U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
October 23, 1990

Attachment No. 2

Duke Power Company
McGuire Nuclear Station

Proposed Changes to Technical Specifications

3/4.7.5 STANDBY NUCLEAR SERVICE WATER POND

LIMITING CONDITION FOR OPERATION

3.7.5 The standby nuclear service water pond shall be OPERABLE with:

a. A minimum water level at or above elevation 739.5 feet Mean Sea Level, USGS datum, and

b. An average water temperature of less than or equal to ~~[illegible]~~ 82°F at elevation ~~[illegible]~~ 718 feet. ~~in the intake structure~~.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION: (Units 1 and 2)

With the requirements of the above specification not satisfied, be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.7.5 The standby nuclear service water pond shall be determined OPERABLE:

a. At least once per 24 hours by verifying the water level to be within its limit,

b. At least once per 24 hours during the months of July, August and September by verifying the water temperature to be within its limit, and

c. At least once per 12 months by visually inspecting the dam and verifying no abnormal degradation, erosion, or excessive seepage.

Attachment No. 3

Duke Power Company
McGuire Nuclear Station

Containment Peak Pressure Analysis

ATTACHMENT
McGuire Nuclear Station Units 1 and 2
FSAR 1989 Containment Pressure Calculation

LOTIC CODE - LONG TERM ANALYSIS

Early in the ice condenser development program it was recognized that there was a need for modeling of long term ice condenser performance. It was realized that the model would have to have capabilities comparable to those of the dry containment (COCO) model. These capabilities would permit the model to be used to solve problems of containment design and optimize the containment and safeguards systems. This has been accomplished in the development of the LOTIC Code (Reference 20).

The model of the containment consists of five distinct control volumes, the upper compartment, the lower compartment, the portion of the ice bed from which the ice has melted, the portion of the ice bed containing unmelted ice, and the dead ended compartment. The ice condenser control volume with unmelted and melted ice is further subdivided into six subcompartments to allow for maldistribution of break flow to the ice bed.

The conditions in these compartments are obtained as a function of time by the use of fundamental equations solved through numerical techniques. These equations are solved for three phases in time. Each phase corresponds to a distinct physical characteristic of the problem. Each of these phases has a unique set of simplifying assumptions based on test results from the ice condenser test facility. These phases are the blowdown period, the depressurization period, and the long term.

The most significant simplification of the problem is the assumption that the total pressure in the containment is uniform. This assumption is justified by the fact that the initial blowdown of the Reactor Coolant System, after the remaining mass and energy release from this system into the containment are small and very slowly changin . The resulting flow rates between the control volumes will also be relatively small. These flow rates then are unable to maintain significant pressure differences between the compartments.

In the control volumes, which are always assumed to be saturated, steam and air are assumed to be uniformly mixed and at the control volume temperature. The air is considered a perfect gas, and the thermodynamic properties of steam are taken from the ASME steam table.

The condensation of steam is assumed to take place in a condensing node located, for the purpose of calculation, between the two control volumes in the ice storage compartment. The exit temperature of the air leaving this node is set equal to a specific value which is equal to the temperature of the ice filled control volume of the ice storage compartment. Lower compartment exit temperature is used if the ice bed section is melted.

CONTAINMENT PRESSURE CALCULATION

The following are the major input assumptions used in the LOTIC analysis for the pump suction pipe rupture case with the steam generators considered as an active heat source for the McGuire Nuclear Station Containment:

1. Minimum safeguards are employed in all calculations, e.g., one of two spray pumps and one of two spray heat exchangers; one of two RHR pumps and one of two RHR heat exchangers providing flow to the core; one of two safety injection pumps and one of two centrifugal charging pumps; and one of two air return fans.

2. $2.22 * 10^6$ lbs. of ice initially in the ice condenser (Basis for Technical Specification limit).

3. The blowdown, reflood, and post reflood mass and energy releases described in Subdivision 6.2.1.3.6 are used.

4. Blowdown and post-blowdown ice condenser drain temperature of 190°F and 130°F are used. (These numbers are based on Reference 22).

5. Nitrogen from the accumulators in the amount of 5870 lbs. is included in the calculations.

6. Nuclear service water temperature of 82°F is used on the spray heat exchanger and the component cooling heat exchanger.

7. The air return fan is effective, 10 minutes after the transient is initiated.

8. No maldistribution of steam flow to the ice bed is assumed.

9. No ice condenser bypass is assumed. (This assumption depletes the ice in the shortest time and is thus conservative.)

10. The initial conditions in the containment are a temperature of 100°F in the lower and dead-ended volumes and a temperature of 75°F in the upper volume. All volumes are at a pressure of 0.3 psig.

11. Pump flow rates versus time given in Table 6.2.1-13C were used.

12. Containment structural heat sinks are assumed with conservatively low heat transfer rates. (See Table 6.2.1-14)

13. The operation of one containment spray heat exchanger ($UA = 1.47 * 10^6$ Btu/hr-^oF) for containment cooling and the operation of one RHR heat exchanger ($UA = 1.64 * 10^6$ Btu/hr-^oF) for core cooling. The component cooling heat exchanger was modeled at $1.6 * 10^6$ Btu/hr-^oF.

14. The air return fan returns air at a rate of 30,000 cfm from the upper to the lower compartment.

15. An active sump volume of 90,000 ft^3 is used.

16. 102% of rated thermal power is used in the calculations.

17. Subcooling of ECC water from the RHR heat exchanger is assumed.

18. Nuclear service water flow to the containment spray heat exchanger was modeled as 3800 gpm. Also the nuclear service water flow to the component cooling heat exchanger was modeled as 5500 gpm.

The minimum time at which the RHR pumps can be diverted to the RHR sprays will be specified in the plant operating procedures as 50 minutes after the accident. A discussion of the core cooling capability of the ECCS is given in Section 6.3.1 for this mode of operation.

With these assumptions, the heat removal capability of the containment is sufficient to absorb the energy releases and still keep the maximum calculated pressure well below the design.

The following plots are provided.

Figure 6.2.1-15, Containment Pressure Transient
Figure 6.2.1-16, Upper Compartment Temperature Transient
Figure 6.2.1-17, Lower Compartment Temperature Transient
Figure 6.2.1-18, Active and Inactive Sump Temperature Transient
Figure 6.2.1-43, Ice Melt Transient

Tables 6.2.1-12 and 6.2.1-13 give energy accountings at various points in the transient.

As can be seen from Figure 6.2.1-15 the maximum calculated containment pressure is 12.36 psig, occurring at approximately 7356 seconds. Table 6.2.1-13A gives total sump volume versus time. Comparing this table with Table 6.2.1-13B, which gives the total sump volume versus elevation, the sump elevation versus time can be determined.

Structural Heat Removal

Provision is made in the containment pressure analysis for heat storage in interior and exterior walls. Each wall is divided into a number of nodes. For each node, a conservation of energy equation expressed infinite difference forms accounts for transient conduction into and out of the containment structural heat sinks used in the analysis. The material property data used is found in Table 6.2.1-15.

The heat transfer coefficient to the containment structure is based primarily on the work of Tagami. An explanation of the manner of application is given in Reference 24. When applying the Tagami correlations, a conservative limit was placed on the lower compartment stagnant heat transfer coefficients. They were limited to a steam-air ratio of 1.4 according to the Tagami correlation. The imposition of this limitation is to restrict the use of the Tagami correlation within the test range of steam-air ratios where the correlation was derived.

TABLE 6.2.1-12

ENERGY ACCOUNTING IN MILLIONS OF BTU

	Approx. End of Blowdown (t = 10.0 sec.) (BTU)	Approx. End of Reflood (t = 299 sec.) (BTU)
*Ice Heat Removal	176.6	225.4
*Structural Heat Sinks	21.2	64.4
*RHR Heat Exchanger Heat Removal	0	0
*Spray Heat Exchanger Heat Removal	0	0
Energy Content of Sump	163.4	237.7
Ice Melted (Pounds)	0.57 (10^6)	0.76 (10^6)

* Integrated Energies

TABLE 6.2-13

ENERGY ACCOUNTING IN MILLIONS OF BTU

	Approx. Time of <u>Ice Melt Out</u> (t = 5348 sec.) (BTU)	Approx. Time of <u>Peak Pressure</u> (t = 7256 sec.) (BTU)
*Ice Heat Removal	588.7	588.7
*Structural Heat Sinks	106.5	146.6
*RHR Heat Exchanger Heat Removal	92.6	159.5
*Spray Heat Exchanger Heat Removal	69.7	162.9
Energy Content of Sump	636.4	656.2
Ice Melted (Pounds x 10^6)	2.22	2.22

* Integrated Energies

TABLE 6.2.1 - 13A

CONTAINMENT SUMP VOLUME VS. TIME

Time (sec)	Volume (Ft^3)
25.0	16786.
51.5	18399.
81.1	19684.
129.7	21143.
189.7	22981.
259.7	24979.
409.3	28787.
599.3	33538.
809.3	38947.
1009.3	44089.
1509.3	56783.
2002.5	68246.
2402.4	74460.
2804.8	78475.
3002.3	80675.
3202.3	82871.
3409.8	84445.

3604.8	85068.
3802.3	85685.
4009.1	86320.
4209.1	86927.
4409.1	87528.
4609.1	88123.
4809.1	88712.
5100.0	89555.
5184.0	89764.
5258.7	89968
5298.5	90000.
End of Transient	89848.

Notes on McGuire sump volume calculation:

The two sump model was created because of the insufficient capacity of the active sump to contain all the water of the RCS system, the melted ice, and the RWST.

Worst Case: Double Ended Pump Suction Guillotine, with Minimum Safeguards

Maximum volume of the active lower compartment sump = 90000 Ft^3

Time in seconds to fill active sump (approx.) = 5298.5 seconds.

TABLE 6.2.1-17 (Page 1)

Structural Heat Sinks

A. Upper Compartment

	Area (ft^2)	Thickness (ft)	
1. Slab 1:	Crane Wall; Ice Condenser End Wall; CRDM Missile Shield and Gate; PRZR and SG Doghouse		
	19749	0.001167	Paint
		1.3593	Concrete
2. Slab 2:	Containment Vessel Dome; Shell		
	23436	0.00059	Paint
		0.05797	Carbon Steel
3. Slab 3:	SG Doghouse; Polar CRane; Platforms; Electrical Equipment		
	34706	0.00059	Paint
		0.02755	Carbon Steel
4. Slab 4:	Internals Storage Stand, Upper and Lower; Reactor Vessel Head Stand		
	1156	0.03125	Stainless Steel
5. Slab 5:	Refueling Canal; Floor Slab		
	4821	0.1563	Stainless Steel
		1.5	Concrete
6. Slab 6:	Operating Floor; Refueling Canal; Crane Wall; SG Doghouse; Accumulator Wells; CRDM Gate; HX and Ceiling		
	41154	0.001167	Paint
		1.825	Concrete

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TABLE 6.2.1-17 (Page 2)

Structural Heat Sinks

B. Lower Compartment

	Area (ft^2)	Thickness (ft)	
1. Slab 7:	SG Supports; Main Steamline Restraints; Pressurizer Supports; Platforms; Steel Columns*; Mechanical and Electrical Equipment		
	33763	0.00059	Paint
		0.03388	Carbon Steel
2. Slab 8:	Containment Shell		
	13879	0.00059	Paint
		0.0625	Carbon Steel
3. Slab 9:	Refueling Canal		
	2269	0.01563	Stainless Steel
		1.5	Concrete
4. Slab 10:	CRDM Missile Shield		
	738	0.00059	Paint
		0.04208	Carbon Steel
		1.5	Concrete
5. Slab 11:	Dead-Ended Compartment Slabs		
	3403	0.001167	Paint
		2.5	Concrete

*In contact with sump

Entire Page Revised

Structural Heat Sinks

B. Lower Compartment (cont'd)

	Area (ft^2)	Thickness (ft)	
6. Slab 12:	Primary Shield Wall; Incore Instrumentation Tunnel; Slabs; Floors		
	20407	0.001167 1.6686	Paint Concrete
7. Slab 13:	Duct Work		
	31360	0.002625	Stainless Steel
8. Slab 14:	Cooling Coils		
	49000	0.0004167	Copper

C. Ice Condenser

	Area (ft^2)	Thickness (ft)	
1. Slab 15:	Ice Baskets		
	180,628	0.00663	Steel
2. Slab 16:	Lattice Frames		
	76,650	0.0217	Steel

Entire Page Revised

TABLE 6.2.1-17 (Page 4)

Structural Heat Sinks

C. Ice Condenser (cont'd)

	Area (ft^2)	Thickness (ft)	
3. Slab 17: Lower Support Structure			
	28,670	0.0267	Steel
4. Slab 18: Ice Condenser Floor			
	3,336	0.000833	Paint
		0.33	Concrete
5. Slab 19: Containment Wall Panels & Containment Shell			
	19,100	1.0	Steel & Insulation
		0.625	Steel Shell
6. Slab 20: Crane Wall Panels and Crane Wall			
	13,055	1.0	Steel & Insulation
		1.0	Concrete

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TABLE 6.2.1-21

BLOWDOWN MASS AND ENERGY RELEASES

TIME	BREAK PATH NO. 1 FLOW		BREAK PATH NO. 2 FLOW	
SECONDS	LBM/SEC	THOUSAND BTU/SEC	LBM/SEC	THOUSAND BTU/SEC
0.000	0.0	0.0	0.0	0.0
0.101	41848.7	23251.0	22257.9	12311.1
0.200	42335.3	23668.6	23974.2	13266.4
0.401	44122.2	25216.9	23413.2	12991.0
0.600	44004.7	25724.1	21324.1	11890.4
1.00	39552.8	24045.4	19335.4	10838.8
1.40	33391.0	21442.3	17325.9	9723.5
2.10	27440.7	18545.1	16922.3	9495.5
2.50	21192.7	14710.8	16486.9	9251.1
3.40	16604.8	11717.9	14682.1	8239.4
3.90	14972.4	10528.1	13944.1	7824.3
4.80	14586.3	9969.3	13087.6	7343.6
5.20	10839.1	8531.1	13104.1	7346.4
5.40	11548.8	8852.9	13011.9	7291.7
6.00	17249.3	11879.5	12675.4	7100.8
6.60	19773.6	13086.2	12218.7	6853.8
7.00	26448.6	17042.8	11631.3	6519.4
8.20	25981.2	16258.1	10206.3	5715.8
8.80	24601.3	15409.5	9571.4	5354.1
9.20	10090.6	6456.8	9735.8	5447.5
9.40	8289.9	5520.9	9485.3	5296.7
10.0	8348.2	5451.2	9818.1	5485.7
10.2	9510.8	6118.5	9654.1	5390.4
10.6	9526.7	6449.7	9661.3	5393.6
11.0	6637.2	5398.0	9562.9	5334.7
11.6	7190.8	5494.1	9355.3	5213.3
13.0	6123.9	4904.2	8733.3	4851.7
14.4	5539.5	4429.0	8093.4	4646.0
15.6	4797.0	4061.2	6603.0	3791.4
16.6	4029.9	3827.2	6025.3	3158.8
18.4	1799.4	2228.6	3347.7	1481.9
19.4	1013.5	1272.5	2352.8	1167.9
19.8	769.5	969.1	1252.6	982.6
22.4	119.8	152.9	253.8	274.0
25.2	33.9	43.8	36.0	46.8

TABLE 6.2.1-22

REFLOOD MASS AND ENERGY RELEASES

TIME	BREAK PATH NO. 1 FLOW		BREAK PATH NO. 2 FLOW	
SECONDS	LBM/SEC	THOUSAND BTU/SEC	LBM/SEC	THOUSAND BTU/SEC
25.2	0.0	0.0	0.0	0.0
25.7	0.0	0.0	167.7	12.2
26.4	5.7	6.6	167.7	12.2
29.3	68.3	79.7	167.7	12.2
33.3	110.3	128.8	167.7	12.2
34.3	285.3	335.2	4096.0	497.7
35.3	336.7	396.4	4768.0	609.0
36.3	336.1	395.7	4760.9	611.2
37.3	331.8	390.6	4707.3	605.5
40.3	318.4	374.6	4539.4	586.5
43.3	306.0	359.9	4380.6	568.4
46.3	294.9	346.7	4235.1	551.7
49.3	284.9	334.8	4102.2	536.5
51.8	277.1	325.5	3995.7	524.4
52.3	275.9	324.1	3980.5	522.5
55.3	267.8	314.4	3868.7	509.7
58.3	260.3	305.6	3765.1	497.9
59.3	135.3	158.0	1444.9	253.2
62.4	134.8	157.5	1412.0	249.5
63.4	254.9	299.2	271.4	128.4
67.4	255.3	299.7	274.0	128.7
86.4	249.9	293.3	290.1	126.3
102.4	245.1	287.6	301.9	124.4
134.4	234.5	275.0	324.8	120.9
136.4	233.7	274.0	326.2	120.7
150.4	227.5	266.8	335.6	118.9
182.4	211.2	247.5	361.4	115.4
184.4	210.1	246.2	363.2	115.2
214.4	190.5	223.0	391.1	112.6
224.4	183.1	214.3	402.4	112.1
248.4	163.2	190.9	433.4	111.8
262.4	149.7	174.9	453.2	112.1
272.4	139.0	162.4	468.8	112.7
288.4	120.0	140.1	497.0	114.4
292.6	114.5	133.7	505.1	115.1

TABLE 6.2.1-23

POST REFLOOD MASS AND ENERGY RELEASES

TIME	BREAK PATH NO. 1 FLOW		BREAK PATH NO. 2 FLOW	
SECONDS	LBM/SEC	THOUSAND BTU/SEC	LBM/SEC	THOUSAND BTU/SEC
292.7	103.3	128.0	567.7	123.1
397.7	101.5	125.8	569.5	121.7
432.7	102.1	126.6	568.8	121.0
462.7	101.0	125.2	570.0	120.7
467.7	101.8	126.2	569.2	120.5
497.7	100.6	124.7	570.4	120.2
532.7	101.2	125.5	569.7	119.5
562.7	100.0	124.0	570.9	119.2
567.7	100.8	125.0	570.2	119.0
632.7	99.5	123.3	571.5	118.2
637.7	100.3	124.3	570.7	117.9
672.7	99.2	123.0	571.8	117.6
712.7	99.8	123.7	571.1	116.8
747.7	98.7	122.3	572.3	116.4
752.7	99.5	123.3	571.5	116.2
817.7	98.3	121.8	572.7	115.3
822.7	99.0	122.8	571.9	115.0
862.7	98.8	122.4	572.2	114.4
927.7	97.6	121.0	573.3	113.5
962.7	98.2	121.8	572.7	112.7
1032.7	96.9	120.1	574.1	117.5
1037.7	97.5	120.9	573.4	117.2
1127.7	96.3	119.4	574.6	115.6
1157.7	96.8	120.0	574.2	114.9
1247.7	95.5	118.4	575.5	113.2
1267.7	96.0	119.0	575.0	112.7
1467.7	94.1	116.7	576.8	113.5
1886.9	94.1	116.7	576.8	113.5
1887.0	95.2	117.9	575.7	113.5
2302.7	95.2	117.9	575.7	113.5
2302.8	67.3	82.7	603.6	125.7
2536.9	67.4	77.5	603.6	60.6

TABLE 6.2.1-25

MASS BALANCE

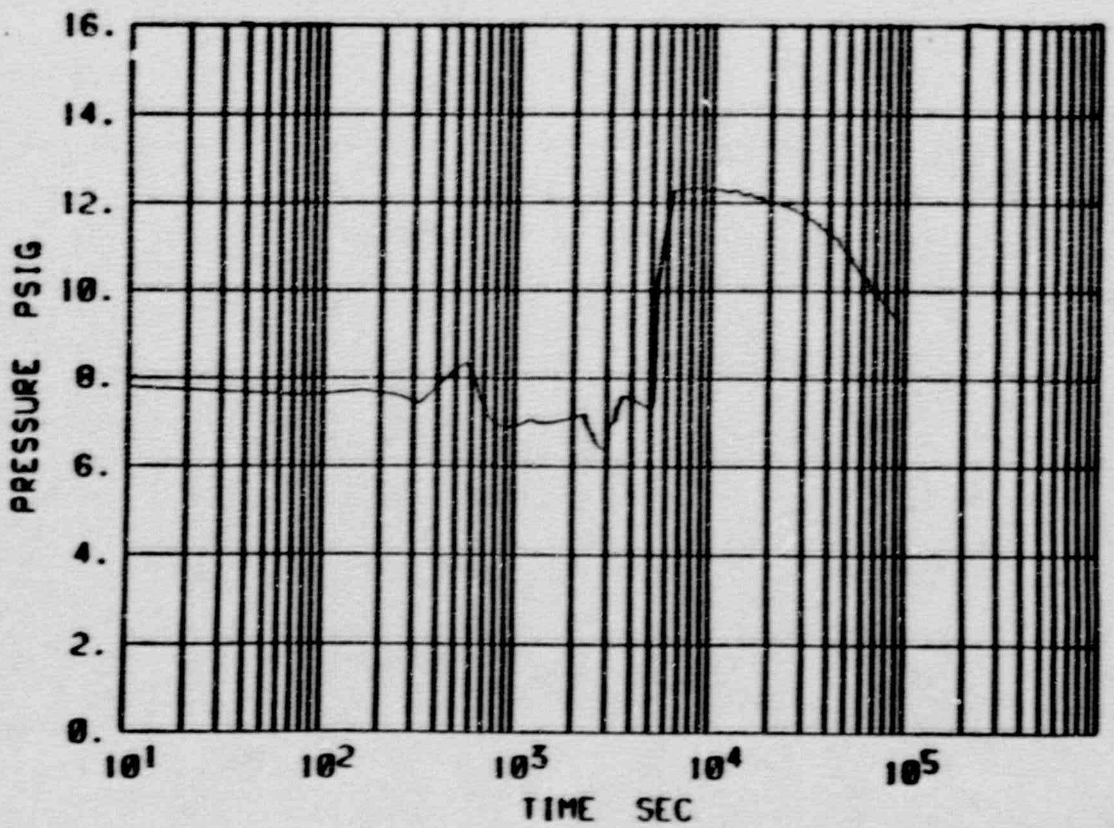
	TIME (SECONDS)	0.00	25.20	25.20	292.60	2307.70	2536.80
		MASS (THOUSAND LBM)					
INITIAL	IN RCS AND ACC	733.33	733.33	733.33	733.33	733.33	733.33
ADDED MASS	PUMPED INJECTION	0.00	0.00	0.00	173.74	1525.72	1679.43
	TOTAL ADDED	0.00	0.00	0.00	173.74	1525.72	1679.43
*** TOTAL AVAILABLE ***		733.33	733.33	733.33	907.07	2259.04	2412.76
DISTRIBUTION	REACTOR COOLANT	496.91	90.69	90.73	171.53	171.53	171.53
	ACCUMULATOR	236.42	160.84	160.80	0.00	0.00	0.00
	TOTAL CONTENTS	733.33	251.53	251.53	171.53	171.53	171.53
EFFLUENT	BREAK FLOW	0.00	481.79	481.79	735.53	2087.50	2241.21
	ECCS SPILL	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL EFFLUENT	0.00	481.79	481.79	735.53	2087.50	2241.21
*** TOTAL ACCOUNTABLE ***		733.33	733.32	733.32	907.06	2259.04	2412.75

ENERGY BALANCE

	TIME (SECONDS)	0.00	25.20	25.20	292.60	2307.70	2536.8[illegible]
		ENERGY (MILLION BTU)					
INITIAL ENERGY	IN RCS,ACC,S GEN	848.43	848.43	848.43	848.43	848.43	848.4[illegible]
ADDED ENERGY	PUMPED INJECTION	0.00	0.00	0.00	12.68	117.01	131.[illegible]
	DECAY HEAT	0.00	8.39	8.39	38.35	181.78	195.[illegible]
	HEAT FROM SECONDAR	0.00	-5.28	-5.28	-5.28	3.82	4.[illegible]
	TOTAL ADDED	0.00	3.10	3.10	45.75	302.61	330.[illegible]
*** TOTAL AVAILABLE ***		848.43	851.53	851.53	894.18	1151.04	1178.[illegible]
DISTRIBUTION	REACTOR COOLANT	293.17	18.29	18.30	38.84	38.84	38.[illegible]
	ACCUMULATOR	14.10	9.59	9.59	0.00	0.00	0.[illegible]
	CORE STORED	23.12	12.12	12.12	4.04	3.88	3.[illegible]
	PRIMARY METAL	169.34	161.29	161.29	137.57	70.08	65.[illegible]
	SECONDARY METAL	95.46	93.95	93.95	84.64	44.60	40.[illegible]
	STEAM GENERATOR	253.24	253.28	253.28	223.07	117.14	107.[illegible]
	TOTAL CONTENTS	848.43	548.54	548.54	488.15	274.54	256.[illegible]
EFFLUENT	BREAK FLOW	0.00	303.09	303.09	410.10	880.56	926.[illegible]
	ECCS SPILL	0.00	0.00	0.00	0.00	0.00	0.[illegible]
	TOTAL EFFLUENT	0.00	303.09	303.09	410.10	880.56	926.[illegible]
*** TOTAL ACCOUNTABLE ***		848.43	851.62	851.62	898.24	1155.10	1182.[illegible]

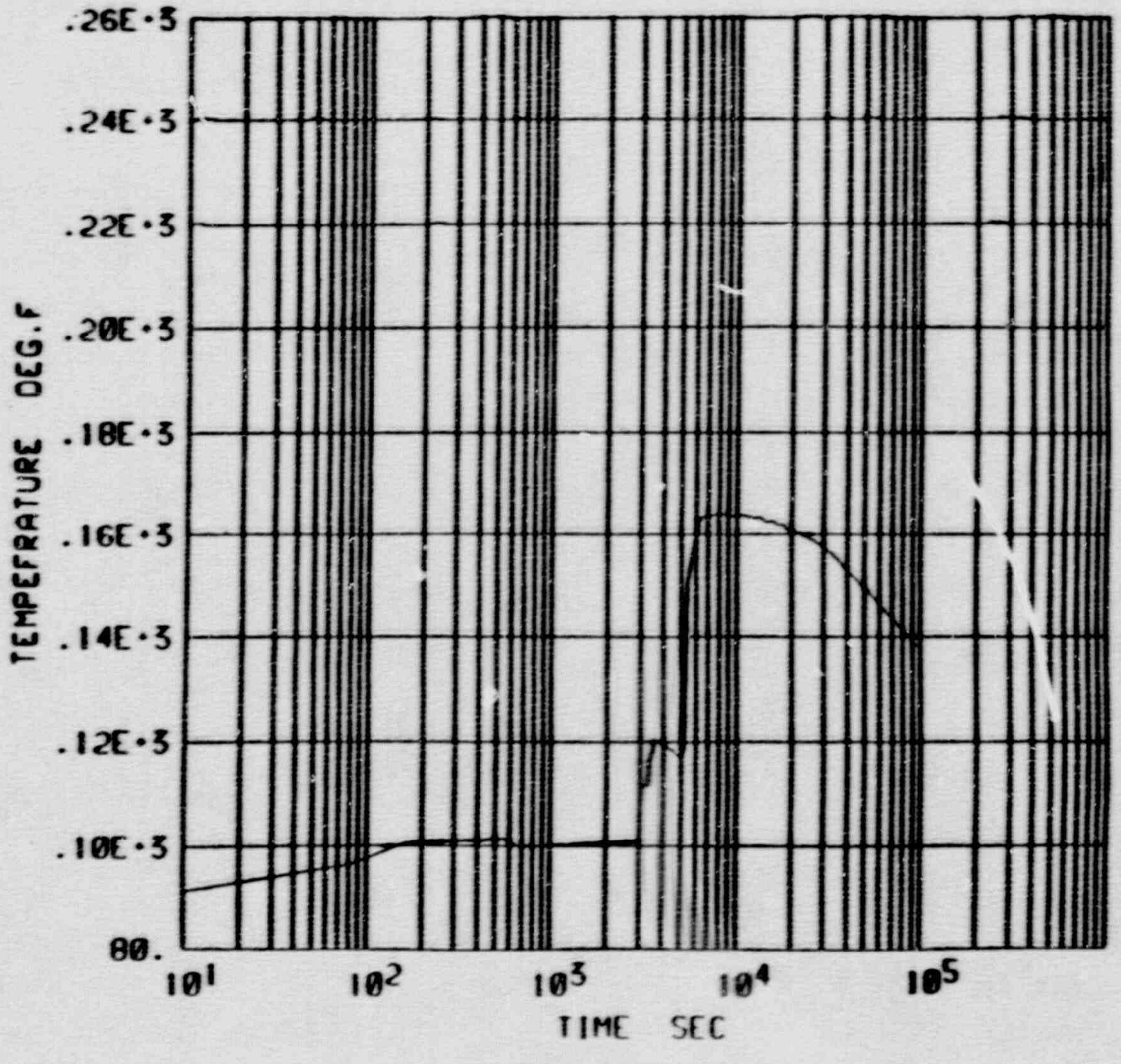
MCGUIRE NUCLEAR STATION
CONTAINMENT PRESSURE TRANSIENT

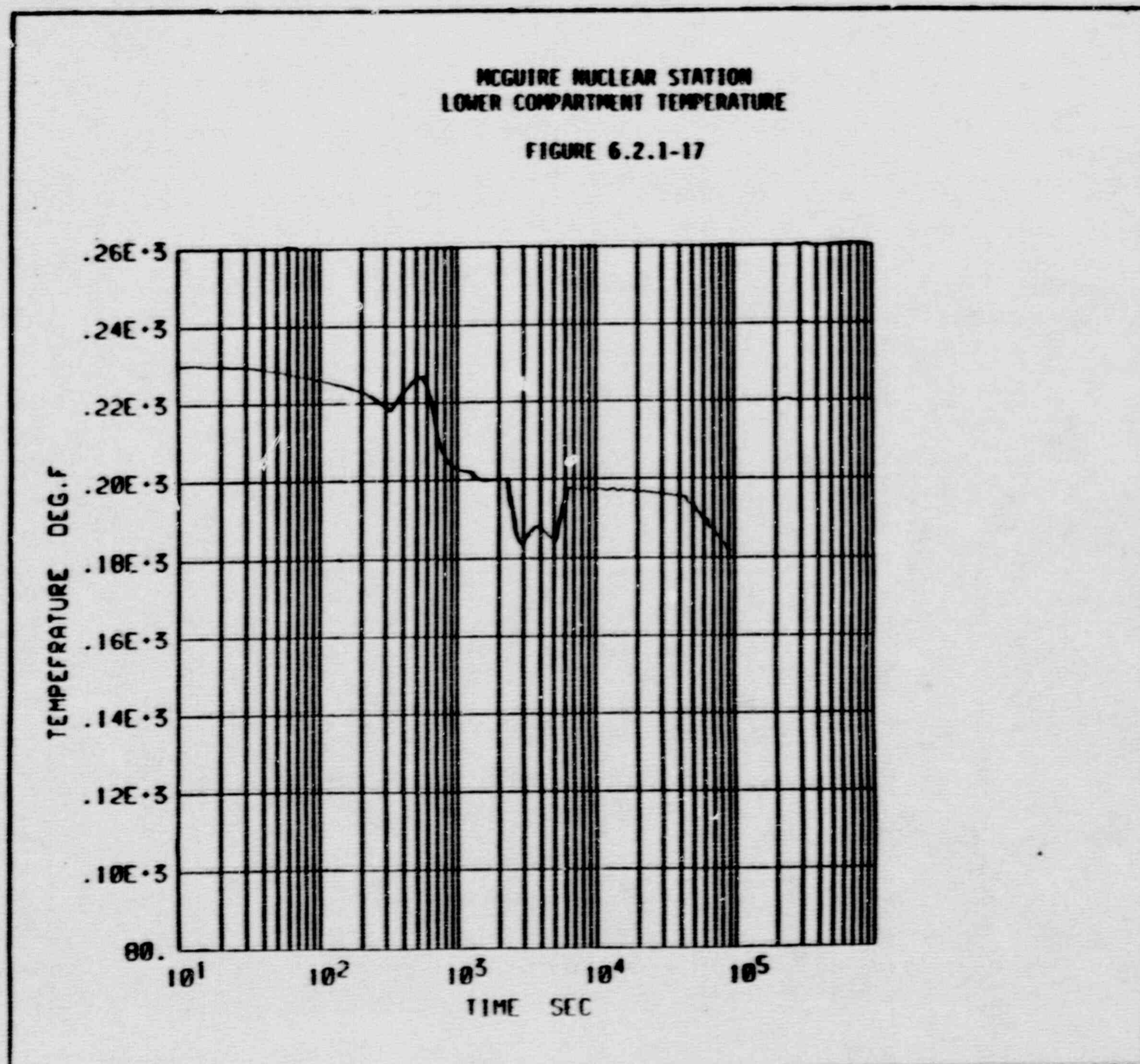
FIGURE 6.2.1-15



MCGUIRE NUCLEAR STATION
UPPER COMPARTMENT TEMPERATURE TRANSIENT

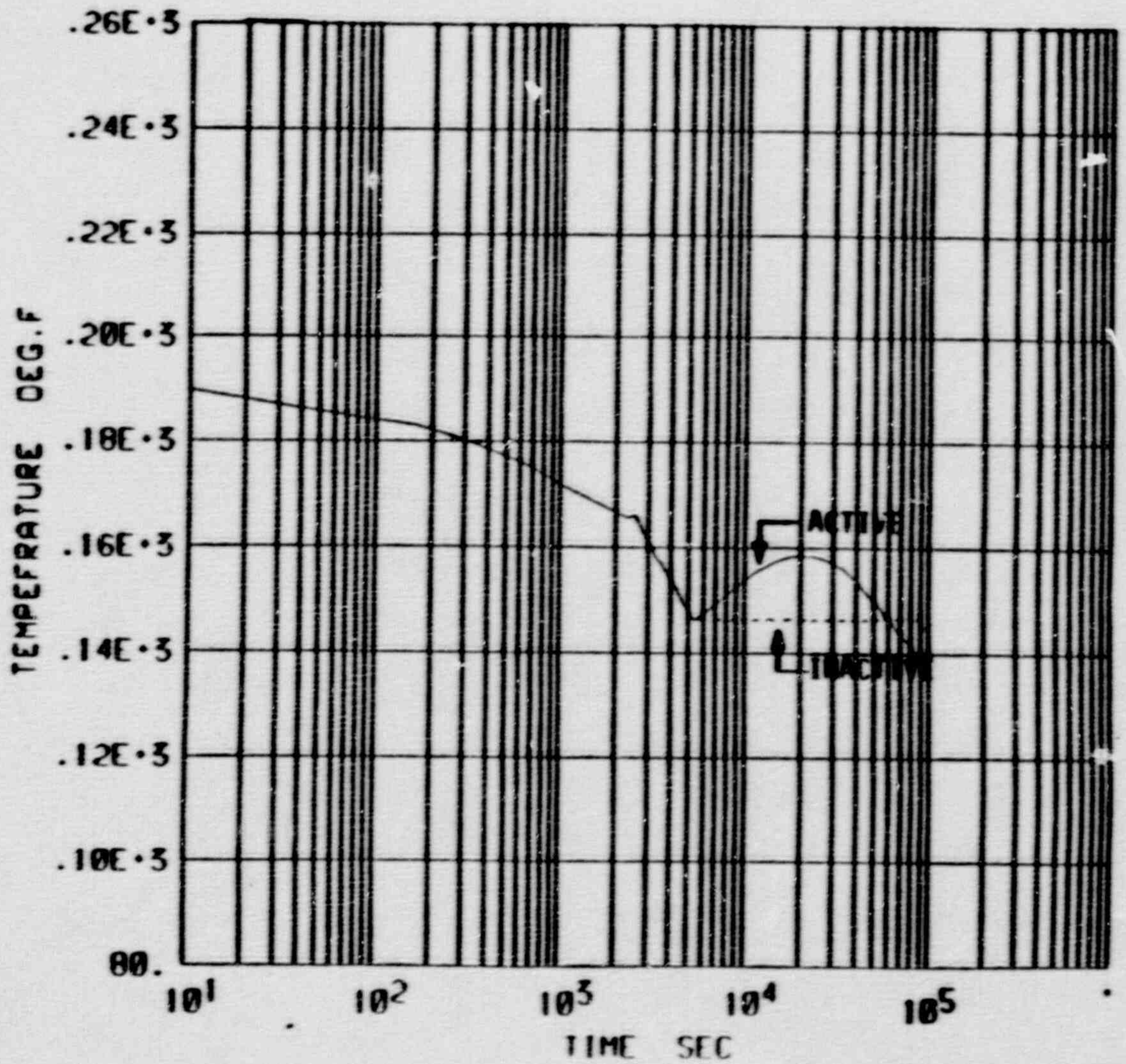
FIGURE 6.2.1-16




MCGUIRE NUCLEAR STATION
LOWER COMPARTMENT TEMPERATURE
FIGURE 6.2.1-17
.26E+3
.24E+3
.22E+3
.20E+3
.18E+3
.16E+3
.14E+3
.12E+3
.10E+3
80.
TEMPERATURE DEG.F
10¹
10²
10³
10⁴
10⁵
TIME SEC

MCGUIRE NUCLEAR STATION
ACTIVE AND INACTIVE SUMP
TEMPERATURE TRANSIENT

FIGURE 6.2.1-18



MCGUIRE NUCLEAR STATION
ICE MELT TRANSIENT
FIGURE 6.2.1-43