Attachment 3

GNRO-2005/00050

Change Analysis for GGNS License Amendment Request for Kaowool Resolution

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Change Analysis for Grand Gulf Nuclear Station License Amendment Request For Kaowool Resolution

Prepared for:

Entergy Operations
Grand Gulf Nuclear Station
Port Gibson, MS
Project 0021-0006-001

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Executive Summary

A risk-informed, performance-based assessment of fire protection in the Grand Gulf Nuclear Station Auxiliary Building was conducted to determine the acceptability of an alternative approach to resolving the Kaowool raceway fire barrier issue for the areas of concern. The assessment was conducted after a preliminary review determined that a risk-informed, performance-based approach had merit and could help to provide a cost-effective solution. The assessment was conducted using the guidance contained in National Fire Protection Association (NFPA) 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants* and its related draft implementation guidance under development by the Nuclear Energy Institute (NEI). Although the guidance document is focused on adoption of a new licensing basis under 10 CFR 50.48(c), the tools and principles were utilized for a focused, fire area assessment to determine whether a license amendment request using the alternative strategy could be supported.

The assessment consisted of a review of current licensing basis for combustible exclusion zones in four elevations of the auxiliary building to establish a baseline understanding, followed by a detailed review of the likelihood and consequences of potential fire scenarios. That review showed that the detailed modeling of the following three general fire scenarios spanned the risk concerns in these zones:

1) **Scenario 1** – Small (350 kW) transient combustible fire(s) in the combustible exclusion zones,
2) **Scenario 2** – Large (3500 kW or 1230 kW depending on elevation) transient combustible fires adjacent to the exclusion zones,
3) **Scenario 3** – Scenarios involving fires in combustible storage areas to determine if the potential to develop a hot gas layer existed.

The fire modeling revealed that unacceptable damage would not occur as a result of maximum expected fire scenarios (MEFSs) and that there was substantial margin between the MEFSs and the limiting fire scenarios (LFSs).

The fire risk analysis focused only on elements of the program that had been or were proposed to be changed from the current licensing basis. These elements are associated with total loss of one division in the combustible exclusion areas under consideration. The risk analysis determined that a conservative estimate of the cumulative core damage frequency associated with all elevations would be approximately 6.20E-08/yr. Changes in safety margin and defense-in-depth also were considered as part of a comprehensive risk-informed, performance based analyses. Modifications are planned to improve fire safety and to ensure a reasonable balance of defense-in-depth elements. Under these conditions, the calculated risk increase, in conjunction with the minimal impacts on defense-in-depth and increase in the safety margin, is considered acceptable under the guidelines of Regulatory Guide 1.174.

This assessment has shown that the use of tools and processes in NFPA 805 can support a license amendment request under 10 CFR 50.90 for certain requirements in 10 CFR Part 50, Appendix R, Section III.G. This assessment provides the support for the determination that the exemption poses no undue risk to public health and safety.

Purpose and Scope

The purpose of this assessment was to perform a risk-informed, performance-based evaluation of the following fire zones in the Auxiliary Building of the Grand Gulf Nuclear Station in order to eliminate reliance on the Kaowool as a raceway fire barrier material and reduce the scope of 3M Interam® wrap that is required to be installed replacing Kaowool.

- Fire Zone 1A101 – Passage Elevation 93' and 103'
- Fire Zone 1A117 – Miscellaneous Equipment Area Elevation 93' and 103'
- Fire Zone 1A211 – Miscellaneous Equipment Area Elevation 119'
- Fire Zone 1A316 – Motor Control Center Elevation 139'
- Fire Zone 1A417 – Miscellaneous Equipment Area Elevation 166'

These evaluations were performed using the guidance of NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants* and Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis*. The assessment also utilized fire protection rulemaking guidance under development by the Nuclear Energy Institute (NEI). Although the guidance document is focused on adoption of a new licensing basis under 10 CFR 50.48(c), the tools and principles were utilized for a focused plant assessment to support a deviation from the previously approved fire protection program.

The intent of this assessment is to support a license amendment request from the commitments made to Section III.G.2 of 10 CFR 50, Appendix R for these areas.

References

1. NFPA 805, (2001) Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants

2. Regulatory Guide 1.174, Rev. 1, November 2002, An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis

3. 10CFR50 Appendix R

4. Analysis 0021.0006.001.002, Rev. 0, Grand Gulf Nuclear Station, Fire Model Evaluation of Cable Interactions in the Auxiliary Building (Enclosure 1)

5. NUREG 1805 (2004), Fire Dynamics Tools (FDT^S) Quantitative Fire Hazard Analysis Methods for the U. S. Nuclear Regulatory Commission Fire Protection Inspection Program

6. Grand Gulf Nuclear Station Calculation MC-QSP64-86058, Rev. 59, Combustible Heat Load Calculation

7. Grand Gulf Nuclear Station, Fire PRA Refinements, Rev. 0 (Enclosure 2)

8. Grand Gulf Nuclear Station Engineering Report GGNS-95-00041, Rev. 0, Internal Plant Examination of External Events

9. NRC Inspection Manual Chapter 00609, Appendix F, April 2004

10. Grand Gulf Nuclear Station Engineering Report GGNS-95-00051, Rev. 1, Documentation of Fire Modeling for Fire Probabilistic Risk Assessment

11. 10CFR50, Appendix A, General Design Criteria 3, Fire Protection

12. NEI 04-02, Rev. 0, Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program under 10CFR50.48(c)

13. Grand Gulf Nuclear Station (1995), "Updated Final Safety Analysis Report (UFSAR), Section 9.5.1"

Background

SECY 99-204 documents the Nuclear Regulatory Commission (NRC) Staff review of Kaowool fire barriers at Joseph M. Farley Nuclear Plants Units 1 and 2 (FNP). The NRC Staff review, as documented in this SECY, found that the fire rating of this Kaowool barrier design is indeterminate, but less than the 1-hour needed to meet the Appendix R requirements. Grand Gulf also uses the same Kaowool raceway fire barrier design as does FNP to satisfy the fire separation of redundant safe shutdown components in accordance with 10 CFR 50, Appendix R, Section III.G.2.

As a result of the review of SECY 99-204, CR-GGN-1999-1004 was initiated and documented this potential deficiency at Grand Gulf where the Kaowool fire wrap system was used as a 1-hour fire rated wrap system in the Control and Auxiliary Buildings to meet Appendix R, Section III.G.2.b and c separation requirements. Hourly fire watch rounds in accordance with Technical Requirements Manual (TRM/UFSAR) Section 6.2.8 were initiated in the Control and Auxiliary Building areas containing this Kaowool fire wrap system. As a result of the continuing evaluation of this issue and discussions with the NRC Staff, Grand Gulf determined that similar potential deficiency existed in the Containment Building where the Kaowool fire wrap system is utilized as a "Radiant Energy Shield" to meet Appendix R, Section III.G.2.f separation requirements. CR-GGN-2000-1516 was initiated to document this potential deficiency and initiate hourly fire watch rounds in accordance with TRM 6.2.8 for these areas.

A re-qualification plan to establish the fire resistance rating and overall acceptability of the Kaowool Fire Wrap System used at Grand Gulf for compliance with 10 CFR 50, Appendix

R, Section III.G.2 separation requirements was established as a result of the Grand Gulf review of SECY 99-204 and the two CR's listed above. The re-qualification plan included both field walkdown and destructive examinations of representative samples of the installed Kaowool configurations to verify/establish the actual details of installation. Once the details of installation were established, the plan was to conduct full-scale fire tests to establish a fire resistance rating for the Kaowool fire wrap system. An area by area evaluation would then be made to determine if the established fire resistance rating of the Kaowool fire wrap system was adequate for the hazards in the area. Several face to face meetings with the NRC Staff were held to determine acceptability of this re-qualification plan. An agreement was reached and the destructive examinations were completed. Deficiencies discovered during these field walkdowns and destructive examinations resulted in two additional CR's being initiated (CR-GGN-2000-1481 and 1801). After reviewing these additional installation deficiencies, it was apparent that the existing Kaowool fire wrap system would have to be completely reworked. Since the existing Kaowool fire wrap materials would have to be completely removed to be adequately reworked, the decision was made to replace it with a fire wrap system that provided the regulatory required fire resistance rating as specified by 10 CFR 50, Appendix R, Section III.G.2.

It was decided to replace the Kaowool material with the Interam® E54 Series one hour rated fire wrap. Modifications were started in the Auxiliary, Control and Containment buildings to replace the material.

After completion of the Control Building modification, as well as the portion of the Containment Building in the 161'-10 elevation, it was determined that the costs associated with the installation of the material had been underestimated by a factor of approximately 2 to 3. As a result, a decision was reached to perform an assessment to determine the feasibility of a risk-informed, performance-based approach to reduce or eliminate the need for the qualified wrap.

A study performed by Kleinsorg Group Risk Services, LLC, concluded that the use of risk-informed, performance-based approaches is warranted and can be accomplished in a cost-effective manner. These approaches would be pursued as an integral part of the comprehensive resolution of the raceway fire barrier issue at Grand Gulf. The results of the project study were compared to the scope of planned plant modifications in the four areas. The fire modeling analyses indicated that much of the cabling currently protected by barrier material would not be challenged by credible fire scenarios even without crediting the barrier material. Consequently, a fire risk analysis would show that enhancement of the wrap material or alternative modifications (e.g. reroutes) would not provide any notable reduction in core damage risk. The specific results showed that many of the proposed modifications would not be necessary given the acceptance criteria for risk associated with the identified non-compliant configuration under a risk-informed, performance-based resolution strategy. The implementation of these modifications would represent a substantial expenditure of resources without a commensurate increase in safety benefit. A focused regulatory submittal and License Amendment for the fire areas of concern was determined to be the best regulatory vehicle for implementing a risk-informed, performance-based approach to fire barrier resolution at Grand Gulf.

Elevation 93'0" and 103'0"

The zones being addressed under this change are Fire Zones 1A101 and 1A117.

Fire Zone 1A101 – Passage

FireZone 1A101, located east of Column Line G.4, contains both Division I and Division II safe shutdown components. All Division II safe shutdown components are located more than 35 feet north of Column Line 11.0. All Division I safe shutdown components in this zone located north of Column Line 11.0 were provided with Kaowool wrap. The minimum separation distance between Division I and Division II safe shutdown components that are not enclosed within noncombustible material is 35 feet. The intervening combustible within this distance consists of one ventilated cable tray containing non-safety related IEEE-383 cable installed in accordance with the requirements of Regulatory Guide 1.75.

The ceiling, North, East and West walls are 3-hour rated fire barriers, except for the portion of the West boundary that is open to Fire Zones 1A114 and 1A117. The floor and South Wall are below-grade, non-rated, exterior barriers.

An automatic sprinkler system is provided for that portion of 1A101 north of Column Line 10.5. An ionization smoke detection system is also provided. Manual fire fighting is provided by installed fire extinguishers and manual hose stations.

Fire Zone 1A117 – Miscellaneous Equipment Area

Fire Zone 1A117, which is located west of Column Line G.4, contains both Division I and Division II safe shutdown components. All Division I safe shutdown components in this zone were provided with Kaowool Wrap.

The ceiling, South and East boundaries, and that portion of the North wall bordering on the Control Building are 3-hour rated fire barriers, except for those portions of the South and East boundaries that are open to Fire Zones 1A120 and 1A101 respectively. The remaining portion of the North wall, as well as the floor and West wall, are below-grade, non-rated exterior boundaries, except for the 2-hour rated portion of the North wall which interfaces with Elevator No. 1 and Stair 1A10

A wet pipe automatic sprinkler system is installed to protect this area west to Column Line J.5 in Fire Zone 1A117. An ionization detection system is also provided. Manual fire fighting is provided by installed fire extinguishers and manual hose stations.

Change Description – El. 93'-0" and 103'-0"

The current licensing basis for GGNS is to ensure one train of safe shutdown equipment is undamaged by a fire. Original commitments for these zones required one train of safe shutdown raceways to be protected with nominal one hour fire wrap. The change being proposed for this area is to replace the existing Kaowool wrap with a qualified one hour rated 3M Interam® wrap on one division where the raceway would be subject to damage from a floor based transient combustible fire. Specifically, the changes being proposed are as follows:

1. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on vertical cable tray ATWT02 from the lowest elevation to the ceiling, which is less than 4.6 m (15 ft) above the grating floor. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary.

2. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on Division 1 horizontal cable tray ATWG from the north wall southward to a point 6.1 m (20 ft) south of penetration AJ-29A where the Division 2 RHR B minimum flow transmitter sensing lines enters west wall of the east corridor of the Auxiliary Building. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary.

3. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on Division 1 horizontal cable tray ATMG from a point 2.1 m (7 ft) south of the north wall southward to point 6.1 m (20 ft) south of penetration AJ-29A where the Division 2 RHR B pump minimum flow transmitter tubing enters the RHR B Pump Room. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary.

4. Abandon in place (or remove at plant's discretion) the Kaowool wrap protecting Division 1 and Division 2 cable trays in the northeast corner of the 28/31 m (93/103 ft) Elevation with the exception of Kaowool wrap which is required for Reg. Guide 1.75 separation requirements.

5. Provide a combustible exclusion zone that, as a minimum, is bound by the north wall of the Auxiliary Building and extends 3.1 m (10 ft) west, 3.1 m (10 ft) east, and 3.1 m (10 ft) south of all cable trays protected with 3M Interam® wrap. In addition to the area cited, provide a combustible exclusion zone from the Division 2 RHR B pump minimum flow transmitter to a point 15.2 m (50 ft) south of the transmitter. This requires relocation of any security lockers that may be located within the combustible exclusion zone.

6. Prohibit combustible storage areas on this elevation.

Elevation 119'0"

Fire Zone 1A211 – Miscellaneous Equipment Area

Fire Zone 1A211, which is located west of Column Line G.4, contains both Division I and II safe shutdown components. All Division I and II safe shutdown components located between 4 feet west of column line G.4 and 30 feet west of column line G.4 were provided with Kaowool wrap. There are no Division I safe shutdown components located west of this 26 foot space and there are no Division II safe shutdown components located to the east of this 26 foot space. Intervening combustibles located within this separation distance consist of cable trays containing IEEE-383 cable installed in accordance with the requirements of Regulatory Guide 1.75.

The ceiling, floor, South wall, and that portion of the North wall that is physically adjacent to the Control Building are 3-hour rated barriers. In addition, those interfaces with Stair 1A10 and Elevator No. 3 are 2-hour rated fire barriers. The remainder of the North wall is a below grade, non-rated exterior barrier. The East and West boundaries of 1A211 are open to Fire Zones 1A201 and 1A222 respectively.

An automatic sprinkler system is installed within the separation distance described above and extends west to Column Line J.5 and east into Fire Zone 1A201 to Column Line 13.0. An ionization detection system is also provided. Manual fire fighting is provided by installed fire extinguishers and manual hose streams.

Change Description – El. 119'-0"

The current licensing basis for GGNS is to ensure one train of safe shutdown equipment is undamaged by a fire. Original commitments for this zone required both trains of safe shutdown raceways to be protected with nominal one hour fire wrap. The change being proposed for this area is to replace a portion of the existing Kaowool wrap with a qualified one hour rated 3M Interam® wrap on one division where the raceway would be subject to damage from a floor based transient combustible fire. A portion of the Kaowool is required to be maintained as a flame propagation retardant. Specifically, the changes proposed are as follows:

1. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on vertical cable trays BTOT52, BTOT53, and BTOT54 from the floor of the 36 m (119 ft) Elevation to a point at least 4.6 m (15 ft) above the floor. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary. This also includes the portion of BMTH within the plane of the vertical tray BTOT.

2. Maintain unrated Kaowool wrap as-is on horizontal cable tray ATWH from the north wall southward down to and including the horizontal cable tray elbow where the tray changes direction from north-south to east-west.

3. Maintain unrated Kaowool wrap as-is on horizontal cable tray BTMH48 from the north wall southward down to and including the horizontal cable tray tee where the tray changes direction from north-south to east-west excluding the portion covered with 3M Interam® within the plane of the vertical tray BTOT..

4. Maintain unrated Kaowool wrap as-is on vertical cable trays ATWT02, ATWT03, and ATWT04 from the floor to a point 4.6 m (15 ft) above the floor, which exceeds the minimum height necessary for a floor based source fire to ignite cables in this array.

5. Abandon in place the remainder of the Kaowool wrap protecting Division 1 and Division 2 cable trays in the northeast corner of the 36 m (119 ft) Elevation with the exception of Kaowool wrap which is required for Reg. Guide 1.75 separation requirements.

6. Provide a combustible exclusion zone that, as a minimum, is bound on the north by the Auxiliary Building wall and extends 3.1 m (10 ft) west, 3.1 m (10 ft) east, and 3.1 m (10 ft) south of all cable tray segments protected with 3M Interam® wrap or are protected with Kaowool wrap that is not abandoned in place (not including that required for Reg. Guide 1.75). This requires relocation of any security lockers that may be located within the combustible exclusion.

7. Limit the size of combustible storage areas on the 36 m (119 ft) Elevation such that the maximum floor area covered by any one combustible storage area is 43 m^2 (462 ft^2) or less. If multiple storage areas are used, then they should be separated by a minimum 9.1 m (30 ft), unless their collective area is 43 m^2 (462 ft^2) or less. Maintain a minimum 23 m (75 ft) separation between combustible storage areas and the combustible exclusion zone.

Elevation 139'0"

Fire Zone 1A316, Motor Control Center

Fire Zone 1A316, which is located west of Column Lines G.4, contains both Division I and II safe shutdown components. All Division I safe shutdown components located 3 feet west of Column Line G.4 and all Division II safe shutdown components east of Column Line H were provided with Kaowool wrap. The minimum separation distance between Division I and Division II safe shutdown components that are not enclosed within noncombustible material is 25 feet. Intervening combustibles consist of two non safety-related open trays and three tray risers containing IEEE 383 cable to non safety related MCC 12B51, which is located along the South wall of the zone between column lines G.4 and H. These trays are located 9 feet from unprotected division I safe shutdown components and are totally enclosed in the vicinity of unprotected division II safe shutdown components to satisfy the requirements of Regulatory Guide 1.75.

The floor, ceiling and walls are 3-hour rated fire barriers, except for those portions of the East and West boundaries that are open to Fire Zones 1A301 and 1A321, respectively. A portion of the North wall is a 2-hour rated exterior fire barrier. In addition, the interface with Stair 1A10 and Elevator No. 3 is a 2-hour rated fire barrier.

An automatic sprinkler system is installed between Column Lines G.4 and H, extending west to Column Line J.5 and east into Fire Zone 1A301 to Column Line 13.0. An ionization detection system is also provided. Manual fire fighting is provided by installed fire extinguishers and manual hose streams.

Change Description – El. 139'-0"

The current licensing basis for GGNS is to ensure one train of safe shutdown equipment is undamaged by a fire. Original commitments for this zone required both trains of safe shutdown raceways to be protected with nominal one hour fire wrap. The change being proposed for this area is to replace a portion of the existing Kaowool wrap with a qualified one hour rated 3M Interam® wrap on one division where the raceway would be subject to damage from a floor based transient combustible fire. A portion of the Kaowool is required to be maintained as a flame propagation retardant. Specifically, the changes being proposed are as follows:

1. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on vertical cable trays BTOT 54, BTOT55, BTOT56, and BTOT57 from the floor of the 42 m (139 ft) Elevation to a point at least 4.6 m (15 ft) above the floor. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary. This also includes cable to BAOT22-28, 31, 32 and BRMI55 in the area within 4.6 m (15 ft) of the floor.

2. Maintain unrated Kaowool wrap as-is on horizontal cable trays ATPI59 and ATWI59 from the north wall southward down to and including the horizontal cable tray elbow where the trays change direction from north-south to east-west.

3. Maintain unrated Kaowool wrap as-is on horizontal cable tray BTMI28 from the north wall southward down to and including the horizontal cable tray elbow where the tray changes direction from north-south to east-west.

4. Maintain unrated Kaowool wrap as-is on vertical cable trays ATWT04, ATWT05, ATWT06, and ATWT07 from the floor to a point 4.6 m (15 ft) above the floor, which exceeds the minimum height necessary for a floor based source fire to ignite cables in this array.

5. Abandon in place the remainder of the Kaowool wrap protecting Division 1 and Division 2 cable trays and conduits in the northeast corner of the 42 m (139 ft) Elevation with the exception of Kaowool wrap which is required for Reg. Guide 1.75 separation requirements.

6. Abandon in place (or abandon at the plant's discretion) the Thermo-Lag wrap installed on Division 2 conduit XRW203.

7. Provide a combustible exclusion zone that, as a minimum, is bound by the north wall of the Auxiliary Building and extends 3.1 m (10 ft) west, 3.1 m (10 ft) east, and 3.1 m (10 ft) south of all cable tray segments protected with 3M Interam® wrap or are protected with Kaowool wrap that is not abandoned in place (not including that required for Reg. Guide 1.75).

8. Limit the size of combustible storage areas on the 42 m (139 ft) Elevation such that the maximum floor area covered by any one combustible storage area is 41 m^2 (440 ft^2) or less. If multiple storage areas are used, then they should be separated by a minimum 8.8 m (29 ft), unless their collective areas are 41 m^2 (440 ft^2) or less. Maintain a minimum 23 m (75 ft) separation between combustible storage areas and the combustible exclusion zone. This requires relocation of the combustible storage area that is adjacent to the combustible exclusion zone.

Elevation 166'0"

Fire Zone 1A417 – Miscellaneous Equipment Area

Fire zone 1A417 contains both Division I and Division II safe shutdown components. All Division I safe shutdown components are located between Column Line G.4 and 23 feet west of G.4. Twenty feet separate Division I safe shutdown components located in adjacent Fire Zone 1A401 from Division II safe shutdown components in Fire Zone 1A417 that are not wrapped with Kaowool. This separation distance does not contain intervening combustibles. All Division I and Division II safe shutdown cable and raceway located in Fire Zone 1A417 between Column Line G.4 and 23 west of G.4 are protected with Kaowool wrap with the exception of two conduits. Conduit 1AARMI07 contains Div I ADS/SRV circuits and conduit 1AXRW203 contains Div II Suppression Pool Temperature monitoring circuits. All other safe shutdown circuits in Fire Zone 1A417 that are located within 20 feet of these conduits were provided with Kaowool wrap, with the exception of two other conduits (1ABRHI19 and 1ABRHI20) contain R20 circuits feeding MCC 16B41.

The floor, part of the North wall (Column Lines G.4 to K), and all of the South wall in this zone are 3-hour fire rated barriers, while the ceiling is the base of the roof slab. The remaining portion of the North wall is an exterior 2-hour rated fire barrier, while the East and West zone boundaries are open to Fire Zones 1A401 and 1A424, respectively.

An automatic, wet-pipe sprinkler system is provided in this zone. An ionization detection system is also provided. Manual fire fighting is provided by installed fire extinguishers and manual hose streams.

Change Description – El. 166'-0"

The current licensing basis for GGNS is to ensure one train of safe shutdown equipment is undamaged by a fire. Original commitments for this zone required both trains of safe shutdown raceways to be protected with nominal one hour fire wrap. The change being proposed for this area is to replace a portion of the existing Kaowool wrap with a qualified one hour rated 3M Interam® wrap on one division where the raceway would be subject to damage from a floor based transient combustible fire. A portion of the Kaowool is required to be maintained as a flame propagation retardant. Specifically, the changes being proposed are as follows:

1. Provide 3M Interam® wrap rated for one-hour ASTM E119 fire resistance on vertical cable trays BTOT57, BTOT58, and BTOT59 from the floor of the 51 m (166 ft) Elevation to the end of the vertical tray section 59. Provide 3M Interam® wrap on various intervening and heat transfer items, including cable trays and conduit, as necessary. This also includes the portion of BTMJ within the plane of the vertical tray BTOT.

2. Maintain unrated Kaowool wrap as-is on horizontal cable trays ATPJ01 and ATNJ33 from the north wall southward down to and including the horizontal cable tray elbow where the trays change direction from north-south to east-west.

3. Maintain unrated Kaowool wrap as-is on horizontal cable tray BTMJ27 from the north wall southward down to and including the horizontal cable tray elbow where the tray changes direction from north-south to east-west excluding the potion covered with 3M Interam® wrap within the plane of the vertical tray BTOT..

4. Maintain unrated Kaowool wrap as-is on vertical cable trays ATWT07, ATWT08, ATWT09, and ATOT09 from the floor to a point 4.6 m (15 ft) above the floor, which exceeds the minimum height necessary for a floor based source fire to ignite cables in this array

5. Abandon in place the remainder of the Kaowool wrap protecting Division 1 and Division 2 cable trays and conduits in the northeast corner of the 51 m (166 ft) Elevation with the exception of Kaowool wrap which is required for Reg. Guide 1.75 separation requirements.

6. Provide a combustible exclusion zone that, as a minimum, is bound by the north wall of the Auxiliary Building and extends 3.1 m (10 ft) west, 3.1 m (10 ft) east, and 3.1 m (10 ft) south of all cable tray segments protected with 3M Interam® wrap or are protected with Kaowool wrap that is not abandoned in place (not including that required for Reg Guide 1.75).

7. Limit the size of combustible storage areas on the 51 m (166 ft) Elevation such that the maximum floor area covered by any one combustible storage area is 30 m^2 (322 ft^2) or less. If multiple storage areas are used, then they should be separated by a minimum 7.6 m (25 ft), unless their collective area is 30 m^2 (322 ft^2) or less. Maintain a minimum 23 m (75 ft) separation between combustible storage areas and the combustible exclusion zone.

Fire Analysis

The detailed fire analysis is provided in Enclosure 1, "Fire Model Evaluation of Cable Interactions in the Auxiliary Building". The following is a summary of the methodology and results.

The analysis uses a performance based deterministic approach to demonstrate the degree to which the proposed wrap arrangement in the interaction areas meets the acceptance criteria for the target components. The goal of the analysis is met by determining and comparing the Maximum Expected Fire Scenario (MEFS) and the Limiting Fire Scenario (LFS) for each interaction area. The MEFS is defined as the fire scenario(s) that represent the most challenging fires that could be reasonable expected for the occupancy type and conditions present. The LFS is the fire scenario that results in a target exceeding the acceptance or performance criteria for the particular target.

Two types of fire scenarios are considered in each interaction area: direct fire exposures and indirect fire exposures. Direct fire exposures involve localized contact with a thermal plume or flame or thermal radiation direct from the source fire to a target. Direct fire exposures typically require close proximity between the source fire and the target. Indirect fire exposures involve fires that are not localized that are sufficiently large to generate a smoke layer that could either lead to flashover conditions or damage a target.

The safety margin is determined by comparing the LFS and MEFS. Typically, the LFS involves increasing the fire size such to the point where the acceptance criteria for a given target are exceeded. Depending on the types of fuel packages considered, this may require an increase in the unit heat release rate while maintaining the floor plan constant or vice versa. Both cases are considered as the most severe condition is not readily obvious. Other parameters that may be altered when assessing the LFS include the fuel package mass and location relative to the target(s).

Acceptance Criteria

Temperature and heat flux acceptance criteria are established for individual cables, conduit, and instrumentation based on values recommended by the NRC for thermoset cables and on environmental qualification testing of individual components and are summarized below:

Acceptance Criteria for Cable, Conduit, and Instrument Targets in the Auxiliary Building.

Component	Acceptance Criteria		Reference
	Temperature °C (°F)	Incident Heat Flux kW/m² (Btu/s-ft²)	
Thermoset cable in a cable tray	329 (625)	11.4 (1.0)	NUREG 1805
Thermoset cable in a conduit	329 (625)	11.4 (1.0)	NUREG 1805
Rosemount Transmitter	121 (250)	1.37 (0.12)	Rosemount Report 98017A, Rev. A

Fire Scenarios

The fire scenarios are selected based on the location and potential for various fuel packages to be located. As noted above, given the fuel package, an ignition source is assumed. In-situ fuel package fire scenarios include a motor control center (MCC) on the 42 m (139 ft) Elevation and various unprotected cable trays that may be ignited by a floor based source fire. Self-propagating cable tray fires are not postulated in the absence of an exposure fire; thus cable tray fires are generally combined with floor based source fires when they are predicted to occur.

Transient fuel packages vary with the requirements for a given floor area. Combustible exclusion zones by procedure have no transients staged or stored. It is assumed in this evaluation that these requirements are not met and that a single trash bag may be located anywhere within the exclusion zone. A large trash bag may be placed upright or on its side; thus two configurations are considered. Based on field measurements, the plan area of an upright trash bag is 0.37 m² (4 ft²) and the plan area of a trash bag on its side is 0.56 m² (6 ft²); the corresponding diameters are 0.69 m (2.3 ft) and 0.84 m (2.8 ft). The fire size associated with a single trash bag fire is 350 kW (330 Btu/s).

Transient fuel packages in other areas may vary considerably and are limited by the combustible control program. A conservative transient fuel package in non-combustible exclusion zones on the 36 m (119 ft), 42 m (139 ft), and 51 m (166 ft) Elevations is assumed to be a trash collection bin, used to transport and collect trash bags throughout the area. Based on field observations, the transportation bins have a capacity to hold ten trash bags and has a plan area of about 2.2 m² (24 ft²) and a base elevation of about 0.3 m (1 ft). A fire involving this fuel package would represent a bounding transient fire scenario in areas beyond a combustible exclusion zone. The assumed heat release rate from this fuel package is 3,500 kW (3,320 Btu/s). Note that this exceeds the ninety-fifth percentile transient fuel package described in the SDP by a factor of nearly fifteen and exceeds the next largest fire size bin, used when the solid and transient fuel packages are expected to generate a fire larger than those provided, of 650 kW (620 Btu/s) by a factor of six.

A different package is assumed for the 28/31 m (93/103 ft) Elevation. Based on the location of this elevation, the trash bins used on the other elevations are not expected to be present. The size of the elevator doors on this elevation, coupled with the fact that there are no access ways from any other area that does not involve climbing stairs precludes the introduction of one of these types of carts. This area also does not support the kind of foot traffic that the other areas do, since it does not serve as an access way for carts/trash removal to any other area outside of this elevation. The largest transient fuel package on the 28/31 m (93/103 ft) Elevations is the equivalent of 3.5 trash bags with an expected fire size of 1,230 kW (1,170 Btu/s). This exceeds the ninety-fifth percentile transient fuel package described in the SDP by a factor of nearly six and exceeds the next largest fire size bin, used when the solid and transient fuel packages are expected to generate a fire larger than those provided, of 650 kW (620 Btu/s) by a factor of two.

Transient fuel packages in combustible storage areas are limited by the Heat Load Calculation [Calculation MC-QSP64-86058] and vary from area to area. Combustible storage areas are remotely located from the interaction areas and thus represent an indirect fire exposure hazard only. On each floor level, the largest combustible storage area is evaluated to determine the most severe indirect fire exposure hazard to the targets in the interaction area. Note that this hazard is present whether or not the safe shutdown cable trays and conduit are wrapped in accordance with Appendix R requirements. The unit heat release rate for miscellaneous Class A fuel packages located in combustible storage areas and unprotected cable trays is 400 kW/m^2 (35.2 Btu/s-ft^2).

When determining the Limiting Fire Scenario (LFS), the heat release rate of the transient fuel packages is increased. This is done by increasing either the plan dimensions such that the unit heat release rate remains constant or by increasing the unit heat release rate such that the plan dimension remain constant. The most severe exposure configuration is not obvious and may vary between the two methods; thus each are assessed when determining the LFS for any given fire scenario involving transient combustible materials. Other types of fire exposures (combustible storage area, large transient located beyond the combustible exclusion zone, cable tray) are not expected to be sensitive to the dimensions and/or the unit heat release rate since the dimensions are fixed or the heat release rate is the dominant parameter.

Results

The results for the different type of Maximum Expected Fire Scenarios analyzed are presented as follows:

Summary of the Most Severe Direct and Indirect MEFSs in the Auxiliary Building.

Direct (Localized) Fire Exposures – Transient Fuel Package in the Combustible Exclusion Zone					
Location	Description	Most Severe Fire Exposure kW/m² (Btu/s-ft²)		Absolute Margin kW/m² (Btu/s-ft²)	Safety Factor/Percent
		Division 1	Division 2		
Interaction Area 1	Transient between horizontal trays	2.54 (0.22)	2.54 (0.22)	8.86 (0.78)	4.5 / 78
Interaction Area 2	Transient between hor. tray and conduit	1.52 (0.13)	2.83 (0.25)	9.88 (0.87)	7.5 / 87
Interaction Area 3	Transient between hor. tray and transmitter	1.15 (0.1)	1.3 (0.11)	10.25 (0.9)	9.9 / 90
Interaction Area 4	Transient between horizontal trays	3.24 (0.29)	3.24 (0.29)	8.16 (0.72)	3.5 / 72
Interaction Area 5	Transient between vertical trays	57.1 (5.03)	3.24 (0.29)	8.16 (0.72)	3.5 / 72
Interaction Area 6	Transient between horizontal trays	3.95 (0.35)	2.14 (0.19)	9.26 (0.82)	5.3 / 81
Direct (Localized) Fire Exposures – Transient Fuel Package near the Combustible Exclusion Zone					
Location	Description	Most Severe Fire Exposure kW/m² (Btu/s-ft²)		Absolute Margin kW/m² (Btu/s-ft²)	Safety Factor/Percent
		Division 1	Division 2		
Interaction Area 1	Large transient	2.88 (0.25)	11.6 (1.02)	8.52 (0.75)	4 / 74
Interaction Area 2	Large transient	Bound by Interaction Area 1			
Interaction Area 3	Large transient	Ignited.	0.56 (0.05)	0.74 (0.07)	2.3 / 57
Interaction Area 4	Large transient	4.14 (0.36)	11.3 (1.0)	7.26 (0.64)	2.8 / 64
Interaction Area 5	Large transient	4.24 (0.37)	8.07 (0.71)	7.16 (0.63)	2.7 / 63
Interaction Area 6	Large transient	4.24 (0.37)	10.2 (0.9)	7.16 (0.63)	2.7 / 63
Indirect (Compartment) Fire Exposures					
Location	Description	Most Severe Fire Exposure °C (°F)		Absolute Margin °C (°F)	Safety Factor/Percent
		Division 1 and Division 2			
28/31 m (93/103 ft) Elevation	Large Transient	85(185)		36 (65)	1.4 /29
36 m (119 ft) Elevation	Combustible Storage Area	150 (302)		179 (323)	2.2 / 54
42 m (139 ft) Elevation	Combustible Storage Area	150 (302)		179 (323)	2.2 / 54
51 m (166 ft) Elevation	Combustible Storage Area	244 (471)		85 (153)	1.4 / 29

The LFS fire size has been shown to exceed the MEFS fire size in terms of the heat release rate by a factor of two or greater, regardless of the fire location. Additional conservatism associated with the LFS indicates that the margin is appropriate and conservative. The results are summarized in the table below for each floor level. Conservative aspects of the calculation approach are not included in the LFS estimate and are expected to provide additional margin beyond that cited below.

Summary of the LFSs for Each Floor Elevation Considered in the Auxiliary Building.

Floor Elevation	LFS Fire Location	LFS Margin[1]
28/31 m (93/103 ft)	Transient fuel package fire located in the general floor area causing a smoke layer temperature of 121°C (250°F)	2 X MEFS
36 m (119 ft)	Transient fuel package fire located within combustible exclusion zone or in the general floor area near the combustible exclusion zone	3 X MEFS
42 m (139 ft)	Transient fuel package fire located within combustible exclusion zone or in the general floor area near the combustible exclusion zone	3 X MEFS
51 m (166 ft)	Transient fuel package fire in a combustible storage area	2 X MEFS

[1]Based on fire scenario heat release rate

Risk Analysis

A detailed risk analysis is provided in Enclosure 2, "Fire PRA Refinements".

Regulatory Guide 1.174 and NFPA 805 specify that the risk associated with a plant change is determined by considering the change in core damage frequency (CDF) and large early release frequency (LERF) that result from the plant change. These changes in CDF and LERF are calculated by comparing the CDF and LERF values for the entire fire area before and after the change to ensure that all contributors to risk are included. The fire risk analysis focused only on elements that had been or were proposed to be changed from the current licensing basis. These elements were associated with transient combustible fires previously described.

The process of determining the risk impact of the proposed change is complicated by the fact that plant fire risk information for GGNS is limited to the Fire IPEEE that was submitted in response to Generic Letter 88-20, Supplement 4. A comprehensive updating and upgrading of the GGNS Fire Risk assessment was not performed as part of this project effort. Instead, a qualitative change assessment was first performed to identify specific fire sequences that would be contributors to the risk associated with the changed configuration. The purpose of this initial qualitative assessment was to eliminate those sequences that would be applicable for both baseline and changed configuration. It is the quantification and summation of this reduced set of sequences that was conservatively used to estimate the change in plant fire risk

that is attributable to the proposed change. GGNS Engineering Report GGNS-95-00041 provided input to this evaluation.

CDF

The fire analysis provided in Enclosure 1 finds that at most, one safe shutdown train may be damaged due to a fire if the wrap as noted in the changes is installed, and these were all from transient fires. Therefore, at most, the review of CDF needs to determine the consequences if loss of one safe shutdown train was to occur. A review of the GGNS Fire Risk Assessment conducted for the IPEEE does not provide this level of detail for the zones in question. A refinement of the existing IPEEE analysis is provided in Enclosure 2 that provides the required level of detail.

The fire in question must occur in a specific location in order to present a challenge to the trays and equipment. A weighting factor for the ignition frequency for the transient fire is therefore appropriate. According to the Inspection Manual Chapter 0609, Appendix F, the weighting factor is applied as follows:

> Weighting Factors for Transient Fires
> A weighting factor may be applied to reflect the likelihood that a transient fire will occur in one specific location versus all the other plausible locations in the fire area where a fire might occur. When applied, the transient fire frequency for the fire area is multiplied by the weighting factor to estimate the fire scenario fire frequency. That is, the weighting factor reduces the transient fire frequency for the entire fire area to that for the specific fire scenario in the specific location.
>
> An arbitrary location may also be chosen for development of a transient fire scenario. In general, the transient fire is positioned so as to optimize the damage potential. In this case, a weighting factor is applied based on the relative floor area represented by the critical floor area versus the total floor area for plausible locations that transient fuel might be located:
>
> • Determine where in the fire area transient fuel materials might be either temporarily or permanently stored.
>
> - Exclude normal pathways, designated clear spaces (e.g., in front of electrical distribution panels), or areas that are not accessible.
> - Include locations that might not be intended for the storage of such materials, but might see temporary storage based on convenience (e.g., materials might be pushed under a cable tray to get them "out of the way").
> - Estimate the total floor space where temporary or permanent storage of transient fuel material is considered plausible (the "plausible" floor area).

- The critical floor area is a subset of the "plausible" floor area.
  - Identify the potential damage targets and potential fire spread paths required for a transient fuel fire to reach those damage targets.
  - Use the ball-and-column diagrams to determine if a transient fire could actually cause damage or initiate the required fire spread if placed in various locations within the "plausible" floor area.
  - Estimate the total floor area where fire spread/damage is possible (the "critical" floor area).

- The weighting factor is the "critical" floor area divided by the "plausible" floor area:

$$WF_{transients} = (\text{critical floor area - ft}^2) / (\text{plausible floor area - ft}^2)$$

The weighting factor will conservatively assume that the plausible floor area is 50% of the total floor area. This is considered to envelope the area of the floor that would potentially have combustibles installed, taking into account passage areas and equipment locations.

The areas that are used to calculate the critical floor areas are the areas of the combustible exclusion areas. The analysis demonstrates that a fire occurring outside of the combustible exclusion area can at most damage one safe shutdown train. Since this is the same licensing basis that was approved by the NRC, it can be determined that there is no net change in risk associated with fires in these areas due to this change. For purposes of determining the risk associated with damaging one train of safe shutdown in the exclusion zones, the following simplifying assumptions will be made:

- The risk will be determined based on the loss of only one division's associated equipment inside the zone at a time since the fire modeling analysis demonstrated that no single fire fails both divisions within the exclusion zone.
- The critical area for the loss of a division will be assumed to be the total area of the combustible exclusion zone, modified to account for that portion of the combustible exclusion zone where damage to that train would be expected to occur.

The ignition factor provided in Engineering Report GGNS-94-0051 is an apportioned value derived by the probability of a fire occurring in the fire compartment. IMC 0609 Appendix F provides the following generic ignition frequencies for fire compartments:

SDP Transient Combustible Ignition Frequencies

Frequency	Ignition Frequency
Low	5.5E-05
Medium	1.7E-04
High	1.7E-03

The areas in question are all classified at a "medium" risk for a transient fire occurrence. The IMC 0609, Appendix F considers an area with the following attributes to be at a medium risk for a transient fire:

- Normal plant operations may, infrequently, involve plant personnel occupying the area for up to several hours.
- Items may be stored in the room on a temporary basis, for example, to conduct repair work on equipment nearby. Such storage should be infrequent rather than routine.
- Repair/maintenance work that may result in introduction of transient fuels or ignition sources (e.g., pump oil change-out activities or routine maintenance on motor bearings) is relatively common (e.g., two or more times per year) while the plant is at power.
- Most pump rooms and areas within the Reactor Building or Auxiliary Building would likely fall into this category (case specific exceptions are possible).
- Most switchgear rooms would typically be ranked medium.

The areas in question are passage areas with incidental equipment installations. Small pumps and electrical equipment are present in all areas, so some maintenance is expected to be conducted. Personnel routinely pass through the area, but the time in the area is normally limited. The passage areas preclude the long term storage of significant quantities of combustible materials. Designated storage areas are provided at a significant distance from the critical floor areas. Based on these circumstances a medium transient fire probability of 1.7E-04 is justified.

As noted above, the critical area will be the area that will be established as the combustible exclusion zones based on the results of the fire analysis. The critical area is further divided to account for the split fractions that have the potential to impact Division 1 equipment and the areas that have the potential to impact Division 2 equipment. This is conservative since not all of the area represented by these split fractions will necessarily fail the division, but instead represent an area of potential overlap. These areas are as follows:

Summary of Critical Floor Areas

Elevation	Zone	Critical Area	Division 1 Damage Area	Division 2 Damage Area
93'/103'	1A101	2,144 ft²	2,144 ft² (100%)	643 ft² (30%)
93'/103'	1A117	1,512 ft²	756 ft² (50%)	1,058 ft² (70%)
119'	1A211	739 ft²	406 ft² (55%)	443 ft² (60%)
139'	1A316	786 ft²	432 ft² (55%)	472 ft² (60%)
166'	1A417	832 ft²	458 ft² (55%)	499 ft² (60%)

The larger area for the 93/103' elevation takes into account that the area both below and above the grated floor on 103' needs to be considered.

The floor areas for each elevation are taken from Engineering Report GGNS-94-0051 or calculated from plant drawings. Using these values, and the critical area calculated above, the following weighting factors can be calculated:

Summary of Weighting Factors

Elevation	Zone	Floor Area (ft^2)	Plausible Area (ft^2)	Div. 1 Damage Area (ft^2)	Div. 2 Damage Area (ft^2)	Division 1 Weighting Factor	Division 2 Weighting Factor
93/103'	1A101	30,329	15,164.5	2,144 ft^2	643 ft^2	0.141383	0.042415
93/103'	1A117	30,329	15,164.5	756 ft^2	1,058 ft^2	0.049853	0.069795
119'	1A211	19,832	9,916	406 ft^2	443 ft^2	0.040989	0.044716
139'	1A316	16,921	8,460.5	432 ft^2	472 ft^2	0.051096	0.055741
166'	1A417	17,756	8,878	458 ft^2	499 ft^2	0.051543	0.056229

The determination of the acceptance of risk impact on changes in CDF is provided in Reg Guide 1.174 and summarized below:

Quantitative Risk Acceptance Criteria

Region	ΔCDF /yr	Status	Comments/Conditions
I	≥ 1.0E-05	Unacceptable	Proposed changes in this region are not acceptable.
II	< 1.0E-05 and ≥ 1.0E-06	Acceptable w/ conditions	Proposed changes in this region are acceptable provided the cumulative total CDF from all initiators is less than 1.0E-04/yr. Cumulative effect of changes must be tracked and included in subsequent changes.
III	< 1.0E-06 and ≥ 1.0E-07	Acceptable w/ conditions	Proposed changes in this region are acceptable provided the cumulative total CDF from all initiators is less than 1.0E-03/yr. Cumulative effect of changes must be tracked and included in subsequent changes.

An area with proposed changes <1.0E-07 are acceptable regardless of the cumulative total CDF from all initiators. Tracking of these changes is not required.

The analysis will conservatively assume that neither automatic nor manual suppression is credited from preventing cable damage. As a result Pas = Pms = 1.0. The analysis will also utilize calculated CDF as a surrogate for ΔCDF. Using these assumptions, weighting factor and ignition frequency calculated above, and the CCDP provided in Enclosure 2, the CDF for each zone and the cumulative CDF can be determined as shown:

Determination of CDF

SCEN	Div. Not Failed	Freq	Weighting Factor	IF	CCDP	Pas	Pms	CDF
101	1	1.70E-04	0.042415	7.21E-06	2.76E-05	1.00E+00	1.00E+00	1.99E-10
101	2	1.70E-04	0.141383	2.40E-05	9.59E-05	1.00E+00	1.00E+00	2.30E-09
117	1	1.70E-04	0.069795	1.19E-05	1.42E-03	1.00E+00	1.00E+00	1.68E-08
117	2	1.70E-04	0.049853	8.48E-06	6.30E-04	1.00E+00	1.00E+00	5.34E-09
211	1	1.70E-04	0.044716	7.60E-06	7.18E-04	1.00E+00	1.00E+00	5.46E-09
211	2	1.70E-04	0.040989	6.97E-06	1.93E-03	1.00E+00	1.00E+00	1.34E-08
316	1	1.70E-04	0.055741	9.48E-06	2.50E-04	1.00E+00	1.00E+00	2.37E-09
316	2	1.70E-04	0.051096	8.69E-06	1.62E-03	1.00E+00	1.00E+00	1.41E-08
417	1	1.70E-04	0.056229	9.56E-06	3.56E-05	1.00E+00	1.00E+00	3.40E-10
417	2	1.70E-04	0.051543	8.76E-06	1.82E-04	1.00E+00	1.00E+00	1.59E-09
							Total	6.20E-08

Where Freq = IPEEE Ignition Frequency for all transient fires for the analyzed zone
SF = Severity Factor
IF = Probability of a severe transient fire for the analyzed zone.
CCDP = Conditional Core Damage Probability
Pas = Probability of failure of automatic suppression
Pms = Probability of failure of manual suppression

As shown, the cumulative CDF associated with this change is below the threshold to be considered negligible (less than 1.0E-07) and therefore, it can be concluded that the ΔCDF is well below the guidance threshold. In addition, the CDF is expected to be much lower, based on the following conservative assumptions:

- The analysis does not credit either manual or automatic suppression.
- Where one raceway of safe shutdown equipment can be damaged in a zone, it is assumed that all equipment associated with that division in that zone is rendered unavailable, as opposed to just those cables installed in the raceway.

This change is thus acceptable for implementation without the need to track future cumulative changes.

LERF

The determination of the acceptance of risk impact on changes in LERF is provided in Reg Guide 1.174 and summarized below:

Quantitative Risk Acceptance Criteria

Region	ΔLERF /yr	Status	Comments/Conditions
I	≥ 1.0E-06	Unacceptable	Proposed changes in this region are not acceptable.
II	< 1.0E-06 and ≥ 1.0E-07	Acceptable w/ conditions	Proposed changes in this region are acceptable provided the cumulative total LERF from all initiators is less than 1.0E-05/yr. Cumulative effect of changes must be tracked and included in subsequent changes.
III	< 1.0E-07 and ≥ 1.0E-08	Acceptable w/ conditions	Proposed changes in this region are acceptable provided the cumulative total LERF from all initiators is less than 1.0E-04/yr. Cumulative effect of changes must be tracked and included in subsequent changes.

An area with proposed changes <1.0E-08 are acceptable regardless of the cumulative total LERF from all initiators. Tracking of these changes is not required.

The analysis will conservatively assume that neither automatic nor manual suppression is credited from preventing cable damage. As a result Pas = Pms = 1.0. Using these assumptions, weighting factor and ignition frequency calculated above, and the CLERP provided in Enclosure 2, the LERF for each zone and the cumulative LERF can be determined as shown:

Determination of LERF

SCEN	Div. Not Failed	Freq	Weighting Factor	IF	CLERP	Pas	Pms	CLERF
101	1	1.70E-04	0.042415	7.21E-06	1.99E-06	1.00E+00	1.00E+00	1.43E-11
101	2	1.70E-04	0.141383	2.40E-05	7.31E-06	1.00E+00	1.00E+00	1.76E-10
117	1	1.70E-04	0.069795	1.19E-05	5.78E-05	1.00E+00	1.00E+00	6.86E-10
117	2	1.70E-04	0.049853	8.48E-06	5.52E-05	1.00E+00	1.00E+00	4.68E-10
211	1	1.70E-04	0.044716	7.60E-06	5.66E-05	1.00E+00	1.00E+00	4.30E-10
211	2	1.70E-04	0.040989	6.97E-06	1.67E-04	1.00E+00	1.00E+00	1.16E-09
316	1	1.70E-04	0.055741	9.48E-06	4.90E-06	1.00E+00	1.00E+00	4.64E-11
316	2	1.70E-04	0.051096	8.69E-06	1.35E-05	1.00E+00	1.00E+00	1.17E-10
417	1	1.70E-04	0.056229	9.56E-06	3.11E-06	1.00E+00	1.00E+00	2.97E-11
417	2	1.70E-04	0.051543	8.76E-06	1.97E-05	1.00E+00	1.00E+00	1.73E-10
							Total	3.30E-09

Where Freq = IPEEE Ignition Frequency for all transient fires for the analyzed zone
SF = Severity Factor

IF = Probability of a severe transient fire for the analyzed zone.
CLERP = Conditional Large Early Release Probability
Pas = Probability of failure of automatic suppression
Pms = Probability of failure of manual suppression

As shown, the cumulative LERF associated with this change is below the threshold to be considered negligible (less than 1.0E-07) and therefore, it can be concluded that the ΔLERF is well below the guidance threshold. In addition, the LERF is expected to be much lower, based on the following conservative assumptions:

- The analysis does not credit either manual or automatic suppression.
- Where one raceway of safe shutdown equipment in a zone can be damaged, it is assumed that all equipment associated with that division in that zone is rendered unavailable, as opposed to just those cables installed in the raceway.

This change is thus acceptable for implementation without the need to track future cumulative changes.

Defense in Depth and Safety Margins

A comprehensive risk-informed, performance-based analysis includes consideration of defense-in-depth and safety margin as part of an integrated evaluation of risk considerations. In general, defense-in-depth involves consideration of the extent to which a proposed change affects the balance among the three echelons of fire-protection:

- Preventing fires from starting
- Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage
- Providing an adequate level of fire protection for structures, systems, and components important to safety, so that a fire that is not promptly extinguished will not prevent essential plant safety functions from being performed

An evaluation of the effects of a proposed change on safety margin involves consideration of the extent to which:

- Codes and standards or their alternatives approved for use by the NRC are met, and
- Safety analysis acceptance criteria in the licensing basis (e.g., FSAR, supporting analyses) are met, or account for analysis and data uncertainty.

Defense-in-Depth

The proposed change maintains an adequate balance in the elements of defense-in-depth. All three elements remain intact, even with the removal of credit for the Kaowool material. A reasonable balance among the elements is preserved and there is no over-reliance on programmatic compensating activities. System redundancy is preserved commensurate with the frequency and consequences of challenging fires. Impacts of common cause failures are unchanged and the overall independence of barriers is not degraded because a qualified one hour barrier is being added to ensure one train of safe shutdown equipment is not damaged by fire. Overall, defenses against human errors are unchanged and the intent of GDC 3 is met.

Additional defense-in-depth is indirectly provided via existing active and passive fire protection features that are not credited. Of particular note is that the presence of the automatic detection system and reliability of manual suppression are not credited. Based on this balance, the defense-in-depth requirements of Regulatory Guide 1.174 and in NFPA 805 are considered to have been satisfied.

The elements of defense-in-depth and how the proposed changes affect these elements are shown below:

Defense-in-Depth Analysis

Element	GGNS CLB	Changes	Net Effect
Preventing fires from starting	Existing plant housekeeping, transient exclusion area, basic plant electrical design	The sizes of some of the combustible exclusion areas are being increased. In addition, the sizes of some of the combustible storage areas are being reduced. Security storage lockers will be relocated out of the combustible exclusion areas.	This element of defense-in-depth is strengthened.
Detecting fires quickly and suppressing those that occur, thereby limiting damage	Detection throughout the fire zone, automatic wet pipe fire suppression system installed in the area, fire extinguishers and manual fire hose stations		This element of defense-in-depth remains the same.
Providing protection for systems and structures so that safe shutdown can be achieved	Physical separation of redundant trains and safe shutdown equipment/cables	Combustible storage areas will be moved where required.	This element of defense-in-depth is strengthened.
	Kaowool was used to protect both divisions within the safe shutdown exclusion area.	One division of safe shutdown trays will be protected with 3M Interam® where subject to damage from a credible floor based transient fire. Certain trays will have the unrated Kaowool maintained as a measure to prevent cable ignition from a transient fire.	This element of defense-in-depth is reduced.

Safety Margin

In this application, the only areas in which consideration of safety margin is relevant are the fire modeling analyses. Based on the selection of the analysis acceptance criteria, the analytical method, and the selection of input parameters, the safety margin requirement is considered to have been satisfied.

The concept of safety margin when applied to fire modeling involves a comparison between the MEFS and LFS. The modeling is performed using commonly available computer software. The acceptance criteria used in the fire modeling analyses are based on industry accepted values for the cable targets being examined. Any margin available in the acceptance criteria is implicitly incorporated into the analysis. Additional safety margin is provided by the development of the fire source characteristics. These characteristics are based on an idealized fire scenario under optimal conditions. The resulting fire related parameters that are used as input in the analysis is the primary source of safety margin. The analysis assumes that the transient fire will cause the total heat value of the available inventory to be released into the room. In addition, the heat release rate that is assumed is several times that which is considered typical in the industry. For instance, the heat release rate value for the assumed transient fire in this analysis is 350 kW. By contrast, the postulated heat release values for transient fires in the NRC SDP process is 75 kW for a normal fire, and 200 kW for a 95^{th} percentile fire. As a result, there is an additional margin of 1.75 introduced when comparing the value assumed in the analysis compared to the worst case transient fire typically assumed by the NRC. In addition, the analysis assumes a fire outside the exclusion area of 3,500 kW, or 17.5 times the 95^{th} percentile transient value. For combustible storage areas, the MEFS is based on the fact that the heat release rate for the combustible storage area is based on the actual plant limitations on the size of the storage area allowed on these elevations. The SDP safety margin is based on the maximum size fire that is analyzed (10,000 kW). For both of these cases, this Safety Margin is considered appropriate for the scenarios evaluated. This conservative approach resulted in a MEFS that is not supported by actual industry events.

The MEFS safety margin is the minimum safety margin relative to the LFS heat release rate. The SDP safety margin is the minimum safety margin relative to the NRC SDP 95^{th} percentile heat release rate for transient fuel packages. These values are summarized as follows:

Summary of Vertical and Horizontal Exposures to Horizontal and Vertical Raceways.

Elevation	Fire Scenario Location	MEFS Safety Margin	SDP Safety Margin
93/103'	Combustible Exclusion Zone	~ 2-3	~3.5-5.25
	General Floor Area	~ 2	~ 4
	15.2 m (50 ft) south of the RHR B minimum flow transmitter	~ 2	~ 4
119'	Combustible Exclusion Zone	~ 3	~ 5.25
	General Floor Area	~ 3	~ 17.5
	Combustible Storage Area	6.5	3.5
139'	Combustible Exclusion Zone	~ 3	~ 5.25
	General Floor Area	~ 3	~ 17.5
	Combustible Storage Area	5.8	3.3
166'	Combustible Exclusion Zone	~ 3	~ 5.25
	General Floor Area	~ 3	17.5
	Combustible Storage Area	2.0	2.4

Based on the selection of the analysis acceptance criteria, the analytical method, and the selection of input parameters, the safety margin requirement is considered to have been satisfied.

Conclusions

The risk-informed, performance-based assessment revealed that the change in the fire protection configuration for the Auxiliary Building is acceptable, and with the proposed recommendations, represent a configuration that maintains an acceptable level of safety while maintaining safety margins and defense-in-depth. The changes meet the key principles of risk-informed decision making, as discussed in Regulatory Guide 1.174:

Principle	Discussion
The proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change, i.e., a "specific exemption" under 10 CFR 50.12 or a "petition for rulemaking" under 10 CFR 2.802.	The proposed change is being proposed as a license amendment request in accordance with 10 CFR 50.90 as a deviation from the previously approved program.
The proposed change is consistent with the defense-in-depth philosophy.	The proposed changes maintain defense-in-depth, as evident by maintaining fire protection systems and features not specifically credited in the risk model, and by having substantial margin between the limiting and maximum expected fire scenario.
The proposed change maintains sufficient safety margins.	Safety margins are maintained primarily by the substantial margin between the limiting and maximum expected fire scenario. Fire protection design features also ensure safety margins are maintained
When proposed changes result in an increase in core damage frequency or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.	Proposed change in core damage frequency is small and consistent with the intent of the Commission's Safety Goal Policy Statement.
The impact of the proposed change should be monitored using performance measurement strategies.	Impact of the changes is in a region that does not require monitoring.

This assessment provides the background necessary to support a license amendment request (in accordance with 10 CFR 50.90) as a change to the previously approved fire protection program. The use of tools and processes in NFPA to support a license amendment request considered an acceptable approach. This assessment provides the support for the determination that the license amendment poses no undue risk to public health and safety.

Key conditions for the acceptance of this risk-informed, performance-based assessment, in addition to the technical discussion in this document, include:

- Completion of 1 hour fire wrap installation on raceways that the analysis determines require it and maintenance of portions of the existing Kaowool wrap.
- Revision of the combustible exclusion areas as determined by this assessment.
- Revision of the combustible storage areas as determined by this assessment.
- Relocation of security lockers to a location outside of combustible exclusion areas.
- Upgrade to the existing fire protection program to ensure the plant is maintained in accordance with the bases for this analysis.