

July 22, 1985

DMB 016

Docket No. 50-289

Mr. Henry D. Hukill, Vice President  
and Director - TMI-1  
GPU Nuclear Corporation  
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Dear Mr. Hukill:

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In our Safety Evaluation Report dated June 4, 1983, we granted exemptions to the technical requirements of Appendix R to 10 CFR 50. The exemptions were based, in part, on your commitment to install 1-hour fire-rated barriers around certain shutdown-related cables. By letter dated February 14, 1984, you proposed using fire-rated cable in lieu of fire barriers for certain applications in the plant. At our request, your letter dated February 11, 1985 provided a "worst-case" sample exemption request for one location in the plant to enable us to evaluate the viability of the proposal. The example also requested exemption for the protection of some barrier supports, but we have evaluated only the exemption for "fire-rated" cable. Enclosed is our sample evaluation of this information.

Based on our sample evaluation, we conclude that the use of Rockbestos "fire-rated" cable in the Fuel Handling Building Fire Zone FH-FZ-1, can be shown to provide an equivalent level of safety to that obtained by installing 1-hour fire-rated barriers around vulnerable shutdown-related cables in this area. However, additional information should be provided in support of the actual exemption requests as indicated in our evaluation. Exemption requests, with supporting information, should be prepared for each fire area in which fire-rated cable is being considered including the Fuel Handling Building. We also request that you provide a schedule for submitting these exemption requests.

Sincerely,

FORWARDED BY  
JLZ

John P. Lopez, Chief  
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Division of Licensing

cc: See next page

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Unit No. 1

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Three Mile Island, Unit 1

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U.S. Nuclear Regulatory Commission  
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Atomic Safety & Licensing Appeal  
Board Panel (8)  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Docketing and Service Section  
Office of the Secretary  
U.S. Nuclear Regulatory Commission  
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SAMPLE EXEMPTION REQUEST

THREE MILE ISLAND NUCLEAR STATION, UNIT 1  
DOCKET NO. 50-289

1.0 Introduction

By letter dated February 14, 1984, the licensee proposed to use Rockbestos "fire-rated" cable in lieu of installing 1-hour fire-rated barriers to protect certain shutdown-related circuits. At our request, the licensee identified some locations in the plant where the use of the "fire-rated" cable would represent a "worst-case" condition. A "sample" exemption request with supporting information was submitted by letter dated February 11, 1985. This exemption is intended to be a test case to determine the viability of using "fire-rated" cable in other locations.

A specific exemption request is needed for each fire area where "fire-rated" cable is proposed in lieu of fire barriers, including a specific request for the Fuel Handling Building. The items discussed in the following evaluation should be discussed for each specific request.

2.0 Evaluation of Fuel Handling Building - Fire Zone FH FZ 1<sup>1/</sup>

2.1 Exemption Requested

The licensee requested an exemption from Section III.G of Appendix R to 10 CFR 50 to the extent that it requires that redundant shutdown-related systems be separated by a 1-hour fire-rated barrier and be free of fire damage.

2.2 Discussion

This fire area is bounded by walls, floor, and ceiling of reinforced concrete. These structural features separate this fire area from other plant locations which the licensee has identified as separate fire areas. Our evaluation of fire area boundary features will be covered in a separate SER.

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<sup>1/</sup> We have evaluated this exemption on the basis that fire rated cable will be installed within or throughout a fire area; however, the licensee designates this fire area as a fire zone.

This fire area contains the following shutdown-related systems:

1. Make-up and Purification Pumps MU-P-1A, 1B and 1C power circuits;
2. Auxiliary Oil Pumps MU-P3A, 3B and 3C power circuits;
3. Reactor Building Emergency Cooling Units AH-E-1A, 1B and 1C power circuits;
4. Decay Heat Pumps DH-P-1A and 1B, power circuits;
5. Borated Water Storage Tank Monitoring instrument circuits;
6. Feeders to 480V AC-ESV CC-1A and 1B;
7. Nuclear Instrumentation Circuits;
8. Steam Generator Pressure Monitoring instrument circuits;
9. Steam Generator Level Monitoring instrument circuits;
10. Reactor Coolant Temperature (cold) Monitoring instrument circuits;
11. Power, control, and control power circuits to the 480V AC ES-SH SWGR-IR 1T;
12. Reactor Coolant Temperature (HOT) Monitoring instrument circuits;
13. Reactor Coolant Pressurizer Level Monitoring instrument circuits;
14. Decay Heat River Water Pumps DR-P-1A and 1B control circuits;
15. Nuclear Services River Water Pumps NR-P-1A, 1B and 1C control circuits;
16. Reactor Building Emergency River Water Pumps RR-P-1A and 1B power circuits; and
17. Reactor Coolant Pressurizer Level Monitoring instrument circuits.

The in-situ fire loading within this zone consists primarily of cable insulation. In addition, eight steel drums, each 55 gal., are located in the southwest section of the zone for the collection of waste materials such as paper, plastic, and clothing. Maintenance materials such as rubber and plastic hose, vacuum cleaners, plastic buckets are kept behind a partial-height wall in the south section of the zone. Cable routings above these transient combustibles are such that only one redundant channel of cable trays (B channel) is located above or in the immediate vicinity of the steel drums containing waste in the southwest section and only one redundant channel of cable trays (A channel) is located above or in the immediate vicinity of the maintenance materials in the south section. Combustibles in other areas of this fire zone consists of cable insulation in trays and small quantities of pump lubricating oil. The overall fire loading, the majority of which is cable insulation in trays, is approximately 49,500 BTU/ft<sup>2</sup> which corresponds to a fire severity on the ASTM E-119 time-temperature curve of 29 minutes.

The cable insulation is contained in open bottom trays which are spread horizontally up to eight trays wide instead of being stacked vertically. At several locations the north-south routed trays pass over or under east-west routed trays. The maximum vertical stacking of trays occurs in the northwest section of the zone where three large and two small cable trays are stacked for a short distance. All cable trays are located in the upper portions of the rooms and corridors, and are readily accessible for manual fire suppression.

This fire area is protected by an area wide fire detection system and an area wide automatic sprinkler system providing full coverage. A hose station and portable fire extinguishers are provided in the fire area for manual fire extinguishment.



By letter dated February 11,, 1985, the applicant committed to either: 1) reroute certain cables outside of the fire area; 2) implement a repair procedure for other fire-vulnerable cables within the area 3) enclose some shutdown cables in a 1-hour fire-rated barrier; or 4) replace one division of the remaining shutdown-related cables with the "fire-rated" cable.

The licensee justified the exemption for the use of "fire-rated" cable on the basis of tests conducted on the "fire-rated" cable and the existing level of fire protection.

### 2.3 Evaluation

The technical requirements of Section III.G are not met in this area (Fire Zone FH FZ 1) because certain shutdown-related cables delineated in the licensee's February 11, 1985, letter are not protected by a 1-hour fire-rated barrier and would not be free of fire damage after being involved in a fire. The staff's concerns, discussed below, need to be resolved before we can find acceptable the use of "fire-rated" cable in lieu of conventional fire walls or fire-rated cable wrap. Some of the concerns are fully resolved but others require further data before a conclusion can be reached.

#### 2.3.1 Functional Capability

We were concerned that the cable would not perform its intended function when exposed to the effects of a fire.

By letter dated June 9, 1984, the licensee submitted the results of a fire test conducted by Underwriter's Laboratories, Incorporated. Representative samples of the cable were subjected to a 1-hour fire endurance and hose stream test in accordance with the method in ASTM E-119. During the fire test and for a period of 93 hours beyond, electrical measurements were taken to confirm the cable's electrical performance. The results confirm that the acceptance criteria of ASTM E-119 were met or exceeded. We, therefore, have reasonable assurance that the cables will function as designed until the fire is extinguished.

#### 2.3.2 Mechanical Damage

We were concerned that the heat produced in a fire would cause structural features such as cable trays to collapse. The falling debris might impact the cable and cause its failure.

The area (Fire Zone FH FZ 1) is protected by a complete fire detection system that alarms in the control room. If a fire should occur, it would be detected in its formative stages before significant temperature rise occurs. The fire brigade would then extinguish the fire using manual fire fighting equipment. Additionally, if rapid fire propagation occurred, the available automatic sprinkler system would actuate to suppress the fire, reduce room temperatures, protect the shutdown-related cable and prevent debris formation. We therefore, have reasonable assurance that the "fire-rated" cable will not be mechanically damaged by falling debris during a fire.

### 2.3.3 Higher Temperatures in Cable Trays

In the proposed application, the "fire-rated" cable would be routed, in part, through cable trays containing conventional cable. We were concerned that a fire involving such cable would be more severe than the E-119 time-temperature curve. The fire test included such a configuration; therefore, this concern has been resolved.

### 2.3.4 Applicable Cable Voltages

In the early fire tests, the conductors of the "fire-rated" cable were energized at 110 Vac. We were concerned that the cable would be used at higher voltages (e.g. 600V). Subsequent fire tests were performed with the conductors energized at 480 Vac and 960 Vac. Therefore, this concern has been resolved.

### 2.3.5 Changes in Electrical Characteristics

We were concerned that the "fire-rated" cable would not provide the electrical performance characteristics that are necessary for successful operation in the various applications. For example, the "fire-rated" cable is proposed for power, control and instrumentation circuits.

The electrical characteristics of the cable (i.e. conductor and insulation) change with temperature increase. Thus, the insulation must be designed and the cable must be sized so that these changes do not affect the performance of the required function. The electrical performance criteria for each application (i.e. power, control or instrumentation) must be specified; the "fire-rated" cable must then be shown to meet these criteria to assure that changes in the electrical characteristics of the "fire-rated" cable during a fire will not affect circuit operation.

The electrical performance criteria for the various applications were not provided in the sample exemption request. However, we believe that acceptable designs can be developed.

### 2.3.6 Post-Fire Operability

Because the "fire-rated" cable would be damaged by a fire, we were concerned that this damage would affect the long-term performance of shutdown functions following the fire.

The extent of cable damage following the fire must be determined so that the electrical characteristics immediately after the fire can be established; then the acceptability of the "fire-rated" cable for further use can be determined. Special precautions may be needed to prevent further cable damage, or cables may need to be replaced, or certain functions may not be needed making the applicable cables unnecessary. These aspects of post-fire operability should be addressed in the licensee's analyses for each fire area. This information was not provided in the sample exemption request.



### 2.3.7 Immersion Resistance

We were concerned that "wet short" conditions were not simulated in the "fire-rated" cable tests but cables in cable trays may be immersed in water for a significant time. The sample exemption request is for stainless steel sheathed cables only. In our opinion, such cables would not be subject to failure by "wet shorts" and this concern is resolved.

### 2.3.8 Thermal Expansion Forces

We were concerned that thermal expansion forces, and post-fire mechanical forces due to firefighting and recovery operations, were not simulated.

For the distributed fire load in this area, a real fire would not result in temperatures approaching the E-119 time-temperature curve over a large portion of the fire area even if the automatic suppression system did not operate. Prompt action by the fire brigade and automatic suppression would further reduce the time-temperature curve. The hose stream tests with repeated application of hose stream forces has resolved this concern.

### 2.3.9 Post-Test Assessment of Operability

We were concerned that no post-test assessment of the operability of the "fire-rated" cables had been made. Subsequent tests have shown that the "fire-rated" cable can remain functional during the fire and for at least 94 hours thereafter. Therefore, this concern is resolved.

### 2.3.10 Mechanical Damage Due to Delay in Automatic Suppression

We were concerned that if the automatic suppression system did not operate as designed for a rapidly developing fire, the "fire-rated" cable could be damaged by debris. In our opinion, the probability of a severe, rapidly developing fire is low with the in-situ final configuration, and the cable would not be damaged even if the automatic suppression was delayed.

### 2.3.11 Improved Separation

The staff suggested that it would be prudent to provide improved separation (i.e., better than required by Reg. Guide 1.75) between the "fire-rated" cable and its redundant counterpart. However, in our opinion, the lack of improved separation would not be a cause to deny the exemption for the sample exemption request. This issue is resolved.

### 2.3.12 Continuous Cable in Each Fire Area

The "fire-rated" cable should be continuous through the fire area (i.e., splices between "fire-rated" and non "fire-rated" cable should be made outside of the fire area boundaries). If not, the licensee should justify why the "fire-rated" cable should not be continuous through the fire area. The licensee should describe the splice and its protection to assure that it does not cause a loss of function due to fire or fire suppressants.

### 3.0 Conclusions

Based on our evaluation, we conclude that with adequate supporting information requested herein the use of "fire-rated" cable in a fire area with a distributed in-situ fire loading and protected by automatic suppression systems can be shown to provide an equivalent level of safety to that achieved by installing a 1-hour fire barrier per Section III.G.2.C of Appendix R.