COVER SHEET

☒ REVISED ☐ ISSUED	INCOPORATED CHC. DOC. WIP-E-1F9900-005-A-1	Change PKG. No. 012944	
THIS DWG. SUPERSEDED BY	REV.	THIS DWG SUPERSEDES	REV.

REVISION NOTES:

This revision is to incorporate WIP-E-1F9900-005-A-1. Revision 7 of this document completely replaced revision 6 and incorporated the elements of WIP-E-1F9900-005-A-1. Revision 7 was a reformat of this document so verbatim incorporation of WIP-E-1F9900-005-A-1 should not be expected. On this revision there is no change to the document information.

WOLF CREEK NUCLEAR OPERATING CORPORATION	ELECTRONIC APPROVAL

Post-Fire Safe Shutdown Operator Manual Actions

SCALE	DRAWING NUMBER	REV
NONE	E-1F9900	9

Selena King
Released by Document Services. Release Date: 2014.12.08 15:32:30 -06'00'

Table of Contents

1.0 Purpose

1.1 The purpose of this document is to evaluate the feasibility and reliability of operator manual actions (OMA) that are potentially necessary to ensure the availability of a post-fire safe shutdown (PFSSD) success path to achieve and maintain hot standby conditions, in response to a single fire event outside the Control Room.

1.2 The OMAs, which are for 10 CFR 50 Appendix R, Section III.G.2, fire areas, are evaluated for feasibility and reliability utilizing the guidance provided in NUREG-1852.

2.0 Scope

2.1 This feasibility and reliability review is applicable to OMAs, as defined in Section 4.12. Attachment A summarizes the OMAs, and the fire areas affected.

2.2 Consistent with the scope of NUREG-1852, actions taken within the Control Room that are potentially necessary to mitigate or prevent the undesirable affects of fire induced spurious equipment operation are not addressed within this review for feasibility and reliability. Control Room Actions are identified in E-1F9910, *Post-Fire Safe Shutdown Fire Area Analysis*, and procedural guidance is provided in OFN KC-016, *Fire Response*.

2.3 Fire areas that do not require a mitigating action to ensure preservation of a PFSSD success path, are not addressed within this review. Refer to E-1F9910 for the detailed PFSSD analysis for each fire area.

2.4 Actions required for transition to cold shutdown are not included. Hot standby is a safe, stable condition for the plant. Consistent with 10 CFR 50 Appendix R, Section III.G.1.b, cold shutdown repairs are required to be completed within 72 hours. However, cold shutdown is not required to be achieved within 72 hours.

3.0 Background

The Wolf Creek comparison to 10 CFR 50, Appendix R is contained in USAR, Appendix 9.5E. Section III.G of Appendix R requires fire protection of safe shutdown capability to ensure the ability to achieve and maintain safe shutdown following a severe fire. Outside containment, three separation methods are recognized by the NRC to ensure at least one success path is available to achieve and maintain safe shutdown following a fire where redundant components are located in the same fire area. These methods are as follows:

1. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour fire rating.

2. 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. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

3. Enclosure of cables and equipment and associated non-safety circuits of redundant trains in a fire barrier having a 1-hour fire rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the area.

Inside non-inerted containments, the following criteria apply:

1. 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.

2. Installation of fire detectors and an automatic fire suppression system.

3. Separation of cables and equipment and associated non-safety circuits of redundant trains by a non-combustible radiant energy shield.

The Wolf Creek response to the requirements of Section III.G of Appendix R is as follows:

> *USAR Appendix 9.5B provides an area-by-area analysis of the power block that demonstrates that no single fire can prevent safe shutdown. Redundant trains of systems required to achieve and maintain hot standby are separated by 3- hour rated fire barriers, or the equivalent provided by III.G.2, or else a diverse means of providing the safe shutdown capability exists and is unaffected by the fire. For redundant trains of systems required to achieve and maintain cold shutdown that could potentially be affected by a single fire, repairs or local operator actions can be performed within 72 hours. As described in Appendix 9.5B and Section 7.4, an auxiliary shutdown panel is provided as a dedicated means of achieving and maintaining hot standby in the event that the main control room is uninhabitable due to a fire. The ESW pump house also complies.*

Initially, Wolf Creek's position was that the license commitment described in the USAR comparison response to 10 CFR 50 Appendix R, Section III.G, allowed the use of "diverse means" to achieve safe shutdown. Diverse means was interpreted by Wolf Creek to mean any reasonable means, in compliance with other license requirements, necessary to ensure the plant can be brought to safe shutdown conditions following a fire. For example, valve or breaker manipulations are considered reasonable since they are performed as part of normal operator duties. Repairs necessary to achieve hot standby conditions were not considered reasonable since they are not allowed by 10 CFR 50 Appendix R.

During the 2005 NRC Fire Protection Triennial Inspection, Wolf Creek received a green non-cited violation (NCV) of License Condition 2.C.(5), "Fire Protection (Section 9.5.1, SER; Section 9.5.1.8, SSER 5)," for failure to ensure that redundant trains of safe shutdown systems in the same fire area were free of fire damage. The NRC inspection report concluded that a green NCV of License Condition 2,C.(5) existed because Wolf Creek credited the use of manual actions to mitigate the effects of fire damage in lieu of providing the physical protection required by 10 CFR Part 50, Appendix R, Section III.G.2.

Wolf Creek denied the NCV, as documented in letter WM 06-0013 (Reference 7.10). The NRC concluded in their response letter (Reference 7.11) to the denial, that the use of operator manual actions in lieu of direct compliance with the separation requirements of 10 CFR 50 Appendix R Section III.G.2, is not within Wolf Creek's current fire protection license basis. The NCV received for this issue during the 2005 NRC Fire Protection Triennial was re-categorized to an Apparent Violation with enforcement discretion. The enforcement discretion identified in the referenced NRC letter was consistent with that published in the March 6, 2006 Federal Register Notice regarding operator manual actions. This Federal Register Notice withdrew the proposed rule from 10 CFR 50 Appendix R to codify the acceptability of operator manual actions in lieu of compliance with the separation requirements of Appendix R, Section III.G.2. Wolf Creek accepted the Apparent Violation and is complying with the following requirements in effort to receive enforcement discretion through March 5, 2009:

- Implement compensatory measures and initiate corrective actions within 6 months of the publication date of the Federal Register Notice (i.e., by September 5, 2006).

- The enforcement discretion will continue provided the appropriate compensatory measures are maintained and the planned corrective actions are completed within 3 years of the publication date of the Federal Register Notice (i.e., March 5, 2009).

In response to the Apparent Violation Wolf Creek developed a plan to address resolution of the manual actions issue. The plan contained the following major milestones:

A. Perform a detailed circuit analysis to determine if a credible circuit fault condition is present to warrant the mitigating manual action currently credited.

   No operator manual actions were eliminated as a result of this additional PFSSD review.

B. Perform a thermal hydraulic analysis (WCNOC-CP-002) to assess plant performance when an OMA was credited in response to fire induced spurious equipment operation.

   Some OMAs were eliminated in cases where the thermal hydraulic analysis demonstrated that the OMA was not required to be implemented to achieve and maintain hot standby.

C. Where cost beneficial, implement plant modifications to comply with 10 CFR 50 Appendix R, Section III.G.2.

   Several plant modifications were implemented to either completely eliminate the need for an operator manual action or improve the overall feasibility and reliability of remaining operator manual actions for a specific fire area. Modifications included: cable reroute, instrument relocation, creation of a new fire area, and application of raceway fire barrier protection.

D. For remaining operator manual actions that were cost prohibitive to address by modification or presented a reasonable success probability for acceptance based on available time margin, a feasibility and reliability analysis, considering NUREG-1852 guidance, was conducted. The NUREG-1852 feasibility and reliability analysis is contained within this document. The information within SECY-08-0093 was utilized as guidance to determine if the identified OMA required prior NRC approval in order to credit an OMA as a permanent resolution. SECY-08-0093 divides equipment important to safe shutdown into the following two classifications:

   - One train of systems necessary to achieve and maintain hot shutdown conditions (identified as "Required for Hot Standby" in this analysis). For fire induced spurious operation within this classification, SECY-08-0093 identifies there is no allowance for OMA without prior NRC approval.

   - Equipment important to safety that could be damaged by a single fire, and the spurious equipment operation could result in either an indirect or direct affect on PFSSD capability. However, the equipment is not credited as an element of the analyzed PFSSD success path. This equipment subset is identified as "Important to Safe Shutdown" within this analysis. SECY-08-0093 indicates that prescriptive requirements of 10 CFR 50, Appendix R Sections III.G.1.a and III.G.2 do not apply, and an OMA is an acceptable mitigating action for the spurious equipment operation. NRC approval is not required in this case.

Consistent with the USAR comparison response to 10 CFR 50 Appendix R, Section III.G, the Control Room (Fire Area C-27), is the only fire area analyzed for PFSSD utilizing the alternative/dedicated shutdown criteria described in Appendix R, Section III.G.3 and Section III.L. All other fire areas are analyzed utilizing Appendix R, Section III.G.1 or Section III.G.2 (redundant shutdown), criteria. In all cases, the identified OMAs mitigate conditions where the separation requirements of Appendix R, Section III.G.2, are not directly satisfied.

4.0 Definitions

4.1 Action

4.1.1 An activity, typically observable, and usually involving the manipulation of equipment, that is carried out by an operator(s) to achieve a certain outcome. The required diagnosis of the need to perform the activity, the subsequent decision to perform the activity, obtaining any necessary equipment, procedures, or other aids or devices necessary to perform the activity, traveling to the location to perform the activity, implementing the activity, and checking that the activity has had its desired effect, are all implied and encompassed by the term "action."

4.2 Available Time (or Time Available)

4.2.1 The time period from a presentation of a cue for an action to the time of adverse consequences if the action is not taken. This time is based on one of the following:

a. Thermal hydraulic analysis, where plant thermal performance is not adversely affected. The thermal hydraulic analysis is documented in WCNOC-CP-002 and SA-08-006. Fire induced spurious equipment actuation requiring OMA implementation are assumed to occur simultaneously at the onset of the event.

b. Established Technical Specification or Technical Requirements Manual for allowed equipment outage times.

c. Referenced source (calculation, analysis, industry document, etc.).

4.3 Cold Shutdown

4.3.1 Plant Mode 5, which is within the following parameters:

Reactivity Condition (k_{eff})	**% Rated Thermal Power** (excluding decay heat)	**Average Reactor Coolant Temperature (°F)**
< 0.99	N/A	≤ 200

4.4 Control Room Action

4.4.1 Action within the Control Room to mitigate or prevent the undesirable affects of fire induced spurious equipment operation.

4.5 Diagnosis Time

4.5.1 The time required for operator(s) to examine and evaluate data to determine the need for, and to make the decision to implement, an action.

4.6 Feasible Action

4.6.1 An action that is analyzed and demonstrated as being able to be performed within an available time so as to avoid a defined undesirable outcome. As compared to a reliable action (see definition), an action is considered feasible if it is shown that it is possible to be performed within the available time; but it does not necessarily demonstrate that the action is reliable. For instance, performing an action successfully one time out of three attempts within the available time shows that the action is feasible, but not necessarily reliable.

4.7 Fire Indicated

4.7.1 The point when the fire is detected by either human or automatic detection means. The duration of early fire growth before fire alarm indication is determined based on NUREG-1805 guidance regarding smoke detector response time. Refer to Attachment B1 for further discussion regarding the use of NUREG-1805 Fire Dynamics Tools (FDT).

4.8 Fire Initiation

4.8.1 The point when the fire event commences.

4.9 Hot Standby

4.9.1 Plant Mode 3, which is within the following parameters:

Reactivity Condition (k_{eff})	**% Rated Thermal Power** (excluding decay heat)	**Average Reactor Coolant Temperature (°F)**
< 0.99	N/A	≥ 350

The residual heat removal (RHR) system is utilized for decay heat removal at RCS temperatures less than 350°F. RHR is a cold shutdown system.

4.10 Important to Safe Shutdown

4.10.1 Component that could be damaged by a single fire, and the spurious equipment operation could result in either an indirect or direct affect on PFSSD capability. However, the equipment is not credited as an element of the analyzed PFSSD success path. This is "orange box" equipment as, defined in Table 1 of SECY-08-0093.

4.11 Multiple Spurious Operation (MSO)

4.11.1 Condition where more than one fire induced equipment mal-operation is required before an undesired event, potentially affecting PFSSD, would occur.

4.12 Operator Manual Action (OMA)

4.12.1 Those actions performed by operators to manipulate components and equipment from outside the main Control Room to achieve and maintain post-fire hot standby, but not including "repairs." Operator manual actions comprise an integrated set of actions needed to help ensure that hot standby can be accomplished, given that a fire has occurred in a particular plant area.

4.13 OMA Implementation Time (or OMA Time)

4.13.1 The time required by the operator(s) to successfully perform the manipulative aspects of an action (i.e., not the diagnosis aspects themselves, but typically as a result of the diagnosis aspects), including obtaining any necessary equipment, procedures, or other aids or devices; traveling to the necessary location; implementing the action; and checking that the action has had its desired effect.

4.14 OMA Uncertainty Time

4.14.1 A time duration to account for varying conditions/uncertainties that could adversely affect overall OMA completion time. Examples considered include:

- Communication and feedback with Control Room
- Electronically controlled door requiring key access
- Obtain RCA access
- Human centered uncertainties such as size, physical strength, and cognitive difference
- Return trip to Control Room as a result of loss of Gaitronics and Radio communication capability

4.15 Preventive Action

4.15.1 Those actions that, upon entering a fire plan/procedure, the operator(s) takes (without needing further diagnosis) to mitigate the potential effects of possible spurious actuations or other fire-related failures, so as to ensure that hot standby can be achieved and maintained. For these actions, it is generally assumed that once the fire has been detected and located, per procedure, the Control Room crew will direct personnel to execute a number of actions, possibly even without the existence of other damage symptoms, to ensure the availability of equipment to achieve its function during the given fire scenario. In many cases, the only criterion for initiating these actions is the presence of the fire itself. The fire must be confirmed before a preventive action will be taken.

4.16 Reactive Action

4.16.1 Those actions taken during a fire in response to an undesired change in plant condition. In reactive actions, the operator(s) detects the undesired change and, with the support of procedural guidance, diagnoses the correct actions to be taken. Thus, with reactive actions, the plant staff responds to indications of changing equipment conditions caused by the fire, and then takes the steps necessary to ensure that the equipment will

function when needed (e.g., manually reopening a spuriously closed valve). The plant staff may not initiate the actions until the procedure indicates that, given the relevant indications, the actions must be performed.

4.17 Reliable Action

4.17.1 A feasible action that is analyzed and demonstrated as being dependably repeatable within an available time, so as to avoid a defined adverse consequence, while considering varying conditions that could affect the available time and/or the time to perform the action. As compared to an action that is only feasible (see definition), an action is considered to be reliable as well if it is shown that it can be dependably and repeatably performed within the available time, by different crews, under somewhat varying conditions that typify uncertainties in the available time and the time to perform the action, with a high success rate.

4.18 Required for Hot Standby

4.18.1 Component on the required safe shutdown path for a particular fire area that is designated to perform one or more of the following safe shutdown functions:

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

This is "green box" equipment as defined in Table 1 of SECY-08-0093.

4.19 Single Spurious Equipment Operation

4.19.1 Condition where the fire induced mal-operation of a single component potentially affects PFSSD.

4.20 Time Margin

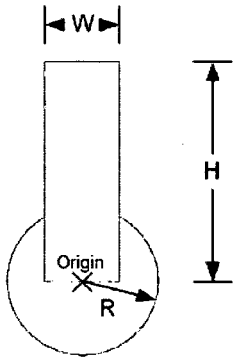
4.20.1 The amount of Available Time (see definition) remaining following OMA implementation, factoring in uncertainty.

4.21 Undetected Fire Growth

Time from initial onset of fire before the fire event is detected.

4.22 Zone of Influence

The distance (height and radius) from an ignition source, as shown below, considering the ignition source fire plume and radiant heating effects. The fire plume is represented by a cylinder that extends above the ignition source. The diameter of the cylinder (W) is based on the ignition source type. The height of the cylinder is calculated based on ignition temperature threshold for targets located above the fire source. Targets outside the Zone of Influence are postulated to be unaffected by fire involved failure of the ignition source. Only one element (height or radius) needs to be exceeded for the target to be outside of the Zone of Influence. Zone of Influence distances and corresponding heat release rates were developed utilizing information from NRC Inspection Manual 0609, Appendix F.



5.0 Methodology

The following methodology was applied for each fire area where fire induced spurious equipment operation could result in the need to perform a mitigating OMA to ensure PFSSD capability. Section 8.0 contains the detailed evaluation for each fire area analyzed, utilizing the format described in Section 5.1. Information generically applicable to the fire areas analyzed in Section 8.0 is provided in Section 5.1.

5.1 Fire Area # and Location

The specific fire area and location within the plant is identified. This is the location of the postulated fire.

5.1.1 Fire Area Features

A general description of the fire area, including the active fire protection features provided.

A plan view sketch of each fire area is provided in Attachment D.

5.1.2 Spurious Equipment Operation requiring Operator Manual Action

A discussion of the equipment that could spuriously operate as a result of the fire is identified. Where relevant, a descriptive location of the affected components within the fire area is provided, as well as the elements of 10 CFR 50 Appendix R, Section III.G.2, that are not directly satisfied. The spuriously operated equipment is classified as either "Required for Hot Standby" or "Important to Safe Shutdown" and a basis is provided for the classification. Additionally, the equipment mal-operation is classified as either "Single Spurious Equipment Operation" or "Multiple Spurious Operation" (MSO), and a basis is provided for the classification.

5.1.3 Operator Manual Action Description

The OMA and location of the action is identified. The OMA is identified as either a "Reactive Action" or "Preventive Action" based on when the OMA implementation occurs in relation to event diagnosis.

Some OMAs necessary to achieve and maintain PFSSD affect more than one component in the plant. The following assesses the impact to PFSSD concerning components affected by OMA implementation. The review determined that implementation of the OMAs identified in Attachment A will not result in an adverse consequence to PFSSD capability.

5.1.3.1 Close KAV0201

Closing instrument air valve KAV0201 will fail air to the air operated components within the Reactor Building. This is performed in order to close letdown isolation valves BGLCV0459 and BGLCV0460 and pressurizer spray valves BBPCV0455B and BBPCV0455C. Table 5.1.3.1-1 identifies the components affected by closing KAV0201. Based on the table, there is not adverse impact of safe shutdown by closing KAV0201.

Table 5.1.3.1-1, OMA Consequence Review for Closing KAV0201

Component	Description	Consequence Review
BBHV7141	Reactor coolant drain tank (RCDT) heat exchanger to pressurizer relief tank (PRT)	Valve is normally closed and fails closed on loss of air. Neither the RCDT nor the PRT are PFSSD components. The position of this valve has no impact on safe shutdown.
BBHV8026	PRT nitrogen supply	Valve is normally closed and fails closed on loss of air. The PRT is not a PFSSD component. This valve is a containment isolation valve and the safety position of this valve is closed. The position of this valve has no impact on safe shutdown.
BBHV8031	PRT drain to reactor coolant drain tank (RCDT)	Valve is normally closed and fails closed on loss of air. Neither the PRT nor the RCDT are PFSSD components. The position of this valve has no impact on safe shutdown.
BBHV8032	Reactor vessel flange leak off	Valve is normally open and fails open on loss of air. This valve allows any leakage from the reactor vessel flange to pass to the RCDT. Flange leakage is not considered in the PFSSD analysis, as it is mechanical. The position of this valve has no impact on safe shutdown.
BBHV8045	Reactor makeup water to PRT	Valve is normally closed and fails closed on loss of air. This valve assists in maintaining water level in the PRT. The PRT is not a PFSSD component. The position of this valve has no impact on safe shutdown.
BBHV8141A	Reactor coolant pump (RCP) A seal water outlet	These valves are on the individual RCP seal return lines. They are normally open and fail open on loss of air. This is the assumed PFSSD position of these valves. A loss of air to these valves has no negative impact on PFSSD.
BBHV8141B	RCP B seal water outlet	
BBHV8141C	RCP C seal water outlet	
BBHV8141D	RCP D seal water outlet	
BBLCV0178	RCP D standpipe fill	These valves are normally closed and fail closed on loss of air. The RCP seal standpipes are not PFSSD components. The position of these valves has no impact on safe shutdown.
BBLCV0179	RCP C standpipe fill	
BBLCV0180	RCP B standpipe fill	
BBLCV0181	RCP A standpipe fill	
BBPCV0455B	Pressurizer spray valve	Air feeds the controllers for the two pressurizer spray valves and modulates the valves. The
BBPCV0455C	Pressurizer spray valve	

Component	Description	Consequence Review
BBPY0455CA	Pressurizer pressure controller	valves fail closed on loss of air, which is the desired PFSSD position. Based on preoperational testing, loss of air to the controller causes the spray valves to close. Based on thermal hydraulic analyses (WCNOC-CP-002), closing the pressurizer spray valves creates a more conservative condition in the primary system.
BBPY0455BA	Pressurizer pressure controller	
BGHCV0123	Excess letdown heat exchanger isolation	Valve is normally closed and fails closed on loss of air. This valve is not a PFSSD component, but in the failed position it would assist in isolating the excess letdown. The position of this valve has no impact on safe shutdown.
BGHV8143	Excess letdown to RCDT	Valve is a three-way valve and fails open to the seal water heat exchanger on loss of air. This valve is not a PFSSD component and the position of this valve has no impact on safe shutdown.
BGHV8146	Regenerative heat exchanger to RCS Loop 1 Cold Leg	These valves are the charging injection valves to the Loop 1 and Loop 4 hot legs. They fail to the open position. For post-fire line-up, charging is isolated using the containment isolation valves BGHV8105 and BGHV8106. The position of these valves has no impact on safe shutdown.
BGHV8147	Regenerative heat exchanger to RCS Loop 4 Cold Leg	
BGHV8149A	Letdown orifice isolation	These valves are the orifice isolation valves on the letdown lines. They fail closed on loss of air. Letdown is isolated using BGLCV459 and BGLCV460. Closing these valves assists in isolating letdown, but the position of these valves has no impact on safe shutdown.
BGHV8149B	Letdown orifice isolation	
BGHV8149C	Letdown orifice isolation	
BGHV8160	Letdown containment isolation valve	Valve is the inboard containment isolation valve on the letdown line. It fails closed on loss of air. Letdown is isolated using BGLCV459 and BGLCV460. Closing this valve assists in isolating letdown, but the position of this valve has no impact on safe shutdown.
BGHY8145	Pressurizer spray from regenerative heat exchanger	Valve is normally closed and fails closed on loss of air. It allows charging water to spray in the Pressurizer. Charging is isolated upstream of this valve using BGHV8105 or BGHV8106. The position of this valve has no impact on safe shutdown.
BGLCV0459	Letdown isolation	These valves are normally open and fail closed on loss of air. The PFSSD position of these two valves is closed. Failing air to these two valves will place them in the PFSSD position.
BGLCV0460	Letdown isolation	
EJHCV8890A	RHR A test line to safety injection (SI)	These valves are normally closed and fail closed on loss of air. The RHR system is not impacted by the closure of these valves. They are not PFSSD components and their position has no impact on safe shutdown.
EJHCV8890B	RHR B test line to safety injection	
EJHCV8825	RHR test line to safety injection	

Component	Description	Consequence Review
EMHV8823	SI / accumulator test line	These valves are normally closed and fail closed on loss of air. The SI system is not used for PFSSD and it is not impacted by the closure of these valves. They are not PFSSD components and their position has no impact on safe shutdown.
EMHV8824	SI pump B test line	
EMHV8843	Boron injection upstream test line	
EMHV8871	Containment isolation test line	
EMHV8881	SI pump A test line	
EMHV8882	Boron injection downstream test line	
EMHV8889A	Hot leg 1 test line	
EMHV8889B	Hot leg 2 test line	
EMHV8889C	Hot leg 3 test line	
EMHV8889D	Hot leg 4 test line	
EPHCV0943	Nitrogen containment isolation	These valves are normally closed and fail closed on loss of air. They are associated with the Nitrogen supply to the SI accumulators. The SI accumulators are not used for PFSSD. The valves are not PFSSD components and their position has no impact on safe shutdown.
EPHV8875A	Accumulator A nitrogen supply	
EPHV8875B	Accumulator B nitrogen supply	
EPHV8875C	Accumulator C nitrogen supply	
EPHV8875D	Accumulator D nitrogen supply	
EPHV8877A	Accumulator A test line	These valves are normally closed and fail closed on loss of air. They are associated with the SI accumulators. The SI accumulators are not used for PFSSD. The valves are not PFSSD components and their position has no impact on safe shutdown.
EPHV8877B	Accumulator B test line	
EPHV8877C	Accumulator C test line	
EPHV8877D	Accumulator D test line	
EPHV8878A	Accumulator A fill line	These valves are normally closed and fail closed. They are used to maintain water level in the SI accumulators. The SI accumulators are not used for PFSSD. The valves are not PFSSD components and their position has no impact on safe shutdown.
EPHV8878B	Accumulator B fill line	
EPHY8878C	Accumulator C fill line	
EPHV8878D	Accumulator D fill line	
EPHV8879A	Accumulator A test line	These valves are normally closed and fail closed on loss of air. They are associated with the SI accumulators. The SI accumulators are not used for PFSSD. The valves are not PFSSD components and their position has no impact on safe shutdown.
EPHV8879B	Accumulator B test line	
EPHV8879C	Accumulator C test line	
EPHV8879D	Accumulator D test line	
EPPV0001	Steam generator nitrogen purge regulator	This is a control valve that fails closed on loss of air. This valve was used to purge the Steam Generators with Nitrogen during plant shutdowns. The PIC for this valve is now valved out of service and a manual valve is used to control the Nitrogen flow. The position of this valve has no impact on safe shutdown.
GTHY0005	Containment purge supply	The dampers are associated with the containment purge system. The dampers are normally closed and fail closed on loss of air. The position of these dampers has no impact on safe shutdown.
GTHY0007	Containment purge supply	
GTHY0008	Containment purge exhaust	
GTHY0011	Mini purge exhaust	
HBHV7126	RCDT vent	These seven components are associated with

Component	Description	Consequence Review
HBHV7127	RCDT outlet	the reactor coolant drain tank. Some of the valves fail open and some fail closed on loss of air. Loss of air to the controller causes valve HBLCV1003 to fail closed. However, the RCDT and associated valves are not PFSSD components. The position of these valves has no impact on safe shutdown.
HBHV7143	RCDT recirculation	
HBHV7144	RCDT recirculation	
HBHV7176	RCDT discharge	
HBLCV1003	RCDT level control	
HBLY1003A	RCDT level controller	
LFLV0097	Containment cooler A drain	These valves are normally closed and fail open on loss of air. The valves allow normal drainage from the containment coolers to drain to the containment normal sumps. They fail open on loss of air to assure that the containment coolers will function properly in an accident case. The containment coolers and drain valves are not PFSSD components and the position of these valves has no impact on safe shutdown.
LFLV0098	Containment cooler B drain	
LFLV0099	Containment cooler C drain	
LFLV0100	Containment cooler D drain	
LFLV0122	Refueling pool standpipe drain to containment sump	Valve is a normally closed and fails closed on loss of air. It is associated with the refueling pool leak detection system. The refueling pool leak detection system is not a PFSSD system. The position of this valve has no impact on safe shutdown.

5.1.3.2 Manipulate Local Controller ABFHC0002

Steam generator atmospheric relief valve (ARV) ABPV0002 can be controlled/isolated by manipulation of ABFHC0002. The local controller is not associated with any other component; so there is no adverse consequence to PFSSD capability.

5.1.3.3 Manipulate Local Controller ABFHC0003

Steam generator ARV ABPV0003 can be controlled/isolated by manipulation of ABFHC0003. The local controller is not associated with any other component; so there is no adverse consequence to PFSSD capability.

5.1.3.4 Isolate ARV ABPV0004

Steam generator ARV ABPV0004 can be isolated by closing air supply valve KAV1429 and nitrogen supply valve KAV1365, and then bleeding air from the regulator. The manipulated equipment is not associated with any other component; so there is no adverse consequence to PFSSD capability.

5.1.3.5 Open Breaker NB00203

Breaker NB00203 is opened to terminate the spurious operation of Train B containment spray. Breaker NB00203 is associated only with containment spray pump B. There are no other components that can be affected by manually opening the breaker. Therefore, there is no adverse consequence to PFSSD capability.

5.1.3.6 Open Breaker NB00102

Breaker NB00102 is opened to terminate the spurious operation of Train A containment spray. Breaker NB00102 is associated only with containment spray pump A. There are no other components that can be affected by manually opening the breaker. Therefore, there is no adverse consequence to PFSSD capability.

5.1.4 Feasibility Analysis of Time Available to Perform Operator Manual Action

1. An event timeline, similar to Figure 5.1.4-1, was developed for each fire area necessitating OMA implementation. The event timeline starts at fire initiation. This is more conservative than NUREG-1852 guidance, which starts the event timeline at fire indicated. The fire induced spurious equipment operation is also postulated to occur at fire initiation. This is conservative, as the cable type utilized (IEEE-383) will not present an immediate failure mode when exposed to fire. Elements of the timeline include:

Fire Initiation – Reference Section 4.8 for definition.

Fire Indicated – Reference Section 4.7 for definition. As discussed in Section 5.1.14, OFN KC-016 *Fire Response*, is entered once the fire condition is confirmed, which is accomplished by one of the following:

a. Fire reported by personnel.

b. Fire alarm verified by inspection.

c. Multiple fire alarms for the same area are received at fire alarm control panel (FACP) KC-008, located in the Control Room.

Diagnosis Time – Reference Section 4.5 for definition. Diagnosis time will start following fire indication.

OMA Implementation Time – Reference Section 4.13 for definition.

OMA Uncertainty Time - Reference Section 4.14 for definition.

Available Time – Reference Section 4.2 for definition.

Time Margin – Reference Section 4.20 for definition.

2. The timeline results are reviewed to determine if adequate time is available to ensure feasibility of the OMA. The OMA is considered feasible, from a timing perspective, if the OMA implementation time (excluding the OMA uncertainty time) for at least one demonstration does not exceed the available time for performing the OMA.

3. The timeline results are reviewed to determine if adequate time margin is available to ensure reliability of the OMA. The OMA is considered reliable, from a timing perspective, if the OMA time plus the OMA uncertainty time does not exceed the available time for OMA implementation.

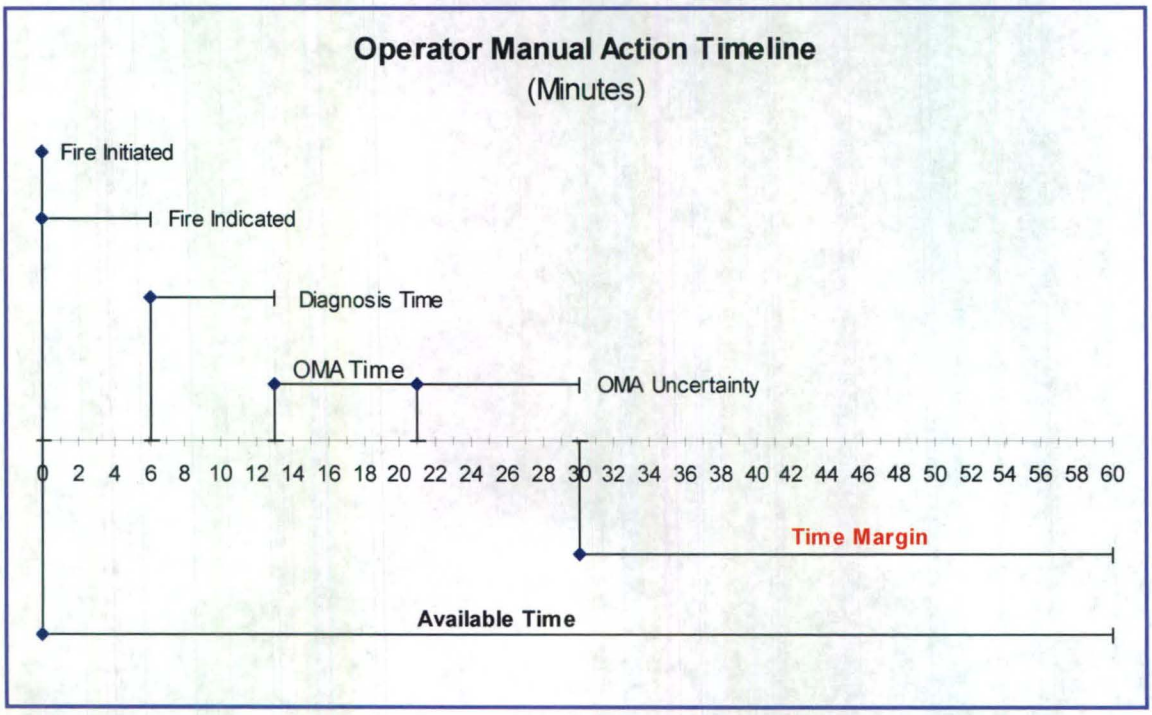


Figure 5.1.4-1, Sample OMA Timeline

5.1.5 Reliability Analysis of Time Available to Perform Manual Actions

This criterion addresses uncertainties to ensure that the OMA can be dependably and repeatedly performed within the available time. An OMA is considered reliable provided that a Time Margin remains when considering Fire Indicated Time, Diagnosis Time, OMA Implementation Time and OMA Uncertainty Time, within the OMA event timeline. The following uncertainty times were included, as applicable, in effort to address OMA reliability:

1. For implementation of each OMA a delay of one (1) minute is included for the OMA action to be understood and repeated back to the Control Room. This delay is invoked in recognition that a limited delay will be present regarding the three-way communication method that will be utilized when the Control Room directs implementation of the OMA. Additional uncertainty time is added for implementation of multiple OMAs.

2. A time delay of three (3) minutes is included, where applicable, to account for cumulative delay through electronically controlled doors that could require key access in the event power is lost to the door. This is a reasonable timeframe for the operator to assess that key access is necessary, in order to obtain ingress beyond affected electronically controlled doors.

3. A time delay of two (2) minutes is included for obtaining necessary access and dosimetry when entering the radiological controlled area (RCA). This time delay is based on the typical processing time to log into and gain access into the RCA. It is recognized that during an emergency, such as fire response, conventional RCA entry may be waived provided a RDD is obtained. However, for conservatism, a time delay has been included within this analysis, which accounts for conventional RCA entry.

4. A time delay of three (3) minutes is included for human centered uncertainties such as size, physical strength, and cognitive difference.

5.1.6 Environmental Factors

The expected environmental conditions for the OMA location and associated egress routes were reviewed for acceptability. Environmental factors considered were radiation, lighting, temperature, humidity, smoke, toxic gas, noise, and Halon fire suppression discharge. The following is the smoke propagation impact review for OMAs.

5.1.6.1 Smoke Propagation Review

A single fire originating within a plant fire area will be contained within the fire area of origin until extinguished. This is the case due to the fire rated barrier construction and associated closure assemblies (fire doors, fire dampers, seismic gap seals, and penetration seals) provided for the fire area boundary. All OMAs are performed outside the fire area of origin and the affected fire area does not have to be traversed in order to perform mitigating manual actions. Therefore, fire propagation does not present an impediment to the performance of OMAs. However, smoke migration beyond the fire boundary could potentially occur as a result of the following:

- Smoke migration through HVAC ductwork or transfer grille prior to activation of the fusible link operated fire damper within the fire barrier opening created by the ductwork.

- Smoke migration resulting from the momentary opening of a fire door within the boundary of the affected fire area to support fire-fighting activities.

Smoke migration via ventilation ductwork or a transfer grille only presents a potential concern during the incipient stage of fire development. Once the 165°F activation temperature of the fusible link is attained, the fire damper will close. This action will substantially reduce ventilation related smoke migration beyond the fire boundary, effectively eliminating it as a smoke propagation concern. For fire dampers within ductwork, initial smoke migration would be limited to that entering ventilation diffusers, with the overall internal duct volume presenting an initial repository for the smoke and hot gases. Transfer grilles are open entirely to the fire environment, which presents a more ready means to spread smoke to an adjacent fire area during incipient stage fire development.

In an effort to limit smoke migration via ventilation systems, AP 10-106, *Fire Preplans*, identifies the HVAC equipment serving each fire area and the respective controls to shutdown each unit. This information provides the necessary guidelines to minimize smoke migration via ventilation equipment during a fire event. Prior to shutdown of the fan, smoke would be drawn into the return ductwork of the respective fan unit. The smoke would then be carried through the ductwork, through the filters and either be exhausted to the outside or re-circulated back into the areas served via the supply ductwork. After a period of time, the filters could become clogged, causing the fan unit to shut down due to low airflow or high dP across the filters, at which time smoke migration through the ductwork would be limited to natural buoyancy of the heated smoke and gases.

Regarding smoke migration via a fire damper protected transfer grille, Table 5.1.6.1-1 identifies the fire areas containing a transfer grille that also require a potential OMA within the same building if the subject fire area is involved in a fire event. OMAs occurring outside the building of fire origin are not a concern, as no transfer grilles are present between power block buildings. Table 5.1.6.1-1 reveals that no transfer grilles directly communicate with an affected fire area and the location of an OMA. Additionally, the travel path necessary to perform the OMA is not subjected to a transfer grille within the affected fire area boundary. Therefore, initial smoke propagation through transfer grilles prior to fire damper activation, will not impede the performance of OMAs.

Table 5.1.6.1-1, Fire Locations with Transfer Grilles and OMAs

Fire Location (Fire Area)	Ventilation Transfer Grille Review	Fire Area Where OMA Implemented	Room Where OMA Implemented	Discussion
A-16	Fire area A-16 contains the following transfer grilles, identified by fire damper and communicating fire area: GLD020 → A-18 GLD027 → A-17 GLD170 → A-3 GLD194, GLD195 → A-28 GLD0407 → A-26 GLD0411 → A-34	A-23	1508 1509	Note 1

Notes:

1. Access to room or rooms where manual action is to be performed does not require the operator to traverse through any identified fire areas that communicate via a fusible link, fire damper protected transfer grille.

The potential to spread smoke and hot gases as a result of fire fighting efforts only presents a concern if egress to the manual action area is potentially impeded or the area where the manual action occurs is directly subjected to smoke migration via the periodic opening of an access doorway for entry into the affected fire area. A review of OMAs required to achieve and maintain hot standby identified one area (C-30) where fire-fighting activities could potentially expose the OMA operator to the fire environment as a result of opening an access door to fight the fire. The C-30 fire area information is provided in Table 5.1.6.1-2.

Fire Area C-30 is a cable chase located on the 2047' elevation of the Control Building. The cable chase has no ventilation openings. However, the access door for the chase opens to the Control Room Cabinet area (south of general Control Room area). The OMA operator could potentially be exposed to the fire fighting efforts for the cable chase, since the initial operator response is to physically report to the Control Room for direction.

Considering the sensitivity of the cable chase location within the Control Room area, the fire brigade will be cautious to limit smoke propagation beyond the C-30 cable chase, and the duration for opening the cable chase door will be limited due to the small footprint (12' x 12') of the chase. Based on this, the OMA operator and overall OMA implementation will not be adversely affected by the fire fighting efforts for Fire Area C-30.

Table 5.1.6.1-2, Locations where OMA Operator Potentially Subjected to Fire Fighting Efforts

Fire Location (Fire Area)	Fire Area Where OMA Performed	Room OMA Performed
C-30	C-27	3601

5.1.7 Equipment Functionality and Accessibility

Equipment credited for implementation of OMA was reviewed to ensure it is accessible, available, and not damaged by the affects of the fire.

5.1.8 Available Indications

Availability of relevant diagnostic indications was reviewed to ensure operators would be able to:

- Detect and diagnose fire location.
- Assess the need to perform OMA.
- Direct personnel performing OMA.
- Provide feedback to the operators, if not directly observable, to verify that the OMA has provided the expected result and the manipulated equipment will remain in the desired position.

5.1.9 Communications

Communication equipment was reviewed, to ensure an acceptable communication method is available to the extent it is needed.

The two primary communication systems available for use are the plant public address system (Gaitronics) and the 900 MHz radio system. The following is a review of Gaitronics and radio availability in the event of a fire outside the Control Room.

5.1.9.1 Gaitronics

The main Gaitronics panel (QF076) is located in the Control Room back panel area. The Gaitronics system is powered from two separate and independent 120/208 VAC sources. The normal source is from PN0703 in Fire Area C-16. Cable routing from PN0703 to QF076 is through Fire Areas C-16, C-18, C-24, C-21 and C-27. The emergency source of power is from PN0803 in fire area C-15. Cable routing from PN0803 to QF076 is through fire areas C-15, C-17, C-23, C-30, C-33, C-22 and C-27. Therefore, except for Fire Area C-27, a fire in any area will not affect both sources of 120 VAC power to the Gaitronics system.

The Gaitronics system utilizes 16-conductor cables to distribute 120 VAC power and communication signals to the field devices. A hot short across conductors within this cable could create noise in the system and/or damage multiple components (amplifiers, power supplies, etc), which will prevent operation of the system. Cables associated with the Gaitronics system are run in conduit, which will provide some protection against the effects of a fire. It is reasonable to conclude that a fire will be detected and fire brigade callout will occur prior to the Gaitronics system becoming damaged. After that, Gaitronics functionality may be adversely affected.

5.1.9.2 Radio

The 900 MHz radio system main panel (QF362) is located in the Communication Corridor, elevation 2061-6. Power for panel QF362 is from batteries located adjacent to the Radio Equipment Room in Fire Area CC-1. The batteries are charged from the QA lighting system and have sufficient capacity to operate the radio system during the fire. A fire induced short anywhere along the coaxial communication cable, used for the antenna system, will disable the entire 900 MHz radio system. Table 5.1.9.2-1 identifies the fire areas where the coaxial cable is routed.

Table 5.1.9.2-1, 900 MHz Radio System Cable Routing

Auxiliary Building	Control Building	Other
A-1	C-1	CC-1
A-6	C-2	Reactor Building
A-8	C-3	RW-1
A-16	C-7	Fuel Building
A-18	C-8	
A-27	C-11	
A-33	C-12	
	C-15	
	C-16	
	C-17	
	C-18	
	C-23	

The on shift operator responsible for OFN KC-016 OMAs is trained to respond to the Control Room for instruction when a fire brigade callout announcement is made for a fire event. This approach allows the Control Room operators to provide initial face-to-face direction to the operator responsible for implementing OFN KC-016 OMAs. For the majority of the plant OMAs, this is the only communication that will be required to successfully implement the OMAs. A copy of OFN KC-016 will also be available within the Control Room for OMA operator use, this will aid in ensuring that the operator manipulates the proper plant equipment.

The on shift operator responsible for OFN KC-016 OMAs is required to carry a radio on their person in effort to improve communication diversity.

5.1.10 Portable Equipment

The portable equipment needed to successfully implement the OMA was identified and reviewed for availability and dedication to PFSSD, where appropriate.

In addition to the radio discussed above, the on shift operator responsible for OFN KC-016 OMAs is required to carry on their person the following portable equipment:

- Hand tool for cutting wire tab type locking devices on components that potentially would be required to be manipulated.
- Master key to unlock electronic card reader controlled doors, in the event electronic door function is affected by the fire.
- Flashlight to aid access/egress in the event normal lighting is affected by the fire.
- Key for ABFHC0002 and ABFHC0003 enclosure housings.

5.1.11 Personnel Protective Equipment (PPE)

The personnel protective equipment required to support the performance of the OMA is identified and assessed for availability. Hard hat, safety glasses, hearing protection, and gloves are not included in this review since this is the standard PPE complement, imposed by the WCNOC Safety Manual, for entry into industrial portions of the plant.

5.1.12 Procedures and Training

Each OMA was reviewed to ensure it is included within OFN KC-016, *Fire Response*. This procedure contains the actions potentially necessary to ensure availability of a PFSSD success path following a single fire event outside the Control Room. The Operations department owns this procedure. Training for the procedure is on a biennial cycle. The procedure is also exercised during fire brigade drill activities that involve postulated fires affecting PFSSD success path. The procedure identifies the following information, per fire area with a potential OMA, to ensure Control Room personnel are aware of the potential fire impact on safe shutdown.

- Equipment susceptible to fire induced spurious operation that could affect PFSSD success path.
- OMAs that are required to achieve PFSSD hot standby.
- OMA to mitigate spurious equipment operation.

- Available diagnostic instrumentation to aid in determining the need to perform OMA.

5.1.13 Staffing

The manpower requirements for OMA implementation are identified and reviewed against Operations staffing level, taking into account the NUREG-1852 guidance that Control Room or fire brigade personnel should not perform OMAs. This review is performed to ensure that an adequate number of qualified personnel will be available so that hot standby conditions can be achieved and maintained in the event of a fire.

One Operations individual is assigned OFN KC-016 OMA responsibility prior to taking the shift watch. This assignment is documented on the Shift Managers Relief Checklist (APF 21-001-01). This position assignment has no Control Room, Fire Brigade, Security, or Emergency Planning responsibility.

5.1.14 Demonstration

1. As previously identified, OMAs are identified within procedure OFN KC-016. The procedure is entered when a fire outside the Control Room is confirmed, as discussed in Section 5.1.4.

   The Control Room Supervisor is responsible for directing OFN KC-016 actions. The procedure is configured such that another Control Room operator can assist in the review of the applicable procedure attachment for potential OMAs. The procedure directs OMA review immediately following fire brigade callout and the request for off-site fire department assistance, which are the initial actions following fire confirmation. The strategic approach to include the OMA review as soon as practical within the fire response procedure ensures that Control Room personnel are promptly made aware of potential OMAs, including the instrumentation that can be relied upon to assess the need for performing the OMA. The OMA review is a continuous action step within OFN KC-016, which means that the operator is responsible for observing the step for potential response throughout the fire event. Based on procedure structure and observed Control Room operator performance during fire brigade drill activities, it is conservatively concluded that Control Room personnel will consistently diagnose the need to perform a reactive OMA within seven (7) minutes of a confirmed fire alarm condition.

2. The seven (7) minute Control Room diagnosis allowance bounds the OFN KC-016 OMA operator initial response to the fire event. As previously discussed in Section 5.1.9.2, the operator assigned OFN KC-016 OMA duty is trained to promptly respond to the Control Room following fire brigade callout. The OFN KC-016 OMA operator effectively has the seven (7) minute Control Room diagnosis time in which to physically respond to the Control Room. This provides adequate time margin for the OFN KC-016 OMA

operator to report to the Control Room from within power block structures.

3. The OMA response outside the Control Room was reviewed to determine that it could be successfully performed (to the extent practical) within the time constraints of this analysis. Multiple operations personnel were timed in the simulated performance of the OMA. The starting point for the timing evolution was the Work Control Center (Room 3613), which is adjacent to the Control Room on the 2047' elevation of the Communications Corridor. Where multiple OMAs were involved for a particular fire area, the timing for each OMA was initiated from Room 3613. This approach was utilized in effort to conservatively account for each OMA response originating from the Control Room in the event that the fire affects radio and Gaitronics communication capability.

   The following timing limitations were applied generically when conducting OMA demonstration timing:

   a. A time delay of two (2) minutes is included where electrical safety personnel protective equipment is required to be donned prior to performing the OMA. This time constraint is consistent with electrical safety dress-out times that have been demonstrated for OFN RP-017.

   b. For fire areas with multiple OMAs where both Gaitronics and radio communication capability could be affected by the fire, a return trip to the Control Room is assumed to be necessary following the implementation of individual OMAs. This action is necessary in order for the operator to receive direction regarding additional required OMA response activities. A five (5) minute duration is applied for return trips to the Control Room from the Auxiliary Building and three (3) minutes for Control and Turbine Building. These times were based on walk down time efforts from the most remote components requiring OMA implementation. A return trip following implementation of the final OMA was not postulated within the OMA timeline as available Control Room indication will reflect OMA implementation.

4. Limitations (environmental, personnel protective equipment, tools, etc.) identified as applicable to the performance of the OMA were incorporated, to the extent practical, when conducting the OMA timed demonstration walkdowns.

5.1.15 Defense-In-Depth Analysis

The concept of defense-in-depth, described in 10 CFR 50, Appendix R, is applied to fire protection in areas important to safety, with the following three objectives:

1. Prevent fires from starting.

   a. One element of fire prevention is maintained through the design control process. The design change process invoked by AP 05-002, *Dispositions and Change Packages*, ensures that Fire Protection is involved with design changes that affect fire protection program items, including but not limited to, fire hazards analysis, PFSSD analysis, and combustible loading analysis. This review ensures that plant changes satisfy the fire protection program license basis.

   b. With limited exception (example: cords and computer cable) Wolf Creek utilizes IEEE-383 rated thermoset cable within safety related areas in effort to reduce the potential for fire ignition and propagation.

      Appendix F, Attachment 5 of NRC Inspection Manual 0609, *Significance Determination Process*, states the following regarding the plausibility of self-ignited cable fires:

      "*Self-ignited cable fires are considered plausible only for thermoplastic or non-qualified thermoset cables. Self-ignited cable fires will be assumed to be implausible for Thermoset cables rated as low flame spread per the IEEE-383 standard. If self-ignited cable fires are not plausible, they will not be considered in the Fire Protection SDP analysis (no self-ignited cable fire scenarios need to be developed).*"

      This approach is consistent with Electric Power Research Institute (EPRI) technical report TR-100370, *Fire-Induced Vulnerability Evaluation (FIVE)*, which identifies that IEEE-383 rated cable is not typically considered a fire source initiator due to a low ignition frequency, considering past nuclear power plant experience and fire tests.

      Considering the above discussion self-ignited cable fires involving IEEE-383 rated cable are not considered credible.

      Due to the limited heat release rate associated with the failure of normal lighting fixtures, emergency lighting units, and public address equipment, these components are not considered a significant ignition source that would promote fire propagation. This approach is supported by the fact that Appendix F of NRC Inspection Manual 0609 does not identify normal lighting or communication equipment as ignition sources to be tabulated. Additionally, the inspection manual specifically excludes the

tabulation of emergency lighting unit batteries as an ignition source.

c. Daily fire prevention is controlled though the implementation of administrative procedures.

Hot work activity is controlled by AP 10-101, *Control of Transient Ignition Sources*. This procedure requires the application of a qualified, dedicated fire watch when performing hot work activities within 35 ft. of a safety related area. Historically, Wolf Creek has not experienced an unreasonable amount of hot work fire events, and those that have occurred have been rapidly detected and extinguished in the incipient stage. Considering Wolf Creek's historical performance regarding the ability to prevent hot work fire events of magnitude, it is reasonable to conclude that the likelihood of a hot work induced fire event warranting OMA implementation is extremely low.

Transient combustible control is implemented by AP 10-102, *Control of Combustible Materials*, with transient combustible material allowances that are commensurate with PFSSD vulnerability. Areas credited with 20 ft. horizontal separation per 10 CFR 50 Appendix R, Section III.G.2.b, do not allow any unattended combustible material quantities without a review by Fire Protection. The transient combustible loading allowance for remaining plant areas are included within the Station's combustible loading calculation (XX-E-004) in effort to ensure the fire hazard categorization remains consistent with that considered in the Fire Hazard Analysis (E-1F9905).

d. In areas were a Zone of Influence review is completed as an element of the defense in depth review, NRC Inspection Manual 0609 Appendix F is utilized as guidance to assess if the target cable requiring OMA implementation is within the ignition source Zone of Influence. Target cable that is beyond the Zone of Influence is postulated to be unaffected by fire involved failure of the ignition source. If the target cable is within the Zone of Influence, additional discussion is provided regarding acceptability of the configuration. This approach provides additional defense in depth review, as it identifies if the target cable is postulated to be affected by a credible fire originating from ignition sources in proximity to the target.

2. Detect rapidly, control, and extinguish promptly those fires that do occur; and,

a. Reliable, active fire detection and suppression systems, described in M-10KC and depicted on plant drawings, are provided, as required by the Fire Hazard Analysis. Active fire protection features (fire pumps, firewater distribution, automatic detection, sprinkler, and Halon) were installed predominantly per the National Fire Protection Association (NFPA) code of record delineated in the USAR. The NRC

accepted the original installation of these systems as described in the Wolf Creek SER. Code deficiencies are evaluated for acceptability. No NFPA code compliance item presents an adverse impact to OMA diagnosis or implementation. Fire protection systems are periodically tested in accordance with the frequency requirements specified in AP 10-100, *Fire Protection Program*. Identified deficiencies are assessed for the need to invoke compensatory measure in accordance with AP 10-103, *Fire Protection Impairment* Control. Deficiencies are entered into the corrective action process for resolution.

b. Portable fire extinguishers and fire hose stations are provided throughout the plant for manual fire fighting efforts. They were installed predominantly per the NFPA code of record. Code deficiencies are evaluated for acceptability. No NFPA code compliance item presents an adverse impact to OMA diagnosis or implementation.

c. A qualified minimum five-member fire brigade is available to investigate and respond to fire events in a prompt and efficient manner. An initial and periodic continuing training program is applied to ensure fire brigade proficiency, which has historically been acceptable, as demonstrated by successful annual audits conducted by loss control representatives from the Station's insurer, Nuclear Electric Insurance Limited (NEIL).

3. Provide protection of structures, systems, and components (SSCs) important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent safe shutdown of the plant.

a. Passive fire barrier features (walls, floors/ceilings, fire dampers, doors, penetration seals, fire wrap, and structural steel fireproofing) separating redundant PFSSD components were predominantly installed in accordance with industry standards and fire tested assemblies. Fire barrier configurations that are unique or are not directly bounded by fire testing are evaluated for acceptability in M-663-00017A. No unique/unbounded fire barrier feature presents an adverse impact to OMA diagnosis or implementation. Passive fire barrier features are periodically tested/inspected (as applicable) in accordance with the frequency requirements specified in AP 10-100, *Fire Protection Program*. Identified deficiencies are assessed for the need to invoke compensatory measures in accordance with AP 10-104, *Breach Authorization*. Deficiencies are entered into the corrective action process for resolution.

b. E-1F9910 documents the PFSSD analysis for plant fire areas. The majority of the fire areas directly comply with the requirements of 10 CFR 50 Appendix R, Section III.G.1 or Section III.G.2. Where the physical separation requirements of Section III.G.1 or Section III.G.2 are not satisfied, this defense in depth objective is not directly satisfied. The identified feasible and reliable OMAs are credited as the mitigating element for this deficiency.

These fire protection defense-in-depth objectives are assessed for each fire area where an OMA is credited for PFSSD. A justification basis is provided regarding the acceptability of the defense in depth approach considering that the PFSSD objective is not directly satisfied by physical separation requirements of 10 CFR 50 Appendix R, Section III.G.1 or Section III.G.2.

5.1.16 Conclusion

Considering the cumulative results of the OMA review, a conclusion statement is provided regarding the overall feasibility and reliability of the OMA.

6.0 E-1F9900 Revision Guidance

6.1 E-1F9900 is part of the Approved Fire Protection Program, as it is incorporated by reference within Updated Safety Analysis Report (USAR). NRC review and approval was obtained for WIP-E-1F9900-004-A-1 (Rev. 1) [E-1F9900, Rev. 7], as documented in License Amendment 191 (Reference 7.43). Subsequent changes to E-1F9900 require prior NRC approval if any one of the following criteria is met:

6.1.1 A Required for Hot Standby OMA is being added.

6.1.2 The Time Margin for a Required for Hot Standby OMA is reduced by more than 10%.

6.2 Important to Safe Shutdown OMA additions or revisions do not require prior NRC approval provided analysis demonstrates that the OMA is feasible and reliable, considering NUREG-1852 guidance.

7.0 References

7.1 NRC Generic Letter 86-10, Implementation of Fire Protection Requirements, dated April 24, 1986

7.2 10 CFR 50 Appendix R, Fire Protection Program For Nuclear Power Facilities Operating Prior To January 1, 1979

7.3 NRC Inspection Manual 0609, Appendix F, Fire Protection Significant Determination Process, dated 02/28/05.

7.4 NUREG/CR-6850, Fire PRA Methodology for Nuclear Power Facilities, published 09/2005

7.5 NUREG-1805, Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program, published 12/2004

7.6 NUREG-1824, Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications

7.7 NUREG-1852, Demonstration of the Feasibility and Reliability of Operator Manual Actions in Response to Fire, Published October 2007

7.8 Regulatory Guide 1.189, Fire Protection For Operating Nuclear Power Plants, March 2007

7.9 Federal Register Notice / Vol. 71, No. 43 / March 6, 2006, Fire Protection Program—Post-Fire Operator Manual Actions

7.10 Wolf Creek Letter WM 06-0013, from Richard Muench, Subject: Response to Noncited Violation 2008-08-03 NRC Inspection Report 2005-08, dated April 14, 2006

7.11 NRC Letter EA-06-170 from Dwight Chamberlain, Subject: Wolf Creek Generating Station - Revised Violation and Exercise of Enforcement Discretion 05000482/2005008-003 (NRC Inspection Report 05000482/2005008), dated July 25, 2006 [Wolf Creek Correspondence Number 06-00357]

7.12 SECY 08-093, Resolution of Issues Related to Fire-Inducted Circuit Failures, dated June 30, 2008

7.13 NRC Letter from Annette L. Vietti-Cook, Secretary to R. W. Borchardt Executive Director for Operations, Staff Requirements – SECY-08-0093 – Resolution Of Issues Related To Fire-Induced Circuit Failures, dated September 3, 2008

7.14 NUREG-0881 SER and SSER through Supplement 5

7.15 Technical Specifications, Wolf Creek Generating Station, Table 1.1-1 (Modes), Amendment 142

7.16 NEI 00-01, Guidance for Post-Fire Safe Shutdown Circuit Analysis, Revisions 1 and 2

7.17 EPRI technical report TR-100370, Fire-Induced Vulnerability Evaluation (FIVE), dated April 1992

7.18 IEEE-383, Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations

7.19 OFN KC-016, Fire Response Revision 31.

7.20 OFN RP-017, Control Room Evacuation, Revision 29.

7.21 AP 05-002, Dispositions and Change Packages, Revision 8

7.22 AP 10-100, Fire Protection Program, Revision 14

7.23 AP 10-101, Control of Transient Ignition Sources, Revision 12

7.24 AP 10-102, Control of Combustible Materials, Revision 13

7.25 AP 10-103, Fire Protection Impairment Control, Revision 23

7.26 AP 10-104, Breach Authorization, Revision 22

7.27 AP 10-106, Fire Preplans, Revision 7

7.28 AP 21-001, Conduct of Operations, Revision 43

7.29 STS KJ-001A, Integrated D/G And Safeguards Actuation Test - Train A, Revision 36

7.30 WCNOC Electrical Safety Manual, Revision 7

7.31 Wolf Creek Safety Manual, Revision 11

7.32 E-1F9905, Fire Hazard Analysis, Revision 3

7.33 E-1F9910, Post Fire Safe Shutdown Fire Area Analysis, Revision 9

7.34 XX-E-013, Post-Fire Safe Shutdown (PFSSD) Analysis, Revision 2

7.35 XX-X-004, Combustible Fire Loading For Each Room in the Various Fire Areas at WCNOC, Revision 4

7.36 M-10KC, System Description Fire Protection System (KC & FP), Revision 5

7.37 M-663-00017A, Fire Protection Evaluations For Unique Or Unbounded Fire Barrier Configurations, Revision W03

7.38 Equipment Qualification Summary Document (EQSD) Section IV, Revision 0

7.39 WCNOC-CP-002, Thermal Hydraulic Analysis for Fires Outside Control Room, Revision 1

7.40 SA-08-006, Thermal Hydraulic Analysis [Control Room Fire], Revision 0

7.41 AN-96-062, RETRAN Analysis of Plant Shutdown Capability following a Postulated Fire in Fire Area A-18, Revision 0

7.42 NUREG/CR-6931, Cable Response to Live Fire (CAROLFIRE) Volume 1: Test Descriptions and Analysis of Circuit Response Data, Published April 2008

7.43 License Amendment 191, NRC Safety Evaluation Report for Wolf Creek OMAs, Dated December 16, 2010 (Wolf Creek Correspondence Number 10-00711)

8.0 Feasibility and Reliability Review

8.1 Fire Area A-16, Auxiliary Building 2026' General Corridor

8.1.1 Fire Area Features

Fire Area A-16 is the general corridor area on the 2026' elevation of the Auxiliary Building. It is effectively separated into two areas (A-16N and A-16S) by a 10 CFR 50 Appendix R, Section III.G.2.b, 20' combustible control zone. The fire area is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection is provided, and a pre-action sprinkler system is located in areas with a high concentration of cable trays. In addition to the ceiling level sprinkler protection, the east corridor, from column line A1 to A4, is provided with an intermediate level of sprinkler protection, located below the lowest cable tray in the corridor. Detection only is provided for 'A' Component Cooling Water (CCW) area, which is open to the east corridor. The raceways of concern are routed in the north and east general corridor areas, and the 'A' CCW area within A-16N. Identified dimensions for the affected areas are based on a rectangular area within the larger footprint of the general corridor.

North Corridor

- Length – (Column line AF-AK) 53 ft.
- Width – (Column line A1- 10' South of A2) 23 ft. 9 in.
- Height – 20 ft. 6 in.

East Corridor

- Length – (Column line 10' South of A2-A5) 53 ft.
- Width - (Column line AJ-AK) 13 ft.
- Height – 20 ft. 6 in.

'A' CCW

- Length –62 ft. 6 in.
- Width - 28 ft.
- Height – 20 ft. 6 in.

Refer to Attachment D for a plan view sketch of the fire area.

The conduits for ABPV0002 are provided with Thermo-Lag fire wrap protection for the entire transition within Fire Area A-16N. The conduits for ABPV0003 are provided with Thermo-Lag fire wrap protection for the entire transition within Fire Area A-16N with the exception of conduit 3J1B1D located near the north wall/ceiling interface in the 'A' CCW area.

The Thermo-Lag was installed to satisfy IEEE-384 electrical separation requirements. It was installed to the initial design requirements for 1-hour fire rating (including thermal short protection), though the barrier was not credited for 10 CFR 50 Appendix R, Section III.G.2, protection. The Thermo-Lag is currently not credited for Appendix R, Section III.G.2, fire barrier protection as subsequent industry fire testing revealed that additional upgrade (stress skin joint reinforcement, trowel grade build-up and barrier interface protection) would be necessary in order for the barrier assembly to be directly qualified as a 1-hour raceway fire barrier system. Though not directly credited or qualified as a fire barrier assembly, the Thermo-Lag fire wrap does provide substantial protection for the circuits associated with ABPV0002 and ABPV0003. Refer to Photo 8.1.1-1 for a typical Thermo-Lag IEEE-384 Protection configuration.

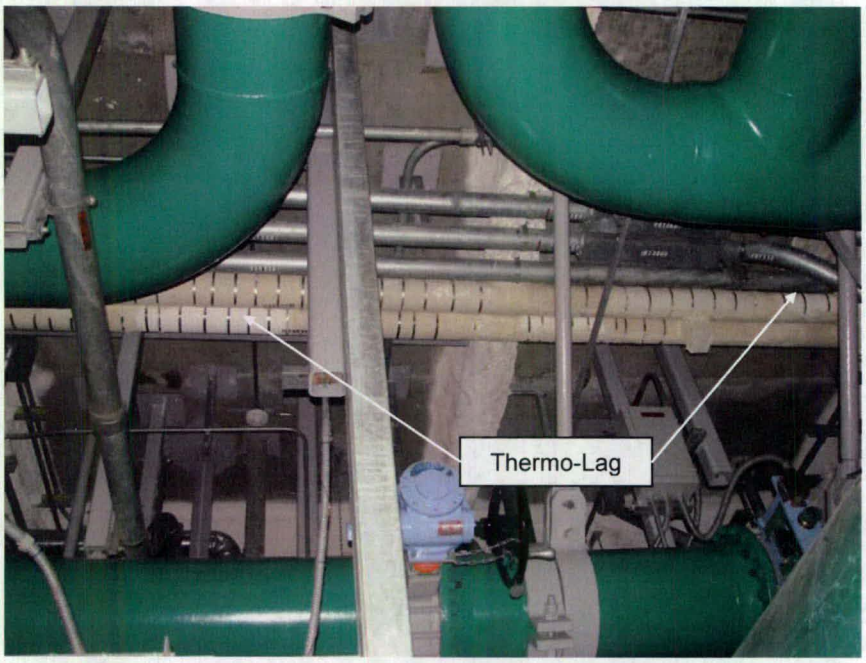


Photo 8.1.1-1, Typical Thermo-Lag IEEE-384 Protection

8.1.2 Spurious Equipment Operation Requiring Operator Manual Action

In Fire Area A-16N, cables associated with steam generator atmospheric relief valves (ARV) ABPV0002 (steam generator 'B'), ABPV0003 (steam generator 'C'), and ABPV0004 (steam generator 'D') may be damaged, preventing control of theses valves from the Control Room. Additionally, a fire in this area could affect auxiliary feedwater for steam generators 'A' and 'D'. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as the cables for ABPV0002, ABPV0003, and ABPV0004 follow the same general routing along the northeast and east corridors. The ARV cables are in multiple raceways. The horizontal separation distance along the northeast corridor from column line AF-AK and the east corridor from column line A2-A5, which envelops all three ARVs, is approximately 5'. Typical vertical separation is approximately 8'-3" between the cable tray for ABPV004 and the conduits for ABPV002 and ABPV003, which are

predominantly located at the same elevation. The cables for ABPV0003 (in conduit) exit the east corridor and transition north of column A3 near the north wall and ceiling interface in the 'A' CCW area. The cables for ABPV0002 (in conduit) transition through the 'A' CCW area north of column line A5. The cable tray for ABPV0004 transitions into the ceiling near the intersection of column lines A4-AK.

Fire wrap protection/upgrade is not practical due to the raceway distance and area congestion.

This is an Important to Safe Shutdown spurious equipment operation, as Thermal Hydraulic Analysis WCNOC-CP-002 determined that hot standby conditions could be maintained with no action taken to close three spuriously open ARVs. Additionally, WCNOC-CP-002 determined that, for three spuriously failed closed ARVs, hot standby could be maintained via steam released through the steam generator safety valves. However, use of the safety valves is not the operational preferred method for maintaining post-fire hot standby. Therefore, it was conservatively concluded that a feasibility and reliability analysis would be completed for the A-16 actions addressing fire induced ARV mal-operation. This event is a multiple spurious equipment operation from a PFSSD perspective, as the fire-induced mal-operation involves multiple steam release paths from the main steam system.

8.1.3 Operator Manual Action Description

Steam generator ARV ABPV0002 can be controlled/isolated by manipulation of ABFHC0002. Steam generator ARV ABPV0003 can be controlled/isolated by manipulation of ABFHC0003. These components are located at local control stations in Fire Area A-23 on the 2037'-7" elevation of the Auxiliary Building (Reference Attachment C, Photos C-2 and C-3).

Steam generator ARV ABPV0004 can be isolated by closing air supply valve KAV1429 and nitrogen supply valve KAV1365, and then bleeding air from the regulator. The air and nitrogen supply valves and regulator are also located in Fire Area A-23, on the 2037'-7" elevation of the Auxiliary Building (Reference Attachment C, Photos C-4 through C-6).

Based on thermal hydraulic analysis (Reference 7.39 and 7.41), the operator can close ABPV0004 and either ABPV0002 or ABPV0003 and leave either ABPV0002 or ABPV0003 full open. The operator will report back to the Control Room for further instructions. The initial OMA response will be a Reactive Action.

8.1.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.1.4-1 reflects the OMA timeline in response to ARV ABPV0002 ABPV0003, and ABPV0004 mal-operation. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A four (4) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. Area detection is provided for Fire Area A-16. Therefore, multiple detection alarms would be initiated for a fire event warranting OMA response action.

Diagnosis Time – A seven (7) minute diagnosis time is utilized, based on Section 5.1.14.1.

OMA Implementation Time – A cumulative twenty seven (27) minute operator implementation time for performing the three OMAs is utilized, based on the demonstrated OMA walkdown time documented in Section 8.1.14.

OMA Uncertainty Time – A twenty six (26) minute OMA uncertainty time is utilized based on Section 8.1.14.

Available Time – Thermal hydraulic analysis AN-96-062 identifies that RHR entry conditions can be achieved in 94 hours after reactor trip if a single steam generator ARV is used and; if a second ARV is placed in service in 60 hours, RHR entry conditions can be achieved in 61 hours. Furthermore, if either ARV ABPV0002 or ABPV0003 is left in the full open position with all remaining ARVs closed, cool down can be controlled from the Control Room by adjusting auxiliary feedwater flow to the associated steam generator with an open ARV. This approach is also supported by thermal hydraulic analysis WCNOC-CP-002, which identifies that three ARVs can remain spuriously open or closed for at least 200 minutes without adverse consequence to reactor performance.

Time Margin – The time margin for OMA performance is one hundred thirty six (136) minutes.

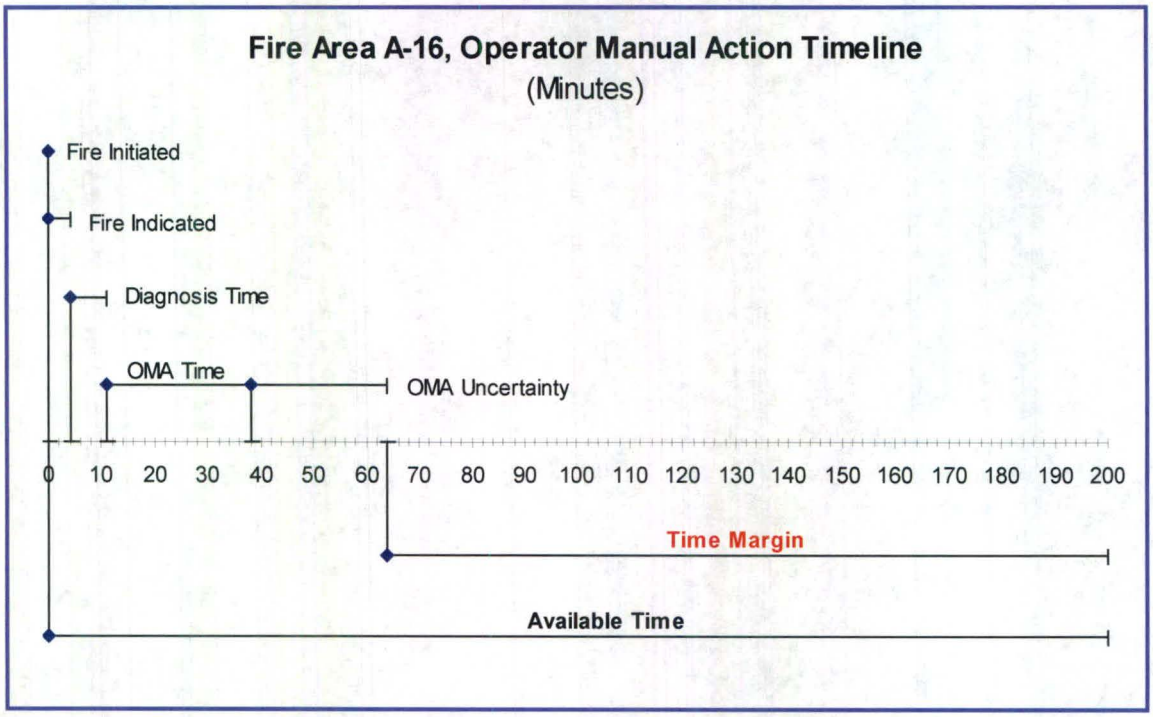


Figure 8.1.4-1, Fire Area A-16 OMA Timeline

8.1.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area A-16 reveals that a one hundred thirty six (136) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMAs are dependable, reliable, and can be performed with a high rate of success.

8.1.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMAs. The postulated fire event is within the general corridor area of the Auxiliary Building 2026' elevation. The location of the OMAs is within the Main Steam Enclosure on the 2037'-7" elevation of the Auxiliary Building (Fire Area A-23). Based on fire barrier separation, the fire will be confined to Fire Area A-16. Access to Fire Area A-23 does not require transition through Fire Area A-16. The travel path and location of the equipment requiring manipulation are physically separated from the fire by rated fire barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Emergency lighting is provided for illumination of potential egress paths, and the components requiring OMA manipulation. Normal radiation conditions within the areas of concern will not be adversely affected by the fire and subsequent spurious equipment operation.

Temperature and humidity conditions within the Main Steam Enclosure will be elevated in the proximity of a spuriously open ARV. Historically, Operations has successfully isolated an ARV by closing its respective local isolation valve, which requires closer, long-term proximity to the ARV discharge line than the prescribed OMA. This historical success demonstrates that the environment within the Main Steam Enclosure will remain tenable regarding local temperature and humidity exposure during the prescribed OMA implementation. Additionally, the discharge piping in the area where the OMA is performed is insulated, which protects against contact exposure with the hot piping.

There are no physical impediments in proximity to the manual action components that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMAs.

8.1.7 Equipment Functionality and Accessibility

The components requiring manipulation for ARV control/isolation are mechanical. No equipment support functions are required for successful manual action implementation. Each is readily accessible for manipulation. These components are physically separated from the fire event by fire rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control. Key access is also required for the enclosure housing ARV controllers ABFHC0002 and ABFHC0003. The OFN KC-016 OMA operator also carries this key.

8.1.8 Available Indications

Point addressable smoke detection is provided for Fire Area A-16. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the area.

To diagnose the spurious opening of an ARV, valve position indication or appropriate pressure instrumentation needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious opening of an ARV:

- ABPV0002 - Steam Generator 'B' pressure indication on ABPI524A
- ABPV0003 - Steam Generator 'C' pressure indication on ABPI534A

- ABPV0004 - Steam Generator 'D' pressure indication on ABPI544A

8.1.9 Communications

A fire in this area could affect the Gaitronics and 900 MHz radio systems. As previously discussed, the operator assigned OFN KC-016 OMA duty will report to the Control Room for instruction following fire brigade callout. This approach allows the Control Room operators to provide face-to-face direction for the OMAs. OMA implementation approach provided in OFN KC-016 is based on availability of communication. If the fire affects communication, OFN KC-016 guidance will be followed to close ABPV0002 and open ABPV0003 and then physically report to the Control Room for further direction. The limiting scenario, reflected by the Figure 8.1.4-1 timeline is that the fire affects communication.

8.1.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMAs. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. Wire cutters will be necessary to remove the lock tabs from the components to be manipulated for ARV ABPV0004 isolation. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key and wire cutters. Key access is also required for the enclosures housing ARV controllers ABFHC0002 and ABFHC0003. The OFN KC-016 OMA operator also carries this key.

8.1.11 Personnel Protection Equipment

No other personnel protective equipment, beyond that normally necessary for Auxiliary Building access, is required to perform the OMA.

8.1.12 Procedures and Training

The OMAs are identified in OFN KC-016. Procedure direction is based on availability of communications. If communication is not affected by the fire, the direction for the ARVs, with a protected auxiliary feedwater source, is to close ABPV0002 and throttle open ABPV0003 per Control Room direction. If the fire affects communication, the direction is to close ABPV0002, open ABPV0003, and physically report back to the Control Room for further direction. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.1.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMAs. Only one person is required to perform the OMAs.

8.1.14 Demonstrations

The OMAs were timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor. Each of the three OMAs were conservatively timed as independently originating from Room 3613 in recognition that radio and Gaitronics communication capability could be affected by the fire. The timing effort reflected that each OMA could be implemented in nine (9) minutes, for a cumulative OMA total of twenty-seven (27) minutes.

Once initial ARV control/isolation is established, PFSSD OMA capability is adequately demonstrated. Operations can continue to transition between the Main Steam Enclosure and the Control Room to affect ARV position change throughout the event course, or steam generator feedwater can be throttled from the Control Room to control decay heat removal. Based on the diversity of available decay heat removal options, timing considerations were that each ARV mal-operation would have to be visited once for OMA implementation.

In addition, the following uncertainty times have been included, resulting in a total uncertainty time of twenty-six (26) minutes.

- Communication and feedback with Control Room for OMAs – 3 minutes
- Electronically controlled door key access – 3 minutes
- Obtain RCA access – 2 minutes
- Transition to Control Room from Fire Area A-23 after OMA implementation (three trips at 5 minutes per trip) – 15 minutes
- Human centered uncertainty – 3 minutes

8.1.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety. A 10 CFR 50 Appendix R, 20' combustible control zone is provided for separation of redundant component cooling water components.

The noteworthy ignition source in proximity to the raceways containing the cables for ABPV002, ABPV003, and ABPV004 are as follows:

- RP266, Auxiliary Relay Panel
- RP331, Reverse Isolation Relay Panel
- XSK01A / XSK01B, Security Panels
- XQA21, Lighting Panel Transformer
- DPEG01C, 'C' CCW Pump Motor
- DPEG01A, 'A' CCW Pump Motor

Due to the lower elevation (2036'-3") of tray 4J3C for ABPV0004, it could be involved in ignition source or transient combustible fire exposure. However, The Thermo-Lag protection for ABPV0002 and ABPV0003 provides additional defense in depth protection such that it is reasonable to conclude that a credible area A-16N fire would not result in the combined fire induced mal-operation of ABPV0002, ABPV0003, and ABPV0004 necessitating OMA implementation.

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection is provided for the area. A pre-action sprinkler system is located in areas with high concentration of cable trays. In addition to the ceiling level sprinkler protection, the east corridor, from column line A1 to A4, is provided with an intermediate level sprinkler protection, located below the lowest cable tray in the corridor. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The pre-action sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the area for manual fire fighting.

The administrative fire impairment controls for the north and east corridor area require a continuous fire watch when either automatic detection or the pre-action sprinkler system is inoperable. This ensures fire suppression response will occur in the incipient fire

stage during conditions when the active fire protection system elements area out of service.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMAs are utilized in lieu of Section III.G.2 protection to ensure a fire in Fire Area A-16 does not challenge PFSSD. The OMA is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.1.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMAs for Fire Area A-16 are dependable, reliable, and can be consistently performed within the required Available Time. A one hundred thirty six (136) minute time margin remains, when applying uncertainty elements to ensure OMA reliability. Therefore, the OMAs are considered both feasible and reliable. Considering that WCNOC-CP-002 demonstrates that the mal-operation of three ARVs does not require outside Control Room action to achieve and maintain post-fire hot standby, the feasibility and reliability analysis for A-16 provides an added defense in depth approach to ensure post-fire safe shutdown capability is maintained with no adverse reactor thermal performance.

8.2 Fire Area C-18, Control Building 2016' Cable Chase

8.2.1 Fire Area Features

Fire Area C-18 is a single room (3419) cable chase located on the 2016' elevation of the Control Building. The chase contains cable and normal room lighting only. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and wet pipe sprinkler protection are provided for the area. No natural or forced ventilation is provided for the fire area. General access to the cable chase is restricted by a normally locked fire door. Approximate cable chase size is as follows:

- Length – 12 ft.
- Width – 12 ft.
- Height – 15 ft. 4 in.

Refer to Attachment D for a plan view sketch of the fire area.

8.2.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01A could spuriously start and discharge valve ENHV0006 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01A and spurious closure of ENHV0006 are located in separate cable trays within the same cable chase. Horizontal spatial separation between the trays of concern (vertical tray 1C8E for PEN01A; vertical tray 1C8B and horizontal tray 1U1G for ENHV0006) is approximately 5 ft. 6 in. with multiple cable trays presenting intervening combustibles between the identified trays. The trays of concern are located on the north side of the cable chase. Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

The minimum horizontal separation distance that involves all of the above PFSSD circuit issues (with the exception of 1C8E for PEN01A) is approximately 5 ft.

8.2.3 Operator Manual Action Description

Containment spray pump PEN01A can be stopped by opening breaker NB0102. The breaker is located on 4.16 KV bus NB01 within the Control

Building 2000' north ESF Switchgear Room (Fire Area C-9). Refer to Attachment C Photo C-7, for a photograph of the respective breaker. This is a Reactive OMA.

8.2.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.2.4-1 reflects the OMA timeline for opening breaker NB0102. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. However, C-18 contains only one smoke detector within the cable chase. Therefore, physical confirmation of the fire event is necessary. This confirmation is postulated to take up to five (5) minutes following receipt of the initial fire alarm indication in the Control Room. This increases the total fire detected time to six (6) minutes.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator action time is utilized for opening NB0102, based on the demonstrated OMA walkdown time documented in Section 8.2.14.

OMA Uncertainty Time – An eight (8) minute OMA uncertainty time is utilized based on Section 8.2.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The limiting time margin for OMA performance is thirty-three (33) minutes.

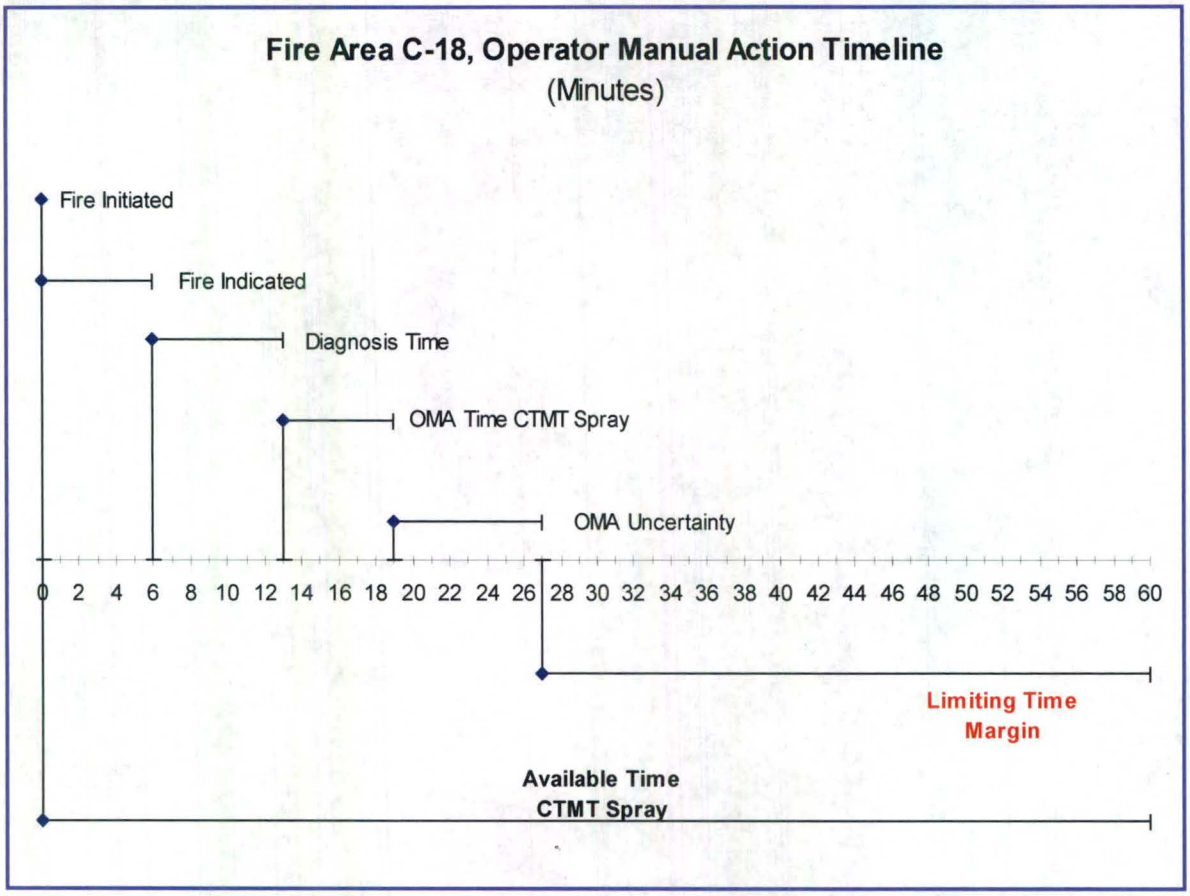


Figure 8.2.4-1, Fire Area C-18 OMA Timeline

8.2.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-18 reveals that a thirty-three (33) minute time margin remains for the OMA. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.2.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3419 located on the 2016' elevation of the Control Building. The location of the OMA for stopping PEN01A containment spray is located on the 2000' elevation of the Control Building, within the north ESF Switchgear Room.

The fire will be confined to the Fire Area C-18 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Emergency lighting is provided for illumination of potential egress paths, the emergency equipment cabinet necessitating access for retrieval of personal protective equipment, and the component requiring OMA manipulation. Normal radiation, temperature, and humidity conditions within the OMA area will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.2.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA component is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.2.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3419. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0931 and BNLI933.
- Containment pressure indicators GNPI0934 and GNPI0936.

8.2.9 Communications

A fire in this area could affect the Gaitronics and 900 MHz radio systems. The OMA does not require constant communication with the Control Room. As previously discussed, the operator assigned OFN KC-016 OMA duty will report to the Control Room for instruction following fire brigade callout. This approach allows the Control Room operators to provide face-to-face direction for the OMA. Once the OMA has been

implemented, the operator can physically report back to the Control Room if the Gaitronics or radio system functionality are affected by the fire.

8.2.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key.

8.2.11 Personnel Protection Equipment

Opening of breaker NB0102 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, which is adjacent to the room where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Control Building access, is required to perform the OMA.

8.2.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.2.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.2.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor.

The timing effort reflected that the OMA for opening NB0102 could be implemented in six (6) minutes. This included time for donning electrical safety PPE.

In addition, the following uncertainty times have been included, resulting in a total uncertainty time of eight (8) minutes.

- Communication and feedback with Control Room – 2 minutes
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.2.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety. Additionally, the cable chase is normally locked, which prevents general access to the area.

The cable chase contains IEEE-383 rated cable and a single light fixture. As discussed in Section 5.1.15.1, IEEE-383 cable and normal lighting are not considered credible ignition sources that would promote fire propagation. Therefore, there are no fixed ignition sources within the cable chase that would initiate a fire event warranting OMA implementation.

As previously discussed, the cable chase is normally locked. This restricts normal access to occasions associated with periodic area inspections and surveillance activities for the access door. Due to the access restriction, transient combustibles are generally not stored in the chase, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the chase. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable chase is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

2. Detect, Control, and Extinguish Fires

   This objective is not affected by the OMA. Smoke detection and wet pipe sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the general area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

   Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-18 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.2.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMA for Fire Area C-18 is dependable, reliable, and can be consistently performed within the required Available Time. A thirty-three (33) minute time margin remains for the OMA, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no adverse reactor thermal performance or unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

8.3 Fire Area C-21, Control Building 2032' Lower Cable Spreading Room

8.3.1 Fire Area Features

Fire Area C-21 is the Lower Cable Spreading Room (3501) on the 2032' elevation of the Control Building. The Room contains predominantly cable. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and a pre-action sprinkler system are provided for the area. Approximate room size is as follows:

- Length – 88 ft.
- Width – 66 ft.
- Height – 14 ft. 10 in.

Refer to Attachment D for a plan view sketch of the fire area.

8.3.2 Spurious Equipment Operation Requiring Operator Manual Action

Cables associated with letdown isolation valves BGLCV0459 and BGLCV0460 may be damaged, preventing these valves from being closed from the Control Room. PFSSD requires one of these valves to be closed to ensure adequate charging flow. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as the cables for both BGLCV0459 and BGLCV0460 are routed in two trays, one below the other, within a multi-cable tray stack. Vertical separation distance between the two trays is less than 12".

This spurious equipment operation is Important to Safe Shutdown, as letdown is not required for PFSSD. However, letdown isolation is required to prevent RCS flow diversion. This event is a multiple spurious equipment operation from a PFSSD perspective, as the fire-induced mal-operation involves two series valves in the chemical and volume control system.

Atmospheric relief valve (ARV) ABPV0001 and ABPV0003 could spuriously open as a result of a C-21 fire. Thermal hydraulic analysis WCNOC-CP-002 determined that no operator action is required to achieve and maintain hot standby with two spuriously open ARVs. However, the thermal hydraulic analysis determined that spuriously open ARVs concurrent with letdown does affect the available time for isolating letdown.

Containment spray pump PEN01A could spuriously start and discharge valve ENHV0006 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01A and spurious closure of ENHV0006 are predominantly routed in

two trays, one below the other, within a multi-cable tray stack. Vertical separation distance between the two trays is less than 12".

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

Cables associated with the control of normal pressurizer spray valves BBPCV0455B and BBPCV0455C may be damaged resulting in spurious valve opening that cannot be closed from the Control Room. PFSSD requires these valves to be closed to prevent RCS depressurization. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not directly satisfied, as a fire could cause valve maloperation. This event is a single spurious equipment operation from a PFSSD perspective, as a single cable fault could affect the control of the respective spray valve. The pressurizer spray valves are Important to Safe Shutdown, as they are not credited as an element of the analyzed PFSSD success path. This determination is supported by Section 3.1.2.2 of NEI 00-01 (Rev. 2), which states the following:

> *"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."

The location where cables associated with each of the above OMA scenarios are closest to each other as a group is in the northeast corner of the spreading room, where each of the cables transition out of the west wall of Cable Chase C-24. The cables associated with PEN01A, ABPV0001, BBPCV455B, and BBPCV455C are in the same set of multi-stack horizontal trays, while cables for letdown are located approximately 3 ft. south within a multi-stack horizontal tray. Horizontal separation distance for the ABPV0003 conduit from the chase area is approximately 19 ft.

In all the above cases, fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

8.3.3 <u>Operator Manual Action Description</u>

Valves BGLCV0459, BGLCV0460, BBPCV0455B and BBPCV0455C can be isolated by closing instrument air supply valve KAV0201 located in the South Pipe Penetration Room on the 2000' elevation of the Auxiliary

Building (Reference Attachment C, Photo C-1). This removes air to BGLCV0459, BGLCV0460, BBPCV0455B, BBPCV0455C and all air operated components within the Reactor Building. Historical performance of STS KJ-001A, which isolates instrument air to the Reactor Building, reveals that BGLCV0459, BGLCV0460, BBPCV0455B, BBPCV0455C will fail closed within three (3) minutes following isolation of instrument air. This is a Reactive OMA.

Containment spray pump PEN01A can be stopped by opening breaker NB0102. The breaker is located on 4.16 KV bus NB01 within the Control Building 2000' north ESF Switchgear Room (Fire Area C-9). Refer to Attachment C, Photo C-7, for a photograph of the respective breaker. This is a Reactive OMA.

8.3.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.3.4-1 reflects the OMA timeline for closing BGLCV0459, BGLCV0460, BBPCV0455B, BBPCV0455C and opening breaker NB0102. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. Total area detection is provided for Fire Area C-21. Therefore, multiple detection alarms would be initiated for a fire event warranting OMA response action.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – Implementation sequence for the two OMAs will be based on Control Room diagnosis. The conservative approach from a feasibility and reliability timing perspective is to postulate the closure of KAV0201 second in the sequence of OMA events. This is conservative since letdown and pressurizer spray have a more restrictive available time for OMA implementation.

A six (6) minute operator action time is utilized for opening NB0102, based on the demonstrated OMA walkdown time documented in Section 8.3.14.

A fifteen (15) minute operator action time is utilized for isolating KAV0201, based on the demonstrated OMA walkdown time documented in Section 8.3.14.

OMA Uncertainty Time – A thirteen (13) minute OMA uncertainty time is utilized based on Section 8.3.14.

Available Time – Thermal hydraulic analysis WCNOC-CP-002 identifies when letdown is open, concurrent with spuriously open atmospheric relief valve related cooling, letdown can remain open and pressurizer spray

may operate for fifty (50) minutes, without adverse consequence to reactor performance.

E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The limiting time margin for OMA performance is eight (8) minutes.

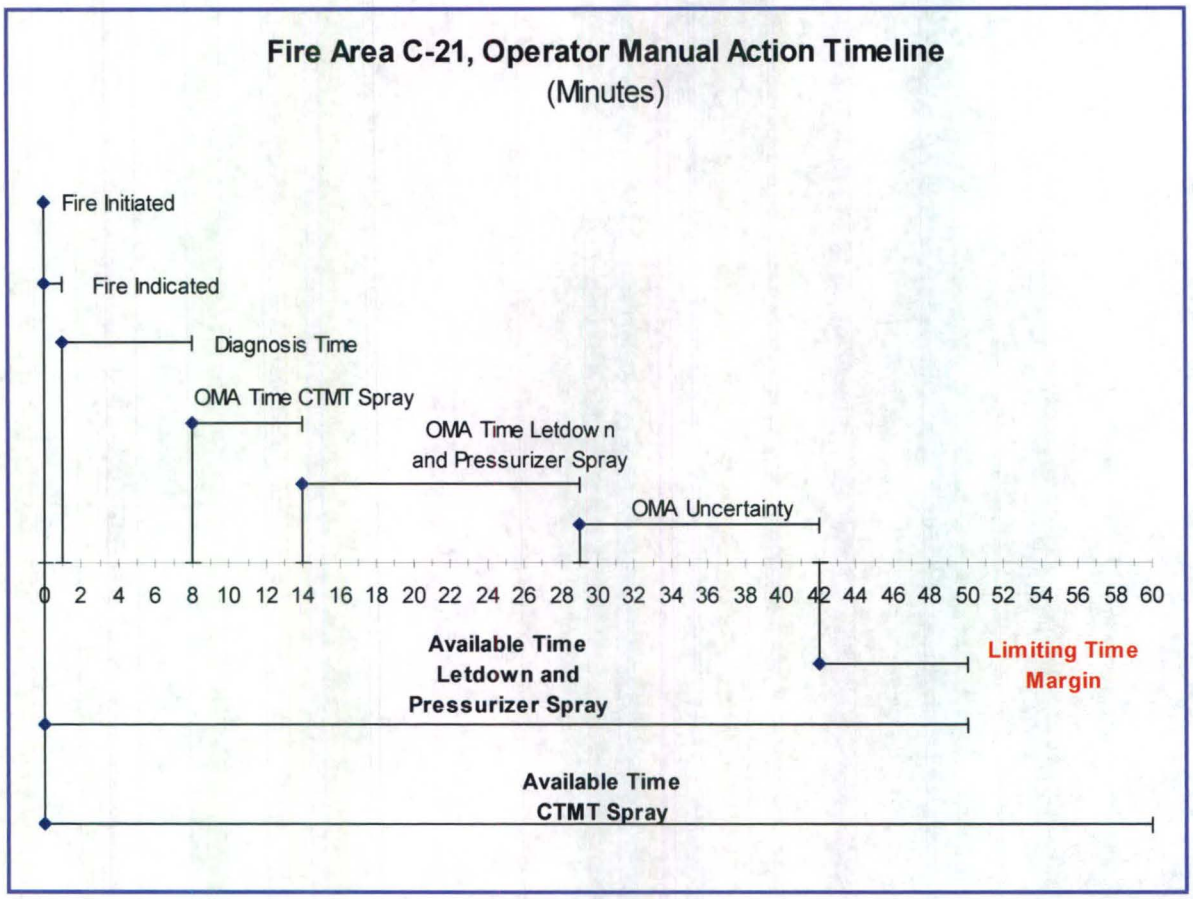


Figure 8.3.4-1, Fire Area C-21 OMA Timeline

8.3.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-21 reveals that an eight (8) minute time margin remains for the most limiting OMA. Application of the uncertainty time provides reasonable assurance that the OMAs are dependable, reliable, and can be performed with a high rate of success.

8.3.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMAs. The postulated fire event is within Lower Cable Spreading Room on the 2032' elevation of the Control Building. The location of the OMA for isolating KAV0201 is in an adjacent structure on the 2000' elevation of the Auxiliary Building, within the south Pipe Penetration Room. The location of the OMA for stopping PEN01A containment spray is located on the 2000' elevation of the Control Building, within the north ESF Switchgear Room.

Based on fire barrier separation, the fire will be confined to Fire Area C-21. The travel path and location of the equipment requiring manipulation are physically separated from the fire by rated fire barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Emergency lighting is provided for illumination of potential egress paths, the emergency equipment cabinet necessitating access for retrieval of personal protective equipment, and the components requiring OMA manipulation. Normal radiation, temperature, and humidity conditions within the OMA areas will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action components that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMAs.

8.3.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA components are physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.3.8 Available Indications

Point addressable smoke detection is provided for the Lower Cable Spreading Room. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the area.

To diagnose a failure of BGLCV0459 and BGLCV0460 to close, valve position indication or appropriate level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of BGLCV0459 and BGLCV0460 failure to close:

- Pressurizer level indicator BBLI0460A.
- VCT level indicator BGLI0185.

To diagnose a spuriously open pressurizer spray valve, RCS pressure indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of a spuriously open BBPCV0455B or BBPCV0455C.

- Pressurizer pressure indicators BBPI0456 and BBPI0458.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0931 and BNLI933.
- Containment pressure indicators GNPI0934 and GNPI0936.

8.3.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMAs do not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

8.3.10 Portable Equipment

KAV0201 is located approximately 10' above the floor. Access to a portable ladder for OMA implementation is available. No other portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key.

8.3.11 Personnel Protection Equipment

Opening of breaker NB0102 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, which is adjacent to the room where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Auxiliary or Control Building access, is required to perform the OMAs.

8.3.12 Procedures and Training

The OMAs are identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.3.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMAs. Only one person is required to perform the OMAs.

8.3.14 Demonstrations

The OMAs were timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor.

The timing effort reflected that the OMA for isolating KAV0201 could be consistently performed within nine (9) minutes. This included time to obtain a ladder to reach KAV0201. The three (3) minute delay for BGLCV0459, BGLCV0460, BBPCV455B, and BBPCV455C closure following the isolation of instrument air is also factored into the overall OMA implementation time. Additionally, three (3) minutes is included in the OMA time for the operator to return to the Control Room after opening breaker NB0102 This is conservative, as radio communication will be available. The resulting cumulative OMA implementation time for KAV0201 is fifteen (15) minutes.

The timing effort reflected that the OMA for opening NB0102 could be implemented in six (6) minutes. This included time for donning electrical safety PPE.

In addition, the following uncertainty times have been included, resulting in a total uncertainty time of thirteen (13) minutes.

- Communication and feedback with Control Room – 2 minutes
- Electronically controlled door key access – 3 minutes
- Obtain RCA access – 2 minutes
- Human centered uncertainty – 3 minutes
- Delay in obtaining and setting up ladder – 3 minutes

8.3.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMAs. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety.

The Lower Cable Spreading Room contains IEEE-383 rated cable normal lighting, emergency lighting, public address equipment, and two electric unit heaters. As discussed in Section 5.1.15.1, IEEE-383 cable, normal lighting, emergency lighting, and public address equipment are not considered credible ignition sources that would promote significant fire propagation. The only noteworthy ignition sources in the room are the electric unit heaters, which are included in the ignition source Zone of Influence review documented in Tables 8.3.15.1-1 and 8.3.15.1-2. The Table 8.3.15.1-2 analysis provides reasonable assurance that a credible fire event within the area would not result in fire induced equipment mal-operation warranting OMA implementation..

The Lower Cable Spreading Room does not have restricted access. However, it is not on the normal plant travel path, and access is typically limited to occasions associated with periodic area inspections and surveillance for the fire protection equipment. Due to the limited access, transient combustibles are generally not stored in the room, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the room. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable spreading room is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

Table 8.3.15.1-1, Photos of Ignition Sources and Targets

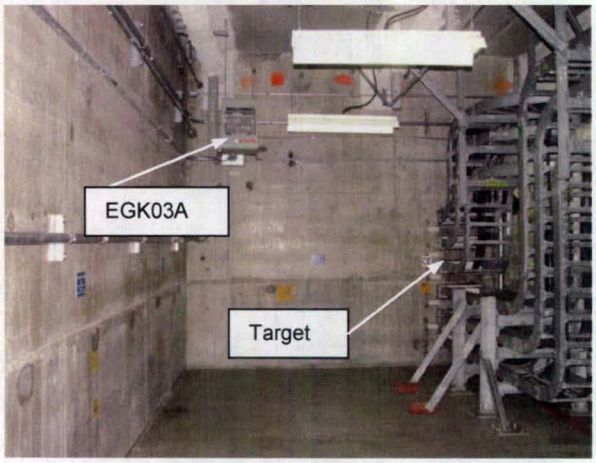
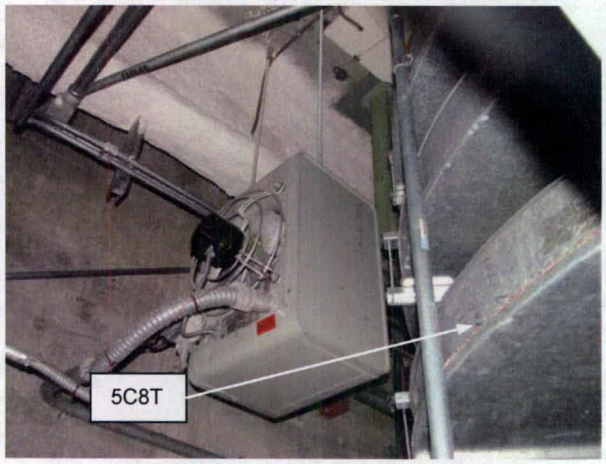
Ignition Source and Target Information	Photo	Comments
Ignition Source EGK03A Description – 10 kW electric heater located in the northwest corner of the cable spreading room Height from Floor – 136" Horizontal Distance to Target – 108" Vertical Distance to Target – N/A Distance to North Wall – 44" Distance to West Wall – 24" Target Cable tray stack east of heater		Target cable trays do not contain OMA cables of concern Ignition source is considered near a wall when applying NRC Inspection Manual 0609 Appendix F guidance.
Ignition Source EGK03B Description – 10 kW electric heater located in the southwest corner of the cable spreading room Height from Floor – 137" Horizontal Distance to Target – 6" Vertical Distance to Target – 0" Distance to South Wall – 40" Distance to West Wall – 24" Target Cable tray stack east of heater, which includes 5C8T and 5C8U		Target cable trays 5C8T and 5C8U (below 5C8T) contain cables associated with letdown isolation valves BGLCV0459 and BGLCV0460 Target cable tray 5J5A (bottom tray in same stack with 5C8T and 5C8U) contains cables associated with pressurizer spray valve control Ignition source is considered near a wall when applying NRC Inspection Manual 0609 Appendix F guidance.

Table 8.3.15.1-2, Zone of Influence Review for Ignition Sources and Targets

Ignition Source	Target	Expected HRR	Target Distance (ft)		Critical Distance (ft)		Comments
		High Confidence HRR	H	R	H	R	
EGK03A	Cable tray stack east of heater	70 kW	N/A	9	4.6	1.8	Target is below ignition source height and is outside the Zone of Influence. This area originally was a construction opening during the initial plant assembly. The approximate 24 ft. x 14 ft. area contains minimal cable concentration. It is not sprinkler protected. This area is procedurally maintained as a Combustible Control Zone per AP 10-102. No unattended transient combustibles are allowed in this area without Fire Protection review. Due to the lack of fixed combustible continuity, and the strict administrative control for transient combustibles in the area housing EGK03A, fire propagation involving heater failure would not transition to cable tray involvement within the room.
		200 kW			7.0	3.0	
EGK03B	Cable tray stack east of heater, which includes 5C8T 5C8U and 5J5A	70 kW	0	0.5	4.6	1.8	Target trays 5C8T, 5C8U, and 5J5A are the third, forth, and seventh cable trays from the top in a stack of seven trays. The top two trays are higher than the heater base. Trays 5C8T, 5C8U, and 5J5A are lower than the heater base. Bottom and topside steel tray covers are provided for the top two trays beyond the zone of influence distance. Tray 5C8T is provided topside steel cover protection for a distance of over 20' from the heater suction side. Trays 5C8U and 5J5A are not provided with tray covers. The encapsulating steel cover protection provided for the trays above the heater ensures that they will not be involved in a fire event initiated from EGK03B failure. Trays 5C8T, 5C8U, and 5J5A will not be within the heat plume from EGK03B since they are located at a lower elevation than the ignition source. Additionally, with EGK03B being near the ceiling, sprinkler response in proximity to the heater will be prompt, providing reasonable assurance that automatic suppression activities would significantly limit fire damage. Trays 5C8T, 5C8U, and 5J5A are not postulated to be affected by EGK03B failure.
		200 kW			7.0	3.0	

2. Detect, Control, and Extinguish Fires

   This objective is not affected by the OMA. Smoke detection and pre-action sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, if necessary. Fire extinguishers and hose stations are provided in the area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

   Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMAs are utilized in lieu of Section III.G.2 protection to ensure a fire in C-21 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.3.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMAs for Fire Area C-21 are dependable, reliable, and can be consistently performed within the required Available Time. An eight (8) minute time margin remains for the most limiting OMA, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no adverse reactor thermal performance or unacceptable loss of RWST inventory. Therefore, the OMAs are considered both feasible and reliable.

8.4 Fire Area C-22, Control Building 2073'-6 Upper Cable Spreading Room

8.4.1 Fire Area Features

Fire Area C-22 is the Upper Cable Spreading Room (3801) on the 2073'-6" elevation of the Control Building. The Room contains predominantly cable. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and a pre-action sprinkler system are provided for the area. Approximate room size is as follows:

- Length – 88 ft.
- Width – 67 ft.
- Height – 12 ft.

Refer to Attachment D for a plan view sketch of the fire area.

8.4.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01B could spuriously start and discharge valve ENHV0012 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01B and spurious closure of ENHV0012 are predominantly routed in two trays, one below the other, within a multi-cable tray stack. Vertical separation distance between the two trays is less than 12". Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a MSO scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

8.4.3 Operator Manual Action Description

Containment spray pump PEN01B can be stopped by opening breaker NB0203. The breaker is located on 4.16 KV bus NB02 within the Control Building 2000' south ESF Switchgear Room (Fire Area C-10). Refer to Attachment C, Photo C-8, for photograph of the respective breaker. This is a Reactive OMA.

8.4.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.4.4-1 reflects the OMA timeline in response to spurious containment spray actuation. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. Total area detection is provided for Fire Area C-22. Therefore, multiple detection alarms would be initiated for a fire event warranting OMA response action.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator implementation time is utilized based on the demonstrated OMA walkdown time documented in Section 8.4.14.

OMA Uncertainty Time – A seven (7) minute OMA uncertainty time is utilized based on Section 8.4.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The time margin for OMA performance is thirty nine (39) minutes.

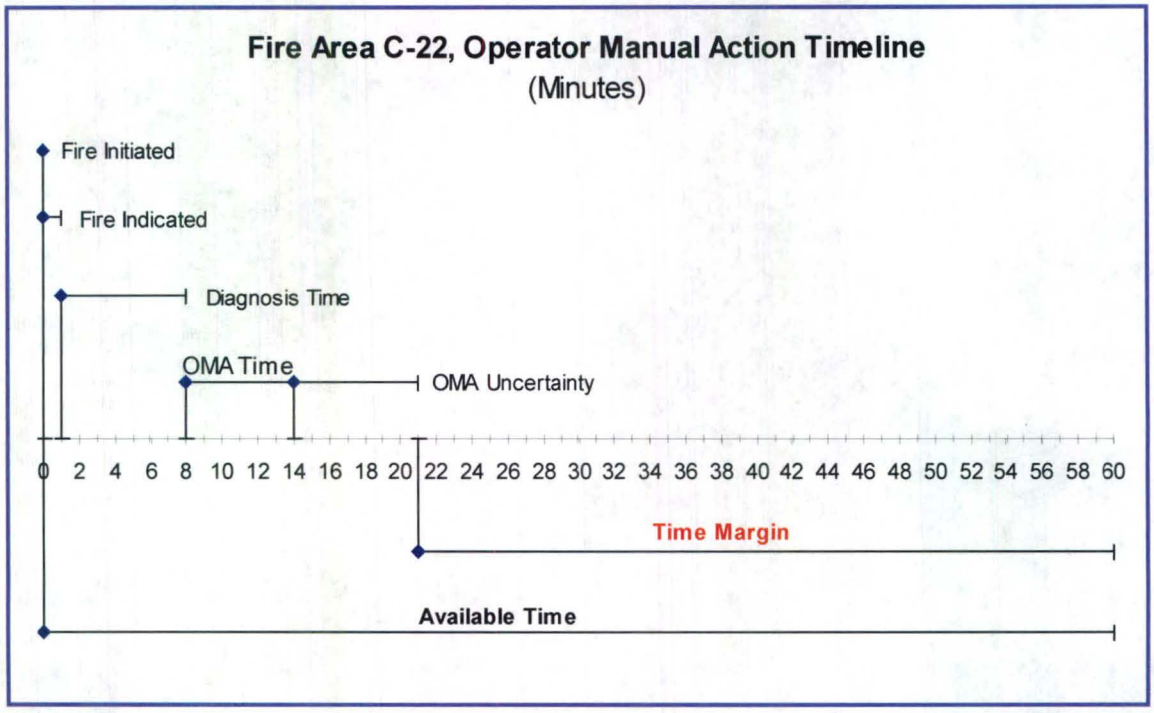


Figure 8.4.4-1, Fire Area C-22 OMA Timeline

8.4.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-22 reveals that a thirty nine (39) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.4.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Upper Cable Spreading Room on the 2073'-6" elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is located on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to Fire Area C-22 Upper Cable Spreading Room. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire-rated barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Emergency lighting is provided for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Normal radiation, temperature, and humidity conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.4.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access

arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.4.8 Available Indications

Point addressable smoke detection is provided for C-22. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the area.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0930 and BNLI0932.
- Containment pressure indicators GNPI0935 and GNPI0937.

8.4.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMA does not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

8.4.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key.

8.4.11 Personnel Protection Equipment

Opening of breaker NB0203 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Control Building access, is required to perform the OMA.

8.4.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.4.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.4.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor. The timing effort reflected that the OMA could be consistently performed within six (6) minutes. This included time to don electrical safety PPE. In addition, the following uncertainty times have been included, resulting in a total uncertainty time of seven (7) minutes.

- Communication and feedback with Control Room – 1 minute
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.4.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety.

The Upper Cable Spreading Room contains IEEE-383 rated cable normal lighting, emergency lighting, public address equipment, and two electric unit heaters. As discussed in Section 5.1.15.1, IEEE-383 cable, normal lighting, emergency lighting, and public address equipment are not considered credible ignition sources that would promote significant fire propagation. The only noteworthy ignition sources in the room are the electric unit heaters, which are included in the ignition source Zone of Influence review documented in Tables 8.4.15.1-1 and 8.4.15.1-2. The Table 8.4.15.1-2 results reveal that the fixed ignition sources are not within the Zone of Influence for the cable trays containing the OMA target cable, and fire propagation would not migrate to the cables of concern before implementation of suppression activities. There is reasonable assurance that a credible fire event within the area would not result in fire induced equipment mal-operation warranting OMA implementation.

The Upper Cable Spreading Room does not have restricted access. However, it is not on the normal plant travel path, and access is typically limited to occasions associated with periodic area inspections and surveillance for the fire protection equipment. Due to the limited access, transient combustibles are generally not

stored in the room, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the room. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable spreading room is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

Table 8.4.15.1-1, Photos of Ignition Sources and Targets

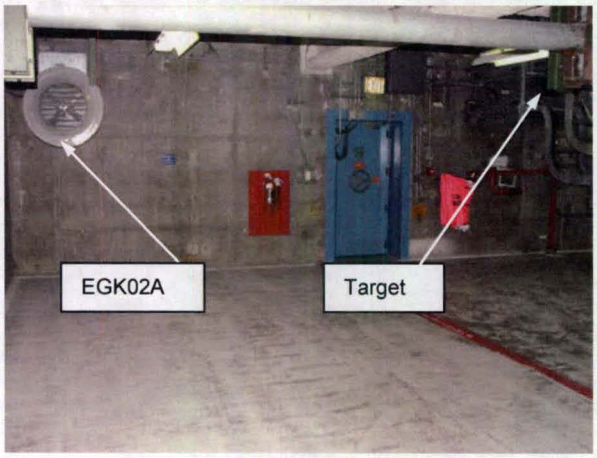
Ignition Source and Target Information	Photo	Comments
Ignition Source EGK02A Description – 40 kW electric heater located in the northwest corner of the cable spreading room Height from Floor – 101" Horizontal Distance to Target – 228" Vertical Distance to Target – 24" Distance to North Wall – 37" Distance to West Wall – 12" Target Cable tray stack east of heater		Target cable trays do not contain OMA cables of concern. Ignition source is considered near a wall when applying NRC Inspection Manual 0609 Appendix F guidance.
Ignition Source EGK02B Description – 40kW electric heater located in the southeast corner of the cable spreading room, north of cable chase C-33 Height from Floor – 101" Horizontal Distance to Target – 26" Vertical Distance to Target – 0" Distance from South Wall – 29" Distance from East Wall – 26" Target Cable tray stack west of heater		Target cable trays do not contain OMA cables of concern. Ignition source is not considered near a wall or corner when applying NRC Inspection Manual 0609 Appendix F guidance.

Table 8.4.15.1-2, Zone of Influence Review for Ignition Sources and Targets

Ignition Source	Target	Expected HRR	Target Distance (ft)		Critical Distance (ft)		Comments
		High Confidence HRR	H	R	H	R	
EGK02A	Cable tray stack east of heater	70 kW	2	19	4.6	1.8	Target is outside the Zone of Influence. This area originally was a construction opening during the initial plant assembly. The approximate 24 ft. x 14 ft. area is not sprinkler protected. This area is procedurally maintained as a Combustible Control Zone per AP 10-102. No unattended transient combustibles are allowed in this area without Fire Protection review. Due to the lack of fixed combustible continuity, and the strict administrative control for transient combustibles in the area housing EGK02A, fire propagation involving heater failure would not transition to cable tray involvement within the room.
		200 kW			7.0	3.0	
EGK02B	Cable tray stack west of heater	70 kW	0	2.1	3.5	1.3	The target cable trays, which do not contain OMA cables of concern, are outside the Zone of Influence for the expected fire exposure (70 kW) and are at the Zone of Influence boundary for a high confidence (200 kW) heat release rate. The closest distance from the trays potentially affected by EGK02B to the trays containing containment spray pump PEN01B valve ENHV0012 cables is approximately 14 horizontal feet. Applying the horizontal tray flame spread rate of 10 ft. per hour from NRC Inspection Manual 0609 Appendix F reflects an approximate 75-minute fire duration before potential fire induced impact to the OMA cables of concern. This duration provides more than adequate time for fire brigade suppression response prior to fire involvement of the OMA cables. Additionally, with EGK02B being near the ceiling, sprinkler response in proximity to the heater will be prompt, providing reasonable assurance that automatic suppression activities would significantly limit fire damage.
		200 kW			5.3	2.1	

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection and pre-action sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, if necessary. Fire extinguishers and hose stations are provided in the area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

   Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-22 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.4.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMA for Fire Area C-22 is dependable, reliable, and can be consistently performed within the required Available Time. A thirty nine (39) minute time margin remains, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

8.5 Fire Area C-23, Control Building 2032' South Cable Chase

8.5.1 Fire Area Features

Fire Area C-23 is a single room (3505) cable chase located on the 2032' elevation of the Control Building. The chase contains cable and normal room lighting only. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and wet pipe sprinkler protection are provided for the area. No natural or forced ventilation is provided for the fire area. General access to the cable chase is restricted by a normally locked fire door. Approximate cable chase size is as follows:

- Length – 12 ft.
- Width – 12 ft.
- Height – 14 ft.

Refer to Attachment D for a plan view sketch of the fire area.

8.5.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01B could spuriously start and discharge valve ENHV0012 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01B and spurious closure of ENHV0012 are located in separate cable trays within the same cable chase. Horizontal spatial separation between the trays of concern (vertical tray 4C8D for PEN01B; vertical tray 4C8B and horizontal tray 4U3A for ENHV0012) is approximately 5 ft. 6 in., with multiple cable trays presenting intervening combustibles between the identified trays. Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

8.5.3 Operator Manual Action Description

Containment spray pump PEN01B can be stopped by opening breaker NB0203. The breaker is located on 4.16 KV bus NB02 within the Control Building 2000' south ESF Switchgear Room (Fire Area C-10). Refer to Attachment C, Photo C-8, for photograph of the respective breaker. This is a Reactive OMA.

8.5.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.5.4-1 reflects the OMA timeline in response to spurious containment spray actuation. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. However, C-23 contains only one smoke detector within the cable chase. Therefore, physical confirmation of the fire event is necessary. This confirmation is postulated to take up to five (5) minutes following receipt of the initial fire alarm indication in the Control Room. This increases the total fire detected time to six (6) minutes.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator implementation time is utilized based on the demonstrated OMA walkdown time documented in Section 8.5.14.

OMA Uncertainty Time – A seven (7) minute OMA uncertainty time is utilized based on Section 8.5.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The time margin for OMA performance is thirty four (34) minutes.

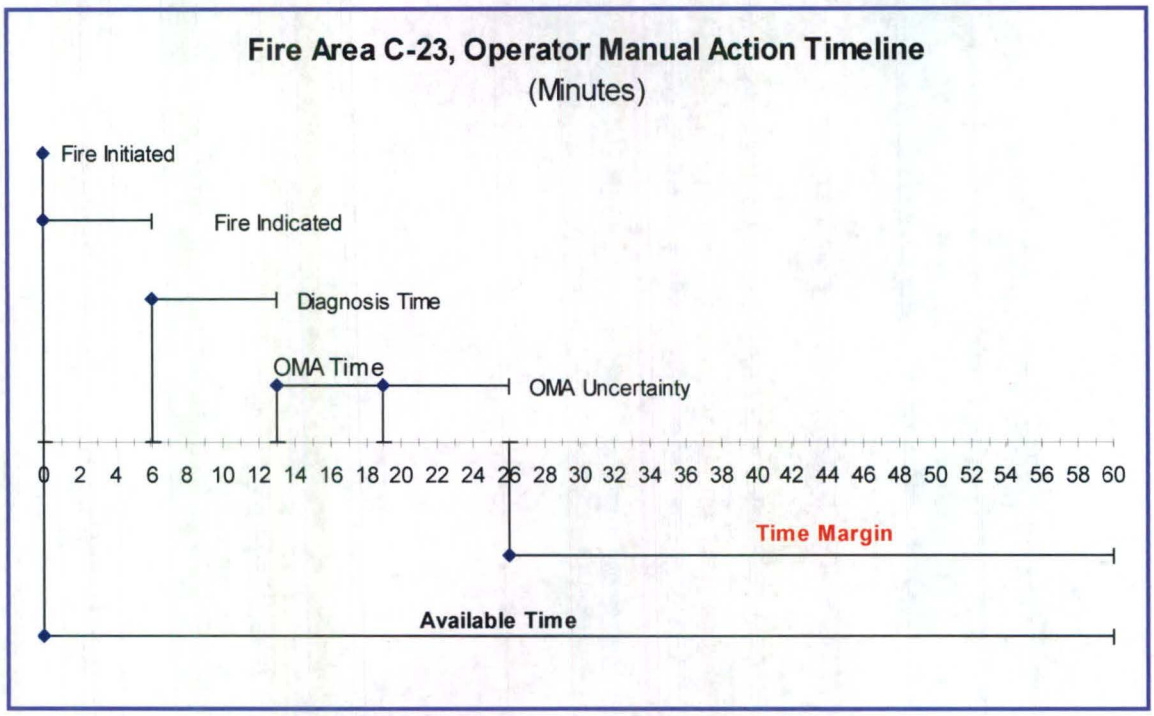


Figure 8.5.4-1, Fire Area C-23 OMA Timeline

8.5.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-23 reveals that a thirty four (34) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.5.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3505 located on the 2032' elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is located on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to the Fire Area C-23 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Emergency lighting is provided for illumination of potential egress paths, the component requiring OMA manipulation, and the emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Normal radiation, temperature, and humidity

conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.5.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.5.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3505. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0930 and BNLI0932.
- Containment pressure indicators GNPI0935 and GNPI0937.

8.5.9 Communications

A fire in this area could affect the Gaitronics and 900 MHz radio systems. The OMA does not require constant communication with the Control Room. As previously discussed, the operator assigned OFN KC-016 OMA duty will report to the Control Room for instruction following fire brigade callout. This approach allows the Control Room operators to provide face-to-face direction for the OMA. Once the OMA has been implemented, the operator can physically report back to the Control Room for further direction, if the fire affects the Gaitronics or radio system functionality.

8.5.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key.

8.5.11 Personnel Protection Equipment

Opening of breaker NB0203 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Auxiliary or Control Building access, is required to perform the OMA.

8.5.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.5.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.5.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor. The timing effort reflected that the OMA could be consistently performed within six (6) minutes. This included time to don electrical safety PPE. In addition, the following uncertainty times have been included, resulting in a total uncertainty time of seven (7) minutes.

- Communication and feedback with Control Room – 1 minute
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.5.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work

limitations that are consistent with other plant areas important to safety. Additionally, the cable chase is normally locked, which prevents general access to the area.

The cable chase contains IEEE-383 rated cable and a single light fixture. As discussed in Section 5.1.15.1, IEEE-383 cable and normal lighting are not considered credible ignition sources that would promote fire propagation. Therefore, there are no fixed ignition sources within the cable chase that would initiate a fire event warranting OMA implementation.

As previously discussed, the cable chase is normally locked. This restricts normal access to occasions associated with periodic area inspections and surveillance activities for the access door. Due to the access restriction, transient combustibles are generally not stored in the chase, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the chase. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable chase is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection and wet pipe sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the adjacent area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-23 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.5.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMA for Fire Area C-23 is dependable, reliable, and can be consistently performed within the required Available Time. A thirty four (34) minute time margin remains, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

8.6 Fire Area C-24, Control Building 2032' North Cable Chase

8.6.1 Fire Area Features

Fire Area C-24 is a single room (3504) cable chase located on the 2032' elevation of the Control Building. The chase contains cable and normal room lighting only. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and wet pipe sprinkler protection are provided for the area. No natural or forced ventilation is provided for the fire area. General access to the cable chase is restricted by a normally locked fire door. Approximate cable chase size is as follows:

- Length – 12 ft.
- Width – 12 ft.
- Height – 14 ft. 10 in.

Refer to Attachment D for a plan view sketch of the fire area.

8.6.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01A could spuriously start and discharge valve ENHV0006 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01A and spurious closure of ENHV0006 are located in separate cable trays within the same cable chase. Worst-case horizontal spatial separation between the trays of concern (vertical tray 1C8E; horizontal tray 1C8J for PEN01A and vertical tray 1C8B; horizontal tray 1C8G for ENHV0006) is less than 12 in., with multiple cable trays presenting intervening combustibles between the identified trays. The identified cable trays are located on the north side of the cable chase. Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

The minimum horizontal separation distance that involves the above PFSSD circuit issue is approximately 3 ft.

8.6.3 Operator Manual Action Description

Containment spray pump PEN01A can be stopped by opening breaker NB0102. The breaker is located on 4.16 KV bus NB01 within the Control

Building 2000' north ESF Switchgear Room (Fire Area C-9). Refer to Attachment C, Photo C-7, for a photograph of the respective breaker. This is a Reactive OMA.

8.6.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.6.4-1 reflects the OMA timeline for opening breaker NB0102. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. However, C-24 contains only one smoke detector within the cable chase. Therefore, physical confirmation of the fire event is necessary. This confirmation is postulated to take up to five (5) minutes following receipt of the initial fire alarm indication in the Control Room. This increases the total fire detected time to six (6) minutes.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator action time is utilized for opening NB0102, based on the demonstrated OMA walkdown time documented in Section 8.6.14.

OMA Uncertainty Time – An eight (8) minute OMA uncertainty time is utilized based on Section 8.6.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The limiting time margin for OMA performance is thirty-three (33) minutes.

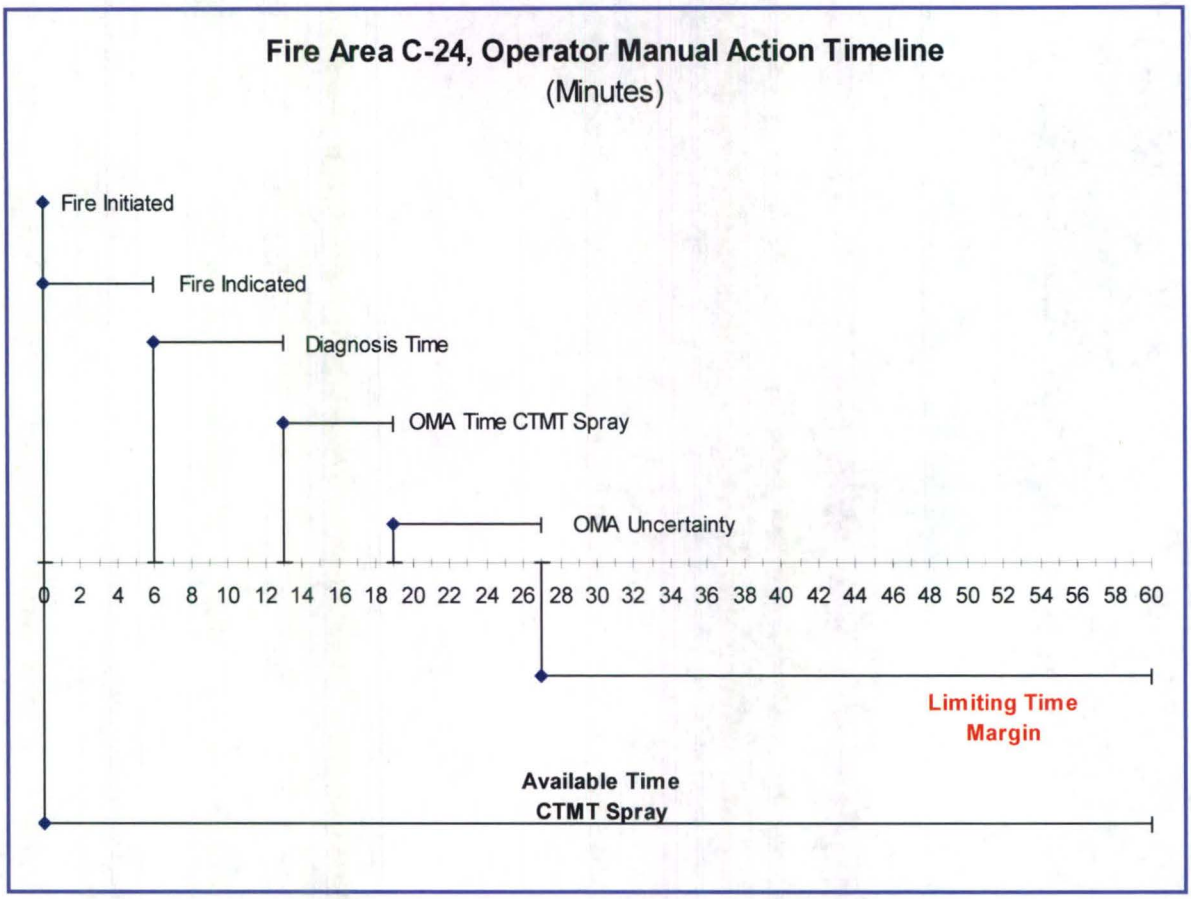


Figure 8.6.4-1, Fire Area C-24 OMA Timeline

8.6.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-24 reveals that a thirty-three (33) minute time margin remains for the OMA. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.6.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3504 located on the 2032' elevation of the Control Building. The location of the OMA for stopping PEN01A containment spray is located on the 2000' elevation of the Control Building, within the north ESF Switchgear Room.

The fire will be confined to the Fire Area C-24 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Emergency lighting is provided for illumination of potential egress paths, the emergency equipment cabinet necessitating access for retrieval of personal protective equipment, and the component requiring OMA manipulation. Normal radiation, temperature, and humidity conditions within the OMA area will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.6.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA component is physically separated from the fire event by several fire rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.6.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3504. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0931 and BNLI933.
- Containment pressure indicators GNPI0934 and GNPI0936.

8.6.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMAs do not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

8.6.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key.

8.6.11 Personnel Protection Equipment

Opening of breaker NB0102 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, which is adjacent to the room where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Auxiliary or Control Building access, is required to perform the OMA.

8.6.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.6.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.6.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor.

The timing effort reflected that the OMA for opening NB0102 could be implemented in six (6) minutes. This included time for donning electrical safety PPE.

In addition, the following uncertainty times have been included, resulting in a total uncertainty time of eight (8) minutes.

- Communication and feedback with Control Room – 2 minutes
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.6.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety. Additionally, the cable chase is normally locked, which prevents general access to the area.

The cable chase contains IEEE-383 rated cable and a single light fixture. As discussed in Section 5.1.15.1, IEEE-383 cable and normal lighting are not considered credible ignition sources that would promote fire propagation. Therefore, there are no fixed ignition sources within the cable chase that would initiate a fire event warranting OMA implementation.

As previously discussed, the cable chase is normally locked. This restricts normal access to occasions associated with periodic area inspections and surveillance activities for the access door. Due to the access restriction, transient combustibles are generally not stored in the chase, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the chase. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable chase is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection and wet pipe sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the adjacent area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-24 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering

the defense in depth fire prevention, detection, and suppression measures discussed above.

8.6.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMA for Fire Area C-24 is dependable, reliable, and can be consistently performed within the required Available Time. A thirty-three (33) minute time margin remains for the OMA, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no adverse reactor thermal performance or unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

8.7 Fire Area C-30, Control Building 2047'-6" Cable Chase

8.7.1 Fire Area Features

Fire Area C-30 is a single room (3617) cable chase located on the 2047'-6" elevation of the Control Building. The chase contains cable and normal room lighting only. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and wet pipe sprinkler protection are provided for the area. No natural or forced ventilation is provided for the fire area. General access to the cable chase is restricted by a normally locked fire door. Approximate cable chase size is as follows:

- Length – 12 ft.
- Width – 12 ft.
- Height – 25 ft. 4 in.

Refer to Attachment D for a plan view sketch of the fire area.

8.7.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01B could spuriously start and discharge valve ENHV0012 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01B and spurious closure of ENHV0012 are located in separate cable trays within the same cable chase. Horizontal spatial separation between the trays of concern (vertical tray 4C8D for PEN01B and vertical tray 4C8B for ENHV0012) is approximately 5 ft. 6 in., with multiple cable trays presenting intervening combustibles between the identified trays. Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

8.7.3 Operator Manual Action Description

Containment spray pump PEN01B can be stopped by opening breaker NB0203. The breaker is located on 4.16 KV bus NB02 within the Control Building 2000' south ESF Switchgear Room (Fire Area C-10). Refer to Attachment C, Photo C-8, for photograph of the respective breaker. This is a Reactive OMA.

8.7.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.7.4-1 reflects the OMA timeline in response to spurious containment spray actuation. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A nine (9) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. However, C-30 contains only one smoke detector within the cable chase. Therefore, physical confirmation of the fire event is necessary. This confirmation is postulated to take up to five (5) minutes following receipt of the initial fire alarm indication in the Control Room. This increases the total fire detected time to fourteen (14) minutes.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator implementation time is utilized based on the demonstrated OMA walkdown time documented in Section 8.7.14.

OMA Uncertainty Time – A seven (7) minute OMA uncertainty time is utilized based on Section 8.7.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The time margin for OMA performance is twenty six (26) minutes.

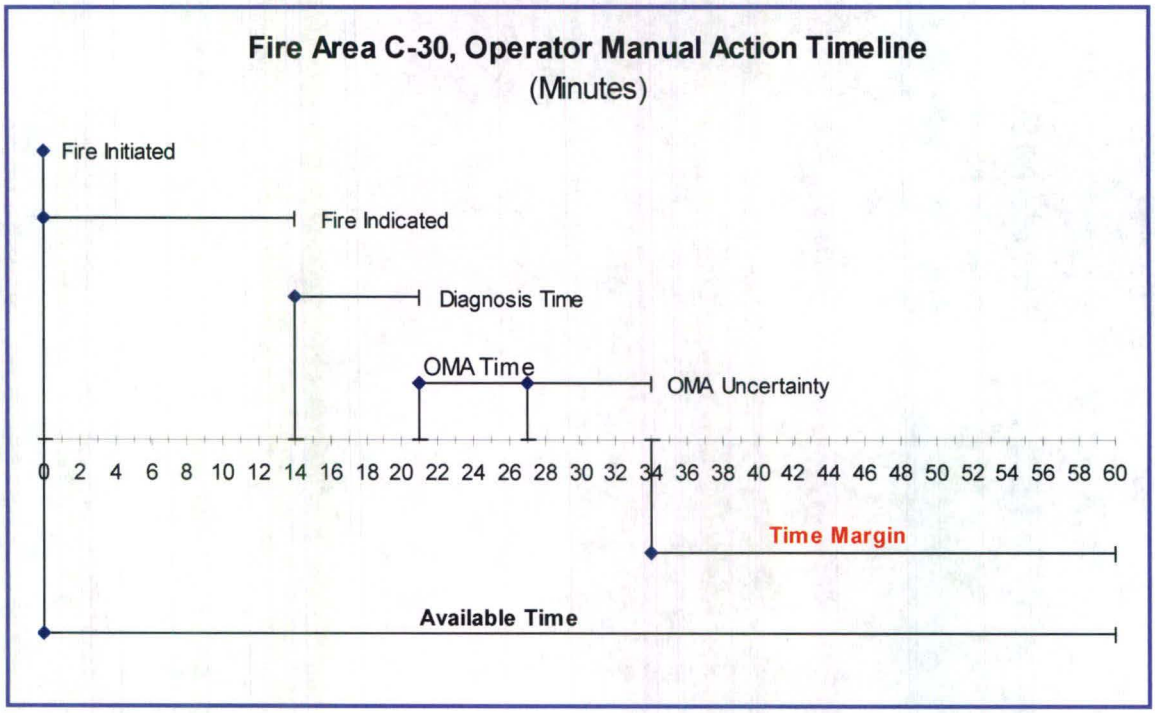


Figure 8.7.4-1, Fire Area C-30 OMA Timeline

8.7.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-30 reveals that a twenty six (26) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.7.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3617 located on the 2047' elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is located on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to the Fire Area C-30 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire-rated barriers. The access door for the cable chase opens to the back of the Control Room in the equipment cabinet area. The OMA operator will be present in the Control Room in order to receive OMA implementation direction. Manual fire fighting efforts, if necessary, will require periodic opening of the cable chase door. However, the smoke propagation review documented in Section 5.1.6 determined that OMA implementation would not be impeded by smoke migration from the fire event.

Emergency lighting is provided for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Normal radiation, temperature, and humidity conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.7.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.7.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3617. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0930 and BNLI0932.
- Containment pressure indicators GNPI0935 and GNPI0937.

8.7.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMA does not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face

direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

8.7.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key and wire cutters.

8.7.11 Personnel Protection Equipment

Opening of breaker NB0203 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Control Building access, is required to perform the OMAs.

8.7.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.7.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.7.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor. The timing effort reflected that the OMA could be consistently performed within six (6) minutes. This included time to don electrical safety PPE. In addition, the following uncertainty times have been included, resulting in a total uncertainty time of seven (7) minutes.

- Communication and feedback with Control Room – 1 minute
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.7.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work limitations that are consistent with other plant areas important to safety. Additionally, the cable chase is normally locked, which prevents general access to the area.

The cable chase contains IEEE-383 rated cable and a single light fixture. As discussed in Section 5.1.15.1, IEEE-383 cable and normal lighting are not considered credible ignition sources that would promote fire propagation. Therefore, there are no fixed ignition sources within the cable chase that would initiate a fire event warranting OMA implementation.

As previously discussed, the cable chase is normally locked. This restricts normal access to occasions associated with periodic area inspections and surveillance activities for the access door. Due to the access restriction, transient combustibles are generally not stored in the chase, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the chase. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable chase is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection and wet pipe sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the adjacent area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-30 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering

the defense in depth fire prevention, detection, and suppression measures discussed above.

8.7.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMAs for Fire Area C-30 are dependable, reliable, and can be consistently performed within the required Available Time. A twenty six (26) minute time margin remains, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

8.8 Fire Area C-33, Control Building 2073'-6" South Cable Chase

8.8.1 Fire Area Features

Fire Area C-33 is a single room (3804) cable chase located on the 2073'-6" elevation of the Control Building. The chase contains cable and normal room lighting only. It is separated from adjacent areas by 3-hour fire rated barriers. Smoke detection and wet pipe sprinkler protection are provided for the area. No natural or forced ventilation is provided for the fire area. General access to the cable chase is restricted by a normally locked fire door. Approximate cable chase size is as follows:

- Length – 13 ft.
- Width – 12 ft.
- Height – 12 ft.

Refer to Attachment D for a plan view sketch of the fire area.

8.8.2 Spurious Equipment Operation Requiring Operator Manual Action

Containment spray pump PEN01B could spuriously start and discharge valve ENHV0012 could spuriously open due to fire induced cable damage. This would result in containment spray actuation. The fire barrier and spatial separation requirements of 10 CFR 50 Appendix R, Section III.G.2, are not satisfied, as control cables for the spurious start of PEN01B and spurious closure of ENHV0012 are located in separate cable trays within the same cable chase. Worst-case horizontal spatial separation between the trays of concern (vertical tray 4C8D; horizontal tray 4C8F for PEN01B and vertical tray 4C8B; horizontal tray 4C8G for ENHV0012) is less than 12 in., with multiple cable trays presenting intervening combustibles between the identified trays. Fire wrap protection is not practical due to the cable tray congestion, and cable reroute is not a cost effective option considering the number of affected fire areas.

Containment spray is an Important to Safe Shutdown spurious equipment operation, as the event would divert RWST inventory to the containment sump. This is a multiple spurious operation scenario from a PFSSD perspective, as two fire induced component mal-operation events are required before containment spray would be spuriously actuated.

8.8.3 Operator Manual Action Description

Containment spray pump PEN01B can be stopped by opening breaker NB0203. The breaker is located on 4.16 KV bus NB02 within the Control Building 2000' south ESF Switchgear Room (Fire Area C-10). Refer to Attachment C, Photo C-8, for photograph of the respective breaker. This is a Reactive OMA.

8.8.4 Feasibility Analysis of Time Available to Perform Manual Actions

Figure 8.8.4-1 reflects the OMA timeline in response to spurious containment spray actuation. The identified times are based on the following:

Fire Initiated - This is the initiating event, which occurs at time zero.

Fire Indicated – A one (1) minute detection response time is utilized based on the Attachment B1 application of NUREG-1805 for smoke detector response. However, C-33 contains only one smoke detector within the cable chase. Therefore, physical confirmation of the fire event is necessary. This confirmation is postulated to take up to five (5) minutes following receipt of the initial fire alarm indication in the Control Room. This increases the total fire detected time to six (6) minutes.

Diagnosis Time – A seven (7) minute diagnosis time is utilized based on Section 5.1.14.1.

OMA Implementation Time – A six (6) minute operator implementation time is utilized based on the demonstrated OMA walkdown time documented in Section 8.8.14.

OMA Uncertainty Time – A seven (7) minute OMA uncertainty time is utilized based on Section 8.8.14.

Available Time – E-1F9910 identifies that containment spray can operate for sixty (60) minutes before RWST level will be below that required for cold shutdown.

Time Margin – The time margin for OMA performance is thirty four (34) minutes.

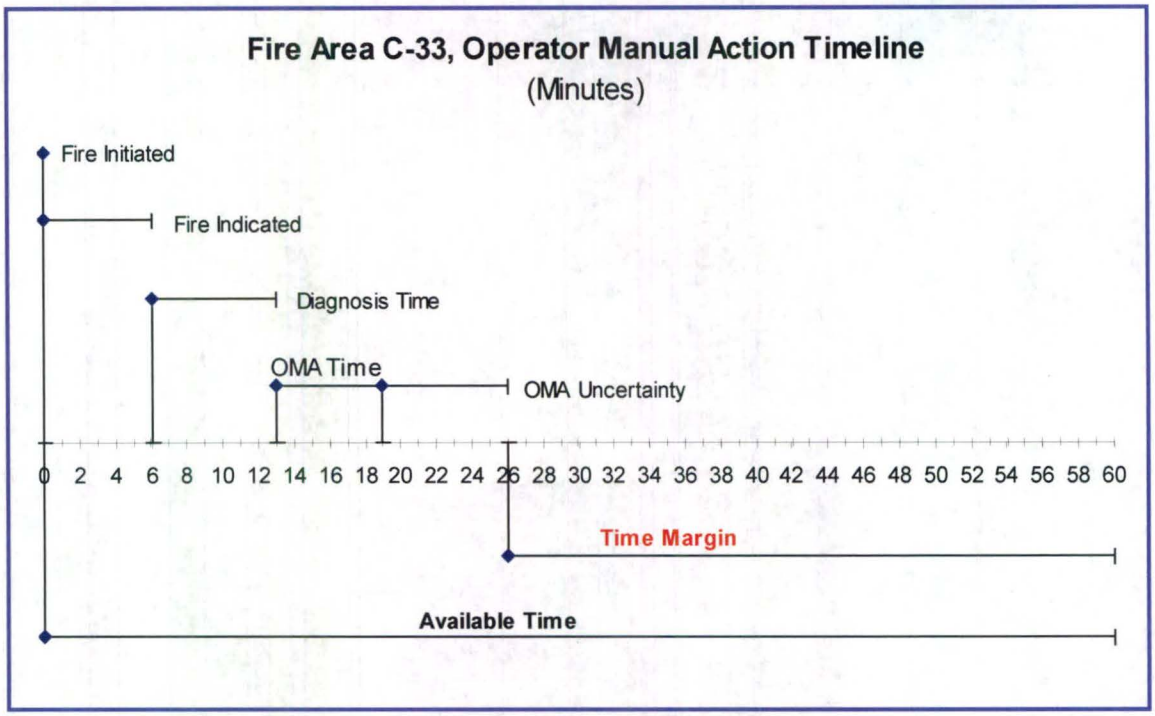


Figure 8.8.4-1, Fire Area C-33 OMA Timeline

8.8.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-33 reveals that a thirty four (34) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.8.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3804 located on the 2073'-6" elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to the Fire Area C-33 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Emergency lighting is provided for illumination of potential egress paths, the component requiring OMA manipulation, and the emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Normal radiation, temperature, and humidity

conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.8.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.8.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3804. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0930 and BNLI0932.
- Containment pressure indicators GNPI0935 and GNPI0937.

8.8.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMA does not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

8.8.10 Portable Equipment

No portable equipment or tools, beyond those required to be carried by the designated OMA operator, are necessary to perform the specified OMA. Key access may be necessary for electronic card reader controlled doors if the fire affects electronic door control. As previously identified, the OFN KC-016 OMA designated operator is required to carry a master key and wire cutters.

8.8.11 Personnel Protection Equipment

Opening of breaker NB0203 requires donning of electrical safety gear to protect against potential arc flash. This PPE is located within Fire Area C-10, where the OMA is performed.

No other personnel protective equipment, beyond that normally necessary for Control Building access, is required to perform the OMAs.

8.8.12 Procedures and Training

The OMA is identified in OFN KC-016. See Section 5.1.12 for further discussion addressing the fire response procedure.

8.8.13 Staffing

The operator assigned OFN KC-016 OMA duty for the shift is responsible for performing the OMA. Only one person is required to perform the OMA.

8.8.14 Demonstrations

The OMA was timed using multiple operators, each starting from the Work Control Center (3613) on the 2047' elevation of the Communications Corridor. The timing effort reflected that the OMA could be consistently performed within six (6) minutes. This included time to don electrical safety PPE. In addition, the following uncertainty times have been included, resulting in a total uncertainty time of seven (7) minutes.

- Communication and feedback with Control Room – 1 minute
- Electronically controlled door key access – 3 minutes
- Human centered uncertainty – 3 minutes

8.8.15 Defense-In-Depth

1. Fire Prevention

The objective of fire prevention is not affected by the OMA. The area of the plant where the fire could occur, necessitating OMA implementation, has combustible loading allowances and hot work

limitations that are consistent with other plant areas important to safety. Additionally, the cable chase is normally locked, which prevents general access to the area.

The cable chase contains IEEE-383 rated cable and a single light fixture. As discussed in Section 5.1.15.1, IEEE-383 cable and normal lighting are not considered credible ignition sources that would promote fire propagation. Therefore, there are no fixed ignition sources within the cable chase that would initiate a fire event warranting OMA implementation.

As previously discussed, the cable chase is normally locked. This restricts normal access to occasions associated with periodic area inspections and surveillance activities for the access door. Due to the access restriction, transient combustibles are generally not stored in the chase, and transient combustible introduction typically only occurs when implementing a modification requiring new cable addition within the chase. This is an infrequent occasion, which does not result in a significant contribution of transient combustibles or introduction of additional ignition sources beyond that presented by low voltage power tools. Therefore, the likelihood of a transient combustible induced fire within the cable chase is extremely low.

As discussed in Section 5.1.15.1.c, the likelihood of a hot work induced fire event requiring OMA implementation is extremely low.

2. Detect, Control, and Extinguish Fires

This objective is not affected by the OMA. Smoke detection and wet pipe sprinkler protection are provided for the area. Fire alarm annunciation is provided locally, and within the Control Room. Smoke detection is point addressable, allowing for prompt recognition of fire location. The sprinkler system will aid in controlling the fire event until manual suppression can be applied, as necessary. Fire extinguishers and hose stations are provided in the adjacent area for manual fire fighting.

3. Protection of SSCs so that Fires Will Not Prevent Safe Shutdown

Historically, this objective has been deterministically satisfied by conforming to the requirements of 10 CFR 50 Appendix R, Sections III.G.1 or III.G.2. The subject OMA is utilized in lieu of Section III.G.2 protection to ensure a fire in C-33 does not challenge PFSSD. This is an acceptable alternative measure to direct compliance with 10 CFR 50 Appendix R, Section III.G.2, considering the defense in depth fire prevention, detection, and suppression measures discussed above.

8.8.16 Conclusion

The above analysis and time-authenticated demonstrations provide reasonable assurance that the OMA for Fire Area C-33 is dependable, reliable, and can be consistently performed within the required Available Time. A thirty four (34) minute time margin remains, when applying uncertainty elements to ensure OMA reliability. Post-fire safe shutdown capability is maintained with no unacceptable loss of RWST inventory. Therefore, the OMA is considered both feasible and reliable.

Attachment A

to

E-1F9900

Summary of OMAs to Achieve and Maintain Hot Standby

Summary of OMAs to Achieve and Maintain Hot Standby

Operator Manual Action	Room / Fire Area Where OMA Implemented	Fire Location (Fire Area)							
		A-16N	C-18	C-21	C-22	C-23	C-24	C-30	C-33
Close valve KAV0201 to fail close letdown valves BGLCV0459 and BGLCV0460 and pressurizer spray valves BBPCV0455B and BBPCV0455C	1322 / A-25			X					
Use local controller ABFHC0002 to control/isolate steam release through ARV for Steam Generator B	1509 / A-23	X							
Use local controller ABFHC0003 to control/isolate steam release through ARV for Steam Generator C	1509 / A-23	X							
Isolate air and nitrogen to atmospheric relive valve ABPV0004 to fail the ARV closed	1508 / A-23	X							
Terminate Train B containment spray by opening breaker NB0203.	3302 / C-10				X	X		X	X
Terminate Train A containment spray by opening breaker NB0102.	3301 / C-9		X	X			X		

Attachment B1

to

E-1F9900

Fire Alarm System Response Time

NUREG-1805, Fire Dynamics Tools (FDT) was utilized to determine smoke detector response time in areas where fire induced spurious equipment actuation results in the potential need for mitigating action to preserve the analyzed PFSSD success path. The results of the fire modeling effort are applied to the OMA timeline analysis for the respective fire area. The FDT utilized in the fire modeling approach was developed, prepared, and validated by the Nuclear Regulatory Commission (NRC) to provide a consistent, simplified fire modeling approach.

NUREG-1805 FDT "11. Estimating Smoke Detector Response Time" (Version 1805.0), was utilized to determine smoke detector response time (where applicable) when applying a simple fire heat release rate from Appendix F of NRC Inspection Manual 0609 (Table 2.3.1). An example of the FDT is provided in Attachment B2.

Input information necessary for the FDT is as follows:

- Fire Heat Release Rate (kW) – a 70 kW fire was postulated, as it represents lowest kW output fire from generic fire bin types identified in Appendix F Table 2.3.1 of NRC Inspection Manual 0609. A lower intensity fire produces a slower detector response time, which is conservative for application to the OMA timeline. The use of 70 kW as a conservative heat release rate is further substantiated by the intermediate-scale cable burn tests documented in NUREG/CR-6931, where a 200 + kW fire was utilized to assess cable performance when subjected to fire exposure.
- Radial Distance to the Detector (ft) – The radial distance to the detector was postulated to be 15' (half the detector listed spacing) or room radial distance, if the room footprint is less than 15' x 15'.
- Height of Ceiling above Top of Fuel (ft) – Distance from ceiling to floor was utilized.
- Ambient air temperature (°F) – The lowest normal temperature identified in EQSD-IV Table 1, was utilized. A lower ambient temperature results in a slower detection response time, which is conservative for application to the OMA timeline.

The input data and resulting detector activation time are summarized in Table B1-1. The detector activation time identified in the table is the longest detector activation time calculated from the three methods (Alpert, Mowrer, and Milke) rounded up to the next whole minute.

Table B1-1, Detector Response Time

Fire Area	NUREG-1805 FDT "11. Estimating Smoke Detector Response Time" Input Data				Detector Activation time (minutes)
	Heat Release Rate (kW)	Radial Distance to Detector (ft)	Ceiling height (ft)	Ambient Temperature (°F)	
A-16N	70	15	20.5	60	4
C-18	70	6	15.33	60	1
C-21	70	15	14.83	60[1]	1
C-22	70	15	12	60[1]	1
C-23	70	6	14.83	60[1]	1
C-24	70	6	14.83	60[1]	1
C-30	70	6	25.33	60[1]	9
C-33	70	6	12	60[1]	1

Note:

1. Control Building cable chase temperatures are not identified in EQSD-IV Table 1. The low temperature (60°F) for the cable spreading rooms was utilized.

Attachment B2

to

E-1F9900

Sample FDT Data Sheet
NUREG-1805 FDT "11. Estimating Smoke Detector Response Time"

CHAPTER 11. ESTIMATING SMOKE DETECTOR RESPONSE TIME

Version 1805.0

The following calculations estimate smoke detector response time.
Parameters should be specified ONLY IN THE YELLOW INPUT PARAMETER BOXES.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s).
The chapter in the NUREG should be read before an analysis is made.

INPUT PARAMETERS

Heat Release Rate of the Fire (Q) (Steady State)	75.00	kW	71.09 Btu/sec
Radial Distance to the Detector (r) **never more than 0.707 or 1/2√2 of the listed spacing**	10.00	ft	3.05 m
Height of Ceiling above Top of Fuel (H)	13.00	ft	3.96 m
Activation Temperature of the Smoke Detector ($T_{activation}$)	86.00	°F	30.00 °C
Smoke Detector Response Time Index (RTI)	5.00	$(m\text{-}sec)^{1/2}$	
Ambient Air Temperature (T_a)	77.00	°F	25.00 °C
			298.00 K
Convective Heat Release Rate Fraction (χ_c)	0.70		
Plume Leg Time Constant (C_{pl}) (Experimentally Determined)	0.67		
Ceiling Jet Lag Time Constant (C_{cl}) (Experimentally Determined)	1.2		
Temperature Rise of Gases Under the Ceiling (ΔT_c) for Smoke Detector to Activate	18.00	°F	10 °C
r/H = 0.77			

Calculate

ESTIMATING SMOKE DETECTOR RESPONSE TIME
METHOD OF ALPERT

Reference: NFPA Fire Protection Handbook, 19th Edition, 2003, Page 3-140

$t_{activation} = (RTI/(\sqrt{u_{jet}}))\ (\ln (T_{jet} - T_a)/(T_{jet} - T_{activation}))$

This method assume smoke detector is a low RTI device with a fixed activation temperature

Where
- $t_{activation}$ = detector activation time (sec)
- RTI = detector response time index $(m\text{-}sec)^{1/2}$
- u_{jet} = ceiling jet velocity (m/sec)
- T_{jet} = ceiling jet temperature (°C)
- T_a = ambient air temperature (°C)
- $T_{activation}$ = activation temperature of detector (°C)

Ceiling Jet Temperature Calculation

$T_{jet} - T_a = 16.9\ (Q_c)^{2/3}/H^{5/3}$ for $r/H \le 0.18$

$T_{jet} - T_a = 5.38\ (Q_c/r)^{2/3}/H$ for $r/H > 0.18$

Where
- T_{jet} = ceiling jet temperature (°C)
- T_a = ambient air temperature (°C)
- Q_c = convective portion of the heat release rate (kW)
- H = height of ceiling above top of fuel (m)
- r = radial distance from the plume centerline to the detector (m)

Convective Heat Release Rate Calculation

$Q_c = \chi_c\ Q$

Where
- Q_c = convective portion of the heat release rate (kW)
- Q = heat release rate of the fire (kW)
- χ_c = convective heat release rate fraction

Q_c = **52.5** kW

Radial Distance to Ceiling Height Ratio Calculation

r/H = 0.77 r/H > 0.15

>0.15	9.06	<0.15	23.88

$T_{jet} - T_a$ = 5.38 ((Qc/r)^2/3)/H

$T_{jet} - T_a$ = 9.06

T_{jet} = **34.06** (°C)

Ceiling Jet Velocity Calculation

$u_{jet} = 0.96\ (Q/H)^{1/3}$ for $r/H \le 0.15$

$u_{jet} = (0.195\ Q^{1/3}\ H^{1/2})/r^{5/6}$ for $r/H > 0.15$

Where
- u_{jet} = ceiling jet velocity (m/sec)
- Q = heat release rate of the fire (kW)
- H = height of ceiling above top of fuel (m)
- r = radial distance from the plume centerline to the detector (m)

Radial Distance to Ceiling Height Ratio Calculation

r/H = 0.77 r/H > 0.15

>0.15	0.65	<0.15	2.56

u_{jet} = (0.195 Q^1/3 H^1/2)/r^(5/6)

u_{jet} = **0.647** m/sec

Smoke Detector Response Time Calculation

$t_{activation} = (RTI/(\sqrt{u_{jet}}))\ (\ln (T_{jet} - T_a)/(T_{jet} - T_{activation}))$

$t_{activation}$ = **4.99 sec** **Answer**

NOTE: If $t_{activation}$ = "NUM" Detector does not activate

METHOD OF MOWRER

References: *Mowrer, F., "Lag Times Associated With Fire Detection and Suppression," Fire Technology, August 1990, p. 244.*

$t_{activation} = t_{pl} + t_{cj}$

Where $t_{activation}$ = detector activation time (sec)
t_{pl} = transport lag time of plume (sec)
t_{cj} = transport lag time of ceiling jet (sec)

Transport Lag Time of Plume Calculation

$t_{pl} = C_{pl} (H)^{4/3}/(Q)^{1/3}$

Where t_{pl} = transport lag time of plume (sec)
C_{pl} = plume lag time constant
H = height of ceiling above top of fuel (m)
Q = heat release rate of the fire (kW)

t_{pl} = **1.00** sec

Transport Lag Time of Ceiling Jet Calculation

$t_{cj} = (r)^{11/6}/(C_{cj}) (Q)^{1/3} (H)^{1/2}$

Where t_{cj} = transport lag time of ceiling jet (sec)
C_{cj} = ceiling jet lag time constant
r = radial distance from the plume centerline to the detector (m)
H = height of ceiling above top of fuel (m)
Q = heat release rate of the fire (kW)

t_{cj} = **0.77** sec

Smoke Detector Response Time Calculation

$t_{activation} = t_{pl} + t_{cj}$

$t_{activation}$ = 1.76 sec **Answer**

METHOD OF MILKE

References: *Milke, J., "Smoke Management for Covered Malls and Atria," Fire Technology, August 1990, p. 223.*
NFPA 92B, "Guide for Smoke Management Systems in Mall, Atria, and Large Areas," 2000 Edition, Section A.3.4.

$t_{activation} = X H^{4/3} / Q^{1/3}$

Where $t_{activation}$ = detector activation time (sec)
$X = 4.6\ 10^{-4}\ Y^2 + 2.7\ 10^{-15}\ Y^6$
H = height of ceiling above top of fuel (ft)
Q = heat release rate from steady fire (Btu/sec)

Where $Y = \Delta T_c\ H^{5/3} / Q^{2/3}$
ΔT_c = temperature rise of gases under the ceiling for smoke detector to activate (°F)

Before estimating smoke detector response time, stratification effects can be calculated. NFPA 92B, 2000 Edition, Section A.3.4 provides following correlation to estimate smoke stratification in a compartment.

$H_{max} = 74\ Q_c^{2/5} / \Delta T_{f\text{-}>c}^{3/5}$

Where H_{max} = the maximum ceiling clearance to which a plume can rise (ft)
Q_c = convective portion of the heat release rate (Btu/sec)
$\Delta T_{f\text{-}>c}$ = difference in temperature due to fire between the fuel location and ceiling level (°F)

Convective Heat Release Rate Calculation

$Q_c = Q\ \chi_c$

Where Q_c = convective portion of the heat release rate (Btu/sec)
Q = heat release rate of the fire (Btu/sec)
χ_c = convective heat releas rate fraction

Q_c = **49.76** Btu/sec

Difference in Temperature Due to Fire Between the Fuel Location and Ceiling Level

$\Delta T_{f\text{-}>c} = 1300\ Q_c^{2/3} / H^{5/3}$

Where $\Delta T_{f\text{-}>c}$ = difference in temperature due to fire between the fuel location and ceiling level (°F)
Q_c = convective portion of the heat release rate (Btu/sec)
H = ceiling height above the fire source (ft)

$\Delta T_{f\text{-}>c}$ = **244.70** °F

Smoke Stratification Effects

$H_{max} = 74\ Q_c^{2/5} / \Delta T_{f\text{-}>c}^{3/5}$

H_{max} = **13.03** ft

In this case the highest point of smoke rise is estimated to be **13.03** ft
Thus, the smoke would be expected to reach the ceiling mounted smoke detector

$Y = \Delta T_c\ H^{5/3} / Q^{2/3}$

Y = **75.39**

$X = 4.6\ 10^{-4}\ Y^2 + 2.7\ 10^{-15}\ Y^6$

X = **2.62**

Smoke Detector Response Time Calculation

$t_{activation} = X H^{4/3} / Q^{1/3}$

$t_{activation}$ = **19.30 sec** **Answer**

Summary of Result

Calculation Method	Smoke Detector Response Time (sec)
METHOD OF ALPERT	4.99
METHOD OF MOWRER	1.76
METHOD OF MILKE	19.30

NOTE

The above calculations are based on principles developed in the NFPA Fire Protection Handbook 19th Edition, 2003, method described in Fire Technology, 1990, and NFPA 92B, "Guide for Smoke Management Systems in Malls, Atria, and Large Areas," 2000 Edition, Section A.3.4. Calculations are based on certain assumptions and have inherent limitations. The results of such calculations may or may not have reasonable predictive capabilities for a given situationsand, and should only be interpreted by an informed user.
Although each calculation in the spreadsheet has been verified with the results of hand calculation, there is no absolute guarantee of the accuracy of these calculations.
Any questions, comments, concerns, and suggestions, or to report an error(s) in the spreadsheet, please send an email to nxi@nrc.gov or mxs3@nrc.gov.

Attachment C

to

E-1F9900

Photos of Equipment Manipulated For Operator Manual Action

Photo C-1, KAV0201

Photo C-2, ABFHC0002

Photo C-3, ABFHC0003

Photo C-4, KAV1429

Photo C-5, KAV1365

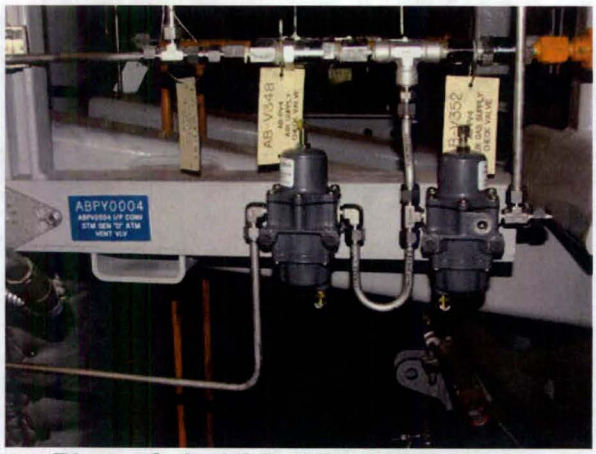


Photo C-6, ABPV0004 Regulators

Photo C-7, NB0102

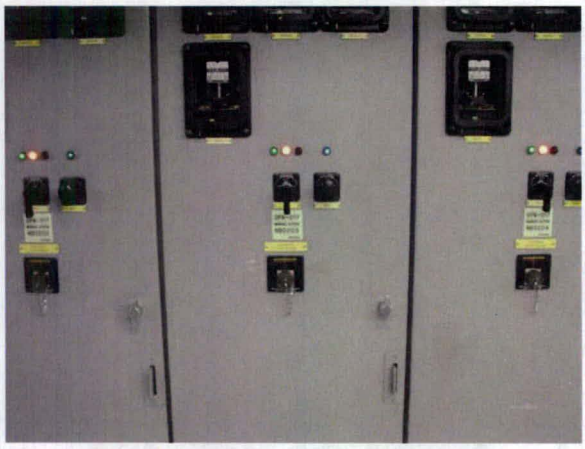


Photo C-8, NB0203

Attachment D

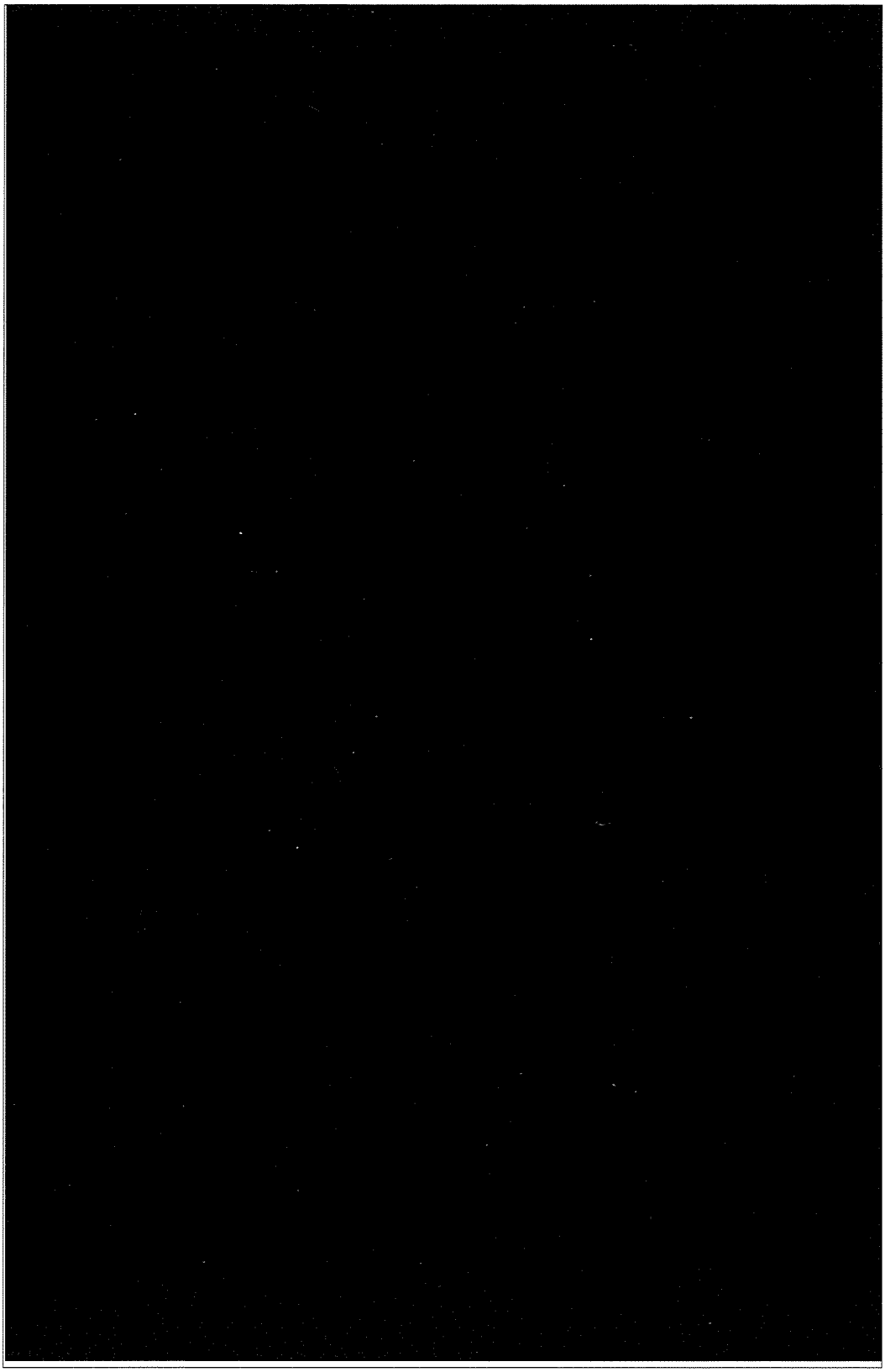
to

E-1F9900

Fire Area Plan View Sketches

(Information Only)

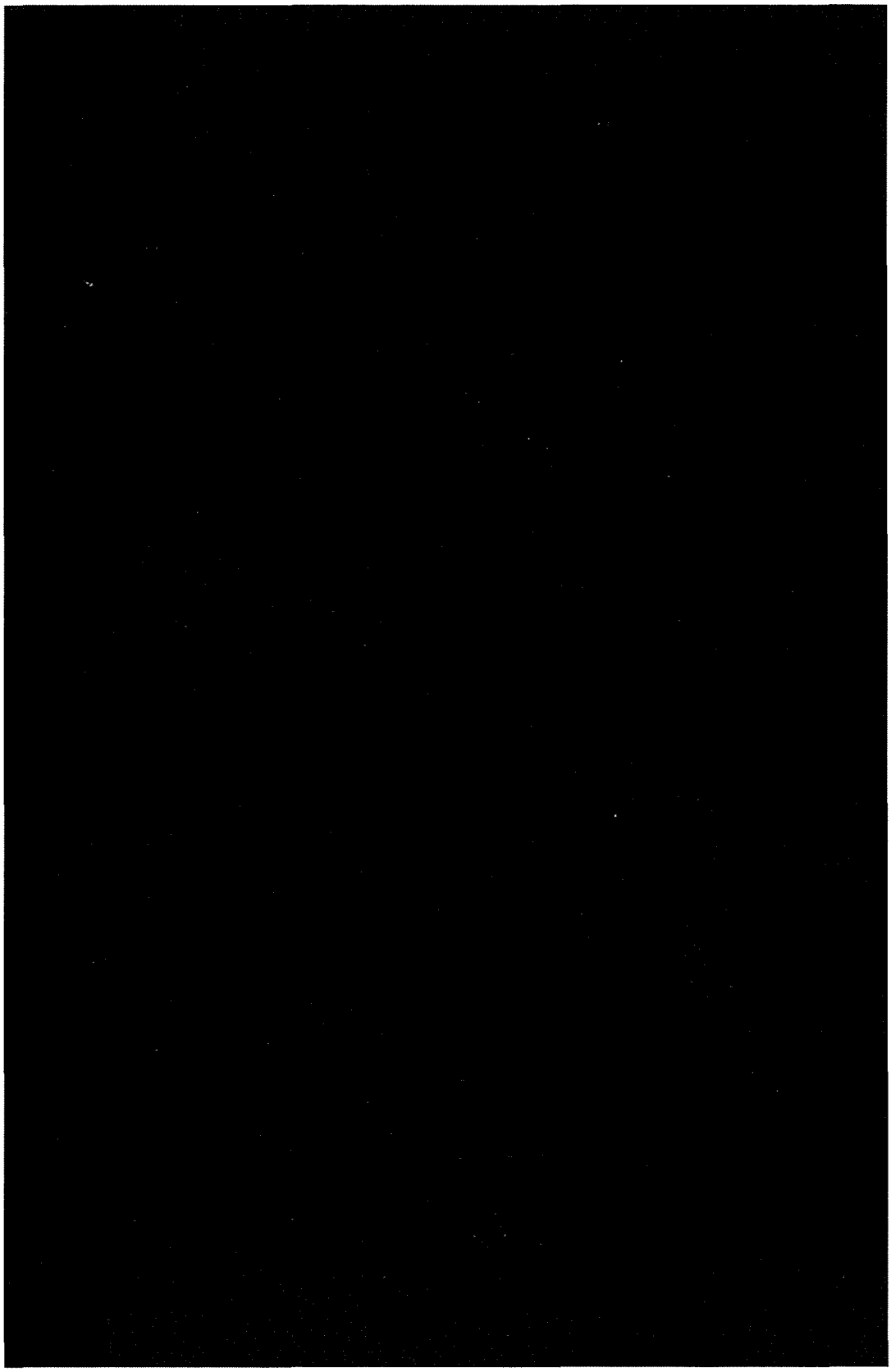
Fire Area A-16
(Page 1 of 1)



Fire Area C-18
(Page 1 of 1)

[redacted]

Fire Area C-21, C-23, and C-24
(Page 1 of 1)



Fire Area C-22 and C-33
(Page 1 of 1)

[redacted]

Fire Area C-30
(Page 1 of 1)

[redacted]