STP 3053 (10/91)
OEP-3.070

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER COMPANY

CALCULATION COVER SHEET

CALC NO.	MC-6458
PRELIM.	
FINAL	X
VOID	

BUILDING/AREA/SYSTEMS: FHB / ALL / SI, CS UNIT: 1/2
SUBJECT: ECCS ISOLATION VALVE LEAK ANALYSIS DISCIPLINE: MECHANICAL
QUALITY CLASS: 2

OBJECTIVE

TO DETERMINE THE TIME FOR LEAKAGE FROM ECCS ISOLATION VALVES HAVING A DEGRADED LEAK RATE TO REACH THE RWST, AND THE TOTAL LEAK RATE INTO THE RWST.

SCOPE

SEE PAGE 4 OF CALCULATION.

SUMMARY OF RESULTS

SEE PAGE 6 OF CALCULATION.

TOTAL NO. OF SHEETS
31

REV. NO.	0						
PREPARER	RP Murphy						
REVIEWER	[illegible]						
SE	[illegible]						
DM	[illegible]						
ISSUE DATE	10-4-95						

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SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

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SUBJECT ECCS Isolation Valve Leak Analysis UNIT/S 1/2 CALC. NO. MC-6458

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CALC. REV. NO.	CHANGE DOC. NO.	DESCRIPTION OF CHANGES	AFFECTED CALC. SHT.	MODIFIED CALC. SHT. NO.
0	—	INITIAL ISSUE	—	—

REV.	PREPARER/DATE	REVIEWER/DATE
0	R P Murphy 5/4/95	J K Coulter 5/25/95

III. TABLE OF CONTENTS

IV. BACKGROUND/OBJECTIVE

A. BACKGROUND

NRC INFORMATION NOTICE NO. 91-056 ALERTS LICENSEES TO POTENTIAL PROBLEMS RESULTING FROM THE LEAKAGE OF ISOLATION VALVES IN THE ECCS RECIRCULATION LINES TO THE RWST, WHICH IS VENTED TO ATMOSPHERE. THE SAFETY INJECTION AND CONTAINMENT SPRAY SYSTEMS AT STP HAVE BEEN EVALUATED FOR THE POTENTIAL LEAK PATH AS DESCRIBED IN THE INFORMATION NOTICE. IT HAS BEEN CONCLUDED THAT THE CONDITION DESCRIBED BY THE IN APPLIES TO BOTH STP UNITS.

THE POTENTIAL EXISTS FOR BACKLEAKAGE OF CONTAMINATED SUMP WATER INTO THE RWST DURING THE RECIRCULATION PHASE OF SAFETY INJECTION FOLLOWING A LOCA. THE POTENTIAL LEAKAGE IS FROM THE SI PUMP RECIRCULATION LINE ISOLATION VALVES, THE CONTAINMENT SPRAY SYSTEM TEST LINE ISOLATION VALVES AND THE RWST SUCTION LINE ISOLATION VALVES. IF BACKLEAKAGE OCCURS, THE RWST MAY BECOME A SOURCE OF AIRBORNE RADIOACTIVITY.

THE DESIGN FUNCTION OF THE RWST SUCTION AND SI/CS ISOLATION VALVES (21 TOTAL VALVES) IS TO PREVENT RADIOACTIVE WATER FROM CONTAMINATING THE RWST DURING RECIRCULATION PHASE (REF. 10). [NOTE: AS A RESULT OF ITS DESIGN FUNCTION IN THIS SYSTEM, CHECK

VALVE SI-002 WILL BE CONSIDERED AN ISOLATION VALVE IN THIS CALCULATION.] THE IMPACT OF A DEGRADED LEAK RATE THROUGH THESE VALVES SHALL BE DETERMINED.

B. OBJECTIVE

THE OBJECTIVE OF THIS CALCULATION IS TO DETERMINE THE IMPACT OF A SUBSTANTIALLY DEGRADED LEAKAGE CONDITION FOR THE ECCS ISOLATION VALVES, THUS ALLOWING A GREATER THAN DESIGN LEAKAGE TO MIGRATE BACK TO THE RWST. THE RWST SUCTION LINE ISOLATION VALVES (SI-0001 AND SI-0002), LOW HEAD/HIGH HEAD SAFETY INJECTION PUMPS' RECIRCULATION LINE ISOLATION VALVES (SI-0011, 12, 13 AND 14), AND THE CONTAINMENT SPRAY PUMP'S TEST LINE ISOLATION VALVE (CS-0008), FOR THE THREE (3) SAFETY TRAINS (A, B &C), ARE CONSIDERED IN THIS ANALYSIS.

THE RESULTS OF THIS CALCULATION WILL PROVIDE THE BASIS FOR ASSUMED INLEAKAGE TO THE RWST (ELAPSED TIME AND INFLUENT RATE), AND CONSEQUENTLY WILL BE USED TO DETERMINE THE EXTENT OF THE RADIOLOGICAL CONSEQUENCES OF THE DEGRADED CONDITION (NC-6013).

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1	BP Murphy 10/17/95	PWarnell. nor 10/18/95

V. SUMMARY OF RESULTS

A) THE DESIGN AND DEGRADED CONDITION LEAKAGE FOR EACH ECCS ISOLATION VALVE IS LISTED IN TABLE 1 BELOW:

TABLE 1

DESIGN AND DEGRADED CONDITION LEAKAGE FOR ECCS VALVES TO RWST

ITEM NO.	VALVE ID	MAXIMUM CALCULATED LEAKAGE CC/HR (DESIGN)	CC/MIN (DESIGN)	CC/MIN (DEGRADED)
1	SI0001A,B,C	48	0.80	8.0
2	SI0002A,B,C	48	0.80	8.0
3	SI0011A,B,C	20	0.33	3.3
4	SI0012A,B,C	20	0.33	3.3
5	SI0013A,B,C	20	0.33	3.3
6	SI0014A,B,C	20	0.33	3.3
7	CS0008A,B,C	18	0.33	3.0

B) THE MOTIVE FORCE FOR LEAKAGE IN THE CONTAINMENT SUMP SUCTION LINE IS THE HIGH PRESSURE IN THE CONTAINMENT RESULTING FROM A LARGE BREAK LOCA. THIS PRESSURE IS REDUCED, WITHIN THE FIRST 2.81 HOURS OF AN ACCIDENT, BELOW A PRESSURE CAPABLE OF FORCING WATER INTO THE RWST. IT IS CONCLUDED THAT NO CONTAMINATED SUMP WATER WILL REACH THE RWST VIA THIS LEAK PATH.

C) THE CS PUMPS MAY BE SECURED UP TO 13.4 DAYS AFTER A DBA LLOCA AND CONTAINMENT WATER WILL NOT REACH THE RWST VIA THIS LEAK PATH

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1	[signature] 10/17/95	[signature] 10/17/95

UNDER THE DEGRADED CONDITIONS ASSUMED.

D) THE MINIMUM TIME FOR LEAKAGE FROM VALVES ASSUMED TO HAVE THE DEGRADED LEAK RATE TO REACH THE RWST FOLLOWING THE INITIATION OF THE RECIRCULATION PHASE OF THE DESIGN BASIS LARGE LOCA IS 42.3 DAYS.

E) THE LEAK RATE OF CONTAMINATED WATER INTO THE RWST AFTER 42.3 DAYS UNDER THE DEGRADED VALVE CONDITIONS IS ASSUMED TO BE 1200 CC/HR.

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VI. METHOD OF ANALYSIS

THE METHOD OF ANALYSIS FOR THIS CALCULATION IS TO ASSUME THE DESIGN BASIS MAXIMUM PERMISSIBLE MAIN SEAT LEAKAGE RATE FOR EACH ECCS ISOLATION VALVE, AS SPECIFIED BY THE PURCHASE SPECIFICATIONS, TO DETERMINE THE RATE OF SUMP WATER BACKLEAKAGE INTO THE RWST. A GREATER LEAK RATE WILL BE ASSUMED TO DETERMINE THE TRANSPORT TIME FOR THE LEAKAGE FROM THE VALVE TO THE RWST. THIS IS THE TIME REQUIRED FOR INLEAKAGE VOLUME TO DISPLACE THE EXISTING WATER VOLUME.

SINCE THE DRIVING FORCE (HEAD) FOR LEAKAGE THROUGH THE RWST SUCTION LINE ISOLATION VALVES (SI-0001 AND 2) IS THE POST ACCIDENT PRESSURE IN THE CONTAINMENT (REF. 1. ALSO SEE ATTACHMENT 1.), THIS LEAK PATH AND PRESSURE/ TIME RELATION WILL BE EVALUATED, FOR THE THREE (3) SAFETY TRAINS (A, B & C).

VII. INPUTS/REFERENCES

1) CALC. NC-7032, REV. 4, DCN-MC-0082, "CONTAINMENT LOCA PRESSURE/ TEMPERATURE ANALYSIS."

2) WESTINGHOUSE EQUIPMENT SPECIFICATION, E-SPEC. G-952851, REV. 0 (W PIP INDEX, SECTION 6.4, TAB 13C).

3) 1L529TS104D, "SPECIFICATION FOR ASME SECTION III BELLOWS SEAL OR PACKLESS METAL DIAPHRAGM VALVE 2 INCHES AND SMALLER," REV. O.

4) CALC. MC-5035, REV. 3, "FLOODING ANALYSIS - REACTOR CONTAINMENT BUILDING."

5) CAMERON HYDRAULIC DATA, 16TH ED.

6) CRANE TECHNICAL PAPER NO. 410, "FLOW OF FLUIDS THROUGH VALVES, FITTINGS AND PIPE," 1988.

7) PIPING AND INSTRUMENT DIAGRAMS, SI AND CS SYSTEMS:

A) 5N129F05013 #1 REV 17 #2 REV 18

B) 5N129F05014 #1 REV 12 #2 REV 11

C) 5N129F05015 #1 REV 13 #2 REV 12

D) 5N109F05037 #2 REV 17 #2 REV 13

8) CS/SI PIPE ISOMETRICS:

A) 5F369PCS515-02 REV 9
B) 5F369PCS515-03 REV 8
C) 5F369PCS515-04 REV 3
D) 5F369PSI572-01 REV 8
E) 5F369PSI572-02 REV 8
F) 2F369PSI572-03 REV 9
G) 2F369PSI572-04 REV 10
H) 2F369PSI572-06 REV 8
I) 7M369PSI272-01 REV 4
J) 2M369PSI272-02 REV 9
K) 5F369PSI572-A01 REV 11
L) 2F369PSI572-05 REV 8
M) 5F369PSI572-07 REV 7

9) REFUELING WATER STORAGE TANK ORIENTATION DRAWING, 14926-0149-01118-BBM.

10) LETTER ST-HL-AE-2723, JULY 12, 1988.

11) CONCRETE DRAWING C-4068, REV 4, SECTION VIEW MAB.

12) CONCRETE DRAWING C-4012, REV 4, MAB PLAN VIEW EL 10'-0".

13) 5L019PS004, "CRITERIA FOR PIPING DESIGN," REV 18.

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0	D.F. Murphy 5/24/95	J.R. Coulter 5/25/95

VIII. ASSUMPTIONS

1) TWO INLET LEAK PATHS EXIST BETWEEN RCB SUMP AND RWST (SEE FIGURES 1 AND 2):

A) SI/CS PUMP SUCTION LINE FROM RWST, LINE NO. SI-1101

B) RETURN HEADER FROM SI RECIRCULATION LINE AND CS TEST LINE TO RWST, LINE NO. SI-1104.

2) FAILURE OF ONE VALVE IN SERIES TO CLOSE. THE FAILURE OF VALVE SI0011, 14 AND 02 TO CLOSE WILL PROVIDE FULL PRESSURE AGAINST A SINGLE ISOLATION VALVE. THIS IS CONSERVATIVE FOR MINIMUM TRANSPORT TIME TO THE RWST.

3) THE INLEAKAGE WATER WILL DISPLACE THE ENTIRE VOLUME OF WATER EXISTING WITHIN THE PIPING AS IT FLOWS TO THE RWST.

4) ALL VALVES LEAK AT 10 TIMES THE MAXIMUM LEAK RATE ALLOWABLE PER THEIR PURCHASE SPEC. THIS REPRESENTS GROSS SEAT LEAKAGE WHEN REPAIR OR REWORK MAY BE REQUIRED.

5) AT THE TIME THE LEAKAGE FROM THE SHORTEST PATH REACHES THE COMMON RETURN TO THE RWST, IT IS CONSERVATIVE TO ASSUME ALL

LEAKAGE, FOR ALL OF THE VALVES, INSTANTANEOUSLY AND SIMULTANEOUSLY REACHES THE RWST. THIS IS TO ACCOUNT FOR ANY MIXING OF CONTAMINATED WATER INTO SI-1104, PRIOR TO REACHING THE COMMON RETURN.

6) THERMAL DIFFERENCE BETWEEN EXISTING WATER IN THE LINE AND INLEAKAGE HAS NO IMPACT ON TRANSPORT TIME. THE REASON IS, THE FLOW RATE IS SMALL, THE FLUIDS HAVE TIME TO REACH A THERMAL EQUILIBRIUM. THERMAL CONDUCTION THROUGH THE PIPING WALLS WILL ALSO CONTRIBUTE TO THERMAL EQUILIBRIUM.

7) ALL CORE DAMAGE RADIOACTIVE PRODUCTS REMAIN IN SOLUTION UNTIL LEAKAGE ENTERS THE RWST.

8) AT INITIATION OF RECIRCULATION MODE, THE CONTAINMENT'S ATMOSPHERIC PRESSURE IS SUFFICIENT TO CAUSE BACKLEAKAGE THROUGH VALVE SI-0001 AND 2, THE SUCTION LINE ISOLATION VALVES TO THE RWST.

9) ALL THREE TRAINS OF HHSI, LHSI AND CS ARE INITIALLY IN SERVICE.

10) THE MAXIMUM LEAKAGE THROUGH VALVES IN SERIES IS ASSUMED TO BE THE MAXIMUM RATED LEAKAGE OF ONE VALVE.

11) AS A RESULT OF THE LLOCA DBA, ALL SI/CS PUMPS OPERATE, THE RWST IS EMPTIED IN APPROX. 20 MINUTES (REFERENCE MC-5037), AND RECIRCULATION COOLING IS ESTABLISHED.

12) THE SWITCH OVER TO RECIRCULATION OCCURS AUTOMATICALLY AT LOW RWST LEVEL.

13) LEAKAGE THROUGH CLOSED ISOLATION VALVES AFTER THEIR RESPECTIVE PUMPS HAVE BEEN SECURED IS NEGLIGIBLE.

14) RECIRCULATION IS ASSUMED TO OCCUR AT T=1216 SEC. (DCN MC-00082 INDICATES THAT RECIRCULATION WOULD OCCUR AT T=1216 SEC.).

15) PIPE LENGTHS AND DIAMETERS FOR SI RECIRCULATION LINES FROM THE DOWNSTREAM ISOLATION VALVE TO THE RWST, PER THE REFERENCED ISOS (SEE FIGURE 2), ARE AS FOLLOWS (FOR SCHEDULE 40 PIPE) (REF 6):

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	UNIT	NOM DIAM (in)	ID (in)	LENGTH (ft in)	EQUIVALENT 6" DIAM (ft) (SEE NOTE)
TRAIN A					
HHSI	1	2"	2.067"	17' 0"	1.98'
	2	2"	2.067"	14' 7"	1.69'
LHSI	1/2	2"	2.067"	1' 1-1/2"	.13'
	1/2	3"	3.068"	8' 4"	2.13'
	1/2	6"	6.065"	1' 5-1/2"	1.46'
				TOTAL	3.72'
COMMON	1/2	6"	6.065"	78' 9"	78.75'
TRAIN B					
HHSI	1	2"	2.067"	17' 0"	1.98'
	2	2"	2.067"	14' 10"	1.72'
LHSI	1/2	2"	2.067"	1' 1-1/2"	.13'
	1/2	3"	3.068"	8' 4"	2.13'
	1/2	6"	6.065"	1' 5-1/2"	1.46'
				TOTAL	3.72'
COMMON	1/2	6"	6.065"	78' 9"	78.75'
TRAIN C					
HHSI	1	2"	2.067"	17' 0"	1.98'
	2	2"	2.067"	14' 7"	1.69'(*)
LHSI	1/2	2"	2.067"	1' 1-1/2"	.13'
	1/2	3"	3.068"	8' 4"	2.13'
	1/2	6"	6.065"	1' 5-1/2"	1.46'
				TOTAL	3.72'
COMMON	1/2	6"	6.065"	70' 7-1/4"	70.60'(*)

COMMON RETURN					
	1	6"	6.065"	93' 2"	93.17"
	2	6"	6.065"	92' 5/16"	92.03"

(*) SHORTEST TOTAL PATH = 1.69' + 70.60' = 72.29' (6" DIA PIPE)

NOTE: THE LENGTH OF THE PIPE IN TERMS OF THE EQUIVALENT 6" DIAMETER IS DETERMINED BY MULTIPLYING THE LENGTH OF THE SPECIFIED DIAMETER PIPE BY THE RATIO OF THE SQUARE OF THE SPECIFIED DIAMETER PIPE TO $(6.065)^2$.

NOTE: "COMMON" REPRESENTS THE PIPING COMMON TO EACH TRAIN'S HHSI AND LHSI RECIRCULATION RETURN PATH UP TO THE CONFLUENCE WITH THE NEXT DOWNSTREAM TRAIN'S RETURN PATH. THUS THE "COMMON" TRAIN PATH MAY INCLUDE LEAKAGE FROM BOTH THE HHSI AND LHSI PUMP IN THEIR RESPECTIVE TRAIN SIMULTANEOUSLY.

NOTE: COMMON RETURN REPRESENTS THE COMMON PIPING THAT ALL SI AND CS TRAINS TAKE TO THE RWST. ESSENTIALLY THIS IS THE VERTICAL PIPE FROM THE FHB TO THE RWST.

NOTE: THE CONSEQUENCE OF USING THE SHORTEST PATH FOR CALCULATIONAL PURPOSES IS THAT FOR THE SAME ASSUMED LEAKAGE FROM THE HH RECIRC VALVE & THE LH RECIRC VALVE FOR THE RESPECTIVE TRAIN, THE ASSUMED VOLUMETRIC LEAKAGE FROM EACH TRAIN HAS NOT COMINGLED WITH FLOW FROM ANY OTHER TRAIN (I.E., EACH TRAIN'S MIGRATION TIME CAN BE SEPARATELY CALCULATED). ONLY WHEN FLOW FROM THE SHORTEST PATH REACHES THE COMMON RETURN IS IT ASSUMED THAT THE FLOW FROM ALL THREE TRAINS TOGETHER CONTRIBUTE TO THE VOLUMETRIC FLOW. FOR CONSERVATISM, AT THE TIME THAT FLOW FROM THE SHORTEST PATH REACHES THE COMMON RETURN, IT IS ASSUMED THAT FLOW FROM ALL THREE TRAINS IS INSTANTANEOUSLY TRANSPORTED THROUGH THE 92.03' TO THE RWST. THIS IS CONSIDERED CONSERVATIVE SINCE MIGRATION OF THE CONTAMINATED WATER BY DIFFUSION WOULD BE DILUTED BY THE EXISTING NON-CONTAMINATED INVENTORY.

16) THE "C" TRAIN HHSI & LHSI RECIRCULATION LINES CONTAIN THE NEAREST LEAKING VALVES TO THE RWST THAT ARE IN CONTINUOUS SERVICE. AS A RESULT, THESE VALVES, SHOULD THEY LEAK, PROVIDE THE SHORTEST PATH, AND THEREFORE THE FIRST RADIOACTIVE SOURCE, TO REACH THE RWST. "NEAREST" MEANS THE PATH HAVING THE LEAST VOLUME.

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17) LEAKAGE TRANSPORT FROM THE VALVES SI-0012 (HHSI), SI-0013 (LHSI) AND CS-0008 (CS) IS VOLUMETRIC BASED ON THE PIPE DIAMETER AND PIPE LENGTH UP TO THE COMMON HEADER.

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18) THE CS PUMPS ARE SECURED BEFORE ANY LEAKAGE REACHES THE COMMON RETURN HEADER. PER FIGURE 2, THE "C" TRAIN CS RECIRCULATION TEST LINE IS ASSUMED TO BE THE CLOSEST TO THE RWST, AND IS ASSUMED TO CONSIST OF APPROXIMATELY 10' 3" OF 6" DIAMETER SCHEDULE 40 PIPING AND FITTINGS. PER REFERENCE NC-6013, THE CS PUMPS MAY BE SECURED AT APPROXIMATELY 6.5 HOURS INTO THE LLOCA DBA. THIS CALCULATION CONCLUDES THAT THE PUMPS MAY BE SECURED AT ANY TIME UP TO 13.4 DAYS INTO THE DBA AND NOT ALLOW BACKLEAKAGE TO THE RWST VIA THIS RETURN PATH.

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IX. NOMENCLATURE

RWST	REFUELING WATER STORAGE TANK
LHSI	LOW HEAD SAFETY INJECTION
HHSI	HIGH HEAD SAFETY INJECTION
CS	CONTAINMENT SPRAY
LOCA	LOSS OF COOLANT ACCIDENT. IN THIS CALCULATION THIS ACRONYM IS USED INTERCHANGEABLY WITH LLOCA.
LLOCA	DESIGN BASIS LARGE BREAK LOCA (LOCA-2, DEPSG)(REF. 1)
DBA	DESIGN BASIS ACCIDENT
H	HEAD PRESSURE, ft
Pa	PRESSURE UNDER ACCIDENT CONDITIONS, PSI (lb/in^2)
k	TEMPERATURE DEPENDENT CONVERSION FACTOR, ft TO PSI. THIS FACTOR IS = 33.899 ft H_2O (WATER) / 14.696 PSI = 2.307 AT 4°C. THIS IS AN ACCEPTABLE VALUE FOR USE WHEN DETERMINING ft H_2O AT AMBIENT CONDITIONS FOR THE RWST HEAD THE TEMPERATURE DEPENDENCE OF k IS IMPORTANT WHEN DETERMINING THE HEAD EQUIVALENT IN ft OF WATER AT WORKING FLUID TEMPERATURES, GIVEN PSI.
ΔEL	CHANGE IN ELEVATION
t	ELAPSED TIME FROM GIVEN REFERENCE POINT, s
s	SECONDS

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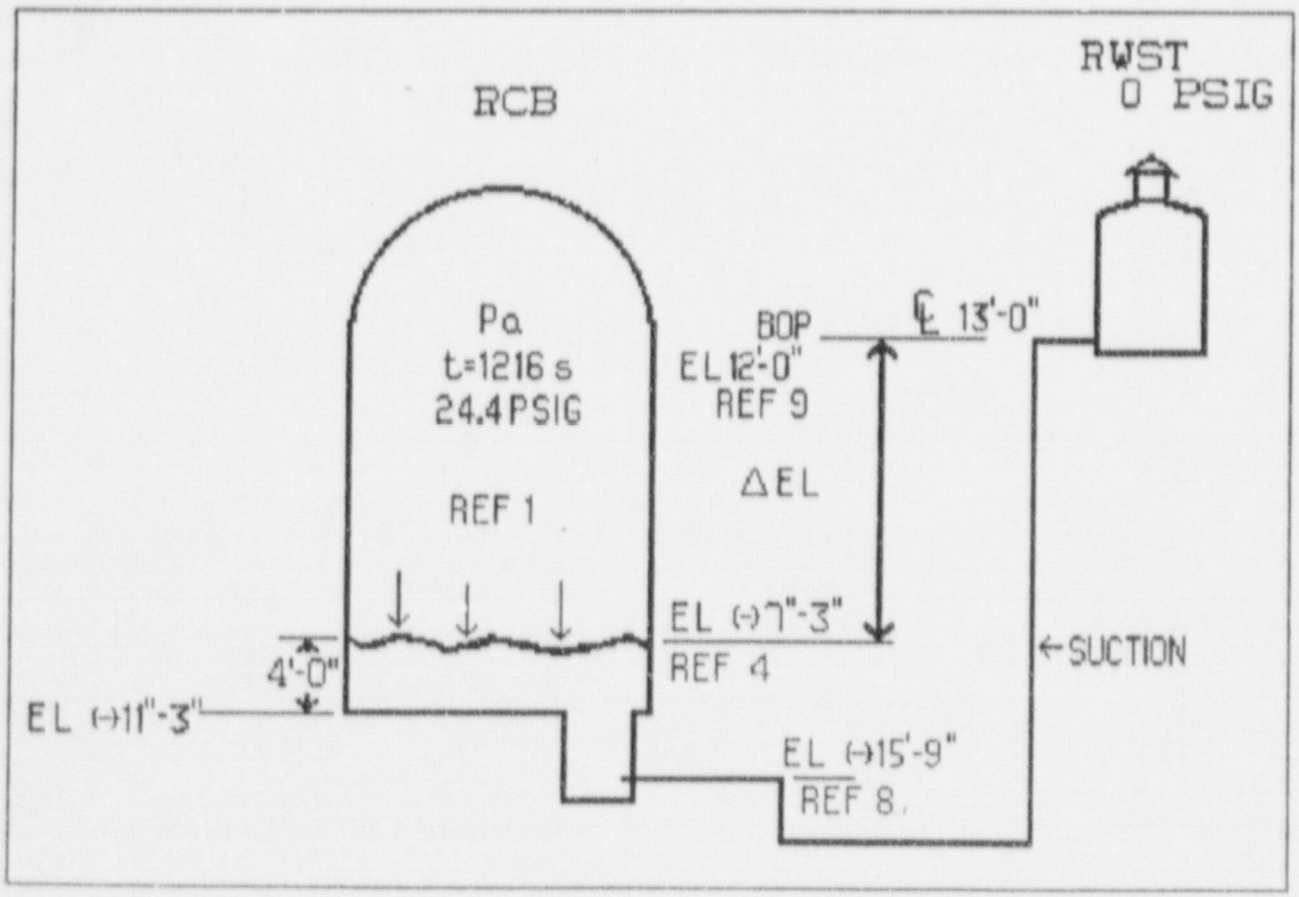
v	VELOCITY, ft/s
q	VOLUMETRIC FLOW RATE, ft^3/s
d	INTERNAL DIAMETER, ft
ft	FEET
L	LENGTH, ft
cc	CUBIC CENTIMETER
HR	HOUR
in	INCH
lb	POUND
PSI	lb/in^2
G	GAGE PRESSURE
A	ABSOLUTE PRESSURE
min	MINUTE
x	MULTIPLICATION

X. CALCULATION

A) DETERMINE CONTAINMENT ATMOSPHERIC PRESSURE EFFECT, DURATION AND AMOUNT OF LEAKAGE FOR SI-0001 UNDER DEGRADED CONDITIONS TO THE RWST:

AT START OF RECIRCULATION MODE, t = 1216 s (REF. 1, ATTACHMENT 1), THE FLOOD LEVEL, CONTAINMENT PRESSURE, AND SYSTEM ALIGNMENT ARE AS SHOWN BELOW:



1) DETERMINE HEAD REQUIRED TO FORCE WATER FROM SUMP INTO RWST:

ΔEL = EL OF BOTTOM OF SUCTION PIPE - EL FLOOD LEVEL

= 12.0 ft - (-7.25 ft) (ASSUMPTION 12)

ΔEL = 19.25 ft.

Pa = H / k = 19.25 ft/ 2.307 = 8.34 PSIG = 23.04 PSIA.

2) DETERMINE PRESSURE HEAD ON THE RCB SUMP AT t = 1216 s (REF. 1, SEE ATTACHMENT 1):

RECIRC SWITCHOVER OCCURS AT t = 1216 s (PAGE 19 OF REF. 1). RATHER THAN INTERPOLATE, IT IS CONSERVATIVE TO USE THE VALUE OF Pa AT t = 1210 s, WHICH IS SHOWN IN THE DCN.

BY INSPECTION OF PAGE 33 OF REF. 1 FOR t = 1210 s (SEE ATTACHMENT 1),

Pa (1210 s) = 39.1058 PSIA.

THEREFORE, CONTAINMENT PRESSURE CAN OVERCOME THE DIFFERENCE IN ELEVATION BETWEEN THE SUMP AND THE RWST IF THE ISOLATION VALVE LEAKS.

3) DETERMINE THE POINT IN TIME DURING THE ACCIDENT AT WHICH THE PRESSURE OF THE CONTAINMENT ATMOSPHERE IS REDUCED BELOW THE DIFFERENTIAL HEAD TO THE RWST:

RATHER THAN INTERPOLATE, IT IS CONSERVATIVE TO DETERMINE THE

PRESSURE AT THE FIRST TIME STEP AT WHICH THE CALCULATED Pa IS LESS THAN THE PRESSURE HEAD REQUIRED TO PUSH WATER INTO THE RWST.

BY INSPECTION OF PAGE 34 OF REF. 1 (SEE ATTACHMENT 1),

Pa (10099.98 s) = 22.8586 PSIA (< 23.04 PSIA).

THEREFORE, CONTAINMENT PRESSURE CAN NOT OVERCOME THE DIFFERENTIAL HEAD TO THE RWST IF THE ISOLATION VALVE LEAKS AFTER APPROXIMATELY 10100 s = 2.81 HOURS INTO THE ACCIDENT OR 2.81 - .34 = 2.47 HRS AFTER COMMENCEMENT OF RECIRCULATION.

4) DETERMINE THE DISTANCE SUMP WATER WILL TRAVEL PAST THE SUCTION LINE ISOLATION VALVE FARTHEST DOWN STREAM, SI-0001, IN 2.47 HRS (SEE FIGURE 1):

NOMINAL LINE DIAMETER IS 16" SCHEDULE 30 (REFS. 7, 8, 13), SO THAT FROM REF. 6,

$d = 15.250$ in

DEGRADED LEAK RATE = 8.0 cc/min (TABLE 2)

velocity = $v = 183.3\ q / d^2$ (REF. 6, EQ. 3-2)

WHERE q IS IN ft^3/s AND d IS IN in.

$q = 8.0$ cc/min

$= 8.0$ cc/min $(3.531 \times 10^{-5}\ ft^3/cc)$ $(1/60$ min/s$)$

$= 4.709 \times 10^{-6}\ ft^3/s$

$v = 183.3 \times (4.709 \times 10^{-6}\ ft^3/s) / (15.25\ in)^2$

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$= 3.71 \times 10^{-6}$ ft/s

$L = v\,T$

$= 3.71 \times 10^{-6}$ ft/s $\times$ 2.47 HRS $\times$ 3600 s/HR

$= 0.033$ ft.

THE CONCLUSION IS THAT THE IMPACT OF CONTAINMENT PRESSURE ON VALVE LEAKAGE TO THE RWST IS NEGLIGIBLE.

B) DETERMINE THE AMOUNT OF LEAKAGE PAST THE CS ISOLATION VALVE, CS-0008, UNDER DEGRADED CONDITIONS:

PER ASSUMPTIONS 13, 17 AND 18, THE CS PUMPS ARE OPERATED AT LEAST 6.5 HOURS INTO THE DBA BEFORE THEY ARE SECURED, AND LEAKAGE THROUGH THE CLOSED ISOLATION VALVE AFTER THE PUMP IS SECURED IS NEGLIGIBLE. PER REFERENCES 6, 7, 8, AND 13, AND FIGURE 2, FOR 6" DIAMETER SCHEDULE 40 PIPE,

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$d = 6.065$".

PER TABLE 2,

LEAKAGE RATE UNDER DEGRADED CONDITIONS = 3.0 cc/min

$v = 183.3\ q / d^2$

$= 183.3 \times 3.0$ cc/min $\times\ 3.531 \times 10^{-5}$ ft^3/cc $\times$ (1/60 min/sec) $/(6.065$ in$)^2$

$= 8.80 \times 10^{-6}$ ft/s

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SO THAT

$$L = v\,t = 8.80 \times 10^{-6}\ ft/s \times 6.5\ HR \times 3600\ s/HR$$

$$= .21\ ft.$$

THE CONCLUSION IS THAT EXCESSIVE VALVE LEAKAGE PAST THE CS ISOLATION VALVE IS NEGLIGIBLE UNDER THE CONDITION THAT THEY ARE SECURED AT APPROXIMATELY 6.5 HOURS INTO THE DBA.

△ DCN 95-03771

THE EMERGENCY OPERATING PROCEDURES FOR A DBA LLOCA MAY ALLOW FOR A CONTINGENCY TO OPERATE THE CS PUMPS FOR A LONGER PERIOD OF TIME, OR TO RESTART THE CS PUMPS. IN ORDER TO DETERMINE THE MAXIMUM TIME THE CS PUMPS CAN BE OPERATED BEFORE CONTRIBUTING TO THE SOURCE TERM, PER ASSUMPTION 18 FOR 10' 3" OF 6" DIAMETER SCHEDULE 40 PIPE, THE TRANSIT TIME FROM THE ISOLATION VALVE TO THE COMMON RETURN HEADER IS CALCULATED AS FOLLOWS:

$$t = L/v = 10.25'/(8.80 \times 10^{-6}\ ft/s) = 1.165 \times 10^{6}\ s$$

$$= 13.48\ DAYS$$

WHERE THE VALUE OF v WAS DETERMINED ABOVE.

C) DETERMINE THE MINIMUM ELAPSED TIME FROM THE BEGINNING OF THE RECIRCULATION PHASE DURING A LARGE BREAK LOCA ACCIDENT FOR LEAKAGE PAST THE HHSI AND LHSI ISOLATION VALVES, SI-0012 AND SI-0013, UNDER DEGRADED CONDITIONS, TO REACH THE RWST.

STP 361 (12-88)

SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER

GENERAL COMPUTATION SHEET

SUBJECT ECCS ISOLATION VALVE LEAK ANALYSIS
UNIT/s 1 & 2

CALC NO MC-6458 SHEET 24 OF

REV.	PREPARER/DATE	REVIEWER/DATE
1	BP Murphy 10/17/95	P Hardcastle 10/17/95

TO DETERMINE THE VOLUMETRIC MIGRATION TIME (ASSUMPTION 17) FOR THE SHORTEST PATH ("C" TRAIN HHSI AND HHSI/LHSI COMMON):

1) FOR HHSI (U2) @ 1.69' (6" DIA),

DEGRADED LEAKAGE RATE OF SI-0012 = 3.3 cc/min (TABLE 1)

$v = 183.3\ q/d^2$

$= 183.3 \times 3.3\ cc/min \times 3.531 \times 10^{-5}\ ft^3/cc \times (1/60\ min/sec) / (6.065\ in)^2$

$= 9.68 \times 10^{-6}\ ft/s$

$t = L/v = 1.69\ ft/(9.68 \times 10^{-6}\ ft/s) = 1.75 \times 10^5\ s$

$= 4.85$ HRS.

2) FOR HHSI/LHSI COMMON @ 70.60' (6" DIA),

DEGRADED LEAKAGE RATE OF SI-0012 AND SI-0013

$= 3.3\ cc/min + 3.3\ cc/min = 6.6\ cc/min$ (TABLE 1)

$v = 183.3 \times 6.6 \times 3.531 \times 10^{-5}\ ft^3/cc \times (1/60\ min/sec) / (6.065\ in)^2$

$= 1.94 \times 10^{-5}\ ft/s$

$t = 70.60\ ft/(1.94 \times 10^{-5}\ ft/s) = 3.64 \times 10^6\ s = 1010.88$ HRS.

THUS THE TOTAL TIME FOR THE LEAKAGE TO REACH THE COMMON RETURN BY THE SHORTEST PATH = 4.85 + 1010.88 = 1015.73 HRS

= 42.32 DAYS.

D) DETERMINE THE TOTAL LEAK RATE INTO THE RWST AT A DELAY TIME

DCP 95-7768-4
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STP 361 (12 88)

SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER

GENERAL COMPUTATION SHEET

SUBJECT ECCS ISOLATION VALVE LEAK ANALYSIS
UNIT/s 1&2

CALC NO MC-6458 SHEET 25 OF ___

REV.	PREPARER/DATE	REVIEWER/DATE
1	D P Murphy 11/16/95	P K Chelliah 11/17/95

OF 42.32 DAYS:

PER SECTION B, THE PATH THROUGH THE RWST SUCTION LINE AND THROUGH THE CS TEST LINES DO NOT REPRESENT A SIGNIFICANT LEAKAGE PATH TO THE RWST. THUS ONLY THE PATHS THROUGH THE HHSI AND LHSI RECIRC LINES, UNDER DEGRADED CONDITIONS, MAY RESULT IN LEAKAGE BACK TO THE RWST AFTER 42.32 DAYS.

TO SUMMARIZE:

LEAK PATH	RATED LEAKAGE cc/HR	DEGRADED LEAKAGE cc/HR
SI-0001,02	40	0
CS-0008	18	0
SI-0011,12	20	200
SI-0013,14	20	200
TOTAL, PER TRAIN		400

THUS THE TOTAL LEAKAGE INTO THE RWST FROM ALL THREE TRAINS IS 1200 cc/HR.

CALC NO MC-6458	SHEET 26	OF 31
REV.	PREPARER/DATE	REVIEWER/DATE
0	[illegible] 5/24/95	[illegible] 5/25/95

GENERAL COMPUTATION SHEET

ISOLATION VALVE LEAK ANALYSIS

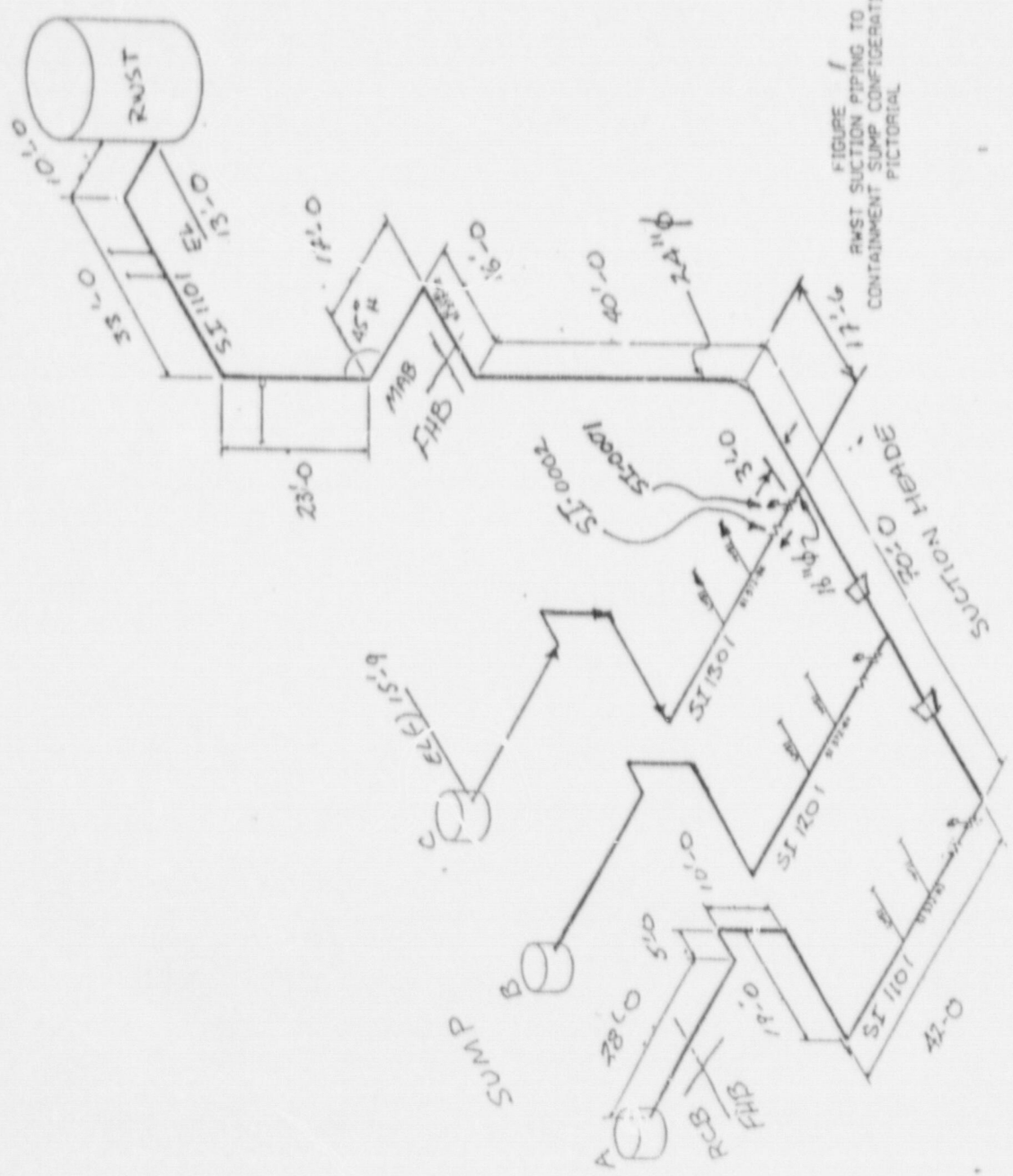

FIGURE 1
RWST SUCTION PIPING TO CONTAINMENT SUMP CONFIGERATION PICTORIAL

STP 261 (12-86)

SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER

GENERAL COMPUTATION SHEET

SUBJECT ECCS ISOLATION VALVE LEAK ANALYSIS
UNIT/s 1 & 2

CALC NO MC-6458 SHEET 28 OF 31

REV.	PREPARER/DATE	REVIEWER/DATE
0	P P Murphy 5/24/95	J S Coulter 5/25/95

TABLE 2
DETERMINATION OF LEAK RATE THROUGH ECCS VALVES

ITEM NO	VALVE					LEAK CRITERIA			
	Description	No	Spec No	Type	Size (Nom Dia)	Spec cc/in-HR	cc/Hr	cc/min	De-graded cc/min
1	RWST Suction Isolation	XSI-0002	Ref. 2	Check	16	3	48	0.80	8.0
2	RWST Suction Isolation	XSI-0001	Ref. 2	Gate	16	3	48	0.80	8.0
3	CS Test Line Isolation	XCS-0008	Ref. 2	Gate	6	3	18	0.30	3.0
4	HHSI Recirc Line Isolation	SI-0011 SI-0012	Ref. 3	Dia-phragm	2	10	20	0.33	3.3
5	LHSI Recirc Line Isolation	SI-0013 SI-0014	Ref. 3	Dia-phragm	2	10	20	0.33	3.3

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

NUMBER DCN NO. MC-00082 | REV. NO. N/A

CALCULATION NC7032, Rev. 4

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EFFECTIVE DATE 3-5-92

AFTER

BREAK	LOCA-1	LOCA-2	LOCA-3	LOCA-4	LOCA-5	LOCA-6
TYPE	DEPSG	DEPSG	DEHL	DECL	0.6 DEPSG	3FT² PSS
SI Operation	Min. ✓	Max. ✓	Max. ✓	Max. ✓	Max. ✓	Max ✓
CHRS	Min. ✓	Min ✓	Min. ✓	Min ✓	Min. ✓	Min ✓
(*) Sump Water Recirculation Switch Time (sec)	1586. ✓	DCN MC-82 1216 ~~1139.2~~ ✓	1139.2 ✓	1139.2 ✓	1139.2 ✓	1139.2 ✓
SI. Flow Rate (lbm/hr)	2.56×10⁶ ✓	3.89×10⁶	3.89×10⁶ ✓	3.89×10⁶ ✓	3.84×10⁶ ✓	3.84×10⁶ ✓
Spray Flow (lbm/hr)	1.888×10⁶	1.888×10⁶	1.888×10⁶	1.888×10⁶	1.888×10⁶	1.888×10⁶
Spray Flow a/f Recirc. (lbm/hr) (psig)	1.801×10⁶	1.801×10⁶	1.801×10⁶	1.801×10⁶	1.801×10⁶	1.801×10⁶
MAX. PRESSURE (psia)	37.86 / 52.06 ✓	40.52 ~~37.48~~ / ~~52.18~~ 55.22	36.79 / 51.49 ✓	30.48 / 45.18 ✓	36.77 / 51.47 ✓	36.04 / 50.74 ✓
Time of Max Pressure (sec)	82.6 ✓	82.6 ✓	89.3 ✓	16.05 ✓	82.6 ✓	82.6 ✓
Max. Temp. (°F)	307. ✓	313.1 ~~307.5~~	282. °F ✓	268.6 ✓	305.5 ✓	295. ✓
Time of Max Temp. (sec)	82.6 ✓	82.6 ✓	89.3 ✓	82.6 ✓	82.6 ✓	82.6 ✓
COPATTA Run. No.	~~X1101~~	DCN MC-82 8003 ~~X9009~~	X8115	X8816	X9010	X9012
Date	~~7/28/84~~	9/18/91 ~~7/28/84~~	7/28/84	7/28/84	7/29/84	7/29/84
~~Output File~~	~~LOCAOUT~~	~~LOCAOUT2~~	~~LOCAOUT3~~	~~LOCAOUT4~~	~~LOCAOUT5~~	~~LOCAOUT6~~
~~Plot File~~	~~LOCAPAT~~	~~LOCADATA2~~	~~LOCADATA3~~	~~LOCADATA4~~	~~LOCADATA5~~	~~LOCADATA6~~
~~Run File~~	~~JCLH6N~~	~~JOB2~~	~~JCL3~~	~~JCL4~~	~~JCL5~~	~~JCL6~~
~~(All on a tape~~	~~LOCATAPE 34927)~~					
DCN MC-82						

(*) USED FOR CALC MC-6458

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SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER

GENERAL COMPUTATION SHEET

SUBJECT CONT. LOCA P/T ANALS. UNIT 1s 1 & 2

CALC NO. NC7032 SHT A3-3 OF A3-91

REV.	PREPARER / DATE	REVIEWER / DATE

Time (sec.)	Vapor Temp. (deg. F)	Sump Temp. (deg. F)	Total Press. (psia)	Cond. Heat Trans. Coeff (Btu/hr-sqft-deg. F)
130.9998	259.399	209.405	53.2142	97.2666
135.9998	259.433	209.239	53.2433	97.3113
140.9998	259.124	210.004	53.0332	96.9909
145.9998	258.712	210.946	52.8	96.6057
150.9998	258.309	211.853	52.5541	96.2411
155.9998	257.928	212.712	52.3234	95.8951
160.9998	257.57	213.527	52.1069	95.5663
165.9998	257.232	214.301	51.9039	95.254
170.9998	256.912	215.039	51.7128	94.9571
174.9998	256.67	215.605	51.5684	94.7299
175.9998	256.611	215.743	51.5335	94.6746
180.9998	256.325	216.414	51.3643	94.4057
185.9998	256.055	217.055	51.2049	94.1497
190.9998	255.799	217.669	51.0544	93.9057
195.9998	255.556	218.256	50.9122	93.6731
200.9998	255.326	218.819	50.7777	93.4511
205.9998	255.107	219.359	50.6502	93.2391
210.9998	254.899	219.877	50.5297	93.0366
215.9997	254.774	220.391	50.4582	92.7823
220.9997	254.648	220.861	50.3858	92.651
224.9997	254.508	221.23	50.3051	92.5015
225.9997	254.51	221.318	50.2582	92.4697
230.9997	254.298	221.764	50.1849	92.2949
235.9997	254.199	222.183	50.0823	92.1312
240.9997	253.965	222.6	49.9948	91.9718
245.9997	253.857	222.991	49.8945	91.8239
254.9997	253.592	223.665	49.7829	91.5578
274.9997	253.049	225.463	49.4771	91.0367
279.9997	252.932	226.168	49.4114	90.9154
304.9997	252.41	229.449	49.121	90.368
329.9997	252.043	232.37	48.9197	89.9071
354.9997	251.669	234.99	48.7155	89.5102
379.9997	251.341	237.368	48.5384	89.1578
404.9997	251.054	239.521	48.3843	88.8439
429.9997	250.232	241.559	47.9365	88.0067
454.9997	249.364	243.426	47.4689	87.0575
479.9997	248.528	245.13	47.0237	86.1259
509.9997	247.563	246.985	46.5167	85.0265
609.9997	244.762	251.984	45.0856	81.4753
709.9997	242.018	255.659	43.7374	78.0554
809.9997	239.512	258.438	42.5525	74.7363
909.9996	237.217	260.583	41.5062	71.5313
1010	235.116	262.274	40.5798	68.4413
1110	233.367	263.639	39.8334	65.4817
1210	231.618	264.759	39.1058	62.8476
1310	231.241	264.395	38.9479	62.5631
1410	230.593	263.886	38.6767	62.0672
1510	229.923	263.379	38.3984	61.547
1530	229.786	263.278	38.3419	61.4398
1610	229.231	262.874	38.1142	61.0027

USE FOR RECIRC SWITCH-OVER FOR CALC MC-6458

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SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION
HOUSTON LIGHTING & POWER

GENERAL COMPUTATION SHEET

SUBJECT CONT. LOCA P/T ANALS. UNIT 1s 1 & 2

CALC NO. NC7032 SHT A3-9 OEA3-91

REV.	PREPARER / DATE	REVIEWER / DATE

Time (sec.)	Vapor Temp. (deg. F)	Sump Temp. (deg. F)	Total Press. (psia)	Cond. Heat Trans. Coeff (Btu/hr-sqft-deg. F)
1710	228.522	262.371	37.8258	60.4365
1810	227.795	261.868	37.5333	59.8485
1910	227.062	261.367	37.2411	59.2436
2025	226.214	260.792	36.9075	58.5099
2524.999	222.797	258.31	35.6028	55.5281
3024.999	219.887	255.941	34.5425	52.5327
3524.999	216.926	253.63	33.5091	49.5402
4024.998	213.689	251.393	32.4306	46.0891
4524.997	207.443	248.965	30.4926	42.0216
5024.996	203.02	246.399	29.2276	38.8744
5524.995	199.17	243.823	28.2051	36.2945
6024.995	195.753	241.311	27.3379	34.4054
6524.994	192.359	238.888	26.5213	32.4229
7024.993	189.074	236.554	25.7714	30.3468
7524.991	185.841	234.308	25.0707	28.5973
8024.99	182.961	232.027	24.4763	27.6706
8524.988	180.486	229.682	23.9869	26.8215
9024.986	178.341	227.347	23.5783	26.0429
9524.984	176.447	225.035	23.2289	25.2852
10099.98	174.373	222.431	22.8586	24.4536
10599.98	170.83	218.235	22.2541	23.3575
11599.98	169.258	216.252	21.997	22.9241
12099.98	167.854	214.341	21.7744	22.5265
13099.98	165.398	210.733	21.3928	21.7723
14099.98	163.159	207.389	21.0594	21.0576
15099.98	161.179	204.284	20.7746	20.5938
16099.98	159.679	202.303	20.5649	20.2407
17099.97	159.174	198.187	20.4954	20.1193
18099.97	157.975	195.389	20.3329	19.8236
19099.97	156.729	192.818	20.1674	19.4941
20099.97	155.103	190.516	19.9564	19.0621
21099.97	153.201	188.662	19.7167	18.5356
22099.97	152.012	186.935	19.5705	18.192
23099.96	151.047	185.352	19.454	17.9047
24099.96	150.206	183.901	19.354	17.6482
25099.96	149.438	182.567	19.2638	17.4087
26099.96	148.703	181.327	19.1786	17.1751
27099.96	148.143	180.142	19.1143	16.9852
28099.96	147.408	179.053	19.031	16.8756
29099.95	146.764	178.044	18.9586	16.759
30099.95	146.16	177.085	18.8916	16.6558
31099.95	145.729	176.143	18.844	16.5813
32099.94	145.159	175.254	18.7818	16.4806
33099.94	144.611	174.427	18.7225	16.383
34099.94	144.135	173.627	18.6714	16.2969
35099.93	143.681	172.854	18.623	16.2136
36099.93	143.238	172.104	18.5762	16.1313
37099.92	142.809	171.373	18.5311	16.0507
38099.92	142.392	170.66	18.4877	15.9715
39099.92	141.989	169.962	18.4459	15.894

(*) $t \cong 10100$ s when pressure falls below 19.25 f. (23.04 PSIA)

Use for calc MC-6458

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