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Waterford 3

**Portions of Enclosure 2 Contain Security-Related Information  
To Be Withheld Under 10 CFR 2.390**

W3F1-2013-0048

December 18, 2013

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

**SUBJECT:** Supplement to NFPA 805 License Amendment Request (LAR) Waterford  
Steam Electric Station, Unit 3  
(Waterford 3)  
Docket No. 50-382  
License No. NPF-38

- REFERENCES:**
1. Entergy letter W3F1-2011-0074 "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001 Edition)", Waterford Steam Electric Station, Unit 3 dated November 17, 2011
  2. Entergy letter W3F1-2012-0005 "Supplemental Information in Support of the NRC Acceptance Review of Waterford 3 License Amendment Request to Adopt NFPA 805, Waterford Steam Electric Station, Unit 3" dated January 26, 2012
  3. Entergy letter W3F1-2012-0064 "Response to Request for Additional Information Regarding Adoption of National Fire Protection Association Standard NFPA 805 License Amendment Request, Waterford Steam Electric Station, Unit 3" dated September 27, 2012
  4. Entergy letter W3F1-2012-0083 "90 Day Response to Request for Additional Information Regarding Adoption of National Fire Protection Association Standard NFPA 805 License Amendment Request, Waterford Steam Electric Station, Unit 3" dated October 16, 2012
  5. Entergy letter W3F1-2013-0022 "Response to 2<sup>nd</sup> Round Request for Additional Information Regarding Adoption of National Fire Protection Association Standard NFPA 805 License Amendment Request, Waterford Steam Electric Station, Unit 3" dated May 16, 2013.
  6. Entergy letter W3F1-2013-0031 Milestones for Schedule of Attachment Revisions to NFPA 805 License Amendment Request (LAR), Waterford Steam Electric Station, Unit 3" dated June 26, 2012.

**When Attachments C, G, and W of Enclosure 2 to this letter are removed this document is no longer Security-Related.**

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Dear Sir or Madam:

By letter dated November 17, 2011, as supplemented by letters dated January 26, September 27, October 16, 2012, and May 16, 2013 (References 1, 2, 3, 4 and 5, respectively), Entergy Operations, Inc. (Entergy), submitted a license amendment request (LAR) to transition its fire protection license basis at the Waterford Steam Electric Station, Unit 3, from paragraph 50.48(b) of Title 10 of the *Code of Federal Regulations* (10 CFR) to 10 CFR 50.48(c), "National Fire Protection Association Standard 805" (NFPA 805).

In response to feedback provided by the NRC during the May 2012 on-site audit, as well as consideration for the basis for several Requests for Additional Information (RAIs) responded to in References 3, 4 and 5, Entergy decided to update selected analyses to remove reliance on any Unreviewed Analysis Methods (UAMs). The benefits of investing the time and resources to update these analyses include:

1. Utilizing only NRC-accepted analysis methods expedites the NRC review process and minimizes the need for license conditions accompanying the Safety Evaluation (SE).
2. Results indicate improved risk metrics due to more rigorous analysis.
3. The more rigorous analysis revealed a previously unidentified vulnerability to transient combustibles in one fire area, allowing the plant to promptly address the issue.
4. Updating the Internal Events PRA (necessary to support the Fire PRA) provides a sound basis for future analyses.


Enclosure 1 contains revised LAR sections impacted by the revised LAR Attachments which are presented in Enclosure 2.

There are no new regulatory commitments contained in this submittal.

If you require additional information, please contact the Regulatory Assurance Manager, John Jarrell at 504-739-6203.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 18, 2013.

Sincerely,

  
DJ/AJH

Enclosures:



- Enclosure 1: Revised LAR Sections
- Enclosure 2: Revised LAR Attachments

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**Enclosure 1 to  
W3F1-2013-0048  
Revised LAR Sections**

**The following sections of the LAR are replaced in their entirety primarily due to the content of revised Attachments and supporting documentation:**

<b>4.1.2.2</b>	<b>NFPA 805 Chapter 3 Requirements Requiring Clarification of Prior NRC Approval</b>
<b>4.2.1.1</b>	<b>Compliance with NFPA 805 Section 2.4.2</b>
<b>4.2.1.2</b>	<b>Safe and Stable Conditions for the Plant</b>
<b>4.5</b>	<b>Fire PRA and Performance-Based Approaches</b>
<b>4.8.1</b>	<b>Results of the Fire Area Review</b>
<b>Table 4-3</b>	<b>Note</b>

**4.1.2.2 NFPA 805 Chapter 3 Requirements Requiring Clarification of Prior NRC Approval**

NFPA 805 Section 3.1 states in part, "Previously approved alternatives from the fundamental protection program attributes of this chapter by the AHJ take precedence over the requirements contained herein." In some cases prior NRC approval of an NFPA 805 Chapter 3 program attribute may be unclear. Waterford 3 requests that the NRC concur with their finding of prior approval for the following sections of NFPA 805 Chapter 3:

- None

There are no clarifications of prior NRC approvals requested in Attachment T.

#### 4.2.1.1 Compliance with NFPA 805 Section 2.4.2

##### Overview of Process

NFPA 805 Section 2.4.2 NSCA states:

*"The purpose of this section is to define the methodology for performing a nuclear safety capability assessment. The following steps shall be performed:*

- (1) Selection of systems and equipment and their interrelationships necessary to achieve the nuclear safety performance criteria in Chapter 1*
- (2) Selection of cables necessary to achieve the nuclear safety performance criteria in Chapter 1*
- (3) Identification of the location of nuclear safety equipment and cables*
- (4) Assessment of the ability to achieve the nuclear safety performance criteria given a fire in each fire area"*

The NSCA methodology review evaluated the existing post-fire SSA methodology against the guidance provided in NEI 00-01, Revision 1, Chapter 3, "Deterministic Methodology," as discussed in Appendix B-2 of NEI 04-02. The methodology is depicted in Figure 4-2 and consisted of the following activities:

- Each specific section of NFPA 805 2.4.2 was correlated to the corresponding section of Chapter 3 of NEI 00-01 Revision 1. Based upon the content of the NEI 00-01 methodology statements, a determination was made of the applicability of the section to the station.
- The plant-specific methodology was compared to applicable sections of NEI 00-01 and one of the following alignment statements and its associated basis were assigned to the section:
  - Aligns
  - Aligns with intent
  - Not in Alignment
  - Not in Alignment, but Prior NRC Approval
  - Not in Alignment, but no adverse consequences

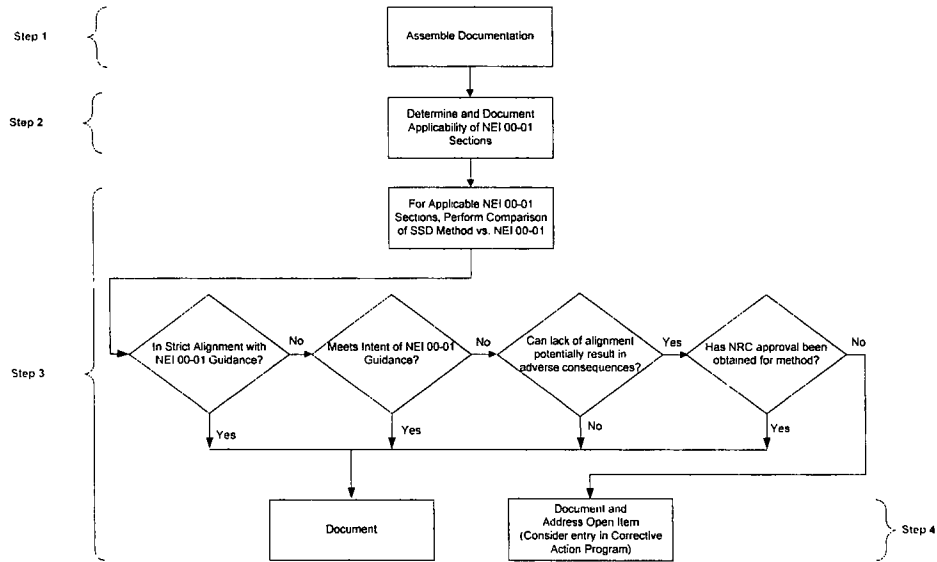
The comparison of the Waterford 3 post-fire SSA to NEI 00-01 Chapter 3 (NEI 04-02 Table B-2) was performed and documented in WF3-FP-09-00001, Rev. 1, "National Fire Protection Association NFPA 805 Nuclear Safety Capability Assessment."

In addition, a review of NEI 00-01, Revision 2, (ML091770265), Chapter 3 was conducted to identify the substantive changes from NEI 00-01, Revision 1 that are applicable to a NFPA 805 fire protection program. This review was performed and documented in WF3-FP-09-00001, Rev. 2, "National Fire Protection Association NFPA 805 Nuclear Safety Capability Assessment".

##### Results from Evaluation Process

The method used to perform the post-fire NSCA with respect to selection of systems and equipment, selection of cables, and identification of the location of equipment and cables,

either meets the NRC endorsed guidance from NEI 00-01, Revision 1, Chapter 3 (as supplemented by the Revision 1 to Revision 2 analysis discussed above) directly or met the intent of the endorsed guidance with adequate justification as documented in Attachment B.



**Figure 4-2 – Summary of Nuclear Safety Methodology Review Process (FAQ 07-0039)**

**Comparison to NEI 00-01, Revision 2**

An additional review was performed of NEI 00-01, Revision 2, Chapter 3 for specific substantive changes in the guidance from NEI 00-01, Revision 1 that are applicable to a NFPA 805 transition. The gaps identified from this review are summarized below:

- Post fire manual operation of rising stem valves in the fire area of concern (NEI 00-01, Section 3.2.1.2).
- Analysis of open circuits on a high voltage (e.g., 4.16 KV) ammeter current transformers (NEI Section 3.5.2.1).
- Analysis of control power for switchgear with respect to breaker coordination (NEI 00-01, Section 3.5.2.4).

The results are provided in Attachment B.

#### 4.2.1.2 Safe and Stable Conditions for the Plant

##### Overview of Process

The nuclear safety goals, objectives and performance criteria of NFPA 805 allow more flexibility than the previous deterministic programs based on 10 CFR 50 Appendix R and NUREG-0800, Section 9.5.1.1 (and NEI 00-01, Chapter 3) since NFPA 805 only requires the licensee to maintain the fuel in a safe and stable condition rather than achieve and maintain cold shutdown.

NFPA 805, Section 1.6.56, defines Safe and Stable Conditions as follows

*"For fuel in the reactor vessel, head on and tensioned, safe and stable conditions are defined as the ability to maintain  $K_{eff} < 0.99$ , with a reactor coolant temperature at or below the requirements for hot shutdown for a boiling water reactor and hot standby for a pressurized water reactor. For all other configurations, safe and stable conditions are defined as maintaining  $K_{eff} < 0.99$  and fuel coolant temperature below boiling."*

The nuclear safety goal of NFPA 805 requires "...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" without a specific reference to a mission time or event coping duration.

For the plant to be in a safe and stable condition, it may not be necessary to perform a transition to cold shutdown as currently required under 10 CFR 50, Appendix R. Therefore, the unit may remain at or below the temperature defined by a hot standby/hot shutdown plant operating state for the event.

##### Results

Demonstration of the NSPC for safe and stable conditions at Waterford 3 was performed in two analyses.

- At-Power analysis, Modes 1-3. This analysis is discussed in Section 4.2.4.
- Non-Power analysis, which includes Modes 3-6 and de-fueled. This analysis is discussed in Section 4.3.

Based on WF3-FP-09-00001, Rev. 2, "NFPA 805 Nuclear Safety Capability Assessment," the NFPA 805 licensing basis for Waterford 3 is to achieve and maintain hot standby conditions (Mode 3) following any fire occurring with the reactor operating at power. This NSCA evaluation compares the NRC endorsed process in Chapter 3 of NEI 00-01, Revision 1 in accordance with NEI 04-02, Revision 2 requirements.

The 'At Power' NSCA postulates a single fire occurring at 100% power and provides the listing of conflicts that may impact the assured success path to meet a particular nuclear safety performance goal. The 'At Power' safe and stable strategy includes entry into hot standby (Mode 3) and stops prior to the point of manually initiating a cool-down. Safe and stable conditions in Mode 3 may be sustained with the following attributes:

#### EDG Fuel Oil

Two EDG fuel oil storage tanks each have a total usable volume of 40,747.6 gallons.

The Technical Specification 3/4.8.1.1 requirement to have at least 39,300 gallons (of 0.8500 specific gravity) fuel oil stored in the tank is based on the worst case time dependent loads of the EDG following a loss of offsite power with a limiting design bases accident. Minimum tank volume holds enough fuel oil to supply its associated diesel engine for seven days. The tanks can be cross connected to supply either EDG. Each tank has a normal and backup fill connection to ensure ability to makeup to the tank, even if the levee fails and the site is flooded.

#### Feedwater

Mode 3 conditions can be maintained via natural circulation supported by steaming from one or both SGs. The CSP has capacity of approximately 210,000 gallons. The minimum operating volume includes an allowance for water not usable because of vortexing and instrument uncertainties, and ensures a minimum of 170,000 gallons is available for the EFW system and 3,500 gallons is available for the CCW makeup system. Additionally, water is available from each of the WCT basins (174,000 and 159,500 gallons) which provide a total of 503,500 gallons.

Should water still be needed then another 250,584 gallons is available from the circulating water system.

#### Atmospheric Dump Valves

The steam generator ADVs provide a regulated method of maintaining SG pressure in a non-power operating condition. On a loss of air or control power, these valves will fail closed. If the ADV is not utilized the MSSV would cycle to remove decay heat. The ADVs are air-operated valves which can be controlled from the MCR or the remote shutdown panel (LCP-43), as needed. Additionally, these valves can be operated manually should the air operating system not be available.

#### Emergency Feedwater Control Valves

The emergency feedwater control valves are arranged with two 100% capacity flow paths to each steam generator. Each flow path has two valves, one control valve and one stop valve. Each valve is powered from its respective electrical train. On a loss of air or control signal these valves fail open. These valves can be operated from the MCR or the remote shutdown panel (LCP-43), as needed. Additionally, each of these valves has a hand-wheel and can be operated locally as needed.

#### Reactor Coolant System Inventory

RCS inventory will be controlled via one of three safety-related high pressure RCS makeup charging pumps. Sufficient borated water inventory is available to support remaining in Mode 3. The sources include two BAMTs, each tank having a capacity of 11,800 gallons and the RWSP with a capacity of 475,500 gallons.

The significant volume of borated water available minimizes any concerns with regard to maintaining the fuel in the reactor vessel in a safe and stable condition during or following a fire event.

Spent Fuel Pool Inventory

Makeup to the SFP is provided by the condensate make-up system, which supplies water from the CSP or from the RWSP. Multiple sources minimize the concern for maintaining the fuel in the SFP in a safe and stable condition following a postulated fire event.

Vital Auxiliaries

A minimum of one train of CCW, HVAC (selected areas only), Vital Electrical, and CVCS remains available for a fire in any location in the facility.

#### **4.5 Fire PRA and Performance-Based Approaches**

Risk-Informed, Performance-Based evaluations are an integral element of an NFPA 805 fire protection program. Key parts of these evaluations include:

- A Fire PRA (discussed in Section 4.5.1 and Attachments U, V, and W).
- NFPA 805 Performance-Based Approaches (discussed in Section 4.5.2).

##### **4.5.1 Fire PRA Development and Assessment**

In accordance with the guidance in RG 1.205, a Fire PRA model was developed for Waterford 3 in compliance with the requirements of Part 4, "Requirements for Fires At-Power PRA," of the ASME and ANS combined PRA Standard, ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Application," (hereafter referred to as Fire PRA Standard). Entergy conducted a peer review by independent industry analysts in November 2010 in accordance with RG 1.200 prior to a risk-informed submittal.

Section 4.5.1.1 describes the Internal Events PRA model. Section 4.5.1.2 describes the Fire PRA model. Section 4.5.1.3 describes the results and resolution of the peer review of the Fire PRA, and Section 4.5.1.4 describes insights gained from the Fire PRA.

###### **4.5.1.1 Internal Events PRA**

The Waterford 3 base internal events PRA was the starting point for the Fire PRA. Attachment U provides a discussion of the internal events PRA and the results and disposition of the most recent peer review.

The most recent peer review of the Waterford PRA model is addressed in Attachment U. The review confirmed that the Waterford 3 internal events PRA complies with Regulatory Guide 1.200, and meets Capability Category II for most SRs of ASME/ANS RA-Sa-2009 (PRA Standard). Though the conclusion of the peer review was that the model quality supported PRA applications, several findings were issued during the review. All of the technical issues identified during the peer review which have a bearing on the fire risk results have been addressed. Attachment U provides additional information on details of the findings and the current status of each.

###### **4.5.1.2 Fire PRA**

The internal events PRA was modified to capture the effects of fire both as an initiator of an event and the subsequent potential failure modes for affected circuits or individual targets. Waterford 3 is a single unit site; therefore, the PRA models are representative of the unit being analyzed. The Fire PRA was developed using the guidance for Fire PRA development in NUREG/CR-6850 with FAQs providing additional guidance. The Fire PRA model is created in CAFTA and is quantified using the EPRI FRANX software.

The Fire PRA quality and results are discussed in the subsequent sections and in Attachments V and W, respectively.

### **Fire Model Utilization in the Application**

Fire modeling was performed as part of the Fire PRA development (NFPA 805 Section 4.2.4.2). RG 1.205, Regulatory Position 4.2 and Section 5.1.2 of NEI 04-02, provide guidance to identify fire models that are acceptable to the NRC for plants implementing a risk-informed, performance-based licensing basis.

Plant specific fire modeling at Waterford 3 in support of the Fire PRA consists of the following:

- Main Control Room (MCR) Abandonment times were estimated based on calculating the time various fire affects would reach threshold values for temperature and visibility. The MCR abandonment calculation was performed using the zone fire model "Consolidated Fire and Smoke Transport (CFAST)."
- Algebraic equations implemented by the NRC Fire Dynamics Tools (FDT) – Reference NUREG-1805, were used to characterize flame radiation, flame height, plume, ceiling jet, and hot gas layer for a variety of ignition source types and heat release rates. These calculations were primarily performed to develop zones of influence (ZOI) parameters for scenario development.

The acceptability of the use of these fire models is included in Attachment J.

#### **4.5.1.3 Results of Fire PRA Peer Review**

The Waterford 3 Fire PRA was peer reviewed against the requirements of ASME/ANS RA-Sa-2009, Part 4. The review was conducted by the Westinghouse Owners Group in November 2010. Two additional focused scope peer reviews were also conducted on FPRA methods adjusted during the development process. The first was completed 9/20/2012 and the second one was completed 5/28/2013. The results (i.e., Supporting Requirement capability assessments and Facts & Observations) documented in the Fire PRA peer review reports were used to support further development of the Fire PRA for the NFPA 805 application.

All peer review findings have been either directly addressed through updated analysis or have been dispositioned for the potential impact on the Fire PRA and the application. The results of the peer reviews are summarized in Attachment V.

#### **4.5.1.4 Risk Insights**

Risk insights were documented as part of the development of the Fire PRA. The total plant fire CDF/LERF was derived using the NUREG/CR-6850 methodology for fire PRA development and is useful in identifying the areas of the plant where fire risk is greatest. A review of the fire initiating events that collectively represent 95% of the calculated fire risk is included as Attachment W (Table W-1 lists all that collectively represent 95% of CDF and gives risk insights for all fire sequences that individually contribute 1% or more of the total CDF or LERF).

**4.5.2 Performance-Based Approaches**

NFPA 805 outlines the approaches for performing performance-based analyses. As specified in Section 4.2.4, there are generally two types of analyses performed for the performance-based approach:

- Fire Modeling (NFPA 805, Section 4.2.4.1).
- Fire Risk Evaluation (NFPA 805, Section 4.2.4.2).

**4.5.2.1 Fire Modeling Approach**

The fire modeling approach was not utilized for the transition.

**4.5.2.2 Fire Risk Approach**

**Overview of Evaluation Process**

The Fire Risk Evaluations were completed as part of the Waterford 3 NFPA 805 transition. These Fire Risk Evaluations were developed using the process described below. This methodology is based upon the requirements of NFPA 805, industry guidance in NEI 04-02, and RG 1.205. These are summarized in Table 4-1.

<b>Table 4-1 Fire Risk Evaluation Guidance Summary Table</b>		
<b>Document</b>	<b>Section(s)</b>	<b>Topic</b>
NFPA 805	2.2(h), 4.2.4, A.2.2(h), A.2.4.4, D.5	Change Evaluation (2.2(h), 2.2.9, 2.4.4 A.2.2(h), A.2.4.4, D.5) Risk of Recovery Actions (4.2.4) Use of Fire Risk Evaluation (4.2.4.2)
NEI 04-02, Revision 2	4.4, 5.3, Appendix B, Appendix I, Appendix J	Change Evaluation, Change Evaluation Forms (App. I), No specific discussion of Fire Risk Evaluation
RG 1.205, Revision 1	C.2.2.4, C.2.4, C.3.2	Risk Evaluations (C.2.2.4) Recovery Actions (C.2.4)

During the transition to NFPA 805, variances from the deterministic approach in Section 4.2.3 of NFPA 805 were evaluated using a Fire Risk Evaluation per Section 4.2.4.2 of NFPA 805. A Fire Risk Evaluation was performed for each fire area containing variances from the deterministic requirements of Section 4.2.3 of NFPA 805 (VFDRs)."

If the Fire Risk Evaluation meets the acceptance criteria, this is confirmation that a success path effectively remains free of fire damage and that the performance-based approach is acceptable per Section 4.2.4.2 of NFPA 805.

The Fire Risk Evaluation process consists of the following steps (Figure 4-7 depicts the Fire Risk Evaluation process used during transition. This is generally based on FAQ 07-0054, Revision 1):

**Step 1 – Preparation for the Fire Risk Evaluation.**

- Definition of the Variances from the Deterministic Requirements. The definition of the VFDR includes a description of the problem statement and the section of NFPA 805 that is not met, type of VFDR (e.g., separation issue or degraded fire protection system), and proposed evaluation per applicable NFPA 805 section.
- Preparatory Evaluation – Fire Risk Evaluation Review. Using the information obtained during the development of Attachment C and the Fire PRA, a review of the VFDR was performed. Depending on the scope and complexity of the VFDR, the reviewers may include the Safe Shutdown/NSCA Engineer, the Fire Protection Engineer, and the Fire PRA Engineer. The purpose and objective of this review was to address the following:
  - Review of the Fire PRA modeling treatment of VFDR.
  - Ensure discrepancies were captured and resolved.

**Step 2 – Performed the Fire Risk Evaluation**

- The Evaluator coordinated as necessary with the Safe Shutdown/NSCA Engineer, Fire Protection Engineer and Fire PRA Engineer to assess the VFDR using the Fire Risk Evaluation process to perform the following:
  - Change in Risk Calculation with consideration for additional risk of recovery actions and required fire protection systems and features due to fire risk.
  - Summary of Fire area change in risk.

**Step 3 – Reviewed the Acceptance Criteria**

- The acceptance criteria for the Fire Risk Evaluation consist of two parts. One is quantitatively based and the other is qualitatively based. The quantitative figures of merit are  $\Delta$ CDF and  $\Delta$ LERF. The qualitative factors are defense-in-depth and safety margin.
  - Risk Acceptance Criteria. The transition risk evaluation was measured quantitatively for acceptability using the  $\Delta$ CDF and  $\Delta$ LERF criteria from RG 1.174, as clarified in RG 1.205, Regulatory Position 2.2.4.
  - Defense-in-Depth. A review of the impact of the change on defense-in-depth was performed, using the guidance from NEI 04-02. NFPA 805 defines defense-in-depth as:
    - Preventing fires from starting.
    - Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting damage.
    - Providing 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.

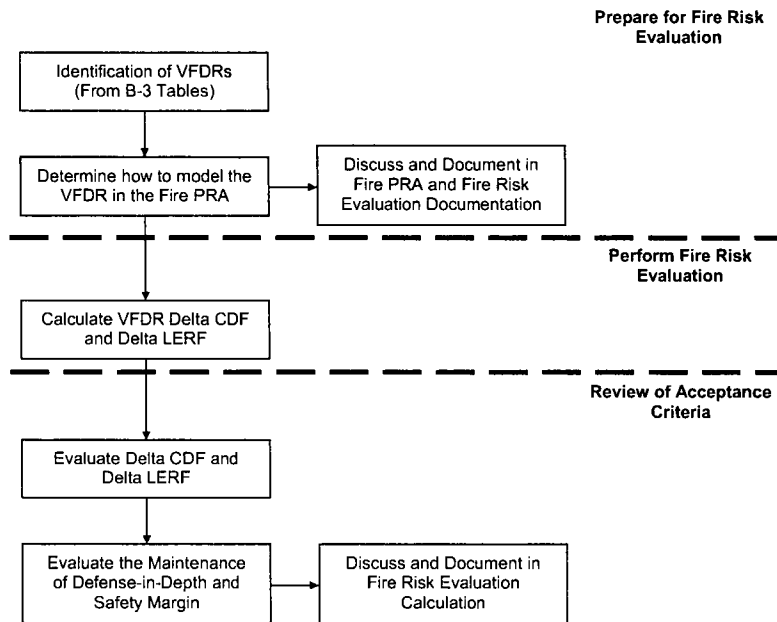
In general, the defense-in-depth requirement was considered to be satisfied if the proposed change does not result in a substantial imbalance among the above three elements.

The review of defense-in-depth was qualitative and addressed each of the elements with respect to the proposed change. Defense-in-depth was performed on a fire area basis.

Fire protection features and systems relied upon to ensure defense-in-depth were identified as a result of the assessment of defense-in-depth.

- o Safety Margin Assessment. A review of the impact of the change on safety margin was performed. An acceptable set of guidelines for completing the assessment is summarized below. Other equivalent acceptance guidelines may also be used.
  - Codes and standards or their alternatives accepted for use by the NRC are met, and
  - Safety analysis acceptance criteria in the licensing basis (e.g., SAR, supporting analyses) are met, or provides sufficient margin to account for analysis and data uncertainty.

The requirements related to safety margins for the change analysis are described for each of the specific analysis types used in support of the FRE.



**FIGURE 4-7**

**Fire Risk Evaluation Process (NFPA 805 Transition)**

[Based on FAQ 07-0054, Revision 1)

**Results of Evaluation Process**

**Disposition of VFDRs**

The Waterford 3 NSCA and the NFPA 805 transition project activities have identified a number of variances from the deterministic requirements of NFPA 805 Section 4.2.3. These variances were dispositioned using the FRE process.

Each variance dispositioned using a FRE was assessed against the FRE acceptance criteria of  $\Delta$ CDF and  $\Delta$ LERF; and maintenance of defense-in-depth and safety margin criteria from Section 5.3.5 of NEI 04-02 and RG 1.205. The results of these calculations are summarized in Attachment C.

Following completion of transition activities and planned modifications and program changes, the plant will be compliant with 10 CFR 50.48(c).

### **Risk Change Due to NFPA 805 Transition**

In accordance with the guidance in RG 1.205, Section C.2.2.4, Risk Evaluations, risk increases or decreases for each fire area using Fire Risk Evaluations and the overall plant should be provided. Note that the risk increase due to the use of recovery actions was included in the risk change for transition for each fire area.

RG 1.205, Section C.2.2.4.2 states in part:

*"The total increase or decrease in risk associated with the implementation of NFPA 805 for the overall plant should be calculated by summing the risk increases and decreases for each fire area (including any risk increases resulting from previously approved recovery actions). The total risk increase should be consistent with the acceptance guidelines in Regulatory Guide 1.174. Note that the acceptance guidelines of Regulatory Guide 1.174 may require the total CDF, LERF, or both, to evaluate changes where the risk impact exceeds specific guidelines. If the additional risk associated with previously approved recovery actions is greater than the acceptance guidelines in Regulatory Guide 1.174, then the net change in total plant risk incurred by any proposed alternatives to the deterministic criteria in NFPA 805, Chapter 4 (other than the previously approved recovery actions), should be risk neutral or represent a risk decrease."*

The risk increases and decreases are provided in Attachment W.

#### 4.8.1 Results of the Fire Area Review

A Summary of the NFPA 805 compliance basis and the required fire protection systems and features is provided in Attachment C -Table C-2. The table provides the following information from the NEI 04-02 Table B-3:

- Fire Area / Fire Zone: Fire Area / Zone Identifier.
- Description: Fire Area / Zone Description.
- NFPA 805 Regulatory Basis: Post-transition NFPA 805 Chapter 4 compliance basis (Note: Compliance is determined on a Fire Area basis therefore a compliance basis is not provided for individual fire zones.)
- Required Fire Protection System / Feature: Detection / suppression required in the Fire Area based on NFPA 805 Chapter 4 compliance. Other Required Features may include Electrical Raceway Fire Barrier Systems, fire barriers, etc. The documentation of required fire protection systems and features does not include the documentation of the fire area boundaries. Fire area boundaries are required and documentation of the fire area boundaries has been performed as part of reviews of engineering evaluations, licensing actions, or as part of the reviews of the NEI 04-02 Table B-1 process. The information is provided on a fire area / fire zone basis. The basis for the requirement of the fire protection system / feature is designated as follows:
  - S – Separation Criteria: Systems required for Chapter 4 Separation Criteria in Section 4.2.3.
  - L – Licensing Action Criteria: Systems required for acceptability of NRC approved Licensing Actions (i.e., Deviations/Safety Evaluations) (Section 2.2.7)
  - E – EEEE Criteria: Systems/Features required for acceptability of Existing Engineering Equivalency Evaluations (Section 2.2.7).
  - R – Risk Criteria: Systems/Features required to meet the Risk Criteria for the Performance-Based Approach (Section 4.2.4).
  - D – Defense-in-Depth Criteria: Systems/Features required to maintain adequate balance of Defense-in-Depth for a Performance-Based Approach (Section 4.2.4).

Attachment W contains the results of the Fire Risk Evaluations, additional risk of recovery actions, and the change in risk on a fire area basis.

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**Table 4-3 NOTE:**

Table 4-3 (**Summary of NFPA 805 Compliance Basis and Required Fire Protection Systems and Features** ) has been replaced in its entirety by the information provided in Attachment C, Table C-2.

**jwill13**

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**A. NEI 04-02 Table B-1 Transition of Fundamental Fire Protection  
Program & Design Elements**

3 Pages Attached

Changed Sections only: 3.3.8 & 3.11.5

<u>NFPA 805 Ch. 3 Ref.</u>	<u>Requirements/Guidance</u>	<u>Compliance Statement</u>	<u>Compliance Basis</u>	<u>Reference Document</u>
3.3.7.3 [Bulk Flammable Gas Cylinder Limitations]	3.3.7.3 Flammable gas storage cylinders not required for normal operation shall be isolated from the system.	Complies	No additional clarification.	EN-DC-161, Control of Combustibles, Rev. 005, Section 5.5 [1] (a) & (b)  EN-IS-109, Compressed Gas Cylinders and Storage, Rev. 007, Section 5.3[10] & [11]
3.3.8 Bulk Storage of Flammable and Combustible Liquids.	3.3.8 Bulk Storage of Flammable and Combustible Liquids. Bulk storage of flammable and combustible liquids shall not be permitted inside structures containing systems, equipment, or components important to nuclear safety. As a minimum, storage and use shall comply with NFPA 30, Flammable and Combustible Liquids Code.	Complies	There is no bulk storage of flammable and/or combustible liquids inside structures containing systems, equipment, or components important to nuclear safety.  Bulk storage is defined as flammable and/or combustible liquid storage in tanks, drums, etc. that is at a staged location and not connected to a system. Flammable and/or combustible liquid storage vessels that are installed as part of a designed system (e.g., day tanks for diesel generators or fire pumps, turbine lube oil tanks) do not constitute bulk storage.	EN-DC-161, Control of Combustibles, Rev. 009, Section 5.4  G164 SH 1, Flow Diagram – Miscellaneous Reactor Auxiliary Systems, Rev. 45, All  NRC Letter, NextEra Energy – Duane Arnold Energy Center – Issuance of Amendment Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program in Accordance with 10CFR 50.48© (TAC NO. ME6818)(ML07270052), 9/10/13, Enclosure 2, Section 3.1.1.3  WF3-FP-10-00011, WF3 Code Compliance Report for NFPA 30 "Flammable and Combustible Liquids Code," 1976 Edition, Rev. 000, All

<u>NFPA 805 Ch. 3 Ref.</u>	<u>Requirements/Guidance</u>	<u>Compliance Statement</u>	<u>Compliance Basis</u>	<u>Reference Document</u>
3.11.5 Electrical Raceway Fire Barrier Systems (ERFBS).	<p>3.11.5* Electrical Raceway Fire Barrier Systems (ERFBS). ERFBS required by Chapter 4 shall be capable of resisting the fire effects of the hazards in the area. ERFBS shall be tested in accordance with and shall meet the acceptance criteria of NRC Generic Letter 86-10, Supplement 1, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Safe Shutdown Trains Within the Same Fire Area." The ERFBS needs to adequately address the design requirements and limitations of supports and intervening items and their impact on the fire barrier system rating. The fire barrier system's ability to maintain the required nuclear safety circuits free of fire damage for a specific thermal exposure, barrier design, raceway size and type, cable size, fill, and type shall be demonstrated.</p> <p>Exception No. 1: When the temperatures inside the fire barrier system exceed the maximum temperature allowed by the acceptance criteria of Generic Letter 86-10, "Fire Endurance Acceptance Test Criteria for Fire Barrier Systems Used to Separate Redundant Safe Shutdown Training Within the Same Fire Area," Supplement 1, functionality of the cable at these elevated temperatures shall be demonstrated. Qualification demonstration of these cables shall be performed in accordance with the electrical testing requirements of Generic Letter 86-10, Supplement 1, Attachment 1, "Attachment Methods for Demonstrating Functionality of Cables Protected by Raceway Fire Barrier Systems During and After Fire Endurance Test Exposure."</p> <p>Exception No. 2: ERFBS systems employed prior to the issuance of Generic Letter 86-10, Supplement 1, are acceptable providing that the system successfully met the limiting end point temperature requirements as specified by the AHJ at the time of acceptance.</p>	Complies with use of EEEE's	<p>ERFBS at Waterford 3 required by Chapter 4 is necessary in Fire Area RAB 6. This ERFBS is rated for 1-hour fire resistance rating in accordance with requirements specified in NRC Generic Letter 86-10 and Generic Letter 86-10, Supplement 1. Obstructions and supports often make it impossible to achieve exact duplication of the specific tested configuration of the one-hour fire barrier system. Where exact replication of a tested configuration cannot be achieved, the field installation is evaluated by a qualified fire protection engineer for acceptability based on the following criteria: 1) The continuity of the fire barrier material is maintained; 2) The thickness of the barrier is maintained; and 3) The nature of the support assembly is unchanged from the tested configuration.</p> <p>Confirmatory Item: ERFBS to be installed in Fire Area RAB 6 will be completed to provide a qualified 1-hour fire resistance rating in accordance with requirements of NRC Generic Letter 86-10 and Generic Letter 86-10, Supplement 1. See Attachment S.</p>	<p>ECF 10-009, WF3 NFPA 805 Fire Risk Evaluation – Fire Area RAB 6, Rev. 001, All</p> <p>G252, Sheet 14, Safe Shutdown Analysis - Appendix R Elect Modifications RAB EL.+35.00&amp; Cable Vault &amp; Relay Room, Rev. 011, Coordinates D3</p> <p>PMC-003-001, Fire Wrap Installation and Rework, Rev.004, Section 10.11</p>
<u>VFDR ID</u>	3.11.5			
<u>VFDR</u>	ERFBS currently being installed in Fire Area RAB 6 shall be completed to provide a qualified 1-hour fire resistance rating in accordance with requirements of NRC Generic Letter 86-10 and Generic Letter 86-10, Supplement 1.			
<u>Disposition</u>	CR-WF3-2011-6349, CA19 is tracking new ERFBS installed in Fire Area RAB 6.			
<u>Status</u>	Open			

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<u>NFPA 805 Ch. 3 Ref.</u>	<u>Requirements/Guidance</u>	<u>Compliance Statement</u>	<u>Compliance Basis</u>	<u>Reference Document</u>
<u>Corrective Action Reference</u>	CR-WF3-2011-6349, CA19			
<u>FRE / Change Eval / Mod Reference</u>	See Attachment S.			

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**B. NEI 04-02 Table B-2 – Nuclear Safety Capability Assessment -  
Methodology Review**

107 Pages Attached

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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A comprehensive list of systems and equipment and their interrelationships to be analyzed for a fire event shall be developed. The equipment list shall contain an inventory of those critical components required to achieve the nuclear safety performance criteria of Section 1.5. Components required to achieve and maintain the nuclear safety functions and components whose fire-induced failure could prevent the operation or result in the maloperation of those components needed to meet the nuclear safety criteria shall be included. Availability and reliability of equipment selected shall be evaluated.

**NEI 00-01 Ref.**  
3 Deterministic Methodology

**NEI 00-01 Guidance**  
This section discusses a generic deterministic methodology and criteria that licensees can use to perform a post-fire safe shutdown analysis to address regulatory requirements. The plant-specific analysis approved by NRC is reflected in the plant's licensing basis. The methodology described in this section is also an acceptable method of performing a post-fire safe shutdown analysis. This methodology is indicated in Figure 3-1. Other methods acceptable to NRC may also be used. Regardless of the method selected by an individual licensee, the criteria and assumptions provided in this guidance document may apply. The methodology described in Section 3 is based on a computer database oriented approach, which is utilized by several licensees to model Appendix R data relationships. This guidance document, however, does not require the use of a computer database oriented approach. The requirements of Appendix R Sections III.G.1, III.G.2 and III.G.3 apply to equipment and cables required for achieving and maintaining safe shutdown in any fire area. Although equipment and cables for fire detection and suppression systems, communications systems and 8-hour emergency lighting systems are important features, this guidance document does not address them. Additional information is provided in Appendix B to this document.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
A deterministic methodology was utilized to assess Waterford 3 conformance with NFPA 805 (2001) Section 2.4.2 Nuclear Safety Capability Assessment. Except as noted in this document, the plant's methodology is consistent with the guidelines of NEI 00-01 Revision 02.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

**NEI 00-01 Ref.**

3.1 Safe Shutdown Systems and Path Development

**NEI 00-01 Guidance**

This section discusses the identification of systems available and necessary to perform the required safe shutdown functions. It also provides information on the process for combining these systems into safe shutdown paths. Appendix R Section III.G.1.a requires that the capability to achieve and maintain hot shutdown be free of fire damage. It is expected that the term "free of fire damage" will be further clarified in a forthcoming Regulatory Issue Summary. Appendix R Section III.G.1.b requires that repairs to systems and equipment necessary to achieve and maintain cold shutdown be completed within 72 hours. It is the intent of the NRC that requirements related to the use of manual operator actions will be addressed in a forthcoming rulemaking.

*The goal of post-fire safe shutdown is to assure that a one train of shutdown systems, structures, and components remains free of fire damage for a single fire in any single plant fire area. This goal is accomplished by determining those functions important to achieve and maintain hot shutdown. Safe shutdown systems are selected so that the capability to perform these required functions is a part of each safe shutdown path. The functions important to post-fire safe shutdown generally include, but are not limited to the following:*

Reactivity control, Pressure control systems, Inventory control systems, Decay heat removal systems, Process monitoring, Support systems, Electrical systems, Cooling systems

These functions are of importance because they have a direct bearing on the safe shutdown goal of being able to achieve and maintain hot shutdown which ensures the integrity of the fuel, the reactor pressure vessel, and the primary containment. If these functions are preserved, then the plant will be safe because the fuel, the reactor and the primary containment will not be damaged. By assuring that this equipment is not damaged and remains functional, the protection of the health and safety of the public is assured.

In addition to the above listed functions, Generic Letter 81-12 specifies consideration of associated circuits with the potential for spurious equipment operation and/or loss of power source, and the common enclosure failures. Spurious operations/actuators can affect the accomplishment of the post-fire safe shutdown functions listed above. Typical examples of the effects of the spurious operations of concern are the following:

- A loss of reactor pressure vessel/reactor coolant inventory in excess of the safe shutdown makeup capability
- A flow loss or blockage in the inventory makeup or decay heat removal systems being used for the required safe shutdown path.

Spurious operations are of concern because they have the potential to directly affect the ability to achieve and maintain hot shutdown, which could affect the fuel and cause damage to the reactor pressure vessel or the primary containment. Common power source and common enclosure concerns could also affect these and must be addressed.

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1 [A, Intro] Safe Shutdown Systems and Path Development

**NEI 00-01 Guidance**

This section discusses the identification of systems available and necessary to perform the required safe shutdown functions. It also provides information on the process for combining these systems into safe shutdown paths. Appendix R Section III.G.1.a requires that the capability to achieve and maintain hot shutdown be free of fire damage. It is expected that the term "free of fire damage" will be further clarified in a forthcoming Regulatory Issue Summary. Appendix R Section III.G.1.b requires that repairs to systems and equipment necessary to achieve and maintain cold shutdown be completed within 72 hours. It is the intent of the NRC that requirements related to the use of manual operator actions will be addressed in a forthcoming rulemaking. Refer to hard copy of NEI 00-01 for Figure 3-1

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

The selection of systems and equipment and their interrelationships necessary to achieve the nuclear safety performance criteria of NFPA 805 are identified as part of the Nuclear Safety Capability Assessment (NSCA). Success paths are identified and logic diagrams are implemented to identify the availability of achieving nuclear safety performance goals of NFPA 805.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

The guidance provided in NEI 00-01 was followed to establish the required fire protection and nuclear safety systems and features necessary to support and fulfill the performance goals, objectives and criteria of NFPA 805.

**Comments**

The Nuclear Safety goals considered as part of NFPA 805 (2001) is to maintain the nuclear fission products (fuel) in a "safe and stable" condition, the definition of hot standby for a Pressurized Water Reactor. As outlined in Section 4.2.1.2, of the Waterford 3 Transition Report (Enclosure 1 to W3F1-2011-0074) depending on the fire, NFPA 805 does not require a plant to transition from power to hot standby to cold shutdown. The fire area by fire area assessment documents the method of accomplishment to the NFPA 805 performance goals.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1 [B, Goals] Safe Shutdown Systems and Path Development

**NEI 00-01 Guidance**

The goal of post-fire safe shutdown is to assure that a one train of shutdown systems, structures, and components remains free of fire damage for a single fire in any single plant fire area. This goal is accomplished by determining those functions important to achieve and maintain hot shutdown. Safe shutdown systems are selected so that the capability to perform these required functions is a part of each safe shutdown path. The functions important to post-fire safe shutdown generally include, but are not limited to the following:

- Reactivity control
- Pressure control systems
- Inventory control systems
- Decay heat removal systems
- Process monitoring
- Support systems
- Electrical systems
- Cooling systems

These functions are of importance because they have a direct bearing on the safe shutdown goal of being able to achieve and maintain hot shutdown which ensures the integrity of the fuel, the reactor pressure vessel, and the primary containment. If these functions are preserved, then the plant will be safe because the fuel, the reactor and the primary containment will not be damaged. By assuring that this equipment is not damaged and remains functional, the protection of the health and safety of the public is assured.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

Nuclear safety performance goals are translated into Nuclear Safety Capability Assessment success paths using the methodology established in NFPA 805. Additionally, logic diagrams are used to demonstrate and document the plant's ability to achieve Safe and Stable post-fire conditions..

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**

3.1 [C, Spurious Operations] Safe Shutdown Systems and Path Development

**NEI 00-01 Guidance**

In addition to the above listed functions, Generic Letter 81-12 specifies consideration of associated circuits with the potential for spurious equipment operation and/or loss of power source, and the common enclosure failures. Spurious operations/actuators can affect the accomplishment of the post-fire safe shutdown functions listed above. Typical examples of the effects of the spurious operations of concern are the following:

- A loss of reactor pressure vessel/reactor coolant inventory in excess of the safe shutdown makeup capability
- A flow loss or blockage in the inventory makeup or decay heat removal systems being used for the required safe shutdown path.

Spurious operations are of concern because they have the potential to directly affect the ability to achieve and maintain hot shutdown, which could affect the fuel and cause damage to the reactor pressure vessel or the primary containment. Common power source and common enclosure concerns could also affect these and must be addressed.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

The cable selection and circuit analysis for NFPA 805 (2001) NSCA components for Waterford 3 considers spurious operation due to associated circuits, common power supplies and for common enclosures. Spurious operation occurrences are considered in both the selection of nuclear safety performance functions and systems as well as the cabling associated with the components relied upon to achieve those functions. High to Low pressure interface valves are considered for spurious operation. This includes multiple spurious operation and three phase AC hot shorts as well as two phase ungrounded DC hot shorts.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
FAQ 06-0006, Clarification of definitions provided for Hi to Low pressure interfaces in NEI 00-01 Rev. 2

**Comments**

Fire protection analysis which were provided previously in support of post-fire safe shutdown or conducted in support of NFPA 805 transition included;

- a.) itemized list of spurious combination considerations for each fire area;
- b.) consideration that any single or multiple combinations of spurious conditions could occur;
- c.) determine the consequences, evaluate the consequences and identify the actions necessary to assure the outcome of post-fire safe shutdown was achieved.

To address the Waterford 3 position on FAQ 06-0006, "High/Low Pressure Interface Definition and NEI 00-01/NFPA-805 Discrepancies", Waterford 3 agrees with and is designed to the NRC definition as "a valve whose spurious opening could result in a loss of RPV/RCS inventory and, due to the lower pressure rating or other breaches such as relief valve operations on the downstream piping, an interfacing LOCA (i.e., pipe rupture in the low pressure piping)."

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1 Criteria / Assumptions

**NEI 00-01 Guidance**  
The following criteria and assumptions may be considered when identifying systems available and necessary to perform the required safe shutdown functions and combining these systems into safe shutdown paths.

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.1 [GE BWR Paths]

**NEI 00-01 Guidance**  
[BWR] GE Report GE-NE-T43-00002-00-01-R01 entitled "Original Safe Shutdown Paths For The BWR" addresses the systems and equipment originally designed into the GE boiling water reactors (BWRs) in the 1960s and 1970s, that can be used to achieve and maintain safe shutdown per Section III.G.1 of 10CFR 50, Appendix R. Any of the shutdown paths (methods) described in this report are considered to be acceptable methods for achieving redundant safe shutdown.

**Applicability**  
Not Applicable

**Alignment Statement**  
Not Applicable

**Alignment Basis**  
Waterford 3 is a 2-Loop Combustion Engineering Pressurized Water Reactor. This requirement applies to BWR (GE) units only and is therefore not applicable to Waterford 3

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.2 [SRVs / LP Systems]

**NEI 00-01 Guidance**  
[BWR] GE Report GE-NE-T43-00002-00-03-R01 provides a discussion on the BWR Owners' Group (BWROG) position regarding the use of Safety Relief Valves (SRVs) and low pressure systems (LPCI/CS) for safe shutdown. The BWROG position is that the use of SRVs and low pressure systems is an acceptable methodology for achieving redundant safe shutdown in accordance with the requirements of 10CFR50 Appendix R Sections III.G.1 and III.G.2. The NRC has accepted the BWROG position and issued an SER dated Dec. 12, 2000.

**Applicability**  
Not Applicable

**Alignment Statement**  
Not Applicable

**Alignment Basis**  
Waterford 3 is a 2-Loop Combustion Engineering Pressurized Water Reactor. This requirement applies to BWR (GE) units only and is therefore not applicable to Waterford 3.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.1.3 [Pressurizer Heaters]

**NEI 00-01 Guidance**

[PWR] Generic Letter 86-10, Enclosure 2, Section 5.3.5 specifies that hot shutdown can be maintained without the use of pressurizer heaters (i.e., pressure control is provided by controlling the makeup/charging pumps). Hot shutdown conditions can be maintained via natural circulation of the RCS through the steam generators. The cooldown rate must be controlled to prevent the formation of a bubble in the reactor head. Therefore, feedwater (either auxiliary or emergency) flow rates as well as steam release must be controlled.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

For RCS Pressure Control the Waterford 3 Nuclear Safety Capability Assessment credits RCS Pressure controlled by energizing proportional pressurizer heaters "when required" and by operation of the pressurizer auxiliary spray valve and Charging system. However, when pressurizer heaters are not available, the charging pump is used to maintain pressurizer level as nearly as constant as possible to conserve pressurizer inventory and enthalpy. OP 901-120 provides procedural guidance when pressurizer heaters are not available.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
OP-901-120, Pressurizer Pressure Control Malfunction Rev. 302  
[E4, Loss of all pressurizer heaters]

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.1.4 [Alternative Shutdown Capability]

**NEI 00-01 Guidance**

The classification of shutdown capability as alternative shutdown is made independent of the selection of systems used for shutdown. Alternative shutdown capability is determined based on an inability to assure the availability of a redundant safe shutdown path. Compliance to the separation requirements of Sections III.G.1 and III.G.2 may be supplemented by the use of manual actions to the extent allowed by the regulations and the licensing basis of the plant, repairs (cold shutdown only), exemptions, deviations, GL 86-10 fire hazards analyses or fire protection design change evaluations, as appropriate. These may also be used in conjunction with alternative shutdown capability.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

If an unmitigated fire is assumed originating in the Control Room, loss of safe shutdown components would be limited to the Control Room proper (RAB1A, 1C, 1D ) and the Cable Vault (RAB1E). Shutdown from outside the Control Room is achieved by use of control and monitoring from the Remote Shutdown Panel, LCP-43, located at EL. +21.00 (RAB 9). As analyzed in the WF3 Nuclear Safety Capability Assessment, the capability for safe plant shutdown, using B train equipment, is provided, and assuring that the Nuclear Safety goal of maintaining the fuel in a safe and stable condition is achieved. The actions performed to activate the Remote Shutdown Panel are Primary Control Station actions and are provided in the WF3 Nuclear Safety Capability Assessment (NSCA), ECF13-001.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev..000  
OP-901-502, Evacuation of Control Room and Subsequent Plant Shutdown Rev. 027  
Regulatory Guide 1.205, Risk-informed Performance Based Fire Protection for Existing Light-Water Nuclear Power Plants Rev. 01

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with Section 3.1.1.4 of Revision 2 of NEI 00-01, the WF3 NSCA is consistent with the criteria contained in Appendix E of NEI 00-01 regarding establishing time zero for the fire condition, as it relates to operator manual actions and recovery actions.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.5 [Initial Conditions]

**NEI 00-01 Guidance**

At the onset of the postulated fire, all safe shutdown systems (including applicable redundant trains) are assumed operable and available for post-fire safe shutdown. Systems are assumed to be operational with no repairs, maintenance, testing, Limiting Conditions for Operation, etc. in progress. The units are assumed to be operating at full power under normal conditions and normal lineups.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

These assumptions have been applied for the Waterford 3 Nuclear Safety Capability Assessment (NSCA).

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.1.6 [Other Events in Conjunction with Fire]

**NEI 00-01 Guidance**

No Final Safety Analysis Report accidents or other design basis events (e.g. loss of coolant accident, earthquake), single failures or non-fire induced transients need be considered in conjunction with the fire.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

No other external events, accidents or failures unrelated to the fire area are assumed to occur concurrently with the postulated fire or any subsequent activities to achieve hot standby. These assumptions have been applied for the Waterford 3 Nuclear Safety Capability Assessment (NSCA).

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

All equipment normally present in the plant is assumed to be functional and may be lost only as a result of fire damage or the loss of offsite power. No other external events, accidents or failures unrelated to the fire are assumed to occur concurrently with the postulated fire.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.7 [ Offsite Power]

**NEI 00-01 Guidance**

For the case of redundant shutdown, offsite power may be credited if demonstrated to be free of fire damage. Offsite power should be assumed to remain available for those cases where its availability may adversely impact safety (i.e., reliance cannot be placed on fire causing a loss of offsite power if the consequences of offsite power availability are more severe than its presumed loss). No credit should be taken for a fire causing a loss of offsite power. For areas where train separation cannot be achieved and alternative shutdown capability is necessary, shutdown must be demonstrated both where offsite power is available and where offsite power is not available for 72 hours.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

Waterford 3 Nuclear Safety Capability Assessment, ECF13-001, Rev 000 incorporates the use of Off-Site power where necessary and available. The analysis focused on the ability of 4KVESWGR2A(2B) to supply power to 4KVESWGR3A(3B) in lieu of the emergency diesel generators. Components required to ensure 4KVESWGR3A(3B) being energized from 4KVESWGR2A (2B) via startup transformers 3A and 3B (SUTs) were selected and an analysis performed. Additionally, no credit is taken for a fire causing a loss of offsite power when performing circuit analysis.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.8 [Safety-Related Equipment]

**NEI 00-01 Guidance**  
Post-fire safe shutdown systems and components are not required to be safety-related.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
Safe Shutdown / NSCA Equipment may or may not be safety-related.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.1.9 [72 Hour Coping]

**NEI 00-01 Guidance**

The post-fire safe shutdown analysis assumes a 72-hour coping period starting with a reactor scram/trip. Fire-induced impacts that provide no adverse consequences to hot shutdown within this 72-hour period need not be included in the post-fire safe shutdown analysis. At least one train can be repaired or made operable within 72 hours using onsite capability to achieve cold shutdown.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

Waterford 3 Nuclear Power Plant's configuration complies. The Nuclear Safety Capability Assessment (NSCA) evaluated those systems necessary to achieve and maintain the plant in a safe and stable condition (Hot Standby) from either the Control Room or the Remote Shutdown Panel (LCP-43). Should a component required to meet a relied upon performance goal be vulnerable to a fire, a Variance From Deterministic Requirement (VFDR) was provided for evaluation in the Fire Risk Evaluation (FRE) for that fire area. NFPA 805 does not require a plant to transition from power to cold shutdown or a 72 hour coping period.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**

3.1.1.10 [Manual / Automatic Initiation of Systems]

**Applicability**

Applicable

**Alignment Statement**

Aligns

**NEI 00-01 Guidance**

Manual initiation from the main control room or emergency control stations of systems required to achieve and maintain safe shutdown is acceptable where permitted by current regulations or approved by NRC; automatic initiation of systems selected for safe shutdown is not required but may be included as an option.

**Alignment Basis**

Manual initiation of main systems is credited. Automatic operation of specific components within main systems is credited where appropriate (i.e., minimum flow valves). In general automatic main system initiation (i.e., Safety Injection Automatic System (SIAS) initiation signals) is not credited. However, fire induced automatic initiation signals are evaluated for the possibility of spurious component operation and their subsequent adverse impact on safe shutdown functionality / NSCA performance criteria.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
Regulatory Guide 1.205, Risk-informed Performance Based Fire Protection for Existing Light-Water Nuclear Power Plants Rev. 01  
WF3-FP-11-00002, (EC40610), Expert Panel for Addressing Multiple Spurious Operations Report Rev. 1

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.1.1.10 of Revision 2 of NEI 00-01, the NSCA methodology includes the possibility of spurious actuation of automatic systems due to fire damage and their subsequent impact on achieving NSCA performance criteria.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.1.11 [Multiple Affected Units]

**NEI 00-01 Guidance**

Where a single fire can impact more than one unit of a multi-unit plant, the ability to achieve and maintain safe shutdown for each affected unit must be demonstrated.

**Applicability**  
Not Applicable

**Alignment Statement**  
None

**Alignment Basis**

Waterford 3 has been licensed as a single unit facility. This requirement does not apply.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.2 Shutdown Functions

**NEI 00-01 Guidance**  
The following discussion on each of these shutdown functions provides guidance for selecting the systems and equipment required for safe shutdown. For additional information on BWR system selection, refer to GE Report GE-NE-T43-00002-00-01-R01 entitled "Original Safe Shutdown Paths for the BWR."

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
This is an introductory paragraph and contains no specific requirements.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.2.1 Reactivity Control

**NEI 00-01 Guidance**  
[BWR] Control Rod Drive System  
The safe shutdown performance and design requirements for the reactivity control function can be met without automatic scram/trip capability. Manual scram/reactor trip is credited. The post-fire safe shutdown analysis must only provide the capability to manually scram/trip the reactor.

[PWR] Makeup/Charging  
There must be a method for ensuring that adequate shutdown margin is maintained by ensuring borated water is utilized for RCS makeup/charging.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
If an automatic reactor trip has not already occurred the Nuclear Safety Capability Assessment (NSCA) credits a manual trip to establish the initial shutdown conditions. Reactivity Control is accomplished by verification that a reactor scram has occurred with all control element assemblies being lowered into the reactor core. Subsequently, borated water is provided and neutron flux is monitored. Reactor coolant inventory control is executed with the availability of Charging pumps for boration. Either the Boric Acid Makeup Tanks or Reactor Water Storage Pool (RWSP) may be used as a source of borated makeup water and is credited in the NSCA accordingly.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
OP-901-524, Fire in Areas Affecting Safe Shutdown Rev. 012

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.2.2 Pressure Control Systems

**NEI 00-01 Guidance**

The systems discussed in this section are examples of systems that can be used for pressure control. This does not restrict the use of other systems for this purpose.

**[BWR] Safety Relief Valves (SRVs)**

The SRVs are opened to maintain hot shutdown conditions or to depressurize the vessel to allow injection using low pressure systems. These are operated manually. Automatic initiation of the Automatic Depressurization System is not a required function.

**[PWR] Makeup/Charging**

RCS pressure is controlled by controlling the rate of charging/makeup to the RCS. Although utilization of the pressurizer heaters and/or auxiliary spray reduces operator burden, neither component is required to provide adequate pressure control. Pressure reductions are made by allowing the RCS to cool/shrink, thus reducing pressurizer level/pressure. Pressure increases are made by initiating charging/makeup to maintain pressurizer level/pressure. Manual control of the related pumps is acceptable.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

For RCS Pressure Control Waterford 3 Nuclear Safety Capability Assessment credits RCS Pressure controlled by energizing proportional pressurizer heaters "when required" and by operation of the pressurizer auxiliary spray valve and operation of the Charging system. However, when pressurizer heaters are not available, the charging pump is used to maintain pressurizer level as nearly as constant as possible during the cooldown process to conserve pressurizer inventory and enthalpy.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
OP-901-112, Charging or Letdown Malfunction Rev. 005  
OP-901-503, Isolation Panel Fire Rev. 308  
OP-901-524, Fire in Areas Affecting Safe Shutdown Rev. 012

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**  
3.1.2.3 Inventory Control

**NEI 00-01 Guidance**

[BWR] Systems selected for the inventory control function should be capable of supplying sufficient reactor coolant to achieve and maintain hot shutdown. Manual initiation of these systems is acceptable. Automatic initiation functions are not required.

[PWR]: Systems selected for the inventory control function should be capable of maintaining level to achieve and maintain hot shutdown. Typically, the same components providing inventory control are capable of providing pressure control. Manual initiation of these systems is acceptable. Automatic initiation functions are not required.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

This function is accomplished by ensuring the charging pump(s) and the associated flow path are available and by monitoring pressurizer level. The charging pump(s) are also required for boration. Either the Boric Acid Makeup Tanks or Refueling Water Storage Pool may be used as a source of borated makeup water.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-11-00002, (EC40610), Expert Panel for Addressing  
Multiple Spurious Operations Report Rev. 1

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.1.2.3 of Revision 2 of NEI 00-01, the NSCA methodology includes the possibility of spurious actuation of automatic systems due to fire damage and their subsequent impact on achieving NSCA performance criteria.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.2.4 Decay Heat Removal

**NEI 00-01 Guidance**

[BWR] Systems selected for the decay heat removal function(s) should be capable of:

- Removing sufficient decay heat from primary containment, to prevent containment over-pressurization and failure.
- Satisfying the net positive suction head requirements of any safe shutdown systems taking suction from the containment (suppression pool).
- Removing sufficient decay heat from the reactor to achieve cold shutdown.

[PWR] Systems selected for the decay heat removal function(s) should be capable of:

- Removing sufficient decay heat from the reactor to reach hot shutdown conditions. Typically, this entails utilizing natural circulation in lieu of forced circulation via the reactor coolant pumps and controlling steam release via the Atmospheric Dump valves.
- Removing sufficient decay heat from the reactor to reach cold shutdown conditions.

This does not restrict the use of other systems.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

This function is provided in safe and stable (hot standby) by use of the Emergency Feedwater systems and Steam Generator Atmospheric Dump Valves or Main Steam Safeties. With the Reactor shutdown and RCP secured, natural circulation is established between the reactor vessel and the steam generators. Decay heat is transferred by the RCS to the steam generators where the steam is vented to the atmosphere by releasing steam through the Atmospheric Dump valves or the Main Steam Safeties.

**Comments**

None

**Reference**

CN-TDA-10-2 (EC31611), Waterford 3 - Appendix R Fire Analysis Report - Westinghouse - Fire Analysis Report Rev. 1  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

## Waterford 3

### NFWA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

#### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

NEI 00-01 Ref.  
3.1.2.5 Process Monitoring

**NEI 00-01 Guidance**

The process monitoring function is provided for all safe shutdown paths. IN 84-09, Attachment 1, Section IX "Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems (10CFR50 Appendix R)" provides guidance on the instrumentation acceptable to and preferred by the NRC for meeting the process monitoring function. This instrumentation is that which monitors the process variables necessary to perform and control the functions specified in Appendix R Section III.L.1. Such instrumentation must be demonstrated to remain unaffected by the fire. The IN 84-09 list of process monitoring is applied to alternative shutdown (III.G.3). IN 84-09 did not identify specific instruments for process monitoring to be applied to redundant shutdown (III.G.1 and III.G.2). In general, process monitoring instruments similar to those listed below are needed to successfully use existing operating procedures (including Abnormal Operating Procedures).

**BWR**

- Reactor coolant level and pressure
- Suppression pool level and temperature
- Emergency or isolation condenser level
- Diagnostic instrumentation for safe shutdown systems
- Level indication for tanks needed for safe shutdown

**PWR**

- Reactor coolant temperature (hot leg / cold leg)
- Pressurizer pressure and level
- Neutron flux monitoring (source range)
- Level indication for tanks needed for safe shutdown
- Steam generator level and pressure
- Diagnostic instrumentation for safe shutdown systems

The specific instruments required may be based on operator preference, safe shutdown procedural guidance strategy (symptomatic vs. prescriptive), and systems and paths selected for safe shutdown.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

Process monitoring instrumentation, in the context of post-fire safe and stable operation, consists of those instruments that are necessary to monitor the operation of the primary NSCA system parameters and the operation of those systems or components that provide required support functions. For any fire scenario, Waterford typically will shutdown using one train of equipment and components. The same train of instrumentation will remain operational to support this equipment.

**Comments**

Instrumentation that provides input signals to the ESFAS and EFAS are also included, since a spurious safeguards signal has the potential of adversely affecting post fire safe and stable configuration. The instrumentation is adequate for meeting the Nuclear Safety Performance Criteria of NFWA 805 (2001).

**Reference**

ECF13-001 - NFWA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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<p><b>NEI 00-01 Ref.</b>          3.1.2.6 Support Systems</p> <p><b>Applicability</b>          Applicable</p> <p><b>Alignment Statement</b>          None</p>	<p><b>NEI 00-01 Guidance</b>          [Blank Heading - No specific guidance]</p> <p><b>Alignment Basis</b>  <i>This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.</i></p> <p><b>Comments</b>          None</p>	<p><b>Reference</b></p>
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# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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NEI 00-01 Ref.  
3.1.2.6.1 Electrical Systems

NEI 00-01 Guidance  
AC Distribution System

Power for the Appendix R safe shutdown equipment is typically provided by a medium voltage system such as 4.16 KV Class 1E busses either directly from the busses or through step down transformers/load centers/distribution panels for 600, 480 or 120 VAC loads. For redundant safe shutdown performed in accordance with the requirements of Appendix R Section III.G.1 and 2, power may be supplied from either offsite power sources or the emergency diesel generator depending on which has been demonstrated to be free of fire damage. No credit should be taken for a fire causing a loss of offsite power. Refer to Section 3.1.1.7.

DC Distribution System

Typically, the 125VDC distribution system supplies DC control power to various 125VDC control panels including switchgear breaker controls. The 125VDC distribution panels may also supply power to the 120VAC distribution panels via static inverters. These distribution panels typically supply power for instrumentation necessary to complete the process monitoring functions.

For fire events that result in an interruption of power to the AC electrical bus, the station batteries are necessary to supply any required control power during the interim time period required for the diesel generators to become operational. Once the diesels are operational, the 125 VDC distribution system can be powered from the diesels through the battery chargers.

[BWR] Certain plants are also designed with a 250VDC Distribution System that supplies power to Reactor Core Isolation Cooling and/or High Pressure Coolant Injection equipment.

The DC control centers may also supply power to various small horsepower Appendix R safe shutdown system valves and pumps. If the DC system is relied upon to support safe shutdown without battery chargers being available, it must be verified that sufficient battery capacity exists to support the necessary loads for sufficient time (either until power is restored, or the loads are no longer required to operate).

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

These systems provide the support to ensure that the electrical components identified in the other systems will be operating as required to achieve post fire safe and stable configuration. The electrical distribution system has been configured to provide the necessary power from either the Emergency Diesel Generators or Offsite Power via the Startup Transformers. The power supply for each powered component is included in the Safe Shutdown (NSCA) Equipment List (SSEL), which is in the NSCA (ECF13-001). The AC Power distribution system consists of two primary trains designated A and B. Each has its own 4.16kV AC switchgear bus, 480V AC switchgear bus, several 480V motor control centers, several 120V AC power distribution panels and diesel generators. There is a partial third train consisting of a 4.16kV AC switchgear bus, 480V AC switchgear bus, two 480V AC motor control centers and various power distribution panels. The 4.16kV AC switchgear bus, 4kV-ESWGR-3AB may be powered by either the Train A or Train B 4kV switchgear. The 125VDC Power Distribution System supplies power for operation of the Reactor trip switchgear, EDG control power for operation of the reactor trip switchgear, EDG control power and field flashing, safe shutdown circuit breaker control power and various valve solenoids and control relays. It also provides backup power to the Static Uninterruptible power supplies (SUPS). The 125VDC Standby Power Distribution system consist of batteries, battery charges, 125VDC switchgears and DC distribution panels. The SUPS supply the Vital 120V AC loads.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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Comments  
None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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NEI 00-01 Ref.  
3.1.2.6.2 Cooling Systems [HVAC]

NEI 00-01 Guidance  
Cooling Systems [Main Section]

Various cooling water systems may be required to support safe shutdown system operation, based on plant-specific considerations. Typical uses include:

- RHR/SDC/DH Heat Exchanger cooling water
- Safe shutdown pump cooling (seal coolers, oil coolers)
- Diesel generator cooling
- HVAC system cooling water

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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NEI 00-01 Ref.

**NEI 00-01 Guidance**  
[HVAC Systems]

HVAC Systems may be required to assure that safe shutdown equipment remains within its operating temperature range, as specified in manufacturer's literature or demonstrated by suitable test methods, and to assure protection for plant operations staff from the effects of fire (smoke, heat, toxic gases, and gaseous fire suppression agents). HVAC systems may be required to support safe shutdown system operation, based on plant -specific configurations. Typical uses include: - Main control room, cable spreading room, relay room - ECCS pump compartments - Diesel generator rooms - Switchgear rooms Plant-specific evaluations are necessary to determine which HVAC systems are essential to safe shutdown equipment operation.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

All of the cooling water systems required to support safe shutdown equipment and components post-fire are located in the SSEL (in the NSCA, ECF13-001) and are included in the analysis of components and cables for a fire in each fire area.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**Alignment Statement**

**Alignment Basis**

All of the HVAC systems required to support safe shutdown equipment and components post-fire are located in the SSEL (in the NSCA, ECF13-001) and are included in the analysis of components and cables for a fire in each fire area.

**Reference**

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.1.2.6.3 of Revision 2 of NEI 00-01, the following is a discussion of how WF3 aligns for the additional HVAC guidelines.

The RAB HVAC System consists of five subsystems. They are the RAB Normal Ventilation System, the Controlled Ventilation Area System (CVAS), the Cable Vault and Switchgear HVAC System, the Diesel Generator Room Ventilation System, and the RAB H&V Equipment Room Ventilation System. The RAB Normal Ventilation System and the Controlled Ventilation Area System are not relied upon post fire. CVAS performs a safety related function following a design basis accident and SIAS actuation to evacuate particular plant areas. The Cable Vault and Switchgear HVAC System are relied upon post fire. It consists of air handling units SVS-MAHU-0001A (1B) and SVS-MAHU-0002A (2B), and their associated dampers and ductwork. The Diesel Generator Room Ventilation System provides ventilation for each of the two emergency diesel generator rooms. The RAB H&V Equipment Room Ventilation System consists of supply fans (HVR-MAHU-0022A (B)), exhaust fans (HVR-MFAN-0024A (B)), and associated dampers and ductwork. The exhaust fans are only required to run when its associated supply fan is running and area thermocouples indicate high room temperature. On high temperature, the dampers will realign to the high temperature mode, which isolates the normal return and draws outside air into the room. The Reactor Building Ventilation System consists of several sub-systems, but only the Containment Cooling System (CCS) is credited post fire. The Control Room HVAC provides cooling and ventilation for the Control Room envelope. This envelope includes the Control Room, computer room, computer room supplementary air conditioning equipment room, HVAC equipment room, emergency living quarters, emergency storage room, toilets, lockers, kitchen corridors, conference room and vault.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.1.3 Methodology for Shutdown System Selection

**NEI 00-01 Guidance**  
Refer to Figure 3-2 for a flowchart illustrating the various steps involved in selecting safe shutdown systems and developing the shutdown paths.

The following methodology may be used to define the safe shutdown systems and paths for an Appendix R analysis:

[Refer to hard copy of NEI 00-01 for Figure 3-2]

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.3.1 Identify safe shutdown functions

**NEI 00-01 Guidance**

Review available documentation to obtain an understanding of the available plant systems and the functions required to achieve and maintain safe shutdown. Documents such as the following may be reviewed:

- Operating Procedures (Normal, Emergency, Abnormal)
- System descriptions
- Fire Hazard Analysis
- Single-line electrical diagrams
- Piping and Instrumentation Diagrams (P&IDs)

[BWR] GE Report GE-NE-T43-00002-00-01-R02 entitled "Original Shutdown Paths for the BWR"

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The Safe Shutdown (NSCA) Equipment List (SSEL) identifies the minimum set of plant equipment that is required to demonstrate the plant's ability to achieve and maintain post-fire safe and stable configuration for all applicable areas of the plant. To develop the list, a thorough review of plant documents, including (P&IDs), System Training Manuals, Normal and Abnormal Operating Procedures, and the Final Safety Analysis Report was conducted.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.3.2 Identify Combinations of Systems that Satisfy Each Safe Shutdown Function

**NEI 00-01 Guidance**

Given the criteria/assumptions defined in Section 3.1.1, identify the available combinations of systems capable of achieving the safe shutdown functions of reactivity control, pressure control, inventory control, decay heat removal, process monitoring, and support systems such as electrical and cooling systems (refer to Section 3.1.2). This selection process does not restrict the use of other systems. In addition to achieving the required safe shutdown functions, consider spurious operations and power supply issues that could impact the required safe shutdown function.

**Applicability**

Applicable

**Alignment Statement**

*Aligns with intent*

**Alignment Basis**

*Safe shutdown functions, systems and components needed to satisfy the NFPA 805 (2001) nuclear safety performance goals were selected using the criteria and assumptions of NEI 00-01, Sections 3.1.1 and 3.1.2.*

**Reference**

*ECF13-001 - NFPA 805 NSCA Calculation Rev. 000*

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.3.3 Define Combinations of Systems for Each Safe Shutdown Path

**NEI 00-01 Guidance**

Select combinations of systems with the capability of performing all of the required safe shutdown functions and designate this set of systems as a safe shutdown path. In many cases, safe shutdown paths may be defined on a divisional basis since the availability of electrical power and other support systems must be demonstrated for each path.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The logical relationship of the safe shutdown equipment is established in the NSCA Logic Diagrams and illustrates how this equipment functions together to achieve the nuclear safety performance goals and can maintain the plant in a safe and stable condition.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

In the second phase of the analysis, control wiring diagrams for all electrically supervised components identified in the SSEL were analyzed to identify those cables required for the component to perform its safe shutdown function. In addition, those cables that could result in the spurious operation of the component or that may be capable of introducing a spurious actuation concern as the result of fire induced cable damage were identified.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

---

**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.1.3.4 Assign Shutdown Paths to Each  
Combination of Systems

**NEI 00-01 Guidance**

Assign a path designation to each combination of systems. The path will serve to document the combination of systems relied upon for safe shutdown in each fire area. Refer to Attachment 1 to this document (NEI 00-01) for an example of a table illustrating how to document the various combinations of systems for selected shutdown paths.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

Nuclear Safety Capability Assessment (NSCA) logic diagrams were utilized to determine success paths for the various safe shutdown functions. Success paths were designated for each system and performance goal in a manner similar to the example in attachment #1 of NEI 00-01. Waterford did not assign a 'path designation' to each combination of systems or equipment. Instead the logic diagrams (with AND and OR gates) provided numerous combinations of 'success paths' that could be used to achieve safe and stable configuration. Waterford then credited one combination of success paths for each function for each fire area. This meets the intent of the guidance.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.2 Safe Shutdown Equipment Selection

**NEI 00-01 Guidance**

The previous section described the methodology for selecting the systems and paths necessary to achieve and maintain safe shutdown for an exposure fire event (see Section 5.0 DEFINITIONS for "Exposure Fire"). This section describes the criteria/assumptions and selection methodology for identifying the specific safe shutdown equipment necessary for the systems to perform their Appendix R function. The selected equipment should be related back to the safe shutdown systems that they support and be assigned to the same safe shutdown path as that system. The list of safe shutdown equipment will then form the basis for identifying the cables necessary for the operation or that can cause the maloperation of the safe shutdown systems.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The SSEL is used as input into the development of the NSCA Logic Diagrams. The SSEL is also used to identify those components requiring post-fire safe shutdown circuit analysis.

**Reference**

**Comments**

none

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.1 Criteria / Assumptions

**Applicability**  
Applicable

**Alignment Statement**  
None

**NEI 00-01 Guidance**

*Consider the following criteria and assumptions when identifying equipment necessary to perform the required safe shutdown functions:*

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Comments**

None

**Reference**

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**

3.2.1.1 [Primary Secondary Components]

**NEI 00-01 Guidance**

Safe shutdown equipment can be divided into two categories. Equipment may be categorized as (1) primary components or (2) secondary components. Typically, the following types of equipment are considered to be primary components: - Pumps, motor operated valves, solenoid valves, fans, gas bottles, dampers, unit coolers, etc. - All necessary process indicators and recorders (i.e., flow indicator, temperature indicator, turbine speed indicator, pressure indicator, level recorder) - Power supplies or other electrical components that support operation of primary components (i.e., diesel generators, switchgear, motor control centers, load centers, power supplies, distribution panels, etc.). Secondary components are typically items found within the circuitry for a primary component. These provide a supporting role to the overall circuit function. Some secondary components may provide an isolation function or a signal to a primary component via either an interlock or input signal processor. Examples of secondary components include flow switches, pressure switches, temperature switches, level switches, temperature elements, speed elements, transmitters, converters, controllers, transducers, signal conditioners, hand switches, relays, fuses and various instrumentation devices. Determine which equipment should be included on the Safe Shutdown Equipment List (SSEL). As an option, include secondary components with a primary component(s) that would be affected by fire damage to the secondary component. By doing this, the SSEL can be kept to a manageable size and the equipment included on the SSEL can be readily related to required post-fire safe shutdown systems and functions.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

Waterford placed the primary and a few of the secondary components on the SSEL. Although some subcomponents were not individually identified (i.e., relays, fuses, hand switches, computer boards, etc), the cable which connected to the subcomponents were identified and assigned to the primary components.

In this manner, the secondary components, which were not placed on the SSEL are analyzed with the cable servicing the device. The third phase of the analysis consisted of the generation of a list of safe shutdown equipment and associated cables (and instrument tubing) for each area.

**Reference**

ECE91-056, Relay Settings and Coordination Curves for 6.9kV and 4.16kV and 480V Busses Rev. 003  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
Waterford 3 FSAR Section 9.5.1

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.2.1.2 [Fire Damage to Mechanical Components (not electrically supervised)]

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**NEI 00-01 Guidance**

3.2.1.2 Assume that exposure fire damage to manual valves and piping does not adversely impact their ability to perform their pressure boundary or safe shutdown function (heat sensitive piping materials, including tubing with brazed or soldered joints, are not included in this assumption). Fire damage should be evaluated with respect to the ability to manually open or close the valve should this be necessary as a part of the post-fire safe shutdown scenario.

**Alignment Basis**

Fire damage to valves, piping and non-combustible tubing is not assumed to adversely impact the ability to function as pressure boundaries or as safe shutdown components. The material of construction for plant systems is primarily carbon steel or stainless steel with an approached melting point of 2500 F exceeding those modeled fire conditions as related to ASTM E119.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PSA-WF3-03-02 (RSC 13-44), Summary of Fire PRA Driven Plant Improvements to Waterford 3 to Support Risk Optimization Rev. 0  
WF3-FP-13-00004, Waterford 3 Defense In Depth Report for NFPA 805 Rev. 0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.2.1.2 of Revision 2 of NEI 00-01, Waterford 3 evaluated rising stem valves included in the NSCA Safe Shutdown Equipment List (SSEL). From calculation PSA-WF3-03-02 and Engineering Report WF3-FP-13-00004, Rev 0 Waterford 3 does not have any recovery actions that would require manual opening or closing of a rising stem valve in order to place the plant in a safe and stable configuration.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.1.3 [Manual Valve Positions]

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**NEI 00-01 Guidance**

Assume that manual valves are in their normal position as shown on P&IDs or in the plant operating procedures.

**Alignment Basis**

The normal operating position of the component's were determined by a review of plant drawings and when necessary plant procedures.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.2.1.3 of Revision 2 of NEI 00-01, the WF3 NSCA assumes that equipment required for safe and stable configuration is available. Although not explicitly stated, this assumption includes that no LCOs are in effect and that no equipment required for achieving safe and stable configuration has been taken out of service for maintenance at the time of the fire event. The NSCA also assumes that the plant is operating at 100% power at the time of the fire event.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

---

**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.1.4 [Check Valves]

**NEI 00-01 Guidance**  
Assume that a check valve closes in the direction of potential flow diversion and seats properly with sufficient leak tightness to prevent flow diversion. Therefore, check valves do not adversely affect the flow rate capability of the safe shutdown systems being used for inventory control, decay heat removal, equipment cooling or other related safe shutdown functions.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
Properly oriented check valves are assumed to provide adequate isolation when credited for boundary isolation.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**  
Valves which constitute system boundaries are included in the SSEL. For configuration control purposes, the first normally closed manual valve or properly oriented check valve credited as a system boundary is listed in the SSEL.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.2.1.5 [Instrument Failures]

**NEI 00-01 Guidance**

Instruments (e.g., resistance temperature detectors, thermocouples, pressure transmitters, and flow transmitters) are assumed to fail upscale, midscale, or downscale as a result of fire damage, whichever is worse. An instrument performing a control function is assumed to provide an undesired signal to the control circuit.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

Damage to instrument cables is assumed to fail the instrument in the least desirable state. That is, the instrument could fail high, low, or in some intermediate condition.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

Instruments providing credited control function interlocks for NSCA equipment were identified as required NSCA components, and the applicable relationship to the NSCA equipment were identified. The required cables to achieve the instrument interlock were included with the initiating instrument and not the interlocked component. Instruments which do not provide a credited control function, but whose spurious operation could adversely affect meeting the Nuclear Safety Performance goals were also considered to be required NSCA components. Examples include instrumentation involved in the initiation of the ESFAS automatic control logics.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.1.6 [Spurious Components]

**NEI 00-01 Guidance**  
Identify equipment that could spuriously operate or mal-operate and impact the performance of equipment on a required safe shutdown path during the equipment selection phase. Consider Bin 1 of RIS 2004-03 during the equipment identification process.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
Waterford 3 addresses Spurious and Multiple Spurious Operation scenarios by evaluating ALL of the circuits and components that can be affected by any single fire for simultaneous spurious concerns. This includes Bin 1 of RIS 2004-03. Waterford 3 followed the methodology for the NFPA 805 circuit analysis for spurious and multiple spurious analysis.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-EE-11-00001, Technical Evaluation of Open-Circuited Current Transformers Rev. 0

Spurious signal from relay contacts and instrumentation contacts are modeled while selecting cables from interlocks. Relay contacts, instrument contacts are assumed to go to positions that could provide permissive or actuate if monitored parameters or interlocked device may change at a point during shutdown (i.e. temperature switch starts fan, level/pressure switch changes suction source, breaker contact closes to align another breaker), its assumed to be in worst case for cable fault and required position.

Note: Revision 2 of NEI 00-01 deleted this section from Revision 1. Spurious components are addressed in Section 3.5.1.2 in Revision 2.

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.1.7 [Instrument Tubing]

**NEI 00-01 Guidance**

Identify instrument tubing that may cause subsequent effects on instrument readings or signals as a result of fire. Determine and consider the fire area location of the instrument tubing when evaluating the effects of fire damage to circuits and equipment in the fire area.

**Applicability**  
Applicable

**Alignment Statement**  
Not Applicable

**Alignment Basis**

ECF13-001 Appendix F, contains an instrument tubing evaluation. The tubing routing (by Fire Area) was entered into the NSCA database as if it were a cable supporting operability of its associated instrument. The tubing was assigned a "CABLE ID" that included the instrument and the letters "TUBING". For example, the tubing for RC-IPT-0100X is identified as "RC-IPT-0100X-TUBING". The potential effect of the fire-induced heating on the tubing was then analyzed on a case-by-case basis during the performance of the Compliance Assessments for each Fire Area. The objective of this analysis was to assess the impact of fluid density changes inside instrument tubing on indication and control signals credited for achieving post-fire safe and stable conditions at the Waterford 3. Heating of the process fluid within the sensing lines during a fire has the potential to result in erroneous readings or spurious equipment actuation.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

Revision 2 of NEI 00-01 deleted this section from revision 1. Instrumentation Tubing is addressed in Section 3.4.1.9 in Revision 2.

**Comments**

The objective of the instrument tubing analysis is to assess the impact of fluid density changes inside instrument tubing on indication and control signals credited for achieving post-fire safe and stable conditions at Waterford 3. Heating of the process fluid within the sensing lines during a fire has the potential to result in erroneous readings or spurious equipment actuation.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.2.2 Methodology for Equipment Selection

**NEI 00-01 Guidance**

Refer to Figure 3-3 for a flowchart illustrating the various steps involved in selecting safe shutdown equipment.

*Use the following methodology to select the safe shutdown equipment for a post-fire safe shutdown analysis:*

[Refer to hard copy of NEI 00-01 for Figure 3-3]

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**  
3.2.2.1 Identify the System Flow Path for Each Shutdown Path

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**NEI 00-01 Guidance**

Mark up and annotate a P&ID to highlight the specific flow paths for each system in support of each shutdown path. Refer to Attachment 2 for an example of an annotated P&ID illustrating this concept.

**Alignment Basis**

Component Selection and Flow path Identification Criteria was performed as part of the phase I process of the Nuclear Safety Capability Assessment (NSCA). In this phase, the functional capability of the plant systems as described by their respective P&ID's, design basis documents, and system descriptions were compared to the functional requirements for safe and stable conditions discussed in Section 5.0 of the NSCA and a list was developed to identify the systems and equipment that must be protected in order to ensure safe and stable conditions. Components in the flow paths that require operation / repositioning to allow the system to function, and components that could spuriously operate and impair achieving safe and stable conditions were identified.

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.2.2.1 of Revision 2 of NEI 00-01, secondary components such as relays, fuses, etc. were included with a primary component such as a panel. Refer to the Alignment Basis in section 3.2.1.1 of this document for a description of how the NSCA addressed and analyzed primary/secondary component relationships.

From P&IDs and the SSEL, the NSCA Logic Diagrams were generated. The NSCA Logic Diagrams contain AND/OR gates that clearly indicate the flow or success path for each of the Nuclear Safety Performance functions. From this point on, the NSCA Logic Diagrams are utilized to show the specific path for achieving safe and stable conditions.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

**NEI 00-01 Ref.**

3.2.2.2 Identify the Equipment in Each Safe Shutdown System Flow Path Including Equipment That May Spuriously Operate and Affect System Operation

**NEI 00-01 Guidance**

Review the applicable documentation (e.g. P&IDs, electrical drawings, instrument loop diagrams) to assure that all equipment in each system's flow path has been identified. Assure that any equipment that could spuriously operate and adversely affect the desired system function(s) is also identified. If additional systems are identified which are necessary for the operation of the safe shutdown system under review, include these as systems required for safe shutdown. Designate these new systems with the same safe shutdown path as the primary safe shutdown system under review (Refer to Figure 3-1).

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

The NSCA Safe Shutdown Equipment List (SSEL) identifies the minimum set of plant equipment that is required to demonstrate the plant's ability to achieve and maintain post-fire safe and stable conditions for all applicable areas of the plant. To develop the list, a thorough review of plant documents, including P&IDs, System Training Manuals, Normal and Abnormal Operating Procedures, and the Final Safety Analysis Report was conducted. The SSEL is the result of an iterative process including component selection, circuit analysis, and area compliance assessments. Safe and stable achievement paths are not designated and the method to achieve and maintain safe and stable conditions is shown on the NSCA Logic Diagrams for each system. The effects of spurious operation have been analyzed as follows:

(1) Mal-operation of required safe and stable equipment due to control circuit interlocks between safe shutdown circuits and other circuits; and

(2) Mal-operation of equipment which is not defined as active or passive safe shutdown but could prevent the achievement of a safe and stable function and thus has been included as required for achieving safe and stable conditions;

(3) Mal-operation of high-low pressure interface valves due to damage to control circuits or hot shorts to AC or DC power circuits.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-11-00002, (EC40610), Expert Panel for Addressing Multiple Spurious Operations Report Rev. 1

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**

3.2.2.3 Develop a List of Safe Shutdown Equipment and Assign the Corresponding System and Safe Shutdown Path(s) Designation to Each.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**NEI 00-01 Guidance**

Prepare a table listing the equipment identified for each system and the shutdown path that it supports. Identify any valves or other equipment that could spuriously operate and impact the operation of that safe shutdown system. Assign the safe shutdown path for the affected system to this equipment. During the cable selection phase, identify additional equipment required to support the safe shutdown function of the path (e.g., electrical distribution system equipment). Include this additional equipment in the safe shutdown equipment list. Attachment 3 to this document provides an example of a (SSEL). The SSEL identifies the list of equipment within the plant considered for safe shutdown and it documents various equipment-related attributes used in the analysis.

**Alignment Basis**

From the original design documentation, developmental analysis provided the foundation necessary to identify equipment required to achieve and maintain post-fire safe and stable conditions. From previous Associated circuit analysis, safe shutdown studies and ancillary licensing requirements (Generic Letters, Regulatory Information Summaries) a database of Safe Shutdown Equipment Listings (SSEL) were gathered. From this foundation an update to a current database was provided and will be maintained over the plant life.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
EE5-32-02, Appendix R Associated Circuit Analysis Coordination Study Rev. 001

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Section 3.2.2.3 of Revision 2 of NEI 00-01 was revised to include additional guidance concerning the identification of instrument tubing that may subsequent effects on instrument readings or signals as a result of a fire. Process instrument tubing analysis is included in the NSCA. Refer to Section 3.2.1.7 of this document for the complete Alignment Basis on Instrument Tubing.

The NSCA Logic Diagrams were utilized to determine flow and diversion paths for NSCA functions and to identify potential SSEL components. An iterative process was utilized to arrive at the final SSEL based on additional support components identified during the cable selection process (such as electrical distribution equipment). Additional information was added such as drawing references and power supplies. Instrument tubing is listed as cables in each fire area and is evaluated, like a cable, when a fire is assumed to affect the tubing.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.1 Nuclear Safety Capability System and Equipment Selection

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**NEI 00-01 Ref.**

3.2.2.4 Identify Equipment Information Required for the Safe Shutdown Analysis

**NEI 00-01 Guidance**

Collect additional equipment-related information necessary for performing the post-fire safe shutdown analysis for the equipment. In order to facilitate the analysis, tabulate this data for each piece of equipment on the SSEL. Refer to Attachment 3 to this document for an example of a SSEL. Examples of related equipment data should include the equipment type, equipment description, safe shutdown system, safe shutdown path, drawing reference, fire area, fire zone, and room location of equipment. Other information such as the following may be useful in performing the safe shutdown analysis: normal position, hot shutdown position, cold shutdown position, failed air position, failed electrical position, high/low pressure interface concern, and spurious operation concern.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

From the original design documentation, developmental analysis provided the foundation necessary to identify safe shutdown related equipments. From previous Associated circuit analysis, safe shutdown studies and ancillary licensing requirements (Generic Letters, Regulatory Information Summaries) a database of Safe Shutdown Equipment Listings were gathered.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

The information listed is provided in the SSEL with the exception of the shutdown path and the spurious concern. These items are determined by fire scenario by fire area.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.1 Nuclear Safety Capability System and Equipment Selection**

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**NEI 00-01 Ref.**

3.2.2.5 Identify Dependencies Between Equipment, Supporting Equipment, Safe Shutdown Systems and Safe Shutdown Paths.

**NEI 00-01 Guidance**

In the process of defining equipment and cables for safe shutdown, identify additional supporting equipment such as electrical power and interlocked equipment. As an aid in assessing identified impacts to safe shutdown, consider modeling the dependency between equipment within each safe shutdown path either in a relational database or in the form of a Safe Shutdown Logic Diagram (SSLD). Attachment 4 provides an example of a SSLD that may be developed to document these relationships.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

Each train of the electrical distribution system has its own Logic diagram and there is another for offsite power. The need to power equipment is understood and not necessarily shown as an interface on the NSCA Logic Diagrams. The power supply is identified for each component in the NCSA Fire Area Compliance assessment Table. Waterford has a cable routing database called Plant Data Management System (PDMS). All of the Safe Shutdown cables are routed by fire area and by cable tray plan point within each cable tray. The end points of each cable (equipment, box, relays, switches, panels, containment penetration, etc.) are listed. This identifies the supporting equipment, interlocks, spurious concerns, etc. for the cable analysis portion of this process."

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

2.4.2.2.1 Circuits Required in Nuclear Safety Functions. Circuits required for the nuclear safety functions shall be identified. This includes circuits that are required for operation, that could prevent the operation, or that result in the maloperation of the equipment identified in 2.4.2.1. This evaluation shall consider fire-induced failure modes such as hot shorts (external and internal), open circuits, and shorts to ground, to identify circuits that are required to support the proper operation of components required to achieve the nuclear safety performance criteria, including spurious operation and signals. This will ensure that a comprehensive population of circuitry is evaluated.

2.4.2.2.2 Other Required Circuits. Other circuits that share common power supply and/or common enclosure with circuits required to achieve nuclear safety performance criteria shall be evaluated for their impact on the ability to achieve nuclear safety performance criteria.

(a) Common Power Supply Circuits. Those circuits whose fire induced failure could cause the loss of a power supply required to achieve the nuclear safety performance criteria shall be identified. This situation could occur if the upstream protection device (i.e., breaker or fuse) is not properly coordinated with the downstream protection device.

(b) Common Enclosure Circuits. Those circuits that share enclosures with circuits required to achieve the nuclear safety performance criteria and whose fire-induced failure could cause the loss of the required components shall be identified. The concern is that the effects of a fire can extend outside of the immediate fire area due to fire-induced electrical faults on inadequately protected cables or via inadequately sealed fire area boundaries.

**NEI 00-01 Ref.**

3.3 Safe Shutdown Cable Selection and Location

**NEI 00-01 Guidance**

This section provides industry guidance on the recommended methodology and criteria for selecting safe shutdown cables and determining their potential impact on equipment required for achieving and maintaining safe shutdown of an operating nuclear power plant for the condition of an exposure fire. The Appendix R safe shutdown cable selection criteria are developed to ensure that all cables that could affect the proper operation or that could cause the mal-operation of safe shutdown equipment are identified and that these cables are properly related to the safe shutdown equipment whose functionality they could affect. Through this cable-to-equipment relationship, cables become part of the safe shutdown path assigned to the equipment affected by the cable.

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.1 Criteria / Assumptions

**NEI 00-01 Guidance**

To identify an impact to safe shutdown equipment based on cable routing, the equipment must have cables that affect it identified. Carefully consider how cables are related to safe shutdown equipment so that impacts from these cables can be properly assessed in terms of their ultimate impact on safe shutdown system equipment. Consider the following criteria when selecting cables that impact safe shutdown equipment:

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The NSCA contains all of the equipment, power supplies, cables, instruments, components and subsequent analysis for NFPA 805 to maintain a Safe and Stable configuration.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.3.1.1 [Cable Selection]

**NEI 00-01 Guidance**

The list of cables whose failure could impact the operation of a piece of safe shutdown equipment includes more than those cables connected to the equipment. The relationship between cable and affected equipment is based on a review of the electrical or elementary wiring diagrams. To assure that all cables that could affect the operation of the safe shutdown equipment are identified, investigate the power, control, instrumentation, interlock, and equipment status indication cables related to the equipment. Consider reviewing additional schematic diagrams to identify additional cables for interlocked circuits that also need to be considered for their impact on the ability of the equipment to operate as required in support of post-fire safe shutdown. As an option, consider applying the screening criteria from Section 3.5 as a part of this section. For an example of this see Section 3.3.1.4.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**Alignment Basis**

All cables including those from interlocks, instruments, and power supplies that could potentially adversely impact the desired operation of an NSCA component are listed. This includes cables external to the component control circuit if any cable fault could adversely impact the required state of the component unless the cable(s) are included with another NSCA component. Cables that were determined not required for safe shutdown were also documented for each NSCA component. The required drawings to perform and verify the cable selection and circuit analysis include the P&ID showing the component, the schematic, and others as required.

**Reference**

EE5-32-02, Appendix R Associated Circuit Analysis Coordination Study Rev. 001

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis alignment Basis

Note: Revision 2 of NEI 00-01 rennumbers this Cable Selection section to 3.3.1.1.1.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.1.2 [Cables Affecting Multiple Components]

**NEI 00-01 Guidance**

In cases where the failure (including spurious actuations) of a single cable could impact more than one piece of safe shutdown equipment, include the cable with each piece of safe shutdown equipment.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

All cables including those from interlocks, instruments, and power supplies that could potentially adversely impact the desired operation of an NSCA component are listed. Circuit analysis is done on a component level. Where a cable may affect several NSCA components, these cables are addressed with those NSCA components' circuit analysis.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 rennumbers this Cables Affecting Multiple Components section to 3.3.1.1.2.

In other cases, interlocks may be communicated from a relay in an "initiating component" control circuit or a separate interposing control circuit. Actuation of the relay then communicates the interlock signal to the control circuit of the interlocked safe shutdown component. In such cases, fire induced cable damage to the power or control circuit of the initiating component or interposing control circuit may prevent communication of the interlock signal to the interlocked components, even if the component is manually repositioned. In such cases, any cables which could be damaged by fire and prevent actuation of the interlock relay were listed as required for the interlocked components. Alternatively, the initiating component was identified as a required safe shutdown component and a separate cable analysis for the component was performed.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.3.1.3 [Isolation Devices]

**NEI 00-01 Guidance**

Electrical devices such as relays, switches and signal resistor units are considered to be acceptable isolation devices. In the case of instrument loops, review the isolation capabilities of the devices in the loop to determine that an acceptable isolation device has been installed at each point where the loop must be isolated so that a fault would not impact the performance of the safe shutdown instrument function.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**Alignment Basis**

As part of the Nuclear Safety Capability Assessment (NSCA) development, *electrical circuit isolation devices take credit for normally open contacts and other isolation devices*. The purpose is to determine if cables are or are not required as part of the circuits cable-selection process and will not impact NSCA components or the ability to achieve safe and stable configuration.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 renumbered this Isolation Devices section to 3.3.1.1.2.1

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.1.4 [Identify "Not Required" Cables]

**NEI 00-01 Guidance**

Screen out cables for circuits that do not impact the safe shutdown function of a component (i.e., annunciator circuits, space heater circuits and computer input circuits) unless some reliance on these circuits is necessary. However, they must be isolated from the component's control scheme in such a way that a cable fault would not impact the performance of the circuit.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

If the fire-induced failure of the cable cannot spuriously reposition or prevent the desired operation of the NSCA component, then the cable is not an NSCA cable. If a cable is not required for achieving safe and stable configuration, then the NSCA identified the cable as not being required.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 renumbered this [Identify "Not Required" Cables] section to 3.3.1.1.3.

In accordance with section 3.3.1.1.3 of Revision 2 of NEI 00-01, cable faults such as hot shorts, open circuits and shorts to ground are considered on each conductor of each unprotected cable associated with NSCA equipment to determine the potential impact of a fire on the equipment. The Alignment Basis statement in Section 3.5.1.1 of this document provides additional details regarding the evaluation process.

The following are examples not considered as required for safe and stable configuration:

- Space heaters
- Computer cables
- Annunciation cables
- Instrumentation that does not provide a credited control function

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.1.5 [Identification of Power Supplies]

**NEI 00-01 Guidance**

For each circuit requiring power to perform its safe shutdown function, identify the cable supplying power to each safe shutdown and/or required interlock component. Initially, identify only the power cables from the immediate upstream power source for these interlocked circuits and components (i.e., the closest power supply, load center or motor control center). Review further the electrical distribution system to capture the remaining equipment from the electrical power distribution system necessary to support delivery of power from either the offsite power source or the emergency diesel generators (i.e., onsite power source) to the safe shutdown equipment. Add this equipment to the safe shutdown equipment list. Evaluate the power cables for this additional equipment for associated circuits concerns.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The Power cables were selected using the components electrical elementary diagram as a guide and performing a point to point review of the associated connection diagrams. During the cable selection process, power supplies and interlocks were identified. The cascading power supplies, pseudo-components created for power supply interlocks and the cascading interlocks all serve to identify required power supplies and their interconnection/dependencies to ensure credited NSCA components are supplied with motive electrical power.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 renumbered this Identification of Power Supplies section to 3.3.1.1.4.

In accordance with section 3.3.1.1.4 of Revision 2 of NEI 00-01, breaker coordination for power cables is addressed in the Alignment Basis statement in Section 3.3.1.7 of this document. Furthermore, cables associate with equipment not required for achieving safe and stable configuration but which are power from buses that supply power to equipment need for safe and stable configuration are evaluated for potential adverse impact on the bus as a circuit associated by common power supply. The Alignment Basis statement in section 3.3.2[B] of this document addresses the associated circuit common power supply evaluation methodology.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.3.1.6 [ESFAS Initiation]

**NEI 00-01 Guidance**

The automatic initiation logics for the credited post-fire safe shutdown systems are not required to support safe shutdown. Each system can be controlled manually by operator actuation in the main control room or emergency control station. If operator actions outside the MCR are necessary, those actions must conform to the regulatory requirements on manual actions. However, if not protected from the effects of fire, the fire-induced failure of automatic initiation logic circuits must not adversely affect any post-fire safe shutdown system function.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**Alignment Basis**

Only manual initiation of main systems were credited in the Nuclear Safety Capability Assessment (NSCA) cable selection process. Automatic operation of specific components within the main systems were credited where appropriate (such as minimum flow valves). In general, automatic main system initiation (i.e., SIAS initiation signals) was not credited in the NSCA. However, fire induced automatic initiation signals were evaluated for the possibility of spurious component operation and their respective adverse impact on achieving safe and stable configuration. Automatic load shedding and sequencing are credited where analysis demonstrates the necessary circuits are unaffected by the fire.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-13-00003, Recovery Action Feasibility & Reliability Review  
Rev. 0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 renumbered this ESFAS Initiation section to 3.3.1.4.1.

In accordance with section 3.3.1.4.1 of Revision 2 of NEI 00-01, in the case of a fire in the Control Room, shutdown would be achieved by use of control and monitoring from the Remote Shutdown Panel (LCP-43) located outside the Control Room at elevation +21.00. Refer to the Alignment Basis in section 3.1.1.4 of this document for a description of Waterford 3's alignment for Alternate Shutdown Capability. A list of recovery actions are provided as part of Table G-1 of the LAR. Refer to the Alignment Basis in section 3.4.1.4 of this document for Waterford 3's alignment for Manual Actions.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.3.1.7 [Circuit Coordination]

**NEI 00-01 Guidance**

Cabling for the electrical distribution system is a concern for those breakers that feed associated circuits and are not fully coordinated with upstream breakers. With respect to electrical distribution cabling, two types of cable associations exist. For safe shutdown considerations, the direct power feed to a primary safe shutdown component is associated with the primary component. For example, the power feed to a pump is necessary to support the pump. Similarly, the power feed from the load center to an MCC supports the MCC. However, for cases where sufficient branch-circuit coordination is not provided, the same cables discussed above would also support the power supply. For example, the power feed to the pump discussed above would support the bus from which it is fed because, for the case of a common power source analysis, the concern is the loss of the upstream power source and not the connected load. Similarly, the cable feeding the MCC from the load center would also be necessary to support the load center.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

Breaker coordination is ensured by reviewing the time current curves from the plant's coordination study to ensure coordination. Coordination assures that the protective device nearest the fault operates prior to operation of upstream devices. The means of assuring circuit protection and coordination is provided in a series of calculations. These calculations demonstrate that the Class 1E and non-Class 1E power supplies credited for safe shutdown compliance do have adequate coordination.

**Reference**

ECE91-056, Relay Settings and Coordination Curves for 6.9kV and 4.16kV and 480V Busses Rev. 003  
ECE91-253, 125VDC Class 1E Coordination Study Rev. 000  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
EE5-32-02, Appendix R Associated Circuit Analysis Coordination Study Rev. 001

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Note: Revision 2 of NEI 00-01 rennumbers this Circuit Coordination section to 3.3.1.1.5

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.2 Associated Circuit Cables

**NEI 00-01 Guidance**

Appendix R, Section III.G.2, requires that separation features be provided for equipment and cables, including associated non-safety circuits that *could prevent operation or cause mal-operation due to hot shorts, open circuits, or shorts to ground, of redundant trains of systems necessary to achieve hot shutdown*. The three types of associated circuits were identified in Reference 6.1.5 and further clarified in a NRC memorandum dated March 22, 1982 from R. Mattson to D. Eisenhut, Reference 6.1.6. They are as follows: - Spurious actuations - Common power source - Common enclosure.

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.3.2 [A] Associated Circuit Cables - Cables  
Whose Failure May Cause Spurious Actuations

**NEI 00-01 Guidance**  
Safe shutdown system spurious actuation concerns can result from fire damage to a cable whose failure could cause the spurious actuation/mal-operation of equipment whose operation could affect safe shutdown. These cables are identified in Section 3.3.3 together with the remaining safe shutdown cables required to support control and operation of the equipment.

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.3.2 [B] Associated Circuit Cables - Common Power Source Cables

**NEI 00-01 Guidance**

The concern for the common power source associated circuits is the loss of a safe shutdown power source due to inadequate breaker/fuse coordination. In the case of a fire-induced cable failure on a non-safe shutdown load circuit supplied from the safe shutdown power source, a lack of coordination between the upstream supply breaker/fuse feeding the safe shutdown power source and the load breaker/fuse supplying the non-safe shutdown faulted circuit can result in loss of the safe shutdown bus. This would result in the loss of power to the safe shutdown equipment supplied from that power source preventing the safe shutdown equipment from performing its required safe shutdown function. Identify these cables together with the remaining safe shutdown cables required to support control and operation of the equipment. Refer to Section 3.5.2.4 for an acceptable methodology for analyzing the impact of these cables on post-fire safe shutdown.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

Breaker coordination is ensured by reviewing the time current curves from the plant's coordination study to ensure coordination. Coordination assures that the protective device nearest the fault operates prior to operation of upstream devices. The means of assuring circuit protection and coordination is provided in a series of calculations. These calculations demonstrate that the Class 1E and non-Class 1E power supplies credited for NSCA compliance do have adequate coordination.

**Reference**

ECE91-056, Relay Settings and Coordination Curves for 6.9kV and 4.16kV and 480V Busses Rev. 003  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.3.2 [C] Associated Circuit Cables - Common Enclosure Cables

**NEI 00-01 Guidance**

The concern with common enclosure associated circuits is fire damage to a cable whose failure could propagate to other safe shutdown cables in the same enclosure either because the circuit is not properly protected by an isolation device (breaker/fuse) such that a fire-induced fault could result in ignition along its length, or by the fire propagating along the cable and into an adjacent fire area. This fire spread to an adjacent fire area could impact safe shutdown equipment in that fire area, thereby resulting in a condition that exceeds the criteria and assumptions of this methodology (i.e., multiple fires). Refer to Section 3.5.2.5 for an acceptable methodology for analyzing the impact of these cables on post-fire safe shutdown.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The electrical circuit design for Waterford 3 provides proper circuit protection in the form of circuit breakers, fuses and other devices that are designed to isolate cable faults before the cable ignition temperature is reached. Adequate *electrical circuit protection and cable sizing were included as part of the original plant electrical design and are maintained as part of the design change process.* Coordinated circuit breaker protection, fire rated barriers and fire rated penetration seal designs combined with the nearly exclusive use of Thermoset cables used at Waterford 3 precludes the propagation of a fire from the fire location to alleviate any fire propagation concerns.

**Reference**

EC 38344, Waterford 3 Thermoset / Thermoplastic Cable Report Rev. 0  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.3 Methodology for Cable Selection and Location

**NEI 00-01 Guidance**

Refer to Figure 3-4 for a flowchart illustrating the various steps involved in selecting the cables necessary for performing a post-fire safe shutdown analysis.  
Use the following methodology to define the cables required for safe shutdown including cables that may cause associated circuits concerns for a post-fire safe shutdown analysis:

[Refer to hard copy of NEI 00-01 for Figure 3-4]

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.3.3.1 Identify Circuits Required for the Operation of the Safe Shutdown Equipment

**NEI 00-01 Guidance**

For each piece of safe shutdown equipment defined in section 3.2, review the appropriate electrical diagrams including the following documentation to identify the circuits (power, control, instrumentation) required for operation or whose failure may impact the operation of each piece of equipment:

- Single-line electrical diagrams
- Elementary wiring diagrams
- Electrical connection diagrams
- Instrument loop diagrams.

For electrical power distribution equipment such as power supplies, identify any circuits whose failure may cause a coordination concern for the bus under evaluation.

If power is required for the equipment, include the closest upstream power distribution source on the safe shutdown equipment list. Through the iterative process described in Figures 3-2 and 3-3, include the additional upstream power sources up to either the offsite or the emergency power source.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

All cables including those from interlocks, instruments and power supplies that could potentially adversely impact the desired operation of a NSCA component are listed. This includes cables external to the component control circuit if any cable fault could adversely impact the required state of the component unless the cable(s) are included with another NSCA components. Cables that were determined not required for safe and stable configuration were also documented for each NSCA component. The required drawings to perform and verify the cable selection and circuit analysis include the P&ID showing the component, the schematic, and others as required.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

Power supply cable selection typically ends at the closest electrical isolation device for the component identified in the NSCA SSEL. For instance, power supply cables to a Motor Control Center (MCC) are not included for a motor operated valve. Only the power supply cable from the MCC to the valve is listed with the valve. The MCC is identified as a required component for safe and stable configuration in the NSCA SSEL and a separate circuit analysis is performed for the MCC. The circuit analysis is performed for the MCC. The circuit analysis for the MCC then includes the following as appropriate: feed power cable, feed circuit breaker, 125 VDC control power, spurious actuation of under voltage coils and non-safe shutdown load power cables.

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.3.2 Identify Interlocked Circuits and Cables Whose Spurious Operation or Mal-operation Could Affect Shutdown

**NEI 00-01 Guidance**

In reviewing each control circuit, investigate interlocks that may lead to additional circuit schemes, cables and equipment. Assign to the equipment any cables for interlocked circuits that can affect the equipment. While investigating the interlocked circuits, additional equipment or power sources may be discovered. Include these interlocked equipment or power sources in the safe shutdown equipment list (refer to Figure 3-3) if they can impact the operation of the equipment under consideration.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

See alignment basis for previous NEI 00-01 section 3.3.3.1. Typically, valve/circuit breaker position interlocks are communicated via the valve limit switch/auxiliary breaker contact. A control circuit cable from the control circuit of the interlocked component's is connected to the limit switch rotor of the initiating valve or auxiliary breaker contact of the initiating circuit breaker. If the interlock is required for the safe and stable valve/circuit breaker to perform its safe and stable function or if inadvertent actuation of the interlock places the valve/circuit breaker in a non-desired position, the initiating component is considered a required safe and stable component. The circuit analysis for the interlocked valve/circuit breaker does not include any cable from the initiating valve/circuit breaker. Rather, circuit analysis was performed for each valve/circuit breaker, and the component relationship depicted on the NSCA Logic Diagrams in the SSEL.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

In some cases, interlocks may be communicated from a relay in the initiating component control circuit or a separate interposing control circuit. Actuation of the relay then communicates the interlock signal to the control circuit of the interlocked safe and stable component's. In such cases, fire induced cable damage to the power or control circuit of the initiating component or interposing control circuit may prevent communication of the interlock signal to the interlocked component's even if the component is manually repositioned. In such cases, any cables which could be damaged by fire and prevent actuation of the interlock relay are listed as required for the interlocked components. Conservatively, the initiating component is identified as a required for safe and stable configuration component. (Note: Components may have been previously identified as associated by spurious operation). This applies to only those interlocks that are credited for components required to achieve safe and stable configuration .

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.3.3.3 Assign Cables to the Safe Shutdown Equipment

**NEI 00-01 Guidance**

Given the criteria/assumptions defined in Section 3.3.1, identify the cables required to operate or that may result in mal-operation of each piece of safe shutdown equipment. Tabulate the list of cables potentially affecting each piece of equipment in a relational database including the respective drawing numbers, their revision and any interlocks that are investigated to determine their impact on the operation of the equipment. In certain cases, the same cable may support multiple pieces of equipment. Relate the cables to each piece of equipment, but not necessarily to each supporting secondary component. If adequate coordination does not exist for a particular circuit, relate the power cable to the power source. This will ensure that the power source is identified as affected equipment in the fire areas where the cable may be damaged.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

All cables that support or could adversely affect the ability to achieve and maintain safe and stable configuration have been identified using the methodology defined by the Nuclear Safety Capability Assessment (NSCA). The cables and NSCA components with which they are associated have been entered into the Plant Data Management System (PDMS).

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.5 Circuit Analysis and Evaluation

**NEI 00-01 Guidance**

This section on circuit analysis provides information on the potential impact of fire on circuits used to monitor, control and power safe shutdown equipment. Applying the circuit analysis criteria will lead to an understanding of how fire damage to the cables may affect the ability to achieve and maintain post-fire safe shutdown in a particular fire area. This section should be used in conjunction with Section 3.4, to evaluate the potential fire-induced impacts that require mitigation.

Appendix R Section III.G.2 identifies the fire-induced circuit failure types that are to be evaluated for impact from exposure fires on safe shutdown equipment. Section III.G.2 of Appendix R requires consideration of hot shorts, shorts-to-ground and open circuits.

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.1 Criteria / Assumptions

**NEI 00-01 Guidance**  
Apply the following criteria/assumptions when performing fire-induced circuit failure evaluations.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 deleted this Cable Failure Configuration section from Revision 1. Cable / circuit failure configurations are addressed in Section 3.5.1.1 in Revision 2.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

#### NEI 00-01 Ref.

3.5.1.1 [Circuit Failure Types and Impact]

#### NEI 00-01 Guidance

Consider the following circuit failure types on each conductor of each unprotected safe shutdown cable to determine the potential impact of a fire on the safe shutdown equipment associated with that conductor.

- A hot short may result from a fire-induced insulation breakdown between conductors of the same cable, a different cable or from some other external source resulting in a compatible but undesired impressed voltage or signal on a specific conductor. A hot short may cause a spurious operation of safe shutdown equipment.
- An open circuit may result from a fire-induced break in a conductor resulting in the loss of circuit continuity. An open circuit may prevent the ability to control or power the affected equipment. An open circuit may also result in a change of state for normally energized equipment. (e.g. [for BWRs] loss of power to the Main Steam Isolation Valve (MSIV) solenoid valves due to an open circuit will result in the closure of the MSIVs). Note that RIS 2004-03 indicates that open circuits, as an initial mode of cable failures, are considered to be of very low likelihood. The risk-informed inspection process will focus on failures with relatively high probabilities.
- A short-to-ground may result from a fire-induced breakdown of a cable insulation system, resulting in the potential on the conductor being applied to ground potential. A short-to-ground may have all of the same effects as an open circuit and, in addition, a short-to-ground may also cause an impact to the control circuit or power train of which it is a part.

Consider the three types of circuit failures identified above to occur individually on each conductor of each safe shutdown cable on the required safe shutdown path in the fire area.

#### Applicability

Applicable

#### Alignment Statement

Aligns

#### Alignment Basis

The NSCA circuit analysis considers cable faults as follows: All AC grounded circuits must consider any and all shorts, hot shorts, shorts to ground, and open circuits. All DC grounded and ungrounded circuits must consider any and all shorts, hot shorts, shorts to ground, and open circuits. All ungrounded circuits (both AC and DC) will be analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire. Three phase AC hot short in the proper sequence to cause spurious operation is not considered credible except for high-low pressure interface components. For ungrounded DC circuits, two hot shorts of the proper polarity (without grounding) causing spurious operation was reviewed in EC 41765 including high-low pressure interface components. Only manual initiation of main systems will be credited for this analysis. Automatic operation of specific components within main systems is credited where appropriate (such as minimum flow valves). In general, automatic main system initiation (i.e., SIAS initiation signals) will not be credited in this analysis. However, fire induced automatic initiation signals must be evaluated for the possibility of spurious component operation and their subsequent adverse impact on achieving a safe and stable configuration. The required cable selection for spurious operation components shall identify the minimum population of cables that could cause the component to spuriously operate. This criterion conservatively assumes other cables of the appropriate polarity and potential are routed in the same raceway with the selected cable(s). For multiple conductor cables, all potential fault consequences due to any combination of hot shorts (inter or intra), shorts to ground, or open circuits should be considered.

WF3-FP-00001, Rev 0, IN 92-18 Motor Operated Valve Failure Evaluation performed the evaluation which identified which MOVs would be susceptible to the IN 92-18 scenario. To meet the guidance of IN 92-18, WF3 will modify the

#### Reference

EC 41765, DC Circuit Proper Polarity Rev. 0  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-11-00002, (EC40610), Expert Panel for Addressing Multiple Spurious Operations Report Rev. 1  
WF3-FP-11-00018, (EC32925), Fire Induced Circuit Failures - RIS 2004-03 Rev. 0  
WF3-FP-13-00001, IN 92-18 Motor Operated Valve Failure Evaluation Rev. 0

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**Alignment Statement**

**Alignment Basis**

identified MOVs either by circuit modification, circuit re-route or physical modification of the valves. The final method selected will be determined during the project scoping phase. The modification will be tracked as Item S1-1 in Attachment S. The Nuclear Safety Capability Assessment (NSCA) is in alignment with the guidance provided for proper polarity DC shorts per revision 2 of NEI 00-01.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.5.1.2 [Circuit Contacts and Operational Modes]

**NEI 00-01 Guidance**

Assume that circuit contacts are positioned (i.e., open or closed) consistent with the normal mode/position of the safe shutdown equipment as shown on the schematic drawings. The analyst must consider the position of the safe shutdown equipment for each specific shutdown scenario when determining the impact that fire damage to a particular circuit may have on the operation of the safe shutdown equipment.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

All circuits' contacts are assumed to be normal position, hand switches either in auto, maintain open, maintain closed or other maintained position as determined from documents.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-13-00001, IN 92-18 Motor Operated Valve Failure Evaluation Rev. 0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.5.1.2 from "Circuit Contacts and Operation Modes" to "Circuit Failure Risk Assessment Guidance".

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.1.3 [Duration of Circuit Failures]

**NEI 00-01 Guidance**

Assume that circuit failure types resulting in spurious operations exist until action has been taken to isolate the given circuit from the fire area, or other actions have been taken to negate the effects of circuit failure that is causing the spurious actuation. The fire is not assumed to eventually clear the circuit fault. Note that RIS 2004-03 indicates that fire-induced hot shorts typically self-mitigate after a limited period of time.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**Alignment Basis**

No credit is taken for fault clearing on a component and then being operable.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

All circuit contacts are assumed to be normal position, hand switches either in auto, maintain open maintain closed or other maintained position as determined from documents. Waterford 3 makes no distinction between required for hot shutdown and important to safe shutdown equipment.

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.5.1.3 from "Duration of Circuit Failures" to "Equipment position". See section 3.2.1.3 for the Alignment Basis for "Equipment Position".

Any fire affecting the RPS or CEDM circuitry would not prevent the reactor from being placed and maintained in a sub critical condition. The RPS does not need power to trip and control elements are dropped when power is removed.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.1.4 [Cable Failure Configurations]

**NEI 00-01 Guidance**  
When both trains are in the same fire area outside of primary containment, all cables that do not meet the separation requirements of Section III.G.2 are assumed to fail in their worst case configuration.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
Cable / circuit failure configurations are addressed in Section 3.5.1.1.

**Reference**

**Comments**  
NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis  
Revision 2 of NEI 00-01 deleted this Cable Failure Configuration section from Revision 1.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.5.1.5 [A, Circuit Failure Risk Assessment Guidance]

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**NEI 00-01 Guidance**

The following guidance provides the NRC inspection focus from Bin 1 of RIS 2004-03 in order to identify any potential combinations of spurious operations with higher risk significance. Bin 1 failures should also be the focus of the analysis; however, NRC has indicated that other types of failures required by the regulations for analysis should not be disregarded even if in Bin 2 or 3. If Bin 1 changes in subsequent revisions of RIS 2004-03, the guidelines in the revised RIS should be followed.

**Alignment Basis**

Waterford 3 addresses Spurious and Multiple Spurious Operation scenarios by evaluating all of the circuit and components that can be affected by any single fire for simultaneous spurious concerns. This includes Bin 1 of RIS 2004-03. Waterford 3 followed the methodology for the NFPA 805 circuit analysis for spurious and multiple spurious analysis. Spurious signal from relays contacts and instrument contacts are modeled while selecting cables from interlocks. Relay contacts and instrument contacts are assumed to go to position that could provide permissive or actuate if monitored parameter or interlocked device may change at a point during shutdown (i.e. temperature switch starts fan, level/pressure switch changes suction source, breaker contact closes to align another breaker), its assumed to be in worst case for cable fault and required position.

**Reference**

As part of the RIS 2004-03 analysis, if an identified cable could result in the spurious actuation of the component due to a hot short, then it was noted *whether the spurious actuation requires an inter-cable hot short or not.*

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 deleted this Cable Failure Configuration section from Revision 1. Cable / circuit failure configurations are addressed in Section 3.5.1.1 in Revision 2.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

#### NEI 00-01 Ref.

#### 3.5.1.5 [B, Cable Failure Modes]

#### NEI 00-01 Guidance

For multi-conductor cables testing has demonstrated that conductor-to-conductor shorting within the same cable is the most common mode of failure. This is often referred to as "intra-cable shorting." It is reasonable to assume that given damage, more than one conductor-to-conductor short will occur in a given cable. A second primary mode of cable failure is conductor-to-conductor shorting between separate cables, commonly referred to as "inter-cable shorting." Inter-cable shorting is less likely than intra-cable shorting. Consistent with the current knowledge of fire-induced cable failures, the following configurations should be considered:

A. For any individual multi-conductor cable (thermoset or thermoplastic), any and all potential spurious actuations that may result from intra-cable shorting, including any possible combination of conductors within the cable, may be postulated to occur concurrently regardless of number. However, as a practical matter, the number of combinations of potential hot shorts increases rapidly with the number of conductors within a given cable. For example, a multi-conductor cable with three conductors (3C) has 3 possible combinations of two (including desired combinations), while a five conductor cable (5C) has 10 possible combinations of two (including desired combinations), and a seven conductor cable (7C) has 21 possible combinations of two (including desired combinations). To facilitate an inspection that considers most of the risk presented by postulated hot shorts within a multi-conductor cable, inspectors should consider only a few (three or four) of the most critical postulated combinations.

B. For any thermoplastic cable, any and all potential spurious actuations that may result from intra-cable and inter-cable shorting with other thermoplastic cables, including any possible combination of conductors within or between the cables, may be postulated to occur concurrently regardless of number. (The consideration of thermoset cable inter-cable shorts is deferred pending additional research.)

C. For cases involving the potential damage of more than one multi-conductor cable, a maximum of two cables should be assumed to be damaged concurrently. The spurious actuations should be evaluated as previously described. The consideration of more than two cables being damaged (and subsequent spurious actuations) is deferred pending additional research.

D. For cases involving direct current (DC) circuits, the potential spurious operation due to failures of the associated control cables (even if the spurious operation requires two concurrent hot shorts of the proper polarity, e.g., plus-to-plus and minus-to-minus) should be considered when the required source and target conductors are each located within the same multi-conductor cable.

E. Instrumentation Circuits. Required instrumentation circuits are beyond the scope of this associated circuit approach and must meet the same requirements as required power and control circuits. There is one case where an instrument circuit could potentially be considered an associated circuit. If fire-induced damage of an instrument circuit could prevent operation (e.g., lockout permissive signal) or cause maloperation (e.g., unwanted start/stop/reposition signal) of systems necessary to achieve and maintain hot shutdown, then the instrument circuit may be considered an associated circuit and handled accordingly.

#### Applicability

Applicable

#### Alignment Statement

Aligns with intent

#### Alignment Basis

The NSCA circuit analysis considers cable faults as follows: All AC grounded circuits must consider any and all shorts, hot shorts, shorts to ground, and open circuits; DC grounded and ungrounded circuits must consider any and all shorts, hot shorts, shorts to ground, and open circuits; ungrounded circuits (both AC and DC) will be analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire; three phase AC hot short in the proper sequence to cause spurious operation is not considered credible except for high-low pressure interface components. Only manual initiation of main systems will be credited for this analysis. Automatic operation of specific components within main systems is credited where appropriate (such as minimum flow valves). In general, automatic main system initiation (i.e., SIAS initiation signals) will not be

#### Reference

EC 41765, DC Circuit Proper Polarity Rev. 0  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**Alignment Statement**

**Alignment Basis**

credited in this analysis. However, fire induced automatic initiation signals must be evaluated for the possibility of spurious component operation and their subsequent adverse impact on safe shutdown. The required cable selection for spurious operation components shall identify the minimum population of cables that could cause the component to spuriously operate. This criterion conservatively assumes other cables of the appropriate polarity and potential are routed in the same raceway with the selected cable(s). For multiple conductor cables, all potential fault consequences due to any combination of hot shorts (inter or intra), shorts to ground, or open circuits are considered.

**Comments**

None

**Reference**

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.2 Types of Circuit Failures

**NEI 00-01 Guidance**

Appendix R requires that nuclear power plants must be designed to prevent exposure fires from defeating the ability to achieve and maintain post-fire safe shutdown. *Fire damage to circuits that provide control and power to equipment on the required safe shutdown path and any other equipment whose spurious operation/mal-operation could affect shutdown in each fire area must be evaluated for the effects of a fire in that fire area. Only one fire at a time is assumed to occur. The extent of fire damage is assumed to be limited by the boundaries of the fire area. Given this set of conditions, it must be assured that one redundant train of equipment capable of achieving hot shutdown is free of fire damage for fires in every plant location. To provide this assurance, Appendix R requires that equipment and circuits required for safe shutdown be free of fire damage and that these circuits be designed for the fire-induced effects of a hot short, short-to-ground, and open circuit. With respect to the electrical distribution system, the issue of breaker coordination must also be addressed.*

This section will discuss specific examples of each of the following types of circuit failures:

- Open circuit
- Short-to-ground
- Hot short.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

*This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.*

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

**NEI 00-01 Ref.**

3.5.2.1 Circuit Failures Due to an Open Circuit

**NEI 00-01 Guidance**

This section provides guidance for addressing the effects of an open circuit for safe shutdown equipment. An open circuit is a fire-induced break in a conductor resulting in the loss of circuit continuity. An open circuit will typically prevent the ability to control or power the affected equipment. An open circuit can also result in a change of state for normally energized equipment. For example, a loss of power to the main steam isolation valve (MSIV) solenoid valves [for BWRs] due to an open circuit will result in the closure of the MSIV. NOTE: The EPRI circuit failure testing indicated that open circuits are not likely to be the initial fire-induced circuit failure mode. Consideration of this may be helpful within the safe shutdown analysis. Consider the following consequences in the safe shutdown circuit analysis when determining the effects of open circuits: Loss of electrical continuity may occur within a conductor resulting in de-energizing the circuit and causing a loss of power to, or control of, the required safe shutdown equipment. In selected cases, a loss of electrical continuity may result in loss of power to an interlocked relay or other device. This loss of power may change the state of the equipment. Evaluate this to determine if equipment fails safe. Open circuit on a high voltage (e.g., 4.16 kV) ammeter current transformer (CT) circuit may result in secondary damage. Figure 3.5.2-1 shows an open circuit on a grounded control circuit. [Refer to hard copy of NEI 00-01 for Figure 3.5.2-1]

Open circuit No. 1: An open circuit at location No. 1 will prevent operation of the subject equipment.

Open circuit No. 2: An open circuit at location No. 2 will prevent opening/starting of the subject equipment, but will not impact the ability to close/stop the equipment.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

All grounded and ungrounded circuits consider open circuits as a fire induced failure mechanism.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-EE-11-00001, Technical Evaluation of Open-Circuited Current Transformers Rev. 0

**Comments**

NEI 001-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.5.2.1 of Revision 2 of NEI 00-01, report; Current Transformer Analysis for Circuit Failure Modes; WF3-EE-11-00001 considered these common enclosures issue: -current transformers that are constructed such that an open secondary circuit could cause ignition of the transformers -current transformers that are susceptible to ignition due to open secondary windings and have secondary circuits extending outside the fire area that are not isolated by transducers which should have had the circuits included in the nuclear safety assessment. The technical evaluation identified that the majority of the current transformer (CT) sets met the screening criteria in that circuits do not extend outside the fire area. The remaining evaluated CT sets were concluded to have a negligible potential for adverse impact on the plant's ability to achieve its nuclear safety performance criteria.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.5.2.2 Circuit Failures Due to a Short-to-Ground [A, General]

**NEI 00-01 Guidance**

This section provides guidance for addressing the effects of a short-to-ground on circuits for safe shutdown equipment. A short-to-ground is a fire-induced breakdown of a cable insulation system resulting in the potential on the conductor being applied to ground potential. A short-to-ground can cause a loss of power to or control of required safe shutdown equipment. In addition, a short-to-ground may affect other equipment in the electrical power distribution system in the cases where proper coordination does not exist.

Consider the following consequences in the post-fire safe shutdown analysis when determining the effects of circuit failures related to shorts-to-ground:

- A short to ground in a power or a control circuit may result in tripping one or more isolation devices (i.e. breaker/fuse) and causing a loss of power to or control of required safe shutdown equipment.

- In the case of certain energized equipment such as HVAC dampers, a loss of control power may result in loss of power to an interlocked relay or other device that may cause one or more spurious operations.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**

All grounded and ungrounded circuits consider any and all shorts to ground.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

All ungrounded circuits (both AC and DC) are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

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**NEI 00-01 Ref.**

3.5.2.2 Circuit Failures Due to a Short-to-Ground [B, Grounded Circuits]

**NEI 00-01 Guidance**

This section provides guidance for addressing the effects of a short-to-ground on circuits for safe shutdown equipment. A short-to-ground is a fire-induced breakdown of a cable insulation system resulting in the potential on the conductor being applied to ground potential. A short-to-ground can cause a loss of power to or control of required safe shutdown equipment. In addition, a short-to-ground may affect other equipment in the electrical power distribution system in the cases where proper coordination does not exist.

**Short-to-Ground on Grounded Circuits**

Typically, in the case of a grounded circuit, a short-to-ground on any part of the circuit would present a concern for tripping the circuit isolation device thereby causing a loss of control power.

Figure 3.5.2-2 illustrates how a short-to-ground fault may impact a grounded circuit.

[Refer to hard copy of NEI 00-01 Rev. 1 for Figure 3.5.2-2]

**Short-to-ground No. 1:**

A short-to-ground at location No. 1 will result in the control power fuse blowing and a loss of power to the control circuit. This will result an inability to operate the equipment using the control switch. Depending on the coordination characteristics between the protective device on this circuit and upstream circuits, the power supply to other circuits could be affected.

**Short-to-ground No. 2:**

A short-to-ground at location No. 2 will have no effect on the circuit until the close/stop control switch is closed. Should this occur, the effect would be identical to that for the short-to-ground at location No. 1 described above. Should the open/start control switch be closed prior to closing the close/stop control switch, the equipment will still be able to be opened/started.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

All grounded and ungrounded circuits consider any and all shorts to ground.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

All ungrounded circuits (both AC and DC) are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

*For multiple conductor cables, all potential fault consequences due to any combination of hot shorts (inter or intra), shorts to ground, or open circuits are considered.*

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.2.2 Circuit Failures Due to a Short-to-Ground [C, Ungrounded Circuits]

**NEI 00-01 Guidance**  
Short-to-Ground on Ungrounded Circuits

In the case of an ungrounded circuit, postulating only a single short-to-ground on any part of the circuit may not result in tripping the circuit isolation device. Another short-to-ground on the circuit or another circuit from the same source would need to exist to cause a loss of control power to the circuit.

Figure 3.5.2-3 illustrates how a short to ground fault may impact an ungrounded circuit.

[Refer to hard copy of NEI 00-01 Rev. 1 for Figure 3.5.2-3]

Short-to-ground No. 1: A short-to-ground at location No. 1 will result in the control power fuse blowing and a loss of power to the control circuit if short-to-ground No. 3 also exists either within the same circuit or on any other circuit fed from the same power source. This will result in an inability to operate the equipment using the control switch. Depending on the coordination characteristics between the protective device on this circuit and upstream circuits, the power supply to other circuits could be affected.

Short-to-ground No. 2:

A short-to-ground at location No. 2 will have no effect on the circuit until the close/stop control switch is closed. Should this occur, the effect would be identical to that for the short-to-ground at location No. 1 described above. Should the open/start control switch be closed prior to closing the close/stop control switch, the equipment will still be able to be opened/started.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
All DC ungrounded circuits consider any and all shorts to ground. All DC ungrounded circuits are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**  
All ungrounded circuits (both AC and DC) are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

### 2.4.2.2 Nuclear Safety Capability Circuit Analysis

#### NEI 00-01 Ref.

3.5.2.3 Circuit Failures Due to a Hot Short [A, General]

#### NEI 00-01 Guidance

This section provides guidance for analyzing the effects of a hot short on circuits for required safe shutdown equipment. A hot short is defined as a fire-induced insulation breakdown between conductors of the same cable, a different cable or some other external source resulting in an undesired impressed voltage on a specific conductor. The potential effect of the undesired impressed voltage would be to cause equipment to operate or fail to operate in an undesired manner.

Consider the following specific circuit failures related to hot shorts as part of the post-fire safe shutdown analysis:

- A hot short between an energized conductor and a de-energized conductor within the same cable may cause a spurious actuation of equipment. The spuriously actuated device (e.g., relay) may be interlocked with another circuit that causes the spurious actuation of other equipment. This type of hot short is called a conductor-to-conductor hot short or an internal hot short.

- A hot short between any external energized source such as an energized conductor from another cable (thermoplastic cables only) and a de-energized conductor may also cause a spurious actuation of equipment. This is called a cable-to-cable hot short or an external hot short. Cable-to-cable hot shorts between thermoset cables are not postulated to occur pending additional research.

#### Applicability

Applicable

#### Alignment Statement

Aligns

#### Alignment Basis

All grounded circuits and ungrounded circuits consider any and all hot shorts. If the hot short results in a spurious actuation, the circuit failure is reviewed to determine if it is the result of an intra or inter cable hot short.

For safe shutdown components requiring three-phase power to operate, a hot short (fault) between energized conductors of different phases will result in large currents within the cable and subsequent detrimental consequences such that the component would be unable to spuriously operate. The two most likely hot short (fault) possibilities are: 1) a three-phase fault, where all three phases come into contact together (an intra-cable hot short) or 2) a phase to phase fault where two different phases come into contact (an inter-cable hot short). The probability of either an intra-cable (internal) or inter-cable (external) three-phase AC hot short (fault) in the proper sequence / phase to cause spurious operation of a motor is considered sufficiently low so as not to be credible and necessitate a circuit analysis and evaluation except for high-low pressure interface components.

For ungrounded DC circuits, two hot shorts of the proper polarity (without grounding) causing spurious operation was evaluated in EC 41765. The conclusion reached in the evaluation was that in areas which DC powered safe shutdown components are located, fire induced DC hot shorts would not prevent the credited train of safe shutdown components from performing their design function.

Cable faults are analyzed between cables within the raceway only, not between cables in separate raceways. Cables in conduits are not assumed to fault with cables outside the conduit.

WF3-FP-00001, Rev 0, IN 92-18 Motor Operated Valve Failure Evaluation performed the evaluation which identified which MOVs would be susceptible to

#### Reference

EC 41765, DC Circuit Proper Polarity Rev. 0  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-13-00001, IN 92-18 Motor Operated Valve Failure Evaluation Rev. 0

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**Alignment Statement**

**Alignment Basis**

the IN 92-18 scenario. To meet the guidance of IN 92-18, WF3 will modify the identified MOVs either by *circuit modification, circuit re-route or physical modification* of the valves. The final method selected will be determined during the project scoping phase. The modification will be tracked as Item S1-1 in Attachment S.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**  
3.5.2.3 Circuit Failures Due to a Hot Short [B, Grounded Circuits]

**NEI 00-01 Guidance**  
A Hot Short on Grounded Circuits

A short-to-ground is another failure mode for a grounded control circuit. A short-to-ground as described above would result in de-energizing the circuit. This would further reduce the likelihood for the circuit to change the state of the equipment either from a control switch or due to a hot short. Nevertheless, a hot short still needs to be considered. Figure 3.5.2-4 shows a typical grounded control circuit that might be used for a motor-operated valve. However, the protective devices and position indication lights that would normally be included in the control circuit for a motor-operated valve have been omitted, since these devices are not required to understand the concepts being explained in this section. In the discussion provided below, it is assumed that a single fire in a given fire area could cause any one of the hot shorts depicted. The following discussion describes how to address the impact of these individual cable faults on the operation of the equipment controlled by this circuit.

[Refer to hard copy of NEI 00-01 Rev. 1 for Figure 3.5.2-4]

Hot short No. 1:

A hot short at this location would energize the close relay and result in the undesired closure of a motor-operated valve.

Hot short No. 2:

A hot short at this location would energize the open relay and result in the undesired opening of a motor-operated valve.

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**Alignment Basis**  
All grounded circuits consider any and all hot shorts.

**Reference**  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**  
All ungrounded circuits (both AC and DC) are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.2 Nuclear Safety Capability Circuit Analysis**

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**NEI 00-01 Ref.**

3.5.2.3 Circuit Failures Due to a Hot Short [C. Ungrounded Circuits]

**NEI 00-01 Guidance**

A Hot Short on Ungrounded Circuits

In the case of an ungrounded circuit, a single hot short may be sufficient to cause a spurious operation. A single hot short can cause a spurious operation if the hot short comes from a circuit from the positive leg of the same ungrounded source as the affected circuit.

In reviewing each of these cases, the common denominator is that in every case, the conductor in the circuit between the control switch and the start/stop coil must be involved.

Figure 3.5.2-5 depicted below shows a typical ungrounded control circuit that might be used for a motor-operated valve. However, the protective devices and position indication lights that would normally be included in the control circuit for a motor-operated valve have been omitted, since these devices are not required to understand the concepts being explained in this section.

In the discussion provided below, it is assumed that a single fire in a given fire area could cause any one of the hot shorts depicted. The discussion provided below describes how to address the impact of these cable faults on the operation of the equipment controlled by this circuit.

[Refer to hard copy of NEI 00-01 Rev. 1 for Figure 3.5.2-5]

Hot short No. 1:

A hot short at this location from the same control power source would energize the close relay and result in the undesired closure of a motor operated valve.

Hot short No. 2:

A hot short at this location from the same control power source would energize the open relay and result in the undesired opening of a motor operated valve.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

All ungrounded circuits consider any and all hot shorts. All ungrounded circuits (both AC and DC) are analyzed as if the circuit is grounded. This process accounts for the possibility of the circuit experiencing a ground fault as result of the fire.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.3 Nuclear Safety Equipment and Cable Location.**

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Nuclear Safety Equipment and Cable Location. Physical location of equipment and cables shall be identified.

**NEI 00-01 Ref.**

3.3.3.4 Identify Routing of Cables

**NEI 00-01 Guidance**

Identify the routing for each cable including all raceway and cable endpoints. Typically, this information is obtained from joining the list of safe shutdown cables with an existing cable and raceway database

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The Plant Data Management System (PDMS) relates safe shutdown cables to route points (i.e., conduit, junction boxes, tray, and equipment). The route points are associated to a fire zone based on conduit and tray drawing. The fire zones are associated with a fire area, from which a fire area affected NSCA equipment impact may be reconciled. The cable to fire area/zone information was taken from PDMS and incorporated into the NFPA 805 NSCA calculation database for development of the Compliance Assessment and Fire Area Summaries which are contained in Appendix C of the NSCA calculation.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

**Comments**

PDMS is used to store the NSCA Safe Shutdown Equipment List (SSEL), support circuit analysis, and cable routing information. ARC software interfaces with the PDMS system and compares equipment to cable to routing relationships.

## Waterford 3

### NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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#### 2.4.2.3 Nuclear Safety Equipment and Cable Location.

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**NEI 00-01 Ref.**

3.3.3.5 Identify Location of Raceway and Cables by Fire Area

**Applicability**  
Applicable

**Alignment Statement**

Aligns with intent

**NEI 00-01 Guidance**

Identify the fire area location of each raceway and cable endpoint identified in the previous step and join this information with the cable routing data. In addition, identify the location of field-routed cable by fire area. This produces a database containing all of the cables requiring fire area analysis, their locations by fire area, and their raceway.

**Alignment Basis**

The Plant Data Management System (PDMS) relates safe shutdown cables to route points (i.e., conduit, junction boxes, tray, equipment). The route points are associated to a fire zone based on conduit and tray drawings. The fire zones are associated with a fire area, from which a fire area affected NSCA equipment impact may be reconciled. The cable to fire area / zone information was taken from PDMS and incorporated into the NFPA 805 NSCA calculation database for development of the Compliance Assessment and Fire Area Summaries which are contained in Appendix C of the NSCA calculation.

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.3.3.5 of Revision 2 of NEI 00-01, in the event that raceways and cable endpoints occur in multiple fire areas, the NSCA methodology includes the fire areas for all of the endpoints.

PDMS is a proprietary relational database that is used to store cable and equipment information.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.3 Nuclear Safety Equipment and Cable Location.

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#### NEI 00-01 Ref.

3.5.2.4 Circuit Failures Due to Inadequate Circuit Coordination

#### NEI 00-01 Guidance

The evaluation of associated circuits of a common power source consists of verifying proper coordination between the supply breaker/fuse and the load breakers/fuses for power sources that are required for safe shutdown. The concern is that, for fire damage to a single power cable, lack of coordination between the supply breaker/fuse and the load breakers/fuses can result in the loss of power to a safe shutdown power source that is required to provide power to safe shutdown equipment.

For the example shown in Figure 3.5.2-6, the circuit powered from load breaker 4 supplies power to a non-safe shutdown pump. This circuit is damaged by fire in the same fire area as the circuit providing power to from the Train B bus to the Train B pump, which is redundant to the Train A pump.

To assure safe shutdown for a fire in this fire area, the damage to the non-safe shutdown pump powered from load breaker 4 of the Train A bus cannot impact the availability of the Train A pump, which is redundant to the Train B pump. To assure that there is no impact to this Train A pump due to the associated circuits' common power source breaker coordination issue, load breaker 4 must be fully coordinated with the feeder breaker to the Train A bus.

[Refer to hard copy of NEI 00-01 Rev. 1 for Figure 3.5.2-6]

A coordination study should demonstrate the coordination status for each required common power source. For coordination to exist, the time-current curves for the breakers, fuses and/or protective relaying must demonstrate that a fault on the load circuits is isolated before tripping the upstream breaker that supplies the bus. Furthermore, the available short circuit current on the load circuit must be considered to ensure that coordination is demonstrated at the maximum fault level.

The methodology for identifying potential associated circuits of a common power source and evaluating circuit coordination cases of associated circuits on a single circuit fault basis is as follows:

- Identify the power sources required to supply power to safe shutdown equipment.
- For each power source, identify the breaker/fuse ratings, types, trip settings and coordination characteristics for the incoming source breaker supplying the bus and the breakers/fuses feeding the loads supplied by the bus.
- For each power source, demonstrate proper circuit coordination using acceptable industry methods.
- For power sources not properly coordinated, tabulate by fire area the routing of cables whose breaker/fuse is not properly coordinated with the supply breaker/fuse. Evaluate the potential for disabling power to the bus in each of the fire areas in which the associated circuit cables of concern are routed and the power source is required for safe shutdown. Prepare a list of the following information for each fire area:
  - Cables of concern.
  - Affected common power source and its path.
  - Raceway in which the cable is enclosed.
  - Sequence of the raceway in the cable route.
  - Fire zone/area in which the raceway is located.

For fire zones/areas in which the power source is disabled, the effects are mitigated by appropriate methods.

Develop analyzed safe shutdown circuit dispositions for the associated circuit of concern cables routed in an area of the same path as required by the power source. Evaluate adequate separation based upon the criteria in Appendix R, NRC staff guidance, and plant licensing bases.

**Applicability**  
Applicable

## Waterford 3

### NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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#### 2.4.2.3 Nuclear Safety Equipment and Cable Location.

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**Alignment Statement**

Aligns

**Alignment Basis**

Typically, electrical circuits fault protection is designed to provide protection for plant electric circuits through the use of protective relaying, circuit breakers, and fuses. This protective equipment is designed and applied to ensure adequate protection of all electrical distribution equipment from electric faults and overload conditions in the circuits. When power cables are affected by fire-induced failures, the operation of these protective devices will result in *isolation of the affected electrical circuits and, thus, will prevent the propagation of the fault to other portions of the electrical system.*

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

In accordance with section 3.5.2.4 of Revision 2 of NEI 00-01, control power for switchgear with respect to breaker coordination is addressed in this section. Typically, integral parts of electrical system protection are the proper coordination of all these devices. Such coordination ensures that the protective device nearest to the fault will operate prior to the operation of any "upstream" devices, limiting the interruption of electrical service to a minimal number of loads. These design practices provide reasonable assurance that circuits having common power supplies with safe shutdown circuits will be sufficiently protected to ensure that fire damage does not result in a loss of the safe shutdown power source. With all of the associated circuits and common power sources recognized and inserted into PDMS for the NSCA, the NSCA becomes the analysis for associated circuits and common power supplies. To confirm that the Electrical Distribution System complies with these guidelines, coordination studies were conducted previously to evaluate the existing electrical circuit protection and coordination for safe shutdown power supplies. The results of these studies indicate that adequate coordination exists for the credited AC Buses at all voltage levels, and such coordination has been assumed in this analysis. For non-safe shutdown loads that require 125 VDC power to ensure breaker trip capabilities, the power circuits were identified as required cables for the applicable safe shutdown switchgear. In this manner, it could be verified that control power was available to isolate faults on power cables to non-safe shutdown loads. There is no battery feeder breaker in the DC system. A single disconnect switch exists between the battery and the panels. Therefore, coordination is not required between the primary feeder breaker and breakers downstream of the panels to prevent isolation of the entire DC system from the battery. The operation of a breaker at the PDP or a downstream breaker will isolate the equipment from a fault. It will result in the loss of only on piece of equipment, and will not affect the entire DC system. In case of a fault on the system, it would be considered as the failure, of one train and the corresponding equipment on the redundant train will still be available for plant shutdown if necessary.

**Reference**

ECE91-055, AC Short Circuit Coordination Study Rev. 006  
ECE91-056, Relay Settings and Coordination Curves for 6.9kV and 4.16kV and 480V Busses Rev. 003  
ECE91-253, 125VDC Class 1E Coordination Study Rev. 000  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.3 Nuclear Safety Equipment and Cable Location.**

---

**NEI 00-01 Ref.**

3.5.2.5 Circuit Failures Due to Common Enclosure Concerns

**NEI 00-01 Guidance**

The common enclosure associated circuit concern deals with the possibility of causing secondary failures due to fire damage to a circuit either whose isolation device fails to isolate the cable fault or protect the faulted cable from reaching its ignition temperature, or the fire somehow propagates along the cable into adjoining fire areas.

The electrical circuit design for most plants provides proper circuit protection in the form of circuit breakers, fuses and other devices that are designed to isolate cable faults before ignition temperature is reached. Adequate electrical circuit protection and cable sizing are included as part of the original plant electrical design maintained as part of the design change process. Proper protection can be verified by review of as-built drawings and change documentation. Review the fire rated barrier and penetration designs that preclude the propagation of fire from one fire area to the next to demonstrate that adequate measures are in place to alleviate fire propagation concerns.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

For circuits associated by common enclosure, typical nuclear power plant design precludes this concern. The uses of coordinated fault interruption devices, fire barrier penetration seals, fire breaks within cable trays, fire-retardant IEEE-383 insulated cable, and automatic detection and suppression systems, all of which are part of Waterford 3's defense-in-depth program, limit the exposure risk due to common enclosure concerns.

**Reference**

ECE91-055, AC Short Circuit Coordination Study Rev. 006  
ECE91-056, Relay Settings and Coordination Curves for 6.9kV and 4.16kV and 480V Busses Rev. 003  
ECE91-253, 125VDC Class 1E Coordination Study Rev. 000  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

The electrical circuit design for Waterford 3 provides proper circuit protection in the form of circuit breakers, fuses and other devices that are designed to isolate cable faults before the cable ignition temperature is reached. Adequate electrical circuit protection and cable sizing were included as part of the original plant electrical design and are maintained as part of the design change process. Fire rated barrier and penetration seal designs used at Waterford 3 precludes the propagation of fire from one fire area to the next to alleviate fire propagation concerns.

## Waterford 3

### NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

#### 2.4.2.4 Fire Area Assessment.

Fire Area Assessment. An engineering analysis shall be performed in accordance with the requirements of Section 2.3 for each fire area to determine the effects of fire or fire suppression activities on the ability to achieve the nuclear safety performance criteria of Section 1.5. [See Chapter 4 for methods of achieving these performance criteria (performance-based or deterministic).

**NEI 00-01 Ref.**

3.4 Fire Area Assessment and Compliance Assessment

**NEI 00-01 Guidance**

By determining the location of each component and cable by fire area and using the cable to equipment relationships described above, the affected safe shutdown equipment in each fire area can be determined. Using the list of affected equipment in each fire area, the impacts to safe shutdown systems, paths and functions can be determined. Based on an assessment of the number and types of these impacts, the required safe shutdown path for each fire area can be determined. The specific impacts to the selected safe shutdown path can be evaluated using the circuit analysis and evaluation criteria contained in Section 3.5 of this document. Having identified all impacts to the required safe shutdown path in a particular fire area, this section provides guidance on the techniques available for individually mitigating the effects of each of the potential impacts.

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**  
3.4.1 Criteria / Assumptions

**NEI 00-01 Guidance**

The following criteria and assumptions apply when performing fire area compliance assessment to mitigate the consequences of the circuit failures identified in the previous sections for the required safe shutdown path in each fire area.

**Applicability**  
Applicable

**Alignment Statement**  
None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**  
None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment**

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**NEI 00-01 Ref.**

3.4.1.1 [Number of Postulated Fires]

**Applicability**

Applicable

**Alignment Statement**

Aligns

**NEI 00-01 Guidance**

Assume only one fire in any single fire area at a time.

**Alignment Basis**

The fundamental basis for the analysis is that a single fire occurs in any plant area. All equipment normally present in the Plant is assumed to be functional and may be lost only as a result of fire damage including a loss of off-site power. No other external events, accidents, or failures unrelated to the fire are assumed to occur concurrently with the postulated fire or any subsequent activities to achieve safe and stable conditions.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

---

**NEI 00-01 Ref.**

3.4.1.2 [Damage to Unprotected Equipment and Cables]

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**NEI 00-01 Guidance**

Assume that the fire may affect all unprotected cables and equipment within the fire area. This assumes that neither the fire size nor the fire intensity is known. This is conservative and bounds the exposure fire that is required by the regulation.

**Alignment Basis**

A basic assumption of the methodology is that there will be fire damage to systems and equipment located within a common fire area. The size and intensity of the fire required causing this system and equipment damage is not determined. Rather, fire damage is assumed to occur regardless of the level of combustibles in the area, the ignition temperatures of any combustible materials, the lack of an ignition source or the presence of automatic or manual fire suppression and detection capability. Fire damage is also postulated for all cables and equipment in the fire area that may be used for safe shutdown, even though most plant fire areas do not contain sufficient fire hazards for this to occur.

**Comments**  
None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.4 Fire Area Assessment.

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**NEI 00-01 Ref.**

3.4.1.3 [Assess Impacts to Required Components]

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**NEI 00-01 Guidance**

Address all cable and equipment impacts affecting the required safe shutdown path in the fire area. All potential impacts within the fire area must be addressed. The focus of this section is to determine and assess the potential impacts to the required safe shutdown path selected for achieving post-fire safe shutdown and to assure that the required safe shutdown path for a given fire area is properly protected.

**Alignment Basis**

Fire damage is also postulated for all cables and equipment in the fire area that may be used for safe shutdown. A method to achieve and maintain the plant in a safe and stable condition to meet all of the NFPA 805 performance goals is documented in the NSCA calculation.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
NFPA 805, Performance Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants Rev. 2001

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**  
3.4.1.4 [Manual Actions]

**Applicability**  
Applicable

**Alignment Statement**  
Aligns

**NEI 00-01 Guidance**

Use manual actions where appropriate to achieve and maintain post-fire safe shutdown conditions in accordance with NRC requirements.

**Alignment Basis**

Guidance for manual actions is provided in NEI 04-02, Rev 2; Reg Guide 1.205 and FAQ 07-0030. Manual actions are utilized as part of the safe shutdown methodology when deemed feasible. A list of the recovery actions is provided as part of Table G-1 of the LAR. A feasibility study has been performed in accordance with FAQ 07-0030 for the approved recovery actions and is referenced in WF3-FP-00003, Recovery Action Feasibility & Reliability Review.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
WF3-FP-13-00003, Recovery Action Feasibility & Reliability Review  
Rev. 0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.4.1.4 from "Manual Actions" to "Required or Important for Safe Shutdown". In accordance with section 3.4.1.4 of Revision 2 of NEI 00-01, the NSCA methodology does not make a distinction between cable/components that would meet the classification of required for hot shutdown and important to Safe Shutdown (SSD). At Waterford 3, all equipment included in the NSCA Safe Shutdown Equipment List (SSEL) is analyzed as a required for hot shutdown component.

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**  
3.4.1.5 [Repairs]

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**NEI 00-01 Guidance**

Where appropriate to achieve and maintain cold shutdown within 72 hours, use repairs to equipment required in support of post fire shutdown.

**Alignment Basis**

Repairs and Cold Shutdown are not part of the Waterford 3 Nuclear Safety Capability Assessment (NSCA) methodology. An analysis has been performed for Waterford 3 to confirm that the plant can achieve and maintain a safe and stable condition for a long duration.

**Reference**

CN-TDA-10-2 (EC31611), Waterford 3 - Appendix R Fire Analysis Report - Westinghouse - Fire Analysis Report Rev. 1  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
FAQ 06-0012, Determining manual Actions that require Change Evaluations Rev. 5  
FAQ 07-0030, OMA Transition to Recovery Actions Rev. 1  
WF3-FP-13-00003, Recovery Action Feasibility & Reliability Review Rev. 0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.4.1.5 from "Repairs" to "Manual Actions". See section 3.4.1.4 for the Alignment Basis for "Manual Actions".

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

### 2.4.2.4 Fire Area Assessment

**NEI 00-01 Ref.**

3.4.1.6 [Assess Compliance with Deterministic Criteria]

**NEI 00-01 Guidance**

Appendix R compliance requires that one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage (III.G.1.a). When cables or equipment, including associated circuits, are within the same fire area outside primary containment and separation does not already exist, provide one of the following means of separation for the required safe shutdown path(s):

- Separation of cables and equipment and associated non-safety circuits of redundant trains within the same fire area by a fire barrier having a 3-hour rating (III.G.2.a)
- Separation of cables and equipment and associated non-safety circuits of redundant trains within the same fire area by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area (III.G.2.b).
- Enclosure of cable and equipment and associated non-safety circuits of one redundant train within a fire area in a fire barrier having a one-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area (III.G.2.c).

For fire areas inside non-inerted containments, the following additional options are also available:

- Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards (III.G.2.d);
- Installation of fire detectors and an automatic fire suppression system in the fire area (III.G.2.e);
- Separation of cables and equipment and associated non-safety circuits of redundant trains by a noncombustible radiant energy shield (III.G.2.f).

Use exemptions, deviations and licensing change processes to satisfy the requirements mentioned above and to demonstrate equivalency depending upon the plant's license requirements.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

For those areas in which NSCA compliance was assessed using Deterministic Criteria the evaluation was performed in accordance with NEI 00-01 Section 3.4.1.7 and the survivability of credited components in a fire area.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
NEI 00-01, Guidance for Post-Fire Safe Shutdown Analysis Rev. 002  
OP-901-502, Evacuation of Control Room and Subsequent Plant Shutdown Rev. 027  
OP-901-524, Fire in Areas Affecting Safe Shutdown Rev. 012

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.4.1.6 from "Assess Compliance with Deterministic Criteria" to "Repairs". See section 3.4.1.5 for Alignment Basis for "Repairs".

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**

3.4.1.7 [Consider Additional Equipment]

**NEI 00-01 Guidance**

Consider selecting other equipment that can perform the same safe shutdown function as the impacted equipment. In addressing this situation, each equipment impact, including spurious operations, is to be addressed in accordance with regulatory requirements and the NPP's current licensing basis.

**Applicability**

Applicable

**Alignment Statement**

*Aligns with intent*

**Alignment Basis**

*During the development of the NSCA, when other equipment was considered, it was analyzed in accordance with the same regulatory requirements, including spurious operation, as the rest of the equipment identified as being required for post-fire safe and stable configuration. The equipment is listed in the SSEL and is on the NSCA logic diagram (Flow Path).*

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.4.1.7 from "Consider Additional Equipment" to "Assess Compliance with Deterministic Criteria" See section 3.4.1.6 for the Alignment Basis for "Assess Compliance with Deterministic Criteria".

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.4 Fire Area Assessment.

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**NEI 00-01 Ref.**

3.4.1.8 [Consider Instrument Tubing Effects]

**NEI 00-01 Guidance**

Consider the effects of the fire on the density of the fluid in instrument tubing and any subsequent effects on instrument readings or signals associated with the protected safe shutdown path in evaluating post-fire safe shutdown capability. This can be done systematically or via procedures such as Emergency Operating Procedures.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

ECF13-001 Appendix F contains an instrument tubing evaluation. The tubing routing (by Fire Area) was entered into the database as if it were a cable supporting operability of its associated instrument. The tubing was assigned a "CABLE ID" that included the instrument and the letters "TUBING". For example, the tubing of RC-IPT-0100X is identified as "RC-IPT-0100X-TUBING". The potential effect of the fire induced heating on the tubing was then analyzed on a case-by-case basis during performance of the Compliance Assessments for each Fire Area. The objective of the instrument tubing analysis is to assess the impact of fluid density changes inside instrument tubing on indication and control signals credited for achieving post-fire safe and stable conditions at the Waterford 3. Heating of the process fluid within the sensing lines during a fire has the potential to result in erroneous readings or spurious equipment actuation.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
PDMSv3.0.5.0, Plant Data Management System Rev. v3.0.5.0

**Comments**

NEI 00-01, Revision 2 Additional Gap Analysis Alignment Basis

Revision 2 of NEI 00-01 changed the subject of section 3.4.1.8 from "Consider Instrument Tubing Effects" to "Consider Additional Equipment". See section 3.4.1.7 for Alignment Basis for "Consider Additional Equipment".

Revision 2 of NEI 00-01 created section 3.4.1.9 for "Consider Instrument Tubing Effects". See section 3.2.1.7 for the Alignment Basis for "Instrument Tubing."

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**

3.4.2 Methodology for Fire Area Assessment

**NEI 00-01 Guidance**

Refer to Figure 3-5 for a flowchart illustrating the various steps involved in performing a fire area assessment.

Use the following methodology to assess the impact to safe shutdown and demonstrate Appendix R compliance:

[Refer to hard copy of NEI 00-01 for Figure 3-5]

**Applicability**

Applicable

**Alignment Statement**

None

**Alignment Basis**

This paragraph provides introductory information and contains no specific requirements. Discussion is provided in subsequent sub-sections.

**Reference**

**Comments**

None

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.4 Fire Area Assessment

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**NEI 00-01 Ref.**

3.4.2.1 Identify the Affected Equipment by Fire Area

**NEI 00-01 Guidance**

Identify the safe shutdown cables, equipment and systems located in each fire area that may be potentially damaged by the fire. Provide this information in a report format. The report may be sorted by fire area and by system in order to understand the impact to each safe shutdown path within each fire area (see Attachment 5 for an example of an Affected Equipment Report).

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

Included as part of the NFPA 805, NSCA calculation (ECF13-001), a Cable Assessment Table (Appendix C), provided a population of cables (for components) and an associated shutdown path with an assessment for each cable by Fire Area, by NSCA Logic Diagram (shutdown function path). The information is provided in a Table similar to those included as part of Attachments 5 and 6 to NEI 00-01. Waterford utilizes the same table for the equipment and cable assessment. The NSCA shutdown path is substituted by the NSCA Logic Diagram. The equipment type, normal mode, shutdown mode, high/low, air fail and power fail columns are provided in the NSCA Safe Shutdown Equipment List (SSEL). Waterford's "Compliance Strategy" column will typically include information on fire wrap utilization, compliance method, shutdown train, equipment available, potential mal-operation and method of compliance.

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Comments**

Waterford is transitioning the NSCA analysis from one that was manually inputted to an electronic version, which will electronically extract cable information from Plant Data Management System (PDMS) and update the NSCA Compliance Logic Safe Shutdown Function Flow Path information in a Fault Tree format. This output provides a Fault Tree (Flow Path) representation (tailored after the Logic diagrams) for all the affected flow paths for each fire area. This will provide a visualization of the equipment available in the credited flow path and the equipment not available in the alternate flow path

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.4 Fire Area Assessment.

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**NEI 00-01 Ref.**

3.4.2.2 Determine the Shutdown Paths Least Impacted By a Fire in Each Fire Area

**NEI 00-01 Guidance**

Based on a review of the systems, equipment and cables within each fire area, determine which shutdown paths are either unaffected or least impacted by a postulated fire within the fire area. Typically, the safe shutdown path with the least number of cables and equipment in the fire area would be selected as the required safe shutdown path. Consider the circuit failure criteria and the possible mitigating strategies, however, in selecting the required safe shutdown path in a particular fire area. Review support systems as a part of this assessment since their availability will be important to the ability to achieve and maintain safe shutdown. For example, impacts to the electric power distribution system for a particular safe shutdown path could present a major impediment to using a particular path for safe shutdown. By identifying this early in the assessment process, an unnecessary amount of time is not spent assessing impacts to the frontline systems that will require this power to support their operation.

Based on an assessment as described above, designate the required safe shutdown path(s) for the fire area. Identify all equipment not in the safe shutdown path whose spurious operation or mal-operation could affect the shutdown function. Include these cables in the shutdown function list. For each of the safe shutdown cables (located in the fire area) that are part of the required safe shutdown path in the fire area, perform an evaluation to determine the impact of a fire-induced cable failure on the corresponding safe shutdown equipment and, ultimately, on the required safe shutdown path.

When evaluating the safe shutdown mode for a particular piece of equipment, it is important to consider the equipment's position for the specific safe shutdown scenario for the full duration of the shutdown scenario. It is possible for a piece of equipment to be in two different states depending on the shutdown scenario or the stage of shutdown within a particular shutdown scenario. Document information related to the normal and shutdown positions of equipment on the safe shutdown equipment list.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

The NSCA shutdown paths (NSCA Logic Diagram Flow Paths) including the equipment, auxiliaries, cables and power supplies were assessed and the Train of equipment least impacted by a fire in each fire area was determined. This Train was then selected as the NSCA shutdown train for the fire area. All of the equipment and cables (All Trains) in the fire area were then evaluated (for all the failure modes discussed in this section) for NSCA safe shutdown for a fire in the fire area. This philosophy aligns to those deterministic requirements of NFPA 805 (2001), section 4.2.3.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**

3.4.2.3 Determine Safe Shutdown Equipment Impacts

**Applicability**  
Applicable

**Alignment Statement**  
Aligns with intent

**NEI 00-01 Guidance**

Using the circuit analysis and evaluation criteria contained in Section 3.5 of this document, determine the equipment that can impact safe shutdown and that can potentially be impacted by a fire in the fire area, and what those possible impacts are.

**Alignment Basis**

As outlined in section 3.4.2.2; the NSCA shutdown paths (NSCA Logic Diagram Flow Paths) including the equipment, auxiliaries, cables and power supplies were assessed and the Train of equipment least impacted by a fire in each fire area was determined. This Train was then selected as the NSCA shutdown train for the fire area. All of the equipment and cables (All Trains) in the fire area were then evaluated (for all the failure modes discussed in this section) for NSCA safe shutdown for a fire in the fire area. This philosophy aligns to those deterministic requirements of NFPA 805 (2001), section 4.2.3.

**Comments**

None

**Reference**

ECF13-001 - NFPA 805 NSCA Calculation Rev. 000

# Waterford 3

## NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)

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### 2.4.2.4 Fire Area Assessment.

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**NEI 00-01 Ref.**

3.4.2.4 Develop a Compliance Strategy or Disposition to Mitigate the Effects Due to Fire Damage to Each Required Component or Cable

**NEI 00-01 Guidance**

The available deterministic methods for mitigating the effects of circuit failures are summarized as follows (see Figure 1-2):

- Provide a qualified 3-fire rated barrier.
- Provide a 1-hour fire rated barrier with automatic suppression and detection.
- Provide separation of 20 feet or greater with automatic suppression and detection and demonstrate that there are no intervening combustibles within the 20 foot separation distance.
- Reroute or relocate the circuit/equipment, or perform other modifications to resolve vulnerability.
- Provide a procedural action in accordance with regulatory requirements.
- Perform a cold shutdown repair in accordance with regulatory requirements.
- Identify other equipment not affected by the fire capable of performing the same safe shutdown function.
- Develop exemptions, deviations, Generic Letter 86-10 evaluation or fire protection design change evaluations with a licensing change process.

Additional options are available for non-inerted containments as described in 10 CFR 50 Appendix R section III.G.2.d, e and f.

**Applicability**

Applicable

**Alignment Statement**

Aligns with intent

**Alignment Basis**

For fire areas that remain in compliance with the NSCA deterministic requirements listed above, the fire area is designated as being in deterministic compliance. For those fire areas not in compliance with the deterministic requirements, the NSCA performance-based methodology was utilized.

**Reference**

ECF11-001, Fire Barrier Design Basis Review Rev. 000  
ECF13-001 - NFPA 805 NSCA Calculation Rev. 000  
NFPA 805, Performance Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants Rev. 2001

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**

3.4.2.5 Document the Compliance Strategy or Disposition Determined to Mitigate the Effects Due to Fire Damage to Each Required Component or Cable

**NEI 00-01 Guidance**

Assign compliance strategy statements or codes to components or cables to identify the justification or mitigating actions proposed for achieving safe shutdown.

The justification should address the cumulative effect of the actions relied upon by the licensee to mitigate a fire in the area. Provide each piece of safe shutdown equipment, equipment not in the path whose spurious operation or mal-operation could affect safe shutdown, and/or cable for the required safe shutdown path with a specific compliance strategy or disposition. Refer to Attachment 6 for an example of a Fire Area Assessment Report documenting each cable disposition.

**Applicability**

Applicable

**Alignment Statement**

Aligns

**Alignment Basis**

*Compliance statements and codes are provided for each cable required for safe and stable configuration in each fire area in the NSCA database. These compliance statements are utilized in conjunction with the NSCA Logic Diagrams to determine available NSCA safe shutdown paths. Reports are generated similar to those included in Attachment 6 of NEI 00-01 for each fire area in a NSCA.*

**Reference**

**Comments**

None

**Waterford 3**  
**NFPA 805 Ch 2 NSCA Methodology Compliance (NEI 04-02 Table B-2)**

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**2.4.2.4 Fire Area Assessment.**

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**NEI 00-01 Ref.**

3.5.1.5 [C, Likelihood of Undesired Consequences]

**NEI 00-01 Guidance**

Determination of the potential consequence of the damaged associated circuits is based on the examination of specific NPP piping and instrumentation diagrams (P&IDs) and review of components that could prevent operation or cause maloperation such as flow diversions, loss of coolant, or other scenarios that could significantly impair the NPP's ability to achieve and maintain hot shutdown. When considering the potential consequence of such failures, the [analyst] should also consider the time at which the prevented operation or mal-operation occurs. Failures that impede hot shutdown within the first hour of the fire tend to be most risk significant in a first-order evaluation. Consideration of cold-shutdown circuits is deferred pending additional research.

**Applicability**

Applicable

**Alignment Statement**

Not Applicable

**Alignment Basis**

Revision 2 of NEI 00-01 deleted this section from Revision 1.

Section 3.5.1.1 discusses how WF3 addressed spurious and/or mal-operation of equipment due to fire induced damage.

**Reference**

NEI 00-01, Guidance for Post-Fire Safe Shutdown Analysis Rev. 002

**Comments**

None