

Enclosure

Instrumentation and Control System
Evaluation Report
Westinghouse Design Verification Program
Class IE Electrical Equipment
Dated 12-11-78

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*(P) Proprietary Report
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Instrumentation and Control Systems Status Report
on Westinghouse Design Verification Program
for Class IE Electrical Equipment

I. Introduction

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires that design control measures provide for verifying the adequacy of a specific design feature by design review, calculational methods, or suitable qualification testing of a prototype unit under adverse conditions.

The complexity of several types of electrical equipment does not lend themselves to analytical methods as the only means for reaching conclusions concerning specific capabilities of equipment and their adequacy for particular applications. Analysis can directly determine only failure limits. The adequacy of Class IE electrical equipment and components is demonstrated by the functional operability of the equipment rather than the failure limits. Industry and regulatory agencies recognizing the need for test programs to demonstrate the continued capability of complex safety-related electrical equipment in post-accident environment (temperature, pressure, chemistry and radiation) and seismic events resulted in the development of test programs and industry standards.

The Institute of Electrical and Electronics Engineers (IEEE) developed documents to provide guidance for demonstrating and documenting the adequacy of safety-related electrical equipment during accident and post-accident conditions. The Regulatory staff develops Regulatory Guides (RGs) which define the acceptability of the standard, conditions or exceptions in its use and implementation of the standard, as augmented by the Regulatory Guide, in the licensing process.

II. Verification Program

We have indicated that industry and the NRC recognized the need for development of standards to be used to provide guidance for demonstrating and documenting the adequacy of safety-related equipment utilized in the nuclear power industry. Westinghouse Electric Corporation implemented a test program concurrently while these standards were being developed and provided its documentation in topical reports. These reports included descriptions of the equipment tested, test procedures, test results and conclusions.

We have in the past found acceptable the analytical methods and testing programs used by Westinghouse to qualify Class IE electrical equipment within the Westinghouse scope of supply for the environmental and seismic conditions to which the equipment may be exposed. The programs are described in topical reports and augmented by information provided in the applicant's Safety Analysis Reports (SARs).

We then expanded the topical report review program to improve and expedite the licensing process. The topical reports used as the technical basis for meeting the Commission's requirements for issuance of a license or construction permit continued to be reviewed. We determined, as a result of our expanded review, there were certain deficiencies in the Westinghouse test program and documentation that had to be corrected to satisfy the requirements of the IEEE qualification standards used as the bases for our evaluations. Many of our concerns have been resolved during our generic review. However, some concerns required verification tests to demonstrate that the equipment or components are capable of meeting their performance specifications under service conditions and adequate documentation be provided to permit an independent evaluation of the test results.

Although the verification program could result in identifying some deficiencies in the installed electrical equipment, we concluded that plant operation prior to completion of the verification program and the correcting of any deficiencies that may be identified would be acceptable because of the low probability of occurrence of the environmental conditions that might adversely affect the operability of this equipment during the time period required to complete our evaluation. Based on the results of the test programs, appropriate action is being taken on all Westinghouse plants in the licensing process to correct any deficiencies identified. These corrective actions will be implemented in all nuclear power plants utilizing the equipment identified as having deficiencies.

Several topical reports are referenced as the bases for qualification of Westinghouse supplied Class IE electrical equipment. The topical reports included in this status report were (1) originally included in the verification program which required either additional data, analysis, or confirmatory testing, and (2) those added or referenced to provide additional documentation in support of the Westinghouse Class IE electrical equipment qualification programs.

III. Summary and Conclusions

The following is a summary of our conclusions resulting from the staff's safety evaluation of the Westinghouse Design Verification Program for Class IE Electrical Equipment. Details of our review are included in Section IV of this report.

A. WCAP-7817(NP) - Seismic Testing of Electrical and Control Equipment
(Supplements 1 thru 8) (Low Seismic Plants)
(Reference 5)

We have concluded that the subject report is acceptable with the following conditions.

1. The topical reports are only applicable for plants having construction permit applications docketed prior to October 1972 and will be reviewed on a case-by-case basis for plants having construction permit applications docketed after October 1972.
2. All nonproprietary topical reports shall be referenced as a group and every topical report shall have its nonproprietary version properly documented.
3. Justification of the Eagle Signal Timer shall be provided as indicated in reference 23.
4. Item 5 - Radiation Monitoring Cabinet, Item 6 - Tracerlab Scintillation Detector and Liquid Sampler, and Item 7 - Tracerlab Stack Gas Detector are not part of this topical report and shall be removed.

B. WCAP-7821(NP) - Seismic Testing of Electrical and Control Equipment
(Supplements 1 thru 6) (High Seismic Plants)
(Reference 6)

We have concluded that the subject report is acceptable with the following conditions.

1. The topical reports are only applicable for plants having construction permit applications docketed prior to October 1972 and will be reviewed on a case-by-case basis for plants having construction permit applications docketed after October 1972.
2. All nonproprietary topical reports shall be referenced as a group and every topical report shall have its nonproprietary version properly documented.
3. Justification of the Eagle Signal Timer shall be provided as indicated in reference 23.
4. Item 2 - Foxboro Process Control Equipment, Item 3 - Safeguards Actuation Racks, Item 5 - Radiation Monitoring Cabinet, Item 6 - Tracerlab Scintillation Detector and Liquid Sampler, and Item 7 - Tracerlab Stack Gas Detector are not part of this topical report and shall be removed.

5. Replacement of all the output relays in the Solid State Protection System, Item 10 of the report, for all high seismic plants where the "g" level is 0.85 or greater at the elevation of the SSPS and Auxiliary Safeguards Cabinets. The replacement relays shall be those qualified in Topical Reports WCAP-8694 and 8655 (Reference 11).

C. WCAP-8021(NP) - Seismic Testing of Electrical and Control Equipment (PG&E Plants - Reference 7)

We have concluded that the subject report is acceptable for the Diablo Canyon application, Dockets 50-275 and 50-323. In addition the report shall reference WCAP-7821 and meet the conditions identified in the acceptance of WCAP-7821.

D. WCAP-8234-A(NP) - Seismic Testing and Functional Verification of Bypass Loop Reactor Coolant RTD's (Reference 8)

We have concluded that the subject report is acceptable with the following conditions.

1. Applicable to plants having construction permit applications docketed prior to October 1972 and will be reviewed on a case-by-case basis for plants having construction permit applications docketed after October 1972.

E. WCAP-8373(NP) - Qualification of Westinghouse Seismic Testing Procedures for Electrical Equipment Tested Prior to May 1974. (Reference 9)

WCAP-7558(NP) - Seismic Vibration Testing with Sine Beats
WCAP-8673(P) - Multi-frequency and Direction Seismic Testing
WCAP-8674(NP) of Relays (Reference 101)

WCAP-8624(P) - General Method for Developing Multi-frequency
WCAP-8695(NP) Biaxial Test Inputs for Bistables (Reference 102)

We have concluded that the subject reports represent a package of information to justify the test methods and procedures in support of WCAP-7817, 7821 & 8021 and are acceptable with the following conditions.

1. The topical reports are only applicable for plants having construction permit applications docketed prior to October 1972 and will be reviewed on a case-by-case basis for plants having construction permit applications docketed after October 1972.

2. All nonproprietary topical reports shall be referenced as a group and every topical report shall have its nonproprietary version properly documented.
3. Justification for Eagle Signal Timer shall be provided as indicated in Reference 23.

- F. WCAP-8694(P) - Seismic Qualification of the Rotary Relay for Use
WCAP-8655(NP) in the Solid State Protection System (Reference 11)
- WCAP-8830(P) - Seismic Operability Demonstration Testing of the
WCAP-8831(NP) Nuclear Instrumentation System Bistable Amplifiers
(Reference 12 & 13)
- WCAP-8832(P) - Seismic Operability Demonstration Testing of the
WCAP-8833(NP) Westinghouse CID 7100 Series Process Analog Instru-
mentation System Bistables (References 14 & 15)
- WCAP-8828(P) - Seismic Operability Demonstration Testing of the
WCAP-8829(NP) Westinghouse ISD 7300 Series Process Instrumentation
Bistables (References 16 & 17)
- WCAP-8848(P) - Seismic Operability Demonstration Testing of the
WCAP-8849(NP) Foxboro Process Instrumentation Bistables
(References 18 & 19)

We have concluded that the subject reports represent a package of information to provide supporting documentation for the bases, test procedures, and test results for WCAP-7817, 7821 and 8021 and are acceptable with the following conditions.

1. The listed reports are only applicable for plants having construction permit applications docketed prior to October 1972 and will be reviewed on a case-by-case basis for plants having construction permit applications docketed after October 1972.
2. All listed nonproprietary topical reports shall be referenced as a group and every topical report shall have its nonproprietary version properly documented.

- G. WCAP-7410L(P) - Environmental Testing of Engineered Safety Features
WCAP-7744(NP) Related Equipment (References 20 & 21)
- WCAP-7829(NP) - Fan Cooler Motors (Reference 22)

The subject reports, WCAP-7410L and 7744, were divided into five major subprograms. WCAP-7829 is included in subprogram A. These reports are applicable for construction permit applications for

which a Safety Evaluation Report was issued prior to July 1, 1974. Our conclusions for each of the subprograms are the following:

Subprogram A: Reactor Containment Fan Cooler Motor Insulation and Lubrication Irradiation

We require that Westinghouse provide the following information for each specific plant that references WCAP 7829 as the basis for qualification.

1. The results of a heat transfer analysis which demonstrates that the full size motor's hot spot temperature resulting from internal and external generated heat will not exceed the qualified level during normal operations (105°C), Design Basis Event operation (122°C), and the post Design Basis event operation (97°C). In addition, it is required that Westinghouse present this information to the users of this topical report as an interface requirement in order to maintain assurance of qualification acceptability.
2. The seismic qualification information for each size motor.

Subprogram B: Process Instrumentation and Control Equipment
(Does not include seismic review and acceptance)

We require that Westinghouse provide the following information for each specific plant that references the subject reports as the basis for qualification of Class IE instruments.

1. Verification that the deviations in accuracy and time of failure noted in the test results are within the specified time and accuracy required in the accident analysis for each specific plant.
2. Identify those instruments inside containment required to follow the course of Condition III and IV events. Verify the capability of each instrument identified and recommend a replacement instrument model for those not capable of long term monitoring.
3. Westinghouse has indicated (Appendix A, Reference 79) that additional instrumentation

located outside of containment is available to the operator to follow the course of Condition III and IV events. Identify the instrumentation and its capability for each specific event and plant.

4. The differential pressure transmitters shall be temperature compensated and the deviations shall be within that required for each specific application.

Subprogram C: Post-Accident Hydrogen Combustion System

We have concluded that this subprogram is acceptable.

Subprogram D: Valve Motor Operators

We have concluded this subprogram is acceptable, except that additional justification must be provided to demonstrate the adequacy of the seismic qualification in accordance with IEEE-344-1975 as supplemented by Regulatory Guide 1.100 Rev 1.

Subprogram E: Electrical Cables and Splices

We have concluded that this subprogram shall be removed from the subject reports.

Miscellaneous Items: Air Operated Valves and Solenoids and Sump Level Instrumentation (Does not include seismic review and acceptance).

We have concluded that the sump level instruments shall be removed from the report and the air operated solenoids and valves are acceptable.

IV. Topical Report Evaluation

The Instrumentation and Control Systems Branch was requested to evaluate the topical reports that were included in the initial verification program, supporting topical reports, and additional material provided in support of the Westinghouse Class IE Electrical Equipment Qualification Program. References 1 through 4 were used as the bases of our evaluation of the functional capability of the Class IE Electrical Equipment included in References 5 through 22, and References 101 and 102. The results of our evaluation follow.

A. WCAP-7817 and Supplements 1 through 8 (Reference 5)

"Seismic Testing of Electrical and Control Equipment (Low Seismic Plants)"

Summary of Report

The subject reports provide detailed descriptions of the equipment tested, procedures used and test results. The test programs cover those plants in which the Design Bases Earthquake (DBE) ground acceleration is less than or equal to 0.2g. The electrical equipment tested in WCAP-7817 and supplements include the following:

- 1.0) Static Inverter
- 2.0) Foxboro Process Control Equipment
- 3.0) Safeguards Actuation Racks
- 4.0) Nuclear Instrumentation System
- 5.0) Radiation Monitoring Cabinet
- 6.0) Tracerlab Scintillation Detector and Liquid Sampler
- 7.0) Tracerlab Stack Gas Detector
- 8.0) Pressure and Differential Pressure Transmitters (5Hz to 25 Hz range)
- 9.0) Westinghouse Computer Instrumentation Division (WCID) Process Instrument Racks
- 10.0) Westinghouse Solid State Protection System
- 11.0) Westinghouse Computer Instrumentation Division (WCID) Process Instrumentation Racks 7300 Series
- 12.0) Instrument Bus Distribution Panel (Type WEB)
- 13.0) DB Switchgear, ESF Test Cabinet, Solatron Regulator and Inverters (Type 3441D97 and 2968D06)

Summary of Regulatory Staff Evaluation, WCAP-7817, Reference 5

Item 1 Static Inverter

Original Basis:

The presence of a continuous a-c output voltage both during and after a test.

Original Results:

No momentary or permanent loss or reduction in output voltage with the inverter loaded at 1 KW.

Concern:

There is no indication of the percent of full load rating represented by the 1 kW load. The test does not verify the effect on the output voltage at rated load. A seismic event can cause electrical noise (microphonics) which can effect solid state designs. As indicated in the test results of Items 2, 4, 5 and 7 that follow, spurious trips and noise in Westinghouse solid state designs did occur. IEEE Std 344-1971 requires that the tests demonstrate the equipment's ability to perform its intended function and sufficient monitoring equipment should be used to evaluate performance before, during and following the tests. The functional operability of the equipment was not demonstrated by the tests.

Commitment:

Retesting of the static inverters and the instrument bus distribution panels (Item 12) will be performed as a unit. During the test, the system will be loaded to 85% of rated capacity which is the approximate load during accident conditions.

Retesting will be performed at PG&E plant levels, Reference 7, with sine beat input in a biaxial direction. The system will be tested in two mounting positions.

Final Results:

The testing has been completed and the results provided to the staff in Reference 6, Supplement 2, Addendum 1. We have reviewed the report and found the methods, Reference 23, acceptable. However, during the initial test a transformer faulted. This component was replaced and the test was completed. The faulted component was sent to the manufacturer for evaluation. The results of the manufacturer's evaluation are provided in Reference 77. We have reviewed the report and concluded that the failure of the transformer was random and the actions taken by the manufacture and Westinghouse to assure that such a failure will not occur in the future are acceptable. There were no failures in the instrument bus distribution panels.

Conclusion:

The test results have demonstrated the functional operability of the static inverter and are, therefore, acceptable.

Item 2 Foxboro Process Control Equipment

Original Basis:

Signals should remain unchanged during the test and be capable of changing state after the test.

Original Results:

Two bistable trips occurred during front-to-back testing. Thirty two signals were monitored during the test. All other bistables monitored performed normally during and after each test.

Concern:

The report indicates that two bistables tripped during the front-to-back test. The conclusion indicates that a false trip could result. No indication is given that additional tests in the horizontal planes were performed. The bistables were not operated during the test to verify their capability to change state during a seismic event. This is unacceptable as indicated in our statements on Item 1. Westinghouse's basis for acceptability in the seismic qualification of the equipment in Items 3, 6, 7 and 10 that follow, required that the bistables be exercised or the input signal level varied during the tests to demonstrate the functional operability of the equipment. It is indicated that the cause of the spurious trips could not be determined. The assumption that the trips were random, due to loose connections or test equipment is unacceptable. The cause of the malfunctions during a test should be determined and the test repeated until the acceptability requirements are met.

Commitment:

Entire typical channels (including signal conditioning circuits and bistables) will be tested to verify that the Foxboro bistables have the capability to change state during a seismic event. The test will represent, as close as practical, the actual service conditions of the equipment. In addition this representative test addresses the NRC's (Mechanical Branch) concern on the behavior of circuit boards when subjected to a multi-frequency biaxial test environment.

The test methods will utilize multi-frequency biaxial inputs. However, since the Foxboro equipment is not used in any USA plants classified as high seismic the test inputs will be low seismic comparable to the levels of WCAP-7817, Reference 5.

Final Results:

The testing has been completed and the results provided to the staff in References 18 and 19. We have reviewed the reports and found the methods, Reference 23, acceptable. The signal output of the modules were monitored and the recorder tracings were provided to demonstrate the functional operability of the bistables before, during, and after the test. No spurious actions or malfunctions were identified.

Conclusion:

The test results have demonstrated the functional operability of the Foxboro Process Control Equipment and are, therefore, acceptable.

Item 3 Safeguard Actuation Racks

Original Basis:

Satisfactory change of a state on demand.

Original Results:

We have reviewed the report and found that no change of state occurred in the pre-trip condition during testing. The circuitry was tripped to the post trip condition during and after the test. The matrices changed state producing the required output signals. The system operated as designed before, during, and after the test. There are no concerns.

Conclusion:

The test results have demonstrated the functional operability of the Safeguard Actuation Racks and are, therefore, acceptable.

Item 4 Nuclear Instrumentation System

Original Basis:

No change in the analog output signal or bistable state during the test.

Original Results:

Several momentary bistable trips occurred in both horizontal directions during the 1 Hz to 5 Hz tests. The trips were random with a duration of 10 - 20 milliseconds. The test results indicate noise on ion chamber B and a superimposed ripple of 60 Hz. The ripple was

± 2 power units (+166 millivolts) in amplitude. No ripple was present without the test set up. The conclusion is that the test set up was the cause of spurious trips.

Concern:

Justification for spurious trips during the 1 Hz to 5 Hz tests, due to test equipment or configuration, is unacceptable. The noise generated by the test equipment or configuration should be located and corrected before continuing with the test programs. The reports indicate that successful tests were completed in the 5 Hz to 25 Hz range with no noise problems utilizing the same test configuration. The test did not meet the basis for acceptance. As we have indicated in Item 2, the cause of malfunctions during a test should be determined and the test repeated until the acceptability requirements are met.

Commitment:

Same as Item 2, however, the test inputs will be as for a PG&E level plant, Reference 7. In addition this test addresses the NRC's (Mechanical Branch) concern on the behavior of circuit boards when subjected to a multi-frequency biaxial test environment.

Final Results:

The testing has been completed and the results provided to the staff in References 12 and 13. During the testing, mechanical failures resulted due to test facility malfunctions. The details of our evaluation of the test methods and the mechanical failures are included in Reference 23. Five tests were performed of which two were resonance surveys and the functional operability was not monitored. All bistables functioned correctly during test two. However, the negative rate bistable was not tripped due to the time duration of the test. The bistable was operated immediately after the test and functioned correctly. No conclusive data was available after test three due to the test facility failure. The final test, test five, was terminated early due to damage sustained from the malfunction during test three. However, five of the bistables operated as required during the test. An unexplained trip occurred at the time the drawer broke loose from the cabinet. A post-check immediately after the test indicated proper operation of all bistable circuits. Reference 12 includes recorder tracings of the bistable outputs and information on the structural capability of the cabinet.

Conclusion:

Based on the test results and the justification provided for the malfunctions identified above, we have concluded that the tests have demonstrated the functional operability of the bistables and is, therefore, acceptable.

Item 5 Radiation Monitoring Cabinet

Item 6 Tracerlab Scintillation Detector and Liquid Sampler

Item 7 Tracerlab Stack Gas Detector

Proposal:

These components will be removed from the "seismic qualification required" list. No credit is taken for the above equipment to mitigate the consequences of postulated accidents.

Conclusion:

We indicated to Westinghouse that we concur with their proposal, however, we require that additional information be provided to determine that no outputs from the radiation monitoring cabinets provide automatic actuating signals to any safety-related system or function. Westinghouse has provided this information for all plants which reference this topical report, Reference 76. We have evaluated the information provided and determined that radiation monitoring system provides no automatic actuating signals to safety-related systems or functions. We therefore conclude that these items shall be removed from the report.

Item 8 Pressure and Differential Pressure Transmitters

Original Basis:

The output signal remain constant during the tests and return to pre-test level after test.

Original Results:

Output signal amplitude oscillations occurred around the normal signal level. The units indicated correct value after test.

Concerns:

The test results do not meet the basis. The output oscillated around the normal signal level. The oscillations could cause trips depending on the monitored variable and the trip point. The tests do not demonstrate that the equipment is capable of meeting its performance specifications under service conditions. The test results do not meet the criteria identified in the Westinghouse basis for acceptance.

Commitment:

Provide detailed drawings of the transmitters and instrument seismic error acceptance criteria.

Final Results:

Westinghouse has provided detailed drawings of the transmitters for verification of their assumptions that the base line variations of the input signal will be repeatable for the entire dynamic range of the transmitters. We have reviewed the additional reports and detailed drawings of the transmitters. We have concluded the base line offset identified in their reports is repeatable. Westinghouse has reviewed the safety-related applications of the instruments for those plants referencing the subject report and provided the instrument seismic error acceptance criteria in Reference 99. We have reviewed the additional information provided and determined that the amplitude of the oscillations were small with respect to the span of the instrument output signal. The oscillations and offsite are evaluated and appear as part of the Safety Analysis Report for specific applications.

Conclusion:

The test results have demonstrated the functional operability of the pressure and differential pressure transmitters and are, therefore, acceptable.

Item 9 WCID 7100 Series Process Instrument Racks

Original Basis:

Signals remain unchanged during test and be capable of changing state after test.

Original Results:

A bistable trip occurred during the front-to-back testing at 5 Hz due to noise spike.

Concerns:

The test did not meet the basis nor was it repeated to determine the cause of the noise. The basis should include capability to change state during a seismic event. The bistables should be exercised during the tests as well as after the tests.

Commitment:

Same as Item 2, to verify that the bistables have the capability to change state during a seismic event. The test inputs will be the same level as WCAP-8021, Reference 7. The test will address the NRC's (Mechanical Branch) concern on the behavior of circuit boards when subjected to a multi-frequency biaxial test environment.

Final Results:

The testing has been completed and the results provided to the staff in References 14 and 15. We have reviewed the reports and found the methods, Reference 23, and the results acceptable. The signal outputs of the modules were monitored and the recorder tracings were provided to demonstrate the functional operability of the bistables before, during and after the test. During one test an erratic indication was noted on the output. The cause of the malfunction was determined to be a faulty crimp connection. The connection was recrimped thus eliminating the problem. No other spurious actions or malfunctions were identified.

Conclusion:

The test results have demonstrated the functional operability of the 7100 Series Process Instrument Equipment and are, therefore, acceptable.

Item 10 Solid State Protection System (SSPS)

Original Basis:

Satisfactory change of state on demand.

Original Results:

The Safety Injection (SI) output and Train A trouble output relays were monitored. The relays were exercised during and after the tests and functioned as designed. Momentary maloperations occurred in the 9.5 Hz range.

Concerns:

The basis and test results are unacceptable. The random operation of the output relays, momentary or latching, is unacceptable. It cannot be determined that all the possible combinations of random operation of the output relays would leave a plant in a safe condition for all normal and accident conditions during and after a seismic event. The SSPS has approximately forty output relays and two hundred eighty contacts providing safety related functions.

Commitment:

Provide justification for the momentary maloperations which occurred in the 9.5 Hz test.

Final Results:

The tests, Reference 47, Attachment 4, show that contact bounce of the output relays starts at an acceleration level of 0.95g and is of a 10 to 15 milli-sec. duration. For low seismic plants no additional analysis or testing is required since accelerations for these plants are below 0.95g. For high seismic plants, however, an engineered safeguard systems analysis was conducted (see Item 10, Reference 6).
Conclusion:

Westinghouse provided a visicorder record verifying that the contact bounce was at a higher g level than required for plants in the low seismic category. We have reviewed the data and concur with Westinghouse. The seismic qualification tests have demonstrated the functional operability of the SSPS for low seismic plants and is, therefore, acceptable.

Item 11 WCID 7300 Series Process Instrument Racks

Original Basis:

Signals remain unchanged during test and be capable of changing state after the test.

Original Results:

No change of signal or contact status occurred during the test. The bistables operated correctly after the test.

Concerns:

The basis is unacceptable. The basis should include the capability to change state during a seismic event. The bistables should be exercised during the tests as well as after the tests.

Commitment:

Same as Item 2, however, the test inputs will be the same level identified in WCAP-8021, Reference 7. The test addresses the NRC's (Mechanical Branch) concern on the behavior of circuit boards when subjected to a multi-frequency biaxial test.

Final Results:

The testing has been completed and the results provided to the staff in References 16 and 17. We have reviewed these reports and found the methods, Reference 23, acceptable. The signal outputs of the modules were monitored and the recorder tracings were provided. No spurious actuations or malfunctions were identified.

Conclusion:

The test results, References 16 and 17, have demonstrated the functional operability of the 7300 Series Process Instrument Equipment and are, therefore, acceptable.

Item 12 Instrument Bus Distribution Panels

Original Basis:

The equipment shall operate properly and perform required safety related functions.

Original Results:

The breaker contact status was monitored. Continuity was maintained at all times during the tests.

Concern:

The unit tested is used in the plant vital AC power distribution system. It cannot be determined if the distribution system was providing power to simulated loads during the testing.

The test did not demonstrate that the equipment is capable of meeting its performance specifications under service conditions. The circuit breakers were not providing power to loads as they would in normal and accident conditions. The test set up did not have the normal input and output cable configurations. The test did not demonstrate that the equipment would meet its functional requirement, providing vital AC power to safety related equipment. The trip mechanisms could be affected by electrical noise causing spurious trips.

Commitment:

As noted in Item 1, in order to demonstrate that the static inverter system and the instrument bus distribution equipment function as required, with loads, a re-test will be conducted.

Final Results:

The instrument bus distribution panels were tested in conjunction with the static inverters (see item 1).

Conclusion:

The test results have demonstrated the functional operability of the instrument bus distribution panel and are, therefore, acceptable.

Item 13 DB Reactor Switchgear, Engineered Safeguards Test Cabinet, Solatron Regulators and Inverters (Type 3441D97 and 2968D06)

Original Basis:

Functional operability before, during, and after the tests.

Original Results:

The equipment operated as designed with the exception of momentary opening of normally closed contacts of some test selection switches in the Engineered Safeguards Test Cabinet.

Concern:

The switches did not function as designed during the seismic test.

Evaluation:

The test data indicates the contact bounce was for a 2 milli-second duration. The contacts are used only in the reset circuit of the blocking relay upon completion of a test. During operation, other than testing, the relay is in the reset mode. In addition, the reset time of 8 to 14 milli-seconds is required to actuate the reset relay.

We have concluded that the contact bounce will not affect the functional capability of the engineered safety features equipment or the testing capability.

Conclusion:

The test results have demonstrated the functional operability of the DB Reactor Switchgear, ESF Test Cabinet, Solatron Regulator and Inverters (Type 3441D97 and 2968D06) and are, therefore acceptable.

- B. WCAP-7821 and Supplements 1 through 6 (Reference 6) "Seismic Testing of Electrical and Control Equipment (High Seismic Plants)"

Summary of Report

The subject reports provide detailed descriptions of the equipment, tested, procedures used and test results. The test programs cover those plants in which the Design Bases Earthquake (DBE) ground acceleration is in the range of 0.2g to 0.4g. The electrical equipment tested in WCAP-7821 and the supplements include the following.

- 1.0) Static Inverter
- 2.0) Foxboro Process Control Equipment
- 3.0) Safeguards Actuation Racks
- 4.0) Nuclear Instrumentation System
- 5.0) Radiation Monitoring Cabinet
- 6.0) Tracerlab Scintillation Detector and Liquid Sampler
- 7.0) Tracerlab Stack Gas Detector
- 8.0) Pressure & Differential Pressure Transmitters
- 9.0) Westinghouse Control Instrumentation Division (WCID) Process Instrument Racks
- 10.0) Westinghouse Solid State Protection System
- 11.0) WCID Process Instruments Racks 7300 Series

12.0) DB Switchgear, ESF Test Cabinet, Solatron Regulator, and Inverters (Type 3441097 and 2968D06)

Summary of Regulatory Staff Evaluation, WCAP-7821

Item 1.0 Static Inverter

Concern:

The concerns, commitment, test method and results are the same as those identified in WCAP-7817, Item 1. The tests were performed to the level identified in Reference 7.

Conclusion:

The test results have demonstrated the functional operability of the static inverter and are, therefore, acceptable.

Item 2 Foxboro Process Control Equipment

Concern:

The concerns are the same as those identified in WCAP 7817, Item 2.

Conclusion:

The Foxboro Process Control Equipment is not used in any USA plants classified as high seismic. Westinghouse proposes to remove reference to this equipment in WCAP-7821. We concur with Westinghouse and find their proposal acceptable. The Foxboro Process Control equipment has been replaced in current Westinghouse designs by the 7100 and 7300 series process control equipment. Reference to the Foxboro equipment shall be removed from this report.

Item 3 Safeguards Actuation Racks

Proposal:

The Safeguards Actuation Racks are not used in any USA plants classified as high seismic. Therefore, reference to this equipment will be removed from WCAP-7821.

Conclusion:

We concur with Westinghouse and find their proposal acceptable. The Safeguards Actuation Racks have been replaced in current Westinghouse designs by the Solid State Protection System (SSPS). Reference to the Safeguard Equipment shall be removed from this report.

Item 4 Nuclear Instrumentation System

Concern:

The concerns, commitment, test method and results are the same as those identified in WCAP-7817, Item 4. The tests were performed at the level identified in Reference 7.

Conclusion:

The test results have demonstrated the functional operability of the Nuclear Instrumentation System and are, therefore, acceptable.

Item 5 Radiation Monitoring Cabinet

Item 6 Tracerlab Scintillation Detector and Liquid Sampler

Item 7 Tracerlab Stack Gas Detector

Proposal:

These components will be removed from the "seismic qualification required" list. No credit is taken for the above equipment to mitigate the consequences of postulated accidents.

Conclusion:

Same as that provided for Items 5, 6 and 7 of WCAP-7817. These items shall be removed from this report.

Item 8 Pressure and Differential Pressure Transmitters

Concern:

Same as those identified in WCAP-7817 Item 8.

Conclusion:

The test results have demonstrated the functional operability of the pressure and differential pressure transmitters and are, therefore, acceptable.

Item 9 WCID 7100 Series Process Instrument Racks

Concern:

The concerns, commitment, test method and results are the same as those identified in WCAP-7817, Item 1. The tests were performed to the level identified in WCAP-8021, Reference 7.

Conclusion:

The test results have demonstrated the functional operability of the 7100 Series Process Instrument System and are, therefore, acceptable.

Item 10 Solid State Protection System

Original Basis:

Satisfactory change of state on demand

Original Results:

The Safety Injection (SI) output and Train A trouble output relays were monitored. The relays were exercised during and after the tests and functioned, as designed, for the 1 Hz to 5 Hz range. Momentary and permanent maloperations occurred in 7 Hz to 9.5 Hz range.

Concern:

The basis and test results are unacceptable. The random operation of the output relays, momentary and latching, is unacceptable. It cannot be determined that all the possible combinations of random operation of the output relays would leave a plant in a safe condition for all normal and accident conditions during and after a seismic event. The SSPS has approximately forty output relays and two hundred eighty contacts providing safety-related functions.

Proposal:

For high seismic plants, an engineered safeguards system analysis was conducted and submitted under the Diablo Canyon docket. The Westinghouse analysis indicated the need to replace only a few of the output relays. However, we concluded in Reference 63 that additional analysis and justification would be required to support the Westinghouse conclusion or we would require all the output relays be replaced by qualified units.

Commitment:

Testing of the replacement relays will be performed at PG&E plant levels, Reference 7, that conservatively simulate the previously recorded test motions at relay mountings.

Final Results:

The seismic qualification of the replacement relays, rotary relays, is documented in WCAP-8694 and 8655, Reference 11. We requested additional information relating to the test setup and results. Westinghouse provided the information, Reference 74, and we have concluded that (1) the mounting method for the output relays is similar for the SSPS and safeguard cabinets; (2) the electrical rating of the contacts is adequate for the applications identified in the report; and (3) the visicorder tracings provide verification of the functional operability of the rotary relays during testing.

Conclusion:

We have concluded that the test results have demonstrated the functional operability of the rotary relays and are, therefore, acceptable. These relays will be required as replacement relays for all high seismic plants where the "g" level is 0.85 or greater at the elevation where the SSPS and auxiliary safeguards cabinets are located, Item 26, Reference 77.

Item 11 WCID 7300 Series Process Analog System

Concern:

The concerns are the same as those identified in WCAP-7817, Item 11.

Conclusion:

The test results, References 16 and 17, have demonstrated the functional operability of the 7300 Series Process Instrument System and are, therefore, acceptable.

Item 12 DB Switchgear, ESF Test Cabinet, Solatron Regulator and Inverters (Type 3441D97 and 2968D06)

Concern:

Same as those identified in WCAP-7817, Item 13.

Conclusion:

The test results have demonstrated the functional operability of the DB Switchgear, ESF Test Cabinets, Solatron Regulator and Inverters (Type 3441D97 and 2968D06) and are, therefore, acceptable.

C. WCAP-8021 (Reference 7)

"Seismic Testing of Electrical and Control Equipment (PG&E Plants)"

Summary of Report

The subject report is similar to References 6 and 7, however, the level of qualification is for plants with a Design Bases Earthquake (DBE) horizontal ground acceleration of 0.4g and a hard soil foundation.

Summary of Regulatory Evaluation - WCAP-8021

This report was not included in the verification program for generic review. The report was reviewed during the Diablo Canyon review, Dockets 50-275 and 323. As indicated in previous evaluations of References 5 and 6, some of the verification test levels were of the value identified in this report. The equipment identified and tested in this report was found acceptable for the Diablo Canyon application as augmented by the additional tests identified in our evaluation of WCAP-7821, Reference 6.

Conclusion:

We have concluded that the report is acceptable for the Diablo Canyon application, however, the report will have to be reviewed for any other application which references it as the bases for the seismic qualification of the Westinghouse supplied equipment.

D. WCAP-8234-A (Reference 8)

"Seismic Testing and Functional Verification of By-Pass Loop Reactor Coolant RTD's"

Summary of Topical Report

The subject report provides a detailed description of the test program, procedures, and results to demonstrate the ability of Resistance Temperature Detectors (RTDs) to perform under earthquake and process conditions. These tests cover those plants in which the Design Basis Earthquake (DBE) ground acceleration is in the range of .2g to

.4g and the applications presently used for the RTD. ($T_{avg}/\Delta T$ temperature systems).

The equipment tested for seismic and functional verification consisted of a Sostman Model 118348-1 and Rosemount Model 176KF RDT. Two of each model were used for the resonant frequency search. The Sostman and Rosemount units with the lowest resonant frequency were used for the seismic and functional verification tests.

The tests were conducted in air and the RTDs were monitoring the ambient temperature of the air. Westinghouse indicates that conducting the test in air rather than water represents the most conservative case since no credit is taken for the damping effects of a test conducted in water.

Summary of Regulatory Staff Evaluation

The RTDs tested are being qualified for use in Westinghouse designs to provide analog signals for $T_{avg}/\Delta T$ protection and control systems. These analog signals provide the input to the overtemperature and overpower ΔT setpoints for reactor trip.

The report indicates the range of the RTDs tested is 32°F to 700°F and the resistance of the platinum sensing elements varies from 200.50 ohms @ 32°F to 480.26 ohms @ 700°F. The normal operating temperature for the sensors will be approximately 625°F. The resistance of the sensing element at ambient is in the range of 225 ohms and during normal operation the resistance will be in the range of 410 ohms.

We requested additional information relating to the construction and design of the sensing element, the test setup details and test results. Westinghouse responded to our request, Reference 35. We have evaluated the information and determined that (1) the changes in the physical properties of the material and components will not adversely effect the operation; and (2) the visicorder tracings verify the functional operability of the RTD'S.

Conclusion:

We have concluded that the test methods, Reference 23 and 33, are acceptable. The test results have demonstrated the functional operability of the Resistance Temperature Detectors identified in the subject report and are, therefore, acceptable. Westinghouse was notified of the results of our evaluation in Reference 62.

- E. WCAP-8373(NP) Reference 9 Qualification of Westinghouse Seismic Testing Procedures for Electrical Equipment Tested Prior to May 1974
- WCAP-7558(NP) Reference 10 Seismic Vibration Testing with Sine Beats
- WCAP-8673(P) Reference 101 Multi-frequency and Direction
WCAP-8674(NP) Reference 101 Seismic Testing of Relays
- WCAP-8624(P) Reference 102 General Method of Developing
WCAP-8695(NP) Reference 102 Multi-frequency Biaxial Test Inputs for Bistables

Summary of Topical Reports

The six subject reports present a package of information relating to the test methods and procedures utilized in qualifying Class IE Electrical Equipment to provide adequate assurance that the equipment tested will sustain seismic excitations to their designated SSE levels.

Summary of Regulatory Staff Evaluation

The details of our evaluation of the above reports are included in Reference 23. This evaluation includes the Mechanical Engineering Branch (MEB) basis, methodology, findings, conclusions and positions relating to the above Westinghouse reports.

Conclusion:

The MEB has concluded that the test methods and procedures identified in the subject reports are acceptable provided the conditions identified in Section IV of Reference 23 are met.

- F. WCAP-8694(P) Reference 11 Seismic Qualification of the Rotary
WCAP-8655(NP) Relay for Use in the Solid State Protection System
- WCAP-8830(P) Reference 12 Seismic Operability Demonstration
WCAP-8831(NP) Reference 13 Testing of the Nuclear Instrumentation System Bistable Amplifiers
- WCAP-8832(P) Reference 14 Seismic Operability Demonstration
WCAP-8833(NP) Reference 15 Testing of the Nuclear Instrumentation System Bistable Amplifiers

WCAP-8828(P) Reference 16	Seismic Operability Demonstration
WCAP-8829(NP) Reference 17	Testing of the Westinghouse 150 7300 Series Process Instrumentation Bistables
WCAP-8848(P) Reference 18	Seismic Operability Demonstration
WCAP-8849(NP) Reference 19	Testing of the Foxboro Process Instrumentation Bistables

Summary of Topical Reports

The subject reports represent a package of information to provide supporting documentation for the bases, test procedures and test results for Topical Reports WCAP-7817, 7821 and 8021, References 5, 6 and 7. Reference 11 provides the basis for the qualification of the replacement relays in the output of the Solid State Protection System (SSPS). The other reports, References 12 thru 19, provides the details of the confirmatory testing required in support of References 5, 6 and 7.

Summary of Regulatory Staff Evaluation

The details of our evaluation of References 11 through 19 are included in the evaluations of Topical Reports WCAP-7817, 7821 and 8021 (References 5, 6 and 7).

Conclusion:

We have concluded the subject reports are acceptable as providing supporting information relating to Topical Reports WCAP-7817, 7821 and 8021. These reports are acceptable based on the conditions identified in our evaluations of WCAP-7817, 7821 & 8021 (References 5, 6 and 7).

- G. WCAP-7410-L (P) & 7744 (NP) (References 20 & 21) "Environmental Testing of Engineered Safety Features Related Equipment (NSSS Standard Scope)" and WCAP-7829, "Fan Cooler Motor Qualification" (Reference 22)

Summary of Reports

The subject reports provide detailed descriptions of the equipment tested, procedures used and test results. The overall test program was divided into subprograms categorized by equipment functional requirements. The post-accident environmental conditions were established by using the 60 psig containment design pressure of the Robert Ginna Nuclear Power Plant No. 1 for the equipment and components located within the containment building. The functional

requirements of the safety-related equipment were verified before, during and after the post-accident environments of temperature, pressure, chemistry and radiation as the result of a loss-of-coolant accident (LOCA). The reports provide descriptions of the following:

- 1.0) The post-accident environment conditions (pressure, temperature, chemistry and radiation) including figures and tables representing the environmental condition versus time profiles used in the test program.
- 2.0) A list of engineered safeguards equipment located inside containment including the operating mode, duration and requirement/nonrequirement for environmental testing.
- 3.0) The test facilities used including the test chamber and recording equipment.
- 4.0) The test procedures, results, and conclusions.

The overall test program was divided as follows:

Subprogram A: Reactor Containment Fan Cooler Motor Insulation and Lubrication Irradiation

Subprogram B: Process Instrumentation and Control Equipment

Subprogram C: Post-Accident Hydrogen Combustion System

Subprogram D: Valve Motor Operators

Subprogram E: Electrical Cables and Splices

Summary of Regulatory Staff Evaluation WCAP-7410-L & 7744 (References 20 and 21) WCAP-7829 (Reference 22)

Subprogram A: Reactor Containment Fan Cooler Motor Insulation and Lubrication Irradiation

Concern:

This test program consisted of testing form wound motor coils after exposure to radiation, thermal aging, and vibration. The bearing lubricant was subjected to radiation to examine the effects on the lubricants consistency. This subprogram was partial type test of the fan cooler motor. There was no supporting information to indicate the fan cooler motors would survive the design bases environment, including chemistry and seismic acceleration, for their required availability.

Commitment:

The concerns of this subprogram are addressed in WCAP-7829, Reactor Containment Fan Coolers (Reference 22).

Status:

Westinghouse has documented additional information in support of WCAP 7829. We have reviewed the reports provided and have found the type tests performed included component tests and a 20 hp sample motor test. These tests demonstrated that the 20 hp motor's insulation system performed satisfactorily with winding hot spot temperatures reaching 122°C when subject to a higher than normal external heat environment. However, internal heat resulting from full-load current primarily produces winding hot spot temperatures in a full size motor.

Conclusion:

The staff has concluded that the tests performed are in conformance with the qualification requirements. However, the method used to determine acceptability using an external versus an internal heat source will not significantly affect the full size motor qualification provided the full size motor's hot spot temperature can be maintained below the qualified level.

To complete the staff's acceptability of this WCAP and information contained in References 38, 40, 50, 66, 91, 92, 93, and 94, we require that Westinghouse provide the following information for each specific plant that references this WCAP.

1. The results of a heat transfer analysis which demonstrates that the full size motor's hot spot temperature resulting from internal and external generated heat will not exceed the qualified level during normal operation (105°C), Design Basis event operation (122°C), and the post Design Basis event operation (97°C). In addition, it is required that Westinghouse present this information to the users of this topical report in order to maintain assurance of qualification acceptability.
2. The seismic qualification information that provides the basis for the qualification of each motor size.

Subprogram B: Process Instrumentation and Control Equipment
(Does not include seismic review results and acceptance).

This test program consisted of testing nine differential pressure transmitters and five static pressure transmitters. The instruments were subjected to pressure, temperature, and humidity, but no chemical environment. Three of the differential pressure transmitters were seismically tested and subjected to radiation. The details of our review and conclusions are included in Reference 25.

Original Concerns:

Our concerns relating to Subprogram B include lack of statements as to required accuracies, not demonstrating the negligible effects of caustic sprays on instrumentations, and the adequacy of seismic testing for various Westinghouse applications.

Commitment:

1. In tabular form Westinghouse will supply accuracy requirements for Westinghouse supplied sensors located inside containment that initiate in the short term (i.e., reactor trip, safety injection, containment and steam line isolation) protective functions to mitigate the consequences of ANS Condition III or IV events.
2. For the Beaver Valley Unit 1, Indian Point Unit 3, and current plants seeking Operating Licenses, Westinghouse will provide an analysis demonstrating the negligible effects of caustic sprays (sodium hydroxide and boric acid, where applicable) on transmitters located inside containment that initiate short term protective and safeguards functions to mitigate the consequences of Condition III and IV events.
3. For Westinghouse scope instruments located inside containment which are explicitly listed in a plant SAR as being required to follow the course of Condition III and IV events, Westinghouse will provide an experimental basis to verify that the instruments to be supplied for the plant will remain operable to perform their monitoring functions over the extended duty times in the accident environments in which they must function.

Status:

Westinghouse has supplied the instrument accuracy requirements in References 52, 58, and 99. We utilized this information in our review of the verification programs test results. In addition

Westinghouse provided an analysis to demonstrate the negligible effects of caustic sprays on transmitters located inside containment, Reference 48. We evaluated the analysis and determined that the chemicals will have a negligible effect on the instruments due to the construction and materials involved; however, this will be confirmed by the verification tests and results.

Westinghouse has performed the verification tests and provided the preliminary results in Reference 79. We have evaluated the test setup, procedures and results. The tests indicate that the instruments are capable of initiating the required automatic protection signals. However, we will evaluate the test data provided in the final report to determine the required time and accuracy deviations are within those required for the instrument applications.

Westinghouse modified pressure and differential pressure instruments for applications requiring long term capability. These instruments were tested and the test details are provided in a final report, Reference 98.

We have evaluated the final test report and concluded that the modified instruments can perform long term monitoring functions based on the test results. The instruments stayed within 8% accuracy for long term and 10% accuracy for the trip functions for the pressure transmitters.

The differential pressure transmitters did not receive the normal number of temperature compensation runs during manufacturing due to time constraints of the test program. The maximum error, negative direction occurred on all three test samples at the same temperature and time. The maximum error was at 15.5 hours. The instruments will be temperature compensated and we will require that the deviations are within that required for each specific application referencing the subject reports.

In addition, Westinghouse has indicated, Reference 79, that other instruments located outside of containment are available to the operator to follow the course of Condition III and IV events.

Reference 72 identifies the plants, instrument safety applications, and instrument models for those plants that reference the subject reports.

Conclusion:

We require that Westinghouse provide the following additional information for each specific plant that references WCAP-7744 and 7410L,

References 20 and 21, as the bases for their Class IE Electrical Equipment Environmental qualification.

1. Verification that the deviations in accuracy and time of failure, noted in the test results of Item 1 above and Reference 99, are within the specified time and accuracy required by the accident analysis for each specific plant.
2. Identify those instruments inside containment required to follow the course of Condition III and IV events. Verify the capability of each instrument identified and recommend a replacement, based on the test result, for those not capable of long term monitoring.
3. Identify the additional instrumentation, located outside containment, that is available to the operator to follow the course of Condition III and IV events and its capability for each specific event and plant.
4. The differential pressure transmitters shall be temperature compensated and the deviations shall be within that required for each specific application.

Subprogram C: Post-Accident Hydrogen Combustion System

Commitment:

The Westinghouse electric hydrogen recombiner environmental and seismic qualification is described in WCAP-7709-L (Proprietary) and WCAP-7820 (Nonproprietary). These WCAPs, as supplemented, have been accepted by the NRC staff in their letter of May 1, 1975, as providing an acceptable basis for environmental and seismic qualification.

Status:

The above referenced WCAPs have been reviewed and found acceptable as indicated above.

Subprogram D: Valve Motor Operators

Concern:

Our concerns relating to Subprogram D are identified in our initial review, Reference 25, of the subject reports. We are concerned with the use of Class B insulation inside containment for longer than 8 hours, justification for seismic testing, traceability of previous tests and radiation exposure of test samples.

Commitment:

Westinghouse has committed to provide the following:

1. Review current applications to determine the applicability of valve motor operators and insulation types for safety-related motor operated valves
2. Provide justification for use of Reliance Electric Motors, Class H insulation, on safety-related Limitorque SMB-0 operators
3. Same as Item 2 for Peerless electric motors

Status:

Westinghouse has documented information in support of their commitments in References 47, 54 and 64. Westinghouse evaluated MOV operators utilizing Class B insulation and provided justification which identified that the duty cycles are less than the time tested, and in addition these valve operators have limited application. Reference 47 included documentation in support of the radiation exposure to test samples prior to the tests. We have reviewed the reports provided, References 86, 87, 88, 89 and 90, and verified the serial numbers of units tested to determine that all the requirements of IEEE 323-1971 for qualification of motor operated valves utilizing type "H" insulation were met.

Conclusion:

We have concluded that the limited application of Class B insulation for the times identified are acceptable for those plants referencing the subject report. The test results for MOVs utilizing type H or HR insulation have demonstrated the functional operability of the MOV's, References 47, 86 through 90 provide adequate documentation, and are, therefore, acceptable, except that additional justification must be provided to demonstrate the adequacy of the seismic qualification in accordance with IEEE-344-1975 as supplemented by Regulatory Guide 1.100, Rev. 1.

Subprogram E: Electrical Cables and Splices

Commitment:

The subject of this subprogram is not within the Westinghouse scope of supply for plants seeking operating licenses and thus should be withdrawn from the generic evaluation. However, we required that

Westinghouse verify this for all plants referencing the subject topical reports.

Status:

Westinghouse indicated, Reference 76, that cables and splices were included in their scope of supply for only one application which references the subject reports.

Conclusion:

We concur with Westinghouse that Subprogram E should be removed from the subject report due to its limited application. We will identify the specific plant to Division of Operating Reactors and recommend they verify the adequacy of the cable and splice qualification for that plant.

We, therefore, conclude that Subprogram E shall be removed from the subject reports.

Miscellaneous Items

(Does not include seismic review and acceptance)

Concern:

We identified an inadequate basis for not testing the sump level instruments and not defining the effects of the environments in which air operated valves and solenoids will function even though the air operated valves fail in the safe direction.

Commitment:

Westinghouse will provide documentation to support the capability of air operated valves and solenoids to function. Westinghouse will identify those plants where the sump level instruments are within their scope of supply.

Status:

Westinghouse indicated, Reference 76, that sump level instruments were included within their scope of supply on only two applications which reference the subject reports.

Westinghouse provided a failure mode analysis for safety-related solenoids, Reference 53. The analysis identified the safety applications, the materials utilized, time required for safety functions and the effects of the environments. We have reviewed the analysis

and concluded that the safety-related valves will perform their function within the required times.

Conclusion:

We concur with Westinghouse that the sump level instrumentation should be removed from the subject report due to the limited application. We will identify the specific two plants that utilize sump level instruments that are in the Westinghouse scope of supply to the Division of Operating Reactors and recommend they verify the adequacy of the qualification of the instruments.

We, therefore, conclude that the sump level instruments shall not be included in the subject report and based on our evaluation of Reference 53 and our initial evaluation, Reference 25, that the air operated valves and solenoids are capable of performing their safety functions.

APPENDIX A

REFERENCES

Documents used in the evaluation of Westinghouse Qualification and Design Verification Program for Class IE Electrical Equipment

- 1) 10 CFR Part 50 Licensing of Production and Utilization Facilities
- 2) IEEE Std 279-1971 Criteria for Protection Systems for Nuclear Power Generating Stations
- 3) IEEE Std 323-1971 IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations
- 4) IEEE Std 344-1971 Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations
- 5) WCAP-7817 (NP) Seismic Testing of Electrical and Control Equipment (Low Seismic Plants)
 Supplements 1 thru 8
- 6) WCAP-7821 (NP) Seismic Testing of Electrical and Control Equipment (High Seismic Plants)
 Supplements 1 thru 6
- 7) WCAP-8021 (NP) Seismic Testing of Electrical and Control Equipment (PG&E Plants)
- 8) WCAP-8234-A (NP) Seismic Testing and Functional Verification of Bypass Loop Reactor Coolant RTDs
- 9) WCAP-8373 (NP) Qualification of Westinghouse Seismic Testing Procedures for Electrical Equipment Tested Prior to May 1974
- 10) WCAP-7558 (NP) Seismic Vibration Testing with Sine Beats
- 11) WCAP-8694 (P) Seismic Qualification of the Rotary Relay for Use in the Solid State Protection System
 WCAP-8655 (NP)
- 12) WCAP-8830 (P) Seismic Operability Demonstration Testing of the Nuclear Instrumentation System Bi-stable Amplifiers
- 13) WCAP-8831 (NP)

(P) Proprietary Report
(NP) Nonproprietary Report

- 14) WCAP-8832 (P) Seismic Operability Demonstration Testing
- 15) WCAP-8833 (NP) of the Westinghouse CID 7100 Series Process Instrument System Bistables

- 16) WCAP-8828 (P) Seismic Operability Demonstration Testing
- 17) WCAP-8829 (NP) of the Westinghouse ISD 7300 Series Process Instrumentation Bistables

- 18) WCAP-8848 (P) Seismic Operability Demonstration Testing
- 19) WCAP-8849 (NP) of the Foxboro Process Instrumentation Bistables

- 20) WCAP-7410L (P) Environmental Testing of Engineered Safety
- 21) WCAP-7744 (NP) Features-Related Equipment

- 22) WCAP-7829 (NP) Fan Cooler Motors

- 23) Memorandum to R. C. DeYoung from J. P. Knight, Report on Seismic Audit of Westinghouse Electrical Equipment (TAR's 3678-1, 3683-1, 0706, 0921-1, 0788-2, 1111-2, and 3000-2), dated August 26, 1976.

- 24) Memorandum to T. A. Ippolito from E. C. Marinos, "Summary of August 7, 1974 Meeting with Westinghouse Electric Corporation," dated Sept. 1, 1974.

- 25) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation - WCAP-7744 and WCAP-7410L (TAR 482)," dated February 7, 1974.

- 26) Letter to R. C. DeYoung from R. R. Maccary, "Evaluation Report - WCAP-7821 (TAR-788)," dated July 12, 1974.

- 27) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation WCAP-7821 and Supplements 1 and 2 (TAR 778)," dated September 19, 1974.

- 28) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation WCAP-7817, and Supplements 1, 2, 3, 4, and 5," dated December 13, 1974.

- 29) Letter to R. Salvatori (W) from D. B. Vassallo, "Removal of WCAP-7817 from List of Acceptable Topical Reports," dated December 23, 1974.

- 30) Letter to D. B. Vassallo from R. Salvatori (W), "Response to Questions WCAP-7821 and Supplements 1 and 2," dated January 13, 1975 (NS-RS-504).

- 31) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation WCAP-8373 (TAR 1111)," dated January 28, 1975.

- 32) Letter to D. B. Vassallo from C. Eicheldinger (W), "Response to Questions on WCAP-7817 and Supplements 1, 2, 3, and 4," dated January 31, 1975 (NS-CE-539).
- 33) Letter to R. C. DeYoung from R. R. Maccary, "Evaluation Report WCAP-8234-A," dated February 14, 1975 (TAR 1114).
- 34) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation WCAP-8234-A," dated February 18, 1975.
- 35) Letter to D. B. Vassallo from C. Eicheldinger (W), "Responses to Questions WCAP-8234-A," dated March 24, 1975 (NS-CE-594).
- 36) Letter to R. C. DeYoung from V. Stello, "Report Evaluation - Westinghouse Responses to Questions WCAP-8234-A (TAR 1114)," dated May 23, 1975.
- 37) Memorandum to J. P. Knight from V. S. Noonan and S. Hou, "Summary of Meeting on Seismic Qualification of Westinghouse Electrical Equipment," dated May 29, 1975.
- 38) Letter to R. C. DeYoung from V. Stello, "Topical Report Evaluation WCAP-7829," dated May 27, 1975.
- 39) Memorandum to V. Stello and R. Maccary from R. C. DeYoung, "Seismic and Environmental Qualification of Instrumentation and Electrical Equipment," dated June 9, 1975.
- 40) Letter to C. Eicheldinger (W) from D. B. Vassallo, "Request for Information - WCAP-7829," dated June 11, 1975.
- 41) Letter to C. Eicheldinger (W) from D. B. Vassallo, "Request for Information WCAP-8234-A," dated June 11, 1975.
- 42) Letter to D. B. Vassallo from C. Eicheldinger (W), "Responses to Staff Evaluation of WCAP's 7817, 7821, 8021, 7410L, and 7744," dated June 16, 1975 (NS-CE-675).
- 43) Letter to R. C. DeYoung from V. Stello, "Unacceptability of WCAP's 7817, 7821, 8021, 7744, and 7410L," dated June 26, 1976.
- 44) Letter to R. C. DeYoung from V. Stello, "Evaluation of Westinghouse Responses to Questions WCAP-7817 (TAR 1454)," dated June 26, 1976.
- 45) Letter to R. C. DeYoung from v. Stello, "Evaluation of Westinghouse Responses to Questions - WCAP-7821 (TAR-788) dated June 26, 1976.

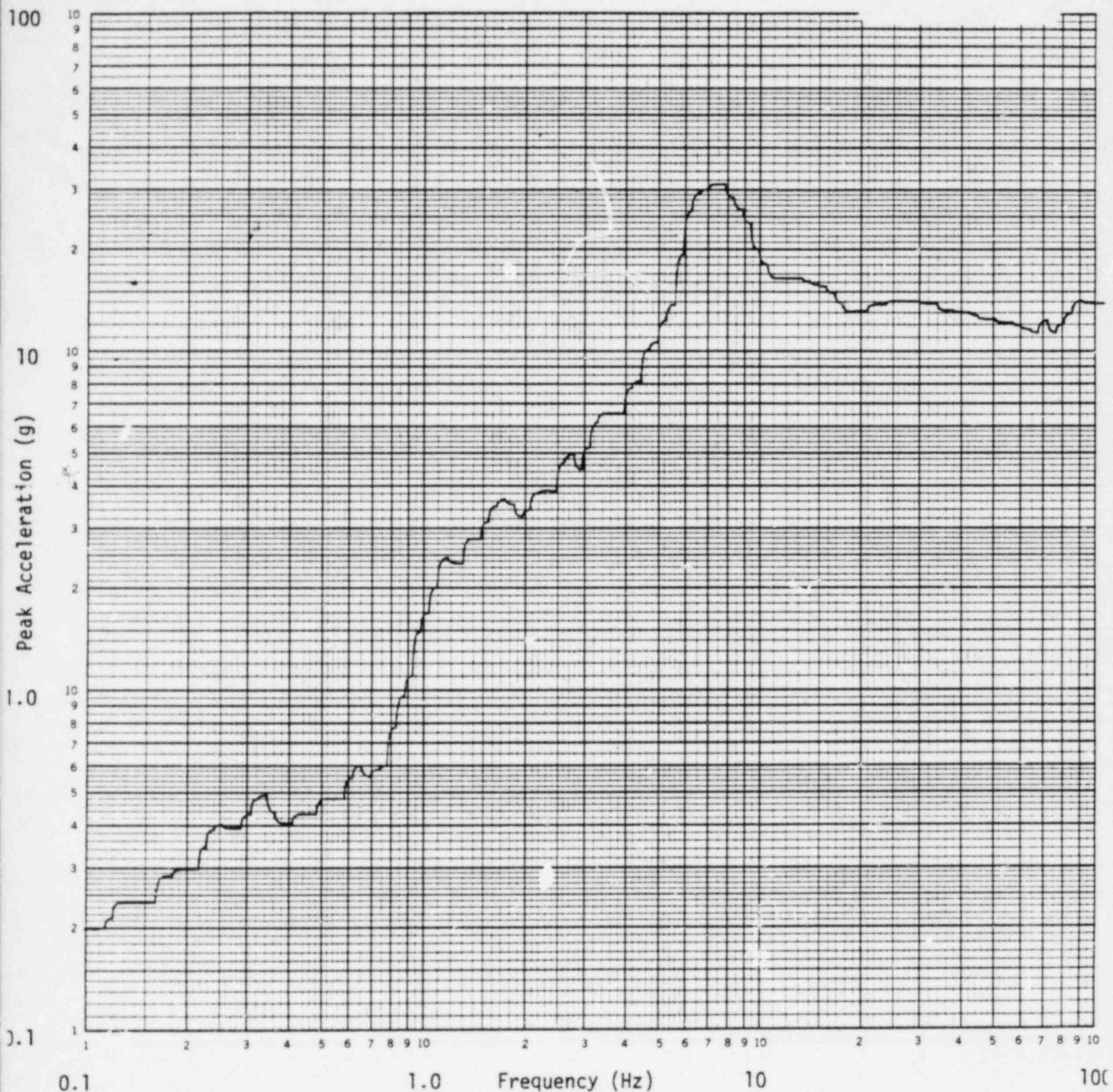
- 46) Memorandum to T. A. Ippolito from D. G. McDonald, "Summary of June 24 Meeting with Westinghouse Electric Corporation," dated July 3, 1976.
- 47) Letter to D. B. Vassallo from C. Eicheidinger (W), "Verification Test Program Proposal," dated July 10, 1975 (NS-CE-692) attachments:
 - a. Letter Report on Reliance Class H Motor-Operated Valve (MOV) Operators
 - b. Information on Westinghouse Radiation Monitoring System
 - c. WCAP's 7817 Supplement 8 and 7821 Supplement 6
 - d. Strip Chart - Relay Contact Bounce at 0.95g (7817 Item 10)
 - e. List of Plants Referencing WCAP-7821.
- 48) Letter to D. B. Vassallo from C. Eicheidinger (W), "Chemical Analysis - Support of Subprogram B in WCAP-7744 and 7410L," dated July 25, 1975 (NS-CE-719).
- 49) Letter to D. B. Vassallo from C. Eicheidinger (W), "Responses to Questions on WCAP-8234," dated July 30, 1975 (NS-CE-727).
- 50) Letter to D. B. Vassallo from C. Eicheidinger (W), "Responses to Questions on WCAP-7829," dated August 1, 1975 (NS-CE-728).
- 51) Note to EICS Branch Members from T. A. Ippolito, "Status of Review of Westinghouse Qualification Topicals," dated August 4, 1975.
- 52) Letter to D. B. Vassallo from C. Eicheidinger (W), "Allowable Accuracy Tolerances for Instruments (Beaver Valley 1 and Indian Point 3)," dated August 8, 1975 (NS-CE-743).
- 53) Letter to D. B. Vassallo from C. Eicheidinger (W), "Failure Analysis for Solenoid Valves WCAP-7744 and 7410L," dated August 15, 1975 (NS-CE-755).
- 54) Letter to D. B. Vassallo from C. Eicheidinger (W), "Qualification of MOV Operators Using Peerless Electric Motors with Class H Insulation WCAP-7744 and 7410L," dated August 15, 1975 (NS-CE-756).
- 55) Letter to R. C. DeYoung from R. R. Maccary, "Evaluation of WCAP-7829 (TAR 1524)," dated August 25, 1975.
- 56) Letter to R. C. DeYoung from V. Stello, "Evaluation of WCAP-8234-A (TAR 1114)," dated August 26, 1975.

- 57) Letter to Alabama Power Company from K. Kniel, "Seismic and Environmental Qualification of Westinghouse Supplied Equipment for Farley Nuclear Plant," dated September 15, 1975.
- 58) Letter to D. B. Vassallo from C. Eicheldinger (W), "Instrument Accuracy Tolerances for Westinghouse Plants in Operating License Review," dated October 1, 1975 (NS-CE-792).
- 59) Letter to D. B. Vassallo from C. Eicheldinger (W), "Requesting Written Response and Status of Verification Program," dated October 2, 1975 (NS-CE-799).
- 60) Note to EICS Branch Members from T. A. Ippolito, "Status of the Review of Westinghouse Qualification Topical Reports," dated October 31, 1975.
- 61) Memorandum to T. A. Ippolito from D. G. McDonald, "Summary of October 30, 1975 Meeting with Westinghouse Electric Corporation," dated November 12, 1975.
- 62) Letter to C. Eicheldinger (W) from D. B. Vassallo, "Acceptance of WCAP-8234 as a Reference Topical Report," dated November 19, 1975.
- 63) Memorandum to T. A. Ippolito from L. Phillips, "Reactor Systems Branch Review of Westinghouse Report on Consequences of Seismic Induced Actuation of Protection System Relays on the Diablo Canyon Nuclear Plant," November 24, 1975.
- 64) Letter to D. B. Vassallo from C. Eicheldinger (W), "Information Related to Motors and Insulation Used on Motor Operated Valves WCAP-7744 and 7410L," dated November 24, 1975 (NS-CE-847).
- 65) Letter to D. B. Vassallo from C. Eicheldinger (W), "Verification Program Applicability to RESAR-41," dated December 3, 1975 (NS-CE-860).
- 66) Letter to C. Eicheldinger (W) from D. B. Vassallo, "Request for Information - WCAP-7829," dated December 18, 1975.
- 67) Letter to D. B. Vassallo from J. T. Collins, "SER Supplement Number 3 for Beaver Valley Unit 1 - Seismic Classification of the Stack Gas Radiation Monitor and Radiation Monitor Cabinet," dated February 18, 1976.
- 68) Memorandum to J. T. Collins from P. G. Stoddart, "Westinghouse Meeting of February 24, 1976, on Seismic Qualification," dated February 26, 1976.

- 69) Memorandum to T. A. Ippolito from D. G. McDonald, "Summary of February 24, 1976 Meeting with Westinghouse Relating to Verification Program," dated March 17, 1976.
- 70) Note to File from P. W. Baranowsky, "Containment Systems Branch Summary and Evaluation of Equipment Design Verification Program by Westinghouse Electric Corporation," dated March 17, 1976.
- 71) Letter to D. B. Vassallo from C. Eicheldinger (W), "Summary of February 24, 1976 Meeting Relating to Verification Program," dated March 17, 1976 (Proprietary Material Included) (NS-CE-992).
- 72) Letter to D. B. Vassallo from C. Eicheldinger (W), "Summary of March 18, 1976 Meeting at Pittsburgh - Westinghouse Verification Program," dated April 7, 1976 (NS-CE-1021).
- 73) Memorandum to T. A. Ippolito from A. J. Szukiewicz, "Summary of March 18, 1976 Meeting with Westinghouse in Pittsburgh - Westinghouse Verification Program," dated June 2, 1976.
- 74) Letter to J. F. Stolz from C. Eicheldinger (W), "Responses to Requests for Information WCAP-8694 and 8655," dated July 30, 1976 (NS-CE-1146).
- 75) Letter to D. B. Vassallo from C. Eicheldinger (W), "Status of Westinghouse Verification Program," dated June 14, 1976 (NS-CE-1059).
- 76) Letter to J. F. Stolz from C. Eicheldinger (W), "Response to Items 23, 25, and 28 of NS-CE-1059, June 14, 1976," dated July 27, 1976 (NS-CE-1132).
- 77) Letter to J. F. Stolz from C. Eicheldinger (W), "Responses to Items 25 and 26 of NS-CE-1059, June 14, 1976," dated August 2, 1976 (NS-CE-1133).
- 78) Letter to J. F. Stolz from C. Eicheldinger (W), "Plant Applicability List and Minutes of August 17 Meeting - Westinghouse Verification Program," dated August 26, 1976 (NS-CE-1179) (Nonproprietary version).
- 79) Same as 78 except includes proprietary information.
- 80) Letter to B. Rusche from Virginia Electric and Power Company, "Environmental Qualification of Westinghouse Supplied Instruments for North Anna Units 1 and 2," dated September 20, 1976 (Includes Proprietary Information).
- 81) Memorandum Docket Number 50-338 and 339 from W. J. Pike, "Summary of September 30 Meeting - Environmental Qualification of Electrical Equipment," dated October 12, 1976.

- 82) Letter to J. F. Stolz from C. Eicheldinger (W), "Submittal of WCAP-8541 for Background Information for Foxboro Instruments Used On North Anna Units 1 and 2," dated October 20, 1976 (NS-CE-1251).
- 83) Letter to B. Rushe from R. A. Wiesemann (W), "Environmental Qualification of Westinghouse NSS Scope Safety-Related Instruments for North Anna Units 1 and 2," dated October 28, 1976 (Proprietary Information).
- 84) Letter to J. F. Stolz from C. Eicheldinger (W), "Sensor Qualification Report IEEE 323-1971 Demonstration Program Interim Test Report for Barton/ITT Modified Differential Pressure Transmitter," dated December 22, 1976 (NS-CE-1315) Proprietary and Nonproprietary Versions.
- 85) Letter to Mr. J. F. Stolz from C. Eicheldinger (W), "Sensor Qualification Program IEEE 323-1971 Demonstration Program Interim Test Report for the Barton/ITT Modified Pressure Transmitter," dated January 4, 1977 (NS-CE-1323) Proprietary and Nonproprietary Versions.
- 86) Franklin Institute Research Laboratories Test Report, "Qualification Test of Limitorque Valve Operators and a Simulated Reactor Containment Post-Accident Steam Environment (F-C3441)," dated September 1972 (Proprietary Information).
- 87) Limitorque Corporation Test Report, "Test of Limitorque Valve Operator to Meet General Requirements of an Electric Valve Actuator in Nuclear Reactor Containment Environment (Eng. Order No. 600198)," dated January 2, 1969 (Proprietary Information).
- 88) Limitorque Corporation Test Report, "Test of Limitorque Valve Operator to Meet Requirements of an Electric Valve Actuator in Nuclear Reactor Containment Environment (Eng. Order No. 338164)," dated May 8, 1969.
- 89) Franklin Institute Test Report, "Test of a Limitorque Valve Operator Under a Simulated Reactor Containment Post-Accident Steam and Chemical Environment (F-C2232-01)," dated November 1968.
- 90) Addendum No. 1 to Limitorque Corporation Test Report, "Test of Limitorque Valve Operator to Meet General Requirements of an Electric Valve Actuator in Nuclear Reactor Containment Environment (Eng. Order No. 600198)," dated January 2, 1969 (Proprietary Information).
- 91) Letter to R. C. DeYoung from R. R. Maccary Evaluation of WCAP-7829 Fan Cooler Motor Unit Tests (TAR-1524)," dated April 28, 1975.
- 92) Letter to R. C. DeYoung from V. Stello, Topical Report Evaluation WCAP-7829 Fan Cooler Motor Tests (TAR 1524)," dated December 5, 1975.

- 93) Letter to D. B. Vassallo from C. Eicheldinger, "Fan Cooler Motor Units Tests," dated March 31, 1976 (NS-CE-1009).
- 94) Letter to D. Zieman from R. E. Uhrig of Florida Power & Light, "St. Lucie Unit No. 1," dated June 14, 1976.
- 95) Letter to R. C. DeYoung from R. Tedesco, "Qualification of St. Lucie Fan Cooler Motors," dated June 24, 1976.
- 96) Letter to J. F. Stolz from C. Eicheldinger (W), "Interim Test Report for Barton/ITT Modified Pressure Transmitter," dated January 4, 1977 (NS-CE-1323) (Proprietary Information).
- 97) Memorandum to J. F. Stolz from J. T. Collins, Seismic Qualification - Radiation Monitoring System, dated March 1, 1977.
- 98) Letter to J. F. Stolz from C. Eicheldinger (W), Final Test Report for the Barton/ITT Modified Pressure Transmitter, dated March 23, 1977 (NS-CE-1384) (Proprietary Information).
- 99) Letter to J. F. Stolz from C. Eicheldinger (W), "Response to Request for Instrument Seismic Acceptance Criteria," dated March 25, 1977 (NS-CE-1278).
- 100) Summary of the January 11, 1977 Meeting on Environmental Qualification of Equipment Alabama Power Company, dated April 18, 1977.
- 101) WCAP-8673 (P) Multi-frequency and Direction
WCAP-8674 (NP) Seismic Testing of Relays
- 102) WCAP-8624 (P) General Method for Developing
WCAP-8695 (NP) Multi-frequency Biaxial Test
Inputs for Bistables

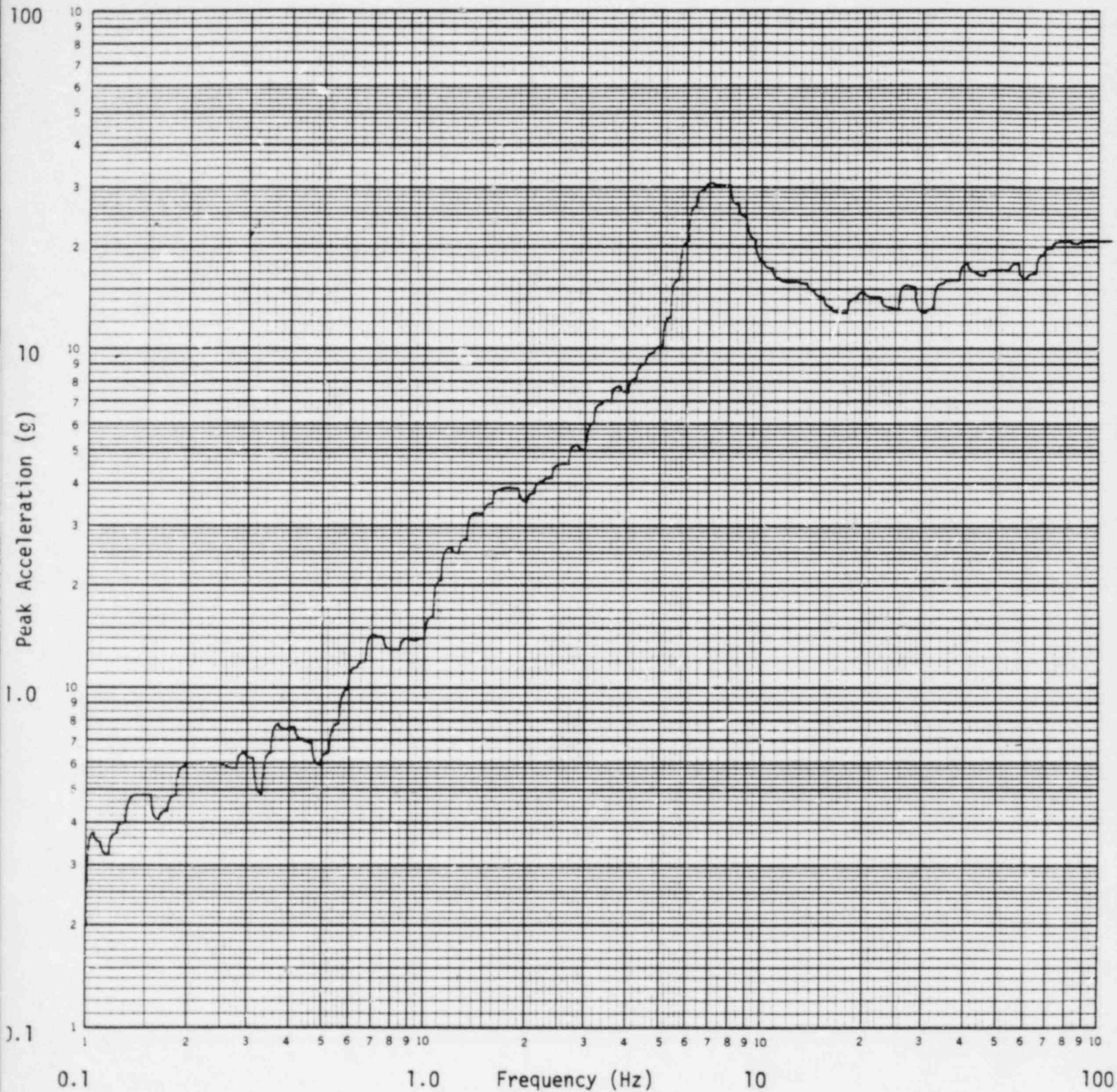


Shock Response Spectrum

Test Direction: 1
Run Number: 8
Transducer Designation: A5
Date of Test: _____

Duration: 20 Seconds
Damping: 5%
Filters: 120
Live _____ Tape X

7300 3-Bay Cabinet

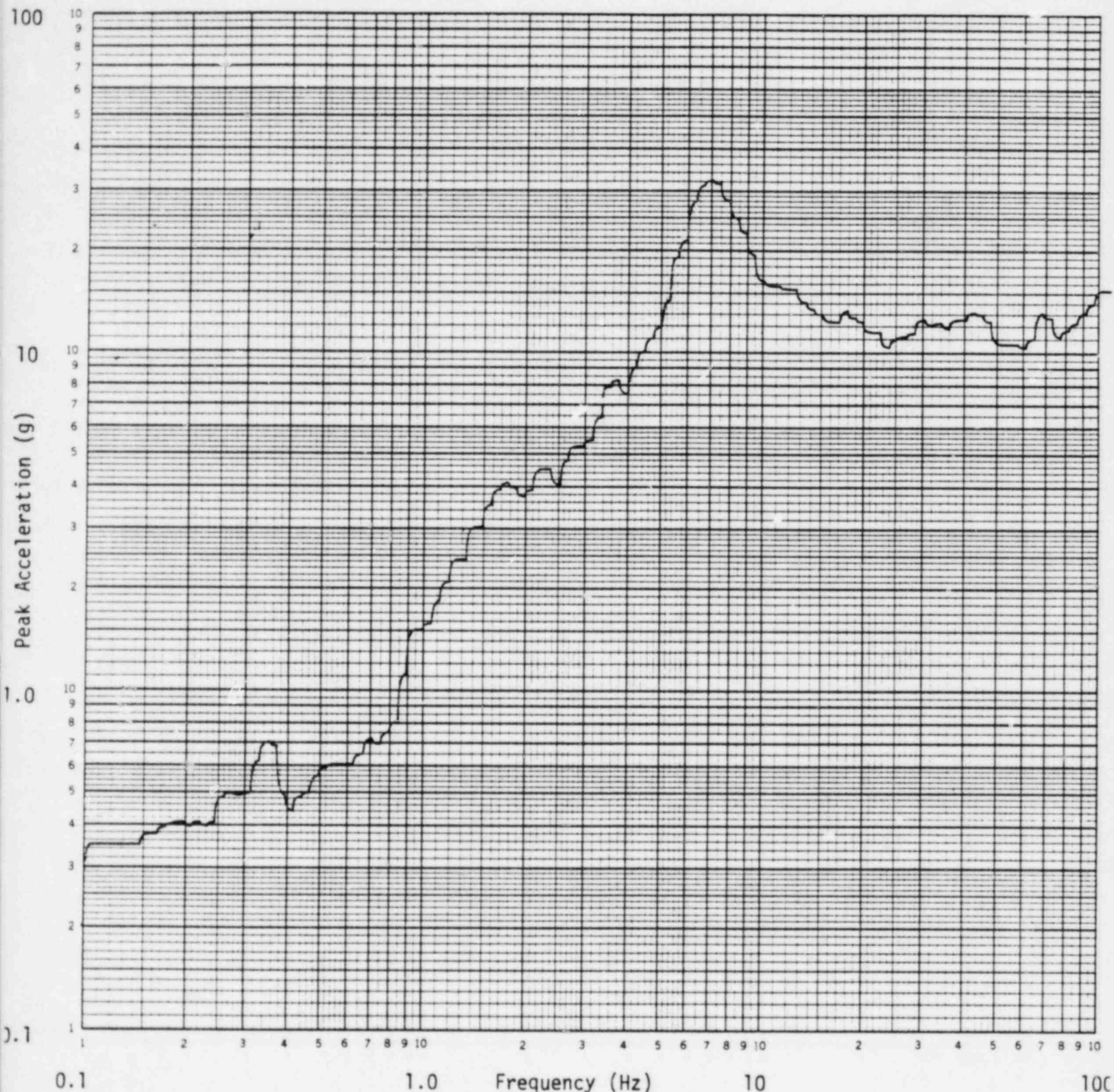


Shock Response Spectrum

Test Direction: 2
Run Number: 1
Transducer Designation: A5
Date of Test: _____

Duration: 20 Seconds
Damping: 5%
Filters: 120
Live _____ Tape X

7300 3-Bay Cabinet

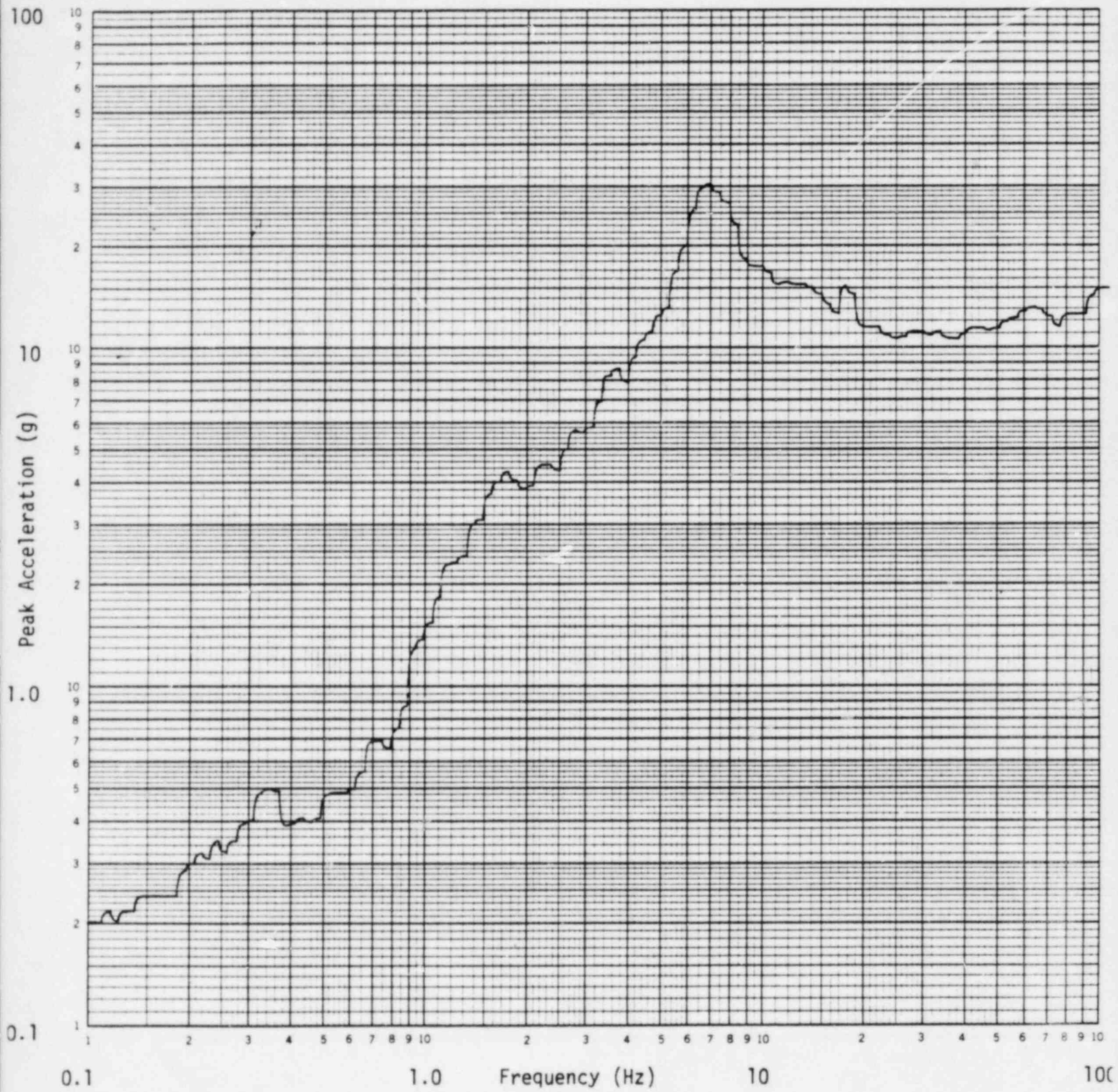


Shock Response Spectrum

Test Direction: 3
Run Number: 1
Transducer Designation: A5
Date of Test: _____

Duration: 20 Seconds
Damping: 5%
Filters: 120
Live _____ Tape X

7300 3-Bay Cabinet



Shock Response Spectrum

Test Direction: 4
 Run Number: 1
 Transducer Designation: A5
 Date of Test: _____

Duration: 20 Seconds
 Damping: 5%
 Filters: 120
 Live _____ Tape X