Attachment 18 to

GNRO-2012/00039

ER Reference - Bechtel. 1986. Bechtel, Radial Wells 1, 3, 5 - Reduction of Multiple Well Test Data (Geotech Calc G-035). Approved July 31, 1986

QUALITY ASSURANCE PROGRAM
CALCULATION COVER SHEET

CALC. NO. C-B861-1

GRAND GULF NUCLEAR STATION UNIT 1

NO. OF SHEETS 36

JOB NO. 9845/15026 DISCIPLINE CIVIL

TITLE

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION UNIT 1

SUBJECT

RADIAL WELLS 1, 3, 5 - REDUCTION OF MULTIPLE WELL TEST DATA (GEOTECH CALC. G-035)

STATEMENT OF PROBLEM

SEE GEOTECH CALC. COVER SHEET

SAR CHECKED ☒ SAR CHANGE REQ'D. ☐ YES ☒ NO SAR CHANGE REQUEST INITIATED ☐

SOURCES OF DATA

SEE CALC. SHEETS

SOURCES OF FORMULAE & REFERENCES

SEE CALC. SHEETS

COMMITTED PRELIMINARY CALC ☐ FINAL CALC ☒ SUPERSEDES CALC NO. _____

REV. NO.	DATE	DESCRIPTION	ORIGINATOR	CHECKED BY	DATE	APPROVED BY	DATE
0	10/4/82	ORIGINAL CALCS	SEE CALC. SHEETS	J Vogel R"	10/31/82	M	

GPD-1369 Rev. 12/83

CALCULATION COVER SHEET

MISSISSIPPI POWER & LIGHT COMPANY

PROJECT GRAND GULF NUCLEAR STATION JOB NO. 9645 CALC. NO. G-035

SUBJECT Radial Wells 1,3,5 - Reduction of Multiple Well Test Data

COMPUTER PROGRAM: ☒ NONE ☐ SCP ☐ OTHER	TOTAL NO. OF SHEETS 35 (Excluding Attachments)
PROGRAM NO(S). _____ VERSION/RELEASE NO. _____	

☐ PRELIMINARY CALC. ☐ COMMITTED PRELIMINARY CALC.

☐ SUPERSEDED CALC. ☒ FINAL CALC.

Purpose: Calculation of distance to line source of recharge
Comparison of theoretical interference effects to field measurements

References: 1) Operations Manual For Radial Water Wells, The Ranney Company, 1981

2) Schaefer, E.J and Kaser, P., 1965, Graphical Aids For the Solution of Formulas Used in Analyzing Induced Infiltration Aquifer Tests, State of Ohio, DNR, Division of Water, Tech Report, 1975

3) Hydrogeology Survey for MP&L, Ranney, 1975

Calc. No.: G-B861.1, Rev. 0

NO.	DESCRIPTION	BY	DATE	CHKD.	DATE	APPROVED	DATE
0	Reduction of Multiple Test Data	DJM	11-18-83	DRB	12/1/83	HW	8-28-84

REVISIONS

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
7693 MISSISSIPPI POWER & LIGHT COMPANY GRAND GULF NUCLEAR STATION	G-035	0	1 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Bennett	12-1-83

Summary

Based on a river level of 41.52 ft MSL and the following conditions for each Collector well at 1230 hours on 10/9/83:

Well	Flow (gpm)	Permeability (gpd/ft²)	Avg. Aquifer Thickness (ft)
1	4300	2085	81.20
3	4100	2350	75.41
5	5200	2500	81.26

I a line source to recharge ("a") was calculated for each well

Well	"a" ft
1	960
3	850 ✓
5	500 ✓

II Calculated interference effects are compared to field observations

Well	Theoretical Drawdown (ft)	Observed Drawdown (ft)
* CPH-2	8.89	3.83 ✓
CPH-4	7.35	3.82 ✓
** 79-1-L2	3.68	0.96 ✓

* Collector Pilot Hole

** Future Site of Radial Collector 6

Calc. file: C-B861 Rev. 0

pg 2

GPD-2700 Rev. 4/82 (ED-36)

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	2 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Bechtel	12-1-83

Purpose: I) To calculate the distance to the line source of recharge for radial collector wells 1, 3, and 5 using data from the multiple well test conducted from 10-5-83 to 10-12-83.

II) Part II will involve calculating the theoretical interferences at Collector Pilot Hole (CPH) 2 and 4 and at site 6-1, under the conditions present during the multiple well test. The results will be compared to the recorded field measurements.

References:

1) Operations Manual For Radial Water Wells, The Ranney Company, 1981
2) Field Data From Multiple Well Test, 10-5-83 to 10-12-83, Attached.
3) Schaefer, E.J. and Kaser, P., 1965, Graphical Aids For the Solution of Formulas Used In Analyzing Induced Infiltration Aquifer Tests, State of Ohio, DNR, Division of Water, Tech. Report No. 6
4) Hydrogeologic Survey For MP&L, Ranney Report, 1975

Formulas Used:

1) $$T = \frac{527.7\, Q \log\left(\frac{\sqrt{4a^2 + r^2}}{r}\right)}{s}$$ 1) Ref. 3 page 3

where: T = Transmissivity (gpd/ft)
Q = Pumping Rate (gpm)
a = distance from pumping well to line of recharge (feet)
r = distance of selected observation point from pumping well (feet)
s = drawdown at selected observation point at distance r from pumping well

Calc. No.: G-B8(a).1 Rev. 0
pg 3

(BECHTEL 2801 REV 8/70)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY

JOB NO.	BRAND GULF NUCLEAR STATION	CALC. NO.	REV. NO.	SHEET NO.
9645		G-035	0	5 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Beitel	12-1-83

2) For Calculating Interference Between Wells

$$s = \frac{527.7\ Q \log\left(\frac{\sqrt{4a^2+r^2}}{r}\right)}{KM}$$

2) Ref. 4

$$s_i = s + \frac{s^2}{2m}$$

where:

s = interference effects at distance "r" (feet)

Q = discharge (gpm)

a = distance from pumping well to line of recharge (feet)

m = average saturated aquifer thickness (feet)

K = hydraulic conductivity (gpd/ft^2)

$\frac{s^2}{2m}$ = correction for dewatering of the aquifer under water table conditions (feet)

3) Average Aquifer Thickness (M)

$$M = \frac{\left[(\text{River Elev.} - a) - \text{Aquifer Bottom Elev.}\right] + \left(\begin{matrix}\text{River Elev.}\\ \text{or}\\ \text{Top of Aquifer}\end{matrix}\right\}_{\text{lowest}} - \text{Aquifer Bottom Elev.}\Big)}{2}$$

where: a = drawdown at the pumping well (feet)

Calc. No.: G-0351 Rev. 0

pg 4

GPD-2704 Rev. 4/83 (ED-86)

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	4 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11/16/83	Dennis Bensel	12-1-83

Given:

a) Aquifer characteristics for each well

Well	Aquifer Top Ft MSL	Aquifer Bottom Ft. MSL	Hydraulic Cond. (K) gpd/ft²	Ref. 1
1	35	-50	2085	
3	55	-40	2350	
5	67	-45	2500	

b) Discharge from each well at time "t" See Section I Ref. 2

Well	Flow (Q) gpm
1	4300 ✓
3	4100 ✓
5	5200 ✓

Calc. Pkg. : G-B801.1 Rev. 0

QPD-2766 Rev. 4/82 (ED-69)

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	5 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11/16/83	Dennis Benzel	12-1-83

I. Calculation of the line source to recharge ("a")

From all the data collected during the multiple well test between 10/5/83 to 10/12/83 one set of conditions must be chosen that are believed to be the most representative of steady state conditions. The parameters chosen to calculate the "a" distance are at 1230 hrs. on 10/9/83.

This time chosen is controlled by conditions in collector 1. Collector 1 had the most variable discharge rates during the test. Therefore any data used must be at a time when the drawdown in collector 1 had become so slow that for all practical purposes steady state conditions can be assumed to exist. Steady state conditions appear to exist at collectors 3 and 5 also. The attached recorder charts, pages 17 through 31, will substantiate this.

In choosing a time reference for calculations, recorder charts from the collector wells and the RWB observation wells were used. There is one RWB observation well for each collector well. RWB wells are located 170 feet from the individual collector well.

The time chosen (1230 hrs on 10/9/83) for this calculation is based on the time when steady state conditions appear to exist simultaneously within each well. As can be seen from the recorder charts these times are: Well 1 - 1845 hrs on 10/8 to 1300 hrs on 10/9; well 3 - 1330 hrs on 10/8 to 1300 hrs on 10/9; and well 5 0945 hrs on 10/8 to 1300 hrs on 10/9.

Because the river remained stable from 10/8 to 10/10 and because all 3 wells achieved steady state conditions for at least 16 hours the calculation for "a" distance will be based on 1230 hr on 10/9/83.

Calc. No.: G-0360-1 Rev 0
pg. 6

GPD-2706 Rev. 4/82 (ED-09)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY

JOB NO. GRAND GULF NUCLEAR STATION	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	6 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Bensel	12-1-83

A. Then determining the "a" distance for time 1230 hrs on 10/9/83 and

River Level = 41.52 ft MSL.

Note: An "a" distance will be "backed" into for each well using equation 1.

The permeability (K) for each well is known, therefore the transmissivity (T) can be calculated for any river level; T = K m. By knowning the "T" value an "a" value will be plugged into equation 1 until the "T" value is achieved.

Then for Well 1B:

$$T = \frac{527.7\ Q \log\left[\frac{\sqrt{4a^2+r^2}}{r}\right]}{s} \qquad \text{(Eq. 1}$$

where: T

K = 2085 gpd/ft²

water level from recorder charts (RW1B) = 42.85 ft

Elevation of Reference Point = 70.25 ft

Well 1B water level elevation = 70.25 - 42.85 = 27.40 ft msl.

s = 41.52 - 27.40 = 14.12 ft. Assuming river level and static water level in the well are the same.

$$m = \frac{[(41.52 - 14.12) - (-50)] + [35 + (-50)]}{2}$$

m = 81.20 ft.

T = K x m = 2085 x 81.20 = 169,302 gpd/ft²

r = 170 ft. from Collector Well 1 to RW1B - via Ranney Co.

Q = 4300 gpm

Calc. No.: G-0861.1 Rev. 0

49

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	70 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Bestel	12-1-83

a = 850 ft

$$169,302 = \frac{(527.7)(4300)\log\left[\frac{\sqrt{4(850^2)+170^2}}{170}\right]}{14.12}$$

$$169,302 = \frac{(2,249,110)(\log 10.05)}{14.12}$$

169,302 ≠ 161,049

a = 950 ft. 169,302 ≠ 168,742

a = 960 ft 169,302 ≈ 169,476

DRB

Direct Solution

$$\log\left[\frac{\sqrt{4a^2+r^2}}{170}\right] = \frac{T(a)}{527.7(Q)}$$

$\log(\quad) = 1.05315$

$\log\sqrt{4a^2+r^2} = 3.2839$

$\log(4a^2+r^2) = 16.5679$

$4a^2+r^2 = 3,697,688.529$

$a = 957.7 \approx 958$ sol. 960

∴ Therefore the distance to line source of recharge for Collector 1 under a river Level of 41.52 ft and pumping 4300 gpm is 825 ft. 958

Then for Well 3:

where &

K = .2350 gpd/ft²

water level from recorder chart RW3B = 45.55'

Elevation of Reference Point = 74.85

Well 3B water level elevation = 74.85 - 45.55 = 29.30 ft MSL

$\Delta = 41.52 - 29.30 = 12.22$

$$m = \frac{\left[(41.52 - 12.22) - (-40)\right] + \left[41.52 - (-40)\right]}{2}$$

m = 75.41 ft.

Calc. No.: G-0360.1 Rev. 0
PAGE 7A

GPD-2700 Rev. 4/82 (ED-89)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY
JOB NO. GRAND GULF NUCLEAR STATION

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	8435

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Bechtel	12-1-83

$T = K \times m = 2350 \times 75.41 = 177,214$ gpd/ft

$r = 170$ ft.

$Q = 4100$ gpm

if $a = 850$ ft then $177,214 = \dfrac{(527.7)(4100)\log\left[\frac{1.5(850)+170}{170}\right]}{12.22}$

$177,214 = \dfrac{(2,163,570)(\log 10.05)}{12.22}$

$177,214 \neq 177,435$

DRB

Direct solution

$a = 842.5, \approx 850$

▲ Therefore the distance to line of recharge for Collector 3 with a river level of 41.52 ft. and pumping 4100 gpm is 850 ft.

Then for Well 58

Calc. No.: G-B861.1, Rev. 0
PAGE 18

where:

$K = 2500$ gpd/ft^2

water level from recorded chart RW58 = 47.29 ft.

Elevation of Reference point = 78.31

Well R58 water level elevation 31.02 ft.

$a = 41.52 - 31.02 = 10.50$ ft.

GPD-1700 Rev. 4/82 (ED-00)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	9 of 35

ORIGINATOR	DATE	CHECKED	DATE
P. Middleton	11-16-83	Dennis Bensel	12-1-83

$$m = \frac{\left[(41.52 - 10.50) - (-45)\right] + \left[41.5 - (-45)\right]}{2}$$

$m = 81.26$ ft

$T = K \times m = 2500 \times 81.26 = 203{,}150$ gpd/ft

$Q = 5200$ gpm

$$203{,}150 = \frac{(527.7)(5200)\log\left[\frac{1.74(850\text{ ft}) + 110^2}{1.78}\right]}{10.50}$$

$$203{,}150 = \frac{(2{,}744{,}040)(\log 10.05)}{10.50}$$

$203{,}150 \neq 261{,}903$

DAB

Direct solution

$a = 501.9 \approx 500$

$a = 500$ ft $\quad 203{,}150 \neq 202{,}729$

$a = 505$ ft $\quad 203{,}150 \approx 203{,}827$

▲ Therefore the distance to line of recharge for Collectors under a river level of 41.52 ft and pumping 5200 gpm is ~~505~~ 505 ft.

Calc. No.: G-B861.1, Rev. 0
PAGE 9

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	10 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-16-83	Dennis Beuzel	12-1-83

II Using the given conditions under which the multiple well test was conducted, and the data and procedures given in Geology calculation G-083, the theoretical interference effects will be calculated for CPH-2, CPH-4, and Collector Site 6 (79-1-L2). The results of these calculations will be compared to the recorded field measurements.

Time = 1230 hrs, on 10/9/83 River Level = 41.52 ft.

A) For calculating interference Equation 2 is used:

The interference effects on CPH-2 from Well 1, 3, and 5 will now be calculated.

Well	Distance
1 to 2	1070
3 to 2	940
5 to 2	3530

Distances Scaled from Drawing 21SKC-2010 Rev A.

Then the theoretical interference effects are:

Well 1 on CPH-2

$$s = \frac{527.7\ Q \log\left(\frac{\sqrt{4a^2 + r^2}}{r}\right)}{Km}$$

and

$$Si = S + \frac{S^2}{2m}$$

where:

Q = 4300 gpm (pg 4)

a = 850 (Calc G-033)

$m = \frac{\left[(41.52 - 17.83) - (50)\right] + (35 - 50)}{2} = 79.34$ ft.

K = 2100 (Calc G-033)

r = 1070

Calc. No.: G-B861.1 Rev. 0
PAGE 10

GPD-2700 (Rev. 4/82 ED-69)

BECHTEL

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	11 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Bensel	12-1-83

$$s = \frac{527.7\,(4300)\,\log\left(\frac{1.5\sqrt{4(850)^2 + 1070^2}}{1070}\right)}{(2100)\,(79.34)}$$

$$s = \frac{(527.7)(4300)(0.2735)}{(2100)\,(79.34)}$$

$s = 3.73$ ✓

$s_i = 3.73 + \frac{3.64^2}{2.79.34)}$

$s_i = 3.82$ ft ✓

Well 3 on CPH2

$Q = 4100$ gpm

$a = 850$ ft

$m = \frac{((41.52 - 19.91) - (-40)) + (41.52 - (-50))}{2} = 76.57$ ft

$K = 2350$ gpd/ft^2

$r = 940$ ft

$$s = \frac{(527.7)(4100)\log\left(\frac{1.5\sqrt{4(850)^2 + 940^2}}{940}\right)}{(2350)(76.57)}$$

$s = 3.79$

$s_i = 3.80$

Well 5 on CPH2

$Q = 5200$ gpm

$a = 850$ ft

$m = \frac{((41.52 - 27.79) - (-45)) + (41.52 - (-45))}{2} = 72.63$ ft

$K = 2500$ gpd/ft^2

$r = 3530$ ft

$$s = \frac{(527.7)(5200)\log\left(\frac{1.5\sqrt{4(850^2) + 3530^2}}{3530}\right)}{(2500)(72.63)}$$

$s = 0.68$ ✓

$s_i = 0.69$ ft ✓

81.24

Calc. No.: G-0361.1, Rev. 0
PAGE 11

GPD-2766 Rev. 4/82 (ED-69)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	12 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Beistel	12-1-83

Then Summing the interference effects from each well on CPH 2

Well	Interference (ft)
1 on 2	3.82 ft
3 on 2	3.88 ft
5 on 2	0.69 ft
Total	8.39 ft.

Drawdown at CPH-2 assuming river level at time "t" is static water level.

TOR 71.84
- 34.15 from recorder charts pg. 17-31
37.69

41.52 river level
- 37.69
3.83 ft drawdown

▲ A total drawdown of 8.39 ft is calculated at CPH-2 at 1230hrs. on 10/9/83 the field measured drawdown at CPH 2 is 3.83 ft. (pg 28)

The interference effects on CPH-4 from wells 1, 3, and 5 will be calculated.

Well	Distance
1 to 4	3640
3 to 4	1630
5 to 4	960

Note: The interference effects for this section will be calculated as above. However the formula will not be copied each time. A program developed for the HP-41CV will be used. The program is listed on page 32

Calc. No. G-B8011 Rev. 0
PAGE 12

GPD-2706 Rev. 4/83 (GD-001)

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	13 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Bensel	12-1-83

Well 1 on CPH-4

Q = 4300 gpm — s = 0.58 ft. ✓
a = 850 ft.
m = 79.34 ft — s_i = 0.59 ft. ✓
K = 2100 gpd/ft²
r = 3640

Well 3 on CPH-4

Q = 4100 gpm — s = 1.92 ft ✓
a = 850 ft.
m = 76.57 ft — s_i = 1.95 ft ✓
K = 2350 gpd/ft²
r = 1630 ft

Well 5 on CPH-4

Q = 5200 gpm — s = 4.66 ✓
a = 850 ft.
m = 72.63 ft — s_i = 4.81 ✓
K = 2500 gpd/ft²
r = 960 ft

Calc. No.: C-B861.1, Rev. 0
PAGE 13

Then Summing

Well	Interference	Drawdown at CPH-4 assuming River Level at time "t" is static water level	
1 on 4	0.59 ft	TOR 76.71	41.52 river
3 on 4	1.95 ft	− 39.01 recorder charts pg. 29	− 37.70
5 on 4	4.81 ft	37.70	3.82 drawdown
Total	7.35 ft ✓		

GPD-2700 Rev. 4/82 ED-001

BECHTEL — MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	14 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Beutel	12-1-83

▲ A total drawdown of 7.35 ft is calculated at CPH-4 at 1230 hrs. on 10/9/83. The field measured drawdown at CPH-4 is 3.82 ft.

The interference effects a future well site 6 (79-162).

Well	Distance
1 on 6	6000 ft.
3 on 6	4100 ft
5 on 6	1400 ft.

Well 1 on 79-162

Q = 4500 (gpm) — s = 0.23 ft ✓

a = 850 ft.

m = 79.34 ft — s_i = 0.23 ft ✓

K = 2100 gpd/ft²

r = 6000 ft

Well 3 on 79-162

Q = 4100 gpm — s = 0.42 ft ✓

a = 850 ft

m = 76.57 ft — s_i = 0.42 ✓

K = 2350 gpd/ft²

r = 4100 ft

Calc. No.: C-BX61.1, Rev. 0
PAGE 14

Well 5 on 79-162

Q = 5200 — s = 2.97 ft. ✓

a = 850 ft

m = 72.63 ft — s_i = 3.03 ft ✓

K = 2500 gpd/ft²

r = 1400 ft

GPD-8700 Rev. 4/82 (ED-66)

CALCULATION SHEET

MISSISSIPPI POWER & LIGHT COMPANY

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645 GRAND GULF NUCLEAR STATION	G-035	0	15 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Bentley	12-1-83

Then summing

Well	Interference (ft)
1 on 79-162	0.28
3 on 79-162	0.42
5 on 79-162	3.03
total	3.68 ft

Drawdown at 79-162 (Site b) assuming river level at time "0" is static water level.

TDR 75.28		41.52	river elev.
-34.72	recorder chart pg. 30	40.56	
40.56		0.96	drawdown

▲ A total drawdown of 3.68 ft. is calculated at 79-162 at 1230hrs. on 10/9/83. The field measured drawdown at 79-162 is 0.96 ft.

III From the above comparisons it appears that the calculations performed to determine interference effects at any single point are conservative. The difference between the calculated values and the observed values are about 100%.

Possible parameters that may contribute to the large difference are:

1) the "a" distance - primarily the a distance used for well 5 - 500 ft calculated versus 850 ft assumed.

2) Permeability - permeabilities used are an average over the thickness of the aquifer, therefore as the river level changes the permeability may also. the equation assumes aquifer homogeneity. The flood plain aquifer does not meet this assumption.

Calc. No.: G8861.1 Rev. 0
PAGE 15

GPD-2700 Rev. 4/82 (ED-69)

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	16 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis R Bechtel	12-2-83

Conclusion:

Although the difference between observed interference effects and measured interference effects are great percentagewise the amount of difference is not substantial and is not of great concern. The calculated values are conservative

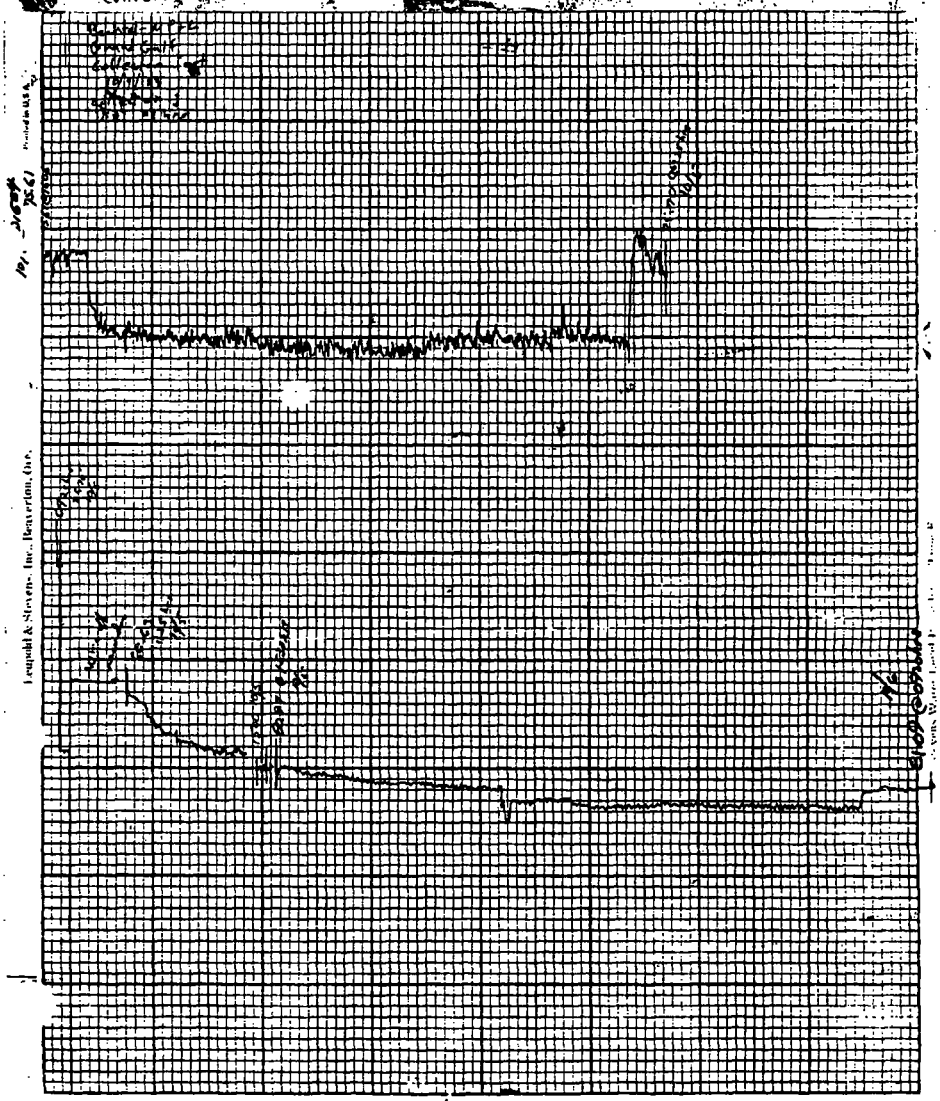
Calc. No.: C-B861.1-000
Page 16

GPD-3700 Rev. 4/82 ED (6)

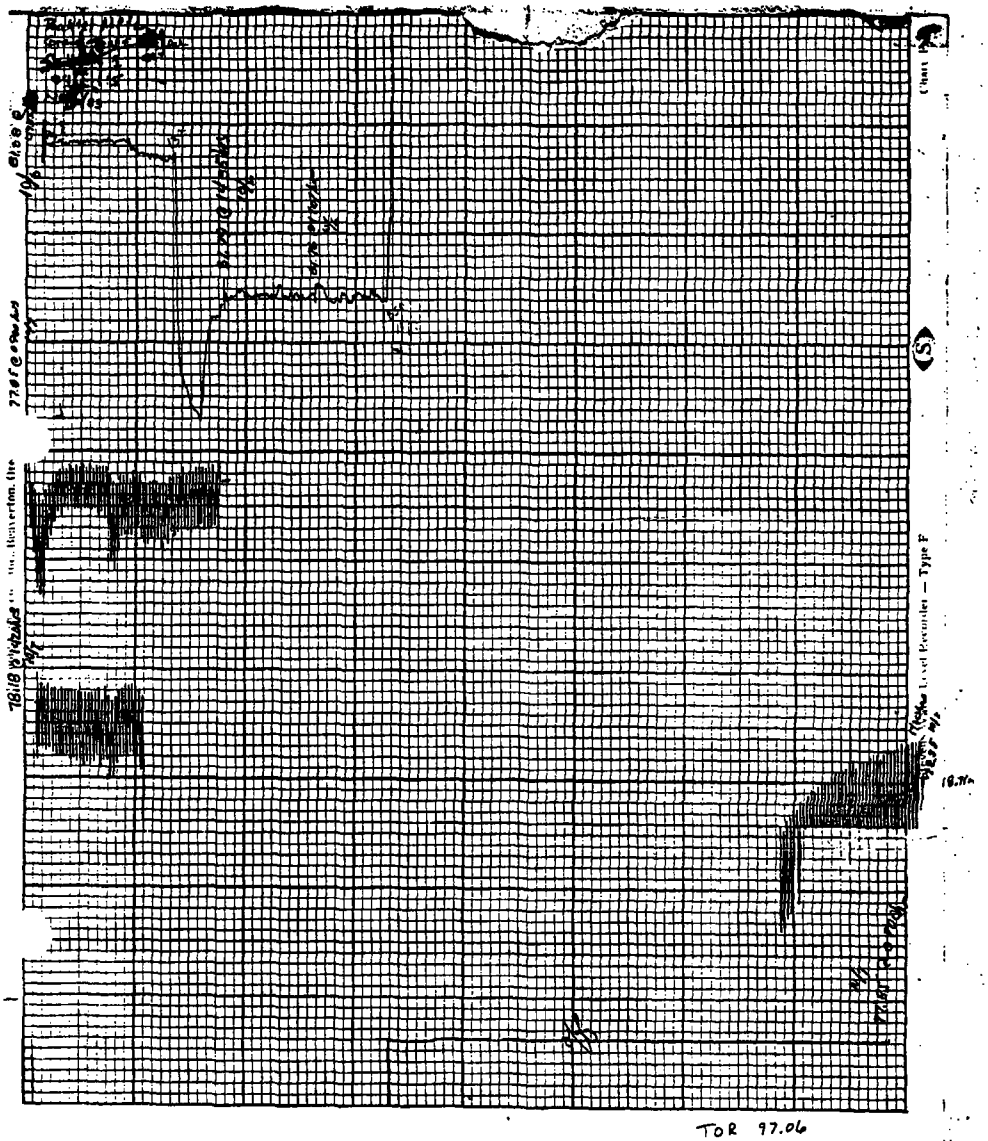
calc. C-B861.1 Rev. 0
pg 17

GEOTECHNICAL GROUP Rev 0
JOB NO. 9645
SUB. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D. Bennett
PAGE 17 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION



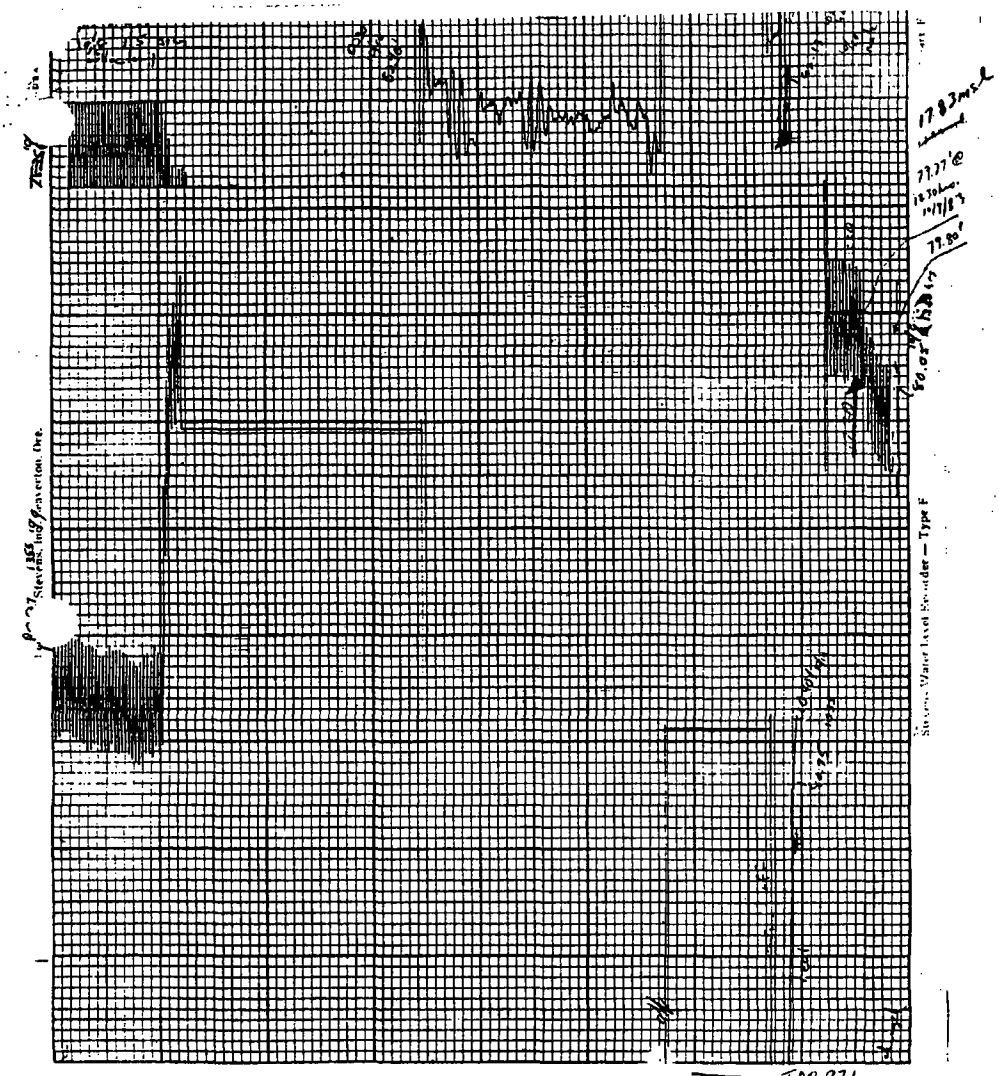
Calc. No.: C-861.1, Rev. 0
Page 18



TOR 97.06

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11/17/83
ORIGINATOR D. Middleton
CHECKED BY D. Kennedy
PAGE 18 OF 35



TOP 97'a

Calc. No.: G-B761.1; Rev. 0

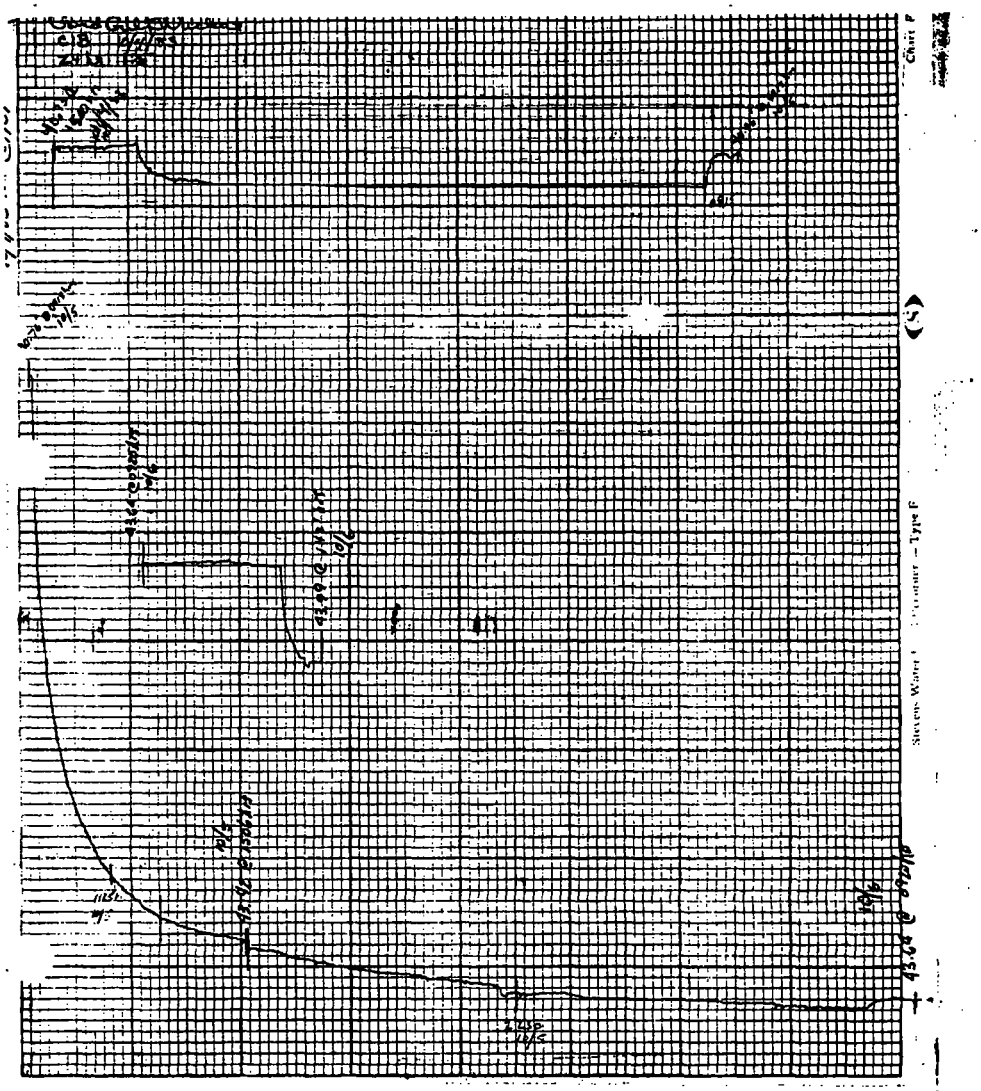
PAGE 19

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D.M. Adleson
CHECKED BY D. Lewis
PAGE 19 OF 35

GEOTECHNICAL GROUP
JOB NO.
CALC. NO.
DATE
ORIGINATOR
CHECKED BY
PAGE OF

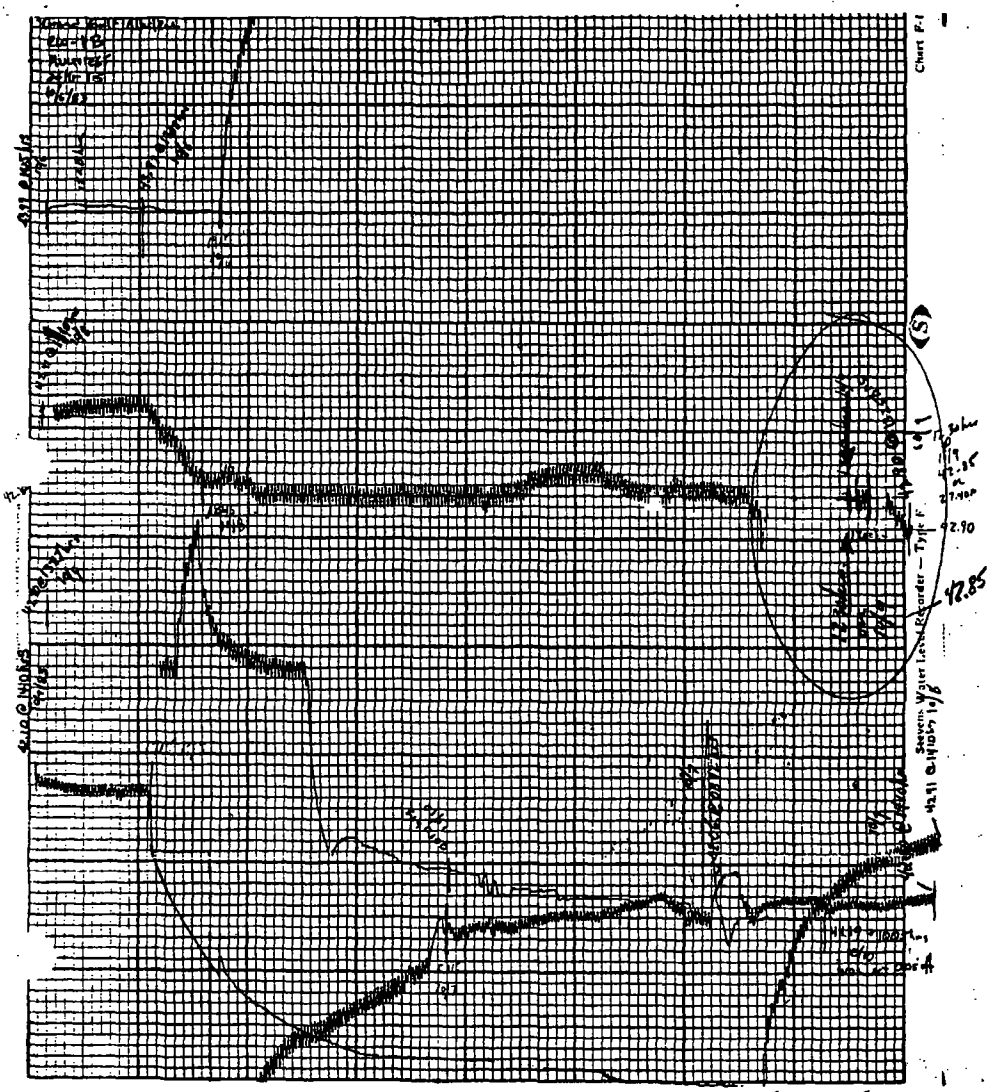
Calc. No.: G-BB61.L. Rev. 0
PAGE 20



GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D.M. Adleson
CHECKED BY
PAGE 20 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

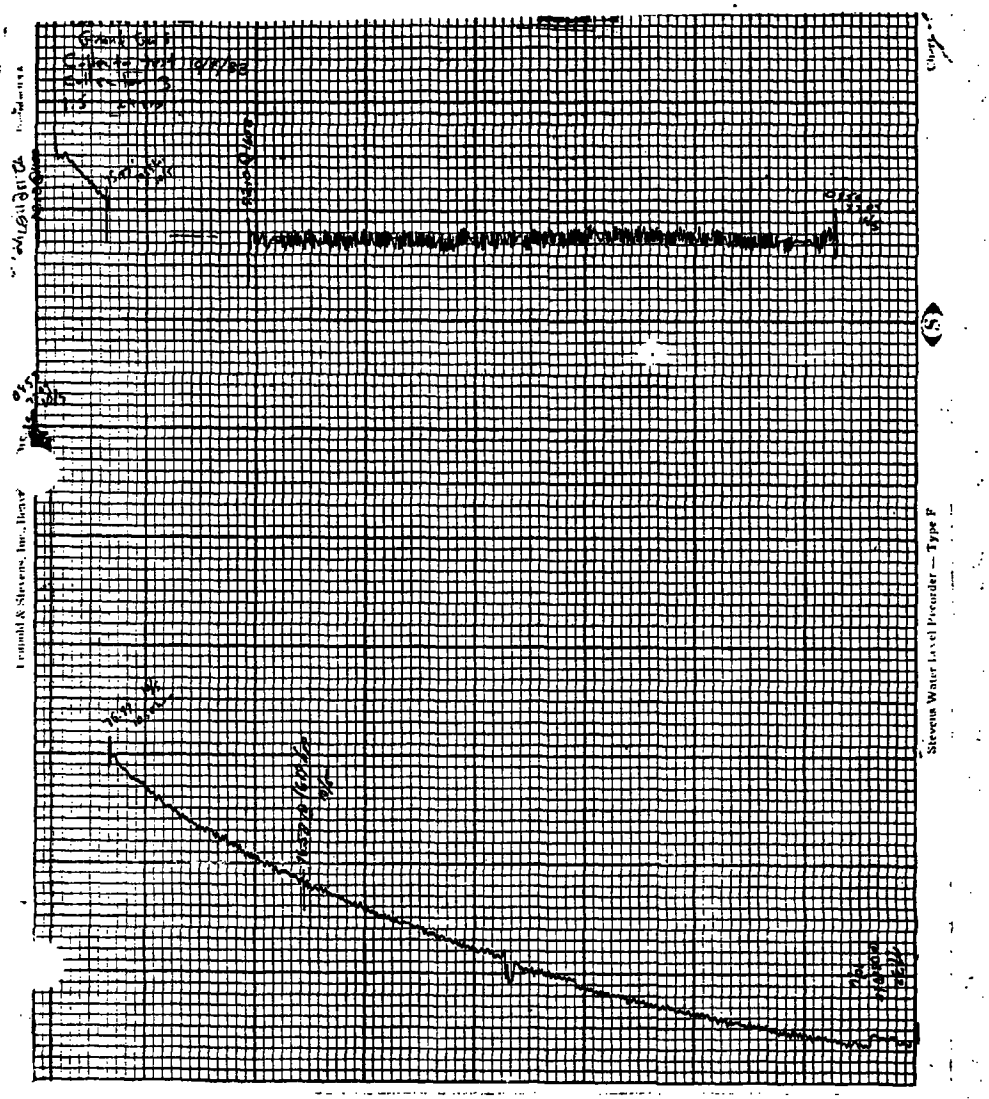
Calc. No.: C-B861 Rev. 0
PAGE 21



GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D. Reinert
PAGE 21 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

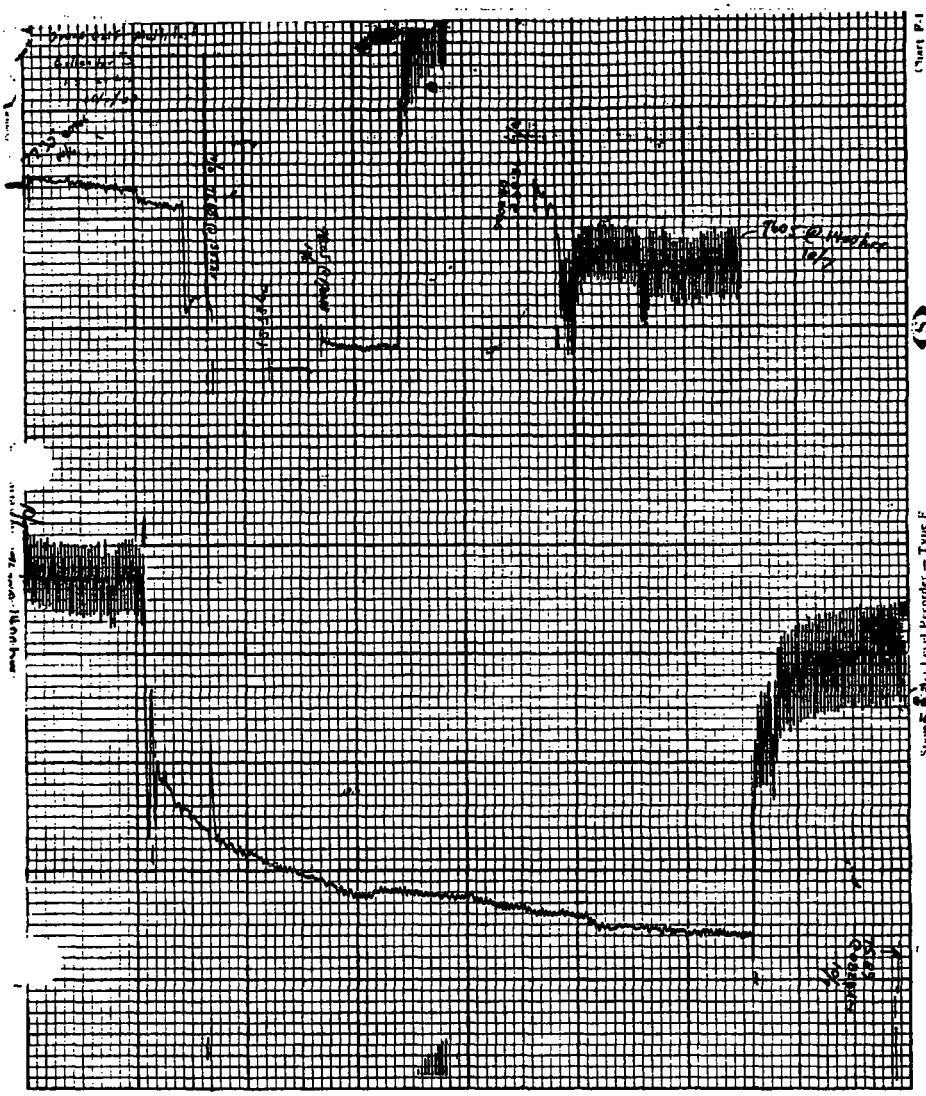
Calc. No. C-B861.1 Rev. 0
Page 22



GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY
PAGE 22 OF 35

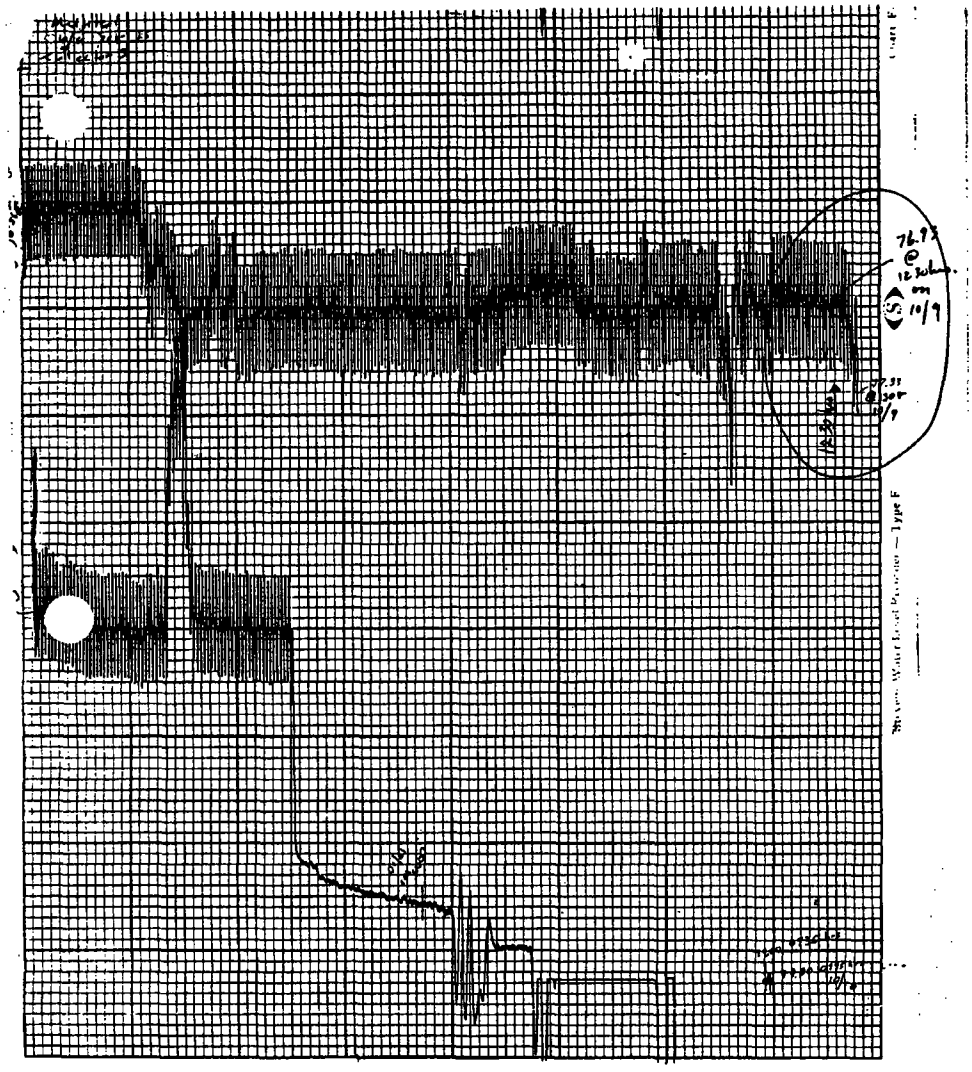
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

Calc. No.: G8601.1 Rev. 0
PAGE 23



GEOTECHNICAL GROUP Rev 0
JOB NO. 7645
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D. Weigel
PAGE 23 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION



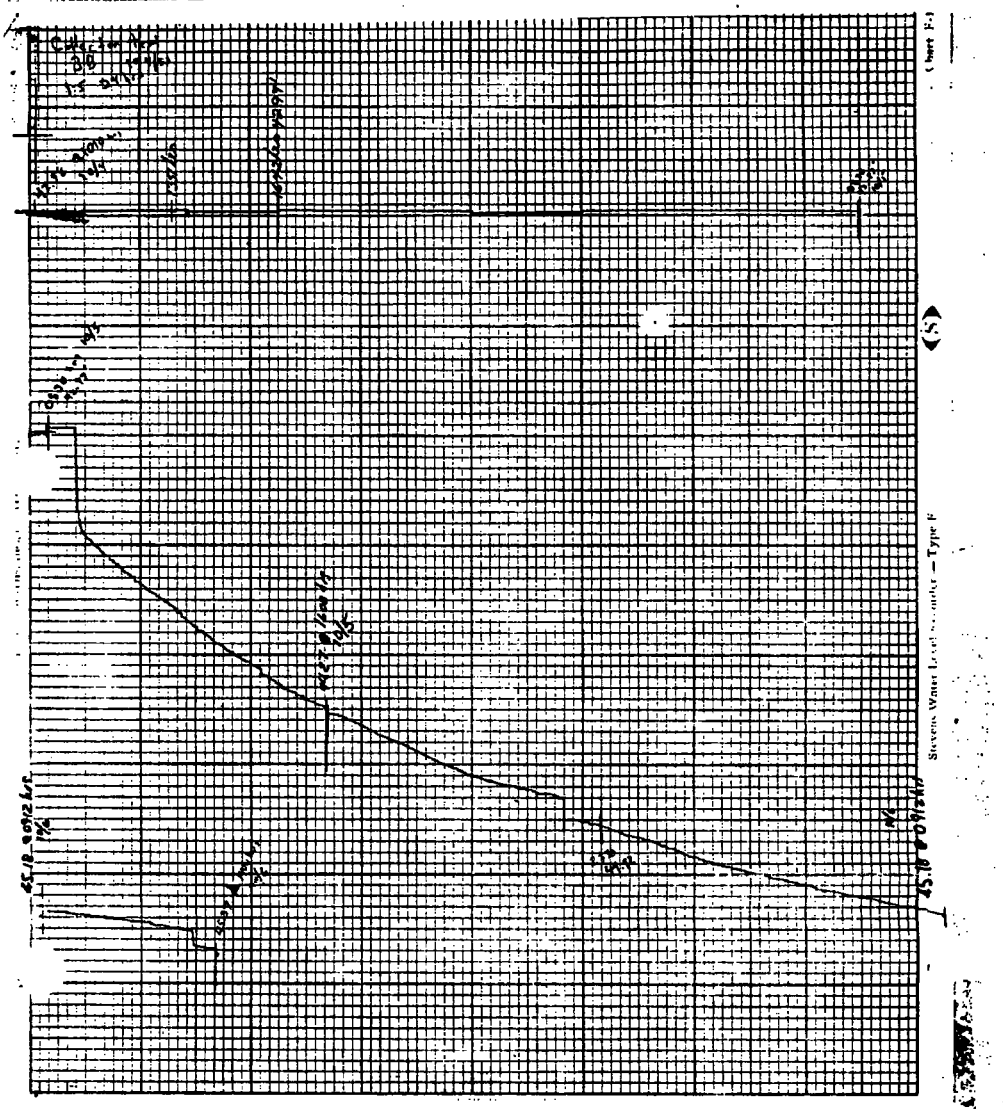
Calc. No.: G-0355 Rev: 0
PAGE 24

TOR 76.84
-76.93
1.91 ft

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-0355
DATE 11-17-83
ORIGINATOR R.M. Middleton
CHECKED BY D. Reisdorf
PAGE 24 OF 35

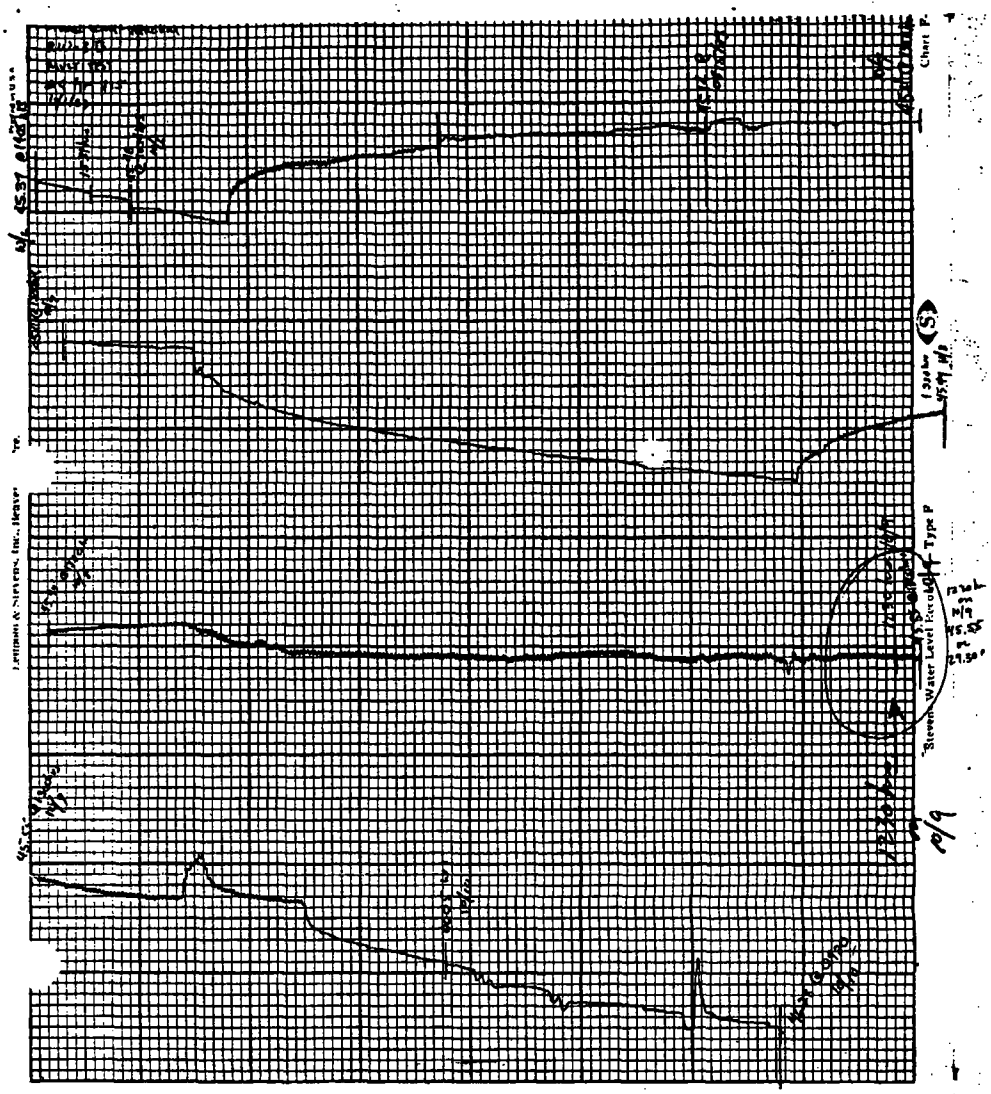
Calc. No. C88611, Rev. 0
Page 25

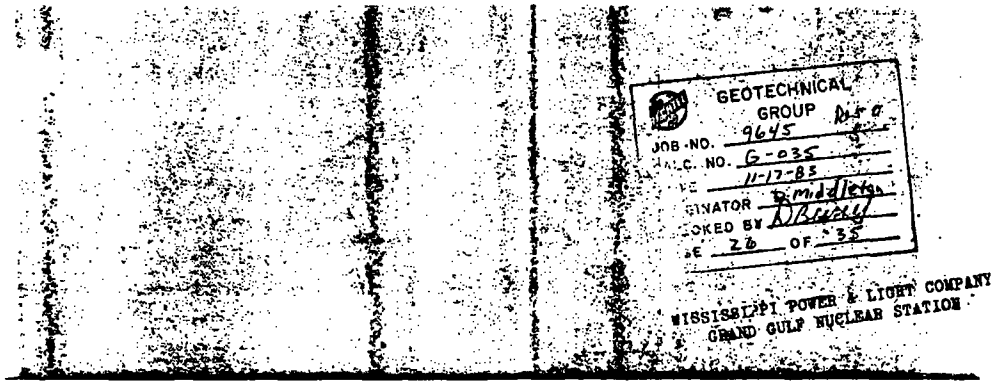


GEOTECHNICAL GROUP
JOB NO. 9645 Part D
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D Bennett
PAGE 25 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

Calc. No.: G-BB61 1, Rev. 0
PAGE 26

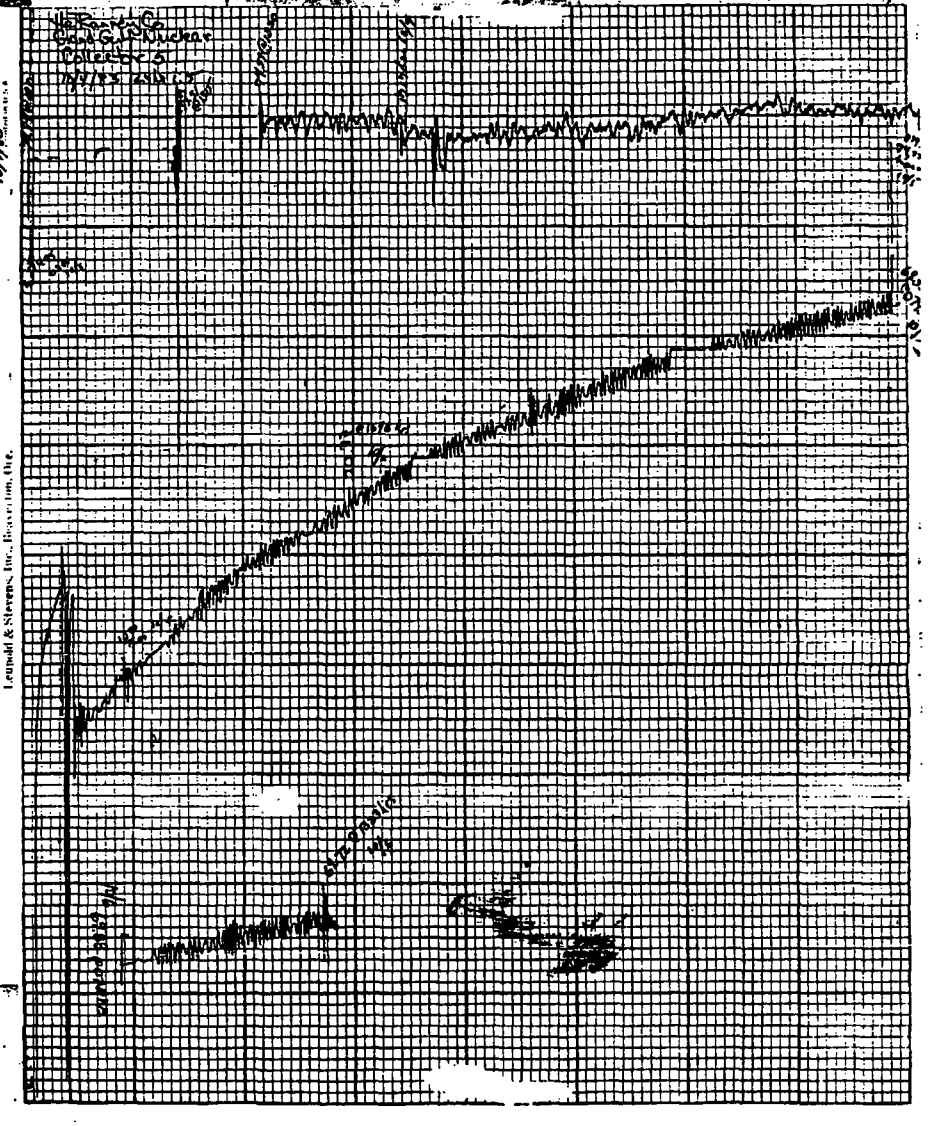




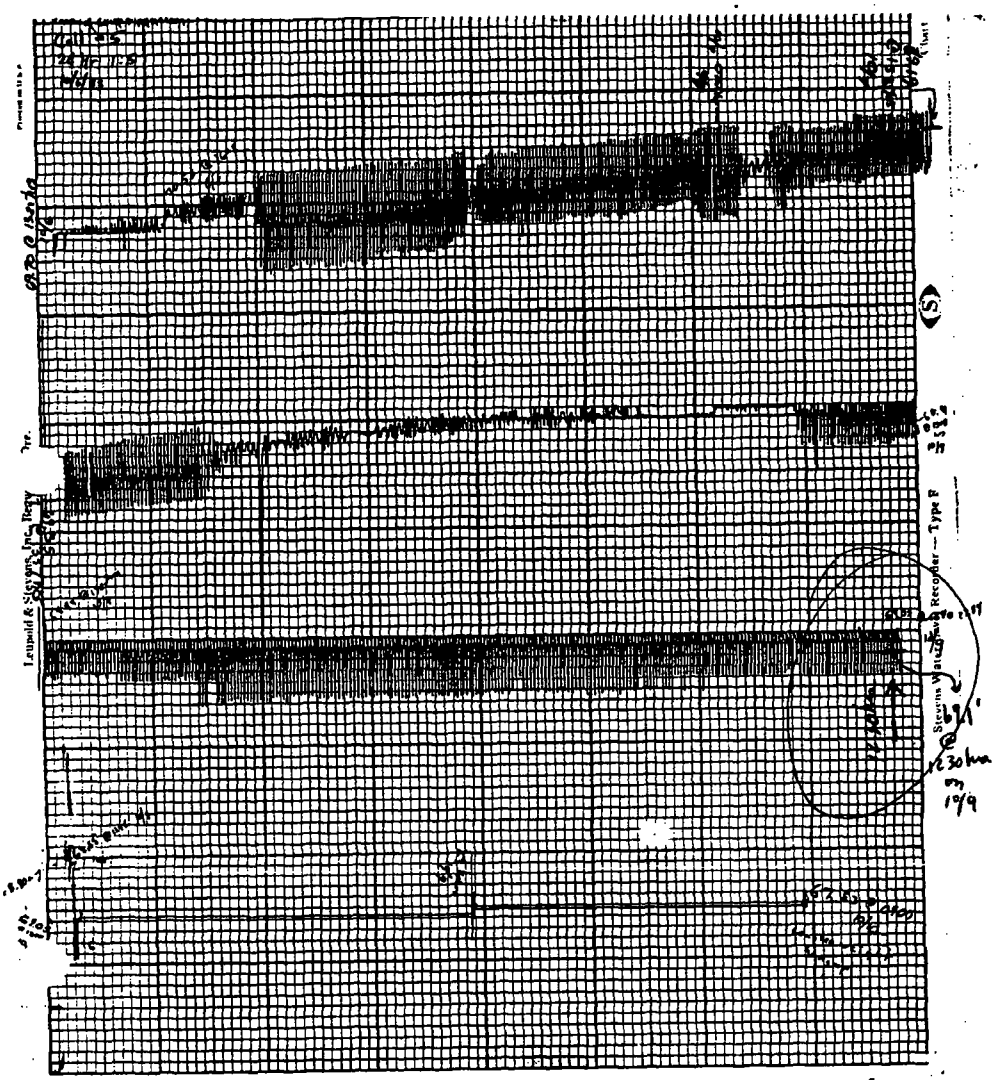
GEOTECHNICAL GROUP
JOB NO. 9645 R-3 O
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D Reisser
PAGE 27 OF 35

Calc. No. G-035, Rev. 0
PAGE 27

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION



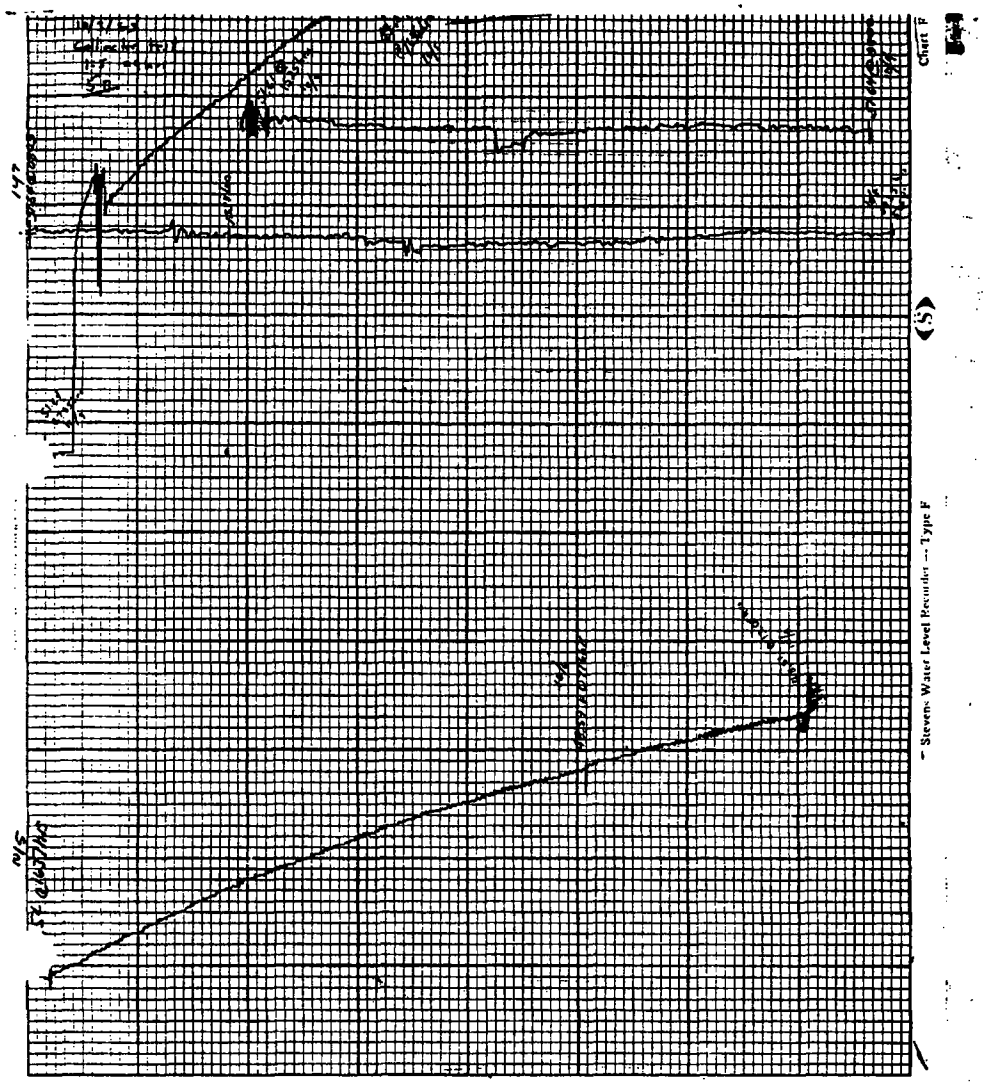
Leonard & Stevens, Inc., Boston, Mass.



GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D Hewlett
PAGE 28 OF 35

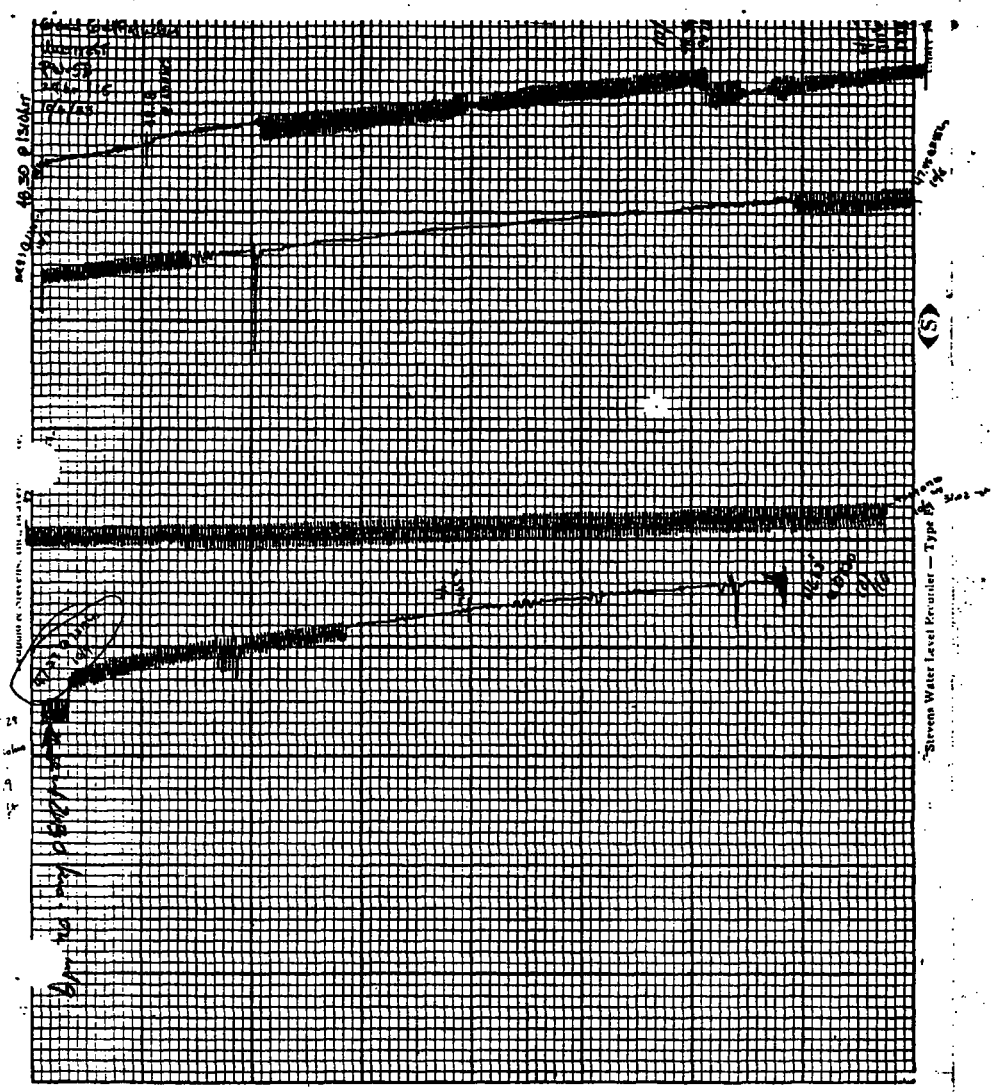
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

Calc. No.: G-0866, Rev: 0
PAGE 29



GEOTECHNICAL GROUP
JOB NO. 9645
CALC. NO. G-035
DATE 12-17-83
ORIGINATOR D Middleton
CHECKED BY D Heuser
PAGE 29 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION



GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
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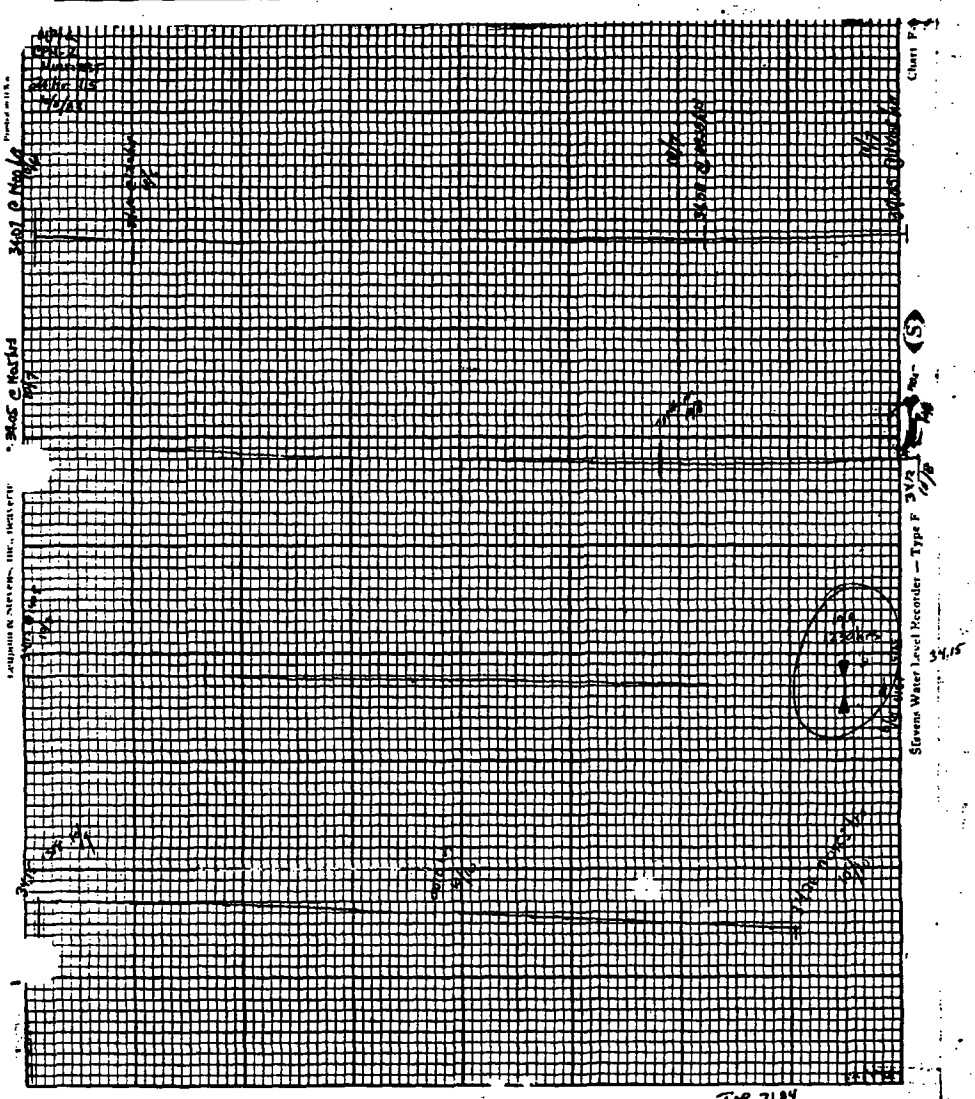
PAGE 30 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION



GEOTECHNICAL GROUP
JOB NO. 9645 TOWO
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY Dhessey
PAGE 31 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

GEOTECHNICAL GROUP
JOB NO. 9645
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY D. Bartell
PAGE 32 OF 35

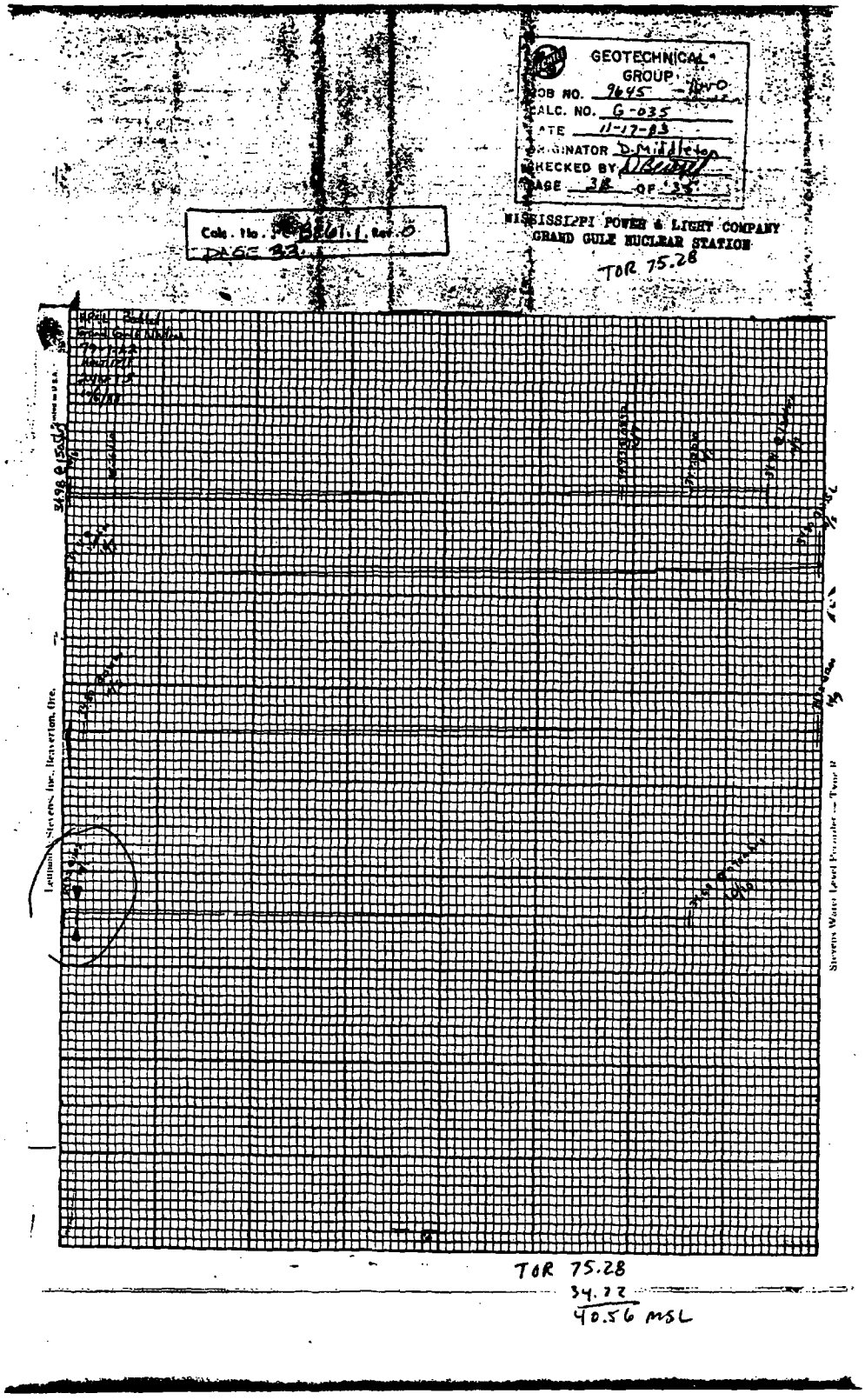
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

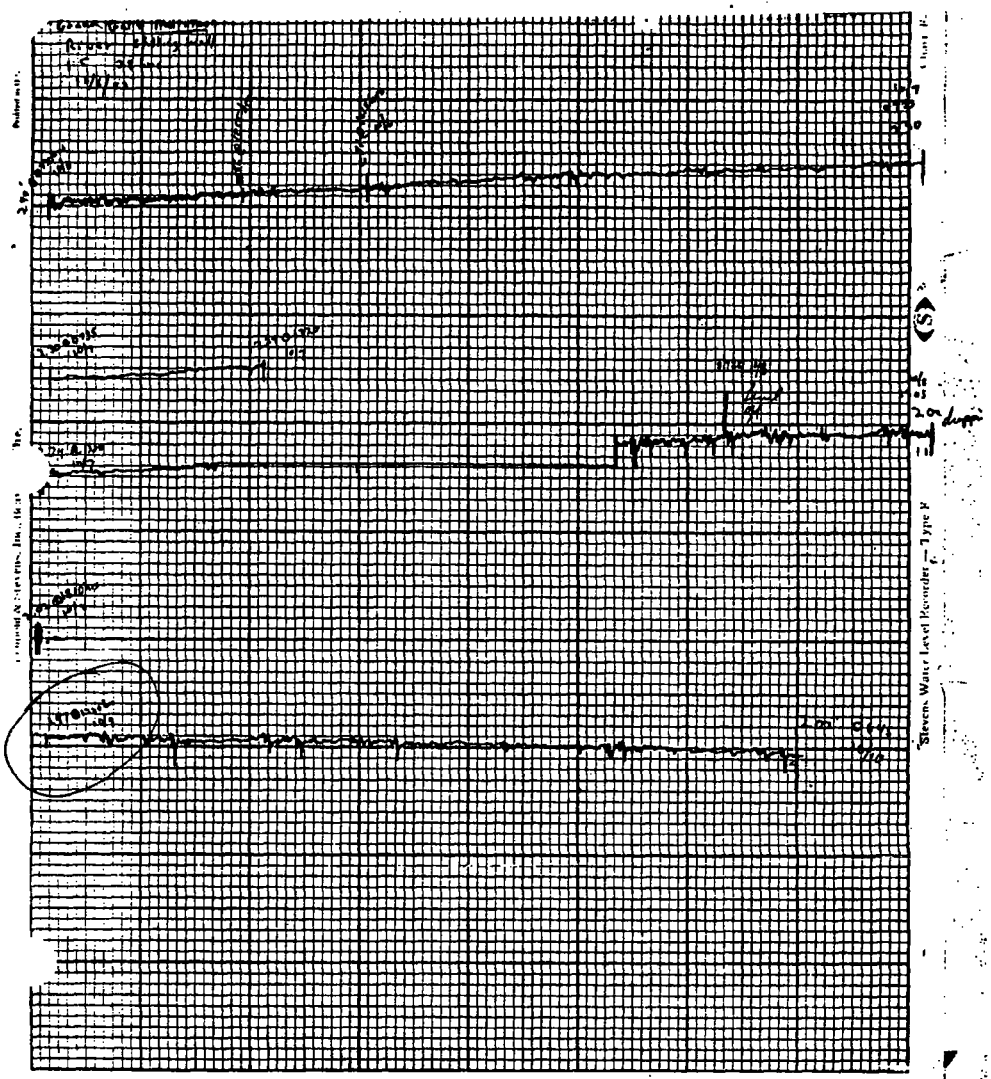
GEOTECHNICAL GROUP
JOB NO.
CALC. NO.
DATE
ORIGINATOR
CHECKED BY
PAGE OF

Calc. No. G-0035 Rev. 0
Sht. 32 of 35

Leupold & Stevens, Inc., Beaverton, Ore.

TOR 76.71
39.02
37.69 MSL


GEOTECHNICAL GROUP
JOB NO. 9645 - NV0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D.Middleton
CHECKED BY DBeasley
PAGE 38 OF 38
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION
Calc. No. G-0361.1 Rev. 0
PAGE 32
TOR 75.28
TOR 75.28
34.72
40.56 MSL



TOR 43.49

GEOTECHNICAL GROUP
JOB NO. 9645 Rev 0
CALC. NO. G-035
DATE 11-17-83
ORIGINATOR D. Middleton
CHECKED BY N Bezwada
PAGE 29 OF 35

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION

Calc. No.: C-9641.1, Rev 0
PAGE 35

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.
9645	G-035	0	35 of 35

ORIGINATOR	DATE	CHECKED	DATE
D. Middleton	11-17-83	Dennis Bechtel	12-1-83

```
01 LBL T INFER
02 LBL 01
03 Recall 04
04 X²
05 289000
06 +
07 √x
08 Recall 04
09 ÷
10 Log
11 527.7
12 X
13 Recall 10
14 ÷
15 T ML?
16 Prompt
17 Store 05
18 ÷
19 T Q?
20 Prompt
21 X
22 Store 06
23 X²
24 2
25 ÷
26 Recall 05
27 ÷
28 Recall 06
29 +
30 Pause
31 Pause
32 End
```

$$S = \frac{527.7\ Q \log\left[\frac{\sqrt{4a^2 + r^2}}{r}\right]}{Km}$$

where a = 850 ft.

Before use For each well:

Store 04 = r

Store 10 = K

Use on Hewlett+ Packard

The results were checked independently without the use of this program. DRB

GPO-27(96 Rev. 4/82 (ED-69))