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L. T. Gucwa
Manager Nuclear Engineering
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NED-84-304

June 7, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

NRC DOCKETS 50-321, 50-366
OPERATING LICENSES DPR-57, NPF-5
EDWIN I. HATCH NUCLEAR PLANT UNITS 1, 2
RESPONSE TO REQUEST FOR INFORMATION ON
SAFETY PARAMETER DISPLAY SYSTEM

Gentlemen:

In response to your letter dated April 23, 1984, Georgia Power Company (GPC) provides herein information related to installation of the Safety Parameter Display System (SPDS) at Plant Hatch. Your questions are restated, followed by the GPC response.

Question:

1. "Conclusions regarding unreviewed safety questions or changes to Technical Specifications"

Response:

No changes to technical specifications are anticipated. A safety evaluation conducted in accordance with 10 CFR 50.59 concluded that the following modifications associated with the installation of the SPDS system posed no unreviewed safety questions:

a. Addition of 100 meter primary meteorological tower and modification of existing 150 foot tower as a backup.

b. Addition of SPDS, Operations Support Center, and Emergency Operations Facility to the Technical Support Center to function as the Emergency Response Facilities (ERFs).

c. Addition, modification, or replacement of instrumentation to provide plant parameters to the SPDS and ERF computers (class IE isolation is provided where necessary).

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Question:

2. "SPDS implementation plan, including:

2.1 proposed method of data validation;"

Response:

The computer system checks validity of any parameter prior to display on the monitors. Data that is probably valid, but cannot be validated (e.g. a redundant signal is not operational) is displayed differently from validated signals. Invalid data is not displayed. The computers perform the following checks to determine validity:

a. a check to see if the operator has temporarily deleted an input signal;

b. a check for process conditions which could invalidate the instrument; and

c. a check of the signals in comparison to available redundant instruments.

Question:

2.2 "description of human factors program and results, i.e., SPDS design characteristics that have been incorporated into the design so that displayed information can be readily perceived and comprehended, and is not misleading to SPDS users;"

Response

Human factors considerations have been incorporated into the SPDS design through several mechanisms including:

a. Work place dimensions and general layout conform to guidelines contained in "Human Engineering Guide to Equipment Design", 1972 edition by Harold Van Cott and Robert G. Kinkade;

b. Information inputs for the displays were determined by Bechtel Power Corporation to provide the operator the necessary process parameters. A list of the inputs was provided to the NRC in a submittal dated August 31, 1983; and

Georgia Power

2.2 (Cont'd)

c. Display design is based on work by the BWROG Control Room Committee and the results of a dynamic screening program conducted at a BWR simulator.

A formal human factors review of the SPDS design will be conducted in conjunction with the Detailed Control Room Design Review (DCRDR). Scope of the human factors review includes design, operator training, and an SPDS simulator evaluation. Human factors criteria are derived from the following sources:

i) NUREG 0835, "Human Factors Acceptance Criteria for the Safety Parameter Display System";

ii) NUREG 0700, "Guidelines for Control Room Design";

iii) EPRI Report NP-1118, "Human Factors Methods for Nuclear Control Room Design, Vol. IV"; and

iv) EG&G Technical Report SSDC-5610, "Human Engineering Design Considerations for CRT-Generated Displays".

Results of the SPDS human factors review will be provided with the DCRDR final report scheduled for submittal to the NRC in June 1986.

Question:

2.3 "proposed method of electrical isolation of the SPDS from safety systems including:

2.3.a For each type of device used to accomplish electrical isolation at Hatch 1 and 2, describe the specific testing performed to demonstrate that the device is acceptable for its applications(s). This description should include elementary diagrams where necessary to indicate the test configuration and how the maximum credible faults were applied to the devices."

Response:

The proposed method of electrical isolation of the SPDS from safety systems is by use of optical isolators qualified for Nuclear Class 1E safety related service.

The requested test results are provided in Foxboro documents Q0AAA20 and

(2.3.a cont'd)

Q0AAB44. Refer to Paragraph 5.4.2 and Figures 22, 31, 76, and 77 of attachment 1.

Question:

2.3.b "Data to verify that the maximum credible faults applied during the test were the maximum voltage/current to which the device is acceptable for its application(s). This description should include elementary diagrams where necessary to indicate the test configuration and how the maximun credible faults were applied to the devices."

Response:

All inputs from the isolators to the SPDS are run in raceways dedicated for low level instrumentation circuits. The maximum possible voltage in those trays is 50 volts, which is considerably less than the 600 volts for which the isolator was tested. The tests at the higher voltage provide a wide margin between the test and actual operating condition. Thus, testing assures that the isolators will perform under the most adverse conditions expected at Plant Hatch. Attachment 1 provides details on the test configuration used for the test program.

Question:

2.3.c "Data to verify that the maximum credible fault was applied to the output of the device in the transverse mode (between signal and return) and other faults were considered (i.e., open and short circuits)."

Response:

Paragraphs 6.4.2.1, 2, and 3 of Attachment 1 provide the required data.

Question:

2.3.d "Definition of the pass/fail acceptance criteria for each type of device."

Response:

Paragraph 4 of Attachment 1 provides acceptance criteria used by Foxboro in their test program.

Question:

2.3.e "A commitment that the isolation devices comply with the environmental qualifications (10 CFR 50.49) and the seismic qualifications which were the basis for plant licensing."

Response:

The Foxboro isolators are located in the main control room which is a mild environment area as defined by 10 CFR 60.49. Accordingly, no specific environmental qualification is required. Paragraph 4 of Attachment 1 provides information relative to the seismic testing for the isolators.

Question:

2.3.f "A description of the measures taken to protect the safety systems from electrical interference (i.e., Electrostatic Coupling, EMI, Common Mode and Cross-talk) that may be generated by the SPDS."

Response:

Hardware for the SPDS computers and monitors meet MIL-STD-416A (computers) and MIL-STD-416 B (monitors). The standards assure that the equipment is suitable for severe battlefield environments. The hardware contains shielding to keep EMI emissions to a minimum as well as assure that the equipment is immune to EMI from external sources. Hardcopy devise is not a MIL-Spec unit, but meets FCC Rules, Part 15 for Class A Computer Equipment. A large steel console used to house the equipment provides additional shielding.

Computer communications are by fiber-optic cable which is expected to eliminate potential problems from noise, cross-talk, etc.

Question:

2.4 "proposed schedule for full implementation, including hardware, software, training, procedures/operator manuals."

Response:

Proposed schedule for implementation was provided on April 15, 1983 in our response to Generic Letter 82-33. Full implementation is scheduled for June, 1986.

Georgia Power

Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4
June 7, 1984
Page Six

Question:

3. "Description of an additional parameter selected to serve as a Radioactivity Control safety function monitor during containment isolation conditions."

Response:

Our position is that the parameters provided on the SPDS and discussed in the August 31, 1983 submittal are adequate to assess the safety status of the plant. We believe the proposed system fully meets the requirements of NUREG 0737, Supplement 1. Additionally, the post accident sampling system (PASS) is provided to sample the containment air. The PASS is an inline sampling system with grab sample capability. The data is not provided to the SPDS computer, but will be available to the operator.

Drywell radiation level is available on the SPDS on a pageable display which could be selected by the operator when needed. Range of the display is 1 R/hr to 10^7 R/hr. [illegible]

Please contact this offic[illegible]ve any questions or comments.

Very truly yours,

L. T. Gucwa

/mb

xc: H. C. Nix, Jr.
J. P. O'Reilly (NRC- Region II)
Senior Resident Inspector

2AP+SLM Style A Signal Limiter
2AP+SSL Style A Signal Selector
2AO-IPD-S Style A Intergrator Power Driver (Solid State)
2AX+DIO Style D Distribution Modules
2AC+DYC-L Style A Dynamic Compensator
2AX+RS Style A Blind Set Plug
2AX+DT Style A Temperature Difference Module

4. CONCLUSIONS

Class 1E Qualification - Performance Criteria

With the exception of the 2AO-L2C-R Contact Output Isolator, which chattered during seismic tests, all modules performed their Class 1E function during and after seismic tests and were within the performance acceptance criteria noted in Test Procedure QOAAA04 Part 1, and are therefore qualified to the Test Response Spectra (TRS) levels achieved in testing.

Both the style A and ECEP 10273 version of the 2AO-L2C-R Contact Output Isolators had output contacts which chattered during tests (i.e., had openings or closures of greater than 100 us). One output (two were monitored) of the Style A version chattered during only one SSE in the left-to-right plane. During all other SSE's and OBE's no chattering occurred.

Both monitored outputs of the ECEP version chattered during the right-to-left and front-to-back planes of the SSE test. Neither output chattered during the OBE test levels. Therefore, without modifications both 2AO-L2C-R Contact Output Isolators are only qualified to the OBE level and not the SSE level.

At the time of this report Foxboro is in the process of investigating other Relays which, hopefully, would perform satisfactorily at the SSE level.

The output shifts on all other modules except two, during all OBE and SSE tests, were less than 0.25%. The two exceptions were as follows:

1. The 2AX+TIM timer's output No. 2 (1 to 30 sec timer) shifted as much as 0.5% during the SSE tests. However, this shift was well within the ±20% accuracy specifications.

2. Output A of 2AP+ALM-AS Alarm fired during the SSE in the left-to-right plane. This alarm was tested as a high alarm with the set point at 51% and the input at 50%. The firing was caused by the set point potentiometer shifting -2.0%, crossing the input, and causing the output to change state. During the other three SSE's the maximum shift observed on this potentiometer was -0.3%. Also, it should be noted that three other set point potentiometers (two in the 2AP+ALM-AR Alarm and the remaining set point potentiometers in the 2AP+ALM-AS Alarm) were tested, none of which had shifts greater than 0.1% during any OBE or SSE test so the potentiometer that shifted was nontypical. Measurements were made of the torque required to change the setting of the potentiometer which had shifted after

seismic tests were completed. It was found to require a torque of 0.05 inch-ounces compared to the other three potentiometers which had minimum torque requirements of 0.15 inch-ounces. Therefore, a specification of 0.20 inch-ounces minimum torque has been established for all potentiometers used in nuclear-related 2AX+ALM alarm cards.

It is reiterated that the -2.0% shift of the nontypical unit was within target acceptance criteria. However, with the addition of the above specification a maximum set point shift of 1.0% would be expected.

Class 1E Qualification - Seismic Criteria

A comparison of 1% damped TRS's, plotted at one-third octave intervals, to target Required Response Spectra (RRS's) for generic Class 1E qualification of rack-mounted modules is presented in Figures 41 thru 72 for nests 1,2,3, and 4. Please refer also to Graphs 79, 80, 81, and 82 which are composite plots of all 1/3 octave TRS Data Points for Nests 1,2,3,4 compared to the target RRS's. A review of these plots indicates that 95% of the one-third octave data points exceeded the target RRS values.

A majority of the remaining points are attributed to test table performance problems. A significant number fall in the 1 to 2.5 hertz frequency range as a result of test table velocity limitations. Most of the points also occurred in the vertical test response spectra. Since amplification factors obtained in the vertical response are much lower than those obtained in the horizontal response, the points of marginal undertesting in the vertical axis are not considered to be significant relative to module performance obtained in testing.

Other data points are considered to have resulted from inconsistencies in test table performance related to the high mass and center of gravity of the fully-loaded N-2ES rack.

In view of the extensive similarity of design and function among the modules tested and the degree of success achieved in enveloping the target generic RRS's for qualification of rack-mounted modules, Foxboro considers the seismic qualification criteria of Figures 1A, 1B, 2A, and 2B to have been met.

Additional 1%, 2.5%, and 5% damped TRS's applicable to nests 1,2,3, and 4 and to the Multi-nest Power Supply at both OBE and SSE test levels are included in Section 8 of this report.

The SSE floor-level response spectra to which the SPEC 200 modules of this report have been qualified _in specific N-2ES rack loading configurations_ will be addressed in an appendix to this report.

5.3.9 2AP+INT-S Style A Square Root Integrator

a. 5 OBE Tests

Plane of Vibration	Output Shift, % During Test 50%	After Test 0%	After Test 100%
Front-to-Back	<0.4	<0.1	<0.1
Back-to-Front	<0.4	<0.1	<0.1
Left-to-Right	<0.4	<0.1	<0.1
Right-to-Left	<0.4	<0.1	<0.1

b. SSE Tests

Plane of Vibration	Output Shift, % During Test 50%	After Test 0%	After Test 100%
Front-to-Back	<0.4	<0.1	<0.1
Back-to-Front	<0.4	<0.1	<0.1
Left-to-Right	<0.4	<0.1	<0.1
Right-to-Left	<0.4	<0.1	<0.1

5.4 Nest No. 4

5.4.1 2AX+DSP Style D Distribution Module

This instrument is a passive device and therefore was not operational during tests. It functioned properly after all tests.

5.4.2 2AO-VAI Isolation Test

1. 2AO-VAI Output Terminals Grounded

Neither channel of the 2AI-I2V Current-to-Voltage Converter which fed the 2AO-VAI Voltage-to-Current converter shifted more than 0.5% when one channel of the 2AO-VAI's output was grounded. Also both channels of the 2AO-VAI functioned properly after the test was completed. Refer to Figure 76 for oscillograph recording of 2AI-I2V outputs.

2. 600 V ac between output and ground.

Both the 2AO-VAI and 2AO-V2I remained operational during this test. There was some ac feedthrough to the 2AI-I2V. Refer to Figure 77 for recordings of outputs.

3. 600 V ac Across the Output Leads

The application of 600 V ac across the output terminals of Section A of 2AO-VAI S/N 3671610 produced the following damage to the unit:

1. Circuit foil from the + output lead connection to J9 opened.

2. Circuit foil from the - output lead connection to J14 opened.

3. Resistor R32 (402, ±3%, 6 W) opened.

4. Capacitor C17 (6.8 uF tantalum) opened.

5. Capacitor C11 (4.0 uF polycarbonate) shorted.

6. Diodes CR19, 20, 21, and 22 (Type 1N4447) opened.

Reference: Schematic No. 10102FY; Drawing No. 10201NZ

No damage occurred to Section B or to the 2AI-I2V Voltage-to-Current Converter due to the application of the test voltage to Section A. Refer to Figure 78 for the 2AI-I2V output recordings.

5.4.3 2AX+DSC Style C Distribution Module

The 2AX+DSC was used to connect a 2AC+A5 Controller and 250PM Display Station during all tests. The controller and display station operated properly before, during and after all OBE and SSE tests.

5.4.4 2ARPS-A6-B+BB2 Style D Multi-nest Power Supply with Battery Backup

a. OBE Tests

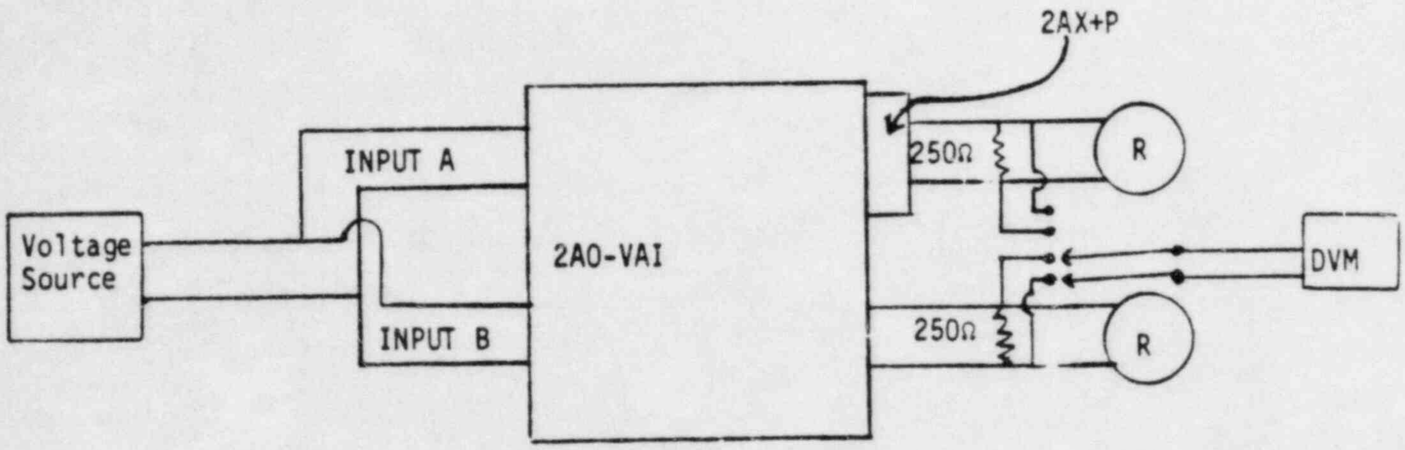
Plane of	Output Shift, %					
	During Test			After Test		
Vibration	+dc V	-dc V	ac V	+dc V	-dc V	ac V
Front-to-Back	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Back-to-Front	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Left-to-Right	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Right-to-Left	<0.75	<0.75	<o.8	<0.1	<0.1	<0.1

b. SSE Test

Plane of	Output Shift, %					
	During Test			After Test		
Vibration	+dc V	-dc V	ac V	+dc V	-dc V	ac V
Front-to-Back	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Back-to-Front	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Left-to-Right	<0.75	<0.75	<0.8	<0.1	<0.1	<0.1
Right-to-Left	<0.75	<0.75	<o.8	<0.1	<0.1	<0.1

c. The 120 V ac power to the 2ARPS-A6 Power Supply was removed during one OBE and one SSE to ensure proper switching to battery backup during seismic tests. No problems were encountered.

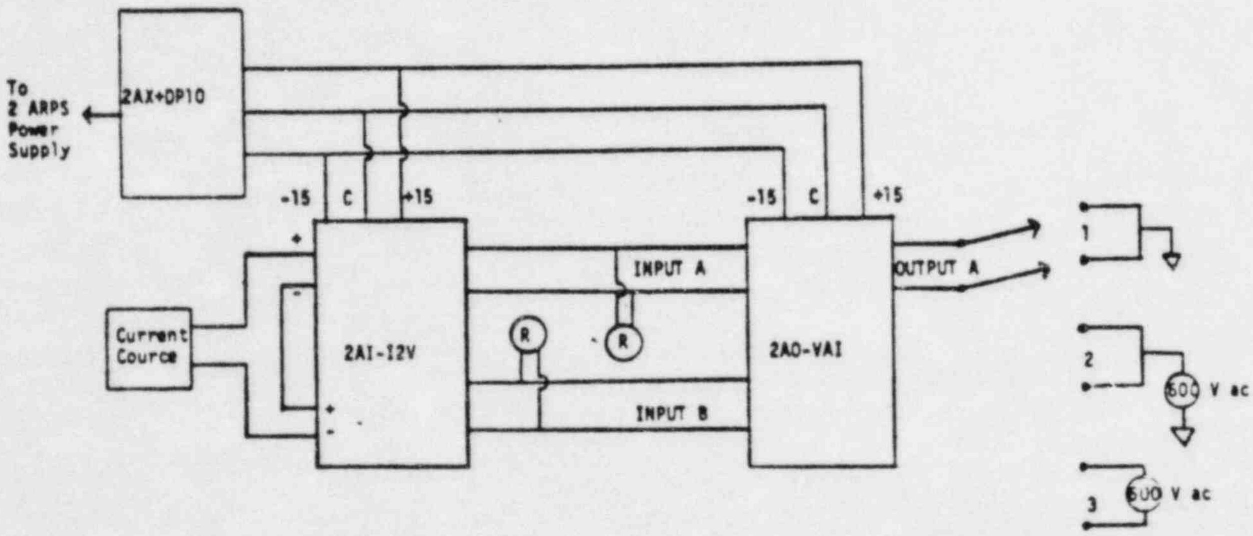
Figure 22
Seismic Test Setup
2AO-VAI Voltage-to-Current Converter



Test Conditions:

Input at 5 V dc; output recorders calibrated for full scale traverse of 12 mA ±5%

Figure 31
Seismic Test Setup
2AO-VAI ECEP 9206
Voltage-to-Current Converter



Test Condition:

Three tests are to be performed: 1) Ground both outputs of Channel A for 10 seconds during 1 SSE. 2) Apply 600 V ac between both output leads tied together and ground for 10 seconds during another SSE. 3) Apply 600 V ac across the output leads during a third SSE for 10 seconds; current source input at 12 mA, recorders calibrated for full scale traverse of 5 V dc ±5%.

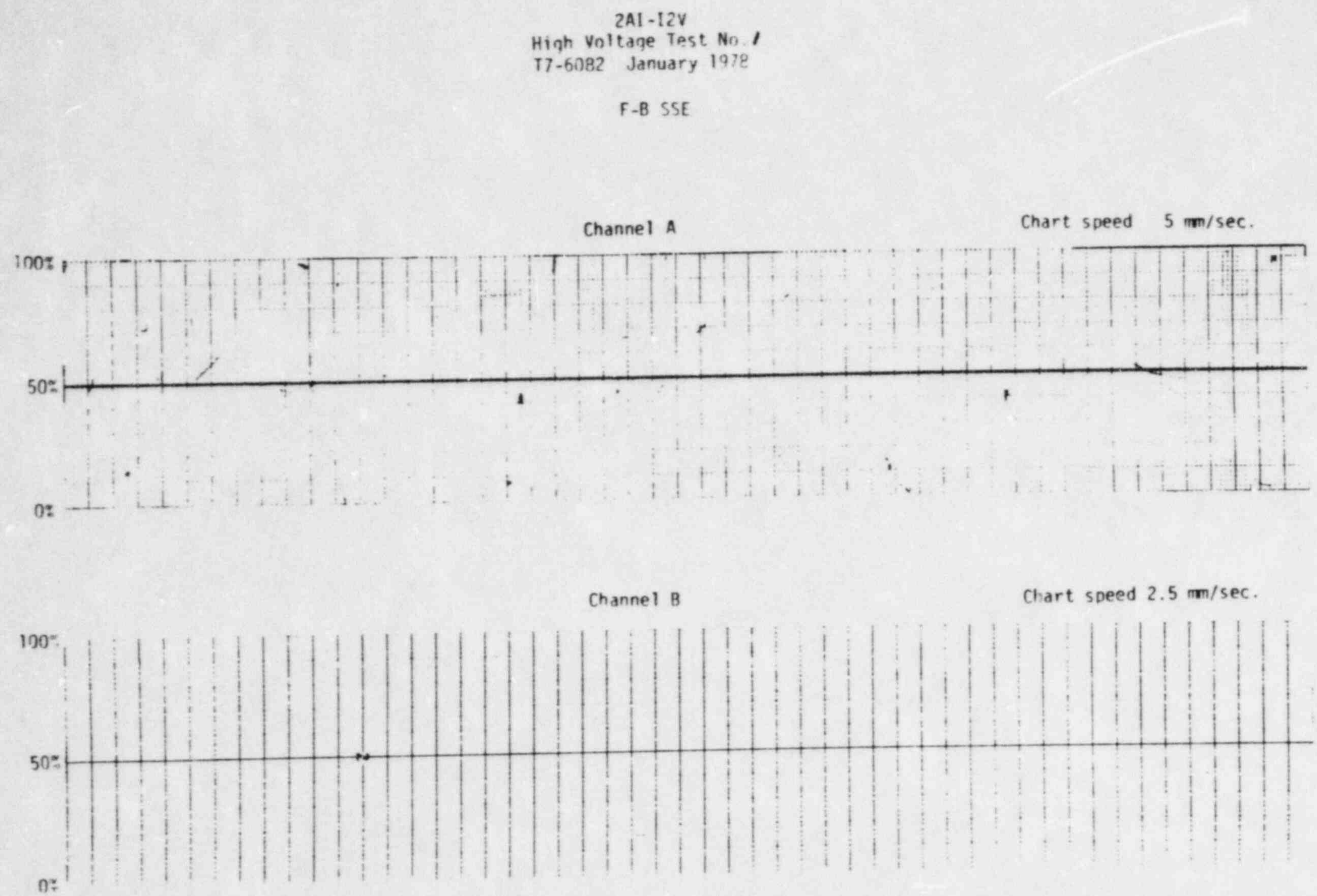


Figure 76
Graphs of High Voltage Test No. 1

2AI-I2V
High Voltage Test No. 2
T7-6082 January 1978

L-R SSE

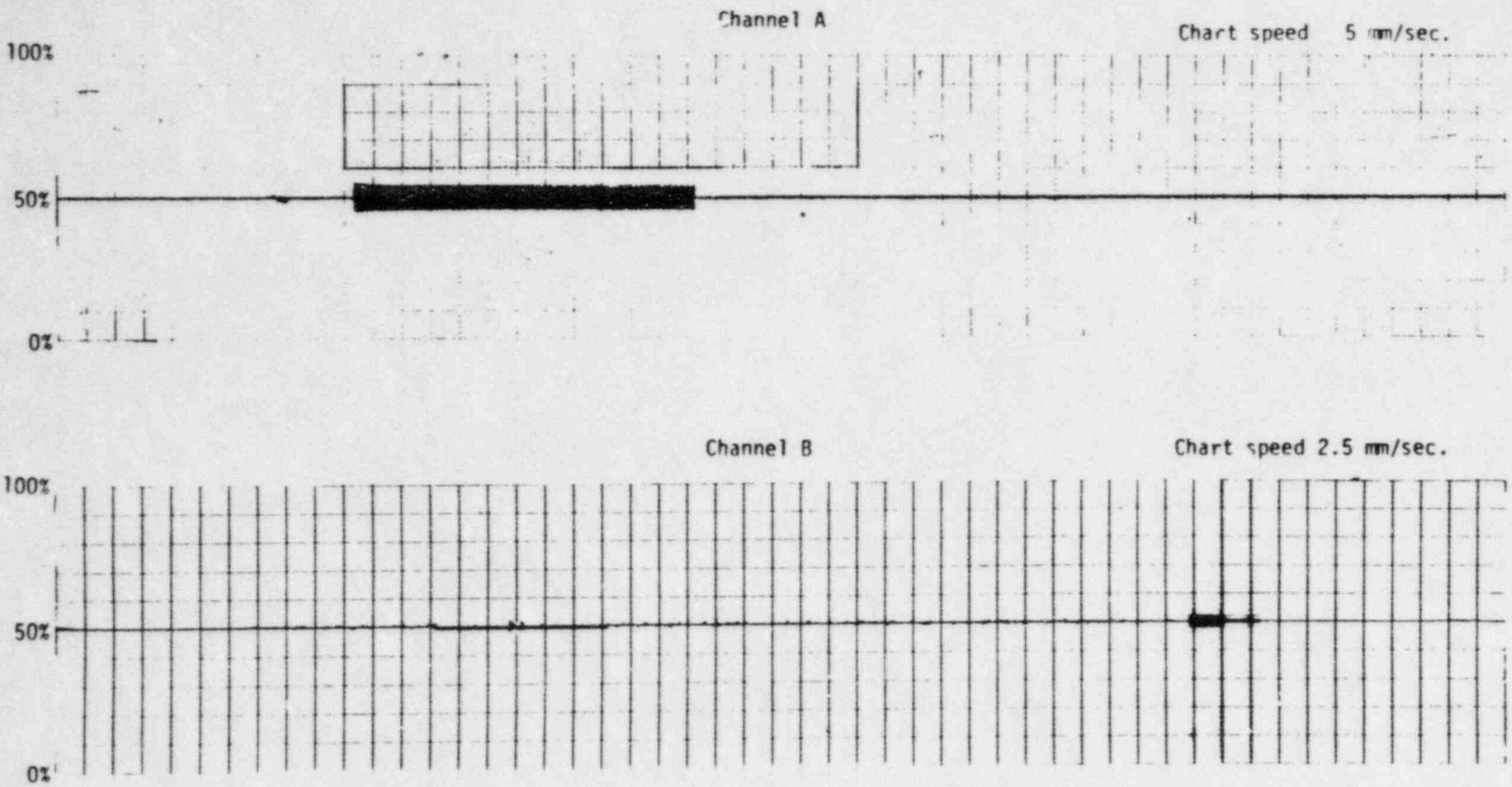


Figure 77
Graphs of High Voltage Test No. 2