NOV 08 1977

Docket No. 50-263
Docket No. 50-282
Docket No. 50-306

Northern States Power Company
ATTN: Mr. Leo Wachter
Vice President
Power Production and System
Operation
414 Nicollet Mall
Minneapolis, MN 55401

Gentlemen:

Enclosed is IE Bulletin No. 77-05 which requires action by you with regard to your power reactor facilities with an operating license or a construction permit.

Should you have questions regarding this Bulletin or the actions required of you, please contact this office.

Sincerely,

James G. Keppler
Director

Enclosures:
1. IE Bulletin No. 77-05
w/attachments (2)
2. List of IE Bulletins
Issued in 1977

cc w/encls:
Mr. L. R. Eliason,
Plant Manager
Mr. F. P. Tierney, Jr.,
Plant Manager
Central Files
Reproduction Unit NRC 20b
PDR
Local PDR
NSIC
TIC
Anthony Roisman, Esq.,
Attorney

OFFICE			RIII	RIII		
SURNAME			Fiorelli/ls	Keppler		
DATE			11/8/77			

November 8, 1977
IE Bulletin 77-05

ELECTRICAL CONNECTOR ASSEMBLIES

Description of Circumstances

Recent tests conducted by the Sandia Laboratories of electrical connector/cable assemblies in a simulated post-LOCA containment environment (LWR) demonstrated that the assemblies failed to perform in an acceptable manner. The connectors are the pin and socket type, with metal shell and screw couplings. The specific test specimens were manufactured by Bendix, ITT Cannon and Gulton Industries using combinations of Anaconda and ITT Surprenant cables. Details of the specific connector/cable combinations, test conditions, test results and other pertinent information are described in the Attachment.

While electrical connectors of the type tested are not normally used in applications that are required to survive LOCA conditions, it is not possible in the absence of specific information to conclude that such applications do not exist. Further, it is unknown whether other manufacturers have supplied similar assemblies, whether such assemblies have been properly qualified for the intended service or whether these type of assemblies are utilized in applications that must continue to operate reliably in a LOCA environment.

Action To Be Taken By Licensees and Permit Holders:

For all power reactor facilities with an operating license or a construction permit:

1. Determine whether your facility utilizes or plans to utilize electical connector assemblies of the type tested by Sandia Laboratories, or any other similar type, in systems that are located inside containment, are subject to a LOCA environment and are required to be operable during a LOCA.

2. If any such applications are identified, review the adequacy of qualification testing for the assemblies and submit the documentation for NRC review.

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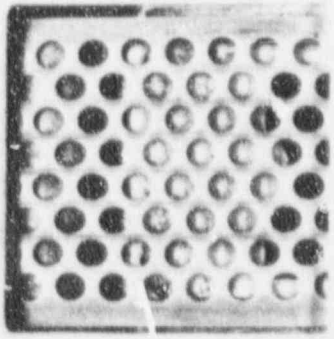

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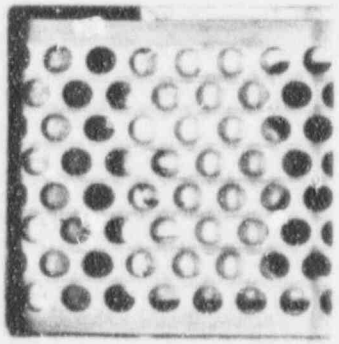

OFFICE ▶			RIII	RIII
SURNAME ▶			Fiorelli/ls	Apple
DATE ▶			11/8/77	

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While electrical connectors of the type tested are not normally used in applications that are required to survive LOCA conditions, it is not possible in the absence of specific information to conclude that such applications do not exist. Further, it is unknown whether other manufacturers have supplied similar assemblies, whether such assemblies have been properly qualified for the intended service or whether these type of assemblies are utilized in applications that must continue to operate reliably in a LOCA environment.

Action To Be Taken By Licensees and Permit Holders:

For all power reactor facilities with an operating license or a construction permit:

1. Determine whether your facility utilizes or plans to utilize electical connector assemblies of the type tested by Sandia Laboratories, or any other similar type, in systems that are located inside containment, are subject to a LOCA environment and are required to be operable during a LOCA.

2. If any such applications are identified, review the adequacy of qualification testing for the assemblies and submit the documentation for NRC review.

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3. If evidence is not available to support a conclusion of adequacy, submit your plans and programs toward qualifying existing equipment or your plans for replacing unqualified assemblies with qualified equipment.

4. Provide your response in writing within 30 days for facilities with an operating license and within 60 days for facilities with a construction permit. Reports should be submitted to the Director of the appropriate NRC Regional Office and a copy should be forwarded to the U. S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, Division of Reactor Construction Inspection, Washington, D. C. 20555.

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

Attachments:
1. Attachment A, Trip Report by W. R. Rutherford, Electrical Connector Assemblies
2. Attachment B, Sequential and Simultaneous Test Profile

IE Bulletin-77-05
November 8, 1977

TRIP REPORT
by
W. R. Rutherford

ELECTRICAL CONNECTOR ASSEMBLIES

On September 1, 1977 a meeting was held in Albuquerque, 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 ar 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.

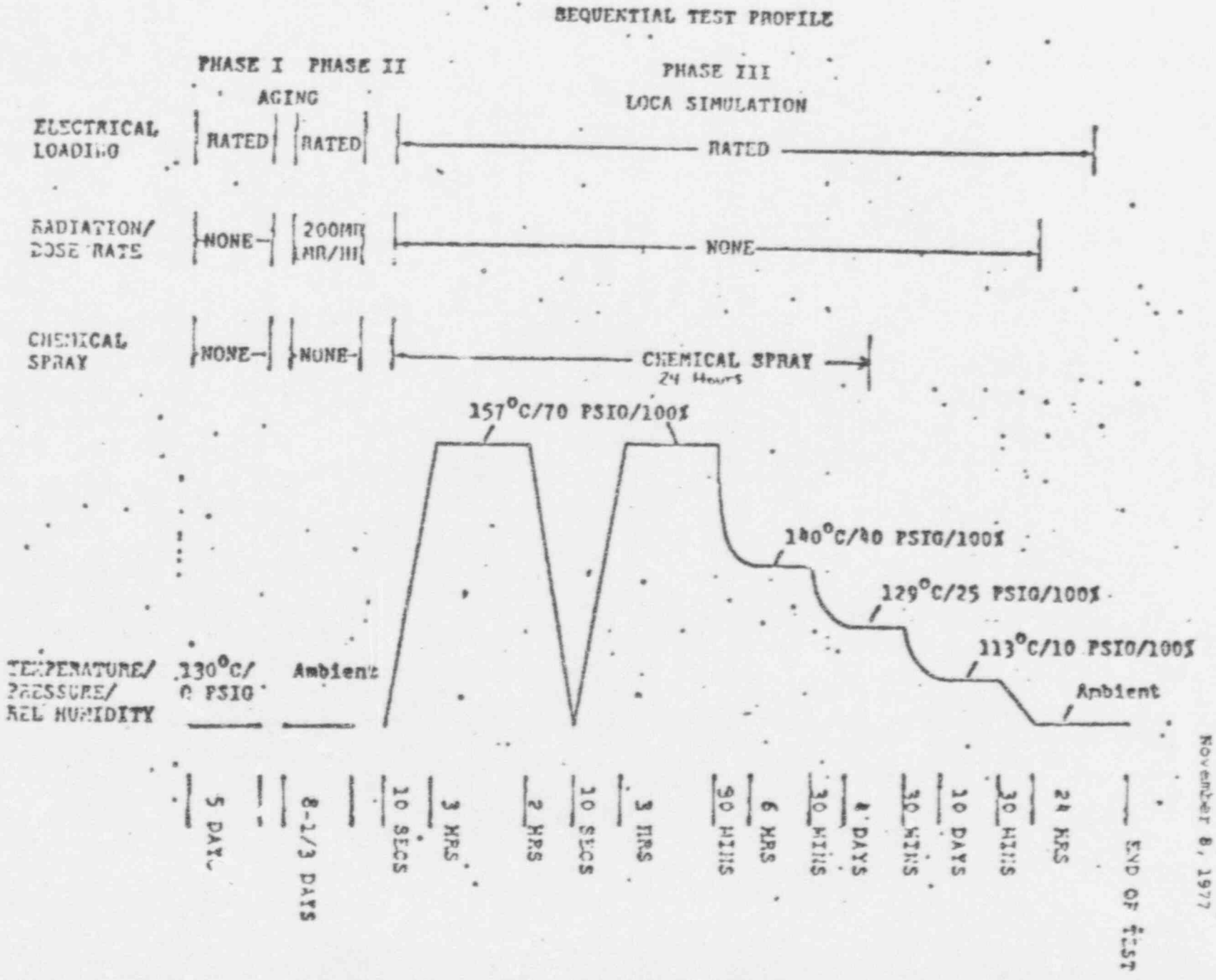

Figure 1

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Attachment B
1 of 2

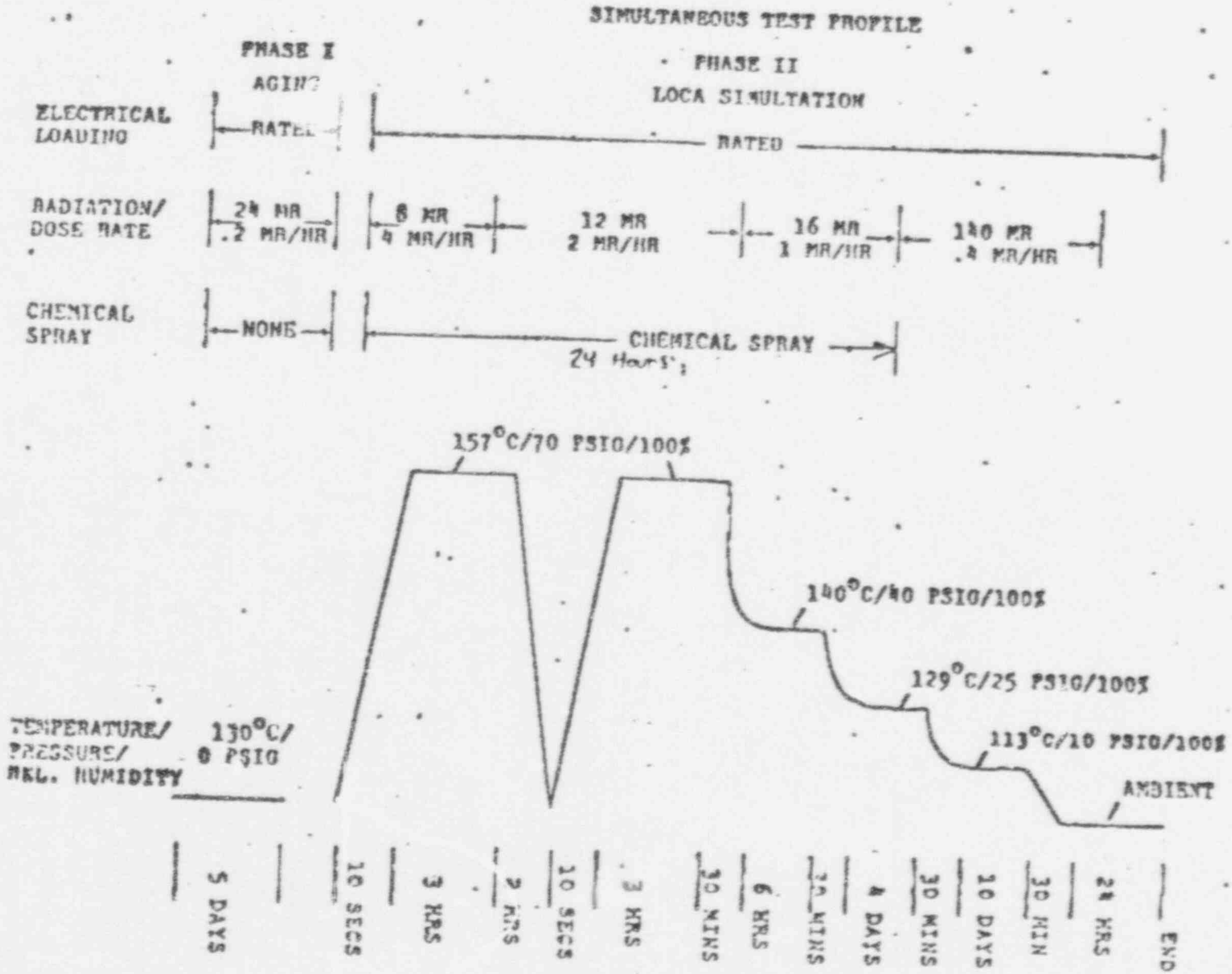
SIMULTANEOUS TEST PROFILE
PHASE I
AGING
PHASE II
LOCA SIMULATION
ELECTRICAL LOADING
RATED
RATED
RADIATION/ DOSE RATE
24 MR
.2 MR/HR
8 MR
4 MR/HR
12 MR
2 MR/HR
16 MR
1 MR/HR
140 MR
.4 MR/HR
CHEMICAL SPRAY
NONE
CHEMICAL SPRAY
24 Hours
157°C/70 PSIG/100%
140°C/40 PSIG/100%
129°C/25 PSIG/100%
113°C/10 PSIG/100%
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

IE Bulletin 77-05
November 8, 1977

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)