ACCELERATED DOCUMENT DISTRIBUTION SYSTEM

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9306280294 DOC.DATE: 93/06/21 NOTARIZED: NO DOCKET #
FACIL:50-387 Susquehanna Steam Electric Station, Unit 1, Pennsylva 05000387
50-388 Susquehanna Steam Electric Station, Unit 2, Pennsylva 05000388
AUTH.NAME AUTHOR AFFILIATION
BYRAM,R.G. Pennsylvania Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
MILLER,C.L. Project Directorate I-2

SUBJECT: Forwards request for deviation from App R,Sections III G,J & L re demonstration of ability to achieve & maintain stable shutdown conditions in event of control room fire,per NRC Info Notice 93-018.Affected valve circuits rewired.

DISTRIBUTION CODE: A006D COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 13
TITLE: OR/Licensing Submittal: Fire Protection

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD1-2 LA	1	0	PD1-2 PD	1	1
	CLARK,R	2	2			
INTERNAL:	ACRS	3	3	NRR/DSSA/SPLB	1	1
	NUDOCS-ABSTRACT	1	1	OC/LEDCB	1	0
	OGC/HDS2	1	0	REG FILE 01	1	1
EXTERNAL:	NRC PDR	1	1	NSIC	1	1

NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK, ROOM P1-37 (EXT. 504-2065) TO ELIMINATE YOUR NAME FROM DISTRIBUTION LISTS FOR DOCUMENTS YOU DON'T NEED!

TOTAL NUMBER OF COPIES REQUIRED: LTTR 14 ENCL 11

RIDS/ADDS

RIDS/ADDS

RIDS/ADDS

mAf

PP&L Pennsylvania Power & Light Company
Two North Ninth Street • Allentown, PA 18101-1179 • 215/774-5151

Robert G. Byram
Senior Vice President-Nuclear
215/774-7502

JUN 21 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
PROPOSED DEVIATION FROM APPENDIX R
MOV-HOT SHORT ISSUE (NRC IN 92-18) **Docket Nos. 50-387**
PLA-3980 FILES A17-15/A18-15/A20-3 **and 50-388**

Dear Mr. Miller:

Attached is a request for deviation from the requirements of Appendix R, Sections III G, J, and L with respect to demonstration of the ability to achieve and maintain stable shutdown conditions in the event of a control room fire.

The Susquehanna SES Appendix R design basis assumed for a control room fire, the fire damages all circuits located in the control room and evacuation is necessary. It also assumed that all required safe shutdown systems would operate when operations personnel reached the remote shutdown panel to isolate those systems electrically from the control room.

On November 20, 1991, we determined through a review of industry events and a subsequent examination of the Susquehanna SES design that a postulated fire in the control room could place the plant in a condition outside of its analyzed basis. This condition was determined to be reportable under the requirements of 10 CFR 50.73(a)(2)(ii)(B) and LER 91-016-00 was made on December 20, 1991.

The scenario which leads to the postulated condition involves a combination of events. A fire must occur in the control room. That fire must also cause a hot short to occur in a motor operated valve circuit and cause the associated motor operator to spuriously run, or attempt to run, while at the same time bypassing the torque and limit switches (the thermal overload relay on the subject valve would also be bypassed per R.G. 1.106). Under this scenario, until the control room circuitry with the hot short is isolated by manual operation of the transfer switches at the remote shutdown panel the affected motor could start and continue to run/stall with the associated valve in the open/close position with the potential to damage the motor and the valve (Reference NRC IN 92-18). While the scenario postulated has the potential to occur, we consider

A006
1/1

the scenario a highly unlikely event. The expectation is based on the nature and quantity of the in-situ combustibles located in the control room (primarily cable insulation on IEEE 383 qualified cables), the presence of detection, the presence of 24-hour manning by trained personnel, rigid control of transient combustibles, and the high likelihood of suppression.

The modifications needed to prevent this condition would require the rewiring of affected valve circuits such that the limit and torque switches are placed downstream of the control room and remote shutdown panel and upstream of the motor starting coil. The rewiring requires internal wiring changes at some valves and their associated motor control center cubicles and the running of new cable and raceway to a significant number of valves. These modifications, while they would not eliminate the potential occurrence of a hot short circuit nor the spurious operation of the MOVs, would eliminate the potential for damage to the valve operator under the Appendix R scenario such that the MOVs would remain operable upon transfer/isolation from the control room circuitry, assuring safe shutdown capability in accordance with the shutdown paths defined in the Susquehanna SES Fire Protection Review Report.

Our evaluation has determined that prescriptive compliance with the interpretation of Appendix R presents a regulatory burden that can be relaxed without an adverse impact upon safety. Specifically, the ability to achieve and maintain safe shutdown in the event of a fire can be reasonably assumed without the performance of modifications. As the cost of performing modifications is estimated to exceed seven million dollars and there is minimum benefit to safety, we request approval of the deviation requested.

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

Very truly yours,

R. G. Byram

Attachment

cc: NRC Document Control Desk (original)
NRC Region I
Mr. G. S. Barber, NRC Sr. Resident Inspector-SSES
Mr. R. J. Clark, NRC Sr. Project Manager-OWFN

APPENDIX R DEVIATION REQUEST NO. 41

CONTROL STRUCTURE
FIRE AREA CS-9
MOV-HOT SHORT ISSUE (NRC IN 92-18)

DEVIATION REQUEST:

10CFR50, Appendix R Sections III G and L requires demonstration of the ability to achieve and maintain stable shutdown conditions in the event of a fire in the control room. The Susquehanna SES Appendix R design basis assumed that a control room fire damages all circuits located in the control room and evacuation is necessary. It also assumed that all required safe shutdown systems would operate when operations personnel reached the remote shutdown panel to isolate those systems electrically from the control room. However, the motor operated valves listed in Tables 1 and 2 of this deviation request have been found to be vulnerable to a fire induced hot short which bypasses their torque and limit switches, potentially rendering the valves inoperable with respect to controlling them from the remote shutdown panel.

We request approval to deviate from the requirements of Appendix R in that the Susquehanna SES fire protection features and shutdown capabilities are adequate to mitigate the effects of a fire in the main control room. Protection against fire induced hot shorts for those valves listed in Tables 1 and 2 provides a level of safety equivalent to that intended by the requirements of Appendix R, Sections III.G, J, and L.

FIRE AREA/FIRE ZONES AFFECTED:

This deviation request applies to Fire Area CS-9, which includes Fire Zones 0-26A, 0-26E, 0-26F, 0-26G, 0-26H, 0-26I, 0-26J, 0-26K, 0-26L, 0-26M, 0-26N, 0-26P, and 0-26R.

REASONS FOR THE DEVIATION REQUEST:

10CFR50, Appendix R, Sections III G and L, requires demonstration of the ability to achieve and maintain stable shutdown conditions in the event of a fire in the control room. Specifically, Section III.L.7 requires: "The safe shutdown equipment and systems for each fire area shall be known to be isolated from associated non-safety circuits in the fire area so that hot shorts, open circuits, or shorts to ground will not prevent operation of the safe shutdown equipment."

Contrary to the above, each of the motor operated valves listed in Table 1 and 2 have been found to be vulnerable to a fire induced hot short that could cause the associated motor operator to spuriously run, or attempt to run, while at the same time bypassing the torque and limit switches. If this were to occur, the valve's motor operator could actuate until thermal overload occurred which would render the valve inoperable from the remote shutdown panel. Additionally, the high stall thrust forces generated could damage the valve in such a manner as to hinder subsequent manual operation should that be required.

EXISTING CONDITIONS:

In general, analysis to support compliance with Appendix R requirements for Susquehanna SES has conservatively used a deterministic approach. Under that approach it is assumed that a fire will occur regardless of the level of fire protection provided. Additionally, any potential consequences of a fire are assumed to occur and their effect upon the ability to achieve and maintain stable cold shutdown conditions in the event of their occurrence must be considered. Deviations have been taken from this approach and have been documented and approved by the NRC.

Based on using the deterministic approach, for an "Appendix R" fire in the Susquehanna SES Control Room (i.e. a fire which results in damage to all circuits in the control room and a control room evacuation), safe shutdown is accomplished from the plant's remote shutdown panels (characterized as Path 2 in the SSES Fire Protection Review Report). The Susquehanna SES Appendix R design basis assumes all safe shutdown systems required to support Path 2 will operate when operations personnel reach the remote shutdown panels and isolate the control room circuitry. However, "hot short" circuit conditions (i.e. a circuit degrades in such a way as to apply power to another circuit where that power is unwanted) have been postulated for various motor operated valve circuits (see Table 1 and 2). These postulated hot short conditions are such that all limit and torque switches could be bypassed (thermal overload relays are normally bypassed per R.G. 1.106). Therefore, if the control room circuitry with the hot short is not isolated by manual operation of the transfer switches at the remote shutdown panel quickly enough, the affected motor could start and continue to run/stall with the associated valve in the open/close position with the potential to damage the motor and the valve.

Fire detection is provided for all portions of the Control Room Fire Area. Manual CO_2 fixed fire suppression is provided in the non-habitable cable chases and underfloor space. Portable fire extinguishers and fire hose stations are provided for manual fire fighting. In addition, the main control room area is required to be occupied at all times by at least six highly trained people. (Relative to fire protection, the unit supervisors are fully qualified brigade leaders while the PCOs attend quarterly training, which includes fire protection, and participate in regularly scheduled fire drills.) Additionally, the control room contains a low amount of combustibles.

JUSTIFICATION:

PP&L recognizes that the use of deterministic analysis for Appendix R has its roots in the fact that in many cases, the occurrence and development of a fire is not generally predictable with a great degree of certainty. However, because of the configuration of the Susquehanna SES Control Room and the fact that the area is equipped with suppression and detection capability, the presence of a low amount of combustibles, and is manned on a 24-hour basis by highly trained individuals, the potential for, frequency of, and severity of fire damage will be greatly reduced from that assumed by the deterministic analysis for the circuits of concern. The logic to support that conclusion follows below.

Potential for the Appendix R Control Room Fire

From a strictly deterministic approach, the control room at Susquehanna SES contains a low quantity of combustibles. Making the Appendix R assumptions that ignition occurs and that fire growth and propagation occur very rapidly results in having to take overly conservative protective actions. Based on a more realistic approach, fire initiation, growth, and propagation are dependent upon the availability of an ignition source, the availability of fuel to ignite, the difficulty associated with igniting the potential fuel, the properties of the fuel with respect to maintaining combustion, and the characteristics of the environment that aids or hinders fire growth.

The principle in situ combustible in the Susquehanna Control Room is cable insulation. These cables are insulated with EPR/Hypalon qualified to the requirements of IEEE 383. Testing conducted at Sandia National Laboratory (NUREG/CR-5546) demonstrated that cabling with EPR/Hypalon insulation did not fail when subjected to 350°C for 45 minutes. Autoignition of this type of cabling was found to occur at approximately 600°C. Transient combustibles are not considered to be a significant threat as they are strictly controlled by administrative procedures under the direction of control room personnel. Therefore, the prevalent fire hazard is considered to be an internal cable fault which has a low potential of inducing a fire by self ignition. The actual hazard is further minimized by the fact that the cable insulation used is non-flame propagating in accordance with the requirements of IEEE 383.

Cabling which has the potential to hot short during a control room fire is located in three locations: 1) in control room cabinets, 2) in the control room underfloor area, and 3) in cable chases. A discussion of each area follows below:

Control Room Cabinets:

Sandia National Laboratory investigated fires in simulated nuclear power plant control room cabinets (NUREG/CR-4527). During this testing, fires were allowed to free burn with no effort to extinguish. Test results indicated that maximum adjacent cabinet peak temperature for all tests was 240°C and it was reached 20 minutes after ignition. The minimum time for an adjacent panel to reach peak temperature was 14 minutes (one test example). In that test the adjacent panel peak temperature was below 80°C. The data for this testing indicated there would be sufficient smoke and other products of combustion to allow early detection (i.e. within 10 minutes of ignition). A layer of heated air formed at the top of test panels which appeared to enhance thermal feedback resulting in increased fire intensity. These cabinets were not top vented.

Control room cabinets at Susquehanna SES are constructed similar to those tested by Sandia National Laboratories. However, the SSES cabinets are top vented which would greatly reduce collection of heated gases at the top of the panel thereby essentially eliminating thermal feedback effects observed in the Sandia testing. Combustible configurations also differ in that the amount of cabling is in all cases less than the tested

configuration and the majority of the cabling is run in flexible conduit. Overall, this results in a significantly lower potential for heat generation and fire propagation with a resultant lower thermal effect potential on uninvolved cables and components.

Sandia testing suggests that although cabling can be damaged in a fire internal to a control room cabinet, that damage will generally occur only as a result of direct flame effects and resulting combustion. The data also suggests that even if adjacent wall temperatures were sufficient to cause cable damage (melting), cabling not in contact with the wall would not be damaged. A visual inspection of the Susquehanna SES control room cabinets did not find cables in contact with metal separating barriers.

While the highest temperatures were reached in the fire involved cabinet, adjacent cabinet temperatures during testing did not exceed 240°C thus precluding fire propagation due to autoignition and heat related cable failure.

To further support the conservative nature of the SSES configuration, the Sandia testing results do not reflect the ability nor effectiveness of fire fighting which would take place in the SSES control room.

Based on the above stated factors, PP&L expects that while a fire could develop internal to a control room cabinet, its likely cause would be an internal cable fault. Because of the nature of the combustibles present (primarily cable insulation), the presence of detection and the likelihood of suppression actions, the fire would be small, of short duration, and of minor consequence. At a minimum, test data and the physical layout of Susquehanna SES cabinets supports that a postulated fire will be limited to directly damaging only one panel section and not a whole panel. The effects on shutdown for such a fire have been analyzed and successful paths to achieve shutdown have been identified.

Underfloor Area and Cable Chases:

Combustibles located in the underfloor area and cable chases are cabling. This cabling has the same properties as that found in the control room cabinets discussed above. Due to the physical configurations, transient combustibles cannot be introduced into these areas.

Both the underfloor area and each control room cable chase are provided with automatic fire detection capability and manual spurt CO_2 suppression. As the control room is manned on a 24-hour basis with detection and suppression capability provided for these areas, it is concluded that fire durations and subsequent damage would be limited.

Additionally, NRC approved SSES Deviation Request No. 37 determined that adequate protection is provided to assure that redundant safe shutdown equipment located in the cable chases and in the underfloor area will remain free of damage in the event of a fire.

Although it may be physically possible (the existence of a combustible pathway) for a fire initiating in the underfloor area to propagate to a control room cabinet, this scenario is highly unlikely due to the presence of the detection and suppression capability and the nature of the combustible material (cable insulation). However, even should a fire propagate to a cabinet, the discussion of the control room cabinets above shows that such a fire would have limited affects.

Other Control Room Fire Related Damage Scenarios:

While cable insulation is the predominant fire threat from a fire loading perspective in the control room, it is possible to assume a fire initiates in one of the offices or the kitchen which are part of the control room fire area. Such a fire would be very limited in nature for several reasons. Combustibles in the control room fire area are controlled by strict administrative guidance. Fire detection and manual fire fighting capability along with 24-hour manning by highly trained personnel assure a quick and effective response to a fire.

While a fire could develop in one of the rooms adjacent to where the control panels, underfloor or cable chases are located, it is unlikely that such a fire would be able to propagate to the cabling of concern in this request because of the way the combustibles are configured (location, amounts and type). Furthermore, any fire postulated is not sufficient to generate thermal effects over a duration which could damage safe shutdown equipment and thereby affect the ability to achieve safe shutdown utilizing Path 2 (i.e. sufficient time to isolate at the remote shutdown panel exists) should evacuation of the control room be necessary due to smoke or other effects.

Conclusions Regarding the Potential for the Appendix R Control Room Fire

While a control room fire can be postulated, our analysis shows a low potential for propagation, particularly with respect to cable insulation, which is the principle contributor to fire loading within the fire area. There is also a low potential for a fire to propagate to the point where it involves anything other than combustibles in proximity to the point of ignition because of the nature of the combustibles and the presence of detection, suppression and 24-hour manning. Consequently, the energy release potential is low. Therefore, the effects of a fire would be limited.

For the hot short conditions being considered to be of concern, those hot shorts must occur in an event which requires control room evacuation and shutdown from the remote shutdown panel (i.e. use of Path 2). Additionally, the hot short(s) must occur prior to manual operation of the transfer switches at the Remote Shutdown Panel. Based on the above, PP&L believes it is unlikely a fire in the Control Room will lead to control room evacuation.

Potential For And Consequences Of A Fire Initiating In A Path 2 Cable

Although there is a potential for a fire initiating in a Path 2 control room cable the probability of this occurring is considered remote. Even if this fire were to occur, it is unlikely it would result in a control room evacuation which would dictate the use of Path 2. Because of the types of cables used at Susquehanna SES, ignition of the insulation is not expected to occur below 600°C.

Consequences Of Fire Damage Should It Occur

As shown above, PP&L believes a control room fire, should it occur, would be limited in its effects, very rapidly controlled, unlikely to lead to a hot short condition, and unlikely to lead to a control room evacuation leading to the use of safe shutdown Path 2 at the Remote Shutdown Panel. Regardless, an engineering study was performed considering the actual control room configuration which analyzed fire scenarios for fires occurring within the various control room panels, cable chases, and the underfloor area. Each scenario examined the effects on redundant equipment and determined an alternate shutdown path. The study showed that while certain Path 2 MOVs whose operability was to be controlled from the Remote Shutdown Panel in the event of a control room evacuation could potentially be damaged, because of the nature and limits of the fire postulated, shutdown could be achieved using other symptom based procedures relying on undamaged equipment. All manual actions to be taken outside of the control room/remote shutdown panel room are supported with either 8-hour emergency lighting or other available battery powered lighting (the latter being the basis for including Appendix R Section III J in this request).

Probabilistic Risk Analysis

To further support our request, PP&L performed a probabilistic risk analysis to determine the effect upon the margin of safety that would result should the modification to the valve circuits in question be performed.

The analysis resulted in four findings:

Analysis Findings:

1) The probability of equipment failure as a result of hot shorts is on the order of random failures.

2) The control room cabinet fires studied in this analysis contribute about $3.2 \times 10^{-5}\%$ to the total core damage frequency for the Susquehanna site.

3) Although modifying the MOV valve circuits to eliminate the potential valve damage from a hot short reduces the core damage frequency from fires by about 25%, this represents an 8 x 10^{-6}% reduction in the total core damage frequency. Therefore, the results and conclusions of the risk analysis demonstrates that the modifications necessary to correct the potential MOV hot short problem provide only a marginal increase to safety as defined by SECY 92-263.

These analysis findings are not sensitive to relaxation of individual assumptions in the study.

CONCLUSION:

There is a potential, because of current circuit designs, for a fire in the control room to cause hot shorts in several motor operated valves required to support shutdown from outside the Susquehanna SES Control Room using Shutdown Path 2. There is a low potential for fire ignition in the control room, particularly with respect to cable insulation, which is the principle combustible found in the control room or from transient combustibles since all activity in the control room is tightly controlled by administrative procedures and shift supervision. There is also a low potential for a fire to propagate to the point where it involves anything other than combustibles in proximity to the points of ignition because of the nature of the combustibles and the presence of detection, suppression and 24-hour manning. Consequently, the energy release potential is low. Therefore, the effects of a fire would be limited. Based on the above, PP&L believes that it is unlikely a fire in the SSES control room will lead to a control room evacuation. We also believe it is even more unlikely that a fire in the control room would cause a hot short in a Path 2 MOV circuit, particularly in the time frame required to produce an inoperable condition in the valve (i.e. the time it takes for the operator to evacuate the control room, travel to the remote shutdown panel, and initiate transfer). Even if damage were to occur to Shutdown Path 2 and a control room evacuation were to occur, a successful shutdown path would remain available. Further, a probabilistic risk assessment performed by PP&L shows that modifying the circuitry in question would not provide a measurable increase in the margin of safety of the plant.

Therefore, we submit that this deviation satisfies the intent of Appendix R in that safe shutdown components important to safety are designed and located to minimize, consistent with other safety requirements, the probability and effects of a fire.

WWW:tah
CS-9

TABLE 1

UNIT 1 MOTOR OPERATED VALVES

VALVE NO.	SYSTEM
HV-143-F023B	RX RECIRC
HV-144-F004	RWCU
HV-01222B	ESW
HV-01224B1	ESW
HV-15766	CAC ISOLATION
HV-15768	CAC ISOLATION
HV-149-F007	RCIC
HV-149-F008	RCIC
HV-149-F010	RCIC
HV-149-F012	RCIC
HV-149-F013	RCIC
FV-149-F019	RCIC
HV-149-F022	RCIC
HV-149-F031	RCIC
HV-150-F045	RCIC
HV-150-F046	RCIC
HV-149-F059	RCIC
HV-149-F060	RCIC
HV-149-F062	RCIC
HV-149-F084	RCIC
HV-15012	RCIC
HV-11210B	RHRSW
HV-11215B	RHRSW
HV-151-F003B	RHR
HV-151-F004B	RHR
HV-151-F006A	RHR
HV-151-F006C	RHR
HV-151-F006B	RHR

UNIT 1 MOTOR OPERATED VALVES (Continued)	
VALVE NO.	**SYSTEM**
HV-151-F006D	RHR
HV-151-F007B	RHR
HV-151-F008	RHR
HV-151-F009	RHR
HV-151-F015B	RHR
HV-151-F016B	RHR
HV-151-F017B	RHR
HV-151-F024B	RHR
HV-151-F028B	RHR
HV-151-F047B	RHR
HV-151-F048B	RHR

TABLE 2

UNIT 2 MOTOR OPERATED VALVES	
VALVE NO.	SYSTEM
HV-243-F023A	RX RECIRC
HV-243-F023B	RX RECIRC
HV-244-F001	RWCU
HV-01222A	ESW
HV-01224A1	ESW
HV-25766	CAC ISOLATION
HV-25768	CAC ISOLATION
HV-249-F007	RCIC
HV-249-F008	RCIC
HV-249-F010	RCIC
FV-249-F012	RCIC
HV-249-F013	RCIC
HV-249-F019	RCIC
HV-249-F022	RCIC
HV-249-F031	RCIC
HV-250-F045	RCIC
HV-250-F046	RCIC
HV-249-F059	RCIC
HV-249-F060	RCIC
HV-249-F062	RCIC
HV-249-F084	RCIC
HV-25012	RCIC
HV-21210A	RHRSW
HV-21215A	RHRSW
HV-251-F003A	RHR
HV-251-F004A	RHR
HV-251-F006A	RHR
HV-251-F006C	RHR
HV-251-F006B	RHR

UNIT 2 MOTOR OPERATED VALVES (Continued)

VALVE NO.	SYSTEM
HV-251-F006D	RHR
HV-251-F007A	RHR
HV-251-F008	RHR
HV-251-F009	RHR
HV-251-F015A	RHR
HV-251-F016A	RHR
HV-251-F017A	RHR
HV-251-F024A	RHR
HV-251-F028A	RHR
HV-251-F047A	RHR
HV-251-F048A	RHR