Docket

11/18/77

Docket No. 50-220

Niagara Mohawk Power Corporation
ATTN: Mr. Gerald K. Rhode
Vice President - Engineering
300 Erie Boulevard West
Syracuse, New York 13202

Gentlemen:

On or about November 8, 1977, you should have received IE Bulletin No. 77-05 on Electrical Connector Assemblies from the Regional Office of the NRC Office of Inspection and Enforcement and a supplement to this Bulletin on or about November 15, 1977, (copies enclosed). This Bulletin requests that, within 30 days, you provide information on whether your Nine Mile Point Unit 1 facility utilizes electrical connector assemblies within containment that could be subject to an accident environment and are required to be operable during an accident; and, if it does, to provide documentation of the environmental qualification testing performed for these connectors.

Due to the safety significance of this matter, the staff also conducted a telephone survey of all operating plants to obtain preliminary information on which facilities utilize such connectors and the adequacy of qualification testing of any such connectors. As you know, this survey determined that such connectors are used in your Nine Mile Point Unit 1 facility. Further, as a result of meetings held with your representatives during the week of November 14, 1977, we determined on a preliminary basis, that the electrical connectors used in your facility are of the general type that failed in tests conducted at the Sandia Laboratories. At these meetings, you were unable to provide the environmental qualification documentation. You advised us that your plant uses connectors manufactured by the D. G. O'Brien Company and that qualification tests

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on these connectors have been conducted. From information we received during our survey about the test performance of other D. G. O'Brien connectors at other facilities, satisfactory qualification of these connectors at your facility is likely. Because of the safety importance of these connectors, you are hereby requested, pursuant to 10 CFR 50.54(f) of the Commission's regulations, to deliver to the Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission, Washington, D. C. 20555, not later than November 28, 1977, information which establishes the required environmental qualification of the connectors used in your facility. This information should include all that requested by IE Bulletin No. 77-05 and Supplement 77-05A thereto, including in particular consideration of accident radiation and steam conditions.

If you are not able to provide complete documentation of the required qualification testing of all applicable connectors, you should, as indicated in the Bulletin, submit plans and programs for qualifying existing equipment or plans for replacing unqualified connectors with qualified equipment. In this case, you must also include with your response a justification that continued operation of the facility, for whatever period it will take to environmentally qualify the connectors in accordance with NRC regulations, would not create undue risk to the health and safety of the public.

Please advise us if you have any questions relative to this matter.

Sincerely,
Original signed by

Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation

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11/18/77

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

November 18, 1977

Docket No. 50-220

Niagara Mohawk Power Corporation
ATTN: Mr. Gerald K. Rhode
Vice President - Engineering
300 Erie Boulevard West
Syracuse, New York 13202

Gentlemen:

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on these connectors have been conducted. From information we received during our survey about the test performance of other D. G. O'Brien connectors at other facilities, satisfactory qualification of these connectors at your facility is likely. Because of the safety importance of these connectors, you are hereby requested, pursuant to 10 CFR 50.54(f) of the Commission's regulations, to deliver to the Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission, Washington, D. C. 20555, not later than November 28, 1977, information which establishes the required environmental qualification of the connectors used in your facility. This information should include all that requested by IE Bulletin No. 77-05 and Supplement 77-05A thereto, including in particular consideration of accident radiation and steam conditions.

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Please advise us if you have any questions relative to this matter.

Sincerely,

Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation

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TRIP REPORT
by
W. R. Rutherford

ELECTRICAL CONNECTOR ASSEMBLIES

On September 1, 1977 a meeting was held in Alburquerque, New Mexico to investigate the electrical connector assembly malfunctions or failures that occurred during tests under LOCA conditions performed by Sandia Laboratories. The following is a description of the equipment, test scope and results of these tests.

Equipment

The test assemblies of particular interest consisted of three types of connectors: Bendix, ITT Cannon, and Gulton installed on two types of cables; Anaconda and ITT Surprenant.

1. Bendix Connector: A 3 conductor/No. 12 AWG with crimp pin conductors, anodized aluminum shell, silicone rubber insert, rigid back plane potting, pliable over-potting.

2. ITT Cannon Connector; A 3 conductor/No. 12 AWG with crimp pin conductors, anodized aluminum shell, silicone rubber insert, anodized aluminum back shell, rubber packing boot, mechanical retaining clamp.

3. Gulton Connector: A 3 conductor/No. 12 AWG with crimp pin conductor, stainless steel shell, hard fiber insert, pin back sealed with RTV 112, stainless shell, back plane poured with Sylgard potting, mechanical clamp termination.

4. Anaconda Cable: A 3 conductor/No. 12 AWG, tinned copper conductor, 30 mil ethylene propylene rubber insulation 15 mil Hypalon jacket, cable asbestos tape, 60 mil Hypalon jacket, rated 600 volts, cable diameter 0.55".

5. ITT Surprenant Cable: A 3 conductor/No. 12 AWG, tinned copper conductor, 30 mil Exane II insulation, silicone glass tape, 65 mil Exane jacket, rated 600 volts, cable diameter 0.455".

Test Scope

The three tests performed by Sandia were composed of two sequential and one simultaneous exposure to LOCA environments. In each case the equipment was exposed to radiation and thermal aging prior to operating under the simulated LOCA conditions. Figures 1 and 2 describe the test profiles for sequential and simultaneous tests respectively (Sandia tests were designed to study synergistic effects). Each of the tests satisfy the intent of IEEE 323-1974. The assemblies were electrically loaded to 20 amperes and 600 volts at the start of the tests. Insulation resistance and capacitance measurements were recorded during the tests to indicate damage.

The equipment assemblies with respect to the sequential and simultaneous tests performed were as follows:

1. Sequential Tests (Two)

Gulton Connector/ITT Cable	1 Assembly
Gulton Connector/Anaconda Cable	1 Assembly
Bendix Connector/ITT Cable	2 Assemblies
ITT Connector/ITT Cable	1 Assembly

2. Simultaneous Test (One)

ITT Connector/ITT Cable	1 Assembly
Bendix Connector/ITT Cable	1 Assembly
Bendix Connector/Anaconda Cable	2 Assemblies

Test Results

Both ITT Cannon connector assemblies and both Gulton connector assemblies showed almost immediate damage in terms of insulation resistance and capacitance as the 70 psig steam was applied.

The ITT Cannon connector assembly failures appeared to be back plane boot seal leakage failures. The assembly construction did not contain potting compound (by design) to protect the pin backs. Therefore, boot failure leads directly to connector failure.

In the case of the Gulton Assemblies, failures were attributed to both the mating surface interface and the back plane seal. The design uses a rigid insert around the mating pins and the O-ring seals are

bypassed by an alignment key slot. This design may lead to leaks due to non-uniform confinement of the O-ring which could cause arcing between pins. Neutron radiography revealed inadequate amounts of potting compound (voids) and cracking of potting compound. These conditions could account for back plane failures. Neutron radiography performed on untested connectors revealed similar conditions, i.e., voids and cracking, thus indicating an apparent quality control problem at Gulton's facility. Other problems detected were identified as:

1. The shrink tube used over the pin cable interface was split lengthwise and had pulled away.

2. The potting material showed virtually no adhesion to, or sealing between, the cable jacket, insulation, and the connector shell.

3. The mechanical clamp had been secured so tightly that it cut the cable jacket.

The Bendix connector assembly was the only type to survive an entire test cycle. One Bendix/Anaconda assembly malfunctioned after about eight days into the 10 psig profile and the Bendix/ITT assembly experienced decreasing resistance and increasing capacitance through the simultaneous tests until both readings were off scale at the end of the 10 psig profile. A second Bendix/Anaconda assembly survived the simultaneous tests. During the sequential tests only Bendix and ITT Cannon assemblies were involved and both assemblies failed. The failures of these assemblies would be difficult to define as either connector or cable failures. The ITT cable exhibited a shrinking characteristic which could have provided a leak path through the sealing medium of the connector.

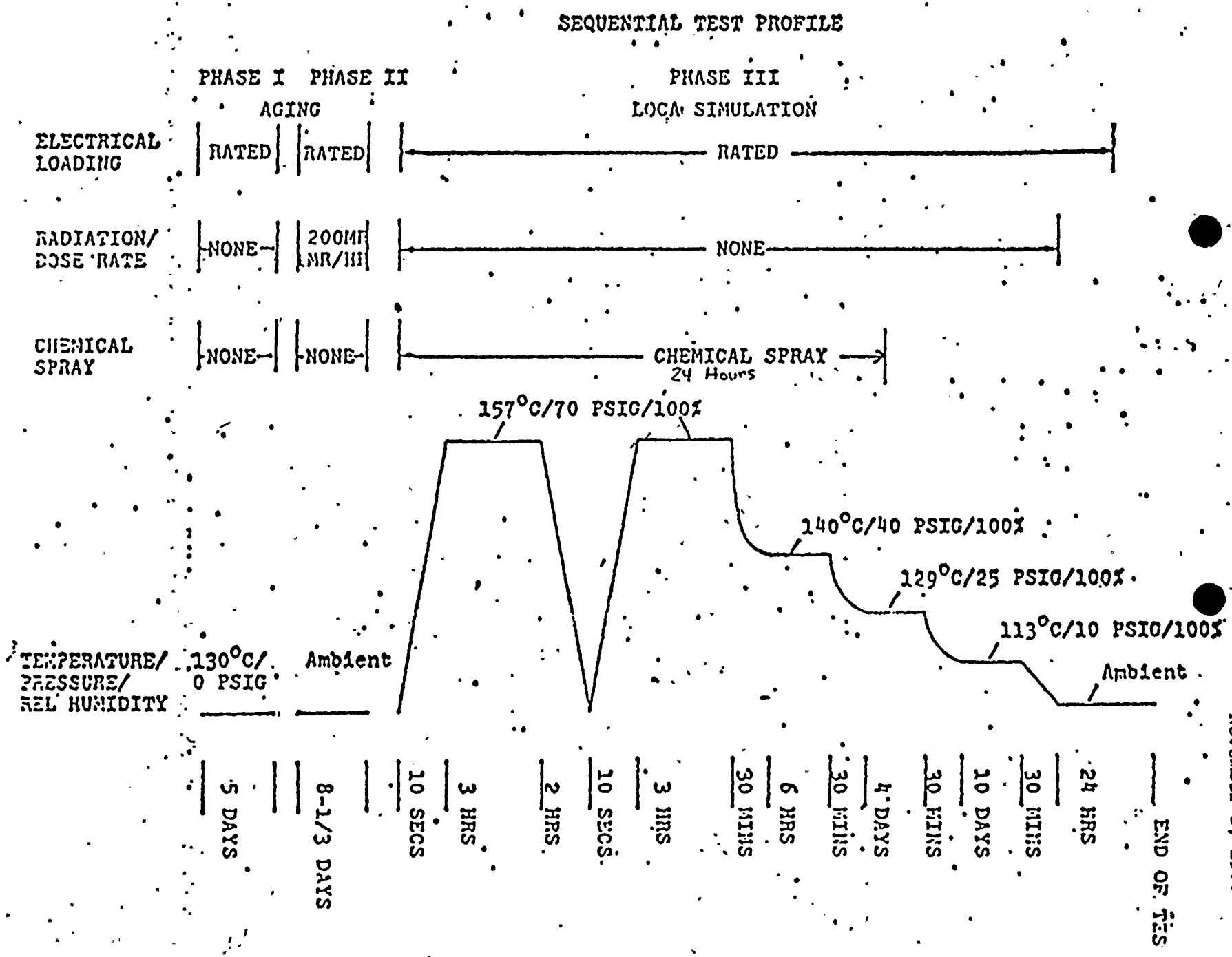

Figure 1

November 8, 1977

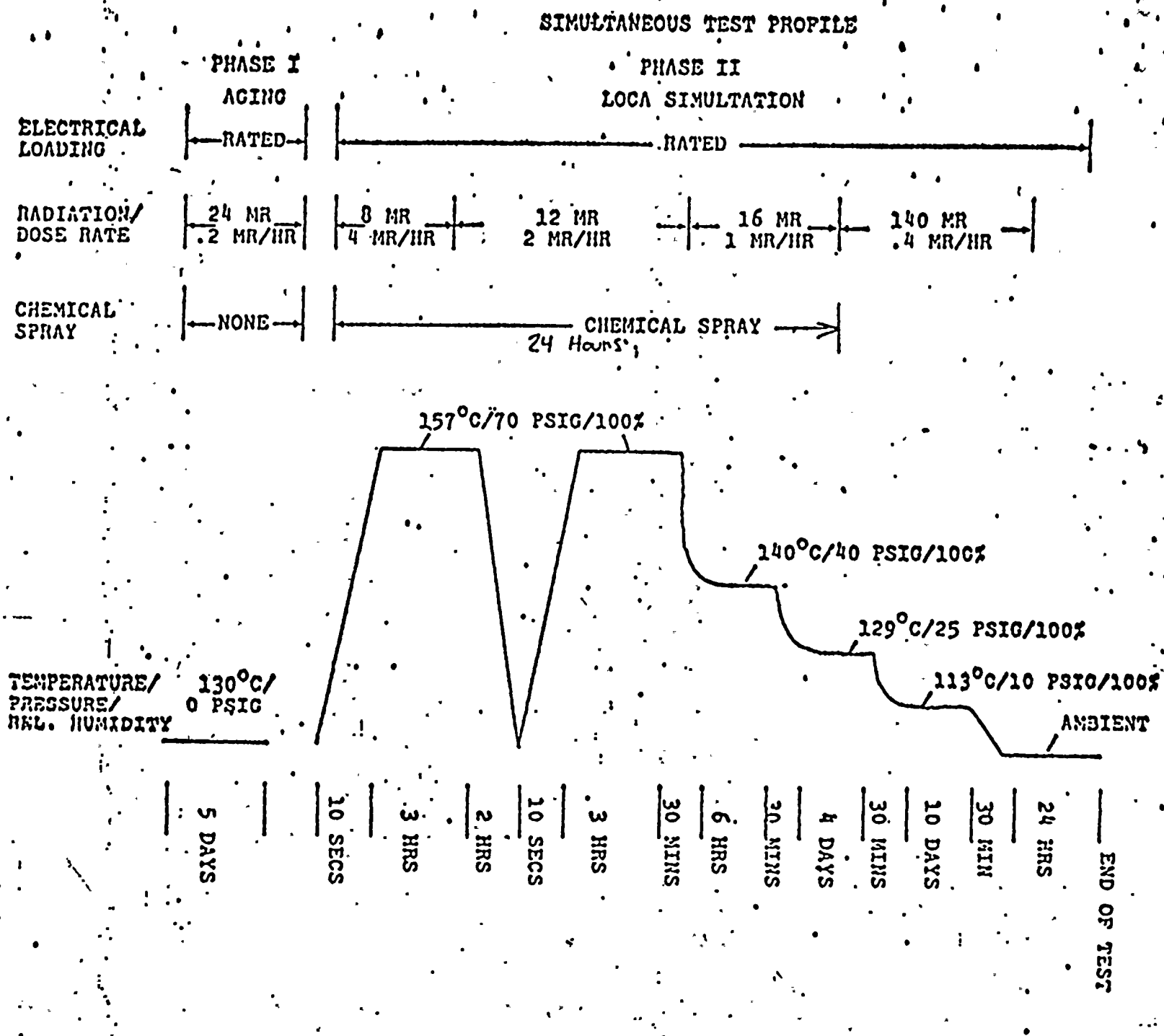
SIMULTANEOUS TEST PROFILE
PHASE I
AGING
PHASE II
LOCA SIMULTATION
ELECTRICAL LOADING
RATED
RATED
RADIATION/ DOSE RATE
24 MR
.2 MR/HR
8 MR
4 MR/HR
12 MR
2 MR/HR
16 MR
1 MR/HR
140 MR
.4 MR/HR
CHEMICAL SPRAY
NONE
CHEMICAL SPRAY
24 Hours
157°C/70 PSIG/100%
140°C/40 PSIG/100%
129°C/25 PSIG/100%
113°C/10 PSIG/100%
AMBIENT
TEMPERATURE/ PRESSURE/ REL. HUMIDITY
130°C/ 0 PSIG
5 DAYS
10 SECS
3 HRS
2 HRS
10 SECS
3 HRS
30 MINS
6 HRS
30 MINS
4 DAYS
30 MINS
10 DAYS
30 MIN
24 HRS
END OF TEST

Figure 2

LISTING OF IE BULLETINS ISSUED IN 1977

Bulletin No.	Subject	Date Issued	Issued To
77-04	Calculational Error Affecting the Design Performance of a System for Controlling pH of Containment Sump Water Following a LOCA	11/4/77	All PWR Power Reactor Facilities with an Operating License (OL) or Contruction Permit (CP)
77-03	On-Line Testing of the W Solid State Protection System	9/12/77	All W Power Reactor Facilities with an Operating License (OL) or Construction Permit (CP)
77-02	Potential Failure Mechanism in Certain W AR Relays with Relays with Latch Attachments	9/12/77	All Holders of Operating Licenses (OL) or Construction Permits (CP)
77-01	Pneumatic Time Delay Set Point Drift	4/29/77	All Holders of Operating Licenses (OL) or Construction Permits (CP)

NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D. C. 20555

November 14, 1977

IE Bulletin 77-05A

ELECTRICAL CONNECTOR ASSEMBLIES

Description of Circumstances

This Bulletin is a supplement to IE Bulletin 77-05, issued November 8, 1977 and the two documents should be considered together.

Bulletin 77-05 described the failure, under test conditions, of a general type of electrical connector. The tests were intended to simulate post-LOCA conditions, therefore the action requested in the Bulletin focussed on the qualification of electrical connectors for use inside containment.

Since issuance of Bulletin 77-05, our attention has been called to circumstances which indicate that the scope of the action requested should be expanded and therefore the response to Bulletin 77-05 should reflect the expanded scope.

Electrical connectors should be qualified to perform their intended function after having been subjected to accident conditions if they are contained in a system whose function is to mitigate that accident.

The location of the connectors that must be qualified is not limited to those inside containment.

Action To Be Taken By Licensees and Permit Holders:

1. Actions requested by Bulletin 77-05 should be expanded to include all connectors in safety systems which are required to function to mitigate an accident where the accident itself could adversely affect the ability of the system to perform its safety function. The examination is not to be limited to only LOCA's nor to areas only within containment.

2. Responses should be provided within 30 or 60 days, as appropriate, of the date of this supplement.

Approved by GAO, B180225 (R0072); clearance expires 7-31-80. Approval was given under a blanket clearance specifically for identified generic problems.