ATTACHMENT I TO JPN-85-23

SUMMARY OF IMPLEMENTATION OF THE ANALOG TRANSMITTER TRIP SYSTEM

NEW YORK POWER AUTHORITY
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
DOCKET NO. 50-333
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Contents

Drawings

Applicable drawings referenced in this report are:

Gilbert Associates, Inc. - 52561733-809-001 through 52561733-809-007

General Electric Co. - 791E456, sheet 1

- 865E365, sheets 1 through 4A - 5 through 11

- 913E702, sheets 1 through 4

- 915E258

- 915E259, sheets 1 and 2

- 915E260

New York Power Authority - 11825-FM-1D-9B (Rev. 9.B)
- 11825-FM-1E (Rev. 13.B)

INTRODUCTION

The reason for the Analog Transmitter Trip System (ATTS) modification is to improve sensor accuracy and reliability; reduce the time that the Reactor Protection system (RPS) logic must be in half scram condition; reduce calibration frequency; and reduce personnel radiation exposure.

The modification replaces instruments with mechanical switches with an electronic analog sensor system capable of more accurately monitoring Emergency Core Cooling System (ECCS) and RPS protection parameters. In addition, the overall repeatability, reliability, and maintainability has been improved. System components such as switches, racks, and accessories have been replaced by nuclear Class 1E qualified equipment meeting more stringent codes and standards than the original equipment. The design of the ATTS enhances the ability of the plant to detect critical process parameters and to minimize spurious or maintenance initiated ECCS system initiations or plant trips.

MODIFICATION SUMMARY

The modification involves the replacement of existing mechanically actuated switches with nuclear qualified Class 1E transmitters which provide inputs to safety systems. Additionally, temperature elements associated with Leak Detection Systems located in the Steam Tunnel, Personnel Access, Torus, Residual Heat Removal (RHR) Heat Exchanger, and Crescent areas are replaced with nuclear-qualified Class 1E Resistance Temperature Detectors (RTD).

The new transmitters and RTD's are routed to the General Electric Co. (GE) ATTS cabinets (9-91 through 9-96). These cabinets contain all the solid state electronics necessary to condition and process the new analog signals. Each cabinet provides alarm outputs to the main control room to indicate the status of the cabinet power supplies and instrument loops housed within.

The modification also replaces GE instrument racks (25-5, 25-5-001, 25-6, 25-6-001, 25-34, 25-56) used to support ATTS instruments. Newly added racks are 25-51-001 and 25-52-001.

Each of the new racks and instruments have been seismically and environmentally qualified based upon conditions at the James A. FitzPatrick Nuclear Power Plant. Qualification for these instrument racks is based upon IEEE 323-1974 and IEEE 344-1975. The new racks are designed to requirements that are more stringent than the racks they replace.

The modification also involves the replacement of exising instrument racks 1-01 as well as providing for modifications to others; these racks are 1-02, 1-03, 1-04, 2-11, and 2-12. The racks are being replaced or modified to provide a seismic Category I structure with a seismic response less than that required by the instruments mounted on them.

Instrument rack accessories such as tubing, fittings, and instrument valves used for the new modified instrument racks have been purchased to requirements of ANSI B31.1 (1980) with ratings equal to or greater than the accessories being replaced. Accessories are supported by the racks to assure no excessive loads are transmitted to the instruments or terminal boxes.

Certain areas/interfaces of the ATTS modifications require specific emphasis; these being:

A. INSTRUMENT LOOPS

Each ATTS instrument loop has been analyzed for time response, accuracy, power requirements, and repeatability by GE in the Licensing Topical Report NEDO-21617-A Class I, December 1978, "Analog Transmitter Trip Unit System for Engineered Safeguard Sensor Trip Inputs." The report was noted in the U.S. Nuclear Regulatory Commission letter MFN279-78, dated June 27, 1978, as acceptable for reference in license applications.

The following is specific information for each instrument loop involved with this modification:

1. The variable name (function) and instrument number can be found on FE drawing 865E365, sheets 10, 11 and 12.

2. The "system" involved can be found in the column headings on GE drawing 865E365, sheets 10, 11 and 12. Sheet 10 contains the RPS and sheets 11 and 12 contain the ECCS.

3. Model Number and Vendor of the Transmitters and RTD's

   a. Transmitters
      Rosemount (Model 1153GB, 1153DB, and 1153AB)

   b. Resistance Temperature Detectors (RTD)
      Weed (Drawing No. 0313-00339-002)

B. TRIP UNIT CABINETS

ATTS cabinets (9-91 through 9-96) and qualifications in accordance with IEEE 323-1974 and IEEE 344-1975 were provided by GE. Postulated failure modes of the components within the cabinets were analyzed and the ability of these cabinets to perform their safety functions documented by GE in the Licensing Topical Report (NEDO-21617-A Class I, December 1978, Ref. F.16).

Each cabinet houses the hardware to power, condition, and calibrate signals from the ATTS instruments along with providing alarm contacts to the main control room. The output contacts from the ATTS cabinets are routed to the same associated equipment as that of the mechanically actuated switches they replaced. As such, all previous analyses for individual instruments or interface equipment remains unchanged.

Original set-point and calibration data was reevaluated by GE with no changes being made.

Following is specific information for each ATTS trip unit cabinet as identified below:

1. Cabinet layout showing location of the power supplies, trip relays, and trip units can be found on GE drawings 915E259, sheets 1 and 2 and 915E260 for RPS cabinets 9-91 through 9-94. GE drawing 915E258

shows the power supplies, trip relays, and trip units locations for ECCS cabinet 9-95 and 9-96.

2. Division to which the cabinet is assigned.

   The "division" assignment for ECCS cabinets 9-95 and 9-96 can be found on GE drawing 913E702, sheet 4. The "channel" assignment for RPS cabinets 9-91, 9-92, 9-93, and 9-94 can be found on GE drawing 913E702, sheet 2.

3. Layout of each card file in the trip unit cabinet showing the trip variable for each card file slot.

   The layout of each card file for ECCS cabinets can be found on GE drawing 915E258. The trip unit variable for each card file slot is found on GE drawing 865E365, sheets 11 and 12.

   The layout of each card file for RPS cabinets can be found on GE drawing 915E259, sheets 1 and 2. The trip unit variable for each card file slot can be found on GE drawing 965E365, sheet 10.

C. POWER SUPPLIES

In accordance with GE design documents the ATTS cabinets used for ECCS (9-95, 9-96) receive power from appropriate Divisional Essential AC and DC distribution systems. The ATTS cabinets used for RPS (9-91, 9-92, 9-93, 9-94) receive power from the appropriate 120 VAC RPS busses.

The RPS cabinets are supplied with 120 VAC through RPS buses A and B. To remain consistent with original design basis of RPS system channels A1 (Cab. 9-91) and A2 (Cab. 9-93) are powered from Bus A and Channels B1 (Cab. 9-92) and B2 (Cab. 9-94) are powered from Bus B (Ref. GE drawing 791E456 sheet 1). The RPS buses are supplied by two independent and redundant power sources. Each power source is a motor generator set which is provided with redundant Class 1E qualified electrical protection assemblies with undervoltage, overvoltage, and underfrequency protection. Precision voltage regulation is done within each ATTS cabinet DC power supply which prevents a single failure

from affecting more than one logic train. During normal plant operation the trip units remain energized thus providing a fail-safe condition on loss of power.

The ECCS cabinets are powered by the plant batteries through inverters. In addition a 115 VAC source is available for back-up from the 120 VAC safeguard buses. Both sources are divisional and consistent with original separation design basis of the plant. The batteries are supplied from emergency buses and sized per FSAR Section 8.73 for two hours continous operation with the charging source removed and based on fully charged batteries prior to source removal. Additionally all ATTS trip units have the ability to detect and annunciate failures from the inverters and power sources.

D. SEPARATION

Requirements of IEEE 279-1971 are fulfilled in several ways. The four channel redundancy of the RPS is maintained in the transmitter of the ATTS. The use of shielding instrumentation cable in steel conduit provides electrostatic and electromagnetic shielding of the information channels. These features preclude random failures and provide complete isolation of the signals. Isolation considerations include sensor and power supply location along with cable routing, fire rating, and separation.

All new wiring of ATTS equipment complies with the separation requirements of IEEE 384-1981 and Regulatory Guide 1.75. All new wiring is run in steel conduit, with no violation of the one inch minimum allowable spacing between redundant conduits. Flexible steel conduit is used at the equipment entrance for isolation of seismic motion. The conduit barrier and the minimum one inch separation between redundant wiring fully isolated all the new wiring of ATTS.

The criteria for this new ATTS wiring exceeds the requirements of the original plant design. This new wiring is a significant improvement in safety margin that can only enhance plant performance.

Where the circuits of ATTS interface with other equipment, the criteria of isolation is maintained. Internal cabinet wiring is separated according to classification. The interface with the Annunciator System is accomplished with interposing relays. The coil to contact isolation of the relays provide the isolation between the detector circuits and the annunciator circuits.

Although the four annunciator circuits are not identified as Associated Circuits per Regulatory Guide 1.75, the designed circuits more than meet what is outlined for IE/Non-IE wiring per IEEE-384 and the original design philosophy.

The output contacts from the ATTS cabinets are routed to the same associated equipment as that of the existing mechanical switches they replaced. As such, all previous analyses for individual instruments or interface equipment remains unchanged. No logic changes have taken place since only the primary element has been replaced by this modification.

Specific plant wiring interconnections can be found on GE "elementary" drawing 865E365, sheets 1 through 11 and GE "interconnection block diagram" drawing 913E702, sheets 1 through 4.

E. ELECTRO-MAGNETIC INTERFERENCE

GE Report NEDO-21617-A outlines a stringent electro-magnetic interference (EMI) test made on the individual components of the ATTS on the basis of EMI parameters which can be found in and around nuclear plants. The implementation of the ATTS has applied criteria to prevent that the results of their test be invalidated. In particular, shielded cables are used for all analog signals and installed in metal conduits. Instrument racks and trip unit racks are grounded. Physical location of instrument racks and trip unit have been selected to minimize potential exposure to a common source of EMI. As an example, the instrument racks are located outside the drywell wall essentially diametrically opposite to each other: MACH-LOG - Reactor Building - sheet 1, Plan - El. 300'-0", Drawing No. 11825-FM-ID-9B (Rev. 9.B); MACH-LOC - Reactor Building - sheet 5, Plan - El. 272'-0", Drawing No. 11825-FM-1E (Rev. 13.B). Per Rosemount Instruction Manual 4247-1, dated July

1976, Table 3, the maximum lead length allowable for size 16 AWG copper wire is 3,820 feet. The maximum cable length for ATTS modification on James A. FitzPatrick Nuclear Power Plant is 828 feet.

The above discussion established that concerns for EMI have been addressed by qualification testing of the equipment and installation criteria.

F. ALARMS

The primary purpose of the high-current gross failure alarm is to detect a short circuit in the transmitter loop. The range of adjustment for high-current gross failure set-point is 30 to 40mA. A 30 $\pm$ 0.5 mA high-current set-point has been chosen. This set-point is within the normal range of adjustment and can detect a short circuit.

The primary purpose of the low-current gross failure alarm is to detect an open circuit in the transmitter loop. The range of adjustment for low-current gross failure set-point is 0.5 to 4 mA. A 2.5 $\pm$ 0.5 mA low-current set-point has been selected. This set-point is within the normal range of adjustment, is unlikely to result in false alarms, and can detect an open circuit.

G. ENVIRONMENTAL QUALIFICATION

The environment at each location where the retrofit hardware is located was compared to the maximum environment as stated in the topical report for normal operation and post-accident temperature and pressure.

The ATTS cabinets are located in a controlled environment (relay room).

The worse accident environment is a high energy line break in the area where the transmitter racks are located (Reactor Building outside the drywell at Elevations 272' and 300'). The postulate accident profiles are enveloped by an ample margin by the loss-of-coolant accident (LOCA) temperature and pressure profiles used for the transmitter environmental qualification.

RTD's used in this modification have been environmentally qualified for their location in the plant. The qualification for all instruments is based upon IEEE 323-1974 and IEEE 344-1975, and meet the requirements of 10 CFR 50.49.

Worst accident environments are:

Reactor Building - Elev. 272'	Reactor Building - Elev. 300'
Peak Temperature 238°F	Peak Temperature 225°F
Plateau @ 195°F from 0.2 to 2.0 sec.	Plateau @ 220°F from 0.3 to 1.0 sec.
Level @ 105°F @ 3,000 sec.	Level @ 120°F @ 2,000 sec.
Peak Pressure 19.5 psia	Peak Pressure 20.5 psia
Plateau @ 19 from 0.2 to 0.8 sec.	Plateau @ 19.5 from 0.06 to 0.6 sec.
Level @ 15 psia @ 1.0 sec.	Level @ 15 psia @ 12 sec.

H. SEISMIC QUALIFICATION

The nine instrument racks built by the Mercury Co., as shown on GAI drawings 52561733 809-001 through -007, have been seismically qualified for the James A. FitzPatrick Nuclear Power Plant per GAI Specification SP-733-001 and IEEE-344-1975.

Technical Report and Procedure 1278 prepared by Nuclear Qualification Services, documents the seismic analysis of the instrument racks.

Further analysis was performed by Gilbert/Commonwealth, Inc. (G/C) to seismically qualify the steel tubing attached to the racks after tubing and valve modifications were made by site engineering. This analysis is documented in G/C Calculations I-JAF-0414-010-1, pages 1 through 20.

The seismic design used for the installation of new cable, raceways, and impulse tubing complies with the following James A. FitzPatrick Nuclear Power Plant requirements:

FSAR Sections 12.4.6.1, 12.4.6.2., 12.4.9, and Tables 12.4.2 and 12.4.6.

The support spacing utilized provides a support system which will remain functional during and following a postulated design basis earthquake (DBE).

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March 25, 1985

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EL2985-027

Mr. Leon Guaquil
Director, Project Engineering, BWR
New York Power Authority
123 Main Street
White Plains, NY 10601

SUBJECT: Appendix R Compliance of James A. FitzPatrick Nuclear Power Plant - Third Party Review (Fire Damper Evaluation Revised to Reflect Comments Provided by NYPA Staff)

Dear Leon:

EPM has consulted with you, Mr. P. Oakes and J.A. FitzPatrick Nuclear Power Plant personnel regarding our review of fire dampers. In an effort to reduce the number of fire dampers required for Appendix R compliance, EPM has prepared a Fire Damper Evaluation (Attachment 1). The evaluation is based both on available documentation and observations made on-site during the week of January 21, 1985.

As with the fire dampers in the Reactor Building, EPM recommends that the analysis be used in support of a safety evaluation in lieu of installing the following fire dampers:

- 72FD-3, 4 and 6 between BR-1 and BR-4
- 72FD-5 between BR-4 and BR-5
- 67FD-1 between SW-1 and CT-1
- 67FD-4, 5, 6, 7 and 8 between SW-1 and TB-1
- 67FD-9, between SW-2 and CT-2
- 67FD-14 between SW-1 and SW-2
- 67FD-12 and 13 between SW-2 and TB-1
- 73FD-1 between SP-1 and SH-1
- 73FD-2 and 3 between SP-2 and SH-1

The remaining fire dampers referenced in the Fire Damper Data Sheet and in our January 16, 1985 letter to you, are considered necessary for Appendix R compliance and our recommendation is that they be upgraded as planned.

This evaluation is based upon conditions noted at the time of the site visit, administrative controls that limit the amount of combustible materials to that stated in the 1983 revised Fire Hazards Analysis and statements made in the references named in Section 2 of the analysis.

Your comments have been incorporated in the analysis.

It should be noted that the analysis reduces the fire ratings being credited for the barriers for which the fire dampers were proposed. This reduced rating will be in conflict with statements made in the 1983 Fire Protection and Safe Shutdown Systems Analysis. This change will have to be reported to the NRC. EPM does not believe that three-hour-ratings are required for all the barriers. Based on the analysis, the barrier ratings can be reduced without impacting on plant safe shutdown capability.

Should you have any questions or comments concerning the evaluation, please do not hesitate to contact me at (617) 875-2121.

Very truly yours,

Enrique E. Margalejo

EEM/kk

Attachment (1)

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FIRE DAMPER EVALUATION
FOR APPENDIX "R" COMPLIANCE

J.A. FITZPATRICK NUCLEAR POWER PLANT

PREPARED BY _____ DATE March 25, 1985

REVIEWED BY _____ DATE March 25, 85

APPROVED BY _____ DATE 3/25/85
for E. E. Margalep

epm

Attachment 1

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EL2985-027

FIRE DAMPER EVALUATION

1. PURPOSE

The purpose of this evaluation is to evaluate the need for fire dampers in duct penetrations in fire area barriers at the J.A. FitzPatrick Nuclear Power Plant.

This evaluation will support the contention that not all of the proposed fire dampers are required. If a fire damper is not needed to prevent the spread of fire beyond a fire barrier, then that fire damper will not be considered necessary.

2. BASIS FOR NOT REQUIRING DAMPERS IN ONE HOUR BARRIERS

Fire dampers are designed for installation in fire walls (three-hour rated) or fire partitions (two-hour rated) where the physical barrier is penetrated by ducting or ventilation openings.

The 15th edition of the NFPA Handbook states in Section 7, Chapter 4:

> "In the gauges commonly used, some sheet metal ducts may protect an opening in a building construction assembly for up to one-hour, if properly hung and adequately fire stopped. Therefore, ducts passing through fire barriers having a rating of up to one-hour of fire resistance can possibly present no extraordinary hazard".

In addition, the 1981 edition of NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation Systems", states that:

> "fire dampers shall be provided where ducts or air grills penetrate partitions required to have a fire resistance of two-hours or more".

Reference is also made to an article published in the April 1983 edition of The Construction Specifier, pages 64-69 titled "Fire Research for HVAC Systems". This article states in part:

> "Studies of the performance of steel ducts...with and without fire dampers under an ASTM E119 fire exposure, were carried out in December 1982 at Underwriters Laboratories, Inc., by the Thermal Insulation Manufacturers Association (TIMA). Two separate fire tests in the wall furnace were conducted on steel ducts....
>
> The demonstrated structural performance of sheet steel ducts in the fire test provided additional evidence for NFPA 90A to maintain its provision that no fire dampers are required where steel ducts penetrate walls having a one-hour fire resistance rating...."

Based on these tests and the references cited, fire dampers are not required for ducts penetrating fire partitions having a one-hour fire resistance rating or less.

3. EVALUATION

(a) Fire Dampers 72FD-3, 4 and 5 are proposed for the duct penetrations between Battery Charging Rooms BR-1 and BR-4. The 1983 Updated Fire Hazards Analysis states that the combustible inventory is 31.2×10^6 Btu in BR-1 and 34.4×10^6 Btu in BR-4. The equivalent fire severity can be determined by dividing the total Btu content by the sq.ft. area to get the heat load. Dividing this by a factor of 1333 Btu/sq.ft./1 minute [Ref. 5] of equivalent fire severity will give an equivalent fire severity in minutes. While the 1983 F.H.A. states that BR-1 and BR-4 have 400 sq.ft. each, the ceiling areas

are 720 sq.ft. It is expected that the hot gases will spread out at ceiling level, thus the equivalent severity that the barrier of concern is exposed to is 32.5 minutes in BR-1 and 35.8 minutes in BR-4. The required rating of the wall between BR-1 and BR-4 would be less than one-hour even with a safety factor of 150% of the largest equivalent fire severity. The duct dampers are therefore not required.

(b) Fire damper 72 FD-5 is proposed for the fresh air duct in the barrier separating Battery Charging Room RB-4 and the Battery Room Corridor BR-5. The equivalent fire severity, based on the methodology stated earlier, is 35.8 minutes for RB-4 and 49.6 minutes for RB-5. A fire barrier rating of one-hour would be adequate to prevent fire spread between these two zones. The barrier rating can be maintained at one-hour without the installation of the fire damper for reasons stated earlier in this analysis. The installation of Fire Damper 72 FD-5 is therefore not required.

(c) Fire damper 67 FD-1 is proposed for installation in the barrier floor separating Switchgear Room SW-1 from Cable Tunnel CT-1. Since these areas both contain Division A components, the barrier is not required. Therefore, fire damper 67 FD-1 is not required.

(d) Fire dampers 67 FD-4, 5 6, 7 and 8 are proposed for the barrier separating Switchgear Room SW-1 from Turbine Building TB-1 Zone TB-12 at the 272 ft. elevation the equivalent fire severities for these areas are 3.8 minutes for SW-1 and 17.5 minutes for TB-1 (Zone TB-12). A fire barrier rating of one-hour is adequate to prevent fire spread between these two areas. The installation of Fire Dampers 67 FD-4, 5, 6 7, or 8 is therefore not required.

(e) Fire damper 67 FD-9 is proposed for the duct opening in the floor separating Cable Tunnel CT-2 from Switchgear Room SW-2. Since both rooms contain Division B components a fire barrier is not required, thus the fire damper is not required.

(f) Fire damper 67 FD-14 is proposed for duct opening in the barrier separating Switchgear Rooms SW-1 and SW-2. Since both rooms have equivalent fire severities below five minutes, a barrier rating of one-hour is adequate to prevent fire spread between the rooms. A fire damper is, therefore, not required.

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(g) Fire dampers 67 FD-12 and 13 are proposed for the duct openings in the wall separating Switchgear Room SW-2 from Turbine Building TB-1 (Zone TB-12). SW-2 has an equivalent fire severity of 4.5 minutes and TB-1 17.5 minutes. A fire barrier of one-hour rating is adequate to prevent fire spread between these areas. The fire dampers are, therefore, not necessary for reasons stated earlier.

(h) Fire damper 73 FD-1 is proposed for the floor opening between the Screen House SH-1 and Safety-Related Pump House SP-1. Fire Dampers 73 FD-2 and 3 are proposed for the floor openings between the Screenwell House SH-1 and Safety-Related Pumps SP-2. The equivalent fire severities are 5.3 minutes for SP-1, 3.9 minutes for SP-2 and 10.2 minutes for SH-1. The areas where the floor openings exist are curbed. There is no continuity of combustibles on the Screenwell House side. Fire dampers are not considered necessary for these openings since a fire in SP-1 or SP-2 would be of low intensity and duration. It is very unlikely that a fire in either area could propagate to the Screenwell House and then down into the other Safety-Related Pump House. It is also extremely unlikely that a fire in the Screenwell House could propagate down into either Safety-Related Pump Room. Hot gases from a fire tend to rise and stratify at an upper elevation. Since the fuel loading in the Screenwell House is so low (10.2 minute equivalent fire severity), the hot gas layer could not develop to any significant degree. In the event of a liquid spill the fire dampers would be of no use and the areas are curbed anyway. Fire dampers are not considered necessary in this area and would do little to enhance fire protection.

4. CONCLUSION

Seventeen fire dampers have been shown to be unnecessary based on low equivalent fire severities. The source of the data for determining the equivalent fire severities was the 1983 Updated Fire Hazards Analysis (Reference 2). In order to keep the analysis viable the combustible loadings must be kept below the one-hour limit. Administrative controls should be implemented to limit the amount of transient and in-situ combustibles.

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While not considered in the analysis, credit should also be taken for the plant fire brigade.

Ionization fire detectors have been provided in BR-1, BR-2, BR-3, BR-4, SW-1, SW-2, SP-1 and SP-2 to help ensure prompt response to any fire situation in those areas.

The fire dampers listed herein are not considered necessary and would do little to enhance fire protection at the plant.

5. REFERENCES

(1) Fire Damper Data Sheet - Attachment 1 James A. FitzPatrick Nuclear Power Plant (NYPA).

(2) Fire Hazards Analysis - James A. FitzPatrick Nuclear Power Plant - Revised 1983 including the Fire Hazards Analysis drawings Fig. 76-A through 76-F.

(3) July 1983 Fire Protection and Safe Shutdown Systems Analysis Report for James A. FitzPatrick Nuclear Power Plant.

(4) List of drawings:

11825-FB23A-11
11825-FB23C-10
11825-FB37D
11825-FB32J10
11825-FB35C
11825-FB23D-9
11825-FB23B-11

(5) 15th Edition of the National Fire Protection Association - Fire Protection Handbook.

(6) 1981 NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation Systems."

(7) April 1983 Edition of "The Construction Specifier".

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