Florida Power & Light Company, 6501 South Ocean Drive, Jensen Beach, FL 34957

FPL

June 28, 2001

L-2001-153
10 CFR 50.12
10 CFR 50.4

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

Re: St. Lucie Unit 1
Docket No. 50-335
Supplemental Risk Information to Support
10 CFR 50 Appendix R K1 Exemption Clarification/Request

Pursuant to commitments made in LER 50-335/1999-009-00 and pursuant to the requirements of 10 CFR 50.12, FPL resubmitted the original 10 CFR 50 Appendix R exemption request K1 for St. Lucie Unit 1 via FPL letter L-2000-164 dated October 4, 2000. The K1 Appendix R exemption dealt with separation issues inside the Unit 1 reactor containment building.

On April 9, 2001, during a telephone conference between FPL and Messrs. Salley, Lain, Jabbour, and Moroney of your staff, FPL committed to submit risk-informed information to support the K1 exemption request. Attached is the information to show that the exemption request meets the criteria of 10 CFR 50.12(a)(2)(ii), where application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

FPL would like to hold a management level meeting to discuss this submittal once the NRC review process starts. My staff will coordinate this meeting with the NRC.

Very truly yours,

Donald E. Jernigan
Vice President
St. Lucie Plant

DEJ/EJW/KWF

Attachment

cc: Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, St. Lucie Plant
Mr. W. A. Passetti, Florida Department of Health and Rehabilitative Services

A006

ST. LUCIE UNIT 1

RISK ASSESSMENT OF THE APPENDIX R VERTICAL SEPARATION DISCREPANCY IN EXEMPTION K1 PRIMARY CONTAINMENT BETWEEN RADIAL LINES 2 AND 6

L-2001-153
Attachment

Table of Contents

1.0 ABSTRACT

The purpose of this evaluation is to provide an engineering evaluation that addresses the risk significance of discrepancies between FPL's Appendix R exemption request K1 and the related NRC safety evaluation reports (SERs) dated February 21, 1985 and March 5, 1987. Specifically, the March 5, 1987 NRC SER states that 25 feet of vertical separation exists between raceways containing redundant divisions of safe shutdown cables in the Unit 1 Containment annular area. The statement in the SER does not match the actual plant condition. This engineering evaluation addresses the physical separation of certain redundant safe shutdown components necessary for safe shutdown capability associated with a postulated fire in containment.

Redundant safe shutdown components were determined from recent engineering reviews and/or walkdown to be separated by less vertical distance than implied by the February 21, 1985 NRC SER and stated in the March 5, 1987 SER. FPL letter L-200-164, dated October 4, 2000 [Reference 4], evaluated this condition and concluded that the existing design features provide adequate protection to prevent fire damage to cables and associated nonsafety related circuits of redundant trains, and resubmitted the St. Lucie Unit 1 K1 exemption request. This submittal provides an evaluation to address the condition from a risk perspective in terms of core damage frequency (CDF) contribution.

The evaluation concludes that the existing configuration is not risk significant. A very conservative estimate found the CDF increase to be less than 1.28E-07 per year.

2.0 PURPOSE/SCOPE

The purpose of this assessment is to evaluate the risk significance of the raceway configuration within the containment structure. The analysis is focused on a specific portion of the containment as defined below. The configuration of raceways within the containment structure does not comply with the specific requirements of 10 CFR 50, Appendix R. However, the configuration as described in the NRC SER was determined to adequately meet the intent of the regulation as evidenced by the NRC approval of Appendix R exemption K1. In general, the exemption relies on the horizontal and vertical separation of raceways. The details of this exemption is discussed and evaluated further in FPL letter L-2000-164. The assessment described herein presents the results of a bounding fire risk assessment to determine the calculated CDF associated with the existing configuration (no vertical separation assumed).

The specific scope of this assessment involves the space defined by the containment structure and the interior biological shield between radial column lines 2 and 6. The width of this area is approximately 20 feet. The electrical raceways in this area are divided into two separate sections defined by the divisional assignment of circuits (system SA, MA, MC, and SB, MB, MD). The electrical raceways in the containment structure are arranged with 'system' SA raceways installed along the biological shield wall (inner wall of the area). The 'system' SB raceways are installed along the outer wall of the area. Between radial column lines 2 and 6, raceways are installed to allow the routing of circuits around the containment structure at both the 23'-0" and 45'-0" elevations.

The risk significance of the existing raceway configuration between radial column lines 2 and 6 will be determined by estimating the CDF contribution associated with a postulated fire event.

3.0 REFERENCES

1. St. Lucie Plant, Unit No. 1, Updated Final Safety Analysis Report, Volume 9.5A
2. EPRI FIVE Methodology, TR-100370, Final Report, April 1992
3. EPRI Fire PRA Implementation Guide, TR-105928, Final Report, December 1995
4. FPL Letter L-2000-164, dated October 4, 2000 subject "10 CFR 50 Appendix R K1 Exemption Clarification/Request."
5. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant Specific Changes to Licensing Basis."
6. Electric Power Research Institute, "EPRI Fire Events Database," 1992 Update

4.0 METHOD OF ANALYSIS

This evaluation is performed using fire risk assessment techniques from the EPRI FIVE Methodology [Reference 2] and the EPRI Fire PRA Implementation Guide [Reference 3]. Simplified fire modeling analyses using the FIVE worksheets are used to characterize the severity of fire that must occur to cause damage to redundant circuits. Insights related to the fire severity are then used in the risk assessment to ensure a bounding estimate of the core damage frequency (CDF) impact is obtained by proper selection of fire ignition frequency.

The potential set of cable/circuit targets were determined by reviewing the entire scope of Appendix R circuits located in the containment. The routing of these circuits were then reviewed to identify those that are located between radial column lines 2 and 6. The St. Lucie Unit 1 safe shutdown analysis (SSA) was reviewed to establish the consequences of postulated circuit damage. The scope of circuit damage was then characterized in terms of component failures and then associated plant system failures. The scope of plant system failures were then used to interface with the plant PSA model to calculate a conditional core damage probability (CCDP). The CCDP was then combined with a fire ignition frequency to obtain a CDF estimate.

The analysis for the risk significance of the in-situ raceway configuration conservatively assumes that the entire calculated CDF is equal to the risk increase. This effectively treats a configuration that would not require an exemption as having zero calculated risk.

5.0 BASES AND ASSUMPTIONS

5.1 Bases

The risk assessment is based on the current plant probabilistic safety assessment (PSA) model. The significance of the risk contribution of the containment raceway configuration is evaluated based on a calculated change in core damage frequency (CDF) and change in large early release frequency (LERF). The calculated change in CDF and change in LERF can be compared to the acceptance guidelines provided in Regulatory Guide (RG) 1.174.

5.2 Assumptions

The cables installed in the Unit 1 containment are a mixture of those that are IEEE 383 qualified and those that are not. In order to simplify the analysis and provide bounding results, all cables are assumed to be non-IEEE 383 cables for the purposes of determining fire ignition frequency and damage threshold temperature.

The calculation of the self-initiated cable fire frequency is based on the volume of cable in the area of interest. It is conservatively assumed that the area between radial column lines 2 and 6 contains 50% of the total cable mass (total Btu value) in the containment structure.

The occurrence of a postulated fire in the containment has the potential to cause instrumentation circuit failures. One of these failures involves the pressurizer pressure instruments. A postulated failure of these circuits could result in a spurious process control system signal to open the power operated relief valves (PORVs). This spurious signal can be bypassed (overridden) by the control room operator using a control switch. A screening human error probability (HEP) of 0.10 is assumed for this action. The use of a screening HEP of 0.1 reflects an acknowledged HRA convention. A value of 0.1 is sufficiently high not to mask any dependent operator actions in accident sequences.

The occurrence of a postulated fire in the containment has the potential to cause loss of steam generator (SG) level instruments. The loss of level instruments is conservatively assumed to cause functional loss of the SG. Potential operator action to reduce auxiliary feedwater (AFW) system flow to minimum levels based on decay heat removal requirements to maintain SG function without level indication is not credited.

The analysis for the risk significance of the in-situ raceway configuration conservatively assumes that the entire calculated CDF is equal to the risk increase. This effectively treats a configuration that would not require an exemption as having zero calculated risk.

6.0 BACKGROUND/LICENSING & DESIGN BASIS

The Background/Licensing and Design Basis discussion applicable to this submittal is the same as that for Reference 4. The text is summarized below to assist the reader of this document.

6.1 Background

On December 16, 1999, and as a result of FPL's ongoing Appendix R review activities, FPL discovered inconsistencies between FPL's exemption request K1 and the related NRC SERs dated February 21, 1985 and March 5, 1987.

The March 5, 1987 NRC SER states that 25 feet of vertical separation exists between raceways containing redundant divisions of safe shutdown cables in the Unit 1 containment annular area. The statement in the SER does not match the actual plant condition. There is a 25-foot vertical separation between floor elevations in the Unit 1 containment, but a 25-foot vertical separation does not exist between raceways containing redundant divisions of safe shutdown cables. As part of the engineering review of the resulting condition report operability and reportability determinations were performed. FPL determined that the fire protection program remained operable. An appropriate 50.72 notification was made on the date of discovery. The condition was determined to be "outside the design basis" and on January 18, 2000, LER 1999-009 was submitted pursuant to 10 CFR 50.73(a)(2)(ii). The corrective action for that LER stated that FPL would resubmit exemption request K1 to clarify the vertical separation criteria. This submittal was made by Reference 4 on October 4, 2000.

6.2 Licensing Basis

St. Lucie Unit 1 was licensed to operate prior to January 1, 1979 and 10 CFR 50.48(a) establishes the requirement that Unit 1 must have a fire protection plan that satisfies Criterion 3, "Fire Protection," of 10 CFR 50 Appendix A, "General Design Criteria for Nuclear Power Plants." Part (b) of 10 CFR 50.48 requires nuclear power plants licensed to operate prior to January 1, 1979 to satisfy the applicable requirements of Appendix R to 10 CFR 50, including specifically the requirements of Sections III.G, III.J, and III.O.

PSL Unit 1 has a number of exemptions from Appendix R requirements, including exemption K1 for the Unit 1 containment. Exemption K1 is the subject of this evaluation. exemption K1 was originally granted by the NRC as discussed in NRC SER dated February 21, 1985 and subsequently revised in NRC SER dated March 5, 1987. Exemption K1 identifies conditions in the Unit 1 containment that deviate from Appendix R Section III.G.2.d.

6.3 Appendix R Requirements

Appendix R, Section III.G.2.d-f;

> *...Inside noninerted containments one of the fire protection means specified above or one of the following fire protection means shall be provided:*

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

The subject of this evaluation, exemption K1 for the Unit 1 containment, is an approved exemption to the requirements of Appendix R Section III.G.2.d.

6.4 Unit 1 Operating License

Unit 1 License Condition 2.C(3), Fire Protection, states;

The licensee shall implement and maintain in effect all provisions of the approved fire protection program as described in the Updated Final Safety Analysis Report for the facility (The fire protection program and features were originally described in licensee submittals L-83-514 dated October 7, 1983, L-83-227 dated April 22 [12], *1983, L-83-261 dated April 25, 1983, L-83-453 dated August 24, 1983, L-83-488 dated September 16, 1983, L-83-588 dated December 14, 1983, L-84-346 dated November 28, 1984, L-84-390 dated December 31, 1984 and L-85-71 dated February 21, 1985) and as approved by NRC letter dated July 17, 1984 and supplemented by NRC letters dated February 21, 1985, March 5, 1987 and October 4, 1988 subject to the following provisions:*

The licensee may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

In the above excerpt, the date referenced for L-83-227 is incorrect. The correct date is April 12, 1983 and will be used throughout the evaluation. This administrative error will be corrected by an amendment to the operating license. FPL corrected this error by FPL letter L-2001-078, dated April 18, 2001, subject "Proposed License Amendments Minor Changes/Corrections."

6.5 FPL Appendix R Exemption Submittals

Each of the submittals identified in the Operating License is summarized below with regard to the vertical and horizontal separation provided in the Unit 1 containment annular area.

6.5.1 FPL submittal to NRC dated April 12, 1983 (L-83-227) does not specifically address the actual vertical or horizontal separation provided in exemption K1. The letter states only that the requirement to maintain 20 feet of horizontal separation is not met. No discussion of vertical separation is provided.

6.5.2 FPL submittal to NRC dated April 25, 1983 (L-83-261) is limited to a discussion of exemption K2 that requested exemption from Section III-O of Appendix R regarding the oil collection system.

6.5.3 FPL submittal to NRC dated August 24, 1983 (L-83-453) provides a minor revision (revised wording resulting from completion of detection modifications and removal of outdated "Zone" references) to the submittal dated April 12, 1983 (L-83-227) and does not specifically address the actual vertical or horizontal separation provided in exemption K1 – only that 20 feet of horizontal separation is not provided. No discussion of vertical separation is provided.

6.5.4 FPL submittal to NRC dated September 16, 1983 (L-83-488) provides a detailed fire hazard analysis of the Unit 1 containment (Fire Area K). As part of this analysis, a discussion of the cable routes for specific components is provided on pages FA-K-16 through FA-K-18 (see Attachment 1). Certain sections of the discussions (pressurizer pressure and level, RCS temperature, and SG 1A and 1B level and pressure) state that;

...Associated cables are routed in separate trays on the 18.00' and 45.00' elevations. In addition to the vertical separation, the cable trays are routed 7 to 11 ft apart horizontally. ...

Note that in the context of the fire hazard analysis, the terminology "routed on 18.00' elevation" indicated the routing was between the 18.00' and 45.00' elevations. Further, the terminology "routed on the 45.00'" indicated the routing was between 45.00' and 62.00' elevations. Throughout the fire hazard analysis, components are listed by floor elevation, not actual elevation of the component.

6.5.5 FPL submittal to NRC dated December 14, 1983 (L-83-588) does not address exemption K1.

6.5.6 FPL submittal to NRC dated October 7, 1983 (L-83-514) does not address exemption K1.

6.5.7 FPL submittal to NRC dated November 28, 1984 (L-84-346) provides a minor revision (Revision 3) to the submittal dated April 12, 1983 and does not specifically address the actual vertical or horizontal separation provided in exemption K1 – only that 20 feet of horizontal separation is not provided. No discussion of vertical separation is provided.

NOTE: It is this submittal that revised exemption K1 by adding "no intervening combustibles" between raceways containing redundant divisions of safe shutdown cables to the description of the exemption.

6.5.8 FPL submittal to NRC dated December 31, 1984 (L-84-390) does not address exemption K1.

6.6 Excerpts from NRC SERs

6.6.1 NRC Safety Evaluation Report dated July 17, 1984 does not address exemption K1.

6.6.2 NRC Safety Evaluation Report dated February 21, 1985 states:

...Redundant cable trays are separated from each other by horizontal distance of more than 7 feet. They are installed on separate elevations separated by approximately 25 feet...

6.6.3 NRC Safety Evaluation Report dated March 5, 1987 states:

...Separation of redundant cables was by more than 7 feet horizontally and 25 feet vertically...

The revised SER included the statement "no intervening combustibles" as part of the exemption.

6.6.4 NRC Safety Evaluation Report dated October 4, 1988 does not address exemption K1.

6.7 Exemption K1

FPL's submittal to NRC dated November 28, 1984 (Revision 3) regarding exemption K1 is as follows:

FIRE AREA K

This fire area is the reactor containment building previously designated as Fire Area 26. Essential equipment within this area is shown in the attached equipment list (this list is provided in this submittal).

The following exemptions to Appendix R to 10 CFR 50 are requested:

Exemption K1

An exemption is requested from Section III-G.2.d of Appendix R because the containment cables and associated nonsafety circuits of redundant trains are not in all cases separated by 20 feet with no intervening combustibles.

Evaluation K1

1) A new reactor coolant pump oil collection system is provided to collect pressurized and unpressurized leaks from each of the reactor coolant pump lube oil systems. This installation will confine the major portion of combustible inventory to a separate oil collection tank in accordance with Appendix R, Section III-O. The remaining combustible oil in the fire area is light.

2) Fire detection is provided as shown on drawings 8770-G-413.

3) Redundant safety-related equipment is protected from exposure to localized combustible sources by spatial separation and/or the use of existing barriers and partitions (i.e., concrete walls, floors and ceilings) having a greater than three hour fire resistive rating.

   Separation is provided to maintain independence of electrical circuits and equipment so that the protective function required during any design basis event can be accomplished. The degree and method of separation varies with the potential hazards in a particular area. This is accomplished by use of spatial separation, barriers, and radiant energy shields where required.

4) Electrical cables are concentrated at the penetration areas at elevation 23.00 ft between column lines 6 and 8. The cables are immediately separated and routed to several items of equipment.

   Radiant energy shields are being provided between safety-related A and B cable trays in the cable penetration area to provide separation.

5) Non IEEE 383 1974 cables in Fire Area K were coated with Flamemastic fire protective coating system. New cables meet the IEEE-383 1974 criteria.

6) Fire Area K is a high radiation area and personnel access is limited, thus minimizing the probability of introducing transient combustibles.

7) The large free volume (2.5 million cubic feet) of Fire Area K allows for dissipation of hot off-gases temperatures and reduces the effect of stratified hot gases at essential components.

8) Instrument cable trays are covered.

Conclusion K1

Based on our evaluation, the existing features in Fire Area K provide adequate separation for a fire in transient or in-situ combustibles. Additional modification would not augment or materially enhance the safety of the plant since it would not aid in the prevention of fire damage to redundant components essential for safe shutdown. Therefore, we conclude, this is an acceptable exemption to Appendix R to 10 CFR 50, Section III-G.2.d.

7.0 ASSESSMENT DETAILS

7.1 Potentially Affected Circuits

The scope of potentially affected circuits was determined by reviewing the St. Lucie Unit 1 SSA. The fire area report for Fire Area K provides a detailed listing of circuits of concern. These circuits are listed in Table 1. The routing of each circuit was researched to determine whether they were located between radial column lines 2 and 6. The results of this review are provided below in terms of the associated component.

System	Train	Equipment ID	Btw 2-6	Remarks
CCW	SA	HVS-1A	N	
CCW	SA	HVS-1B	Y	Review of raceway drawings and power cable routing determined that only one CFC unit is affected.
CCW	SB	HVS-1C	N	
CCW	SB	HVS-1D	N	
CVCS		V-2507	Y	Review of PSL-ENG-SEMS-98-035 for Fire Area K determined that there are no unacceptable fire induced failures for this component.
CVCS	SB	I-SE-01-1	Y	Fire induced spurious actuation (closure) isolates RCP seal bleedoff. Could adversely impact CVCS injection method of RCP seal cooling. This requires tripping of the RCPs to prevent seal failure.
CVCS		MV-02-1	Y	Fire induced spurious actuation assumed to cause RCP seal thermal shock leading to seal LOCA if CCW is concurrently lost.

System	Train	Equipment ID	Btw 2-6	Remarks
CVCS	SA	I-SE-02-1	Y	Fire induced spurious actuation causes loss of charging injection flowpath to LOOP 1B1.
CVCS		MV-02-2	Y	Review of PSL-ENG-SEMS-98-035 for Fire Area K determined that there are no unacceptable fire induced failures for this component.
CVCS	SA	I-SE-02-2	Y	Fire induced spurious actuation causes loss of charging injection flowpath to LOOP 1A2.
CVCS	SA	I-SE-02-3	Y	Fire induced failure causes loss of system SA pressurizer auxiliary spray. Fire induced spurious actuation causes undesired pressurizer auxiliary spray.
CVCS	SB	I-SE-02-4	Y	Fire induced failure causes loss of system SB pressurizer auxiliary spray. Fire induced spurious actuation causes undesired pressurizer auxiliary spray.
HLP		V-1402	Y	Fire induced failure causes loss of PORV function. Plant modification to valve power cable precludes fire induced spurious opening of valve. However, valve can still spuriously open due to false control signals which can be over-ridden by operator action in the control room.
HLP		V-1403	Y	Fire induced failure results in inability to close valve.
HLP		V-1404	Y	Fire induced failure causes loss of PORV function. Plant modification to valve power cable precludes fire induced spurious opening of valve. However, valve can still spuriously open due to false control signals which can be over-ridden by operator action in the control room.
HLP		V-1405	Y	Fire induced failure results in inability to close valve.
HLP	SA	V-2516	Y	Fire induced spurious actuation could cause valve to remain open. Isolation of letdown possible using LCV-2110P and LCV-2110Q which are outside fire area.
HLP	SA	V-3481	N	
HLP	SA	V-1441	Y	Valves V-1445, V-1446, and V-1449 precludes inventory loss via this flowpath.
HLP	SA	V-1443	Y	"
HLP	SA	V-1446	Y	"
HLP	SA	V-1449	Y	"
HLP	SA	V-3651	N	
HLP	SB	V-2515	Y	Fire induced spurious actuation could cause valve to remain open. Isolation of letdown possible using LCV-2110P and LCV-2110Q which are outside fire area.
HLP	SB	V-3480	N	
HLP	SB	V-1442	Y	Valves V-1445, V-1446, and V-1449 precludes inventory loss via this flowpath.
HLP	SB	V-1444	Y	"

System	Train	Equipment ID	Btw 2-6	Remarks
HLP	SB	V-1445	Y	"
HLP	SB	V-3652	Y	Fire induced spurious opening required three phase cable to cable hot short. Estimated conditional failure probability of 1.0E-3. See section 7.2 for details.
INST		CH-001	NA	Separation of NI meets applicable separation requirements.
INST		L-9011	NA	
INST		LT-9012	N	
INST		TE-1115	N	QSPDS temperature indication will also be available.
INST		LT-9022	Y	Review of PSL-ENG-SEMS-98-035 for Fire Area K determined that fire induced failure disables SG 1B wide range level instrument at HSCP. No impact since HSCP not used for a fire in this area.
INST		TE-1125	Y	Redundant instrument TE-1115 not affected. QSPDS temperature indication will also be available.
INST	IA	LT-9005	N	
INST	IA	PT-1100X	Y	Fire induced spurious signal could cause opening of pressurizer spray valves. Operator action to trip RCPs required.
INST	IB	LT-9006	Y	Review of PSL-ENG-SEMS-98-035 for Fire Area K determined that failure could cause spurious operation of 1B FW system at below 15% power. Affects SG 1B.
INST	IB	PT-1100Y	Y	See discussion for PT-1100X.
INST	MA	LT-9013A	N	
INST	MA	PT-8013A	N	
INST	MA	LT-9023A	Y	Fire induced failure disables SG 1B level indication.
INST	MA	PT-1102A	Y	Fire induced spurious signal could cause SIAS or false open signal to PORV. Operator actions required securing auto-started equipment (LPSI and HPSI motors), or overriding PORV opening. Requires satisfying 2 of 4 logic.
INST	MA	PT-8023A	Y	Fire induced failure disables SG 1B pressure instrumentation. Redundant instrument available outside of Fire Area K – PT-08-1B.
INST	MB	LT-9013B	N	
INST	MB	PT-8013B	N	
INST	MB	LT-9023B	Y	See discussion for LT-9023A.
INST	MB	PT-1102B	Y	See discussion for PT-1102A.
INST	MB	PT-8023B	Y	See discussion for PT-8023A.
INST	MC	LT-9013C	N	
INST	MC	PT-8013C	N	
INST	MC	LT-9023C	Y	See discussion for LT-9023A.

System	Train	Equipment ID	Btw 2-6	Remarks
INST	MC	PT-1102C	Y	See discussion for PT-1102A.
INST	MC	PT-8023C	Y	See discussion for PT-8023A.
INST	MD	LT-9013D	N	
INST	MD	PT-8013D	N	
INST	MD	LT-9023D	Y	See discussion for LT-9023A.
INST	MD	PT-1102D	Y	See discussion for PT-1102A. Radiant energy shield 'protects' associated conduit.
INST	MD	PT-8023D	Y	See discussion for PT-8023A.
INST	SA	RE-26-80B	Y	Separation of NI meets applicable separation requirements.
INST	SA	LT-1110X	Y	Fire induced spurious signal could cause start signal to charging pumps.
INST	SA	PT-1103	Y	Fire induced spurious signal could interfere with valve controls for transition to cold shutdown – SDC valves, SIT valves, etc.
INST	SB	RE-26-80A	NA	Separation of NI meets applicable separation requirements.
INST	SB	LT-1110Y	Y	Fire induced spurious signal could cause start signal to charging pumps. Radiant energy shield 'protects' associated conduit.
INST	SB	PT-1104	Y	Fire induced spurious signal could interfere with valve controls for transition to cold shutdown – SDC valves, SIT valves, etc. Radiant energy shield 'protects' associated conduit.
MS	SB	FCV-23-4	Y	Fire induced spurious actuation (opening) affects SG 1A blowdown path. However, redundant isolation valve FCV-23-3 is not affected.
MS	SB	FCV-23-6	Y	Fire induced spurious actuation (opening) affects SG 1B blowdown path. However, redundant isolation valve FCV-23-5 is not affected.
RCS		Pzr Htrs	Y	Fire induced failure disables pressurizer heaters.
RCS	IA	PCV-1100E	Y	Fire induced spurious actuation could result in pressurizer spray. Requires tripping of RCP to terminate spray.
RCS	IA	PCV-1100F	Y	"
SI	SA	V-3623	N	
SI	SA	V-3624	N	
SI	SA	V-3643	Y	Fire induced spurious actuation could result in pressurizer spray. Requires tripping of RCP to terminate spray.
SI	SA	V-3644	N	
SI	SB	V-3613	N	
SI	SB	V-3614	N	
SI	SB	V-3633	Y	Fire induced spurious actuation could result in pressurizer spray. Requires tripping of RCP to terminate spray.
SI	SB	V-3634	N	

The information presented above on a per component basis was aggregated and a bounding fire scenario was developed. The characterization of this bounding fire scenario in terms of plant system functions is necessary in order to simplify the interface with the plant PSA model. The plant PSA model must be quantified with the associated plant system functions failed. In general, this is performed by selecting key model basic events and setting them to 'TRUE,' or to a failure probability of 1.0. The quantification being performed for this assessment were done without an initiating event frequency. As a result, the quantification of the model produces a CCDP value. This value must then be separately combined with a fire ignition frequency to obtain the CDF.

The scope of plant system failures includes consideration of fire induced failure of the PORVs. However, the specific set of cable failures could cause two different failure modes. In one case, the cable failures could result in the inability to open the PORVs. In another case, the failure of instrument cables could result in a spurious PORV open demand signal. The instrument circuit failures would have to occur on at least two of the four instrument loops to satisfy the logic requirements. Since these two scenarios are mutually exclusive, two separate cases are required in order to properly characterize the risk.

Scenario 1 – This scenario evaluates the case wherein fire induced circuit failure results in the inability to open the PORVs and thus cannot be opened for feed and bleed cooling. This CCDP estimation assumes the fire results in a T1 (general reactor trip) initiating event (IE). The latest Unit 1 working baseline PSA model was used. The treatment of the individual fire induced system failures is summarized below.

System	Description	PSA Treatment for CCDP Estimate
CCW	The postulated fire should be assumed to disable fan cooler unit 1B.	FAILED TAG HVS-1B
CVCS	The postulated fire should be assumed to disable charging injection valves I-SE-02-1 and I-SE-02-2. For valves I-SE-02-1 and I-SE-02-2, the conditional failure probability should be 0.10 for each valve to reflect the single cable to cable hot short that is required. The postulated fire should also be assumed to disable RCP seal cooling via CVCS.	Failing MV-02-2 closed is equivalent to failing I-SE-02-1 and I-SE-02-1 closed. Set PSA event MMVK1MV022 to 0.10 Loss of seal injection does not result in an Initiating Event or loss of normal seal cooling (from CCW), Seal Injection is not credited in the PSA – An operator action is credited for securing the RCPs if CCW to the seals is lost.

System	Description	PSA Treatment for CCDP Estimate
HLP/RCS	The postulated fire should be assumed to disable both PORVs (unable to open). The fire induced failure of the block valve (normally open) is immaterial to this scenario. The postulated spurious actuation (opening) of the PORVs due to false control signals is addressed in scenario 2.	Both PORVs assumed failed closed: Set PSA event OMM1V1402O to 1.0 Set PSA event OMM1V1404O to 1.0 Block valves assumed failed open: Set PSA event OMVC1-1403 to 1.0 Set PSA event OMVC1-1405 to 1.0 Block valves are assumed open when event occurs: Set PSA event ZZ1ABKSHUT to 0.0 Set PSA event ZZ1ABLKRO to 0.0 Set PSA event ZZ1BBKSHUT to 0.0 Set PSA event ZZ1BBLKRO to 0.0 Set PSA event ZZBLKV1403 to 1.0 Set PSA event ZZBLKV1405 to 1.0
FW	Feedwater should be disabled. Supporting instrumentation impacted by fire that adversely impacts ability to operate system and 'low flows.'	MFW – Failed Set PSA event FMM1PCS09 to 1.0 Set PSA event FMM1PCS10 to 1.0
RCS	Fire induced failure of instruments may cause spurious opening of pressurizer spray valves. Since heaters are not considered to be functional, tripping of the RCPs is credited in the Appendix R post fire safe shutdown analysis.	Treatment of the fire induced spurious PORV opening event is addressed in Scenario 2. Pressurizer spray valves addressed below.
AFW	Fire induced failure of one SG blowdown valve per SG occurs. Valves FCV-23-4 and FCV-23-6 are affected (fails to close). Loss of level indication for SG 1B could result in loss of generator function.	FCV-23-4 & 6 – Failed Open Set PSA event FMM1PCS47 to 1.0 Set PSA event FMM1PCS48 to 1.0 AFW flow to SG 1B Failed: Set PSA event FCVN109294 to 1.0

In addition to the PSA events listed above, the probability of the following PSA events was adjusted:

Assumes T1 = 1 and all other IEs = 0.

It is assumed that instead of a spurious signal there could be no signal from the pressurizer pressure input to the diverse trip:

Set PSA Event NMM1P1102A to 1.0
Set PSA Event NMM1P1102B to 1.0
Set PSA Event NMM1P1102C to 1.0
Set PSA Event NMM1P1102D to 1.0

The PSA only models failure of main spray valves to open. It is assumed that this is a valid fire-related failure mode. Spurious opening of the spray valve is not modeled. The spurious opening of the spray potentially alters the calculated CCDP value in that the failure probability of the safety valve(s) to reclose following an open demand could be higher if the pressurizer 'bubble' has collapsed. This is discussed further in Section 7.5.

Failed tag PCV-1100E
Failed tag PCV-1100F

The PSA only models failure of auxiliary spray valves to open. It is assumed that this is a valid fire-related failure mode. The discussion of a postulated spurious spray event is discussed above.

Failed tag SE-02-3 Failed tag SE-02-4

The fire analysis assumes that if a fire fails V3652 to a closed position an operator can enter containment and manually open the valve when SDC is required. For this CCDP estimation it is assumed that the valve cannot be opened and thus fails hot leg suction for the 'B' LPSI pump (i.e., SDC via 'B' LPSI pump):

Failed tag V3652

The quantification of the plant PSA model given the set of 'failures' described above produced a CCDP of:

CCDP = 1.72E-03 (@ 1E-09 truncation)

Scenario 2 – This scenario evaluates the case wherein fire induced circuit failures result in a spurious PORV open signal. This signal results from instrumentation circuit failures. Operator action to override the spurious signal from the control room is available, but is not specifically credited in the CCDP calculation. This CCDP estimation assumes the fire results in a T2 (PORV challenge) initiating event (IE). The latest Unit 1 working baseline PSA model was used. The treatment of the individual fire induced system failures is summarized below.

System	Description	PSA Treatment for CCDP Estimate
CCW	The postulated fire should be assumed to disable fan cooler unit 1B.	FAILED TAG HVS-1B
CVCS	The postulated fire should be assumed is disable charging injection valves I-SE-02-1 and I-SE-02-2. For valves I-SE-02-1 and I-SE-02-2, the conditional failure probability should be 0.10 for each valve to reflect the single cable to cable hot short that is required. The postulated fire should also be assumed to disable RCP seal cooling via the charging flow.	Failing MV-02-2 closed is equivalent to failing I-SE-02-1 and I-SE-02-1 closed. Set PSA event MMVK1MV022 to 0.10 Loss of seal injection does not result in an Initiating Event or loss of normal seal cooling (from CCW), Seal Injection is not credited in the PSA – An operator action is credited for securing the RCPs if CCW to the seals is lost.

System	Description	PSA Treatment for CCDP Estimate
HLP/RCS	The postulated fire should be assumed to cause both PORVs to open (unable to close) and block valves (unable to close). The spurious opening is due to false control signals that can be over-ridden by an operator action in the main control room (control switch).	Both PORVs assumed failed open: Set PSA event OMM1PORVA to 1.0 Set PSA event OMM1PORVB to 1.0 Block valves assumed failed open: Set PSA event OMVC1-1403 to 1.0 Set PSA event OMVC1-1405 to 1.0 Block valves are assumed open when event occurs: Set PSA event ZZ1ABKSHUT to 0.0 Set PSA event ZZ1ABLKRO to 0.0 Set PSA event ZZ1BBKSHUT to 0.0 Set PSA event ZZ1BBLKRO to 0.0 Set PSA event ZZBLKV1403 to 1.0 Set PSA event ZZBLKV1405 to 1.0 The operator action to over-ride the false control signal is not treated explicitly in the quantification for CCDP and needs to be applied separately.
FW	Feedwater should be disabled. Supporting instrumentation impacted by fire that adversely impacts ability to operate system and 'low flows.'	MFW – Failed Set PSA event FMM1PCS09 to 1.0 Set PSA event FMM1PCS10 to 1.0
RCS	Fire induced failure of instruments may cause spurious opening of pressurizer spray valves. Since heaters are not considered to be functional, tripping of the RCPs is credited in the Appendix R post fire safe shutdown analysis.	Treatment of the fire induced spurious PORV opening event is assumed to be not recoverable in this quantification. Pressurizer spray valves addressed below.
AFW	Fire induced failure of one SG blowdown valve per SG occurs. Valves FCV-23-4 and FCV-23-6 are affected (fails to close). Loss of level indication for SG 1B could result in loss of generator function.	FCV-23-4 & 6 – Failed Open Set PSA event FMM1PCS47 to 1.0 Set PSA event FMM1PCS48 to 1.0 AFW flow to SG 1B Failed: Set PSA event FCVN109294 to 1.0

In addition to the PSA events listed above, the probability of the following PSA events was adjusted:

Assumes T2 = 1 and all other IEs = 0.

It is assumed that instead of a spurious signal there could be no signal from the pressurizer pressure input to the diverse trip:

Set PSA Event NMM1P1102A to 1.0
Set PSA Event NMM1P1102C to 1.0
Set PSA Event NMM1P1102B to 1.0
Set PSA Event NMM1P1102D to 1.0

The PSA only models failure of main spray valves to open. It is assumed that this is a valid fire-related failure mode. Spurious opening of the spray valve is not modeled. The spurious opening of the spray potentially alters the calculated CCDP value in that the failure probability of the safety valve(s) to reclose following an open demand could be higher if the pressurizer 'bubble' has collapsed. This is discussed further in Section 7.5.

Failed tag PCV-1100E Failed tag PCV-1100F

The PSA only models failure of auxiliary spray valves to open. It is assumed that this is a valid fire-related failure mode. The discussion of a postulated spurious spray event is discussed above.

Failed tag SE-02-3 Failed tag SE-02-4

The fire analysis assumes that if a fire fails V3652 to a closed position an operator can enter containment and manually open the valve when SDC is required. For this CCDP estimation it is assumed that the valve cannot be opened and thus fails hot leg suction for the 'B' LPSI pump (i.e., SDC via 'B' LPSI pump):

Failed tag V3652

<u>CCDP = 2.13E-03</u> (@ 1E-09 truncation)

7.2 Treatment for Fire Induced Cable Failures

The containment fire analysis considered three potential fire induced cable failure modes - open circuit, short circuit, and hot shorts. A key feature of the analysis is that the potential for spurious equipment actuation is considered for all three failure modes.

Open circuit – a postulated fire induced open circuit would result in the interruption of power or control signals. In this case, components would align themselves in a de-energized state. Valves that require power to maintain a desired position would be assumed to change state. Relays that are normally energized would de-energize. The consequences of this relay action may include spurious actuation of mechanical system components. In no case were fire induced failures credited to assist components in achieving the desired state for this analysis. The open circuit failure mode was treated using a conditional failure probability of 1.0.

Short circuit – a postulated fire induced short circuit is defined as those fire induced failures wherein the conductors of an individual cable become 'connected' together in any combination. The failure modes that were considered included shorting of all conductors in power circuits, and the selected shorting of conductors within individual control cables to cause spurious equipment actuation. This latter case is often referred to as a conductor to conductor hot short. For example, a control cable between a motor control center and the valve actuator would be treated using failure modes that included the shorting of conductors to generate a spurious valve open or close signal. As in the prior case, fire induced cable failures were not credited to assist components achieve the desired state for this analysis. This short circuit failure mode was treated using a conditional failure probability of 1.0.

Hot short - this cable failure mode is a special case of the more general short circuit failure mode. This case involves an instance wherein the energized conductor(s) of a given cable becomes connected to the de-energized conductor(s) of another cable causing undesired spurious actuation of equipment associated with the second cable. This is typically referred to as a cable to cable hot short. This failure mode is very unlikely since it also requires that these 'shorted' conductors not include certain other conductors such as neutral or ground, and be connected long enough to cause the affected component to change state. As such, the application of a non-unity conditional failure probability is appropriate. While an explicit analysis to determine this value for each case was not performed, a simplified assessment was performed to provide a reasonable range of possible values.

The simplified assessment that was performed considered a hypothetical case involving two cables, each consisting of two conductors. Cable 1 is assumed to be connected to a de-energized solenoid valve whose desired post fire status is to remain de-energized. The conductors for this cable are identified as 'S1' (hot conductor) and 'S2' (neutral conductor). Cable 2 is assumed to be a power supply cable consisting of conductors 'P' (hot conductor) and 'N' (neutral conductor). The cables are assumed to be routed in a grounded raceway system. This configuration involves 5 conductors. The grounded raceway system is treated as a single 'virtual' conductor.

The possible cable shorting configurations involve pairs of conductors, groups of three, four, and a single case involving all five conductors. There are a total of 26 'shorting' combinations. However, only combinations that involve the connection of conductor 'S1' of cable 1 with conductor 'P' in cable 2 would spuriously energize the solenoid valve. This pair occurs in combinations 2, 11, 14, 15, 21, 22, 24, and 26 shown in the table below. However, only in combination 2 will the pair produce a hot short with no potential involvement by the other conductors. The statistical probability of this occurring is 1 in 26, i.e., 3.85E-2. In all other combinations, a hot short can be produced only if this pair is shorted for a sufficient time to energize the solenoid valve before another conductor in the combination enters the shorted configuration. Thus, the statistical probability in these cases is between zero (if another conductor is involved immediately) and an upper bound value greater than zero (determined by the delay before another conductor becomes involved).

The upper bound of the conditional probability of this temporal delay during which only conductors P and S1 are shorted can be approximated by the statistical fraction of pairs within this combination which involve this specific pair. Therefore, in the case of combination 11 involving conductors S1, S2, and P, there are three possibilities for the 'initiating' pair - S1/S2, S1/P, and S2/P. S1/P is the hot short combination of concern and represents 1 out of 3 possible pairs. Therefore, the conditional probability of combination 11 producing a hot short is between zero and 1/3rd out of 26. Repeating this process for all of the higher order combinations, the conditional probability of hot short in combinations 11, 14, and 15 is between zero and 1/3rd out of 26 each; in combination 21, 22 and 24 it is between zero and 1/6th out of 26 each; and in combination 26 it is between zero and 1/10th out of 26. Adding these fractions, the upper bound of the conditional probability of the higher order combinations producing a hot short is:

$$\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{6}+\frac{1}{6}+\frac{1}{6}+\frac{1}{10} = 1.6 \; out \; of \; 26 = 6.15E-2$$

The overall probability of a hot short being produced is between 3.85E-2 (for the single combination of only conductors S1 and P and the lower bound, i.e. zero, of the higher order combinations) and (3.85E-2 + 6.15E-2 = 1.00E-1 (for the upper bound of all combinations involving conductors S1 and P)). The analysis can not determine the actual probability more precisely without further information regarding the temporal characteristics of conductor pair shorting in the higher order combinations. However, it can be readily derived that any other cable configuration involving a larger number of conductors will produce a range of probability of hot short that is lower than in this case.

This simplified assessment concluded that the lower and upper bound conditional probabilities were 3.85E-2 and 1.00E-1, respectively. It was noted that the hot short conditional probability of 6.8E-2 presented in NUREG/CR-2258 is approximately the mean of these upper and lower bound values. Based on this information, and the fact that the credible fire events are all self-initiated cable fires, the Unit 1 containment assessment conservatively used the upper bound conditional probability of 1.00E-01 for all postulated cable to cable hot short failures. In cases where multiple hot short events are being considered, each event is considered to be a completely independent event. Common cause is therefore not applicable. Therefore, the spurious actuation of a three-phase motor due to hot shorts on the power cable would have a conditional probability of 1.0E-3 (0.10 x 0.10 x0.10 = 1.0E-3).

Conductor Shorting Combinations

ID	Conductors					Spurious Actuation	Note	ID	Conductors					Spurious Actuation	Note
	S1	S2	P	N	G				S1	S2	P	N	G		
1	x	x				n	2	14	x		x	x		n	2,4
2	x		x			Y		15	x		x		x	n	1,4
3	x			x		n	2	16	x			x	x	n	1
4	x				x	n	1	17		x	x	x		n	2
5		x	x			n	2	18		x	x		x	n	1
6		x		x		n	3	19		x		x	x	n	1
7		x			x	n	1	20			x	x	x	n	1
8			x	x		n	2	21	x	x	x	x		n	2,4
9			x		x	n	1	22	x	x	x		x	n	1,4
10				x	x	n	3	23	x	x		x	x	n	1
11	x	x	x			n	2,4	24	x		x	x	x	n	1,4
12	x	x		x		n	2	25		x	x	x	x	n	1
13	x	x			x	n	1	26	x	x	x	x	x	n	1,4

Conductor Definition:
S1 - positive conductor to solenoid valve
S2 - negative conductor to solenoid valve
P - positive conductor of energized cable
N - negative conductor of energized cable
G - ground (neutral) of raceway

Notes:

1. All combination containing conductor G result in no voltage or are short circuit conditions wherein no potential would be available to the solenoid.
2. This combination represents a short circuit condition on the power supply circuit to the solenoid.
3. This combination involves the connection of neutral conductors only.
4. Higher order combination containing the conductors that could cause a spurious actuation.

7.3 Containment Area Self-Initiated Cable Fire Frequency

A review of the tier 2 documents from the original Fire IPEEE found that the cumulative plant-wide cable combustible load used to partition the fire frequency among the fire compartments was 1.26×10^{10} Btu. A review of the Unit 1 UFSAR found that the current cable combustible load within containment is 1.086×10^{9} Btu. The baseline plant-wide fire frequency for self-initiated cable fires from the EPRI FIVE Methodology is 6.3E-3/yr. Using these values, the total self-initiated cable fire frequency in the Unit 1 containment can be calculated. This total frequency needs to be partitioned to reflect the fraction of cables physically located in the area of interest – between radial column lines 2 and 6. In order to ensure that the results of this analysis are bounding, it is assumed that 50% of the total combustible load in the Unit 1 containment occurs between radial column lines 2 and 6.

$$\frac{1.086\,x\,10^{9}}{1.26\,x\,10^{10}}\;x\;6.3E-3\;x\;0.50\;=\;2.72E-4\,/\,yr$$

7.4 Fire Scenario Development

The space between the containment structure and the interior biological shield between radial column lines 2 and 6 does not contain any significant fire ignition sources. An engineering walkdown conducted during refueling outage SL1-17 to identify potential fire ignition sources found a limited number of motor operated valves (MOVs) and electrical cabinets to be located in the area. However, the MOVs are not considered to be credible fire ignition sources because the of motor enclosure construction (NEMA TENV – totally enclosed non-ventilated) and the few electrical cabinets that were observed were totally enclosed. Based on these observations, the only credible fire scenario in the area of interest is a self-initiated cable fire.

The cables installed in the Unit 1 containment are a mixture of IEEE 383 and non-IEEE 383 qualified. The non-IEEE 383 cables are coated with Flamemastic. The Flamemastic coating provides a degree of fire protection that would tend to minimize the likelihood of cable damage and/or ignition due to fire exposure. The coating would impede the development of the fire and the extent of fire propagation and thereby reduce the magnitude of a postulated self-initiated cable fire event. However, in order to simplify the analysis and provide bounding results, the cables were assumed to be non-IEEE 383 cables for the purposes of determining fire ignition frequency and damage threshold temperature. This approach introduces conservatism into the analysis. The fire modeling was performed using the simplified analysis tools from the EPRI FIVE Methodology. This approach was used together with a conservative estimation of the source fire intensity in order to provide bounding results.

The trays are arranged in vertical stacks. All trays have solid bottoms. The bottom tray in each stack is an instrumentation tray that is provided with a solid cover. The top tray in each stack also has a solid cover where exposed to overhead traffic (i.e., directly beneath a grating or opening). All trays are coated with Flamemastic. The circuits in the instrumentation trays are considered to be low energy circuits that are not potential ignition sources. The top tray in each stack is a power circuit tray typically carrying 480 VAC power circuits. Between the top and bottom tray are either one or two control circuit trays.

In the area of interest, the system SA trays are arranged in two stacks as described above. One stack is located on the 23' nominal elevation with another located directly above it at the 45' nominal elevation. The highest tray on the 23' nominal elevation is at 42'-0". The lowest tray on the 45' nominal elevation is at 54'-2". A similar configuration exists for the system SB trays. The highest tray on the 23' nominal elevation is at 42'-0". The lowest tray on the 45' nominal elevation is at 57'-2". However, in the area between radial column lines 5 and 6, the 'lower' stack of system SB trays transitions to the upper elevation via cable tray risers. The arrangement of these trays is shown in the Figures 1 and 2.

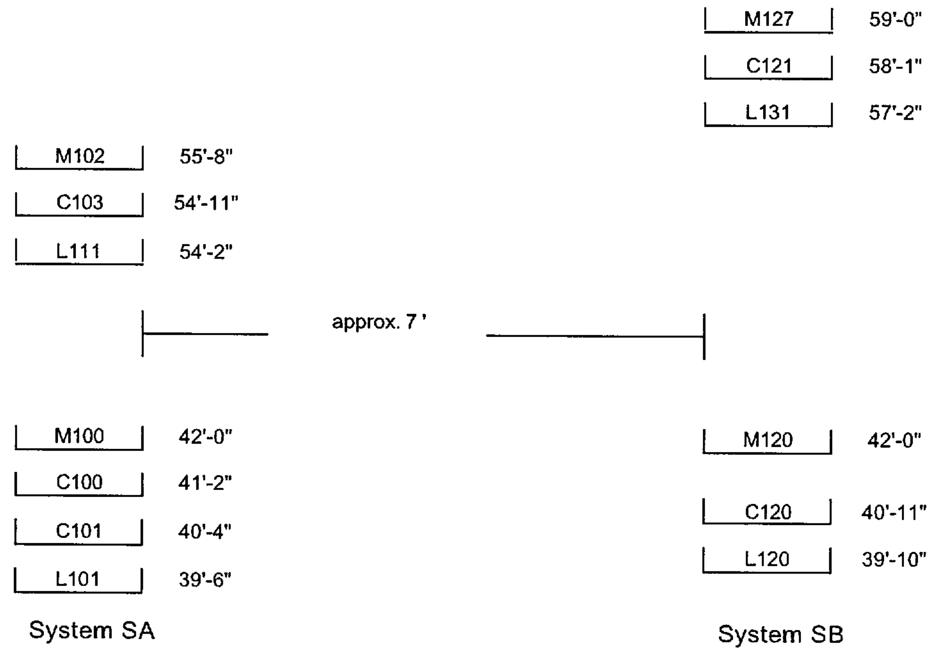

Figure 1 – Arrangement of Trays Between Radial Column Lines 2 and 5.5
- not to scale -

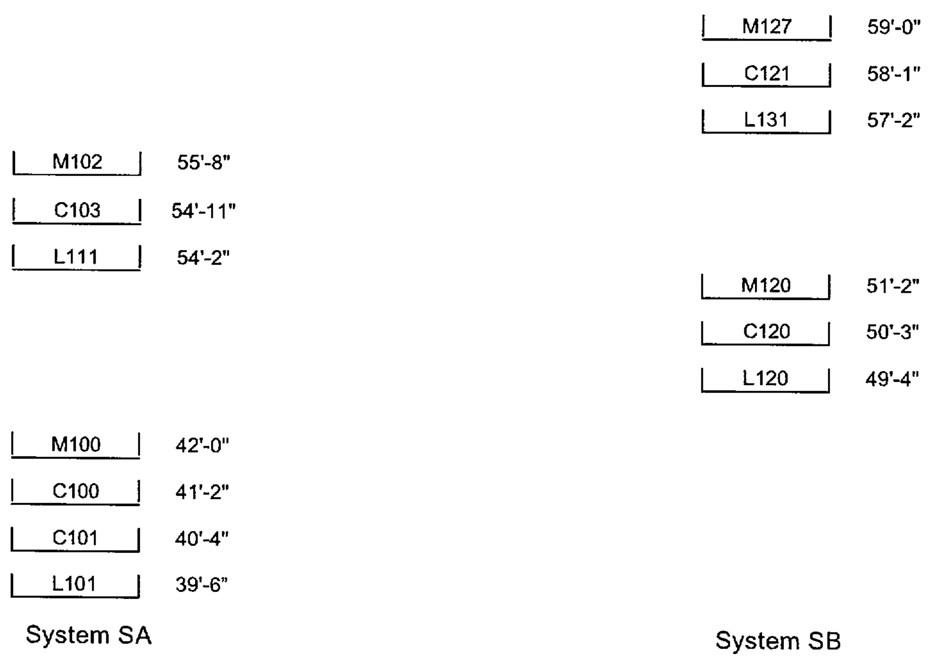

Figure 2 – Arrangement of Trays Between Radial Column Lines 5.5 and 6
- not to scale -

The system SA and SB tray stacks are separated by a horizontal distance of approximately 7'. Based on these elevations, the key interactions distances are 12' vertically and 7' horizontally.

Postulated Fire Source	Target Distances			
	SA		SB	
	Vertical	Horizontal	Vertical	Horizontal
SA	-	-	15'-2" [1]	7'
SB	12'-2" [1]	7'	-	-

Note 1: The vertical spacing distances are applicable only between column lines 2 and 5.5. Between column lines 5.5 and 6, the trays of have limited vertical spacing, but maintain the 7 foot horizontal spacing.

The minimum 'available' vertical separation of the redundant systems of cable trays between column lines 2 and 5.5 is about 12 feet with a horizontal separation of 7 feet. Between column lines 5.5 and 6 only the horizontal separation of 7 feet is available. The configuration of this area involves grating that forms the nominal floor elevations at 23'-0", 45'-0", and 62'-0". An inside of plume scenario is not applicable to this configuration since the targets would be of the same system. An outside of plume scenario is also not applicable because the grating precludes the trays from exposure to ceiling jet effects (no ceiling). Therefore, radiant exposure case is the only credible scenario. The EPRI FIVE Radiant Exposure Worksheet was used to analyze the 7' of available spacing to determine the critical fire intensity. The critical fire intensity represents that value wherein the postulated fire is likely to cause damage to the target cable trays. The worksheet is provided in Table 2 and shows a critical fire intensity of 770 Btu/s.

The input parameters for the worksheet are summarized below.

1. Target Damage Threshold – a critical radiant heat flux of 0.50 Btu/s/ft^2 is used. This value is consistent with guidance in FIVE and the EPRI Fire PRA Implementation Guide.
2. Radiant Heat Release Fraction – a value of 0.40 is used based on recommendations in the EPRI FIVE Methodology.
3. Peak Fire Intensity – the peak fire intensity was determined by iteration. A fire intensity was gradually increased to a point where the critical radiant flux distance was equal to the available target spacing (7').

The analysis determined that a postulated self-initiated cable fire would have to have an intensity greater than 770 Btu/s in order to represent a potential concern. This result is conservative because it does not credit the Flamemastic coating or the radiant shielding provided by the piping, structural steel, and other non-combustible features located between the system SA and SB cable tray stacks. In addition, the analysis methodology using the FIVE worksheets are derived based on the fire source and target points.

The fire scenario being considered involves a linearly distributed fire along a distance that is much greater than the spacing. Therefore, the actual incident heat flux is much lower than calculated. The area also contains many features that limit the locations where line of sight exists between the redundant tray stacks (i.e., HVAC duct, safety injection tanks, structural/support steel, and process piping).

The characterization of a self-initiated cable fire having a fire intensity of 770 Btu/s can be determined using the data from Table 1E of the EPRI FIVE Methodology Report. This table provides the heat release rates for a variety of cable types. Because the cables are a mixture of IEEE 383 and non-IEEE 383 cables, a composite heat release rate was developed based on the average of several values. The values in the table below are taken from the EPRI FIVE Methodology Report.

Cable Type	Heat Release Rate
PE/PVC	51.89 Btu/s/ft^2
XPE/FRXPE	41.85 Btu/s/ft^2
XPE/CLS.PE	17.97 Btu/s/ft^2
Composite	37.24 Btu/s/ft^2

The equation for determining the heat release rate for a self-initiated cable fire is provided as equation (2) of Attachment 10.4 to FIVE and involves a combustion efficiency of 45%.

$$Q_{fs} = 0.45\ q_{bs}\ A \qquad 770\ Btu/s\ =\ 0.45\ x\ 37.24\ Btu/s/ft^2\ x\ A$$

$$A\ =\ 45.9\ ft^2$$

Based on the analysis present above, a postulated self-initiated cable fire would have to involve a surface area of greater than 45.9 ft^2 to result in a heat rate that presents a potential concern. A credible event involving a self-initiated cable fire is expected to be characterized by a relatively long development phase, a period of time where peak fire intensity occurs, and a burn out phase wherein the available combustible material is assumed to be depleted. For the scenario being considered, the 45.9 ft^2 'critical' area represents the surface area actively burning at any given time. It is not meant to represent the total area affected by a fire.

A self-initiated cable fire event is modeled in this analysis based on a nominal cable tray width of 24 inches. In order to achieve the calculated surface area, a total linear length of cable tray involved in the fire must be at least 22.9 feet. A review of the raceways in the area of interest found the system SA trays on the 23' nominal elevation to be configured in a stack of 4 trays (M100, C100, C101, and L101). The top and bottom trays have solid covers and are therefore effectively enclosed. While exposure of these trays to a postulated fire could result in damage to the cables contained in the trays, the solid enclosure effectively eliminates their contribution as a radiant heat source. Only the two middle trays (C100 and C101) represent a credible radiant heat source because of their open top configuration. Therefore, a linear length of approximately 11.4 feet of each tray must be actively burning to represent a potential challenge to the system SB trays located on the opposite side of the annular space. The other tray stacks contain three trays each with only the one middle tray available as a radiant heat source. For these tray stacks, a minimum length of 22.9 feet of actively burning tray would be required.

The fire modeling analysis presented above is very conservative in that two key features are not credited. One is the presence of Flamemastic and the other is the radiant heat shielding provided by intervening non-combustible elements (.i.e., HVAC duct, safety injection tanks, structural/support steel, and process piping). Given that a self-initiated cable fire has been identified as the only credible ignition source, the Flamemastic will tend to prevent a fully involved fire from occurring. The significance of these variables can be assessed in the context of an uncertainty assessment by changing the target damage threshold from 0.50 Btu/s/ft^2 to 1.0 Btu/s/ft^2 and the radiant heat release fraction from 0.40 to 0.30. The 1.0 Btu/s/ft^2 value is the FIVE Methodology recommended value for IEEE 383 qualified cables. A heat release fraction of 0.30 is in the midpoint of the range of realistic values provided in FIVE. The worksheet in Table 3 shows that the corresponding peak fire intensity with these altered parameters is 2,050 Btu/s which is over 2 ½ times larger than the critical fire size.

These areas of conservatism, taken together with the calculated results, indicate that redundant cable damage is not likely to occur due to self-initiated cable fires. However, the assessment will evaluate the risk significance of a hypothetical case where fire damage to redundant cables does occur.

7.5 Core Damage Frequency Estimate

Section 7.3 develops a self-initiated cable fire frequency of 2.72E-04/yr. This frequency was calculated using methods consistent with the EPRI FIVE Methodology and represents all postulated fire events. The fire modeling analysis presented in Section 7.4 shows that a severe fire must occur. A severity factor of 0.20 is applied to address this fact. The application of this severity factor effectively treats 80% of the postulated fire events as being relatively small fires that cannot challenge redundant cables given the configuration of the area. This value was developed by reviewing the fire events reported in the EPRI Fire Events Database using a process described in the EPRI Fire PRA Implementation Guide. The severity factor of 0.20 is consistent with the EPRI recommended severity factor for control room electrical cabinets (0.20), and more conservative than the recommended severity factor for switchgear room electrical cabinets (0.12).

Section 7.1 provides the CCDP for the two bounding cases associated with the postulated containment fire. Scenario 1 assumes the fire causes functional failure of the PORVs and resulted in a CCDP of 1.72E-03.

Scenario 2 assumes the fire causes a spurious instrument signal that opens the PORVs. The CCDP for this case does not include crediting of operator action to override the signal and resulted in a CCDP of 2.13E-03. The operator action to mitigate this initiating event involves the use of control room switches to override the spurious signal. This operator action is assigned a screening human error probability (HEP) of 0.10.

The development of Scenario 1 did not explicitly treat fire induced spurious spray actuation. Spurious pressurizer spray can collapse the 'bubble' and increase the likelihood of failure of a safety valve to close following an open demand. The consequences of this sequence of event is bounded by the CCDP for Scenario 2. Therefore, the full scope of potential fire induced failures for Scenario 1 can be conservatively treated by using the Scenario 2 CCDP value.

Combining the various elements of the risk assessment provides the bounding CDF estimate for the postulated fire event.

Scenario	Ignition Freq	Severity Factor	HEP	CCDP	CDF
1 – PORV Functional Failure	2.72E-04	0.20		2.13E-03	1.16E-07/yr.
2 – Spurious PORV Open	2.72E-04	0.20	0.10	2.13E-03	1.16E-08/yr.
TOTAL					1.28E-07/yr.

The total estimated change in CDF is 1.28E-07/yr. Since the baseline CDF is approximately 2E-05/yr., the change in CDF calculated above is in Region III of RG 1.174 Figure 3 and is, therefore, considered very small and is thus not risk significant.

The change in LERF due to the postulated fire event can be estimated as follows:

Change in LERF = change in Steam Generator Tube Rupture (SGTR) contribution + ISLOCA contribution + (1% of the change in non-SGTR CDF contribution) [note: it is estimated that 1% of the non-SGTR related CDF would lead to a large early release]

- Change in SGTR contribution: The fire scenarios addressed do not impact the SGTR contribution and thus there is no LERF impact.

- Change in ISLOCA: The only postulated fire-related impact related to LERF would be from a hot short causing a spurious opening of V3652 (SDC hot leg suction). It is estimated that there is a 1E-03 failure probability for the three-phase hot short related to this valve (see section 7.2 of this evaluation). Both V3651 and V3652 must open to initiate an ISLOCA. The fire scenario of concern does not impact V3651. V3651 is a motor operated valve with power removed from the valve with the unit at power. The valve, therefore, is essentially a manually operated valve from a non fire-related spurious transfer perspective. If it is assumed that there is a 24 hour exposure to V3651 spuriously opening following the postulated fire event, a conservative change in ISLOCA can be calculated as follows:

  (1E-03 x 2.72E-04/yr x .2) x (24 hours x 1.3E-07/hr) = ε

  where 1.3E-07/hr is the assumed manual valve transferring open failure rate

- 1% of the non-SGTR related change in CDF : 0.01 x 1.28E-07 = 1.28E-09

The total change in LERF is estimated to be 1.28E-09/yr. The baseline LERF is less than 1E-05/yr. The change in LERF is in Region III of RG 1.174 Figure 4 and is, therefore, considered very small. The change in LERF is thus not risk significant.

Table 1

APPENDIX R CONTAINMENT CABLE LISTING

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
CCW	10307A*	SA	CFC HVS-1A PWR	HVS-1A	NEEDS TO RUN TO PROVIDE CONTAINMENT COOLING
CCW	10308A*	SA	CFC HVS-1B PWR	HVS-1B	NEEDS TO RUN TO PROVIDE CONTAINMENT COOLING
CCW	10309A*	SB	CFC HVS-1C PWR	HVS-1C	NEEDS TO RUN TO PROVIDE CONTAINMENT COOLING
CCW	10310A*	SB	CFC HVS-1D PWR	HVS-1D	NEEDS TO RUN TO PROVIDE CONTAINMENT COOLING
CVCS	10090A*		RCP SEAL INJ MV-02-1 PWR	MV-02-1	
CVCS	10090E*		RCP SEAL INJ MV-02-1 INTLK	MV-02-1	
CVCS	10090C*		RCP SEAL INJ MV-02-1 LS	MV-02-1	Spurious actuation concern - RCP seal thermal shock
CVCS	10090D*		RCP SEAL INJ MV-02-1 LCL PB	MV-02-1	Spurious actuation concern - RCP seal thermal shock
CVCS	10091A*		RCP SEAL INJ MV-02-2 PWR	MV-02-2	
CVCS	10091C*		RCP SEAL INJ MV-02-2 LS	MV-02-2	Spurious actuation concern - RCP seal thermal shock
CVCS	10091D*		RCP SEAL INJ MV-02-2 LCL PB	MV-02-2	Spurious actuation concern - RCP seal thermal shock
CVCS	10160G*		V-2507 RCP BLEED-OFF, SOL PWR	V-2507	
CVCS	10160H*		V-2507 RCP BLEED-OFF, LS	V-2507	
CVCS	10176D*	SA	CHG LINE 1B1 I-SE-02-1 LS	1-SE-02-1	
CVCS	10176C*	SA	CHG LINE 1B1 I-SE-02-1 PWR	1-SE-02-1	Spurious actuation concern - charging injection flowpath
CVCS	10176F*	SA	CHG LINE 1A2 I-SE-02-2 LS	1-SE-02-2	
CVCS	10176E*	SA	CHG LINE 1A2 I-SE-02-2 PWR	1-SE-02-2	Spurious actuation concern - charging injection flowpath
CVCS	10189J*	SA	AUX SP I-SE-02-3 LS	1-SE-02-3	
CVCS	10189H*	SA	AUX SP I-SE-02-3 PWR	1-SE-02-3	Spurious actuation concern - pzr spray
CVCS	10159T*	SB	I-SE-01-1 RCP BLEED-OFF, LS	1-SE-01-1	
CVCS	10159R*	SB	I-SE-01-1 RCP BLEED-OFF, SOL PWR	1-SE-01-1	Spurious actuation concern - RCP bleed-off line
CVCS	10189M*	SB	AUX SP I-SE-02-4 LS	1-SE-02-4	
CVCS	10189L*	SB	AUX SP I-SE-02-4 PWR	1-SE-02-4	Spurious actuation concern - pzr spray
HLP	10117C*		PORV V-1402 LS	V-1402	
HLP	10117A*		PORV V-1402 PWR	V-1402	Spurious PORV opening - hot short modification to resolve
HLP	10118A*		PRZR REL ISOL V-1403 PWR	V-1403	Spurious Block Valve operation

Table 1

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
HLP	10118C*		PRZR REL ISOL V-1403 LS	V-1403	Spurious Block Valve operation
HLP	10118D*		PRZR REL ISOL V-1403 LCL CNTL	V-1403	Spurious Block Valve operation
HLP	10117G*		PORV V-1404 LS	V-1404	
HLP	10117E*		PORV V-1404 PWR	V-1404	Spurious PORV opening - hot short modification to resolve
HLP	10120A*		PRZR REL ISOL V-1405 PWR	V-1405	Spurious Block Valve operation
HLP	10120C*		PRZR REL ISOL V-1405 LS	V-1405	Spurious Block Valve operation
HLP	11255A*	SA	RCGVS V-1441 SOL PWR & IND	V-1441	Excessive Leakage - challenges single CVCS pump
HLP	11255B*	SA	RCGVS V-1443 SOL PWR & IND	V-1443	Excessive Leakage - challenges single CVCS pump
HLP	11255C*	SA	RCGVS V-1446 SOL PWR & IND	V-1446	Excessive Leakage - challenges single CVCS pump
HLP	10157E*	SA	LETDN ISOL V-2516 PWR	V-2516	
HLP	10157F*	SA	LETDN ISOL V-2516 LS	V-2516	
HLP	10250C*	SA	SDC ISOL V-3481 LS	V-3481	
HLP	10250A*	SA	SDC ISOL V-3481 PWR	V-3481	SDC Line - 3 phase hot short to cause spurious opening
HLP	10253A*	SA	SDC ISOL V-3651 PWR	V-3651	SDC Line - 3 phase hot short to cause spurious opening
HLP	10253C*	SA	SDC ISOL V-3651 LS	V-3651	
HLP	11256A*	SB	RCGVS V-1442 SOL PWR & IND	V-1442	Excessive Leakage - challenges single CVCS pump
HLP	11256B*	SB	RCGVS V-1444 SOL PWR & IND	V-1444	Excessive Leakage - challenges single CVCS pump
HLP	11256C*	SB	RCGVS V-1445 SOL PWR & IND	V-1445	Excessive Leakage - challenges single CVCS pump
HLP	10157A*	SB	LETDN STP V-2515 PWR	V-2515	
HLP	10157B*	SB	LETDN STP V-2515 LS	V-2515	
HLP	10249C*	SB	SDC ISOL V-3480 LS	V-3480	
HLP	10249A*	SB	SDC ISOL V-3480 PWR	V-3480	SDC Line - 3 phase hot short to cause spurious opening
HLP	10254A*	SB	SDC ISOL V-3652 PWR	V-3652	SDC Line - 3 phase hot short to cause spurious opening
HLP	10254C*	SB	SDC ISOL V-3652 LS	V-3652	
INST	10060A*		NI WIDE RANGE LOG CH-001	CH-001	7 FOOT HORIZONTAL SEPARATION FROM RE-26-80
INST	10060B*		NI WIDE RANGE LOG CH-001	CH-001	7 FOOT HORIZONTAL SEPARATION FROM RE-26-80

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
INST	10060C*		NI WIDE RANGE LOG CH-001	CH-001	7 FOOT HORIZONTAL SEPARATION FROM RE-26-80
INST	10060D*		NI WIDE RANGE LOG CH-001	CH-001	7 FOOT HORIZONTAL SEPARATION FROM RE-26-80
INST	10619H*		SG 1A NARROW LOOP L-9011 IND	L-9011	
INST	10380C*		SG 1A LVL LT-9012	LT-9012	
INST	10380H*		SG 1B LVL LT-9022	LT-9022	
INST	10136D*		RCS TEMP RTD 1 TE-1115	TE-1115	
INST	10136K*		RCS TEMP RTD 2 TE-1115 (HSCP)	TE-1115	
INST	10137D*		RCS TEMP RTD 1 TE-1125	TE-1125	
INST	10137M*		RCS TEMP RTD 2 TE-1125	TE-1125	
INST	10619P*	IA	FW REG SYS 1A LT-9005	LT-9005	
INST	10097C*	IA	PRZR PR CH-P 1100X PT-1100X	PT-1100X	
INST	10624P*	IB	FW REG SYS 1B LT-9006 (HSCP)	LT-9006	
INST	10098A*	IB	PRZR PR CH-P-1100Y PT-1100Y	PT-1100Y	
INST	10376C*	MA	SG 1A LVL LT-9013A	LT-9013A	
INST	10377C*	MA	SG 1B LVL LT-9023A	LT-9023A	
INST	10372A*	MA	PRZR PR PT-1102A	PT-1102A	
INST	10378E*	MA	SG 1A PR PT-8013A	PT-8013A	
INST	10379E*	MA	SG 1B PR PT-8023A	PT-8023A	
INST	10376F*	MB	SG 1A LVL LT-9013B	LT-9013B	
INST	10377F*	MB	SG 1B LVL LT-9023B	LT-9023B	
INST	10373A*	MB	PRZR PR TP-1102B	PT-1102B	
INST	10378F*	MB	SG 1A PR PT-8013B	PT-8013B	
INST	10379F*	MB	SG 1B PR PT-8023B	PT-8023B	
INST	10376J*	MC	SG 1A LVL LT-9013C	LT-9013C	
INST	10377J*	MC	SG 1B LVL LT-9023C	LT-9023C	
INST	10374A*	MC	PRZR PR PT-1102C	PT-1102C	

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
INST	10378G*	MC	SG 1A PR PT-8013C	PT-8013C	
INST	10379G*	MC	SG 1B PR PT-8023C	PT-8023C	
INST	10376R*	MD	SG 1A LVL LT-9013D	LT-9013D	
INST	10377M*	MD	SG 1B LVL LT-9023D	LT-9023D	
INST	10375A*	MD	PRZR PR PT-1102D	PT-1102D	
INST	10378H*	MD	SG 1A PR PT-8013D	PT-8013D	
INST	10379H*	MD	SG 1B PR PT-8023D	PT-8023D	
INST	10138C*	SA	PRZR LVL Y LT-1110X	LT-1110X	
INST	10140C*	SA	PRZR PR LO RANGE PT-1103	PT-1103	
INST	10058A	SA	EXCORE NEUT MON SA RE-26-80B	RE-26-80B	7 FOOT HORIZONTAL SEPARATION FROM CH-001
INST	10058C*	SA	EXCORE NEUT MON SA RE-26-80B	RE-26-80B	7 FOOT HORIZONTAL SEPARATION FROM CH-001
INST	10138B*	SB	PRZR LVL Y LT-1110Y	LT-1110Y	
INST	10141C*	SB	PRZR PR LO RANGE PT-1104	PT-1104	
INST	10059A	SB	EXCORE NEUT MON SB RE-26-80A	RE-26-80A	7 FOOT HORIZONTAL SEPARATION FROM CH-001
INST	10059C*	SB	EXCORE NEUT MON SB RE-26-80A	RE-26-80A	7 FOOT HORIZONTAL SEPARATION FROM CH-001
MS	10319D*	SB	SG 1A BLDN FCV-23-4 PWR	FCV-23-4	
MS	10319E*	SB	SG 1A BLDN FCV-23-4 LS	FCV-23-4	
MS	10319K*	SB	SG 1B BLDN FCV-23-6 PWR	FCV-23-6	
MS	10319L*	SB	SG 1B BLDN FCV-23-6 LS	FCV-23-6	
RCS	10130B*		PCV-1100E LS RTGB IND	PCV-1100E	
RCS	10130E*		PCV-1100F LS RTGB IND	PCV-1100F	
RCS	10122E*		PRZR PROP HTR BK P1 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122F*		PRZR PROP HTR BK P1 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122G		PRZR PROP HTR BK P1 N1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122H		PRZR PROP HTR BK P1 F1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122J		PRZR PROP HTR BK P1 G1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10122K		PRZR PROP HTR BK P1 N2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122L		PRZR PROP HTR BK P1 F2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122M		PRZR PROP HTR BK P1 G2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122N		PRZR PROP HTR BK P1 N3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122P		PRZR PROP HTR BK P1 F3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122Q		PRZR PROP HTR BK P1 G3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122R		PRZR PROP HTR BK P1 N4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122S		PRZR PROP HTR BK P1 F4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10122T		PRZR PROP HTR BK P1 G4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123E*		PRZR PROP HTR BK P2 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123F*		PRZR PROP HTR BK P2 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123G		PRZR PROP HTR BK P2 AA1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123H		PRZR PROP HTR BK P2 R1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123J		PRZR PROP HTR BK P2 Q1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123K		PRZR PROP HTR BK P2 AA2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123L		PRZR PROP HTR BK P2 R2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123M		PRZR PROP HTR BK P2 Q2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123N		PRZR PROP HTR BK P2 AA3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123P		PRZR PROP HTR BK P2 R3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123Q		PRZR PROP HTR BK P2 Q3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123R		PRZR PROP HTR BK P2 AA4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123S		PRZR PROP HTR BK P2 R4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10123T		PRZR PROP HTR BK P2 Q4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124A*		PRZR BU HTR BK B1 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124B*		PRZR BU HTR BK B1 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124E		PRZR BU HTR BK B1 CC1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Table 1

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10124F		PRZR BU HTR BK B1 L1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124G		PRZR BU HTR BK B1 HH1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124H		PRZR BU HTR BK B1 CC2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124J		PRZR BU HTR BK B1 L2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124K		PRZR BU HTR BK B1 HH2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124L		PRZR BU HTR BK B1 CC3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124M		PRZR BU HTR BK B1 L3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124N		PRZR BU HTR BK B1 HH3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124P		PRZR BU HTR BK B1 CC4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124Q		PRZR BU HTR BK B1 L4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124R		PRZR BU HTR BK B1 HH4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124S		PRZR BU HTR BK B1 K1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124T		PRZR BU HTR BK B1 P1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10124U		PRZR BU HTR BK B1 P3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125A*		PRZR BU HTR BK B2 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125B*		PRZR BU HTR BK B2 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125E		PRZR BU HTR BK B2 H1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125F		PRZR BU HTR BK B2 B1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125G		PRZR BU HTR BK B2 GG1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125H		PRZR BU HTR BK B2 H2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125J		PRZR BU HTR BK B2 B2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125K		PRZR BU HTR BK B2 GG2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125L		PRZR BU HTR BK B2 H3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125M		PRZR BU HTR BK B2 B3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125N		PRZR BU HTR BK B2 GG3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125P		PRZR BU HTR BK B2 H4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10125Q		PRZR BU HTR BK B2 B4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125R		PRZR BU HTR BK B2 GG4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125S		PRZR BU HTR BK B2 P2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125T		PRZR BU HTR BK B2 P4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10125U		PRZR BU HTR BK B2 K4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126A*		PRZR BU HTR BK B3 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126B*		PRZR BU HTR BK B3 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126E		PRZR BU HTR BK B3 S1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126F		PRZR BU HTR BK B3 DD1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126G		PRZR BU HTR BK B3 Z1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126H		PRZR BU HTR BK B3 S2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126J		PRZR BU HTR BK B3 DD3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126K		PRZR BU HTR BK B3 Z2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126L		PRZR BU HTR BK B3 S3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126M		PRZR BU HTR BK B3 DD3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126N		PRZR BU HTR BK B3 Z3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126P		PRZR BU HTR BK B3 S4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126Q		PRZR BU HTR BK B3 DD4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126R		PRZR BU HTR BK B3 Z4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126S		PRZR BU HTR BK B3 E1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126T		PRZR BU HTR BK B3 FF1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126U		PRZR BU HTR BK B3 J2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126V		PRZR BU HTR BK B3 E2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126W		PRZR BU HTR BK B3 FF4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10126X		PRZR BU HTR BK B3 J3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127A*		PRZR BU HTR BK B4 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10127B*		PRZR BU HTR BK B4 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127E		PRZR BU HTR BK B4 U1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127F		PRZR BU HTR BK B4 Y1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127G		PRZR BU HTR BK B4 W1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127H		PRZR BU HTR BK B4 U2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127J		PRZR BU HTR BK B4 Y2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127K		PRZR BU HTR BK B4 W2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127L		PRZR BU HTR BK B4 U3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127M		PRZR BU HTR BK B4 Y3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127N		PRZR BU HTR BK B4 W3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127P		PRZR BU HTR BK B4 U4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127Q		PRZR BU HTR BK B4 Y4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127R		PRZR BU HTR BK B4 W4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127S		PRZR BU HTR BK B4 J1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127T		PRZR BU HTR BK B4 M2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10127U		PRZR BU HTR BK B4 K2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128A*		PRZR BU HTR BK B5 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128B*		PRZR BU HTR BK B5 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128E		PRZR BU HTR BK B5 EE1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128F		PRZR BU HTR BK B5 BB1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128G		PRZR BU HTR BK B5 D1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128H		PRZR BU HTR BK B5 EE2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128J		PRZR BU HTR BK B5 BB2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128K		PRZR BU HTR BK B5 D2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128L		PRZR BU HTR BK B5 EE3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128M		PRZR BU HTR BK B5 BB3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10128N		PRZR BU HTR BK B5 D3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128P		PRZR BU HTR BK B5 EE4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128Q		PRZR BU HTR BK B5 BB4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128R		PRZR BU HTR BK B5 D4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128S		PRZR BU HTR BK B5 J4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128T		PRZR BU HTR BK B5 M1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10128U		PRZR BU HTR BK B5 K3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129A*		PRZR BU HTR BK B6 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129B*		PRZR BU HTR BK B6 PNL PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129E		PRZR BU HTR BK B6 X1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129F		PRZR BU HTR BK B6 C1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129G		PRZR BU HTR BK B6 T1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129H		PRZR BU HTR BK B6 X2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129J		PRZR BU HTR BK B6 C2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129K		PRZR BU HTR BK B6 T2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129L		PRZR BU HTR BK B6 X3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129M		PRZR BU HTR BK B6 C3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129N		PRZR BU HTR BK B6 T3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129P		PRZR BU HTR BK B6 X4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129Q		PRZR BU HTR BK B6 C4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129R		PRZR BU HTR BK B6 T4 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129S		PRZR BU HTR BK B6 A1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129T		PRZR BU HTR BK B6 FF2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129U		PRZR BU HTR BK B6 V2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129V		PRZR BU HTR BK B6 A2 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10129W		PRZR BU HTR BK B6 FF3 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
RCS	10129X		PRZR BU HTR BK B6 V1 PWR	Pzr Htrs	Loss of heaters requires proceeding to cold shutdown
RCS	10130C*	IA	PCV-1100E E/P 1100E	PCV-1100E	Spurious actuation concern - pzr spray
RCS	10130D*	IA	PCV-1100F E/P 1100F	PCV-1100F	Spurious actuation concern - pzr spray
SI	10243D*	SA	SIT 1A1 V-3623 LS	V-3623	
SI	10243C*	SA	SIT 1A1 V-3623 PWR	V-3623	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10269C*	SA	SIT 1A1 ISOL V-3624 LS	V-3624	
SI	10269D*	SA	SIT 1A1 ISOL V-3624 LCL CNTL	V-3624	
SI	10269H	SA	SIT 1A1 V-3624 LCL CNTL & IND	V-3624	
SI	10269J*	SA	SIT 1A1 ISOL V-3624 RTGB IND	V-3624	
SI	10269A*	SA	SIT 1A1 ISOL V-3624 PWR	V-3624	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10243H*	SA	SIT 1B2 V-3643 LS	V-3643	
SI	10243G*	SA	SIT 1B2 V-3643 PWR	V-3643	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10272C*	SA	SIT 1B2 ISOL V-3644 LS	V-3644	
SI	10272D*	SA	SIT 1B2 ISOL V-3644 LCL CNTL	V-3644	
SI	10272H	SA	SIT 1B2 ISOL V-3644 CNTL & IND	V-3644	
SI	10272J*	SA	SIT 1B2 ISOL V-3644 RTGB IND	V-3644	
SI	10272A*	SA	SIT 1B2 ISOL V-3644 PWR	V-3644	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10243B*	SB	SIT 1A2 V-3613 LS	V-3613	
SI	10243A*	SB	SIT 1A2 V-3613 PWR	V-3613	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10270C*	SB	SIT 1A2 ISOL V-3614 LS	V-3614	
SI	10270D*	SB	SIT 1A2 ISOL V-3614 LCL CNTL	V-3614	
SI	10270H	SB	SIT 1A2 ISOL V-3614 CNTL & IND	V-3614	
SI	10270J*	SB	SIT 1A2 ISOL V-3614 RTGB IND	V-3614	
SI	10270A*	SB	SIT 1A2 ISOL V-3614 PWR	V-3614	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN
SI	10243F*	SB	SIT 1B1 V-3633 LS	V-3633	
SI	10243E*	SB	SIT 1B1 V-3633 PWR	V-3633	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN

Table 1

Sys	Cable#	Trn	Cable Function	Equipment ID	Remarks
SI	10271C*	SB	SIT 1B1 ISOL V-3634 LS	V-3634	
SI	10271D*	SB	SIT 1B1 ISOL V-3634 LCL CNTL	V-3634	
SI	10271H	SB	SIT 1B1 ISOL V-3634 CNTL & IND	V-3634	
SI	10271J*	SB	SIT 1B1 ISOL V-3634 RTGB IND	V-3634	
SI	10271A*	SB	SIT 1B1 ISOL V-3634 PWR	V-3634	NEEDED TO ISOLATE SIT FOR COLD SHUTDOWN

Table 2

FIRE MODELING WORKSHEET
Peak Fire Intensity 770 Btu/sec

FIXED COMBUSTIBLE / RADIANT EXPOSURE
ENGLISH UNITS VERSION

1	CRITICAL RADIANT FLUX TO TARGET (REPRESENTATIVE CONSERVATIVE VALUE = 1) LOOK UP VALUE FROM TABLE 1E	0.5	Btu/s/ft2
2	PEAK FIRE INTENSITY (USE TABLE 2E FOR GUIDANCE	770	Btu/s
3	RADIANT FRACTION OF HEAT RELEASE (REPRESENTATIVE VALUE = 0.4	0.4	--
4	RADIANT HEAT RELEASE RATE ([BOX2]X[BOX3])	308	Btu/s
5	CRITICAL RADIANT FLUX DISTANCE (LOOK UP VALUE FROM TABLE 10E)	7.00	ft
6	ACTUAL DISTANCE BETWEEN SOUCE/TARGET (FROM FIRE COMPARTMENT CCDS)	7	ft
	IF THE EXPOSURE FIRE IS LOCATED WITHIN THIS DISTANCE (INDICATED IN BOX 5) OF THE TARGET, CRITICAL CONDITIONS CAN OCCUR. OUTSIDE THIS RANGE, CRITICAL CONDITIONS ARE NOT INDICATED FOR THE SCENARIO UNDER CONDSIDERATION		

Table 3

FIRE MODELING WORKSHEET
Peak Fire Intensity 1540 Btu/sec

FIXED COMBUSTIBLE / RADIANT EXPOSURE
ENGLISH UNITS VERSION

1	CRITICAL RADIANT FLUX TO TARGET (REPRESENTATIVE CONSERVATIVE VALUE = 1) LOOK UP VALUE FROM TABLE 1E	1.0	Btu/s/ft2
2	PEAK FIRE INTENSITY (USE TABLE 2E FOR GUIDANCE	1540	Btu/s
3	RADIANT FRACTION OF HEAT RELEASE (REPRESENTATIVE VALUE = 0.4	0.4	--
4	RADIANT HEAT RELEASE RATE ([BOX2]X[BOX3])	616	Btu/s
5	CRITICAL RADIANT FLUX DISTANCE (LOOK UP VALUE FROM TABLE 10E)	7.00	ft
6	ACTUAL DISTANCE BETWEEN SOUCE/TARGET (FROM FIRE COMPARTMENT CCDS)	7	ft
	IF THE EXPOSURE FIRE IS LOCATED WITHIN THIS DISTANCE (INDICATED IN BOX 5) OF THE TARGET, CRITICAL CONDITIONS CAN OCCUR. OUTSIDE THIS RANGE, CRITICAL CONDITIONS ARE NOT INDICATED FOR THE SCENARIO UNDER CONDSIDERATION		