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November 20, 1981  
File 7917-6

U.S. Nuclear Regulatory Commission  
Chemical Engineering Branch, NRR  
ATTN: Mr. V. Benaroya  
Washington, D.C. 20555

Gentlemen:

Contract NRC-03-81-140  
Trojan Nuclear Plant Request for  
Exemption From the Requirements  
of Section III, Paragraph G of  
Appendix R to 10 CFR Part 50

By letter dated March 19, 1981, the licensee requested an exemption from Section III.G.2., "Fire Protection of Safe Shutdown Capability," of Appendix R to 10 CFR Part 50 for the following areas:

- A. Intake Structure (23 ft. level)
- B. Fuel Building (45 ft. level)
- C. Auxiliary Building (45 ft. level)
- D. Turbine Building (45 ft. level)
- E. Cable penetration area outside containment

Section III.G.2. of Appendix R requires that redundant safe shutdown systems (cables and equipment) and associated non-safety circuits be protected against the damaging effects of fires in either in-situ or transient combustibles. Such protection consists of either complete 3 hr. fire rated barrier separation or a combination of fire detection, fire suppression and barriers that will maintain system availability for 1 hr. under fire test conditions.

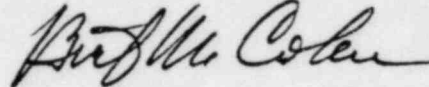
An on-site review was not conducted by GBA. Therefore, the conclusions arrived at were conservatively based on information provided by the licensee in PGE-1012, "Trojan Nuclear Plant Fire Protection Review," and in telephone conversations.

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Attached is our review of the licensee's exemption request and our recommendations.

Very truly yours,



Bert M. Cohn  
Project Director

Encl.

cc: C. Poslusny  
W. Johnston  
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Contracting Officer

ENCLOSURE 1  
CHEMICAL ENGINEERING BRANCH/FIRE PROTECTION SECTION  
FIRE PROTECTION REVIEW  
EXEMPTION REQUEST  
TROJAN NUCLEAR PLANT  
DOCKET NO. 50-344

## 1.0 INTRODUCTION

By letter dated March 19, 1981, the licensee requested an exemption from Section III.G.2, "Fire Protection for Safe Shutdown Capability," of Appendix R to 10 CFR Part 50, to the extent that it requires:

Paragraph III.G.2.a. - Separation of cables and equipment and associated circuits of redundant trains by a fire barrier having a 3 hr. rating. Structural steel forming a part of or supporting such fire barriers should be protected to provide fire resistance equivalent to that required of the barrier;

Paragraph III.G.2.b. - Separation of cables and equipment and associated circuits of redundant trains by a horizontal distance of more than 20 ft. with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area; or

Paragraph III.G.2.c. - Enclosure of cable and equipment and associated circuits of one redundant train in a fire barrier having a 1 hr. rating. In addition, fire detectors and an automatic fire suppression system should be installed in the fire area.

Each of the areas involved in the requested exemption is discussed separately.

## 2.0 INTAKE STRUCTURE (23 ft. level)

### 2.1 Discussion

This level of the Intake Structure contains the redundant service water pumps A, B and C and the circuits essential for operation of the pumps. In addition, the diesel engine and electric motor driven fire pumps are located on this elevation of the intake structure. The licensee has stated that the fire pumps are separated from each other and from the area containing the service water pumps by 3 hr. fire rated walls and doors.

In the area containing the service water pumps, the separation between the A and C pumps and between the B and C pumps is 14 ft., with the C pump midway between the A and B pumps. Circuits in the area are installed with as little as 2 in. separation between an open cable tray of one division and a conduit containing redundant circuits.

In December 1978, the licensee proposed to provide ionization detectors "near" each service water pump to provide early detection and alarm. In addition, the licensee proposed to provide a 1/2 in. thick marinite board shield between redundant systems at the two locations where redundant circuit crossovers occur. A 1 in. layer of Kaowool blanket would also be provided around one of the circuits at the crossover point. The marinite board and Kaowool would extend 1 to 2 ft. beyond the crossover point.

The licensee also indicated that the circulating water system, with pumps located in the plant yard area, can perform the functions of the service water system if all three service water pumps were damaged by fire. The licensee stated that minimum water supplies would provide sufficient water for the circulating water system to perform necessary shutdown operations for seven days if the service water pumps were inoperable and offsite power was not available. With offsite power available, circulating water system water supplies can be replenished continuously.

The licensee has stated that an exemption is justified since the cable fire protection affords an equivalent degree of protection as the methods required by Appendix R.

## 2.2 Evaluation

Section III.G.2. of Appendix R requires protection of redundant circuits required for safe shutdown "Except as provided for in paragraph G.3 of this section." Paragraph G.3 details the requirements for alternate shutdown systems where the provisions of paragraph G.2 are not satisfied.

The licensee has provided an alternate shutdown system to the service water pumps in that the circulating water pumps can supply adequate water to the service water system to perform shutdown functions. However, the defense-in-depth concept of protection requires certain additional protection for primary systems required for safe shutdown. Exposure fires in in-situ or transient combustibles can rapidly affect equipment or circuits in an area where they are separated by less than 20 ft. of clear, open area without intervening combustibles. Appendix R requires that, as a minimum, areas where redundant safe shutdown systems are not separated by 3 hr. rated fire barriers should be provided with fire detection and a fixed fire suppression system. Such protection is required as a first line of defense in trying to maintain the operability of redundant shutdown systems.

## 2.3 Conclusion

Based on our evaluation, we conclude that sufficient protection is not provided for the redundant service water pumps and their electrical circuits in the intake structure. Since alternate shutdown is provided for this area, the 1 hr. barriers required by Section III.G.2. of Appendix R are not required. However, sufficient defense-in-depth has not been provided in accordance with NRC guidelines. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be granted only if they meet the requirements of Section III.G.3. of Appendix R.

To provide sufficient defense-in-depth protection of redundant systems and to meet the requirements of Section III.G.3. of Appendix R, the licensee should provide an automatic suppression system in the service water pump room of the intake structure.

### 3.0 FUEL BUILDING AND AUXILIARY BUILDING (45-ft. level)

#### 3.1 Discussion

These two areas are not separated by walls and are therefore considered together as one fire area. This area contains the redundant component cooling water pumps A, B and C, the redundant component cooling water make-up pumps A and B, the redundant service water booster pumps A, B, C and D, redundant vent fans for these pumps, and the circuits essential for operation of the pumps and fans. The separation between the A and B component cooling water pumps is 14 ft., and between the redundant make-up pumps is 4 ft. Redundant sets of service water booster pumps (A, C and B, D) are separated by 24 ft. Component cooling water pump C is 18 ft. from service water booster pumps and 13 ft. from component cooling water pump A. Redundant circuits cross the area with minimum 5 ft. separation between redundant circuits and equipment.

In July, 1979, the licensee proposed to provide ionization detectors near each service water booster pump and component cooling water pump. Suppression capability is provided by manual hose stations and portable extinguishers. No additional protection is provided for redundant circuits and equipment in close proximity.

The licensee has stated that an exemption is justified since the fire protection provided affords an equivalent degree of protection as the methods required by Appendix R.

#### 3.2 Evaluation

Section III.G.2. of Appendix R requires protection of redundant systems required for safe shutdown as detailed in 1.0 above. This fire protection is considered the minimum protection necessary to prevent damage to redundant systems in the same fire area.

Exposure fires in in-situ or transient combustibles can rapidly affect equipment and circuits in an area where they are separated by less than 20 ft. of clear, open area without intervening combustibles. Since such separation is not provided between redundant systems in this area, reliance on ionization detectors over the pumps and manual fire suppression activities is not adequate to assure that at least one safe shutdown system will be unaffected by a fire.

#### 3.3 Conclusion

Based on our evaluation, we conclude that sufficient protection is not provided for the redundant safe shutdown systems on the 45 ft. level of the auxiliary and fuel buildings. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be denied.

To provide sufficient protection to redundant safe shutdown systems to assure that at least one system will be unaffected by a fire in this area, the licensee should provide the following for the general floor areas not separated from the pumps by 3 hr. fire rated barriers:

- a. An automatic fire detection system that provides total area coverage.
- b. An automatic water suppression system for the entire area.
- c. A 1 hr. fire rated barrier completely enclosing all circuits and equipment of one safety division that will maintain the circuit integrity and equipment availability for 1 hr. under ASTM E-119 fire test conditions.

#### 4.0 TURBINE BUILDING (45 ft. level)

##### 4.1 Discussion

Safety related areas on this elevation of the Turbine building include the emergency diesel generator rooms A and B, auxiliary feedwater pump rooms A and B, the auxiliary feedwater control panel room, and part of the general floor area which contains safe shutdown cabling. The diesel generator and auxiliary feedwater pump rooms and the auxiliary feedwater control panel room are separated from each other and other plant areas by 3 hr. fire barriers. The only areas containing redundant safe shutdown systems are the diesel driven auxiliary feedwater pump room, the auxiliary feedwater control panel room, and a portion of the general area. Each of these three areas will be considered separately.

The licensee has stated that an exemption is justified since the fire protection provided affords an equivalent degree of protection as the methods required by Appendix R.

4.1.1 Protection for redundant circuits in the diesel driven auxiliary feedwater pump room was provided by construction of a complete 3 hr. fire barrier to separate all but one channel A circuit from the channel B pump and circuits in the area. The channel A circuit that was not separated from the room supplies power to a motor-operated valve in one of the two fuel oil lines to the auxiliary feedwater B pump diesel fuel oil day tank. An automatic sprinkler system is also provided in the diesel driven pump room.

4.1.2 The auxiliary feedwater control panel room contains the emergency shutdown cabinet (C-160) and associated circuits. Loss of redundant shutdown circuits in this panel would prevent operation of both of the emergency feedwater pumps which are required for safe plant shutdown.

Protection for this area is provided by a total flooding halon system with a detector and a discharge nozzle located in cabinet C-160. Ionization detectors are utilized to actuate the system. The licensee has indicated that the halon system will be deactivated whenever anyone enters the room. Manual fire suppression capability is provided by standpipe hose stations and portable dry chemical fire extinguishers.

4.1.3 The part of the general floor area containing redundant shutdown circuits is between column lines S-U and 51 to 71. The redundant circuits in close proximity provide the automatic start functions for the A and B auxiliary feedwater pumps. Conduit containing the A channel crosses over the cable tray containing the B channel with a vertical separation of 38 in.

In December 1978, the licensee committed to provide a fire barrier between the two circuits at the crossover point. The barrier consists of a 1-in. thick Kāowōol blanket wrapped around the tray and a 1/2 in. thick marinite board placed horizontally between the tray and conduit. The protection extends only 1 to 2 ft. beyond the crossover point. In addition, automatic fire detection would be provided for the area.

#### 4.2 Evaluations

- 4.2.1 The channel A circuit remaining in the Channel B auxiliary feedwater pump room provides a function associated only with the channel B pump. Loss of this channel A circuit will not affect any channel A systems essential to operation of safe shutdown equipment redundant to channel B systems in this area. Therefore, enclosing the one channel A circuit in a 1 hr. fire rated barrier is not necessary to protect safe shutdown capability.
- 4.2.2 Section III.G.2. of Appendix R requires protection of redundant systems required for safe shutdown as detailed in 1.0 above. This protection is considered the minimum necessary to prevent damage to redundant systems in the same fire area. Section III.G.3. of Appendix R requires an alternate shutdown system where protection of such systems does not meet the provisions of III.G.2.

Redundant circuits located in the same electrical panel can easily be damaged by fires either within the panel or in transient combustibles outside the panel. The presence of an automatic halon suppression system is not sufficient to assure that redundant systems in the room will not be damaged by a fire. A fire could damage redundant circuits before the halon system actuates. A failure of the suppression system would increase the possibility of damage to redundant systems. The halon system is also shut off before and during personnel access to the room -- a time when fire hazards are likely to be increased. The use of any manual fire suppression efforts in the area could also cause damage to the circuits in the panel from waterspray or dry chemical interference at contact points.

- 4.2.3 The licensee stated that damage to the redundant A and B channel circuits in the open floor area between columns S-U and 51 to 71 would not have an adverse effect on safe shutdown. The circuits involved are related only to the automatic start-up functions for the auxiliary feedwater pumps. If these circuits are damaged, the pumps can be started manually from the control room or at the pump control panel. Therefore, protection of these circuits in accordance with Section III. G.2. of Appendix R is not necessary.

#### 4.3 Conclusions

- 4.3.1 Based on our evaluation of the auxiliary feedwater pump room, we conclude that sufficient protection is provided for redundant safe shutdown functions. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be granted for this area on the 45 ft. level of the Turbine Building.

- 4.3.2 Based on our evaluation of the auxiliary feedwater control panel room on the 45 ft. level of the Turbine Building, we conclude that sufficient protection is not provided for the redundant safe shutdown systems in the room. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be denied.

To provide sufficient protection to redundant safe shutdown systems to assure that at least one system will be unaffected by a fire in this area, the licensee should comply with the requirements of Section III.G. of Appendix R. Since the nature of the remote shutdown panel in this area makes protection in accordance with Section III.G.2. of Appendix R impractical, the licensee should provide an alternate shutdown system for this area in accordance with Section III.G.3. of Appendix R. The alternate shutdown system should meet the requirements of Section III.L. of Appendix R to 10 CFR Part 50. The alternate shutdown capability should be electrically isolated from this area so that a fire in this area or in the area of the alternate shutdown capability which destroys redundant circuits will not affect the ability to safely shut down the plant.

- 4.3.3 Based on our evaluation of the general floor area between columns S-U and 51-71 on the 45 ft. level of the Turbine Building, we conclude that sufficient protection is provided for redundant safe shutdown functions. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be granted for this area.

## 5.0 CABLE PENETRATION AREA OUTSIDE CONTAINMENT

### 5.1 Discussion

The cable penetration area outside containment includes the area between the Auxiliary and Containment Buildings from elevation 45 ft. through 93 ft. This area is open on two sides to the yard area. A floor slab at elevation 93 ft. provides a roof over the area.

This area contains numerous cables in open trays, including redundant safe shutdown system circuits. The trays pass from the Auxiliary Building through an open area to a vertical cable chase behind a penetration shield wall. In the chase, the cables descend from elevation 83 ft. to the individual penetrations into containment. Redundant circuits are above one another near the Auxiliary Building wall; vertical separation is 13 ft. Near the shield wall and in the cable chase behind the shield wall the redundant circuits are separated by approximately 45 ft. with numerous cable trays between the redundant circuits.

Other combustibles and equipment in the area includes a storage rack with gas cylinders containing nitrogen, nitrous oxide, argon, helium, acetylene and propane. The cylinders are stored approximately 32 ft. from the closest safe shutdown related cables. The pressurizer heater switchgear is located below the cables. The switchgear includes an oil-filled transformer at each end. A partial concrete deck at elevation 64 ft. extends over the switchgear and transformer but does not completely separate the cables above from the switchgear area.



Protection for this area is provided by a deluge waterspray system with spray heads distributed to provide water spray directly on the cable trays. Cross-zoned ionization and photoelectric smoke detectors are used for detection and suppression system actuation. This system also provides protection for the pressurizer switchgear and control panel and the two transformers below the partial concrete deck at elevation 59 ft. Manual fire suppression capability is provided by portable fire extinguishers and hose lines.

The licensee has stated that an exemption is justified since the cable fire protection affords an equivalent degree of protection as the methods required by Appendix R.

## 5.2 Evaluation

Section III.G.2. of Appendix R requires protection of redundant systems required for safe shutdown as detailed in 1.0 above. This fire protection is considered the minimum protection necessary to prevent damage to redundant systems in the same fire area.

Section D.1.(g) of Appendix A to BTP ASB 9.5-1 requires that safety related systems should be protected from the effects of fires in oil-filled transformers by either (a) replacing the transformers with dry transformers or transformers that are insulated and cooled with noncombustible liquid or (b) enclosing the transformers with a 3 hr. fire barrier and installing automatic waterspray protection for the transformer. Such protection is considered necessary to protect redundant circuits from the potentially severe fire which could be associated with oil-filled transformers.

Exposure fires in in-situ or transient combustibles can rapidly affect circuits in an area when they are separated horizontally by less than 20 ft. of clear, open space without intervening combustibles. Any delay in the operation of the automatic water suppression system, or a failure of the system, would leave redundant circuits exposed to fire damage. Because of the fire potential represented by the installed cables, gas cylinders and transformers, in conjunction with postulated transient combustibles, reliance on automatic suppression systems and manual suppression activities is not sufficient to assure that at least one safe shutdown system will be unaffected by a fire.

## 5.3 Conclusion

Based on our evaluation, we conclude that sufficient protection is not provided for the redundant safe shutdown systems located in the cable penetration area outside containment. Therefore, the licensee's request for exemption from the requirements of Section III.G.2. of Appendix R to 10 CFR Part 50 should be denied.

To provide sufficient protection to redundant safe shutdown systems to assure that at least one system will be unaffected by a fire in this area, the licensee should take the following steps to upgrade the protection:

- a. Provide complete 3 hr. fire-rated barriers to separate the compressed gas cylinder storage area from the cable penetration area or remove the cylinders from the area.

- b. Provide complete 3 hr. fire-rated barriers to separate the oil-filled transformers from the cable penetration area and provide complete waterspray protection for the transformers that is separate from the cable penetration area waterspray system. In lieu of the above, the licensee should replace the transformers with dry type transformers or transformers that are insulated and cooled with noncombustible liquid.
- c. Provide a 1 hr. fire rated barrier to completely enclose all circuits of one safe shutdown division in the cable penetration area. The barrier should be capable of protecting circuit integrity for 1 hr. under ASTM E-119 fire test conditions, and should also protect all structural supports for the protected circuits and any other trays whose collapse under fire conditions could affect the protected circuits.
- d. Extend the waterspray suppression system to protect the entire cable penetration area, including the ground level below the cables.