NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

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June 12, 1984

Docket No. 50-423
B11223

Director of Nuclear Reactor Regulation
Attn: Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) B. J. Youngblood to W. G. Counsil, Additional Draft SER Sections for Millstone Nuclear Power Station, Unit No. 3, dated February 24, 1984.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
Summary/Submittal of Responses to PSB Electrical Draft SER Items

Reference (1) included the PSB Electrical Draft SER write-up which identified several open items with regard to information provided within our OL application. We have subsequently held two meetings, May 14, 1984 and May 31, 1984, to discuss and resolve these open items. Attachment 1 provides a summary status of all items originally open. The responses, Attachment 2, reflects those discussed during the meetings except where the summary status indicates a response was subsequently revised.

If you have any questions, please contact our Licensing representative directly.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY
et. al.

BY NORTHEAST NUCLEAR ENERGY COMPANY
Their Agent

W. G. Counsil
W. G. Counsil
Senior Vice President

C. F. Sears
By: C. F. Sears
Vice President
Nuclear and Environmental Engineering

B001
1/40

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Then personally appeared before me C. F. Sears, who being duly sworn, did state that he is Vice President of Northeast Nuclear Energy Company, an Applicant herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Applicants herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Lorraine J. D'Amico
Notary Public

My Commission Expires March 31, 1988

Attachment 1

Status of PSB Electrical SER Items

Section/Question	Status	Remarks/Required Action
8.2.1.1	Closed	Attached.
8.2.2.1/430.4	Confirmatory	Response to Q430.4 will be incorporated into a future FSAR Amendment per NRC reviewer's request. Once done this item will be considered closed. Because this item was originally considered closed and the response to Q430.4 previously submitted, no further documentation is attached.
8.2.2.2/430.5	Closed	Attached.
8.2.2.3/430.6	Closed	Attached.
8.2.2.5/430.7b	Confirmatory	Attached. Response to Q430.7b will be incorporated into a future FSAR Amendment per NRC reviewer's request. Once done this item will be considered closed.
8.2.2.6	Closed	Attached.
8.2.3.1	Closed	Attached.
8.3.1.2/430.3	Closed	Attached.
8.3.1.3/430.9	Confirmatory	Attached. Response to Q430.9 will be incorporated into a future FSAR Amendment per NRC reviewer's request. Once done this item will be considered closed.
8.3.1.4/430.10	Closed	Attached.
8.3.1.5/430.11	Confirmatory	Attached. Once results of station electric system voltage testing is complete or the predicting analysis, this item will be considered closed.
8.3.1.6/430.12	Closed	Attached.
8.3.1.7/430.13	Closed	Attached.
8.3.1.8/430.14	Closed	Attached.

Section/Question	Status	Remarks/Required Action
8.3.1.9/430.16	Closed	Attached. Note: This item was agreed to be closed during a telecon on June 4, 1984 between the NRC and Applicant. Also note this item was originally closed and then open. Because it was originally closed and related we have attached the response to 430.16 along with our response to SER Section 8.3.1.10.
8.3.1.10/430.18 and 16	Closed	Attached.
8.3.1.11/430.19	Open	Attached. The NRC staff is still considering Applicant's current position.
8.3.1.13/430.22	Closed	Attached.
8.3.2.1	Closed	Attached.
8.3.2.2	Closed	Attached.
8.3.2.3	Closed	Attached.
8.3.3.1.1/430.51	Closed	Attached.
8.3.3.1.3/430.49	Closed	Attached.
8.3.3.3.3/430.28	Closed	Attached. A verified statement there are no power cables traversing the Instrument Rack Room and Control Room has been added to the response subsequent to the May 31, 1984 meeting between the NRC and Applicant.
8.3.3.3.6/430.32	Closed	Attached.
8.3.3.3.7/430.34	Closed	Attached.
8.3.3.3.9/430.35	Under further review	Attached. NRC reviewer is considering further information presented on May 31, 1984. If adequate this item will be considered closed.
8.3.3.3.10/430.38	Under further review	Attached. NRC reviewer is considering further information presented on May 31, 1984. If adequate this item will be considered closed.

Section/Question	Status	Remarks/Required Action
8.3.3.3.12	Closed	Attached.
8.3.3.3.14	Open	Attached. A revised response based on meeting discussion on cable separation is currently being prepared and will be forwarded to the NRC. With this submittal the item will be considered closed.
8.3.3.3.15	Closed	Attached.
8.3.3.3.16	Closed	Attached.
8.3.3.4/430.48	Open	Attached.
8.3.3.6.1	Closed	Attached.
8.3.3.6.2	Closed	Attached. Discussed rewrite is being provided.
"Additional Item"	Closed	AM-39 attached. NRC reviewer will provide an additional write-up in the SER. A rewrite will be provided which describes the use of SJO and SO cable in lighting circuits as dicussed during the May 31, 1984 meeting between the NRC and Applicant.

Attachment 2

northerly right-of-way for 38 miles and 20 miles to the Manchester and Card substations respectively.

Separate and independent structures are provided for each of the six 345 kV transmission lines connecting generators 1, 2 and 3 and reserve station service transformers 1, 2 and 3 to the switchyard.

The inspection and testing of the 345-kV circuit breakers and the transmission line protective relaying are done on a routine basis, without removing the generators, transformers, and transmission lines from service. The insulating oil for the transformer is sampled and tested on a routine basis. During these routine inspections and tests, the operability and functional performance of the electric systems are in compliance with General Design Criterion 18, "Inspection and Testing of Electric Power Systems."

8.2.2 Analysis

The possibility of power failure due to faults in the connections to the system and the associated switchyard is minimized by the following arrangements:

1. The connections to the system have been designed to comply with the Northeast Power Coordinating Council "Basic Criteria for the Design and Operation of Interconnected Power Systems" and the "Reliability Standards for the New England Interconnected Power Pool" adopted by that pool. Compliance with these criteria ensure that the supply of offsite power will not be lost following severe faults in the interconnected transmission system. Transient stability studies have been performed to verify that widespread or cascading interruptions to service will not result from these contingencies. In addition, the loss of Millstone 3 or the loss of any other generating plant in the system will not result in cascading system outages and thus will not cause loss of offsite power to the units. Since the only electrical facility shared among the Millstone Units is the switchyard, compliance with General Design Criterion 5, sharing of structures, systems, and components, is assured.

   The 345 kV circuit breakers are air blast type and are pneumatically operated. Electrical controls are provided for both local and remote Millstone 1 control room operation. Each power circuit breaker has a separate pneumatic supply unit capable of operating the breaker for five close-open operations after the loss of the compressor. Each pneumatic compressor is supplied from a separate feeder at the switchyard essential ac panel. The circuit breakers are equipped with a closing solenoid and two trip solenoids. A standard anti-pump and trip-free control scheme is used.

   Primary and backup relaying are both high speed protective schemes. Primary and backup protective relays are used,

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB03 (193) DESCRIPTION & ANALYSIS DEMONSTRATING COMPLIANCE WITH GDC5 (8.2.1.1)

Description and analysis demonstrating compliance with GDC 5 analysis with description of design provisions demonstrating that the offsite power system meets the requirements of GDC 5 has not been presented in Section 8.2 of the FSAR in accordance with the guidelines of Regulatory Guide 1.70. This item will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to revised FSAR section 8.2.2.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB04 (194) 430.5 PHYSICAL SEPARATION OF OFFSITE CIRCUITS BETWEEN SWITCHYARD AND CLASS IE SYSTEM (8.2.2.2)

As implied by Section 8.1.2 of the FSAR, the Millstone design provides two immediate access offsite circuits between the switchyard and the 4.16 kv Class IE busses. It is the staff position that these two circuits be physically separate and independent such that no single event can simultaneously affect both circuits in such a way that neither can be returned to service in time to prevent fuel design limits or design conditions of the reactor coolant pressure boundary from being exceeded. The physical separation and independence of these two circuits has not been described or analyzed in the FSAR.

The applicant by amendment 3 to the FSAR presented additional information in regard to these circuits. However, based on the additional information the staff was unable to conclude that the design meets GDC 17. This item will continue to be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.5.

NRC Letter: May 3, 1983

Question No. Q430.5 (SRP Section 8.2)

The Millstone design provides two immediate access offsite circuits between the switchyard and the 4.16 kV Class 1E buses. It is the staff position that these two circuits be physically separate and independent such that no single event can simultaneously affect both circuits in such a way that neither can be returned to service in time to prevent fuel design limits or design conditions of the reactor coolant pressure boundary from being exceeded. The physical separation and independence of these two circuits has not been described or analyzed in the FSAR. Provide the description and analysis and justify areas of noncompliance with the above staff position. The analysis should include separation and independence of control and protective relaying circuits as well as the power circuits.

Response:

The design of two offsite circuits from the 345 kV switchyard to the 4.16 kV Class 1E buses is via separate transformers (main/normal station service and reserve station service). FSAR Figure 8.1-1 shows the tie lines, transformer, and bus arrangement connections.

The tie lines to the main/normal station service transformers and to the reserve station service transformer are physically separate and electrically independent. The main/normal station service transformers and the reserve station service transformers are located at opposite ends of the plant. The connection from the normal station service transformers and from the reserve station service transformers to the 4.16 kV Class 1E buses is via physically separate and electrically independent underground duct lines. Figure 1.2-1 shows the tie line routes from the switchyard to the main/normal and to the reserve station service transformers. FSAR Figure 1.2-2 shows the physical separation between the normal station service and the reserve station service transformers. FSAR Figure 8.3-7, Sheets 1 and 2 shows the embedded conduit duct lines as they enter the redundant switchgear rooms in the control building.

The control power for these buses is from different dc panels and batteries. The breakers in the Class 1E buses (34C and D are independently protected with separate relaying.

These circuits are completely redundant and separated so that no single failure can disable both offsite power supplies to the Class 1E buses and therefore, the design is in compliance with General Design Criterion 17, Electrical Power Systems.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB05 (195) 430.6 VERIFICATION TESTING FOR GENERATOR CIRCUIT BREAKERS (8.2.2.3)

As described in Section 8.3.1.1.1 of the FSAR, the Millstone design arrangement provides two immediate access offsite circuits. One of these circuits utilizes a generator circuit breaker to isolate the turbine generator from the main and normal station service transformers. Other facilities that utilize generator circuit breakers have been required to perform verification testing. The applicant, by amendment 3 to the FSAR, provided their verification test program with results. Based on these test results, it appears that the capability of the generator breakers has been adequately demonstrated and is acceptable. However, subsequent to the staff's request for information, a revision to the NRC Standard Review Plan (SRP) (NUREG-0800) was issued that provided more specific guidelines with respect to generator circuit breakers. The applicant will, therefore, be further requested to review these specific guidelines with respect to their test results and provide a positive statement of compliance or justification for any deviations. The specific guidelines are located in Appendix A to SRP Section 8.2 and are dated July 1983. This item will continue to be pursued with the applicant and the results of the staff review will be included in a supplement to this report.

Response:

Refer to the revised response to question no. 430.6.

NRC Letter: May 3, 1983

Question No. Q430.6 (SRP Section 8.2)

The Millstone design arrangement provides two immediate access offsite circuits. One of these circuits utilizes a generator circuit breaker to isolate the turbine generator from the main and normal station service transformers. Other facilities that utilize generator circuit breakers have been required to perform verification testing. Provide a verification test program with results to demonstrate the breaker's ability to perform its intended function during steady-state operation, power system transients, and major faults.

Response:

The capabilities of the generator circuit breaker have been demonstrated by design tests and conformance tests made on similar breakers supplied to US users. The breaker capabilities have also been verified by certain production tests. The testing complies with ANSI C37.09 - 1979 as well as the more specific proposed standard Test Procedure for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis, C37.09b.1/D1, presently being developed by a Working Group of the IEEE Switchgear Committee.

<u>Specific Guidelines of Appendix A to SRP Section 8.2</u>

1. A generator circuit breaker is used to isolate the unit generator from the offsite and onsite ac power systems in order to provide immediate access for the onsite ac power system to the offsite source.

2. The generator circuit breaker is designed to perform its intended function during steady-state operation, power system transients, and major faults. The following performance tests and capabilities demonstrate the design:

   A. <u>Dielectric Tests</u>

   CERDA Test Report 1738A documents the design dielectric tests (Duke Power Breaker).

   CERDA Test Report 25859 documents low frequency (50Hz) withstand tests of each pole as follows:

   1. High voltage bus hi-pot tested at 75 kV for 72 seconds

   2. Low voltage wiring hi-pot tested at 2 kV for 72 seconds

The breaker has the dielectric capabilities for a 1.46
rating of 36 kV maximum, 170 kV BIL, even though the
application for Millstone Unit 3 requires 25.2 kV and 1.48
150 kV, respectively.

PSB05

B. Load Current Switching 1.51

CERDA Test Report 2090A documents a test of 40 load 1.53
current switching operations at 35 kA (Public Service
Company of New Hampshire). 1.55

In addition, prototype tests included 100 load break 1.57
operations at 30 kA.

PSB05

C. Fault Current Interrupting Capability 2.2

KEMA Test Report 292-81A documents short circuit tests 2.4
performed on one pole of a breaker (TVA). In this 2.6
test, fault ~~currents were 273 kA RMS symmetrical at 15~~
~~kV .56 percent assymmetry~~. These fault currents 2.7
clearly envelope the Millstone 3 requirement of 230.9
kA symmetrical, 370 kA assymmetrical.

780 kA peak rating current and 275 kA RMS breaking current.

PSB05

Fault current interuptions were more than conducted at 2.8
minimum rated air pressure. The air system is designed 2.9
to maintain full rated pressure, (~~RMS~~ reclosing duty is
not contempleted) thus, fault current interuption at 2.10
minimum rated air pressure is not a requirement.

D. Maximum Rate of Rise of Recovery Voltage 2.13

The same KEMA test report, 292-81A, demonstrated RRRV 2.15
capability of about 5 kV/microsecond. A Duke Power 2.17
Breaker was tested with an applied RRRV of
12 kV/microsecond.

The Millstone 3 RRRV has been calculated at 4.72 2.18
kV/microsecond (without resistors).

PSB05

E. Short-Time Current Carrying Capability 2.21

The one-second short time current capability of 275 kA 2.23
RMS was demonstrated for Duke Power as shown in KEMA
Test Report 2283-74A. 2.25

Assuming failure of the protective relay actuation of the 2.27
generator breaker, backup relaying time is 30 cycles,
maximum. The highest I^2t the KEMA obtained was 738 kA 2.28
peak, 254 kA RMS symmetrical during 1.26 seconds.

The above testing clearly envelopes the Millstone 3 2.29
requirements.

PSB05

F. Momentary Current Carrying Capability 2.32

The momentary (close and latch) capability of 1000 kA peak was demonstrated on a Duke Power Breaker. See KEMA Test Report 2945-78A. 2.34 2.35

The symmetrical current rating forms the basis for the momentary current rating. KEMA has demonstrated 738 kA peak, 254 kA RMS symmetrical for 1.26 seconds. 2.37 2.38

G. Transformer Magnetizing Current Interruption 2.41

This capability was demonstrated for Duke Power, as shown in CERDA Test Report 2000A. An unloaded 2500 MVA transformer was switched, without damping resistors, giving voltage surges not regarding 1.1 per unit. Tests on smaller transformers have given voltage surges up to 2.5 per unit. 2.43 2.45 2.47

H. Thermal Capability 2.50

EdF Test Report HM 51 02 806A documents tests made for TVA. 2.52

One pole of the Millstone 3 generator circuit breaker was subjected to heat run tests to measure the temperature rises, both with normal cooling systems operating and with various losses of cooling equipment simulated, at rated current (34.4 kA. 2.54 2.55 2.56

The nameplate capability of NUSCo's breaker will be 37.5 kA continuous, even though the maximum continuous current will be 34.4 kA. 2.57 3.2

I. Mechanical Operation Test 3.5

One pole of a Duke Power generator breaker was subjected to 2000 no-load operations. Two hundred of these were done at -20°C ambient temperature, and 200 operations were performed with the hottest spot of the breaker at 105°C. 3.7 3.9 3.10 3.11

In factory tests, NUSCo's breaker perform 25 operation with various conditions of low, normal, and high control voltage and pressure. 3.12 3.13

3. Tripping selectively between the generator circuit breakers and the switchyard high voltage generator circuit breakers ensures unnecessary tripping of the switchyard generator circuit breakers during abnormal events in order to maintain offsite power to the station loads. 3.15 3.16 3.17

4. A load break switch is not utilized at Millstone 3. 3.18 | PSB 05

Therefore, the design meets the requirements of Appendix A of SRP 8.2 | PSB 05

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB06 (196) 430.7 GENERATION REJECTION SCHEME (8.2.2.5)

There are four transmission circuits that connect the Millstone switchyard to the grid system. The four circuits are routed on two tower lines - two circuits per tower line. Section 8.1.3 of the FSAR indicates that a simultaneous failure of either of the two tower lines with only one circuit in service on the other tower line, may result in instability of Millstone generation. The applicant, in order to prevent instability, has installed a rejection scheme to automatically reduce generator output at Millstone Unit 3.

The applicant, by amendment 3 to the FSAR, provided a description of the rejection scheme. However, in order to conclude that the design meets GDC 17 and 18 for the proposed mode of operation (one of four offsite transmission lines out of service), the staff requires additional description of surveillance, operability requirements, and analysis demonstrating compliance with the requirements of GDC 17 and 18 be documented in the FSAR. This item will be pursued with the applicant the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.7.

NRC Letter: May 3, 1983 1.8

Question No. Q430.7 (SRP Section 8.2) 1.11

a. It is the staff position that the Millstone grid stability 1.13
analysis must show that loss of the largest single supply to the 1.14
grid does not result in the complete loss of preferred power.
The analysis should consider the loss, through a single event, of 1.15
the largest capacity being supplied to the grid, removal of the 1.16
largest load from the grid, or loss of the most critical
transmission line. The combined capacity of Millstone Units 1, 1.17
2, and 3 is to be supplied to the grid through the <u>common</u>
<u>Millstone switchyard</u>. The combined capacity of the three units 1.19
appears to be the largest capacity being supplied to the grid and
should be considered in the Millstone grid stability analysis. 1.20
Provide the results of the grid stability analysis when 1.21
simultaneous loss of the combined capacity of Units 1, 2, and 3 1.22
is considered and justify areas of noncompliance with the above
staff position.

b. There are four transmission circuits that connect the Millstone 1.23
switchyard to the grid system. The four circuits are routed on 1.24
two tower lines - two circuits per tower line. Section 8.1.3 of 1.25
the FSAR indicates that a simultaneous failure of either of the
two tower lines with only one circuit in service on the other 1.26
tower line, may result in instability of Millstone generation.
The Applicant, in order to prevent instability, has installed a 1.27
protection scheme to automatically reduce generator output at 1.28
Millstone Unit 3. Describe the protection scheme. 1.29

Response: 1.32

<u>Answer to Part A</u> 1.33

By careful design of the switchyard and protective relays, NU has 1.34
practically eliminated the possibility of the simultaneous loss of 1.36
three units at Millstone. Nevertheless, the loss of the Millstone 1.37
plant and all four transmission circuits has been simulated in design
studies. The transmission circuits were outaged along with the 1.38
station in order to simulate worst case conditions, and this outage 1.39
was simulated both with and without a fault.

The stability analysis indicates that the rest of the system will 1.40
remain in synchronism after the loss of the entire output of the 1.41
Millstone station. The system was modelled for one set of operating 1.42
conditions; hence, it is possible that a similar test under heavy
transfer conditions within the interconnected system might result in 1.43
instability. However, we are certain that the probability of losing 1.44
all three units simultaneously is extremely small becuase of the
preventive measures discussed below in this response. Accordingly, 1.46
NU believes it is reasonable to count upon onsite power sources to
supply the necessary station service power requirements in the very 1.47
remote event that all three Millstone units should be lost at once

accompanied by the total loss of the transmission supply to the 1.48
station.

A primary objective in designing the connection of the Millstone 1.49
Nuclear Power Station to the 345 kV transmission network in 1.50
Connecticut has been to prevent the loss of the entire station
output. The reliability criteria of The Northeast Power Coordinating 1.51
Council (NPCC) and the New England Power Pool (NEPOOL) are a 1.52
fundamental part of this design process. The following are the most 1.53
severe outages which the system has been designed to survive in order
to minimize the possiblity of a total plant outage: 1.54

a. With any one of the four Millstone 345 kV transmission circuits 1.56
out of service, the plant remains stable for any three-phase 1.57
fault normally cleared (four cycles) or any one-phase fault
normally cleared (four cycles) or any one-phase fault with 1.58
delayed clearing (nine cycles). These tests are done with 1.59
maximum generation at Millstone to simulate worst case
conditions.

b. The reliability criteria further require testing to determine if 1.60
the loss of two circuits on a common structure can be tolerated. 2.1
The event which is used to test the loss of the two circuits is a 2.2
simultaneous line to ground fault on different phases of the two 2.3
circuits. With all lines in service, the system remains stable 2.4
for this two circuit disturbance. It should be recognized that 2.5
the four circuits leaving the millstone switchyard are paired on
two rows of double circuit structures for only a short distance, 2.6
and, hence the exposure to this outage is small.

c. Also, the simultaneous loss of two Millstone circuits on common 2.7
structures following a previous (nonsimultaneous) outage of 2.8
either of the other Millstone circuits (or any other critical
element) must not result in instability. All of the critical 2.9
outages of this type effectively result in the loss of three of
the four Millstone circuits and leave the Millstone station 2.10
weakly tied to the transmission grid. To prevent instability for 2.11
these extremely severe (and highly improbable) disturbances, it
is necessary to reduce output after the initial line outage and 2.12
before the loss of the two circuits on common structures takes
place and/or install an automatic generation rejection scheme. 2.13

Because of the significant economic penalties involved, the reduction 2.15
of generation after the initial line outage is considered a highly 2.16
undesirable solution to the potential stability problems identified
in item (c) above and should be avoided to the extent possible. 2.17
Therefore, a post disturbance generation curtailment scheme has been 2.18
provided. This system continuously monitors the individual state of 2.19
six critical system components together with the generation output at 2.20
the Millstone complex. Should the system condition arise where 2.21
1) any one of the six critical lines or elements is unavailable,
2) the generation at Millstone is above a predetermined MW level, and 2.22
3) two specific transmission circuits are forced out, then generation 2.23
will automatically be curtailed at Millstone. Stability studies 2.24

indicate that during maximum output conditions (2640) MW), Millstone Units 1 and 3 can be successfully tripped and system stability maintained leaving Millstone Unit 2 in synchronism with the transmission network. The tripping of these units results in a generation reduction of up to approximately 1810 MW with 870 MW remaining synchronized. This generation reduction scheme is described in the answer to Part B of this question. The scheme is called a Severe Line Outage Detection (SLOD).

Additional testing was carried out for Possible but Improbable (PBI) events which are specified in the NPCC and NEPOOL reliability criteria. The one PBI event which could have a serious effect at Millstone is a three-phase fault followed by delayed clearing due to a three-phase stuck circuit breaker. This results in the Millstone units losing synchronism. This stability problem has been eliminated by designing the protective relay schemes and circuit breaker installations so that at most, one pole will fail to clear. The breakers which are designed to meet this criteria are classified as having independent pole tripping.

NU insures independent pole tripping by installing breakers with mechanically independent poles and two separate methods of tripping the circuit breaker. These installations include two sets of relays and trip coils. There are two sets of current and potential transformers, the wiring for the relay packages are installed in separate duct banks, the relay packages are physically separated in the control house and two separate dc supplies are provided.

The 345 kV switchyard at Millstone is designed so that the loss of more than one transmission circuit due to a failure of a breaker to trip requires at least two circuit breakers to simultaneously fail to operate. The failure of even one circuit breaker is very unusual. At least three circuit breakers would have to fail before three transmission lines would be lost due to malfunctions in the switchyard. At that point, the generation rejection scheme would operate to keep one unit in service. In order to lose the entire station, at least four circuit breakers must fail.

To summarize: The Company is taking extensive precautions to prevent the sudden loss of the three generating units at Millstone Station and the simultaneous loss of offsite power. We believe these measures make the probability of such an occurrence extremely small.

<u>Answer to Part B</u>

The operation of the Millstone generation rejection scheme is based on the outage of combinations of certain transmission circuit elements. The scheme has been name Severe Line Outage Detector (SLOD). See reference to SLOD in the answer to Part A of this question.

This system will continuously monitor the individual status of six critical transmission elements in the area of the Millstone Station together with the generation output of the Millstone complex.

Generation will be curtailed automatically if a system condition arises where any of ten combinations of the six elements are outaged, and generation at Millstone is above 1200 MW.

To monitor the status of the 345 kV system, SLOD equipment has been required at the Millstone and at Montville switchyards. In addition, it will be necessary to install high speed backup relay protection with a permissive overreaching audio tone scheme on both ends of the Millstone to Manchester and the Millstone to Southington lines.

At Millstone, three logic packages will be provided. The operation of any two logic units will provide a tripping output. The current detecting devices of each logic package will sense the available state of each of the four transmission circuits emanating from the Millstone switchyard. Signals indicating the availability state of two remote components (the Montville 345 kV tie breaker, and the Montville - Haddam Neck Line) will be transmitted to Millstone. The megawatt output from each of the Millstone units will be measured and summed to provide an indication of the toal megawatt output of the Millstone units. Should the comparative logic in the SLOD package indicate that any one of the combinations of transmission outages listed below exist, and the generation level at the Millstone Station is above 1200 MW, then Millstone Units 1 and 3 will be curtailed immediately.

The combinations of unavailable components which must be monitored are:

1. Necessary to meet NPCC and NEPOOL criteria:

   Millstone - Manchester, Millstone -Card and Millstone - Montville

   Millstone - Southington, Millstone - Card and Millstone - Montville

   Millstone - Montville, Millstone - Manchester and Millstone - Southington

   Millstone - Card, Millstone - Manchester and Millstone - Southington

   Montville - Haddam Neck, Millstone - Manchester and Millstone - Southington

   Montville 345 kV tie breaker, Millstone - Manchester and Millstone - Southington

2. Also included to simplify the SLOD package logic but not required to meet NPCC and NEPOOL criteria are:

   Millstone - Southington, Millstone - Card and Montville - Haddam Neck

Millstone - Manchester, Millstone - Card and Montville - Haddam Neck

Millstone - Southington, Millstone - Card and Montville 345 KV tie breaker

Millstone - Manchester, Millstone - Card and Montville 345 KV tie breaker

As mentioned above, signals indicating the availability status of the two remote components at Montville are required at Millstone. To monitor the status of the 345 KV circuit breaker at Montville, and the availability of the Montville-Haddam Neck line, three logic units will be required at Montville. The three independent logic packages will supply information to the Millstone logic packages via an independent transfer tone transmitter.

Since the operation of the generation rejection scheme should take place in less than 12 cycles to maintain stability, all transmission line faults must be cleared at high speed. This will require the addition of high speed backup protection using permissive overreaching audio tone equipment on the Millstone-Manchester line and the Millstone-Southington line at both terminals.

With the Generation Rejection scheme in service, it will be permissible to operate with high Millstone Station output when any one of six critical transmission elements is out of service. As a member of NEPOOL and the NPCC, the Applicant will be required to comply with either of the following operability requirements with one line out of service:

1) Have SLOD fully operational, or

2) Reduce load to a total station output of 1200 MW within 4 hours.

These instructions will be documented as part of the Connecticut Valley Electric Exchange (CONVEX) operating instructions for the Millstone switchyard and will be regulated by CONVEX. To facilitate regulation, CONVEX is aware of the condition of all lines and the status of the SLOD scheme via an annunciator located at CONVEX (CONVEX is an operating division of NEPOOL).

The operability requirements specified above assures that, upon loss of a double circuit line with a third line out of service and generation in excess of 1200 MW, offstie power will be available for safe shutdown; maintaining system stability minimizes the probability of coincident loss of both offsite supplies. This is consistent with the requirements of GDC 17.

GDC 17 also requires that the probability of losing an offsite supply coincident with loss of the nuclear power unit be minimized. Because of the necessity for SLOD to complete its function within 12 cycles, SLOD trips Millstone Unit 3 by tripping the switchyard breakers instead of the generator breaker (this eliminates the extra time required for relay and communication channel operation in a transfer trip scheme). Under these conditions, station auxiliary loads high speed transfer to the reserve station service transformers, and the normal station service transformer (which is tripped when SLOD trips Unit 3) can be re-energized by closing a switchyard breaker. Therefore, both offsite supplies will be available to assure safe shutdown of the unit in accordance with GDC 17.

The SLOD scheme was manufactured to be a reliable unit. Each line is monitored by a logic package which utilizes redundant channels (2-out-of-3 logic) in case of a failure of one channel. Each logic package alarms in the event of a channel failure and triggers a SLOD trouble alarm in the Millstone Unit 1 control room and at CONVEX. Also, a failed channel causes arming of the logic, indicating the monitored system component to be out of service. Additionally, every eight (8) hours, the SLOD scheme automatically tests ~~the entire scheme including the logic package combinations that would result in a trip (functional test)~~. In the event of failure, a SLOD trouble alarm is actuated in the Millstone Unit 1 control room and at CONVEX. Upon receiving the SLOD trouble alarm, the operator will dispatch a person to the Millstone switchyard control house to evaluate the condition of the system. In the event that one line is out of service and the SLOD system is not operating in one hour, CONVEX will reduce station output to 1200 MW or below during the next three (3) hours. The continual channel surveillance and periodic (8-hours) functional tests that are run automatically, ensure conformance to the General Design Criteria 18.

→ one ~~each~~ channel, yielding a complete scheme verification once every twenty-four (24) hours.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB07 (197) DESCRIPTION AND ANALYSIS DEMONSTRATING COMPLIANCE WITH GDC 17 (8.2.2.6)

A system description and analysis sufficient to demonstrate compliance with GDC 17 has not been presented to Section 8.2 of the FSAR in accordance with the guidelines of Regulatory Guide 1.70. This item will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to revised FSAR section 8.2.2.

along with breaker failure relaying to provide redundant
protective relaying for the switchyard. 2.23

Two 125V dc batteries are located in the switchyard control 2.24
and relay enclosure for switchyard relaying and control.
Each battery has its own charger and dc distribution panel. 2.25
The redundant batteries and protective relaying systems are 2.26
physically and electrically separate. The essential ac 2.27
station service for the power circuit breaker pneumatic
supply units and the other switchyard requirements is 2.28
supplied from one of two separate sources.

2. The 345-kV system is protected from lightning and switching 2.31
surges by overhead electrostatic shield wires, surge
arrestors on main buses, and rod gaps on the disconnect 2.32
switches.

3. Primary and backup relaying is provided for each circuit 2.33
along with circuit breaker failure backup protection. These 2.34
provisions permit the following:

   a. Any circuit can be switched under normal or fault 2.36
   conditions without affecting another circuit.

   b. Any single circuit breaker can be isolated for 2.37
   maintenance without interrupting power or protection of
   any circuit.

   c. Short circuits on any section of a bus are isolated 2.38
   without interrupting service to any element other than
   those connected to the faulty bus section. 2.39

   d. The failure of any circuit breaker to trip initiates 2.40
   the automatic tripping of the adjacent breaker or
   breakers and thus may result in the loss of a line or 2.41
   generator for this contingency condition; however,
   power can be restored to the good element in less than 2.42
   1 hour by manually isolating the fault with appropriate
   disconnect switches. 2.43

Complete battery failure is considered highly unlikely since two 2.45
independent 125V dc battery systems are provided. Failure of a 2.46
single battery system results only in a momentary loss of one set of
protective relays until the DC is manually transferred to the other 2.47
battery. Therefore, no single failure could negate the effectiveness 2.48
of the relaying to clear a fault.

The Millstone design provides two immediate access offsite circuits 2.49
between the switchyard and the 4.16 KV Class IE buses. Within the 2.51 8.2.26
switchyard, the tie line terminations are separated electrically by
two circuit breakers so that a fault on one offsite supply circuit 2.52 PSE-7
along with a breaker failure will not cause the second offsite supply
to be lost. The tie lines are supported on dead end tower and the 2.53
second tie line circuit terminating on the reserve station service 2.54
separate structures with one circuit terminating at the main transformer

transformer dead end tower. The normal ~~reserve~~ station service transformers and the reserve station service transformers are located on opposite sides of the unit. The connection from the normal station service transformers and from the reserve station service transformers to the 4.16 KV Class IE buses is via physically separate and electrically independent under ground duct lines. The Figure 1.2-1 shows the tie line routes from the switchyard to the main/normal and to the reserve station service transformers. The Figure 1.2-2 shows the physical separation between the normal and the reserve station service transformers. Figure 8.3-7 Sheets 1 and 2 show the embedded conduit duct lines as they enter the redundant ~~switchyard~~ Switchgear rooms in the control building.

8.2.2.6 PSE-7

The control power for these buses is from different dc panels and batteries. The breakers in the Class IE buses (34C and 34D) are independently protected with separate relaying.

The offsite source that will normally be available immediately on a unit trip is from the main and normal station service transformers. This source is not lost on a unit trip because the generator breaker effects the disconnection of the unit from the grid leaving the main and normal station service transformers backfed from the switchyard. The second source of offsite power is available through a fast transfer to the reserve station service transformers. Testing the normal immediate access circuit during plant operation would be inappropriate as this would disconnect the unit from the grid. The fast transfer feature of the alternate immediate access offsite circuits will not be tested during plant power operation since it risks unnecessary plant trips. Immediate access is not required of a second offsite source, and for the Millstone 3 design, if the fast transfer is not successful the reserve station service transformers can be connected to the emergency buses by manual control switch operation in an acceptable time.

8.2.3.1 PSE-8

The automatic transfer of emergency 4.16 KV buses 34C (Train A) and 34D (Train B) from either the normal to the reserve station service transformer or the normal or reserve station transformer to the emergency generators will be tested prior to initial startup and during refueling shutdowns of the unit to prove the operability of the system. Therefore, appropriate testing and testability of the transfer of power upon loss of normal power satisfies the requirements of General Design Criterion 18, Inspection and Testing of Electric Power Systems.

Physical separation of the offsite power sources, switchyard protection, redundancy, and transmission system design based on load flow and stability analyses minimize the possibility of simultaneous failure of power sources (normal station service supply, reserve station service supply and standby ac emergency generators) in compliance with General Design Criterion No. 17 "Electric Power Systems."

The 345 kV transmission system supplying offsite power to Millstone is normally operated at 357 kV at Millstone. This system voltage is

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB08 (198) DESCRIPTION AND ANALYSIS DEMONSTRATING COMPLIANCE WITH GDC 18 (8.2.3.1)

A system description and analysis sufficient to demonstrate compliance with GDC 18 has not been presented in Section 8.2 of the FSAR in accordance with the guidelines of Regulatory Guide 1.70. This item will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to revised FSAR section 8.2.2.

transformer dead end tower. The normal reserve station service transformers and the reserve station service transformers are located on opposite sides of the unit. The connection from the normal station service transformers and from the reserve station service transformers to the 4.16 KV Class 1E buses is via physically separate and electrically independent under ground duct lines. The Figure 1.2-1 shows the tie line routes from the switchyard to the main/normal and to the reserve station service transformers. The Figure 1.2-2 shows the physical separation between the normal and the reserve station service transformers. Figure 8.3-7 Sheets 1 and 2 show the embedded conduit duct lines as they enter the redundant ~~switchyard~~ SWITCHGEAR rooms in the control building.

8.2.2.6
PSE-7

The control power for these buses is from different dc panels and batteries. The breakers in the Class IE buses (34C and 34D) are independently protected with separate relaying.

The offsite source that will normally be available immediately on a unit trip is from the main and normal station service transformers. This source is not lost on a unit trip because the generator breaker effects the disconnection of the unit from the grid leaving the main and normal station service transformers backfed from the switchyard. The second source of offsite power is available through a fast transfer to the reserve station service transformers. Testing the normal immediate access circuit during plant operation would be inappropriate as this would disconnect the unit from the grid. The fast transfer feature of the alternate immediate access offsite circuits will not be tested during plant power operation since it risks unnecessary plant trips. Immediate access is not required of a second offsite source, and for the Millstone 3 design, if the fast transfer is not successful the reserve station service transformers can be connected to the emergency buses by manual control switch operation in an acceptable time.

8.2.3.1
PSE-8

The automatic transfer of emergency 4.16 KV buses 34C (Train A) and 34D (Train B) from either the normal to the reserve station service transformer or the normal or reserve station transformer to the emergency generators will be tested prior to initial startup and during refueling shutdowns of the unit to prove the operability of the system. Therefore, appropriate testing and testability of the transfer of power upon loss of normal power satisfies the requirements of General Design Criterion 18, Inspection and Testing of Electric Power Systems.

Physical separation of the offsite power sources, switchyard protection, redundancy, and transmission system design based on load flow and stability analyses minimize the possibility of simultaneous failure of power sources (normal station service supply, reserve station service supply and standby ac emergency generators) in compliance with General Design Criterion No. 17 "Electric Power Systems."

The 345 kV transmission system supplying offsite power to Millstone is normally operated at 357 kV at Millstone. This system voltage is

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB09 (199) 430.3 POSITIVE STATEMENT OF COMPLIANCE WITH BTP PSB-1 (8.3.1.2)

Branch Technical Position PSB-1 has not been identified in Table 8.1-2 of the FSAR; thus, a positive statement as to compliance with staff guidelines has not been provided.

The applicant by amendment 3 to the FSAR stated that Branch Technical Position PSB-1 is currently under review and will be addressed in a future amendment to the FSAR. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.3 and revised FSAR table 8.1-2.

NRC Letter: May 3, 1983 1.9

Question No. Q430.3 (SRP Section 8.1) 1.12

Criterion 50 of Appendix A to 10CFR50, IEEE Standard 485, Regulatory 1.13
Guide 1.63 and Branch Technical Positions ICSB 4, PSB-1 and PSB-2 1.14
have not been identified in Table 8.1-2 of the FSAR; thus, a positive
statement as to compliance with these criteria and staff guidelines 1.15
has not been provided in the FSAR. Provide a statement of compliance 1.16
and justify areas of noncompliance.

Response: 1.17

Refer to revised FSAR Section 8.1, Table 8.1-2. Compliance will be 1.19
made with the guidelines of Branch Technical Position PSB-1 with
clarification of the individual positions stated in the responses to 1.20
NRC Questions 430.9, 430.10, and 430.11.

Note: (Revisions to 430.9, 10 and 11 are found after the responses to PSB 10, 11 and 12 respectively.)

TABLE 8.1-2 (Cont)

Criteria	Title	FSAR Section Applicability 8.1	8.2*	8.3.1	8.3.2	Remarks
RG 1.108	Periodic Testing of Diesel Generators Used as Onsite Electric Power Stations at Nuclear Power Plants	X		X		See Section 1.8
RG 1.118	Periodic Testing of Electric Power for Protection System		X	X	X	See Section 1.8
RG 1.120	Fire Protection Guidelines for Nuclear Power Plants	X	X	X	X	See Section 1.8
RG 1.128	Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants	X			X	See Section 1.8
RG 1.129	Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants	X			X	See Section 1.8
RG 1.131	Qualification Tests of Electric Cables, Field Splices, and Connections for Light Water-Cooled Nuclear Power Plants	X		X	X	See Section 1.8
5. Branch Technical Positions (BTP) EICSB						
BTP ICSB 1(PSB) - Rev. 1	Backfitting of the Protection and Emergency Power Systems of Nuclear Reactors	X		X	X	
BTP ICSB 2(PSB) - Rev. 1	Diesel Generator Reliability Qualification Testing	X		X		
BTP ICSB 4(PSB) - Rev. 1	Requirements on Motor-Operated Valves in the ECCS Accumulator Lines					See Section 7.6.4
BTP ICSB 8 (PSB) - Rev. 1	Use of Diesel Generator Sets for Peaking	X		X		
BTP ICSB 11(PSB) - Rev. 1	Stability of Offsite Power Systems	X	X			
BTP ICSB 15(PSB) - Rev. 1	Reactor Coolant Pump Breaker Qualification	X	X	X		
BTP ICSB 17(PSB) - Rev. 1	Diesel Generator Protective Trip Circuit Bypasses	X		X		
BTP ICSB 18(PSB) - Rev. 1	Application of the Single Failure Criterion to Manually-Controlled Electrically-Operated Valves	X		X		
BTP ICSB 21(PSB) - Rev. 1	Guidance for Application of Reg. Guide 1.47	X	X	X	X	
BTP PSB 2	Criteria for Alarms and Indications Associated with Diesel Generator Unit Bypassed and Inoperable Status	X		X		

420.3

TABLE 8.1-2 (Cont)

Criteria	Title	FSAR Section Applicability 8.1	8.2*	8.3.1	8.3.2	Remarks
BTP PSB 1	Adequacy of Station Electric Distribution System Voltages	X		X		
6. American National Standards Institute (ANSI)**						
ANSI C37	Power Switchgear	X		X	X	
ANSI C50	Rotating Electrical Machinery	X		X		
ANSI C57	Transformer, Regulators, and Reactors	X		X		
7. Insulated Cable Engineers Association (ICEA)**						
ICEA P-46-426	Power Cable Ampacities	X	X	X	X	
ICEA P-54-440	Standard Publication "Ampacities-Cables in Open Top Trays"	X	X	X	X	
ICEA S-61-402	Thermoplastic - Insulated Thermoplastic - Jacketed Cables	X	X	X	X	
ICEA S-68-516	Ozone Resistant Ethylene Propylene Rubber Insulation	X	X	X	X	
ICEA S-66-524	Crosslinked Thermosetting Polylene Cables	X	X	X	X	
ICEA S-19-81	Applicable Test Power Cable Insulation and Jacket	X	X	X	X	
ICEA S-67-401	Metallic and Associated Coverings for Impregnated-Paper - Insulated Cables	X	X	X	X	
ICEA S-56-434	Polyethylene-Insulated Thermoplastic Jacketed Cables	X	X	X	X	
8. National Electrical Manufacturers Association (NEMA)						
NEMA AB-1	Molded Case Circuit Breakers	X		X	X	
NEMA AB-2	Procedure for Verifying Performance of Molded Case Circuit Breakers	X		X	X	
NEMA EI2	Instrument Transformers	X		X		
NEMA FU1	Low-Voltage Cartridge Fuses,	X		X	X	
NEMA ICS	Industrial Controls, and Systems	X		X	X	
NEMA PB-1	Panelboards	X		X	X	
NEMA PB-2	Dead-Front Distribution Switchboards	X		X	X	

TABLE 8.1-2 (Cont)

Criteria	Title	FSAR Section Applicability 8.1	8.2*	8.3.1	8.3.2	Remarks
NEMA PV-5	Constant-Potential Type Electric Utility (Semiconductor Static Converter) Battery Chargers	X			X	
NEMA SG3	Low Voltage Power Circuit Breakers	X		X		
NEMA SG4	AC High Voltage Power Circuit Breaker	X		X		
NEMA SG5	Power Switchgear Assemblies	X		X		
NEMA SG6	Power Switching Equipment	X		X		
NEMA TR-1	Transformers, Regulators, and Reactors	X		X		
NEMA MG1	Motors and Generators	X		X	X	
NEMA WC5	Thermoplastic - Insulated Wire and Cable	X	X	X	X	
NEMA VE-1	Cable Tray Systems	X				
9. Miscellaneous**						
MIL C-17	Coaxial Cable	X		X	X	
NFPA No. 70	National Electric Code	X	X	X	X	
NFPA No. 78	Lightning Protection Code	X	X	X		
UL Standard 96A	Installation Requirements - Master Labeled Lightning Protection System	X	X	X		

NOTES:

* The preferred power system is not a Class 1E system and is designed as a normal system based on good engineering practice and experience. The intent is to consider, where applicable, non-Class 1E systems, the GDC, I^EE Standards, Regulatory Guides, and Branch Technical Positions as indicated

** The issue, including Addenda, in effect on the date of the Request for Proposal for purchase of the specific equipment

TABLE 1.9-1 (Cont)

SRP Section	Specific SRP Acceptance Criteria	Summary Description of Difference	Corresponding FSAR Section	
7.2 (Rev. 2)	BTP ICSB 26 - Sensor qualification.	Sensors for reactor trip on turbine trip when power level is 50% or more are not seismically qualified.	7.2.1.1.2	
7.5 (Rev. 2)	III.6 - NUREG-0696 compliance.	The Safety Parameter Display System, and the Emergency Response Facilities are not discussed.	7.5.3	
8.3.1 (Rev. 2)	II.4.f - Compliance to NUREG/CR-0660.	NUREG/CR-0660 is not addressed.	8.3.1	
~~BTP PSB-1 (Rev. 0) (Section 8.3)~~	~~Adequacy of station electric distribution system voltages.~~	~~FSAR does not provide a discussion of compliance with this BTP.~~	~~8.3~~	430.3
9.1.2 (Rev. 3)	III.2.e - Evaluation of lighter load drops at maximum heights.	This evaluation has not been performed.	9.1.2.3	
9.1.3 (Rev. 1)	II.1.d (4) - BTP ASB 9-2, decay heat removal.	Decay heat removal is based on Westinghouse generated curves, not BTP ASB 9-2.	9.1.3.2	
9.1.4 (Rev. 2)	III.6 - Evaluation of lighter loads drops at maximum heights.	This evaluation has not been performed.	9.1.4.1	
9.2.1 (Rev. 2)	III.3.d - Location of radiation monitors.	No manual valve in series with motor operated valve.	9.2.1	
9.2.2 (Rev. 1)	II.3.e - Loss of coolant test for reactor coolant pumps.	Reactor coolant pumps have not been tested for the 20-minute time requirement.	9.2.2	
9.4.1 (Rev. 2)	II.4 - Compliance to Regulatory Guide 1.95.	The control room pressurization system and the chlorine detectors are not Seismic Cat. I.	9.4.1.3	

410.21

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB10 (200) 430.9 DESCRIPTION OF COMPLIANCE WITH POSITION 1 OF BTP PSB-1 (8.3.1.3)

Section 8.3.1.1.4 of the FSAR indicates that a degraded voltage scheme with two-out-of-four logic is provided on each of the 4.16 kv Class IE buses. The applicant was requested to provide reference to electric schematic drawings that describe the degraded voltage scheme and provide a description, with voltage and time setpoints, to indicate how the Millstone design complies with the guidelines of position 1 of branch technical position PSB-1 (NUREG-0800 Appendix 8A).

The applicant in response provided the requested references to electric schematic drawings and indicated that compliance of the design with position 1 of the branch technical position was currently under review and will be addressed in a future amendment. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to revised response to question no. 430.9.

NRC Letter: May 3, 1983

Question No. Q430.9 (SRP Section 8.3.1, Appendix 8A)

Section 8.3.1.1.4 of the FSAR indicates that a degraded voltage scheme with two-out-of-four logic is provided on each of the 4.16 kV Class 1E buses. Provide reference to electric schematic drawings that describe the degraded voltage scheme and provide a description, with voltage and time setpoints, to indicate how the Millstone design complies with the guidelines of position 1 of Branch Technical Position PSB-1 (NUREG-0800, Appendix 8A) and provide justification for any deviations.

Response:

The degraded voltage scheme with two-out-of-four logic provided for each 4.16 kV Class 1E bus is described in the following drawings, and logic and elementary diagrams (refer to FSAR Section 1.7):

<u>One Line Drawings</u>

12179-EE-1K
12179-EE-1M

<u>Logic Diagrams</u>

12179-LSK-24-3C,D,H,J,K
12179-LSK-24-4A,B

<u>Elementary Diagrams</u>

12179-ESK-5BD,BE,BF,BG
12179-ESK-7J,L

The second level of protection is in addition to the undervoltage scheme which also employs a two-out-of-four coincidence logic to prevent spurious trips of the offsite power source. Two separate time delays are incorporated in the degraded voltage scheme. The first time delay establishes the existence of a sustained degraded voltage on the bus. Following the delay, an alarm in the control room alerts the operator to the degraded condition. The subsequent occurrence of an accident signal (SIS or CDA) will immediately separate the Class 1E distribution system from the offsite power system. The second time delay is of a limited duration such that the permanent connected Class 1E loads will not be damaged. Following the delay, if the operator has failed to restore adequate voltages, the Class 1E distribution system is automatically separated from the offsite power system. No bypasses are incorporated in the scheme.

The Class 1E voltage sensors are physically loaded and electrically connected to the Class 1E switchgear. Test and calibration of the voltage sensors during power operation can be performed on an individual relay basis.

PSB-10

The Technical Specification will include limiting condition for operation, Surveillance Requirements, trip setpoint with minimum and maximum limits, and allowable values for the second-level voltage protection sensors and associated time delay devices.

PSB-10

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB11 (201) 430.10 AUTO. RESET OF THE LOAD SEQUENCER ON LOW VOLTAGE (8.3.1.4)

As stated in Section 8.3.1.1.3 of the FSAR, the emergency generator load sequencer (EGLS) has the capability to automatically reset during a sustained low voltage condition on the essential bus. It is the staff concern that this capability may unnecessarily delay the connection of the required mitigating loads within the times allowed by the accident analysis.

The applicant by amendment 3 revised the FSAR to indicate that automatic reset occurs only when there is a loss of offsite power subsequent to an accident signal. Based on the revision to the FSAR it appears that the load sequencer is used to sequence loads on either onsite and offsite power subsequent to an accident signal. Based on the revision to the FSAR it appears that the load sequencer is used to sequence loads on either onsite and offsite power sources when there is an accident signal. This use of the load sequencer contradicts FSAR section 8.3.1.1.3 which states that the load sequencer is used only to sequence loads onto power source. Clarification of this time will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.10.

NRC Letter: May 3, 1983 1.8

Question No. Q430.10 (SRP Section 8.3.1, Appendix 8A) 1.11

As stated in Section 8.3.1.1.3 of the FSAR, the emergency generator 1.12
load sequencers (EGLS) have the capability to automatically reset 1.13
during a sustained low voltage condition on the essential bus. It is 1.14
the staff concern that this capability may unnecessarily delay the
connection of the required mitigating loads within the times allowed 1.15
by the accident analysis. Address the staff concern, describe the 1.16
design of the EGLS for automatic reset during sustained low voltage
conditions, and describe how the design meets position 2 of Branch 1.17
Technical Position PSB-1 (NUREG-0800, Appendix 8A) and justify areas 1.18
of noncompliance with postion 2.

Response: 1.19

Refer to revised FSAR Section 8.3.1.1.3, Item 1, starting and 1.20
loading, for clarification of the use of the emergency generator load 1.21
sequencer relative to the containment recirculation pumps. In 1.22
addition, refer to FSAR Section 6.2.2.2, containment recirculation
system, for the accident analysis relative to the containment 1.23
recirculation pumps.

Refer to revised FSAR Section 8.3.1.1.3, Item 1, Starting and 1.24
Loading, for the conditions under which the EGLS will automatically 1.25
reset.

The design of the load sequencer complies with Position 2 of Branch 1.26
Technical Position PSB-1. The Class 1E Bus load standing scheme is 1.27
provided via the emergency generator load sequencer. The 1.28
requirements for automatically preventing load shedding during
sequencing of the emergency loads to the bus and of reinstating the 1.29
load shedding scheme upon completion of the load sequencing action is
inherent in the emergency generator load sequencer design. The 1.31
Technical Specifications will include a test requirement to
demonstrate the operability of the emergency generator load sequencer 1.32
at least once every 18 months during shutdown.

1. Starting and Loading - The emergency generators are started 3.42
on loss of power (LOP) to the respective 4.16 kV bus to 3.43
which each generator is connected, by a safety injection 3.44
signal (SIS), by a containment depressurization accident
signal (CDA), or manually. If the normal and alternate 3.45
offsite power sources are not available, the emergency 3.46
generators are then automatically connected to the 4.16 kV
emergency buses and sequentially loaded.

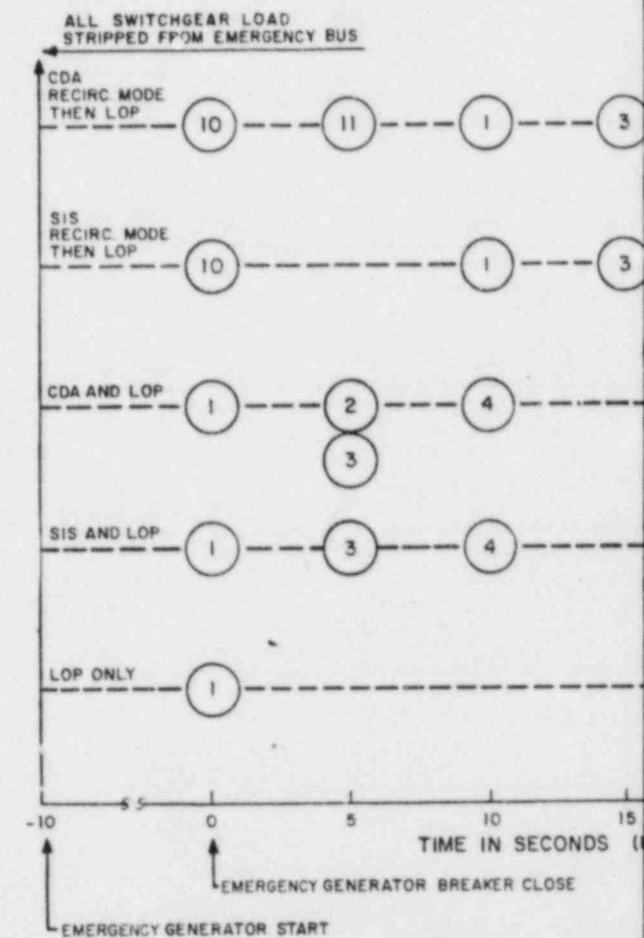
Upon receiving an automatic start signal, the emergency ac 3.48
power sources are capable of starting automatically without 3.50
local attendance. They are accelerated to rated speed, 3.51
frequency and voltage within 10 seconds, and are ready to 3.53
accept load in accordance with the unit's sequential loading
schedule. 3.54

The capacity of one emergency generator is sufficent to meet 3.56
the engineered safety features demand caused by the range of 3.57
incidences shown in Table 8.3-1. The emergency generator 3.58
loading sequence for the above shutdown condition is also 3.59
stated in Table 8.3-1. The loading sequence prevents system 3.60
instability during motor starting. A fast responding 4.2
exciter and a voltage regulator ensure quick voltage 4.3
recovery after any load step. Each emergency generator unit 4.4
has two start control circuits.

Sequential loading is achieved by an emergency generator 4.6
load sequencer (EGLS). The EGLS automatically performs the 4.8
functions of load shedding, load blocking, and sequential
load application under the conditions of LOP, SIS and LOP, 4.9
and CDA and LOP. Under the conditions of SIS without LOP 4.10
the EGLS does not introduce load shedding, load blocking, or 4.11
sequential load application into any of the control circuits 4.12
of the engineered safety features. Under the condition of 4.13
CDA without LOP, the EGLS delays the start of the
containment recirculation pumps but does not introduce load 4.14 430.10
sheddding, load blocking, or sequential load application 8
into the control circuits of any other engineered safety 4.15
feature. All EGLS interactions with the control circuits of 4.16
the engineered safety features are within the time intervals
allowed by the accident analysis. 4.17

During the first 40 seconds, the EGLS sequences initial 4.19
damage mitigating loads automatically. After the first 4.20
40 seconds, the manual start block signal is removed and
additional emergency bus loads may be started manually. 4.21
Typical loads manually started are the pressurizer heaters, 4.22
the fuel pool cooling pump, and turbine protection
equipment. 4.23

Under the condition of SIS without LOP or CDA without LOP, 4.25
the EGLS has the capability to automatically reset should a 4.26 430.10
LOP occur on the essential bus. LOP is initiated by either 4.28
of the schemes described in Section 8.3.1.1.4 under



NOTES:

□ = MANUALLY INITATED

○ = AUTOMATICALLY INITIATED

* = FURTHER LOADING ON SHEETS 2, 3, AND 4

(1) CHARGING PUMP 550 kW OR 403 kW

(2) QUENCH SPRAY PUMP 313 kW

(3) SAFETY INJECTION PUMP 346 kW OR 181 kW

[4] RHR PUMP 380 kW OR 200 kW OR 344 kW

(5)(5A) SERVICE WATER PUMPS 464 kW EACH

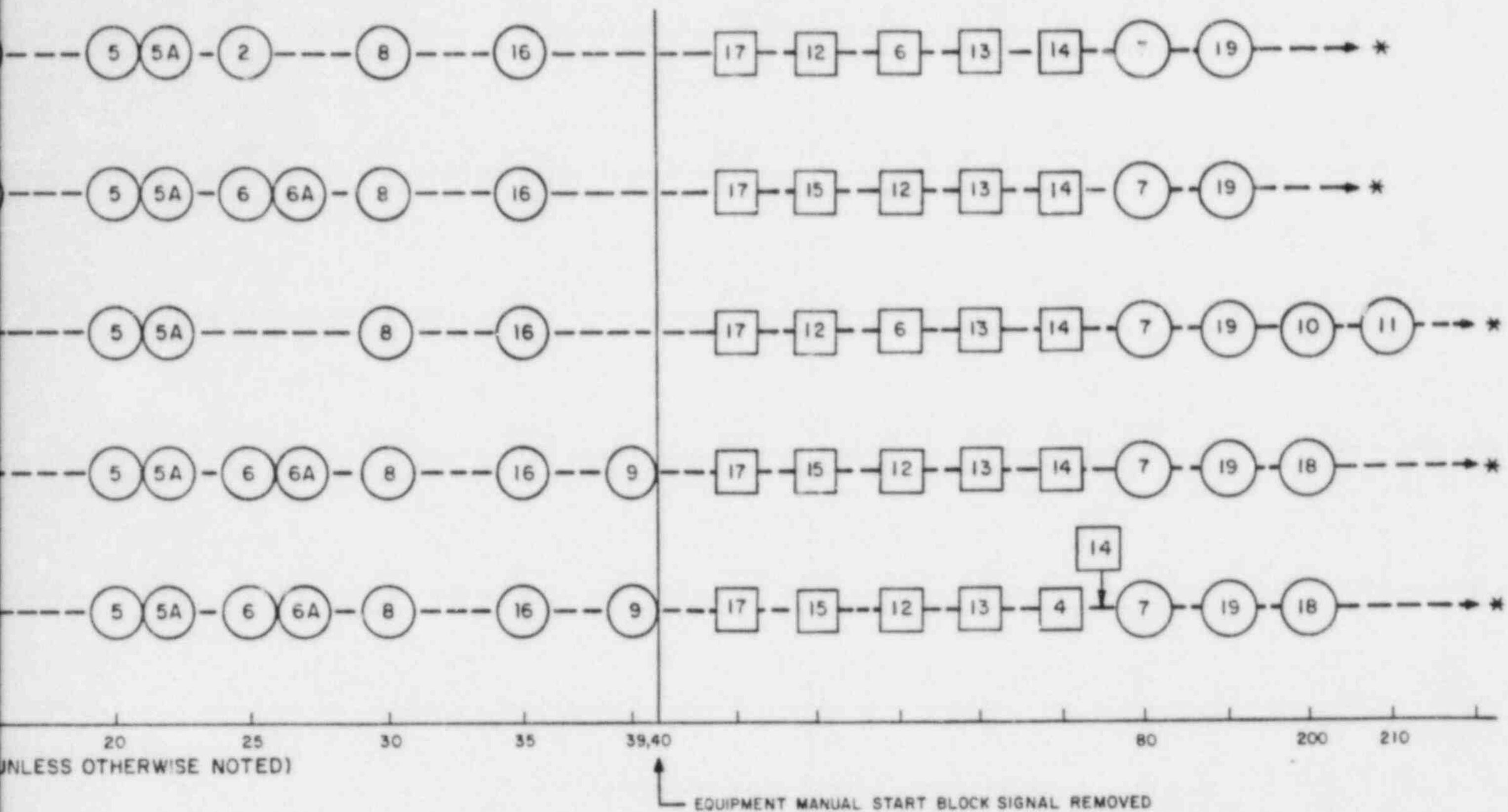
[6](6A) REACTOR PLANT COMPONENT WATER PUM 519 kW EACH

(7) CONTROL BUILDING CHILLER 226 kW

(8) AUXILIARY FEED PUMP 476 kW

(9) CONTAINMENT AIR RECIRCULA 197 kW

(10)(11) CONTAINMENT RECIRCULA 367 kW EACH



P

TION FAN

TION PUMP

[12] PRESSURIZER REHEATER 346 kW

[13] FUEL POOL COOLING PUMP 81 kW

[14] 3 EHS-MCC1A3 250 kW TRAIN A ONLY

[15] INSTRUMENT AIR COMPRESSOR 164 kW TRAIN B ONLY

(16) AUXILIARY BUILDING FILTER SYSTEM 180 + 56 kW

[17] FUEL BUILDING FILTER SYSTEM 150 + 118 kW

(18) CONTROL ROD DRIVE MECHANISM COOLING FAN, 162 kW

(19) INST RACK AIR CONDITIONING UNIT 62 kW

TABLE 8.3-1
EMERGENCY GENERATOR LOADING

(SHEET 1 OF 4)

AMENDMENT 8 MAY 1984

TI APERTURE CARD

Also Available On Aperture Card

8406220248-01

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB12 (202) 430.11 ADEQUACY OF STATION ELECTRIC DIST. SYS. VOLTAGE (8.3.1.5)

It is the staff position that the voltage levels at the safety-related loads should be optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources. The applicant was requested to (1) perform a voltage analysis and verification by actual measurement in accordance with the guidelines of positions 3 and 4 of branch technical position PSB-1 (NUREG-0800, Appendix 8A) and (2) provide the voltage at the terminals of each Class IE load as determined by analysis for all modes of plant operation.

By amendment 3 to the FSAR, the applicant indicated that this item is currently under review and will be addressed in a future amendment to the FSAR. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.11.

NRC Letter: May 3, 1983

Question No. Q430.11 (SRP Section 8.3.1, Appendix 8A)

The voltage levels at the safety related loads should be optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources. Perform a voltage analysis and verification by actual measurement in accordance with the guidelines of positions 3 and 4 of Branch Technical Position PSB-1 (NUREG-0800, Appendix 8A). Provide the voltage at the terminals of each Class 1E load as determined by analysis and by actual measurement for all modes of plant operation. Verify that all Class 1E loads will operate at or within design voltage limits under all conditions of operation. Where terminal voltage determined by analysis is not adequate to meet the design voltage rating of the equipment, provide justification.

Response:

The analysis will consider steady-state and transient loads on all Class 1E ac distribution buses for all modes of plant operation and accident conditions with the offsite power sources at minimum and maximum anticipated voltage and only the offsite source being considered available.

PSB 12

Testing to verify the analyses will be performed on one of the offsite power sources because testing on both offsite sources doubles the time required to perform the test without improving the level of confidence in validity of the analytical model. If the mode is accurate for one configuration, it will be accurate for all configurations provided the input data is correct and the input data will be verified via the independent technical review. The 120/208 V buses fed from regulated supplies will not be tested because the bus voltage remains nearly constant for wide variations in supply voltage to the regulating device. Since this application cannot be modified modeled in the analysis, testing of the regulated buses under the test will not be necessary.

Voltage and bus loading levels will be recorded under steady-state conditions. Voltage levels will also be recorded during the starting of both a large Class 1E and non-Class 1E motor (not concurrently). The test values, when compared with the analytical values, will be used to verify the analytical model. Tap settings of intervening transformers will be selected to ensure that the steady-state terminal voltage of Class 1E 460 V and 4 kV motors will be in the range of 414 to 506 V and 3600 to 4400 V respectively, during all modes of plant operation and accident conditions. The analysis will ensure that start voltages remain above the start capability of all Class 1E loads. The above satisfies the intent of Positions 3 and 4 of Branch Technical Position PSB-1.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB13 (203) 430.12 RELIABILITY OF THE LOAD SEQUENCER (8.3.1.6)

With respect to the use of a solid-state load sequencer at Millstone Unit 3, the applicant was requested to provide the results of a reliability analysis that demonstrates that overall reliability, availability, or capability of onsite and offsite power sources to supply power to safety loads on demand has not been significantly reduced by the use of solid state load sequencers.

By amendment 3 to the FSAR, the applicant indicated that their response would be submitted at a later date. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no 430.12.

NRC Question No. Q430.12 (SRP Section 8.3.1)

"Provide the results of a reliability analysis for the solid state load sequencer that demonstrates the overall reliability or capability of the onsite power system to supply power to safety loads on demand has not been significantly reduced by the use of solid state load sequencers."

Response:

The use of solid state load sequencers produces an insignificant effect on the capability of the onsite power system to supply power to safety loads on demand. This conclusion can be drawn by examining the results of section 2.3.3.4 in the Millstone 3 Probabilistic Safety Study (PSS). As part of the study, a reliability analysis was performed for the ~~solid state~~ emergency generator load sequencer (EGLS) system using fault tree models.

Results of the fault tree analysis show that each of the two redundant EGLS trains has an unavailability of 9.25×10^{-4} per demand. Unavailability, in this case, is defined as the probability that a particular EGLS train will not successfully load its safety loads onto the corresponding emergency onsite power supply. For each EGLS train, approximately 90% of the total unavailability is due to components other than solid state devices. The percent contribution by component type is shown below:

a)	Relay failures	45%
b)	Power supply failures	27%
c)	Circuit breaker failures	11%
d)	Solid state device failures	10%
e)	Push button switch failures	6%
f)	Fuse failures	1%

The reason that solid state devices are negligible contributors to EGLS unavailability is that an automatic test of most of the solid state logic is performed on a continuing basis. The automatic test sequence is performed at intervals of 30 seconds and does not contribute to system unavailability. Any failures detected during the autotest sequence will produce an audible alarm in the control room which requires operator response. The affected EGLS train displays the number of the test state in which the failure occurred, allowing the operator to quickly diagnose the problem.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB14 (204) 430.13 DIESEL GENERATOR PROTECTIVE RELAYING (8.3.1.7)

Section 8.3.1.1.3 of the FSAR indicates that diesel generator protective relaying is bypassed under accident condition in accordance with branch technical position ICSB 17. The applicant by amendment 3 to the FSAR, provided drawing reference numbers that describe the design of the bypass circuitry, the 2-out-of-3 logic circuitry, and relaying that is not bypassed under accident conditions. The drawings will be reviewed with the applicant either prior to or during the staffs confirmation drawing review. The results of the staff review will be reported in a supplement to this report.

Response:

This item ~~will be~~ was discussed during ~~the~~ a Branch meeting with PSB (electrical) and subsequently closed.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB15 (205) 430.14 COMPLIANCE WITH POSITION 4 OF REGULATORY GUIDE 1.9 (8.3.1.8)

Section 8.1.7 of the FSAR indicates that the diesel generator voltage (prior to connection of the first load block) may drop below the 75 percent minimum level permitted by position 4 of Regulatory Guide 1.9 (Revision 2).

The applicant by amendment 3 to the FSAR provided the following justification for the momentary voltage dip. The voltage dip to levels below 75 percent is considered inconsequential to the successful loading of the standby generator unit. The basis for this voltage dip being considered inconsequential, the magnitude of the voltage dip, available design margins, and the effect on loads will be pursued in a supplement to this report.

Response:

Refer to the revised response to question no. 430.14.

NRC Letter: May 3, 1983

Question No. Q430.14 (SRP Section 8.3.1)

Section 8.1.7 of the FSAR indicates that the diesel generator voltage (prior to connection of the first load block) may drop below the 75 percent minimum level permitted by position 4 of Regulatory Guide 1.9 (Revision 2). Provide justification for this exception to Regulatory Guide 1.9 and correct inconsistency between statements of compliance found in Sections 1.8 and 8.3.1.2.6 of the FSAR.

Response:

Refer to revised FSAR Table 1.8-1 and revised FSAR Section 8.3.1.2.6.

The magnitude of the voltage dip will be different for each of the three phases since the peak inrush current is dependent upon the instantaneous voltage at the time the circuit is closed. The magnitude will also be different each time the transformers are energized because the instantaneous voltage can be expected to be different and the residual flux in the transformer cores will be different.

The magnitude of the voltage dip due to transformer exciting current is of little consequence because of its transient nature. It does not require long-term regulator corrections because it is self canceling. It will not be of sufficient duration to cause the pick up of instantaneous overcurrent relays, and at the MCC level it will not last through contactor pickup.

It is important to recognize that the voltage requirement of Regulatory Guide 1.9 is intended to ensure that engineered safety feature and emergency shutdown motors have power of sufficient quality to allow them to start and remain running during the loading sequence. The voltage dip caused by the load center transformer inrush current occurs and is restored before the first block of load is applied. Once the 4.16 kV and 480 V buses have been energized in preparation for loading, the emergency diesel generator output voltage and frequency remain within the limits specified in Regulatory Guide 1.9, Section C.4 throughout the loading sequence.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB16 (206) 430.18 DIESEL GENERATOR TESTING AT 2000 HOUR RATING (8.3.1.10)

Section 1.8 of the FSAR indicates that the Millstone design does not comply with position C2(a)3 of Regulatory Guide 1.108. It appeared that the full load carrying capability of the diesel generator may not be tested for the 2000 hour rating.

The applicant by amendment 3 revised the FSAR to state that the diesel generator will be tested at the 2000 hour rating for 22 hours. The applicant also defined the 2000 hour rating to be 5335 kw and the maximum rating at which the diesel generator can be operated. Based on the applicant's response, the staff concludes that the 2000 hour rating is being used as the continuous rating of the diesel generator and that the diesel generator is being tested accordingly. Thus, the 2 hour overload test also required by position C2(a)3 of Regulatory Guide 1.108 should be greater than the 2000 hour rating of the diesel generator. Generally, the 2 hour rating is 10 percent greater than the continuous rating.

Testing of the diesel at the 2 hour rating will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no 430.16 and 430.18.

NRC Letter: May 3, 1983 1.8

Question No. Q430.16 (SRP Section 8.3.1) 1.11

Section 1.8 of the FSAR indicates that the Millstone design does not 1.12
comply with position C2(a)4 of Regulatory Guide 1.108. The Applicant 1.14
has implied that the diesel generator load shedding test will be
conducted using the 2,000 hour rating for rejection of the single 1.15
largest load and the continuous rating for complete loss of load.
Justify use of continuous versus 2,000 hour rating for complete loss 1.16
of load.

Response: 1.17

~~Refer to FSAR Section 1.8, revised Table 1.8-1,~~ under ~~Regulatory~~ 1.18 X
~~Guide 1.108. Load rejection tests, both for loss of the largest~~ 1.19
~~single load as well as loss of full load, will be carried at the~~
~~continuous rating of the diesel generator.~~ 1.20

PSB 16

Refer to FSAR Section 1.8, revised Table 1.8-1, under Regulatory Guide 1.108. Also refer to FSAR Section 8.3, Table 8.3-1, sheets 2 through 4. This latter table indicates the worst case emergency diesel loading to be 4926 KW. The continuous rating of the diesel is 4986 KW. Since the continuous rating capability of the diesel is never realized under worst case conditions, load rejection tests done at the continuous rating (as opposed to the maximum service load) are conservative and comply with Regulatory Guide 1.108. The two load rejection tests (full load and largest single load) will therefore be carried out at the continuous rating of the diesel.

NRC Letter: May 3, 1983 1.8

Question No. Q430.18 (SRP Section 8.3.1) 1.11

Section 1.8 of the FSAR indicates that the Millstone design does not 1.12
comply with position C2(a)3 of Regulatory Guide 1.108. It appears 1.14
that the full load carrying capability of the diesel generator may
not be tested for the 2,000 hour rating. Justify not testing at the 1.16
2,000 hour rating and define the 2,000 hour rating of the diesel
generator at Millstone 3. 1.17

Response: 1.18

Refer to FSAR Section 1.8, revised Table 1.8-1, under Regulatory 1.19
Guide 1.108. Testing of the full load carrying capability of the 1.20
diesel will be done at the continuous rating (4986 kw) for 22 hours
and at 10 percent above the continuous rating for 2 hours. 1.21

The 2,000-hour rating is 5,335 kW and is the maximum rating at which 1.22
the emergency generator can be operated based on a 2,000-hour 1.23
maintenance interval.

TABLE 1.8-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference
1.108	Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants (Rev. 1, August 1977)	Comply, with the following clarifications and exceptions: Section C.2(a)2: Proper operation for design-accident-loading-sequence will be demonstrated under conditions as close to design as possible. (430.15, 430-16, 430-18) Section C.2(a)9: Comply as stated in the ERRATA dated September 1977.	8.3.1
1.109	Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I (Rev. 1, October 1977)	Comply	13.3.1
1.110	Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (Rev. 0, March 1976)	Comply	
1.111	Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors (Rev. 1, July 1977)	Comply	2.3.5.2.3

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB17 (207) 430.19 DIESEL GENERATOR LOAD ACCEPTANCE TEST AFTER OPERATION AT NO LOAD (8.3.1.11)

Section 7.4.2 of IEEE Standard 387-1977 requires, in part, that the load acceptance test consider the potential effects on load acceptance after prolonged no load or light load operation of the diesel generator. The applicant was requested to provide the results of load acceptance test or analysis that demonstrates the capability of the diesel generator to accept the design accident load sequence after prolonged no loads operation over the full range of ambient air temperatures that may exist at the diesel engine air intake.

In response the applicant, by amendment 3 to the FSAR, provided the results of a manufacturer analysis. Based on the analysis the staff concludes that the diesel generators have the capability to accept load after prolonged no load operation over the full range of ambient air temperatures. How this no load capability is considered in the load acceptance tests will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.19.

NRC Letter: May 3, 1983 1.8

Question No. Q430.19 (SRP Section 8.3.1) 1.11

Section 6.4.2 of IEEE Standard 387-1977 requires, in part, that the 1.12
load acceptance test consider the potential effects on load 1.13
acceptance after prolonged no load or light load operation of the
diesel generator. Provide the results of load acceptance tests or 1.14
analysis that demonstrates the capability of the diesel generator to
accept the design accident load sequence after prolonged no load 1.15
operation. This capability should be demonstrated over the full 1.16
range of ambient air temperatures that may exist at the diesel engine 1.17
air intake. If this capability cannot be demonstrated for minimum 1.18
ambient air temperature, conditions, describe design provision that 1.19
will assure an acceptable engine air intake temperature during no
load operation.

Response: 1.20

As indicated in FSAR Section 8.3.1.1.3, the emergency generator is 1.21
capable of operating for 24 hours at rated speed, no load, without 1.23
any deterioration in its load acceptance or load carrying capability.

Based on testing of a prototype machine, the emergency generator 1.24
manufacturer (Colt Industries) has performed an analysis and has 1.25
advised that the only limitation to prolonged (greater than 24 hours) 1.26
operation, at no load or light load (less than 20 percent of rated 1.27
load) with the combustion air ambient temperature range of -17°F to
102°F, is the accumulation of combustion and lubrication products in 1.28
the exhaust system.

The manufacturer recommends that the engine be run at above 1.29
50 percent load for at least one hour in each 24-hour period to 1.30
minimize the accumulations and has included statements to cover this
extended operation as indicated above in their operation instruction 1.31
manuals. Plant procedures have incorporated these recommendations. 1.32

Since required testing has demonstrated no problems with the 1.33
prototype machine, and precautions have been taken into account in 1.34
plant procedures, additional testing is unwarranted.

PSB 17

Colt Industries

Fairbanks Morse
Engine Division
701 Lawton Avenue
Beloit, Wisconsin 53511
608/364-4411

ROUTING

	ROOM
GRP	14 GP
JMC	JMC
DGF	

May 25, 1984

Northeast Utilities Service Company
P. O. Box 270
Hartford, CT 06141

Attention: Mr. Dominick Fontana

Subject: Millstone Unit #3
No Load Operation
Weather Watch Test
PC-2 Diesel Generator Sets

Gentlemen:

Colt Industries conducted a 24 hour, no load operation, weather watch test on a 12-cylinder PC-2 powered Diesel Generator Set during the Nuclear D.G. Set Demonstration conducted in our plant in 1971. An outline of this test is contained in "Fast Start Large Capacity Diesel Generators For Nuclear Plant Protection" which we have mailed to you.

Although not specifically mentioned in the technical paper, the unit was shutdown and thoroughly inspected at the completion of the test. There was no deleterious accumulation of lube oil or fuel oil in the engine as a result of the test.

We are aware of no conditions that would have prevented rated load operation after the test. No-load testing of the prototype was conducted to determine if any factors would prevent this full load acceptance, and none were found.

We trust this provides you with the information you need.

Very truly yours,

J. M. Moriarty
MANAGER UTILITY SALES

JMM:jc

cc: R. A. Dudley, Boston

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB18 (208) 430.22 DIESEL GENERATOR BYPASS & INOPERABLE STATUS INDICATION (8.3.1.13)

By amendment 3 to the FSAR, the applicant expanded Section 8.3.1.1.3 of the FSAR to describe control room status indicators for equipment which, when made inoperable, can render the diesel generator incapable of responding to an automatic start signal. It is the staff position, in accordance with position 2.2 of Branch Technical Position PSB-2, that all status indicators which indicate that the diesel generator is incapable of responding to an automatic start signal be sufficiently precise to prevent misinterpretation. This item will be pursued with the applicant and the results of the staff review will be presented in a supplement to this report.

Response:

Refer to the revised response to question no. 430.22.

NRC Letter: May 3, 1983

Question No. Q430.22 (SRP Section 8.3.1, Appendix 8A)

Section 8.3.1.1.3 of the FSAR describes the surveillance instrumentation provided to monitor the status of the diesel generator. Expand the FSAR to describe how the Millstone design complies with the guidelines of Branch Technical Position PSB-2 (NUREG-0800, Appendix 8A) and provide justification for any deviations.

Response:

Refer to revised FSAR Section 8.3.1.1.3.

The following is a discussion of compliance with the guidelines of Branch Technical Position PSB-2.

Position (2.1)

Emergency generator bypass or deliberately induced inoperability status is provided automatically in the control room for those conditions expected to occur more frequenctly than once a year and manually for those conditions expected to occur less frequently than once a year.

PSB 18

Position (2.2)

All status indication is sufficiently precise to prevent misinterpretation. Bypass or deliberately induced inoperability indication is separate from other indication. The arrangement is such that the operator can clearly determined the status of each emergency generator. Annunciation is provided in the control room and at the emergency generator; However, bypass or deliberately induced inoperability indication is not provided at the emergency generator. Sufficient information is provided to operate the emergency generator locally.

Position (2.3)

The emergency generators are not shared with the other units at the Millstone site.

Position (2.4)

The indication system is designed and installed in a manner that precludes adverse effects on the emergency generator. Failures in the indication equipment will not result in failure or bypass of the emergency generator. The bypass indication does not compromise the independence between the redundant emergency generators.

Position (2.5) 1.45

The indication system includes the capability of ensuring its 1.46
operable status during normal plant operation to the extent that 1.47
indicating (LAMP) and annunciating (HORN) functions can be verified.

The alarm system is provided with a first-out feature. The 6.18
following list shows the functions that are annunciated in
the control room.

a. Emergency Generator not Ready for Auto Start 6.21
b. Emergency Generator Auto Start 6.22
c. Emergency Generator Differential Relay 6.23
d. Emergency Generator Emergency Shutdown 6.24
e. Emergency Generator Overvoltage 6.25
f. Emergency Generator Underfrequency 6.26
g. Day Tank Fuel Oil Level Low-Low 6.27
h. Emergency Generator Breaker Auto Close Blocked 6.28
i. Emergency Generator Control - Local 6.29
j. Emergency Generator Local Panel-Trouble 6.30
k. Emergency Generator Overload 6.31
l. Emergency Generator Supply Auto Trip 6.32
m. Emergency Generator Neutral Auto Trip 6.33

Conditions which can deliberately render the diesel generator 6.36 430.22 8
inoperable are statused in the control room in accordance with Branch 6.37
Technical Position PSB-2 and Regulatory Guide 1.47. The following 6.38
are automatically indicated in the control room:

a. Emergency Generator Breaker Racked Out/Loss of DC 6.41
b. Emergency Generator Air Starting Air Compressor 6.42
Control Circuit Open 6.43
c. Emergency Generator Crankcase Vacuum Pump Control 6.46
Circuit Open 6.47 430.22
d. Emergency Generator DC Fuel Oil Pump Control Circuit 6.50
Open 6.51
e. Emergency Generator Remote Voltage Mode Switch in Manual 6.53
f. Emergency Generator Local Voltage Mode Switch in Manual 6.54

In addition, manual indication is provided for those conditions 6.57 430.22 8
expected to occur less frequently than once a year.

3. <u>Tests and Inspections</u> - Factory production tests were 6.59
performed on the diesel generator units by the manufacturer 6.60
at his facilities in accordance with the requirements of
IEEE 387. The testing included a program of the 7.1
manufacturer's standard commercial tests on the diesel
engine, generator, excitation system, controls, and 7.2 430.21
accessory/auxiliary equipment.

The qualification test program agrees with Position 5 of 7.4
Regulatory Guides 1.6, 1.9 and 1.108 as augmented by Branch 7.5
Technical Position ICSB 2 (Table 8.1-2) and consists of load 7.8
capability qualification, start and load acceptance
qualification, and margin qualification as follows:

a. Three hundred valid start and load tests were performed 7.11
at the factory on one unit. The start tests consisted 7.13
of 270 starts with the diesel generator unit initially
at warm standby temperature with at least 50 percent of 7.14

the continuous generator rating applied on reaching rated speed and voltage and continued operation until 7.17
temperature equilibrium was attained.

An additional 30 starts were performed with the diesel 7.18
generator unit initially at normal operating temperature and other conditions per above.

The emergency generator unit failure rate did not 7.20
exceed three failures during 300 valid start and load 7.21
tests.

b. Load carrying capability tests were performed to 7.24
demonstrate the ability of the diesel generator units to carry and reject loads in accordance with IEEE 387,
Section 6.3.1. 7.25

430.21

c. Two margin tests were performed at the factory on each 7.28
diesel generator unit demonstrating the start and load capability of each unit with a margin in excess of
design requirements. 7.29

The starting, accelerating, and loading capability of the 7.31
emergency generator were witnessed before the units were 7.32
accepted from the manufacturer.

Tests and inspections were performed in accordance with 7.34
Section 8.3.1.1.2 to ensure that all components were correct 7.35
and properly mounted, connections were correct, circuits 7.37
were continuous, and components were operational:

Tests of the diesel generator units during the 7.39
preoperational test program and at least once every
18 months consist of the following, as more fully described 7.41
by IEEE 387 and supplemented by Regulatory Guide 1.108:

430.21

a. Start test 7.44
b. Load acceptance tests 7.45
c. Rated load tests 7.46
d. Design load tests 7.47
e. Load rejection tests 7.48
f. Functional tests 7.49
g. Electrical tests 7.50
h. Fuel supply switching tests 7.51
i. Reliability tests 7.52
j. Subsystem tests 7.53

430.21

Availability and proper actions tests are performed to 7.56
verify that the safety related loads do not exceed the
emergency generator rating and that each emergency generator 7.57
is suitable for starting, accepting, and operating the
required loads. 7.58

Availability tests are performed monthly while the unit is 7.60
in operation, with only one diesel allowed to be tested at a 8.1
time. The tests consist of a manually initiated start of 8.2
the emergency generator, followed by manual synchronization 8.3
with the essential bus, and assumption of the load by the
emergency generator up to the nameplate rating. Normal 8.5
plant operation is not affected by this test.

Operational tests are performed at approximately 18-month 8.7
intervals, during reactor shutdown for refueling and consist 8.9
of emergency generator automatic starting, load shedding,
and sequential starting of load blocks initiated by a 8.10
simulated loss of offsite power signal together with a
simulated safety injection signal.

Testing of the circuits that initiate and control standby 8.12
power, including electrical protective relays, permissives, 8.14
bypasses, and control devices, is in accordance with the
basic requirements for protection systems consistent with 8.15
IEEE 279 and 338 (Table 8.1-2).

Each emergency generator is given a thorough periodic 8.17
inspection following the manufacturer's recommendation. 8.18

8.3.1.1.4 Design Criteria 8.21

The seismic qualification test program for demonstrating the 8.23
capability of Class 1E equipment to withstand the effects of a 8.24
seismic event in accordance with IEEE 344 as augmented by Branch 8.25
Technical Position ICSB 10, and Regulatory Guides 1.30 and 1.100 8.28
(Table 8.1-2) is discussed in Section 3.10.

The environmental qualification test program for demonstrating the 8.30
capability of Class 1E equipment to function throughout its qualified 8.31
life in accordance with IEEE 323 as augmented by Regulatory
Guide 1.89 and interpreted by NUREG-0588 is discussed in 8.32
Section 3.11.

1. Interrupting Capacity - The generator breaker, switchgear, 8.35
load centers, motor control centers, and distribution panels 8.37
are sized for interrupting capacity based on maximum short 8.38
circuit availability at their location. Switchgear is 8.41
applied within its interrupting and latch ratings in 8.42
accordance with ANSI C37.010, "Application Guide for AC High 8.43
Voltage Circuit Breakers." The calculations to document 8.44
this application take into account the fault contributions 8.45
of all rotating machines in addition to the system 8.46
contribution at the point of fault. Source impedances are 8.48
kept low enough to ensure adequate starting voltage for all 8.49
motors. Load center transformer impedance is selected to 8.50
limit short circuit currents at load center buses and motor 8.52
control center buses. Low voltage metal enclosed breakers 8.53
at load centers and molded case breakers at motor control 8.54

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB19 (209) 430.41 DESIGN & QUALIFICATION OF DC SYSTEM LOADS FOR VOLTAGE VARIATIONS (8.3.2.1)

Loads connected to the dc bus may be subject to voltage variations from 90 to 143 volts due to battery discharge and equalizing charge. It is the staff position that dc loads be designed and qualified to operate when subject to these voltage variations.

The applicant in response to this position indicated by amendment 3 to the FSAR that a description as to their extent of compliance would be provided at a later date. This item will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Amendment 4 to the FSAR revised the battery terminal design voltage variation from 90-143V DC to 105-139.8V DC. The DC components are specified to operate between 90 and 140V DC. This should resolve this topic with no further action required.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB20 (210) 430.43 DC SYSTEM MONITORING ANNUNCIATION (8.3.2.2)

The specific requirements for dc power system monitoring derive from the generic requirements in Section 5.3.2(4), 5.3.3(5), and 4.3.4(5) of IEEE 308-1974, and in RG 1.47, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems." In summary, these general requirements state that the dc system (batteries, distribution systems, and chargers) shall be monitored to the extent that it is shown to be ready to perform its intended function.

It is the staff position that the following indications and alarms of the Class 1E direct current power system status shall be provided in the control room:

-battery float charge (ammeter)
-battery circuit output current (ammeter)
-battery charger output current (ammeter)
-dc bus voltage (voltmeter)
-battery discharge alarm
-dc bus overvoltage alarm
-dc system ground alarm
-battery disconnect open alarm
-battery charger disconnect open alarm
-battery charger failure alarm (one alarm for a number of abnormal conditions which are usually indicated locally)

The staff has concluded that the above-cited monitoring, augmented by the periodic test and surveillance requirements that are included in the Technical Specifications, provide reasonable assurance that the Class 1E dc power system is ready to perform its intended safety function.

By amendment 3 to the FSAR the applicant has indicated that battery float charge (ammeter), battery charger output current (ammeter), battery discharge alarm, and battery disconnect open alarm have not been provided in the control room. This lack of monitoring will be pursued with the applicant and the results of the staff review will be reported in a supplement to this request.

Response:

Refer to the revised response to question no. 430.43.

NRC Letter: May 3, 1983 1.8

Question No. Q430.43 (SRP Section 8.3.2) 1.11

The specific requirements for dc power system monitoring derive from 1.12
the generic requirements in Sections 5.3.2(4), 5.3.3(5), and 5.3.4(5) 1.13
of IEEE 308-1974, and in RG 1.47, "Bypassed and Inoperable Status
Indication for Nuclear Power Plant Safety Systems." In summary, 1.15
these general requirements state that the dc system (batteries,
distribution systems, and chargers) shall be monitored to the extent 1.16
that it is shown to be ready to perform its intended function.

It is the staff position that the following indications and alarms of 1.17
the Class 1E direct current power system status shall be provided in 1.18
the control room:

- Battery float charge (ammeter) 1.20
- Battery circuit output current (ammeter) 1.21
- Battery charger output current (ammeter) 1.22
- Dc bus voltage (voltmeter) 1.23
- Battery discharge alarm 1.24
- Dc bus overvoltage alarm 1.25
- Dc system ground alarm 1.26
- Battery disconnect open alarm 1.27
- Battery charger disconnect open alarm 1.28
- Battery charger failure alarm (one alarm for a number of 1.29
  abnormal conditions which are usually indicated locally)

The staff has concluded that the above-cited monitoring, augmented by 1.31
the periodic test and surveillance requirements that are included in 1.32
the Technical Specifications, provide reasonable assurance that the
Class 1E dc power system is ready to perform its intended safety 1.33
function.

Describe the extent to which the above staff position is followed and 1.34
justify areas of noncompliance.

Response: 1.35

The dc power system monitoring, augmented by the periodic test and 1.36
surveillance requirements included in the Technical Specifications 1.37
(FSAR Chapter 16), provides assurance that the Class 1E dc power
system is ready to perform its intended function. The dc power 1.40
system is monitored in the following manner:

1. Battery Float Charge

Battery breaker position indication is provided in the control room. This indication coupled with the absence of the dc bus low voltage alarm (i.e., bus voltage above 125 V) provides sufficient information to determine that a battery is on float charge. Dc bus low voltage alarm is provided in the control room.

Battery float charge indication can be obtained by use of jacks placed across ammeter shunt in battery leads located at the distribution switchboard.

2. Battery Circuit Output Current

Battery circuit output ammeters are provided in the control room.

3. Battery Charger Output Current

Indication provided from Item 5 (specifically no battery discharge) coupled with the absence of the dc bus low voltage alarm (i.e., bus voltage above 125 V) provides sufficient information to determine that the battery charger and not the battery is powering the associated dc loads. Battery charger output current is indicated locally at the battery charger.

4. Dc Bus Voltage

Dc bus voltmeters are provided in the control room.

5. Battery Discharge Alarm

Battery discharge indication (ammeter and undervoltage alarm) is provided in the control room.

6. Dc Bus Overvoltage Alarm

Indication provided from Item 10 provides sufficient information to determine an overvoltage condition.

7. Dc System Ground Alarm

Dc system ground alarms are provided in the control room.

8. Battery Disconnect Open Alarm

There is no battery disconnect switch local to the battery; there is a battery breaker located at the distribution switchboard.

Battery breaker position indication is provided in the control room.

9. <u>Battery Charger Disconnect Open Alarm</u>

Indication provided from Item 5, coupled with the dc bus low voltage alarm (i.e., bus voltage below 125 V), provides sufficient information to determine that the battery and not the battery charger is powering the associated dc loads.

10. <u>Battery Charger Failure Alarm</u>

Battery charger trouble alarms are provided in the control room. The individual abnormal conditions which make up the battery charger trouble alarm are:

- Charger failure
- No charge
- Phase failure
- High/low voltage
- High temperature

In addition, the following system alarms are provided in the control room:

<u>Battery Trouble</u>

This is a common alarm indicating one of the following conditions:

a. Battery Switchboard - Undervoltage positive or negative ground.

b. Battery Chager - Loss of ac, low output volt, low phase volts, high temperature, high output volts, or diode fuse failure.

<u>Battery (Bypass Indication)</u>

Induced inoperability status is provided automatically in the control room for those conditions (battery breaker position) expected to occur more frequently than once a year and manually for those conditions expected to occur less frequently than once a year.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB 22 (212) 430.51 SUBMERGED ELECTRICAL EQUIPMENT RESULT AS A RESULT OF A LOSS-OF-COOLANT ACCIDENT (8.3.3.1.1)

The applicant was requested to identify all electrical equipment, both safety and nonsafety, that may become submerged as a result of a LOCA. For all such equipment that is not designed and qualified for service in such an environment, the applicant was requested to provide analysis to determine the following:

1. The safety significance of the failure of this electrical equipment (e.g. spurious actuation or loss of actuation function) as a result of flooding.

2. The effect on Class 1E power sources serving this equipment as a result of such submergence; and

3. Any proposed design changes resulting from this analysis.

The applicant by amendment 3 to the FSAR stated that the response to the above request will be submitted at a later date. This items will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.51.

NRC Letter: May 3, 1983

Question No. Q430.51 (SRP Sections 8.3.1 and 8.3.2)

Identify all electrical equipment, both safety and nonsafety, that may become submerged as a result of a LOCA. For all such equipment that is not designed and qualified for service in such an environment, provide analysis to determine the following:

1. The safety significance of the failure of this electrical equipment (e.g. spurious actuation or loss of actuation function) as a result of flooding.

2. The effects on Class 1E power sources serving this equipment as a result of such submergence.

3. Any proposed design changes resulting from this analysis.

Response:

There is no safety- or nonsafety-related electrical equipment, which is required post-LOCA or whose failure position will affect station shutdown capability, located inside the containment that may become submerged.

The following safety-related equipment is connected to a Class 1E power supply and is located inside the containment. It may become submerged as a result of a LOCA but is not designed and qualified for submergence:

Group One

3SIL*MV8808A	3CCP*MOV222	3CCP*MOV226
3SIL*MV8808B	3CCP*MOV223	3CCP*MOV227
3SIL*MV8808C	3CCP*MOV224	3CCP*MOV228
3SIL*MV8808D	3CCP*MOV225	3CCP*MOV229

Group Two

3CCP*SOV179A
3CCP*SOV179B

Each of the circuits for Group One equipment is deenergized during normal plant operation. Each of the circuits for Group Two equipment is provided with two series connected interrupting devices which meet the requirements of Regulatory Guide 1.75 for an isolation device and Regulatory Guide 1.63 for penetration protection.

There is nonsafety-related electrical equipment connected to Class 1E power supplies, located inside the containment, which may become submerged as a result of a LOCA and which are not designed and qualified for submergence. Each of the circuits for this equipment is provided with two series connected interrupting devices which meet

the requirements of Regulatory Guide 1.75 for an isolation device and 1.55
Regulatory Guide 1.63 for penetration protection.

There is nonsafety-related electrical equipment connected to Non- 1.56
Class 1E power supplies, located inside the containment, which may 1.57
become submerged as a result of a LOCA and which is not designed and
qualified for submergence. Each of these circuits is not powered 1.58
from Class 1E power supplies. Moreover, where the available fault 1.59
current exceeds the current carrying capability of the penetration
conductors, secondary (i.e., backup) penetration protection is 1.60
provided in addition to the normal circuit protection (i.e., primary
penetration protection) in accordance with Regulatory Guide 1.63. 2.1

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB

(PB) (21) 430.44 RESTORATION OF POWER WITHIN TWO HOURS (8.3.2.3)

Section 8.3.2.1 of the FSAR indicates that power will be available to dc system loads for at least two hours in the event of loss of ac power. After 2 hours it has been assumed that ac power is either restored or that the emergency generators are available to energize the battery chargers. Based on the staff's review of recent applications, this period for restoration of ac power appears to be too short. The applicant was requested to provide the basis and operational experience data for the assumption that ac power can be restored within two hours. By amendment 3 to FSAR the applicant indicated that the requested information will be provided at a later date.

Response:

Refer to the revised response to question no 430.44.

NRC Letter: May 3, 1983

Question No. Q430.44 (SRP Section 8.3.2)

In Section 8.3.2.1 of the FSAR, you state that power will be available to dc system loads for at least two hours in the event of loss of all ac power. After two hours, you have assumed that ac power is either restored or that the emergency generators are available to energize the battery chargers. Based on the staff's review of recent applications, this period for restoration of ac power appears to be too short. Provide the basis and operational experience data for the assumption that ac power can be restored within two hours.

Emergency procedures and training requirements for station blackout events are described in generic letter 81-04. Provide a statement of compliance with these generic requirements.

Response:

The Millstone 3 auxiliary feedwater (AFW) system is designed to NRC recommendation GL-3 (refer to generic letter dated March 10, 1981) which requires at least one AFW system pump and its associated flow path and essential instrumentation should automatically initiate AFW system flow and be capable of operating independently of any ac power sources for at least 2 hours. For Millstone Unit 3, if both offsite and onsite ac power are lost, cooling water can still be provided to the steam generator by the AFW system employing a steam turbine driven pump that does not relv on ac power for operation.

FSAR Section 8.3.2.1.2.2 states the ampere-hour (AH) capacity of each 125V battery is capable of supplying all safety related loads per Table 8.3-4 for a minimum of two (2) hours without charging. Using the battery sizing criteria of IEEE 485-1978 and the load demand shown in Table 8.3-4, the two train batteries (Battery-1 and Battery-2) are suitable for supplying their safety related loads for a minimum of four (4) hours without charging. Battery-1 and Battery-2 are the critical batteries during a loss of AC power because they supply Train A and B shutdown and protection instrumentation and DC control power for breaker operations and emergency generator startup necessary for restoration of AC power. Therefore, it can be stated that DC power would be available to the critical safety related loads for at least four hours without charging.

PSB 21

Appropriate review of procedures and training programs for station blackout events (generic letter 81-04) will be completed prior to full load date. The review will include the consideration of measures to conserve battery power sources.

The basis for the assumption that AC power can be restored within 2 hours (?) is as follows:

Eighty seven percent of the time, offsite AC power can be restored to the Millstone 3 plant within two hours of loss. This estimate is based on an aggregate recovery factor for offsite AC power restoration at nuclear power plants within the region of the Northeast Power Coordinating Council. In addition, special mitigating and preventive features employed at the site were incorporated into the 0.87 recovery estimate to make it Millstone specific.

As part of the Millstone 3 Probabilistic Safety Study (PSS), the frequency of station blackout per year was determined. This involved using historical data on the loss of offsite power (LOP) at nuclear power plants along with a reliability analysis of the Millstone 3 emergency onsite AC power system. The PSS reports a frequency of .112 per year for LOP and an unavailability of 4.56×10^{-4} per demand for both emergency onsite power sources. PSB 21

The frequency of *station blackout* (SBO) can be defined as:

SBO frequency = (LOP frequency). Q (both emergency onsite power sources)

Substituting from above:

$$\text{SBO frequency} = (.112/\text{yr}).(4.56 \times 10^{-4}) = 5.1 \times 10^{-5}/\text{yr}$$

Since the probability of successfully restoring offsite AC power within two hours is 0.87, the probability of restoration exceeding two hours is 0.13. Therefore, the frequency of a SBO exceeding two hours is:

SBO frequency (exceeds 2 hrs.) = (SBO frequency). p (restoration exceeds 2 hours)

and substituting,

$$\text{SBO frequency (exceeds 2 hr.)} = (5.1 \times 10^{-5}/\text{yr}).(.13) = 6.6 \times 10^{-6}/\text{yr}$$

As shown above, the chance of a SBO exceeding two hours is very small on a per year basis and does not even account for recovery of the onsite power sources.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB23 (213) 430.49 DESIGN CRITERIA, INDEPENDENCE OF REDUNDANT SYSTEMS (8.3.3.1.3)

By amendment 3 to the FSAR, the applicant stated that each redundant safety related system is protected. Based on this statement the staff concludes that Class 1E equipment will meet the protection requirement of GDC 2 and 4 and the single failure requirement of GDC 17 and is therefore, acceptable. However, FSAR section 8.3.1.4.1 still contained the apparent contradictory statement. Clarification of this item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.49.

NRC Letter: May 3, 1983 1.8

Question No. Q430.49 (SRP Sections 8.3.1 and 8.3.2) 1.11

In Section 8.3.1.4.1 of the FSAR, you define design criteria for 1.12
independence and availability of Class 1E systems. The definition 1.14
includes the statement that "separation of equipment is maintained to
prevent loss of redundant features for single events and accidents." 1.15
Similarly, in Section 8.3.1.1.2 of the FSAR, you state that redundant 1.16
Class 1E buses are physically and electrically separated so that any 1.17
credible event which might effect one bus will not jeopardize proper
operation of the other bus. 1.18

The above statements imply that, with sufficient separation, only one 1.19
of the redundant Class 1E divisions need to be protected from the 1.20
effects of any single event or accident. Such a design does not meet 1.21
the protection requirements of GDC 2 and 4, the single failure
requirement of GDC 17, or the guidelines of IEEE Standard 308-1974. 1.22
Define all credible events, accidents, or design basis events and 1.23
describe how each Class 1E power system component is designed and 1.24
qualified to withstand (or is protected from) the effects of each
defined credible event. Defined credible events should include, but 1.25
not be limited to: Design basis events listed in Table 1 of IEEE
Standard 308-1974 and failures of non-Class 1E or nonseismic 1.26
Category I structures, systems, or components. Where separation is 1.27
used to prevent loss of redundant features from any single event or
accident, justify noncompliance with the requirements of GDC 2, 4, 1.28
and 17.

Response: 1.29

Each redundant safety-related system is protected. Refer to revised 1.31
FSAR Sections 8.3.1.1.2, 8.3.1.4.1, and 8.3.1.4.2. the response
to Question 430.23. PSB 23

design meets the requirements of IEEE 308 and 379, and Regulatory Guides 1.6 and 1.53 (Table 8.1-2).

The design of circuits that initiate and control emergency power satisfies the same single failure requirements as protective systems in accordance with IEEE 279 (Table 8.1-2).

Physical separation of redundant equipment for the Class 1E ac power systems including cables and raceways, emergency diesel generators, distribution panels, and containment electrical penetrations are provided. The design of the Class 1E ac power system provides for redundant portions of this system to be located in a Seismic Category I structure as per General Design Criterion 2 (Table 8.1-2), to be protected as per General Design Criteria 3 and 4 (Table 8.1-2). The ventilation system design meets the single failure criteria as described in Section 9.4.1. Doors separating redundant portions of the Class 1E ac power systems assure that events such as fire and flooding in one structure will not be propagated to other redundant equipment structures as per General Design Criteria 3 and 4 (Table 8.1-2).

The design meets the requirements of Branch Technical Position ICSB 1 (Table 8.1.2).

The Class 1E ac power system consists of two completely redundant and independent load groups with regard to both power sources and associated distribution systems. Two emergency 4.16 kV switchgear buses are provided along with eight emergency 480V load centers, 13 emergency 480V motor control centers and one stub 480V motor control center.

These emergency load groups constitute two segregated and nonparalleled divisions of safety-related power supply to all the engineered safety features electrical systems.

1. <u>Class 1E 4.16 kV System</u> - The Class 1E 4.16 kV system indicated on Figure 8.1-1 consists of two redundant emergency buses. The emergency buses 34C and 34D are each rated 2,000 amp with incoming sections rated 3,000 amp. Each bus can be supplied from normal station service transformer A, reserve station service transformer A, or an emergency generator.

   During normal operation, power is supplied through the normal station service transformer A from the unit generator via the isolated phase bus duct, with the generator breaker closed. Normal station service transformer A supplies power to emergency 4.16 kV buses 34C (Train A) and 34D (Train B), via normal buses 34A and 34B, respectively. Normal station service transformer A has the capacity to supply 4.16 kV normal auxiliaries and those emergency auxiliaries (both

Total of cable types
Total number of cables
Total of raceway types
Reel traceability report

The percent fill is computed by adding the cross-sectional areas on all cables in a raceway section.

8.3.1.4 Independence of Redundant Systems

8.3.1.4.1 Principal Criteria

The principal design criterion that establishes the minimum requirements for preserving the independence of redundant Class 1E power systems through physical arrangement and separation and for assuring the minimum required equipment availability during any design basis event (Class 1E power system and design basis events areas defined in IEEE 308) is as follows:

> Class 1E electrical equipment is physically and electrically separated from its redundant counterpart or mechanically protected as required to prevent the occurrence of common mode failures. Separation of equipment is maintained to prevent loss of redundant features for single ~~events and accidents~~ failures. 430.49

8.3.1.4.2 Equipment Considerations

Design features of the major Class 1E system components which ensure conformance to the design base are described below. 430.23

The safety related portions of the onsite ac power system are divided into two load groups (trains). The safety related actions of each load group are redundant and independent of the safety actions provided by its redundant counterpart.

Redundant safety related systems are not subject to common mode failure through failure of the ventilation system. The ventilation systems are discussed in Section 9.4. 430.23

Redundant safety related systems are located in fire protected areas. The fire protection system is discussed and analyzed in Section 9.5.1 and in the Fire Protection Evaluation Report.

Safety related equipment in all plant areas is either protected from automatic fire protection effluents or, on the basis of test data, have demonstrated their operability in the environment that may be caused by the fire protection effluents. 430.23

Redundant safety related systems (including cable, electrical equipment, actuated equipment, sensors, and sensor to processor connections) are located in protected areas or the electrical circuits are provided with either a Class 1E isolation device or two series connected Class 1E interrupting devices. Missile protection is discussed and analyzed in Section 3.5. Flood protection is 430.23

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB24 (214) 430.28 ROUTING OF POWER CABLES IN THE CABLE SPREADING AREA (8.3.3.3.3)

The applicant by amendment 3 to the FSAR, documented that potential electrical fires caused by fault current in the power cables are not considered to be a hazard. Fires resulting from fault current if possible would be contained in the rigid steel conduit. The staff agrees with the applicants and concludes that rigid steel conduit provides an acceptable level of assurance that other circuits located in the cable spreading area will not be affected by failure of the traversing power circuits.

In regard to failure of traversing power circuits as well as other circuits due to the design basis even fire in the cable spreading room, the inclusion of these traversing cables in their design capability to shutdown the plant (alternate shutdown capability) will be pursued with the applicant and coordinated with ASB. The results of the staff review will be reported in a supplement to this report.

In addition, design criteria for routing of power circuits in the control room and instrument rack room as well as external events such as fire and energetic events in these rooms as well as the cable spreading room will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.28 and revised FSAR section 1.8, R. G. 1.75.

NRC Letter: May 3, 1983

Question No. Q430.28 (SRP Sections 8.3.1 and 8.3.2)

In Section 1.8 of the FSAR, you imply taking exception to Position C12 of Regulatory Guide 1.75. Position C12 indicates that:

1. Power supply feeders to instrument and control room distribution installed in enclosed raceways should not be considered acceptable

2. Traversing power circuits separated from other circuits in the cable spreading area by a minimum distance of 3 feet and barriers should not be considered acceptable

3. Traversing power circuits routed in imbedded conduit which in effect removes them from the cable spreading area should be considered acceptable.

Power circuits that traverse the cable spreading area at Millstone are installed in enclosed raceways (rigid steel conduits). In accordance with Position C12 of Regulatory Guide 1.75, the routing should not be considered acceptable. Justify the adequacy of the proposed routing in steel conduit.

Response:

The degree of separation required between power circuits and other circuits varies with the hazards present at any given location.

The cable spreading room is a protected area and is not subject to external energetic events such as flood, high energy pipe rupture, missles, etc. Potential electrical fires caused by fault current in the power cables are not considered to be a hazard as such fires, if possible, would be contained in the rigid steel conduit.

(4160 V, 480 V, and 120 V ac service) that traverse the cable spreading room

The control room, instrument rack room, and cable spreading room are protected areas and are not subject to external energetic events such as flood, high energy pipe rupture, missiles, etc. Potential electrical fires caused by fault current in power cables, limited to 120 V ac and/or 125 V dc, are not considered to be a hazard due to the use of fire retardant materials, low energy cables, and the separation provided as described in FSAR Section 8.3.1.4.2.

PSB-27

power supply feeders and facilities serving the control room and instrument systems,

The loss of the control room, instrument rack room, or the cable spreading room due to the design basis fire will not compromise the capability to achieve cold shutdown as outlined in the Fire Protection Evaluation Report.

above cables or the

Thus, no credit is assumed for the conduit enclosed cable surviving the cable spreading room fire.

(4160 V, 480 V and 120 ac service)

There are no power cables that traverse the Instrument Rack Room or Control Room.

R.G. No.	Title	Degree of Compliance	FSAR Section Reference

7. Position C.12

   1) Power cables that supply power to instrument rack room and control room distribution panels, limited to 120 V ac and/or 125 V dc, are:

      a. Enclosed in rigid conduit in the cable spreading room. The rigid conduit is either aluminum or steel

      b. Enclosed in rigid conduit with flexible conduit at entrance to the panels in the instrument rack room and control room.

   2) Power cables (from the above distribution panels) to facilities serving the control room and instrument rack room, limited to 120 V ac and/or 125 V dc, are enclosed in rigid conduit except at entrance/exit to floor sleeves in the cable spreading room, instrument rack room and control room, and at entrance to equipment in the instrument rack room and control room. 430.28

   3) (other) Power cable (4160 V, 480V, and 120 V ac service) other than 120 V ac and/or 125 V dc that traverses the cable spreading room are enclosed in rigid steel conduit.

   4) The loss of the above cables or the control room, instrument rack room, or the cable spreading room due to the design basis event fire will not compromise the capability to achieve cold shutdown as outlined in the Fire Protection Evaluation Report.

   5) The Millstone 3 design utilizes a single cable spreading room.

8. Position C.16 (Section 5.6.2 of IEEE-384)

   The minimum 6 inch separation (or a barrier) applies to spacing between exposed terminals, contacts, and equipment of redundant Class 1E circuits or Class 1E and non-Class 1E circuits for testing and maintenance purposes. A minimum of 1 inch separation (or a barrier)

TABLE 1.8-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference

a spacing of 10 inches (i.e., the nominal vertical tray spacing) is maintained, a tray cover on the lower tray, a tray bottom on the upper tray, or a barrier interposed between the Class 1E and the non-Class 1E circuits provides the necessary separation.

Where plant arrangement in the control room, instrument rack room, or cable spreading room, precludes the above referenced minimum 10 inches vertical separation or the minimum horizontal separation, either the non-Class 1E circuit(s) or the Class 1E circuit(s) are run in an enclosed raceway (i.e., conduit or tray with covers top and bottom or a barrier is interposed between the non-Class 1E circuit(s) and Class 1E circuit(s). The minimum distance between cable and an enclosed raceway or cable and a barrier is one inch.

6. Position C.10

Class 1E cable and raceways shall be marked at intervals not exceeding 15 feet. The 5 foot requirement is a typographical error which has been confirmed by the NRC.

7. Position C.12

1) Power cables that supply power to instrument rack room and control room distribution panels, limited to 120 V ac and/or 125 V dc, are:

   a. Enclosed in rigid conduit in the cable spreading room. The rigid conduit with is either aluminum or steel

   b. Enclosed in rigid conduit with flexible conduit at entrance to the panels in the instrument rack room and control room.

2) Power cables (from the above distribution panels) to facilities serving the control room and instrument rack room, limited to 120 V ac and/or 125 V dc, are enclosed in rigid conduit except at entrance/exit to floor sleeves in the cable spreading room, instrument rack room and control room, and

12. Where the required physical separation is not practical, appropriately designed barriers (missile, fire, etc.) are installed between redundant Class IE circuits and between non-Class IE and Class IE circuits.

13. Fire barriers are installed at all locations where trays penetrate a wall or a floor.

14. Cable splices in raceways are prohibited.

15. Provisions are made for connecting the third reactor plant component cooling pump and the third charging pump to either of the two redundant 4.16 kV emergency switchgear buses. (Figures 8.3-4 and 8.3-5). Cables are routed from the pump motor to a transfer switch. From the transfer switch, the cables are routed to the breaker cubicle on each emergency bus. In each instance, mechanical interlocks are provided to prevent the emergency buses from being connected. The power cable from each motor to the transfer switch is Train C and routed independently in rigid metal conduit. Separation of Train C conduit meets the physical separation requirements for safety related conduits. 430.23

16. Provisions are made for connecting the second fuel oil transfer pump for each emergency generator to redundant 480 V motor control centers. (Figure 8.3-6). Cables are routed from the pump motor to a transfer switch. From the transfer switch, the cables are routed to the breaker compartment on each emergency bus. In each instance, mechanical interlocks are provided to prevent the emergency buses from being connected. The power cable from each motor to the transfer switch is Train C and routed independently in rigid metal conduit. Separation of Train C conduit makes the physical separation requirements for safety related conduit.

17. Power supply feeders to instrument rack room and control room distribution panels, limited to 120 V ac and/or 125 V dc, are installed in rigid conduit with flexible conduit at entrance to panels. 430.28 8

    Power feeds (from the above distribution panels) to facilities serving the control room and instrument systems, limited to 120 V ac and/or 125 V dc, are run in rigid conduit except at entrance/exit to floor sleeves and equipment. 430.28 8

    Other power cables (4160 V, 480 V, and 120 V ac service) that must traverse the cable spreading room are run in rigid steel conduit for the whole length. 430.28

18. In general, internal to control panels and cabinets, the minimum separation distance between redundant Class IE circuits and non-Class IE circuits is:

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB25 (215) 430.32 TRANSFER OF LOADS BETWEEN REDUNDANT DIVISIONS (8.3.3.3.6)

Section 9.5.4.3 of the FSAR states, in part, that one fuel transfer pump on each fuel oil storage tank is arranged to allow transfer from the A electrical bus to the B electrical bus, or visa versa, by means of a 480-volt, seismically qualified Class IE transfer switch manually operated under administrative control.

It is the staff position that the designs of each interconnection should prevent a single failure or inadvertent closure of one interconnecting device from compromising division independence. An acceptable design includes a minimum of two series connected disconnect devices that are physically separated, interlocked, administratively kept normally open, and annunciated in the control room upon closure.

The applicant by amendment 3 to the FSAR, identified all interconnections and described how each meet the above staff position. Based on the descriptions the staff concludes that the design meets the above stated position and is acceptable with the following exception. Interconnection of the second fuel oil transfer pump is not annunciated in the control room upon closure. Justification for this area of noncompliance will be pursued with the applicant and the results of the staff evaluation will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.32.

NRC Letter: May 3, 1983 1.8

Question No. Q430.32 (SRP Sections 8.3.1 and 8.3.2) 1.11

You state in Section 9.5.4.3 of the FSAR, in part, that one fuel oil 1.12
transfer pump on each fuel oil storage tank is arranged to allow 1.13
transfer from the A electrical bus to the B electrical bus, or vice
versa, by means of a 480-volt, seismically qualified Class 1E 1.14
transfer switch manually operated under administrative control. It 1.15
appears that the Millstone design includes provision for manually
transferring loads between redundant Class 1E divisions other than 1.16
those described in Chapter 8 of the FSAR.

It is the staff position that the designs of each interconnection 1.17
should prevent a single failure or inadvertent closure of one 1.18
interconnecting device from compromising division independence. An 1.19
acceptable design includes a minimum of two series connected
disconnect devices that are physically separated, interlocked, 1.20
administratively kept normally open, and annunciated in the control
room upon closure. Identify all interconnections between redundant 1.21
distribution systems; describe how each interconnection meets the
above staff position; and justify areas of noncompliance. 1.22

Response: 1.23

There are four electrical loads with the capability of being powered 1.24
from either redundant Class 1E distribution systems (the third 1.25
charging pump, the third reactor plant component cooling pump, and
the second fuel oil transfer pump for each emergency generator). 1.26
Refer to revised FSAR Section 8.3.1.1.2. 1.27

In addition, each non-Class 1E load center powered from non-Class 1E 1.28
bus 34A is provided with a 75 percent capacity tie to a non-Class 1E 1.31
load center powered from non-Class 1E bus 34B (i.e., buses 32G-32H,
32F-32J, 32E-32K, 32D-32L, 32C-32M, 32B-32N, 32A-32P). Non-Class 1E 1.33
bus 34A is electrically connected by a Class 1E tie breaker to
Class 1E bus 34C; non-Class 1E bus 34B is electrically connected by a 1.35
Class 1E tie breaker to Class 1E bus 34D. Refer to Figure 8.1-1. 1.36

In each instance there is a minimum of two series connected and 1.37
physically separated disconnect devices. All interconnections are 1.38
administratively kept normally open. Interconnections for the third 1.39
charging pump, the third reactor plant component cooling pump, and
the second fuel oil transfer pump for each emergency generator are 1.40
interlocked. Interconnections for the third charging pump and the 1.41
third reactor plant component cooling pump are annunciated in the 1.42
control room upon closure.

A non-Class 1E load center 75 percent capacity tie is provided to 1.43
allow selected loads to be powered from the opposite bus in the event 1.44
of a load center transformer failure. Such an event and the 1.46

resulting operating procedure modifications would be known in the control room.

The capability of running the second fuel oil transfer pump for each 1.47
emergency generator from the opposite Class 1E train is provided to 1.48
facilitate fuel oil transfer in the unlikely event that one train is
rendered unavailable after a loss of offsite power. Such an event 1.50
would be known in the control room.

FSAR Figure 8.3-6 presents the arrangement of electrical power 1.51
supplies to the fuel oil transfer pumps. When aligned with the 1.53
Class 1E Division associated with its respective emergency generator,
the second fuel oil transfer pump is controlled automatically by its 1.54
respective combination starter. In order to power the second fuel 1.55
oil transfer pump from the opposite redundant Class 1E Division,
administratively controlled manual actions (utilizing key locks) are 1.56
required. The following are the step-by-step actions required to 1.57
power 3EGF*PID, normally aligned with Train B, from Train A (refer 1.58
to FSAR Figure 8.3-6).

1. Open circuit breaker in combination starter at position 4K 2.2
   in MCC 32-1U. Remove key A-D (which can only be removed 2.3
   with circuit breaker in the open position). This locks the 2.4
   combination starter in the open position.

2. Insert key A-D in transfer switch 3EGF*TRSIB and turn to 2.5
   open position. Open circuit breaker CB1 in 3EGF*TRSIB 2.6
   (which can only be opened with key A-D in the position).
   Key A-D is held captive in open position when circuit 2.7
   breaker CB1 is open. Remove key B-D (which can only be 2.8
   removed with circuit breaker CB1 in the open position) This 2.9
   locks circuits breaker CB1 in 3EGF*TRSIB in the open
   position.

3. Insert key B-D in location for circuit breaker CB2 in 2.10
   transfer switch 3EGF*TRSIB and turn to clock position.
   Close circuit breaker CB2 (which can only be closed with key 2.11
   B-D in closed position). Key B-D is held captive in close 2.12
   position when circuit breaker CB2 is closed. Remove key C-D 2.13
   (which can only be removed with circuit breaker CB2 in the
   closed position). This locks circuit breaker CB2 in 2.14
   3EGF*TRSIB in the close position.

4. Insert key C-D in circuit breaker at position 3M in MCC 32- 2.15
   1T and turn to close position. Close circuit breaker at 2.16
   position 3M in MCC 32-1T (which can only be closed with key
   C-D in the close position). Key C-D is held captive in 2.17
   close position when circuit breaker at position 3M in MCC
   32-1T is closed.

When aligned with the opposite redundant Class 1E Division, the second fuel oil transfer pump is controlled manually by a circuit breaker.

The use of the transfer switch would be implemented by the control room operations since this group will control the key. This action, obtaining the key, would itself announce the fact that the transfer will take place.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB26 (216) 430.34 PHYSICAL ELECTRICAL SEPARATION OF HEAT TRACING CIRCUITS (8.3.3.3.7)

Section 8.3.1.1.4(8) of the FSAR indicates that piping subject to freezing and/or boron precipitation are electrically hea˙ traced. Two heat tracing circuits are provided for each pipe subject to freezing. The other circuit is connected through an isolation transformer to division B.

The applicant by amendment 3 to the FSAR, stated that the physical and electrical independence of these circuits is justified because they are treated as associated circuits. Identification of systems with piping subject to freezing and further justification of the physical separation of the subject heat tracing circuits will be pursued with the applicant. The results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.34.

NRC Letter: May 3, 1983

Question No. Q430.34 (SRP Sections 8.3.1 and 8.3.2)

Section 8.3.1.1.4(8) of the FSAR indicates that piping subject to freezing or boron precipitation are electrically heat traced: Two heat tracing circuits are provided for each pipe. One heat trace circuit is connected to Class 1E division A while the other circuit is connected through an isolation transformer to division B. Provide a description and justification of the physical and electrical independence between the two heat tracing circuits and between the redundant Class 1E divisions.

Response:

The two heat tracing circuits are powered and controlled from two separate heat tracing panels. Power to these panels are connected through isolation transformers to safety-related Trains A and B, (refer to revised FSAR Section 8.3.1.1.4). These isolation transformers have been demonstrated to be sufficiently current-limiting under short circuit testing. With applied short circuits, the test shows that the output is limited to 175 percent (of rated output) and the input is limited to 150 percent (of rated input). These current values are within the capability of the power supply and therefore, the isolation transformers prevent unacceptable loading to the power supply. This demonstrates the adequacy of these isolation transformers as an isolation device in accordance with the requirements of Regulatory Guide 1.75, Position 1.[1]

X

PSB 26

The isolation transformers are protected by Class 1E circuit breakers, located in Class 1E motor control centers. In addition, the isolation transformers are Class 1E and equipped with an ac input circuit breaker. Since they are current-limiting, the output is short circuit protected. As indicated, a minimum of two series connected and physically separated Class 1E circuit breakers have been provided.

The output cable of these transformers is scheduled in dedicated conduit up to the distribution panel. The non-Class 1E distribution panel is equipped with a main circuit breaker. The individual heat tracing circuits are routed in dedicated conduit to junction boxes located local to the traced pipes. These features minimize the possibilities of a fault challenging the isolation transformers. In any case, the current-limiting feature of the isolation transformer precludes unacceptable influence on the Class 1E system.

Normally, one train (primary circuit) maintains temperature above its setpoint. Upon failure of the primary circuit, a backup circuit (opposite train) will maintain temperature above its setpoint.

INSERT A ←

Ⓐ 430.34

Note:

1. THE TEST RESULTS DEMONSTRATING THE ADEQUACY OF THE ISOLATION TRANSFORMERS AS ISOLATION DEVICES ARE CONTAINED IN THE FOLLOWING:

a) NOTES OF CONFERENCE, PURCHASE ORDER No. 2421.500-608, ISOLATION TESTS, DATED JANUARY 23, 1982.

ISSUE

b) POWER CONVERSION PRODUCTS INC.' LETTER DATED SEPTEMBER 12, 1982.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB27 (217) 430.35 USE OF BATTERY CHARGER AS AN ISOLATION DEVICE (8.3.3.3.9)

Section 8.3.2.1.i of the FSAR states that battery charger 5 is powered from a Class 1E emergency bus, furnishes dc power to nonsafety loads, and meets all the requirements of an isolation device. The applicant was requested to provide test results and/or analysis that demonstrates that any failure or combination of failure or malfunction in the nonsafety circuits will not cause unacceptable influence on Class 1E circuits.

In response the applicant by amendment 3 to the FSAR indicated (1) that the output cables from the charger to the distribution switchboard are run in dedicated conduit to preclude hot short from an external voltage source and (2) that short circuits tests will be conducted.

Protection from hot short from distribution switchboard to load and short circuits test plan and results will be pursued with the applicant. The results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.35.

NRC Letter: May 3, 1983

Question No. Q430.35 (SRP Sections 8.3.1 and 8.3.2)

In Section 8.3.2.1.1 of the FSAR, you state that battery charger 5 is powered from a Class 1E emergency bus, furnishes dc power to nonsafety loads, and meets all the requirements of an isolation device. Provide test results and/or analysis that demonstrates that any failure or combination of failure or malfunction in the nonsafety circuits will not cause unacceptable influence on Class 1E circuits. In addition, define the requirements for this isolation device.

Response:

The letter from C & D Batteries, dated January 13, 1984, which will be sent under separate cover, demonstrates the current-limiting capabilities (both in the equalizing and float operation mode) of battery chargers furnished for Millstone 3. The failure criterion for this test was unacceptable influence on the input (Class 1E bus). The results clearly show that during current-limit operation, no unacceptable influence was exhibited at the input. These results demonstrate the adequacy of Battery Charger 5 as an isolation device in accordance with the requirements of Regulatory Guide 1.75, Postion 1.

Battery Charger 5 is protected by a Class 1E circuit breaker located in Class 1E motor control center 32-2T (refer to FSAR Figure 8.3-2). In addition, Battery Charger 5 is Class 1E and equipped internally with an ac input circuit breaker and a dc output circuit breaker. As indicated, a minimum of two series connected and physically separated Class 1E circuit breakers have been provided. INSERT E1

PSB-27

The output of Battery Charger 5 up to the distribution switchboard is run in dedicated conduit. The non-Class 1E distribution switchboard is equipped with a main circuit breaker and feeder circuit breakers. These features minimize the possibility of an uncleared fault threatening the battery charger. In any case, the current-limiting feature of the battery charger precludes unacceptable influence on the Class 1E system.

The station design relative to Battery Charger 5 is a single train related.

INSERT E2

INSERT E1

THE OUTPUT OF BATTERY CHARGER 5 UP TO THE DISTRIBUTION SWITCHBOARD INCLUDES CONTROLLED ROUTING (i.e. CONTINUATION OF THE CIRCUIT IN RIGID CONDUIT).

INSERT E2

THE NON-CLASS 1E DISTRIBUTION SWITCHBOARD IS EQUIPPED WITH A MAIN CIRCUIT BREAKER AND FEEDER CIRCUIT BREAKERS. SINCE ALL OTHER NON-CLASS 1E INTERCONNECTIONS WITH THE CLASS 1E SYSTEMS INCLUDE CONTROLLED ROUTING (i.e. CONTINUATION OF THE CIRCUIT WITH THE SAME COLOR CODE OR CONTINUATION OF THE CIRCUIT IN RIGID CONDUIT) BEYOND THE CLASS 1E ISOLATION DEVICE, THE OUTPUT FEEDER CIRCUITS INCLUDE DE FACTO CONTROLLED ROUTING.

THESE FEATURES PRECLUDE UNACCEPTABLE INFLUENCE ON THE CLASS 1E SYSTEM.

C&D Batteries

3043 Walton Road
Plymouth Meeting, PA 19462
Phone: (215) 828-9000
Teletype: 510-660-8436

January 13, 1984

C. D. Nardella
Stone & Webster
P.O. Box 2325
Boston, MA 02107

Subject: Purchase Order No. 2445-200-260
Battery Chargers
Millstone Nuclear Power Station

Dear Mr. Nardella:

The enclosed Certificate of Compliance and Test Data will satisfy Specification No. 2445-200-260 Page 1 - 40 Current Limit Curves. The battery chargers regardless of output rating have the same control circuit. The curves for the ARR130HK50 would be the same as the ARR130K200 except for the values.

If you have any questions, please feel free to contact me at (215) 828-9000, extension 324.

Sincerely,

Joe Meyer
Engineering Administrator

/c
encl.

C&D Batteries

Stone & Webster Eng. Corp.
Agent for NUSCO
TO: Millstone Nuclear Power Station
Unit #3
Waterford, CT 06385

Date December 20, 1983

CERTIFICATE OF COMPLIANCE

It is hereby certified that the material, processes or services supplied to Northeast Utilities Company

on purchase order number 2445-200-260 our invoice number 9-22735

shipped via Truck

are in compliance with the purchase order number 2445-200-260

and specification(s) 2445-200-260 Rev. 2

Remarks: It is hereby certified that the original battery chargers, ARR130K200F will function the same as attached current limit curves.

Signed: Jerry Rogers
Quality Control Supervisor

Jerry Rogers

C & D BATTERIES

( ) Attica, Ind.
( ) Brookston, Ind.
( ) Conshohocken, Pa.
( ) Conyers, Ga.
(X) Eshbach, Pa.
( ) Pennsburg, Pa.
( ) Santa Rosa, Calif.
( ) Huguenot, N.Y.
( ) Perth, Ontario

TEST DATA

C&D BATTERIES
An ALLIED Company
3043 WALTON ROAD, PLYMOUTH MEETING, PA 19462
TELEPHONE: 215-828-9000 • TELETYPE: 510-660-8436

NEMA

FLOAT CURRENT LIMIT TEST

MODEL NO. ARR130K200F

SERIAL NO. ES831983 DATE 12-20-83 BY R. Perks

CUSTOMER Baltimore Gas & Electric Co.

ORDER NO. ______ C&D INVOICE 1-94446

C&D I.P. 9501 C&D T.P. 9503 SPEC. T.P. ______

SPEC NO. 2588 ASSEMBLY DWG. NBC-1469 CONNECTION DWG. NBC-1471, NBC-1- NBC-1360

(NOMINAL AC LINE)

AC VOLTS	AC AMPS	DC VOLTS	DC AMPS
480	2.0	132.0	.02
	14.0	131.9	40
	25.0	131.7	80
	36.0	131.6	120
	48.0	131.5	160
	57.0	131.5	200
	60.0	130.0	214 current limit setting

Increasing Load Beyond Current Limit Setting

AC VOLTS	AC AMPS	DC VOLTS	DC AMPS
480	60.0	125.0	213
	60.0	120.0	212
	60.0	115.0	208
	60.0	110.0	206
	60.0	105.0	204

Decreasing Load

AC VOLT	AC AMPS	DC VOLTS	DC AMPS
480	60.0	105.0	204
	60.0	110.0	207
	60.0	115.0	209
	60.0	120.0	212
	60.0	125.0	213
	60.0	129.8	214 current limit setting
	57.0	131.5	200 full load

RIPPLE 28 MV (RMS) @ 200 AMPS ON ______ AH BAT. DBRN ______

DIELECTRIC TEST ACCEPTED (X) WITHHELD ( )

REMARKS ______

CONNECTED FOR 480 V/AC

RELEASED FOR SHIPMENT

C&D [signature] TITLE [signature] DATE 12/20/83
CUSTOMER ______ TITLE ______ DATE ______

CERTIFIED CORRECT.

TEST DATA

C&D BATTERIES
An ALLIED Company

3043 WALTON ROAD, PLYMOUTH MEETING, PA 19462
TELEPHONE: 215-828-9000 • TELETYPE: 510-660-8436

NEMA

EQUALIZE CURRENT LIMIT TEST

MODEL NO. ARR130K200F

SERIAL NO. ES831983 DATE 12-20-83 BY R. Perks

CUSTOMER Baltimore Gas & Electric Co.

ORDER NO. ____ C&D INVOICE 1-94446

C&D I.P. 9501 C&D T.P. 9503 SPEC. T.P. ____

SPEC NO. 2588 ASSEMBLY DWG. NBC-1469 CONNECTION DWG. NBC-1471, NBC-147
NBC-1360

(NOMINAL AC LINE)

AC VOLTS	AC AMPS	DC VOLTS	DC AMPS
480	2.4	140.0	.02
	15.0	139.9	40
	25.0	139.8	80
	36.0	139.6	120
	48.0	139.4	160
	57.0	139.4	200
	63.0	138.6	223 current limit setting

Increasing Load Beyond Current Limit Setting

AC VOLTS	AC AMPS	DC VOLTS	DC AMPS
480	63.0	125.0	214
	63.0	120.0	211
	63.0	115.0	208
	63.0	110.0	206
	63.0	105.0	204

Decreasing Load

AC VOLT	AC AMPS	DC VOLTS	DC AMPS
480	63.0	105.0	204
	63.0	110.0	207
	63.0	115.0	209
	63.0	120.0	211
	63.0	125.0	213
	63.0	138.2	223 ~~current~~ limit setting
	58.0	139.5	200 full load

RIPPLE 28 MV (RMS) @ 200 AMPS ON ____ AH BAT. DERN ____

DIELECTRIC TEST ACCEPTED (X) WITHHELD ( )

REMARKS ____

CONNECTED FOR 480 ____ V/AC

RELEASED FOR SHIPMENT

C&D [signature] TITLE [signature] DATE 12/20/83
CUSTOMER ____ TITLE ____ DATE ____

CERTIFIED CORRECT.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB28 (218) 430.38 TRANSFORMERS USED AS ISOLATION DEVICES (8.3.3.3.10)

As indicated in Section 8.3.1.1.2 (item 3) and Figure 8.3-3 of the FSAR, Non-Class IE NSS loads are connected to the Class IE 120V vital ac buses through transformers that are qualified as isolation devices.

By amendment 3 to the FSAR the applicant provided results of tests and design provisions that are being implemented to assure that non-Class IE circuits are sufficiently isolated and will not caused unacceptable influence on any Class IE circuit.

Clarification of these design provisions will be pursued with the applicant and the result of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.38.

NRC Letter: May 3, 1983

Question No. Q430.38 (SRP Sections 8.3.1 and 8.3.2)

Non-Class 1E NSSS loads are connected to the Class 1E 120 V vital ac buses through transformers. You have stated that these transformers are qualified as isolation devices. Provide test results and/or analysis that demonstrates that any failure or combination of failures (including hot short) in the nonsafety circuits will not cause unacceptable influence on any Class 1E circuits. In addition, provide a description of the non-Class 1E load with respect to its size and the capacity and capability of the Class 1E system to supply the non-Class 1E load.

Response:

Testing was performed to demonstrate the adequacy of the transformers as isolation devices in accordance with the requirements of Regulatory Guide 1.75, Position 1.(1) This testing was performed with the station inverter as the power source for the isolation transformer. A short circuit was applied to the output of the isolation transformer. The failure criteria for this testing was either shutdown of the inverter, or unacceptable deviation from the specified inverter output requirements. The inverter exhibited no unacceptable deviation from required output and did not current-limit or shutdown. These isolation transformers are protected by Class 1E fuses located in the Class 1E 120 V ac vital buses (refer to FSAR Figure 8.3-3). In addition, these isolation transformers are Class 1E and equipped with ac input circuit breakers. As indicated, two series connected and physically separated Class 1E interrupting devices (fuse, circuit breaker) have been provided.

X PSB 28

PSB 28

The output circuits of these transformers is run in dedicated conduit up to the nonvital 120 V ac busses. The nonvital bus is equipped with feeder circuit fuses. The output of the isolation transformers is also fused. These features minimize the possibilities of an uncleared fault or hot short from challenging the isolation transformers. In any case, the design features of the isolation transformers, as demonstrated in the above referenced testing, precludes unacceptable influence on the Class 1E system.

The non-Class 1E loads are limited to control and instrument application only and are included in the design of the Class 1E system. The capacity and capability of the Class 1E system is discussed in Sections 8.3.1.1.2 and 8.3.1.1.3.

Note:

INSERT B

430.38

(B)

1. THE TEST RESULTS DEMONSTRATING THE ADEQUACY OF THE ISOLATION TRANSFORMERS AS ISOLATION DEVICES ARE CONTAINED IN THE FOLLOWING:

a) NOTES OF CONFERENCE, PURCHASE ORDER NO. 2421.500-608, ISOLATION TESTS, DATED JANUARY 22, 1982
ISSUE

b) NOTES OF CONFERENCE, PURCHASE ORDER NO. 2421.500-608, TESTING WITH INVERTER, DATED FEBRUARY 2, 1982
ISSUE

c) POWER CONVERSION PRODUCTS INC. LETTER DATED SEPTEMBER 12, 1982.

Issue Date: January 22, 1982
J.O.No. 12179
NES-26503
NOTES OF CONFERENCE
PURCHASE ORDER NO. 2421.500-608
ISOLATION TESTS
MILLSTONE NUCLEAR POWER STATION - UNIT 3
NORTHEAST UTILITIES SERVICE COMPANY

Held in the Offices of
Power Conversion Products, Inc.
Crystal Lakes, Illinois

December 3, 1981

Present for Power Conversion Products Inc. (PCP) -

Messrs. C. F. Seyer
J. Mitchell
E. Peters
M. Grant

Present for Northeast Utilities Service Company (NUSCo.) -

Mr. J. M. Clark

Present for Stone & Webster Engineering Corporation (S&W) -

Messrs. J. J. LaMarca
E. A. Kuti

PURPOSE

The purpose of this meeting was to test an isolation transformer as specified in the test section of the specification (E-608).

DISCUSSION

1. PCP Performed the following tests:
   (a) Dielectric Strength Test
   (b) Short Circuit Test
   (c) Surge Withstand Test
   (d) Voltage Regulation Test
   (e) Harmonic Distortion Test

2. During the short circuit test no phase shift occurred on the primary side of the transformer at either full load or 0.8 pf. PCP explained that the internal capacitator for the third harmonic filter corrected the power factor to unity under this loading.

3. The Credible Voltage Test was not performed because PCP's facilities are not equipped to perform this test. PCP is investigating whether the tests can be performed at either the nearby Square D or Allen Bradley facility. No date has been set for this test.

4. PCP stated that a high voltage alarm would cost $50.00 for each 5 or 10 kVa unit.

5. PCP will prepare a test report describing the test circuit, the test procedures, the test results and their conclusions. The report will be submitted to S&W.

6. S&W will review the preliminary test results with the equipment specialist upon return to Boston.

The following are attached:

Attachment No.	
1.	Test Procedure
2.	Test Circuit
3.	Test Results
4.	Oscilloscope pictures of the current and voltage waveforms of the short circuit test for the worst case conditions.

EAKuti:LRR

Issue Date: January 22, 1982 ATTACHMENT 1

Power Conversion Products, Inc.

Process Specifications | PS-79-3-20489

Title: PRODUCTION TESTING OF AC LINE REGULATORS

Scope: To establish a guideline for the testing of AC line regulators manufactured by Power Conversion Products.

Purpose: To incorporate Power Conversion Products Test Plan.

Description: Process Specification PS-79-3 will be used for testing of all AC line regulators.

A. Mechanical Inspection

The regulator will be given a complete visual and mechanical inspection. The following inspection points will be verified:

1. All units to be checked to assure there are no loose nuts, bolts, screws, or parts loose in chassis.
2. No components missing.
3. All components tight.
4. All nuts tight.
5. Lockwashers on all screws, except where a rivnut is used.
6. Screws in all holes.
7. Proper size hardware used: lugs, screws, nuts, etc.
8. Wires extending through lugs flush or not over 1/16 inch.
9. Lugs will be mounted as follows: 1 lug, open side down, 2 lugs, bottom one, open side down and top one, open side up.
10. Stress bend in all wires and leads.
11. Wires harnessed and run neatly.
12. Wires not against or close enough to any heat-producing component which could cause deterioration of wire insulation.
13. No burned insulation or components.

DISTRIBUTION

C	M

Written by	Approved	Revision	Issued	Page 1 of 8
[illegible] 11/25/81				

A. Mechanical Inspection (cont.)

14. Wires not too tight or too much excess wire.

15. Components flush on board except where mounted with clamp or potted.

16. Tracks on P.C. boards not cut or broken.

17. Proper soldering of all solder connections.

18. Serial number tag installed.

19. P.C. boards and all components and parts clean of all solder and flux.

20. No scratches on chassis or units

21. All units to be blown out.

B. Electrical Inspection

1.0 SPECIFICATIONS: The following sequence of priority shall apply in determining the authority of specifications.

1.1 Customer documentation shall be governed and defined by his purchase order and shall establish first priority of authority.

1.2 Suplimental customer communications, when properly documented, can ammend ~~the~~ contractual requirements of the purchase order.

1.3 This specification shall have next priority.

1.4 Further process specifications shall ammend this procedure, when issued.

1.5 Test configuration and test equipment shall be arranged as shown in Dwg. Q-53-13498.

1.6 Input waveform of the supply line shall not contain more than 3% waveform distortion from a normal sinewave.

1.7 If the supply voltage is polyphase, the line to line unbalance must be less than 5% at the start of test. Line balance shall be verified with the unit operating at full load.

DISTRIBUTION

C	M

Written by	Approved	Revision	Issued	Page 2 of 8
[illegible] 11/25/81				

1.8 Adjustment shall be provided in the AC mains supply that will allow adjusting the input voltage to the unit under test (UUT), as measured at the input terminal connections, to be adjusted to the nominal input voltage, ± 1%, the maximum required input voltage + 2%, -0% and the minimum input voltage +0, -2%.

NOTE: Where "continuously" adjustable input voltage cannot be used (i.e. Input powers in excess of 48 KVA) step adjustments may be used and voltage adjustments made as close as possible to the required limits, with attempts made to have the input maximum in excess of the upper specification limit, and input minimum below the lower specification limit. If the input voltage tolerance of Paragraph 1.8 cannot be met the actual AC input as measured shall be recorded.

1.9 Input Metering Requirements

1.9.1 Input voltage to the UUT shall be measured with an AC voltmeter accurate to at least 1% and readable to 1%. Voltage measurements shall be made at the UUT input terminal connections. When testing a polyphase unit, measurements shall be made on all phases (not necessarily simultaneously) and the requirements of paragraph 3.2 verified. For recording data the mean reading of input voltage shall be used.

1.9.2 Input current to the UUT shall be measured with a current transformer type AC ammeter accurate and readable to at least 1%. Care shall be taken that the meter shall read only the UUT current. When testing a polyphase unit the current of each phase shall be monitored (not necessarily simultaniously) and the mean reading shall be the one recorded.

NOTE: If the UUT input current inbalance exceed 10%, discontinue testing.

1.9.3 Input power (watts) shall be measured with a suitable ranged dynamometer type wattmeter accurate and readable to at least 2%. On polyphase units the input connections, to the extent practicle, shall be the voltage measurement on the mean voltage phase, and the 2 current readings on the highest and lowest current phases (when unbalanced).

2.0 Output connections

Unless otherwise specified, the UUT output shall be connected to the resistive load bank cables and bundled together.

2.1 UUT output voltage shall be measured at the UUT output terminals with a meter accurate to ½%. Note: For routine testing of identical products, the voltage measurement may be made with an AC voltmeter accurate to 1% and repeatable to 1% provided that:

a. Periodically the product is verified to conform to specification requirements with a meter of ½% accuracy, and

b. The UUT performance is such that the worst case of meter error and unit performance combined will be within specification limits.

2.2 UUT output current shall be measured with a calibrated current transformer and voltmeter accurate to ½%. The current transformer shall be connected in accordance with Q-55-13498. Note: For routine testing of identical products the output current readings may be made with a calibrated direct reading ammeter or current transformer and voltmeter accurate to 2% provided that the output current is set by the load conditions such that the load current shall be at least 2% above the required FLC.

3.0 Proof of Performance Testing

3.1 Each new design and each unit of an established design, when of a nonhomogenious lot, shall be subjected to this test sequence.

3.2 Additonal units of a homogenious lot shall be tested in accordance with the same test sequence except that certain data requirements are eliminated as shown on the following Table 1.

3.3 Testing will be conducted as specified in section 5.6 and will normally be in the sequence listed in Table 1. However, for reasons of efficiency, the test sequence may be altered, provided that:

a. In all cases, the dielectric strength test must be performed before any other electrical testing is attempted, and

b. All of the tests required by Table 1 are completed.

DISTRIBUTION

C	M

TABLE 1

Test Name	Spec. Para.	Proof of Performance	Subsequent Item
Dielectric Strength	4.1	100%	100%
Circuit Operation	4.2	100%	100%
Range Adjustment	4.3	100%	100%
Voltage Regulation	4.4	100%	100%
Harmonic Distortion	4.5	100%	100%
Maximum Output Current Test	4.6	100%	-
Short Circuit Test	4.7	100%	100%
* Surge Withstand	4.8	100%	-
* Conversion Efficiency & Power Factor (when required by customer specification)	4.9	100%	-
High Voltage Shutdown	4.10	100%	100%
Maximum Credable Voltage Test	4.11	ON SAMPLE ONLY	

4.0 Detailed Test Procedures

4.1 Dielectric Test

The dielectric strength of the regulator shall be tested in accordance with the following table:

A. 1000 VAC plus 2 times the input voltage from the primary terminals to dead metal for 1 minute.

B. 1500 VAC from the output terminals to dead metal for 1 minute.

C. 1000 VAC plus 2 times the input voltage from the primary terminals to the output terminals for 1 minute.

For this test, all semiconductors, capacitors, and sensitive control components may be short circuited; printed circuit control boards may be removed.

* REQUIRED ON 1ST DESIGN TEST OF EACH REGULATOR TYPE ONLY.

4.2 Circuit Operation

Circuit operation testing shall proceed only after successful completion of the dielectric strength test.

4.2.1 Apply AC voltage to the UUT, while monitoring the input current, input voltage, output voltage, and the UUT meters. As soon as it is established that the UUT is performing properly, adjust the input AC to its nominal value, verify adjustment of controls, etc.

4.3 Range Adjustment

Range adjustment shall be performed with the UUT operating under nominal input conditions, and an output load of approximately 50%. The output voltage shall be continuously adjustable within ± 10% of the nominal output voltage rating.

4.4 Voltage Regulation

Voltage regulation testing shall be performed to demonstrate that the combined effects of line and load variations will not result in a deviation in regulator output greater than that allowed by the UUT specifications. Proper readings of meters should be noted during regulation testing.

Definitions of Regulation

$$\pm\% \text{ Regulation} - \frac{E(h) - E(1) \times 100}{E(h) + E(1)}$$

Where: E(h) is the highest UUT output voltage recorded.
E(1) is the lowest UUT output voltage recorded.

4.4.1 Voltage regulation records for performance testing will be taken with the UUT delivering nominal output voltage, resistive load connected, and the input voltages of rated low, nominal and high line. A minimum of five different levels of load current shall be taken as follows: 100% FLC, 75% FLC, 50% FLC, 25% FLC, 0% FLC.

4.4.2 Voltage regulation records for subsequent items need only have 3 load current variations recorded and when adequate data is available on any type design, nominal line readings may be omitted as well. (i.e. Readings at minimum and maximum input with 100% FLC, 50% FLC, and 10% FLC or "0" FLC as required.)

DISTRIBUTION

C	M

4.5 Harmonic Distortion Test

During the regulation test measure the output waveform harmonic distortion with a calibrated distortion analyzer. Harmonic distortion shall not exceed 5% of the fundamental waveform.

4.6 Maximum Output Current Test

At the completion of the regulation test, the load shall be increased as a step function until the current and voltage degins to decrease. This current shall not be more than 250% of full load rated output current. Measure and record this value of current.

4.7 Apply a bolted short circuit to the output terminals of the UUT. The value of input current under this condition shall not exceed 150% of the full load rated input current. Measure and record this value of current. The maximum transient input current of ½ cycle duration shall not exceed 300% of rated current and shall decay to a maximum of 150% after 1 cycle.

4.8 Surge Withstand Test

Perform surge withstand capability test in accordance with PCP Process Specification PS-79-5 and IEEE-472-1974.

4.9 Conversion Efficiency and Power Factor

4.9.1 The efficiency of the regulator shall be determined by measuring the total power at the input terminals by means of watt-meters and by measuring the RMS values of the output voltage and current at the output terminals at rated output. From the values thus measured, the efficiency shall be calculated as follows:

$$\text{Efficiency} = \frac{\text{Output WATTS}}{\text{Input WATTS}} \times 100$$

4.9.2 The power factor for single and three phase regulators shall be calculated as follows:

$$PF = \frac{\Sigma \text{ Watts Per Phase}}{\Sigma \text{ RMS VA Per Phase}}$$

For single phase regulators, the input watts can be measured with a suitable wattmeter and the volt amperes can be calculated from the measurements of the true RMS input current, using RMS responding meters.

DISTRIBUTION

C	M

For a balanced three phase source and load, the input power factor may be calculated as follows:

$$PF = \frac{\text{Input Watts}}{\sqrt{3}\ (\text{RMS Phase Volts})\ (\text{RMS Line Current})}$$

4.10 High Voltage Shutdown

Verify that the high voltage shutdown trips the input circuit breaker at 115% of rated output voltage.

4.11 Maximum Credible Voltage Test

A sequence of credible AC voltages shall be applied to all output for 1 min. These voltages and the manner of application shall be:

a. 144 V ac RMS min. applied between each line and ground
b. 305 V ac RMS min. applied between each line and ground
c. 250 V ac RMS min. applied between the output lines
d. 528 V ac RMS min. applied between the output lines

The regulators shall be fully loaded with a resistive load before and during the test.

The transient primary current during these tests shall not exceed 300 percent of rated primary current. No fire or explosion shall occur. The opening of the secondary winding is an acceptable occurance which is not a reason for failure since isolation is still maintained.

DISTRIBUTION

C	M

ATTACHMENT 2

Issue Date: January 22, 1982

power conversion products, inc.
crystal lake, Illinois 60014

TITLE
UNIT TESTING
CONFIGURATION
AC LINE REGULATOR

SCALE	DATE	DRAWN	CHECKED	APP
NONE		EA		

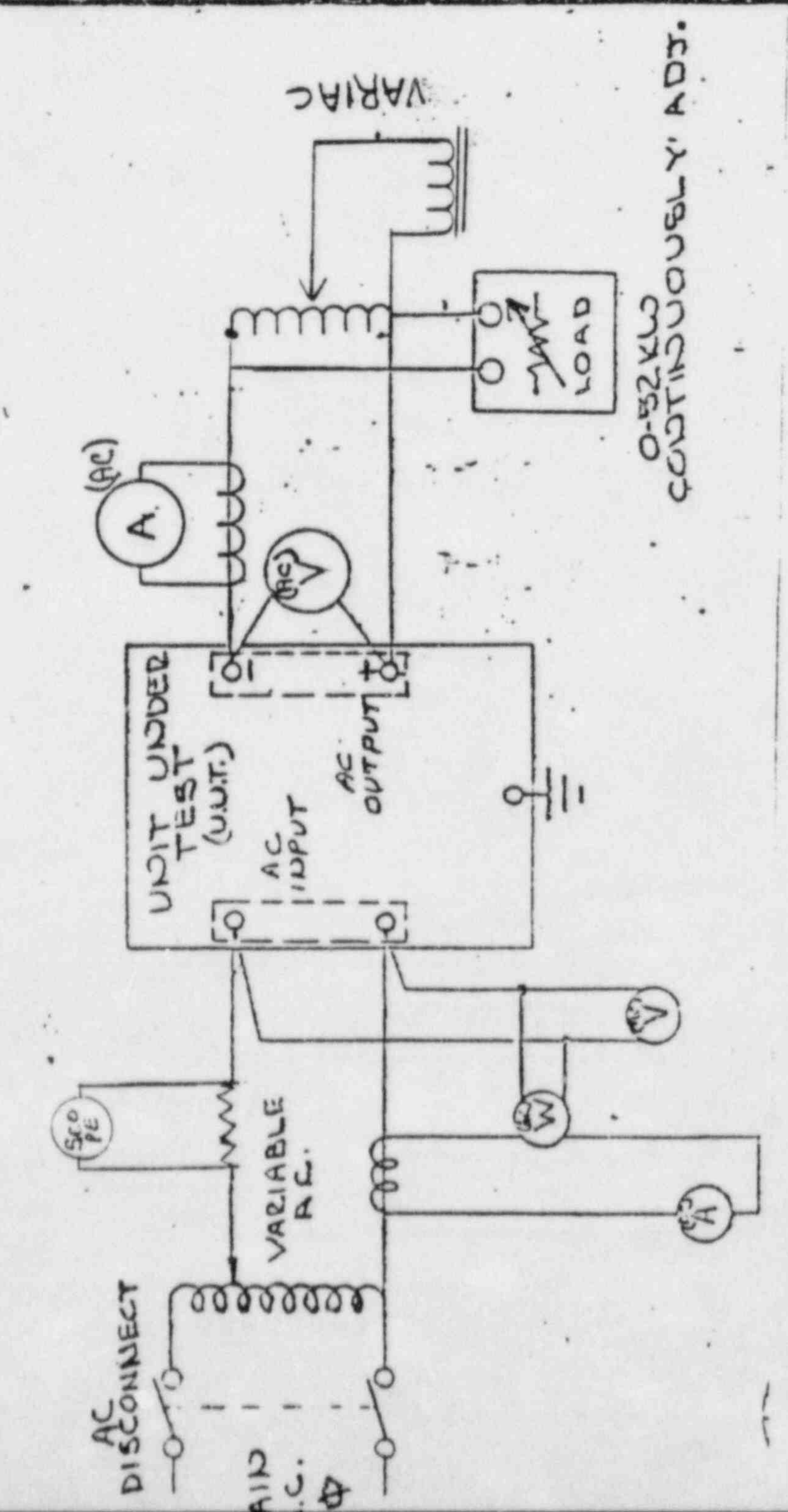
MATERIAL

WEIGHT PER 1000 PIECES

GROSS NET

TREATMENT AND FINISH

CUSTOMER'S NAME



forty two east street, crystal lake, illinois 60014, telephone: 815/459-9100, twx 910/634-3356

Issue Date: January 22, 1982

ATTACHMENT 3

FINAL INSPECTION DATA - PS-79-3

power conversion products inc. BY MC DATE 12-2-81

CUSTOMER Northeast Utilities PCP JOB 20489

MODEL RTF 120/120-5 SERIAL 20489-101 1st ____ SUBSQ ____

TESTED ON BENCH # 2

DESCRIPTION OF INSTRUMENTATION

DESCRIPTION	INSPECTION NO.	DESCRIPTION	INSPECTION NO.
INPUT VOLTS	IN297	WATTMETER	IN275
INPUT AMPS	IN281		
OUTPUT VOLTS	IN238		
OUTPUT AMPS	IN259	CURRENT TRANSFORMER	IN241
HI-POT TESTER	IN262		IN241
DISTORTION ANALYZER	IN272		

TEST DATA

SPEC. PARA.	DESCRIPTION	
4.1	DIELECTRIC STRENGTH	INPUT TO GROUND 7500, INPUT TO OUTPUT 1500 OUTPUT TO GROUND 1500
4.2	CIRCUIT OPERATION	VERIFIED X
4.3	ADJUSTMENT RANGE	OUTPUT VOLTS 92.2 TO 171.5
4.4	REGULATION	SEE REVERSE SIDE
4.5	HARMONIC DISTORTION	
4.6	MAXIMUM OUTPUT CURRENT TEST	MAXIMUM CURRENT 49.5 OUTPUT VOLTAGE 118.8 input current 55
4.7	SHORT CIRCUIT TEST	OUTPUT CURRENT 63
4.8	SURGE WITHSTAND TEST	PERFORMED YES X NO ____
4.9	CONVERSION EFFICIENCY AND POWER FACTOR	SEE REVERSE SIDE
4.10	HIGH VOLTAGE SHUTDOWN	TRIP VOLTAGE N/A

INPUT CONDITIONS FOR TESTS 4.3, 4.6, 4.7, 4.8, 4.9

PERFORMANCE [illegible] 1.0 Pow Factor

S/N 209 -101

MIN. AC 108 INPUT
Issue Date: January 22, 1982

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS KW	POWER FACTOR	EFFICIENCY	
42.0	120.3		1.9	50	5.27	0.98	96 %	
31.5	120.5		1.9	39	4.14	0.98	92	
21.0	120.5		2.2	27	2.89	0.99	88	
10.5	120.3		2.1	17	1.70	0.93	74	
0	120.2		1.9	10	.30	N/A	N/A	

NOM. AC 120 INPUT
60, Hz 1 Ø

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS KW	POWER FACTOR	EFFICIENCY	
42.0	120.1		1.1	46	5.26	0.95	96 %	
31.5	120.1		1.5	35	4.14	0.99	91	
21.0	120.2		1.8	24	2.87	1.00	87	
10.5	120.0		1.8	14	1.74	1.04	72	
0	119.9		1.6	—	.34	N/A	N/A	

MAX. AC 132 INPUT

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS KW	POWER FACTOR	EFFICIENCY	
42.0	119.6		1.0	43	5.26	0.93	95 %	
31.5	119.8		1.3	33	4.16	0.96	91	
21.0	119.9		1.6	22	2.92	1.01	86	
10.5	119.8		1.5	13	1.77	1.03	71	
0	119.7		1.4	—	.36	N/A	N/A	

PERFORMANCE DATA

.8 Po Factor

S/N 204 101

MIN. AC 108 INPUT

Issue Date: January 22, 1982

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS			
42.0	119.2		1.1					
31.5	119.5		1.0					
21.0	120.2		1.8					
10.5	120.7		2.7					
0	120.1		1.9					

NOM. AC 120 INPUT

60, Hz 1 P

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS			
42.0	120.1		1.4					
31.5	120.4		1.9					
21.0	120.8		2.7					
10.5	120.4		2.3					
0	119.9		1.6					

MAX. AC 132 INPUT

OUTPUT AMPS	OUTPUT VOLTS		HARMONIC DISTORTION	INPUT AMPS	INPUT WATTS			
42.0	120.6		2.3					
31.5	121.1		2.9					
21.0	121.3		3.3					
10.5	120.2		2.0					
0	119.7		1.4					

Issue Date: January 22, 1982
Isolation Test on A current limiting and Isolating Voltage Regulators
Specification No. 2421.500-608 conducted on December 3, 1981

ATTACHMENT #4

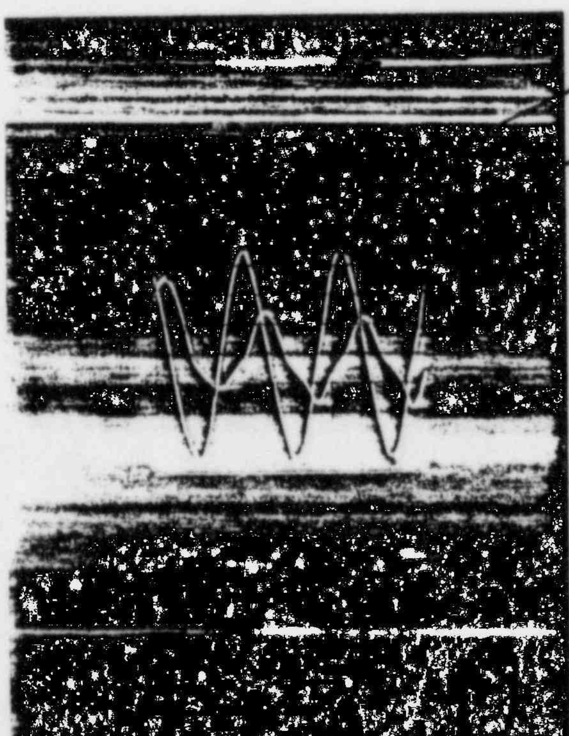
Run #1
Full Load
1.0 P.F.
Shorted
Involt =119.9V
Primary AMP 63A

Voltage
120V RMS

Current
I peak=1.5 I rated

Current
Ipeak=2.6 I rated

Voltage
120V RMS



Voltage
120V RMS

Current
I peak=Irated

Run #2

Full Load
1.0 P.F.
Shorted
Involt=120.1V
Primary AMP-63A

Run #3

Full Load
1.0 P.F.
Unshorted
Steady State

Issue Date: January 22, 1982

Run #4
Full Load
0.8 P.F. Lag
Involt=116V
Primary AMP=59A

Run #5
Full Load O
0.8 P.F.
Involt= 116V
Primary AMP=59A

Voltage
120V RMS

Current
I peak=1.9
I rated

Current
Negative Peak
I peak-2.9
I rated

Voltage
120V RMS

Current
I peak=1.
I rated

Current
Neg. Peak
I peak=3.0
I rated

Current
I peak=3.3
I rated

Voltage
120V RMS

Run #6
Full Load
0.8 P.F. Lag.
Involt=116V Primary AMP=59A

J.O.No. 12179
NES- 26902
February 25, 1982
NOTES OF CONFERENCE
ISOLATION TRANSFORMER 2421.500-608
TESTING WITH INVERTER SUPPLY
MILLSTONE NUCLEAR POWER STATION - UNIT 3
NORTHEAST UTILITIES SERVICE COMPANY

Held in the Offices of
Elgar Corporation
San Diego, California

February 2, 1982

Present for Elgar
Corporation (EC) -

Messrs: J. Reed
H. MacAlpin
M. Carle

Present for Power Conversion
Products, Inc. (PCP) -

Mr. T. Caroway

Present for Stone & Webster
Engineering Corporation (SWEC)

Mr. J. LaMarca

PURPOSE

The purpose of this meeting was to test an isolation transformer from an inverter supply similar to the safety-related 120V vital bus supply on Millstone 3.

DESCRIPTION

The test procedure which was followed during this test sequence was written by the SWEC equipment specialist and is included as Attachment 1. A description of the inverter used as the supply for the test is included as Attachment 2. The inverter did not include a solid state switch as the Millstone 3 units will contain; however, EC states that at 150 percent overload the solid state switch will transfer to the secondary source supplied by a MCC through a regulating transformer without any discontinuities in the voltage or current waveforms. Twelve different oscillogram traces of current and voltage input to the isolation transformer were made to document the test data. These traces are labeled Trace A through Trace L and are included as Attachment 3. A sketch of the test circuitry is included as Attachment 4.

The isolation transformer under test was a Power Conversion Product Model RTF-120/120-5, 5 KVA, 120 Volt-48 amp input, 120 Volt-42 amp output as specified for use as the isolation device between the safety-related 120V ac vital bus and the nonsafety-related 120V ac nonvital bus.

Traces A, B, C and D were made to comply with the requirements of Test 1 (see Attachment 1). The inverter was used as the power source for Traces A and B while an outside source (stiff source) was used for Traces C and D. Traces E And F were recorded for Test 2, G and H for Test 3, and, I and J for Test 4. Traces K and L show the starting characteristics of the isolation transformer with no load and full load connected to the secondary winding.

The failure criteria for the test was either shutdown of the inverter after the short circuit was applied to the isolation transformer secondary winding during any test or unacceptable deviations from the specified inverter output requirements due to the isolation transformer.

The inverter during any of the tests did not shutdown or current limit which would occur prior to shut down. The maximum peak current recorded was 211 amperes (149 x $\sqrt{2}$ from test) while the maximum that the inverter can supply before it begins to current limit is 332 amperes peak (150% of rate peak current).

The voltage waveshape on the oscillogram increased about 10 percent on a continuous basis after a short circuit was applied. EC explained the occurrence as a change in crest factor due to redistribution of harmonics in the pulse-width modulated wave of the inverter output and that all of the specified requirement were still met. The SWEC equipment specialist will be asked to review this data for his concurrence.

In addition to the test itself, the isolation transformer arrived at EC in a slightly damaged state. Two capacitors from the A2 printed circuit board had fallen off and paint on the inside front cover had scratched off. Apparently the A2 board was mounted too high and resulted in interference with the front cover. PCP said a fix was being investigated.

JL:CAM

ATTACHMENT 1 NES-I6902

TEST PROCEDURE

Test #1 a. No load at the output of the regulating transformer.

b. No additional load on the bus.

c. Apply a short circuit to the output of the regulating transformer.

d. Observe the output of the inverter during the application of the short.

Test #2 a. Apply 5 kW load, resistive, to the output of the regulating transformer.

b. No additional load on the bus.

c. Apply a short circuit to the output of the regulating transformer.

d. Observe the output of the inverter during th application of the short.

Test #3 a. Apply 5 kW load, rsistive, to the output of the regulating transformer.

b. Load the bus with an additional 20 kW, resistive, load.

c. Apply a short circuit to the output of the regulating transformer.

d. Observe the output of the inverter during the application of the short.

Test #4 a. Remove the load from the output of the regulating transformer.

b. Load the bus with 20 kW, resistive, load.

c. Apply a short circuit to the output of the regulating transformer.

d. Observe the output of the inverter during the application of the short.

NOTE: During the above tests, an oscilloscope shall be connected to the output of the inverter. The scope shall be equipped with a camera to photograph the transients produced during the application of the short circuit to the output of the regulating transformer. The oscilloscope shall not be triggered internally but rater from an external source if only a few cycles are to be observed (1 to 10 cycles).

There is no need to observe the wave shape in detail; only peak values are of interest, a sweep speed of 200 Sec per CM would be adequate. The above is a voltage measurement of the inverter output.

The output current of the inverter should also be monitored using a shunt or an inductive pickup probe and again a sweep speed of 200 Sec per CM would be adequate.

an Onan power systems company
8225 Mercury Court
San Diego California 92111
TWX 910 335 1246

ATTACHMENT 2

PERFORMANCE SPECIFICATION FOR DC TO AC STATIC INVERTER

ELGAR MODEL NO. INV 253-1-101

Elgar Model No. INV 253-1-101, Solid State DC to AC Static Inverter was designed for a Nuclear Safety Related Class 1E application.

1. A. DC Input Power Requirements: 105 to 140 VDC, 300 amperes maximum.
   B. Bypass Input Power: 120 VAC, 1 phase, 2 wire, 60Hz, 208 amperes.
   C. Auxilliary Input Power 120 VAC, 1 phase, 60Hz, for space heater only - 88 watt rating at 120 VAC.
2. Output Power Rating: 25KVA continuous (208 amperes)
3. Output Power Configuration: 120 VAC, 1 phase, 2 wire, 60Hz
4. Output Characteristics:
   A. Static Voltage Regulation: ± 2%
   B. Dynamic Voltage Regulation:
      1) 15% maximum peak-to-peak output voltage deviation for a 100% resistive step load change.
      2) 10% maximum peak-to-peak output voltage deviation for a 50% resistive step load change.

      Note: Recovery to the regulation band limits will occur within three cycles after initiation of (1) or (2) above.
   C. Output Frequency Stability: 60Hz ± .01% (free running frequency non-sync operation)
   D. Total Harmonic Distortion: 5% maximum
   E. Load Power Factor Range: 0.7 lagging to unity
   F. Overload Rating: 125% for 2 hours
      150% for 1 minute
   G. Short Circuit Protection: Electronic Current Limiting above 150% of unit output rating.
5. Efficiency: Efficiency figures are based on resistive loads and apply for 135 VDC or 105 VDC inputs.

% Load	Efficiency %
25	78
50	84
75	86
100	86

continued...

6. Front Panel Controls:
   A. DC Input Circuit Breaker
   B. DC Precharge Pushbutton
   C. Inverter Output Circuit Breaker
   D. Output AC Ammeter/Voltmeter Phase Selector Switch
   E. Break-Before-Make three position output transfer switch - "Inverter-Off-Bypass"
   F. Synchronization Enable Pushbutton Switch

7. Metering:
   A. DC Input Voltmeter (0-200 VDC)
   B. DC Input Ammeter (0-400 ADC)
   C. AC Output Voltmeter (0-150 VAC)
   D. AC Output Ammeter (0-300 AAC)
   E. Output Frequency Meter (57-63Hz)
   F. AC Bypass Input Voltmeter (0-150VAC)
   G. AC Bypass Input Ammeter (0-300 AAC)

8. Front Panel "LED" Indicators
   A. Reverse Polarity
   B. Overload
   C. DC Fuse Open
   D. AC Output High
   E. AC Output Low
   F. Input DC Low
   G. Fan Failure
   H. Output Breaker Tripped
   I. Loss of Sync
   J. Transfer Switch Not On Normal Source
   K. Bypass - Transfer Switch Position
   L. Off - Transfer Switch Position
   M. Inverter - Transfer Switch Position

Continued...

9. Remote Alarm Contact Closure (Opens for Alarm)

   This is a summary alarm that is activated by the following conditions.

   A. Output or Input Breaker Tripped

   B. Overload

   C. Output Voltage Low

   D. Output Voltage High

   E. Input DC Voltage Low

   F. Fan Failure

   G. Loss of Sync

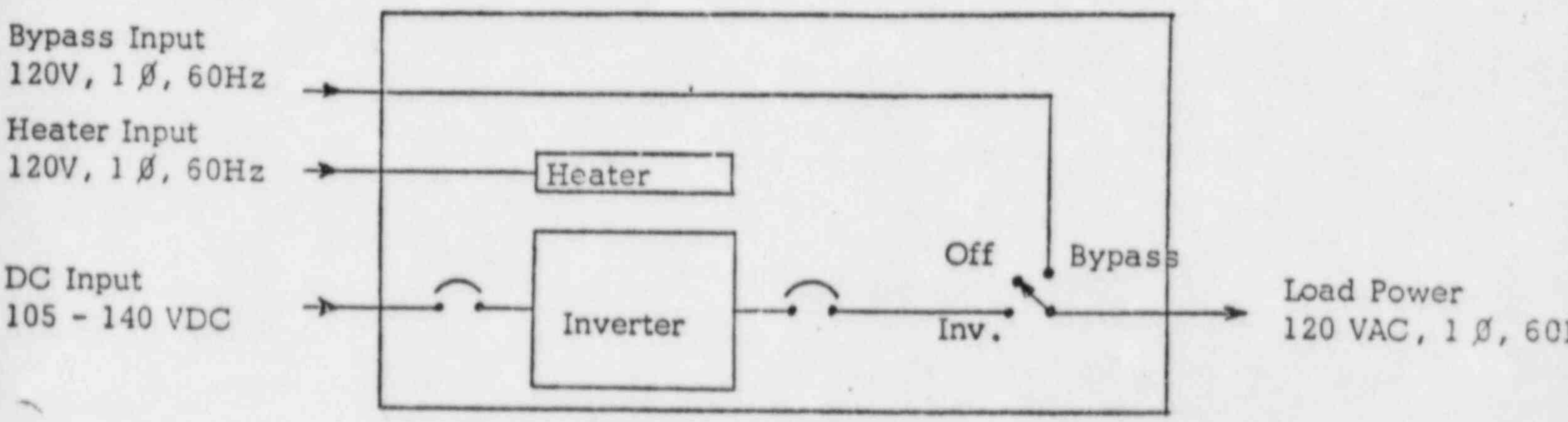
   H. Transfer Switch Not On Normal Source

10. Physical Size and Weight: Refer to Elgar Drawing No. 643-201-7X entitled, "Installation Drawing Inverter 253-1-101"

11. Operating Temperature Range: $10^\circ C$ to $50^\circ C$ at 50% Relative Humidity

12. Cooling: Forced Air - 2000 SCFM Top Discharge

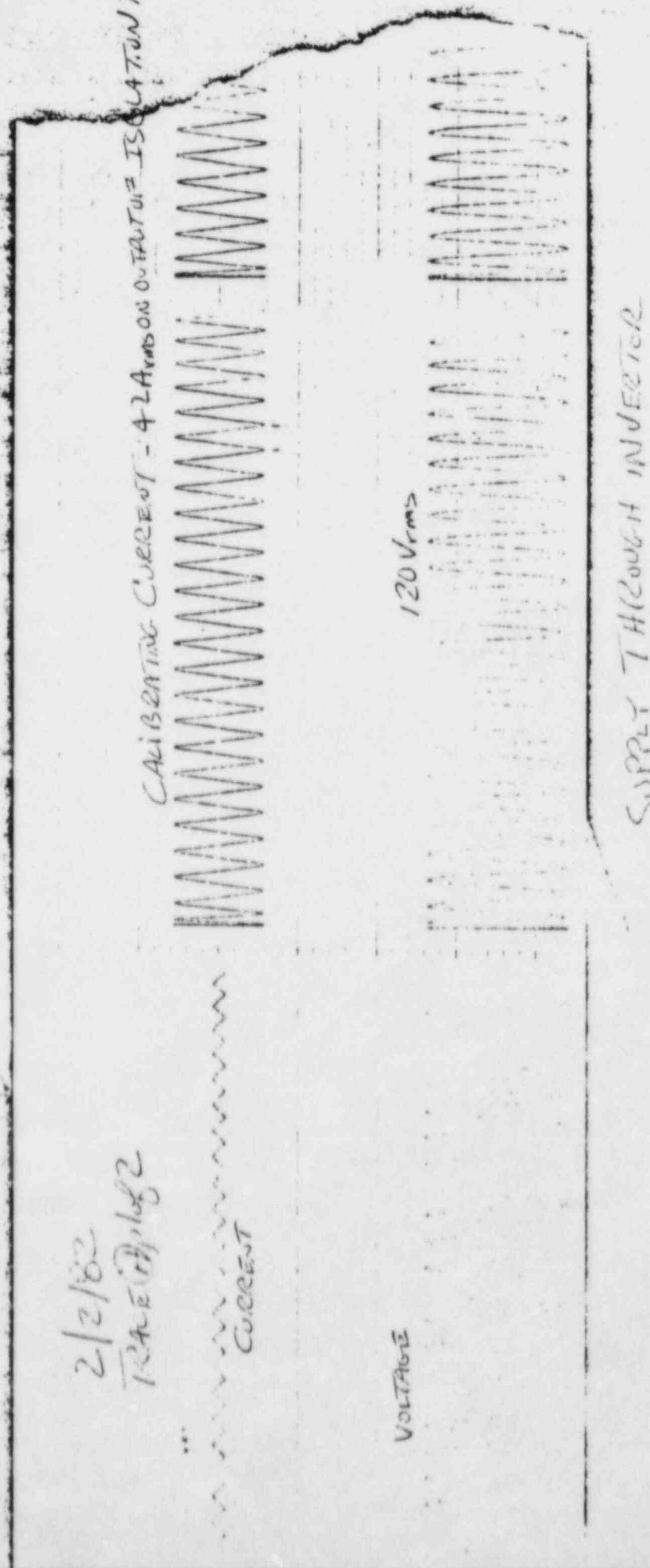
J. Reed
3/17/80



INV 253-1-101 One Line Diagram

J. Reed
3/17/80

ATTACHMENT 3

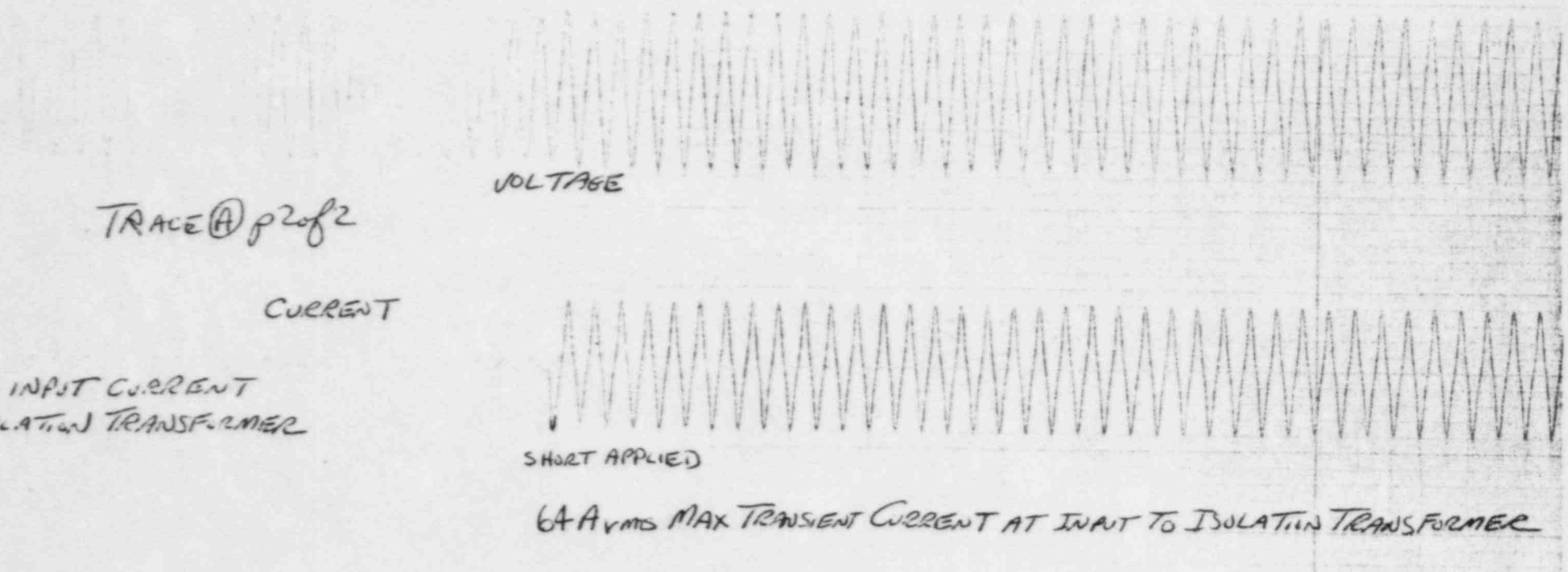


TRACE (A)

2/2/82

120 V_{rms} SOURCE BY INVERTOR

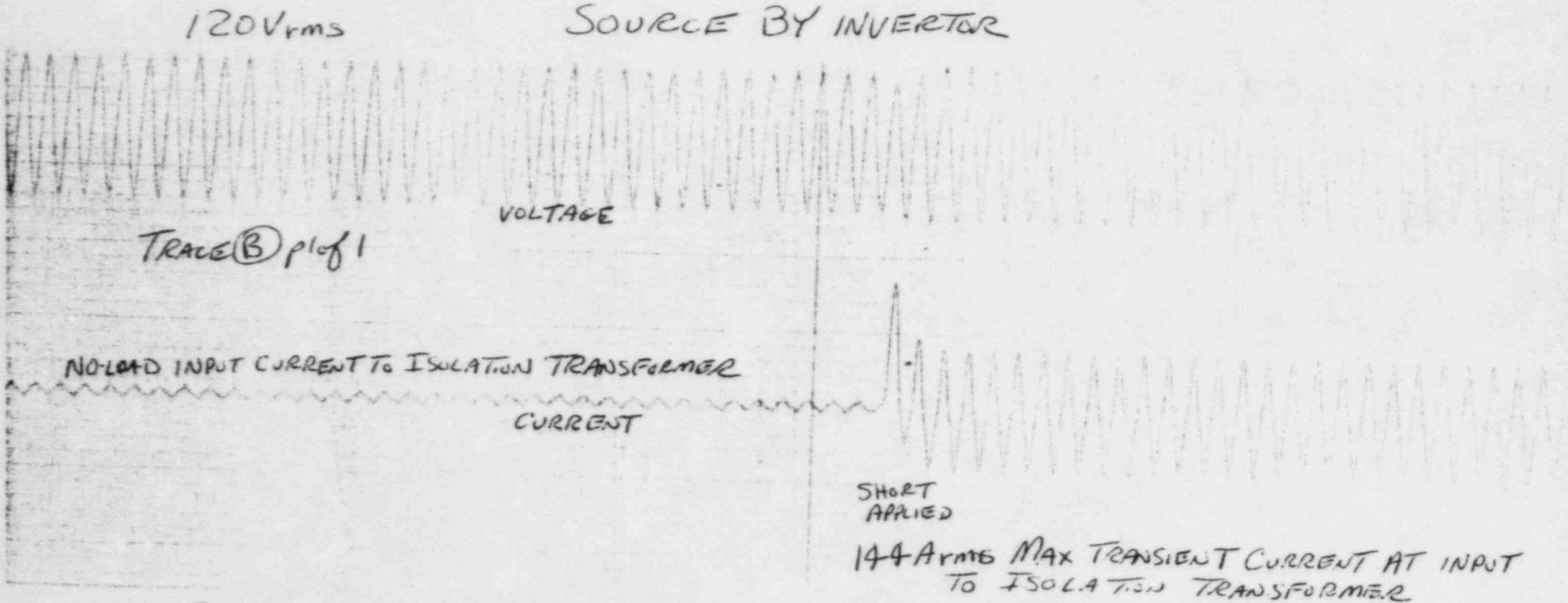
TRACE (A) p 2 of 2



SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH NO LOAD CONNECTED TO EITHER THE ISOLATION TRANSFORMER OR THE INVERTER

TRACE (A)

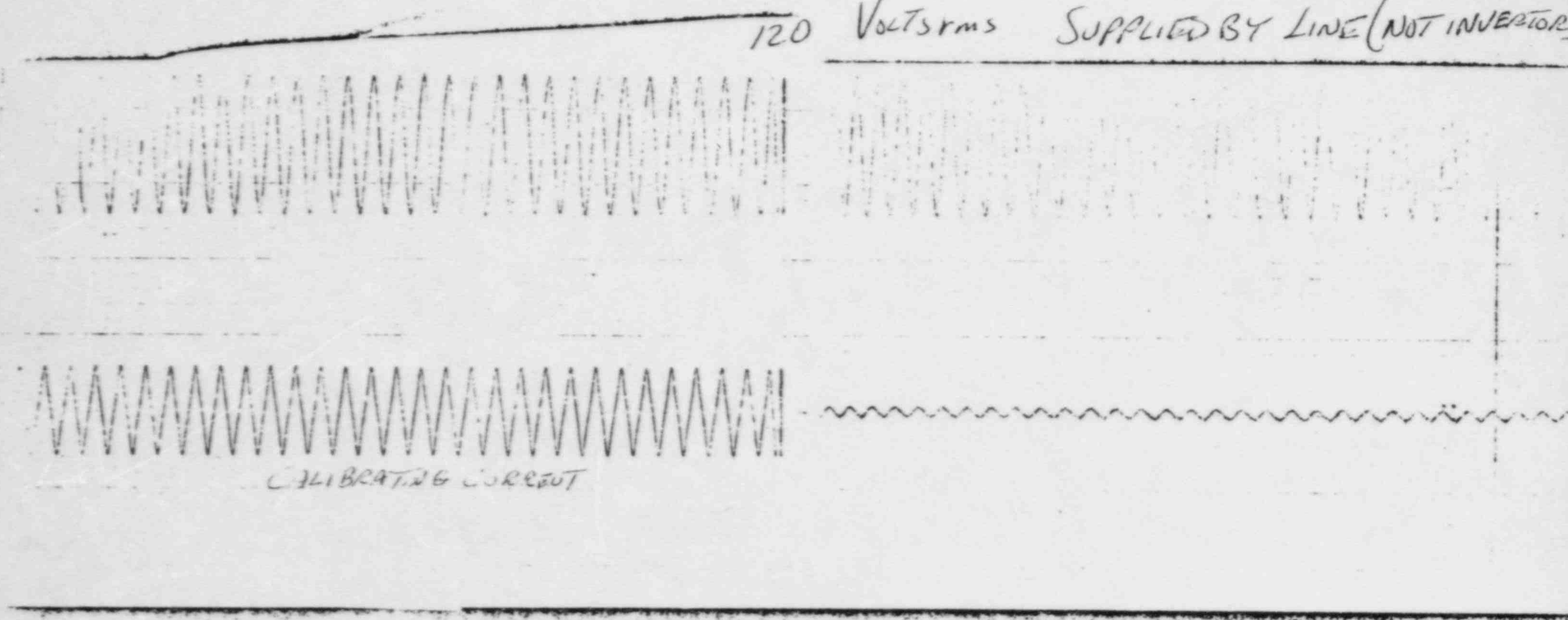
2/2/82



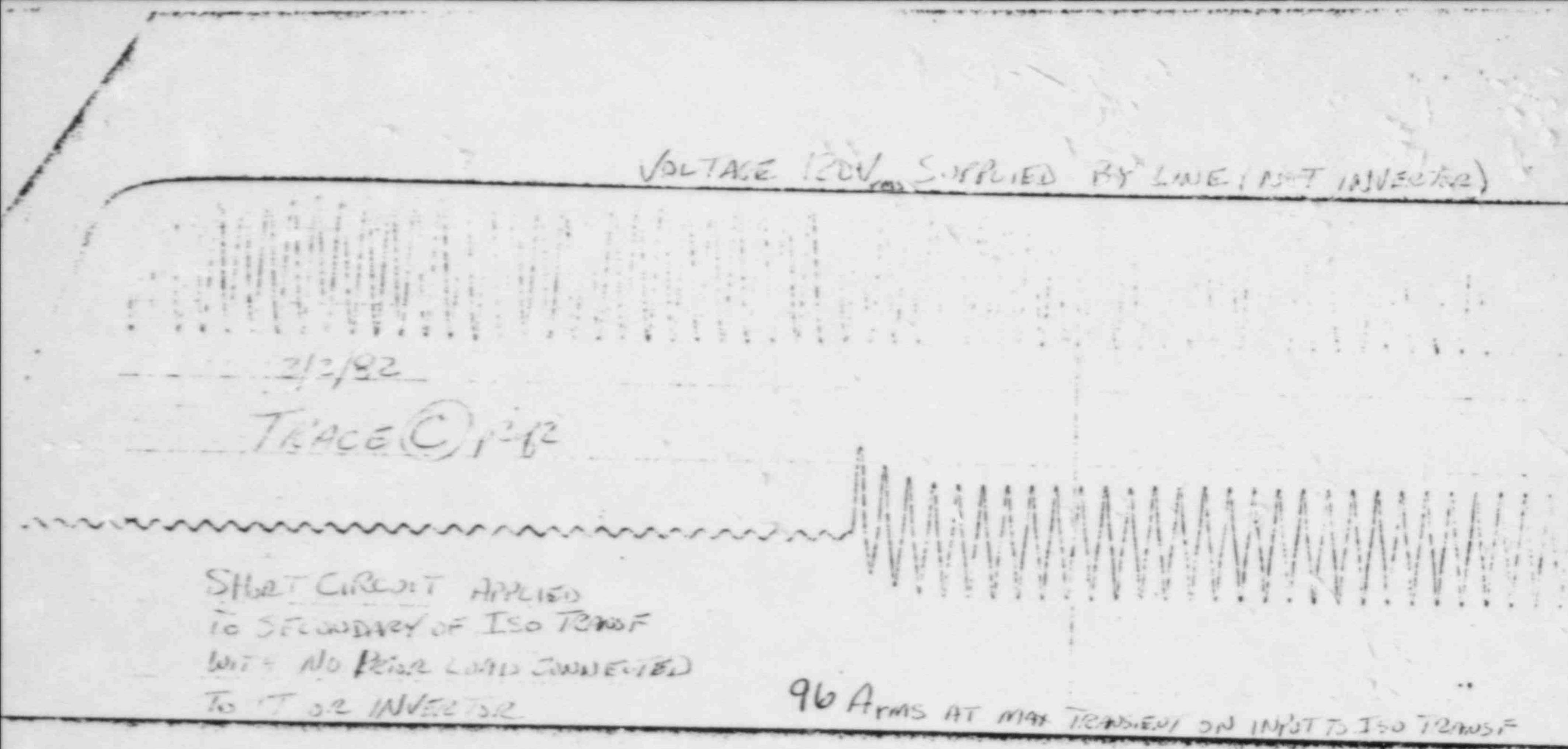
SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH NO LOAD CONNECTED TO EITHER THE ISOLATION TRANSFORMER OR THE INVERTOR.

TRACE (B)

TRACE (C) Page 1 of 2
2/2/82

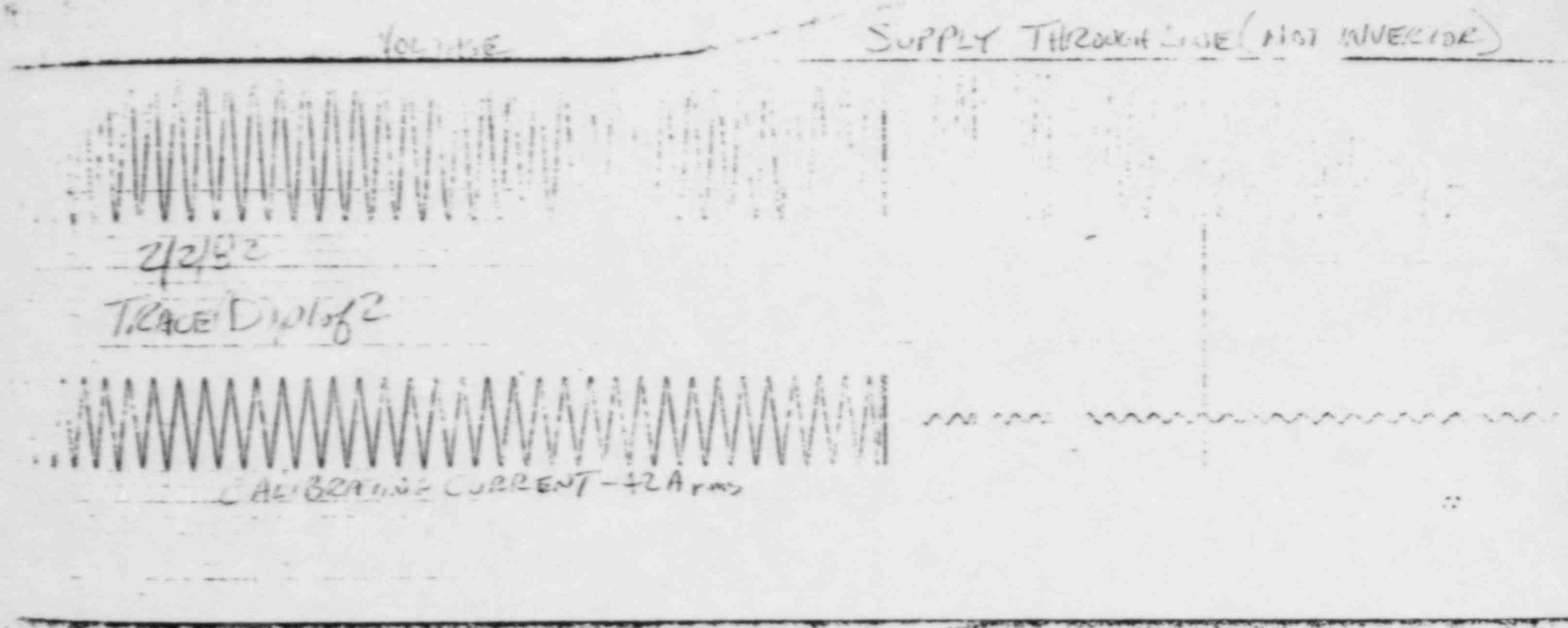


TRACE (C)


VOLTAGE 120V rms SUPPLIED BY LINE (NOT INVERTER)
2/2/82
TRACE (C)
SHORT CIRCUIT APPLIED
TO SECONDARY OF ISO TRANSF
WITH NO PRIOR LOAD CONNECTED
TO IT OR INVERTER
96 Arms AT MAX TRANSIENT ON INPUT TO ISO TRANSF

TRACE (C)

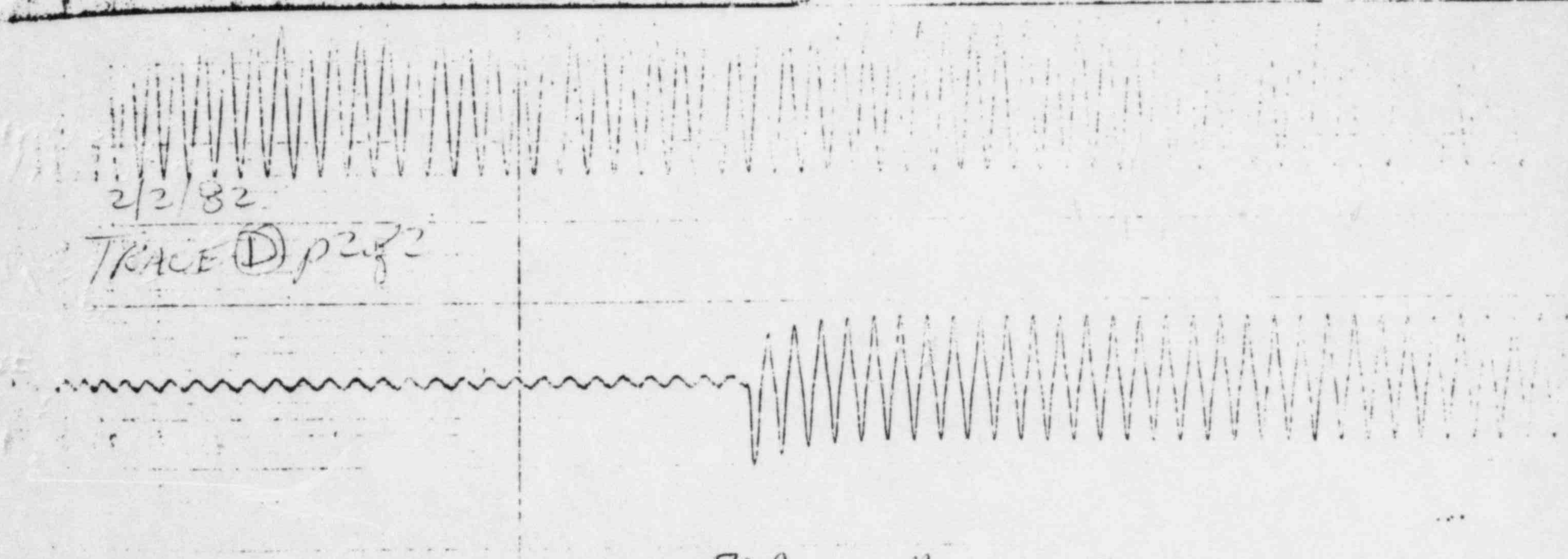
(1)



VOLTAGE
SUPPLY THROUGH LINE (NOT INVERTOR)
2/2/82
TRACE D pl of 2
CALIBRATING CURRENT - 42 A rms

TRACE (D)

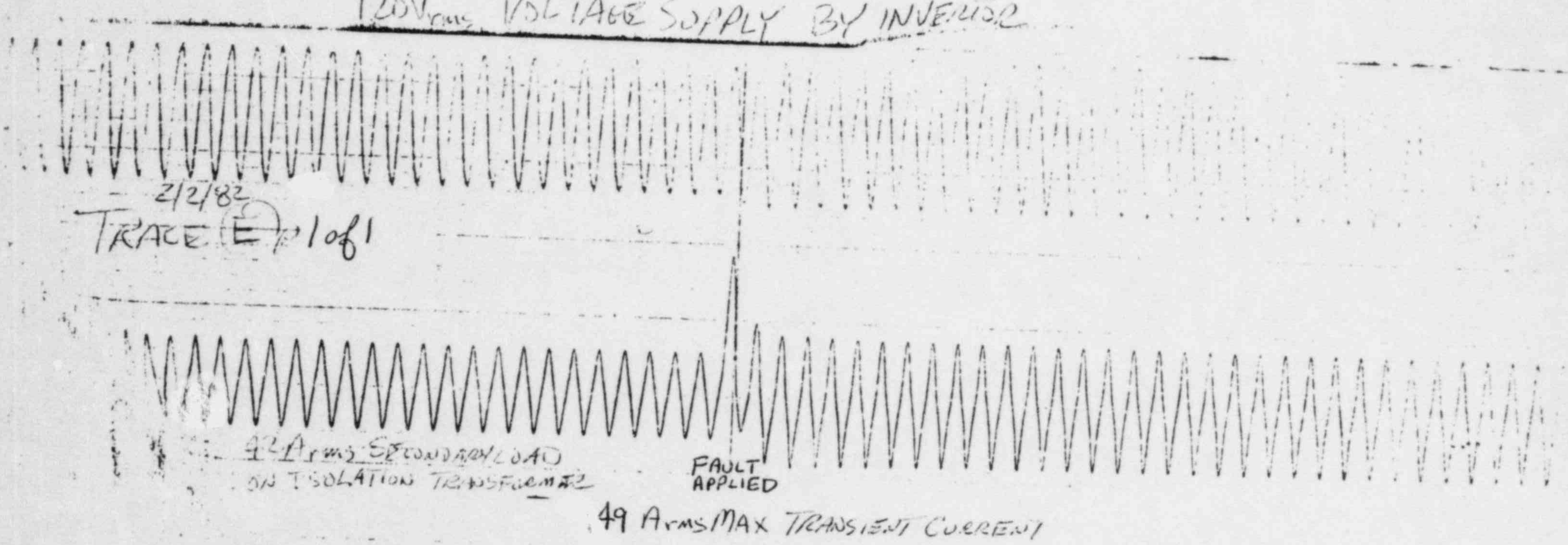
VOLTAGE SUPPLIED BY LINE (NOT INVERTOR)



80 Amps rms Ma. TRANSIENT

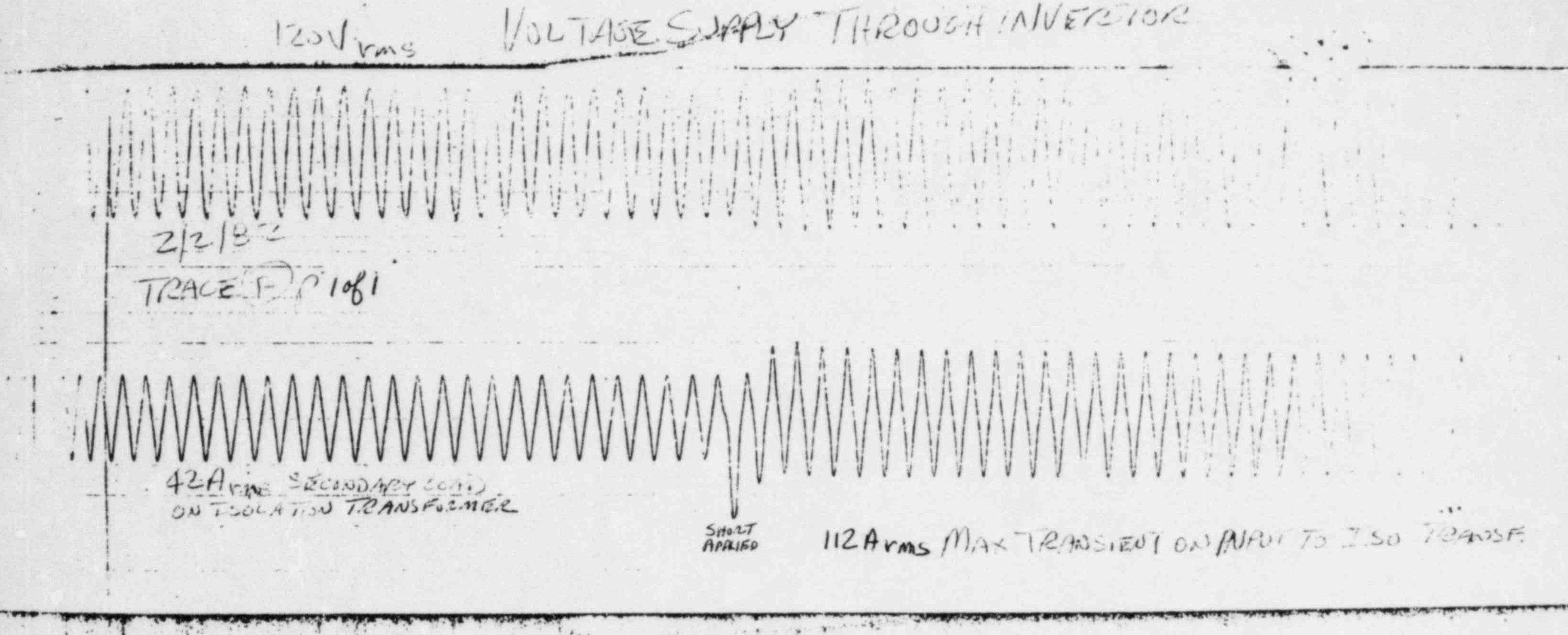
SHORT CIRCUIT APPLIED
TO SECONDARY OF ISOLATION
TRANSFORMER WITH NO
PRIOR LOAD CONNECTED TO
EITHER THE ISO TRANSF. OR
THE INVERTOR

TRACE (D)



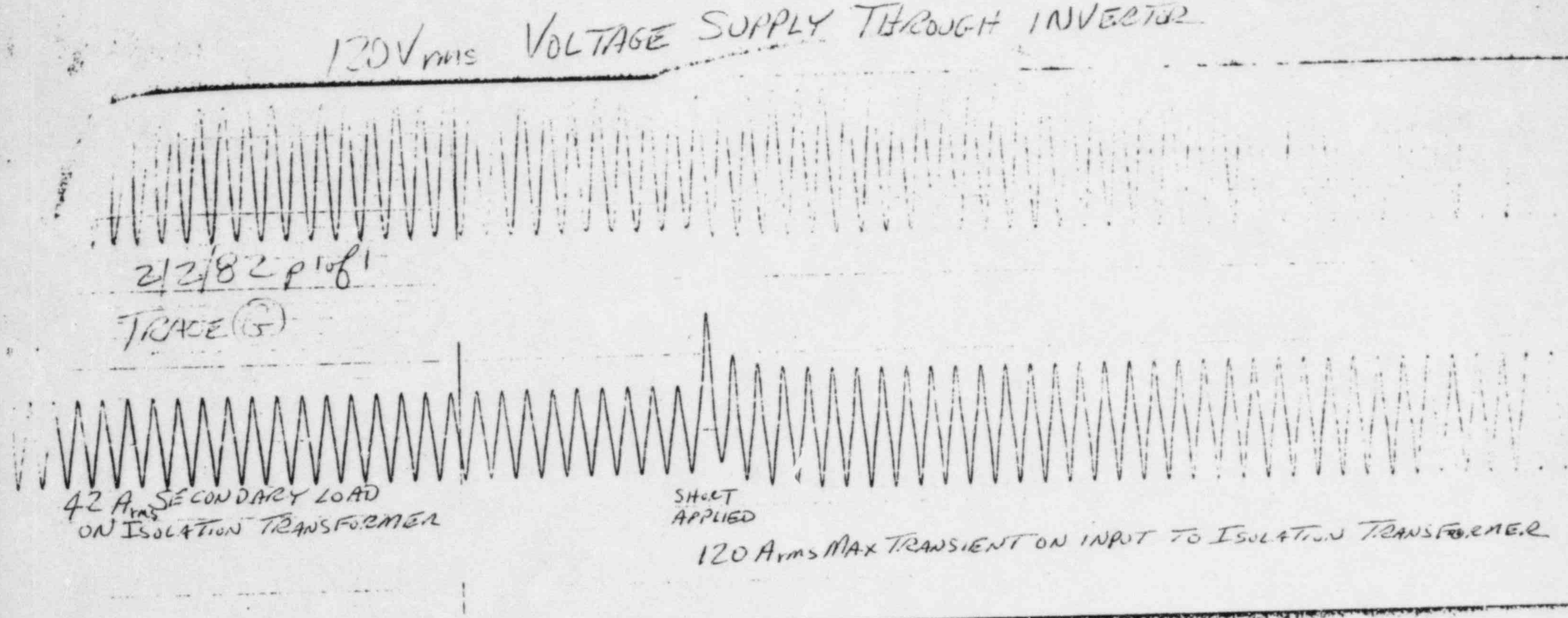
Short Circuit Applied to Secondary of Isolation Transformer with 5KW of load (42Arms) connected to the Iso. Transf. had no other load connected to the inverter

Trace (E)



SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH 5KW OF LOAD (42 A rms on secondary) CONNECTED AND NO OTHER LOAD ON INVERTER

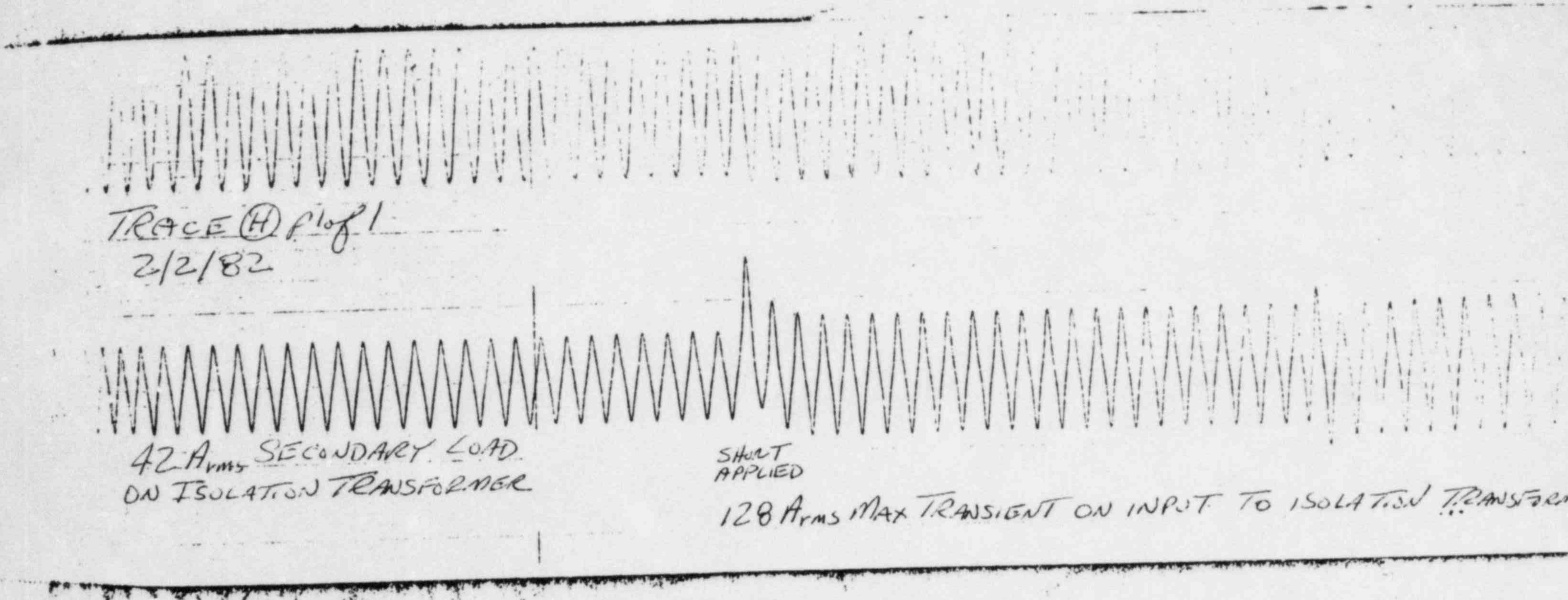
TRACE (F)



SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH 5KW OF LOAD CONNECTED AND WITH AN ADDITIONAL 20KW OF LOAD CONNECTED TO THE INVERTOR

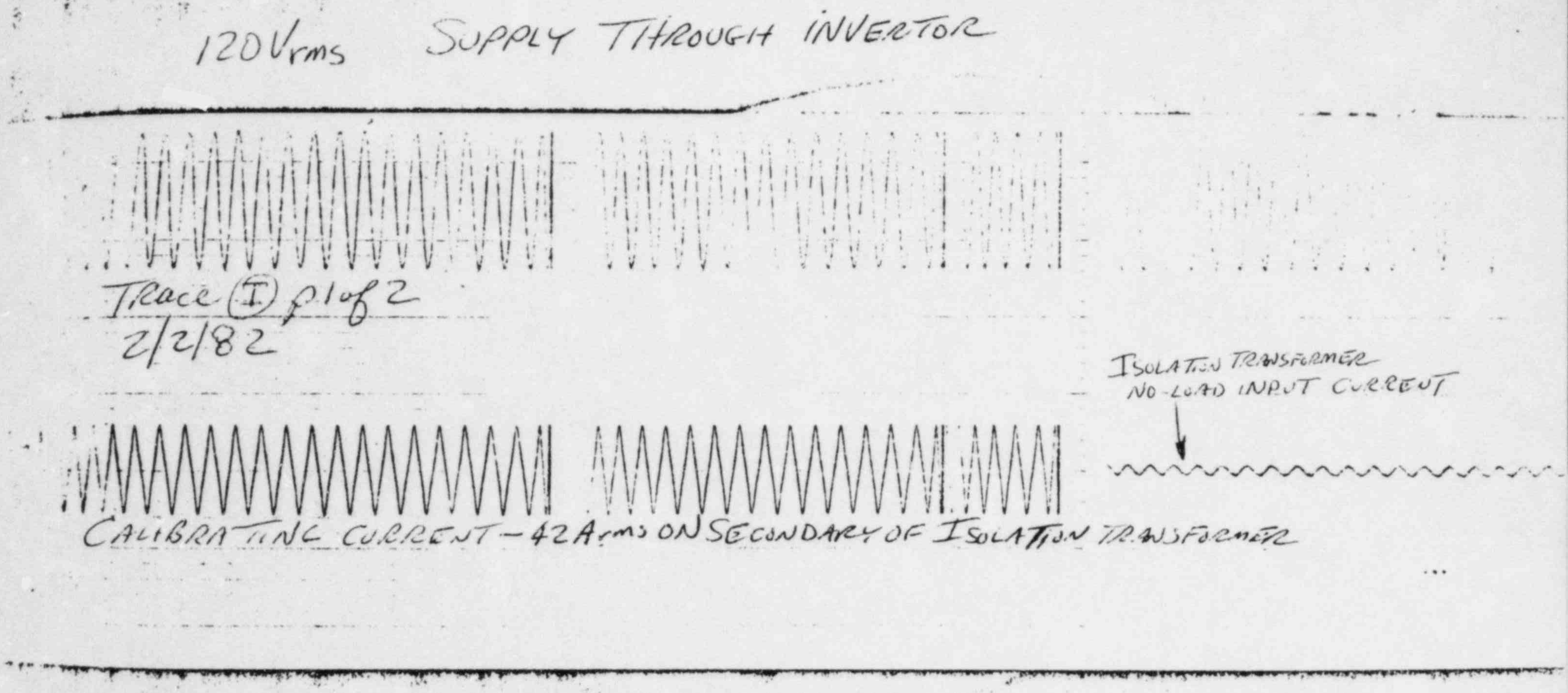
TRACE (G)

120 V_{rms} SUPPLY THROUGH INVERTER



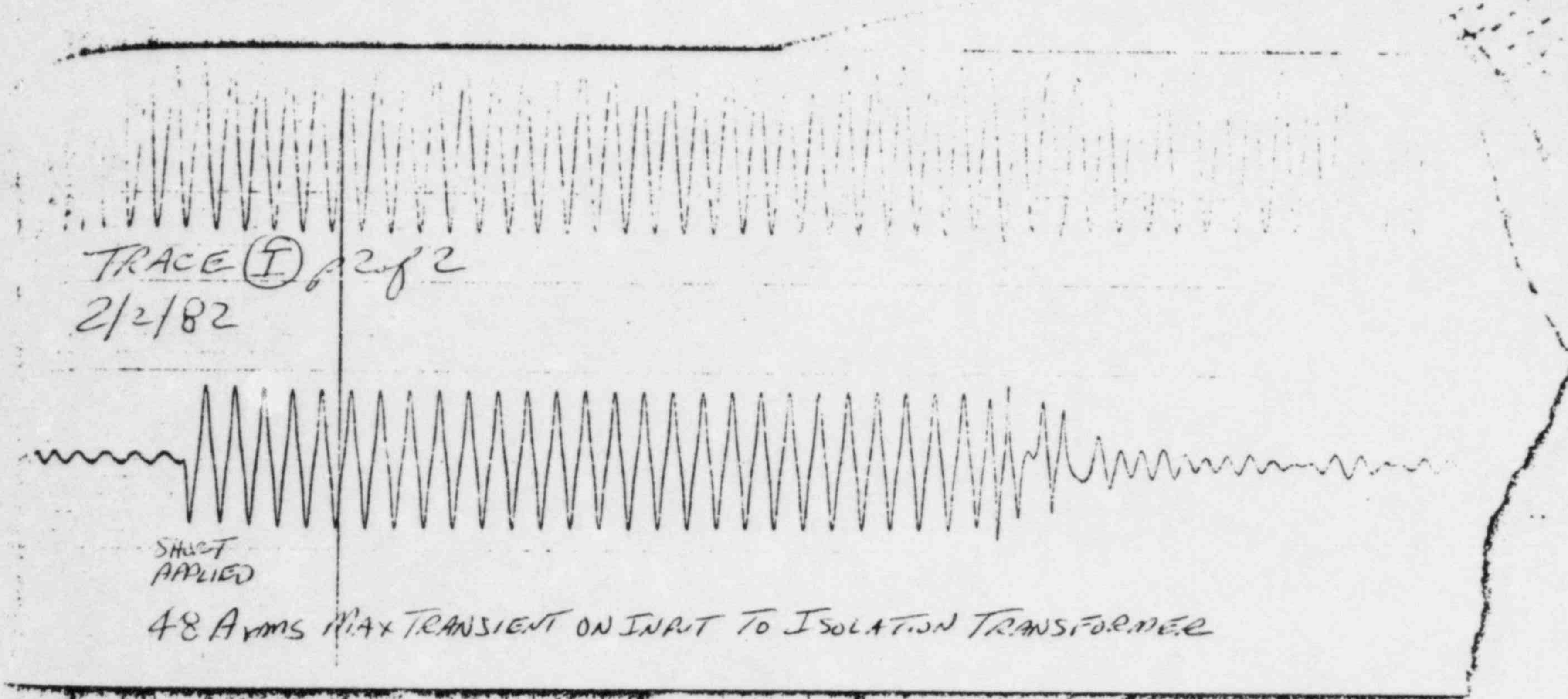
SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH 5KW OF LOAD CONNECTED AND WITH AN ADDITIONAL 20KW OF LOAD CONNECTED TO THE INVERTOR

TRACE (H)


120 Vrms SUPPLY THROUGH INVERTOR
TRACE (I) p1 of 2
2/2/82
ISOLATION TRANSFORMER
NO-LOAD INPUT CURRENT
CALIBRATING CURRENT - 42 Arms ON SECONDARY OF ISOLATION TRANSFORMER

TRACE (I)

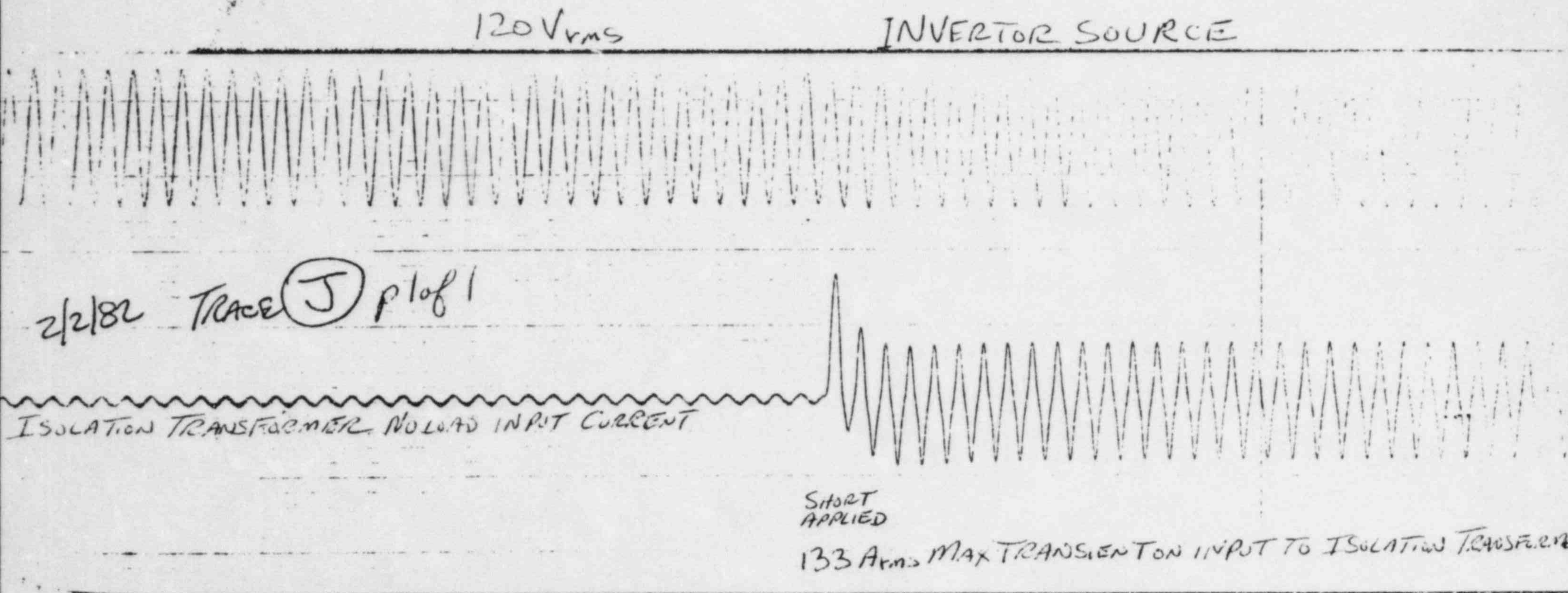
120 V_{rms} SUPPLY THROUGH INVERTOR



(9)

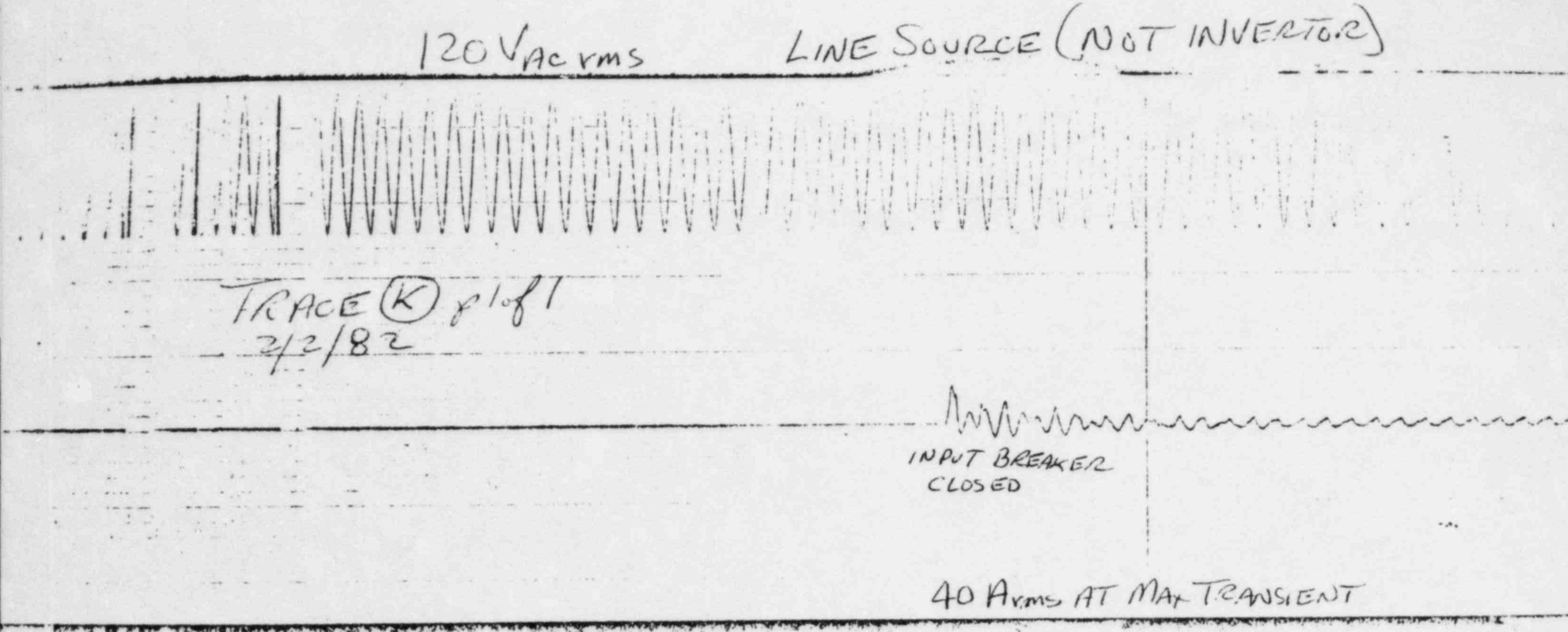
SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH NO LOAD CONNECTED BUT WITH THE INVERTOR PRE-LOADED TO 20KW

TRACE (I)



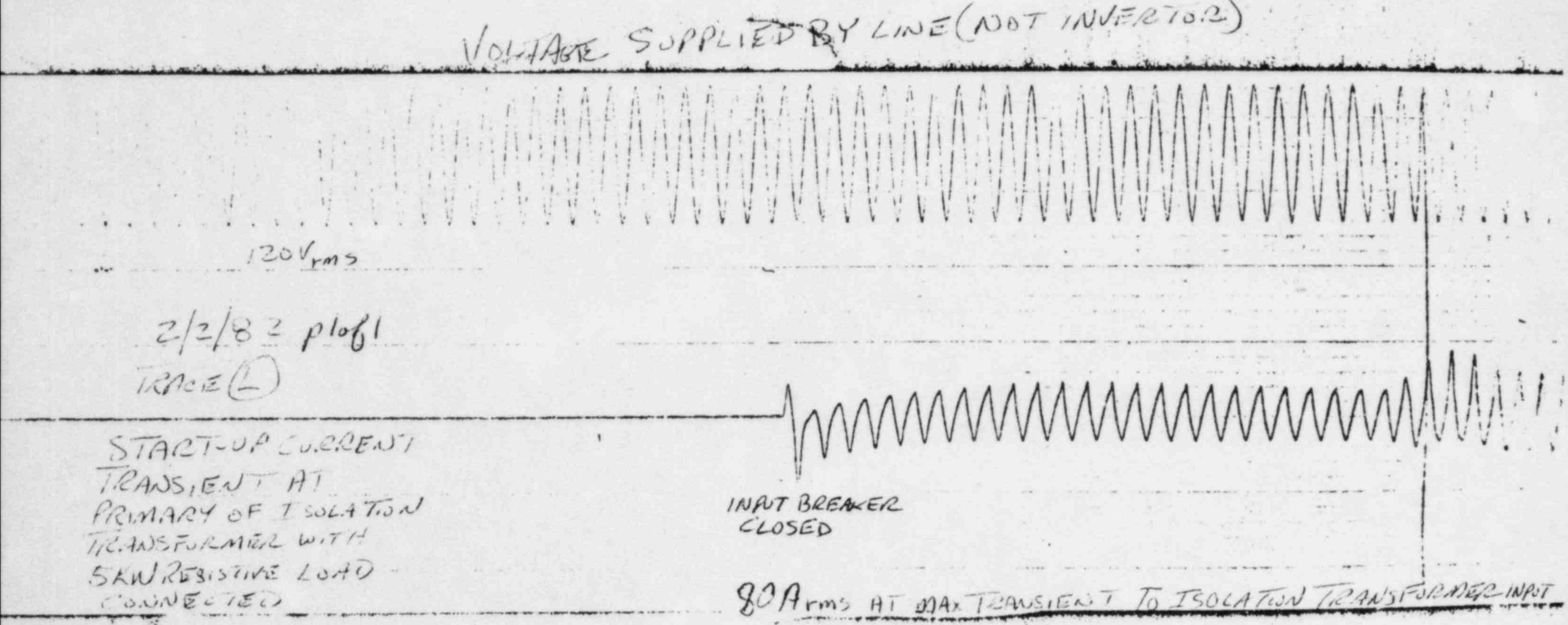
SHORT CIRCUIT APPLIED TO SECONDARY OF ISOLATION TRANSFORMER WITH NO LOAD CONNECTED BUT WITH THE INVERTOR PRE-LOADED TO 20KW

TRACE (J)



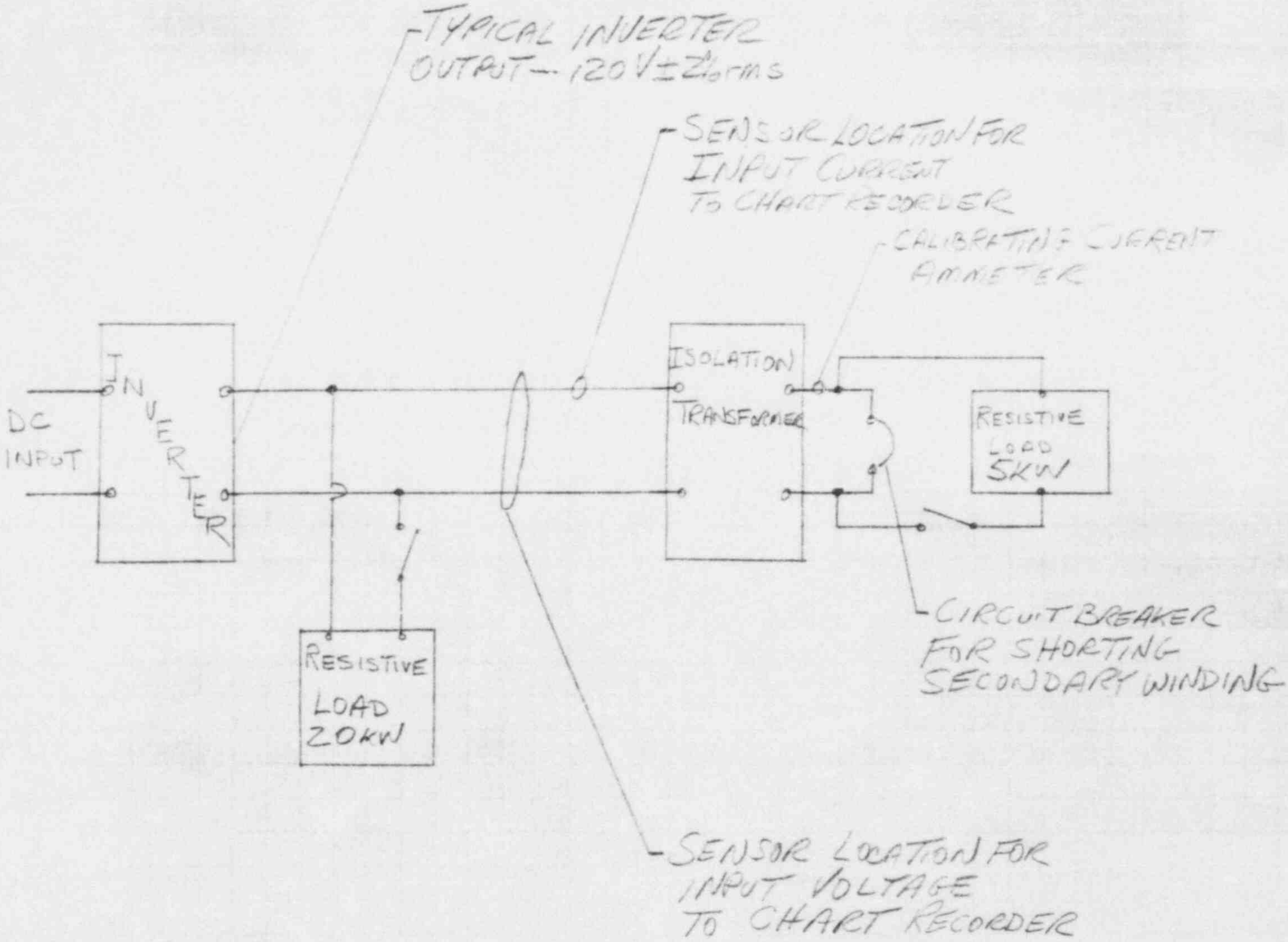
START-UP CURRENT TRANSIENT
AT INPUT TO ISOLATION TRANSFORMER
WITH NO LOAD CONNECTED

TRACE (K)


VOLTAGE SUPPLIED BY LINE (NOT INVERTOR)
120 V_{rms}
2/2/82 p1of1
TRACE (L)
START-UP CURRENT TRANSIENT AT PRIMARY OF ISOLATION TRANSFORMER WITH 5KW RESISTIVE LOAD CONNECTED
INPUT BREAKER CLOSED
80 A_{rms} AT MAX TRANSIENT TO ISOLATION TRANSFORMER INPUT

TRACE (L)

ATTACHMENT 4
TEST CIRCUIT



power conversion products inc.

Date: September 21, 1982

P. O. Number: 2421.500-608

Stone & Webster Engineering Corp.
245 Summer Street
Boston, Massachusetts 02107

Factory Number: 20489

Station: Millstone Nuclear Power Station - Unit 3

Attn: Lead Electrical Engineer

The following Test Report is being sent for approval:

Copies	Repro	Number and Description	Spec. Par.
1		Maximum Credible Voltage Test (3 pages)	

Please review and approve these documents by November 2, 1982 -- manufacturing will proceed in anticipation of your approval. Please note these drawings are controlled and will be reissued if revised.

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

Very truly yours,

POWER CONVERSION PRODUCTS, INC.

Lawrence G. Lutz
Manager, Product Design

TEST REPORT

MAXIMUM CREDIBLE VOLTAGE TEST

for

NORTHEAST UTILITIES SERVICE COMPANY

MILLSTONE NUCLEAR POWER STATION - UNIT 3

J.O. NO. 12179

I. INTRODUCTION

The Maximum Credible Voltage Test is performed on an AC Line Regulator, Model RTF-120-120-5, hereafter referred to as the specimen, in order to demonstrate compliance with Stone & Webster specification 2421.500-698 regarding this requirement.

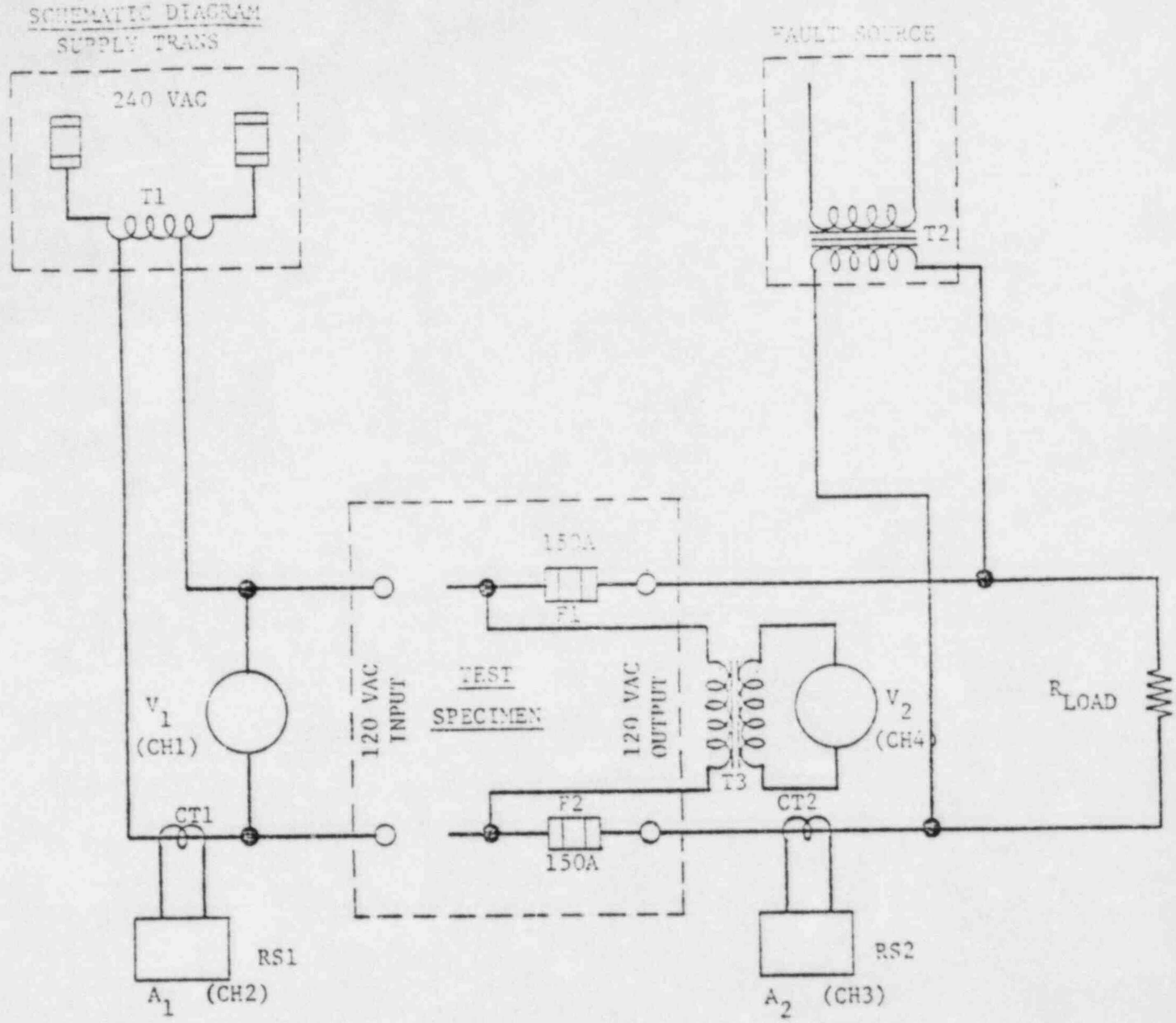
II. TEST DESCRIPTION

With the specimen delivering full rated load at nominal input voltage and frequency. A fault voltage of 505 VAC is applied to the output terminals. The specimen isolates this fault from the input circuit bis fast-acting fuses. The test data that follows demonstrates successful isolation of this fault.

Prepared by [signature] Date 9/21/82

Lawrence G. Lutz
Manager of Product Engineering

A. SCHEMATIC DIAGRAM



B. TEST EQUIPMENT

CT1 = Current Transformer, PCP #IN279, Wound for X60 Multiplier.
CT2 = Current Transformer, PCP #IN240, Wound for X60 Multiplier.
RS1&2 = Meter Shunt, 5A, 50mV
T3 = Potential Transformer, Radio = 3000:115
T1,2 = Supply Transformer (From Utility)

C. INSTRUMENTATION

Honeywell Model #1858 Visicorder, PCP #IN3156 with #1883-MTD Galvanometers
With Settings as follows: Timeline = .01 Sec.
Record Speed = 20 In/Sec.
Voltage Settings = Channel 1 = .1V/DIV = Vin
2 = .05V/DIV = Iin
3 = .05V/DIV = Iout
4 = .05V/DIV = Vout

IV. TEST RESULTS

Upon application of the fault energy, the input current increased to approximately 1080 amperes for less than one-tenth of one cycle, after which the fuses F1 & F2 cleared the fault.

The equipment is not damaged in any way; however, the following components failed: triacs CR2,4, op-amp IC1, voltage regulator VR1.

Copies of the recorder plot have been forwarded to Stone & Webster under separate cover.

V. CONCLUSION

The specimen successfully withstood application of the postulated credible voltage; however, the input current exceeded the specified value. Stone & Webster is to evaluate the effect of this current and advise PCP of its impact.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB29 (219) THE USE OF INTERRUPTING DEVICES ACTUATED BY FAULT CURRENT AS AN ISOLATION DEVICE (8.3.3.3.12)

Section 1.8 of the FSAR indicates exception to position C1 of Regulatory Guide 1.75 by stating that interrupting devices actuated by fault current are isolation devices when justified by test or analysis. Identification of Non-Class 1E circuits isolated by interrupting devices actuated by fault current and the justification by test or analysis will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Information presented under R.G 1.75 in Table 1.8 N-1 is only applicable to Chapter 7.0. Justification for use of the position of R.G 1.75 in Chapter 7.0 is provided in WCAP 8892A. FSAR table 1.8 N-1 will be revised to delete reference to section 8.3.1.4 for this regulatory guide. Compliance of this guide to Chapter 8.0 requirements is found in FSAR Table 1.8-1 page 30.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB30 (220) SEPARATION OF CABLES AT ENTRY, EXIT & CROSSING OF RACEWAYS (8.3.3.3.14)

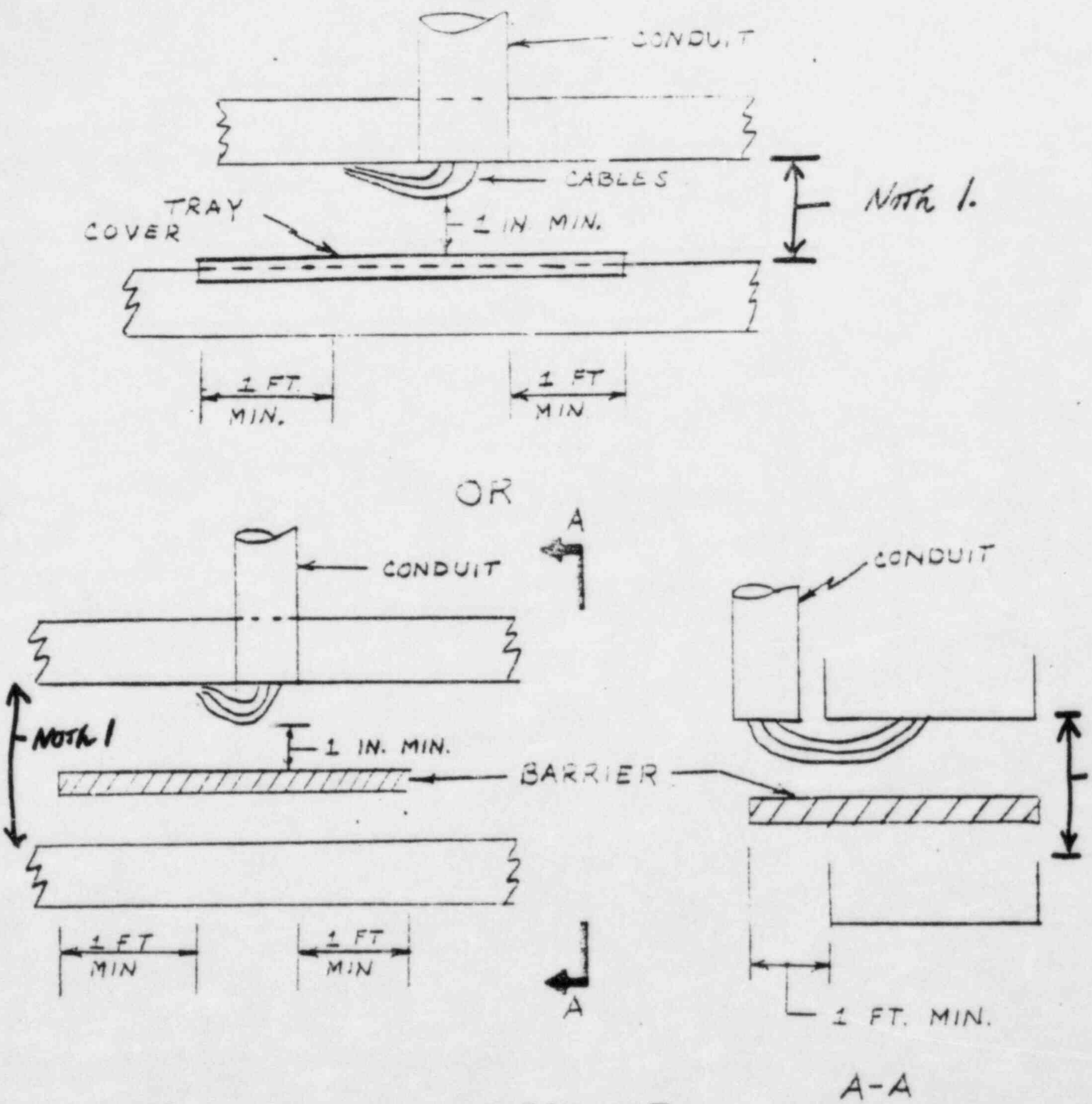
In Section 1.8 of amendment 3 of the FSAR, the applicant has indicated with respect to clarification of the guidelines of Regulatory Guide 1.75, that separation at cable entry/exit from cable trays is equivalent to perpendicular cable tray crossing. Further clarification of the separation will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to revised section 1.8, R. G. 1.75 and new Figure 8.3-8.

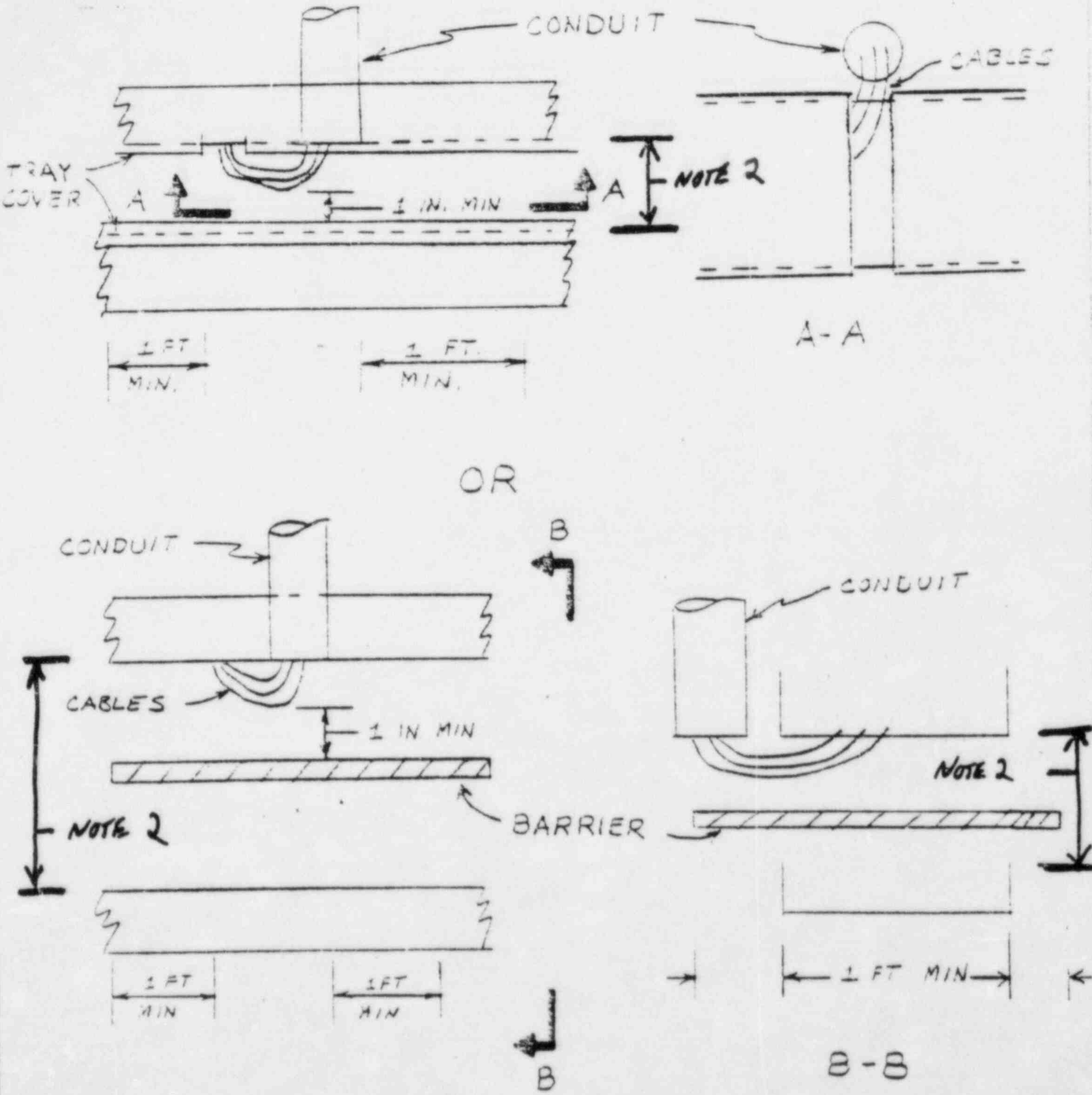
TABLE 1.8-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference
1.75*	Physical Independence of Electric Systems (Rev. 2, September 1978)	Comply, with the following exceptions and clarifications: 1. <u>General (Clarification)</u> For separation purposes, location of cable entry/exit from cable tray is considered to be equivalent to perpendicular cable tray crossings. Refer to Figure 8.3-8. Ventilated tray covers are considered equivalent to solid tray covers. 2. <u>Position C.1</u> The power circuits for the non-Class 1E pressurizer heaters, control rod drive mechanism cooling fans, and containment air recirculation fans connected to Class 1E power sources are provided with two separate Class 1E breakers connected in series. In addition, the interconnecting cables (i.e., from power source to load) are identified by the same color code as the Class 1E power source to which they are connected. Power circuits for other non-Class 1E equipment connected to Class 1E power sources are provided with two separate Class 1E breakers or fuses connected in series. In addition, the interconnecting cables are identified by the same color code as the Class 1E power source to which they are connected (i.e., from power source to the load or up to and including the second breaker). Cable from the second breaker to the load are routed in rigid conduit. The controlled routing (i.e., continuation of the circuit with the same color code or continuation of the circuit in rigid conduit) ensures the physical and electrical independence of the power circuit beyond the Class 1E isolation device (i.e., battery charg[illegible] isolation transformer, two series connecte[illegible] [illegible]terrupting devices (circuit breakers, fuses) or circuit breakers that trip on accident or loss of power signals). Coordination between the two series connected	7.1 8.3.1.4



NOTE 1) MINIMUM VERTICAL SEPARATION MAINTAINED BETWEEN TRAYS

FIGURE 8.3-8 (SH 1 OF 2)
CABLE TRAY
CABLE ENTRY/EXIT



NOTE 2) LESS THAN MINIMUM VERTICAL SEPARATION BETWEEN TRAYS.

FIGURE 8.3-8 (SH 2 OF 2)
CABLE TRAY
CABLE ENTRY/EXIT

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB31 (221) 430.36 COORDINATION OF BREAKERS (8.3.3.3.15)

In Section 1.8 of amendment 3 to the FSAR the applicant, with respect to compliance with position C1 of Regulatory Guide 1.75, indicated that coordination is not required between two series connected breakers used as isolation devices. The staff agrees that coordination is not required between the two series connected breakers. However, coordination is required between each of the breakers and their main supply breaker. Surveillance and testability of the breakers and their coordination will be pursued with the applicant and the results of the staff evaluation will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.36.

NRC Letter: May 3, 1983 1.9

Question No. Q430.36 (SRP Sections 8.3.1 and 8.3.2) 1.12

In Section 1.8 of the FSAR, you take exception to position C1 of 1.13
Regulatory Guide 1.75. Interrupting devices, actuated only by fault 1.15
current, are used as isolation devices. It is the staff position 1.16
that nonessential circuits (powered from Class 1E buses) be either
disconnected by an accident signal or connected to the Class 1E bus
through two series connected and coordinated interrupting devices 1.17
actuated by fault current. Identify and describe each non-Class 1E 1.18
or nonessential circuit that is to be isolated from Class 1E circuits
by an interrupting device actuated only by fault current and that is
in noncompliance with the above staff position. In order to justify 1.20
noncompliance with the staff position, provide the test or analysis
that demonstrates that each non-Class 1E circuit identified will not
cause unacceptable influence on Class 1E circuits.

Response: 1.21

Non-Class 1E (nonessential) circuits connected to Class 1E buses are 1.22
disconnected by an accident signal and/or loss of power, or connected
through two series connected Class 1E interrupting devices. Each of 1.23
the series connected interrupting devices has the capability to
interrupt a fault prior to degrading the Class 1E bus. Tripping 1.25
coordination between the two series connected interrupting devices is
not required; tripping coordination with main supply breaker is 1.26
provided. The Class 1E interrupting devices will be tested and 1.27
calibrated periodically to assure that proper coordination with main 1.28
breaker is maintained. Refer to revised FSAR Table 1.8-1. 1.29

PSB 31

TABLE 1.3-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference
1.75*	Physical Independence of Electric Systems (Rev. 2, September 1978)	Comply, with the following exceptions and clarifications: 1. <u>General (Clarification)</u> For separation purposes, location of cable entry/exit from cable tray is considered to be equivalent to perpendicular cable tray crossings. Refer to Figure 8.3-8. Ventilated tray covers are considered equivalent to solid tray covers. 2. <u>Position C.1</u> The power circuits for the non-Class 1E pressurizer heaters, control rod drive mechanism cooling fans, and containment air recirculation fans connected to Class 1E power sources are provided with two separate Class 1E breakers connected in series. In addition, the interconnecting cables (i.e., from power source to load) are identified by the same color code as the Class 1E power source to which they are connected. Power circuits for other non-Class 1E equipment connected to Class 1E power sources are provided with two separate Class 1E breakers or fuses connected in series. In addition, the interconnecting cables are identified by the same color code as the Class 1E power source to which they are connected (i.e., from power source to the load or up to and including the second breaker). Cable from the second breaker to the load are routed in rigid conduit. The controlled routing (i.e., continuation of the circuit with the same color code or continuation of the circuit in rigid conduit) ensures the physical and electrical independence of the power circuit beyond the Class 1E isolation device (i.e., battery charger, isolation transformer, two series connected interrupting devices (circuit breakers, fuses) or circuit breakers that trip on accident or loss of power signals). Coordination between the two series connected	7.1 8.3.1.4

TABLE 1.8-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference

Class 1E breakers is not required. Coordination between the two series connected Class 1E breakers and the Class 1E main supply breaker is provided.

3. Position C.4 (Clarification)

Associated circuits are identified by the same color code as the Class 1E circuit with which they are associated. This color code exists up to and including an isolation device, except as discussed under Position C.1.

Associated circuits meet all other requirements of Class 1E circuits up to and including the isolation device.

4. Position C.6 (Clarification)

Analyses of potential hazards in Section 5.1.1.1 of IEEE-384 are accomplished as follows:

1) The high pressure piping and missile analyses are described in FSAR Sections 3.6 and 3.5 respectively.

2) The fire protection analyses are outlined in FSAR Section 9.5.1. and the Fire Protection Evaluation Report.

3) Cable that is not flame retardant is enclosed in a dedicated raceway for the entire length of the run.

4) The building design for flooding is described in FSAR Section 3.4.

5. Position C.7 (Section 4.6 of IEEE-384)

Minimum separation between Class 1E and non-Class 1E circuits are as specified in Sections 5.1.3, 5.1.4, or 5.6.2 of IEEE-384, except as discussed under Position C.16.

Where plant arrangement in the control room, instrument rack room, or cable spreading room precludes the minimum vertical separation, but

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB32 (222) DESIGN CRITERIA OF ASSOCIATED CIRCUIT FROM THE ISOLATION DEVICE TO LOAD (9.3.3.3.16)

8

In Section 1.8 of amendment 3 to the FSAR the applicant, with respect to compliance with position C1 of Regulatory Guide 1.75, has stated that Non-Class 1E equipment connected to Class 1E power supplies are (1) identified with the same color code from the source to the load as the Class 1E power source to which they are connected, (2) are connected to the power source through two separate series Class 1E breakers or fuses, and (3) are routed in rigid steel conduit except for selected loads.

Additional design criteria or clarification of the above criteria will be pursued with the applicant such as-physical and electrical independence of associated circuits irrespective of the isolation device. The resolution of the staff review will be reported in a supplement to this report.

Response:

Refer to revised FSAR section 1.8, R. G. 1.75.

TABLE 1.8-1 (Cont)

R.G. No.	Title	Degree of Compliance	FSAR Section Reference
1.75*	Physical Independence of Electric Systems (Rev. 2, September 1978)	Comply, with the following exceptions and clarifications: 1. General (Clarification) For separation purposes, location of cable entry/exit from cable tray is considered to be equivalent to perpendicular cable tray crossings. Refer to Figure 8.3-8. Ventilated tray covers are considered equivalent to solid tray covers. 2. Position C.1 The power circuits for the non-Class 1E pressurizer heaters, control rod drive mechanism cooling fans, and containment air recirculation fans connected to Class 1E power sources are provided with two separate Class 1E breakers connected in series. In addition, the interconnecting cables (i.e., from power source to load) are identified by the same color code as the Class 1E power source to which they are connected. Power circuits for other non-Class 1E equipment connected to Class 1E power sources are provided with two separate Class 1E breakers or fuses connected in series. In addition, the interconnecting cables are identified by the same color code as the Class 1E power source to which they are connected (i.e., from power source to the load or up to and including the second breaker). Cable from the second breaker to the load are routed in rigid conduit. The controlled routing (i.e., continuation of the circuit with the same color code or continuation of the circuit in rigid conduit) ensures the physical and electrical independence of the power circuit beyond the Class 1E isolation device (i.e., battery charger, isolation transformer, two series connected interrupting devices (circuit breakers, fuses) or circuit breakers that trip on accident or loss of power signals). Coordination between the two series connected	7.1 8.3.1.4

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB33 (223) 430.48 COMPLIANCE WITH THE GUIDELINES OF 0737 (8.3.3.4)

Two TMI items related to GDC 17 are identified in NUREG-0737. These items are II.E.3.1., "Emergency Power Supply for Pressurizer Heaters," and II.G.1, "Emergency Power for Pressurizer Equipment." The background, the NUREG position, and clarification of the positions are included in the NUREG report.

The applicant was requested to describe how the Millstone design complies with each of these TMI items. In response the applicant by amendment 3 to the FSAR described compliance with the positions associated with each of these items but did not address compliance with the clarifications. Additional documentation as to compliance with the clarifications will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.48.

NRC Letter: May 3, 1983 1.8

Question No. Q430.48 (SRP Sections 8.3.1 and 8.3.2) 1.11

Describe how the Millstone design complies with the guidelines of 1.12
NUREG-0737, Items II.E.3.1 and II.G.1, and justify areas of 1.13
noncompliance.

Response: 1.14

These positions are clarified below: 1.15

II.E.3.1 Emergency Power Supply for Pressurizer Heaters 1.16

Position (1) 1.17

One bank of pressurizer backup heaters (PBH) is required to maintain 1.18
natural circulation at hot standby (Section 5.4.10.3.6). One bank of 1.20
PBHs is normally connected to each safety-related train.

Position (2 and 3) 1.22

One bank of PBHs is required within 60 minutes to maintain natural 1.23
circulation at hot standby (Section 5.4.10.3.6). Upon loss of power, 1.25
each emergency generator load sequencer permits manual loading of a
PBH, after 40 seconds, onto its respective emergency generator 1.27
(Table 8.3-1).

Position (4) 1.29

PBH connections to the safety-related trains meet the requirements of 1.30
Regulatory Guides 1.63 and 1.75 as discussed in the response to NRC 1.32
Question 430.55.

Clarification (1) 1.35

One bank of PBHs is nornally connected to one Class IE safety-related 1.36
train. A second bank of PBHs is normally connected to the other 1.38
Class IE safety-related train.

Clarification (2) 1.40

One bank of PBHs is required to maintain natural circulation at hot 1.41
standby (Section 5.4.10.3.6). One bank of PBHs is normally connected 1.43
to each safety-related train.

Clarification (3) 1.45

Each emergency generator has the capacity to provide power to one 1.46
bank of PBHs concurrently with the loads required for a 1.47
loss-of-coolant accident (Table 8.3-1).

Clarification (4)

Upon loss of power (offsite), each emergency generator load sequencer permits manual loading of a PBH, after 40 seconds, onto its respective emergency generator (Table 8.3-1).

Clarification (5A and C)

each emergency generator has the capacity to provide power to one bank of PBHs concurrently with the loads required for any accident. Upon loss of power (offsite), each emergency generator load sequencer permits manual loading of a PBH, after 40 seconds, onto its respective emergency generator. (Refer to Table 8.3-1)

Clarification (6)

PBH connections to the safety-related trains meet the requirements of regulatory Guides 1.63 and 1.75 and discussed in the response to NRC Question 430.55.

Clarification (5B and 7)

One bank of PBHs is normally connected to each Class IE safety-related train. The PBH connections to the safety-related trains meet the requirements of Regulatory Guide 1.75 (as discussed in the response to NRC Question 430.55). The emergecny generator load sequencer permits manual loading of the PBH, after 40 seconds, onto its respective emergency generator (Refer to FSAR Table 8.3-1).

The use of a safety injection actuation signal to shed the PBH from a safety-related train is not required. The reset of a safety injection actuation signal to permit operation of the PBH from a safety-related train is not required.

II.G.1 Emergency Power for Pressurizer Equipment

Position (1)

There are two power operated relief valves (PORV). PORVs are powered from redundant Class 1E trains.

Position (2)

There are two PORV block valves. Each PORV block valve is powered from the opposite safety-related train from which its associated PORV is powered.

Position (3)

The PORVs and the PORV block valves are Class 1E.

Position (4) 2.29

The pressurizer level indicators are powered from vital buses 2.30
(Figure 8.3-3). The vital bus system is discussed in 2.31
Section 8.3.1.1.2 and analyzed in Section 8.3.1.2.5.

Clarification (1) 2.35

There are two PORV block valves. The PORV block valves are powered 2.37
from redundant Class IE sources. This feature provides, to the 2.39
extent practical, the capability to close or open the PORV block
valves.

Clarification (2) 2.41

Each PORV block valve is powered from the opposite safety-related 2.42 PSB 33
train from which its associated PORV is powered.

Clarification (3) 2.45

The PORVs and the PORV block valves are Class IE and are normally 2.46
connected to a safety-related train.

Clarification (4) 2.49

Instrument air is not required for the Millstone 3 design. 2.50

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB34 (224) 430.46 PRIMARY AND BACKUP FAULT PROTECTION FOR CONTAINMENT (8.3.3.6.1)

Section 8.3.1.1.4 (items 2 m and 4) of the FSAR indicaters that primary and backup containment electrical penetration protection is provided only where the available fault-current exceeds the current-carrying capabilities of penetration conductors for loads connected to safety related buses that are not qualified to the containment accident environment. This design for containment electrical penetration protection does not meet the guidelines of position 1 of Regulatory Guide 1.63. Position 1 requires: a) primary and backup protection where maximum available fault-current exceeds the current-carrying capability of penetration versus capability of the conductors and b) all conductors, that pass through containment electric penetrations, must have primary and backup protection versus only those that are connected to safety related buses and loads that are not qualified to the containment accident environment.

In justification for this area of noncompliance with position 1 of Regulatory guide 1.63, the applicant by amendment 3 to the FSAR stated:

"For Class 1E containment circuits which are fully qualified for the containment environment (both accident and normal), the single failure is assumed to be a failure of the circuit to survive the environmental for which it is qualified. For this condition, a single protective device properly selected to protect the penetration, fully satisfies the single failure criterion of IEEE 279-1971, and the intent of IEEE Std. 317-1976 and Regulatory Guide 1.63, Revision 2."

The staff disagrees. The staff considers the event to be circuit failure and the single failure to be loss of the primary fault current protective device. This item will be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.46.

NRC Letter: May 3, 1983

Question No. Q430.46 (SRP Sections 8.3.1 and 8.3.2)

In Section 8.3.1.1.4 (Items 2 and 4) of the FSAR, you indicate that primary and backup containment electrical penetration protection is provided only where the available fault-current exceeds the current-carrying capabilities of penetration conductors for loads connected to safety related buses that are not qualified to the containment accident environment. This design for containment electrical penetration protection does not meet the guidelines of position 1 of Regulatory Guide 1.63. Position 1 requires: a) primary and backup protection where maximum available fault-current exceeds the current-carrying capability of the penetration versus capability of the conductors and b) all conductors, that pass through containment electric penetrations, to have primary and backup protection versus only those that are connected to safety related buses and loads that are not qualified to the containment accident environment.

a. Provide justification for noncompliance with the guidelines of Position 1 of Regulatory Guide 1.63.

b. Describe how the Millstone design complies with each of the guidelines of IEEE Standard 317-1976 as augmented by Regulatory Guide 1.63 and provide justification for any deviations.

c. Provide coordinated fault-current versus time curves for each representative type cable that penetrates primary containment. For each cable, the curves must show the relationship of the fault carrying capability between the electric penetrations, the primary overcurrent protective device, and the backup overcurrent protective device.

d. Provide the test report with results that substantiates the capability of the electrical penetration to withstand the total range of time versus fault current without seal failure for worst case environmental conditions.

Response:

Refer to Conax Corp. Report IPS-927, Design Qualification Report for Electric Penetration Assemblies for Millstone Nuclear Power Plant Unit 3, dated July 14, 1982 (Note 1). Field testing after installation is conducted in accordance with Section 7 of IEEE 317.

For Class IE containment circuits which are fully qualified for the containment environment (both accident and normal), the single failure is assumed to be a failure of the circuit to survive the environment for which it is qualified. For this condition, a single protective device properly selected to protect the penetration, fully satisfies the single failure criterion of IEEE 279-1971, and the intent of IEEE Std. 317-1976 and Regulatory Guide 1.63, Revision 2.

This position is documented in an NRC document entitled, "Position on Protection of Containment Electrical Penetration Against Failures Caused by Fault and Overload Currents for SEP Plants".

While it is recognized that some NRC positions generated for SEP plants are not in all instances acceptable for new plants, the position referenced is one which does not compromise safety and, fully satisfies the intent of criteria, standards, and guides applicable to Millstone Unit 3.

For the current carrying capability and the protection of the containment electrical penetrations refer to:

1. Electrical Penetration Protection Power Circuits (Note 1)

2. Notes of telephone discussion, dated January 19, 1983, between Mr. W. Federick (Conax Corp.) and Mr. K. Lum (SWEC) (Note 1)

3. Conax Corp. Report IPS-701, Thermal Capability Curves for Conax Electrical Penetration Assemblies and Electric Conductor Seal Assemblies, Rev. A dated July 16, 1981 (Note 1).

During normal operating conditions

If a fault were to occur in a class IE MOV circuit under normal operation, the branch circuit protective device failed to clear the fault, and the penetration feedthru leaked; radiation would not be released to the public because of the subatmospheric containment design.

Faults on class IE MOV circuits during normal operation are very unlikely because the entire class IE circuit (penetration, splice, cable, raceway and MOV) have been qualified to operate in the accident environment. Also, the class IE MOV's are not operated (energized) during normal operation, except for special surveillance requirements, and their stroke times are in the order of 30 seconds. PSB 34

However, the licensee will commit to a complete penetration leak test should a fault occur on a class IE MOV circuit under normal operation.

During ACCIDENT CONDITIONS

The basis for not installing two breakers in series for class IE circuits as implied by Regulatory Guide 1.63 position 1 is that primary protection is provided by the environmentally qualified circuit and backup protection is provided by the qualified branch circuit protective device. The failure of the environmentally qualified circuit must not be considered consequential to the accident (event) otherwise its redundant counterpart circuit would also be expected to fail resulting in a common mode failure of accident mitigating systems.

The availability of Class IE circuits to perform their intended function has been maximized by the above approach. For example, the quench spray system is required to mitigate containment overpressurization and to eventually bring the containment to subatmospheric pressure per the design basis. If two branch circuit protective devices were installed in series in the MOV circuits, system unavailability due to improper branch circuit protective device operation would be doubled.

Although it remains ~~the~~ the Applicants' position that this analysis is fully in accordance with single failure analytical techniques, we commit to, at the first refueling outage following commercial operation, the installation of backup protective devices in those circuits which now do not have such devices. We are doing so solely to resolve this issue in an expedited manner without further economic impacts.

Millstone Nuclear Power Station, Unit No. 3

Open Items

Power Systems Branch (Electrical)

PSB35 (225) 430.47 COMPLIANCE OF PENETRATION PROTECTIVE DEVICES TO CRITERIA OF IEEE 279 (8.3.3.6.2)

In Section 1.8 of the FSAR the applicant provided clarifications as to how the guidelines of Regulatory Guide 1.63 are to be implemented in the Millstone design for protection of containment electrical penetrations. The clarifications state that overcurrent protective devices are not required to comply with criteria listed in IEEE 279 (except Section 4.2) and need not be Class 1E or seismically qualified. Position 1 of Regulatory Guide 1.,63, on the otherhand, states that overcurrent protective devices should conform to the criteria of IEEE 279. The proposed Millstone design does not meet the guidelines of position 1 of Regulatory Guide 1.63.

Justification for not meeting testing and independence as well as other requirements of IEEE 279 will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

Refer to the revised response to question no. 430.47.

NRC Letter: May 3, 1983

Question No. Q430.47 (SRP Sections 8.3.1 and 8.3.2)

In Section 1.8 of the FSAR, you provided clarifications as to how the guidelines of Regulatory Guide 1.63 are to be implemented in the Millstone design for protection of containment electrical penetrations. The clarifications state that overcurrent protective devices are not required to comply with criteria listed in IEEE 279 (except Section 4.2) and need not be Class 1E or seismically qualified. Position 1 of Regulatory Guide 1.63, on the otherhand, states that overcurrent protective devices should conform to the criteria of IEEE 279. The proposed Millstone design does not meet the guidelines of position 1 of Regulatory Guide 1.63. Provide justification for noncompliance.

Response:

Electrical penetrations installed as part of the containment structure may require the application of special considerations for their protective and fault isolation devices. These special considerations arise only where the potential exists for an uncleared fault at the interior position, to result in penetration seal failure such that a breach of containment results.

In instances where this possibility exists, the criteria for the protection requirements are based on the resulting site boundary release levels. If the site boundary release limits are not exceeded for the condition postulated, special protective device qualifications such as the ability to remain operable throughout and following a seismic event are not necessary.

Penetration seal failure occurring during normal operation, including start up and shutdown, would not result in the site boundary release limits being exceeded. Shutdown under seismic conditions and coincident with seal failure also yields the same result since the plant precludes LOCA occurrence as a result of a seismic event.

Acceptable assurance that a penetration seal failure will not occur during an accident condition is provided by a design which incorporates one or both of the features listed below:

- Independent primary and backup protection schemes operating to independent isolation devices, or,

- A single protective scheme and isolating device in conjunction with the protected circuit possessing full accident environment qualification for those portions (cables, splices, driven device, etc.) which are within the containment and electrically supplied by the penetration.

The use of redundant non-Class 1E protective devices for non-Class 1E and Class 1E circuits is acceptable since the circuit protection and isolation devices are located outside of the containment, in a mild environment. Failure of this protection during a seismic event (which could result in damage to the penetration assembly) is not of consequence since, as stated above, the plant design precludes any consequential DBA inside the containment as a result of SSE conditions.

Overcurrent protection devices are not within the scope of IEEE 279 as written. However, those principles developed in IEEE 279 which ensure a highly reliable design are used for guidance in the protection system design. Refer to the response to NRC Question 430.46 for further information on this topic.

All penetration protective devices will be subjected to periodic calibration and testing.

Concerning the testing and independence requirements of IEEE 279

INDEPENDENCE

The backup penetration protection devices for non-Class IE and Class 1E circuits need not be Class IE or seismically qualified. However, the majority of these devices are molded case circuit breakers and were purchased to the same requirements as the Class IE molded case circuit breakers. Also, these backup devices are located in separate MCC type enclosures and do not require control power to operate as they are self contained.

The DC control power for the reactor coolant pump motor primary and backup breakers is derived from different station batteries.

The above testing and independence features in conjunction with satisfying the single failure criteria meet the intent of IEEE-279-1971 relative to penetration protection.

R.G. No.	Title	Degree of Compliance	FSAR Section Reference
1.75*	Physical Independence of Electric Systems (Rev. 2, September 1978)	Comply, with the following exceptions and clarifications: 1. General (Clarification) For separation purposes, location of cable entry/exit from cable tray is considered to be equivalent to perpendicular cable tray crossings. Refer to Figure 8.3-8. 8 Ventilated tray covers are considered equivalent to solid tray covers. Short lengths of cable (less than 10 feet) enclosed in a protective wrap of woven silicon dioxide are considered to be protected from electrically induced problems in adjacent cables to the same degree as the same cable in an enclosed raceway. INSERT D1 Metal clad cable, type MC, Aluminum sheath cable (in which aluminum is continuously welded) utilized in low energy, 120 V ac and 125 V dc nominal, circuits and in low density applications is considered ~~adequate protection~~ adequately protected. INSERT D2 8 Aluminum interlocked armor cable utilized in low energy, 120 V ac and 125 V dc nominal, circuits and in low density applications is considered adequate protection. INSERT D3 2. Position C.1 The power circuits for the non-Class 1E pressurizer heaters, control rod drive mechanism cooling fans, and containment air recirculation fans connected to Class 1E power sources are provided with two separate Class 1E breakers connected in series. In addition, the interconnecting cables (i.e., from power source to load) are identified by the same color code as the Class 1E power source to which they are connected. 8 Power circuits for other non-Class 1E equipment connected to Class 1E power sources are provided with two separate Class 1E breakers or fuses 8	7.1 8.3.1.4

INSERT D1

THE PROTECTIVE WRAP OF WOVEN SILICON DIOXIDE (TRADE NAME SIL-TEMP) IS 60 MILS THICK AND IS WRAPPED LONGITUDINALLY AROUND CABLE(S) WITH A 50 PERCENT OVERLAP TO ENSURE THAT CABLE(S) IS ENCLOSED BY ONE THICKNESS OF THE PROTECTIVE WRAP.

INSERT D2

AS SUCH THE MINIMUM SEPARATION BETWEEN THESE CABLES AND OTHER CABLES OR RACEWAY (WHERE REQUIRED) IS ONE INCH. THESE CABLES ARE FURTHER DESCRIBED AS FOLLOWS:

2) LARGEST CONDUCTOR SIZE, NUMBER 10 AWG
3) NO MORE THAN 6 CONDUCTORS
4) NO MORE THAN THREE NUMBER 10 AWG CONDUCTORS WITH REMAINING CONDUCTORS OF SMALLER SIZE
5) ALUMINUM SHEATH CABLE MAY HAVE AN OVERALL JACKET OF NEOPRENE OR HYPALON.

(A TYPE MC CABLE IN WHICH THE ALUMINUM IS CONTINUOUSLY WELDED)

1) TYPE MC CABLE IS A FACTORY ASSEMBLY OF CONDUCTORS, EACH INDIVIDUALLY INSULATED, ENCLOSED IN A METALLIC SHEATH OF INTERLOCKING TAPE OR A SMOOTH OR CORRUGATED TUBE.

INSERT D3

Type SO or SJO cords for lighting drops to fixtures are size 12 AWG or smaller and supply 120V ac or 125V dc, low energy in low density applications. Adequate protection is provided by one inch or greater distance to Class 1E raceways.