NORTHEAST UTILITIES

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WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
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July 14, 1988

Docket No. 50-423
B12964
Re: 10CFR50.62

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

References: (1) E. L. Doolittle letter to J. F. Opeka, Request for Additional Information--ATWS, dated October 14, 1986.

(2) E. J. Mroczka letter to U.S. Nuclear Regulatory Commission, ATWS Rule--Plant-Specific Information ATWS AMSAC Design, dated April 20, 1988.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
ATWS Rule--Plant-Specific Information
ATWS Mitigation System Actuation Circuitry (AMSAC) Design

On October 14, 1986 (Reference (1)), the NRC informed Northeast Nuclear Energy Company (NNECO) that the Staff had completed its review of the Westinghouse Owners' Group (WOG) Topical Report WCAP-10858, "AMSAC Generic Design Package," submitted in response to 10CFR50.62, "Requirements for Reduction of Risk From Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants," and concluded that the generic design is acceptable.

However, the NRC, in their safety evaluation contained in Reference (1), identified 14 items that must be addressed on a plant-specific basis prior to the implementation of plant-specific designs required to be in compliance with the ATWS rule requirements. In Reference (2), NNECO provided responses to 14 items requested in the NRC's Safety Evaluation of the AMSAC generic design for Millstone Unit No. 3. The revised responses to Items 3, 6, 9, 11, and 12 concerning plant-specific details regarding ATWS AMSAC design are being sent in response to the Staff's request made during a telephone conference between the NRC Staff and NNECO representatives on June 2, 1988.

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If there are any questions regarding this submittal, please contact our licensing representative directly.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

E. J. Mroczka
Senior Vice President

By: W. D. Romberg
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cc: W. T. Russell, Region I Administrator
D. H. Jaffe, NRC Project Manager, Millstone Unit Nos. 2 and 3
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PLANT-SPECIFIC DETAILS REGARDING
ATWS MITIGATION SYSTEM ACTUATION CIRCUITRY (AMSAC)
FOR MILLSTONE UNIT NO. 3

QUESTION 3

Safety-Related Interface

The plant specific submittal should show that the implementation is such that the existing protection system continues to meet all applicable safety criteria.

RESPONSE

The AMSAC inputs for measuring turbine impulse chamber pressure and narrow-range steam generator water level are derived from existing transmitters and channels within the 7300 process protection system. Connections to these channels are made downstream of Class 1E isolation devices which are located within the protection cabinets. These isolation devices ensure that the existing protection system continues to meet all applicable safety criteria (the applicable safety criteria are described in the Millstone Unit No. 3 FSAR, Sections 7.1.2 and 7.2) by providing isolation as demonstrated in Appendix A of this submittal. Buffering of the AMSAC outputs from the safety-related final actuation device is achieved through qualified relays. The relays selected for this application are widely used throughout the industry in both safety and nonsafety applications. To demonstrate the capability of these isolation devices, the devices were qualified in a manner consistent with the requirements of Appendix A of the NRC SER. Details of this test can be found in Appendix A of this submittal.

Rev. 1

These output buffering relays are normally de-energized and, as a result, will not initiate actuations upon a loss of power to the relays or upon a relay coil failing open. Challenges to the existing safety systems are minimized through this approach and the use of redundant hardware with a majority vote to energize the relay coils. In the unlikely event of a random failure where a relay contact would operate spuriously, starting of an auxiliary feedwater pump or tripping of the turbine could occur.

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QUESTION 6

Operating Bypasses

The plant specific submittal should state that operating bypasses are continuously indicated in the control room; provide the basis for the 70 percent or plant specific operating bypass level; discuss the human factors design aspects of the continuous indication; and discuss the diversity and independence of the C-20 permissive signal (defeats the block of AMSAC).

RESPONSE

The Millstone Unit No. 3 AMSAC design includes an operating bypass which is continuously indicated in the control room via an annunciator on the main control board. WOG Letter OG-87-10 dated February 26, 1987, has been submitted to the NRC by the WOG providing the basis for the C-20 set point. The basis is as follows: short-term protection against high reactor coolant system pressures is not required until 70 percent of nominal power. However, in order to minimize the amount of reactor coolant system voiding during an ATWS, AMSAC will operate at and above 40 percent of nominal power. Furthermore, since the potential exists for spurious AMSAC actuations during start-up at the lower power levels, to assure the above requirements are met, AMSAC will be automatically blocked at turbine loads less than 40 percent by the C-20 permissive. The C-20 permissive signal uses the existing turbine impulse chamber pressure sensors. The indication of the bypass status is consistent with existing bypass design philosophy used for the control room. For guidance on diversity and independence for the process signals and power supplies, see these specific questions/responses.

For Millstone Unit No. 3 AMSAC logic, the time delay on de-energizing the C-20 permissive is set at 260 seconds. This is based on the results of the analyses performed for Revision 1 of WCAP-10858-A. The longer time delay on de-energizing will ensure that the AMSAC actuation logic can be satisfied for a sufficient period of time for intermediate power ATWS events. The 260 seconds value differs from the value on page 3-2 of WCAP-10858-A, Revision 1. This latter value is a conservative generic value which falls within the range of 180 to 420 seconds shown in Figure 1-3 of WCAP-10858. The Millstone Unit No. 3 value (260 seconds) was compared to the results of a generic study for Model F steam generators. The study examined the minimum expected steam generator inventory reduction rates for intermediate power level ATWS events. The minimum rates were used to determine time required to maintain the C-20 permissive. The Millstone Unit No. 3 specific value falls within the acceptable range (180 to 420 seconds) and is conservative in relation to the analysis performed by Westinghouse which predicts steam generator inventory loss. Rev. 1

The total time response for the turbine trip on an AMSAC signal is given in WCAP-10858P-A, Revision 1, Section 11, page 3-7. Setting the AMSAC signal delay to 25 seconds allows additional time for the turbine trip response and sensor delays, such that the overall response time is within the WCAP requirements.

PLANT-SPECIFIC DETAILS REGARDING
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QUESTION 9

Electrical Independence from Existing Reactor Protection System

The plant specific submittal should show that electrical independence is achieved. This is required from the sensor output to the final actuation device at which point non-safety-related circuits must be isolated from safety related circuits by qualified Class 1E isolators. Use of existing isolators is acceptable. However, each plant specific submittal should provide an analysis and tests which demonstrate that the existing isolator will function under the maximum worst case fault conditions. The required method for qualifying either the existing or diverse isolators is presented in Appendix A.

RESPONSE

Electrical independence from the existing Reactor Trip System (RTS) is required from the sensor output to, but not including, the final actuation device. This is to separate safety-related circuits from nonsafety-related circuits. The Millstone Unit No. 3 AMSAC fulfills this requirement. For the turbine impulse chamber pressure and steam generator level inputs, NNECO has elected to use the existing pressure and steam generator level transmitters, loop power supplies, and new isolation devices being added within the 7300 system process protection cabinets. Electrical independence between the non-Class 1E AMSAC logic circuitry and the Class 1E process protection cabinet circuits is provided through isolation devices which have been tested as described in Appendix A of this document. Moreover, the non-Class 1E logic circuitry and outputs of AMSAC are isolated from Class 1E circuits. Appendix A of this document provides information on the criteria used for testing the isolation device. Rev. 1

PLANT-SPECIFIC DETAILS REGARDING
ATWS MITIGATION SYSTEM ACTUATION CIRCUITRY (AMSAC)
FOR MILLSTONE UNIT NO. 3

QUESTION 11

Environmental Qualification

The plant specific submittal should address the environmental qualification of ATWS equipment for anticipated operational occurrences only, not for accidents.

RESPONSE

The AMSAC equipment at Millstone Unit No. 3 will be located in areas that are considered a mild environment that would at no time be significantly more severe than the environment that would occur during normal plant operation or during anticipated operational occurrences. AMSAC equipment has been designed to perform its function during normal plant operating conditions or during anticipated operational occurrences. The only anticipated operational occurrences that would affect AMSAC equipment are loss of off-site power and a loss of heating and ventilation system. The AMSAC logic power supply is provided by an independent inverter which is backed by a battery. This power supply is connected to a motor control center which is backed by the diesel generator when needed. Therefore, a loss of off-site power will not prohibit AMSAC's protective function. Also, AMSAC will be located where there is a redundant train, Class 1E heating and ventilation system; therefore, loss of off-site power will not affect AMSAC's operation due to high temperature effects. The environmental and seismic qualification aspects of the isolation device are discussed in Appendix A of this document. Rev. 1

PLANT-SPECIFIC DETAILS REGARDING
ATWS MITIGATION SYSTEM ACTUATION CIRCUITRY (AMSAC)
FOR MILLSTONE UNIT NO. 3

QUESTION 12

Testability at Power

Measures are to be established to test, as appropriate, non-safety related ATWS equipment prior to installation and periodically. Testing of AMSAC may be performed with AMSAC in bypass. Testing of AMSAC outputs through the final actuation devices will be performed with the plant shutdown. The plant specific submittals should present the test program and state that the output signal is indicated in the control room in a manner consistent with plant practices including human factors.

RESPONSE

The nonsafety-related ATWS circuitry is testable with the plant on-line. The complete end-to-end testing of the AMSAC system from sensors through final actuation device will be performed with plant shutdown at each refueling. Rev. 1

The AMSAC system for Millstone provides for periodic testing through a series of overlapping tests. These operational tests will be performed quarterly with the AMSAC outputs bypassed. This bypass is accomplished through a permanently installed bypass switch which negates the need to lift leads, pull fuses, trip breakers, or physically block relays. Status outputs to the plant computer and main control board, indicating that a general warning condition exists with AMSAC, are initiated when the system's outputs are bypassed. Once the system bypass is established, a series of overlapping tests are performed to verify analog channel accuracy, set point (bistable trip) accuracy, coincidence logic operation including operation and accuracy of all timers, and continuity through the output relay coils. Switches are provided for each output relay to perform testing of AMSAC outputs through the final actuation devices with the plant shut down. A simplified block diagram is shown in Figure 3 reflecting the test overlaps for the periodic on-line tests. A summary of each of the overlapping tests follows. Rev. 1

Analog Input Channel Testing

The field input to each analog input channel is replaced with a variable test reference which is used to confirm accuracy of the channel gain and offset. The test reference is then ramped up and down throughout a portion of the channel range to verify accuracy of the channel set point and associated deadband. This test confirms operation of the input channel signal conditioning circuitry, analog-to-digital converters, and processor operation.

Processor Logic Testing

The second sequence of testing verifies that each actuation logic processor performs the proper coincidence logic, including timing functions, and generates the proper outputs. In this test, the field input channel for the processor under test is replaced with test references. These test references simulate the channel values as either above or below the set point to verify all combinations of coincidence logic and generation of the proper processor outputs to the majority voting modules is performed. This test confirms operation of the input channel signal conditioning circuitry, analog-to-digital converters, processor operation, and output circuits to the majority voters.

Majority Voter and Output Relay Tests

Each majority voting module and associated output relays are tested to verify operation of the majority vote (2 out of 3) and that continuity exists for each of the output relay coils. Integrity of the relay coils along with associated wiring is verified while exercising the voting logic.

APPENDIX A
AMSAC ISOLATION DEVICE

Electrical independence of AMSAC from the existing RTS is provided through several means for Millstone Unit No. 3. A block diagram showing the relationship of AMSAC to the existing RTS is provided in Figure 4 which details the AMSAC/RTS connections and points of isolation.

The steam generator narrow-range level inputs to AMSAC are derived from existing isolated signals from the process protection system. These signals are provided from differential pressure transmitters to the process protection cabinet to AMSAC. This arrangement does not require the use of new isolators to provide electrical independence of these instrument channels from the existing RTS. However, to prevent overloading of the existing current loops, several isolators of the existing type were added.

For measuring turbine load at the first stage, NNECO has elected to utilize the existing pressure transmitters. As with the narrow-range steam generator inputs, the isolated signals are from the process protection cabinet.

Isolation is provided in the process protection cabinet for the signals used as input for AMSAC. As reported in WCAP-9982A, Westinghouse 7300 Series Process Control System Noise Tests, these isolation devices, which are powered by a Class 1E source, have been tested to demonstrate that the device is acceptable for its application. The purpose of the tests was to determine whether or not protection circuitry could be perturbed to the extent that protective action would be prevented by the pickup or presence of credible interference on control wiring in close proximity to protection wiring within the process control racks. Isolation devices are used in the Process Control Systems 7300 Series equipment to electrically isolate the protection circuits inside the process control racks from control circuits outside the cabinets. The system was subjected to tests that included magnetic noise tests, output cable voltage faults (maximum credible voltages: 550 VAC, 250 VDC), cross-talk, random noise, etc. The acceptance criteria for these tests were (a) the postulated fault should not prevent required protective action, and (b) spurious protective action caused by the postulated fault should be acceptable.

As mentioned, the subject of interferences that could negate protective actions was covered in various tests carried out for the WCAP for the Westinghouse 7300 Series Process Control System Noise Tests. This report includes a series of tests that were performed before any faults or circuity abnormalities were applied. These tests were carried out to demonstrate that a credible perturbation in the control wiring would not degrade protection action or be reflected back into the protection wiring. Any of these interferences (i.e., noise, cross-talk, etc.) that would be generated by AMSAC falls under the same category as those tested for the test report. Since AMSAC is separate from the RTS and the cable is not routed in an area that exceeds the 550 VAC and 250 VDC test limits, any interference from AMSAC would not affect the RTS.

Under all tested conditions, the protection circuitry operated as intended. The test showed conclusively that electrical interference imposed onto the isolator output wiring (control wiring) is not a consideration as to the proper operation of the perturbed channel nor any adjacent channels. The recordings verified that the interference imposed onto the control wiring was not induced into the protection wiring. The magnitude of the electrical interference introduced into the system and the stringent test procedures far exceeded any conditions that would be present in actual plant operations.

Relays are provided at the output of AMSAC for isolating the non-Class 1E AMSAC circuits from the Class 1E final actuator circuits. For Millstone, the AMSAC outputs are provided from separate relay panels within the AMSAC cabinet. Separation of the Train A, B, and non-Class 1E circuits within the AMSAC cabinet is achieved through a combination of metal barriers, conduit, and distance. These relays have been tested with a maximum credible fault applied to the relay coil in the transverse mode. Tests have been performed with the relay coil operating contact in both the open and closed position. Figure 5 depicts the simplified diagram of this output isolation circuit, and point of application for the maximum credible faults. Details of the actual tests, fault levels and their origin, test data, and pass/fail acceptance criteria will be submitted in the AMSAC Equipment Qualification Report.

Additionally, the SER requires that the isolation devices comply with the environmental qualifications (10CFR50.49) and with the seismic qualifications which were the basis for plant licensing. The isolation device at the output of AMSAC is the boundary between safety-related and nonsafety-related circuits and therefore must be qualified. For the Millstone configuration, the AMSAC output isolation device will be qualified in accordance with the current Westinghouse seismic qualification program.

This program has developed and implemented the requirements of IEEE-344-1975, "IEEE Standard for Seismic Qualification of Class 1E Electrical Equipment for Nuclear Power Generating Stations," for Westinghouse-supplied instrumentation and control systems. The isolations provided at the protection system have been seismically qualified. Environmental Qualification Reports, however, are not applicable to the AMSAC output relays since these are located in a mild environment. The methodology for qualification is contained in WCAP-8587, Revision 6.A (Methodology for Qualifying Westinghouse WRD-Supplied NSSS Safety-Related Electrical Equipment).

The Class 1E loads operated by the isolation relay contacts are powered from a Class 1E source. The plant-specific details of the wiring configuration can be found on the Millstone Unit No. 3 elementary drawings if needed.

A series of tests have been completed at the Westinghouse Technology and Training Center to determine the isolation capability of the Struthers-Dunn Type 219 plug-in relay. This relay is used in the output of the ATWS AMSAC for isolating the non-Class 1E AMSAC circuits (relay coil) from the Class 1E final actuation circuits (relay contacts). Rev. 1

Three Type 219 relays with four single-break, double-throw (4PDT) contacts built to Westinghouse Design Specification 405A10 were taken from stock for this series of tests. Testing was done between November 10 and 25, 1987.

Following is a brief summary of the test results.

Test 1

- Hypot using 1500 VAC across open contacts (wired in series) to coil.
- Hypot tester was factory set to alarm when leakage current exceeded 1 mA.
- No alarm on any relay.

Test 2

- Meggered, using 60 VDC, from coil to frame, each contact to frame, each contact to coil, and each contact to contact.
- Lowest resistance--30,000 MOhm, contact to contact.

Test 3

- 582 VAC across open contacts (wired in series) to coil.
- Lowest leakage impedance--47.5 MOhm. Rev. 1

Test 4

- 582 VAC across open contacts (wired in series) to frame.
- Lowest leakage impedance--42.5 MOhm.
- Greatest induced coil voltage--0.29 mV.

Test 5

- 582 VAC across sets of open contacts.
- Lowest leakage impedance--70.8 MOhm.

Test 6

- 582 VAC across open contacts wired in parallel.
- Lowest leakage impedance--26.0 MOhm.
- Highest induced coil voltage--2.0 mV.

Test 7

- 590 VAC across the coil.

APPENDIX A
AMSAC ISOLATION DEVICE
(continued)

o Results.

Relay Number	Time for Coil to Open (Seconds)	Induced Contact Voltage: Digital Multimeter (Volts)	Induced Contact Voltage: Recorder Trace (Volts)
1	19.45	Not Observed	0.731
2	19.92	0.618	0.774
3	20.40	1.40	1.032

o All the by-products resulting from the coil burning open were contained within the clear polycarbonate relay cover.

o The cover was warm to the touch immediately after the coil burned open.

For this test (Figure 1), the relays had been tested with the maximum credible fault (MCF) of 590 VAC applied to the relay coil in the transverse mode. A normally closed contact was connected to a strip chart to determine the duration of the relay actuation (if any) during application of a fault to the relay coil and to measure the resulting induced voltage on the contact. A second normally closed contact was connected to a DVM to measure induced voltage on the contact for tests on relays 2 and 3. The fault voltage and induced voltage were measured and recorded as listed above. Rev. 1

For each of the relay test cases, the fault current passed through the relay coils was in the range of 0.38 to 1.08 amperes and was limited by the coil impedance itself.

The relays clearly demonstrated their isolation capability by limiting any propagation of the faulted conditions from the non-Class 1E coil to the Class 1E contacts to a negligible value. This induced contact voltage (maximum of 1.4 volts) was not large enough to cause damage to components typically found in plant protection circuits which AMSAC will be connected. Based upon the performed tests, the Struthers-Dunn relay was demonstrated to be an effective isolation device for the output circuits of AMSAC.

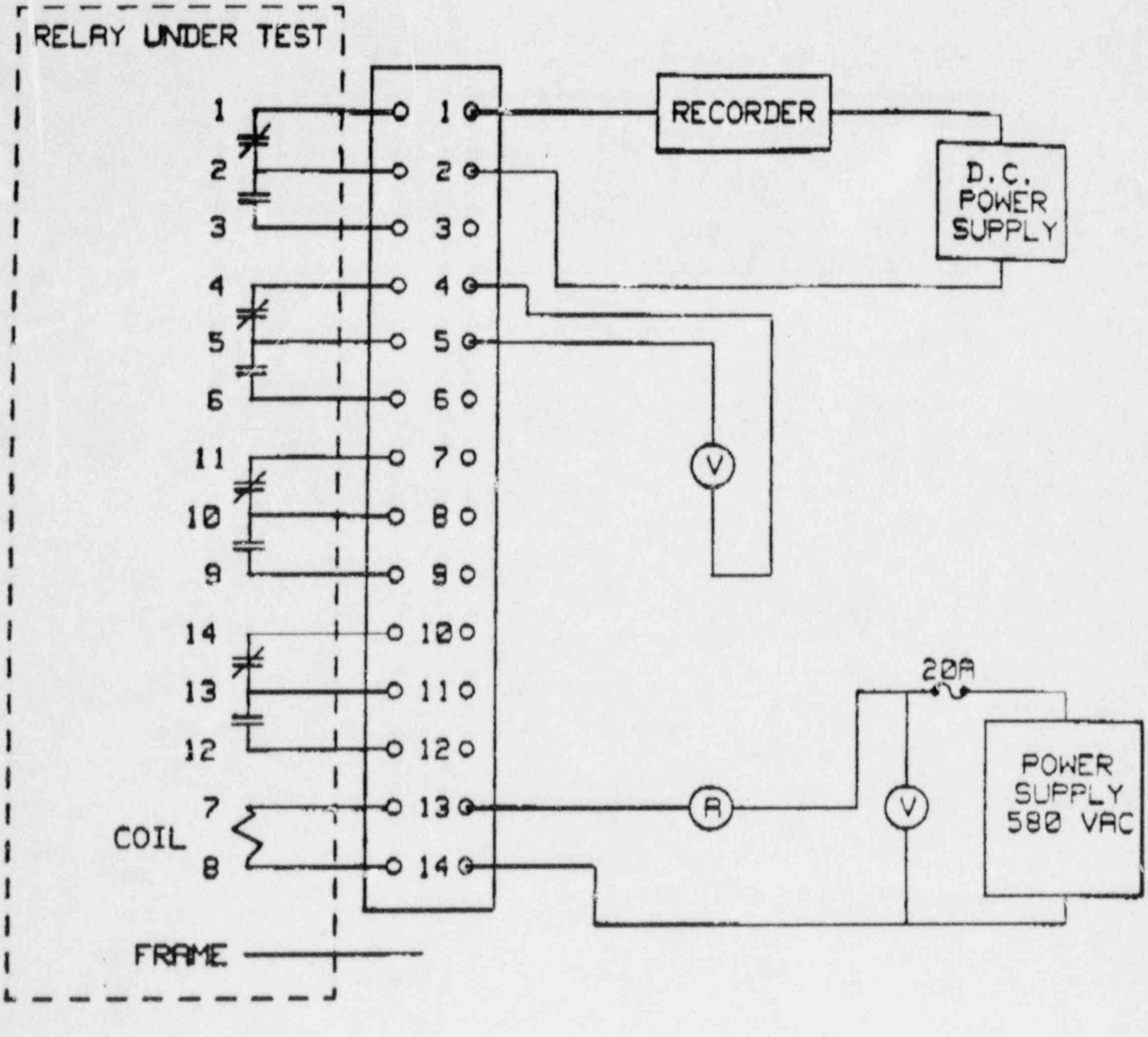

FIGURE 1 – COIL TO CONTACT INDUCED VOLTAGE