Enclosure 4 to AEP-NRC-2016-83

DONALD C. COOK NUCLEAR PLANT

Calculation PRA-QNT-007, Calculation of Regulatory Guide 1.177 Risk Parameters for Potential One-Time Emergency Technical Specification Completion Time Change for Unit 1 and Unit 2 Train B Reserve Feed

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CALCULATION/REPORT COVER SHEET

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Title: Calculation of Regulatory Guide 1.177 Risk Parameters for Potential One-Time Emergency Technical Specification Completion Time Change for Unit 1 and Unit 2 Train B Reserve Feed

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Description: This calculation documents the PRA quantitative risk impact and allowed outage time associated with MODE 1 full power operation of CNP Unit 1 during U2C23 with Unit 1 and Unit 2 Train B Reserve Feed out of service for a potential one-time extended TS CT.

If the Reviewer is the Preparer's supervisor, the supervisor review is needed and is approved: ☒ N/A

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Qualification Matrix Verification

* The responsible Engineering Supervisor/Manager approval signature also serves to signify that the qualifications of the individual(s) assigned as Preparer(s) and Reviewer(s) and Independent Design Verifier(s) were verified in the Plant Qualification Matrix.

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This document includes the following pages: 1-19 (19 Pages total)

Table of Contents

List of Tables

List of Figures

List of Attachments

List of Abbreviations

AFW	Auxiliary Feedwater
AMSAC	ATWS Mitigating System Actuation Circuitry
ATWS	Anticipated Transient Without Scram
CCP	Centrifugal Charging Pump
CDF	Core Damage Frequency
CST	Condensate Storage Tank
CRDM	Control Rod Drive Mechanism
CT	Completion Time
CTS	Containment Spray system
CVCS	Chemical and Volume Control System
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EOP	Emergency Operating Procedure
ESFAS	Engineered Safety Features Actuation System
ESW	Essential Service Water
FW	Feedwater
F-V	Fussell-Vesely
HEP	Human Error Probability
HFE	Human Failure Event
HLR	High Level Requirement
HSS	High Safety Significant
ICCDP	Integrated Conditional Core Damage Probability
ICLERP	Integrated Conditional Large Early Release Probability
IE	Internal Events
LERF	Large Early Release Frequency
LOCA	Loss of Coolant Accident
LSS	Low Safety Significant
MAAP	Modular Accident Analysis Program
MDAFP	Motor-Driven Auxiliary Feedwater Pump
MOR or MORW	Model of Record
MTI	Maintenance Technical – Instrument and Control
NRC	Nuclear Regulatory Commission
OOS	Out of service or Unavailable
PAC	Plant Air Compressor
PORV	Power-Operated Relief Valve
PRA	Probabilistic Risk Assessment
PDS	Plant Damage State
PRM	Plant Response Model
RAW	Risk Achievement Worth
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RWST	Refueling Water Storage Tank
SDG	Supplemental Diesel Generator
SBO	Station Blackout
SG	Steam Generator
SR	Supporting Requirement
SSPS	Solid State Protection System
SI	Safety Injection
SIP	Safety Injection Pump
TDAFP	Turbine-Driven Auxiliary Feedwater Pump
TS	Technical Specification

1 Purpose

This calculation documents the PRA quantitative risk impact and allowed outage time associated with MODE 1 full power operation of CNP Unit 1 during U2C23 with Unit 1 and Unit 2 Train B Reserve Feed out of service for a potential one-time extended TS CT. It contains information in a format that is readily usable in the Emergent Technical Specification Change request for continued unit operation if the unavailability of the Unit 1 and Unit 2 Train B Reserve Feed exceeds plant TS CT time limits.

2 Method

The PRA risk impact of operation with Unit 1 and Unit 2 Train B Reserve Feed unavailable will be estimated using the PRA Model (Input 3.1) and an updated Fire PRA model (Input 3.2), modified for this application as described in this document. Truncation limits for the model are identical to the truncation limits used in the associated model documentation that is demonstrated to be convergent. Regulatory Guide 1.177 (Reference 7.7) risk parameters are calculated using the following general equations:

$\Delta CDF = CDF_{inst} - CDF_{base}$

where

CDF_{inst} = the Unit 1 CDF value when only Train B Reserve Feed is unavailable, with appropriate allowances for the operation and maintenance restrictions described below (Assumption 4.1) are in place

CDF_{base} = the Unit 1 "base case" nominal maintenance CDF value

$\Delta LERF = LERF_{new} - LERF_{base}$

where

$LERF_{inst}$ = the Unit 1 LERF value when only Train B Reserve Feed is unavailable, with appropriate allowances for the operation and maintenance restrictions described below (Assumption 4.1) are in place

$LERF_{ave}$ = the Unit 1 "base case" nominal maintenance LERF value

ICCDP = (ΔCDF)*(Duration (days) / 365 days/year)

ICLERP = (ΔLERF)*(Duration (days) /365 days/year)

The Westinghouse Generation III SHIELD seal (referred to as the Shutdown Seal or SDS) has been installed in both units. The updated FPIE model credits the capability of this seal based on the guidance in PWROG-14001 (Reference 7.4). The Fire PRA model does not currently credit the SDS and will not credit it for this analysis.

Two risk cases in both the FPIE and Fire PRA models are quantified for this analysis:

1. A baseline CDF and LERF value with nominal test and maintenance.
2. CDF and LERF values with Unit 1 and Unit 2 Train B Reserve Feed failed, with zero maintenance other than the exceptions listed in Assumption 4.1.

The FPIE model is a CAFTA two-top (CDF and LERF) fault tree model and the two risk cases are quantified using PRAQuant and fault tree solver FTREX. The model is solved at the truncation levels demonstrated for convergence in the FPIE quantification notebook (Reference 7.1).

The Fire PRA model is a WinNUPRA two-top (CDF and LERF) fault tree model and the two risk cases are quantified using the WinNUPRA software package. The model is solved at the truncation levels demonstrated for convergence in the Fire PRA working model notebook (Reference 7.2).

3 Inputs

This is a non-design calculation and there are no design inputs. This section only lists the PRA model revisions used for clarity.

3.1 The 2016 FPIE model of record (model revision CNP FPIE 2016-R0, Reference 7.1) is used to calculate the risk from internal events and internal flooding.

3.2 The Fire PRA working model contains refinements to address a condition identified in late 2015 (Reference 7.9) in which it was identified that CNP did not perform a peer review which was a license condition of the NFPA 805 transition. This model (model revision CNP FIRE 2016-R0w1, Reference 7.2) is used to calculate the risk from internal fires. This model revision contains credit for a still to be completed fire wrapping modification, and credit for this modification is removed for this calculation (Assumption 4.6).

This version of the Fire PRA model is considered to be acceptable for use as an application-specific model in an emergent license amendment request, as opposed to the current model of record as this updated model corrects several identified deficiencies and resolves findings from the LERF model focused-scope peer review. Sufficient documentation of the model changes is provided for eventual update into the model of record documentation, and quantification convergence has been demonstrated in accordance with the PRA standard (Reference 7.5). Although the documentation does not strictly meet the PRA standard supporting requirements, it is considered to be sufficient for emergent license amendment requests (Assumption 4.8).

4 Assumptions

4.1 The average PRA model basic events for the following equipment are adjusted to match the out of service durations during the Unit 1 and Unit 2 Train B Reserve Feed outage.

- Unit 2 is currently in a scheduled refueling outage. The majority of the mitigating systems on Unit 2 Train B are currently unavailable and will remain unavailable during the duration of the Unit 1 and Unit 2 Train B Reserve Feed outage. Although it is possible that some Unit 2 Train B equipment will be available during the outage, it will not be credited for this analysis.

- The Unit 1 East – Unit 2 West ESW crosstie is scheduled to be closed for outage work on the Unit 2 West ESW pump. This crosstie valve will be assumed to be closed for this risk analysis.

- No additional Unit 1 equipment will be unavailable for the duration of the Unit 1 and Unit 2 Train B Reserve Feed outage.

- No surveillance testing will occur on Unit 1 PRA credited equipment

4.2 The Westinghouse Gen III SHIELD seal (referred to as the Shutdown Seal or SDS) has been installed in both units. The updated FPIE model credits the capability of this seal based on the guidance in PWROG-14001 (Reference 7.4). The Fire PRA does not currently credit the SDS and credit will not be applied for this calculation.

4.3 To the extent practicable and controllable, no other work is assumed be undertaken that could jeopardize operation of Unit 1. For example, main turbine valve testing or similar activities, or maintenance work on BOP components that have potential to initiate a unit trip, are assumed to be avoided while repair of Unit 1 and Unit 2 Train B Reserve Feed is in progress

4.4 The plant operating equipment alignment (i.e., secondary plant pumps such as condensate booster pumps, hotwell pumps, or generator cooling pumps and fans) is assumed to not be changed, except in response to emergent equipment conditions or failures that require action to maintain the unit in operation. That is, no purely elective change in plant alignment that could challenge unit operation with a transient is assumed during the Unit 1 and Unit 2 Train B Reserve Feed cable repair.

4.5 Unit 1 and Unit 2 Train B Reserve Feed repair work is assumed to proceed around the clock, to an identified plan and schedule, until reserve feed is again available. The total duration is assumed to be 100 hours.

4.6 A modification to install fire wrap on the Unit 1 Train B DIS cables is currently in progress and is credited in the Fire PRA working model. Credit for this modification is removed for this risk analysis. The impact of this change on the base case LERF Fire PRA result is estimated by cutset manipulation in WinNUPRA. This is conservative, because this method slightly underestimates the increase (due to truncation) and thus overestimates the delta CDF.

4.7 Since Unit 2 is not online, only the risk to Unit 1 is quantified for this risk analysis. Shutdown risk for Unit 2 is currently being managed by the shutdown risk management program and will continue to be managed by that program for the duration of the reserve feed outage.

4.8 The working model version of the Fire PRA model is considered to be acceptable for use as an application-specific model in an emergent license amendment request, as opposed to the current model of record as this updated model corrects several identified deficiencies and resolves findings from the LERF model focused-scope peer review. Sufficient documentation of the model changes is provided for eventual update into the model of record documentation, and quantification convergence has been demonstrated in accordance with the PRA standard (Reference 7.5). Although the documentation does not strictly meet the PRA standard supporting requirements, it is considered to be sufficient for emergent license amendment requests.

5 Calculations

5.1 Modifications to the Fire PRA model

As discussed in Assumption 4.6, the Fire PRA currently credits a modification to install fire wrap on the Unit 1 Train B DIS cables in the turbine building (Reference 7.2). Credit for this modification is removed by setting the HFEs to restore power to DIS in the turbine building to logically true (always failed). The following basic events are set to failed:

Table 1 – Fire PRA HFEs Modified

Basic Event Name	Basic Event Description
1Z--ALTPWR3A-OMA	ALT SOURCE OF PWR TO H2 IGNITER NOAFW/480GPM/DELAY
1Z--ALTPWR3B-OMA	ALT SOURCE OF PWR TO H2 IGNITER AFW/480GPM/DELAY
1Z--ALTPWR3C-OMA	ALT SOURCE OF PWR TO H2 IGNITER NOAFW/<480GPM/DELAY
1Z--ALTPWR3D-OMA	ALT SOURCE OF PWR TO H2 IGNITER AFW/<480GPM/DELAY

5.2 Quantification of Unit 1 and Unit 2 Train B Reserve Feed Outage

One case of the FPIE and Fire PRA models are run consistent with the cases developed in Section 2. The baseline CDF and LERF values

The FPIE model is solved using the PRAQuant file (DC1-OSP.qnt) at a 5E-11 truncation for CDF and 5E-13 truncation for LERF, consistent with the truncation used for the base model quantification (Reference 7.1). Flag files are used as described below to modify the model for quantification.

The Fire PRA model is solved using a CCDP/CLERP truncation of 1E-10, and a concatenation truncation of 1E-10 for CDF and 1E-11 for LERF. The quantification process used is described in the working model notebook (Reference 7.2). Basic event data files are used as described below to modify the model for quantification.

1. A baseline CDF and LERF value with nominal test and maintenance values

    a. For the FPIE Model, these values are taken from the quantification notebook (Reference 7.1)

    b. For the Fire PRA model, this is taken from the working model notebook (Reference 7.2). The LERF value is estimated by using the WinNUPRA sensitivity module which manipulates cutsets. This is conservative, because this method slightly underestimates the increase (due to truncation) and thus overestimates the delta CDF. The basic events modified in Table 1 are set to 1.0 and the higher LERF value is reported as the basecase.

2. CDF and LERF values with Unit 1 and Unit 2 Train B Reserve Feed failed, with zero maintenance other than the exceptions listed in Assumption 4.1. Since the FPIE model uses CAFTA and the Fire PRA uses WinNUPRA, the modified basic events and process are different but accomplish the same thing.

    a. For the FPIE model, a CAFTA flag file is used (DC1-U2C23-TR-B-OSP.flg) to modify the following basic events.

       The 4kV bus basic events represent failure of reserve feed, since other power sources are incapable of powering that bus. The Unit 2 Train B EDG and EP breakers are also failed to ensure the train is fully unpowered. SDG, CCW heat exchanger, and ESW crosstie alignments are set in accordance with operating practices during the Unit 2 Train B outage.

Table 2 – FPIE Basic Event Settings for Unit 1 and Unit 2 Train B Reserve Feed Outage

Component	Basic Event	Probability
Unit 2 Bus 2A	2ABBS------2AFA	1
Unit 2 Bus 2B	2ABBS------2BFA	1
Unit 1 Bus 1A	1ABBS------1AFA	1
Unit 1 Bus 1B	1ABBS------1BFA	1
Unit 2 AB EDG	2SBDG----DGABFR	1
Unit 2 EP Breaker T21A12 to 4kV Bus T21A	2ABCB--T21A12CO	1
Unit 2 EP Breaker T21B2 to 4kV Bus T21B	2ABCB---T21B2CO	1
Probability SDG aligned to Unit 2 Train A	F-SDG-FEED-2CD	1
Probability SDG aligned to Unit 2 Train B	F-SDG-FEED-2AB	0
Probability Unit 2 East CCW Heat Exchanger in service	CCW-2EAST-HX	1
Probability Unit 2 West CCW Heat Exchanger in service	CCW-2WEST-HX	0
Unit 1 West-Unit 2 East ESW Crosstie Closed (IE PRA Only)	XHOS-1W2E-ESW-XT	1
All other Test or Maintenance Events	Basic Events ending in "TM" and "TM2"	0

b. For the Fire PRA model, the Resolve.BED basic event data file is edited to add the following basic events. Resolve.BED is an override file which overrides the basic event values for each fire scenario during Fire PRA quantifications. In addition to the basic events modified for the internal events analysis, the Unit 2 Train B pumps are also failed in the Fire PRA to ensure fire failures of the equipment are not double counted.

Table 3 – Fire PRA Basic Event Settings for Unit 1 and Unit 2 Train B Reserve Feed Outage

Component	Basic Event	Probability
4KV BUS 1A GENERAL FAILURE ALL FAILURE MODES	1ABBS------1AFA	1
4KV BUS 1B GENERAL FAILURE ALL FAILURE MODES	1ABBS------1BFA	1
4KV BUS 2A GENERAL FAILURE ALL FAILURE MODES	2ABBS------2AFA	1
4KV BUS 2B GENERAL FAILURE ALL FAILURE MODES	2ABBS------2BFA	1
4KV BREAKER T21B2 FAILS TO REMAIN CLOSED	2ABCB---T21B2CO	1
4KV BREAKER T21A12 FAILS TO REMAIN CLOSED	2ABCB--T21A12CO	1
MOTOR PUMP PP-7W OP PUMP FAILS TO CONTINUE RUNNING	2BBPM----PP7WPR	1
MOTOR PUMP PP-10W FAILS TO CONTINUE RUNNING	2CBPM---PP10WPR	1
MOTOR PUMP PP-3W OP PUMP FAILS TO CONTINUE RUNNING	2DBPM----PP3WPR	1
MOTOR PUMP PP-50W OP PUMP FAILS TO CONTINUE RUNNING	2FBPM---PP50WPR	1
EDG DGAB FAILS TO CONTINUE RUNNING	2SBDG----DGABFR	1
FRACTION OF TIME UNIT 2 EAST CCW IS IN SERVICE	UNIT-2-E-CCW	1
FRACTION OF TIME UNIT 2 WEST CCW IS IN SERVICE	UNIT-2-W-CCW	0

5.3 CDF and LERF Results

The final results are presented in the tables below. ICCDP and ICLERP results are calculated assuming a total duration of 100 hours using the equations from Section 2.

Table 4 – FPIE PRA Model Results

FPIE Case	Internal Events CDF (/yr)	Internal Events LERF (/yr)	ICCDP	ICLERP
FPIE Base Case	2.0E-05	2.7E-06	1.1E-07	1.6E-08
Unit 1 and Unit 2 Train B Reserve Feed Current Outage Configuration	3.0E-05	4.1E-06		

Table 5 - Fire PRA Model Results

Fire PRA Case	Fire CDF (/yr)	Fire LERF (/yr)	ICCDP	ICLERP
Fire PRA Base Case	5.4E-05	4.0E-06	1.1E-06	1.1E-07
Unit 1 and Unit 2 Train B Reserve Feed Current Outage Configuration	1.5E-04	1.4E-05		

Table 6 - Total CDF and LERF Results

Case	ICCDP	ICLERP
FPIE	1.1E-07	1.6E-08
Fire PRA	1.1E-06	1.1E-07
Total	1.2E-06	1.3E-07

5.4 Analysis of Results

This section presents an analysis of the Internal Events and Fire PRA model results. Importance analyses and cutsets from risk-significant sequences are analyzed for risk insights.

5.4.1 Internal Events Model Results Analysis

The additional risk from internal initiating events from CDF and LERF is provided in Figure 1 and Figure 2. The top operator actions are shown in Table 7 and Table 8. To produce these importance rankings, the CAFTA cutset files from the configuration case is delete-termed against the base case, to produce a cutset file that has only changed cutsets in it. This process is done for both CDF and LERF. The contribution of cutsets containing the listed events (F-V importance expressed as a percentage) is also provided.

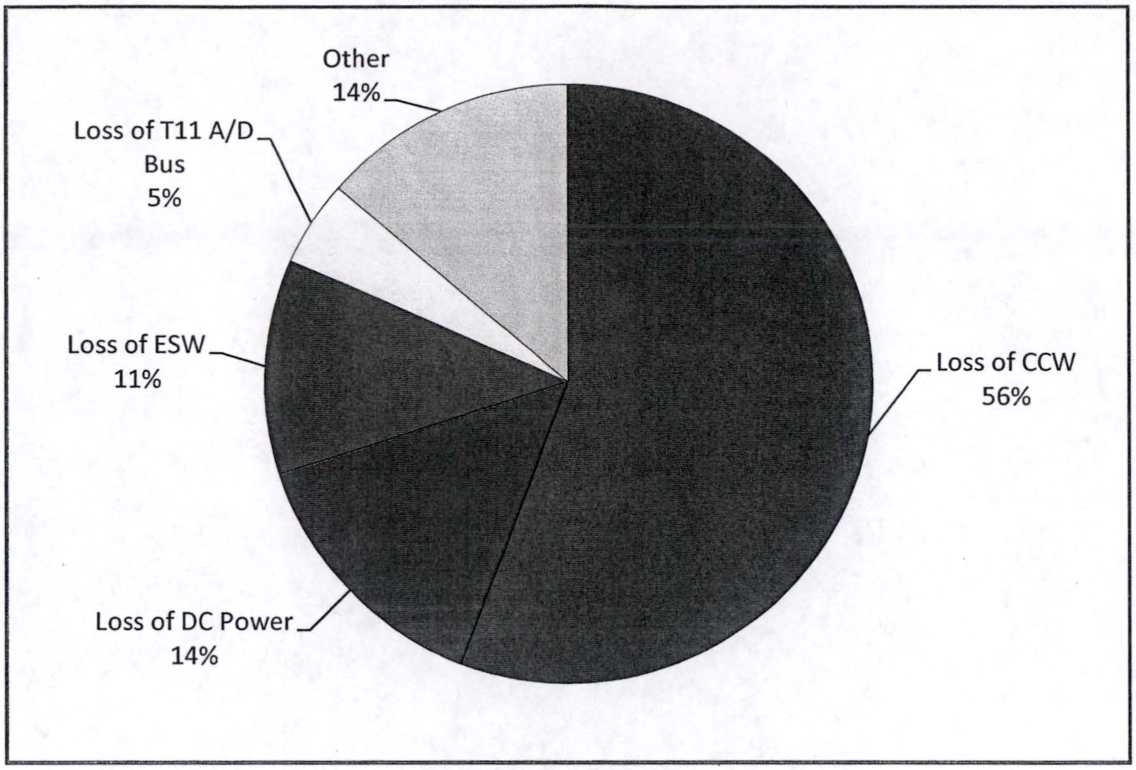

Figure 1 - Additional Risk by Initiating Event for FPIE Model (CDF)

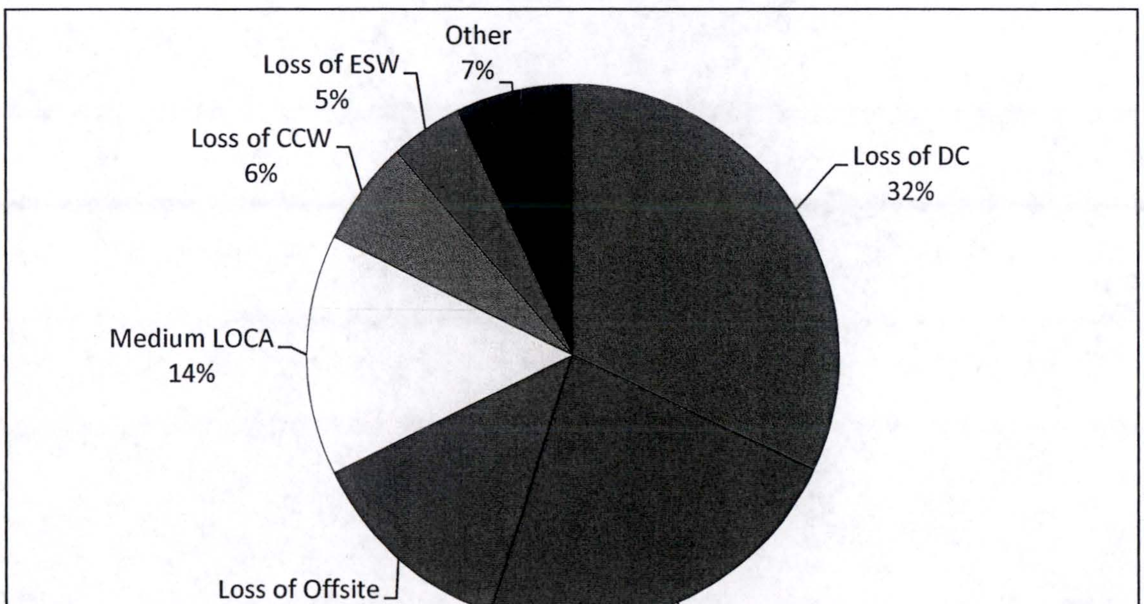

Figure 2 - Additional Risk by Initiating Event for FPIE Model (LERF)

Table 7 – FPIE CDF Top Operator Actions

Basic Event Description	Basic Event Name	% CDF
RECOGNIZE RCP CVCS NEEDS COOLING	1-----CCW-COGHE	9%
TRIP RCP EARLY BEFORE SDS DMG	1-----CCW-RCPHE2	7%
COOLDOWN, DEPRESSURIZE AND TERMINATE SI	1-------E3-CDHE	3%
CROSS-TIE TO UNIT 2 AFW	0D---XTIEUNITHE	1%
XFER 69KV ALT POWERSOURCE TO BUS T11B	1ABBS-T11B-EPHE	1%

Table 8 - FPIE LERF Top Operator Actions

Basic Event Description	Basic Event Name	% LERF
COOLDOWN, DEPRESSURIZE AND TERMINATE SI	1-------E3-CDHE	16%
XFER 69KV ALT POWERSOURCE TO BUS T11B	1ABBS-T11B-EPHE	6%
CLOSE BKR BTWN EP AND T-BUS	0A-EP-TBUS---HE	3%
CROSS-TIE TO UNIT 2 AFW	0D---XTIEUNITHE	1%
OPERATOR FAILS TO ISOLATE RUPTURED SG (EXECUTION)	1------SG-ISOHE	0.8%

The additional initiating event risk from the FPIE model for the configuration for CDF indicates that most of the risk comes from loss of CCW events, followed by loss of DC power (primarily to Train A). This is reasonable as the Unit 2 Train B CCW pump is not assumed to be available, so the loss of CCW can occur due to a failure of only three pumps instead of all four.

For LERF the loss of DC event is the most significant because SBO sequences are high LERF contributors due to lack of power for the hydrogen igniters. The second most significant LERF event is a SGTR, because SGTR often results in a containment bypass and is thus a large LERF contributor. CCW sequences are not as significant because AFW is typically available (it is not reliant on CCW support) which prevents induced SGTRs during a severe accident.

The top two operator actions for CDF involve tripping the RCPs after a loss of RCP seal cooling. This limits the RCP seal LOCA size to less than 480 gpm/pump can be mitigated using the CVCS and AFW crossties from the opposite unit.

Other top operator actions for CDF include cooling down after a SGTR, crosstie of AFW, and aligning EP to the 4kV safety busses. This result is reasonable as the Unit 2 Train B equipment and reserve feed outage has placed more emphasis on previously significant events.

The LERF results are very similar, with additional SGTR and SBO mitigating actions being included. This is reasonable for LERF as SGTR and SBO sequences are more LERF significant for the reasons described in the initiating event review.

The top modified CDF cutsets support the importance metric review insights.

```
7.49E-07    IE-VDC-A      0-SEQ-CCWT-006      164-GPM
            1ABCB---T11A9FO    SDSSUCCESS
5.66E-07    IE-CCW        0-SEQ-CCW-013       21-GPM        CCW-1EAST
            FL-ESW-CCW-NO-R    PP10PR----CCF123   RCP-LO1      SDSFAILTOACTUATE
5.66E-07    IE-CCW        0-SEQ-CCW-013       21-GPM        CCW-1WEST
            FL-ESW-CCW-NO-R    PP10PR----CCF123   RCP-LO1      SDSFAILTOACTUATE
3.81E-07    IE-ESW4       0-SEQ-ESW-013       21-GPM        BPM-RUNFR-CCF123
            ESW-1EAST2EAST     FL-ESW-CCW-NO-R    RCP-LO1      SDSFAILTOACTUATE
3.02E-07    IE-CCW        0-SEQ-CCW-007       164-GPM       1-----CCW-COGHE
```

```
CCW-1EAST    FL-ESW-CCW-NO-R    PP10PR----CCF123  SDSSUCCESS
```

The top changed cutset is a loss of Unit 1 Train A DC initiating event, followed by failure to disconnect 4kV bus T11A from the RCP bus, resulting in inability to close the EDG breaker due to electrical interlocks. The loss of DC prevents any large breakers on the Unit 1 Train A electrical system from being aligned, which results in an unrecoverable SBO and eventually core damage.

The next 4 changed cutsets all involve a loss of CCW or ESW initiating event, which is the result of a common cause failure of all three CCW or ESW pumps that are available. This cutset appears because the Unit 2 Train B pumps are initially unavailable.

The importance analysis was also reviewed for a list of important equipment to confirm the findings from the cutset review. When ranked by RAW, the following components were indicated to be the most important (CDF ranking is shown, LERF ranking offers similar insights). The ranking indicates that the most important equipment is the Train B DC system (both long term and short term mission times are shown). This is due to the high importance of the loss of Train A DC in the initiating events analysis. The second most important equipment is the Unit 1 East CCW train.

Table 9 – FPIE Risk-Significant Equipment (CDF RAW)

Basic Event Description	Basic Event Name	RAW
BATTERY BANK AB FAILURE IN 1 HR MISSION TIME	1RBBY--BANKABFA1	2764
DISTRIB PANEL TDAB GENERAL FAILURE IN 1HR MISSION TIME	1RBDP----TDABFA1	2574
MOTOR PUMP PP-10E FAILS TO CONTINUE RUNNING	1CAPM---PP10EPR	1171
HEAT EXCH HE-15E PLUGGING	1CAHE---HE15EPL	1037
BATTERY BANK AB FAILURE	1RBBY--BANKABFA	690
DISTRIB PANEL TDAB GENERAL FAILURE	1RBDP----TDABFA	655

Based on a review of the results, risk management actions should focus on protecting the Unit 2 Train A equipment, and the Unit 1 ESW and CCW systems. Operators should focus on the most risk-significant actions related to a loss of CCW or ESW and the potential for loss of power due to only one train of reserve feed remaining. Equipment protection for electrical systems and CCW and ESW are of particular importance. Although SGTR was identified as a contributor, the additional risk from this event is primarily due to the potential for loss of power, so an emphasis on protecting equipment is appropriate.

5.4.2 Fire PRA Model Results Analysis

The top operator actions and fire scenarios from the Fire PRA quantification are presented in Table 10 through Table 13. The contribution of cutsets containing the event to CDF and LERF (F-V importance expressed as a percentage) is used to rank the importance values.

Table 10 – Fire CDF Top Operator Actions

Basic Event Description	Basic Event Name	% CDF
OPERATOR FAILS TO MAN. OPEN ONE BIT OUT VLVS	1--SY-BITOUT-OMA	21%
OPERATOR FAILS TO TRIP RCP (FIRE)	1-----CCW-RCPHEF	14%
OPERATOR FAILS CVCS CROSSTIE (COGNITION)	1F--COG-CVCS-OMA	3%
OPERATOR FAILS AFW CROSSTIE (MANIPULATION)	0D---XTIEUNITHEF	2%
OPERATOR FAILS TO CLOSE EP BREAKER	1A0BS-T11AD--HEF	1%

Table 11 – Fire LERF Top Operator Actions

Basic Event Description	Basic Event Name	% LERF
OPERATOR FAILS TO MAN. OPEN ONE BIT OUT VLVS	1--SY-BITOUT-OMA	22%
OPERATOR FAILS TO TRIP RCP (FIRE)	1-----CCW-RCPHEF	15%
OPERATOR FAILS TO ENERGIZE HYDROGEN IGNITERS (EXECUTION)	1Z-------8-EHHE	13%
OPERATOR FAILS TO ENERGIZE HYDROGEN IGNITERS (EXECUTION)	1Z-BS--1A-COGHE	8%
OPERATOR FAILS TO CLOSE EP BREAKER	0D---XTIEUNITHEF	3%

Table 12 - Fire CDF Top Fire Scenarios

Fire Scenario Description	Fire Scenario	% CDF
Fire in Unit 1 Turbine Building El' 609, Unit 1 Plant Air Compressor	IE-90Z-36	19%
Fire in Unit 1 Turbine Building El' 609, Unit 1 Control Air Compressor	IE-90Z-37	19%
All Fixed Fire Sources in Screenhouse (ESW) MCC Room for ESW	IE-FZ29G-F	5%
All Transient Fire Sources in Screenhouse MCC Room for ESW	IE-FZ29G-T	5%
Transient Fire in Unit 1 Containment Piping Annulus	IE-66-1	3%
Unit 1 ESW MCCs	IE-FZ29E-T	3%

Table 13 - Fire LERF Top Fire Scenarios

Fire Scenario Description	Fire Scenario	% LERF
Unit 1 Turbine Generator Severe Lube Oil Fire	IE-2A-1S	17%
Unit 1 Turbine Generator Hydrogen System Fire	IE-90Z-49S	17%
Fire in Unit 1 Turbine Building El' 609, Unit 1 Plant Air Compressor	IE-90Z-36	8%
Fire in Unit 1 Turbine Building El' 609, Unit 1 Control Air Compressor	IE-90Z-37	8%
Fixed Fire of 4kV Safety Bus T11D	IE-40B-T11D	4%
Fixed Fire of 4kV Safety Bus T11C	IE-40B-T11C	3%
Transient Fire in Unit 1 Containment Piping Annulus	IE-66-1	3%

The top operator actions include crosstie of CVCS following an RCP seal LOCA and failing to crosstie AFW. This is a logical result as the unavailability of the Unit 2 Train B ESW and CCW systems has increased the importance of

sequences involving RCP seal LOCAs. RCP seal LOCAs less than 480 gpm/pump can be mitigated using the CVCS and AFW crossties from the opposite unit.

The top actions also include an operator action to trip the RCPs. This limits the RCP seal LOCA size to less than 480 gpm/pump can be mitigated using the CVCS and AFW crossties from the opposite unit.

Also included are actions to energize the hydrogen igniters (for LERF) and to close in EP to the Unit 1 Safety Busses if the EDGs fail. These actions have highlighted importance because of the unavailability of a train of reserve feed.

The top fire scenarios include fire scenarios in the turbine building (Fire Zones 90-93) and the ESW pump areas (29E and 29G). These fire scenarios have increased importance because they fail both of the affected unit's ESW pumps leaving only one ESW pump (the Unit 2 East ESW pump) available to supply flow to both units. Since one pump is not always sufficient for Fire PRA success (because of the need to supply flow to both units), this is assumed to result in an RCP seal LOCA and require mitigation via the unit crossties. The top cutsets for scenario IE-90Z-36 confirm this analysis, and similar cutsets appear in other top scenarios. Although the turbine generator fires are also noted as significant, turbine generator fires are quick to develop and no qualitative benefit can be gained by establishing fire watches. The containment piping annulus is also generally not accessed at power and fire watches would provide limited benefit in this area.

```
1.    3.583e-003   1--LT480GPMPPSLF 1--SY-BITOUT-OMA IE-FIRE
                   UNIT-1-E-CCW
2.    2.390e-003   1-----CCW-RCPHEF IE-FIRE          UNIT-1-E-CCW
3.    1.250e-003   1---480GPMPP-SLF IE-FIRE          UNIT-1-E-CCW
4.    1.178e-003   1--LT480GPMPPSLF 2BAPM----PP7EPS  IE-FIRE
                   UNIT-1-E-CCW
5.    5.888e-004   1--LT480GPMPPSLF 2FAPM---PP50EPS  IE-FIRE
                   UNIT-1-E-CCW
6.    4.990e-004   1--LT480GPMPPSLF 1F--COG-CVCS-OMA IE-FIRE
                   UNIT-1-E-CCW
7.    3.977e-004   1--LT480GPMPPSLF 2CAPM---PP10EPS  IE-FIRE
                   UNIT-1-E-CCW
```

The top cutsets (except cutsets 2 and 3, which result in a greater than 480 gpm/pump seal LOCA which cannot be mitigated), all include an RCP seal LOCA, less than 480 gpm/pump, along with failure of crosstie to the other unit. These failures include failure of the operator action to crosstie CVCS, or hardware failures of the Unit 2 East ESW, CCW, or charging pumps.

Due to the nature of the Fire PRA, risk-significant equipment review does not provide the same insights as it does for the FPIE model, because it can be masked by the fact that many fires damage the risk significant equipment and thus it does not show up in a review of equipment importance. The insights from the fire scenario review provide a better overall picture of the important areas to protect from fires.

Based on the review of the results, risk management actions should focus on maintaining the Unit 2 Train A equipment as available, and establishing hourly fire watches in areas identified as risk significant. Operator action review should focus on the crosstie of CVCS and tripping the RCPs to mitigate an RCP seal LOCA.

6 Conclusions

This calculation analyzes the risk impact with MODE 1 full power operation of Cook Unit 1 with the Unit 1 and 2 Train B Reserve Feed out of service. The calculated values of 1.2E-06 ICCDP and 1.3E-7 ICLERP of are within the Regulatory Guide 1.177 acceptance guidelines of less than 1E-5 ICCDP and 1E-6 ICLERP for one time TS completion time changes, given a total TS completion time of 100 hours (Reference 7.7). This one-time TS completion time change is therefore considered acceptable with appropriate compensatory actions in place to reduce risk.

A configuration document impact assessment is not performed because this calculation is a one-time calculation intended to support a potential Exigent TS change, so it is known that no other documents are impacted by this calculation.

7 References

7.1 PRA-NB-QU, Internal Events Quantification Notebook, Revision 2, 9/1/2016

7.2 PRA-FIRE-NB-W, Fire PRA Working Model Notebook, Revision 1, 9/30/2016

7.3 PRA-FIRE-17663-005-LAR, DC Cook Fire PRA Fire-Induced Risk Model, Rev. 1, 11/5/2014

7.4 PWROG-14001-P, PRA Model for the Generation III Westinghouse Shutdown Seal, Rev. 1, July 2014

7.5 ASME/ANS RA-Sa-2009, Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plants, 2/2/2009

7.6 Regulatory Guide 1.200, AN APPROACH FOR DETERMINING THE TECHNICAL ADEQUACY OF PROBABILISTIC RISK ASSESSMENT RESULTS FOR RISK-INFORMED ACTIVITIES, Rev. 2, March 2009

7.7 Regulatory Guide 1.177, AN APPROACH FOR PLANT-SPECIFIC, RISK-INFORMED DECISIONMAKING: TECHNICAL SPECIFICATIONS, Rev. 1, May 2011

7.8 Regulatory Guide 1.174, AN APPROACH FOR USING PROBABILISTIC RISK ASSESSMENT IN RISK-INFORMED DECISIONS ON PLANTSPECIFIC CHANGES TO THE LICENSING BASIS Rev. 2 May 2011

7.9 AR 2015-13810, Quality of Resolution of NFPA 805 License Condition

Attachment 1 – Files on CD

The following files are critical to this calculation and are included in the attached CD:

Date	Time	Size	Filename
10/11/2016	09:06 AM	42,581,603	CNP FIRE 2016-R0w1-OSP.7z
10/09/2016	05:38 PM	72,036	DC1-CDF-BASE-ZTM-Imp.xlsx
10/09/2016	04:09 PM	656,428	DC1-CDF-BASE-ZTM.CUT
10/10/2016	08:24 PM	86,750	DC1-CDF-U2C23-TR-B-OSP-Imp.xlsx
10/09/2016	04:09 PM	1,753,196	DC1-CDF-U2C23-TR-B-OSP.CUT
10/09/2016	05:42 PM	112,614	DC1-LERF-BASE-ZTM-Imp.xlsx
10/09/2016	04:28 PM	5,549,038	DC1-LERF-BASE-ZTM.CUT
10/10/2016	08:24 PM	122,194	DC1-LERF-U2C23-TR-B-OSP-Imp.xlsx
10/09/2016	04:54 PM	10,325,444	DC1-LERF-U2C23-TR-B-OSP.CUT
10/09/2016	03:50 PM	321	DC1-U2C23-TR-B-OSP.flg
10/07/2016	11:33 AM	271	DC1-U2C23-U2TB.flg
10/09/2016	03:45 PM	29	DC1-ZTM.flg
10/10/2016	04:07 PM	267,989	DELTA-INI-HFE-IMP.xlsx
10/09/2016	03:13 PM	68,379	FIRE-HEP.BED
10/09/2016	03:13 PM	2,183,415	FIREBASE.BED
10/09/2016	03:14 PM	65,915	MCR-HEP.bed
10/09/2016	03:14 PM	16,019	Resolve.Bed
10/10/2016	08:25 PM	1,313,608	U1 CDF BASE ZTM FPRA IMP.xlsx
10/10/2016	08:24 PM	235,019	U1 CDF U2C23 TR B OSP FPRA IMP.xlsx
10/10/2016	08:25 PM	242,742	U1 LERF BASE ZTM FPRA IMP.xlsx
10/09/2016	09:56 PM	239,818	U1 LERF U2C23 TR B OSP FPRA IMP.xlsx