of Vessel Average Tempe	erature Uncertainty	0			
	4.	15X15 Upgrade Fuel		0			
	5.	Maximum Fuel Rod Time Step Logi	ic	0			
	6.	Radiation Heat Transfer Logic		0			
	7.	NOTRUMP-EM Evaluation of Fuel	Pellet Thermal	0			
		Conductivity Degradation					
	8. SBLOCTA Cladding Strain Requirement for Fuel			0			
		Rod Burst					
	9.	Fuel Rod Gap Conductance Error		0			
	10.	Radiation Heat Transfer Model Erro	r	0			
	11.	SBLOCTA Pre-DNB Cladding Heat	t Transfer	0			
		Coefficient Calculation					
	12.	Error in the Upper Plenum Fluid Vo	lume Calculation	0			
B.	Plann	ed Plant Modification Evaluations	t Modification Evaluations				
	1.	None		0			
C.	2018]	ECCS Model Assessments					
	1.	UO ₂ Fuel Pellet Heat Capacity		0			
n	Other						
D .		None		0			
	1.	Tone		v			
LICE	NSING	BASIS PCT + PCT ASSESSMEN'	$\overline{\Gamma S}$ $\overline{PCT} =$	2012			

Serial Number 19-246 Docket Nos. 50-280/281 Attachment 4

10 CFR	<u> 50.46</u>	MARG	IN UTILIZATI	ON - WES	<u> TINGHOU</u>	SE LARG	E BREAK LOCA	
Plant Name:			Surry Power Station, Unit 1					
Utility Name:			Virginia Electric and Power Company					
Analysi	is Infor	rmation						
EM:			ASTRUM (2004)) Li	miting Breរ	ık Size:	DEG	
Analysi	is Date:	:	10/6/2010					
Vendor	••		Westinghouse					
FQ:			2.5	F۵	H:	1.7		
Fuel:		ا	Upgrade	SC	GTP (%):	7		
Notes:]	None					
							Clad Temp (°F)	
LICEN	SING]	BASIS	1.5.675					
1	Analysi	is of Red	cord PCT				1853	
PCT AS	SSESS	MENTS	S (Delta PCT)					
A.]	Prior E	ECCS M	Iodel Assessmen	its				
•	1.	Evaluat	ion of Fuel Pellet	t Thermal C	onductivity		183	
,	\mathbf{r}	Degrada	ation Radial Drafila Onti	ion			12	
	2. 2	HOTSP	Caulai Fionie Oph	 Prature Calci	ilation		-13	
•	5.	for 7IR	U Cladding				0	
2	4	Rod Int	ernal Pressure Ca	alculation			0	
4	5.	HOTSP	OT Iteration Algo	orithm for (Calculating t	he	Ő	
		Initial I	Fuel Pellet Averag	ige Tempera	iture			
(6.	WCOB	RA/TRAC Therm	nal-Hydraul	ic History F	ïle	0	
Dimension used		ion used in HSDF	RIVER Bac	kground				
,	7. WCOBRA/TRAC Automated Restart Process Logic Erro		ogic Error	0				
5	8. Initial Fuel Pellet Average Temperature Uncertainty		linty	0				
		Calcula	tion					
9	9.	Elevatio	ons for Heat Slab	Temperatu	re Initializat	ion	0	
	10.	Heat Tr	ansfer Model Erro	or Correction	ons		0	
	11.	Correcti	ion to Heat Trans	sfer Node In	itialization		0	
	12.	Mass Co	onservation Error	r Fix			· 0	
	13.	Correcti	ion to Split Chanr	nel Momen	tum Equatio	n	0	
	14.	Heat Tr	ansfer Logic Corr	rection for l	Rod Burst C	alculation	0	
	15.	Change	s to Vessel Superl	rheated Stea	m Propertie	s	0	
-	16.	Update to Metal Density Reference Temperatures			0			
	17.	Decay Heat Model Error Corrections			0			
	18.	Correction to the Pipe Exit Pressure Drop Error				0		
	19.	WCOB	RA/TRAC Ū19 F	File Dimens	ion Êrror Co	orrection	0	
,	20.	Revised	l Heat Transfer M	Iultiplier Di	stributions		-7	
-	21.	HOTSP	OT Burst Strain H	Error Corre	ction		51	
	22.	Change	s to Grid Blockag	ge Ratio and	l Porosity		0	
-	23.	Grid He	eat Transfer Enha	incement Ca	lculation		0	
-	24.	Vessel S	Section 7 Mid-Lev	evel Elevatio	on Modeling	Г р	0	
-			· · · · · · · · · · · · · · · · · · ·	Page 2	of 6	,		

	25.	Burst Elevation Selection	0
	26.	Errors in Decay Group Uncertainty Factors	4
	27.	Evaluation of Additional Containment Metal	0
	28.	Error in Oxidation Calculations	0
	29.	Error in use of ASME Steam Tables	0
	30.	Core Barrel Unheated Conductor Errors	0
	31.	Discrepancy in Wetted Perimeter Inputs	0
	32.	Inconsistent Application of Numerical Ramp Applied	0
		to the Entrained Liquid / Vapor Interfacial Drag Coefficient	
	33.	Inappropriate Resetting of Transverse Liquid Mass Flow	0
	34.	Steady-State Fuel Temperature Calibration Method	0
B.	Plan	ned Plant Modification Evaluations	
	1.	None	0
C.	2018	ECCS Model Assessments	
	1.	Vapor Temperature Resetting	0
D.	Othe	er de la companya de	
	1.	None	0
LICI	ENSIN	G BASIS PCT + PCT ASSESSMENTS PCT =	2071

Serial Number 19-246 Docket Nos. 50-280/281 Attachment 4

10 CFI	R 50.46	MARGIN UTILIZATION - WEST	INGHOUSE SM.	ALL BR	EAK LOCA		
Plant Name:		Surry Power Station, Unit	Surry Power Station, Unit 2				
Utility Name:		Virginia Electric and Pow	Virginia Electric and Power Company				
Analy	sis Info	rmation	-				
EM:		NOTRUMP	Limiting Break	Size:	2.75 inches		
Analy	sis Date	e: 5/7/2009					
Vendo	or:	Westinghouse					
FQ:		2.5	F∆H:	1.7			
Fuel:		Upgrade	SGTP (%):	7			
Notes:	:	None					
					Clad Temp (°F)		
LICE	NSING	BASIS					
	Analys	is of Record PCT			2012		
PCT A	ASSESS	MENTS (Delta PCT)					
А.	Prior	ECCS Model Assessments					
	1.	Urania-Gadolinia Pellet Thermal	Conductivity Ca	lculation	. 0		
	2.	Pellet Crack and Dish Volume Ca	alculation.		0		
	3.	Treatment of Vessel Average Ter	nperature Uncert	ainty	0		
	4.	15X15 Upgrade Fuel	-		0		
	5.	Maximum Fuel Rod Time Step L	ogic		0		
	6.	Radiation Heat Transfer Logic	-		0		
	7.	NOTRUMP-EM Evaluation of Fi	uel Pellet Therma	al	0		
	0	Conductivity Degradation			0		
	δ.	SBLOCIA Cladding Strain Requ	irement for Fuel		0		
	Q	Fuel Rod Gan Conductance Error			0		
). 10	Radiation Heat Transfer Model E	rror		0		
	10.	SBLOCTA Pre-DNB Cladding H	ant Transfer		0		
	11.	Coefficient Calculation			0		
	12.	Error in the Upper Plenum Fluid	Volume Calculat	ion	0		
_							
В.	Plann	ed Plant Modification Evaluation	18		-		
	1.	None			0		
C	2019 L	CCS Model Assessments					
C.	1.	UO_2 Fuel Pellet Heat Capacity			0		
		2			-		
D.	Other						
	1.	None			0		
	NSING	BASIS PCT + PCT ASSESSME	INTS	PCT =	2012		
				<u> </u>			

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Serial Number 19-246 Docket Nos. 50-280/281 Attachment 4

Plant Name: Surry Power Station, Unit 2 Utility Name: Virginia Electric and Power Company Analysis Information EM: ASTRUM (2004) Limiting Break Size: DEG Analysis Date: 10/6/2010 Vendor: DEG Vendor: Westinghouse FQ: 2.5 FAH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None LICENSING BASIS Analysis of Record PCT 1853 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 183 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pallet Pacific Ontion 12
Utility Name: Virginia Electric and Power Company Analysis Information EM: ASTRUM (2004) Limiting Break Size: DEG Analysis Date: 10/6/2010 Vendor: Westinghouse DEG FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Clad Temp (°F) Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pallat Padial Profile Ontion 13
Analysis Information Limiting Break Size: DEG EM: ASTRUM (2004) Limiting Break Size: DEG Analysis Date: 10/6/2010 Vendor: Westinghouse FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 1. L Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pellet Pacial Profile Ontion 12
EM: ASTRUM (2004) Limiting Break Size: DEG Analysis Date: 10/6/2010 DEG Vendor: Westinghouse Imiting Break Size: DEG FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1853 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pallat Radial Brafile Option 12
Analysis Date: 10/6/2010 Vendor: Westinghouse FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 183 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 12
Vendor: Westinghouse FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 183 Degradation 13
FQ: 2.5 FΔH: 1.7 Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 183 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 12
Fuel: Upgrade SGTP (%): 7 Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 183 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 12
Notes: None Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) 1853 A. Prior ECCS Model Assessments 183 Degradation 13
Clad Temp (°F) LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity Degradation 2. Pollet Padial Profile Option
LICENSING BASIS Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 13
Analysis of Record PCT 1853 PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2. Pollet Padial Profile Option 13
PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pollet Padial Profile Option 13
PCT ASSESSMENTS (Delta PCT) A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2 Pallet Padial Profile Ontion 13
 A. Prior ECCS Model Assessments 1. Evaluation of Fuel Pellet Thermal Conductivity 183 Degradation 2. Pollet Padial Profile Option 13
 Evaluation of Fuel Pellet Thermal Conductivity Degradation Pollet Padial Profile Option 13
Degradation 2 Pollet Padial Profile Option
2 Pollet Padial Profile Ontion 12
3 HOTSPOT Burst Temperature Calculation 0
for ZIRLO Cladding
4 Rod Internal Pressure Calculation 0
5. HOTSPOT Iteration Algorithm for Calculating the 0
Initial Fuel Pellet Average Temperature
6. WCOBRA/TRAC Thermal-Hydraulic History File 0
Dimension used in HSDRIVER Background
7. WCOBRA/TRAC Automated Restart Process Logic Error 0
8. Initial Fuel Pellet Average Temperature Uncertainty 0
Calculation
9. Elevations for Heat Slab Temperature Initialization 0
10.Heat Transfer Model Error Corrections0
11. Correction to Heat Transfer Node Initialization 0
12. Mass Conservation Error Fix 0
13.Correction to Split Channel Momentum Equation0
14. Heat Transfer Logic Correction for Rod Burst Calculation 0
15. Changes to Vessel Superheated Steam Properties 0
16. Update to Metal Density Reference Temperatures 0
17. Decay Heat Model Error Corrections 0
18. Correction to the Pipe Exit Pressure Drop Error 0
19. WCOBKA/TKAC U19 File Dimension Error Correction U 20. Deviced Heat Transfer Multiplier Distributions
20. Kevised Heat Transfer Multiplier Distributions -/
21. HOTSPOT Duist Strall Ellor Correction 31 22. Changes to Grid Blockage Patio and Porosity 0
22. Changes to One Diockage Ratio and Polosity 0

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 Burst Elevation Selection Errors in Decay Group Uncertainty Factors Evaluation of Additional Containment Metal Error in Oxidation Calculations Error in use of ASME Steam Tables Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	
 Errors in Decay Group Uncertainty Factors Evaluation of Additional Containment Metal Error in Oxidation Calculations Error in use of ASME Steam Tables Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	0
 Evaluation of Additional Containment Metal Error in Oxidation Calculations Error in use of ASME Steam Tables Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	4
 Error in Oxidation Calculations Error in use of ASME Steam Tables Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	0
 Error in use of ASME Steam Tables Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	0
 Core Barrel Unheated Conductor Errors Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	0
 Discrepancy in Wetted Perimeter Inputs Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient Inappropriate Resetting of Transverse Liquid Mass Flow 	0
 32. Inconsistent Application of Numerical Ramp Applied to the Entrained Liquid / Vapor Interfacial Drag Coefficient 33. Inappropriate Resetting of Transverse Liquid Mass Flow 	0
to the Entrained Liquid / Vapor Interfacial Drag Coefficient 33. Inappropriate Resetting of Transverse Liquid Mass Flow	0
33. Inappropriate Resetting of Transverse Liquid Mass Flow	
	0
34. Steady-State Fuel Temperature Calibration Method	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2018 ECCS Model Assessments	
1. Vapor Temperature Resetting	0
D. Other	
1. None	
LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 20'	0