January 30, 2002

MEMORANDUM TO: John N. Hannon, Chief
Plant Systems Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

FROM: Mark A. Cunningham, Chief ***/RA/***
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SUBJECT: ASSESSMENT OF THE IMPACT OF APPENDIX R FIRE PROTECTION EXEMPTIONS ON FIRE RISK FOR QUAD CITIES UNITS 1 AND 2, AND DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

In a Staff Requirements Memorandums (SRM) on SECY 98-058 dated June 30, 1998, the staff was directed to "closely examine plants whose individual plant examinations for external events (IPEEEs) show fire protection vulnerabilities to gain a thorough understanding of the particular risk contributors." In addition, in another SRM dated April 1, 1999, the staff was directed as follows: "When assessing the effect of exemptions to Appendix R, the staff needs to consider the cumulative effect of exemptions at a particular plant."

To respond to the Commission's SRMs, the staff, with contractor support from Sandia National Laboratories (SNL), performed a study to assess the core damage frequency (CDF) impact of Appendix R exemptions at nine plants. The results of the study were summarized in SECY 99-182, dated July 9, 1999. The findings of the SNL study are provided in a June 1999 letter report from SNL entitled, "An Assessment of the Impact of Appendix R Fire Protection Exemptions on Fire Risk." The plants selected in the SNL study had reported higher fire-induced CDFs in the plants' IPEEE fire analyses than those in other IPEEE submittals. However, Quad Cities Units 1 and 2, which reported a high fire-induced CDF estimate and also had over 30 Appendix R exemptions, was not included in the study because Quad Cities was revising its original IPEEE fire analysis. The results of the SNL study indicated that five exemptions at two plants (three for Dresden and two for Farley) were found to be potentially risk significant. A third plant, Robinson, had 13 exemptions, none of which taken individually were found to be risk significant; however, the cumulative impact of these exemptions at Robinson was found to be potentially risk significant.

As a result of the SNL study, the licensees for Farley and Robinson provided additional detailed information on exemptions for these two plants. Based on the additional information provided by the licensee, NRR determined that the impacts of the Appendix R exemptions at Robinson were insignificant. Also, Farley has withdrawn its exemptions.

Subsequent to the completion of the SNL study, Commonwealth Edison submitted revised IPEEE fire analyses for Quad Cities and Dresden. Therefore, the exemptions for Quad Cities and the potentially risk significant exemptions for Dresden needed further evaluation. This evaluation was done by RES and is provided in the attachment. Our evaluation confirms the findings from the SNL study that a simple count of the number of exemptions at a given plant

provides little or no direct insight into the potential risk significance of exemptions at that plant. Similarly, a comparison of the number of exemptions between plants does not provide a reliable indication of the relative risk significance of exemptions at each plant.

With respect to the impact of the individual Appendix R exemptions, our findings indicate that the Appendix R exemptions for Quad Cities Units 1 and 2, and Dresden Units 2 and 3 had either a small or a very small impact on plant core damage frequencies (CDFs), with the large majority of the exemptions having a very small impact on the plant's CDF.

With respect to the cumulative effect of the Appendix R exemptions, our findings indicate that the cumulative CDF impacts due to the exemptions at Quad Cities Units 1 and 2, and Dresden Units 2 and 3 were small.

Ed Chow had provided a draft of this evaluation to Ed Connell of your staff, and we incorporated Ed Connell's comments in the final version. If you have any further questions regarding this evaluation, please contact Dr. Chow at 415-6571.

Attachment: As stated

DOCUMENT NAME: G:\IP3\FIRE-EXEMPTIONS-IMPACT.WPD
OAR in ADAMS? (Y or N) Y ADAMS ACCESSION NO.: _____ TEMPLATE NO. RES-__

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ATTACHMENT

ASSESSMENT OF THE IMPACT OF APPENDIX R FIRE PROTECTION EXEMPTIONS ON FIRE RISK FOR QUAD CITIES UNITS 1 AND 2, AND DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

BACKGROUND:

The Commission has recognized that strict compliance with the fire protection requirements in 10CFR Part 50, Appendix R for certain plant conditions and configurations may not significantly enhance the level of fire safety that was already provided by the licensee. Licensees could request an exemption from the Appendix R requirements by demonstrating that an alternative fire protection approach could provide an equivalent level of fire protection as that required by Appendix R.

The staff has granted Appendix R exemptions because the proposed alternative fire protection strategies provided an adequate level of fire protection and meet the underlying purpose of the regulation. The staff notes that the core damage frequencies (CDFs) from fires associated with the alternative strategies are not necessarily equivalent to that associated with a compliance-based strategy. Since the exemptions often represent relaxations, it is conceivable that the granting of exemptions could result in some increase in CDFs from fires.

In a Staff Requirements Memorandum (SRM) on SECY 98-058, dated June 30, 1998, the staff was directed to "closely examine plants whose individual plant examinations for external events (IPEEEs) show fire protection vulnerabilities to gain a thorough understanding of the particular risk contributors. In evaluating those facilities, consideration is to be given to the cumulative effects of exemptions to current regulations to ensure that an adequate level of fire protection is maintained. The staff is directed to report to the Commission the results of lessons learned from the IPEEE efforts." In addition, in another SRM dated April 1, 1999, the staff was directed as follows: "When assessing the effect of exemptions to Appendix R, the staff needs to consider the cumulative effect of exemptions at a particular plant."

To respond to the Commission's SRMs, the staff, with contractor support from Sandia National Laboratories (SNL), performed a study to assess the impact of Appendix R exemptions on CDF at nine plants representing a total of 13 units. The plants selected reported higher fire-induced CDFs in the plants' IPEEE fire analyses than those in other IPEEE submittals. The plants included in this study were Calvert Cliffs Unit 1, Dresden Units 2 and 3, Farley Units 1 and 2, Kewaunee, Palisades, Robinson Unit 2, St. Lucie Units 1 and 2, Summer, and Turkey Point Units 3 and 4. However, Quad Cities Units 1 and 2, which reported a high fire-induced CDF estimate and also had over 30 Appendix R exemptions, was not included in the study because the licensee was revising the Quad Cities IPEEE fire analysis. The findings of the SNL study are provided in a June 1999 letter report entitled, "An Assessment of the Impact of Appendix R Fire Protection Exemptions on Fire Risk."

The results of the SNL study indicated that five exemptions at two plants (three for Dresden and two for Farley) were found to be potentially risk significant. A third plant, Robinson, had 13

exemptions, none of which taken individually were found to be risk significant; however, the cumulative impact of these exemptions at Robinson were found to be potentially significant. With respect to the other plants, the impacts of exemptions were insignificant.

Subsequently, in a note dated February 28, 2001, from John Hannon, NRR noted that the exemptions granted to Robinson do not represent a significant risk because of design features that were not recognized in the SNL study. In addition, NRR noted that the licensee for Farley has stated in a letter dated June 29, 2000, that it does not need the exemptions in question and they have withdrawn these exemptions.

Subsequent to the completion of the SNL study, Commonwealth Edison submitted revised IPEEE fire analyses for Quad Cities and Dresden. RES assessed the exemptions for Quad Cities and the potentially risk significant exemptions for Dresden. The purpose of this evaluation was to investigate the impact of Appendix R exemptions at Quad Cities and Dresden on the plant CDFs using the licencee's revised IPEEE fire analyses. The staff made use of the FIREDAT database which contains information on the exemptions for the two plants. The attached appendix contains the results of the assessment of individual Appendix R exemptions for the two plants.

The original Quad Cities IPEEE submittal identified fire protection vulnerabilities. The original Quad Cities IPEEE reported a large CDF (about 5E-3/RY for each unit) associated with postulated fire events. The licensee's revised Quad Cities IPEEE results showed significantly reduced fire-induced CDF (6.6E-5/RY for Unit 1 and 7.1E-5/RY for Unit 2). The differences between the CDFs in the original and revised analyses were discussed in a letter dated September 13, 1999, from Joel P. Dimmette, Jr., Commonwealth Edison Company to the NRC.

The differences between the CDFs in the original and revised analyses were mostly due to: (1) more detailed and realistic information on cable routing, (2) a revised fire initiation frequency evaluation, (3) the safe shutdown model employed, and (4) the fire propagation model used. On the basis of the re-analysis, the licensee submitted a letter dated November 5, 1999, from R. M. Krich, Commonwealth Edison Company to the NRC stating that the Appendix R exemptions have little risk significance at Quad Cities. The staff had not assessed the Quad Cities' analysis on the exemptions from Appendix R. Therefore, we performed an independent assessment of the impact of the exemptions from Appendix R.

The original Dresden IPEEE submittal identified no fire protection vulnerabilities. The original Dresden IPEEE reported large CDFs (about 2.5E-4/RY for Unit 2 and 2.8E-4/RY for Unit 3) associated with postulated fire events. The licensee submitted a re-analysis to the NRC on March 30, 2000, in which they stated that the revised Dresden fire-induced CDFs are about 1.7E-5/RY for Unit 2 and 3.1E-5/RY for Unit 3. The differences between the CDFs in the original and revised analyses were mostly due to the use of improved fire risk models that had less conservatism. The results of the SNL study identified three potentially significant exemptions at Dresden related to a lack of fixed automatic suppression. Two of these three exemptions also cited a lack of fixed detection. Each of the three exemptions impacted one or more areas identified in the IPEEE as significant or dominant contributors to fire-induced CDF.

DISCUSSION:

The staff has reviewed the exemptions for Quad Cities and Dresden, using risk insights gained through an examination of the corresponding IPEEE fire analysis. The staff has attempted to address both the quantitative and qualitative risk implications of the exemptions. The quantitative implications relate to the quantification of risk from fire as represented by the fire-induced CDF. Qualitative risk implications relate to the impact that exemptions may have had on fire protection defense-in-depth (i.e., on the elements of fire prevention, fire detection and suppression, and protection of plant safe shutdown equipment).

The fire areas or zones impacted by a given exemption were compared to those cited in the IPEEE. To the extent possible, the CDFs corresponding to the impacted fire areas or zones as reported in the revised IPEEEs were used to determine the impact of the exemption. If the impact of an exemption on the plant CDF is less than 1E-6/RY, we designated it as "very small." If the impact of an exemption on the plant CDF is in the range from 1E-6/RY to 1E-5/RY, we designated it as "small."

After the staff assessed the impact of each individual exemption on the plant CDFs for the two plants, the staff considered the impact of individual exemption to assess the cumulative effect of exemptions on fire risk for the two plants.

Limitations

There are various limitations of this study. The most significant limitation is the reliance on the IPEEE fire submittals as the primary basis for developing risk insights. The intent of the IPEEE was for licensees to identify potential plant vulnerabilities and gain an appreciation of severe accident behavior at each plant. The staff's IPEEE review has considered only the IPEEE process documented in the submittal without validating the accuracy of the licensees' detailed findings or CDF estimates. This study utilized the IPEEEs in a manner that goes beyond the original intent of the IPEEE process.

Another limitation is the lack of detailed information used in this study. The initial assessments were completed based on (1) abstracts from the FIREDAT database of the rationale used by the staff to grant the exemption, and (2) insights gleaned from the corresponding IPEEE submittal. No site visits or follow-up discussions with plant personnel were undertaken to address the risk impact of the exemptions.

Even with the limitations as discussed above, the IPEEEs provide the best information readily available to address questions about the potential risk significance of Appendix R exemptions.

Results

The staff has examined 37 individual exemptions at Quad Cities. With respect to the impact of individual exemptions at Quad Cities, the results of this study have shown that 30 of these exemptions at Quad Cities had very small impacts on plant CDF, and the rest had small impacts on the plant CDF. In the case of Dresden, the staff evaluated the three exemptions which were identified as potentially significant in SECY 99-182 and determined that two of the

them have very small impacts on the plant CDF, and the remaining exemption has a small impact on the plant CDF. The bases for these conclusions are provided in the attached appendix.

With respect to the cumulative effect of exemptions, the staff found that the cumulative CDF impacts at the two plants were small.

Our review indicates that licensees depended on various aspects of fire protection defense-in-depth to minimize the risk from fire. However, even assuming that the licensees had upgraded the fire protection capabilities in the impacted areas, the plant CDFs would not be reduced significantly. The reason is because the CDFs in the revised IPEEEs are much lower than those in the original IPEEEs, and the impacts of exemptions on the lowered CDFs were mostly insignificant.

In general, the exemptions at Quad Cities can be separated into three categories depending on the licensee's defense-in-depth approach:

1. Manual versus Fixed Automatic Suppression

   To ensure plant safety, the plant usually uses fixed fire suppression systems (e.g., fire sprinkler systems) as a preferred means to protect safe shutdown equipment. If an exemption involves the lack of fixed fire suppression systems in fire areas containing redundant trains of safe shutdown equipment, the licensee would rely on automatic fire detection and manual fire fighting.

2. Lack of Separation and Absent Fire Barriers

   To ensure plant safety, the plant often considered separation and fire barriers as a passive means to protect safe shutdown equipment. In the event of lack of separation and not installing fire barriers required by Appendix R, the licensee took active measures for fire prevention, minimizing fire hazards, prompt intervention, and alternative shutdown or manual recovery.

3. Reliance on Manual Recovery Actions to Overcome Damage to Redundant Trains

   Instead of using passive or active protection of one safe shutdown system, the licensee relies on operator actions and plant procedures to recover lost systems and components. The impact of this type of exemption on the CDF would depend on the complexity and timing of the manual actions, and the experience and training of the operators.

CONCLUSIONS:

With respect to the impact of individual Appendix R exemptions, the results of this study have shown that the large majority of these exemptions at Quad Cities had very small impact on the plant CDF, and the rest had small impact on the plant CDF. In the case of Dresden, two of the three exemptions which were previously identified in the SNL study as potentially significant

have very small impacts on the plant CDF, and the remaining exemption has a small impact on the plant CDF.

With respect to the cumulative effect of the Appendix R exemptions, this study found that the cumulative CDF impacts at Quad Cities Units 1 and 2, and Dresden Units 2 and 3 were small.

The results of this study confirm the findings of the previous SNL report that a simple count of the number of exemptions at Quad Cities or Dresden provides little or no direct insight into the potential risk significance of exemptions at either plant. Similarly, the results of this study confirms that a comparison of the number of exemptions between plants does not provide a reliable indication of the relative risk significance of exemptions at each plant. In the case of Quad Cities, even though there is a large number (37) of exemptions at Quad Cities, only 7 exemptions at Quad Cities had small impacts on CDF, and the cumulative impacts of all exemptions at Quad Cities were determined to be small.

The staff finds that the exemptions examined do not represent a vulnerability.

APPENDIX

ASSESSMENT OF INDIVIDUAL APPENDIX R FIRE PROTECTION EXEMPTIONS FOR QUAD CITIES UNITS 1 AND 2, AND DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

Plant: Quad Cities

Exemption#: QUAD-01

Document Accession #: 8307120145-01

Appendix R Section: III.G.3

Exemption Description: No fixed fire suppression associated with panels and switchgear and motor control centers.

Potential for CDF Reduction: Very small

Analysis: Since smoke detection and manual fire suppression equipment are available, a fire in these areas would be detected and extinguished.

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Plant: Quad Cities

Exemption#: QUAD-02

Document Accession #: 8307120145-02

Appendix R Section: III.G.2.a

Exemption Description: 3-hour fire barriers not provided between redundant divisions of safe shutdown equipment in Reactor Building basement.

Potential for CDF Reduction: Very small

Analysis: The fire loading in this area is estimated to be small. Since smoke detection and manual fire suppression equipment are available, and there are one-hour fire-rated barriers for redundant cable trays, a fire in this area would be detected and extinguished.

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Plant: Quad Cities

Exemption#: QUAD-03

Document Accession #: 8908240308-01

Appendix R Section: III.G.1

Exemption Description: Turbine Building Northern and Southern Zone Groups require manual operations to prevent spurious operations and high impedance faults of safe shutdown equipment.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: Plant shutdown procedures are in place for operators to trip breakers and pull fuses. Operators would trip applicable breakers within 30 minutes after the scram before initiating the reactor water makeup system. Operators would also trip applicable breakers within 3 hours after the scram before initiating the torus cooling. It appears that there is sufficient time for operators to perform tripping of the breakers. In addition, operators would need to pull fuses in a timely manner. Since the fuses are easily identifiable, are readily accessible, can be removed easily, and are under periodic surveillance, operators can pull fuses in a timely manner.

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Plant: Quad Cities

Exemption#: QUAD-04

Document Accession #: 8908240308-02

Appendix R Section: III.G.1

Exemption Description: Control power circuits for Diesel Generator and 480 V breakers require hot shutdown repairs to compensate for fire-induced electrical design deficiencies.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: Plant surveillance procedures are in place for operators to maintain replacement fuses and fuse pullers near the controls.

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Plant: Quad Cities

Exemption#: QUAD-05

Document Accession #: 8908240308-03

Appendix R Section: III.G.2.a

Exemption Description: Complete 3-hour fire rated barriers are not provided in Unit 1 and 2 Reactor Building Torus Fire Zones.

Potential for CDF Reduction: Very small

Analysis: Since fire detection is available for all affected zones, and there exists an automatic fire suppression system in fire zones 11.2.2 and 11.3.2, a fire would be detected and announced in the control room. The fire would be extinguished by the fire brigade promptly.

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Plant: Quad Cities

Exemption#: QUAD-06

Document Accession #: 8908240308-04

Appendix R Section: III.G.2.a

Exemption Description: Complete 3-hour fire rated barriers are not provided for both units Reactor/Turbine Building interface boundary.

Potential for CDF Reduction: Very small

Analysis: For most of the fire zones affected, there are fire detection system and/or fire suppression systems available. Even though the steam chase and fire zones 1.1.1.4 and 1.1.1.5 do not have fire detection systems available, these areas contain no safe shutdown components. In addition, there are automatic fixed fire suppression systems available in the turbine building adjacent to the steam chase. The fire loads near the Reactor/Turbine Building interface boundary are considered to be negligible, and the fire risk is considered to be very small.

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Plant: Quad Cities

Exemption#: QUAD-07

Document Accession #: 8908240308-05

Appendix R Section: III.G.2.a

Exemption Description: Automatic fire detection and fixed fire suppression systems are not provided in twenty-one Reactor Building fire zones.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as "small."

Analysis: Only two of the fire zones have a high fire load; however, there are automatic fire suppression systems available to protect these two fire zones. The fire zones that do not have either fire detection systems or fixed fire suppression systems have either negligible fire loads or no safe shutdown components. All fire zones containing safe shutdown equipment are equipped with fire detection. In the event of a fire, the fire would be detected in its early stages, and it is expected that the fire brigade would extinguish the fire promptly.

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Plant: Quad Cities

Exemption#: QUAD-08

Document Accession #: 8908240308-06

Appendix R Section: III.G.3

Exemption Description: Auxiliary computer room, control room, and auxiliary electrical equipment room fire zones do not have fixed fire suppression systems.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as "small."

Analysis: If a fire occurs in the affected areas, it is expected that automatic detection systems or plant personnel would detect the fire promptly, and the fire brigade would be dispatched to extinguish the fire. In addition, the control room and the auxiliary electrical equipment room are part of fire area SB-I which is mostly surrounded by 3-hour fire rated barriers. It is expected that a fire would not spread to adjacent fire areas.

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Plant: Quad Cities

Exemption#: QUAD-09

Document Accession #: 8908240308-07

Appendix R Section: III.G.2.a.

Exemption Description: Complete 3-hour fire rated barriers are not provided between redundant divisions of safe shutdown system components in fire zones having the 4 kv bus duct penetrations.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the bus duct is not expected to fail within an hour, and it is very likely that the fire brigade would extinguish the fire within an hour. Therefore, complete 3-hour fire rated barriers are not provided between redundant divisions of safe shutdown system components in fire zones having the 4 kv bus duct penetrations.

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Plant: Quad Cities

Exemption#: QUAD-10

Document Accession #: 8908240308-08

Appendix R Section: III.G.2.a.

Exemption Description: A complete 3-hour fire rated barrier is not provided for the Standby Gas Treatment System and Reactor Building Vent System piping.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the HVAC piping is not expected to fail within an hour, and it is very likely that the fire brigade would extinguish the fire within an hour. Therefore, a complete 3-hour fire rated barrier is not needed for the Standby Gas Treatment System and Reactor Building Vent System piping

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Plant: Quad Cities

Exemption#: QUAD-11

Document Accession #: 8908240308-09

Appendix R Section: III.G.3

Exemption Description: Automatic fire detection and fixed fire suppression systems are not installed in the Drywell Expansion Gap.

Potential for CDF Reduction: Very small

Analysis: A fire in the drywell expansion gap spreading into other areas would only affect one fire area in the Reactor Building of one unit, and independent shutdown path would be available. Since a fire in the drywell expansion gap would not impact safe shutdown functions of Unit 1 or Unit 2, automatic fire detection and fixed fire suppression systems are not needed in the drywell expansion gap.

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Plant: Quad Cities

Exemption#: QUAD-12

Document Accession #: 8908240308-10

Appendix R Section: III.G.2.a.

Exemption Description: A complete 3-hour fire rated barrier is not provided in the Turbine Building Southern and Central Zone Groups.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the fire would be detected quickly, and it is expected that the fire brigade would extinguish the fire promptly. Therefore, a complete 3-hour fire rated barrier is not needed in the Turbine Building Southern and Central Zone Groups.

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Plant: Quad Cities

Exemption#: QUAD-13

Document Accession #: 8908240308-11

Appendix R Section: III.G.2.a.

Exemption Description: A complete 3-hour fire rated barrier is not provided in the Turbine Building Northern and Southern Zone Groups.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the fire would be detected quickly, and it is expected that the fire brigade would extinguish the fire promptly. Therefore, a complete 3-hour fire rated barrier is not needed in the Turbine Building Northern and Southern zone Groups.

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Plant: Quad Cities

Exemption#: QUAD-14

Document Accession #: 8908240308-12

Appendix R Section: III.G.2.a.

Exemption Description: A complete 3-hour fire rated barrier is not provided for four zones in the Turbine Building Operating Floor.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the fire would be detected quickly, and it is expected that the fire brigade would extinguish the fire promptly. Therefore, a complete 3-hour fire rated barrier is not needed for four zones in the Turbine Building Operating Floor.

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Plant: Quad Cities

Exemption#: QUAD-15

Document Accession #: 8908240308-13

Appendix R Section: III.G.2.a.

Exemption Description: Unrated, metal, watertight door does not provide a complete 3-hour fire rated barrier between redundant safe shutdown system components.

Potential for CDF Reduction: Very small

Analysis: Since fire suppression is available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the steel watertight door would be expected to withstand a fire until the automatic fire suppression system extinguishes the fire. Therefore, a complete 3-hour fire rated barrier between redundant safe shutdown system components is not needed.

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Plant: Quad Cities

Exemption#: QUAD-16

Document Accession #: 8908240308-14

Appendix R Section: III.G.2.a.

Exemption Description: A complete 3-hour fire rated barrier is not provided in the Northern Central Zone Groups of the Turbine Building.

Potential for CDF Reduction: Very small

Analysis: Since fire detection and automatic fire suppression are available, and fire loadings are expected to be low, a fire of major significance is not expected. In the event of a fire, the fire would be detected quickly, and it is expected that automatic fire suppression and/or the fire brigade would extinguish the fire promptly. Therefore, a complete 3-hour fire rated barrier is not needed for the Northern Central Zone Groups of the Turbine Building.

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Plant: Quad Cities

Exemption#: QUAD-17

Document Accession #: 9106060039-01

Appendix R Section: III.G.2.b.

Exemption Description: 20 feet of horizontal space free of intervening combustibles and area wide suppression is not provided for a fire area containing redundant reactor vessel water level indicating instrumentation in the Reactor Building.

Potential for CDF Reduction: Very small

Analysis: Since fire loadings are expected to be low in the fire zones containing the reactor vessel water level indicating instrumentation, a fire of major significance is not expected. Since fire detection is available in the fire zones, a fire, if occurred in the vicinity, would be detected quickly, and it is expected that the control room operators would dispatch a fire brigade to extinguish the fire promptly.

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Plant: Quad Cities

Exemption#: QUAD-18

Document Accession #: 9106060039-02

Appendix R Section: III.G.2.b.

Exemption Description: Adequate separation is not provided between redundant Suppression Pool level indicators in the Reactor Building. Detection and suppression are also not provided.

Potential for CDF Reduction: Very small

Analysis: Since access for the torus level is restricted, the accumulation of transient combustibles would be minimized. Because fire loadings are expected to be low in the torus level, a fire of major significance is not expected. Detection is available for cable trays on the torus level. Detection is provided throughout the ground floor. In the event of a fire, the licensee indicated that there were three hours available for the fire brigade to control the fire and implement smoke removal activities before initiation of the monitoring of the torus water level. In view of the substantial time available for the fire brigade to control the fire and remove the smoke, operators would be able to gain access to the torus in a timely manner to monitor the torus water level.

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Plant: Quad Cities

Exemption#: QUAD-19

Document Accession #: 9106060039-03

Appendix R Section: III.J.

Exemption Description: Emergency lights are not provided for Suppression Pool level sight glasses in Reactor Building.

Potential for CDF Reduction: Very small

Analysis: Since access for the torus level is restricted, fire loadings are expected to be low in the torus level, and a fire of major significance is not expected. Detection is available for cable trays. In the event of a fire, the licensee indicated that there were three hours available for the fire brigade to control the fire and implement smoke removal activities before initiation of the monitoring of the torus water level. In view of the substantial time available for the fire brigade to control the fire and remove the smoke, it is expected that fire brigade would extinguish the fire, and operators would have sufficient time to obtain portable lights for suppression pool level sight glasses. Therefore, emergency lights are not needed for Suppression Pool level sight glasses in Reactor Building.

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Plant: Quad Cities

Exemption#: QUAD-20

Document Accession #: 9106060039-04

Appendix R Section: III.G.1.b.

Exemption Description: Fuse pulling, which would constitute a “repair,” is required to prevent spurious equipment operation during hot shutdown.

Potential for CDF Reduction: Very small

Analysis: There are only two fire scenarios that require fuse pulling. Fuse pulling can be accomplished easily and without errors.

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Plant: Quad Cities

Exemption#: QUAD-21

Document Accession #: 9106060039-05

Appendix R Section: III

Exemption Description: Modification of combustible loading calculations from previously approved exemptions.

Potential for CDF Reduction: Very small

Analysis: The original loading of less than 30,000 Btu/ft^2 was too restrictive and did not allow for normal plant operation. The licensee proposed to increase the loading to 40,000 Btu/ft^2 which would allow normal plant operation and would not present any additional concerns.

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Plant: Quad Cities

Exemption#: QUAD-22

Document Accession #: 9403070103-01

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation of redundant trains by a 3-hour fire rated barrier or provision of alternative shutdown capability in fire zones 1.1.1.1, and 11.2.2 in the Reactor Building Unit 1.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because fire detection is available for all of the affected fire zones, a fire, if occurred, would be promptly detected and annunciated in the control room. In addition, cable tray enclosures are fire rated for one hour. It is unlikely that a fire would spread and damage redundant trains before the fire brigade or the fire suppression system extinguishes it.

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Plant: Quad Cities

Exemption#: QUAD-23

Document Accession #: 9403070103-02

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation of redundant trains by a 3-hour fire rated barrier or provision of alternative shutdown capability in fire zones 1.1.1.2 of the Reactor/Turbine Building interface boundary wall.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because area-wide fire detection is available (except inside the steam tunnel, drywell personnel air lock, and trackway), and fixed fire suppression and detection systems are installed in the Turbine Building fire zones adjacent to the steam chase, it is unlikely that a fire would propagate between the Reactor and Turbine Buildings before the fire brigade or the fire suppression system extinguishes it.

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Plant: Quad Cities

Exemption#: QUAD-24

Document Accession #: 9403070103-03

Appendix R Section: III.G.3

Exemption Description: Lack of complete fixed fire detection and fire suppression in fire zones 1.1.1.1, 1.1.1.2, 1.1.1.3, 11.2.1, 11.2.2, and 11.2.4, all areas for which shutdown capability is provided is provided in Reactor Building Unit 1.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: The fire zones that do not have either fire detection systems or fixed fire suppression systems have either negligible fire loads or no safe shutdown components. The fire barriers and the space volumes in the fire zones are sufficient to contain the fire hazard in the fire zones. In the event of a fire, the fire would be detected in its early stages, and it is expected that the fire brigade would extinguish the fire promptly.

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Plant: Quad Cities

Exemption#: QUAD-25

Document Accession #: 9403070103-04

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation between redundant RHR trains by a 3-hour fire barrier in fire zones 1.1.2.1, 1.1.2.2, and 11.3.2 in Reactor Building Unit 2.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because fire detection is available for all of the affected fire zones, a fire, if occurred, would be promptly detected and annunciated in the control room. In addition, cable tray enclosures are fire rated for one hour. It is unlikely that a fire would spread and damage redundant trains before the fire brigade or the fire suppression system extinguishes it.

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Plant: Quad Cities

Exemption#: QUAD-26

Document Accession #: 9403070103-05

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation between redundant RHR trains by a 3-hour fire rated barrier in fire zones 1.1.2.2, 8.2.6.E, and 8.2.8.C in Reactor Building and Turbine Building.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because fire detection and suppression are available, and there is an interface wall between Reactor and Turbine Building, it is unlikely that a fire would propagate between Reactor and Turbine Building before the fire brigade or the fire suppression system extinguishes it.

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Plant: Quad Cities

Exemption#: QUAD-27

Document Accession #: 9403070103-06

Appendix R Section: III.G.3

Exemption Description: Lack of automatic fire detection and fixed suppression systems in zones 1.1.2.3, 11.1.4, 11.3.3, and 11.3.4, areas in which safe shutdown capability is provided in the Reactor Building.

Potential for CDF Reduction: Very small

Analysis: All fire zones containing safe shutdown equipment are equipped with fire detection. Therefore, a fire would be detected in its early stages and would be extinguished by the fire brigade.

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Plant: Quad Cities

Exemption#: QUAD-28

Document Accession #: 9403070103-07

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation of redundant safe shutdown systems by 3-hour rated fire barriers in Southern and Central Zone Groups, areas 8.2.2.B, 8.2.3.B, 8.2,.10, and 14.1.1.

Potential for CDF Reduction: Very small

Analysis: Because of the considerable in-situ combustible loadings in all of the affected fire zones, automatic fire suppression is available. Either the fire detection system or the fire suppression system would detect a fire and alarm the fire brigade. Therefore, either the automatic fire suppression system or the fire brigade would promptly extinguish the fire.

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Plant: Quad Cities

Exemption#: QUAD-29

Document Accession #: 9403070103-08

Appendix R Section: III.G.2.a.

Exemption Description: Lack of separation between redundant divisions of safe shutdown components by a 3-hour rated fire barrier in fire zones 8.2.8.A, 8.2.8.B, 8.2.8.C, and 8.2.8.D on Turbine Building operating floor.

Potential for CDF Reduction: Very small

Analysis: There are fire detection systems available for all of the affected fire zones. In addition, there are automatic suppression systems for the motor generator sets. Since the fire detection system would readily detect a fire, it is expected that automatic fire suppression or the fire brigade would promptly extinguish the fire.

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Plant: Quad Cities

Exemption#: QUAD-30

Document Accession #: 9403070103-09

Appendix R Section: III.G.2

Exemption Description: Lack of 3-hour rated fire barriers between fire zones 8.2.1.A and 11.1.1.B and the rest of the Southern Zone Group in the Turbine Building.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because automatic fire suppressions are available, and there is a water-tight steel door between the fire zones, it is unlikely that a fire would propagate between the fire zones before the automatic fire suppression or the fire brigade extinguishes the fire.

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Plant: Quad Cities

Exemption#: QUAD-31

Document Accession #: 9403070103-10

Appendix R Section: III.G.2.a.

Exemption Description: Lack of 3-hour rated fire barriers between fire zones 8.2.7.C, and 8.2.7.E, and 8.2.8.D and Northern and Central Zone Groups.

Potential for CDF Reduction: Very small

Analysis: There are automatic fire detection and suppression systems for fire zone 8.2.8.D. There are suppression systems for fire zone 8.2.7.C and 8.2.7.E. If a fire occurs, it would be detected early and the automatic fire suppression or the fire brigade would extinguish the fire.

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Plant: Quad Cities

Exemption#: QUAD-32

Document Accession #: 9403070103-11

Appendix R Section: III.G.3

Exemption Description: Lack of complete area-wide automatic fixed fire suppression and detection systems in fire zone 6.3 of the Auxiliary Electric Equipment Room (AEER) of the Service Building.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: A fire in the AEER would be detected by the automatic fire detection system, and a fire brigade would be promptly dispatched to extinguish the fire. Even if there is extensive fire damage in the AEER, the alternative safe shutdown system can be used to shut down the plant.

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Plant: Quad Cities

Exemption#: QUAD-33

Document Accession #: 9403070103-12

Appendix R Section: III.G.3

Exemption Description: Lack of area-wide fixed fire suppression in fire zone 2.0 of the control room.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: Since the control room is manned continuously, and there is fire detection system available, a fire would be most likely detected in its early stages and extinguished promptly by the fire brigade. In addition, an alternative shutdown capability is available independent of the control room.

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Plant: Quad Cities

Exemption#: QUAD-34

Document Accession #: 9403070103-13

Appendix R Section: III.G.2.b.

Exemption Description: Lack of 20-feet of horizontal space that is free of intervening combustibles and lack of automatic fire suppression systems in fire zones 1.1.1.2, 1.1.1.3, 1.1.2.2, and 1.1.2.3 of the Reactor Building.

Potential for CDF Reduction: Very small

Analysis: Since combustible loadings in all of the affected fire zones are expected to be low, a fire of major significance is not expected. Because fire detection is available for all of the affected fire zones, a fire, if occurred, would be promptly detected and annunciated in the control room. It is unlikely that a fire would spread and damage all the instrument racks before the fire brigade extinguishes it.

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Plant: Quad Cities

Exemption#: QUAD-35

Document Accession #: 9403070103-14

Appendix R Section: III.G.2.b.

Exemption Description: Lack of separation of redundant Suppression Pool level indicators by 20 feet of horizontal space free of intervening combustibles or fire hazards in fire zones 1.1.1.1, 1.1.1.2, 1.1.2.1, and 1.1.2.2.

Potential for CDF Reduction: Very small

Analysis: Since access for the torus level is restricted, the accumulation of transient combustibles would be minimized. Because fire loadings are expected to be low in the torus level, a fire of major significance is not expected. Detection is available for cable trays on the torus level. Detection is provided throughout the ground floor. In the event of a fire, the licensee indicated that there were three hours available for the fire brigade to control the fire and implement smoke removal activities before initiation of the monitoring of the torus water level. In view of the substantial time available for the fire brigade to control the fire and remove the smoke, operators would be able to gain access to the torus in a timely manner to monitor the torus water level.

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Plant: Dresden 2 and 3

Exemption#: DRS-01

Document Accession #: 8302080194-01

Appendix R Section: III.G.3

Exemption Description: Fire detection system and fixed fire suppression system not installed in Control Room Panels area, 4KV switchgear areas, and 480 V, 250V, and 125V Motor Control Center areas.

Potential for CDF Reduction: Very small

Analysis: The SNL study identified that the switchgear room has a potentially significant impact on the CDF because its CDF contribution exceeds 1E-5/RY. The revised fire IPEEE results showed that the switchgear room contribution to the fire-induced CDF is less than 1E-6/yr.

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Plant: Dresden 2 and 3

Exemption#: DRS-04

Document Accession #: 8908220394-05

Appendix R Section: III.G.3

Exemption Description: Fixed fire suppression system and or fire detection systems not installed in 22 fire zones of Turbine Building.

Potential for CDF Reduction: Very small

Analysis: The SNL study determined that the CDF contributions of fire zones 7.0.A.1 and 8.2.6.A exceed 1E-5/RY, and the CDF contributions of the others were less than 1E-6/RY. The revised fire IPEEE results showed the CDF contributions of fire zones 7.0.A.1 and 8.2.6.A were less than 1E-6/yr.

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Plant: Dresden 2 and 3

Exemption#: DRS-10

Document Accession #: 8908220394-08

Appendix R Section: III.G.3

Exemption Description: Automatic fire suppression not installed in two zones of Reactor Building.

Potential for CDF Reduction: The impact on CDF reduction is in the range from 1.0E-6/RY to 1.0E-5/RY and is designated as “small.”

Analysis: The SNL study determined that the CDF contribution of fire zone 1.1.1.3 was about 5.1E-5/RY, and the CDF contribution of fire zone 1.1.1.2 was about 7.4E-6/RY. The revised fire IPEEE results showed the CDF contribution of fire zone 1.1.1.3 was less than 1E-5/yr.