TEST REPORT

FOR

A 20 KVA UPS SYSTEM
POWER CIRCUIT ISOLATION TEST

PREPARED FOR

BECHTEL POWER CORPORATION
SAN FRANCISCO, CALIFORNIA

FOR

PUBLIC SERVICE ELECTRIC & GAS COMPANY
HOPE CREEK GENERATING STATION
HANCOCKS BRIDGE, NEW JERSEY

NUCLEAR SAFETY RELATED

PREPARED BY

CYBEREX INCORPORATED
7171 INDUSTRIAL PARK BOULEVARD
MENTOR, OHIO 44060

TEST REPORT NO. T-10656
REVISION 0 - FEBRUARY 1985

TABLE OF CONTENTS

REFERENCES:

1. IEEE STD. 384-1981
2. Nuclear Regulatory Guide 1.75
3. Nuclear Regulatory Safety Evaluation Report - NUREG 1048 Section 8.3.3.3.4

CERTIFICATION

FOR

POWER CIRCUIT ISOLATION TEST REPORT

This is to certify that Cyberex, Inc. has reviewed the contents of this report, and it is true and correct for the Power Circuit Isolation Testing performed on a Class IE 20 KVA UPS System Tag Number 0BD595, Bechtel Power Corporation's Specification Number 10855-E-154(Q).

This report meets the intent of Cyberex, Inc. test plan TP0086 and IEEE Standard 384-1981 Section 7.1.2 and Section 7.1.2.3.

NUCLEAR SAFETY RELATED

Cyberex, Inc.

Prepared By: V. Gelazis
VALDAS GELAZIS — 2/22/85
DATE

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DATE

SECTION I

SECTION I

A. INTRODUCTION

An Uninterruptible Power Supply (UPS), Hope Creek TAG #0BD595 S/N 9743-23 (20 KVA) was subjected to an UPS/Inverter Isolation Test program as described in Cyberex test procedure TP0086. Testing was performed on January 10 thru 14 of 1985.

The test specimen is of identical rating, material, configuration and construction to all of the Hope Creek's Class 1E UPS Systems.

The intent of the program is to show that the UPS/Inverter is a power circuit isolation device between Class 1E power input sources and Non-Class 1E load circuits, as defined by IEEE Std. 384-1981 Sections 7.1.2, 7.1.2.3 and NRC Reg. Guide 1.75.

The Test Program was designed to measure the effects on the inputs to the UPS when its output is shorted or grounded. On Hope Creek, application of certain UPS systems is such that the UPS input is supplied from Class 1E power sources while the UPS output supplies non-class 1E loads. Therefore a shorted or grounded UPS output fault condition during which the UPS system must function as both a power circuit isolation device and as an input current limiter to limit the effects of the faults on the Class 1E power sources to acceptable values.

The UPS system was subjected to five fault conditions.

The 200% overload test requested by the customer cannot be performed due to design limitations of the inverter. The inverter, due to its current limit feature, will not support a 200% overload. Application of 200% overload, or any load above the inverter's current limit setting, will cause the Static Switch to transfer the load (overload) to the back-up AC source. The transfer to back-up source will be annunciated by the UPS. Overload caused by the short on UPS load side will be reduced in approximately 1.5 seconds by 150A fuse F301 in regulator circuit of the back-up source.

B. ACCEPTANCE CRITERIA

Testing is to demonstrate that the application of faults at the inverter output and at the load side of UPS does not exceed the input current and voltage of the "alternate" DC and "Normal" AC supply as shown below:

SOURCE	VARIATION
"Alternate" DC Supply	105-140V DC 0-364A DC
"Normal" AC Supply	480 ± 10%V (L-L) 3 Phase 55A 0-132A Peak for 10 msec
"Back-Up" AC Supply	480V ± 10%V 1 Phase 0-78A 0-500A Peak for 10 msec

SECTION II

SECTION II

TEST PROGRAM

A. TEST SETUP:

The test specimen (UPS) consists of three cabinets and was interconnected as shown by Cyberex drawing D-9743-001.

External connections to the UPS were:

Normal Source - 480V, 60Hz, 3 Phase
Back-Up Source - 480V, 60Hz, 1 Phase
Alternate DC Source - 125V nominal battery
(rated 80KW for 30 minutes)
Ground - Building Ground
Inverter Output - To Fault Breaker
UPS Output - To 20 KVA, .8pf load and to fault breaker

Normal and backup power was supplied by a single 1000 KVA distribution transformer. Backup source power was provided from Phase A - B of the transformer.

The required faults were applied by closing the "Fault" breaker with the appropriate jumper installed on the load side terminals. An opto-coupler energized by inverter or UPS output voltage was also connected to the load terminals of the "Fault" breaker to generate the "Trigger" pulse to the recorders.

B. INSTRUMENTATION:

The data recording was done by two Gould Model 2800W eight channel chart recorders which were triggered simultaneously by closing the "Fault" breaker. The recorders were set up so that pre-trigger data (retained for reference) represented 25% of the total record. Each record is the result of 8192 samples/channel taken at 10 microsecond intervals, resulting in a record 81.92 milliseconds long in time. The data is then plotted from memory to a chart 204.8cm long with the trigger point (event initiation) 51.2cm from the start. The waveform time base on this chart is 400 microseconds/cm or 40 microseconds/mm (which is the smallest chart division.) The trigger is recorded by an event pen located between channels 7 & 8. The event pen between channels 1 & 2 recorded pulses 2 milliseconds apart generated by an internal clock as a check of recorders speed control.

Signal conditioners were used to isolate the recording system from the power sources and to convert the measured values to voltage within the recorders input capability. The signal conditioners used were:

- Potential Transformer - 4:1 ratio
- Current Transformers - 1000:1 ratio with 10 Ohm burden resistors (clamp on type)
- Hall effect DC Current Sensor - 3000 Amp/10 volts
- Isolation Amplifier - Two channel with selectable ratios from 5:1 to 5000:1
- Coaxial Shunt - 508 micro ohm, used during retest in place of AC current transformer, isolated through Channel 2 of the isolation amplifier.

C. CALIBRATION AND SCALES

The recorders, isolation amplifier, current and potential transformers and the hall effect sensors were factory calibrated instruments received from their manufacturers and their operations were verified for proper function.

The coaxial shunt resistance was checked on a Kelvin double bridge which was in calibration. The isolation amplifier ratios were determined by the two voltmeter method (the voltmeters were in calibration) and resulted in the following values:

RANGE	INPUT	OUTPUT	TRANSFER FUNCTION
Channel #2 50mV/DIV	55.5mV	10mV	5.55mV/mV
Channel #2 100mV/DIV	108.5mV	10mV	10.85mV/mV
Channel #2 .2V/DIV	220mV	10mV	22.0mV/mV
Channel #2 .5V/DIV	545.4mV	10mV	54.54mV/mV
Channel #1 50V/DIV	61 Volts	10mV	6100mV/mV

The other signal conditioner transfer functions are:

Potential transformer (4:1)	4 volts/volt
Current transformer with 10 Ohm burden	100 Amps/volt
Hall Effect Sensor	300 Amps/volt
T & M Shunt	1969 Amps/volt

The recorder scales were calculated as follows:

The recorder chart channel width is 5cm.

The recorder range settings are indicated at full scale, therefore the chart scale is the product of recorder range/5cm and the signal conditioner transfer function.

For Example:

Potential Transformers (4:1)

4 Volts/Volt x 500 Volt/5 cm = 400 Volts/cm
or 4 Volts/Volt x 100 Volts/5 cm = 80 Volts/cm

Alternate Voltage was measured by the isolation amplifier on 50V/DIV range and recorder set on 10mV/cm range (.05VFS). The calibration was adjusted until recorder deflection at 50 Volt/cm was equal to a voltmeter reading of the battery voltage. Before performing the "repeat" test the isolation amplifier's transfer ratio was measured and the chart scale was changed to 61 Volts/cm with the recorder of nominal calibration.

NOTE: Scales for all channels have been shown on recorder charts in Attachment No. 3.

SECTION III

SECTION III

TEST RESULTS AND DISCUSSIONS

A. GROUND FAULT TESTS

The ground fault test configurations are listed in Table 1, Fig. 2 (Sh. 10) of the test procedure, it describes the tested fault conditions.

An operating UPS will charge the stray capacitances to the grounded enclosures. The ground fault tests simply discharged this stored charge. During Tests 1 through 21 there was no disturbance on any of the input sources: ALTERNATE, NORMAL or BACK-UP when each of the fault types were applied.

Channel 7B of the charts indicates the ground fault current sensed by CT7. The fault current was indicated as one or more narrow spikes less than 2 amperes with corresponding narrow dip in the UPS and/or inverter output voltage waveform.

During the ground fault tests the two events occurred which are described under Anomalies in Section III (Channel 5A memory and misplaced cliplead in Test #14.)

All ground fault tests were successful in accordance with the test acceptance criteria.

Refer to Test #1 thru #4 and #6 thru #21 Charts in Attachment 3.

B. Test No. #5

Test #5 was intended to show the tranfer from NORMAL source to ALTERNATE source without any fault applied. This test was performed by manually opening CB201 (NORMAL source input breaker) to simulate loss of Normal AC voltage. This test has no bearing on the isolation test.

C. INVERTER/UPS OUTPUT TO NEUTRAL FAULT TEST

This series of tests simulated a direct short (phase to neutral) on the inverter and UPS outputs. The UPS reacts to an output fault by transferring the load (fault) to the back-up (480V AC, single phase) source if it is available. When the back-up source is not available the inverter goes into the current limit mode and the alternate (125V DC) source is only supplying inverter no load current (20-25 Amps) continuously as a result of inverter's DC filter circuit. In all cases the alternate (DC) and normal (480V AC) supplies did not exceed the acceptance criteria values.

The current transformers used to monitor fault currents prematurely saturated and do not indicate the actual magnitude of the fault current. Most tests were repeated using a coaxial shunt to record the fault currents. Due to the short time frame of the charts, the final resolution of continuous faults on the back-up source were not shown. Typically these faults persisted for 1.5 seconds until F301 fuse in the AC regulator melted out reducing the fault current to about 100 amps RMS.

Refer to Charts for Tests #22 through #34 in Attachment 3.

D. ANOMALIES:

1. Recorder Channel 5A memory developed a bad spot seen on the charts as a narrow spike to full scale. Therefore the "NORMAL" source phase C to A voltage was moved from Channel 5A to a spare channel 8B during Test No. 7 through 34.

2. During Test 14, when changing trigger circuit leads at the "Fault" breaker, a cliplead was left connecting the inverter output to UPS output on the load side of "Fault" breaker. When the "Fault" breaker was closed this cliplead drew current derived from the instantaneous voltage differences between the inverter and UPS output (supplied by back-up source) until it melted. Since there was no adverse impact on the input sources Test 14 was not repeated.

3. Tests 22 through 34, with the exception of 25 & 31, were repeated with a coaxial shunt replacing back-up input current transformer (CT4) since the fault currents saturated CT4. The shunt used was T&M Co. Model F10007-40. Channel #2 of the isolation amplifier was used to isolate the shunt output from the recording system. Channel 2B was used to record the shunt/isolation amplifier output.

4. When ground fault tests were finished, the ground current transformer CT7 was left connected to Channel 7B and was reacting to (measuring) the magnetic fields generated by fault currents in nearby conductors.

TABLE 1

CHART LIST, GROUND FAULT TESTS

TEST NO.	MANUAL BYPASS SW. POSITION	AVAILABLE SOURCES	FAULT TYPE	COMMENTS *
1	NORMAL	ALL	INVERTER OUTPUT TO GROUND	*
2	BYP-PREF	ALL	INVERTER OUTPUT TO GROUND	*
3	BYP-ALT	ALL	INVERTER OUTPUT TO GROUND	*
4	BYP-PREF ISOLATE	NORMAL ALTERNATE	INVERTER OUTPUT TO GROUND	*
6	NORMAL	ALTERNATE BACK-UP	INVERTER OUTPUT TO GROUND	*CHANGED CHANNEL 5A TO 8B (SEE ANOMALY NO. 1)
7	NORMAL	NORMAL BACK-UP	INVERTER OUTPUT TO GROUND	*
8	NORMAL	ALL	UPS OUTPUT TO GROUND	*
9	BYP-PREF	ALL	UPS OUTPUT TO GROUND	*
10	BYP-ALT	ALL	UPS OUTPUT TO GROUND	*
11	BYP-ALT ISOLATE	NORMAL ALTERNATE	UPS OUTPUT TO GROUND	*
12	NORMAL	ALTERNATE BACK-UP	UPS OUTPUT TO GROUND	*
13	NORMAL	NORMAL BACK-UP	UPS OUTPUT TO GROUND	*
14	BYP-ALT ISOLATE	BACK-UP	UPS OUTPUT TO GROUND	*MISPLACED CLIPLEAD (SEE) ANOMALY NO. 2)
15	NORMAL	ALL	NEUTRAL TO GROUND	*
16	BYP-PREF	ALL	NEUTRAL TO GROUND	*

TEST NO.	MANUAL BYPASS SWITCH POSITION	AVAILABLE SOURCES	FAULT TYPE	COMMENTS *
17	BYP-ALT	ALL	NEUTRAL TO GROUND	*
18	BYP-PREF ISOLATE	NORMAL ALTERNATE	NEUTRAL TO GROUND	*
19	NORMAL	ALTERNATE BACK-UP	NEUTRAL TO GROUND	*
20	NORMAL	NORMAL BACK-UP	NEUTRAL TO GROUND	*
21	BYP-ALT ISOLATE	BACK-UP	NEUTRAL TO GROUND	*

* No deviation was observed on voltage and current waveforms of Alternate DC, Normal AC and Back-up AC source.

TABLE 2

CHART LIST, NEUTRAL FAULT TESTS

TEST NUMBER	MANUAL BYPASS SWITCH POSITION	SOURCES AVAILABLE	FAULT TYPE	COMMENTS**
22	NORMAL	ALL	INVERTER OUTPUT TO NEUTRAL	FUSE F151 CLEARED (OPEN)**
22 REPEAT 1	NORMAL	ALL	INVERTER OUTPUT TO NEUTRAL	FUSE F151 CLEARED **
23	BYP-PREF	ALL	INVERTER OUTPUT TO NEUTRAL	**
23 REPEAT 1	BYP-PREF	ALL	INVERTER OUTPUT TO NEUTRAL	FUSE F151 CLEARED **
24	BYP-ALT	ALL	INVERTER OUTPUT TO NEUTRAL	**
24 REPEAT 1	BYP-ALT	ALL	INVERTER OUTPUT TO NEUTRAL	**
25	BYP-PREF ISOLATE	NORMAL ALTERNATE	INVERTER OUTPUT TO NEUTRAL	**
26	NORMAL	ALTERNATE BACK-UP	INVERTER OUTPUT TO NEUTRAL	FUSE F151 CLEARED **
26 REPEAT 1	NORMAL	BACK-UP	INVERTER OUTPUT TO NEUTRAL	SHOOT ** THROUGH CURRENT
27	NORMAL	NORMAL BACK-UP	INVERTER OUTPUT TO NEUTRAL	F151 CLEARED**
27 REPEAT 1	NORMAL	NORMAL BACK-UP	INVERTER OUTPUT TO NEUTRAL	**
28	NORMAL	ALL	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
28 REPEAT 1	NORMAL	ALL	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **

TEST NUMBER	MANUAL BYPASS SWITCH POSITION	SOURCES AVAILABLE	FAULT TYPE	COMMENTS**
29	BYP-PREF	ALL	UPS OUTPUT TO NEUTRAL	**
29 REPEAT 1	BYP-PREF	ALL	UPS OUTPUT TO NEUTRAL	SHOOT THROUGH CURRENT **
30	BYP-ALT	ALL	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
30 REPEAT 1	BYP-ALT	ALL	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
31	BYP-PREF	NORMAL ALTERNATE	UPS OUTPUT TO NEUTRAL	**
32	NORMAL	ALTERNATE BACK-UP	UPS OUTPUT TO NEUTRAL	F101 & F301 OPENED AFTER CHART ENDS **
32 REPEAT 1	NORMAL	ALTERNATE BACK-UP	UPS OUTPUT TO NEUTRAL	F301 OPENED AFTER CHART ENDS **
33	NORMAL	NORMAL BACK-UP	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
33 REPEAT 1	NORMAL	NORMAL BACK-UP	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
34	BYP-ALT	BACK-UP	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **
34 REPEAT 1	BYP-ALT ISOLATE	BACK-UP	UPS OUTPUT TO NEUTRAL	F301 CLEARED AFTER CHART ENDS **

** No deviation was observed on voltage and current waveforms of Alternate DC or Normal AC source.

Discussion of events on Test Charts 22-34 follows:

Test 22 — Illustrates the typical events resulting from a fault on on the inverter output.

1. Inverter goes into current limit.
2. Static Switch transfers to back-up. The inverter is still connected to the load.
3. Back-up source clears F151 (870 Amp peak) and recovers to supply the load with only a short interruption.

Test 23 and 23 Repeat 1 — Differ due to the phase angle of fault application. The Static Switch is still energized and active in the BYP position and the static switch output is disconnected from the load. During Test 23 Repeat 1 the static switch initiated a transfer to back-up source with the resulting shoot through clearing F151 (1000 Amp peak).

Test 24 and 25 — Illustrates inverter current limit. The inverter is not connected to the UPS load. Back-up source is supplying the load.

Test 26 and 27 — Are similar to Test 23 and 23 Repeat 1. The two possibilities are illustrated.

Test 28 Repeat 1 — Illustrates a fast transfer to back-up source without inverter going into current limit and fault current supplied from back-up source. (675 Amp RMS measured at 480V incoming side) SEE NOTE #1

Test 29 Repeat 1 — Illustrates a current of 1500 Amp peak (at 480V) supplied by back-up source. SEE NOTE #1

Test 30 Repeat 1 — Illustrates the fault current supplied by back-up source. (750 Amps RMS) SEE NOTE #1

Test 31 — Illustrates a delayed inverter current limit. The inverter attempted to supply the fault but did not exceed the acceptance criteria during the delay.

Test 32 — Illustrates a fault occuring near voltage zero crossing causing a delay in inverter current limit initiation.

Test 33 — Illustrates a quick transfer, fault occurred at voltage maximum.

Test 33 Repeat 1 — Illustrates a minimum disturbance to the inverter transfer. The fault occurred near voltage zero crossing.

Test 34 Repeat 1 — Illustrates the maximum continuous fault current requirement from back-up source (700 Amp RMS). SEE NOTE #1

NOTES: #1 In these cases the current exceeds the acceptance current level for the back-up source. However, the Hope Creek Class 1E motor control center circuit breaker (thermal magnetic - 90 Amps) will clear any fault in excess of 600 amperes within 0.02 seconds.

SECTION IV

SECTION IV

CONCLUSIONS

The input sources (Alternate DC, Normal AC, and Back-up AC) were not affected by connecting an output line to ground. There was no disturbance indicated on any input source waveform, at or after the ground fault application in all UPS configurations. The Alternate DC and Normal Ac sources were not adversely affected by applying line to neutral faults to either the Inverter or UPS outputs. Output faults reduce power requirements from these sources due to Inverter's current limit action mode which is supplied by the Inverter's input filter capacitor bank which acts as a low pass filter.

The back-up source is required to supply the fault current, which is limited in magnitude and duration by the line voltage regulator's series impedance and overcurrent protective devices.

The maximum fault current requirement from the "BACK-UP" is substantially sinusoidal 60 HZ current for approximately 1.5 seconds until F301 melts out, but the Hope Creek MCC circuit breaker will clear the fault in less than 1.5 seconds.

SECTION V

ATTACHMENT 1

CYBEREX TEST PROCEDURE
NO. TP-0086

TEST PROCEDURE

UPS INVERTER ISOLATION TEST

FOR: PUBLIC SERVICE ELECTRIC & GAS CO.
HOPE CREEK GENERATING STATION
BECHTEL POWER CORPORATION
P.O. 10855-E-154(Q)-AC

BY: CYBEREX, INC.
7171 INDUSTRIAL PARK BLVD.
MENTOR, OHIO 44060

INDEX

1. OBJECTIVE:

To establish, by test, that the inverter of the UPS system, employed at Hope Creek Generating Station, is a power circuit isolation device.

2. PASS CRITERIA:

Definition of Isolation Device: a device is considered to be a power circuit isolation device if it is applied such that the maximum credible voltage or current transient applied to the non-class IE side of the device will not degrade below an acceptable level, the operation of the circuit on the other side of that device. In this case, a fault on non-IE side of the UPS (load side) will not degrade or affect the Class-IE (input side) of the inverter.

3.0 INPUT POWER SOURCES:

SOURCE	NORMAL VARIATION
"Alternate" DC Supply	105-140 VDC 0-364 ADC
"Normal" AC Supply	480 +10% V (L-L) 3 phase, 0-55A 0-132AP for 10 mSec
"Backup" AC Supply	480 +10%V 1 phase, 0-78A 0-500AP for 10 mSec

4. FAULT LOCATION AND TYPE

Faults will be applied to inverter AC output and loadside output terminal by closing a switch as required.

FAULT TYPES:

1. Inverter Output (Hot) to Ground
2. UPS Loadside Output (Hot) to Ground
3. Neutral to Ground
4. Inverter Output (Hot) to Neutral
5. UPS Load side Output (Hot) to Neutral

Figure 2 shows the circuit configuration for the above five faults.

5.0 TEST FACILITY AND EQUIPMENT

A. DC SUPPLY - C&D 4LCW-15 Battery (60 cells, 80KW for 30 min.) with 400 Amp charger.

B. AC SUPPLY - 480V, 3 Phase, 4W, 60 Hz, 1200A, grounded neutral.

C. AC LOAD BANK - 0-30KW or 0-30 KVA @ 0.8PF.

D. FAULT APPLICATION DEVICE - GE Circuit Breaker TKMA2Y1200 1200A, 3 Pole.

5.1 TEST INSTRUMENTATION

A. Gould Inc., model 2800W high frequency recording system. Eight channel, independent scale select +.05 to +500 volts full scale. Two units are required for monitoring the various test. The two units designated are A & B.

B. Potential transformer 480V, 60HZ primary 120V secondary (4:1 ratio) Six units required-designated PT1-6.

C. Current transformer 1000:1 ratio with 10 OHM burden resistor (.01 V/A). Seven units required-designated CT1-7.

D. Wideband DC Isolation Amplifier, TEK Model A6902A Designated VT.

E. DC Current Sensor - 0-3000AFS Model 1A-5024P, F.W. Bell Inc., - Designated IT.

6.0 TEST PROCEDURE

6.1 GENERAL NOTES

A. Determine and record all signal conditioner transfer ratio (multiplier) values before starting test.

B. Verify the following before starting up the unit:
System connections per Fig 1 & 2.
Static switch in preferred position.
"Test" switch centered.
"Return Mode" switch in "auto" position.
"Sync" switch - on.
All "isolate" toggle switches - on.
Auctioneer bypass switch in "Normal" position.
Manual bypass switch in "Normal position (will change as specified in each test). See Table 1
All power sources energized (will change a specified in each test). See Table 1
Adjust output load to 20 KVA @ 0.8PF (133.3A resistive and 100A inductive).*

C. The recorder system (connection per Fig 2) set up is as follows:

All channels in "storage" mode
Trigger on "external analog" and DC coupled
Pretrigger delay at 25%
Trigger Mode to "manual"
Memory size to 8K Bytes/Channel
Center all recorder pens
Set range switches to achieve desired scales.
External trigger will be generated by closing "fault" circuit breaker through OPTO coupler dircuit to both recorders simultaneously.

D. The recorder time base that controls the recording length and time resolution will be initially set at 10KHZ for high resolution recording at the fault application. The resulting record will consist 20.4 mSEC of data before the fault application and 61.4 msec after for a total diplay of 81.8 msec or 4.9 cycles of 60 Hz power frequency. The record will consist of 8192 samples 400 microseconds apart.

*Run the unit for at least 30 minutes before applying load.

6.2 FAULT TEST PI EDURES

A. Select recoding time base, enter test #
B. Arm both recorders, wait until memory is full
C. With required "fault" jumper installed connect the trigger lead to the unused "fault" CB output terminal.
D. Close "fault" breaker, wait for "recording" lights to go out then open "fault" breaker.
E. Wait for data to be plotted.
F. Repeat above for all the test modes.

6.3 "TEST MODES"

Table 1 shows the actual test numbers.

6.3.1 A. All source breakers closed
B. Manual bypass switch in "Normal" position
C. Install jumpers as shown on Fig. 2 to the following faults:

1. Inverter Hot-Ground
2. UPS load side Hot-Ground
3. Neutral-Ground
4. Inverter Hot-Neutral
5. UPS load side Hot-Neutral

6.3.2 A. All source breakers closed
B. Manual bypass switch in "Bypass Pref" position
C. See 6.3.1.C 1 thru 5

6.3.3 A. All source breakers closed
B. Manual bypass switch in "Bypass Alt" position
C. See 6.3.1.C 1 thru 5

6.4.1 A. Back-up source breaker open
B. Manual Bypass switch in "Bypass Pref Iso" position
C. See 6.3.1.C 1 thru 5

6.5.1 A. All source breakers closed
B. Manual bypass switch in "Normal" position
C. Trip the normal source breaker to observe the impact on the alternate source (DC battery).

6.6.1 A. Normal source breaker open
Back-up and alternate source breakers closed
B. Manual bypass switch in "Normal" position
C. See 6.3.1.C 1 thru 5

6.7.1 A. Alternate source breaker open (battery in maintenance)
Back-up and normal source breakers closed.
B. Manual bypass switch in "Normal" position
C. See 6.3.1.C 1 thru 5

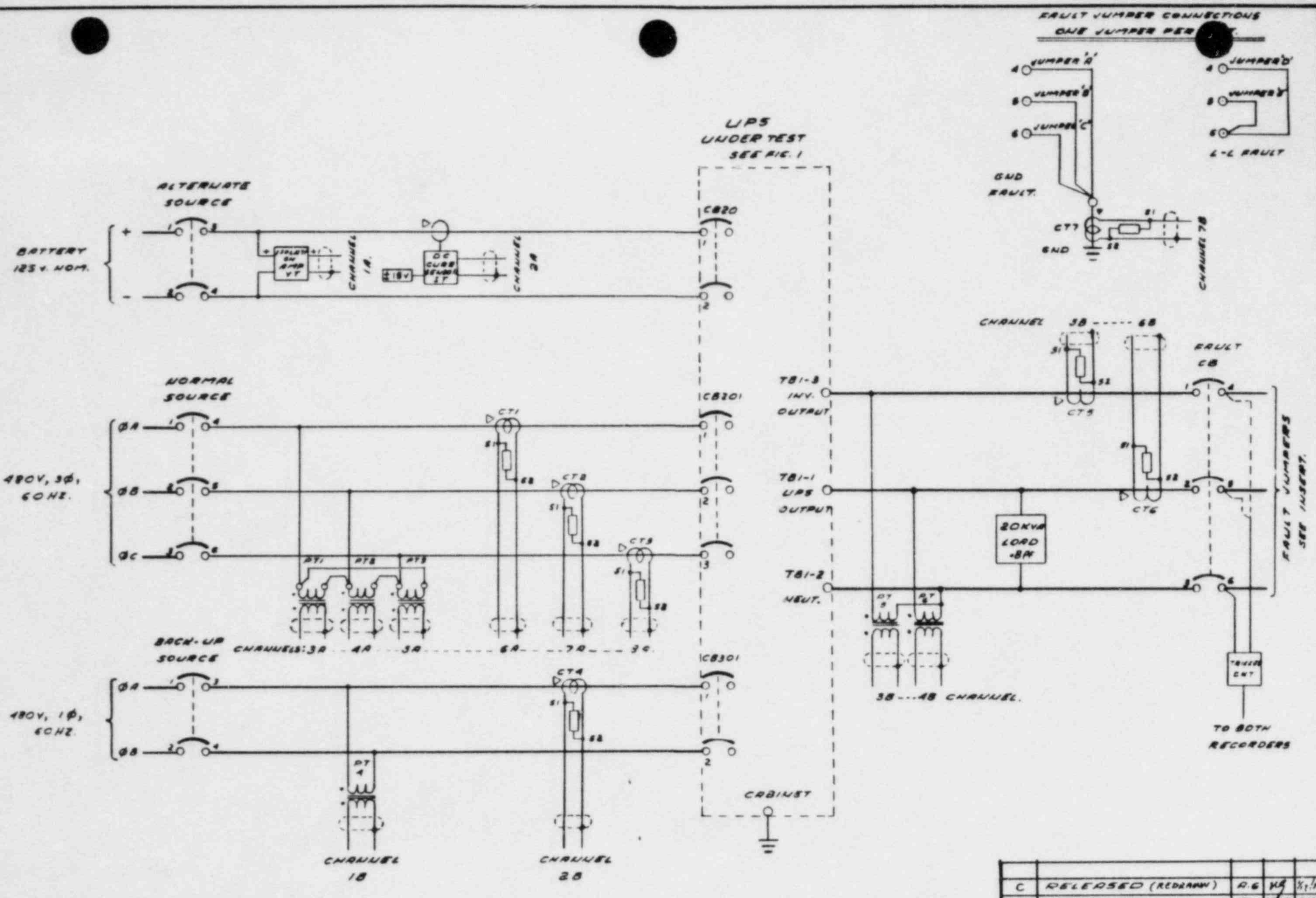
6.8.1 A. Back-up source breaker closed, normal and alternate source breakers open.
B. Manual bypass switch in "Byp. Alt. Isolate" position
C. See 6.3.1.C 2, 3, & 5

UF INVERTER ISOLATION TEST

TABLE - 1

TEST MODE SECTION	SOURCE BREAKERS POSITION	MANUAL BYPASS SWITCH POSITION	INVERTER TO GROUND	FAULT TYPE PER SEC. 4.0			
				UPS-GRD.	NEUTRAL-GROUND	INVERTER-NEUTRAL	UPS-NEUTRAL
6.3.1	ALL BREAKERS CLOSED	NORMAL	1	8	15	22	28
6.3.2	ALL BREAKERS CLOSED	BYP PREF	2	9	16	23	29
6.3.3	ALL BREAKERS CLOSED	BYP ALT	3	10	17	24	30
6.4.1	BACK-UP BKR. OPEN	BYP PREF ISOLATE	4	11	18	25	31
[illegible]5.1	TRIP NORMAL CHECK TRANSFER	NORMAL 5					
6.6.1	NORMAL BREAKER OPEN. BACK-UP AND ALTERNATE BREAKER CLOSED	NORMAL	6	12	19	26	32
6.7.1	ALT. BREAKER OPEN (BATT IN MAINTENANCE) B.U. & NORMAL BREAKER CLOSED	NORMAL	7	13	20	27	33
6.8.1	BACK-UP BREAKER CLOSED. NORMAL AND ALT. BKRS. OPEN	BYP ALT ISOLATE	-	14	21	-	34

NOTE: NUMBERS IN CIRCLES INDICATE THE ACTUAL TEST NUMBERS



NOTES:

1. TWO 8 CHANNEL RECORDERS USED — DESIGNATED A & B.
2. ALL SHIELDS TIED TO RECORDER CHASSIS WHICH IS GROUNDED.

ISSUE	DESCRIPTION	BY	APPVD	DATE
C	RELEASED (REDRAWN)	A.G	[illegible]	[illegible]

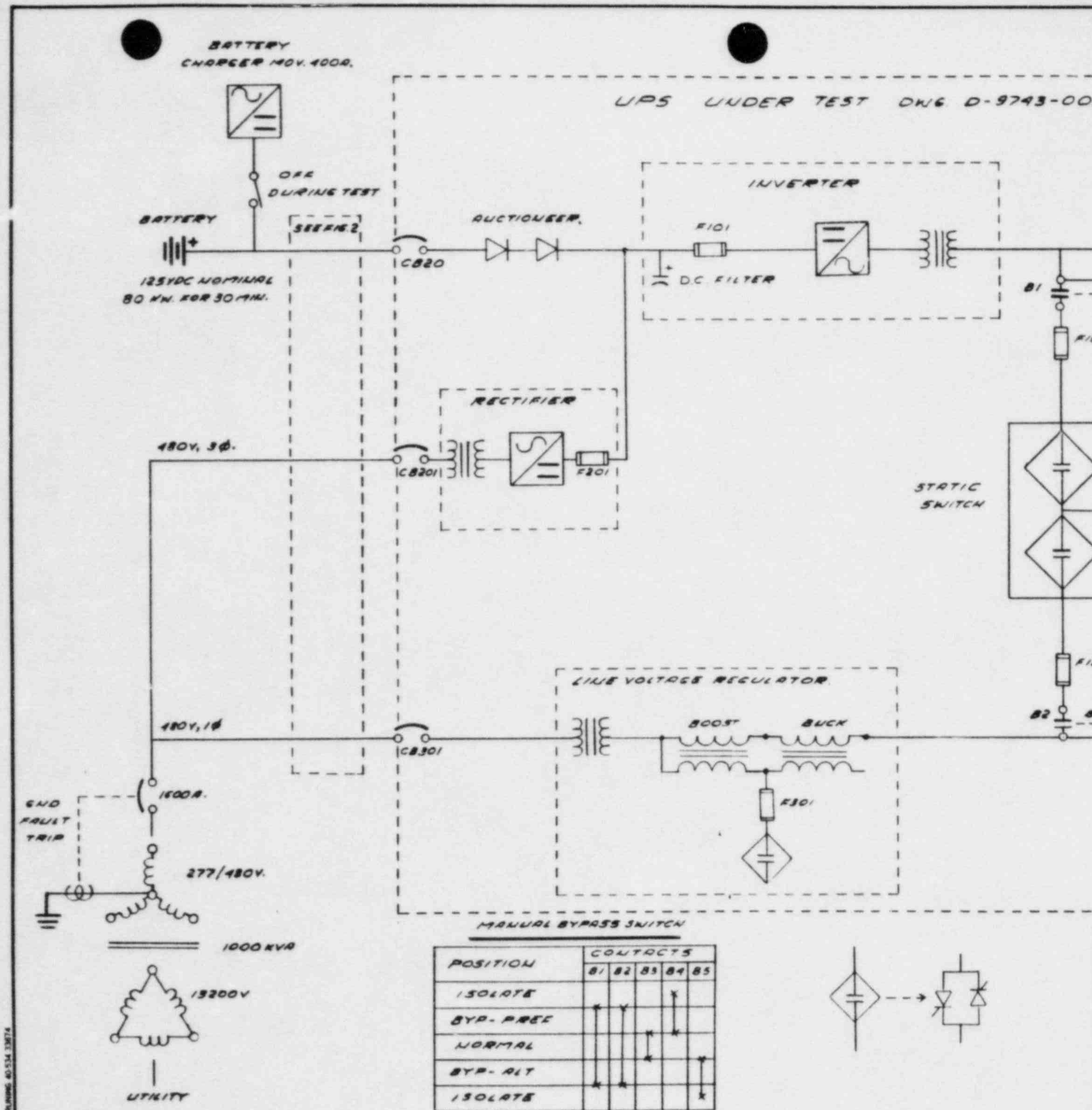
CYBEREX INC.
7171 INDUSTRIAL PARK BLVD. MENTOR, OHIO 44060

STATUS | SCALE | DWN BY A.G | CHKD | APPVD | DATE

TITLE INSTRUMENTATION AND FAULT CONNECTION

DWG SIZE, NUMBER FIG. 2

SHEET 10 OF 10



ISSUE	DESCRIPTION	BY	APPVD	DATE
D	RELEASED (Redrawn)	R.G.	[illegible]	[illegible]

CYBEREX INC.
7171 INDUSTRIAL PARK BLVD MENTOR, OHIO 44060

STATUS | SCALE | DWN BY R.G. | CHKD | APPVD | DATE

TITLE: TEST SET UP ONE LINE DIAGRAM

DWG SIZE NUMBER: FIG. 1

SHEET 9 OF 10

ATTACHMENT 2

ONE LINE DIAGRAM
20 KVA UPS
DWG. NO. D-9743-001

SEE

APERTURE

CARDS

*OVERSIZED DRAWINGS

(ADDITIONAL DOCUMENT PAGES FOLLOW)

APERTURE CARD NO# 8503110457

AVAILIBILITY PDR CF HOLD

NUMBERS OF PAGES. 1

ATTACHMENT 3

RECORDER CHARTS
TEST 1 THRU 34

TOTAL NO. 45

DOCUMENT/ PAGE PULLED

ANO. 8503110455

NO. OF PAGES 43

REASON

☐ PAGE ILLEGIBLE

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