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SUBJECT: Forwards Rev 4 to "Fire Protection Review Rept."

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JUN 18 1993

Director of Nuclear Reactor Regulation
Attention: Mr. C.L. Miller, Project Director
Project Directorate I-2
Division of Reactor Projects
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

**SUSQUEHANNA STEAM ELECTRIC STATION
REVISION NO. 4 TO THE SSES
FIRE PROTECTION REVIEW REPORT
PLA-3991 FILES R41-2/S013/P5-1/A17-15**

Docket Nos. 50-387
and 50-388

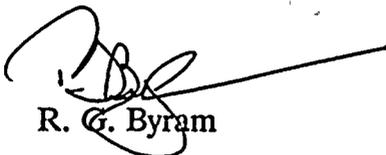
Dear Mr. Miller:

Attached are thirteen copies of the Susquehanna SES Fire Protection Review Report, Revision No. 4. The changes made under Revision No. 4 were submitted for Commission review under PLA-3317, dated December 29, 1989. We were notified of the completion of your review by a letter dated March 29, 1993.

Please note that Deviation Requests Nos. 39 and 40, which your staff is evaluating under a separate action, have been included in the revised report with a notation indicating they have not yet been approved by the NRC.

Should you have any questions, please contact Mr. W. W. Williams at (215) 774-5610.

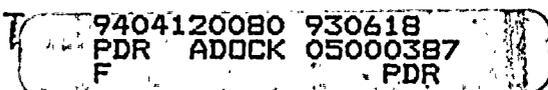
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R. G. Byram

Attachment

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Mr. G. S. Barber, NRC Sr. Resident Inspector-SSES
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SUSQUEHANNA STEAM ELECTRIC STATION

UNITS 1 & 2

5B-387

FIRE PROTECTION REVIEW REPORT

SUMMARY TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
1.0	Introduction
1.1	Objective
1.2	Background
1.3	Philosophy
1.4	Fire Protection Program
1.5	Content and Format
2.0	Definitions
3.0	Safe Shutdown Analysis
3.1	Introduction
3.2	Criteria
3.3	Methodology
3.4	Long Term Compliance
4.0	Fire Protection System Description
4.1	Fire Protection Water Supply System
4.2	Automatic Wet Pipe Sprinkler Systems
4.3	Dry Pipe Sprinkler Systems
4.4	Automatic Preaction Sprinkler Systems
4.5	Deluge Systems
4.6	Wet Standpipes and Hose Stations
4.7	Portable Fire Extinguishers
4.8	Carbon Dioxide Systems
4.9	Halon Extinguishing Systems
4.10	Insulation and Jacketing of Cable
4.11	Raceway Wrapping
4.12	Fire Detection System
5.0	Comparison of Susquehanna SES Design and Fire Protection Features to Regulatory Requirements
6.0	Fire Hazards Analysis by Plant Area
6.1	Introduction
6.2	Fire Area Descriptions

7.0

Deviations

7.1

Introduction

7.2

Deviation Request Index

Individual Deviations

8.0

Drawings

APPENDIX R DEVIATION REQUEST NO. 7

FIRE SPREAD LIMITATIONS

DEVIATION REQUEST:

It may be assumed in the case of non-rated fire zone boundaries that fire spread will occur only into the next most immediate fire zone (horizontally and vertically), and that damage beyond the adjacent fire zone through a second non-rated fire zone boundary need not be considered.

FIRE AREAS/ZONES AFFECTED:

This assumption was used generally throughout the fire barrier analysis.

REASON FOR DEVIATION REQUEST:

As described in the methodology section of our response to the NRC on Concern No. 1, the fire spread limitation criteria delineated by this request was applied as follows:

- o Each individual fire zone (primary fire zone) was examined relative to all adjacent fire zones for the availability of a common safe shutdown path. An adjacent fire zone is defined as any fire zone which has a physical point of contact with the primary fire zone.
- o If a common safe shutdown path is available in the primary fire zone and all adjacent fire zones, then the inherent assumption of the fire spread limitation criteria outlined above assures us that, for a fire starting in this primary fire zone, a safe shutdown path is available.
- o If a common safe shutdown path is not available, fire rated barriers are required between the primary fire zone and any conflicting adjacent fire zone. This condition similarly assures us that, for a fire starting in the primary fire zone, a safe shutdown path is available.

The acceptability of this methodology, allows the use of the buffer zone concept. The buffer zone takes two forms:

- (1) The spent fuel pool has been utilized as a buffer zone. In spite of the walls of the pool not being rated fire barriers, the thickness of the walls and volume of water contained in the pool preclude propagation of a fire.

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- (2) The buffer zone concept acts as a spatial barrier between two adjacent fire areas. Using the fire spread limitations, and by assuring multiple paths within two or more adjacent fire zone (referred to as buffer zones), adequate separation between fire areas with different safe shutdown paths is provided without fire walls. This concept is best described by the example below:

FIRE ZONE A (1)	FIRE ZONE B (1) (2)	FIRE ZONE C (1) (2)	FIRE ZONE D (2)
--------------------	------------------------	------------------------	--------------------

- o Fire Zone A and Fire Zone D have different available shutdown paths, and are in different adjacent Fire Areas.
- o Fire Zone B and C both have available shutdown paths which are common to each other and Fire Zones A and D.
- o Using the assumption that a fire will spread to the next adjacent zone the following scenarios are possible:

<u>FIRE ORIGIN</u>	<u>FIRE INVOLVES FIRE ZONE</u>	<u>PATH USED FOR SHUTDOWN</u>
FIRE ZONE A	A, B	(1)
FIRE ZONE B	A, B, C	(1)
FIRE ZONE C	B, C, D	(2)
FIRE ZONE D	C, D	(2)

- o A successful shutdown path is demonstrated in each case.
- o Those fire zones which satisfies the criteria described above and are physically located at a point where they separate two fire areas were labeled as Buffer fire zones.

This concept is utilized at higher levels in the reactor building where there is a minimal amount of safety related equipment. Utilizing this concept minimizes the number of fire rated boundaries by precluding the need for a rated barrier between adjacent zones.

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APPENDIX R DEVIATION REQUEST NO. 8

ONE HOUR FIRE BARRIER WRAP WITH LIMITED SUPPRESSION

DEVIATION REQUEST:

The installation of a three hour fire barrier wrap in Fire Zones 0-28B-I, 0-28B-II, 1-2D and 0-28H without automatic suppression in order to comply with 10 CFR 50 Appendix R, Section III.G.2.a would not significantly enhance the fire protection for those fire zones nor overall plant safety, and therefore a one hour fire barrier is acceptable.

FIRE AREAS/ZONES AFFECTED:

This deviation request applies to Fire Areas CS-17 (Fire Zone 0-28B-I), CS-24 (Fire Zone 0-28B-II), R-1B (Fire Zone 1-2D) and CS-15 (Fire Zone 0-28H).

REASON FOR DEVIATION REQUEST:

10 CFR 50 Appendix R, Section III.G.2.a requires that redundant safe shutdown equipment/cables be separated by a fire barrier having a 3-hour rating when automatic suppression is not provided.

The redundant safe shutdown equipment/cables are separated by a fire barrier having a 1-hour rating and no automatic suppression is provided.

EXISTING ARRANGEMENT:

Fire Zones 0-28B-I and 0-28B-II contain safety related load centers and miscellaneous battery chargers and distribution panels. Two-hour rated barrier walls separate equipment by division and all cabling in these zones is enclosed in conduit. The combustible loadings for these fire zones are low. Manual suppression equipment and ionization detectors are provided in these fire zones.

Fire Zone 1-2D consists of one room (approximately 14' X 25') housing various control cables and Unit 1's remote shutdown panel. Approximately 75% of the cabling in the fire zone is contained in conduit. The minority division raceways located on the fire zone consist of control cable for the Emergency Service Water System. The combustible loading for the fire zone is low. Manual suppression equipment and ionization smoke detectors are provided in the fire zone.

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Fire Zone 0-28H consists of one room (approximately 20' x 50') housing various cables in conduit and the cold instrument repair facility. The minority division raceways are located above a non-rated false ceiling and are run in conduit. The combustible loading for the fire zone is low. Manual suppression and ionization detectors are provided for the fire zone.

JUSTIFICATION:

When the combustible loading and reasonable transient combustibles are considered, fire detection, manual fire suppression, and one-hour rated cable enclosures without automatic suppression provide adequate protection for safe shutdown cables.

NRC APPROVAL:

This deviation request was transmitted to the NRC on February 9, 1982 (PLA-1013). The NRC approved this deviation request in Supplement No. 4 to the Susquehanna SES Safety Evaluation Report.

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APPENDIX R DEVIATION REQUEST NO. 9

INSUFFICIENT SPATIAL SEPARATION OF SWITCHGEAR ROOM COOLER FANS

DEVIATION REQUEST:

One division of electrical equipment and raceway for the emergency switchgear cooling equipment is provided with one hour rated fire barrier only when it is located within 9 feet of the redundant division of the emergency switchgear cooling equipment.

FIRE AREAS/ZONES AFFECTED:

This deviation request applies to Fire Zone 2-5A-S which is in Fire Area R-2A and Fire Zone 2-5A-W which is in Fire Area R-2A and R-2B.

REASON FOR DEVIATION REQUEST:

10 CFR 50, Appendix R, Section III.G.2 requires the existence of an automatic fire suppression system and a one hour fire rated barrier wrap for one redundant safe shutdown system located within 20 feet of redundant division equipment.

The Emergency Switchgear Cooling System Division I compressor motor and motor operated valve are located within 9 feet of the Division II compressor motor and motor operated valve. Providing a one hour wrap for the motors is not possible, as wrapping would negate its qualification.

EXISTING ARRANGEMENT:

The Emergency Switchgear Cooling System equipment are located in Fire Zones 2-5A-S and 2-5A-W. Specifically the equipment is located on a mezzanine above Fire Zones 2-5G and 2-5H and 15 feet above the floor elevation. The switchgear cooling equipment is the only equipment located on the mezzanine. The mezzanine can only be accessed via a vertical ladder.

The area around the switchgear cooling equipment is protected by automatic sprinklers and automatic detection. Also a one hour fire rated barrier wrap for Division raceways located within 20 feet of redundant Division electrical equipment except for the specific equipment for which this deviation is being requested.

JUSTIFICATION:

The area around the switchgear cooling equipment is provided with automatic sprinkler protections and automatic detection. The area around the equipment has low in-situ combustibles. The equipment is located 15 feet vertically and 8 feet horizontally from any transient combustibles. Also it is highly unlikely that transient combustibles would be brought to the mezzanine since the only access is a vertical ladder.

NRC APPROVAL:

This deviation request was sent to the NRC on December 13, 1983 in PLA-1985. NRC approval was received in Supplement No. 6 to the Susquehanna SES Safety Evaluation Report.

APPENDIX R DEVIATION REQUEST NO. 10

FIRE AREA D-3 BOUNDARIES

DEVIATION REQUEST:

The three hour rated fire walls for Fire Area D-3 are adequate based on the fire protection, the dikes provided for dirty oil tanks, and the low probability that the maximum, potential combustibles will be involved in a single fire.

FIRE AREAS/ZONES AFFECTED:

This deviation affects Fire Area D-3 (Fire Zone 0-41C). The adjacent Fire Areas are D-1 (Fire Zone 0-41A) and D-2 (Fire Zone 0-41B).

REASON FOR DEVIATION REQUEST:

NRC guidance to 10 CFR 50 Appendix R requires that fire area boundaries should be rated for 3 hours or the rating should be based on the combustible loading, and all combustibles shall be considered consumed. A modification to the "C" Diesel Generator Bay has added a 2200 gallon waste oil tank. If both the new and existing dirty oil tanks are assumed full and all combustibles consumed then the loading exceeds the 3 hour rating of the fire barrier.

EXISTING ARRANGEMENT:

I. Protection

All diesel generator fire areas are provided with fire suppression and fire detection for the basement and ground floor elevations. The top floor has no detection or suppression. Redundant safe shutdown raceways protected by a 1 hour fire rated wrap are located in the basement of D-1 and D-3.

II. Combustibles:

The present in-situ combustibles in Fire Area D-3 have an average fire duration of approximately 115 minutes.

When the largest diesel is being maintained a total of 1860 gallons of transient lube oil could be in Fire Area D-3. This

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would result in a total combustible loading of 3 hour and 25 minutes.

In the event that two diesels would be required to undergo maintenance at the same time, the fire severity would be 4 hours and 46 minutes; the probability of this situation arising is considered to be small. Additionally, taking a second diesel generator out of service would be unscheduled and would require technical specification action.

III. Arrangement:

Both dirty oil tanks are located in the east end of the basement of the "C" Diesel Building. Each is independently provided with a diked area designed to contain the entire tank contents with allowance for fire protection water.

The 550 gallon diesel fuel day tank is located at the west end of the ground floor.

JUSTIFICATION:

The oil hazards are properly protected including individual dikes. The dirty oil tanks will not normally contain oil.

The existing dikes will limit the heat release rate and allow the sprinkler system and/or manual fire fighting to gain control of the fire prior to 3 hours.

It is also reasonable to assume that the lube oil in the diesel crankcase would not be involved; and the fire would involve either the dirty oil tanks or the fuel oil day tank.

The dirty oil tanks will normally be empty. It is not considered likely that more than 1860 gallons of dirty oil will be present at any one time. The maximum of 3400 gallons of dirty oil would only result from the simultaneous maintenance of two diesel-generators, and this is not a planned event in the 40 year station life.

The existing fire rated barriers consist of 24" concrete walls. While the walls would be expected to provide at least a 5 hour rating, there are approximately 30 penetrations with only a 3 hour rating. There are no doors, HVAC ducts, etc. requiring rating in these walls.

It is reasonable to conclude, based on the actual hazards, protection in Fire Areas D-1, D-2, D-3 and arrangement of the combustibles, that the existing three hour rated walls are sufficient.

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APPENDIX R DEVIATION REQUEST NO. 11

HVAC PENETRATIONS REACTOR BUILDING FIRE WALLS

DEVIATION REQUEST:

Fire dampers are not required to be installed in the following ventilation duct penetrations in fire rated wall assemblies between affected Fire Zones.

<u>Penetration</u>	<u>Fire Zone/Fire Zone</u>
X-25-3-37	1-3A/1-3B-N
X-25-5-23	1-5B/1-4G
X-25-5-13	1-5B/1-5A-N
X-25-5-15	1-5B/1-5A-N
X-27-4-16	1-4A-S/1-4G
X-27-4-17	1-4A-S/1-4G
X-27-5-29	1-5B/1-5A-S
X-27-5-30	1-5B/1-5A-S
X-28-5-44	1-5A-W/1-5E
X-29-5-25	1-5A-W/1-5E
X-30-5-4	2-5B/2-5A-N
X-30-5-5	2-5B/2-5A-N
X-30-5-32	2-5B/2-4G
X-30-5-50	2-5B/2-5A-N
X-32-4-3	2-4A-S/2-4G
X-32-4-4	2-4A-S/2-4G
X-32-5-41	2-5B/2-5A-S
X-33-5-26	2-5A-W/2-5E
X-33-5-27	2-5A-W/2-5E

FIRE AREAS/ZONES AFFECTED:

This deviation request concerns Fire Areas in the Unit 1 and Unit 2 Reactor Buildings.

REASON FOR DEVIATION REQUEST:

NRC guidance to 10 CFR 50, Appendix R, Section III.G.2 requires that fire areas shall have three hour barriers, and such barriers shall have fire rated dampers installed at duct penetrations. Various fire walls within the Unit 1 and Unit 2 Reactor Building have ventilation system (HVAC) duct penetrations without fire dampers thus rendering the rating of the barrier less than three hours.

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EXISTING ARRANGEMENT:

A description of the wall assemblies penetrated by ventilation ducts is provided in Table DR11-1.

See attached sheets of Drawing C-205789 for details. Attached Drawing A-205790, Sht. 1, provides the legend for understanding these drawings.

JUSTIFICATION:

The NFPA 90A-1985, Section 3-3.2.1.1 states: "Approved fire dampers shall be provided where ducts or air grills penetrate partitions required to have a fire resistance rating of 2 hours or more." The maximum average combustible loading for any Fire Zone in the Reactor Buildings is limited to 1-1/2 hours. This is based on a conservative estimate of in-situ combustibles and an allowance of 15 minutes for transient combustibles. The specific combustible configurations and potential for transient combustibles were evaluated for each duct penetration. It was concluded that the exposure to these fire barriers due to concentrated combustibles in proximity to the barriers in no case presently exceed one hour. Therefore, the subject duct assemblies do not require fire dampers per Section 3-3.2.1.1 of NFPA 90A.

Attached Drawing C-205789 documents the actual combustible configuration surrounding each HVAC duct assembly and wall penetration in the affected Fire Zones. Cables in cable trays are the primary source of combustible materials contributing to the postulated fire in each Fire Zone.

Transient and specific in-situ combustibles were examined in each affected Fire Zone and are presently calculated to provide average combustible loadings of less than 1-1/2 hours. Additionally, no localized concentration of combustibles was found which exceeded one hour. All of the subject duct assemblies are well above their respective flood elevations. Heat generated from transient combustibles was not found to be of a magnitude which would negatively affect duct assemblies. In-situ combustibles in these areas were found to be either of a low magnitude or located in Fire Zones that have an automatic suppression system which would mitigate the heat generated as a result of a fire.

An analysis was performed by PP&L which examined the effect of the worst case combustible configuration on an HVAC duct assembly. This case is found in Fire Zone 1-3B-N. The analysis postulated that the combustibles concentrated in the vicinity of the duct assembly were consumed and that the area was enclosed to

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create a localized furnace. With these postulated conditions, the maximum temperature which could be developed in this furnace area was calculated to be 216°F. The analysis continued by examining the heat transfer effect between the 216°F duct assembly and the cooler supply air being transmitted through the duct and discharging into adjacent Fire Zone 1-3A. The maximum air discharge temperature into Fire Zone 1-3A was calculated to be 146°F.

The results of the analysis lead to the following conclusions:

- o . Since the maximum temperature on the fire side of the fire barrier is 216°F, the non-fire side of the fire barrier will remain below the ambient temperature plus a 250°F temperature rise, which is the fire barrier acceptance test criteria.
- o . Since the HVAC duct temperatures remain below 160°F, a fire damper operated by a 160°F or higher fusible link would not operate. All dampers at Susquehanna have fusible links with a 160°F actuation temperature or higher.
- o . Since automatic sprinklers in the Reactor Buildings are rated at 212°F minimum, the increased room temperature resulting from an air inlet temperature of 145°F will not result in sprinkler system activation. (The analysis calculated the final room temperature of Fire Zone 1-3A to be 105°F.)

Since the configuration in Fire Zone 1-3B-N with respect to concentrated combustibles in the vicinity of the duct assembly represents the worst case, it can be concluded that the 216°F calculated furnace temperature represents the worst case situation covered by this deviation request. Automatic sprinkler protection where provided will reduce this maximum temperature. Equipment and cables in the adjacent affected Fire Zone will not be damaged unless, in the event of a fire in an unsprinklered Fire Zone, sufficient heated air can be transferred via the HVAC duct. Air will not be transferred if the HVAC system is not operating, nor is it possible for hot air to be released from a return air duct. Therefore, only cases where a supply duct in an unsprinklered area transferring heated air to an adjacent Fire Zone need to be considered. This limits consideration to only three Fire Zones: 1-3B-N, 1-5A-W and 2-4A-S.

As discussed previously, the analysis of a fire in Fire Zone 1-3B-N demonstrates that the adjacent zone (1-3A) is not affected. The combustible concentration in Fire Zones 1-5A-W and 2-4A-S is significantly less than in Fire Zone 1-3B-N and the corresponding adjacent zones (1-5E and 2-4G, respectively) are

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sprinklered. Therefore, based on the analysis for Fire Zone 1-3B-N, it can be concluded that there would be no equipment or cable failures in either Fire Zone 1-5E or 2-4G due to a fire in respective Fire Zones 1-5A-W or 2-4A-S.

Furthermore, a fact-finding report on air duct penetrations through a one-hour fire resistive wall assembly was conducted by Underwriters Laboratories, Inc. (see Attachment #1). This report describes the performance of HVAC duct penetrations through a one-hour rated fire resistive wall assembly when the wall assembly was subjected to a fire test conducted in accordance with the requirements of the Standard for Fire Tests of Building Construction Materials, UL 263 (ASTM E119).

The air duct assemblies which penetrated the wall assembly consisted of two square 10 inch by 10 inch inside dimension galvanized steel ducts and one square 10 inch by 10 inch inside dimension Class I rigid fiberglass duct. All the air duct assemblies had open duct drops on both sides of the wall assembly. None of the air duct assemblies contained fire dampers. The fire resistive wall assembly consisted of 5/8 inch thick gypsum wallboard screw attached to steel studs which were spaced 24 inches on center.

The fire performance included temperatures measured and recorded at various locations within, on the top surface of, to the side of and above the air duct assemblies, the structural integrity of the air duct assemblies, the passage of flames through the air duct assemblies, and the passage of flames through the wall assembly. In the test, the galvanized steel duct assembly was 0.022 inch thick (Susquehanna SES minimum thickness is 0.048 inch), and it was exposed to flames of controlled extent and severity in accordance with the Standard Time-Temperature Curve. In the test, all of the duct assemblies were in the positive pressure area of the furnace which would have aided flame propagation through the ducts to the non-fire side of the wall.

The test results showed that the galvanized steel ducts were intact and remained in place with no degradation of the duct assembly. This test confirms the validity of NFPA 90A, Section 3-3.2.2.1.1. It should be noted that all ducting subject to this deviation request is constructed of galvanized steel. Therefore, this test also gives substance to our deviation request in that the ducts in the test experienced a maximum furnace temperature of approximately 1700°F with no degradation whereas the duct in our analyzed worst case combustible configuration has been calculated to experience a maximum furnace temperature of approximately 216°F.

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The NFPA "Fire Protection Handbook" (14th edition, Pages 7-69) states: "In the gauges commonly used, some sheet 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 fire resistance can be assumed to present no extraordinary hazard. If the wall, partition, ceiling, or floor is required to have a fire resistance rating of more than one hour, a fire damper is required . . . "

The analysis of the worst case combustible configuration covered by this deviation request shows significantly lower postulated fire temperatures than those associated with the one-hour fire referred to in the NFPA handbook. Also, the minimum 18-gauge (0.048 inch thick) sheet metal ducts used at Susquehanna (Ref: Drawing C-1126) are heavier than the commonly used gauges referred to by the NFPA statement. The ducts are seismically hung (Ref: Drawing C-1129 through C-1136) and adequately fire stopped. (Ref: Respective penetration drawing for each listed duct penetration on Drawing C-205789, all sheets.)

Therefore, it is our position that these ducts adequately mitigate the effects of a fire and do not require fire dampers. Furthermore, this Deviation Request will remain valid for these HVAC duct penetrations as long as the sprinklered areas remain sprinklered and as long as combustible configuration changes in non-sprinklered areas do not cause:

- a) Calculated maximum fire barrier exposure temperatures during a fire to exceed 1700°F (the maximum Standard Time-Temperature Curve value for a one-hour fire test), and/or
- b) Calculated temperatures in adjacent sprinklered fire areas to reach a level at which automatic sprinkler systems would be activated.

The following descriptions and drawings (C-205789, all sheets, and A-205790, Sht. 1) provide the basis for our position and address each horizontal ventilation duct penetration on an individual case-by-case basis. Through this case-by-case approach, each duct penetration is shown in its actual combustible configuration in the plant. Parameters such as nearby combustibles, direction of duct air flow, location of duct openings, sprinkler protection, HVAC system and general duct and Fire Zone configuration have been examined to clarify and specifically document the rationale used for this deviation request.

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SUSQUEHANNA STEAM ELECTRIC STATION

UNITS 1 & 2

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SUMMARY TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
1.0	Introduction
1.1	Objective
1.2	Background
1.3	Philosophy
1.4	Fire Protection Program
1.5	Content and Format
2.0	Definitions
3.0	Safe Shutdown Analysis
3.1	Introduction
3.2	Criteria
3.3	Methodology
3.4	Long Term Compliance
4.0	Fire Protection System Description
4.1	Fire Protection Water Supply System
4.2	Automatic Wet Pipe Sprinkler Systems
4.3	Dry Pipe Sprinkler Systems
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4.9	Halon Extinguishing Systems
4.10	Insulation and Jacketing of Cable
4.11	Raceway Wrapping
4.12	Fire Detection System
5.0	Comparison of Susquehanna SES Design and Fire Protection Features to Regulatory Requirements
6.0	Fire Hazards Analysis by Plant Area
6.1	Introduction
6.2	Fire Area Descriptions

7.0

Deviations

7.1

Introduction

7.2

Deviation Request Index

Individual Deviations

8.0

Drawings

APPENDIX R DEVIATION REQUEST NO. 7

FIRE SPREAD LIMITATIONS

DEVIATION REQUEST:

It may be assumed in the case of non-rated fire zone boundaries that fire spread will occur only into the next most immediate fire zone (horizontally and vertically), and that damage beyond the adjacent fire zone through a second non-rated fire zone boundary need not be considered.

FIRE AREAS/ZONES AFFECTED:

This assumption was used generally throughout the fire barrier analysis.

REASON FOR DEVIATION REQUEST:

As described in the methodology section of our response to the NRC on Concern No. 1, the fire spread limitation criteria delineated by this request was applied as follows:

- o Each individual fire zone (primary fire zone) was examined relative to all adjacent fire zones for the availability of a common safe shutdown path. An adjacent fire zone is defined as any fire zone which has a physical point of contact with the primary fire zone.
- o If a common safe shutdown path is available in the primary fire zone and all adjacent fire zones, then the inherent assumption of the fire spread limitation criteria outlined above assures us that, for a fire starting in this primary fire zone, a safe shutdown path is available.
- o If a common safe shutdown path is not available, fire rated barriers are required between the primary fire zone and any conflicting adjacent fire zone. This condition similarly assures us that, for a fire starting in the primary fire zone, a safe shutdown path is available.

The acceptability of this methodology, allows the use of the buffer zone concept. The buffer zone takes two forms:

- (1) The spent fuel pool has been utilized as a buffer zone. In spite of the walls of the pool not being rated fire barriers, the thickness of the walls and volume of water contained in the pool preclude propagation of a fire.

SSES-FPRR

- (2) The buffer zone concept acts as a spatial barrier between two adjacent fire areas. Using the fire spread limitations, and by assuring multiple paths within two or more adjacent fire zone (referred to as buffer zones), adequate separation between fire areas with different safe shutdown paths is provided without fire walls. This concept is best described by the example below:

FIRE ZONE A (1)	FIRE ZONE B (1) (2)	FIRE ZONE C (1) (2)	FIRE ZONE D (2)
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- o Fire Zone A and Fire Zone D have different available shutdown paths, and are in different adjacent Fire Areas.
- o Fire Zone B and C both have available shutdown paths which are common to each other and Fire Zones A and D.
- o Using the assumption that a fire will spread to the next adjacent zone the following scenarios are possible:

<u>FIRE ORIGIN</u>	<u>FIRE INVOLVES FIRE ZONE</u>	<u>PATH USED FOR SHUTDOWN</u>
FIRE ZONE A	A, B	(1)
FIRE ZONE B	A, B, C	(1)
FIRE ZONE C	B, C, D	(2)
FIRE ZONE D	C, D	(2)

- o A successful shutdown path is demonstrated in each case.
- o Those fire zones which satisfies the criteria described above and are physically located at a point where they separate two fire areas were labeled as Buffer fire zones.

This concept is utilized at higher levels in the reactor building where there is a minimal amount of safety related equipment. Utilizing this concept minimizes the number of fire rated boundaries by precluding the need for a rated barrier between adjacent zones.

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APPENDIX R DEVIATION REQUEST NO. 8

ONE HOUR FIRE BARRIER WRAP WITH LIMITED SUPPRESSION

DEVIATION REQUEST:

The installation of a three hour fire barrier wrap in Fire Zones 0-28B-I, 0-28B-II, 1-2D and 0-28H without automatic suppression in order to comply with 10 CFR 50 Appendix R, Section III.G.2.a would not significantly enhance the fire protection for those fire zones nor overall plant safety, and therefore a one hour fire barrier is acceptable.

FIRE AREAS/ZONES AFFECTED:

This deviation request applies to Fire Areas CS-17 (Fire Zone 0-28B-I), CS-24 (Fire Zone 0-28B-II), R-1B (Fire Zone 1-2D) and CS-15 (Fire Zone 0-28H).

REASON FOR DEVIATION REQUEST:

10 CFR 50 Appendix R, Section III.G.2.a requires that redundant safe shutdown equipment/cables be separated by a fire barrier having a 3-hour rating when automatic suppression is not provided.

The redundant safe shutdown equipment/cables are separated by a fire barrier having a 1-hour rating and no automatic suppression is provided.

EXISTING ARRANGEMENT:

Fire Zones 0-28B-I and 0-28B-II contain safety related load centers and miscellaneous battery chargers and distribution panels. Two-hour rated barrier walls separate equipment by division and all cabling in these zones is enclosed in conduit. The combustible loadings for these fire zones are low. Manual suppression equipment and ionization detectors are provided in these fire zones.

Fire Zone 1-2D consists of one room (approximately 14' X 25') housing various control cables and Unit 1's remote shutdown panel. Approximately 75% of the cabling in the fire zone is contained in conduit. The minority division raceways located on the fire zone consist of control cable for the Emergency Service Water System. The combustible loading for the fire zone is low. Manual suppression equipment and ionization smoke detectors are provided in the fire zone.

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Fire Zone 0-28H consists of one room (approximately 20' x 50') housing various cables in conduit and the cold instrument repair facility. The minority division raceways are located above a non-rated false ceiling and are run in conduit. The combustible loading for the fire zone is low. Manual suppression and ionization detectors are provided for the fire zone.

JUSTIFICATION:

When the combustible loading and reasonable transient combustibles are considered, fire detection, manual fire suppression, and one-hour rated cable enclosures without automatic suppression provide adequate protection for safe shutdown cables.

NRC APPROVAL:

This deviation request was transmitted to the NRC on February 9, 1982 (PLA-1013). The NRC approved this deviation request in Supplement No. 4 to the Susquehanna SES Safety Evaluation Report.

SSES-FPRR

APPENDIX R DEVIATION REQUEST NO. 9

INSUFFICIENT SPATIAL SEPARATION OF SWITCHGEAR ROOM COOLER FANS

DEVIATION REQUEST:

One division of electrical equipment and raceway for the emergency switchgear cooling equipment is provided with one hour rated fire barrier only when it is located within 9 feet of the redundant division of the emergency switchgear cooling equipment.

FIRE AREAS/ZONES AFFECTED:

This deviation request applies to Fire Zone 2-5A-S which is in Fire Area R-2A and Fire Zone 2-5A-W which is in Fire Area R-2A and R-2B.

REASON FOR DEVIATION REQUEST:

10 CFR 50, Appendix R, Section III.G.2 requires the existence of an automatic fire suppression system and a one hour fire rated barrier wrap for one redundant safe shutdown system located within 20 feet of redundant division equipment.

The Emergency Switchgear Cooling System Division I compressor motor and motor operated valve are located within 9 feet of the Division II compressor motor and motor operated valve. Providing a one hour wrap for the motors is not possible, as wrapping would negate its qualification.

EXISTING ARRANGEMENT:

The Emergency Switchgear Cooling System equipment are located in Fire Zones 2-5A-S and 2-5A-W. Specifically the equipment is located on a mezzanine above Fire Zones 2-5G and 2-5H and 15 feet above the floor elevation. The switchgear cooling equipment is the only equipment located on the mezzanine. The mezzanine can only be accessed via a vertical ladder.

The area around the switchgear cooling equipment is protected by automatic sprinklers and automatic detection. Also a one hour fire rated barrier wrap for Division raceways located within 20 feet of redundant Division electrical equipment except for the specific equipment for which this deviation is being requested.

JUSTIFICATION:

The area around the switchgear cooling equipment is provided with automatic sprinkler protections and automatic detection. The area around the equipment has low in-situ combustibles. The equipment is located 15 feet vertically and 8 feet horizontally from any transient combustibles. Also it is highly unlikely that transient combustibles would be brought to the mezzanine since the only access is a vertical ladder.

NRC APPROVAL:

This deviation request was sent to the NRC on December 13, 1983 in PLA-1985. NRC approval was received in Supplement No. 6 to the Susquehanna SES Safety Evaluation Report.

APPENDIX R DEVIATION REQUEST NO. 10

FIRE AREA D-3 BOUNDARIES

DEVIATION REQUEST:

The three hour rated fire walls for Fire Area D-3 are adequate based on the fire protection, the dikes provided for dirty oil tanks, and the low probability that the maximum, potential combustibles will be involved in a single fire.

FIRE AREAS/ZONES AFFECTED:

This deviation affects Fire Area D-3 (Fire Zone 0-41C). The adjacent Fire Areas are D-1 (Fire Zone 0-41A) and D-2 (Fire Zone 0-41B).

REASON FOR DEVIATION REQUEST:

NRC guidance to 10 CFR 50 Appendix R requires that fire area boundaries should be rated for 3 hours or the rating should be based on the combustible loading, and all combustibles shall be considered consumed. A modification to the "C" Diesel Generator Bay has added a 2200 gallon waste oil tank. If both the new and existing dirty oil tanks are assumed full and all combustibles consumed then the loading exceeds the 3 hour rating of the fire barrier.

EXISTING ARRANGEMENT:

I. Protection

All diesel generator fire areas are provided with fire suppression and fire detection for the basement and ground floor elevations. The top floor has no detection or suppression. Redundant safe shutdown raceways protected by a 1 hour fire rated wrap are located in the basement of D-1 and D-3.

II. Combustibles:

The present in-situ combustibles in Fire Area D-3 have an average fire duration of approximately 115 minutes.

When the largest diesel is being maintained a total of 1860 gallons of transient lube oil could be in Fire Area D-3. This

SSES-FPRR

would result in a total combustible loading of 3 hour and 25 minutes.

In the event that two diesels would be required to undergo maintenance at the same time, the fire severity would be 4 hours and 46 minutes; the probability of this situation arising is considered to be small. Additionally, taking a second diesel generator out of service would be unscheduled and would require technical specification action.

III. Arrangement:

Both dirty oil tanks are located in the east end of the basement of the "C" Diesel Building. Each is independently provided with a diked area designed to contain the entire tank contents with allowance for fire protection water.

The 550 gallon diesel fuel day tank is located at the west end of the ground floor.

JUSTIFICATION:

The oil hazards are properly protected including individual dikes. The dirty oil tanks will not normally contain oil.

The existing dikes will limit the heat release rate and allow the sprinkler system and/or manual fire fighting to gain control of the fire prior to 3 hours.

It is also reasonable to assume that the lube oil in the diesel crankcase would not be involved; and the fire would involve either the dirty oil tanks or the fuel oil day tank.

The dirty oil tanks will normally be empty. It is not considered likely that more than 1860 gallons of dirty oil will be present at any one time. The maximum of 3400 gallons of dirty oil would only result from the simultaneous maintenance of two diesel-generators, and this is not a planned event in the 40 year station life.

The existing fire rated barriers consist of 24" concrete walls. While the walls would be expected to provide at least a 5 hour rating, there are approximately 30 penetrations with only a 3 hour rating. There are no doors, HVAC ducts, etc. requiring rating in these walls.

It is reasonable to conclude, based on the actual hazards, protection in Fire Areas D-1, D-2, D-3 and arrangement of the combustibles, that the existing three hour rated walls are sufficient.

SSSES-FPRR

APPENDIX R DEVIATION REQUEST NO. 11

HVAC PENETRATIONS REACTOR BUILDING FIRE WALLS

DEVIATION REQUEST:

Fire dampers are not required to be installed in the following ventilation duct penetrations in fire rated wall assemblies between affected Fire Zones.

<u>Penetration</u>	<u>Fire Zone/Fire Zone</u>
X-25-3-37	1-3A/1-3B-N
X-25-5-23	1-5B/1-4G
X-25-5-13	1-5B/1-5A-N
X-25-5-15	1-5B/1-5A-N
X-27-4-16	1-4A-S/1-4G
X-27-4-17	1-4A-S/1-4G
X-27-5-29	1-5B/1-5A-S
X-27-5-30	1-5B/1-5A-S
X-28-5-44	1-5A-W/1-5E
X-29-5-25	1-5A-W/1-5E
X-30-5-4	2-5B/2-5A-N
X-30-5-5	2-5B/2-5A-N
X-30-5-32	2-5B/2-4G
X-30-5-50	2-5B/2-5A-N
X-32-4-3	2-4A-S/2-4G
X-32-4-4	2-4A-S/2-4G
X-32-5-41	2-5B/2-5A-S
X-33-5-26	2-5A-W/2-5E
X-33-5-27	2-5A-W/2-5E

FIRE AREAS/ZONES AFFECTED:

This deviation request concerns Fire Areas in the Unit 1 and Unit 2 Reactor Buildings.

REASON FOR DEVIATION REQUEST:

NRC guidance to 10 CFR 50, Appendix R, Section III.G.2 requires that fire areas shall have three hour barriers, and such barriers shall have fire rated dampers installed at duct penetrations. Various fire walls within the Unit 1 and Unit 2 Reactor Building have ventilation system (HVAC) duct penetrations without fire dampers thus rendering the rating of the barrier less than three hours.

SSES-FPRR

EXISTING ARRANGEMENT:

A description of the wall assemblies penetrated by ventilation ducts is provided in Table DR11-1.

See attached sheets of Drawing C-205789 for details. Attached Drawing A-205790, Sht. 1, provides the legend for understanding these drawings.

JUSTIFICATION:

The NFPA 90A-1985, Section 3-3.2.1.1 states: "Approved fire dampers shall be provided where ducts or air grills penetrate partitions required to have a fire resistance rating of 2 hours or more." The maximum average combustible loading for any Fire Zone in the Reactor Buildings is limited to 1-1/2 hours. This is based on a conservative estimate of in-situ combustibles and an allowance of 15 minutes for transient combustibles. The specific combustible configurations and potential for transient combustibles were evaluated for each duct penetration. It was concluded that the exposure to these fire barriers due to concentrated combustibles in proximity to the barriers in no case presently exceed one hour. Therefore, the subject duct assemblies do not require fire dampers per Section 3-3.2.1.1 of NFPA 90A.

Attached Drawing C-205789 documents the actual combustible configuration surrounding each HVAC duct assembly and wall penetration in the affected Fire Zones. Cables in cable trays are the primary source of combustible materials contributing to the postulated fire in each Fire Zone.

Transient and specific in-situ combustibles were examined in each affected Fire Zone and are presently calculated to provide average combustible loadings of less than 1-1/2 hours. Additionally, no localized concentration of combustibles was found which exceeded one hour. All of the subject duct assemblies are well above their respective flood elevations. Heat generated from transient combustibles was not found to be of a magnitude which would negatively affect duct assemblies. In-situ combustibles in these areas were found to be either of a low magnitude or located in Fire Zones that have an automatic suppression system which would mitigate the heat generated as a result of a fire.

An analysis was performed by PP&L which examined the effect of the worst case combustible configuration on an HVAC duct assembly. This case is found in Fire Zone 1-3B-N. The analysis postulated that the combustibles concentrated in the vicinity of the duct assembly were consumed and that the area was enclosed to

SSES-FPRR

create a localized furnace. With these postulated conditions, the maximum temperature which could be developed in this furnace area was calculated to be 216°F. The analysis continued by examining the heat transfer effect between the 216°F duct assembly and the cooler supply air being transmitted through the duct and discharging into adjacent Fire Zone 1-3A. The maximum air discharge temperature into Fire Zone 1-3A was calculated to be 146°F.

The results of the analysis lead to the following conclusions:

- o . Since the maximum temperature on the fire side of the fire barrier is 216°F, the non-fire side of the fire barrier will remain below the ambient temperature plus a 250°F temperature rise, which is the fire barrier acceptance test criteria.
- o . Since the HVAC duct temperatures remain below 160°F, a fire damper operated by a 160°F or higher fusible link would not operate. All dampers at Susquehanna have fusible links with a 160°F actuation temperature or higher.
- o . Since automatic sprinklers in the Reactor Buildings are rated at 212°F minimum, the increased room temperature resulting from an air inlet temperature of 145°F will not result in sprinkler system activation. (The analysis calculated the final room temperature of Fire Zone 1-3A to be 105°F.)

Since the configuration in Fire Zone 1-3B-N with respect to concentrated combustibles in the vicinity of the duct assembly represents the worst case, it can be concluded that the 216°F calculated furnace temperature represents the worst case situation covered by this deviation request. Automatic sprinkler protection where provided will reduce this maximum temperature. Equipment and cables in the adjacent affected Fire Zone will not be damaged unless, in the event of a fire in an unsprinklered Fire Zone, sufficient heated air can be transferred via the HVAC duct. Air will not be transferred if the HVAC system is not operating, nor is it possible for hot air to be released from a return air duct. Therefore, only cases where a supply duct in an unsprinklered area transferring heated air to an adjacent Fire Zone need to be considered. This limits consideration to only three Fire Zones: 1-3B-N, 1-5A-W and 2-4A-S.

As discussed previously, the analysis of a fire in Fire Zone 1-3B-N demonstrates that the adjacent zone (1-3A) is not affected. The combustible concentration in Fire Zones 1-5A-W and 2-4A-S is significantly less than in Fire Zone 1-3B-N and the corresponding adjacent zones (1-5E and 2-4G, respectively) are

SSES-FPRR

sprinklered. Therefore, based on the analysis for Fire Zone 1-3B-N, it can be concluded that there would be no equipment or cable failures in either Fire Zone 1-5E or 2-4G due to a fire in respective Fire Zones 1-5A-W or 2-4A-S.

Furthermore, a fact-finding report on air duct penetrations through a one-hour fire resistive wall assembly was conducted by Underwriters Laboratories, Inc. (see Attachment #1). This report describes the performance of HVAC duct penetrations through a one-hour rated fire resistive wall assembly when the wall assembly was subjected to a fire test conducted in accordance with the requirements of the Standard for Fire Tests of Building Construction Materials, UL 263 (ASTM E119).

The air duct assemblies which penetrated the wall assembly consisted of two square 10 inch by 10 inch inside dimension galvanized steel ducts and one square 10 inch by 10 inch inside dimension Class I rigid fiberglass duct. All the air duct assemblies had open duct drops on both sides of the wall assembly. None of the air duct assemblies contained fire dampers. The fire resistive wall assembly consisted of 5/8 inch thick gypsum wallboard screw attached to steel studs which were spaced 24 inches on center.

The fire performance included temperatures measured and recorded at various locations within, on the top surface of, to the side of and above the air duct assemblies, the structural integrity of the air duct assemblies, the passage of flames through the air duct assemblies, and the passage of flames through the wall assembly. In the test, the galvanized steel duct assembly was 0.022 inch thick (Susquehanna SES minimum thickness is 0.048 inch), and it was exposed to flames of controlled extent and severity in accordance with the Standard Time-Temperature Curve. In the test, all of the duct assemblies were in the positive pressure area of the furnace which would have aided flame propagation through the ducts to the non-fire side of the wall.

The test results showed that the galvanized steel ducts were intact and remained in place with no degradation of the duct assembly. This test confirms the validity of NFPA 90A, Section 3-3.2.2.1.1. It should be noted that all ducting subject to this deviation request is constructed of galvanized steel. Therefore, this test also gives substance to our deviation request in that the ducts in the test experienced a maximum furnace temperature of approximately 1700°F with no degradation whereas the duct in our analyzed worst case combustible configuration has been calculated to experience a maximum furnace temperature of approximately 216°F.

SSES-FPRR

The NFPA "Fire Protection Handbook" (14th edition, Pages 7-69) states: "In the gauges commonly used, some sheet 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 fire resistance can be assumed to present no extraordinary hazard. If the wall, partition, ceiling, or floor is required to have a fire resistance rating of more than one hour, a fire damper is required . . . "

The analysis of the worst case combustibile configuration covered by this deviation request shows significantly lower postulated fire temperatures than those associated with the one-hour fire referred to in the NFPA handbook. Also, the minimum 18-gauge (0.048 inch thick) sheet metal ducts used at Susquehanna (Ref: Drawing C-1126) are heavier than the commonly used gauges referred to by the NFPA statement. The ducts are seismically hung (Ref: Drawing C-1129 through C-1136) and adequately fire stopped. (Ref: Respective penetration drawing for each listed duct penetration on Drawing C-205789, all sheets.)

Therefore, it is our position that these ducts adequately mitigate the effects of a fire and do not require fire dampers. Furthermore, this Deviation Request will remain valid for these HVAC duct penetrations as long as the sprinklered areas remain sprinklered and as long as combustibile configuration changes in non-sprinklered areas do not cause:

- a) Calculated maximum fire barrier exposure temperatures during a fire to exceed 1700°F (the maximum Standard Time-Temperature Curve value for a one-hour fire test), and/or
- b) Calculated temperatures in adjacent sprinklered fire areas to reach a level at which automatic sprinkler systems would be activated.

The following descriptions and drawings (C-205789, all sheets, and A-205790, Sht. 1) provide the basis for our position and address each horizontal ventilation duct penetration on an individual case-by-case basis. Through this case-by-case approach, each duct penetration is shown in its actual combustibile configuration in the plant. Parameters such as nearby combustibles, direction of duct air flow, location of duct openings, sprinkler protection, HVAC system and general duct and Fire Zone configuration have been examined to clarify and specifically document the rationale used for this deviation request.

SSES-FPRR

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