



444 South 16th Street Mall
Omaha NE 68102-2247

February 13, 2002
LIC-02-0021

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

- References:
1. Docket No. 50-285
 2. Letter from NRC (A. B. Wang) to OPPD (R. T. Ridenoure), "Fort Calhoun Station, Unit No. 1 - Request for Additional Information (TAC No. MB3654)," dated February 7, 2002 (NRC-02-014)
 3. Letter from OPPD (W. G. Gates) to NRC (Document Control Desk), "Fort Calhoun Station Unit No. 1 License Amendment Request, Pressure and Temperature (P-T) Limit Curve for 40 Effective Full Power Years (EFPY)," dated December 14, 2001 (LIC-01-0114)

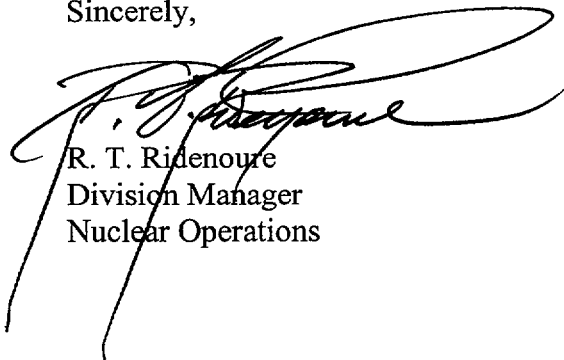
SUBJECT: Fort Calhoun Station Unit No. 1 - "Response to Request for Additional Information: P-T Curve License Amendment Request"

The Attachment provides Omaha Public Power District's (OPPD) response to the NRC's request for additional information presented in Reference 2 regarding the License Amendment Request submitted by OPPD in Reference 3. The attachment is non-proprietary. This information supports and does not alter the contents of Reference 3.

I declare under penalty of perjury that the foregoing is true and correct. (Executed on February 13, 2002)

If you have any questions or require additional information, please contact Dr. Richard Jaworski at (402) 533-6833.

Sincerely,



R. T. Ridenoure
Division Manager
Nuclear Operations

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RTR/RLJ/rj

Attachment: Response to Request for Additional Information
 P-T Curve License Amendment Request

c: E. W. Merschoff, NRC Regional Administrator, Region IV
 A. B. Wang, NRC Project Manager
 W. C. Walker, NRC Senior Resident Inspector
 Division Administrator, Public Health Assurance, State of Nebraska
 Winston & Strawn

Response to Request for Additional Information
P-T Curve License Amendment Request

NRC's Request:

By letter dated December 14, 2001, Omaha Public Power District proposed to apply ASME Code Case N-640, to Appendix G to Section XI of the ASME Boiler and Pressure Vessel Code, as the underlying basis for the establishment of pressure-temperature (P-T) limit curves. The proposed technical specification change seeks to employ a single P-T limit curve for reactor pressure vessel (RPV) heatup and cooldown. This single heatup/cooldown P-T limit curve is a composite curve generated from the most limiting pressure for a given temperature from a 100°F/hr cooldown curve (above 178°F), 50°F/hr cooldown curve, 75°F/hr heatup curve, and an isothermal curve. The NRC staff requires the following information to complete our review of your submittal.

For each curve (the 100°F/hr cooldown curve, the 50°F/hr cooldown curve, the 75°F/hr heatup curve, and the isothermal curve) used to develop the composite heatup/cooldown curve, provide the following data for each temperature point given in Table 1 of Westinghouse letter LTR-PS-01-26, Rev. 00:

K_{Im} - the crack tip stress intensity due to membrane (pressure) stresses for the 1/4 T and 3/4 T flaws;

K_{It} - the crack tip stress intensity due to thermal stresses for the 1/4 T and 3/4 T flaws;

K_{Ic} - the material fracture toughness at the crack tip of the 1/4 T and 3/4 T flaws;

$T_{1/4T}$ - the RPV metal temperature at the tip of the 1/4 T flaw; and

$T_{3/4T}$ - the RPV metal temperature at the tip of the 3/4 T flaw.

OPPD's Response:

Tables 1 through 4 provide the requested data with references to both corrected and uncorrected values of the Reactor Coolant System (RCS) temperature and $P_{allowable}$. The requested data cannot be presented to include the effect of pressure and temperature correction factors. This information is calculated only in the uncorrected state. Therefore, to facilitate comparison with Reference 3 above, each table includes the corresponding "Corrected Values" for RCS temperature and $P_{allowable}$.

**TABLE 1: Requested Data for OPPD Fort Calhoun Unit 1
Cooldown, 100°F/hr**

Corrected Values												
RCS Temp.(°F)	Composite P-Allow (ksi)	RCS Temp.(°F)	P-Allowable (ksi)		Crack Tip Temp. (°F)		Kim (ksi-in ^{1/2})		Kic (ksi- in ^{1/2})		Kit (ksi- in ^{1/2})	
			1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t
354	3.867	340	3.867	4.663	370.573	393.003	93.175	104.959	200	200	13.63	-9.915
344	3.344	330	3.867	4.664	360.636	383.121	93.175	104.982	200	200	13.663	-9.94
334	2.851	320	3.866	4.664	350.686	373.215	93.151	104.982	200	200	13.688	-9.959
324	2.447	310	3.778	4.664	340.726	363.292	91.031	104.982	195.766	200	13.709	-9.975
314	2.116	300	3.168	4.665	330.759	353.354	76.333	105.004	166.385	200	13.726	-9.988
304	1.845	290	2.668	4.665	320.785	343.404	64.285	105.004	142.3	200	13.74	-9.999
294	1.623	280	2.258	4.665	310.807	333.444	54.407	105.004	122.562	200	13.751	-10.007
284	1.442	270	1.922	4.665	300.824	323.477	46.311	105.004	106.388	200	13.76	-10.014
274	1.293	260	1.647	4.665	290.838	313.503	39.684	105.004	93.138	200	13.767	-10.019
264	1.172	250	1.422	4.665	280.849	303.524	34.263	105.004	82.284	200	13.773	-10.024
254	1.072	240	1.237	4.665	270.858	293.541	29.806	105.004	73.394	200	13.777	-10.027
244	0.990	230	1.086	4.076	260.865	283.555	26.167	91.747	66.113	173.455	13.781	-10.03
234	0.895	220	0.962	3.512	250.871	273.566	23.179	79.052	60.15	148.057	13.784	-10.032
224	0.794	210	0.861	3.05	240.876	263.575	20.746	68.652	55.267	127.254	13.787	-10.034
214	0.717	200	0.778	2.671	230.88	253.583	18.746	60.122	51.268	110.216	13.789	-10.036
204	0.649	190	0.71	2.361	220.883	243.588	17.107	53.144	47.994	96.263	13.79	-10.037
194	0.593	180	0.654	2.107	210.885	233.593	15.758	47.426	45.313	84.836	13.792	-10.038
184	0.548	170	0.609	1.9	200.887	223.597	14.674	42.767	43.118	75.479	13.793	-10.039
174	0.510	160	0.571	1.729	190.889	213.6	13.758	38.918	41.32	67.818	13.793	-10.039
164	0.480	150	0.541	1.59	180.89	203.603	13.035	35.789	39.848	61.544	13.794	-10.04
154	0.455	140	0.516	1.476	170.891	193.605	12.433	33.223	38.643	56.407	13.795	-10.04
144	0.434	130	0.495	1.383	160.892	183.606	11.927	31.130	37.657	52.201	13.795	-10.041
134	0.417	120	0.478	1.306	150.893	173.608	11.517	29.397	36.849	48.757	13.795	-10.041
124	0.404	110	0.465	1.243	140.894	163.609	11.204	27.979	36.187	45.937	13.796	-10.041
114	0.392	100	0.453	1.192	130.894	153.609	10.915	26.831	35.646	43.629	13.796	-10.041
104	0.383	90	0.444	1.15	120.894	143.61	10.698	25.885	35.203	41.738	13.796	-10.042
94	0.376	80	0.437	1.116	110.895	133.611	10.530	25.120	34.84	40.191	13.796	-10.042
84	0.369	70	0.43	1.088	100.895	123.611	10.361	24.490	34.542	38.924	13.796	-10.042
74	0.364	60	0.425	1.065	90.895	113.612	10.240	23.972	34.299	37.886	13.797	-10.042
64	0.360	50	0.421	1.046	80.895	103.612	10.144	23.544	34.1	37.037	13.797	-10.042

**TABLE 2: Requested Data for OPPD Fort Calhoun Unit 1
Cooldown, 50°F/hr**

Corrected Values												
RCS Temp.(°F)	Composite P-Allow (ksi)	RCS Temp.(°F)	P-Allowable (ksi)		Crack Tip Temp. (°F)		Kim (ksi-in ^{1/2})		K _{ic} (ksi- in ^{1/2})		K _{it} (ksi- in ^{1/2})	
			1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t
354	4.007	340	4.007	4.554	355.446	366.803	96.549	102.506	200	200	6.897	-5.02
344	3.344	330	4.007	4.554	345.447	356.804	96.549	102.506	200	200	6.898	-5.021
334	2.851	320	3.581	4.554	335.447	346.805	86.284	102.506	179.477	200	6.898	-5.021
324	2.447	310	3.031	4.554	325.447	336.805	73.032	102.506	152.962	200	6.898	-5.021
314	2.116	300	2.58	4.554	315.448	326.806	62.165	102.506	131.253	200	6.898	-5.021
304	1.845	290	2.212	4.554	305.448	316.806	53.298	102.506	113.48	200	6.898	-5.021
294	1.623	280	1.91	4.554	295.448	306.806	46.021	102.506	98.927	200	6.898	-5.021
284	1.442	270	1.662	4.554	285.448	296.806	40.046	102.506	87.013	200	6.898	-5.021
274	1.293	260	1.46	4.174	275.448	286.806	35.179	93.953	77.258	182.878	6.898	-5.021
264	1.172	250	1.294	3.571	265.448	276.806	31.179	80.380	69.272	155.746	6.898	-5.021
254	1.072	240	1.159	3.078	255.448	266.806	27.926	69.283	62.733	133.532	6.898	-5.021
244	0.981	230	1.048	2.674	245.448	256.806	25.252	60.189	57.38	115.345	6.898	-5.021
234	0.890	220	0.957	2.343	235.448	246.807	23.059	52.739	52.997	100.455	6.898	-5.021
224	0.815	210	0.882	2.072	225.448	236.807	21.252	46.639	49.408	88.264	6.898	-5.021
214	0.760	200	0.821	1.85	215.448	226.807	19.782	41.642	46.47	78.282	6.898	-5.021
204	0.710	190	0.771	1.669	205.448	216.807	18.577	37.568	44.065	70.11	6.898	-5.021
194	0.669	180	0.73	1.52	195.448	206.807	17.589	34.214	42.095	63.42	6.898	-5.021
184	0.636	170	0.697	1.399	185.448	196.807	16.794	31.490	40.483	57.942	6.898	-5.021
174	0.609	160	0.67	1.299	175.448	186.807	16.144	29.239	39.163	53.457	6.898	-5.021
164	0.586	150	0.647	1.217	165.448	176.807	15.589	27.393	38.082	49.785	6.899	-5.021
154	0.568	140	0.629	1.151	155.448	166.807	15.156	25.908	37.197	46.779	6.899	-5.021
144	0.553	130	0.614	1.096	145.448	156.807	14.794	24.670	36.472	44.317	6.899	-5.021
134	0.540	120	0.601	1.051	135.448	146.807	14.481	23.657	35.879	42.302	6.899	-5.021
124	0.530	110	0.591	1.015	125.448	136.807	14.240	22.847	35.394	40.652	6.899	-5.021
114	0.522	100	0.583	0.985	115.448	126.807	14.047	22.171	34.996	39.301	6.899	-5.021
104	0.515	90	0.576	0.96	105.448	116.807	13.879	21.609	34.67	38.195	6.899	-5.021
94	0.510	80	0.571	0.94	95.448	106.807	13.758	21.158	34.404	37.29	6.899	-5.021
84	0.505	70	0.566	0.923	85.448	96.807	13.638	20.776	34.186	36.548	6.899	-5.021
74	0.502	60	0.563	0.91	75.448	86.807	13.565	20.483	34.007	35.941	6.899	-5.021
64	0.498	50	0.559	0.899	65.448	76.807	13.469	20.236	33.861	35.445	6.899	-5.021

**TABLE 3: Requested Data for OPPD Fort Calhoun Unit 1
Heatup, 75°F/hr**

Corrected Values												
RCS Temp.(°F)	Composite P-Allow (ksi)	RCS Temp.(°F)	P-Allowable (ksi)		Crack Tip Temp. (°F)		Kim (ksi-in ^{1/2})		K _{1c} (ksi- in ^{1/2})		K _{1t} (ksi- in ^{1/2})	
			1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t
354	2.918	340	3.030	4.282	317.758	301.404	73.011	96.384	136.107	200.000	-9.932	7.229
344	2.575	330	2.642	4.174	307.759	291.406	63.665	93.949	117.401	195.137	-9.932	7.229
334	2.258	320	2.325	3.564	297.760	281.408	56.009	80.224	102.092	167.664	-9.931	7.228
324	1.998	310	2.065	3.021	287.762	271.411	49.756	68.000	89.562	143.211	-9.930	7.228
314	1.786	300	1.853	2.579	277.764	261.415	44.648	58.058	79.380	123.340	-9.929	7.227
304	1.613	290	1.680	2.218	267.767	251.422	40.488	49.919	71.035	107.057	-9.928	7.226
294	1.471	280	1.538	1.921	257.772	241.429	37.052	43.240	64.197	93.713	-9.926	7.224
284	1.355	270	1.422	1.678	247.777	231.440	34.267	37.774	58.595	82.781	-9.923	7.222
274	1.259	260	1.327	1.480	237.785	221.455	31.963	33.310	54.005	73.824	-9.919	7.218
264	1.172	250	1.248	1.317	227.795	211.474	30.071	29.633	50.244	66.487	-9.914	7.215
254	1.072	240	1.184	1.184	217.809	201.500	28.535	26.642	47.164	60.477	-9.906	7.209
244	0.99	230	1.131	1.074	207.827	191.535	27.259	24.182	44.640	55.555	-9.896	7.202
234	0.918	220	1.089	0.985	197.852	181.582	26.227	22.169	42.573	51.524	-9.883	7.192
224	0.845	210	1.053	0.912	187.886	171.646	25.374	20.532	40.881	48.224	-9.866	7.179
214	0.791	200	1.024	0.853	177.931	161.732	24.662	19.192	39.495	45.523	-9.843	7.161
204	0.743	190	1.000	0.804	167.993	151.848	24.083	18.097	38.360	43.313	-9.812	7.137
194	0.703	180	0.979	0.764	158.074	142.003	23.595	17.198	37.432	41.505	-9.769	7.105
184	0.671	170	0.962	0.732	148.184	132.211	23.185	16.482	36.672	40.027	-9.712	7.061
174	0.646	160	0.948	0.707	138.333	122.493	22.839	15.905	36.050	38.820	-9.635	7.003
164	0.626	150	0.935	0.687	128.533	112.870	22.529	15.456	35.543	37.835	-9.532	6.924
154	0.61	140	0.924	0.671	118.801	103.378	22.262	15.105	35.128	37.032	-9.393	6.818
144	0.599	130	0.913	0.660	109.163	94.061	21.993	14.845	34.789	36.380	-9.207	6.677
134	0.591	120	0.902	0.652	99.648	84.979	21.736	14.681	34.513	35.850	-8.956	6.486
124	0.588	110	0.890	0.649	90.300	76.213	21.445	14.597	34.289	35.422	-8.620	6.228
114	0.588	100	0.878	0.649	81.174	67.873	21.143	14.606	34.106	35.080	-8.165	5.881
104	0.592	90	0.861	0.654	72.316	60.119	20.754	14.712	33.959	34.809	-7.540	5.392
94	0.609	80	0.837	0.670	63.426	53.334	20.168	15.088	33.835	34.604	-6.501	4.440
84	0.641	70	0.792	0.702	58.831	52.072	19.073	15.804	33.783	34.569	-4.364	2.973
74	0.64	60	0.745	0.735	54.416	51.036	17.958	16.534	33.734	34.541	-2.182	1.486
64	0.638	50	0.699	0.767	50	50	16.842	17.264	33.685	34.513	0	0

**TABLE 4: Requested Data for OPPD Fort Calhoun Unit 1
Isothermal**

Corrected Values												
RCS Temp.(°F)	Composite P-Allow (ksi)	RCS Temp.(°F)	P-Allowable (ksi)		Crack Tip Temp. (°F)		Kim (ksi-in ^{1/2})		Kic (ksi- in ^{1/2})		Kit (ksi- in ^{1/2})	
			1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t	1/4t	3/4t
354	4.014	340	4.014	4.443	340	340	193.424	200.000	96.712	100.000	0	0
344	3.344	330	3.411	4.443	330	330	164.381	200.000	82.190	100.000	0	0
334	2.851	320	2.918	4.443	320	320	140.602	200.000	70.301	100.000	0	0
324	2.447	310	2.514	4.443	310	310	121.133	200.000	60.566	100.000	0	0
314	2.116	300	2.183	4.443	300	300	105.193	200.000	52.597	100.000	0	0
304	1.845	290	1.912	4.282	290	290	92.143	192.753	46.072	96.376	0	0
294	1.623	280	1.69	3.639	280	280	81.459	163.831	40.729	81.915	0	0
284	1.442	270	1.509	3.113	270	270	72.711	140.151	36.355	70.076	0	0
274	1.293	260	1.36	2.683	260	260	65.549	120.764	32.774	60.382	0	0
264	1.172	250	1.239	2.33	250	250	59.685	104.892	29.842	52.446	0	0
254	1.072	240	1.139	2.041	240	240	54.884	91.896	27.442	45.948	0	0
244	0.990	230	1.057	1.805	230	230	50.953	81.256	25.477	40.628	0	0
234	0.924	220	0.991	1.611	220	220	47.735	72.545	23.868	36.273	0	0
224	0.869	210	0.936	1.453	210	210	45.100	65.413	22.550	32.707	0	0
214	0.830	200	0.891	1.323	200	200	42.943	59.574	21.472	29.787	0	0
204	0.793	190	0.854	1.217	190	190	41.177	54.793	20.589	27.397	0	0
194	0.763	180	0.824	1.13	180	180	39.731	50.879	19.866	25.439	0	0
184	0.739	170	0.8	1.059	170	170	38.547	47.674	19.274	23.837	0	0
174	0.719	160	0.78	1.001	160	160	37.578	45.051	18.789	22.525	0	0
164	0.702	150	0.763	0.953	150	150	36.784	42.902	18.392	21.451	0	0
154	0.689	140	0.75	0.914	140	140	36.135	41.144	18.067	20.572	0	0
144	0.678	130	0.739	0.882	130	130	35.603	39.704	17.801	19.852	0	0
134	0.669	120	0.73	0.856	120	120	35.167	38.525	17.584	19.262	0	0
124	0.661	110	0.722	0.834	110	110	34.811	37.560	17.405	18.780	0	0
114	0.655	100	0.716	0.817	100	100	34.519	36.769	17.259	18.385	0	0
104	0.650	90	0.711	0.802	90	90	34.280	36.122	17.140	18.061	0	0
94	0.646	80	0.707	0.791	80	80	34.084	35.593	17.042	17.796	0	0
84	0.643	70	0.704	0.781	70	70	33.924	35.159	16.962	17.579	0	0
74	0.640	60	0.701	0.773	60	60	33.792	34.804	16.896	17.402	0	0
64	0.638	50	0.699	0.767	50	50	33.685	34.513	16.843	17.257	0	0