CALCULATION TITLE PAGE

PROJECT San Onofre ~~Units~~ 2 & 3 JOB ORDER NO. N/A DISCIPLINE Mechanical

SUBJECT: Diesel Generator Fuel Oil Tank S2(3)2421MT035(36) Size Calculation

CALCULATION NO.: DC-M-15.6 QUALITY CLASS II NO. PAGES 22

RESPONSIBLE ENGINEER (signature) [signature] DATE 1/20/85

INDEPENDENT REVIEW ENG. (signature) [signature] DATE 2/1/85

ORIGINAL ISSUE

	NAME	DATE	SIGNATURE
GROUP LEADER	T. Herring III	2/7/85	[signature]
DISCIPLINE SUP. ENGR.	K.L. Johnson		
PROFESSIONAL ENGR. (if required)			

RECORD OF REVISIONS

NO.	REASON FOR REVISION	DATE	RESP. ENGR.	IRE	GL	DSE	PE

PROFESSIONAL ENGINEER'S SEAL

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. _____ MADE BY M.A. Herschthal DATE 1/24/85 CHK. BY [illegible] DATE 1/30/85

Purpose:

The purpose of this calculation is to conservatively calculate the fuel oil consumption of an emergency diesel generator for seven days of dual unit service in the event of a total loss of offsite power to both Units 2 and 3 and a LOCA on one unit. The calculation will be used to determine if the fuel oil tanks currently installed, S2(3)2421MT035(036), have sufficient capacity to support a design change as specified by Work Request 6094. This change would qualify one diesel generator for shared unit duty per Reg Guide 1.81.

Summary:

Sufficient capacity in one diesel generator fuel oil storage tank exists to supply the required diesel generator loads per ANSI-N-195 while the diesel is selected for shared unit duty. The worst case accident resulted in a calculated amount of fuel oil per ANSI-N-195 of 46,964.7 gallons. Therefore, the current tank size of 55,000 gallons and technical specification minimum of 47,000 gallons will continue to be adequate for a diesel used for shared unit service.

References:

A) SO23-SPE-017, Diesel Generator Capacity Test

B) SO23-3-3.12, Integrated ESF Refueling Test

C) Regulation Guide 1.81, Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

D) ANSI-N-195, Fuel Oil Systems for Standby Diesel Generators

E) Work Request 6094

Calculation:

ANSI-N-195 requires sufficient class one on-site oil storage for emergency diesel generators for seven days. The fuel oil storage capacity shall be calculated based upon "the diesel generator operating at the minimum

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CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. MADE BY T.S. Hesselton DATE 1/24/85 CHK. BY [illegible] DATE 4/30/85

required capacity for the plant condition which is most limiting for the calculation of such capacity. A 10% margin is added to the capacity for conservatism." Train A is used for the calculation since this train has the largest diesel load.

The Loss of Coolant Accident (LOCA) concurrent with a Loss of Offsite Power (LOOSP) on one unit plus a LOOSP on another unit is the limiting load profile a diesel will have to supply during shared unit duty.

The loss of electric power accident is described in FSAR section 15.3.2.1. The worst case diesel loading for this accident is clear. The worst case loading for the LOCA, which is described in FSAR section 15.6.3.3, is not clear. A diesel generator load profile for a large break LOCA with loss of electric power on one unit plus a loss of electrical power on the other unit (case 1) and a small break LOCA with loss of electric power on one unit plus a loss of electrical power on the other unit (case 2) will be calculated.

CASE I

The diesel generator loading for case 1 is illustrated in figure 1. The initial load on the diesel for the large break LOCA is assumed to be ~5100 kw as determined by the calculations attached to Work Request 6094. It is assumed the Emergency Core Cooling System (ECCS) pumps are initially at their maximum rated flow.

At 30 minutes after the initiating transient or, t=0.5 hrs., the operator secures the LPSI pump on the LOCA unit (-373 kW).

At t=1.5 hrs., the operator will connect the non-1E loads to the emergency bus which were initially disconnected on a LOOSP concurrent with a Safety Injection Actuation Signal (SIAS). Specifically, the Technical Support Center (TSC) UPS (+10 kW), the health physics computer UPS (+10 kW) and the non-1E instrument bus UPS (+50 kW) are connected to the emergency bus on the LOOSP unit.

At t=2 hrs., the operator performs the following evolution on a LOCA unit: 2 charging pumps are secured (-102 kW), one hydrogen recombiner (+75 kW) is

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energized, one auxiliary feedwater pump is throttled from full load (-206 kW) and one spent fuel pool pump and its associated room cooler is placed in-service (+23.5 kW). In addition, one spent fuel pool cooling pump and its room cooler (+23.5kw) is placed in service and throttles one auxiliary feedwater pump (-206 kW) on the LOOSP unit.

It is conservatively assumed that the heat sink on the LBLOCA unit are the steam generators until t=6hrs. At this time, the operator will secure the auxiliary feedwater pump on the LOCA unit (-450 kW) in addition to securing the two boric acid makeup pumps (-42 kW).

At t=24 hrs., the LOOSP is assumed to have cooled down to shutdown cooling conditions. At this time the operator secures the auxiliary feedwater pump (-450 kW), 2 charging pumps (-102 kW), secures the pressurizer 1E heaters (-200 kW), and starts one LPSI pump (+373 kW) on the LOOSP unit. This leaves a load of 3584 kW on the diesel generator for the following six days. This load is very conservative as it is assumed that all ESF loads remain in service at their rated capacity for the entire 7 days other than those mentioned above. The fuel consumption calculation and load profile in tabular form is shown on Table 1. The calculated fuel oil consumed is 41,324.4 gallons.

Multiplying this number by 1.10 as required by ANSI-N-145 gives 45,456.8 gal. This is less than the current 47,000 gal technical specification limit.

CASE II

The diesel generator loading for case 2 is illustrated in Figure 2 and Table 2. The initial load on the diesel is conservatively assumed to be the maximum load as determined by the calculations attached to the Work Request minus 123 kW since the LPSI pump on the LOCA unit will be initially on minimum flow. The initial load on the diesel in this case is 4977 kW.

At t=0.5 hrs., the operator again secures the LPSI pump (-250 kW) on the LOCA unit.

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CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. _____ MADE BY [illegible] DATE 1/24/85 CHK. BY [illegible] DATE 2/1/85

At t=1.5hrs., the operator will connect the TSC UPS (+10 kW), the health physics computer UPS (+10 kW), and the non 1E instrument bus UPS (+50 kW) to the emergency bus on the LOCA unit. Also, the operator will connect the non 1E instrument bus UPS (+50 kW) to the emergency bus on the LOOSP unit.

At t=2 hrs., the operator again performs the following on the LOCA unit: secures two charging pumps (-102 kW), energizes the hydrogen recombiner (+75 kW) throttles one AFW pump (-206 kW), and places a spent fuel pool cooling pump and its associated room cooler in service (+23.5 kW). In addition, the operator will throttle the auxiliary feedwater pump (-206 kW) and place the spent fuel pool pump and its room cooler (+23.5 kW) in service on the LOOSP unit.

At t=6hrs. the operator will secure two boric acid makeup pumps (-42 kW) on the LOCA unit.

At t=24 hrs. it is assumed that shutdown cooling will be placed in service on both units. Both auxiliary feedwater pumps will be secured (-900 kW), two LPSI pumps will be placed in service (+746 kW), two charging pumps will be secured (-102 kW) on the LOOSP unit, and the pressurizer non 1E heaters will be secured (-200 kW) on the LOOSP unit. Once shutdown cooling is placed in service, the HPSI pump, which is now being used for recirculation on the LOCA unit, is throttled to 90% of its design capacity (-44 kW). In addition, it is conservatively assumed that for the remainder of the seven day period that the containment spray pump will be utilized 20% of the time for recirculation of the containment emergency sump (-266kw).

As can be seen from Table 2, the diesel then runs for the next six days at 3647 kW load. The total fuel oil consumed is 42,461.7 gallons. Multiplying this number by 1.10 as required by ANSI-N-195 gives 46,707.9 gallons. Again, this is less than the current 47,000 gallon technical specification minimum.

DWG. NO.

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. _____ MADE BY [signature] DATE 1/24/85 CHK. BY [signature] DATE 1/30/85

FUEL OIL REQUIRED FOR ROUTINE TESTING

ANSI-N-195 also requires sufficient tank capacity for routine diesel generator testing. Testing the diesel at the 4700 kW rated load for 4 hours would constitute sufficient testing capacity. This would require an additional 4 hours x 60 min/hour x 5.25 gal/min = 1260 gallons. The fuel oil required for testing need not be included in the basis for the technical specification fuel oil capacity. The technical specifications valve should include the fuel oil required to mitigate the design basis event plus conservatisms.

MH025

DWG. NO.

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. _____ MADE BY [signature] DATE 1/24/85 CHK. BY [signature] DATE 1/30/85

TABLE 1
Diesel Generator Load Table
Case-I, Large Break LOCA (1 Unit)
And Loss of Offsite Power (2 Units)

EVENT/OPERATOR ACTION	TIME	D/G LOAD
LBLOCA (1 Unit) + LOOSP (2 Units)	0 Hrs	5100 kW
Secure 1 LPSI Pp. (LOCA Unit)	0.5 Hrs	-373 kW 4727 kW
Energize TSC UPS, HP Computer UPS, and 2 Non 1-E UPS	1.5 Hrs	+10 kW +10 kW +100 kW 4847 kW
Secure 2 Charging Pps. (LOCA Unit), Energize 1 H Recombiner (LOCA Unit), Throttle 2 AFW Pps., Energize 2 Spent Fuel Pool Pps., Energize 2 Spent Fuel Pool Pp. Coolers	2.0 Hrs	-102 kW +75 kW -412 kW +46 kW +1 kW 4455 kW
Secure 1 AFW Pp (LOCA Unit) Secure 2 BAMU Pps (LOCA Unit)	6.0 Hrs	-450 kW -42 kW 3963 kW
Secure 1 AFW Pp, 2 Charging Pps, Start 1 LPSI Pp, Secure PZR Heaters	24.0 Hrs	-450 kW -102 kW +373 kW -200 kW 3584 kW

LOAD	FUEL COMSUMPTION RATE *		TIME		FUEL CONSUMED
5100 kW	5.693 gpm	x	30 min	=	170.8 gal
4727 kW	5.280 gpm	x	60 min	=	316.8 gal
4847 kW	5.413 gpm	x	30 min	=	162.4 gal
4455 kW	4.979 gpm	x	240 min	=	1195.0 gal
3963 kW	4.435 gpm	x	1080 min	=	4789.8 gal
3584 kW	4.015 gpm	x	8640 min	=	34689.6 gal
			TOTAL	=	41324.4 gal
			x 1.10	=	45456.8 gal

* Extrapolated/Interpolated based on 3.95 gpm consumption @ 3525 kW and 5.25 gpm consumption at 4700 kW.

DWG. NO.

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. _____ MADE BY [signature] DATE 1/24/85 CHK. BY [signature] DATE 2/1/85

TABLE 2
Diesel Generator Load Table
Case-II, Small Break LOCA (1 Unit)
And Loss of Offsite Power (2 Units)

EVENT/OPERATOR ACTION	TIME	D/G LOAD	
SBLOCA (1 Unit) + LOOSP (2 Units)	0 Hrs	4977 kW	✓
Secure 1 LPSI Pp. (LOCA Unit)	0.5 Hrs	-250 kW	✓
		4727 kW	✓
Energize TSC UPS, HP Computer UPS,	1.5 Hrs	+10 kW	✓
and 2 Non 1-E UPS		+10 kW	✓
		+100 kW	✓
		4847 kW	✓
Secure 2 Charging Pps. (LOCA Unit),	2.0 Hrs	-102 kW	✓
Energize 1 H Recombiner (LOCA Unit),		+75 kW	✓
Throttle 2 AFW Pps., Energize 2		-412 kW	✓
Spent Fuel Pool Pps., Energize 2		+46 kW	✓
Spent Fuel Pool Pp. Coolers		+1 kW	✓
		4455 kW	✓
Secure 2 BAMU Pps (LOCA Unit)	6.0 Hrs	-42 kW	✓
		4413 kW	✓
Containment Spray Pp Used 20% (LOCA Unit)	24.0 Hrs	-266 kW	✓
Secure PZR Heaters, Secure 2 Charging		-200 kW	✓
Pps (Both LOOSP Unit), Secure 2 AFW Pps,		-102 kW	✓
Start 2 LPSI Pps., Throttle 1 HPSI Pp.		-900 kW	✓
(LOCA Unit)		+746 kW	✓
		-44 kW	✓
		3647 kW	✓

LOAD	FUEL COMSUMPTION RATE *		TIME		FUEL CONSUMED	
4977 kW ✓	5.556 gpm	x	30 min	=	166.7	gal ✓
4727 kW ✓	5.280 gpm	x	60 min	=	316.8	gal ✓
4847 kW ✓	5.413 gpm	x	30 min	=	162.4	gal ✓
4455 kW ✓	4.979 gpm	x	240 min	=	1195.0	gal ✓
4413 kW ✓	4.932 gpm	x	1080 min	=	5326.6	gal ✓
3647 kW ✓	4.085 gpm	x	8640 min	=	35294.2	gal ✓
			TOTAL	=	42461.7	gal ✓
			x 1.10	=	46707.9	gal ✓

* Extrapolated/Interpolated based on 3.95 gpm consumption @ 3525 kW and 5.25 gpm consumption at 4700 kW.

DWG. NO.

ENGINEERING DEPARTMENT

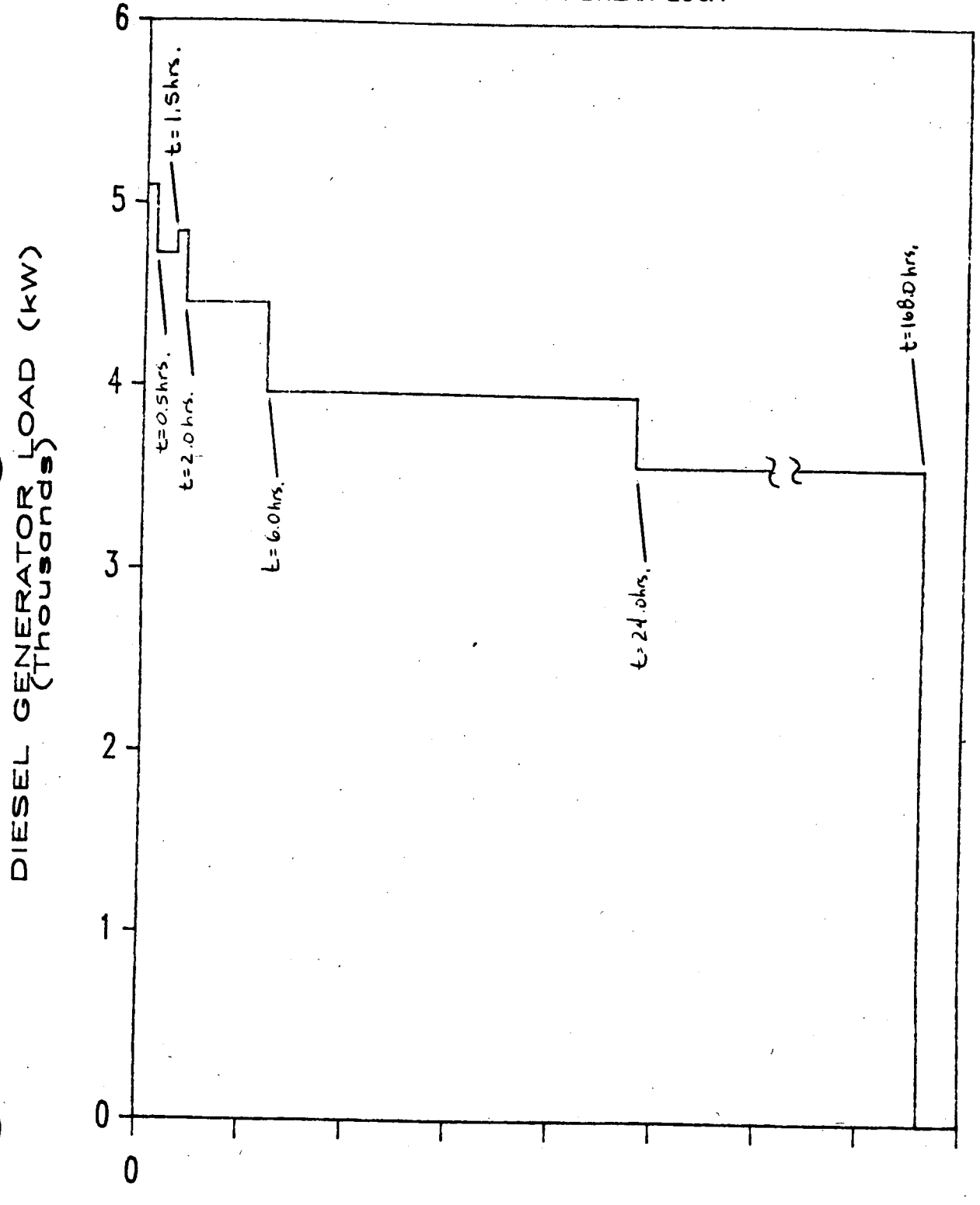
CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. _____ MADE BY [signature] DATE 1/24/85 CHK. BY SDR DATE 2/1/85

7 DAY DIESEL GENERATOR LOAD PROFILE

CASE 1 LARGE BREAK LOCA



ENGINEERING DEPARTMENT

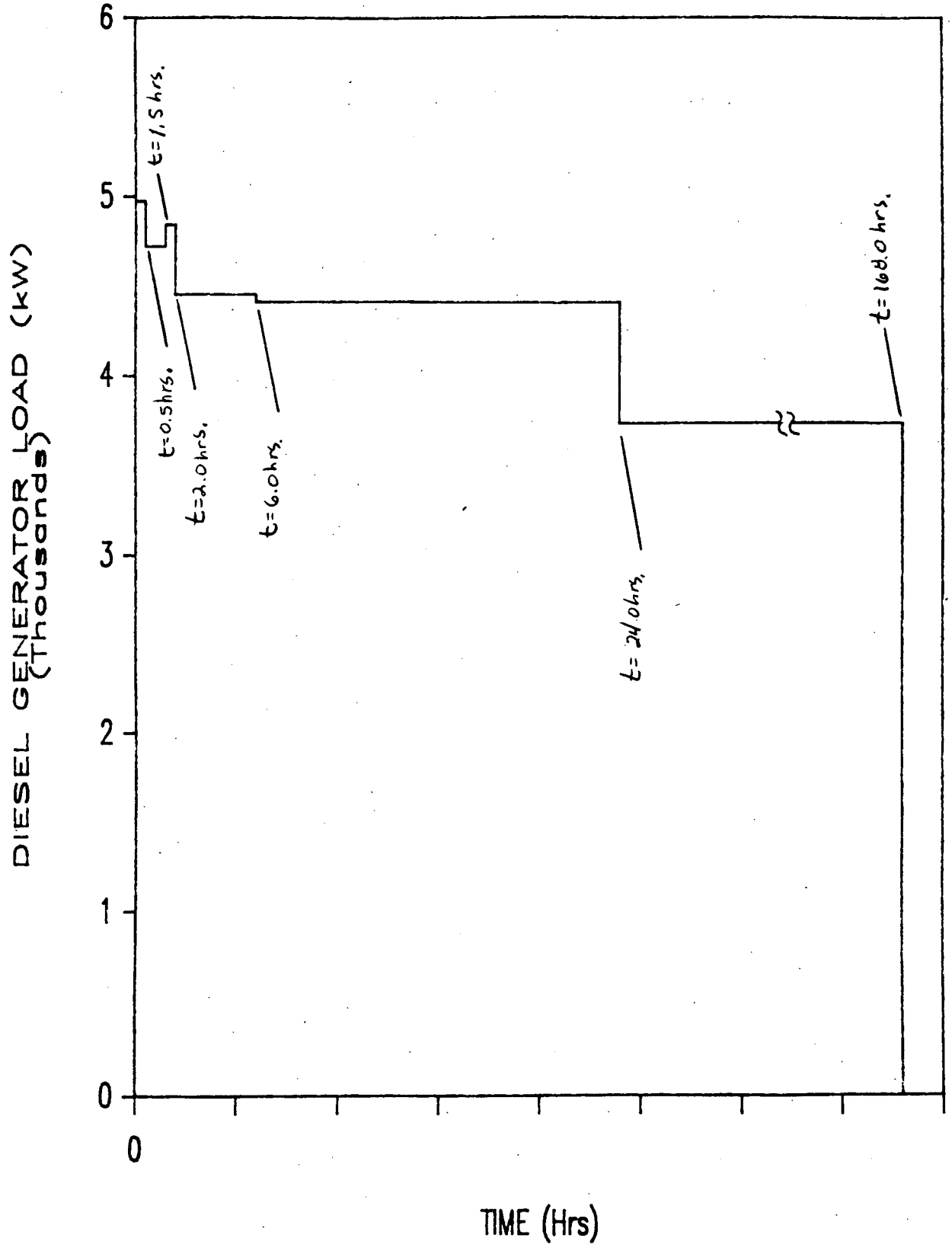
CALCULATION SHEET

SUBJECT: DIESEL GENERATOR FUEL OIL STORAGE TANK SIZE ANALYSIS DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. _____ MADE BY M. Kerabolos DATE 1/24/95 CHK. BY SDR DATE 2/1/95

7 DAY DIESEL GENERATOR LOAD PROFILE

CASE 2 SMALL BREAK LOCA



ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: DIESEL GENERATOR FUEL OIL STORAGE TANK SIZE ANALYSIS DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. _____ MADE BY [signature] DATE 1/24/95 CHK. BY [signature] DATE 2/1/95

FUEL CONSUMPTION TEST

TEST TITLE: FUEL CONSUMPTION TEST - 4.12.1 PARA. D.

OBJECTIVE: To accurately determine fuel consumption as a function of Generator Load.

DESCRIPTION OF TEST: Fuel Consumption to be measured and recorded at 0, 25, 75 and 100% load by means of turbine flow meters and the resulting data ultimately expressed in terms of LBS/BHPH.

ACCEPT/REJECT CRITERIA: All loads will be maintained ± 5%. Engine speed shall be the speed corresponding to an output of 60 Hz, as maintained by the governor.

TECH. ED. [illegible]

403-12-251-A1

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. _____ MADE BY MMersdorf DATE 1/24/85 CHK. BY SOR DATE 2/1/85

FUEL CONSUMPTION TEST

PROCEDURE:

1. START THE SSDG SET AND BRING IT UP TO RATED SPEED AND VOLTAGE, NO LOAD.
2. OPERATE IN THIS MODE UNTIL THERMAL EQUALIZATION OCCURS.
3. WHILE OPERATING AT RATED SPEED AND VOLTAGE, ZERO (0) LOAD, MEASURE FUEL CONSUMPTION AND COMPLETE THE RECORD SHEETS.
4. INCREASE LOAD TO 25% (1175 KW) AND COMPLETE THE ASSOCIATED RECORD SHEETS.
5. INCREASE LOAD TO 50% (2350 KW) AND COMPLETE THE ASSOCIATED RECORD SHEETS.
6. INCREASE LOAD TO 75% (3525 KW) AND COMPLETE THE ASSOCIATED RECORD SHEETS.
7. INCREASE LOAD TO 100% (4700 KW) AND COMPLETE THE ASSOCIATED RECORD SHEETS.
8. REMOVE LOAD AND RUN AT RATED SPEED AND VOLTAGE UNTIL TEMPERATURES STABILIZE, THEN SHUT THE UNIT DOWN.

BECHTEL 471

403-12-251-81

ILD

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA

CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW. 3 PHASE. 60 HERTZ. 0.8 PF. 4160 VOLT
SERVICE

STEWART & STEVENSON

OFFICIAL TEST RECORD

BECHTEL A71

FUEL CONSUMPTION TEST

JOB NO. N73402
METHOD NO. STEWART & STEVENSO
DATE 29 June 79
TESTED BY
CALC. BY
CHECKED BY
GOV'T. INSP.

ENGINE LOAD 0 %

ENGINE LOAD 0 KW

FUEL FLOW

80218
80214 A. IN - FREQUENCY 1100 / 1250 Hz = 8.22 G.P.M.

80216
80215 B. OUT - FREQUENCY 1021 / 1049 Hz = 7.28 G.P.M.

FUEL CONSUMPTION

A. G.P.M. IN = 8.22

B. G.P.M. OUT = 7.28 LBS. OF FUEL USED = G.P.M. x MIN. x 7.15 = 6.721 LBS

FUEL CONSUMPTION = 0.94 G.P.M.
(A-B)

403-12-257-8

ENGINEERING DEPARTMENT
CALCULATION SHEET

SUBJECT Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. MADE BY [redacted] DATE 1/24/85 CHK. BY [redacted] DATE 2/1/85

SHEET 13 OF 22 SHEETS

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16B

REVISION E

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. _____ MADE BY MMKedrolowicz DATE 1/24/85 CHK. BY SDC DATE 2/1/85

OFFICIAL TEST RECORD

STEWART & STEVENSON

BECHTEL 471

FUEL CONSUMPTION - CALCULATION SHEET

JOB NO. N73402
METHOD NO. _____
DATE _____
TESTED BY _____
CALC. BY _____
CHECKED BY _____
GOV'T. INSP. _____

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO. _____
MODEL NO. _____
SERIAL NO. _____
RATING 4700 KW, 3 PHASE, 60 HZ
0.8 PF, 4160 VOLTS
SERVICE _____

0% LOAD 0 KW LENGTH OF TIME OF TEST 1 MIN. 000 SEC. FUEL USED 0.94 G

FUEL USED LBS. (GAL. X 7.15 @ 19,350 B.T.U.)

HOURS = (MIN X 60 SEC/MIN) + SEC / 3600 SEC/HOUR

= 1 X60 + 0 / 3600

= 0.0166 HOURS

KWH = KW X HOURS

= 0 X 0.1666

= 0 KWH.

LBS/BHPH = LBS/KWH ÷ 1.341

= 0 ÷ 1.341

= 0 LBS/BHPH

LBS/KWH = LBS ÷ KWH

= 6.721 ÷ 0

= 0 LBS/KWH

42

16C 403-12-251-8 REVISION E

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SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW, 3 PHASE, 60 HERTZ, 0.8 PF, 4160 VOLT
SERVICE

STEWART & STEVENSON

OFFICIAL TEST RECORD

FUEL CONSUMPTION TEST

BECHTEL 471

JOB NO. N73402
METHOD NO. STEWART & STEVENSO
DATE 21 June 78
TESTED BY [illegible]
CALC. BY [illegible]
CHECKED BY [illegible]
GOV'T. INSP.

ENGINE LOAD 25 %

ENGINE LOAD 1175 KW

FUEL FLOW

A. IN - FREQUENCY 1204 / 1249 Hz = 8.23 G.P.M.

B. OUT - FREQUENCY 913 / 900 Hz = 6.33 G.P.M.

80218 80214 80216 80215

FUEL CONSUMPTION

A. G.P.M. IN = 8.23

B. G.P.M. OUT = 6.33 LBS. OF FUEL USED = G.P.M. x MIN. x 7.15 = 13.585 LBS

FUEL CONSUMPTION = 1.90 G.P.M.
(A-B)

403-12-251-81

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REVISION E

ENGINEERING DEPARTMENT
CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO.

MADE BY [illegible] DATE 11/24/85 CHK. BY [illegible] DATE 11/85

SHEET 5 OF 22 SHEETS

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW, 3 PHASE, 60 HZ
0.8 PF, 4360 VOLTS
SERVICE

STEWART & STEVENSON

OFFICIAL TEST RECORD

BECHTEL 471

FUEL CONSUMPTION - CALCULATION SHEET

JOB NO. N73402
METHOD NO.
DATE 29 June 77
TESTED BY
CALC. BY
CHECKED BY
GOV'T. INSP.

25% LOAD 1125 KW LENGTH OF TIME OF TEST 1 MIN. 000 SEC. FUEL USED 1.90 G

FUEL USED LBS. (GAL. X 7.15 @ 19,350 B.T.U.)

HOURS = (MIN X 60 SEC/MIN) + SEC / 3600 SEC/HOUR

= (1 X60 + 0) / 3600

= 0.01666 HOURS

KWH = KW X HOURS

= 1125 X 0.01666

= 19.5755 KWH.

LBS/KWH = LBS ÷ KWH

= 13.585 ÷ 19.5755

= 0.6939 LBS/KWH

LBS/BHPH = LBS/KWH ÷ 1.341

= 0.6939 ÷ 1.341

= 0.5175 LBS/BHPH

ENGINEERING DEPARTMENT
CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. MADE BY DATE 11/24/15 CHK. BY DATE 2/11/15

SHEET 16 OF 22 SHEETS

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16E 1122 12 251-8 REVISION E

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. ______ MADE BY [signature] DATE 1/24/85 CHK. BY SDR DATE 2/1/85

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO. ______
MODEL NO. ______
SERIAL NO. ______
RATING 4700 KW, 3 PHASE, 60 HERTZ, 0.8 PF, 4360 VOLT
SERVICE ______

STEWART & STEVENSON

OFFICIAL TEST RECORD

BECHTEL 471

JOB NO. N73402
METHOD NO. STEWART & STEVENSON
DATE 25 June 79
TESTED BY [signature]
CALC. BY [signature]
CHECKED BY [signature]
GOV'T. INSP. ______

Q.C. 3311

FUEL CONSUMPTION TEST

ENGINE LOAD 50 %

ENGINE LOAD 2350 KW

FUEL FLOW

80218, 80214, 80216, 80215

A. IN - FREQUENCY 1215 1264 Hz = 8.31 G.P.M.

B. OUT - FREQUENCY 730 820 Hz = 5.32 G.P.M.

FUEL CONSUMPTION

A. G.P.M. IN = 8.31

B. G.P.M. OUT = 5.32

LBS. OF FUEL USED = G.P.M. x MIN. x 7.15 = 21.375 LBS.

FUEL CONSUMPTION (A-B) = 2.99 G.P.M.

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW, 3 PHASE, 60 HZ
0.8 PF, 4360 VOLTS
SERVICE

STEWART & STEVENSON

JOB NO. N73402
METHOD NO.
DATE 12-Jun-78
TESTED BY
CALC. BY
CHECKED BY
GOV'T. INSP.

OFFICIAL TEST RECORD

BECHTEL 471

FUEL CONSUMPTION - CALCULATION SHEET

Q.C. 8511 G-2

50% LOAD 2350 KW LENGTH OF TIME OF TEST 1 MIN. 000 SEC. FUEL USED 2.96 GAL
FUEL USED LBS. (GAL. X 7.15 @ 19,350 B.T.U.)

HOURS = (MIN X 60 SEC/MIN) + SEC / 3600 SEC/HOUR

= (1 X60 + 0) / 3600

= 0.01666 HOURS

KWH = KW X HOURS

= 2350 X 0.01666

= 39.151 KWH.

LBS/KWH = LBS ÷ KWH

= 21.378 ÷ 39.151

= 0.5460 LBS/KWH

LBS/BHPH = LBS/KWH ÷ 1.341

= 0.5460 ÷ 1.341

= 0.4071 LBS/BHPH

ENGINEERING DEPARTMENT
CALCULATION SHEET

SUBJECT Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO.
MADE BY DMK DATE 12/4/85
CHK. BY SDC DATE 2/11/85

SHEET 18 OF 22 SHEETS

REVISION E

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. ______ MADE BY MSMerzlubb DATE 1/24/85 CHK. BY [illegible] DATE 2/1/85

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA

CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW, 3 PHASE,
60 HERTZ, 0.8 PF, 4360 VOLT

SERVICE

STEWART & STEVENSON

OFFICIAL TEST RECORD

FUEL CONSUMPTION TEST

BECHTEL 471

JOB NO. N73402
METHOD NO. STEWART & STEVENSON
DATE 27 June 78
TESTED BY [signature]
CALC. BY [signature]
CHECKED BY [signature]
GOV'T. INSP.

Q.C. 5311 6-29-78

ENGINE LOAD 75 %

ENGINE LOAD 3525 KW

FUEL FLOW

80218
80214
80216
80215

A. IN - FREQUENCY 1200 / 1270 Hz = 8.28 G.P.M.

B. OUT - FREQUENCY 340 / 700 Hz = 4.33 G.P.M.

FUEL CONSUMPTION

A. G.P.M. IN = 8.28

B. G.P.M. OUT = 4.33

LBS. OF FUEL USED = G.P.M. x MIN. x 7.15 = 28,242 LBS.

FUEL CONSUMPTION (A-B) = 3.95 G.P.M.

REVISION E

117 1103 12 2514 16H

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis   DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. ______ MADE BY [signature] DATE 1/24/85   CHK. BY [initials] DATE 2/1/85

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO. ______
MODEL NO. ______
SERIAL NO. ______
RATING 4700 KW, 3 PHASE, 60 HZ
0.8 PF, 4360 VOLTS
SERVICE ______

STEWART & STEVENSON

OFFICIAL TEST RECORD

JOB NO. N73402
METHOD NO. ______
DATE 25 June 79
TESTED BY [signature]
CALC. BY [signature]
CHECKED BY [signature]
GOV'T. INSP. ______

BECHTEL 471

Q.C. 8311 6-24-

FUEL CONSUMPTION - CALCULATION SHEET

75% LOAD 3525 KW   LENGTH OF TIME OF TEST 1 MIN. 00 SEC.   FUEL USED 3.95 GAL

FUEL USED ______ LBS. (GAL. X 7.15 @ 19,350 B.T.U.)

HOURS = (MIN X 60 SEC/MIN) + SEC / 3600 SEC/HOUR

= (1 X60 + 0) / 3600

= 0.01666 HOURS

KWH = KW X HOURS

= 3525 X 0.01666

= 58.7265 KWH.

LBS/KWH = LBS ÷ KWH

= 28.242 ÷ 58.7265

= 0.4809 LBS/KWH

LBS/BHPH = LBS/KWH ÷ 1.341

= 0.4809 ÷ 1.341

= 0.3586 LBS/BHPH

REVISION E

118 1102 12 2514 161

ENGINEERING DEPARTMENT

CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC m - 15.6

J.O. NO. ______ MADE BY [signature] DATE 1/24/85 CHK. BY SBR DATE 2/1/85

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA

CONT. NO. ______
MODEL NO. ______
SERIAL NO. ______
RATING 4700 KW, 3 PHASE, 60 HERTZ, 0.8 PF, 4360 VOLT
SERVICE ______

STEWART & STEVENSON

OFFICIAL TEST RECORD

BECHTEL 471

JOB NO. N73402
METHOD NO. STEWART & STEVENSON
DATE 25 June 75
TESTED BY [signature]
CALC. BY [signature]
CHECKED BY [signature]
GOV'T. INSP. ______

Q.C. 8511 6-24

FUEL CONSUMPTION TEST

ENGINE LOAD 100 %

ENGINE LOAD 4700 KW

FUEL FLOW

80218
80214
80216
80215

A. IN - FREQUENCY 1210 / 1263 Hz = 8.29 G.P.M.

B. OUT - FREQUENCY 363 / 358 Hz = 3.04 G.P.M.

FUEL CONSUMPTION

A. G.P.M. IN = 8.29

B. G.P.M. OUT = 3.04 LBS. OF FUEL USED = G.P.M. x MIN. x 7.15 = 37,537 LBS.

FUEL CONSUMPTION (A-B) = 5.25 G.P.M.

49 403-12-251-81 16J

REVISION E

SOLD TO SOUTHERN CALIFORNIA EDISON
ADDRESS P.O. BOX 700
SAN CLEMENTE, CALIFORNIA
CONT. NO.
MODEL NO.
SERIAL NO.
RATING 4700 KW. 3 PHASE. 60 HZ
0.8 PF. 4360 VOLTS
SERVICE

STEWART & STEVENSON

JOB NO. N73402
METHOD NO. 0
DATE 2[illegible]
TESTED BY [illegible]
CALC. BY [illegible]
CHECKED BY [illegible]
GOV'T. INSP.

OFFICIAL TEST RECORD

BECHTEL 471

FUEL CONSUMPTION - CALCULATION SHEET

D.C. 9311 6-2[illegible]

100% LOAD 4700 KW LENGTH OF TIME OF TEST 1 MIN. 000 SEC. FUEL USED 5.25 CAL

FUEL USED LBS. (CAL. X 7.15 @ 19,350 B.T.U.)

HOURS = (MIN X 60 SEC/MIN) + SEC / 3600 SEC/HOUR

= (1 X60 + 0) / 3600

= 0.01666 HOURS

KWH = KW X HOURS

= 4700 X 0.01666

= 78.302 KWH.

LBS/KWH = LBS ÷ KWH

= 37.537 ÷ 78.302

= 0.4793 LBS/KWH

LBS/BHPH = LBS/KWH ÷ 1.341

or 4793

= 0.4793 ÷ 1.341

= 0.3574 LBS/BHPH

ENGINEERING DEPARTMENT
CALCULATION SHEET

SUBJECT: Diesel Generator Fuel Oil Storage Tank Size Analysis DESIGN CALCULATION NO. DC M - 15.6

J.O. NO. MADE BY [illegible] DATE 1/24/95 CHK. BY [illegible] DATE 2/1/95

SHEET 22 OF 22 SHEETS

50 403-12-251-Q 16K REVISION E

ENCLOSURE V