WESTINGHOUSE MOTOR COMPANY
ROUND ROCK, TEXAS

WMC ENGINEERING REPORT
WMC-ER-88-005

DATE: September 14, 1988

SUBJECT: Evaluation of the Southern California Edison 600 HP motors (built on S.O. 65F15619) for continuous operation at 700 HP, 1.15 service factor

ABSTRACT: The charging pump motor design was evaluated from thermal, mechanical, and insulation considerations. This analysis reveals that the motors can operate satisfactorily at 700 HP, 1.15 service factor continuous.

The calculated total operating temperature of the winding at the new load and service factor is expected to be less than 92C at an ambient of 27C. At this temperature, the insulation system has a qualified total design life of over 40 years.

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I. INTRODUCTION:

In 1965, Westinghouse supplied two 600 HP motors to Southern California Edison Company which are installed at San Onofre Nuclear Generating Station, Unit 1. These motors (S.O.# 65F15619) drive charging pumps and have the following name plate ratings:

600 HP, 4160 V, 3580 RPM, 3 Phase, 60 HZ, 72 AMPS, Locked KVA Code J, Insulation Class B, SF 1.15, 40°C Rise at SF 1.0. The motors were also required to run under accident condition at 860 HP for 1 hour and 770 HP for 6 months at a minimum of 90% voltage.

The new proposed continuous rating is 700 HP at 1.15 service factor and the new "accident" condition requirements are 796 HP for 6 hours and 694 HP for 30 days. (See Appendix V)

The motors were built at the Westinghouse Buffalo Plant with design life expectancy of 40 years. One of the charging pump motors is always in operation. Approximate run time for each motor is 92,000 hours for the 21 year period, as stated by customer. One of the motors was rewound in 1972. The rewind was due to the mechanical seizure of the pump that caused the motor windings to burn out. (See Appendix VI)

Southern California Edison Company by their letter of August 15, 1988, (Appendix IX) has asked for recertification of these charging pump motors from 600 HP at 1.15 service factor to 700 HP at 1.15 service factor. This analysis is based on the requirements defined in this letter.

II. GENERAL:

An induction motor is an electromechanical device that converts electrical energy into mechanical energy. This energy conversion, however, is not 100% efficient and the difference between the mechanical output of the motor and its electrical input is lost in the process. This difference constitutes the losses in the motor. Some of these losses are mechanical in nature, such as friction and windage, but the bulk of the losses are electromagnetic.

The electromagnetic losses consist of the "copper" losses which are caused by the flow of electric currents in the windings, the iron losses in the electrical steels caused by the setting up of the alternating magnetic fields, and the stray losses, which are due to harmonic and physical proximity effects in the machine construction.

The losses in the motor manifest themselves as heat which causes the temperature of the windings to rise above the ambient temperature.

Any given motor designed for a specified horsepower can be uprated to a higher horsepower within the limits of its maximum or pull-out torque capabilities for stable operation. The increased load, however, is accompanied by an increase in the power input to the motor and hence by an increase in the stator current. This causes additional losses in the stator windings, resulting in an increase in the winding temperature.

The degree to which the power output from the motor can be increased depends on the difference between the safe maximum operating temperature for the winding insulation system and the winding operating temperature for the base load for which the motor was originally designed. Equally important are mechanical considerations such as increased mechanical stresses in individual components at higher loads and the suitability of these components to function reliably at these loads.

All these factors are examined in the following sections to determine whether the 600 HP motor can be uprated to 700 HP.

III. MECHANICAL CONSIDERATIONS:

The torque in a motor is generated in the air gap and travels along two paths. One of the paths is through the rotor laminations into the shaft, along to the coupling and to the pump. The other path is through the stator core, into the frame structure and into the foundation. The major mechanical components to consider in this transfer of torque are as follows:

1. Shaft extension
2. Shaft extension key
3. Shaft journal
4. Interface between rotor laminations and shaft
5. Stator core welding to frame
6. Stator foot bolting

The above components were analyzed in terms of uprating the motors to run continuously at 700 HP, 3579 RPM and 1.15 service factor. Following are the results of this analysis; (Note: Modern motors are built with safety factors of 4.0 or greater)

1. Shaft extension diameter - The safety factor at the uprated loading condition is - 9.39.

2. Shaft extension key - The factor of safety at the new rating is 6.15 in shear and 4.65 in compression. This analysis does not account for the coupling press fit as carrying any loading and as a result the analysis is conservative.

3. Shaft journal diameter - Safety factor is equal to 10.8 based on the new rating.

4. Interface between rotor laminations and shaft --

   a. Press fit capability - 25.3 times rated torque
   b. Key shear - Factor of safety of 70.17
   c. Key compression - Factor of safety of 53.02

   The press fit and key loading were calculated separately.

5. Stator core welding to frame - Safety factor is equal to 220.

6. Stator foot - Force per bolt is 1037.5 lbs. at 700 HP vs. clamping force preload of the existing bolts of 52380 lbs.

Bearings - Uprating of the motor from 600 to 700 HP continuous operation affects the bearings primarily from the increase in temperature of the bearing housing due to the higher motor temperature. This increase in temperature will be somewhere between the new ΔT of the windings and the new ΔT of the motor air temperature. If we consider the higher of these which is the winding ΔT, the new surrounding temperature for the bearings would be 57°C. For a sleeve bearing, since the oil viscosity changes with temperature, the total bearing temperature is not directly related to the ambient temperature. Past experience has shown that a rise of 1° of ambient results in a 0.7° rise in bearing temperature. For the 700 HP operation, the bearing temperature would increase by 11.9°C. This would result in a bearing temperature of 59.9°C based on the original test data. The standard limits for this type of bearing is 90C total temperature. There is thus considerable margin in the operation of the bearings at the 700 HP rating.

Discussion

The mechanical analysis reveals that there is adequate margin in the motor design to be able to run continuously at the new rating of 700 HP, 1.15 service factor, 3579 RPM. This margin is due to the following reasons:

1. Original overdesign of motor. A number of motors were built on this frame size in the past with ratings of 1000 HP.
2. A number of the motor components are designed for short circuit torques which are significantly greater than the normal running torques. These short circuit torques will not change with the uprating of the motor.

IV. THERMAL EVALUATION AND ELECTRICAL PERFORMANCE:

1. Thermal evaluation was made on the design for the new continuous and accident conditions. The thermal analysis indicates that temperature rise of motors when operated at 700 HP, SF 1.15 will not exceed 65C. With the ambient temperature of 80F (27C), the maximum total operating temperature of winding will be 92C. This motor has Class "B" insulation which has 130°C total temperature capability. Since the new accident condition of 796 HP is less than 700 HP at 1.15 SF or 805 HP for the same ambient condition, the temperature rise under accident conditions will also be less than 65C.

2. The above conclusions are based on the following:

   a. Computer studies at 700 HP, SF 1.15, which indicate a temperature rise of 49C.

   b. Evaluation of expected temperature rise based on test data on two similar motors, one of which is an exact duplicate.

c. The subject motors did not receive any temperature tests as these were not specified by the customer. They were tested only for routine commercial test. Copy of test reports are attached. (Appendix II)

d. Test Report #1 (Appendix III) relates to S.O. 27N7703, which is a duplicate of the subject motors. This test shows a temperature rise of 26.5C at a load of 600 HP. Test Report #2 for S.O. 18N6403 (Appendix IV) gives a temperature rise of 29C at 600 HP. Based on these two tests, we expect a temperature rise of 38C when the motor is operated at 700 HP SF 1.15. (See Appendix VIII)

Test Report #1 indicates the motor loading as 299 HP (See Appendix III). Review of other data such as air temperature rise, (the machine will have approximately 4000 CFM of air flowing through it), KW input, phase amperes, and speed (RPM), indicates that the heat run test was at 600 HP. We are satisfied that 299 HP was entered on the test report in error. The test conducted on S.O. 18N6403, which has a temperature rise of 29C at a load of 601 HP also confirms this conclusion.

The calculated temperature rise at 600 HP at 1.00 service factor is 32C.

e. Taking a very conservative approach and assuming that the test reported on Test Report #1 was at half load (299 HP), the temperature rise calculation for operation at 700 HP, 1.15 SF (Appendix VIII) indicates a rise of less than 65C. Total temperature of winding with 27C ambient will be less than 92C which is within Class B insulation limits.

3. Electrical performance data at new 700 HP rating is as follows. (Completed motor data sheets at old and new ratings are attached as Appendix VII): -

	Efficiency (Full Load)	P.F. (Full Load)	Inrush % F.L.	Starting Torque	POT	Rated Amps	Speed (RPM)
600 HP	94.3	91.6	888%	166	382	72	3583
700 HP	94.5	92.3	770%	142	326	83	3579

The motor has pull-out torque of 153% at 70% voltage on 700 HP rating base. It is suitable for operation at 700 HP without any damage for 15 seconds at 70% voltage as required per Spec BSO-356, Para. 3.06.03.

Electrical calculations at 600 HP and 700 HP are attached as Appendix I.

V. INSULATION LIFE:

The subject motors were built in 1965 and have been in operation for 21 years. The qualified life of the original designs is 40 years.

There are two motors on this application. One of the two motors is always running. If both motors had equally shared the operation, each would have run for 92,000 hours. Of these two motors, however, one was rewound in 1972. The actual operation time seen by the motor insulation is therefore 92,000 and 66,000 hours respectively (assuming the other motor was not in operation when the first was being rewound). The motors have been started once a week. The number of starts for these motors has been estimated by SCE as 1100 and 780 respectively. Additional customer maintenance data indicates that the insulation resistance of the stator windings has been in excess of 1000 megohm, and that the polarization index has been 3.2 and 4.5 on the two motors.

The actual load at which these motors were run was not provided to WMC by SCE. The actual operating temperature rise of the motor is not known because these motors do not have temperature detectors installed in them.

Analysis of Insulation

Based on the thermal evaluation, the expected temperature rise of the stator windings at 700 HP and at a SF of 1.15 is less than 65C. Based on the customer stated ambient of 27C, the expected total operating temperature of the winding is thus 92C at the new load. At this temperature, the insulation system will have a qualified theoretical total life of greater than 40 years. (See Appendix X)

Normal thermal ageing is only one of the many phenomena that eventually cause the failure of an insulation system. Some of the other factors that come into the picture include overtemperatures, overvoltages, steep fronted voltage surges, contamination and the absence of proper preventive maintenance. Excessive number of starts, bus transfers and other phenomena that may impose severe stresses can and do result in the failure of weak spots in the insulation system.

The insulation resistance and the polarization index of the motors indicate that the insulation was in good condition when these readings were last taken. The stated acceptance values by Southern California Edison per EQCN-1 page 6 for these two parameters are 5.17 megohm and less than 2.0 respectively. The readings of 1000 megohm, and 3.20 and 4.5 represent adequate margins.

The number of starts that the motors have seen is not excessive.

VI. CONCLUSION

Foregoing discussions conclude that these motors have an adequate design margin and can operate satisfactorily at 700 HP, 1.15 service factor with required safety factors in the mechanical parts and within permissible temperature rise of the winding insulation.

Because of the original design margins, the total temperature of the windings even with the increased loading will be well within the Class B (130C) insulation limits.

Since total temperature will not exceed 92C, the insulation system will have a qualified theoretical total life of more than 40 years. However, because of the influence of environmental and other factors on insulation life (See discussion in Section V), it is not possible to certify the remaining life of the insulation system. On the other hand, if the motors have been well maintained over their life and the adverse factors indicated in the discussion in Section V have been absent, then the windings would be expected to have their normal total qualified life to be more than 40 years.

DISCLAIMER:

This report and the analysis contained herein are based on the original design information and the maintenance, operational, and other information given to WMC by Southern California Edison.

The conclusions of this study represent our best opinions and are NOT to be interpreted in any way to include warranties, explicit or implicit, OR assumption of any responsibilities or liabilities for and due to the operation and performance of these motors.

BASIC SPECIFICATIONS

HORSE-POWER	=	600.
POLES	=	2.
LINE VOLTAGE	=	4160.
FRAME SIZE	=	688.5
MOTOR TYPE	=	CF
W DESIGN	=	B
ENCLOSURE	=	WPI

EXCEPTIONS

(1)	(2)	(3)	(4)*	(6)	(7)	(8)	(9)	(10)	(11)
PHASE	FREQ1	FREQ2	O.VOLT	POT/FLT	TS/FLT	KVA/HP	(S)MIN	(S)MAX	EFF
3.	60.0	0.0	80.	175.	60.	6.30	0.0	2.5	94.1
(12)	(13)*	(14)*	(15)	(16)	(17)	(18)	(19)*	(20)*	(21)
P.F.	'S'	WKK	ALTITUDE	(AMB)MAX	(AMB)MIN	TIME	S.F.	(RISE)SF	(RISE)FL
91.2	1.	224.0	3300.	40.	-30.	24.00	1.00	60.	0.
(22)	(23)*	(24)	(25)*	(26)*	(27)	(28)	(29)	(30)	(31)
RES TEMP	RISE CAL	HARMONIC	(LT)MIN	(LT)MAX	STR BORE	STR I.D.	RTR O.D.	STR TYPE	STR VENT
85.	1.	0.0	1.	1.	0.	15.500	15.300	0.	0.
(32)*	(33)*	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)*
S1	STR PCHG	RTD	STR IRON	SP HTR	TH GRD	S.L.	WEDGE	RTR TYPE	(COND)R
48.	1.	0.	0.	0.0	0.0	0.0	0.	0.	2.
(42)*	(43)	(44)*	(45)*	(46)	(47)	(48)	(49)	(50)	(51)
(COND)B	RTR VENT	S2	RTR PCHG	E-RING-F	E-RING-R	RTR IRON	RTR BORE	SHAFT	SKEW
1.	0.	87.	2.	0.	0.	0.	2.	0.	0.0
(53)*	(54)*	(55)	(56)	(57)	(60)*	(61)	(62)*	(63)	(64)
BAR EXT	RING WDH	RING SPT	'S' TEMP	(F+W)NL	INS TYPE	INS VOLT	STR WIRE	(COND)1	(WT)1
2.880	2.250	0.	0.	0.	2.	3.1	12.	1.000	1.000
(65)	(66)	(67)*	(68)*	(69)*	(70)*	(71)	(72)*	(73)*	(74)*
NO.VOLT	PH BELTS	THROW	CONN	PAR	(TPC)1	1/2 TURN	(W1)1	(W2)1	(TK1)1
1.0	1.	20.	1.	1.	7.	0.	0.204	0.204	0.081
(75)*	(76)	(77)	(78)*	(79)	(80)	(81)	(82)	(83)	(84)
(P1)1	(TK2)1	(P2)1	(M)1	(TPC)2	KD	(W1)2	(W2)2	(TK1)2	(P1)2
1.	0.0	0.	1.	0.	0.0	0.0	0.0	0.0	0.
(85)	(86)	(87)	(88)	(89)*	(90)*	(96)	(97)*	(98)	
(TK2)2	(P2)2	(M)2	COIL MI	I-SPEC	UNITS	'SHAFT'	BY-PASS	TYPE CAL	
0.0	0.	0.	0.	2.	1.	0.0	110011.	0.	

** WESTINGHOUSE PROPRIETARY INFORMATION

APPENDIX I

PROGRAM ME7337 IDENT SB363 S.O.65F15619 SO. CAL. EDISON DATE-88-07-12 ENGR-BANSAL

TYPE	FRAME	H.P.	POLES	FREQ	ENCL	(RISE)SF	S.F.	TIME	DESIGN	VOLTAGE(INS)CLASS	
CF	688.5	600.0	2.	60.0	WPI	60.	1.00	24.00	B	4160.	B

PHASE	LINE VOLTAGE	WIRE TYPE	WIRE COND	WIRE WEIGHT	PHASE BELTS	* * * CORE LENGTH * * * TOTAL	STATOR(IRON)	ROTOR	STATOR I.D.	ROTOR O.D.	SINGLE AIR-GAP
3.	4160.	61152CL	1.025	0.975	60.	14.000	13.000	12.500	15.500	15.300	0.1000

	ASSEMBLY	PUNCHING	VENTS	SLOTS	IRON	THICK	IDENT.(END-RING)DWG & ITEM		
STATOR		23D9694H01	2X0.500	48.	10502PF	0.018	00	UPPER	386D379H02
ROTOR		222A153H01	3X0.500	87.	10502PF	0.018	00	LOWER	386D379H02

NOISE	LOCKING	(+)CUSP	(-)CUSP	SHAFT	(F+W)NL	SKEW	RING COND	COND(BAR)	LENGTH	WIDTH(BAR)	DEPTH
				M	7897.	0.0	0.400***	1.000***	20.000	.250	1.250

UNIT P	UNIT E	UNIT I	UNIT Z	UNIT T	UNIT N
447600.	2401.8	62.121	38.663	875.31	3600.

LB-CU	THROW	BALANCE	CONN	PAR	TPC	MCL	VCUI	VR	VB	CAL.(LOE)	MAX.
346.14	20.	YES	Y	1.	7.	49.208	1038.256	392.041	537.225	42.740***	44.000

W1	W2	TK1	P1	TK2	P2	N	SPACE-W	SPACE-D	*RR	KVAR	(PF)FLC
.204	.204	.081	1	.0	0	1	0.010	0.110	0.00229	112.0	98.1

(25.C)R	T((85.C)	(I)NL	(W)NL	*XM	*CORE	(B)AG	(B)T1	(B)T2	(B)C1	(B)C2	(B)T1X
0.4868	0.5994	20.415	15673.	2.98739	0.01653	40.39	91.67	124.85	85.47	121.57	136.57

		SLIP	RPM	EFF	P.F.	(HP)OUT	(T)OUT	INPUT	LOSSES	(I)L	CUI/LB
LOCKED	ROTOR(1)	100.00- 75C	0.	0.0	24.3	0.0	1459.37	1112768.	1112768.	634.976	1014.52
LOCKED	ROTOR(2)	100.00- 85C	0.	0.0	24.7	0.0	1468.89	1127696.	1127696.	633.813	1043.47
BREAK	DOWN	3.98	3457.	87.7	68.8	2209.35	3356.56	1878699.	231008.	378.953	373.01
1-1/4	LOAD	0.61	3578.	94.6	92.4	750.43	1101.53	591715.	32044.	88.853	20.51
1.15	LOAD	0.56	3580.	94.5	92.2	690.22	1012.62	544714.	29946.	81.990	17.46
FULL	LOAD	0.49	3583.	94.3	91.6	599.95	879.50	474529.	27084.	71.899	13.43
3/4	LOAD	0.36	3587.	93.6	89.3	450.05	658.93	358687.	23042.	55.721	8.06
1/2	LOAD	0.24	3591.	91.9	83.4	299.61	438.14	243273.	19825.	40.500	4.26

		*R1	*R2	*X1	*X2	*(HP)OUT	*(T)OUT	*INPUT	*LOSSES	*(I)L	O/O SAT*
LOCKED	ROTOR(1)	0.00751	0.01631	0.06352	0.03169	0.0	1.66726	2.48608	2.48608	10.22166	76.3
LOCKED	ROTOR(2)	0.00775	0.01648	0.06354	0.03176	0.0	1.67814	2.51943	2.51943	10.20294	76.4
BREAK	DOWN	0.00775	0.00427	0.06709	0.04935	3.68224	3.83472	4.19727	0.51610	6.10027	93.3
1-1/4	LOAD	0.00775	0.00427	0.07208	0.05264	1.25072	1.25846	1.32197	0.07159	1.43033	99.9
1.15	LOAD	0.00775	0.00427	0.07208	0.05265	1.15037	1.15688	1.21697	0.06690	1.31985	99.9
FULL	LOAD	0.00775	0.00427	0.07208	0.05267	0.99992	1.00480	1.06016	0.06051	1.15741	100.0
3/4	LOAD	0.00775	0.00427	0.07208	0.05268	0.75008	0.75280	0.80136	0.05148	0.89697	100.0
1/2	LOAD	0.00775	0.00427	0.07208	0.05269	0.49935	0.50056	0.54351	0.04429	0.65196	100.0

LOSSES(WATTS)	CORE	(CU)1	(CU)2	F+W	S.L.	TOTAL	X TRANSIENT	*XD	*XD'	(T)OC	(T)SC
1.15-LOAD	7401.	6044.	2955.	7765.	5782.	29946.	X NO KVAR	3.059	0.11037	1.89	0.0682
FULL-LOAD	7401.	4648.	2219.	7783.	5033.	27084.	X WITH KVAR	13.413	0.11353	8.01	

ALL DATA ON THIS PAGE ARE CALCULATED

	CUI/LB	(C/S)1	CUR/LB	(C/S)R	CUB/LB	(C/S)B
LOCKED ROTOR	1014.52	6.04	4205.29	23.96	1285.78	7.32

PERFORMANCE	POT/FLT	(S)FL	(EFF)FL	(PF)FL	TS/FLT	(KVA/HP)S	SCORE	(RISE)SF
SPECIFIED	1.75	0.0- 2.5	94.1	91.2	0.60	6.30		60.
CALCULATED	3.82	0.5	94.3	91.6	1.66	7.63	-63	32.

MAXIMUM SAFE RISE	STR	E-R	BAR
COLD	155	200	300
HOT	123	176	276

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/04/11, REVISION DATE 83-11-20)

APPENDIX I

(1)

TYPE	FRAME	H.P.	POLES	PHASE	LINE VOLTS	FREQ	ENCL	SF RISE	S.F.	TIME	DESIGN	INS VOLT	INS CLASS	MAX KVAR	FLC PF	MTR WKK
CF	688.5	600.0	2.	3.	4160.	60.	WPI	60.	1.00	24.00	B	4160.	B	112.0	90.1	

(2)

	SLIP	RPM	EFF	P.F.	(HP)OUT	(T)OUT	LINE AMP
LOCKED ROTOR(1)	100.00- 75C	0.	0.0	24.3	0.0	1459.37	634.98
LOCKED ROTOR(2)	100.00- 85C	0.	0.0	24.7	0.0	1468.89	633.81
BREAK DOWN	3.99	3457.	87.7	68.8	2209.35	3356.56	378.95
1-1/4 LOAD	0.61	3578.	94.6	92.4	750.43	1101.53	88.85
1.15 LOAD	0.56	3580.	94.5	92.2	690.22	1012.62	81.99
FULL LOAD	0.49	3583.	94.3	91.6	599.95	879.50	71.90
3/4 LOAD	0.36	3587.	93.6	89.3	450.05	658.93	55.72
1/2 LOAD	0.24	3591.	91.9	83.4	299.61	438.14	40.50

(3) LINE VOLTS = 4160.(100.0/U,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	23.0	0.0	1424.13	1058932.	1058932.	639.092	0.0	0.0	0.0	8.52	7.42
95.00	180.	3.4	22.6	47.54	1387.21	1035829.	1000587.	634.986	2.22	0.093	0.093		
90.00	360.	6.8	22.4	93.09	1358.06	1016665.	967441.	630.733	8.87	0.096	0.189		
85.00	540.	8.7	22.2	117.11	1139.01	1000845.	913697.	626.354	19.96	0.106	0.295		
80.00	720.	12.8	22.0	169.70	1237.82	987978.	861599.	621.865	35.48	0.113	0.408		
75.00	900.	16.9	22.0	221.97	1295.28	977805.	812430.	617.266	55.44	0.107	0.515		
70.00	1080.	20.6	21.9	266.69	1296.87	967404.	768663.	611.689	79.83	0.107	0.622		
65.00	1260.	24.1	22.0	310.11	1292.58	960322.	729190.	606.243	108.65	0.109	0.731		
60.00	1440.	27.7	22.1	354.70	1293.61	956015.	691621.	600.726	141.92	0.112	0.843		
55.00	1620.	31.3	22.3	400.90	1299.67	954319.	655457.	595.136	179.61	0.115	0.958		
50.00	1800.	35.1	22.5	448.70	1309.17	954447.	619925.	589.494	221.74	0.119	1.077		
45.00	1980.	38.8	22.6	495.42	1314.08	952379.	583003.	583.949	268.31	0.123	1.199		
40.00	2160.	42.6	22.9	544.87	1324.80	953290.	547024.	578.276	319.31	0.128	1.327		
35.00	2340.	46.6	23.3	599.62	1345.76	959363.	512259.	572.357	374.74	0.132	1.459		
30.00	2520.	51.1	24.2	675.98	1408.79	986413.	482345.	565.454	434.61	0.135	1.594		
25.00	2700.	56.0	25.5	769.11	1496.02	1025450.	451917.	557.814	498.92	0.133	1.727		
20.00	2880.	61.2	27.4	888.45	1620.14	1082628.	420080.	548.926	567.66	0.128	1.855		
15.00	3060.	67.1	30.2	1053.25	1807.67	1170814.	385350.	537.723	640.84	0.119	1.974		
10.00	3240.	74.8	37.1	1386.27	2247.05	1382000.	348149.	517.330	718.45	0.100	2.074		
9.50	3258.	75.8	38.4	1443.21	2326.43	1419964.	343641.	513.389	726.45	0.008	2.082		
9.00	3276.	76.8	39.8	1504.96	2412.64	1461033.	338656.	508.880	734.50	0.008	2.090		
8.50	3294.	77.9	41.4	1570.33	2503.68	1504194.	333057.	503.801	742.59	0.008	2.098		
8.00	3312.	78.9	43.2	1639.35	2599.51	1549345.	326732.	498.043	750.73	0.007	2.105		
7.50	3330.	80.0	45.1	1711.88	2699.86	1596261.	319549.	491.472	758.91	0.007	2.112		
7.00	3348.	81.1	47.2	1787.59	2804.11	1644531.	311348.	483.919	767.14	0.007	2.119		
6.50	3366.	82.2	49.5	1865.81	2911.15	1693454.	301934.	475.174	775.41	0.006	2.125		
6.00	3384.	83.3	52.0	1945.33	3019.08	1741910.	291076.	464.973	783.73	0.006	2.131		
5.50	3402.	84.4	54.8	2024.21	3124.87	1788162.	278497.	452.979	792.09	0.006	2.137		
5.00	3420.	85.6	57.9	2099.32	3223.77	1829566.	263878.	438.767	800.49	0.006	2.142		
4.50	3438.	86.8	61.3	2165.86	3308.53	1862179.	246861.	421.802	808.94	0.005	2.147		
4.00	3456.	87.9	65.0	2216.57	3368.36	1880214.	227069.	401.406	817.43	0.005	2.153		
3.50	3474.	89.1	69.1	2240.78	3387.51	1875366.	204157.	376.740	825.97	0.005	2.158		
3.00	3492.	90.3	73.5	2223.27	3343.72	1836073.	177916.	346.790	834.55	0.005	2.163		
2.50	3510.	91.5	78.1	2141.08	3203.60	1745175.	148310.	310.231	843.18	0.005	2.168		
2.00	3528.	92.7	82.8	1974.16	2938.77	1588789.	116415.	266.252	851.85	0.006	2.174		
1.50	3546.	93.8	87.3	1688.98	2501.47	1343284.	83604.	213.465	860.56	0.007	2.181		
1.00	3564.	94.7	91.2	1263.37	1861.67	995201.	52947.	151.500	869.32	0.010	2.191		
0.50	3582.	94.7	92.1	685.53	1005.10	539922.	28637.	81.317	878.12	0.023	2.215		

(4)	RPM	WKK	(SEC)T	(KW-SE)TL	(KW-SE)I	(RISE)I	(KW-SE)R	(RISE)R	(KW-SE)B	(RISE)B
ACCELERATION	3582.	224.	2.21	1388.6	577.9	10.9	497.9	23.7	278.9	9.9

(RECORD FILE E7337FX 74-08-25, PROGRAM VERSION 74/36/11, REVISION DATE 83-11-20)

APPENDIX I

(3) LINE VOLTS = 3744.(90.0/0,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	22.7	0.0	1123.06	834573.	834573.	566.915	0.0	0.0	0.0	10.72	9.42
95.00	180.	3.4	22.4	37.50	1094.24	816569.	788766.	563.336	2.22	0.118	0.118		
90.00	360.	6.8	22.1	73.45	1071.53	801678.	747055.	559.629	8.87	0.122	0.240		
85.00	540.	8.7	21.9	92.43	898.92	789429.	720647.	555.814	19.96	0.135	0.375		
80.00	720.	12.8	21.8	133.96	977.16	779510.	679740.	551.902	35.48	0.144	0.518		
75.00	900.	16.9	21.7	175.27	1022.78	771723.	641135.	547.895	55.44	0.137	0.656		
70.00	1080.	20.6	21.7	210.65	1024.35	763800.	606818.	543.033	79.83	0.137	0.792		
65.00	1260.	24.1	21.7	245.01	1021.25	758491.	575872.	538.285	108.65	0.141	0.933		
60.00	1440.	27.7	21.8	280.32	1022.35	755375.	546420.	533.474	141.92	0.146	1.079		
55.00	1620.	31.3	22.0	316.92	1027.41	754330.	518070.	528.598	179.61	0.151	1.231		
50.00	1800.	35.1	22.2	354.80	1035.19	754728.	490210.	523.673	221.74	0.158	1.389		
45.00	1980.	38.8	22.4	391.83	1039.31	753379.	461234.	518.831	268.31	0.165	1.554		
40.00	2160.	42.6	22.6	431.04	1048.03	754393.	433000.	513.874	319.31	0.175	1.728		
35.00	2340.	46.6	23.0	474.47	1064.88	759517.	405729.	508.704	374.74	0.185	1.913		
30.00	2520.	51.1	24.0	535.10	1115.18	781351.	382334.	502.680	434.61	0.191	2.104		
25.00	2700.	55.9	25.3	609.11	1184.80	812772.	358549.	496.015	498.92	0.192	2.296		
20.00	2880.	61.2	27.1	704.07	1283.91	858727.	333674.	488.263	567.66	0.187	2.483		
15.00	3060.	67.0	30.0	835.43	1433.84	929589.	306557.	478.498	640.84	0.175	2.658		
10.00	3240.	74.8	36.8	1101.81	1785.96	1099419.	277709.	460.755	718.45	0.146	2.804		
9.50	3258.	75.8	38.1	1147.52	1849.79	1130050.	274241.	457.325	726.45	0.012	2.816		
9.00	3276.	76.8	39.6	1197.16	1919.19	1163234.	270406.	453.398	734.50	0.011	2.827		
8.50	3294.	77.8	41.2	1249.78	1992.61	1198170.	266091.	448.973	742.59	0.011	2.838		
8.00	3312.	78.9	42.9	1305.43	2070.02	1234794.	261209.	443.952	750.73	0.010	2.848		
7.50	3330.	79.9	44.8	1364.03	2151.26	1272950.	255655.	438.218	758.91	0.010	2.858		
7.00	3348.	81.0	46.9	1425.35	2235.88	1312330.	249301.	431.620	767.14	0.009	2.867		
6.50	3366.	82.1	49.2	1488.88	2323.04	1352403.	241992.	423.973	775.41	0.009	2.875		
6.00	3384.	83.2	51.7	1553.71	2411.30	1392307.	233542.	415.040	783.73	0.008	2.884		
5.50	3402.	84.4	54.5	1618.32	2498.28	1430687.	223729.	404.522	792.09	0.008	2.891		
5.00	3420.	85.5	57.6	1680.27	2580.26	1465457.	212293.	392.039	800.49	0.008	2.899		
4.50	3438.	86.7	61.1	1735.75	2651.50	1493484.	198940.	377.106	808.94	0.007	2.906		
4.00	3456.	87.9	64.8	1778.95	2703.35	1510127.	183357.	359.115	817.43	0.007	2.913		
3.50	3474.	89.1	69.0	1801.28	2723.10	1508682.	165252.	337.302	825.97	0.007	2.920		
3.00	3492.	90.3	73.4	1787.59	2688.47	1477457.	144234.	310.510	834.55	0.007	2.927		
2.50	3510.	91.4	78.1	1727.80	2585.21	1409494.	120863.	278.247	843.18	0.007	2.934		
2.00	3528.	92.6	83.0	1596.02	2375.86	1285680.	95327.	238.988	851.85	0.008	2.942		
1.50	3546.	93.7	87.7	1370.26	2029.44	1091016.	69039.	191.855	860.56	0.010	2.952		
1.00	3564.	94.6	91.7	1025.92	1511.78	809413.	44250.	136.125	869.32	0.014	2.967		
0.54	3580.	94.6	93.3	602.68	884.03	475475.	25979.	78.589	877.34	0.037	3.003		

(4)	RPM	WKK	(SFC)T	(KW-S)TL	(KW-S)L	(RISE)L	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3580.	224.	3.00	1462.6	613.9	11.9	517.8	24.7	292.9	10.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/04/11, REVISION DATE 83-11-20)

APPENDIX I

(1) LINE VOLTS = 3328.(80.0/0,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTM SEC
100.00	0.	0.0	22.4	0.0	862.08	640515.	640515.	496.498	0.0	0.0	0.0	14.02	12.32
95.00	180.	3.4	22.0	28.80	840.16	626851.	605502.	493.420	2.22	0.154	0.154		
90.00	360.	6.8	21.8	56.41	822.92	615579.	573628.	490.234	8.87	0.158	0.312		
85.00	540.	8.7	21.6	71.00	690.50	606340.	553503.	486.955	19.96	0.176	0.489		
80.00	720.	12.8	21.5	102.93	750.76	598892.	522236.	483.593	35.48	0.189	0.678		
75.00	900.	16.9	21.4	134.69	785.98	593085.	492729.	480.150	55.44	0.181	0.859		
70.00	1080.	20.6	21.4	161.92	787.38	587207.	466539.	475.970	79.83	0.182	1.041		
65.00	1260.	24.1	21.4	188.37	785.16	583332.	442928.	471.886	108.65	0.189	1.230		
60.00	1440.	27.7	21.6	215.56	786.17	581146.	420462.	467.749	141.92	0.198	1.428		
55.00	1620.	31.3	21.7	243.75	790.20	580555.	398840.	463.553	179.61	0.209	1.637		
50.00	1800.	35.0	21.9	272.93	796.32	581077.	377594.	459.315	221.74	0.221	1.858		
45.00	1980.	38.8	22.1	301.46	799.61	580246.	355480.	455.144	268.31	0.237	2.095		
40.00	2160.	42.6	22.4	331.67	806.43	581245.	333940.	450.874	319.31	0.257	2.352		
35.00	2340.	46.5	22.8	365.14	819.52	585423.	313149.	446.419	374.74	0.281	2.633		
30.00	2520.	51.0	23.7	411.93	858.49	602551.	295377.	441.235	434.61	0.301	2.934		
25.00	2700.	55.8	25.0	469.09	912.45	627135.	277322.	435.499	498.92	0.313	3.247		
20.00	2880.	61.0	26.8	542.54	989.34	663047.	258455.	428.828	567.66	0.315	3.562		
15.00	3060.	66.9	29.6	644.32	1105.83	718408.	237898.	420.430	640.84	0.298	3.860		
10.00	3240.	74.6	36.4	851.40	1380.19	851202.	216178.	405.192	718.45	0.244	4.103		
9.50	3258.	75.6	37.7	887.16	1430.09	875224.	213586.	402.244	726.45	0.019	4.123		
9.00	3276.	76.6	39.2	925.95	1484.41	901288.	210719.	398.867	734.50	0.018	4.141		
8.50	3294.	77.7	40.8	967.13	1541.97	928773.	207487.	395.060	742.59	0.017	4.157		
8.00	3312.	78.7	42.5	1010.76	1602.76	957645.	203822.	390.738	750.73	0.016	4.173		
7.50	3330.	79.8	44.4	1056.78	1666.68	987795.	199645.	385.797	758.91	0.015	4.188		
7.00	3348.	80.9	46.5	1105.04	1733.43	1019005.	194857.	380.107	767.14	0.014	4.202		
6.50	3366.	82.0	48.8	1155.19	1802.40	1050885.	189336.	373.505	775.41	0.013	4.215		
6.00	3384.	83.1	51.4	1206.54	1872.50	1082785.	182938.	365.783	783.73	0.012	4.228		
5.50	3402.	84.3	54.2	1257.95	1941.96	1113681.	175488.	356.677	792.09	0.012	4.239		
5.00	3420.	85.4	57.3	1307.56	2007.92	1141977.	166782.	345.852	800.49	0.011	4.250		
4.50	3438.	86.6	60.7	1352.43	2065.95	1165249.	156584.	332.879	808.94	0.011	4.261		
4.00	3456.	87.8	64.5	1388.06	2109.33	1179882.	144642.	317.213	817.43	0.010	4.271		
3.50	3474.	88.9	68.6	1404.99	2123.99	1178362.	130492.	297.896	825.97	0.010	4.281		
3.00	3492.	90.1	73.2	1399.89	2105.39	1158592.	114517.	274.766	834.55	0.010	4.292		
2.50	3510.	91.3	78.0	1355.39	2028.01	1107265.	96377.	246.425	843.18	0.011	4.302		
2.00	3528.	92.5	82.9	1255.06	1848.30	1012572.	76515.	211.901	851.85	0.012	4.314		
1.50	3546.	93.5	87.8	1080.80	1600.73	862086.	55988.	170.341	860.56	0.015	4.329		
1.00	3564.	94.3	91.9	810.26	1193.98	640807.	36489.	120.930	869.32	0.025	4.354		
0.71	3574.	94.4	93.5	606.44	891.03	479078.	26771.	88.917	874.42	0.044	4.398		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3574.	224.	4.40	1605.6	685.9	12.9	556.8	25.7	319.9	11.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/04/11, REVISION DATE 83-11-20)

APPENDIX I

(1) LINE VOLTS = 3120.(75.0/0,STR 40C;RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	22.2	0.0	746.19	554407.	554407.	461.894	0.0	0.0	0.0	16.12	14.22
95.00	180.	3.4	21.9	24.93	727.30	542646.	524163.	459.058	2.22	0.178	0.178		
90.00	360.	6.8	21.6	48.84	712.45	532957.	496635.	456.122	8.87	0.183	0.361		
85.00	540.	8.7	21.4	61.47	597.86	525028.	479279.	453.102	19.96	0.204	0.566		
80.00	720.	12.8	21.3	89.13	650.10	518651.	452272.	450.004	35.48	0.220	0.785		
75.00	900.	16.9	21.3	116.64	680.65	513697.	426789.	446.831	55.44	0.211	0.996		
70.00	1080.	20.6	21.2	140.23	681.93	508695.	404187.	442.980	79.83	0.213	1.210		
65.00	1260.	24.1	21.3	163.16	680.06	505426.	383815.	439.216	108.65	0.223	1.433		
60.00	1440.	27.7	21.4	186.72	680.98	503620.	364435.	435.403	141.92	0.236	1.668		
55.00	1620.	31.3	21.6	211.15	684.51	503199.	345788.	431.535	179.61	0.251	1.919		
50.00	1800.	35.0	21.8	236.44	689.85	503743.	327466.	427.627	221.74	0.269	2.188		
45.00	1980.	38.7	22.0	261.16	692.71	503112.	308392.	423.781	268.31	0.293	2.482		
40.00	2160.	42.5	22.2	287.34	698.64	504069.	289819.	419.842	319.31	0.326	2.807		
35.00	2340.	46.5	22.6	316.35	710.01	507791.	271901.	415.733	374.74	0.366	3.174		
30.00	2520.	50.9	23.5	356.93	743.85	522773.	256616.	410.953	434.61	0.406	3.580		
25.00	2700.	55.7	24.8	406.52	790.74	544252.	241098.	405.664	498.92	0.437	4.017		
20.00	2880.	61.0	26.7	470.29	857.61	575609.	224890.	399.516	567.66	0.452	4.469		
15.00	3060.	66.8	29.5	558.76	959.00	623943.	207237.	391.775	640.84	0.435	4.903		
10.00	3240.	74.5	36.2	739.19	1198.18	739931.	188649.	377.740	718.45	0.349	5.252		
9.50	3258.	75.5	37.5	770.33	1241.75	760946.	186440.	375.024	726.45	0.026	5.278		
9.00	3276.	76.5	39.0	804.20	1289.23	783762.	183994.	371.913	734.50	0.024	5.303		
8.50	3294.	77.6	40.6	840.18	1339.56	807842.	181235.	368.403	742.59	0.023	5.326		
8.00	3312.	78.6	42.3	878.33	1392.76	833161.	178102.	364.417	750.73	0.021	5.347		
7.50	3330.	79.7	44.2	918.61	1448.77	859634.	174528.	359.859	758.91	0.020	5.366		
7.00	3348.	80.8	46.3	960.91	1507.33	887078.	170425.	354.608	767.14	0.018	5.385		
6.50	3366.	81.9	48.6	1004.91	1567.92	915160.	165689.	348.511	775.41	0.017	5.402		
6.00	3384.	83.0	51.1	1050.05	1629.63	943331.	160193.	341.376	783.73	0.016	5.418		
5.50	3402.	84.2	53.9	1095.34	1690.94	970709.	153785.	332.956	792.09	0.015	5.433		
5.00	3420.	85.3	57.1	1139.19	1749.37	995911.	146284.	322.938	800.49	0.014	5.447		
4.50	3438.	86.5	60.5	1179.04	1801.09	1016838.	137483.	310.919	808.94	0.013	5.460		
4.00	3456.	87.7	64.3	1210.98	1840.24	1030336.	127160.	296.390	817.43	0.013	5.473		
3.50	3474.	88.9	68.4	1227.05	1855.00	1030092.	114928.	278.486	825.97	0.013	5.486		
3.00	3492.	90.1	73.0	1223.60	1840.25	1013646.	101052.	256.967	834.55	0.013	5.499		
2.50	3510.	91.2	77.8	1185.74	1774.17	969627.	85265.	230.565	843.18	0.014	5.513		
2.00	3528.	92.4	82.9	1100.76	1638.62	889015.	68031.	198.500	851.85	0.015	5.528		
1.50	3546.	93.4	87.8	948.26	1404.43	757289.	50046.	159.604	860.56	0.020	5.547		
1.00	3564.	94.2	92.0	711.30	1048.15	563466.	32956.	113.352	869.32	0.036	5.584		
0.82	3571.	94.3	93.1	602.82	886.68	477055.	27452.	94.837	872.50	0.049	5.633		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3571.	224.	5.63	1741.5	755.9	13.9	592.7	27.6	344.9	11.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/06/11, REVISION DATE 83-11-20) 199

APPENDIX I

BASIC SPECIFICATIONS

HORSE-POWER	=	700.
POLES	=	2.
LINE VOLTAGE	=	4160.
FRAME SIZE	=	688.5
MOTOR TYPE	=	CF
W DESIGN	=	B
ENCLOSURE	=	JPI

EXCEPTIONS

(1)	(2)	(3)	(4)*	(6)	(7)	(8)	(9)	(10)	(11)	
PHASE	FREQ1	FREQ2	O.VOLT	POT/FLT	TS/FLT	KVA/HP	(S)MIN	(S)MAX	EFF	
3.	60.0	0.0	80.	175.	60.	6.30	0.0	2.5	94.3	
(12)	(13)*	(14)*	(15)	(16)	(17)	(18)	(19)*	(20)*	(21)	
P.F.	'S'	WKK	ALTITUDE	(AMB)MAX	(AMB)MIN	TIME	S.F.	(RISE)SF	(RISE)FL	
91.4	1.	224.0	3300.	40.	-30.	24.00	1.15	70.	0.	
(22)	(23)*	(24)	(25)*	(26)*	(27)	(28)	(29)	(30)	(31)	
RES TEMP	RISE CAL	HARMONIC	(LT)MIN	(LT)MAX	STR BORE	STR I.D.	RTR O.D.	STR TYPE	STR VENT	
95.	1.	0.0	1.	1.	0.	15.500	15.300	0.	0.	
(32)*	(33)*	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)*	
S1	STR PCHG	RTD	STR IRON	SP HTR	TH GRD	S.L.	WEDGE	RTR TYPE	(COND)R	
48.	1.	0.	0.	0.0	0.0	0.0	0.	0.	2.	
(42)*	(43)	(44)*	(45)*	(46)	(47)	(48)	(49)	(50)	(51)	
(COND)R	RTR VENT	S2	RTR PCHG	E-RING-F	E-RING-R	RTR IRON	RTR BORE	SHAFT	SKEW	
1.	0.	87.	2.	0.	0.	0.	2.	0.	0.0	
(53)*	(54)*	(55)	(56)	(57)	(60)*	(61)	(62)*	(63)	(64)	
BAR EXT	RING WDH	RING SPT	'S' TEMP	(F+W)NL	INS TYPE	INS VOLT	STR WIRE	(COND)1	(WT)1	
2.880	2.250	0.	0.	0.	2.	3.1	12.	1.000	1.000	
(65)	(66)	(67)*	(68)*	(69)*	(70)*	(71)	(72)*	(73)*	(74)*	
NO.VOLT	PH BELTS	THROW	CONN	PAR	(TPC)1	1/2 TURN	(W1)1	(W2)1	(TK1)1	
1.0	1.	20.	1.	1.	7.	0.	0.204	0.204	0.081	
(75)*	(76)	(77)	(78)*	(79)	(80)	(81)	(82)	(83)	(84)	
(P1)1	(TK2)1	(P2)1	(M)1	(TPC)2	KD	(W1)2	(W2)2	(TK1)2	(P1)2	
1.	0.0	0.	1.	0.	0.0	0.0	0.0	0.0	0.	
(85)	(86)	(87)	(88)	(89)*	(90)*	(96)	(97)*	(98)		
(TK2)2	(P2)2	(M)2	COIL MI	I-SPEC	UNITS	'SHAFT'	BY-PASS	TYPE CAL		
0.0	0.	0.	0.	2.	1.	0.0	110011.	0.		

** WESTINGHOUSE PROPRIETARY INFORMATION

200
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APPENDIX I

TYPE	FRAME	H.P.	POLES	FREQ	ENCL	(RISE)SF	S.F.	TIME	DESIGN	VOLTAGE	(INS)CLASS
CF	688.5	700.0	2.	60.0	[illegible]	70.	1.15	24.00	B	4160.	B

PHASE	LINE VOLTAGE	WIRE TYPE	WIRE COND	WIRE WEIGHT	PHASE BELTS	*** CORE LENGTH *** TOTAL	STATOR(IRON)	ROTOR	STATOR I.D.	ROTOR O.D.	SINGLE AIR-GAP
3.	4160.	61152CL	1.025	0.975	60.	14.000	13.300	12.500	15.500	15.300	0.1000

	ASSEMBLY	PUNCHING	VENTS	SLOTS	IRON	THICK	IDENT.	(END-RING)	DWG & ITEM
STATOR		23D9694H01	2X0.500	48.	10502PF	0.018	00	UPPER	386D379H02
ROTOR		222A153H01	3X0.500	87.	10502PF	0.018	00	LOWER	386D379H02

NOISE	LOCKING	(+)CUSP	(-)CUSP	SHAFT	(F+W)NL	SKEW	RING COND	COND(BAR)	LENGTH	WIDTH(BAR)	DEPTH
				M	7897.	0.0	0.600***	1.000***	20.000	.250	1.250

UNIT P	UNIT E	UNIT I	UNIT Z	UNIT T	UNIT N
522200.	2401.8	72.474	33.140	1021.19	3600.

LB-CU	THROW	BALANCE	CONN	PAR	TPC	MCL	VCUI	VR	VB	CAL.(LOET)	MAX.
346.14	20.	YES	Y	1.	7.	49.208	1038.256	392.041	537.225	42.760***	44.000

W1	W2	TK1	P1	TK2	P2	M	SPACE-W	SPACE-D	*RR	KVAR	(PF)FLC
.204	.204	.081	1	.0	0	1	0.013	0.110	0.00271	112.0	97.8

(25.C)RTT	(95.C)	(I)NL	(W)NL	*XM	*CORE	(B)AG	(B)T1	(B)T2	(B)C1	(B)C2	(B)T1X
0.4868	0.6182	20.415	15685.	3.48529	0.01417	40.39	91.67	124.85	85.47	121.57	136.57

		SLIP	RPM	EFF	P.F.	(HP)OUT	(T)OUT	INPUT	LOSSES	(I)L	CUI/LB
LOCKED	ROTOR(1)	100.00- 75C	0.	0.0	24.3	0.0	1459.37	1112766.	1112766.	634.976	1014.52
LOCKED	ROTOR(2)	100.00- 95C	0.	0.0	25.1	0.0	1478.17	1142425.	1142425.	632.654	1072.19
BREAK	DOWN	4.07	3454.	87.5	68.9	2202.74	3349.62	1878832.	236084.	378.537	383.85
1-1/4	LOAD	0.74	3573.	94.6	92.6	875.08	1286.18	689952.	37321.	103.457	28.67
1.15	LOAD	0.68	3576.	94.6	92.5	805.44	1183.05	635147.	34456.	95.262	24.31
FULL	LOAD	0.58	3579.	94.5	92.3	699.89	1027.03	552516.	30541.	83.119	18.51
3/4	LOAD	0.43	3584.	94.0	90.7	525.19	769.50	416795.	25114.	63.748	10.89
1/2	LOAD	0.29	3590.	92.6	86.1	350.00	512.06	281913.	20886.	45.451	5.53

		*R1	*R2	*X1	*X2	*(HP)OUT	*(T)OUT	*INPUT	*LOSSES	*(I)L	O/O SAT*
LOCKED	ROTOR(1)	0.00876	0.01903	0.07411	0.03697	0.0	1.42908	2.13092	2.13092	8.76142	76.3
LOCKED	ROTOR(2)	0.00933	0.01942	0.07414	0.03713	0.0	1.44749	2.18772	2.18772	8.72939	76.4
BREAK	DOWN	0.00933	0.00510	0.07828	0.05758	3.14677	3.28011	3.59792	0.45210	5.22307	93.3
1-1/4	LOAD	0.00933	0.00510	0.08409	0.06140	1.25012	1.25949	1.32124	0.07147	1.42750	99.9
1.15	LOAD	0.00933	0.00510	0.08409	0.06141	1.15063	1.15850	1.21629	0.06598	1.31443	99.9
FULL	LOAD	0.00933	0.00510	0.08409	0.06143	0.99985	1.00572	1.05805	0.05849	1.14687	100.0
3/4	LOAD	0.00933	0.00510	0.08409	0.06145	0.75027	0.75353	0.79815	0.04809	0.87960	100.0
1/2	LOAD	0.00933	0.00510	0.08409	0.06146	0.50000	0.50144	0.53986	0.04000	0.62714	100.0

LOSSES(WATTS)	CORE	(CU)1	(CU)2	F+W	S.L.	TOTAL	% TRANSIENT	*XD	*XD'	(T)OC	(T)SC
1.15-LOAD	7401.	8415.	4163.	7737.	6740.	34456.	% NO KVAR	3.569	0.12877	1.85	0.0667
FULL-LOAD	7401.	6406.	3112.	7760.	5863.	30541.	% WITH KVAR	15.648	0.13246	7.84	

	CUI/LB	(C/S)I	CUR/LB	(C/S)R	CUB/LB	(C/S)B
LOCKED ROTOR	1014.52	6.04	4205.29	23.96	1285.78	7.32

ALL DATA ON THIS PAGE ARE CALCULATED

PERFORMANCE	PUT/FLT	(S)FL	(EFF)FL	(PF)FL	TS/FLT	(KVA/HP)S	SCORE	(RISE)SF
SPECIFIED	1.75	0.0- 2.5	94.3	91.4	0.60	6.30		70.
CALCULATED	3.26	0.6	94.5	92.3	1.42	6.54	-11	49.

MAXIMUM SAFE RISE	STR	E-R	BAR
COLD	155	200	300
HOT	117	171	271

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/04/11, REVISION DATE 83-11-20)

PROGRAM ME7337 IDENT SR363 S.O.65F15619 SO. CAL. EDISON DATE-88-07-12 ENGR-BANSAL PAGE 3 199

(1)

TYPE	FRAME	H.P.	POLES	PHASE	LINE VOLTS	FREQ	ENCL	SF RISE	S.F.	TIME	DESIGN	INS VOLT	INS CLASS	MAX KVAR	FLC PF	MTR WKK
CF	688.5	700.0	2.	3.	4160.	60.	WPI	70.	1.15	24.00	B	4160.	B	112.0	97.8	

(2)

		SLIP	RPM	EFF	P.F.	(HP)OUT	(T)OUT	LINE AMP
LOCKED	ROTOR(1)	100.00- 75C	0.	0.0	24.3	0.0	1459.37	634.98
LOCKED	ROTOR(2)	100.00- 95C	0.	0.0	25.1	0.0	1478.17	632.65
BREAK	DOWN	4.07	3454.	87.5	68.9	2202.74	3349.62	378.54
1-1/4	LOAD	0.74	3573.	94.6	92.6	875.08	1286.18	103.46
1.15	LOAD	0.68	3576.	94.6	92.5	805.44	1183.05	95.26
FULL	LOAD	0.58	3579.	94.5	92.3	699.89	1027.03	83.12
3/4	LOAD	0.43	3584.	94.0	90.7	525.19	769.50	63.75
1/2	LOAD	0.29	3590.	92.6	86.1	350.00	512.06	45.45

(3) LINE VOLTS = 4150.(100.0/0,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	23.0	0.0	1424.13	1058930.	1058930.	639.091	0.0	0.0	0.0	8.52	7.22
95.00	180.	3.4	22.6	47.54	1387.21	1035827.	1000585.	634.986	2.59	0.093	0.093		
90.00	360.	6.8	22.4	93.09	1358.06	1016662.	947438.	630.731	10.37	0.096	0.189		
85.00	540.	8.7	22.2	117.11	1139.01	1000845.	913697.	626.354	23.34	0.106	0.295		
80.00	720.	12.8	22.0	169.70	1237.81	987976.	861596.	621.864	41.49	0.113	0.409		
75.00	900.	16.9	22.0	221.97	1295.27	977804.	812429.	617.266	64.83	0.108	0.516		
70.00	1080.	20.6	21.9	266.69	1296.87	967402.	768662.	611.688	93.36	0.108	0.624		
65.00	1260.	24.1	22.0	310.11	1292.58	960320.	729187.	606.241	127.08	0.111	0.735		
60.00	1440.	27.7	22.1	354.70	1293.61	956014.	691620.	600.726	165.98	0.114	0.849		
55.00	1620.	31.3	22.3	400.90	1299.66	954317.	655456.	595.135	210.06	0.118	0.967		
50.00	1800.	35.1	22.5	448.70	1309.17	954445.	619924.	589.493	259.34	0.122	1.089		
45.00	1980.	38.8	22.6	495.42	1314.08	952378.	583001.	583.948	313.80	0.128	1.217		
40.00	2160.	42.6	22.9	544.87	1324.80	953288.	547022.	578.274	373.45	0.134	1.351		
35.00	2340.	46.6	23.3	599.62	1345.76	959361.	512258.	572.356	438.28	0.141	1.492		
30.00	2520.	51.1	24.2	675.98	1408.79	986411.	482345.	565.453	508.30	0.145	1.637		
25.00	2700.	56.0	25.5	769.11	1496.02	1025448.	451917.	557.813	583.51	0.145	1.781		
20.00	2880.	61.2	27.4	888.45	1620.14	1082625.	420078.	548.925	663.90	0.141	1.922		
15.00	3060.	67.1	30.2	1053.25	1807.67	1170814.	385349.	537.723	749.48	0.131	2.053		
10.00	3240.	74.8	37.1	1386.26	2247.05	1381997.	348148.	517.329	840.25	0.110	2.162		
9.50	3258.	75.8	38.4	1443.21	2326.43	1419961.	343639.	513.388	849.61	0.009	2.172		
9.00	3276.	76.8	39.8	1504.96	2412.63	1461032.	338656.	508.879	859.03	0.009	2.180		
8.50	3294.	77.9	41.4	1570.33	2503.68	1504191.	333056.	503.800	868.49	0.008	2.188		
8.00	3312.	78.9	43.2	1639.34	2599.51	1549342.	326731.	498.042	878.01	0.008	2.196		
7.50	3330.	80.0	45.1	1711.88	2699.85	1596259.	319549.	491.471	887.58	0.007	2.204		
7.00	3348.	81.1	47.2	1787.59	2804.10	1644528.	311347.	483.919	897.20	0.007	2.211		
6.50	3366.	82.2	49.5	1865.80	2911.14	1693450.	301933.	475.174	906.88	0.007	2.217		
6.00	3384.	83.3	52.0	1945.33	3019.08	1741909.	291075.	464.972	916.60	0.006	2.224		
5.50	3402.	84.4	54.8	2024.21	3124.87	1788161.	278496.	452.978	926.38	0.006	2.230		
5.00	3420.	85.6	57.9	2099.32	3223.76	1829565.	263878.	438.767	936.21	0.006	2.236		
4.50	3438.	86.8	61.3	2165.85	3308.53	1862178.	246861.	421.801	946.09	0.006	2.241		
4.00	3456.	87.9	65.0	2216.56	3368.35	1880211.	227068.	401.405	956.02	0.005	2.247		
3.50	3474.	89.1	69.1	2240.77	3387.50	1875363.	204157.	376.740	966.01	0.005	2.252		
3.00	3492.	90.3	73.5	2223.27	3343.71	1836071.	177916.	346.789	976.04	0.005	2.258		
2.50	3510.	91.5	78.1	2141.08	3203.59	1745173.	148310.	310.230	986.13	0.006	2.263		
2.00	3528.	92.7	82.8	1974.16	2938.76	1588787.	116415.	266.252	996.27	0.006	2.270		
1.50	3546.	93.8	87.1	1688.97	2501.47	1343283.	83604.	213.465	1006.46	0.008	2.277		
1.00	3564.	94.7	91.2	1263.37	1861.67	995201.	52947.	151.500	1016.71	0.011	2.288		
0.51	3582.	94.7	92.2	700.22	1026.77	551327.	29082.	82.973	1026.77	0.030	2.319		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3582.	224.	2.32	1435.1	600.9	10.9	509.8	23.7	287.9	10.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/34/11, REVISION DATE 83-11-20)

APPENDIX I

PROGRAM MF7337 IDENT SA363 S.O.65F15619 SO. CAL. EDISON DATE-88-07-12 ENGR-BANSAL PAGE 4 199

(3) LINE VOLTS = 3744.1 90.0/0,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	22.7	0.0	1123.06	834570.	834570.	566.914	0.0	0.0	0.0	10.72	9.22
95.00	180.	3.4	22.4	37.50	1094.23	816567.	788765.	563.335	2.59	0.118	0.118		
90.00	360.	6.8	22.1	73.45	1071.53	801676.	747053.	559.628	10.37	0.122	0.240		
85.00	540.	8.7	21.9	92.43	898.92	789427.	720646.	555.813	23.34	0.135	0.375		
80.00	720.	12.8	21.8	133.96	977.16	779509.	679739.	551.901	41.49	0.145	0.520		
75.00	900.	16.9	21.7	175.27	1022.78	771721.	641133.	547.894	64.83	0.138	0.658		
70.00	1080.	20.6	21.7	210.65	1024.35	763798.	606817.	543.032	93.36	0.139	0.796		
65.00	1260.	24.1	21.7	245.01	1021.25	758489.	575871.	538.284	127.08	0.143	0.940		
60.00	1440.	27.7	21.8	280.32	1022.35	755374.	546419.	533.473	165.98	0.150	1.089		
55.00	1620.	31.3	22.0	316.92	1027.41	754328.	518070.	528.597	210.06	0.156	1.246		
50.00	1800.	35.1	22.2	354.80	1035.19	754726.	490210.	523.673	259.34	0.164	1.410		
45.00	1980.	38.8	22.4	391.83	1039.31	753377.	461233.	518.830	313.80	0.174	1.585		
40.00	2160.	42.6	22.6	431.04	1049.03	754393.	432999.	513.874	373.45	0.187	1.772		
35.00	2340.	46.6	23.0	474.47	1064.88	759516.	405728.	508.703	438.28	0.201	1.973		
30.00	2520.	51.1	24.0	535.10	1115.18	781350.	382333.	502.679	508.30	0.212	2.185		
25.00	2700.	55.9	25.3	609.11	1184.80	812770.	358548.	496.014	583.51	0.217	2.402		
20.00	2880.	61.2	27.1	704.07	1283.91	858725.	333674.	488.262	663.90	0.215	2.617		
15.00	3060.	67.0	30.0	835.43	1433.84	929587.	306556.	478.497	749.48	0.202	2.819		
10.00	3240.	74.8	36.8	1101.80	1785.96	1099417.	277708.	460.755	840.25	0.168	2.987		
9.50	3258.	75.8	38.1	1147.52	1849.78	1130048.	274241.	457.324	849.61	0.013	3.000		
9.00	3276.	76.8	39.6	1197.15	1919.19	1163232.	270406.	453.398	859.03	0.013	3.013		
8.50	3294.	77.8	41.2	1249.78	1992.60	1198168.	266091.	448.972	868.49	0.012	3.025		
8.00	3312.	78.9	42.9	1305.43	2070.02	1234792.	261208.	443.951	878.01	0.011	3.036		
7.50	3330.	79.9	44.8	1364.03	2151.25	1272947.	255654.	438.217	887.58	0.011	3.047		
7.00	3348.	81.0	46.9	1425.35	2235.87	1312326.	249300.	431.620	897.20	0.010	3.057		
6.50	3366.	82.1	49.2	1488.88	2323.03	1352400.	241991.	423.973	906.88	0.010	3.067		
6.00	3384.	83.2	51.7	1553.71	2411.29	1392305.	233541.	415.040	916.60	0.009	3.076		
5.50	3402.	84.4	54.5	1618.32	2498.28	1430683.	223728.	404.521	926.38	0.009	3.084		
5.00	3420.	85.5	57.6	1680.27	2580.26	1465455.	212292.	392.038	936.21	0.008	3.092		
4.50	3438.	86.7	61.1	1735.74	2651.50	1493481.	198939.	377.106	946.09	0.008	3.100		
4.00	3456.	87.9	64.8	1778.95	2703.34	1510126.	183356.	359.114	956.02	0.008	3.108		
3.50	3474.	89.1	69.0	1801.28	2723.09	1508680.	165252.	337.102	966.01	0.007	3.115		
3.00	3492.	90.3	73.4	1787.59	2688.47	1477455.	144233.	310.510	976.04	0.008	3.123		
2.50	3510.	91.4	78.1	1727.79	2585.21	1409492.	120863.	278.246	986.13	0.008	3.131		
2.00	3528.	92.6	83.0	1596.02	2375.86	1285681.	95327.	238.988	996.27	0.009	3.139		
1.50	3546.	93.7	87.7	1370.26	2029.43	1091015.	69038.	191.854	1006.46	0.011	3.150		
1.00	3564.	94.6	91.7	1025.92	1511.78	809413.	44250.	136.125	1016.71	0.017	3.168		
0.65	3577.	94.7	93.3	709.43	1041.72	558784.	29666.	92.351	1023.92	0.036	3.203		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3577.	224.	3.20	1536.8	650.9	11.9	538.8	24.7	306.9	10.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/04/11, REVISION DATE 83-11-20)

APPENDIX I

APPENDIX I

PROGRAM PE7337 IDENT SB363 S.O.65F15619 SO. CAL. EDISON DATE-88-07-12 ENGR-BANSAL PAGE 5 199

(3) LINE VOLTS = 3328.(80.U/O,STR 40C,RTR 40C)

ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	22.4	0.0	862.08	640516.	640514.	496.497	0.0	0.0	0.0	14.02	12.02
95.00	180.	3.4	22.0	28.80	840.15	626849.	605499.	493.419	2.59	0.154	0.154		
90.00	360.	6.8	21.8	56.41	822.91	615577.	573625.	490.233	10.37	0.159	0.313		
85.00	540.	8.7	21.6	71.00	690.50	606338.	553501.	486.955	23.34	0.177	0.490		
80.00	720.	12.8	21.5	102.93	750.76	598891.	522235.	483.593	41.49	0.190	0.680		
75.00	900.	16.9	21.4	134.69	785.98	593084.	492729.	480.149	64.83	0.183	0.863		
70.00	1080.	20.6	21.4	161.92	787.38	587206.	466539.	475.969	93.36	0.185	1.048		
65.00	1260.	24.1	21.4	188.37	785.16	583330.	442927.	471.886	127.08	0.194	1.242		
60.00	1440.	27.7	21.6	215.56	786.17	581145.	420461.	467.748	165.98	0.205	1.446		
55.00	1620.	31.3	21.7	243.75	790.20	580552.	398839.	463.552	210.06	0.218	1.664		
50.00	1800.	35.0	21.9	272.93	796.32	581076.	377593.	459.314	259.34	0.234	1.899		
45.00	1980.	38.8	22.1	301.46	799.61	580245.	355479.	455.143	313.80	0.256	2.155		
40.00	2160.	42.6	22.4	331.67	806.43	581243.	333939.	450.874	373.45	0.285	2.440		
35.00	2340.	46.5	22.8	365.14	819.52	585422.	313148.	446.419	438.28	0.322	2.761		
30.00	2520.	51.0	23.7	411.93	858.49	602549.	295376.	441.234	508.30	0.358	3.119		
25.00	2700.	55.8	25.0	469.09	912.45	627136.	277322.	435.498	583.51	0.387	3.506		
20.00	2880.	61.0	26.8	542.54	989.34	663046.	258454.	428.828	663.90	0.402	3.908		
15.00	3060.	66.9	29.6	644.32	1105.83	718407.	237898.	420.429	749.48	0.388	4.295		
10.00	3240.	74.6	36.4	851.48	1380.19	851199.	216177.	405.191	840.25	0.311	4.606		
9.50	3258.	75.6	37.7	887.16	1430.09	875223.	213586.	402.243	849.61	0.023	4.630		
9.00	3276.	76.6	39.2	925.95	1484.41	901286.	210718.	398.867	859.03	0.022	4.651		
8.50	3294.	77.7	40.8	967.13	1541.96	928771.	207486.	395.060	868.49	0.020	4.671		
8.00	3312.	78.7	42.5	1010.75	1602.75	957642.	203822.	390.737	878.01	0.019	4.690		
7.50	3330.	79.8	44.4	1056.78	1666.67	987792.	199645.	385.796	887.58	0.017	4.708		
7.00	3348.	80.9	46.5	1105.04	1733.42	1019002.	194856.	380.107	897.20	0.016	4.724		
6.50	3366.	82.0	48.8	1155.18	1802.39	1050881.	189335.	373.504	906.88	0.015	4.739		
6.00	3384.	83.1	51.4	1206.53	1872.50	1082784.	182937.	365.782	916.60	0.014	4.753		
5.50	3402.	84.3	54.2	1257.95	1941.95	1113680.	175488.	356.677	926.38	0.013	4.766		
5.00	3420.	85.4	57.3	1307.55	2007.91	1141975.	166781.	345.852	936.21	0.013	4.779		
4.50	3438.	86.6	60.7	1352.43	2065.95	1165247.	156583.	332.878	946.09	0.012	4.791		
4.00	3456.	87.8	64.5	1388.05	2109.33	1179880.	144642.	317.212	956.02	0.012	4.802		
3.50	3474.	88.9	68.6	1404.98	2123.99	1178360.	130492.	297.896	966.01	0.011	4.814		
3.00	3492.	90.1	73.2	1399.89	2105.38	1158590.	114517.	274.766	976.04	0.011	4.825		
2.50	3510.	91.3	78.0	1355.39	2028.00	1107264.	96376.	246.424	986.13	0.012	4.837		
2.00	3528.	92.5	82.9	1255.05	1868.29	1012572.	76515.	211.901	996.27	0.014	4.851		
1.50	3546.	93.5	87.8	1080.80	1600.73	862084.	55988.	170.341	1006.46	0.018	4.869		
1.00	3564.	94.3	91.9	810.26	1193.98	640805.	36488.	120.930	1016.71	0.034	4.903		
0.94	3570.	94.4	92.9	703.55	1035.08	555723.	30995.	103.779	1019.95	0.043	4.946		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3570.	224.	4.95	1757.1	763.9	13.9	596.7	27.6	347.9	12.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/06/11, REVISION DATE 83-11-20)

(3) LINE VOLTS = 3120.(75.0/0,STR 40C,RTR 40C) ALL DATA ON THIS PAGE ARE CALCULATED

(A) SLIP	(B) RPM	(C) EFF	(D) P.F.	(E) (HP)OUT	(F) (T)OUT	(G) INPUT	(H) LOSSES	(J) LINE AMP	(K) (T)LOAD	(L) (SEC)A	(M) (SEC)T	SOTC SEC	SOTH SEC
100.00	0.	0.0	22.2	0.0	746.19	554406.	554406.	461.893	0.0	0.0	0.0	16.12	13.82
95.00	180.	3.4	21.9	24.93	727.29	542644.	524162.	459.057	2.59	0.178	0.178		
90.00	360.	6.8	21.6	48.84	712.45	532955.	496635.	456.121	10.37	0.184	0.362		
85.00	540.	8.7	21.4	61.47	597.86	525027.	479278.	453.101	23.34	0.205	0.567		
80.00	720.	12.8	21.3	89.13	650.10	518652.	452272.	450.004	41.49	0.221	0.788		
75.00	900.	16.9	21.3	116.64	680.65	513696.	426788.	446.831	64.83	0.214	1.002		
70.00	1080.	20.6	21.2	140.23	681.93	508695.	404186.	442.979	93.36	0.217	1.219		
65.00	1260.	24.1	21.3	163.16	680.06	505425.	383815.	439.216	127.08	0.229	1.448		
60.00	1440.	27.7	21.4	186.72	680.98	503620.	364435.	435.402	165.98	0.245	1.694		
55.00	1620.	31.3	21.6	211.15	684.51	503198.	345787.	431.535	210.06	0.265	1.958		
50.00	1800.	35.0	21.8	236.44	689.85	503743.	327466.	427.627	259.34	0.289	2.248		
45.00	1980.	38.7	22.0	261.16	692.71	503112.	308391.	423.780	313.80	0.323	2.571		
40.00	2160.	42.5	22.2	287.34	698.64	504069.	289819.	419.842	373.45	0.372	2.943		
35.00	2340.	46.5	22.6	316.35	710.00	507790.	271900.	415.732	438.28	0.439	3.381		
30.00	2520.	50.9	23.5	356.92	743.85	522772.	256616.	410.952	508.30	0.516	3.898		
25.00	2700.	55.7	24.8	406.52	790.74	544250.	241097.	405.663	583.51	0.594	4.491		
20.00	2880.	61.0	26.7	470.29	857.61	575607.	224889.	399.515	663.90	0.657	5.149		
15.00	3060.	66.8	29.5	558.76	958.99	623941.	207236.	391.774	749.48	0.658	5.807		
10.00	3240.	74.5	36.2	739.19	1198.18	739928.	188649.	377.740	840.25	0.505	6.311		
9.50	3258.	75.5	37.5	770.33	1241.75	760944.	186440.	375.024	849.61	0.035	6.346		
9.00	3276.	76.5	39.0	804.19	1289.22	783760.	183994.	371.912	859.03	0.032	6.378		
8.50	3294.	77.6	40.6	840.18	1339.55	807841.	181234.	368.403	868.49	0.029	6.407		
8.00	3312.	78.6	42.3	878.33	1392.76	833159.	178102.	364.417	878.01	0.027	6.434		
7.50	3330.	79.7	44.2	918.61	1448.77	859633.	174528.	359.859	887.58	0.024	6.458		
7.00	3348.	80.8	46.3	960.91	1507.32	887076.	170425.	354.608	897.20	0.022	6.481		
6.50	3366.	81.9	48.6	1004.91	1567.92	915158.	165688.	348.510	906.88	0.021	6.501		
6.00	3384.	83.0	51.1	1050.05	1629.63	943330.	160193.	341.375	916.60	0.019	6.520		
5.50	3402.	84.2	53.9	1095.34	1690.93	970707.	153784.	332.955	926.38	0.018	6.538		
5.00	3420.	85.3	57.1	1139.19	1749.36	995910.	146283.	322.937	936.21	0.017	6.554		
4.50	3438.	86.5	60.5	1179.04	1801.09	1016836.	137483.	310.918	946.09	0.016	6.570		
4.00	3456.	87.7	64.3	1210.98	1840.24	1030336.	127160.	296.390	956.02	0.015	6.585		
3.50	3474.	88.9	68.4	1227.05	1855.00	1030091.	114928.	278.486	966.01	0.015	6.600		
3.00	3492.	90.1	73.0	1223.60	1840.24	1013644.	101052.	256.967	976.04	0.015	6.615		
2.50	3510.	91.2	77.8	1185.74	1774.17	969626.	85265.	230.565	986.13	0.016	6.631		
2.00	3528.	92.4	82.9	1100.76	1638.61	889014.	68031.	198.500	996.27	0.018	6.649		
1.50	3546.	93.4	87.8	948.26	1404.43	757289.	50046.	159.604	1006.46	0.025	6.674		
1.00	3564.	94.2	92.0	711.30	1048.15	563466.	32956.	113.352	1016.71	0.061	6.735		
0.97	3565.	94.2	92.2	693.16	1021.10	548938.	31956.	110.171	1017.36	0.047	6.782		

(4)	RPM	WKK	(SEC)T	(KW-S)TL	(KW-S)I	(RISE)I	(KW-S)R	(RISE)R	(KW-S)B	(RISE)B
ACCELERATION	3565.	224.	6.78	2009.5	895.9	15.7	659.6	30.5	394.9	13.9

(RECORD FILE C7337FX 74-08-25, PROGRAM VERSION 74/34/11, REVISION DATE 83-11-20) 199

APPENDIX I

APPENDIX II

S.O.	Style No.			S.O.C.		Serial
65F15619				6.. 5H4C		792473

Rot. Serial	Prim. Amps	H.P.	Volts	Phase	Cycles	Poles	R.P.M.
1-(2)	72	600	4160	3	60	2	3580

SASR		Volts			Amperes			Watts	R.P.M.
NO LOAD	STD	4160			17.7			15,900	
	TEST	4160		18.0	18.10	18.10		16,700	

- Sec. Volts: NTRS — Test: Spin H.P. [illegible]
- Res. Prim.: [illegible] ok — Test: [illegible]
- Res. Prim. Std.: 9450 OK — Test: [illegible]
- Balance: OK — [illegible] — In Machine Name: [illegible] Locked Rotor Amps
- End Play: HTR, 480V, 5A — Do Oil Rings Turn: N.L. Brg. Temp Run
- Coil Amps: NTRS 480V, 48A — Rotation: (Locked Rotor Amps 708)
- Bearings: [illegible] — Connection Star Delta: Cust. [illegible] CPLG.
- Remarks: NTRS [illegible] Power House Aux — Date Rec'd
- Passed by: PJL — Date: 10-26-65 — Inspected by: [illegible] — Date: 10-26-6[illegible]
- Released by: [illegible] — Date: 10/27/65 — Shipped by: [illegible] — Date: 10-26

TEST RECORD—INDUCTION MOTORS WESTINGHOUSE FORM 2660M

65F15619

Where caps cannot be taken Rot.______ Stat. 15 510

S.O. [illegible] 15

End Play______ Insp.______

No. blower rub. int.______ Final brg. front 35

" " " ext.______ Temp. Rear 35

Balance - on rubber - on steel Room 29 °C

	on rubber	on steel
Front		.00075
Rear		.00015
Axial		.00025

Limit______

Floats OK

Commutator indicates______ Run Till Brg. Tem Flat

Tester PJL Insp.______ Date______

BU226

Locked Rotor Amps

65F15619

[illegible] 15

LV X-1 4160

LA X-1 660 660 672

PJL, JE 10-26-65

S.O.	STYLE NO	TYPE		STA. SERIAL		L. SPEC.	
65F15619		CSP (?)				792470	
ROT. SERIAL	PRIM. AMPS	H.P.	VOLTS	PHASE	CYCLES	POLES	R.P.M.
2-(2)	72	600	4160	3	60	2	3580

		VOLTS		AMPERES			WATTS	R.P.M.
NO LOAD	STD	4160			17.7		15960	
	TEST	4160		17.7	17.4	17.7	16500	

Sec. Volts St'd. [illegible] Amps. OVER

Res. Prim. St'd. [illegible] Sec. St'd. Test O.K.

Ins. Prim. St'd. 94 Test OK Sec. St'd. Test [illegible] + Chk

Balance — In Machine Runs LOCKED ROTOR AMPS — H.L.

End Play [illegible] .5A Do Oil Rings Turn BRG. TEMP RUN (LOCKED

Coll. Rings ADV — .4 [illegible] Rotation ROTOR AMPS 7[illegible])

Bearings [illegible] OK Connection Star Delta CUST [illegible]

Remarks POWERHOUSE AUX Date Rec'd

Tested by [illegible] Date 10/27/65 Inspected by [illegible] Date [illegible]

Released by [illegible] Date 12/21/65 Shipped by [illegible] Date [illegible]

TEST RECORD — INDUCTION MOTORS [illegible] 2000M

65F15619 m 25

T1-T3 — 2.440

T1-T2 — 2.435

T2-T3 — 2.425

[illegible]

520

510

470

[illegible]

LOCKED ROTOR [illegible]

[illegible]

F R

S.O. 65F15619

Where caps cannot be taken Rot. 2 Stat. 2

Insp.

End Play ______ Final brg. front 26 °C

No. blower rub. int. ______ Temp. Rear 35 °C

" " " ext. ______ Room 28 °C

Balance - on rubber - on steel

Front [illegible] WITH HALF KEY ______ Limit ______

Rear [illegible] ______ Floats OK

Axial [illegible] ______ Run TILL BRG TEMP FLAT

Commutator indicates ______

Tester ______ Insp. ______ Date ______

BU226

TESTS AND CURVES REQUIRED	✓
ENGINEERING TEST	
COMMERCIAL TEST	
TEST OF NOISE see attached	
TEST FOR DEAD POINTS	
INSULATION TEST STANDARD—SPECIAL	
PERFORMANCE CURVES BY LOSSES—DIAGRAM	
PERFORMANCE CURVES BY BRAKE TEST	
SPEED TORQUE CURVE incl watts	
RUNNING SATURATION	
LOCKED SATURATION—FULL VOLTAGE POINT—CURVE	
COLD RESISTANCES	
HOT RESISTANCES	
TEMP. BY THERMOMETER	✓
FULL LOAD TEMP. RUN ... BELTED	
% OVERLOAD TEMP. RUN ... BELTED	
% OVERLOAD TEMP. RUN ... BELTED	
NO LOAD RATED VOLTAGE TEMP. RUN	
ARE SPECIAL TESTS PARTS REQD. YES NO	

TEMP. RISE GUAR., FULL LOAD 24 HRS. 60 C
Test With filters % OVERLOAD ... HRS. ... C
% OVERLOAD ... HRS. ... C

DATA	CALC	GUAR.		TEST	CALC. DIAG VALUES
FREQUENCY	[illegible]			60	
VOLTS	4160			4160	
MAG. AMPS. PER TERM. AT N. L. NORMAL VOLTS	16.2			17.7	
LOCKED AMPS. PER TERM. AT ... VOLTS—COLD					
LOCKED AMPS. PER TERM. AT NORMAL TEMP.	655			643	
ST'G. AMPS. (NEEDLE SWING) AT NORMAL TEMP.—N. L.					
LOCKED #FT. MAIN WDG. AT ... VOLTS—COLD				1500	
LOCKED AMPS. AUXIL. WDG. AT ... VOLTS—COLD					
LOCKED K-WATTS MAIN WDG. AT ... VOLTS—COLD	1260			1275	
LOCKED K-WATTS AUXIL. WDG. AT ... VOLTS—COLD					
MINIMUM STARTING VOLTAGE, NO LOAD				✓	
MAX. SEC. VOLTS BETWEEN RINGS					
SEC. AMPS. PER RING AT NORMAL HP					
STATOR RESISTANCE (T-T) AT 25°C—(75)	.571			.585	
AUXIL. WINDING RES. AT 25°C—75°C					
ROTOR RES. (SET RINGS) AT 25°C—75°C				[illegible]	0
STRAY LOAD LOSS	4500			6630	
STATOR I²R LOSS AT FULL LOAD	4200			4640	
ROTOR I²R LOSS AT FULL LOAD	2200			2005	
CORE LOSS ONLY	5100			6025	
FRICTION AND WINDAGE LOSS	8800			9600	
NO LOAD I²R	305			275	
TOTAL NO LOAD LOSSES				15,900	
GOVERNOR R.P.M.					
FULL LOAD R.P.M.	3584			3584.5	
FULL LOAD WATTS KW	472			476.5	
FULL LOAD AMPS.	71	74		72.7	
FULL LOAD TORQUE—OZ. LB. FT.	881			879	
PULL-IN TORQUE ÷ F.L.T. OZ. LB. FT.					
MAX TORQUE ÷ F.L.T.—OZ. LB. FT.	3.82			3.84	
STARTING TORQUE ÷ F.L.T.—OZ. LB. FT.	1.84			1.79	
% SLIP AT FULL LOAD	.444			.431	
EFFICIENCY 1¼ LOAD					
FULL LOAD	94.7	93.0		93.9	
¾ LOAD	94.4	92.5		92.9	
½ LOAD	94.2	91.0		90.7	
¼ LOAD				84	
APPARENT EFFICIENCY AT FULL LOAD					
POWER FACTOR 1¼ LOAD					
FULL LOAD	92.2	90.0		91	
¾ LOAD	92.2	88.0		89.8	
½ LOAD	88.0	85.0		83.3	
¼ LOAD				70.3	

TEMP TESTS	NO. 1	NO. 2	NO. 3	NO. 4
DATE OF TEST	11/13			
% ... LOAD HP	299			
KIND OF LOAD	DYNO			
LENGTH OF TEST Hrs.	4.25			
NORMAL AMP.				
FRAME				
STATOR CORE	31			
COP. TH.	24			
RES.	26.5			
COUPLE				
TH.				
RES.	17,100			
ROTOR COP. TH.				
RES.				
ROTOR IRON				
...	13			
... IN	26			
AIR OUT	38.5			
FREQUENCY	60			
VOLTS	4160			
WATTS K.W	464			
AMPS.—PH. 1	72			
AMPS.—PH. 2	71			
AMPS.—PH. 3	71			
R.P.M.	3584			
93 SLIP	.444			
AIR. TEMP.	27			

NOISE DATA: METER READINGS

ENGR'S COMMENTS

N.L.— ... WINDAGE— ... MAGNETIC ... PITCH
F.L.— ... WINDAGE— ... MAGNETIC ... PITCH
O.K. OBJ.—QUIET APPL. ... O.K. OBJ.—COMML. APPL. QUIET AT ... H.P. AMPS. ... VOLTS
STA. BORE ... ROTOR O.D. ... AIR GAP (SINGLE) SPEC. ... ACTUAL

NOTE—(INCLUDING RECORD OF CHANGES DURING TEST) Also take tests per attached sheet to meet customers specs. No witness test. Customer inspection only maybe

INSULATION TEST STATOR ... VOLTS ROTOR ... VOLTS CHARGE TESTING TO (76)
CUSTOMER ... APPROVED ... DATE ...
C ... NUMBERS ... TEST RECORDED BY ... DATE ...

DATA SHEET FOR INDUCTION MOTOR

6/14 1964

AIR COOLED—O.E./O.E. EXTERNAL—INTERNAL VENT. WPI WITH FILTERS
OPEN—SEMI-ENCLOSED—SPLASH DRIP PROOF—WITHOUT FAN
HOR.-VERT.-TAPER-STR. SHAFT ELEC. D220829 LINESTART CLASS ... STATOR NO. ... SIGNATURE ...
SLEEVE BEARINGS—NO CLUTCH MECH. D221196 GEN. PURPOSE ... ROTOR NO. ... CAPACITOR ...
TYPE CSP FRAME NO. 6886S-A TYPE ROTOR Brazed
600 HP. 3 PHASE 60 CYCLES 2 POLES 4160 VOLTS 35 ... R.P.M.
O. 27N2703 NO. MCHS. ON ORDER 3 DUP. OF S.O. ... 1 282424

APPENDIX IV
TEST 2

TESTS AND CURVES REQUIRED	√
ENGINEERING TEST	✓
COMMERCIAL TEST	
TEST OF NOISE	
TEST FOR DEAD POINTS	
INSULATION TEST STANDARD—SPECIAL	
PERFORMANCE CURVES BY LOSSES—DIAGRAM	
PERFORMANCE CURVES BY BRAKE TEST	
SPEED TORQUE CURVE	
RUNNING SATURATION	
LOCKED SATURATION—FULL VOLTAGE POINT—CURVE	
COLD RESISTANCES	
HOT RESISTANCES	
TEMP. BY THERMOMETER	
FULL LOAD TEMP. RUN. SELTED	
% OVERLOAD TEMP. RUN. SELTED	
% OVERLOAD TEMP. RUN. SELTED	
NO LOAD RATED VOLTAGE TEMP. RUN	
ARE SPECIAL TESTS PARTS REQD. - YES NO	

TEMP RISE GUAR. FULL LOAD 24 HRS 40 C
% OVERLOAD HRS C
% OVERLOAD HRS C

TEMP TESTS	NO 1	NO 2	NO 3	NO 4
OF TEST	1-7-57			
[illegible] HP	601.5			
KIND OF LOAD	DYNO			
LENGTH OF TEST				
% NORMAL AMP.				
RISE FRAME				
RISE STATOR CORE	22			
[illegible] COP. TH.	22.5			
RES.	29			
THERMOCOUPLE				
[illegible]				
WL [illegible]	29400			
ROTOR COP. TH.				
RES.				
ROTOR IRON	19.5			
[illegible]	12.5			
AIR IN	29			
AIR OUT	38			
FREQUENCY	60			
VOLTS	4600			
WATTS	478400			
AMPS—PH 1	65			
AMPS—PH 2	65.1			
AMPS—PH 3	65			
R.P.M.	3572.3			
% SLIP	.77			
AIR TEMP	28.5			

DATA	CALC.	GUAR.		TEST	CHAR. VALUES
FREQUENCY	60			60	
VOLTS	4600			4600	
MAG. AMPS. PER TERM. AT N. L. NORMAL VOLTS	11.55			11.7	
LOCKED AMPS. PER TERM. AT ... VOLTS—COLD					
LOCKED AMPS. PER TERM. AT NORM. TEMP.	335	350		312.5	RATIOED FROM 2440 VOLTS
ST'G. AMPS. (NEEDLE SWING) AT NORM. TEMP.—N. L.					
LOCKED AMPS. MAIN WDG. AT ... VOLTS—COLD				810	
LOCKED AMPS. AUXIL. WDG. AT ... VOLTS—COLD					
LOCKED K-WATTS MAIN WDG. AT ... VOLTS—COLD				483	
LOCKED K-WATTS AUXIL. WDG. AT ... VOLTS—COLD					
MINIMUM STARTING VOLTAGE, NO LOAD					
MAX. SEC. VOLTS BETWEEN RINGS					
SEC. AMPS. PER RING AT NORMAL HP.				✓	
STATOR RESISTANCE (T-T) AT 25°C—75°C	.822			.85	
AUXIL. WINDING RES. AT 25°C—75°C					
ROTOR RES. (SET RINGS) AT 25°C—75°C				[illegible]	
STRAY LOAD LOSS	7700			8446	
STATOR I²R LOSS AT FULL LOAD	5450			5390	
ROTOR I²R LOSS AT FULL LOAD	4680			3640	
CORE LOSS ONLY	3270			3124	
FRICTION AND WINDAGE LOSS	8100			8800	
NO LOAD I²R	137			176	
TOTAL NO LOAD LOSSES	11507			12100	
GOVERNOR R.P.M.					
FULL LOAD R.P.M.	3564	3560		3572	
FULL LOAD WATTS	476800			477[illegible]	
FULL LOAD AMPS.	66.5	66.5		65	
FULL LOAD TORQUE—OZ. LB. FT.				883	
PULL-IN TORQUE % F.L.T. OZ. LB. FT.				.85	
MAX. TORQUE % F.L.T.—OZ. LB. FT.	2.32	2.00		2.12	
STARTING TORQUE % F.L.T.—OZ. LB. FT.	.99	.90		.918	
% SLIP AT FULL LOAD	[illegible]			.778	
EFFICIENCY 1¼ LOAD				94[illegible]	
FULL LOAD	93.9	93.5		93	
¾ LOAD		92.5		93	
½ LOAD		90		92	
¼ LOAD				87.5	
APPARENT EFFICIENCY AT FULL LOAD					
POWER FACTOR 1¼ LOAD				91.3	
FULL LOAD	90	90		92.2	
¾ LOAD		88		91.7	
½ LOAD		80		89	
¼ LOAD				76.3	

F-11

NOISE DATA: METER READINGS

ENGR'S COMMENTS

N.L.— WINDAGE— MAGNETIC PITCH
F.L.— WINDAGE— MAGNETIC PITCH
O.K. OBJ. —QUIET APPL. O.K. OBJ. —COMM. APPL. QUIET AT H.P. AMPS VOLTS
STA. CORE ROTOR O.D. AIR GAP (SINGLE) SPEC. ACTUAL

NOTE—INCLUDING RECORD OF CHANGES DURING TEST: Ratio from L 536186 except rated 600 HP instead of 450. Thermalastic Insulation
* customer to witness commercial test

INSULATION TEST STATOR VOLTS ROTOR VOLTS CHARGE TESTING TO

CUSTOMER The Detroit Edison Co. APPROVED Kossler DATE 1-8-59

NUMBERS 502300-301 TEST RECORDED BY J. M. Lusczak DATE 1-19-60

DATA SHEET FOR INDUCTION MOTOR 4-14-1958

OPEN DRIP-PROOF

ELEC. D 531805 LINESTART CLASS Dis B STATOR NO. SIGNATURE Kossler

SLEEVE BEARINGS MECH. D 508989 GEN. PURPOSE ROTOR NO. CAPACITOR

TYPE CSP FRAME NO. 683-H TYPE ROTOR Sk[illegible]

600 HP 3 PHASE 60 CYCLES 2 POLES 4600 VOLTS 3564 R.P.M.

S.O. 18K6408 NO. MCHS ON ORDER 2 MOTOR L-453272

APPENDIX V

September 9, 1988

Mr. L. Elder:

SUBJECT: Charging Pump Motor Recertification
San Onofre Nuclear Generating Station, Unit 1

Reference: 1. Memo from G. J. Stawniczy to W. W. Strom dated August 15, 1988

2. Letter from L. E. Elder (W) to G. J. Stawniczy dated July 15, 1988

The above references provide information on overload and normal loading conditions for the charging pump motor recertification effort. To further clarify these references, the following values are stated:

796 HP for 6 hours
694 HP for 30 days
600 HP for normal operation

The attached memo for file provides information on the rewind of the south charging pump motor in 1972.

Allen J. Thiel

APPENDIX VI

SAN ONOFRE NUCLEAR GENERATING STATION

MEMORANDUM FOR FILE

June 21, 1972

SUBJECT: SOUTH CHARGING PUMP AND MOTOR FAILURE

On April 30, 1972, a routine unit startup was in progress with no unusual conditions existing. The unit was on the line at 55 MWe and the auxiliaries on A & B transformers. The unit tripped on high steam generator level at 12:53:24 a.m.

One minute after the trip, the south charging pump was running and pumping from the volume control tank. Four minutes later the low level in the volume control tank initiated an "open" signal to the refueling water storage tank suction valve and a "close" signal to the volume control tank suction valve (MOV-LCV 1100 C). However, electrical bus 2C was de-energized and the motor for MOV-LCV 1100 C had no power. Consequently, the south charging pump continued to pump from the volume control tank until power was restored to bus 2C (about four minutes). It is estimated that the pump cavitated for three minutes under hydrogen pressure from the volume control tank. The charging pump was vented twelve minutes after the trip but eventually failed some twenty-two minutes after venting.

Subsequent investigation revealed that the pump had seized and caused the motor to burn up. The motor was shipped to Westinghouse in Los Angeles for repair. The pump was dismantled, inspected, and repaired on station.

The pump was found in the following condition:

1. Pressure break-down sleeve fused to the pressure break-down bushing.
2. The 5th, 8th, 9th, 10th and 11th stage impeller wear rings fused to the inter-cover wear rings.
3. Inboard and outboard bearings and mechanical seals had excessive clearances.

Repair of the pump required 49 shifts, 123 mandays and the following parts:

1. New pump shaft
2. New impeller wear rings
3. New inter-cover wear rings

4. New inter-cover bushings
5. New impeller spacers
6. New impeller lock nut
7. New thrust runner
8. New inboard and outboard mechanical seals and bearings.

The pump was returned to service May 22, 1972. Bearing oil temperature and pump vibrations were normal. The motor was drawing 59 amps at 87 gpm.

KSF:kk

APPENDIX VII

ATTACHMENT 2

INDUCTION MOTOR DATA SHEET (600 HP - Original Rating)

1. MOTOR NO.		G8A	G8B		
2. SERVICE		Charging Pump			
3. M/R NO.					
4. HORSEPOWER		600	600		
5. SERVICE FACTOR		1.15			
6. VOLTAGE		4160	DATA		
7. PHASE		3	SAME		
8. FREQUENCY HERTZ		60	AS		
9. SYNCHRONOUS SPEED - RPM		3600	G8A		
10. FULL LOAD SPEED - RPM		3583			
11. NEMA DESIGN LETTER		J			
12. INSULATION CLASS		B			
13. TEMP. RISE °C (BY RESIS.)		40			
14. FULL LOAD CURRENT		72			
15. LOCKED ROTOR CURRENT		639			
16. LOCKED ROTOR TORQUE - % F. L.		166			
17. BREAKDOWN TORQUE - % F. L.		382			
18. EFFICIENCY: 100% LOAD		94.3			
75% LOAD		93.6			
50% LOAD		91.9			
19. POWER FACTOR: 100% LOAD		91.6			
75% LOAD		89.3			
50% LOAD		83.4			
20. ENCLOSURE*		WP-1			
21. MOUNTING		H			
22. ROTATION**		CCW			
23. BEARING TYPE		SLEEVE			
24. FRAME NO.		688.5H			
25. MANUFACTURER		WESTINGHOUSE			
26. SERIAL NO.					
27. SPACE HEATER WATTS		230			
VOLTS 1Φ OR 3Φ		480V 1Φ			
28. O/A DIMEN DWG NO		4117D64			
29. WEIGHT		5200 LBS.			
30. % SLIP (NEMA "D" ONLY)		N/A			
31. V BELT		N/A			
32. [illegible]		MOTOR -	193 $LB-FT^2$		
		LOAD	31 $LB-FT^2$		

MOTOR NO.		G8A	G8B		
33. STALLED MOTOR PF		24.3			
34. OPEN CIRCUIT TIME CONSTANT		1.89			
35. SHORT CIRCUIT TIME CONSTANT		.068			
36. TRANSIENT REACTANCE AND X/R		xd'= 0.110		x/R=18	
37. BUYER'S CABLE SIZE		4/0			
38. SPECIAL MODIFICATIONS					

* ENCLOSURE:
- XP - EXPLOSION PROOF (CHEMICAL TYPE)
- DP - DRIPPROOF
- TENV - TOTALLY ENCLOSED NON-VENTILATED
- TEFC - TOTALLY ENCLOSED FAN COOLED
- WP I - WEATHER PROTECTED - TYPE I
- WP II - WEATHER PROTECTED - TYPE II

** VIEWED FROM END OPPOSITE COUPLING

NO. DATE REVISIONS BY DATE APPD
SCALE
JOB NO. DRAWING NO. REV.

3-2-1

INDUCTION MOTOR DATA SHEET (700 HP - New Rating)

No.	Item				
1.	MOTOR NO.	G8A	G8B		
2.	SERVICE	Charging Pump			
3.	M/R NO.				
4.	HORSEPOWER	700	700		
5.	SERVICE FACTOR	1.15			
6.	VOLTAGE	4160	DATA		
7.	PHASE	3	SAME		
8.	FREQUENCY HERTZ	60	AS		
9.	SYNCHRONOUS SPEED - RPM	3600	G8A		
10.	FULL LOAD SPEED - RPM	3579			
11.	NEMA DESIGN LETTER	H			
12.	INSULATION CLASS	B			
13.	TEMP. RISE °C (BY RESIS.)	65			
14.	FULL LOAD CURRENT	83			
15.	LOCKED ROTOR CURRENT	639			
16.	LOCKED ROTOR TORQUE - % F. L.	142			
17.	BREAKDOWN TORQUE - % F. L.	326			
18.	EFFICIENCY: 100% LOAD	94.5			
	75% LOAD	94.0			
	50% LOAD	92.6			
19.	POWER FACTOR: 100% LOAD	92.3			
	75% LOAD	90.7			
	50% LOAD	86.1			
20.	ENCLOSURE*	WP-1			
21.	MOUNTING	H			
22.	ROTATION**	CCW			
23.	BEARING TYPE	SLEEVE			
24.	FRAME NO.	688.5H			
25.	MANUFACTURER	WESTINGHOUSE			
26.	SERIAL NO.				
27.	SPACE HEATER WATTS	230			
	VOLTS 1Φ OR 3Φ	480V 1Φ			
28	O/A DIMEN DWG NO				
29	WEIGHT	5200 LBS.			
30	% SLIP (NEMA "D" ONLY)	N/A			
31	V BELT	N/A			
32	[illegible]	MOTOR - 193 LB-FT² LOAD 31 LB-FT²			

No.	MOTOR NO.	G8A	G8B			
33.	STALLED MOTOR PF	24.3				
34.	OPEN CIRCUIT TIME CONSTANT	1.85				
35.	SHORT CIRCUIT TIME CONSTANT	.067				
36.	TRANSIENT REACTANCE AND X/R	xd' = .129 x/R = 18				
37.	BUYER'S CABLE SIZE	4/0				
38.	SPECIAL MODIFICATIONS					

* ENCLOSURE:
- XP - EXPLOSION PROOF (CHEMICAL TYPE)
- DP - DRIPPROOF
- TENV - TOTALLY ENCLOSED NON-VENTILATED
- TEFC - TOTALLY ENCLOSED FAN COOLED
- WP I - WEATHER PROTECTED - TYPE I
- WP II - WEATHER PROTECTED - TYPE II

** VIEWED FROM END OPPOSITE COUPLING

NO. DATE REVISIONS BY CHK'D APP'D
SCALE CHECKED DRAWN
JOB NO DRAWING NO REV

ATTACHMENT 2

APPENDIX VII

ESTIMATION OF TEMPERATURE RISE BY RESISTANCE
(From Test 1, S.O. 27N7703)

Ref. Test Rating 600 HP SF 1.00 (S.O. 27N7703)		New Rating 700 HP SF 1.15 (S.O. 67F15619)
49.21	MCL	49.21
71.5	% End	71.5
28.5	% Core	28.5
9.68	I_1^2R + LL	15.16
2.76	Core Portion	4.32
7.40	Core Loss	7.40
10.16	Σ in Core	11.72
6.92	Loss in Ends	10.84
2.22	I_2^2R	4.16
7.78	FW	7.74
27.08	Total Loss	34.46

Reference Temperature Test Data

Air Out = 38.5°C

Air In = 26°C

Air Rise = 12.5°C

Rise by Resistance = 26.5°C

Core Length = 14 inches

Air Rise New Rating

(1) Air rise of Reference = 12.5°C

Average Air Rise $= \frac{12.5}{2} = 6.25°C$

(2) Ratio as total losses per inch of core

$$\text{Air rise} = (6.25)\,\frac{34.46}{27.08} \times \frac{14}{14} = 8°\text{C average}$$

$$\text{Total air rise} = 8 \times 2 = 16°\text{C}$$

<u>Rise by Resistance New Rating</u>

Rise by Resistance of Reference = 26.50°C

Less Average Air - 6.25

Difference = 20.25

Rise by Resistance of New Design =

$$= \frac{20.25 \times \left(\frac{10.84}{6.92}\right) + \left(\frac{11.72}{10.16} \times \frac{14}{14}\right)}{2} + \text{Average Air}$$

$$= 27.54 + \text{Average Air}$$

$$+ 27.54 + 8 = 35.5°\text{C}$$

<u>Symbols</u>

MCL	=	Mean length of stator conductor in inches
% End	=	Percentage of end turn portion of stator conductor
% Core	=	Percentage of core portion of stator conductor
$I_1{}^2R$	=	Stator copper loss in kW
LL	=	Stray load loss in kW
Core portion & end turn loss	=	$(I_1{}^2R + LL)$ loss is separated in direct proportion to the length of mean conductor (MCL) in core and end turns.

ESTIMATION OF TEMPERATURE RISE BY RESISTANCE
(From Test 2, S.O. 18N6403)

Ref. Test Rating 600 HP SF 1.00 (S.O. 18N6403)		New Rating 700 HP SF 1.15 (S.O. 67F15619)
48.5	MCL	49.21
73.	% End	71.5
27.	% Core	28.5
13.84	$I_1{}^2R$ + LL	15.16
3.74	Core Portion	4.32
3.13	Core Loss	7.40
6.87	Σ in Core	11.72
10.10	Loss in Ends	10.84
3.64	$I_2{}^2R$	4.16
8.80	FW	7.74
29.40	Total Loss	34.46

Reference Temperature Test Data

Air Out = 38°C

Air In = 29°C

Air Rise = 9°C

Rise by Resistance = 29°C

Core Length = 13 inches

Air Rise New Rating

(1) Air rise of Reference = 9°C

Average Air Rise $= \frac{9}{2} = 4.5$°C

(2) Ratio as total losses per inch of core

$$\text{Air rise} = (4.5)\,\frac{34.46}{29.4} \times \frac{13}{14} = 5^\circ\text{C average}$$

$$\text{Total air rise} = 5 \times 2 = 10^\circ\text{C}$$

<u>Rise by Resistance New Rating</u>

Rise by Resistance of Reference	=	29.00°C
Less Average Air		- 4.50
Difference	=	24.50

Rise by Resistance of New Design =

$$= 24.50 \times \frac{\left(\frac{10.84}{10.10}\right) + \left(\frac{11.72}{6.87} \times \frac{13}{14}\right)}{2} + \text{Average Air}$$

$$= 32.55 + \text{Average Air}$$

$$+ 32.55 + 5 = 37.5^\circ\text{C}$$

APPENDIX VIII

ESTIMATION OF TEMPERATURE RISE BY RESISTANCE
(From Test 1, S.O. 27N7703)

Ref. Test Rating 299 HP SF 1.00 (S.O. 27N7703)		New Rating 700 HP SF 1.15 (S.O. 67F15619)
49.21	MCL	49.21
71.5	% End	71.5
28.5	% Core	28.5
4.02	$I_1{}^2R$ + LL	15.16
1.15	Core Portion	4.32
7.40	Core Loss	7.40
8.55	Σ in Core	11.72
2.87	Loss in Ends	10.84
.56	$I_2{}^2R$	4.16
7.84	FW	7.74
19.81	Total Loss	34.46

Reference Temperature Test Data

Air Out	= 38.5°C	Air Rise	= 12.5°C
Air In	= 26°C	Rise by Resistance	= 26.5°C
		Core Length	= 14 inches

Air Rise New Rating

(1) Air rise of Reference = 12.5°C

Average Air Rise $= \frac{12.5}{2} = 6.25$°C

(2) Ratio as total losses per inch of core

$$\text{Air rise} = (6.25)\ \frac{34.46}{19.81} \times \frac{14}{14} = 11°C \text{ average}$$

$$\text{Total air rise} = 11 \times 2 = 22°C$$

Rise by Resistance New Rating

Rise by Resistance of Reference = 26.50°C

Less Average Air - 6.25

Difference = 20.25

Rise by Resistance of New Design =

$$= 20.25 \times \frac{\left(\frac{10.84}{2.87}\right) + \left(\frac{11.72}{8.55} \times \frac{14}{14}\right)}{2} + \text{Average Air}$$

$$= 52.12 + \text{Average Air}$$

$$+ 52.12 + 11 = 63.1°C$$

Southern California Edison Company
P. O. BOX 800
2131 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

August 15, 1988

Mr. Lee Elder
Westinghouse Electric Corporation
9095 Telstar Avenue
El Monte, California 91731

Dear Mr. Elder:

SUBJECT: Recertification of Charging Pump Motors G8A/G8B
San Onofre Nuclear Generating Station Unit 1

Reference: 1. SCE letter from R. L. Phelps to D. Nastasy, dated July 22, 1988

2. Westinghouse letter from J. D. Nastasy to L. E. Elder, dated July 28, 1988

3. Westinghouse letter from J. D. Nastasy to L. E. Elder, dated August 2, 1988

As discussed with you and Mr. Don Fellows of SCE on July 22, 1988, we are requesting that Westinghouse immediately begin recertification of the existing charging pump motors (G8A, G8B) from 600 HP/Service Factor 1.15 to 700 HP/SF 1.15. Westinghouse is expected to provide a letter of certification with backup analyses for the charging pump motors and a certificate of conformance to the original Specification No. BSO-356 (Attachment 1) and the equipment qualification requirements in the Reference 1 letter. Please also provide a completed motor data sheet (Attachment 2) and supply existing test data/drawings for these motors. SCE is not requesting a new warranty on these motors.

In response to your questions in Reference Nos. 2 and 3 letters, Attachments 3, 4, and 5 are enclosed to provide the required information.

Completion of this work is expected by August 26, 1988. A new quotation for this work is also required as soon as possible.

If you have any questions regarding this material, please call me at (818) 302-8522, or Mr. Allen Thiel at (818) 302-7496.

Very truly yours,

A.A. Hernandez for

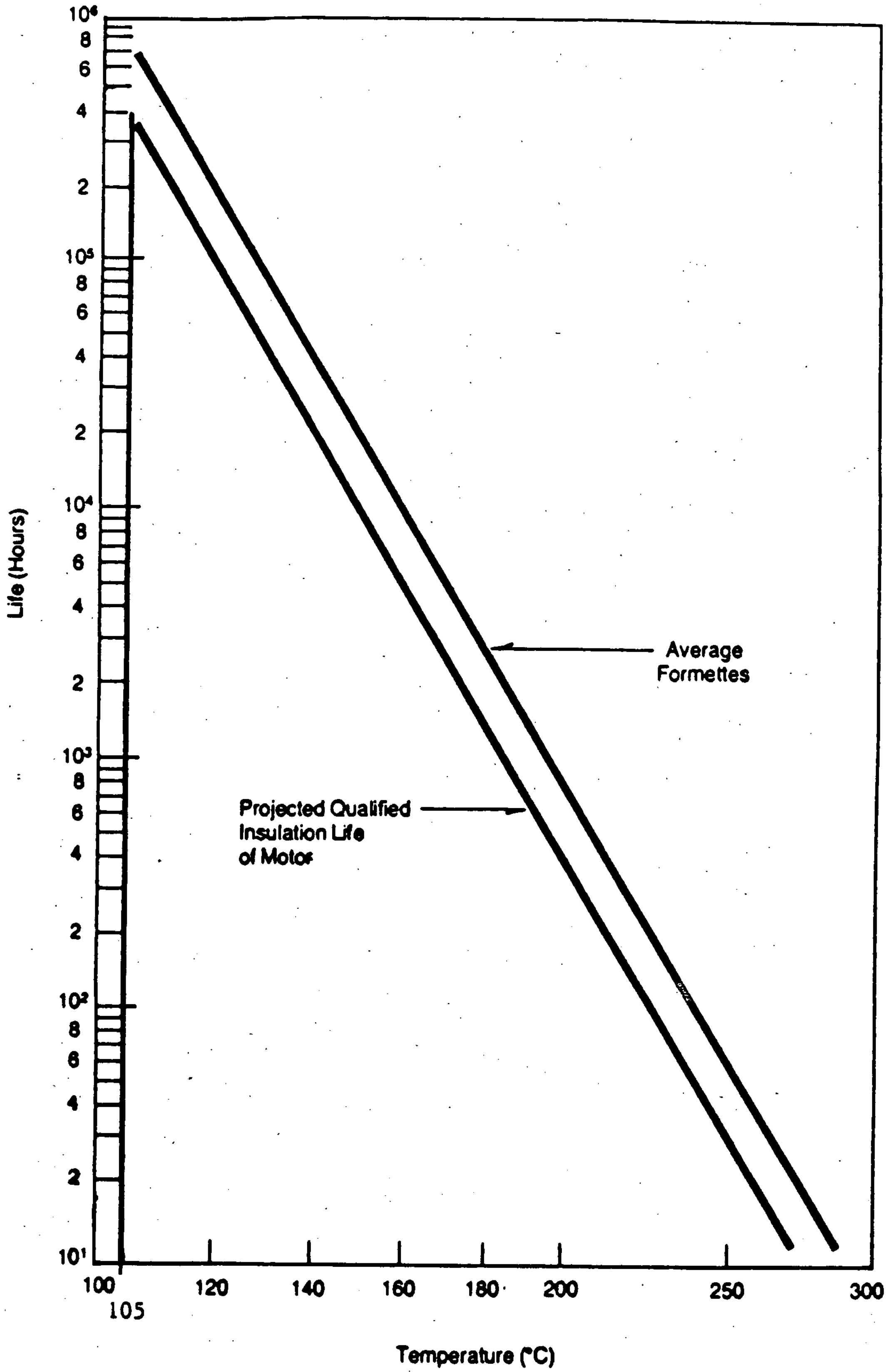
George J. Stawniczy
Project Engineer

00221
Attachments

cc: J. Harim
D. Nastasy

Projected Qualified Life

of Thermalastic Epoxy Insulation



ENCLOSURE 2

MEMORANDUM FOR FILE

October 27, 1988

SUBJECT: Justification for Continued Operation of South Charging Pump G8B
San Onofre Nuclear Generating Station
Unit 1

PURPOSE: The purpose of this memorandum for file is to document the evaluation which provides the justification for continued operation for the south charging pump motor (G8B) until the cycle 11 refueling outage tentatively scheduled for the first quarter of 1991.

BACKGROUND:

Discovery of the Problem:

In mid-June of this year, the Nuclear Systems Engineering Group asked the Mechanical Group to evaluate the capability of the charging pump motors to support higher flow requirements during the initial phase of safety injection. Westinghouse performed the evaluation and concluded that the motors are capable of supporting the higher flow requirements. Part of the basis for the Westinghouse conclusion was that the motors were constructed with a frame size capable of supporting a much higher horsepower requirement than needed, even for the new safety injection flows.

During the same time period the NRC noted that the charging pump motors operate beyond their service factor of 1.15 during the initial safety injection phase. The NRC required that the motors be recertified to bring the accident operation within the rated service factor. To respond to the NRC request, Westinghouse asked SCE to provide the maintenance history for the motors. During the research into the maintenance history, SCE learned that the south charging pump motor was rewound in 1972 after a major incident when the pump seized. Continuing research revealed a shop data sheet which confirmed the work at Westinghouse's Compton Repair Facility. Unfortunately, all other supporting records from Compton were routinely destroyed because there were no record retention requirements.

The discovery that the south charging pump motor was rewound caused the qualification for it to be suspect. The qualification package [7] is based on the materials and shop practices of the Westinghouse Buffalo plant where the motor was originally manufactured. Review of the north charging pump motor maintenance history has revealed no rewind activity, therefore, its'qualification status is not suspect.

Location & Environment:

The charging pump motors operate at 4160 V and have a nameplate horsepower rating of 600 with a service factor of 1.15. In Reference 2, Westinghouse recertified the motors for 700 horsepower with a service factor of 1.15. The design pressure for the pumps is 2735 psig. The charging pumps are located in the Reactor Auxiliary Building below the volume control tank at elevation 5 ft. The evironmental zone is area "8".

As defined in Reference 3, the DBA parameters for the charging pump rooms are a composite of the LOCA and HELB accidents. However, the DBA humidity parameter is the result of a HELB (2" steam line MSS-8-2"-EG) which is almost immediately cut off (1 second duration) by an excess flow check valve installed by DCP 3341.6TM. Analysis of this break scenario [10] shows a stabilized temperature of 102.7°F which is within the operating ambient temperature range of 104°F defined for the charging pump rooms [3]. Although the humidity increase resulting from this break is not analyzed, it is reasonable to assume that effects on charging pump motors would be negligible due to their elevated temperature (above ambient) from either energized motor space heaters or motor selfheating . Due to their elevated temperature, condensation within the motor is extremely unlikely. Additional credit can be taken for charging pump room ventilation which would quickly dissipate the amount of steam released by such a short duration break in a 2" steam line.

Note: Normal Auxiliary Building ventilation would not be affected by the subject HELB.

Therefore, the only harsh environment seen by the charging pumps is a slight increase in temperature (104°F, HELB) and 4.0×10^6 rads TID (LOCA).

Safety function of the Charging Pumps:

A. Normal operation: The charging pumps provide the head necessary to inject process fluid from the Chemical and Volume Control System against the full system pressure of the Reactor Coolant System.

B. Post - Accident: Per the SONGS 1 original design bases, no credit is taken for charging pump flow during the safety injection mode immediately post DBA. Credit is taken for long term (120 days) recirculation requirements post DBA. However, until the cycle 10 refueling outage, consistent with the main feedwater system single failure analysis [11], credit is taken for charging pump borated water injection immediately following a steam line break outside Containment. Beginning with the cycle 10 return to service, no credit will be taken for charging pump flow during the safety injection mode due to the implementation of DCP's 3501.0TE, 3501.01TJ, 3501.02TJ and 3501.03TE. These DCP's increase the reliability of the main feedwater and auxiliary feedwater systems under post accident environmental conditions, thus eliminating the main feedwater single failure analysis concerns.

DISCUSSION:

A. **Safety Analysis:** The following considerations stated in 10CFR50.49, paragraph (i), will be analyzed to ensure that the plant was operating and can be operated safely pending completion of rewinding and qualification of the subject motor.

(1) Accomplishing the safety function by some designated alternative if the principal equipment has not been demonstrated to be fully qualified.

If the south charging pump (G8B) fails, the alternative would be the north charging pump G8A. G8A is fully qualified by M38305.

(2) The validity of partial test data in support of the original qualification.

Westinghouse evaluated the rewound motor to assess the impact on environmental qualification. Westinghouse noted that all records from the Los Angeles Repair Facility had been routinely destroyed; therefore, this evaluation is based on information and data supplied by SCE consisting of the attached (see Enclosure 1) rewind design sheet and insulation specification, and a description of the rewind methods and materials used by the Westinghouse repair shop in 1972. This methods/materials description is supplied by Mr. Eric Hart of the SCE Westminster Motor Shop. Mr. Hart formerly worked for Westinghouse in their Los Angeles repair shop during 1972. Mr. Hart's description of the rewind methods and materials is believed to apply to the rewind of the SONGS 1 G8B charging pump motor. This belief is supported by the following:

(1) This rewind was performed using the standard rewind specification in place at the Los Angeles repair facility. Deviation from this specification and methodology would not be expected.

(2) Field inspection of the subject motor revealed that the motor leads are General Electric Vulka-Flex. This motor lead insulation material is consistent with that which would have been used during rewind work at the Los Angeles repair facility during the 1972 time frame.

As noted above, the post DBA environment is limited to 104°F and 4.0×10^6 rads TID. Based on this environment and the motor rewind information supplied by SCE (Enclosure 1), Westinghouse determined that the materials used in the rewound motor are suitable for the post accident environment and that there should be no safety concern through fuel cycle 10 (see Enclosure 2).

The thermal aging effects induced by overload operation during the intitial period of safety injection were evaluated by Westinghouse in Reference 2. The results were acceptable (i.e., greater than 40 years qualified life) and the overload operation has a minor impact on the equivalent age of the motor, which has a substantial margin. Since the rewound motor also has a Class B insulation system, similar thermal aging characteristice would be expected.

The Westinghouse conclusion is buttressed by the fact that the motor has operated satisfactorily for 16 years since it was rewound.

(3) Limited use of administrative controls over equipment that has not been demonstrated to be fully qualified.

No administrative controls are necessary. There is a high level of confidence that the motor will perform its intended safety function. If the motor should fail, the failure mode will be consistent with those anticipated in the Emergency Operating Instructions and will not be misleading to the operators.

(4) Completion of the safety function prior to exposure to the accident environment resulting from a design basis event and ensuring that the subsequent failure of the equipment does not degrade any safety function or mislead the operator.

There is high confidence in the post accident operability of the subject motor for the full required 120 days. There are no credible failure modes related to the subject motor which would result in misleading information to the operator or degradation of the safety function of the redundant train.

(5) No significant degradation of any safety function or misleading information to the operator as a result of failure of equipment under the accident environment resulting from a design basis event.

As noted above, only one pump operates at any given time and is fully capable of providing the necessary flow to fulfill the intended safety function. Additionally, the motor is a simple on/off device and the pump's flow performance can be readily assessed with qualified instruments. Thus, no misleading information will be supplied to the operators.

Safety Analysis Conclusion:

The insulation system of south charging pump motor G8B has suitable material characteristics to withstand and function in post accident environmental conditions and is considered to be in a justifiable configuration for operation in the past, present and until the Cycle 11 refueling outage.

B. Replacement Schedule Considerations:

Rewind or replacement for the G8B charging pump motor is scheduled for the cycle 11 refueling outage tentatively scheduled to begin during the first quarter of 1991. Given the above safety analysis conclusion and reasonable confidence in the rewind materials and processes, it is considered prudent to wait until the cycle 11 refueling outage for the following reasons:

(1) Per the Westinghouse evaluation and recertification, the charging pump motors (including the rewound G8B motor) are considered to have sufficient design margin to meet the increased flow requirements during initial safety injection and still remain within a service factor of 1.15, without exceeding the class "B" motor winding temperature limit of 130°C. Therefore, the G8B motor meets current design/licensing requirements and motor rewind is not driven by these considerations.

(2) During fuel cycle 11, Design change Packages may be implemented which will increase charging flow requirements. These increased flow requirements will necessistate motor rewind but they have not yet been fully defined. Until these requirements are defined, motor rewind should be delayed so as to avoid redundant and costly rewind activity.

(3) Sufficient data upon which to base a cycle 10 rewind decision was not available until October, 1988. the length of time involved (from mid June to mid October 1988) is reasonable considering the range of issues and the resultant volume of communications between Westinghouse and SCE necessary to resolve these issues. This process was further complicated due to the difficulty of document retrieval relating to the motor rewind work during 1972.

Given the final evaluation completion date of mid October, the potential cost/schedule impact due to expanded cycle 10 outage scope would be significant (see Enclosure 3).

CONCLUSION:

Per the above safety analysis, there is sufficient confidence in the rewind materials and process to assume that the G8B charging pump motor will perform its intended safety function under post accident conditions until the cycle 11 refueling outage.

Steven W. Smith
STEVEN W. SMITH
Engineering Consultant

cc:

C. R. HOVER
L. D. TIPTON
R. L. PHELPS
A. C. LLORENS
CDM FILES
N.E. FILES

REFERENCES

(1) Westinghouse letter to SCE, H. B. Lavender to A. J. Thiel, September 14, 1988. Subject: Recertification of Charging Pump Motor G8A/G8B.

(2) Westinghouse letter to SCE, J. L. Epsteing to G. J. Stawniczy, September 15, 1988. Subject: Recertification of SONGS Unit 1 Charging Pump Motor.

(3) M37387, Rev. 7, Retrofit General Design Criteria Manual.

(4) Westinghouse letter to SCE, L. E. Elder to G. J. Stawniczy, July 15, 1988. Subject: SCE Company San Onofre Nuclear Generating Station Unit 1 Charging Pump Documentation Package.

(5) Station Procedure #S01-1.0-23 "Transfer to Cold Leg Injection & Recirculation".

(6) Telcon by C. R. Hover, L. D. Tipton of SCE and A. Alsammarae of S & L with A. Anderson of Westinghouse, September 19, 1988. Subject: Insulation Specification from Rewind Shop for South Charging Pump (G8B).

(7) EQDP M38305, "Westinghouse 3 Phase Induction Motor".

(8) System Description, SD-S01-310, "Chemical & Volume Control System".

(9) System Description, SD-S01-580, "Safety Injection, Spray and Recirculation Systems".

(10) SONGS 1 Calculation No. DC-2160, Area 8 Temperature Increase Calculation: High Energy Line Break, dated 11/22/85 (part of SONGS 1 PT Profiles package).

(11) SCE letter to the NRC, M. O. Medford to NRC Document Control Desk, December 1, 1987. Subject: Docket No. 50-206 Engineered Safety Features Single Failure Analysis San Onofre Nuclear Generating Station Unit 1.

Enclosure 1

Southern California Edison Company

P. O. BOX 800

2131 WALNUT GROVE AVENUE

ROSEMEAD, CALIFORNIA 91770

October 24, 1988

Mr. Lee Elder
Westinghouse Electric Corporation
9095 Telstar Avenue
El Monte, CA 91731

Dear Mr. Elder:

Subject: Information on Rewind Methods for
South Changing Pump Motor
San Onofre Nuclear Generating Station Unit 1

As agreed during our meeting on October 13, 1988, enclosed is a Memorandum for File prepared by Mr. Eric Hart of the SCE Westminster Motor Shop (formerly worked for Westinghouse at the Los Angeles repair shop) regarding the rewind methods for the south changing pump motor G8B.

In addition, an inspection was performed on the motor leads for the motor. The following information was found on the leads: "Vulkaflex apparatus lead #S1-58709, 5000V, #4AWG" black in color.

If you have any questions regarding this information, please call Mr. Allen Thiel at (818) 302-8339.

GJS 10/24/88

G. J. STAWNICZY

aH

GJS:AT:aw:0139i

Attachments (3)

cc: Mr. D. Nastasy
Mr. J. Harim

bcc: M. L. Merlo
A. T. Kaneko
E. Hart
A. Thiel
J. Evelyn

MEMORANDUM FOR FILE

October 15, 1988

South Charging Pump Motor Rewind
San Onofre Nuclear Generating Station, Unit 1

During the recent effort to recertify the Unit 1 charging pump motors, G8A and G8B, it was discovered that the south charging pump motor G8B was rewound in 1972. A memorandum for file date June 21, 1972 stated that the charging pump had seized, causing the motor to fail. The motor was shipped to Westinghouse in Los Angeles for repair.

A document search was performed by both Westinghouse and SCE to identify the rewind specification and material used. This information was needed to determine the traceability of rewind material to verify environmental qualification requirements were met. No information was located other than the attached rewind design sheet and insulation specification. This document was located by Mr. Eric Hart of the Southern California Edison Westminister Motor Shop, who formerly worked for Westinghouse in its Los Angeles repair shop during 1972.

Since a detailed specification was not found, Mr. Hart has provided the following description of the rewind methods and materials used by the Westinghouse repair shop in 1972, which are believed to apply to the rewind of the San Onofre Unit 1 south charging pump motor at that time:

> This rewind was performed using the standard rewind specification in place at the Los Angeles repair facility, and deviations from this specification and methodology would not be expected. The motor was wound with an epoxy mica insulating material. The lead cable material is General Electric Vulka-Flex. The slot liner is dacron mylar. The wedges and filler material are canvas-based micarta. The dipping varnish is B-172 epoxy. The connection insulation is the same material as used on the coils. On inspection, if the cable material is not identifiable as Vulka-Flex, the only other insulation material used at that time for lead cable at this voltage was glass reinforced silicon rubber, which is red.

Prepared by: ______________________
Allen J. Thiel

____
Eric Hart

MISCF023/1
ATTACHMENT

SOUTHERN CALIF. EDISON — 5/2/72 — LA C P. 1/2 386

Field	Value
Manufacturer	(W) ☒
Style No. or Model	65F15619
Form	
Serial No.	1S-65
H.P.	600
Type	CSP
Frame	688.5H
R.P.M.	3580
Volts	☐ 220 ☐ 440 4160
Amps	72.
Cycles	☑ 60
Phase	3
P.F.	
Wound Rotor	
Squirrel Cage	
Syn.	
Motor	
Gen.	
Stator	☒
Rotor	☐
Class of Insulation	
Treatment — Dips & Bakes / Thermoset / Silicone / Other	☐ ☐

A C WINDING DATA NOTE

Iron	Bore 15½	Width 14⅜	Slot: Semi Closed ☐ Open ☒	Coil Ext.: Front 11½ Rear 11½

No. Coil Tie Rings: (4) — Coil Throw 1- 20

Grouping

Connection: ✓ Series / Parallel — Star ☑ Delta ☐

Lead Length: 21" — No. of Leads: 3 OPP — Tape Ends ☐ — Tape Each Coil ☐

Group Connections: 1-7 ☐ 1-4 ☐ 1-5 ☐ 1-3 ☐

COIL DATA

No. Coils: 48 — Weight: 7½ lbs each — Wire Size: 2 - .081 X .204

Wire Insulation: DCC ☐ MT ☐ EN ☐ Glass ☐ Other

Sketch Wire Arrangement

7 turns of 2 wires in parallel

6 groups with 8 coils — groups with coils

Start coils lead long — Fin. coils lead long

Mush ☐ Pull Mush ☐ Pull Strap ☐ Form ☒

Ins. Cell & Size

Cell Wrapper — Slot Ins.

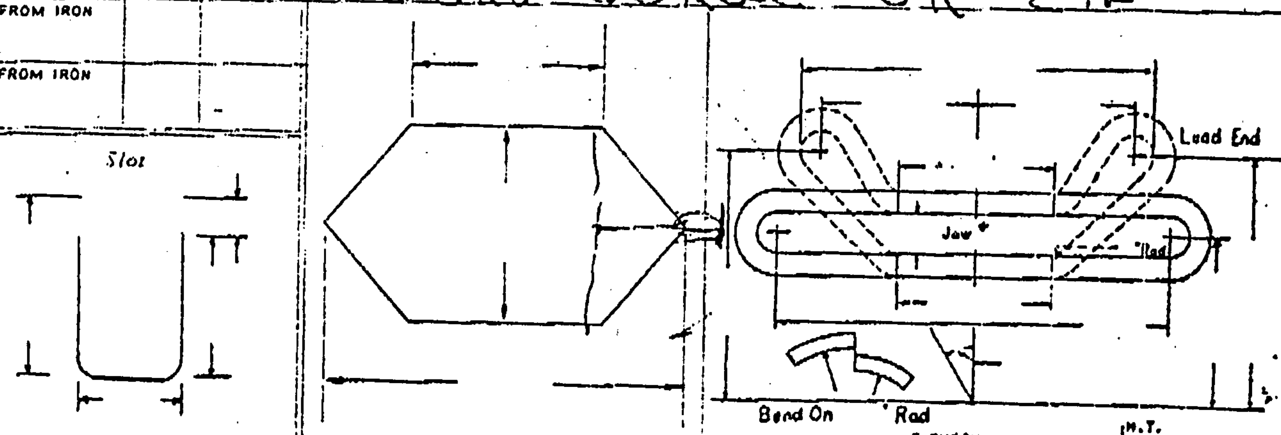
Taping: 6 KV SURGE OK ET

BANDING

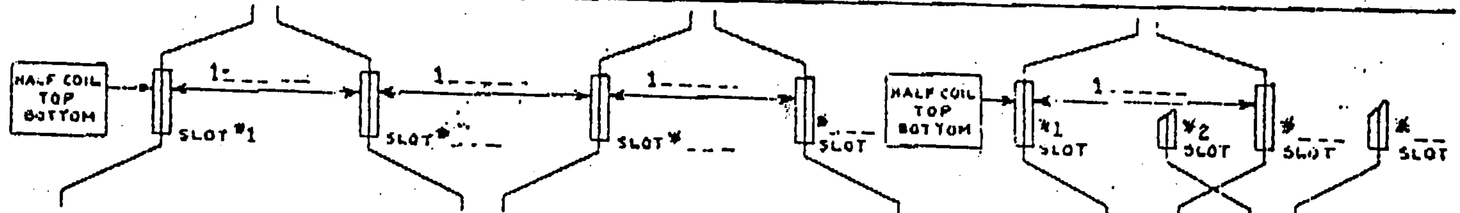
Glass | Non Mag. | Steel

	No.	Position	Width	Wire Size
Core		Between		
Front		In. from Iron		
Rear		In. from Iron		

TOTAL DEPTH OF LAMINATION



STRAP COIL ROTOR DATA



CONNECTION END

LOOP STUBS TO 12¾" — CONNECTIONS ON SIDE

REMARKS:

COMPOUND ON END TURNS OF COILS

Locator Code	Desc.	HP-KW-KVA	RPM	Volts
	PH	Cycles	Amps	Poles / P.F. / Mfgr. / Frame

AC APPARATUS REPAIR DATA
WESTINGHOUSE FORM 23839B

4160V

Date 5/72 Insulation Spec. ORDER # C386

1ST Dip varnish before ✓ AFTER ___ spreading
Leads 1 sleeve 2 mica 3 glass
Compound B-7-300 ✓ ends ___ overall
Grd. insulation 5/2 T 43865AE-1AL mica
End insulation 3 1/2 Lap 43865AD-1A8 ___
43866AB-19C ✓
overall insulation 1 1/2 Lap 41514 ET, 004 glass
___ space in Slot sect.

continuous Taping
___ 1/2 Lap 43865AD-1A1 Slot sect. ___
___ 1/2 Lap 43866AB-19C Slot sect ___
___ 1/2 Lap 43865AD ___
43866AB ___ overall

Final Dip Light varnish ___ Heavy ___
Ends only ✓

Remarks
after compound put 1 layer
mica ~~[illegible]~~ on ends by hand —
then 2-layers by machine

43865 AE
43865 AD

October 19, 1988

G. J. STAWNICZY

SUBJECT: Inspection of South Charging Pump Motor Leads, San Onofre Nuclear Generating Station Unit 1

Reference: Letter to O. G. Hollaway from G. J. Stawniczy dated October 14, 1988, Same Subject

Per your request from the above reference, Retrofit has inspected the Unit 1 South Charging Pump Motor (MG-8B) motor leads at the terminal box. The following information was found on the motor leads: "Vulkaflex apparatus lead #S1-58709, 5000V, #4AWG", black in color. Attached is the Construction Work Order 88101310000 for your documentation.

If you have any questions, contact me at PAX 87-521.

O. G. Hollaway

TElkins:ks

cc: K. O'Connor
T. Elkins
A. Kaneko
R. Phelps
A. Thiel
M. McElroy

Enclosure 2

Westinghouse Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

October 26, 1988

SCE-88-751

SCE P.O. S8D00038
W G.O. LA-39867

Mr. George J. Stawniczy
Engineering Division G03
Southern California Edison Company
2244 Walnut Grove Avenue
P.O. Box 800
Rosemead, California 91770

Reference: Southern California Edison Company Letters:
1) R. L. Phelps to L. E. Elder - dated 10/20/88
2) G. J. Stawniczy to L. E. Elder - dated 10/24/88

Southern California Edison Company
San Onofre Nuclear Generating Station Unit 1
South Charging Pump Motor

Dear Mr. Stawniczy:

Attached is the updated Westinghouse position on the subject motor. This update is based on new and additional information received in a meeting with SCE on October 13, 1988, and confirmed in the Southern California Edison Company letters referenced above.

This transmittal completes all outstanding engineering actions related to recertification of the SCE SONGS 1 charging pump motors.

If you should have any questions, please do not hesitate to call.

Sincerely,

for Joe Harini

L. E. Elder, Project Manager
Western Area
U.S. Nuclear Projects I

JAH/mbs

Attachment

cc: A. Worthington - W - 1L, 1A
A. J. Thiel - Rosemead - 1L, 1A
R. L. Phelps - Rosemead - 1L, 1A
B. L. Craig - W - 1L, 1A
H. C. Calton - W - 1L, 1A

Southern California Edison Company
P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

October 20, 1988

Mr. L.E. Elder, Project Manager
Westinghouse Electric Corp.
P.O. Box 355
Pittsburgh, PA 15230-0355

Dear Mr. Elder:

Pursuant to our action item from the SCE - Westinghouse meeting on October 13, 1988, we are enclosing the page from the Retrofit General Design Criteria Manual which is applicable for the charging pump room, area 8.8.

The 100% humidity requirement is based on the break of a small steam line in the auxiliary building, which is terminated by an excess-flow check valve. This event does not result in area radiation or plant trip, so that normal ventilation systems are assumed to remain in service. Consequently, the puff release of steam would cause only a brief humidity excusion above the normal 60% RH. The limiting post-accident environmental conditions for the charging pumps will therefore be 104^{o}F, 0 PSIG, 60% RH and 4 X 10^{6} RADS for a LOCA.

If you have any questions or require additional information, please contact me.

Very truly yours,

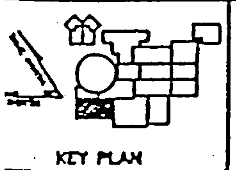
R.L. Phelps

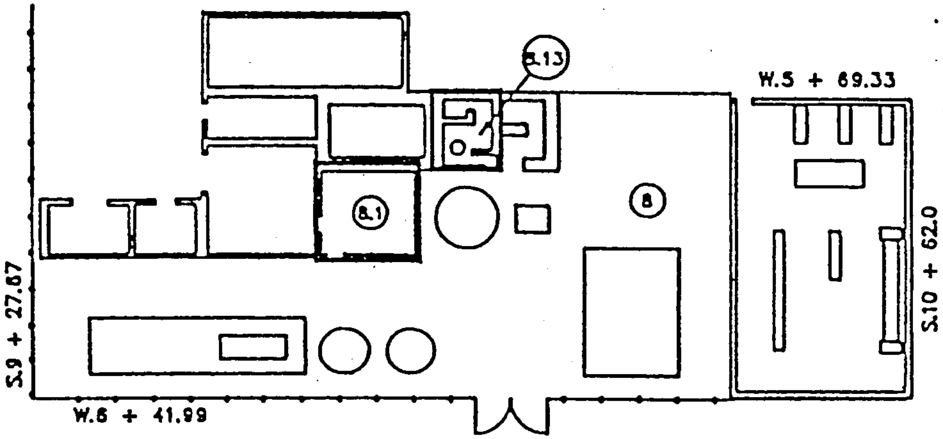
Enclosure
CRH:ts

cc: B. Craig

0082L-27

M-37387 REV. 7



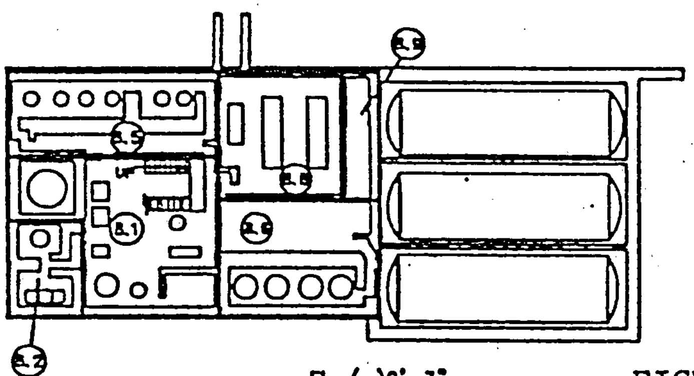


YARD AREA EL. 20'-0"

ENVIRONMENTAL CONDITIONS

	TEMP. °F	PRESSURE PSIG	RH %	CS	RADS	DURATION
NORMAL						
AREA 8 – 8.13	80	0	60	N/A	$3X10^3$	40 YEARS
POST ACCIDENT						
HELB	80	0				
AREA 8	104	0	100	N/A		
AREA 8.1	104	0	100	N/A		
AREA 8.2	104	0	100	N/A		
AREA 8.5	104	0	100	N/A		
AREA 8.6	104	0	100	N/A		
AREA 8.8	104	0	100	*N/A*		
AREA 8.9	104	0	100	N/A		
AREA 8.13	155	0	100	N/A		
LOCA					$4X10^6$	120 DAYS

* 60% AFTER CYCLE 10 ~~??~~ REFUELING OUTAGE.



EL. (-)2'-3"

FIGURE B-9

SPECIFIC AREAS NOT NUMBERED ARE AREA 8.

ENVIRONMENTAL ZONE MAP

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
0	9/13/85	ORIGINAL	[illegible]	[illegible]	[illegible]

AREA 8
AUXILIARY BLDG.
SOUTHERN CALIFORNIA EDISON
SAN ONOFRE UNIT 1

IMPELL

SCALE: NONE
JOB NO.: 0310-082
DRAWING NO. | REV.
SHEET OF

7

RCS/ME(88)-561

SOUTHERN CALIFORNIA EDISON CO.
SONGS - UNIT 1

Rewind of South Charging Pump Motor

This documentation supersedes both RCS/ME(88)-459 Rev. 1 and RCS/ME(88)-523.

Attachment 3 of SCE/G. J. Stawniczy letter of August 15, 1988 to L. Elder identified the motor (S.O. 65F15619) on the South Charging Pump (G8B) was rewound in 1972. SCE memorandum of July 21, 1972 indicated this work was performed at Westinghouse Los Angeles Apparatus Repair plant. Subsequent to issuing RCS/ME(88)-459 Rev. 1, limited detail records (Insulation Spec, Order #C386 dated 5/72) pertaining specifically to repair of the South charging pump motor were recovered by SCE. The following evaluation is based on those records as supplemented by motor rewind materials and processes identified by SCE/G. J. Stawniczy letter of October 24, 1988 to L. Elder and motor environmental conditions during Cycle 10 identified by SCE/R. L. Phelps letter of October 20, 1988 to L. E. Elder.

An investigation of all the information referenced above concerning the rewind indicates the materials used in the coils are made of Mica, glass cloth, epoxy and polyester. All of these materials could be expected to meet SCE radiation requirements of 4×10^6 rads. SCE has identified the other materials used in the rewind such as slot liner, cable, etc. and based on test data of other similar materials, these could also be expected to meet 4×10^6 rads.

It is concluded that the rewind was done with acceptable materials and practices at the time.

Westinghouse believes there is no basis for a safety concern during Cycle 10 with respect to this rewound motor and engineering judgement would support continued operation through the end of that cycle.

A. A. Anderson 10/25/88

A. A. Anderson
NSD/RCS Mechanical Equipment

Approved: J. D. Nastasy 10/25/88

J. D. Nastasy, Manager
NSD/RCS Mechanical Equipment

MEMORANDUM FOR FILE
October 27, 1988

DISCUSSION OF POTENTIAL COST/SCHEDULING IMPACT FACTORS FOR REWIND OF THE SO1 G8B SOUTH CHARGING PUMP MOTOR

In light of the indeterminate qualification status and associated JCO relating to the SO1 G8B motor rewind in 1972, the following discussion of cost and scheduling impact is deemed necessary. Potential Cycle 10 outage impact and costs are based on a rewind decision date of 10/25/88 (see page 3).

There are three basic options:

1) Rewind existing motor
2) Replace with surplus motors
3) Purchase new motor for installation during cycle 11 outage

Option 1: Rewind existing motor
Rewinding can be further divide into two paths:

a) Rewind motor during the Cycle 10 outage to current rating (600/700 HP) at a capital cost of 173K. Potential outage impact of 10 to 14 day extension at 80k/day. Total cost is estimated at 973k to 1293k, depending on outage impact.*

b) Rewind motor during the Cycle 10 outage to maximum allowed rating of 1000 HP at a capital cost of 260k and an estimated outage extension of 28 days at 80k/day. Total estimated cost is 2500k.

Option 2: Replace with surplus 1000 HP motor

Capital cost 242k. Outage schedule impact unknown but there is a high potential for significant impact.

* Note: Rewinding to 600/700 HP during Cycle 10 still leaves the necessity of further rewind during Cycle 11 in order to accomodate increased charging flow requirements post Cycle 11 outage.

Option 3: Purchase new 1000 HP motor for installation during the cycle 11 outage. A new motor is not available for the cycle 10 outage.

Capital cost 37.5k.

Summary:

Option 1 (a) -- 973k to 1293k: motor replacement (37.5k) still necessary during Cycle 11 outage.

Option 1 (b) -- 2500k

Option 2 -- 242k. High probability of significant outage extension.

Option 3 -- 37.5k.

Conclusion: Given the JCO conclusion of no safety concern, the most reasonalbe option, based on cost and scheduling, is to delay rewind until the Cycle 11 outage.

ENCLOSURE 3

Financial Justification for Delaying Charging Pump Motor Rewind

1. Rewind Option: @ 600/700 hp. — 173 K Capital Cost
— 10 to 14 day outage extension (@ 80K / day)
— rewind to 1000 hp @ Cycle XI - 250K

@ 1000
@ 1000 hp — 260 K Capital Cost
28 day outage extension (@ 80 k / day)

2. Replace w/ Surplus 1000 hp motors — 242 K
— schedule impact unknown, potential for high impact on outage end date

3. Delay, rewind @ Cycle XI — 37.5K rewind @ Cycle XI, per motor

minimum differential cost is 200K, not counting labor or outage extension costs.

George J [signature] 10/25/88

ENCLOSURE 3

SUBJECT: Pump Motor Load Test for Diesel Generator Loading
San Onofre Nuclear Generating Station, Unit 1

References: A. Design Calculation DC-2990, LOCA Injection Mode Pump Loads, Revision 0

B. Design Calculation DC-1809, Emergency Diesel Generator Loading, Revision 4

C. Special Engineering Procedures, SO1-SPE-696 through SO1-SPE-702, Revision 0

To support the Emergency Diesel Generator loading evaluation, SCE Engineering performed a calculation (Reference A) to re-assess motor loads for seven (7) safety related pumps. As part of the input data for this calculation, Inservice Test (IST) data was utilized to establish the performance characteristics of these pumps. The IST program at SONGS 1 is consistent with the requirements of Section XI of the ASME Code. In accordance with Section XI, inservice tests are performed periodically to assess the operational readiness of safety related pumps. The parameters that are measured during these tests consist of speed, inlet pressure, differential pressure, flow rate, vibration amplitude, and bearing temperature. The measured values of these parameters are then compared to acceptable limits to confirm the operational readiness of these pumps. Since some of these pumps cannot practically be tested at full flow conditions, as is the case for SI and RW pumps, a bypass mini-flow is used to establish the reference values of the test parameters. This is consistent with Article IWP-3110 of ASME Section XI Code.

For the purpose of calculation DC-2990, the IST data was used to confirm the pump performance curves which were then used to establish the brake horsepower required for the operation of these pumps during a postulated LOCA. These brake horsepower values were then used to determine diesel generator loads in Calculation DC-1809 (Reference B).

In order to confirm that the brake horsepower values obtained from the pump performance curves were valid, additional pump motor load tests were performed on these seven pumps (Reference C). The objective of these tests was to obtain different data points on the performance curves to provide greater assurance of the validity of these curves and to obtain pump motor loading data to aid in verifying the Diesel Generator Load Calculation DC-1809.

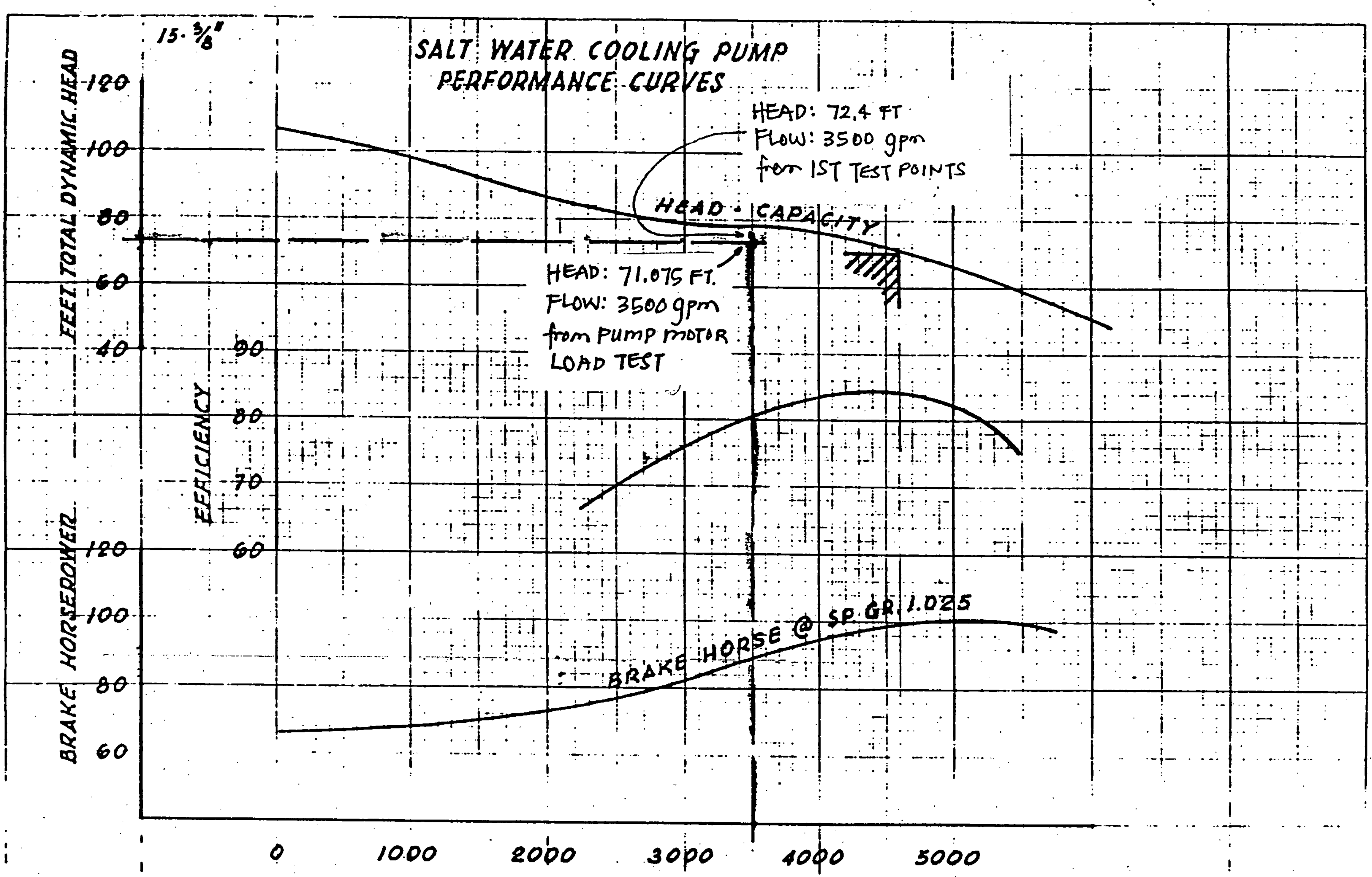
The Special Engineering Procedures (Reference C) were made exclusively for the pump motor load tests and were similar to the pump Inservice Test per

Section XI of the ASME Code. Typically, these procedures recorded the flow, and suction and discharge pressures through the normal plant instrumentation; additionally, motor voltages and amperages were measured with instruments calibrated to ±1% accuracy.

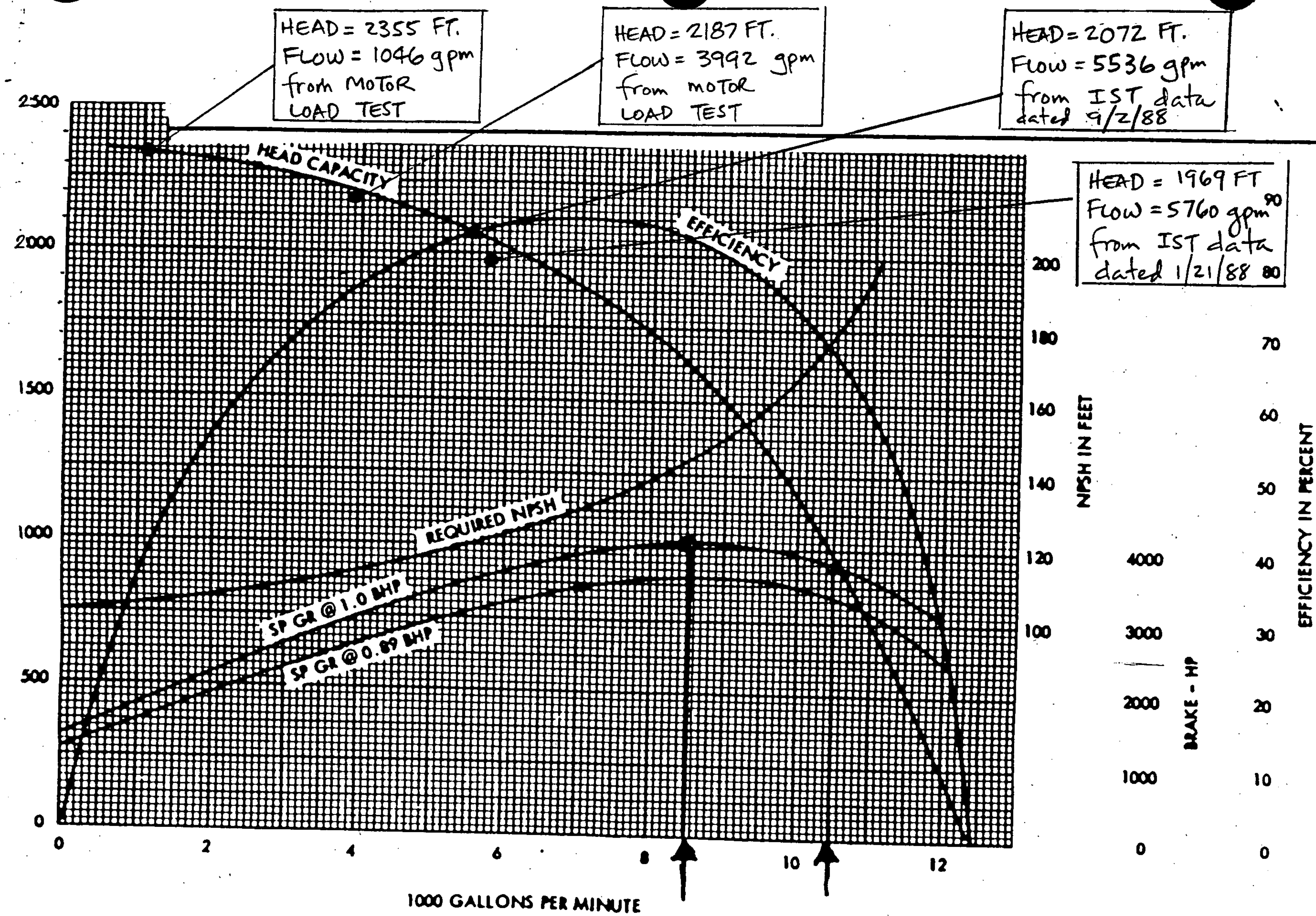
In the case of the main feedwater pumps, the test was conducted with the flow orifice for Steam Generator A installed backwards. The orifice was installed backwards following the inspection of the line and the orifice during the second mid-cycle outage (February through August 1988). This was not discovered until the plant was subsequently brought to full power and the deviation from previous full power flow data became apparent. Based on an evaluation made with regard to the total flow, this deviation was found to have no significant impact both on the SG flow requirements or the pump curve verification. The test values obtained for the Main Feedwater Pumps have demonstrated that the pumps continue to operate consistent with the pump performance curve.

The results of these tests are summarized on the attached marked up pump performance curves. It can be seen that the latest test data is consistent with the IST data used in the calculation. Consequently, it is concluded that the brake horsepower values established in Calculation DC-2990 remain valid input for the Emergency Diesel Generator Loading Calculation, DC-1809.

G-13A



15-3/8"
SALT WATER COOLING PUMP
PERFORMANCE CURVES
HEAD: 72.4 FT
FLOW: 3500 gpm
from 1ST TEST POINTS
HEAD - CAPACITY
HEAD: 71.075 FT.
FLOW: 3500 gpm
from PUMP MOTOR
LOAD TEST
FEET TOTAL DYNAMIC HEAD
120
100
80
60
40
EFFICIENCY
90
80
70
60
BRAKE HORSEPOWER
120
100
80
60
BRAKE HORSE @ SP GR 1.025
0
1000
2000
3000
4000
5000



PUMP G-3B

FEEDWATER PUMP

(FSA FIGURE 4.6
FEEDWATER PUMP PERFORMANCE CURVES

G-10S AUXILIARY FEEDWATER PUMP

PACIFIC PUMPS DRESSER HUNTINGTON PARK, CALIFORNIA

TEST PERFORMANCE CURVE NO. 42768-SP

CONTRACTOR BECHTEL

CUSTOMER SO. CAL. EDISON

ITEM NO. ______ P.O. 6J036807

IMPELLER PATTERN H-6149 H-6150/51

MAXIMUM DIAMETER 8 8

RATED DIAMETER 8 8

MINIMUM DIAMETER 7 7

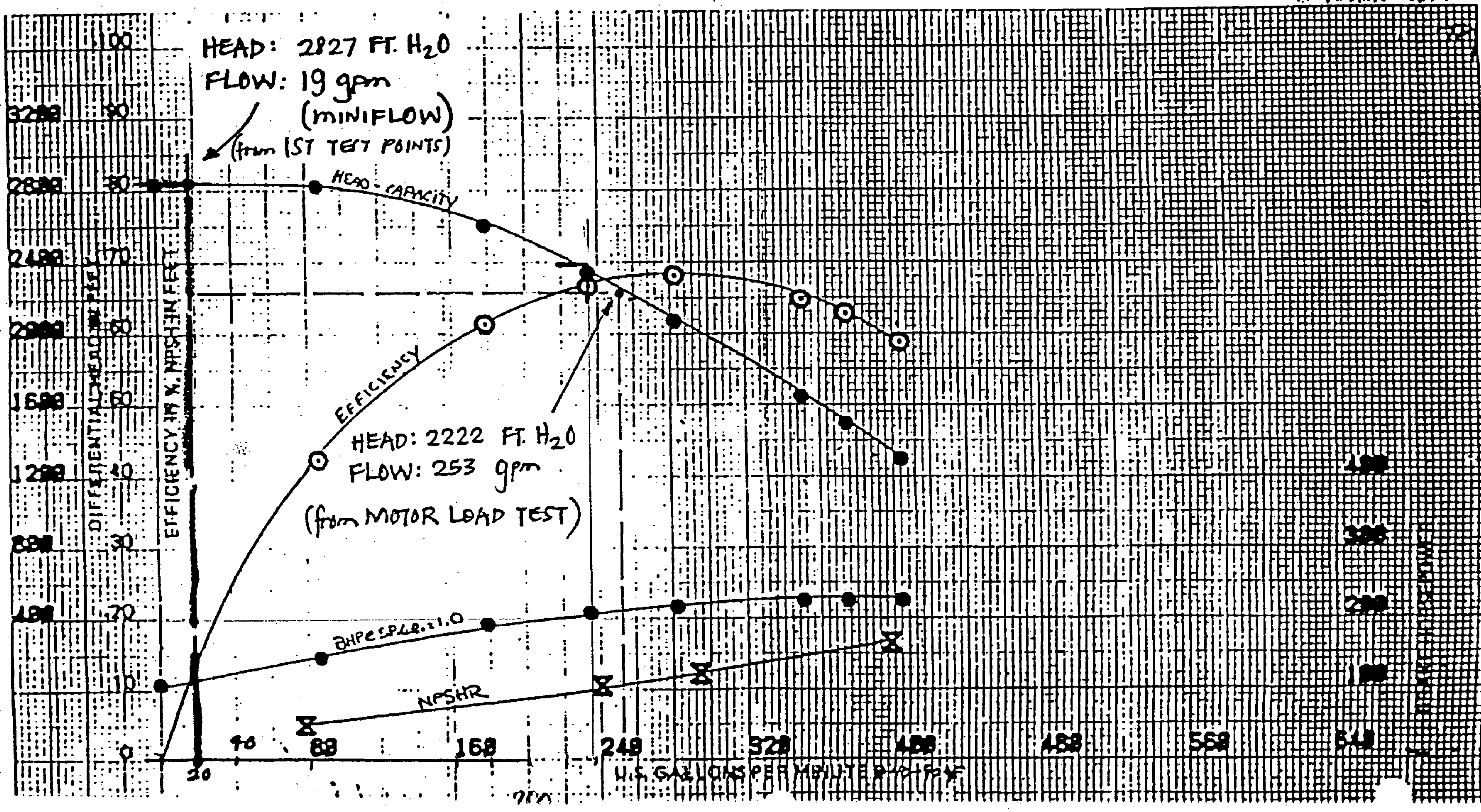
AUX FW Motor Driven G-10S

SIZE 2" TYPE BFJTC STAGES 10

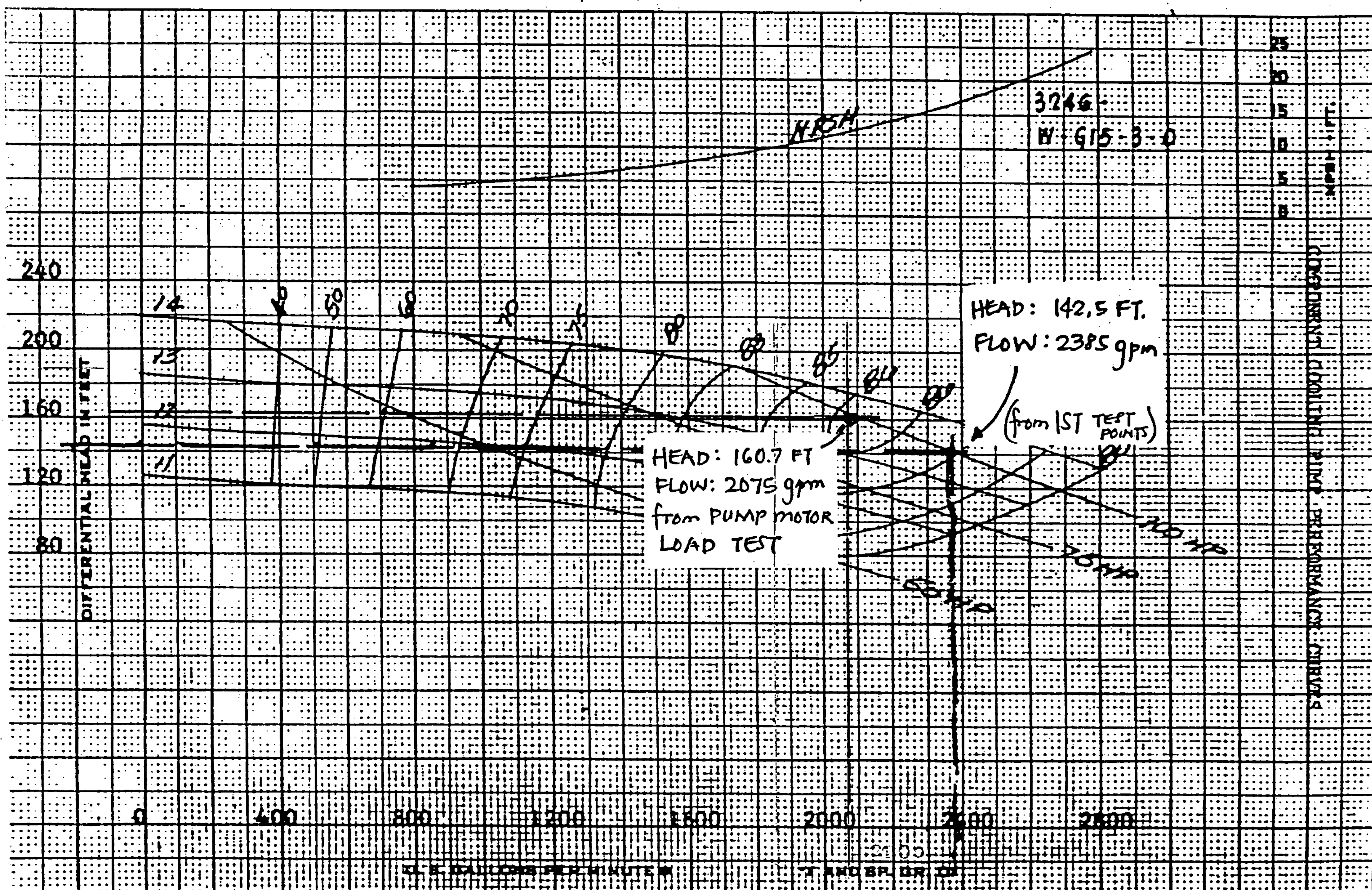
R.P.M. 3570 DATE 5/13/66

PUMP NUMBER 42768-SP

PERFORMANCE ALSO APPLIES TO PUMP NUMBER NH 43212



COMPONENT COOLING WATER PUMP G-15A



Supersedes 46.0-12 dated 12-30-60

PACIFIC PUMPS, INC. HUNTINGTON PARK, CALIF.	R.P.M. 1770	IMPELLER PATTERN D-2658		ITEM NO. G-15A, B, + C. Component Cooling Pumps	WESTINGHOUSE - APD	DATE 6-22-62 PAGE NO. 46.0-12
PUMP SIZE AND TYPE 6x14 DS/1	NO. STGS. 1	WEARING RING CLEARANCE .016 IN.	MIN. INT. DIM. 1"	JOB NO. PO: 44430		CURVE 1

CHARGING PUMP
G-8B

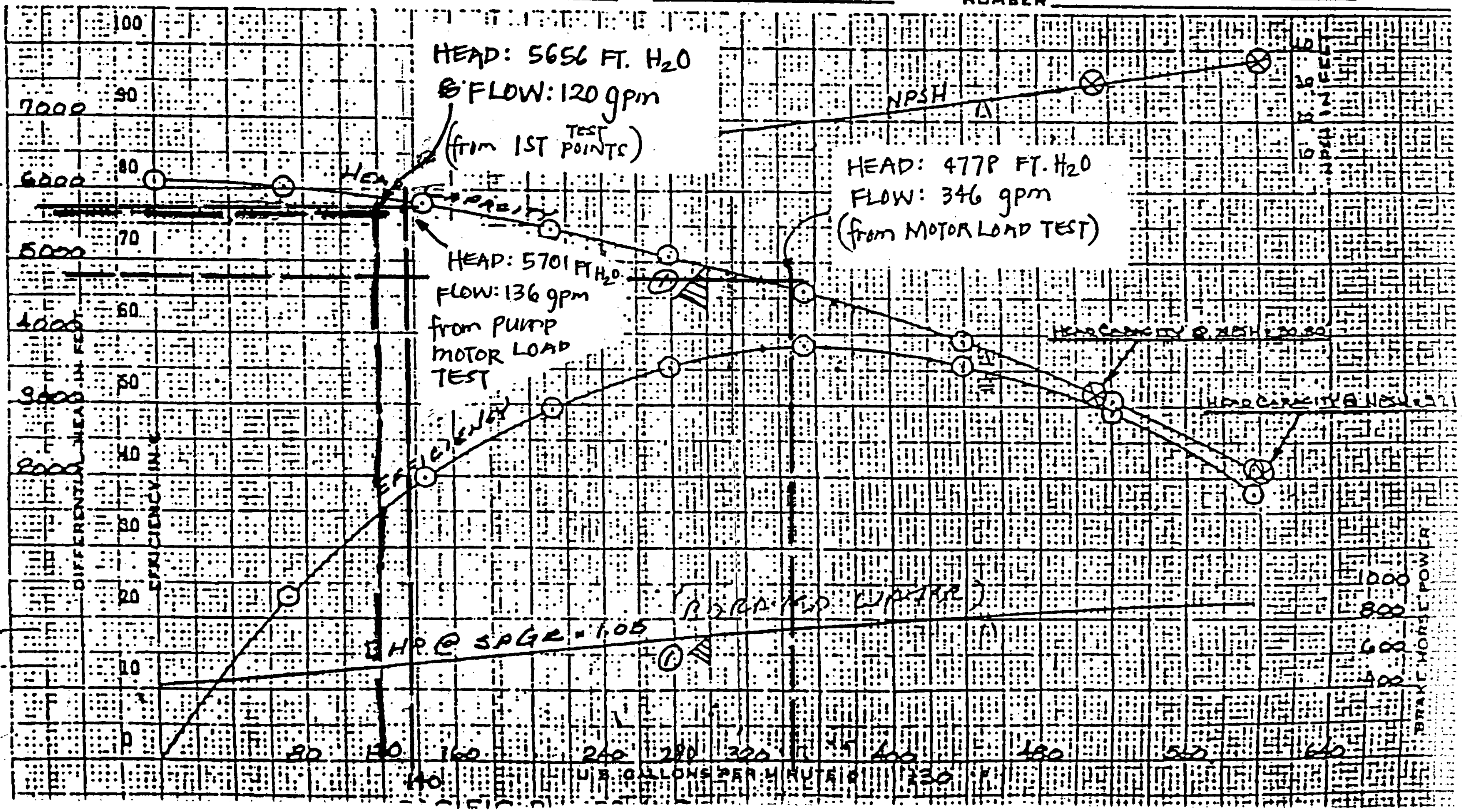
① ADDED 11-10-87 FOR 300 OPERATIO
PLEASE NOTE CALCULATED BHP IS 6 2.

CONTRACTOR: WESTINGHOUSE APD
CUSTOMER: SOUTHERN CALIFORNIA EDISON
ITEM NO. 1 P.O. 54K41430

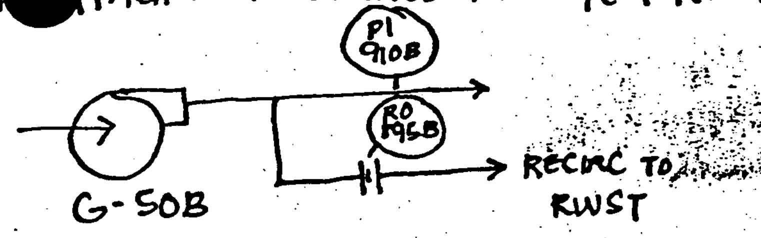
TEST PERFORMANCE CURVE NO. 30002A

SIZE 2" TYPE Z STAGES 12
R.P.M. 3570 DATE 11-15-65
PUMP NUMBER 38771 (G-8B)
PERFORMANCE ALSO APPLIES TO PUMP NUMBER ______

IMPELLER PATTERN	M-5255	M-6113	M-5156
MAXIMUM DIAMETER	10 1/4	10 1/4	10 1/4
RATED DIAMETER	10 1/4	STAGE 2-7 10 1/4 STAGE 8 10	STAGE 9-10 10 1/4 STAGE 11-12 10
MINIMUM DIAMETER	9 1/4	9 1/4	9 1/4



PER ATTACHED IN SERVICE PUMP TEST RECORD



DISCH PRESS. 162 PSIG
SUCTION PRESS 13.7 PSIG

ΔP 148.3 PSIG or 342.1 FT. OF H_2O

FLOW - MINI FLOW

G-50B

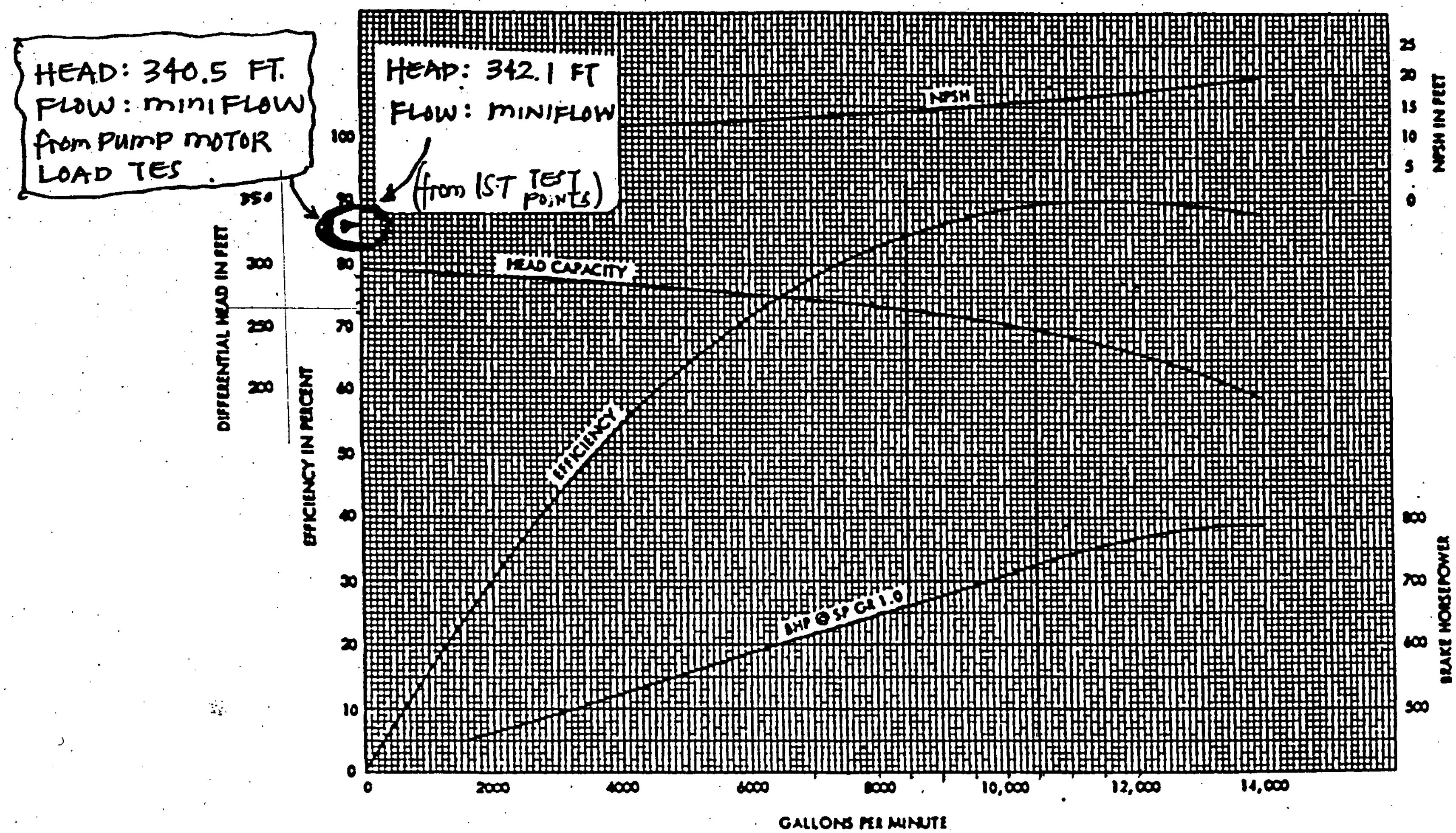
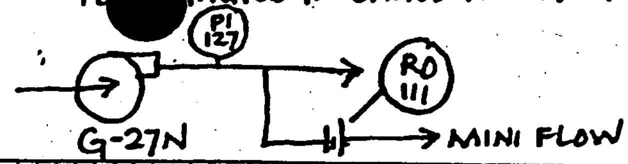


FIGURE 4.7
SAFETY INJECTION PUMP PERFORMANCE CURVES

K+E 10 X 10 TO THE INCH 46 0782
7 X 10 INCHES
KEUFFEL & ESSER CO.

PE TACHED INSERVICE PUMP TEST RECORD



DISCH PRE 215 PSIG
SUCT. PRESS: 14.12 PSIG
ΔP=200.88 PSIG or 463.4 FT. H
FLOW: MINI FLOW