Consumers Power Company

General Offices: 212 West Michigan Avenue, Jackson, MI 49201 • (517) 788-0550

March 11, 1983

Dennis M Crutchfield, Chief
Operating Reactor Branch No 5
Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

DOCKET 50-155 - LICENSE DPR-06 -
BIG ROCK POINT PLANT - SEP TOPIC VII-1.A "ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, INCLUDING QUALIFICATION OF ISOLATION DEVICES" - RESPONSE TO FINAL SAFETY EVALUATION REPORT

By letter dated September 2, 1982, the NRC issued its final safety evaluation report (SER) for SEP Topic VII-1.A "Isolation of Reactor Protection System from Non-Safety Systems, Including Qualification of Isolation Devices". As stated in the SER and as reiterated during the integrated assessment meetings during the week of November 15 to 19, 1982, the NRC concludes that suitable isolation devices exist in the Reactor Protection System (RPS) with the exception of isolation of possible effects from the RPS motor-generator sets and alternate feed. The NRC is specifically concerned that sustained voltage or frequency transients in the RPS power supply (motor-generator or alternate feed) could overheat half of the scram solenoid valves and prevent a scram. Therefore, the NRC recommends that suitably qualified isolators be installed in each protection bus.

The enclosure to this letter provides justification to support our position that once setpoint adjustments have been made to the regulator and over-voltage relay associated with each RPS motor-generator set, the existing protective devices in addition to existing administrative controls and preventive maintenance programs ensure safe and reliable operation of the RPS and its associated scram solenoid valves. Therefore, Consumers Power Company considers the aforementioned NRC recommendations to be unwarranted and this SEP topic to be closed.

Kerry A Toner

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Kerry A Toner
Senior Licensing Engineer

CC Administrator, Region III, USNRC
NRC Resident Inspector - Big Rock Point

Enclosure

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PDR ADOCK 05000155
P PDR

OC0383-0006B-NL02

Consumers Power Company

Big Rock Point Plant

Docket 50-155 - License DPR-06

SEP TOPIC VII-1.A
"ISOLATION OF REACTOR PROTECTION SYSTEMS, INCLUDING
QUALIFICATION OF ISOLATION DEVICES" -
RESPONSE TO FINAL SAFETY EVALUATION REPORT

ENCLOSURE

March 11, 1983

37 Pages

SEP TOPIC VII-1.A
"ISOLATION OF REACTOR PROTECTION SYSTEM FROM NON-SAFETY SYSTEMS, INCLUDING QUALIFICATION OF ISOLATION DEVICES"
RESPONSE TO FINAL SAFETY EVALUATION REPORT

ENCLOSURE

By letter dated September 2, 1982, the NRC issued its final safety evaluation report (SER) for SEP Topic VII-1.A "Isolation of Reactor Protection System from Non-Safety Systems, Including Qualification of Isolation Devices". As stated in the SER, and as reiterated during the integrated assessment meetings during the week of November 15 to 19, 1982, the NRC concludes that suitable isolation devices exist in the Reactor Protection System (RPS) with the exception of isolation of possible effects from the RPS motor-generator sets and alternate feed.

The remaining concern associated with this topic is that a sustained voltage or frequency transient in the RPS power supply (motor-generator or alternate feed) could overheat half of the scram valves and prevent a scram. Therefore, the NRC recommends the installation of suitably qualified isolators in each protection bus. The purpose of this enclosure is to provide justification that existing protective devices, coupled with administrative controls and preventive maintenance programs, in effect ensure safe and reliable operation of the RPS and, subsequently, the NRC recommendations are not warranted.

Previous correspondence associated with this topic provided specific operating details of the protective devices in the RPS power supplies. Setpoints, required operating ranges and equipment characteristics, however, were not included in that correspondence. Consideration of such parameters is essential in evaluating the adequacy of the present system at Big Rock Point.

Figure 1 is a simplified diagram of one RPS power supply illustrating the protective devices and metering provided. In addition, Figure 1 includes a table listing the devices and present setpoints. The three conditions under consideration; i.e., over-voltage, under-voltage and under-frequency will be subsequently discussed. Discussion of the pilot solenoids is provided first, however, since the operating requirements and failure characteristics of the solenoids must be established.

The ASCO Type 8316 solenoid valves utilized in the RPS at Big Rock Point are normally powered from the RPS motor-generator sets and are industrially rated at 120 VAC, 60Hz/110 VAC, 50Hz. Normal operating ranges are 102 to 120 VAC for 60Hz operation and 93.5 to 110 VAC for 50Hz operation. The manufacturer's catalog specifies that all solenoid valves are tested to operate at 15% under the nominal voltage at maximum operating pressure differential and are capable of operating for short periods at 10% over the nominal voltage (132 VAC for 60Hz operation, 121 VAC for 50Hz operation).

Failures have been experienced with the solenoid valves at Big Rock Point Plant; however, gross failure to several solenoid valves has never been experienced. The failures that have occurred have been attributed to aging of component parts within the solenoid valves. On February 2, 1979, Consumers Power Company submitted its response (Attachment I) to IE Bulletin 78-14 which addressed the deterioration of Buna-N components in ASCO solenoid valves. As evidenced by that letter and associated General Electric Company correspondence, aging is a key factor in failures associated with the solenoid valves and tends to reinforce the fact that a sustained transient is required to cause overheating and faulty operation of the solenoid valves. Periodic replacement of critical parts has been implemented at Big Rock Point as indicated in Attachment I. Scram testing during refueling outages verifies proper operation of the scram solenoid pilot valves.

OVER-VOLTAGE PROTECTION

Over-voltage protection (Figure 1, Item 59) for each 120 VAC RPS motor-generator (M-G) bus is accomplished through the use of a General Electric Company Type 12PJV11A1 relay. The operating range of this relay is 70 to 160 VAC at 60Hz. The present setpoint of the relay is 140 VAC. At 140 VAC, the relay will act to trip the output of the M-G set by opening the field circuit.

The setpoint of 140 VAC was apparently chosen to protect against regulator failure and not to detect setpoint drift which would be detected by operations personnel during their routine rounds. Regulator range, as determined by initial testing of the power supplies by the manufacturer, was determined to be 96.5 to 143.5 VAC at no load and 96.0 to 143 VAC at full load conditions (see Attachment II).

During this review of the components receiving power from the M-G s. .s, it becomes apparent that the over-voltage setpoint should be adjusted downward to provide greater protection against over-voltage conditions. In addition to the solenoid valves which are rated at 120 VAC/60Hz with a short duration over-voltage limit of 132 VAC at 60Hz, the neutron monitoring system instrumentation has power input requirements of 115 VAC ± 10% or 103.5 to 126.5 VAC at 60Hz. Therefore, Consumers Power Company plans to reduce the setpoint of the over-voltage relays to 125 VAC.

To accomplish this change in over-voltage setpoint, adjustments to the M-G set voltage regulator are also deemed necessary. The present setpoint for the regulator is 120 ± 2 VAC. This setpoint will be reduced to 115 ± 2 VAC which will not only provide an acceptable margin for the over-voltage trip, but will also (1) provide a voltage source to the solenoid valves within their operating range of 102 to 120 VAC, (2) reduce I^2R losses by approximately 8% in all components powered by the 120 VAC RPS bus and, (3) improve the reliability of neutron monitoring system components by not utilizing excess potential on consumable items such as electron tubes.

UNDER-VOLTAGE PROTECTION

Two under-voltage devices exist within the RPS power supplies to guard against under-voltage conditions. The under-voltage relay (Figure 1, Item 27) in the 480 VAC prime mover control circuitry functions as a "loss-of-voltage" sensor to not only provide annunciation to the control operator that a loss of power to the M-G set has occurred, but also to trip the output of the M-G set by opening the field circuit after a 10 second time delay. This relay is an AGASTAT Type DEH-SR-22-Q time delay relay with a nominal voltage rating of 120

VAC, 50-60Hz. Pickup voltage of this relay is approximately 85% (102 VAC) of nominal voltage and dropout occurs at approximately 50% (60 VAC). (This information was obtained through telephone conversation with the manufacturer's representative as no technical information on this relay is readily available.)

As stated previously, the function of the under-voltage relay is to sense the loss of prime mover supply voltage and permit the control room operator to transfer to the alternate feed (see Attachment III, Alarm Procedure ALP 1.2, #30 and #33) prior to losing the 120 VAC M-G output at the end of the 10-second timing interval.

It is not the function of the M-G set under-voltage relay to protect against degraded conditions on the 480 VAC supply buses. Degraded conditions are detected by other protective relaying schemes in the station power system which trip the supply breaker to the 2400 VAC bus (also deenergizing the 480 VAC buses). Tripping of the 2400 VAC bus breaker will occur 10 seconds after a sustained degraded voltage level of 89% rated voltage (i.e., 107 VAC on the 120V potential transformers) is reached on all three phases of the 2400 volt bus (see Attachment IV, Section 2.18.4.2). Also, it is worth noting that the M-G outputs remain essentially constant until the trip occurs. (In fact, the M-G outputs are essentially constant down to 70% of rated voltage with full load on the generator, see Attachment II.) This is due primarily to over-sizing of the motor for the M-G set and the large inertia flywheel which keeps the generator at near rated speed.

The second under-voltage device associated with the RPS supply is the under-voltage breaker, CB-RE11 (see Figure 1). This breaker serves three functions: (1) to rapidly deenergize the scram solenoid buses in the event of a manual scram (although a trip signal is also initiated in the RPS logic from the manual scram pushbutton), (2) to rapidly deenergize the scram solenoid buses when the reactor mode switch is placed in "Shutdown" position, and (3) to deenergize the scram solenoid buses if low voltage is sensed on the RPS bus. The setpoint of this breaker is 52 ± 20 VAC.

Although adequate under-voltage protection is provided by the above devices for both the M-G set 120 VAC bus and the alternate feed, Consumers Power Company does not believe that under-voltage protection is essential to prevent overheating of the solenoid coils in the RPS. Figure 2 portrays the results of a recent test performed with spare pilot solenoids at Big Rock Point Plant. (Three spare solenoids were tested for voltage decrease to establish test validity and the average was utilized in the construction of Figure 1. Only one solenoid was utilized for the voltage increase test as solenoid response during the voltage decrease test was nearly identical.) Results of the test indicate that on decreasing voltage, power consumption (VA) of the coil at voltages lower than the minimum operating voltage of 102 VAC is less than that amount required at the minimum operating voltage. When the plunger releases from the core, a sharp increase in current is detected; however, the volt-amperes required is still less than that required at minimum operating voltage and is only 54% of the volt-amperes required at maximum recommended operating voltage of 120 VAC. It is extremely doubtful that overheating of the coil would occur under low voltage conditions. Further, with the voltage decreased to a point where plunger drop-out occurs, erratic operation can be expected from all neutron monitoring instrumentation (and other devices receiving RPS power); and in all probability, a trip of the affected RPS channel would have already occurred.

UNDER-FREQUENCY PROTECTION

Under-frequency protection for the RPS power supplies is indirectly obtained. However, Consumers Power Company believes the protection adequately satisfies the intent of current licensing criteria.

As stated in previous correspondence[2] associated with this topic, grid frequencies are extremely stable. An upward shift in frequency is not of concern for overheating as an upward shift increases the inductive reactance of the solenoid coils thereby decreasing the current and reducing any heating effect. A downward shift in frequency is, however, a cause for concern.

Existing procedures address instability in grid frequency (see Attachment IV, Section 2.18.4.3 and Attachment V) and provide instructions for separation from the grid. At the separation frequency of 57.6Hz (96% of rated frequency) any additional heating to a solenoid coil rated for 120 VAC, 60Hz/110 Vac, 50Hz is considered insignificant.

Under-frequency protection for the M-G sets is provided by thermal overloads (TOL)s in the motor circuit. Additional loading imposed by either excessive load current on the M-G set output or loading due to bearing seizure would be detected by TOL devices.

The devices used for TOL protection (Item 49, Figure 1) are General Electric Company CR 124B1, Size 2 TOL relays with Type CR 123C30.3B heater elements. The TOLs are designed for 115% of full load current (see Attachments VI and VII).

Attachment VIII lists the nameplate data for the motor and generator of each RPS M-G set. By comparison of the data and as illustrated by the test report (Attachment II), the motor is oversized and provides extremely good frequency regulation in addition to providing the necessary starting torque to accelerate the generator and flywheel to operating speed. Starting of the M-G set, however, normally results in receipt of the TOL alarm (see Attachment III, Alarm Procedure ALP 1.2, #29 and #32).

Figure 3 is a typical speed-torque-current curve for the type of motor used in the M-G set (A curve of this type has been requested from General Electric Company for the specific motor design but has not been received). From this curve, typical response of the TOL relays can be determined.

Full load current on the M-G set is 31.3 amperes. The TOL heaters are rated at 115% of full load current or 36 amperes. At full load the motor is rated at 1765 RPM which will provide an output frequency of 58.8Hz (actual loading of the generator at Big Rock Point is approximately 40% of full load).

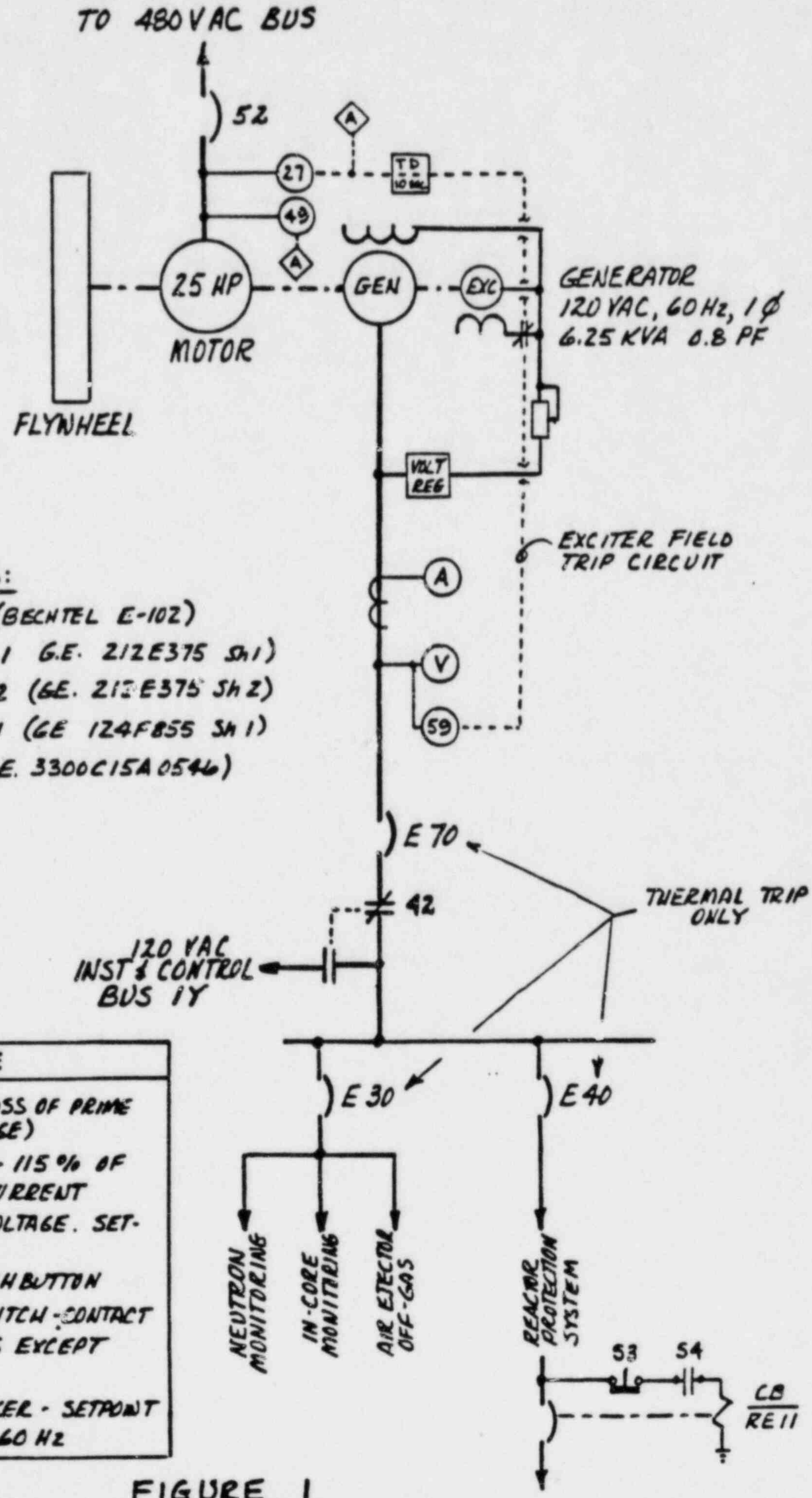
If additional loading is imposed on the generator, either from excessive load or bearing seizure, both current and torque will increase and speed will decrease. At 115% of full load, motor current will reach 36 amperes, torque will approach 144% of full-load torque and speed will decrease to 1746 RPM, resulting in an output frequency of 58.2Hz.

If loading continues to increase to a point where speed decreases to 92% of synchronous speed (i.e., 1656 RPM), the output frequency will decrease to 55.2 Hz, motor current will reach 200% of full-load current (or 62.6 amperes) and torque will approach 195% of full-load torque. At this point, the TOL will trip in approximately 80 seconds (see Attachment VII). If further loading occurs, at approximately 83% of synchronous speed the motor will stall as the breakdown torque is reached.

The previous example is a severe case of overloading a motor, however, it describes the characteristics of the various parameters and illustrates the response of the TOL trip device. Less severe would be a loading of 125% of full load. In this case, the TOL relay will ultimately trip (note that timing criteria is not defined see Attachment VII, Heater Selection). At 125% loading, motor speed would decrease to 1737 RPM, output frequency would decrease to 57.9Hz and motor torque would approach 155% of full-load torque.

In addition to the protective devices described above, the RPS M-G sets undergo inspection as part of the preventive maintenance program during each refueling outage. The performance of the RPS M-G sets has been entirely satisfactory since plant startup with only normal maintenance required. Continuous monitoring of M-G set performance is part of the operator's daily routine (see Attachment IX).

In conclusion, it is the opinion of Consumers Power Company that the existing protective devices (with changes to the overvoltage relaying and regulator setpoints to be completed during the 1983 refueling outage) and administrative controls associated with the RPS M-G sets provide an adequate defense against sustained voltage or frequency transients in the RPS power supply and do not constitute a hazard to plant safety. Consumers Power Company, therefore, concludes that the NRC recommendations are unwarranted.



REFERENCE DRAWINGS:

- 0740G 30102 (BECHTEL E-102)
- 0740G 30743 SH 1 G.E. 212E375 SH 1)
- 0740G 30743 SH 2 (G.E. 212E375 SH 2)
- 0740G 30734 SH 1 (GE 124F855 SH 1)
- 0740E 30773 (G.E. 3300C15A0546)

DEVICE TABLE	
(27)	AC UNDERVOLTAGE (LOSS OF PRIME MOVER SUPPLY VOLTAGE)
(49)	THERMAL OVERLOAD - 115% OF FULL LOAD MOTOR CURRENT
(59)	120 VAC BUS OVERVOLTAGE. SETPOINT OF 140 VAC.
S3	MANUAL SCRAM PUSHBUTTON
S4	REACTOR MODE SWITCH - CONTACT CLOSED IN ALL MODES EXCEPT SHUTDOWN.
CB/RE11	UNDERVOLTAGE BREAKER - SETPOINT OF 52 ± 20 VAC, 60 Hz

FIGURE 1

RES 2-8-83

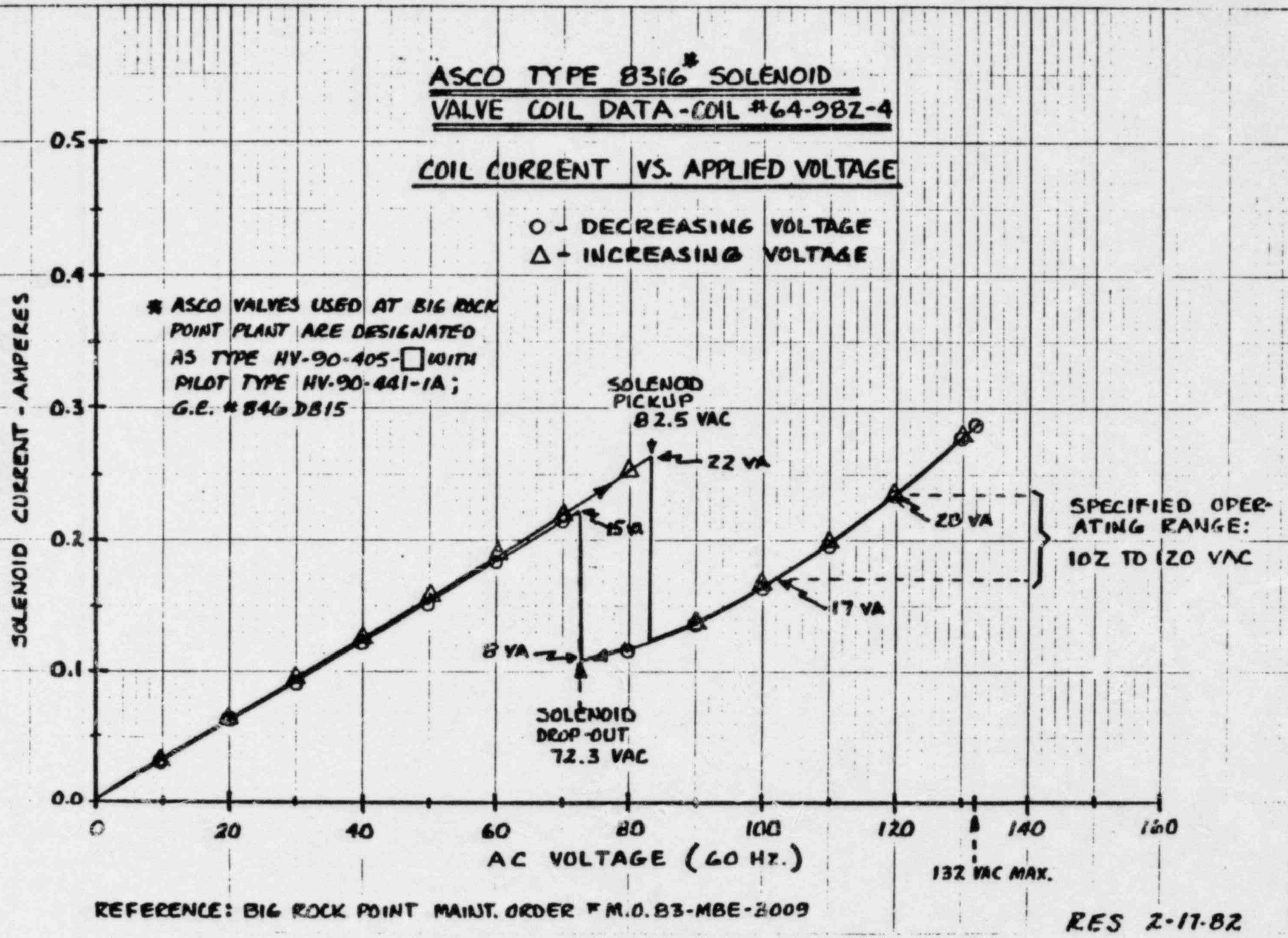
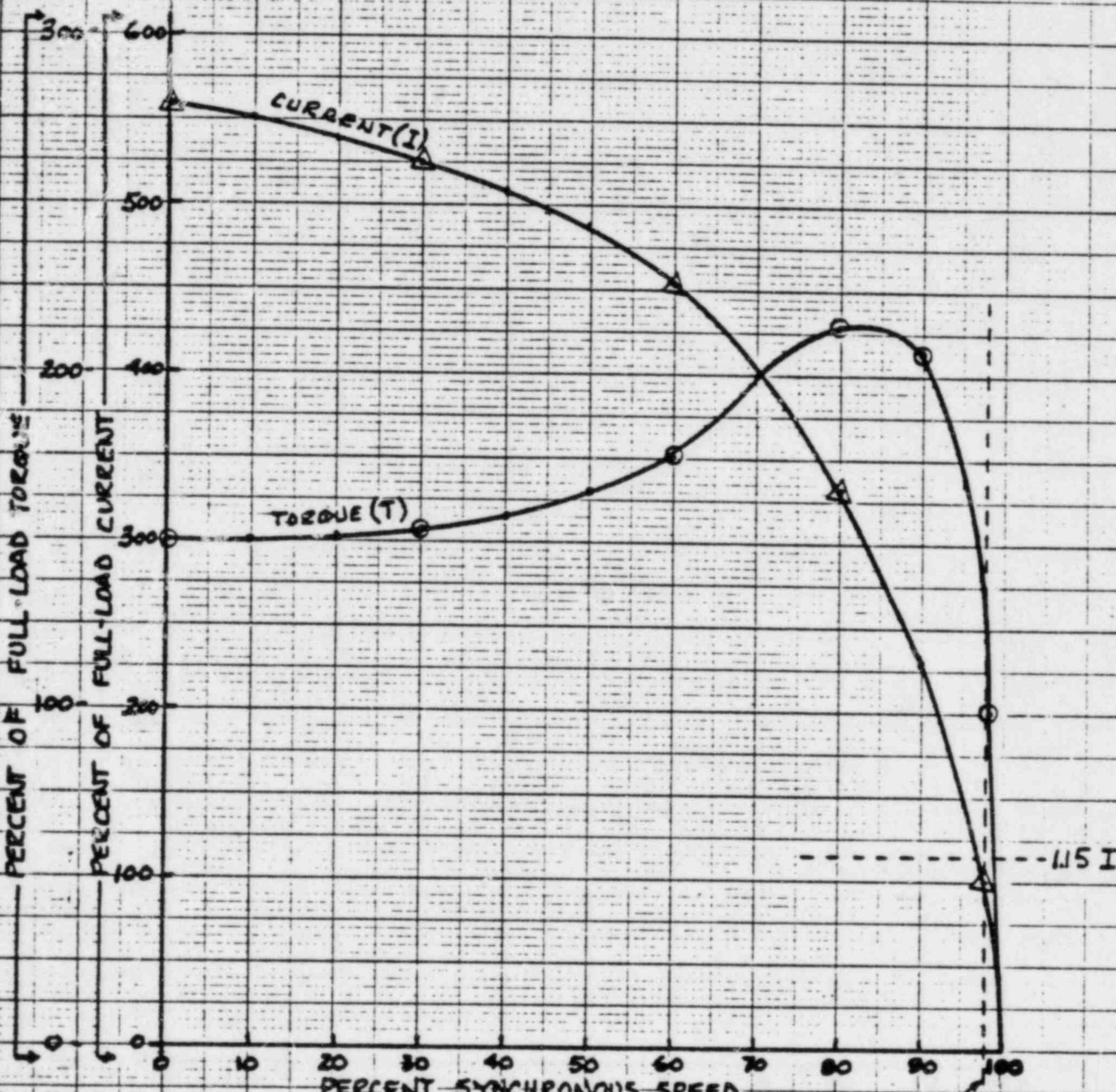

ASCO TYPE 8316* SOLENOID
VALVE COIL DATA - COIL #64-982-4
COIL CURRENT VS. APPLIED VOLTAGE
O - DECREASING VOLTAGE
Δ - INCREASING VOLTAGE
* ASCO VALVES USED AT BIG ROCK POINT PLANT ARE DESIGNATED AS TYPE HV-90-405-□ WITH PILOT TYPE HV-90-441-1A; G.E. #846 DB15
SOLENOID PICKUP 82.5 VAC
22 VA
15 VA
8 VA
SOLENOID DROP-OUT 72.3 VAC
20 VA
17 VA
SPECIFIED OPERATING RANGE: 102 TO 120 VAC
132 VAC MAX.
SOLENOID CURRENT - AMPERES
0.0
0.1
0.2
0.3
0.4
0.5
0
20
40
60
80
100
120
140
160
AC VOLTAGE (60 Hz.)
REFERENCE: BIG ROCK POINT MAINT. ORDER # M.O. 83-MBE-3009
RES 2-17-82

FIGURE 2

FIGURE 3



TYPICAL SPEED-TORQUE-CURRENT CURVE FOR A DESIGN B, 3Ø, 60Hz INTEGRAL-HORSEPOWER SQUIRREL CAGE INDUCTION MOTOR

REFERENCES:

1. ANSI/NEMA STANDARDS PUBLICATION MG1-1978, MOTORS & GENERATORS
2. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, FINK & CARROLL, TENTH EDITION, McGRAW-HILL
3. MOTOR APPLICATION AND MAINTENANCE HANDBOOK, ROBERT W. SMEATON, McGRAW-HILL

RES 2-10-83

Consumers Power Company

FEB 6 1979

COPY

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

February 2, 1979

Mr James G Keppler
Office of Inspection and Enforcement
Region III
US Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

DOCKET 50-155 - LICENSE DPR-6 -
BIG ROCK POINT PLANT - RESPONSE TO IE BULLETIN
78-14: DETERIORATION OF BUNA-N COMPONENTS IN
ASCO SOLENOIDS

The subject bulletin addressed failure of Buna-N components in ASCO solenoid valves. Consumers Power Company's response to the subject bulletin's request for information is delineated below:

Item

Review Buna-N material applications in your control rod scram systems and determine the time since installation and, for installed material, the time since packaging.

Response 1

Our records indicate that the subject scram solenoid valves were shipped from General Electric in 1966 and installed in 1966 and 1967. There is no data available concerning the length of package or storage time prior to shipment.

Item

Report the results of the review set forth in Item 1 above and describe your schedule for replacement, both in response to this bulletin and for periodic maintenance.

Response 2

The scram solenoid valves will be rebuilt with the kits specified in General Electric's Service Information Letter (SIL) 128, Rev 1, Supp 1, during the next refueling outage scheduled to begin in February 1979. A preventive maintenance program has been established to replace the affected solenoid valve parts on a five-year frequency.

Item

Describe the bases for your schedule of replacement identified in response to Item 2 above. Justify any proposed replacement time in excess of three years.

Response 3

General Electric's letter dated January 30, 1979 (copy attached) reported that a combination of shelf and in-service life of seven years for the subject components is conservative based on industry experiences with failure of Buna-N components in scram pilot valves. Records at Big Rock Point reinforce GE's recommendation as the Big Rock Point failures discussed in the subject bulletin involved valves which had been installed for approximately twelve years before the first failure of this type occurred. As a result, a scheduled preventive maintenance kit replacement program has been established with a replacement frequency of five years. This is conservative and justifiable based on both industry and BRP's past experiences.

David A Bixel (Signed)

David A Bixel
Nuclear Licensing Administrator

CC Director, Office of Nuclear Reactor Regulation
Director, Office of Inspection and Enforcement

GENERAL ELECTRIC

ATTACHMENT I

NUCLEAR ENER

GENERAL ELECTRIC

NUCLEAR ENE

BUSINESS GR

GENERAL ELECTRIC COMPANY, 175 CURTNER AVE., SAN JOSE, CALIFORNIA 95125

G-EJ-9-10

cc: F. Turski
C. Hinton

January 30, 1979

Mr. J. Rang
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

SUBJECT: RESPONSE TO NRC-IE BULLETIN 78-14

Dear Mr. Rang:

This letter has been prepared by the General Electric Company to provide information to the operating BWR owners to assist them in responding to the NRC-IE Bulletin 78-14, and to provide a clarification of the recommendations in Service Information Letter 128.

In order to establish a common base for discussing maintenance recommendations, and their bases, it is helpful to start with a few definitions.

1. Cure-Date (C.D.)

This is the date on which the Buna-N elastometer parts are created in a molding and heat curing process. This is the true "beginning-of-life" for the material. While the cure-date is the ideal reference for defining useful life of an elastomer, historically it has not been identified on piece parts for a variety of manufacturing related reasons.

2. Packaging Date (P.D.)

This is the date on which the various piece parts are packaged into replacement part kits. The times between curing and packaging are not always known accurately; therefore, it is conservatively assumed to be equal to or less than two years (P.D. = C.D. +2 yrs.).

3. Service Life (S.L.)

Service life is defined as the period of time from packaging date during which the elastomer retains enough of its design properties to perform its design function. Service life includes shelf time prior to installation.

Discussion

The service life of elastomer parts in a pneumatic system is affected by environmental factors such as temperature, radiation, air quality, etc. The initial Service Information Letter (3/31/75) recommended replacement of the Buna-N parts after three years of actual service. This recommendation was made with knowledge that as much as four years could elapse between the cure-date and the beginning of actual service. It was also made without the benefit of a significant quantity of service life data. The 1/30/76 revision to the Service Information Letter revised the expected service life based on actual in-service performance data (see Figure 1). At that time there were three plants that reported diaphragm failures. These three plants had times to failure of 7, 7 and 10 years from the time the valves or valve parts were shipped to the sites. At the time of failure of diaphragms of the last two of these three plants there were eight other plants that had been in operation longer with no failures in 1252 valves. (At another plant there were two failures not related to aging/hardening of the elastomer material. The first was at four years after valve shipping dates; the second at seven years; these are considered isolated failures not related to the subject of this letter.)

The 8/78 supplement to the Service Information Letter took into account, for the first time, the failure of the Buna-N disc in the solenoid valve core assembly (plunger). Prior to this time only the dynamic (i.e., flexing) parts of the valves were considered to have a limited life. The disc in the plunger is almost completely surrounded and is mechanically captured by the metal plunger body. It is a passive element which flexes only minimally when the plunger strikes the valve seat. The first time a failure of the Buna-N disc in the solenoid plunger was observed at a plant there were 14 other plants that had been in operation longer with no similar failures in 2574 valves. The actual time to failure from the year the valves were built was ten years.

Figure 1 summarizes the experience to date with failures of Buna-N components in scram pilot valves. It is clear that the probability of aging-type failures beginning to occur before seven years from the packaging date is low enough to be acceptable; therefore, a combination of shelf and in-service life of seven years from packaging date is conservative.

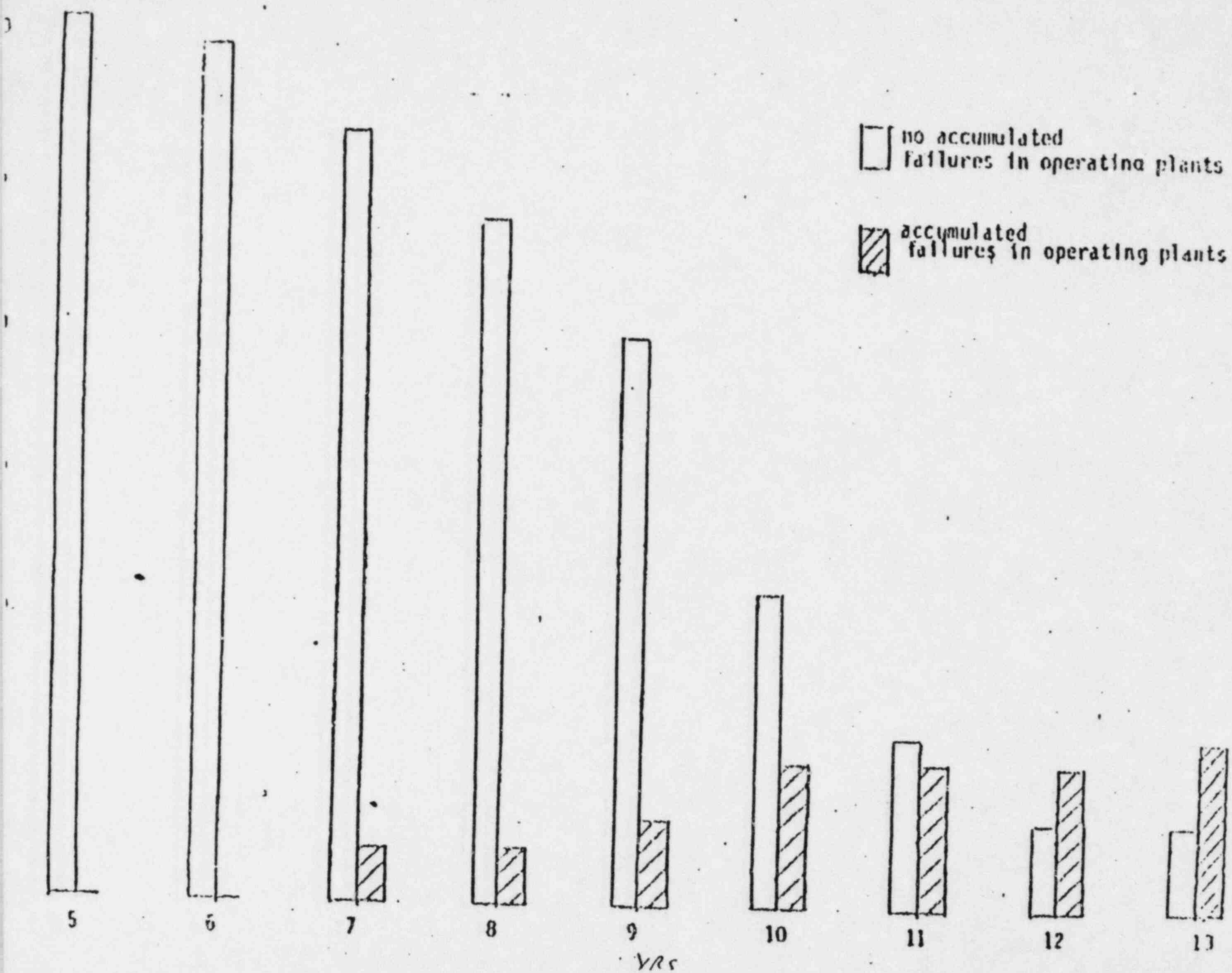
Very truly yours,

Mireille Costandi

M. A. Costandi
Product Service Engineer
BWR Product Service
[illegible]

Figure 1

Scram Pilot Val.



ATTACHMENT I

ATTACHMENT II

TEST REPORT

BECHTEL CORPORATION
62 First Street
San Francisco, California

Tests per Spec 3159-E-14
Paragraph 5.0 - Special Requirements
Addendum No. 1

Test Report - 022
Requisition: 474-96320-1

April 1962

GENERAL ELECTRIC COMPANY

Test Report - 022

REPORT OF TEST
SYNCHRONOUS MOTOR-GENERATOR SET

Purchaser

MOTOR-GENERATOR SET - 5L84284A21Y18 Serial No: 2587296

MOTOR - 5K4326A21Y54 - rated K326Z - 4 pole - 25 HP - 1800 RPM - 3 phase - 220/440 volts - 60 cycles

GENERATOR - 5SJ4284A21Y13 - rated SJ284Z - 4 pole - 6.25 KVA - .8 PF - 5 KW - 1800 RPM - 1 phase - 120 volts - 60 cycles

Set complete with flywheel and voltage regulator 3S7932EA127A2

NOTE: This set has been rebuilt using 5LS4284A21Y9 substituting motor above for 5SK4326A2Y8.

CUSTOMER - BECHTEL CORPORATION

SPEC - 3159E14, Rev. 2 - Addendum No. 1.

SPECIAL NOTES:

1. Voltage regulator requires approximately 240 volts for operation. Generator has 120 volt output. Potential transformer must be used. Transformers were supplied originally, but were not returned with sets. Transformer used for these tests has same rating and is property of Test Department.

2. Oscillograms contained in this test report have been cut to convenient lengths for ease of handling. To assure continuity, the oscillogram demonstrating five second interruption of motor power was properly numbered on timing line before being cut.

Tests by: Z. Savicki
Small AC Motor & Generator Department - Test

Test report prepared by: John H. Herrick

Tests certified and approved by: John H. Herrick
Small AC Motor & Generator Department
Schenectady, New York

GENERAL ELECTRIC COMPANY

REPORT OF TEST

SYNCHRONOUS MOTOR-GENERATOR SET

BECHTEL CORPORATION

Test Summary for spec 3159-E-14 - Addendum No. 1
Supporting data and oscillograms included in report.

5.1 Generator operating with regulator at rated voltage. The range at no load is 96.5 to 143.5 volts and at full load is 96.0 to 143 volts.

5.2 Flywheel maintains frequency. Frequency did not drop below 59.2. This was when generator was operating at full load with 70% voltage on drive motor.

5.3 Voltage regulator maintains voltage at required level demonstrated in oscillograms.

5.4 Generator operated at 2590 VA - 2560 watts, approximately 1.0 PF, a load of 5050 VA - 1930 watts, .382 PF added. Voltage did not dip below 105 volts. No noticable frequency change. Demonstrated by oscillogram. These combinations of loads are worst conditions in spec. Set meets requirements under these conditions. Other conditions would also meet requirement.

5.5 Generator operated at full load with 70% voltage on motor (440 volt x .70 = 308) for approximately two hours. Power to motor removed ~~[illegible]~~ for five seconds. Set maintained voltage and frequency output. Demonstrated by oscillogram.

5.6 Full load and no load harmonic analysis taken. Maximum harmonic was the third at full load condition - 3.2%. Maximum allowable 5%. Full load and no load crest factor 1.485 which meets requirement of 1.414 ± 10%.

Dropped .6%
= .7 volts

GENERAL ELECTRIC COMPANY

REPORT OF TEST

SYNCHRONOUS MOTOR GENERATOR SET

Purchaser

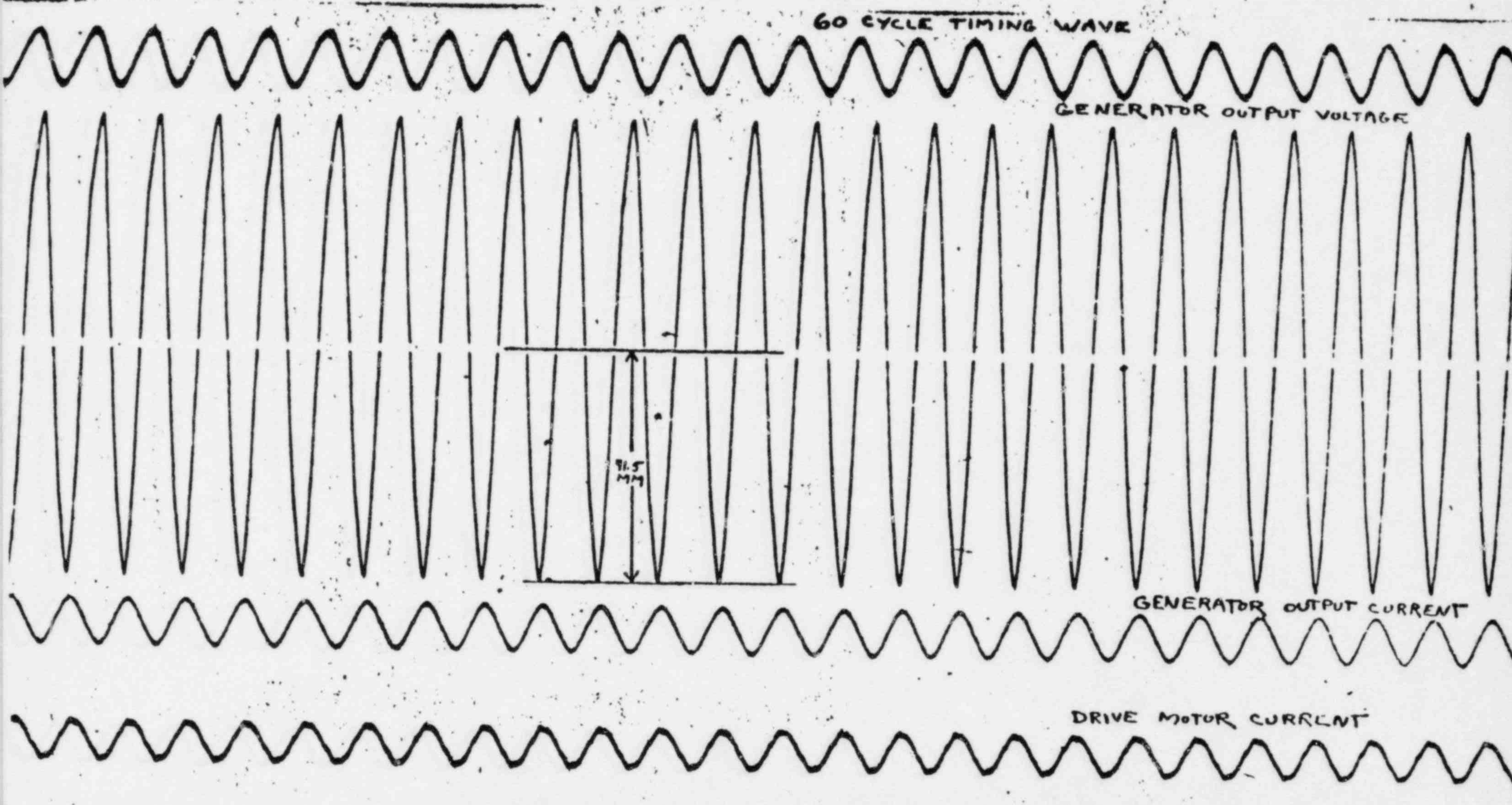
BECHTEL CORPORATION
62 First Street
San Francisco, California

Reqn: 474-96320-1

M-G Set 5L84284A21Y18
Motor 5K4326A21Y54
Generator 5SJ4284A21Y13

MOTOR INPUT										GENERATOR OUTPUT				EXCITER FIELD		NOTES
L1-L2	L2-L3	L1L3	L1	L2	L3	Ave	1	2	Total							
Volts	Volts	Volts	Amps	Amps	Amps	Amps	Watts	Watts	Watts	Volts	Amps	Watts	FREQ	Volts	Amps	
440	440	440	7.71	7.71	7.51	7.64	-765	2400	1635	0	0	0	0	0	0	RUNNING LIGHT MOTOR DATA
440	440	440	8.1	8.18	7.9	8.06	-430	2730	2300	120	0	0	60	9.4	.160	RATED VOLTS NO LOAD ON GENERATOR - MOTOR FULL VOLTAGE
308	308	308	6.20	6.30	6.40	6.30	125	1850	1975	120	0	0	59.9	9.4	.160	RATED VOLTS - NO LOAD ON GENERATOR - MOTOR 70% VOLTAGE
440	440	440	13.55	13.75	14.0	13.77	1900	6025	7925	120	52	5000	59.9	16.5	.280	RATED VOLTS - FULL LOAD ON GENERATOR - MOTOR FULL VOLTAGE
308	308	308	16.20	16.60	16.60	16.47	2525	5175	7700	120	52	5000	59.2	18.4	.300	RATED VOLTS - FULL LOAD ON GENERATOR MOTOR 70% VOLTAGE (AFTER 1½ HRS OPERATION)
308	308	308	10.4	10.6	10.65	10.55	1275	3275	4500	120	21.6	2560	59.9	10.7	.190	
308	308	308	15.45	15.75	15.80	15.67	2350	4925	7275							MOTOR DATA FOR LOAD ABOVE PLUS LOAD BELOW.
										122	41.3	1930	59.9	19.2	.320	THIS LOAD ADDED TO LOAD ABOVE. TO DEMONSTRATE 315? E.1Y 5.4

VOLTAGE REGULATION 120 VOLTS FULL LOAD TO 120V NO LOAD - 0%
VOLTAGE RANGE WITH REGULATOR 96.5 TO 143.5 NO LOAD
VOLTAGE RANGE WITH REGULATOR 96.[illegible] TO 143.[illegible] FULL LOAD



FULL LOAD CREST FACTOR

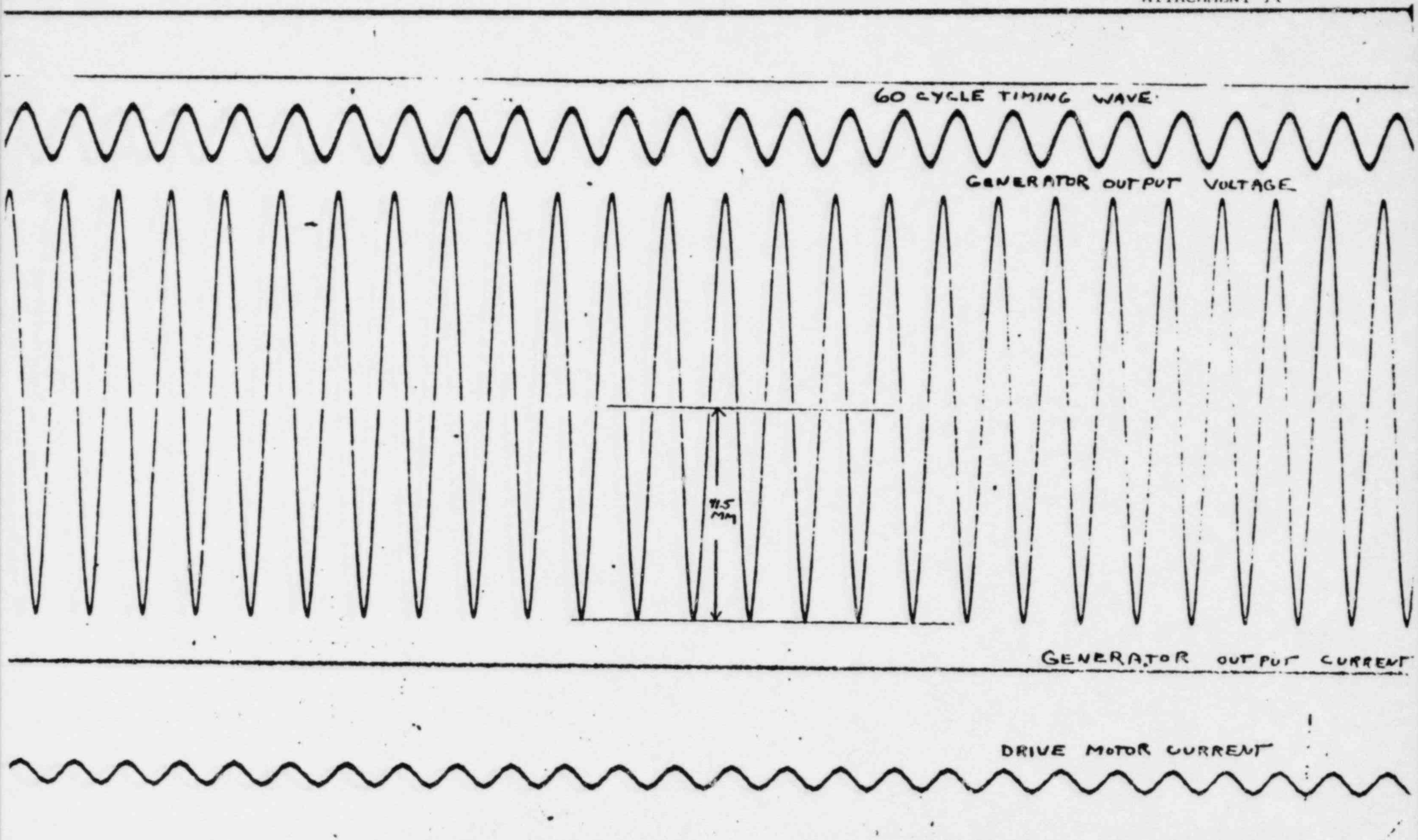
OSCILLOGRAPH (CALIBRATION OF GENERATOR OUTPUT VOLTAGE = 4.3V/MM

41.5 MM X 4.3 = 17[illegible]

MG SET 5LS4284A21Y18

REQ 474-96320-1

TEST REPORT # 077



NO LOAD CREST FACTOR
OSCILLOGRAPH CALIBRATION OF
GENERATOR OUTPUT VOLTAGE = 4.3V/mm
41.5 MM X 4.3 = 178.5 PEAK VOLTS
120 VOLTS ADJUSTED ON RMS METER
CREST FACTOR 178.5/120 = 1.485

MG SET 5LSY2BY A21Y1B
REQ 474-96320-1
TEST REPORT .022

JHH

ATTACHMENT II

GENERAL ELECTRIC COMPANY

REPORT OF TEST

SYNCHRONOUS MOTOR GENERATOR SET

Purchaser

BECHTEL CORPORATION
62 First Street
San Francisco, California

Motor-Generator Set: 5LS4284A21Y18
Motor: 5K4326A21Y54
Generator: 5SJ4284A21Y13

Reqn: 474-96320-1

Test: Harmonic Analysis
to check Spec. 3159-E-14 - 5.6

No Load						Rated Load					
Freq.	Harm.	%	Freq.	Harm.	%	Freq.	Harm.	%	Freq.	Harm.	%
60	1	100	960	16	.21	60	1	100	960	16	-
120	2	.17	1020	17	-	120	2	.16	1020	17	.30
180	3	.11	1080	18	.01	180	3	3.2	1080	18	-
240	4	-	1140	19	-	240	4	-	1140	19	.12
300	5	.26	1200	20	.02	300	5	.89	1200	20	-
360	6	.01	1260	21	-	360	6	.06	1260	21	.11
420	7	.33	1320	22	.01	420	7	.98	1320	22	-
480	8	.02	1380	23	.13	480	8	.07	1380	23	.36
540	9	.01	1440	24	-	540	9	.17	1440	24	-
600	10	.07	1500	25	-	600	10	.095	1500	25	.12
660	11	.19	1560	26	-	660	11	.22	1560	26	-
720	12	.02	1620	27	-	720	12	-	1620	27	.01
780	13	.39	1680	28	.01	780	13	.60	1680	28	-
840	14	-	1740	29	-	840	14	-	1740	29	.01
900	15	.02	1800	30	-	900	15	.18	1800	30	-

1-40-DB 1 5

ATTACHMENT II

2 COPIES FILE BY HA Tomkins DATE 8/8/62

1 COPIES L Hausler 1 COPIES RD Darron/LM Day

COPIES COPIES

STATION Big Rock FILE NO. 740-DB1 Sh 4

CP CO. GWO. 3159 REQ'N E-14 ORDER E-14

MANUFACTURER General Electric MFR. ORDER 474-96920-1

DESC. OF EQUIPMENT MD Set 5KW 120V

TITLE Test Data

MFR. DWG. NO. 22 REV.

MATERIAL CLASSIFICATION MD Set D-1.0

RECEIVED
RECORD CORP
APR 1 C 1965
POWER DIV
S.F.

NUCLEAR STEAM SUPPLY SYSTEM ANNUNCIATOR WINDOW LAYOUT 1

Panel C02

Ref Prints M-121, M-122, GE 198E134

Dump Tank Valve Closure 1	Neutron Flux High Scram 4	Short Period Scram 7	Reactor Low Water Level Scram 10	Steam Drum Low Water Level Scram 13	Scram Dump Tank High Water Level Scram 16	Reactor High Press Scram 19	Encl High Press Scram 22	Main Steam Isolation Valve Scram 25	Recirc Line Valves Closed Scram 28	Condenser Lo Vacuum Scram 31
Channel 1 Scram 2	Neutron Flux High 5	Short Period 8	Shutdown Mode One Rod Off 00 11	Steam Drum Low Water Level 14	Scram Dump Tank Hi Water Level 17	Reactor Very High Press 20	Accumu- lator Leak 23	Low Accum Press Block Rod With- drawal 26	Reactor Protec- tion Mg Set 1 Motor Overload 29	Reactor Protec- tion MG Set 2 Motor Overload 32
Channel 2 Scram 3	Manual Scram 6	Short Period Start- Up 9	In-Core Flux High 12	Steam Drum Hi Water Level 15	Rod Position MC Set Overload 18	High Reactor Press 21	Rod Drive Filter Hi Diff Press 24	Low Accumu- lator Press 27	Loss of Power to MG Set 1 30	Loss of Power to MG Set 2 33

Device	Normal	Contact Off Normal	Silence	Contact Returns to Normal	Reset	Test
Lamps	Off	Normal Flash	Steady On	Fast Flash	Off	Normal Flash
Audible	Off	On	Off	Off	Off	On

Ann No	Alarm Description	Sensor	Trip Setting	Corrective Action
				3. If leakage detected, have repaired as soon as possible. 4. Check Control Room Fuse C02-5 (10 amp).
28	Recirc Line Valves Closed Scram	"SR" Scram Auxiliary Relays From Position Switches	10% Closure of Both Disch or Both Suction Valves, or Any Combination of Both of These Valves, One in Each Loop	1. Automatically causes scram actions as indicate in Annunciator 2, Part 2. 2. Recirculation flow of 6 x 10^6 lb/hr (minimum) is required before a scram recovery is made.
29	Reactor Protection MG Set 1 Motor Overload	42-1A-61	115% Rated Current of Motor	1. Check generator ammeter for high output. (Nor mal is 15-20 amps.) If normal, problem is in the motor end. Switch Channel 1 Safety System the alternate power supply and shut the MG set down. 2. Notify Shift Supervisor so that immediate repa can be made. 3. If generator output is high, leave set in serv and notify Shift Supervisor and Instrument Department immediately.
30	Loss of Power to MG Set 1	27-1	Loss of Voltage	1. Transfer to the "Alternate" power supply. 2. After a 10-second TD, output on MG set will dr to "0."

Ann No	Alarm Description	Sensor	Trip Setting	Corrective Action
31	Condenser Low Vacuum Scram	PS-652, 653, 654, 655	8" Hg ± .5" ABS -22" Vacuum	1. Scram initiation as outlined in Annunciator 2 Part 2, of this section. 2. Normal heat sink (main condenser) is lost. 3. A further drop to 10" Hg ABS (~20" Hg vac) ca all steam admission valves to turbine and mai condenser to close. 4. This scram function is bypassed with reactor pressure less than 450 psig, mode switch "BPD position or mode switch in "Refuel" position. 5. Check CCWPs on, air ejectors and OG isolation valve.
32	Reactor Protection MG Set 2 Motor Overload	42-2A-61	115% Rated Current of Motor	1. Check generator ammeter for high output (norm is ~15-20 amps). If output is normal, the problem is in the motor end. Switch Safety System Ch 2 to the alternate power supply and shut the MG Set 2 down. 2. Notify the Shift Supervisor so that immediate repairs can be made. 3. If the generator output is high, leave the MG Set 2 in service and notify the Shift Supervis and Instrument Department immediately.

Ann No	Alarm Description	Sensor	Trip Setting	Corrective Action
33	Loss of Power to MG Set 2	27.2	Loss of Voltage	1. Transfer to the alternate power supply. 2. After a 10-second TD, output of MG Set 2 will drop to "0."

* At 1350 psia, see Technical Data Book, Section 15.5.F.

2.18 LOSS OF TRANSMISSION SYSTEM

NOTIFY THE SHIFT SUPERVISOR, WHEN ENTERING THIS PROCEDURE, TO REFER TO THE SITE EMERGENCY PLAN VOLUME 9A FOR CLASSIFICATION AND EMERGENCY PLAN ACTION.

Loss of 138-kV System occurs when 199 OCB opens or when there is a power failure of 138-kV line. Three general situations exist when the 138-kV System is lost: (1) When generator is on line and no scram occurs; (2) when generator is on line and a scram occurs; and (3) when generator is off line.

NOTE: The 46-kV line is assumed to be available in any case.

NOTE: A situation has been postulated where the loss of the Transmission System occurs, the bypass valve fails to open and the reactor fails to scram (ATWS). The operator guidance is written in Off-Normal Procedure "Multiple Rod Insert Failure."

2.18.1 Generator On Line - No Scram

2.18.1.1 Symptoms

1. Generator output will drop to station power load.
2. Turbine bypass valve open alarm will annunciate.
3. 199 OCB trip alarm will annunciate if loss of 138-kV System is due to 199 OCB trip.

2.18.1.2 Automatic Actions

1. Turbine control will transfer if 199 OCB trips open and generator output will drop to maintain station load.
2. Turbine bypass valve will open to control reactor pressure.

2.18.1.3 Immediate Operator Actions

1. Check turbine bypass valve for proper operation.
2. Check that turbine generator has reduced to meet station power load.
3. Adjust turbine speed to equal 60 hertz on generator.

2.18.1.4 Subsequent Operator Action

1. Reduce reactor power by inserting control blades according to reactor operating instructions to reduce steam flow through turbine bypass valve. This is to prevent loss of condenser vacuum. The reactor recirculating pump should not be manually tripped. If possible, both should be left in service in order to maintain load on turbine generator.

2. Refer to SOP 13, Step 6.5 for <u>resetting to normal</u> after turbine auto transfer to speed control.

3. When 138-kV line is normal and 199 can be closed, restore plant load to normal.

2.18.2 <u>Generator On Line - Scram Occurs</u>

2.18.2.1 Symptoms

1. Generator output will drop to zero.

2. 116 OCB trip alarm will annunciate.

3. 199 OCB trip alarm will annunciate.

4. Channel 1 scram and Channel 2 scram alarms will annunciate.

5. Station lighting will be lost and emergency lighting will come on.

2.18.2.2 Automatic Actions

1. Reactor will scram.

2. Turbine will trip.

3. Reactor feed pumps and reactor recirc pumps will trip on undervoltage.

4. Emergency generator crank circuit is energized and diesel comes up to speed, but is not connected into MCC-2B. The 2A-2B bus tie remains closed.

5. At two seconds after undervoltage, the following equipment trips:

   a. Service water pump(s).

b. Reactor feed pump(s).

c. Condensate pump(s).

d. Control rod drive pump(s).

e. Reactor cooling water pump(s).

f. Service air compressors.

g. Plant exhaust fan(s).

h. Screen wash pump.

i. AC bearing and seal oil pump.

j. Auxiliary oil pump.

k. Power to MCC Bus 1E (radwaste).

l. Power to MCC Bus 2D (Ventilation System).

6. After 3.6-second time delay, the 1126 OCB opens and the 7726 OCB closes.

7. The condenser circulating water pumps trip only after ~4.5-second delay after loss of station power.

8. After 10-second time delay, if station power has not been restored via off-site power sources, the 1136 breaker will open, de-energizing the 2400-V bus. Emergency Power Bus 2B will be subsequently energized through shunt tripping of the 2A-2B or (1A-2B) tie breaker and closure of the emergency diesel generator output breaker.

9. If potential is restored to station power bus (from 46-kV line) by automatic closure of 7726 OCB, the following equipment restarts automatically in the order listed:

   a. Condenser circulating water pumps come on immediately if breakers have not tripped, ~4.5 seconds after initial loss of power.

   b. Service Water Pump 1 and/or 2 (2 seconds).

c. Condenser circulating water pumps (if tripped), starting sequence at 2 seconds (pumps will start in about 1/2 minute).

d. Reactor Cooling Water Pump 1 or 2 (4 seconds).

e. Control Rod Drive Pump 1 and/or 2 (4 seconds).

f. Condensate Pumps 1 and/or 2 (6 seconds).

g. Service Air Compressors 1, 2 and/or 3 (6 seconds).

h. Plant Exhaust Fans A and/or B (8 seconds).

i. Screen wash pump (10 seconds).

j. AC bearing and seal oil pump (10 seconds).

k. Auxiliary oil pump (10 seconds).

2.18.2.3 Immediate Operator Actions

1. Perform immediate actions as listed in ONP 2.31.3.

2. Check emergency condenser for proper operation and subsequently throttle outlet valves to prevent rapid cooldown.

3. When potential is restored to the station power bus by automatic closure of 7726 OCB, verify that equipment listed under Automatic Actions restarts as described and start other equipment as needed.

4. Upon total loss of the station power 2400-V bus and subsequent actuation of the emergency diesel generator refer to SOP 28, Step 6.2 for loading of emergency diesel generator with essential Plant loads.

2.18.2.4 Subsequent Operator Actions

1. Restart reactor feed pump to maintain normal drum level.

2. Restart reactor recirculating pump in order to control reactor vessel differential temperatures.

3. Maintain primary system cooling rate less than 100°F/hour, and less than 150°F Δ T between any two points on reactor vessel or any two points on the steam drum.

4. Place turbine on gear when it slows to stop.

5. When potential returns to 138-kV line, scope and close 199 OCB (follow line rules).

6. Restore station power to normal using procedure SOP 14.6.8.2

2.18.3 Generator Is Off Line

2.18.3.1 Symptoms

1. 199 OCB trip alarm will annunciate.

2. Station lighting will be lost momentarily. Emergency lighting will come on.

3. Breaker 52-2B24 trip alarm.

2.18.3.2 Automatic Actions

1126 OCB will open and 7726 OCB will close if it was in automatic.

NOTE: Refer to 2.18.2.2, Items 4 through 10 for other automatic actions.

2.18.3.3 Immediate Operator Actions

Check items listed in 2.18.2.2.10 for auto starts.

2.18.3.4 Subsequent Operator Actions

Same as 2.18.2.4 except 4.

2.18.4 System Emergencies - Manual Separation From Transmission System for Severe System Disturbances

2.18.4.1 Symptoms

1. Decreasing system voltage.

2. Decreasing system frequency (hertz).

3. Decreasing Plant output.

NOTE: Slowing down of auxiliary equipment at Big Rock is estimated to result in a 2% decrease in Plant output per cycle decrease.

2.18.4.2 Automatic Actions

The 1136 breaker will automatically open when a substained degraded voltage is detected on the 2400-V bus. Tripping of the 1136 breaker will occur ten (10) seconds after a sustained degraded voltage of 107 volts or less is reached on all three (3) phases of the 2400-V bus' 120-V metering circuits.

2.18.4.3 Immediate Operator Actions

1. Refer to System Separation Frequency Limits, as outlined in the System Emergency section of the Plant Station Binder (posted on gen console).

2. If time permits contact Power Control before system frequency drops to separation limit and advise as to possible need to separate.

3. If immediate separation becomes mandatory -

   a. If Plant output is more than 50 MWeg, trip one reactor recirc pump to reduce load.

   b. Immediately open the 199 OCB. Turbine will transfer to speed control and generator output will drop to approximate station power load.

   c. Adjust generator frequency (hertz) to 60 cycles with the generator synchronizing control.

2.18.4.4 Subsequent Operator Actions

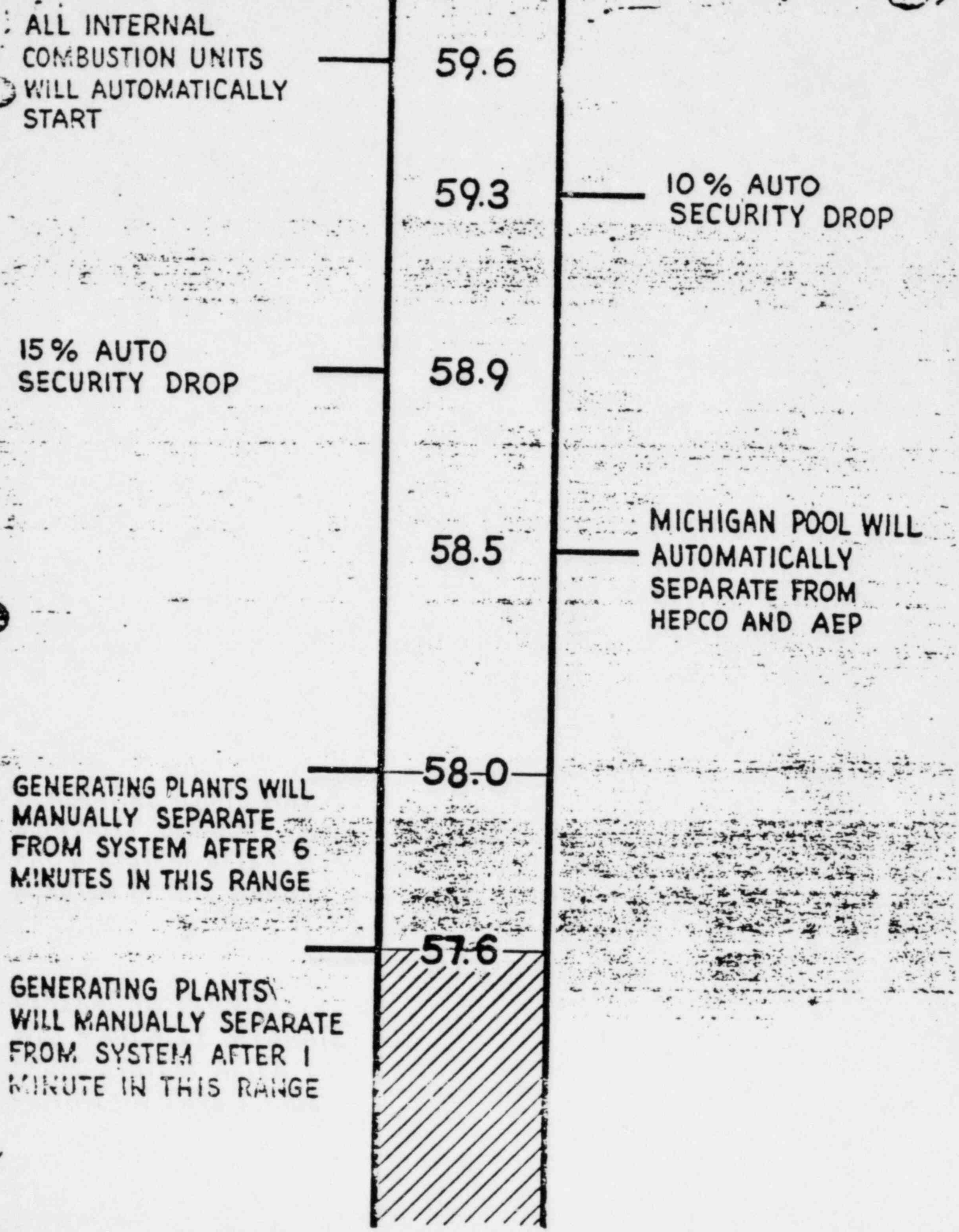
1. Insert control rods in accordance with approved insertion sequence to reduce reactor power and decrease turbine bypass valve opening to a minimum value.

2. Refer to SOP 13, Step 6.5 for <u>resetting to normal</u> after turbine auto transfer to speed control.

3. Restart the second reactor recirculation pump according to approved procedure.

4. Increase reactor power and Plant load in accordance with reactor operating instructions and power control approval.

ATTACHMENT V



SYSTEM PROTECTION – SETTINGS

Plant: Big Rock | Bus: 1A | ACN 052-1A-18

Voltage: 480 Volt | MCC: 1A

Protected System: Reactor Protection System #1 M-G Set

Q Listed: Yes | Notes: (52-1A61) (M-82B) Was SS 457, Rev 1

Protective Device

LABORATORY TECHNICAL SERVICES – TEST RECORD

Plant Procedure No. ______ Revision No. ______

Lab Procedure No. ______ Revision No. ______

Plant FC or MO No. ______

Reference Documents ______

Unit, Phase or Zone	Function or Element	Setting	Acceptance Criteria	AS FOUND Setting	AS FOUND Variance	Accept Status (✓) In	Out	In Op	AS LEFT Setting	AS LEFT Variance
Magnetic										
X-Phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							
Y-Phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							
Z-Phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							

*NOTE: SET O.L. RELAYS AT 115%

INFORMATION ~~CONTROL~~ COPY
SYSTEM PROTECTION &
LABORATORY SERVICES DEPT

Breaker Data
MFG GE | Pole 3 | Type M
Cat No. TF136M2050 | Frame -
Size 50 | Range 160-560
Trip Time - | CT Ratio -

Motor Data
HP 25 | Volt 480 | FLA 31.3
RPM 1765 | Frame 326K | ENCL -
LRA 200 | NEMA Code B | SF 1.15

Starter Data
MFG GE | NEMA Size - | Type -
Cat No. - | OL HTR C123C30.3B

Short Circuit Data 2.3 MVA, 3∅ Max Gen

*Indicates Addition or Change Since Last Issue Specifications

SS No. 446 | Revision No. 0

Settings Issued by [illegible] | Date 10/23/78

CALIBRATED TEST EQUIPMENT USED

Description	CP Number	Cal Due Date

Remarks ______

Test Completed by ______ Date ______

Copy 1 (White) Retained by System Protection Until Receipt of Completed Copy 4 (Goldenrod)
Copy 2 (Canary) Field Record Copy – Documentation of Settings Applied and Test Results
Copy 3 (Pink) Retained by Field Lab – Documentation of Settings Applied and Test Results
Copy 4 (Goldenrod) Returns This Copy to System Protection – [illegible] of Settings Applied [illegible]

ATTACHMENT VI

SYSTEM PROTECTION – SETTINGS

LABORATORY TECHNICAL SERVICES

Plant Big Rock Bus 2A ACB 052-2A-21

Voltage 480 Volts MCC 2A

Protected System Reactor Protection System 2 M-G Set (M-83B)

Q Listed YES Notes: (52-2A61)

Protective Device

Plant Procedure No. Revision No.

Lab Procedure No. Revision No.

Plant FC or MO No.

Reference Documents

Unit, Phase or Zone	Function or Element	Setting	Acceptance Criteria	AS FOUND Setting	AS FOUND Variance	Accept Status (✓) In	Accept Status (✓) Out	Accept Status (✓) In Op	AS LEFT Setting	AS LEFT Variance
Magnetic										
X-Phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							
Y-Phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							
Z phase	Pickup	400A	--							
	Position	5	--							
	Test Point	Inst@800A	4 Cy or less							

INFORMATION ~~CONTROL~~ COPY
SYSTEM PROTECTION &
LABORATORY SERVICES DEPT.

Breaker Data	MFG GE	Pole 3	Type M			
	Cat No. TF136M2050	Frame -				
	Size 50	Range 160-560				
	Trip Time -	CT Ratio -				
Motor Data	HP 25	Volt 440	FLA 31.3			
	RPM 1765	Frame 326K	ENCL -			
	LRA 200	NEMA Code B	SF 1.15			
Starter Data	MFG GE	NEMA Size -	Type -			
	Cat No. -	OL HTR C123C30.3B				

Short Circuit Data 2.1 KVA, 3ϕ Max Gen

*Indicates Addition or Change Since Last Issue Specifications

SS No. 551 Revision No. 0

Settings Issued by [signature] Date 7-5-78

CALIBRATED TEST EQUIPMENT USED

Description	CP Number	Cal Due Date

Remarks

Test Completed by Date

Copy 1 (White) Retained by System Protection Until Receipt of Completed Copy 4 (Goldenrod)
Copy 2 (Canary) Plant Record Copy – Documentation of Settings Applied and Test Results
Copy 3 (Pink) Retained by Field Lab – Documentation of Settings Applied and Test Results
Copy 4 (Goldenrod) Field Lab Returns This Copy to System Protection – Documentation of Settings Applied and Test Results

ATTACHMENT VI

ATTACHMENT VII

CR124A1 AND B1

A-C OR D-C THERMAL OVERLOAD RELAYS

GENERAL

The CR124 relay is designed to provide protection against running overloads and stalled rotor overloads for A-C or D-C motors having full-load currents up to 30 amperes at voltages up to 600 volts A-C- 250 volts D-C.

HEATER SELECTION

Select the heaters so that the rated full load current of the motor does not exceed the "maximum motor amps" listed in the heater table.

The relay will trip ultimately at approximately 125% of the listed "Minimum Motor Amps".

ADJUSTABLE RANGE

By turning the knurled knob on top of the relay, the overload trip setting for a specific heater can be adjusted for any value between 85% and 115% of the "maximum motor amps" listed for the heater in the table. The dial is marked:

90% (equivalent to one heater smaller)
100% (maximum motor amps listed in the heater table below)
110% (equivalent to one heater larger)

Overload relay heaters are available in rated current increments of 10%. The adjustable feature permits the exact matching of the relay to the motor full load current over this 10% range.

CONTROL CONTACTS

Connect the coil of the magnetic starter in series with the "normally closed" circuit of the overload relay (refer figure 1). These contacts are designed to carry 5 amps continuously and have an inrush capacity of 60 amps. The current to be interrupted should not exceed the values listed below:

A-C		D-C	
Volts	Amps	Volts	Amps
110	15	115	0.35
220	10	230	0.17
440/550	5		

HAND RESET / AUTOMATIC RESET

The relay is normally shipped in the "Hand Reset" position. To set the relay to the "Automatic Reset" position pull out the slide arm near the control contacts by 1/"5". The "Automatic Reset" feature should be used only when suitable precautions have been taken to ensure that reapplication of power to the motor will not result in danger to personnel and / or equipment.

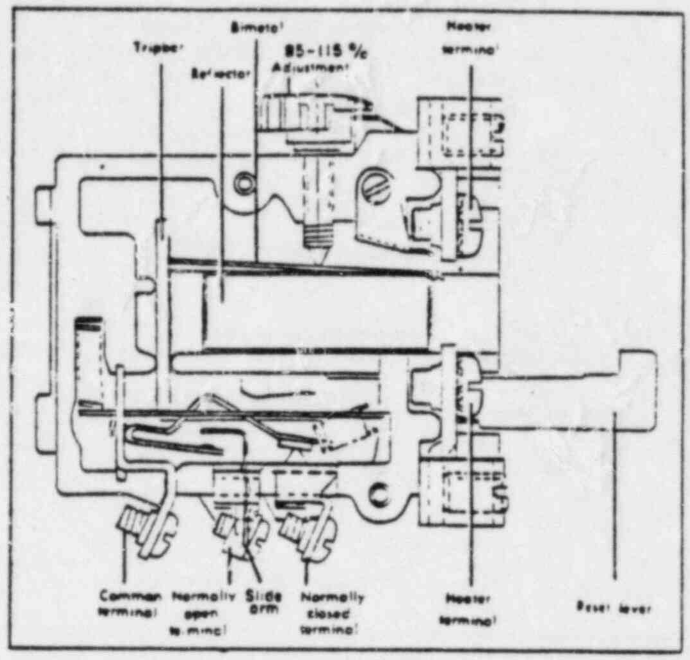


Fig. 1 CR124 OVERLOAD RELAY

SIGNAL CIRCUIT

An indicating light or bell may be connected in series with the "normally open" circuit to provide a signal when the relay has tripped on overload (Refer Figure 1).

SHORT CIRCUIT PROTECTION

Fuses should be used to protect the relay and the starter from excessive currents due to short circuits. The rating of such fuses should not exceed that shown in the heater table. In place of fuses, other branch circuit protective devices can be used in accordance with the National Electrical Code.

INSTALLATION

The relay must be installed in a vertical position, with the dial at the top, and should be located preferably in the same ambient as the motor that it protects. For consistent results the relay should not be exposed to drafts. Mount the heater securely to the terminals as indicated in Figure 1 with notches toward the line terminals of the relay (at the top).

REPAIR AND RENEWAL PARTS

The relays are accurately calibrated by means of specialized equipment and no attempt should be made to readjust or repair the unit. Renewal parts are not available. In the event of damage to the relay complete replacement is necessary.

REACTOR PROTECTION SYSTEM M-G SET

NAME PLATE DATA

Motor:

Model:	5K4326A21Y54
H.P.:	25
Serv Factor:	1.15
Full Load RPM:	1765
Volts:	220/440, 3∅, 60Hz
Current @ 208:	62.6
Type:	K
Full Load AMPS:	62.6/31.3
Frame:	326Z
Class:	B
C°Rise:	40°
Code:	F
Time Rating:	Continuous

Generator:

Model:	5SJ4284A21Y13
Type:	SJ
Frame: 284Z KVA: 6.25 PF: .8	
RPM: 1800 Volts: 120, 60 Hz, 1∅	
Full Load AMPS:	52
Enclosure:	DP
Thermal Rise:	50°C
Fld By Resis:	60°C
IB:	GEI 65501A
Exc Fld AMP: - RVFL	.270

Serial No:

#1	TV2587296 B
#2	TV2587297 B

ATTACHMENT IX

DAILY LOG SHEET

57	97	1000	93	95	97	100+	100+			10.15	43	.30	1780	575	63	.92	240	540	162	31	14"	252	286	67	72	210	202	[illegible]	[illegible]	
60	97	1100	90	96	97	100+	100+				45	.30	1780	578	63		241	540	162	31	14"	257	286	67	72	211	201	185	[illegible]	
61	[illegible]	1200	97	97	97	100+	100+			10.15	45	.30	1780	578	63	.92	241	540	162	30	14"	276	284	67	72	210	[illegible]	185	[illegible]	
61	[illegible]	1300	96	97	96	100+	100+				45	.30	1780	578	63		241	[illegible]	161	31	14"	297	286	67	72	210	202	[illegible]	[illegible]	
60	88	1400	97	97	97	100+	100+			10.15	45	.30	1780	578	63	.93	241	840	163	30	14"	297	286	67	72	210	201	[illegible]	[illegible]	
60	87	1500	97	97	96	100+	100+				50	.40	1780	578	63		241	840	161	31	14"	259	287	67	72	210	203	[illegible]	171	
60	87	1600	96	96	96	100+	100+			10.15	50	.40	1780	578	63	.94	241	840	161	31	14"	297	297	67	72	210	201	[illegible]	[illegible]	OK
61	87	1700	97	98	97	100	100				50	.40	1780	578	63		241	840	163	31	14"	293	286	67	72	[illegible]	[illegible]	[illegible]	[illegible]	
61	87	1800	96	97	96	100	100			10.15	45	.30	1780	578	63	.94	242	840	163	31	14"	296	285	67	72	210	203	174	[illegible]	OK
57	88	1900	96	97	96	100	100				45	.30	1780	578	63		241	845	162	31	14"	294	284	67	72	208	202	[illegible]	[illegible]	
59	87	2000	97	99	96	100	100			10.15	45	.30	1780	578	63	.94	242	840	162	31	14"	297	285	67	72	201	202	174	[illegible]	OK
60	97	2100	96	97	96	100	100				45	.30	1780	578	63		241	835	160	31	14"	297	235	67	72	210	201	[illegible]	[illegible]	
60	87	2200	97	98	97	100	100			10.15	45	.30	1780	578	63	.93	242	840	161	31	14"	297	285	67	72	204	202	[illegible]	[illegible]	
59	97	2300	97	98	96	100	100				45	.26	1780	575	63		242	545	162	31	14"	296	284	67	72	[illegible]	[illegible]	[illegible]	[illegible]	OK
60	87	2400	96	97	96	100	100			10.15	45	.26	1780	578	63	.93	242	[illegible]	161	31	14"	296	284	67	72	201	201	[illegible]	[illegible]	OK
60 Avg.												.30 Avg.	1780 Avg.			.93 Avg.														

Off Gas Filter	Level Reactor Cooling Water
.6	7'1"
.6	7'1"
.7	7'½"

Cond. Stor.	Emerg Condenser #10
9'6"	73"
10'4"	73
10'1"	73"

HYDROGEN

Purity	Bottles Added
98	
97	
97.5	

TIME	WEATHER: Outside Temp.	Barometer	Weather Conditions	Direction of Wind	M.G. SETS No. 1 V	No. 1 A	No. 2 V	No. 2 A	Inv. V	CLEANUP SYSTEM Temp. 1	Temp. 4	Temp. 5	Diff Press	Flow GPM	TEMPERATURES Fuel Pool	#2 Recirc Pump Seal Temp	OCB COUNTERS (MID)	Air Compressor Counter
0200	22	29.58	P CLDY	SE@8	120	21.5	122	21.5	114	565	465	90	5.5	58	54	121	116	116
0400	20	29.61	P CLDY	E@10	120	21.5	122	21.5	114	565	465	90	5.5	58	54	121		
0600	19	29.63	CLDY	E@10	120	21.5	122	21	114	565	465	90	5.3	58	54	121	732	47.8
0800	18	29.65	CLDY	E@8	120	22	122	21	114	[illegible]	[illegible]	[illegible]	5.[illegible]	58	53	[illegible]	199	199
1000	18	29.61	PT CLDY	E→1[illegible]	120	22	122	21	114	565	465	[illegible]	5.3	58	53	[illegible]		
1200	24	29.61	PT CLDY	SE→10	120	22	122	21	114	565	465	76	5.3	58	53	120	41	33.5
1400	28	29.65	Clear	SE→1[illegible]	120	22	122	21	114	565	465	46	5.2	58	53	[illegible]	1126	
1600	22	29.68	Pt CLDY	E→12	120	22	122	21	114	565	465	46	5.2	58	53	120		
1800	18	29.68	Pt CLDY	E@12	120	22	122	21	114	565	465	46	5.2	58	53	120	135	
2000	14	29.70	Clear	SE@[illegible]	120	22	122	21	114	565	465	96	5.2	58	53	120	7720	
2200	12	29.70	Clear	E[illegible]	120	22	122	21	114	565	465	46	5.2	58	53	120		
2400	10	29.15	Pt Clear	E@2	120	22	122	21	114	564	465	92	5.5	58	55	117	133	
Average	19		Pt Clear	E@10														

R.D.S. CHANNELS	Shift A: A	B	C	D	Shift B: A	B	C	D	Shift C: A	B	C	D
REACTOR WATER LEVEL	N	N	N	N	N	N	N	N	N	N	N	N
STEAM DRUM LEVEL	N	N	N	N	N	N	N	N	N	N	N	N
DISCHARGE PIPE TEMP	87	104	106	77	[illegible]	102	105	95	[illegible]	103	106	96

Inverter Fuses: [illegible]

STACK GAS MON. BACKGROUND	
Shift A	[illegible]
Shift B	[illegible]
Shift C	[illegible]

(4) A	(4) B	(4) C
5	CAL	80
3	CAL	77
3	C[illegible]	73

(8) A	(8) B	(8) C
[illegible]	CAL	CAL
[illegible]	CAL	CAL
[illegible]	[illegible]	[illegible]

FLOW METERS	Makeup Demin	Demin Water Transfer	Feedwater Flow	Steam Flow
Present Rdg	502804	[illegible]	911175	945637
Previous Rdg	502803	[illegible]	909121	943741
Total Flow	1	0	2054	1896

COND Demin Shift	No. 1 Basket DP	No. 1 Flow GPM	No. 2 Basket DP	No. 2 Flow GPM	No. 3 Basket DP	No. 3 Flow GPM	System DP
A	1.5	560	1.8	470	2.2	600	36
B	1.4	560	1.8	470	2.3	620	36.5
C	1.5	5[illegible]	1.8	470	2.3	620	36.5

LIQUID RADWASTE BATCH RELEASES	Shift A		Shift B		Shift C	

LIQUID PROCESS MONITOR FLOWS			
SHIFT	A	B	C
SPHERE SERVICE WATER	[illegible]	[illegible]	[illegible]
SPHERE COOLING WATER	[illegible]		[illegible]
RADWASTE DISCHARGE	[illegible]	[illegible]	[illegible]
MAIN CONDENSATE	[illegible]	[illegible]	[illegible]
CANAL DISCHARGE	[illegible]	[illegible]	[illegible]

PUMPING MINUTES

1 CCWP	2 CCWP	1 ECS	2 ECS	1 EDS	2 EDS	1 TS	2 TS	RWS	OGS
[illegible]	[illegible]	5173.0	5540.1	14994.2	2465.7	4660.4	4716.7	[illegible]	95341
[illegible]	[illegible]	5170.2	5516.9	14993.1	2464.7	4655.3	4710.9	8828.0	95207
[illegible]	[illegible]	2.8	23.2	1.1	1.0	5.6	5.8	—	10.4