NORTHEAST UTILITIES
NU

P.O. BOX 270
HARTFORD, CONNECTICUT 06101
(203) 666-6911

April 26, 1979

Docket No. 50-336

Director of Nuclear Reactor Regulation
Attn: Mr. R. Reid, Chief
Operating Reactors Branch #4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Reference: (1) R. Reid letter to D. C. Switzer dated April 19, 1978.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Electrical Penetration Testing Evaluation

Reference (1), which documented NRC Staff authorization for Cycle 2 operation for Millstone Unit No. 2, requested that Northeast Nuclear Energy Company (NNECO) perform Insulation Resistance (IR) tests on those conductors remaining in service with IR readings between 50 and 100 megohms. Reference (1) also requested that the results of the tests be submitted. Accordingly, NNECO hereby provides Attachment 1, Electrical Penetration Testing Evaluation.

As stated within, the completed testing and replacement program ensures that all in-service electrical penetration conductors meet or exceed the criteria established for the start of Cycle 2 operation. Specifically, all safety-related circuits have a minimum IR of 100 megohms, and all in-service conductors have a minimum IR of 50 megohms.

Attachment 1 serves as the basis for NNECO's conclusion that the as-modified conductor configuration is acceptable for Cycle 3 operation. We trust you will find it acceptable to concur with our evaluation.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil
Vice President

Attachment

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DOCKET NO. 50-336

ATTACHMENT 1

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

ELECTRICAL PENETRATION TESTING EVALUATION

APRIL, 1979

MILLSTONE UNIT NO. 2
ELECTRICAL PENETRATION TESTING EVALUATION

References: (1) E. J. Ferland letter to B. H. Grier dated October 28, 1977.
(2) B. H. Grier letter to D. C. Switzer dated November 8, 1977.
(3) D. C. Switzer letter to G. Lear dated November 23, 1977.
(4) D. C. Switzer letter to G. Lear dated February 10, 1978.

INTRODUCTION

Interaction between certain low voltage control penetrations manufactured by General Electric (GE) for Millstone Unit No. 2 ultimately resulted in plant shutdown on November 20, 1977, the start of the first refueling outage. These conditions were characterized by a lowered Insulation Resistance (IR) between adjacent conductors within certain penetration modules. The GE low voltage control penetration modules were replaced with Conax penetration modules during the 1977 - 1978 refueling outage. Complete testing of the remaining GE penetrations of a like type (similar construction) to the low voltage control was also carried out at that time. An assessment of these failures and details of the 1978 testing and replacement program are contained in References (1) through (4).

The 1978 testing program indicated that 3% of the total penetration conductors of a like type to the low voltage control had an IR less than 100 megohms, with 1.2% less than 50 megohms. Seventy-five percent of these conditions occurred within the CEDM power and CEA position indication penetrations assemblies, although the CEDM power and indication penetrations make up only 30% of the total penetration conductors. The remaining low IR's occurred in the 480 volt power and instrumentation penetrations assemblies.

Prior to returning to service, Millstone Unit No. 2 replaced all penetration conductors which exhibited an IR of less than 50 megohms with acceptable spare conductors (i.e., IR greater than 50 megohms). Additionally, all conductors associated with safety-related circuits were confirmed as having an IR greater than 100 megohms. A total of 81 conductors remained in service with an IR between 50 and 100 megohms. These 81 conductors were to be re-tested during the 1979 refueling outage to ascertain if further degradation was taking place.

As a result of the testing performed on these 81 conductors, a more thorough test of like type penetration modules was carried out.

The 1979 penetration testing program has identified a changing IR condition within the CEDM power, CEA position indication and two instrumentation penetration modules which appear to be similar to the anomolies noted in the low voltage control penetration problems identified in 1978. The IR testing program has detected this degradation at an early stage and NNECO has taken the appropriate steps to assure a satisfactory conductor configuration for continued plant operation. It is recognized that prudent engineering judgment requires corrective action to preclude recurrence. Action is underway to develop a long-term solution to eliminate the need for a yearly test program.

1979 TESTING PROGRAM

The 81 conductors to be tested consisted of 50 within the CEDM power and 31 within the CEA position indication penetration assemblies. The tests were conducted during the early part of the refueling outage and were extended to include a random sample of conductors with an IR greater than 100 megohms. Results of this test revealed that of the 81 conductors committed to be tested, 42 IR readings decreased, with 25 IR readings dropping below 50 megohms.

The test results identified a changing condition of conductor IR which predicated a more thorough test program to determine the extent of IR degradation.

This second phase of the IR testing program required a test of at least 10% of all penetration conductors of a like type to the low voltage control penetrations. This 10% sample would also concentrate on areas within modules where a lowered IR was identified in 1978, however, random samples of high IR conductors were also included.

If, during the 10% check, any degradation of IR was identified by readings below 50 megohms, the test criteria dictated that a 100% test of that penetration assembly would be conducted.

TEST RESULTS

The results of the IR testing program are summarized in Table 1. Note that three penetration types show a changing IR condition (i.e., CEDM power, CEA position indication and instrumentation). While 42% of the conductors in this type of module were tested, only 3% exhibited a changing IR or IR less than

50 megohms. Also, note that 70% of all low IR conductors identified were located in the CEA position indication modules which have the highest conductor density of 140 conductors per module.

The instrumentation penetrations required a change of 23 conductors, which is only 0.4% of the conductors tested in this category of penetration. Additionally, all low IR instrument conductors were located in 2 out of the 42 modules.

Because safety-related circuits utilize the instrumentation penetration, a more detailed evaluation was conducted and the results are provided later.

In all instances, conductors identified with IR readings less than 50 megohms were replaced with conductors having an IR greater than 50 megohms. Additionally, conductors associated with safety-related circuits utilize penetration modules with 100% of their conductors having IR's greater than 100 megohms.

Eighty-five percent of the conductors requiring change were contained in the CEDM power and CEA position indication penetration assemblies. These systems are not safety-related and performed throughout the last operating cycle without anomaly.

INSTRUMENTATION PENETRATION TEST EVALUATION

There are 6 instrumentation penetrations containing 7 modules per penetration for a total of 42 modules. Each module contained 85 #14 AWG conductors. A total of 25 modules were tested under the second phase of the 1979 test program. (18 modules at 10%; and 7 modules at 100% per the test program criteria.)

Initial selection of modules to be tested was based on 1978 test results where an IR of less than 100 megohms had been identified. Where during the 1979 tests, the 10% check determined any conductor to be less than 50 megohms, a 100% check was performed on the entire penetration assembly.

The selection of wires to be included in the 10% test was determined by their close proximity to known low IR conductors which were abandoned in 1978. Following the procedure above, it was determined that only 2 modules were in service with conductors less than 50 megohms.

Evaluating these two modules, one was found with 17 conductors less than 100 megohms (8 above 10 megohms) and the second module was found with 7 conductors less than 100 megohms (2 above 10 megohms). The lowest value in each case was 0.25 megohm and 0.5 megohm, respectively.

All degraded circuits have now been transferred so as to establish a minimum operating value of 50 megohm. In addition, all the safety-related circuits have been moved out of the two suspect modules and into modules which are demonstrated to have all conductors with IR's above 100 megohms. On this basis, there is reasonable assurance that no failures will occur during Cycle 3 operation as was the case during Cycle 2.

CONTACT RESISTANCE

The elevated contact resistance which was identified in the low voltage control modules as a source of heat, was not identified in the balance of penetrations tested both in 1978 and 1979. It can be postulated that poor contact and the resulting heating effects in the low voltage control penetrations originally accelerated the IR degradation which is now only beginning to surface in the balance of like type penetrations.

MECHANICAL INTEGRITY

It should also be noted that the degradation of IR has in no way affected the mechanical integrity of the penetration seals. As noted in Reference (4) on the construction of the GE penetrations, there are actually four epoxy seals in each penetration module. The inner seals provide the mechanical pressure boundary while the outer seals serve to provide mechanical support for the pigtail conductors.

NNECO's initial inspection in 1978 of a removed module established that the IR degradation had occurred in the outer epoxy seal. Although an additional module is not available for detailed examination at this time, there is sufficient evidence to conclude that the identified degradation results from a similar condition.

In conclusion, all conductors which had IR less than 50 megohms were replaced with acceptable spares and additional tests assured that all conductors associated with safety-related circuits maintained an IR greater than 100 megohms. This testing and replacement program ensures that all in-service electrical penetration conductors meet or exceed the criteria established for the start of Cycle 2 operation. Additional engineering activities are now underway so that a test program will not be required to be repeated each refueling outage.

TABLE 1

Penetration Type	L.V.* Control Power	480 V Power	CEDM Power	CEA Position Indication	Instrument	In-Core Detector	Out-of Core Dectector	480V & 6.9KV* Power	Total
Penetrations	4	2	8	2	6	2	4	12	40
Module/Pene	4	7	7	4	7	6	1	-	-
Wires/Mod	85	3 w/10 4 w/19	3 w/10 4 w/19	140	85	5 w/90 1 w/25	14	-	-
Total Mod.	16	14	56	8	42	12	4	-	152
Total Wires	1360	212	848	1120	3570	950	56	-	8116
Tested 1978	-	100%	100%	100%	100%	100%	100%	-	-
% IR< 100MΩ	-	15	11	5	0.6	0	0	-	3
% IR< 50 MΩ	-	10	4	1	0.4	0	0	-	1.2
Tested 1979	-	11%	63%	100%	25%	11%	100%	-	42%
% IR< 100MΩ	-	0	13	23	0.8	0	0	-	6
% IR< 50MΩ	-	0	4	13	0.6	0	0	-	3
Changed in 1978(Mods)	28**	-	-	-	-	-	-	-	28
To change (Mods)	-	14	56	8**	42	0	0	0	120**
Total Wires To Change	-	212	848	1120	3570	0	0	0	5750

* The 480 volt power, 6.9 KV power and the low voltage control power penetrations were not tested due to differences in construction which do not allow circuit interaction.

** Due to high conductor density, a larger number of replacement modules may be required as was done with the low voltage control.