UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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DIABLO CANYON
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Docket Nos. 50-275 and 50-323

Pacific Gas and Electric Company
ATTN: Mr. John C. Morrissey
Vice President & General Counsel
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Gentlemen:

We have completed our evaluation of your report entitled "Westinghouse Protection Systems Noise Tests" which was submitted with your letters dated January 16, 1975, April 7, 1975 and November 24, 1975.

We have found that the test program is acceptable and that it demonstrates acceptable performance as implemented at Diablo Canyon. Other applicants referencing the report will need to provide justification that the tests reported encompass the potential electrical faults or interference reflecting into the systems tested as a result of the particular plant's design. Our evaluation is provided in the enclosure.

Sincerely,

Olan D. Parr, Chief
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Division of Project Management

Enclosure:
Evaluation

cc: See page 2

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RFCayot RSBain JACrockwell NHDaines EEHall WRJohnson
DVKelly [illegible] [illegible] [illegible] [illegible]
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EVALUATION OF THE WESTINGHOSUE PROTECTION SYSTEM NOISE TEST REPORT

1.0 Summary of Report

The subject report was initiated as a result of our concerns relating to the qualification of electrical isolation devices, design criteria requiring electrical and physical separation between protection and control circuits and "as built" protection systems immunity to electrical noise.

We have indicated in our Safety Evaluation Report of the Diablo Canyon Nuclear Power Station, Units 1 and 2 dated October 16, 1974, that during the CP reviews of both units the physical and electrical isolation of protection and control was not adequate and the implementation of the design presented in the FSAR does not meet the requirements of Sections 4.2, 4.6 and 4.7 of IEEE Std 279-1971.

The voltages and test methods were selected to cover the credible voltages and noise conditions for the systems tested. Westinghouse defined the following acceptance criteria for all tests.

a. Noise would not degrade the ability of the protection systems to provide the necessary action

b. Noise which causes initiation of protective actions, will be reported and evaluated on a case by case basis.

The test report was divided into three sections covering the following Westinghouse supplied systems:

Section A Solid State Protection System (SSPS). Appendix A of this section contained isolation verification tests and results for the Light Emitting Diodes (LEDs) used for isolation in the SSPS.

Section B Nuclear Instrumentation System

Section C Process Analog System 7100 Series

Test Descriptions

The above identified systems were subjected to the following tests. Representative channels were energized and the functional operability checked for each test.

Noise Susceptibility Tests

These tests were run in accordance with MIL-N 19900B, dated June 7, 1960, Military Specification - Nuclear Propulsion Control and Instrumentation Equipment, General Requirements, Paragraph 4.6.11, Susceptibility.

Output Cable Voltage Faults

The maximum credible voltages (118 V AC and 250 V DC) were applied to each system output cabling to determine the effect on the input side. Two additional tests were conducted on the Analog Process System. A 460 V AC fault test and a 125 V DC test switching a 2.17h inductive lo. to simulate the inductive component of the isolator output circuit. The isolator output circuits were disconnected during the fault tests. The isolators and connectors have already been qualified for fault vol ages and currents which verified operability of the input side during destruction of components in the output portion of the isolator. The output cable voltage fault tests were to verify the adequacy of the cable separation (input/output) of the "as built" systems.

Magnetic Interference Tests

These tests were conducted by disconnecting the output cables and introducing a 118 V AC power source and providing a 100 ohm load at the connector end to allow 1 ampere to flow in the output wiring. The input side of the isolator was monitored for induced noise. Since the input/output wiring in the Process Analog System are closer than the other systems the 1 ampere AC current was routinely switched.

Light Emitting Diode (LED) Verification Tests

These tests were conducted by introducing a common mode voltage source the isolation board. A 2 Kv dc dynamic source and impulse tests at 2K peak. 1Mhz ringing down in 6 - 10 cycles applied for 1 minute. A 140 rms 60 Hz dynamic source was applied to the output side of the isolato and the input monitored to determine the effect of a destruct fault voltage. The tests were performed to demonstrate that potentials applied on the non-protection side are not directly (flashover) or indirectly (induced or capacitance) coupled into the protection logic side.

The basis for selecting the 1 amp value for the magnetic interference tests described above were based on an analytical study. The calculat considered untwisted control cables running parallel for 30 meters with three-phase conductors carrying 200 amperes. The induced loop current was calculated to be 2.7 micro-amperes in a 100 ohm load. The 1 ampere was selected to provide a conservative value for the test.

Test Procedures Description and Results

The test report provided detailed test procedures and descriptions for the tests identified above. Westinghouse summarized the results of the tests for each of the systems tested.

2.0 Summary of Regulatory Review

We reviewed the detailed test procedures, setup, description, functional checks and test results for the systems identified in the summary of the report. The results of all the tests conducted indicated that the tests performed did not introduce interference or noise from the non-safety to the safety portion of the systems. The functional verification portion of the tests indicated that the equipment performed as designed, before, during and after tests. The safety functions of the systems were exercised during the tests.

As we have indicated in the summary of this report, the test program was initiated as a result of our concerns relating to the lack of physical separation between the protection and control circuits in the final implementation of the system designs which could result in interaction between control and safety functions. Westinghouse has indicated as part of their acceptance criteria that noise which causes initiation of protective actions, if any, would be acceptable. We found this criteria unacceptable. IEEE Std 279-1971, requires that the protection system shall, with precision and reliability, automatically initiate appropriate protective action whenever a condition monitored by the system reaches a pre-set level. The acceptance criteria was modified indicating that any spurious operation would be reported and evaluated on a case by case basis.

The original report did not include 460 V AC tests on the isolator output wiring. We informed Westinghouse of this requirement at a meeting held February 6, 1975 (see reference, Enclosure 2). We were later informed that the 460 V AC had been performed during the original tests and would be documented in Supplement 1 of the report. We reviewed the report through Supplement 1 and found it acceptable with the following exceptions (1) the acceptance criteria must be modified and (2) the noise susceptibility tests must be modified and repeated due to lack of justification for locating the noise source 18 inches from the equipment tested.

We required that modified MIL-N-19000B Noise Susceptibility Test Program or a new program be initiated for the Analog Process System which will include the following requirements. The test program will include all the provisions or similar requirements of MIL-N-19000B. However, the noise source output cable shall run in the same cable ways, vertical and horizontal, as the input/output cables of the Analog Process System for the distance defined in the MIL. Spec. test program. The basis for the 18-inch distance from the noise source output cable for the equipment tested in the MIL-N-19000B tests is that typical cableways aboard

ships are 18 inches wide. If the installed equipment experiences noise interference problems, the source can be detected and separated by at least a distance of 18 inches.

Subsequent to our review, Westinghouse informed the staff that the subject tests were run in the manner identified in the Regulatory Position of our review during the original testing. We indicated to Westinghouse that the information documented should be adequate to perform an independent evaluation of the test scope, basis, procedures, implementation and results of the test program performed. Supplement 3 documents revised acceptance criteria and additional material addressing our requirements relating to the MIL-N-19900 Noise Susceptibility Test Program identified in our evaluation of the subject report dated August 15, 1975. (see references, Enclosure 2). The test results indicated that the systems tested operated as designed before, during and after the tests. The safety functions of the systems were exercised during the tests.

Regulatory Position

We have concluded that the test program, as documented through Supplement 3, is acceptable. The results of the test program indicate that the systems are not degraded below an acceptable level and can perform their safety functions, during the faulted conditions tested, as implemented at the Diablo Canyon Nuclear Power Station.

We require that any applicant referencing this report provide justification that the tests reported encompass the potential electrical faults or interference reflecting into the systems tested as a result of their particular balance-of-plant designs.

The requirements of Regulatory Guide 1.75, "Physical Independence of Electric Systems" must be met for any new system designs and for all designs for construction permit applications for which the issue date of the Safety Evaluation Report is February 1, 1974, or after. We utilized IEEE Std 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," in our review of this Westinghouse Test Report. Other references used are included in Enclosure 2.

ENCLOSURE 2

REFERENCES

1. Report of Process Instrumentation Isolation Amplifiers, dated March 28, 1973.

2. Westinghouse Topical Report WCAP 7488L Solid State Protection System Description, dated January, 1971.

3. Summary of Electrical Site Visit and Meeting Held on February 20-22, 1[illegible] dated March 18, 1974.

4. Summary of Meeting with Westinghouse Electric Corporation, dated August 7, 1974.

5. Safety Evaluation Report, Diablo Canyon Nuclear Power Station Units 1 and 2, dated October 16, 1974.

6. Summary of Meeting Held February 6, 1975 to discuss separation and qualification, dated March 5, 1975.

7. Letter dated April 7, 1975, PG&E to NRC, transmitting Supplement 1 to the Westinghouse Protection System Noise Test Report.

8. Letter dated September 4, 1975, O. Parr to J. Morrissey, transmitting the results of the Regulatory Staff review of the Westinghouse Protection System Noise Test Report.

9. Letter dated November 24, 1975, PG&E to NRC, transmitting the Westinghouse letter NS-RPE-1047 including Supplement 3 to the Westinghouse Protection System Noise Test Report.

10. IEEE Std 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."

11. Regulatory Guide 1.75, "Physical Independence of Electric Systems, Revision 1", dated January, 1975.

Attachment 5

Westinghouse Protection Systems
Noise Test Report, Revision 2, October 1975

L1/NRC/ba