VOGTLE ELECTRIC GENERATING PLANT - UNIT 2

PRESSURE AND TEMPERATURE LIMITS REPORT

REVISION 0

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VOGTLE ELECTRIC GENERATING PLANT - UNIT 2

PRESSURE AND TEMPERATURE LIMITS REPORT

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VOGTLE ELECTRIC GENERATING PLANT (VEGP) - UNIT 2

PRESSURE AND TEMPERATURE LIMITS REPORT

1.0 Reactor Coolant System (RCS) Pressure and Temperature Limits Report (PTLR) - Unit 2

This PTLR for VEGP Unit 2 has been prepared in accordance with the requirements of Technical Specification (TS) 5.6.6. The TS addressed in this report are listed below:

LCO 3.4.3 RCS Pressure and Temperature (P/T) Limits

LCO 3.4.12 Cold Overpressure Protection Systems (COPS)

2.0 Operating Limits

The parameter limits for the specifications listed in section 1.0 are presented in the following subsections. The current limits were developed using a methodology that is in accordance with the NRC-approved methodology specified in Specification 5.6.6 (Ref. 1) with two exceptions. The two exceptions are the fluence methodology used to calculate the heatup and cooldown limits and the incorporation of random pressure uncertainty in the cold overpressure protection system setpoints. Future changes to these limits will be made in full compliance with the NRC-approved methodology, and the first revision to the limits after initial implementation of this PTLR will be submitted to the NRC for prior approval. Subsequent revisions will be made in accordance with the NRC-approved methodology without prior approval. It should be noted that the heatup and cooldown limit curves and the cold overpressure protection system setpoints were approved by the NRC staff by Amendment 65 dated June 8, 1995.

2.1 RCS Pressure and Temperature (P/T) Limits (LCO 3.4.3)

2.1.1 The RCS temperature rate-of-change limits are (Ref. 2):

a. A maximum heatup of 100 ^{0}F in any 1-hour period.

b. A maximum cooldown of 100 ^{0}F in any 1-hour period.

c. A maximum temperature change of less than or equal to 10 ^{0}F in any 1-hour period during inservice hydrostatic and leak testing operations above the heatup and cooldown limit curves.

2.1.2 The RCS P/T limits for heatup and cooldown are specified by Figures 2.1-1 and 2.1-2, respectively.

2.2 Cold Overpressure Protection System (COPS) Setpoints (LCO 3.4.12)

The power-operated relief valves (PORVs) shall each have lift settings in accordance with Figure 2.2-1.

The setpoints in combination with the relief capacity of the PORVs will protect the RCS from the limiting mass injection transient of two centrifugal charging pumps plus the positive displacement pump injecting into the RCS and the limiting heat input transient of starting a RCP with the RCS 50 ^{0}F colder than the secondary coolant.

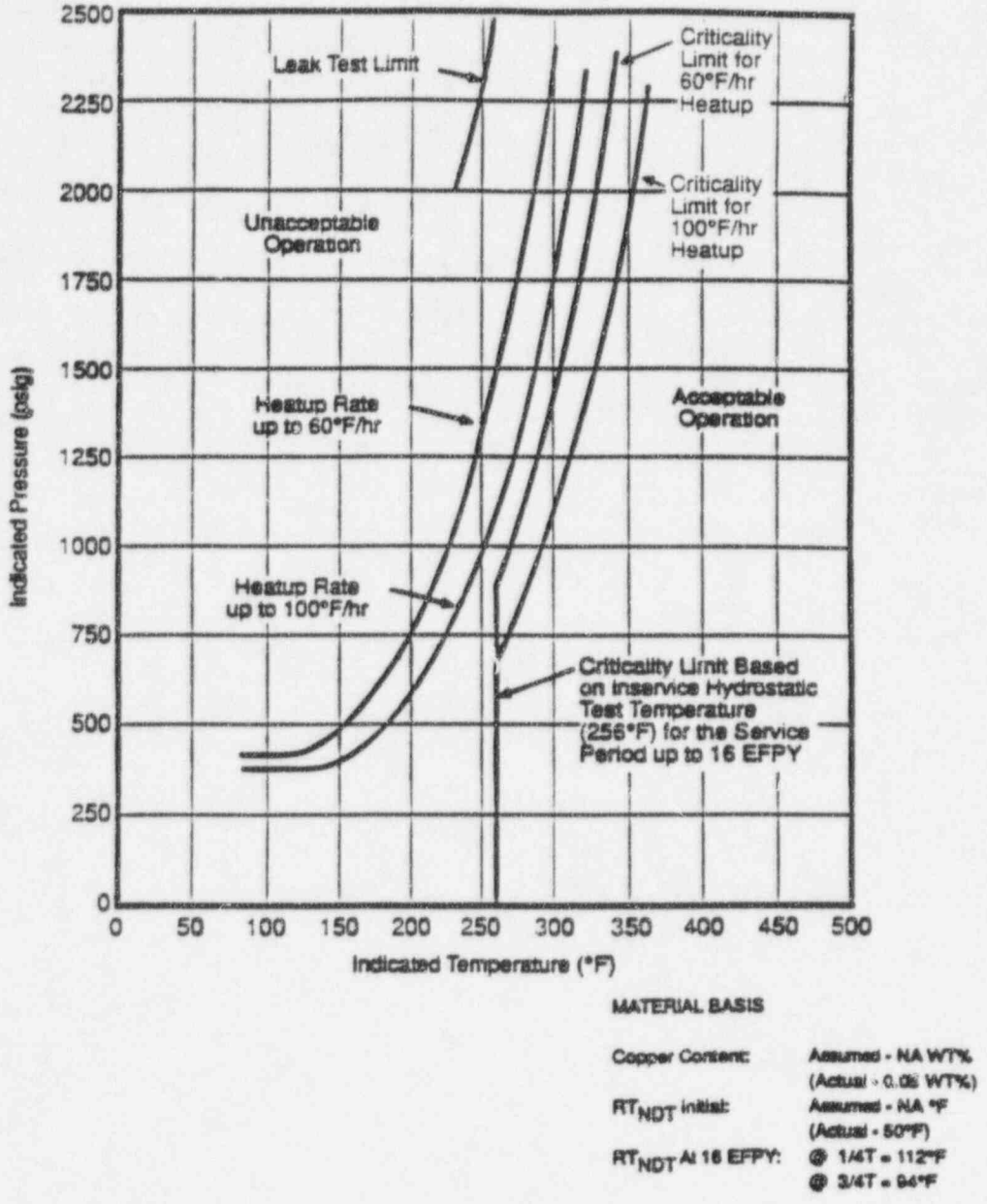

Figure 2.1-1

Unit 2 Reactor Coolant System Heatup Limitations (Heatup Rates up to 100 ^{0}F/hr) Applicable for the First 16 EFPY (With Margins of 10 ^{0}F and 60 psig for Instrumentation Errors and Margin of 74 psig for Pressure Difference Between Pressure Instrumentation and Reactor Vessel Beltline Region).

Table 2.1-1
Data Points for Unit 2 Reactor Coolant System Heatup Limitations

60 HU		Criticality Limit		100 HU		Criticality Limit		Hydrostatic Leak Test	
T	P	T	P	T	P	T	P	T	P
85	424.16	256	0.00	85	392.65	256	0.00	236	2000
90	424.16	256	424.16	90	392.65	256	392.65	256	2485
95	424.16	256	424.16	95	392.65	256	392.65		
100	424.16	256	424.16	100	392.65	256	392.65		
105	424.16	256	424.16	105	392.65	256	392.65		
110	424.16	256	424.16	110	392.65	256	392.65		
115	426.05	256	426.05	115	392.65	256	392.65		
120	430.17	256	430.17	120	392.65	256	392.65		
125	436.54	256	436.54	125	392.65	256	392.65		
130	444.80	256	444.80	130	392.91	256	392.91		
135	455.01	256	455.01	135	395.01	256	395.01		
140	466.83	256	466.83	140	398.78	256	398.78		
145	480.60	256	480.60	145	404.26	256	404.26		
150	496.06	256	496.06	150	411.25	256	411.25		
155	513.18	256	513.18	155	420.00	256	420.00		
160	532.19	256	532.19	160	430.37	256	430.37		
165	553.06	256	553.06	165	442.41	256	442.41		
170	575.69	256	575.69	170	456.11	256	456.11		
175	600.46	256	600.46	175	471.42	256	471.42		
180	627.17	256	627.17	180	488.61	256	488.61		
185	656.06	256	656.06	185	507.64	256	507.64		
190	687.47	256	687.47	190	528.48	256	528.48		
195	721.18	256	721.18	195	551.45	256	551.45		
200	757.46	256	757.46	200	576.37	256	576.37		
205	796.74	256	796.74	205	603.64	256	603.64		
210	838.85	256	838.85	210	633.15	256	633.15		
215	884.12	256	884.12	215	665.08	256	665.08		
220	932.78	260	932.78	220	699.80	260	699.80		
225	985.00	265	985.00	225	737.19	265	737.19		
230	1040.94	270	1040.94	230	777.51	270	777.51		
235	1101.29	275	1101.29	235	820.97	275	820.97		
240	1165.91	280	1165.91	240	867.77	280	867.77		
245	1235.02	285	1235.02	245	918.16	285	918.16		
250	1309.37	290	1309.37	250	972.28	290	972.28		
255	1388.91	295	1388.91	255	1030.47	295	1030.47		
260	1474.02	300	1474.02	260	1092.78	300	1092.78		
265	1565.15	305	1565.15	265	1159.94	305	1159.94		
270	1662.80	310	1662.80	270	1231.65	310	1231.65		
275	1767.31	315	1767.31	275	1308.88	315	1308.88		
280	1878.79	320	1878.79	280	1391.50	320	1391.50		
285	1997.96	325	1997.96	285	1479.91	325	1479.91		
290	2125.07	330	2125.07	290	1574.56	330	1574.56		
295	2260.56	335	2260.56	295	1675.71	335	1675.71		
300	2405.07	340	2405.07	300	1783.88	340	1783.88		
				305	1899.34	345	1899.34		
				310	2022.83	350	2022.83		
				315	2154.30	355	2154.30		
				320	2294.29	360	2294.29		

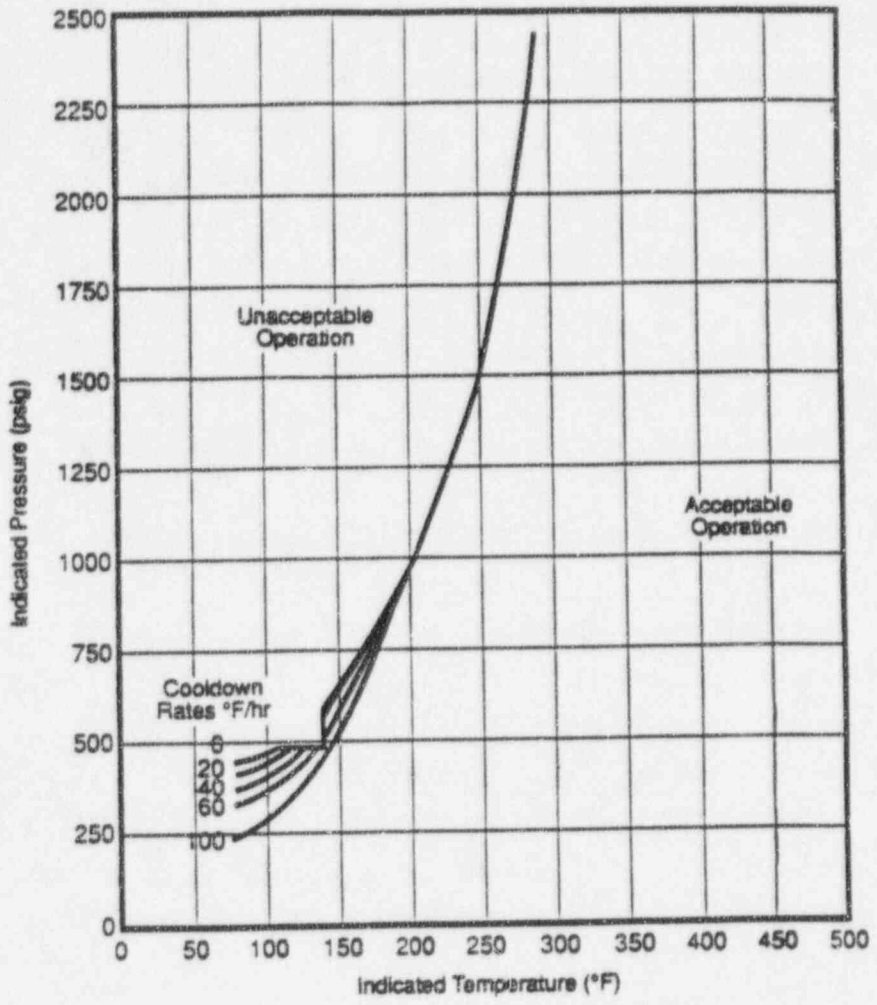

Figure 2.1-2
Unit 2 Reactor Coolant System Cooldown Limitations (Cooldown Rates up to 100 ^{0}F/hr) Applicable for the First 16 EFPY (With Margins of 10 ^{0}F and 60 psig for Instrumentation Errors and Margin of 74 psig for Pressure Difference Between Pressure Instrumentation and Reactor Vessel Beltline Region).

Table 2.1-2
Data Points for Unit 2 Reactor Coolant System Cooldown Limitations

Steady State		20 CD		40 CD		60 CD		100 CD	
T	P	T	P	T	P	T	P	T	P
80	439.56	80	399.79	80	359.43	80	318.38	80	234.54
85	448.29	85	408.97	85	369.02	85	328.62	85	246.12
90	457.67	90	418.74	90	379.44	90	339.65	90	258.63
95	467.65	95	429.39	95	390.70	95	351.61	95	272.23
100	478.50	100	440.83	100	402.83	100	364.49	100	286.85
105	487.00	105	453.16	105	415.82	105	378.33	105	302.77
110	487.00	110	466.33	110	429.91	110	393.34	110	319.90
115	487.00	115	480.63	115	445.13	115	409.57	115	338.53
120	487.00	120	487.00	120	461.38	120	426.95	120	358.64
125	487.00	125	487.00	125	479.04	125	445.84	125	380.31
130	487.00	130	487.00	130	487.00	130	466.05	130	403.80
135	487.00	135	487.00	135	487.00	135	487.00	135	429.09
140	487.00	140	487.00	140	487.00	140	487.00	140	456.47
140	600.06	140	569.93	140	540.48	140	511.52	145	485.97
145	620.72	145	592.17	145	564.10	145	537.04	150	517.75
150	643.08	150	615.87	150	589.70	150	564.35	155	552.20
155	666.94	155	641.59	155	617.09	155	593.97	160	589.23
160	692.76	160	669.05	160	646.72	160	625.70	165	629.17
165	720.36	165	698.77	165	678.52	165	659.89	170	672.20
170	750.14	170	730.61	170	712.66	170	696.86	175	718.62
175	782.07	175	764.80	175	749.61	175	736.57	180	768.61
180	816.32	180	801.53	180	789.20	180	779.25	185	822.54
185	853.09	185	841.28	185	831.83	185	825.27	190	880.52
190	892.81	190	883.81	190	877.63	190	874.70		
195	935.33	195	929.55	195	926.94	195	927.94		
200	980.99	200	978.69	200	979.87				
205	1030.06								
210	1082.72								
215	1139.08								
220	1199.92								
225	1265.01								
230	1334.76								
235	1409.74								
240	1490.05								
245	1576.15								
250	1668.31								
255	1767.04								
260	1872.77								
265	1985.79								
270	2106.52								
275	2235.61								
280	2373.08								

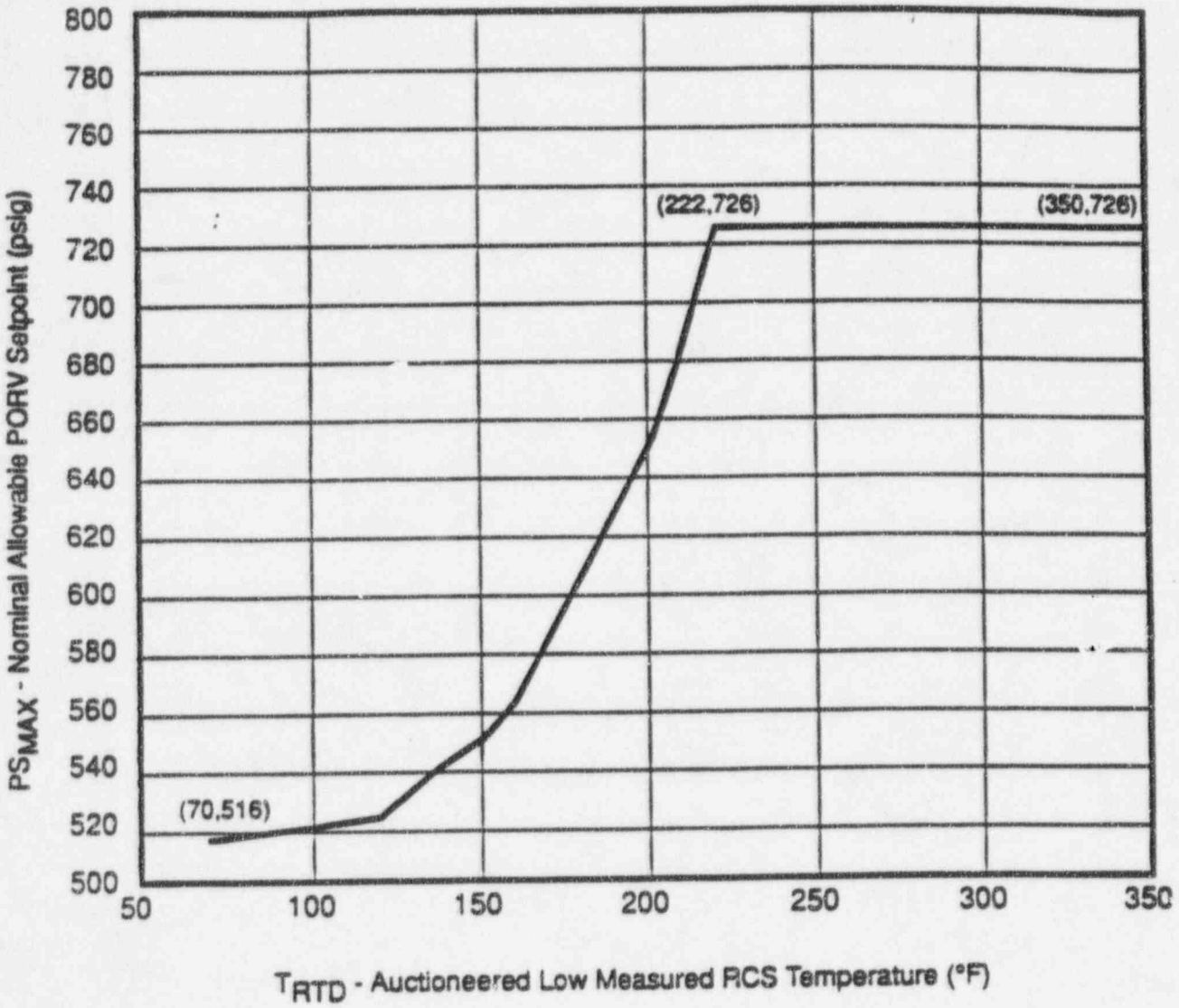

Figure 2.2-1
Unit 2 Maximum Allowable Nominal PORV Setpoint for the Cold Overpressure Protection System.

Table 2.2-1
Data Points for Unit 2 PORV Setpoints

Temperature (^{0}F)	Pressure (psig)
70	516
100	518
120	522
150	547
160	560
200	642
210	675
222	726
350	726

3.0 Supplemental Data Tables

Table 3.0-1 is a comparison of the measured surveillance material 30 ft-lb transition temperature shifts and upper shelf energy decreases with Regulatory Guide 1.99, Revision 2 predictions.

Table 3.0-2 shows the calculation of the surveillance material chemistry factors using surveillance capsule data. However, since there has been only one surveillance capsule removed from the Vogtle Unit 2 reactor vessel, this table has been intentionally left blank.

Table 3.0-3 provides the unirradiated Vogtle Unit 2 reactor vessel toughness data. The bolt-up temperature is also included in this table.

Table 3.0-4 provides a summary of the fluences used in the generation of the heatup and cooldown curves.

Table 3.0-5 provides a summary of the adjusted reference temperatures (ARTs) of the Vogtle Unit 2 reactor vessel beltline materials at the 1/4-T and 3/4-T locations for 16 EFPY.

Table 3.0-6 shows the calculation of the ART at 16 EFPY for the limiting Vogtle Unit 2 reactor vessel material lower shell plate B8628-1).

Table 3.0-7 provides a summary of the fluences used in the PTS evaluation.

Table 3.0-8 provides RT_{PTS} values for Vogtle Unit 2 for 32 EFPY.

Table 3.0-9 provides RT_{PTS} values for Vogtle Unit 2 for 48 EFPY.

Table 3.0-1

Comparison of the Vogtle Unit 2 Surveillance Material 30 ft-lb Transition Temperature Shifts and Upper Shelf Energy Decrease with Regulatory Guide 1.99 Revision 2 Predictions

Material	Capsule	Fluence ($\times 10^{19}$ n/cm^2, E > 1.0 MeV)	30 ft-lb Transition Temperature Shift		Upper Shelf Energy Decrease	
			Predicted[a] (°F)	Measured (°F)	Predicted[a] (%)	Measured (%)
Lower Shell Plate B8628-1 (Longitudinal)	U	0.444	24	0	16	0
Lower Shell Plate B8628-1 (Transverse)	U	0.444	24	0	16	0
Weld Metal	U	0.444	28	0	16	0
HAZ Metal	U	0.444	-	0	-	0

(a) Based on Regulatory Guide 1.99, Revision 2, methodology using mean wt. % values of Cu and Ni.

Table 3.0-2(*)						
Vogtle Unit 2 Calculation of Chemistry Factors Using Surveillance Capsule Data						
Material	Capsule	Fluence (f) (n/cm^2, $E > 1.0$ MeV)	FF[a]	ΔRT_{NDT} (^{O}F)	$FF*\Delta RT_{NDT}$ (^{O}F)	FF^2
	Sum:					
	Chemistry Factor =					
Weld Metal						
	Sum:					
	Chemistry Factor =					

(a) Fluence Factor (FF) per Regulatory Guide 1.99, Revision 2, is defined as $FF = f^{(0.28 - 0.10 \log f)}$

(*) This table was intentionally left blank pending completion of the evaluation of the second surveillance capsule.

Table 3.0-3			
Vogtle Unit 2 Reactor Vessel Toughness Table (Unirradiated)			
Material Description	Cu (%)[a]	Ni (%)[a]	Initial RT_{NDT} (^{O}F)[b]
Closure Head Flange	--	--	10[c]
Vessel Flange	--	--	-60[c]
Intermediate Shell Plate R4-1	0.06	0.64	10
Intermediate Shell Plate R4-2	0.05	0.62	10
Intermediate Shell Plate R4-3	0.05	0.59	30
Lower Shell Plate B8825-1	0.05	0.59	40
Lower Shell Plate R8-1	0.06	0.62	40
Lower Shell Plate B8628-1	0.05	0.59	50
Longitudinal Welds	0.07	0.13	-10
Circumferential Weld	0.06	0.12	-30

(a) The average values of copper and nickel content.

(b) Initial RT_{NDT} values are measured values.

(c) These values are used for considering flange requirements for the heatup/cooldown curves. Per the methodology given in WCAP-14040, Revision 1, the minimum boltup temperature is 60 ^{O}F.

Table 3.0-4					
Vogtle Unit 2 Reactor Vessel Surface Fluence Values at 16 EFPY (Fluence Based on E > 1.0 MeV)					
Azimuthal	0^{O}	15^{O}	25^{O}	35^{O}	45^{O}
Surface	8.99E+18	1.34E+19	1.52E+19	1.24E+19	1.42E+19

Table 3.0-5		
Summary of Adjusted Reference Temperatures (ARTs) for the Vogtle Unit 2 Reactor Vessel Beltline Materials at the 1/4-T and 3/4-T Locations for 16 EFPY'		
Component	16 EFPY ART[a]	
	1/4-T (°F)	3/4-T (°F)
Intermediate Shell Plate R4-1	80	61
Intermediate Shell Plate R4-2	70	53
Intermediate Shell Plate R4-3	90	73
Lower Shell Plate B8825-1	100	83
Lower Shell Plate R8-1	110[b]	91
Lower Shell Plate B8628-1	110[b]	93[b]
Longitudinal Welds	81	55
Circumferential Weld	54	29

(a) The ARTs presented here are based on the peak reactor vessel surface fluence of 1.52×10^{19} n/cm^2 (E > 1.0 MeV) at 16 EFPY, which is conservative for the longitudinal weld seams.

(b) These ART values are used to generate the heatup and cooldown curves.

Table 3.0-6		
Calculation of Adjusted Reference Temperature at 16 EFPY for the Limiting Vogtle Unit 2 Reactor Vessel Material (Lower Shell Plate B8628-1)		
Parameter	ART Value	
Operating Time	16 EFPY	
Material	B8628-1	B8628-1
Location	1/4-T	3/4-T
Chemistry Factor, CF (^{o}F)	31	31
Fluence $\times 10^{19}$ n/cm^2 (E > 1.0 MeV), f[a]	0.9057	0.3215
Fluence Factor, FF[b]	0.972	0.688
ΔRT_{NDT} = CF x FF, (^{o}F)	30	21.5
Initial RT_{NDT}, I (^{o}F)	50	50
Margin, M (^{o}F)[c]	30	21.5
ART = I + (CF x FF) + M (^{o}F) per Regulatory Guide 1.99, Revision 2	110	93

(a) Fluence, f, is based upon f_{surf} (10^{19} n/cm^2, E > 1.0 MeV) = 1.52 at 16 EFPY. The Vogtle Unit 2 reactor vessel wall thickness is 8.625 inches at the beltline region.

(b) Fluence Factor (FF) per Regulatory Guide 1.99, Revision 2, is defined as $FF = f^{(0.28 - 0.10 \log f)}$.

(c) Margin is calculated as $M = 2(\sigma_i^2 + \sigma_\Delta^2)^{0.5}$. The standard deviation for the initial RT_{NDT} margin term, σ_i, is 0 ^{o}F since the initial RT_{NDT} is a measured value. The Standard deviation for ΔRT_{NDT} term σ_Δ, is 17 ^{o}F for the plate, except that σ_Δ need not exceed 0.5 times the mean value of ΔRT_{NDT}.

Table 3.0-7					
Neutron Exposure Projections[1] at Key Locations on the Vogtle Unit 2 Pressure Vessel Clad/Base Metal Interface					
EFPY	0°	15°	25°	35°	45°
32	1.80	2.69	3.04	2.47	2.84
48	2.70	4.05	4.56	3.69	4.26

(1) Fluence in 10^{19} n/cm^2 (E > 1.0 MeV).

Table 3.0-8

RT_{PTS} Values for Vogtle Unit 2 for 32 EFPY

Material	CF (^{o}F)	Surface Fluence (n/cm^2, E > 1.0 MeV)	FF	ΔRT_{NDT} (CF x FF) (^{o}F)	I (^{o}F)	M (^{o}F)	RT_{PTS} (^{o}F)
Inter. Shell Plate R4-1	37	3.04×10^{19}	1.29	47.7	10	34	92
Inter. Shell Plate R4-2	31	3.04×10^{19}	1.29	40.0	10	34	84
Inter. Shell Plate R4-3	31	3.04×10^{19}	1.29	40.0	30	34	104
Lower Shell Plate B8825-1	31	3.04×10^{19}	1.29	40.0	40	34	114
Lower Shell Plate R8-1	37	3.04×10^{19}	1.29	47.7	40	34	122
Lower Shell Plate B8628-1	31	3.04×10^{19}	1.29	40.0	50	34	124
Longitudinal Weld	47	3.04×10^{19}	1.29	60.6	-10	56	107
Circumferential Weld	43	3.04×10^{19}	1.29	55.5	-30	56	82

(1) RT_{PTS} values were calculated using the peak 32 EFPY vessel clad/base metal interface fluence of 3.04×10^{19} n/cm^2 (E > 1.0 MeV), which is conservative for the longitudinal weld seams (See Table 3.0-7).

Table 3.0-9

RT_{PTS} Values for Vogtle Unit 2 for 48 EFPY

Material	CF (^{o}F)	Surface Fluence (n/cm^2, E > 1.0 MeV)	FF	ΔRT_{NDT} (CF x FF) (^{o}F)	I (^{o}F)	M (^{o}F)	RT_{PTS} (^{o}F)
Inter. Shell Plate R4-1	37	4.56×10^{19}	1.384	51.2	10	34	95
Inter. Shell Plate R4-2	31	4.56×10^{19}	1.384	42.9	10	34	87
Inter. Shell Plate R4-3	31	4.56×10^{19}	1.384	42.9	30	34	107
Lower Shell Plate B8825-1	31	4.56×10^{19}	1.384	42.9	40	34	117
Lower Shell Plate R8-1	37	4.56×10^{19}	1.384	51.2	40	34	125
Lower Shell Plate B8628-1	31	4.56×10^{19}	1.384	42.9	50	34	127
Longitudinal Weld	47	4.56×10^{19}	1.384	65.0	-10	56	111
Circumferential Weld	43	4.56×10^{19}	1.384	59.5	-30	56	86

(1) RT_{PTS} values were calculated using the peak 48 EFPY vessel clad/base metal interface fluence of 4.56×10^{19} n/cm^2 (E > 1.0 MeV), which is conservative for the longitudinal weld seams (See Table 3.0-7).

4.0 Reactor Vessel Material Surveillance Program

The reactor vessel material surveillance program is in compliance with 10 CFR 50, Appendix H, and is described in section 16.3 of the VEGP FSAR. The withdrawal schedule is presented in FSAR table 16.3-3. The Unit 2 surveillance capsule reports are as follows:

1. WCAP-13007, August 1991, "Analysis of Capsule U From the Georgia Power Company Vogtle Electric Generating Plant Unit 2 Reactor Vessel Radiation Surveillance Program."

5.0 Reactor Vessel Surveillance Data Credibility

This discussion is not currently applicable to Unit 2 since the analysis of the second surveillance capsule is not complete at this time.

6.0 References

1. WCAP-14040, Revision 1, December 1994, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," as approved by the NRC by letter dated October 16, 1995 (TAC M91749).

2. Louis L. Wheeler to C. K. McCoy, dated June 8, 1995, "Issuance of Amendments - Vogtle Electric Generating Plant, Units 1 and 2 (TAC Nos. M90966 and M90967)."

Enclosure 3

LCV-0474-B

The first revision to the limits after initial implementation of the PTLR will be submitted to the NRC for prior review and approval. Subsequent revisions will be made without prior approval

5.6 Reporting Requirements

5.6.6 Reactor Coolant System (RCS) PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR) (continued)

testing as well as heatup and cooldown rates shall be established and documented in the PTLR for the following: ~~[The individual specifications that address RCS pressure and temperature limits must be referenced here.]~~

INSERT 21

b. The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in ~~the following documents. [Identify the NRC staff approval document by date.]~~

c. The PTLR shall be provided to the NRC upon issuance for each reactor vessel fluency period and for any revision or supplement thereto.

Reviewers' Notes: The methodology for the calculation of the P-T limits for NRC approval should include the following provisions:

1. The methodology shall describe how the neutron fluence is calculated (reference new Regulatory Guide when issued).

2. The Reactor Vessel Material Surveillance Program shall comply with Appendix H to 10 CFR 50. The reactor vessel material irradiation surveillance specimen removal schedule shall be provided, along with how the specimen examinations shall be used to update the PTLR curves.

3. Low Temperature Overpressure Protection (LTOP) System lift setting limits for the Power Operated Relief Valves (PORVs), developed using NRC-approved methodologies may be included in the PTLR.

4. The adjusted reference temperature (ART) for each reactor beltline material shall be calculated, accounting for radiation embrittlement, in accordance with Regulatory Guide 1.99, Revision 2.

5. The limiting ART shall be incorporated into the calculation of the pressure and temperature limit curves in accordance with NUREG-0800 Standard Review Plan 5.3.2, Pressure-Temperature Limits.

LCV-0474-B

WCAP-14040, Revision 1, December 1994, Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves as approved by the NRC by letter dated October 16, 1995 (TAC M91749).

(continued)

CHAPTER 5.0 ADMINISTRATIVE CONTROLS
INSERTS

INSERT 21
TO PAGE 5.0-21
5.6.6 PTLR

LCO 3.4.3 "RCS Pressure and Temperature Limits"
LCO 3.4.12 "Cold Overpressure Protection Systems"