GULF STATES UTILITIES COMPANY
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July 24, 1985
RBG - 21655
File No. G9.5

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

River Bend Station - Unit 1
Docket No. 50-458

Enclosed for your review is Gulf States Utilities Company response to request for additional information identified by the Nuclear Regulatory Commissions Power Systems Branch (PSB) regarding second level undervoltage protection at River Bend Station. Enclosure 1 contains a brief discussion regarding the second level undervoltage protection and backup calculations which have been previously discussed with your staff. No additional Technical Specification or FSAR changes are required as the result of this information.

Sincerely,

J. E. Booker

J. E. Booker
Manager-Engineering
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/ERG/JEP

Enclosure (1)

B001
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ENCLOSURE 1

An evaluation has been performed establishing the adequacy of the RBS electrical systems in terms of acceptable voltages. When considering the loads removed from the 120 volt panelboards as a result of the Division I and II Diesel Generator load reduction effort, the second level undervoltage set point of 90% was found to be acceptable. Considering a voltage at the low voltage load of 115v - 10%, or 103.5 volts, and considering worst case loading on the buses, a voltage of 3702v -- or 89% of 4160v -- is calculated at the 4160v switchgear. This is less than the chosen setpoint of 90% - 3740v.

In accordance with Branch Technical Position PSB-1, the voltages on the RBS electrical distribution system will be obtained by test and compared to analytically derived voltage values for equivalent load and grid conditions. This test verification process will determine whether additional evaluation of set points will be required.

The Technical Specification allowable value for the second level lower limit is approximately 87% voltage on the 4160v bus. This is slightly less than the voltage level calculated when assuming worst case bus loading and the lowest grid voltage of 95% of 230kV. GSU maintains the grid at 102% of 230kV, with 95% grid voltage as a lowest allowable. It is not expected that the RBS electrical distribution system and Class 1E equipment will be subjected to low voltages. Because short duration transient voltages on the 4160 volt buses are not expected to be less than 90%, the lower allowable limit of the second level undervoltage relay of 87% is not expected to adversely affect operation of Class 1E loads at RBS.

On the Division III electrical system, when considering worst case loading on the 4160v and 480v MCC buses, and grid voltage of 95% of 230kV, calculation results yield 90% voltage on the 115 volt panelboard. The use of the ITE-27N relay for the second level of undervoltage protection provides assurance that low voltage loads will continue to properly operate. Accuracy of the ITE-27N relay is $\pm$ .8% over the anticipated range of RBS operating temperatures and control power voltage. Transient undervoltage conditions on the GSU grid coincident with the lower Technical Specification allowable value for undervoltage tripping at 89% will not adversely affect the operation of Division III loads at RBS.

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DIV. I & II

1st Level : 27-1 4200 -120V L-N 2424.87 - 69.28

ITE-27H 49V DO

1715.79 v / 2401.78 = 71.47% or 2970.24 v

Set Point = 49V

Repeatability = ±2%/1yr = ±.98 V or 3029.9 3911.06

Amb Temp 1v @ 55°C = ±1 v

Allowable Set Point = 49 ± 1.98 v (±4.04%)

HI = 50.98V or 74.29 % or 3090.464 v

Lo = 47.02V or 68.5 % or 2849.6 v

2nd Level : 27-2 4200 -120V L-N 2424.87 - 69.28 v

ITE -27H 61.7 V DO = 89.92% or 3740.67 v

Set Point = 61.7 v

Repeatability = ±2%/1yr = ±1.234 v or 3815.17 3665.55

Amb Temp 1v @ 55°C = ±1v

Allowable Set Point = 61.7 ± 2.234 v (±3.6%)

HI = 63.93 v or 93.2 % or 3877.12 v

Lo = 59.47 v or 86.7 % or 3606.72 v

Tech Spec Values

	Set Point	Allowable Value
1st Level	2970 v ± 60 v	2970 ± 120
2nd Level	3740 v ± 75 v	3740 ± 135

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DIV III

1ST Level: 27 N

4200 - 120V L-L

NOM ~ 87 v DO = 73 % or 3045V

Set Point = 87v 76.9% 3197V

Tolerance ≅ ± 5% = ± 4.35V or 69.5% or 2892v

78.3% 3258V

Allowable ≅ ± 7% = ± 6.09V or 68.1% or 2831v

2ND Level: 27/62

4200 - 120V L-L

ITE - 27N 109v PU (DO @ 99%) or 91.7% or 3815 PU

107.9 v DO 90.8% 3777 DO

Set Point = 107.9 v ± .8% or ± .863v

Hi = 108.76v or 91.5 % or 3806.6 v

Lo = 107.037v or 90.1 % or 3746.30 v

Allowable

Hi = 110.06 v 92.6% or 3852 v

Lo = 105.77 v 89. % or 3702 v

Tech Spec Values

	Set Point	Allowable Value
1ST Level	3045v ± 153v	3045v ± 214v
2ND Level	3777v ± 30v	3777v ± 75v

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

for reference to Method Cor p 10 + 11

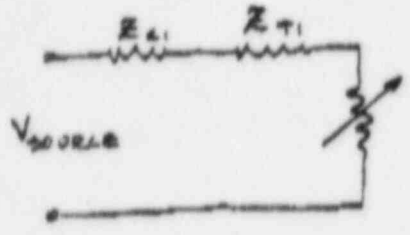
CALCULATION IDENTIFICATION NUMBER				PAGE 8
J.O. OR W.O. NO. 12210	DIVISION & GROUP ELECTRICAL	CALCULATION NO. E-206	OPTIONAL TASK CODE N/A	

TRIAL # 1 CONT'D

• ASSUME CONSTANT KVA & DETERMINE VOLTAGE @ IEISS LDC 1B

$V_{SOURCE} = 0.886\ (4160) = 3685.76$ VOLTS

FOR 1ST ITERATION, LET $V_{LDC} = 448$ VOLTS



WHERE $Z_{LDC} = \frac{kV^2}{MVA}$ @ PF = 0.8

REFLECT Z_{C1} TO XFMR SECONDARY

$$Z_{C1}' = .0744\ (0.140)\left[\frac{480}{4160(.95)}\right]^2 = 0.00015 \angle 28.508^\circ$$

$$Z_{T1} = .0817\ \frac{(.48)^2}{1.5} = 0.01255 \angle \tan^{-1}(9)$$

$$Z_{LDC} = \frac{(0.448)^2}{1.390} = 0.14439 \angle 40^\circ (0.8)$$

$$Z_{TOT} = Z_{C1}' + Z_{T1} + Z_{LDC} = 0.15341 \angle 40.27964$$

$$V_{LDC} = V_{SOURCE}'\ \frac{Z_{LDC}}{Z_{TOT}}$$

where $V_{SOURCE}' = 3685.76\ \frac{480}{4160(.95)} = 447.663$

$= 447.663\ (.94125)$

$= 421.354$ (ITER #1)

418.047 #2

417.594 #3

417.531 #4

417.522 #5

417.521 #6

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET For reference to Method for p10 of 11

A 5010.86

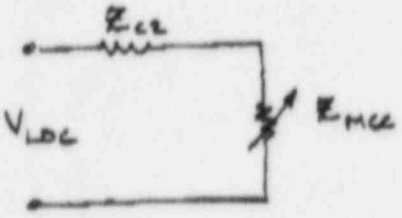
CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 12210	DIVISION & GROUP ELECTRICAL	CALCULATION NO. E-206	OPTIONAL TASK CODE N/A	PAGE 9

TRIAL #1 CONT'D

- ASSUME CONSTANT KVA; DETERMINE VOLTAGE @ 1EHSA-MCC14B

$V_{SOURCE} = V_{LDC} = 417.521$ VOLTS

FOR 1ST ITERATION, LET $V_{MCC} = 412$ VOLTS



WHERE $Z_{MCC} = \frac{KV^2}{MVA}$ @ pf = 0.8

$Z_{CC} = 0.00467 \angle 59.388°$

$Z_{MCC} = \frac{(0.412)^2}{0.208} = 0.81608 \angle \cos^{-1}(0.8)$

$Z_{TOT} = Z_{CC} + Z_{MCC} = 0.82094 \angle 36.888°$

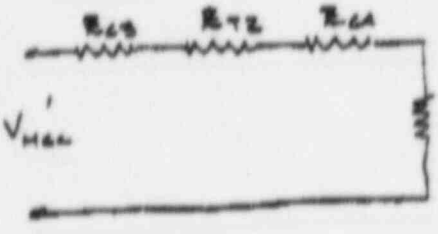
$V_{MCC} = V_{LDC} \frac{Z_{MCC}}{Z_{TOT}}$

$= 417.521\ (0.99432)$

$= 415.148$

- ASSUME CONSTANT IMPEDANCE ; DETERMINE VOLTAGE @ MCC-PNL14B1

$V_{SOURCE} = V_{MCC} = 415.148$ VOLTS



WHERE $Z_{PNL} = \frac{(0.216)^2}{0.005421}$ @ pf = 1.0

REFLECTING V_{MCC} AND Z_{CB} TO XFMR SECONDARY

$V'_{MCC} = 415.148 \left[\frac{240}{480(.99)}\right] = 218.499$ VOLTS

$Z'_{CB} = 0.2480 \left[\frac{240}{480(.99)}\right]^2 = 0.09040 \angle 7.638°$

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CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				PAGE 10
J.O. OR W.O. NO. 12210	DIVISION & GROUP ELECTRICAL	CALCULATION NO. E-206	OPTIONAL TASK CODE N/A	

$Z_{CA} = 0.00348 \angle 5.638°$

$Z_{T2} = 0.0263 \frac{(.24)^2}{.019} = 0.10099 \angle \tan^{-1}(.88)$

$Z_{PNL} = \frac{(0.216)^2}{0.003421} = 13.63812 \angle 0$

$Z_{TOT} = Z'_{LD} + Z_{T2} + Z_{CA} + Z_{PNL}$

$= 13.81554 \angle 0.3174$

$V_{PNL} = V'_{MCC} \frac{Z_{PNL}}{Z_{TOT}}$

$= 218.499 (0.9878)$

$= 219.724$ VOLTS

TRIAL #2

USING SUCCESSIVE APPROXIMATION TO RESULT IN A PANELBOARD VOLTAGE OF 216 VOLTS THE PREVIOUS CALCULATION IS REFERENCED FOR THE METHOD AND Z_{LOC}, Z_{MCC}, AND Z_{TOT} ARE ADJUSTED

ASSUME V_{SOURCE} = 89% VOLTAGE @ (ENSA SWGR)
$= 0.89 (4160) = 3702.4$ VOLTS

- REF p. 8 (for method)

line 7 - let $V_{LOC} = 422$ VOLTS FOR 1st iteration

line 25 - $Z_{LOC} = \frac{(0.422)^2}{1.99} = 0.12612 \angle \cos^{-1}(0.8)$

line 29 - $V'_{SOURCE} = 3702.4 \left[\frac{480}{4160(.95)}\right] = 449.684$

$Z_{TOT} = 0.13717 \angle 40.68394$ (1st iter)

$V_{LOC} = 420.022$ (ITER# 1)
419.792 (ITER# 2)
419.719 (ITER# 3)
419.710 (ITER# 4)
419.709 (ITER# 5)

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CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				PAGE 11
J.O. OR W.O. NO. 12210	DIVISION & GROUP ELECTRICAL	CALCULATION NO. E-206	OPTIONAL TASK CODE N/A	

TRIAL #2 CONT'D

- REF p 9 & (for method)

Line 5 - $V_{SOURCE} = V_{LOL} = 419.709$ VOLTS

Line 7 - Let $V_{MCC} = 412$ VOLTS FOR 1ST ITERATION

Line 17 - $Z_{MCC} = \frac{(0.412)^2}{0.208} = 0.81608 \angle \cos^{-1}(0.8)$

Line 20 - $Z_{TOT} = 0.82074 \angle 36.88764$

Line 22 - $V_{MCC} = 417.323$ (ITER# 1)

- REF p 9 & (for method)

Line 30 - $V_{SOURCE} = V_{MCC} = 417.323$ VOLTS

Line 40 - $V'_{MCC} = 417.323 \left[\frac{240}{480(.99)}\right] = 219.644$ VOLTS

REF p 10 & (for method)

Line 14 - $V_{PNL} = V'_{MCC} \frac{Z_{PNL}}{Z_{TOT}}$

$= 219.644 (0.9873)$

$= 216.854$ VOLTS

HENCE, FOR 88.6% VOLTAGE AT IENS# SUGGIB A PANELBOARD VOLTAGE OF 219.724 VOLTS RESULTS; AND FOR 89% VOLTAGE AT IENS# SUGGIB A PANELBOARD VOLTAGE OF 216.854 RESULTS. SINCE A DESIRED PANELBOARD VOLTAGE OF 216 IS REQUIRED, USE LINEAR INTERPOLATION TO DETERMINE IENS# SUGGIB VOLTAGE

$\frac{216.854 - 219.724}{89 - 88.6} = 2.825$ VOLT CHANGE IN PANEL VOLTAGE PER 1% VOLTAGE VARIATION AT THE M.V. BUS

$216 - 219.724 = 0.276$ VOLTS AT PANEL ΔV

$\frac{0.276}{2.825} + 88.6\% = 88.698\%$ VOLTAGE @ IENS# SUGGIB ~ 3690 VOLTS.