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SUBJECT: Requests approval for deviations to 10CFR50,App R,Section III.G.2.

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WILLIAM F. CONWAY
EXECUTIVE VICE PRESIDENT
NUCLEAR

161-02241-WFC/RAB/KLMC
August 30, 1989

Docket Nos. 50-528/529/530

Document Control Desk
U. S. Nuclear Regulatory Commission
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Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Request for Deviations to 10 CFR 50, Appendix R,
Section III.G.2
File: 89-056-026

This letter requests approval for deviations to 10 CFR 50, Appendix R, Section III.G.2. Attachment 1 provides the detailed description and justification for the deviations. The no significant hazards consideration is provided in Attachment 2 for your review and approval.

If you have any questions concerning this matter please contact Mr. A. C. Rogers of my staff at (602) 371-4041.

Sincerely,

WFConway/KH

WFC/RAB/KLMC/jle

Attachments

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ATTACHMENT 1

1. A deviation is requested from Section III.G.2 to the extent that it requires fire barriers used for the purpose of redundant circuit separation to provide a cold side temperature of less than 325 degrees F on the safe shutdown cable.

DISCUSSION

Fire Zones 10B, 42B, 42C, 46A, 46B, 46E, 47B and 52D contain Train A associated safe-shutdown raceways protected with the TSI Thermo-Lag fire barrier system. The fire barrier was installed as a 1-hour fire-rated system in accordance with the vendor's specification in effect at the time of installation. The fire test performed to qualify the 1-hour rating did not address intervening steel. Further research by the vendor has identified the need for intervening steel, which penetrates the protective envelope, to be wrapped for 18 inches from the point of contact with the Thermo-Lag envelope. Since the 18-inch criteria did not exist at the time of installation, the additional protection was not provided. An 8-inch criteria was utilized for installation purposes on intervening steel which came in physical contact with the protected raceway. The 8-inch criteria, however, was not applicable to intervening steel which penetrated the protective envelope but did not come in physical contact with the protected raceway or associated supports.

A fire test has been performed to determine the effect of having less than 18-inches of protection on an intervening steel member in contact with the protected raceway. The fire test results were then extrapolated in order to determine the effect of 8-inches protection on the intervening steel member. The resultant temperature at the protected raceway was found to be less than 175 degrees F. Therefore, the 8" of protection as presently installed on intervening steel that penetrates the protective envelope and is in physical contact with the protected raceway, is acceptable for a one-hour rating.

A "worst case" fire test was also conducted to determine the effect of intervening steel that does not contact the protected raceway and is not wrapped with Thermo-Lag. The test demonstrated that a 400 degree F temperature could be maintained on the inside of the protected raceway. A review of accelerated aging tests shows the ability of the cable to maintain its integrity, even if subjected to temperature extremes at or below 400 degrees F over the 40-year life of the plant. The condition tested was a 3/4", schedule 40, pipe two inches away from a 2-inch conduit. This configuration is conservative in relation to actual plant installations, since the penetrating elements are typically small conduits and ground wires which are attached to imbed plates, large steel beams or concrete walls which would tend to absorb significant amounts of heat. Additionally, the test fixture was a small box (0.5 cubic feet) which restricted heat dissipation. Field installations of the fire barrier typically enclose a large volume and cover the entire length of the raceway in a particular room.

Electrical cables used for safe-shutdown circuits are IEEE-383 qualified and are capable of resisting a heat flux of 1.76 BTU/sec-ft^2 before sustaining damage. A calculation has been performed that shows that if the clearance between the safe-shutdown cable and the penetrating item is a minimum of 0.10 of the radius of the cable, the penetrating item would have to have a temperature over 1000 degrees F to cause a heat flux sufficient to damage the cable. The above referenced fire test also measured the surface temperature of the 3/4-inch pipe, inside the envelope. Since this test showed a maximum surface temperature of 735 degrees F, a temperature of 1000 degrees F inside the protected envelope is not believed to be credible. Additionally, the calculation is conservative in respect to actual plant installations because it allows the penetrating item to be in very close proximity to the protected raceway (1/10 of an inch for a 2-inch conduit).

The above fire zones contain fixed combustibles, primarily in the form of electrical cable insulation, with the exception of zones 46A, 46B and 46E which are the charging pump rooms. These zones are provided with ionization and line-thermal detectors with automatic pre-action systems in the cable trays (Zone 10B has an automatic halon system and Zones 46A, 46B and 46E have area pre-action sprinklers and ionization detectors). The fire zones are also provided with hose reels and portable extinguishers as secondary fire suppression systems and plant fire department response is expected within 15 minutes of the alarm condition.

CONCLUSION

The existing installation provides equivalent protection to that required by Section III.G.2, and modifying the existing Thermo-Lag fire barrier to comply with the current suggested installation criteria would not significantly enhance the protection currently provided.

2. A deviation is requested from Section III.G.2 to the extent that it requires fire barriers used for the purpose of redundant circuit separation to be of a "Fire Tested" configuration.

DISCUSSION

Fire Zone 73 contains train A associated raceways protected with TSI thermo-lag fire barrier insulation. The fire barrier insulation was installed as a 3-hour fire-rated system in accordance with the vendor's specification in effect at the time of installation. The fire test performed to qualify the 3-hour rating did not address intervening steel. Further research by the vendor has identified the need for intervening steel which penetrates the protective envelope to be wrapped for 18-inches from point of contact with Thermo-Lag insulation. Since the 18-inch criteria did not exist at the time of installation, the additional protection was not provided. An 8-inch criteria, however, was utilized for installation purposes for intervening steel which came in physical contact with the protected raceway. The 8-inch's of additional protection was measured from point of contact with the protected raceway. The 8-inch criteria, however, was not applicable to intervening steel which penetrated the protective envelope but did not come in physical contact with the protected raceway and associated supports.

A "worst case" heat transfer calculation has been performed to determine the minimum fire resistance provided to raceways by the existing thermo-lag configuration. It has been found that a minimum of 18 minutes of protection will be provided by the "worst-case" existing configuration. The "worst-case" configuration was found to be P-1000 channel unistrut fully exposed by the fire environment with no consideration for heat sinks. This configuration is rare in relation to typical plant installations. Typically the supports are attached to imbed plates or large steel beams which will significantly absorb heat. For example, the duration of protection is increased 50% to 27 minutes if the unistrut support is attached to an imbed plate. The following conservative factors were utilized in the calculation.

1. The configuration evaluated is considered the "worst case" with respect to actual plant conditions. Intervening steel of larger mass and attachments to large heat sinks as imbedded plates and steel beams will significantly increase the duration to achieve 325 degrees F.

2. The assumption is made that the intervening steel is subjected to direct flame impingement with a maximum view factor. Protected raceways are typically located along walls or on high ceilings and direct flame impingement is not likely. In addition, the magnitude of radiant and convective heat energy received by the intervening steel is inversely proportional to the distance from the source.

3. The assumption is made that no heat is absorbed by the thermo-lag through the mechanism of sublimation. Thermo-lag insulation will absorb approximately 750 BTU's per pound in the solid phase and as much as 6000 BTU's per pound in the vapor phase by endothermic decomposition.

4. The assumption is made that all heat received by the intervening steel is absorbed by the protected raceway conduit with no consideration for re-radiation of heat to the environment.

5. The assumption is made that cable temperature within the protected raceway conduit is equal to the intervening steel support temperature at the point of contact.

Electrical cables used for safe-shutdown circuits are IEEE 383 qualified and meet an additional criteria of resisting 210,000 BTU/Hr of heat for the flame test. In addition, our review of PVNGS accelerated aging tests show the ability, to maintain cable integrity even if subjected to temperature extremes at or below 400 degrees F over the 40-year life of the plant. These characteristics, therefore, will provide additional conservatism to the heat transfer calculation discussed above.

Fire Zone 73 contains minimal fixed combustibles and has an equivalent fire severity of two minutes. In addition, the calculated fire loading includes anticipated transient combustibles. The existing Thermo-Lag configuration, therefore, will provide more than adequate protection considering the combustible loading.

This Fire Zone is provided with a smoke detection system, Fire Hose Station, and portable extinguishers. The Plant Fire Department response is expected within 15 minutes of the alarm condition.

CONCLUSION

The existing design provides equivalent protection to that required by Section III.G.2 and modifying the existing thermo-lag fire barrier system to comply with the current installation criteria would not significantly enhance the protection currently provided.

3. A deviation is requested from Section III.G.2 to the extent that it requires fire barriers used for the purpose of redundant circuit separation to be of a "Fire-Tested" configuration.

DISCUSSION

Fire Zones 74A and 74B contain safe-shutdown raceways protected with the TSI Thermo-Lag fire barrier insulation. The fire barrier installation was installed as a 1-hour fire-rated system in accordance with the vendor's specification in effect at the time of installation. The fire test performed to qualify the 1-hour rating did not address intervening steel. Based on a three hour fire test, the vendor has identified the need for intervening steel which penetrates the protective envelope to be wrapped for 18-inches from point of contact with Thermo-Lag insulation for both 1-hour and 3-hour application. Since the 18-inch criteria did not exist at the time of installation, the additional protection was not provided. An 8-inch criteria, however, was utilized for installation purposes for intervening steel which was in physical contact with the protected raceway. The 8-inch's of additional protection was measured from point of contact with the protected raceway. The 8-inch criteria, however, was not applicable to intervening steel which penetrated the protective envelope but did not come in physical contact with the protected raceway and associated supports.

A "worst case" heat transfer calculation has been performed to determine the minimum fire resistance provided to raceways by the existing thermo-lag configuration. It has been found that a minimum of 18 minutes of protection will be provided by the "worst-case" existing configuration. The "worst-case" configuration was found to be P-1000 channel unistrut fully exposed by the fire environment with no consideration for heat sinks. This configuration is rare in relation to typical plant installations. Typically the supports are attached to imbed plates or large steel beams which will significantly absorb heat. For example, the duration of protection is increased 50% to 27 minutes if the unistrut support is attached to an imbed plate. The following conservative factors were utilized in the calculation.

1. The configuration evaluated is considered the "worst case" with respect to actual plant conditions. Intervening steel of larger mass and attachments to large heat sinks as imbedded plates and steel beams will significantly increase the duration to achieve 325 degrees F.

2. The assumption is made that the intervening steel is subjected to direct flame impingement with a maximum view factor. Protected raceways are typically located along walls or on high ceilings and direct flame impingement is not likely. In addition, the magnitude of radiant and convective heat energy received by the intervening steel is inversely proportional to the distance from the source.

3. The assumption is made that no heat is absorbed by the thermo-lag through the mechanism of sublimation. Thermo-lag insulation will absorb approximately 750 BUT's per pound in the solid phase and as much as 6000 BTU's per pound in the vapor phase by endothermic decomposition.

4. The assumption is made that all heat received by the intervening steel is absorbed by the protected raceway conduit with no consideration for re-radiation of heat to the environment.

5. The assumption is made that cable temperature within the protected raceway conduit is equal to the intervening steel support temperature at the point of contact.

Electrical cables used for safe-shutdown circuits are IEEE 383 qualified and meet an additional criteria of resisting 210,000 BTU/Hr of heat for the flame test. In addition, our review of PVNGS accelerated aging tests show the ability, to maintain cable integrity even if subjected to temperature extremes at or below 400 degrees F over the 40-year life of the plant. These characteristics, therefore, will provide additional conservatism to the heat transfer calculation discussed above.

The MSSS Building combustible loading consists of cable insulation, Fyrquel oil for main steam isolation and feedwater isolation valves, and transient combustibles. In comparison the oil contained in the valves accounts for the greatest combustible load. All four isolation valves including associated oil reservoirs and tubing are seismic category I qualified components. Based on the seismic design it is reasonable to assume that total leakage of oil from all valves will not occur simultaneous with a fire event. This position is consistent with precedence set for seismically qualified reactor coolant pumps. Given the assumption that the postulated fire will only involve random leakage from the largest single valve, the equivalent fire severity for each zone is 16 minutes. In addition to fixed combustibles, this also assumes 50 lbs. of ordinary combustibles and 55 gallons of oil as transients. In addition "Fyrquel," which has a 650 degree F firepoint, will significantly reduce the potential for fire ignition and flame propagation should a random leak occur. Due to the low fire loading and the conservative characteristics of the heat transfer calculation for the existing thermo-lag fire resistance, adequate protection will be provided to assure one safe shutdown path will be available.

The MSSS Building has a unique roof design which will eliminate the buildup of a hot gas layer. The building has an open roof design with an 8.5 foot high opening between the top of the wall (elevation 156'-0") and the bottom of the missile shield which allows the structure to vent pressures

developed during postulated high energy line breaks. In addition, the east wall contains large openings for main steam and feedwater piping penetrations which will allow additional venting of hot gases and products of combustion. The physical characteristics of the building, therefore, will prevent room temperatures from reaching those specified in the ASTM E-119 time temperature curve.

Fire Zones 74A and 74B are fully protected by automatic pre-action sprinkler systems. Area wide protection, is provided for the 100', 120', 120' mezzanine, and 140' elevations. Each of the elevations above 100' is separated by open grating which will allow some cumulative effect of sprinkler system discharge since each zone is hydraulically designed to allow two elevations to operate simultaneously. Fire detection is provided on each elevation for early warning and actuation of the pre-action valve. Due to the high density of sprinkler heads (65 sq. ft. coverage per head per elevation) it is reasonable to assume that intervening steel will receive direct water impingement and thermal shorts to the protected raceway will be prevented.

Both fire zones are provided with hose stations and portable extinguishers for secondary fire suppression. The plant fire department response is expected within 15 minutes of the alarm condition.

CONCLUSION

The existing design provides equivalent protection to that required by Section III.G.2, and modifying the existing Thermo-Lag fire barrier system to comply with the current installation criteria would not significantly enhance the protection currently provided.

4. A deviation is requested from Section III.G.2 to the extent that it requires fire barriers used for the purpose of redundant circuit separation to be of a "Fire-Tested" configuration.

DISCUSSION

Fire Zones 37B, 37D on elevation 70'-0", and 39B on elevation 88'-0", contain train A associated raceways protected with TSI Thermo-Lag fire barrier insulation. The exposed train B cables and equipment are associated with essential cooling water and safety injection systems. The train A protected circuits are associated with auxiliary feedwater and steam generator systems and the redundant train B cables and equipment are not located on these elevations. The fire barrier insulation was installed as a 3-hour fire-rated system in accordance with the vendor's specification in effect at the time of installation. The fire test performed to qualify the 3-hour rating did not address intervening steel. Further research by the vendor has identified the need for intervening steel which penetrates the protective envelope to be wrapped for 18-inches from point of contact with Thermo-Lag insulation. Since the 18-inch criteria did not exist at the time of installation, the additional protection was not provided. An 8-inch criteria, however, was utilized for installation purposes for intervening steel which came in physical contact with the protected raceway. The 8-inch's of additional protection was measured from point of contact with the protected raceway. The 8-inch criteria, however, was

not applicable to intervening steel which penetrated the protective envelope but did not come in physical contact with the protected raceway and associated supports.

A "worst case" heat transfer calculation has been performed to determine the minimum fire resistance provided to raceways by the existing thermo-lag configuration. It has been found that a minimum of 18 minutes of protection will be provided by the "worst-case" existing configuration. The "worst-case" configuration was found to be P-1000 channel unistrut fully exposed by the fire environment with no consideration for heat sinks. This configuration is rare in relation to typical plant installations. Typically the supports are attached to imbed plates or large steel beams which will significantly absorb heat. For example, the duration of protection is increased 50% to 27 minutes if the unistrut support is attached to an imbed plate. The following conservative factors were utilized in the calculation.

1. The configuration evaluated is considered the "worst case" with respect to actual plant conditions. Intervening steel of larger mass and attachments to large heat sinks as imbedded plates and steel beams will significantly increase the duration to achieve 325 degrees F.

2. The assumption is made that the intervening steel is subjected to direct flame impingement with a maximum view factor. Protected raceways are typically located along walls or on high ceilings and direct flame impingement is not likely. In addition, the magnitude of radiant and convective heat energy received by the intervening steel is inversely proportional to the distance from the source.

3. The assumption is made that no heat is absorbed by the thermo-lag through the mechanism of sublimation. Thermo-lag insulation will absorb approximately 750 BTU's per pound in the solid phase and as much as 6000 BTU's per pound in the vapor phase by endothermic decomposition.

4. The assumption is made that all heat received by the intervening steel is absorbed by the protected raceway conduit with no consideration for re-radiation of heat to the environment.

5. The assumption is made that cable temperature within the protected raceway conduit is equal to the intervening steel support temperature at the point of contact.

Electrical cables used for safe-shutdown circuits are IEEE 383 qualified and meet an additional criteria of resisting 210,000 BTU/Hr of heat for the flame test. In addition, our review of PVNGS accelerated aging tests show the ability, to maintain cable integrity even if subjected to temperature extremes at or below 400 degrees F over the 40-year life of the plant. These characteristics, therefore, will provide additional conservatism to the heat transfer calculation discussed above.

Fire Zones 39B, 37D, and 37B contain minimal fixed combustibles and have an equivalent fire severity of one, four, and five minutes, respectively.

In addition, the calculated fire loadings include anticipated transient combustibles. The existing thermo-lag configuration, therefore, will provide more than adequate protection considering the combustible loading.

All three Fire Zones are provided with smoke detection systems, Fire Hose Stations, and portable extinguishers. The Plant Fire Department response is expected within 15 minutes of the alarm condition.

CONCLUSION

The existing design provides equivalent protection to that required by Section III.G.2, and modifying the existing thermo-lag fire barrier system to comply with the current installation criteria would not significantly enhance the protection currently provided.

ATTACHMENT 2

Description of Change

This proposed change is deviation from Appendix R, Section III.G.2 requirements. The specific deviations are outlined in Attachment 1. The deviations are primarily due to intervening steel penetrating the fire barrier not having as much Thermo-lag insulation installed as the tested configuration. The fire barriers were evaluated by Engineering and found to be adequate for their intended purpose even though they deviate from the tested configuration.

Basis for No Significant Hazards Determination

The deviations requested from Appendix R, Section III.G.2 do not involve a significant hazards consideration because operation of Palo Verde Units 1, 2, and 3 in accordance with the above deviations would not:

(1) Increase the probability of occurance or the consequences of an accident or malfunction of equipment important to safety. This conclusion is based on the following:

a) The as built configuration has been evaluated by Engineering and determined to be equivalent to that required by Appendix R, Section III.G.2. Both the testing performed by the vendor and calculations using extremely conservative assumptions have shown the current fire barrier installations to be adequate.

b) The combustible loading in the areas where the deviations are requested are minimal.

c) All the fire zones have some type of fire detection equipment. The on site Fire Department will respond to an alarm within 15 minutes.

(2) Create the possibility of an accident or malfuntion of a different type than any evaluated previously in the Final Safety Analysis Report. These deviations do not affect any safety analysis assumptions or affect the function of equipment important to safety or safety related. The as built fire barrier configuration has been analyzed and determined to provide fire protection equivalent to the requirements of Appendix R, Section III.G.2.

(3) Reduce the margin of safety. The deviations requested have all been evaluated by Engineering and found to provide protection equivalent to the requirements of Appendix R, Section III.G.2. The existing design assures that at least one train of equipment necessary to achieve and maintain hot or cold shutdown is free of fire damage. Thus no margin of safety is reduced.