

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO EXEMPTIONS FROM 10 CFR 50, APPENDIX R
H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

DOCKET NO. 50-261

1.0 Introduction

By letters dated January 19, 1981, March 11, 1982, and April 27, 1982 the licensee requested exemptions from Section III.G within 4 plant fire areas, Section III.M and Section III.O. By letter dated June 7, 1983, the licensee withdrew one exemption request for Subsection III.G, Pipe Alley (Fire Zone 28). We have not completed our review for Subsection III.G.2, Component Cooling Pump Room (Fire Zone 5) and Subsection III.O, Oil Collection System.

Section III.G.2 requires that one train of cables and equipment necessary to achieve and maintain safe shutdown be maintained free of fire damage by one of the following means:

- a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier.
- b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards.

In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or

- c. Enclosure of cable and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

If these conditions are not met, alternative shutdown capability is required and a fixed suppression system installed in the fire area of concern if it contains a large concentration of cables or other combustibles. These alternative requirements are not deemed to be equivalent; however, they provide adequate protection for those configurations in which they are accepted.

Because it is not possible to predict the specific conditions under which fires may occur and propagate, the design basis protective features are specified in the rule rather than the design basis fire. Plant-specific features may require protection different than the measures specified in Section III.G. In such a

8312140202 831125
PDR ADOCK 05000261
F PDR

case, the licensee must demonstrate, by means of a detailed fire hazards analysis, that existing protection or existing protection in conjunction with proposed modifications will provide a level of safety equivalent to the technical requirements of Section III.G of Appendix R.

In summary, Section III.G is related to fire protection features for ensuring that systems and associated circuits used to achieve and maintain safe shutdown are free of fire damage. Fire protection configurations must either meet the specific requirements of Section III.G or an alternative fire protection configurations must be justified by a fire hazard analysis.

Our general criteria for accepting an alternative fire protection configuration are the following:

- The alternative assures that one train of equipment necessary to achieve hot shutdown from either the control room or emergency control stations is free of fire damage.
- The alternative assures that fire damage to at least one train of equipment necessary to achieve cold shutdown is limited such that it can be repaired within a reasonable time (minor repairs with components stored on-site).
- Modifications required to meet Section III.G would not enhance fire protection safety above that provided by either existing or proposed alternatives.
- Modifications required to meet Section III.G would be detrimental to overall facility safety.

2.0 Analytical Method

The licensee employed an analytical method to demonstrate the inherent protection afforded to existing safe shutdown systems. The intent of this method was to provide common parameters by which individual fire areas could be judged to demonstrate that verbatim compliance with compliance with Section III.G of Appendix R would not enhance the fire protection for safe shutdown.

The method can be summarized as follows:

- The redundant cables and components of concern are identified.
- Their geometry and configuration within the fire area are described.
- The type of cable insulation and failure criteria are specified.
- The minimum quantity of flammable liquid needed to produce sufficient heat flux and heat energy to damage the cables is calculated, considering several heat transfer modes, i.e. radiation, plume impingement, and stratification.

The analysis determines the heat flux into the room needed to cause electrical failure of redundant cables. This heat flux is converted to a quantity of flammable liquid, usually acetone, in a circular pool configuration.

We and our contractor, Brookhaven National Laboratory have reviewed the analytical method. We have determined that the results of the methodology as applied do not demonstrate the equivalence of the protection provided for safe shutdown to the specific alternatives set forth in Section III.G of Appendix R. For example:

- The method does not consider the heat released to the room by secondary fires involving insitu combustibles. The method uses an electrical failure criterion with the thermal energy release to the room by a single exposure fire; when the cables of concern are at the conditions of electrical failure, other cables within the enclosure are burning and releasing energy to the room.
- The method does not consider the increased heat release rate of a given fire when it occurs against a wall or in a corner; the method only considers the heat release of a fire as it occurs in an open area.
- The method does not consider the affects of excess pyrolyzate, resulting from the degradation of plastics, burning in the stratified layer.
- The method does not consider all of the alternatives set forth in Section III.G i.e., 3 hour fire barrier, 1 hour fire barrier with suppression system, 20 feet separation free of combustible with automatic suppression and alternate or dedicated shutdown capability independent of the area. The method only considers separation without automatic suppression and uses a stratification model which does not include the effects of separation.

The licensee has not used the results of this analysis to compare the protection provided with that specified in Section III.G. The licensee has only stated that the accumulation of this quantity of flammable liquids in the required configuration is an unrealistic condition, and will be prevented by administrative controls. We do not deem this to be a valid argument because there is no positive means of preventing the accumulation of transient materials in individual plant areas. As documented in Inspection and Enforcement Branch Reports, recent inspections at plants such as Davis Besse (50-346/82-03, April 1, 1982), Duane Arnold (50-331/81-25, January 11, 1982), D.C. Cook (50-315/81-11, December 31, 1981), and Nine Mile Point (50-220/82-09), have demonstrated that substantial quantities of hazardous substances such as 55 gallon drums of waste oil are located in even highly restricted and controlled entry areas.

We have not relied upon the results of the licensee's analysis in our evaluation. We have evaluated each exemption request using our standard method of review:

- a) Review the information submitted and that existing in the docket file to determine the configuration of the redundant components,
- b) Evaluate the existing fire protection, proposed modifications, and other compensating features or mitigating factors to determine the overall level of fire protection in the area of concern, and
- c) Determine if the overall level of safety is equivalent to that provided by Section III.G of Appendix R.

This method has been used for all Appendix R reviews to date, because in our opinion based on the information available today, it is not considered possible to predict the severity of or probability of fire occurrence in individual areas.

3.0 RHR Pit (Fire Zone 27)

3.1 Exemption Requested

The licensee requested an exemption from III.G.2 of Appendix R to the extent that it requires 3 hour fire rated barriers be installed to separate redundant trains.

3.2 Discussion

Fire Zone 27 is located west of the Auxiliary Building at elevation 203 feet. The area is separated from other plant areas by concrete walls. Entrance into the area is through a hatch and down a 25 foot ladder. The ceiling height in the area is 26 feet 6 in. The fire protection in the area consists of smoke and heat detectors, standpipe hose stations and portable fire extinguishers.

Fire Zone 27 contains two residual heat removal (RHR) pumps and associated piping. No equipment or circuit within this zone is required for hot shutdown, but one train of the RHR system is necessary to achieve and maintain cold shutdown. Each RHR pump is mounted on a concrete pedestal approximately 4 ft. high with the top of the pump about 10 ft. above floor elevation. The redundant pumps are separated by a 22 ft high concrete barrier which completely bisects the RHR pit into two individual pump bays. Each pump bay has a sump approximately 3 ft. x 3 ft. x 6 in. deep with an installed sump pump. The sumps are adjacent to each other and separated by the same barrier which divides the zone. A hole approximately 4 in. in diameter joins the sumps so each sump pump can serve as a backup to the other.

The licensee indicates that a fire in the RHR pit would cause damage to both trains of the RHR control and power cables; however, the licensee also indicates that the cables could be repaired within 72 hours, the time allowed by Section III.G.1.

The combustible in Fire Zone 27 is lubricating oil contained in the RHR pumps. Each pump contains 8 gallons of oil. The oil comprises a fuel load of 6500 BTU/sq. ft. which if totally consumed, would correspond to a fire severity of about 5 minutes on the ASTM E-119 standard time temperature curve.

The licensee justifies this exemption on the following:

- a) Access to the area is limited.
- b) The in-situ combustible loading is light.
- c) Smoke and heat detection are provided.
- d) A partial height (22 feet) concrete barrier separates the RHR pumps.
- e) An analytical model was employed to show that the magnitude of an exposure fire needed to ignite the in-situ lube oil is significantly higher than reasonably expected.

f) Hot surfaces necessary to cause ignition of the lube oil do not exist in the area.

3.3 Evaluation

This area does not comply with Section III.G because the redundant RHR trains are not separated by 3-hour fire rated barriers, there is no automatic suppression system, and there is no alternate cold shutdown capability independent of the area.

This area is normally locked and the pumps are not running. Even with the pumps running there are no hot surfaces in the area. The few cables for the pumps are in conduit. The only significant in-situ combustible in the fire area is the pump motor lubricating oil. The probability of ignition of the oil is low because the lubricating oil has a high flashpoint (approximately 450°) and sufficiently hot surfaces do not exist in this fire area to cause the ignition of the lube oil. If a fire occurred in the RHR pit, access into the pit for nominal fire fighting would be difficult due to the smoke and hot products of combustion that would vent through the hatch entrance. We anticipate that manual fire fighting activities would be conducted from hatch entrance rather than from inside the RHR pit. This may result in water damage to both trains of RHR. However, with proper fire fighting procedures along with the concrete wall separating the pumps, such damage could easily be prevented. In addition, because the RHR pumps are only used during cold shutdown, there are emergency procedures which could be used to maintain safe conditions in the unlikely event of a fire and fire fighting activities that affect both pumps.

Because the area is normally locked, a partial height wall separates the RHR pump, the area contains few combustibles, and the pumps are only needed for cold shutdown, an automatic suppression is not necessary. The fire detectors should assure prompt detection of a fire should it occur. This arrangement would provide reasonable assurance that a fire would not damage both RHR pumps and the damage to cables would be limited so that it could be repaired within 72 hours.

3.4 Conclusion

Based on the above evaluation, the level of existing fire protection for this area does provide a level of fire protection equivalent to the technical requirements of Section III.G of Appendix R. Therefore, the exemption for the RHR pit (Fire Zone 27) should be granted.

4.0 Service Water Pump Area

4.1 Exemption Requested

The licensee requests an exemption from Section III.G.2 of Appendix R to the extent that it requires one-hour fire rated barriers or 20 feet of separation free of intervening combustibles to separate redundant divisions and an automatic fire suppression system.

4.2 Discussion

The service water pump area is located in the Intake Structure. This structure is formed by metal walls, concrete floor and an open roof. The area contains four service water pumps. One pump is needed for safe shutdown. The pumps are aligned with two to four feet separation between pumps. The separation between A and D pumps is approximately 13 feet. Control and power cables to the pumps are routed in conduit through the concrete floor and terminate directly into the motor end of the pumps.

The in-situ combustible is 6 gallons of lubricating oil contained in each of the service water pumps. The fire protection in the area consist of manual hose stations and portable fire extinguishers. The licensee justifies this alternative on the following:

- a) Manual fire fighting capability,
- b) Television Camera Surveillance of the area in lieu of fire detection, and
- c) An analytical model employed to show that the magnitude of an exposure fire needed to damage redundant components is significantly higher than reasonably expected.

4.3 Evaluation

This area does not comply with Section III.G because it does not have an automatic suppression system and twenty feet of separation free of intervening combustibles. There is no alternate shutdown capability independent of this area and there is no automatic fire detection system. This area is under continuous television surveillance by security personnel. The in-situ combustible load is light. The only cables in the room are two short sections per pump that rise from the floor near each pump and terminate at the pump. The lubricating oil is contained in the pump and there are no hot surfaces in the area.

The licensee has conducted an analysis to determine quantity of fuel, spilled on the floor of the area, that is needed to create a fire and corresponding heat flux of enough severity to cause cable damage. The analysis indicates that 17 gallons of acetone in a 8 foot diameter pool, is needed to effect damage. However, as discussed in Section 2.0 there is no positive means of preventing the accumulation of transient materials in individual plant areas.

With the low combustible loading, and continuous surveillance in this area, there is reasonable assurance that a fire would be detected promptly and could be extinguished manually.

4.4 Conclusion

Based on the above evaluation, the level of existing protection for this area does provide a level of fire protection equivalent to the technical requirements of Section III.G of Appendix R. Therefore, the exemption for the Service Water Pump Area should be granted.

5.0 Fire Barrier Cable Penetration Seal Qualification

5.2 Exemption Requested

The licensee requested an exemption for certain penetration seals from Section III.M.2 of Appendix R to 10 CFR 50 to the extent that the acceptance criteria for fire barrier cable penetration seal qualification requires that the temperature levels recorded on the unexposed side of the seal be analyzed to demonstrate that the maximum temperature be sufficiently below the cable insulation ignition temperature. Subsequently, the licensee requested that the seals in question be accepted as two hour rated seals in their installed locations.

5.2 Discussion

Our initial review of the initial exemption request from Section III.M acceptance criteria evaluated whether a selected fire barrier cable penetration seal had been properly qualified as having a three-hour rating. We concluded that it was not and that several 3-hour rated barriers contained 2-hour rated seals. By memorandum dated April 21, 1981, we denied the licensee's request for exemption.

On July 18, 1981, we met with the licensee to discuss the exemption request. At the meeting, we agreed that the fire seal had successfully been qualified as having a two-hour fire rating, and could be acceptable where justified that the fire barrier need only be rated at two hours. We requested that the licensee identify the fire barriers that contain this seal and the fire loading on both sides of the seal. By letter dated October 7, 1981, the licensee provided the requested information.

5.3 Evaluation

This alternative does not meet the requirements of Section III.M.2 of Appendix R, because two-hour penetration seals are installed in three-hour rated fire barriers. The penetration seals meet Section III.M.2 acceptance criteria for two hours. The fire barriers in which the penetration seals are installed have been shown to separate fire areas which have a fuel load less than two hours.

With the exception of the North Cable Vault, the in-situ fuel loading of the fire area is equivalent to a fire severity of approximately one hour or less. Because the in-situ fuel loads have a fire severity considerably less than the fire resistive rating of the penetration shields, the probability of postulated fires propagating from one fire area to another through the 2-hour fire rated penetration seals is low.

The North Cable Vault has a fuel load equivalent to a fire severity of one hour and 59 minutes. However this area is protected by (1) early warning fire detection, (2) automatic CO₂ fire extinguishing system, and (3) manual fire fighting capability. The automatic fire suppression system and reasonable fire brigade response should be adequate to preclude failure of these seals during a fire.

Therefore, we find the use of the 2-hour fire rated penetration seals in the fire barriers specified provides a level of protection equivalent to that required by Section III.M.2 of Appendix R.

5.4 Conclusion

Based on our evaluation, we conclude that the 2-hour fire rated penetration seals in the fire barriers specified, provide a level of safety equivalent to the technical requirements of Section III.M of Appendix R and therefore, the licensee's request should be granted.

Summary

Based on our evaluation discussed above, we agree with the licensee that modifications required to meet Section III.G and III.M would not enhance fire safety above that provided by existing and proposed alternatives. Therefore, the licensee's requests for exemptions for the following areas should be granted:

1. RHR Pitt (Fire Zone 27)
2. Service Water Pump Area
3. Fire Barrier Cable Penetration Seal Qualification

Principle Contributor: John Stang, DE