Plant: Oconee Nuclear Station **Date: September 7, 2007**

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Purpose of FAQ:

The purpose of the FAQ is to clarify the following:

1. The process for selecting equipment and cabling to evaluate for non-power operational modes
2. The process for analyzing key safety functions in different plant operational states
3. The actions beyond the normal fire protection program defense-in-depth actions taken when a specific key safety function is lost.[1]

Is this Interpretation of guidance?

Yes / No

Proposed new guidance not in NEI 04-02? Yes/ No

Details:

NEI 04-02 guidance needing interpretation (include section, paragraph, and line numbers as applicable):

NEI 04-02 Section 4.3.3 and Appendix F.

Circumstances requiring guidance interpretation or new guidance:

NEI 04-02, Revision 1, Section 4.3.3 states:

"The nuclear safety goal of NFPA 805 requires evaluation of the effects of a fire 'during any operational mode and plant configuration.'"

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[1] According to Section 1.3.1, "Nuclear Safety Goal," of NFPA 805, "[t]he nuclear safety goal shall be to provide *reasonable assurance* that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition." As stated, this does not mandate a fire risk evaluation comparable to what would be expected during full power. Therefore, it is recognized that, for non-power operations, a "risk-informed" approach has been developed which addresses what is believed to be (and evidenced through the referenced studies) the most risk-significant POSs during non-power operations when including considerations of fire effects, namely total loss of KSFs. Nonetheless, it does not constitute a complete surrogate for a non-power risk evaluation since, under plant-specific conditions (believed to be relatively rare), there may be non-power POSs where less than total loss of a KSF (e.g., a reduction in the availability of credited paths ["redundancy decrease"] such that at least one path still remains), including consideration of fire effects, could result in a risk-significant contribution.

Section NEI 04-02 Section 4.3.3 further goes on to provide a strategy that "*…demonstrate[s] that the nuclear safety performance criteria are met for High Risk Evolutions (HREs as defined by NUMARC 91-06) during non-power operational modes…"*

The strategy as described was endorsed in Regulatory Guide 1.205. However, the use of the term High Risk Evolutions, as defined in NUMARC 91-06, may not be completely appropriate in this context, and appears to be causing regulatory concern. NUMARC 91-06 defines a High[er] Risk Evolution (HRE) as:

> "*Outage activities, plant configurations or conditions during shutdown where the plant is more susceptible to an event causing the loss of a key safety function."*

NUMARC 91-06 provides a suggested method for the management of Key Safety Functions during outages. The method is based on providing greater defense-in-depth during higher risk evolutions. The method does not focus on the event that may cause the degradation of a KSF, rather it is focused on the availability of systems (pre event). The following sections of NUMARC 91-06 illustrate that focus:

> *"3.0 OUTAGE PLANNING AND CONTROL*
>
> *…Outage safety can be improved by focusing on the AVAILABILITY of systems that provide and support KEY SAFETY FUNCTIONS as well as on measures that can reduce both the likelihood and consequences of adverse events."*

"3.2 Level of Activities

Guidelines

…

3.
Activities that may impact KEY SAFETY FUNCTIONS should be limited and strictly controlled during HIGHER RISK EVOLUTIONS or infrequently performed evolutions.
4.
Outage planning and execution should consider the potential introduction of hazards (e.g., fire, flooding, etc.) posed by the level and/or scope of activities in a given area of the plant and establish compensatory measures as appropriate."

"3.3 Providing Defense in Depth

A fundamental element of outage planning and control is to ensure that the systems and components that perform KEY SAFETY FUNCTIONS during shutdown are AVAILABLE when needed. The objectives are to provide backup for KEY SAFETY FUNCTIONS, particularly during HIGHER RISK EVOLUTIONS, to optimize safety system AVAILABILITY, to provide administrative controls that support the FUNCTIONALITY of key equipment, and to provide procedures designed to mitigate the loss of KEY SAFETY FUNCTIONS.

Guidelines

4
Systems, structures and components identified to provide DEFENSE IN DEPTH during periods of the outage should be controlled such that they remain AVAILABLE during these periods."

"3.4 Contingency Planning

The AVAILABILITY of equipment and personnel to respond to degraded conditions during an outage is an important element of shutdown safety. CONTINGENCY PLANS can be used to reestablish DEFENSE IN DEPTH if planned systems or equipment become unavailable or to protect AVAILABLE equipment. In general, as the level of planned DEFENSE IN DEPTH decreases, the use of CONTINGENCY PLANS should increase. CONTINGENCY PLANS may take the form of mandatory prerequisite activities, procedures, pre-outage schedules or changes to the schedule during the outage, or other approved direction.

Guidelines

1. CONTINGENCY PLANS should be available when entering a HIGHER RISK EVOLUTION;
2. CONTINGENCY PLANS should be developed when SSC AVAILABILITY drops below the planned DEFENSE IN DEPTH.
3. CONTINGENCY PLANS should consider the use of alternate equipment to respond to the loss of dedicated safety and monitoring equipment, and should also consider additional monitoring or controls to minimize the potential for unplanned equipment unavailability."

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Consistent with the guidance provided in NUMARC 91-06, the following process will assess the effects of a fire on the ability to maintain KSFs during the outage. The process is risk-informed to the extent that the strategies will vary depending on the plants status [This is a strange comment, varying requirements based on the POS does not make a strategy risk informed, it simply makes the requirements variable. To be risk informed the requirements need increase the required defense-in-depth during HREs in a way that attempts to adequately compensate for the increased risk caused by the HRE.] (i.e., different strategies based on whether the plant is in a higher risk evolution)

Therefore, the strategy defined in NEI 04-02 will be fire-risk-informed based on configurations or Plant Operating States (POS) during an outage where the risk is intrinsically high, and will utilize normal risk management controls, and fire protection processes and procedures during lower risk periods.

Detail contentious points if licensee and NRC have not reached consensus on the facts and circumstances:

None

Potentially relevant existing FAQ numbers:

None

Response Section:

Proposed resolution of FAQ and the basis for the proposal:

Many studies have been performed to characterize the risk associated with non-power states. Using Core Damage Frequency (CDF) as a risk metric, it is accepted that most outage configurations or POS are of relatively low risk and that only a few configurations or POS represent a risk near or greater than at-power operations.

NUREG/CR-6143 and NUREG/CR-6144

NUREG/CR-6143 and 6144 document Low Power and Shutdown (LPSD) risk studies performed in the early 1990's. NUREG/CR-6143 evaluated BWR risk using Grand Gulf Unit 1 as the study plant, while NUREG/CR-6144 evaluated PWR risk using Surry Unit 1.

In Phase 1 of the studies, a coarse screening analysis was performed to examine accidents initiated by internal events (including fire and flooding) for all POS. The objective of the Phase 1 study was to identify potentially "…vulnerable plant configurations, to characterize the potential core damage scenarios and to provide a foundation for a detailed phase 2 analysis."

Based on the results of the Phase 1 study, the Phase 2 analysis focused on POS 5 for BWRs, which covers approximately Cold Shutdown as defined by the Grand Gulf Tech Specs. For PWRs, mid-loop operation was selected as the plant configuration to be analyzed. Thus, it can be seen that these two plant configurations are clearly important with respect to risk during LPSD conditions.

NRC Public LPSD Workshop - 1999

The NRC sponsored a public LPSD workshop in 1999 to gather information regarding LPSD risk. A summary of the results of the workshop and presentations provided by the industry and NRC are contained in Sandia Report SAND99-1815. Some excerpts are provided below:

Westinghouse Experience and Insights from Shutdown Risk Projects

LPSD risk was dominated by events related to low reactor coolant system (RCS) inventory conditions and a few periods of high vulnerability.

Scientech Presentation on Shutdown Risk Monitoring

LPSD CDF is less than, but comparable to full-power CDF. In some cases, instantaneous risk may be higher in LPSD than at-power, but only for very short durations. Most of the risk is associated with low inventory conditions early in the outage.

Shutdown Risk Assessment at Seabrook Station

The mean CDF is numerically comparable to full-power CDF, although of higher uncertainty. However, estimates for health effects (i.e., Level 3) were negligible. It was recommended that high thermal margin configurations be considered for screening.

CDF from internal events is 88% of total LPSD CDF

Loss of RHR with RCS at low level 71%

Loss of RHR with RCS filled	11%
LOCA (RCS Drain down event)	18%

Risk Perspective from EPRI

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For both BWR and PWR analyses, the LPSD risk is dominated by peak risk periods characterized by relatively high instantaneous risk over short periods of time early during the outage. The risk contribution of these peaks to the entire outage risk was greater than 80%, for both BWRs and PWRs. The dominant contributor to risk is human error (50%).

Example BWR Results

Outage Average CDF	4.9E-6/yr
Peak CDF	6.1E-5/yr
Minimum CDF	4.4E-7/yr
Ratio of Peak to Min	~140

Outage Core Damage Probability (cumulative risk) 6.5E-7
Peak Risk Core Damage Probability (CDP) 5.5E-7

Example PWR Results

Outage Average CDF	1.8E-4/yr
Peak CDF	1.0E-3/yr
Minimum CDF	7.0E-7/yr
Ratio of Peak to Min	~1400

Outage Core Damage Probability (cumulative risk)	2.2E-5
Peak Risk Core Damage Probability (CDP)	1.9E-5

NRC Shutdown SDP Process

Inspection Manual IM0609, Appendix G, describes the NRC Shutdown SDP process. It acknowledges step increases in risk for PWRs when (1) the RCS boundary is breached and the steam generators cannot be used for DHR, and (2) during midloop conditions. For BWRs, it is recognized that a step increase occurs during cold shutdown.

The following simplified POS are defined in IM0609, Appendix G; they will be used to describe the recommended actions with respect to NFPA 805.

PWR [IM0609, Appendix G Attachment 2]

POS 1 - This POS starts when the RHR system is put into service. The RCS is closed such that a steam generator could be used for decay heat removal, if the secondary side of a steam generator is filled. The RCS may have a bubble in the pressurizer. This POS ends when the RCS is vented such that the steam generators cannot sustain core heat removal. This POS typically includes Mode 4 (hot shutdown) and portions of Mode 5 (cold shutdown).

POS 2 -This POS starts when the RCS is vented such that: (1) the steam generators cannot sustain core heat removal and (2) a sufficient vent path exists for feed and bleed. This POS includes portions of Mode 5 (cold shutdown) and Mode 6 (refueling). Reduced inventory operations and midloop operations with a vented RCS are subsets of this POS.

POS 3 -This POS represents the shutdown condition when the refueling cavity water level is at or above the minimum level required for movement of irradiated fuel assemblies within containment as defined by Technical Specifications. This POS occurs during Mode 6.

BWR [IM0609, Appendix G Attachment 3]

POS 1 - This POS starts when the RHR system is put into service. The vessel head is on and the RCS is closed such that an extended loss of the DHR function without operator intervention could result in a RCS re-pressurization above the shutoff head for the RHR pumps.

POS 2 -This POS represents the shutdown condition when (1) the vessel head is removed and reactor pressure vessel water level is less than the minimum level required for movement of irradiated fuel assemblies within the reactor pressure vessel as defined by Technical Specifications OR (2) a sufficient RCS vent path exists for decay heat removal.

POS 3 - This POS represents the shutdown condition when the reactor pressure vessel water level is equal or greater than the minimum level required for movement of irradiated fuel assemblies within the reactor pressure vessel as define by Technical Specifications. This POS occurs during Mode 5.

Disposition of POS

Based on the studies cited above and the understanding that LPSD risk is concentrated in only certain POS, the strategy will be risk-informed based on the POS.

The disposition of the POS with respect to NFPA 805 risk evaluations are provided in Tables 1 and 2. For other non-power conditions (e.g., PWR Mode 3, BWR Startup Mode 2), it is recommended that the at-power process be used, since it should generally be bounding.

Table 1 – PWR POS Disposition

POS / Configuration	Disposition	Discussion
POS 1 with SG Heat Removal Available	Screened Provide appropriate fire protection/fire prevention There is no reason to screen out by POS. A normally low risk POS can quickly become high risk if a utility decides to perform a HRE, e.g. opens a drain path that would disable SG cooling and potentially cause a loss of inventory.	In this POS, if SGs are available in addition to RHR, significant redundancy and diversity exists for heat removal. Just having inventory in the SGs can provide substantial passive heat removal, providing additional time to recover other heat removal methods. Inventory control is not generally challenged during this POS.
POS 1 with SG Heat Removal Unavailable [Consider limiting to configurations where time to boil is less than 2 hours and/or RCS level is being changed]	Perform actions per NEI 04-02, Section 4.3.3	Without SG Heat Removal capability, heat removal is limited to RHR and potentially bleed and feed. RCS pressurization on loss of heat removal could render RHR unavailable due to high pressure. Activities in this POS often involve changing RCS level. During RCS level changes, the likelihood of loss of inventory control is higher, challenging the inventory control safety function.
POS 2	Perform actions per NEI 04-02, Section 4.3.3.	This is the generally the highest risk configuration/POS for a PWR. Due to low inventory, times to boil and damage are low, on the order 2 hours or less.
POS 3	Evaluate potential RCS drain paths that could be affected by fire	During this POS, substantial inventory exists to cope with an extended loss of active heat removal. Times to boil are often on the order of 16 or more hours. However, fire induced RCS draindown events can reduce margins substantially.

Table 2 -BWR POS Disposition

POS / Configuration	Disposition	Discussion
POS 1	Perform actions per NEI 04-02, Section 4.3.3.	Inventory control is not generally challenged during this POS. However, loss of RHR could lead to a re-pressurized condition and there could be situations where the unavailability of high pressure injections systems from service could limit the mitigation capabilities. Placing RHR inservice can easily cause a loss of inventory in BWRs. An event that happens too often is a valve misalignment were the SDC and suppression pool cooling suction valves are both simultaneously opened causing a loss of inventory from the RCS to the suppression pool. This can happen in any POS.
POS 2	Perform actions per NEI 04-02, Section 4.3.3.	This is generally a period of relatively high risk in a BWR especially early in the outage when the decay heat is still relatively high.
POS 3	Evaluate potential RV drain paths that could be affected by fire	During this POS, substantial inventory exists to cope with an extended loss of active heat removal. Times to core boil damage are often on the order of 16 or more hours. However, induced RV draindown events can reduce margins substantially.

If appropriate, provide proposed rewording of guidance for inclusion in the next Revision:

See revisions to NEI 04-02 Section 4.3.3 and Appendix F below.

4.3.3 Non-Power Operational Modes Transition Review

The nuclear safety goal of NFPA 805 requires the evaluation of the effects of a fire "during any operational mode and plant configuration". The concept of protection of equipment from the effects of fire during plant shutdown conditions is discussed in NUREG-1449. In general, the underlying concerns are the differences between the functional requirements (i.e. different (or additional) set of systems and components) and time dependencies on decay heat removal system operation during non-power operations and full power operations. The current industry approach for evaluating risk during shutdown conditions involves the normal fire protection program defense-in-depth actions as well as qualitative and/or quantitative assessments and is based on NEI 93-01 and NUMARC 91-06.

The strategy for controls/protection of equipment during non-power operations, for plants adopting NFPA 805, will be a combination of the normal fire protection program defense-in-depth actions and additional risk-informed steps based on configurations or Plant Operating States (POS). Additional controls/measures will be established during a POS where the risk is intrinsically high[2]; during low risk periods normal risk management controls and fire prevention / protection processes and procedures will be utilized. If a HRE is in progress, the outage period should not be considered low risk regardless of the POS. Appendix F contains an example of the various Plant Operational States that would be evaluated for additional protection from the effects of fire during non-power states.

The normal fire protection program defense-in-depth actions are credited for addressing the risk impact of those fires that potentially impact one or more trains of equipment that provide a Key Safety Function required during non-power operations, but would not be expected to cause the total loss of that Key Safety Function. These actions are considered to be adequate to address minor losses of system capability or redundancy during those POS states where risk is relatively low.

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[2] According to Section 1.3.1, "Nuclear Safety Goal," of NFPA 805, "[t]he nuclear safety goal shall be to provide *reasonable assurance* that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition." As stated, this does not mandate a fire risk evaluation comparable to what would be expected during full power. Therefore, it is recognized that, for non-power operations, a "risk-informed" approach has been developed which addresses what is believed to be (and evidenced through the referenced studies) the most risk-significant POSs during non-power operations when including considerations of fire effects, namely total loss of a KSF. As such, these are expected to account for most, if not all, POSs that can be considered "intrinsically high" when considering fire effects." Nonetheless, this approach does not constitute a complete surrogate for a non-power risk evaluation since, under plant-specific conditions (believed to be relatively rare), there may be non-power POSs where less than total loss of a KSF (e.g., a reduction in the availability of credited paths ["redundancy decrease"] such that at least one path still remains), including consideration of fire effects, could result in a risk-significant contribution.

These normal fire protection program defense-in-depth actions are:

1. Control of Ignition Sources
   a. Hot Work (cutting, welding and/or grinding)
   b. Temporary Electrical Installations
   c. Electric portable space heaters
2. Control of Combustibles
   a. Transient Fire Hazards
   b. Modifications
   c. Flammable and Combustible Liquids and Gases
3. Compensatory Actions for fire protection system impairments
   a. Openings in Fire Barriers
   b. Inoperable fire detectors or detection systems
   c. Inoperable fire suppression systems
4. Housekeeping

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F. Considerations for Non-Power Operational Modes

The current industry approach for evaluating risk during shutdown conditions involves qualitative and/or quantitative assessments and is based on NUMARC 91-06. The strategy for controls/protection of equipment during non-power operations, for plants adopting NFPA 805, will be a combination of the normal fire protection program defense-in-depth actions and additional risk-informed steps based on configurations, Plant Operating States (POS) or plant evolution (e.g. is a HRE in process). Additional controls/measures will be established during a POS where the risk is intrinsically high[2]; during low risk periods normal risk management controls and fire prevention / protection processes and procedures will be utilized.

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The normal fire protection program defense-in-depth actions are credited for addressing the risk impact of those fires that potentially impact one or more trains of equipment that provide a Key Safety Function required during non-power operations, but would not be expected to cause the total loss of that Key Safety Function. These actions are considered to be adequate to address minor losses of system capability or redundancy during those POS states where risk is relatively low.

These normal fire protection program defense-in-depth actions are:

5. Control of Ignition Sources
   a. Hot Work (cutting, welding and/or grinding)
   b. Temporary Electrical Installations
   c. Electric portable space heaters
6. Control of Combustibles
   a. Transient Fire Hazards
   b. Modifications
   c. Flammable and Combustible Liquids and Gases
7. Compensatory Actions for fire protection system impairments
   a. Openings in Fire Barriers
   b. Inoperable fire detectors or detection systems
   c. Inoperable fire suppression systems
8. Housekeeping

The process to demonstrate that the nuclear safety performance criteria are met during non-power modes of operations involves the following steps:

- Review the existing Outage Management Processes to determine Plant Operational States that will be evaluated for additional fire protection controls during non-power modes
- Identify Components/Cables
  - o Review plant systems to determine success paths that support each of the defense-in-depth KSFs for those selected POSs and identify components necessary to maintain those paths, and then
  - o Identify cables required for the selected components and then determine their routing
- Perform Fire Area Assessments (identify pinch points)
- Manage risk associated with fire-induced vulnerabilities during the outage

These steps are described in the sections below.

F.1 Review the existing Outage Management Processes to determine Plant Operational states that will be evaluated for additional fire protection controls during non-power modes

To begin the process of assessing the fire protection plan for non-power modes of operation, discussions should be held between the Probabilistic Risk Assessment (PRA) Staff, the Fire Protection, and the Outage Management staff to determine the best way to integrate NFPA 805 fire protection aspects into existing Outage Management Processes.

In accordance with NUMARC 91-06

- CONTINGENCY PLANS should be available when entering a HIGHER RISK EVOLUTION[3];
- CONTINGENCY PLANS should be developed when system AVAILABILITY drops below the planned DEFENSE IN DEPTH;
- CONTINGENCY PLANS should be developed when periods of high risk are encountered.

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Disposition of the POSs (to determine which POSs would have contingency plans established) are provided in Tables 1 and 2. For other non-power conditions

[3] According to Section 1.3.1, "Nuclear Safety Goal," of NFPA 805, "[t]he nuclear safety goal shall be to provide *reasonable assurance* that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition." As stated, this does not mandate a fire risk evaluation comparable to what would be expected during full power. Therefore, it is recognized that, for non-power operations, a "risk-informed" approach has been developed which addresses what is believed to be (and evidenced through the referenced studies) the most risk-significant POSs during non-power operations when including considerations of fire effects, namely <u>total</u> loss of a KSF. As such, these are expected to account for most, if not all, POSs that can be considered "higher risk evolutions" when considering fire effects." Nonetheless, this approach does not constitute a complete surrogate for a non-power risk evaluation since, under plant-specific conditions (believed to be relatively rare), there may be non-power POSs where less than total loss of a KSF (e.g., a reduction in the availability of credited paths ["redundancy decrease"] such that at least one path still remains), including consideration of fire effects, could result in a risk-significant contribution.

(e.g., PWR Mode 3, BWR Startup Mode 2), it is recommended that the normal fire protection program controls, processes and procedures be used.

Table 1 – PWR POS Disposition

POS / Configuration	Disposition	Discussion
POS 1 with SG Heat Removal Available	Screened Provide appropriate fire protection/fire prevention There is no reason to screen out by POS. A normally low risk POS can quickly become high risk if a utility decides to perform a HRE, e.g. opens a drain path that would disable SG cooling and potentially cause a loss of inventory.	In this POS, if SGs are available in addition to RHR, significant redundancy and diversity exists for heat removal. Just having inventory in the SGs can provide substantial passive heat removal, providing additional time to recover other heat removal methods. Inventory control is not generally challenged during this POS.
POS 1 with SG Heat Removal Unavailable [Consider limiting to configurations where time to boil is less than 2 hours and/or RCS level is being changed]	Perform actions per NEI 04-02, Section 4.3.3	Without SG Heat Removal capability, heat removal is limited to RHR and potentially bleed and feed. RCS pressurization on loss of heat removal could render RHR unavailable due to high pressure. Activities in this POS often involve changing RCS level. During RCS level changes, the likelihood of loss of inventory control is higher, challenging the inventory control safety function.
POS 2	Perform actions per NEI 04-02, Section 4.3.3.	This is the generally the highest risk configuration/POS for a PWR. Due to low inventory, times to boil and damage are low, on the order 2 hours or less.
POS 3	Evaluate potential RCS drain paths that could be affected by fire	During this POS, substantial inventory exists to cope with an extended loss of active heat removal. Times to boil are often on the order of 16 or more hours. However, fire induced RCS draindown events can reduce margins substantially.

Table 2 -BWR POS Disposition

POS / Configuration	Disposition	Discussion
POS 1	Perform actions per NEI 04-02, Section 4.3.3.	Inventory control is not generally challenged during this POS. However, loss of RHR could lead to a re-pressurized condition and there could be situations where the unavailability of high pressure injections systems from service could limit the mitigation capabilities. Placing RHR inservice can easily cause a loss of inventory in BWRs. An event that happens too often is a valve misalignment were the SDC and suppression pool cooling suction valves are both simultaneously opened causing a loss of inventory from the RCS to the suppression pool. This can happen in any POS.
POS 2	Perform actions per NEI 04-02, Section 4.3.3.	This is generally a period of relatively high risk in a BWR especially early in the outage when the decay heat is still relatively high.

POS 3	Evaluate potential RV drain paths that could be affected by fire	During this POS, substantial inventory exists to cope with an extended loss of active heat removal. Times to core boil damage are often on the order of 16 or more hours. However, induced RV draindown events can reduce margins substantially.

F.2 Review KSFs to determine success paths that support defense-in-depth for those selected POSs

Review existing plant outage processes (outage management and outage risk assessments) to determine equipment relied upon to provide Key Safety Functions (KSF), including support functions, during the POSs to be evaluated. Each outage evolution identifies the diverse and/or redundant methods of achieving the KSF. For example to achieve the Decay Heat Removal KSF a plant may credit DHR Train A, DHR Train B, HPI Train A, HPI Train B, and Gravity Feed and Chemical and Volume Control.

Compare the equipment credited for achieving these KSFs against the equipment credited for nuclear safety. Note the position/function for the component. For example, the existing nuclear safety analysis (Appendix R analysis) may credit the valve in the closed position however; the valve may be required open for shutdown modes of operation.

For those components not already credited (or credited in a different way e.g., on versus off, open versus closed, etc.) analyze the circuits in accordance with the nuclear safety methodology.

F.3 Perform Fire Area Assessments (Identify pinch points)

Identify locations where 1) fires may cause damage to the equipment (and cabling) credited above or 2) recovery actions credited for the KSF are performed (for those KSFs that are achieved solely by recovery action, i.e., alignment of gravity feed).

Figure F-1 depicts this process.

F.4 Manage risk associated with fire-induced vulnerabilities during the outage

The strategy for controls/protection of equipment during non-power operations, for plants adopting NFPA 805, will be a combination of the normal fire protection program defense-in-depth actions and additional risk-informed steps based on configurations or Plant Operating States (POS). Additional controls/measures will be established during a POS where the risk is intrinsically high[2]; and during low risk periods normal risk management controls and fire protection processes and procedures will be utilized. Figure F-2 depicts this process.

- For higher risk POSs (see Tables 1 and 2). Identify fire areas where a single fire may damage all the credited paths for a KSF. This may include fire modeling to determine if a postulated fire (MEFS – LFS) would be expected to damage the KSF equipment. For those areas consider combinations of the following options to reduce fire risk depending upon the significance of the potential damage:

    - Prohibition or limitation of hot work in fire areas during periods of increased vulnerability
    - Verification of operable detection and /or suppression in the vulnerable areas.
    - Prohibition or limitation of combustible materials in fire areas during periods of increased vulnerability
    - Plant lineup modifications (removing power from equipment once it is placed in its desired position)

- Provision of additional fire patrols at periodic intervals or other appropriate compensatory measures (such as surveillance cameras) during increased vulnerability
- Use of recovery actions to mitigate potential losses of key safety functions.
- Identification and monitoring in-situ ignition sources for “fire precursors” (e.g., equipment temperatures).

- For other POSs, review the normal fire prevention processes to ensure that controls are established/maintained in fire areas that contain KSF equipment/cabling. These normal fire protection program processes are:
  - Control of Ignition Sources
    - Hot Work (cutting, welding and/or grinding)
    - Temporary Electrical Installations
    - Electric portable space heaters
  - Control of Combustibles
    - Transient fire hazards
    - Modifications
    - Flammable and Combustible liquids and gases
  - Compensatory Actions for fire protection system impairments
    - Openings in fire barriers
    - Inoperable fire detectors or detection systems
    - Inoperable fire suppression systems
  - Housekeeping
- NUMARC 91-06 discusses the development of outage plans and schedules. A key element of that process is to ensure the KSFs perform as needed during the various outage evolutions. The results of the fire area analysis of those components relied upon to maintain defense in depth should be factored into the plant’s existing outage planning process. For example,
  - During outage planning, the Fire Area assessment should be referenced to identify areas of single-point KSF vulnerability during higher risk POSs that will occur during the outage to develop any needed contingency plans/actions
  - For KSF Equipment removed from service during the outage, the impact should be Deleted: Revaluated based on KSF equipment status, POS, and Fire area assessment to develop needed contingency plans/actions.

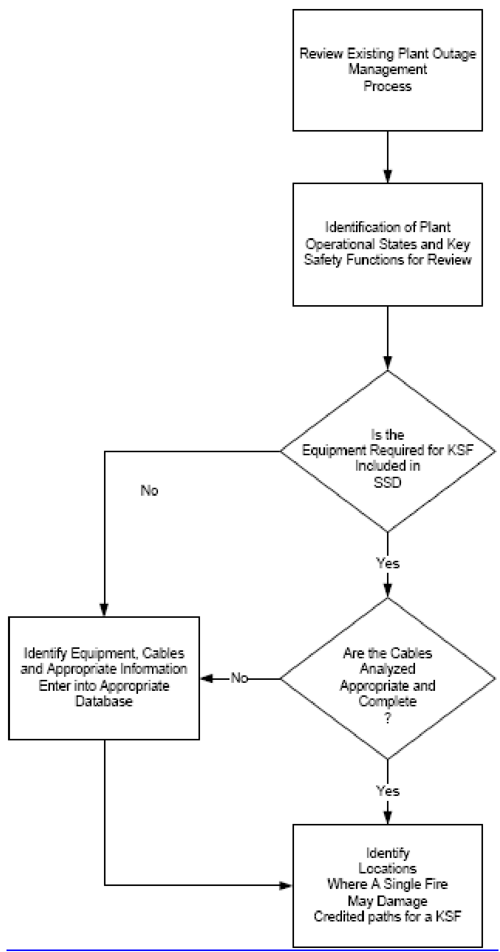

Figure F-1 Equipment/Cable Selection Process

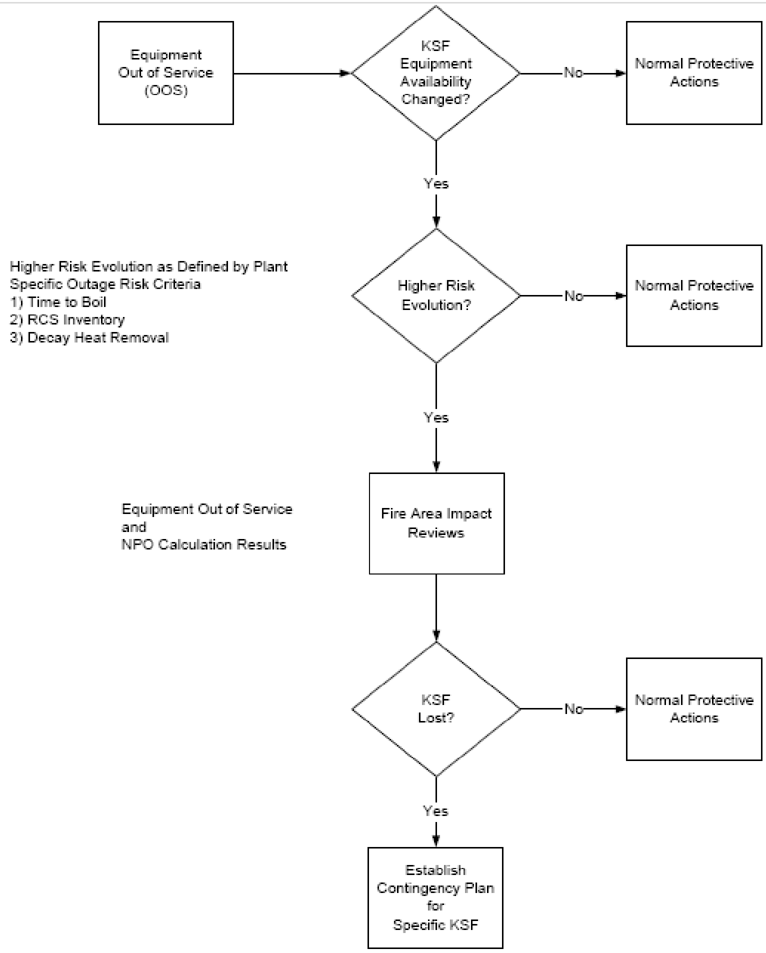

Figure F-2 Fire Area Assessments

Table F-1
NFPA 805 – Non-Power Operational Guidance

NFPA 805 Requirements	Implementing Guidance	Process and Results
The nuclear safety goal is to provide reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition.	▪ Review the existing Outage Management Processes to determine Plant Operational States that will be evaluated for additional fire protection controls during non-power modes ▪ For those POSs, review to determine equipment relied upon to provide Key Safety Functions (KSF) ▪ Identify those systems / components that require additional analyses. For example, a KSF may rely on instrumentation that is currently not part of the "Safe Shutdown Analysis", or a component may have been modeled in one position (closed, off, etc.) but to support the KSF it would need to be evaluated in an additional position (open, on, etc.)	▪ List the Plant Operational States that will be evaluated as higher risk ▪ List the KSFs and the systems / components to be evaluated to support those functions. ▪ Document additional circuit analysis. Use the guidance of NEI 00-01 for circuit analysis ▪ Document cable location for new cables.
	▪ Identify locations where 1) fires may cause damage to the equipment (and cabling) credited above, or 2) recovery actions credited for the KSF are performed (for those KSFs that are achieved solely by recovery action i.e., alignment of gravity feed).	▪ Evaluate on a fire area basis the loss of KSFs. Document those areas.
	▪ Identify fire areas where a single fire may damage all the credited paths for a KSF. This may include fire modeling to determine if a postulated fire (MEFS – LFS) would be expected to damage equipment evaluated.	▪ For the areas identified above, determine if a single fire in the area can cause a loss of all credited paths for a KSF. o Conservatively, assume the entire contents of a fire area are lost. If this does not result in the loss of all credited paths for a KSF, document success. o If fire modeling is used to limit the damage in a fire area, document that fire modeling is credited and ensure the basis for acceptability of that model (location, type, and quantity of combustible, etc.) is documented. These critical design inputs should be maintained during outage modes. See next step below.

Table F-1
NFPA 805 – Non-Power Operational Guidance

NFPA 805 Requirements	Implementing guidance	Process and Results
	• For those areas that may cause the loss of all credited paths for a single KSF associated with higher risk evolutions, consider one or more of the following options to mitigate potential fire damage depending upon the significance of the potential damage: o Prohibition or limitation of hot work in fire areas during periods of increased vulnerability o Verification of operable detection and /or suppression in the vulnerable areas. Prohibition or limitation of combustible materials in fire areas during periods of increased vulnerability o Provision of additional fire patrols at periodic intervals or other appropriate compensatory measures (such as surveillance cameras) during increased vulnerability o Use of recovery actions to mitigate potential losses o Identification and monitoring insitu ignition sources for "fire precursors" (e.g., equipment temperatures). o Reschedule the work to a period of lower risk or higher DID. For other POSs, review the fire prevention processes to ensure that controls are established/maintained in fire areas that contain KSFs. Also review compensatory measures to ensure that fire protection systems/features are maintained or compensatory measures are in place for those systems that protect KSFs. (Also see footnotes 1 on page 1 under "Purpose of FAQ," 2 on page 8 under NEI 04-02 "Section 4.3.3" and 3 on page 11 under "Section F.1")	

From: Jeffrey Mitman Date: April 16, 2008, 4:11 PM
To: Ray Gallucci
Subject: Re: Latest Non-Power Ops FAQ

Attached are my comments on the subject FAQ. Comments are shown as revision marks in the attached document. I have three general but significant comments:

1) HREs can occur in normally low risk POSs. For example a utility may decided to perform a HRE in a PWR POS 1 by entering the switchyard and performing significant work. This happened several months ago at Farley when the utility performed switch yard breaker work that ultimately isolated half of the unit's ring bus early in the outage when time to boil was ~15 minutes. The bottom line is that licensees should not be given a pass simply based on the POS. They should be required to evaluate all POSs for occurrences of HREs and perform adequate analysis during those conditions.

2) It doesn't appear that the FAQ addresses hot shorts. I'm particularly concerned about a hot short that would cause one of the RHR suctions valves from recirc on a BWR or from the hotleg on a PWR to close. Most plants do not have redundancy on these valves. Therefore, if the valves go closed due to a hot short all RHR/SDC is lost. There are probably other hot shorts that could also cause problems that should be looked for.

3) During shutdown human actions are much more important that at-power. During shutdown additional human actions are often required in the plant (in contrast to the control room) for example because an electrical bus may be de-energized and therefore valve manipulation must be performed in the plant instead of from the control room. The fire analysis should consider access to plant equipment during a fire. An opportunistically located fire may prevent access to standby equipment which is credited in the DID analysis.

Jeff