# Severe Accident Mitigation Design Alternatives (SAMDAs) for the APR1400

**Revision 2**

**Non-Proprietary**

**August 2018**

# REVISION HISTORY

| Revision | Date | Page/Section | Description |
|---|---|---|---|
| 0 | December. 2014 | All | First Issue |
| 1 | February 2018 | All | SAMDA evaluation and Level 3 analysis revisions based on 2017 PRA update |
| 2 | August 2018 | • Section 4.4.2, 4.4.4.5, 7.5.2 7.5.7, 7.6.4 7.6.6, 7.19.2 9.3.1, 9.3.3, 9.16.1, 10.4.2, 10.4.2.1 thru 10.4.2.6, 10.4.4.1 thru 10.4.4.7, 10.6, and 11<br>Appendix A: Sections 1, 5.1, 7, 8, 9, 10, and 11 | SAMDA evaluation and Level 3 analysis revisions for the 3% discounted rate sensitivity case. |

# ABSTRACT

This document represents the SAMDA analysis for the APR1400 design. Specifically, this report documents the calculation of the monetary value of unmitigated base risk, then evaluates the maximum risk reduction that could be expected from implementing a risk reduction strategy. Consideration of SAMDAs includes identifying a broad range of potential alternatives, then determining whether or not implementation of those alternatives is feasible or would be beneficial on a cost-risk reduction basis.

Preliminary screening eliminated all SAMDA candidates from further consideration, based on inapplicability to the APR1400 design, design features that have already been incorporated into the APR1400 design, inapplicability to a design certification analysis, or extremely high cost of the alternatives considered.

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAC | alternate alternating current |
| AC | alternating current |
| ADV | atmospheric dump valve |
| AF | auxiliary feedwater |
| AFW | auxiliary feedwater |
| AFWST | auxiliary feedwater storage tank |
| AMSAC | ATWS mitigation system actuation circuitry |
| AOC | averted offsite property damage costs |
| AOE | averted occupational exposures |
| AOSC | averted onsite costs |
| AOV | air-operated valve |
| APE | averted public exposure |
| ASD | auxiliary shutdown |
| ATWS | anticipated transient without scram |
| BWR | boiling water reactor |
| CCF | common-cause failure |
| CDF | core damage frequency |
| CE | combustion engineering |
| CET | containment event tree |
| CFR | code of federal regulations |
| COE | cost of enhancement |
| COL | combined license |
| CS | containment spray |
| CST | condensate storage tank |
| DC | direct current |
| ECCS | emergency core cooling system |
| ECSBS | emergency containment spray backup system |
| ECW | essential chilled water |
| EDG | emergency diesel generator |
| EOP | emergency operating procedure |
| FSAR | final safety analysis report |

| | |
|---|---|
| GSI | generic safety issue |
| HPCI | high-pressure coolant injection |
| HP/LP | high pressure/low pressure |
| HVAC | heating, ventilation, and air conditioning |
| HVT | holdup volume tank |
| IRWST | in-containment refueling water storage tank |
| ISLOCA | interfacing system loss-of-coolant accident |
| LC | load center |
| LOCA | loss-of-coolant accident |
| LOCV | loss of containment vacuum |
| LOOP | loss of offsite power |
| LPSD | low power and shutdown |
| LSSB | large secondary steamline break |
| LRF | large release frequency |
| MCC | motor control center |
| MCR | main control room |
| MDAFP | motor-driven auxiliary feedwater pump |
| MOV | motor-operated valve |
| MSIV | main steam isolation valve |
| NEI | nuclear energy institute |
| NEPA | national environmental policy act |
| NPV | net present value |
| NRC | nuclear regulatory commission |
| PCB | power circuit breaker |
| P&ID | piping and instrumentation diagram |
| PAR | passive autocatalytic recombiner |
| POSRV | pilot-operated safety relief valve |
| PRA | probabilistic risk assessment |
| PV | present value |
| PW | present worth |
| RCIC | reactor core isolation cooling |
| RCP | reactor coolant pump |
| RPV | reactor pressure vessel |

| | |
|---|---|
| RSP | remote shutdown panel |
| SAMA | severe accident mitigation alternative |
| SAMDA | severe accident mitigation design alternative |
| SAT | standby auxiliary transformer |
| SBO | station blackout |
| SG | steam generator |
| SGTR | steam generator tube rupture |
| SLC | secondary liquid control |
| STC | source term category |
| SWGR | switchgear |
| T&M | test and maintenance |
| TB | turbine building |
| TDAFP | turbine-driven auxiliary feedwater pump |
| UAT | unit auxiliary transformer |
| WinMACCS | melcor accident consequence code system |

# 1. PURPOSE

This document provides an evaluation of severe accident mitigation design alternatives (SAMDA) for the APR1400 reactor. This evaluation is performed to address the potential costs and potential benefits of severe accident mitigation design alternatives for the APR1400 design. This document has been developed in accordance with applicable regulatory requirements as follows:

The National Environmental Policy Act (NEPA), Section 102.(C)(iii) requires, in part, that:

> all agencies of the Federal Government shall ... (C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on ... (iii) alternatives to the proposed action.

10 CFR 52.47(b)(2) requires the submittal of an environmental report as required by 10 CFR 51.55.

10 CFR 51.55 requires each applicant for a standard design certification to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The purpose of this report is to document the SAMDA analysis for the APR1400 design. Specifically, this report documents the calculation of the monetary value of unmitigated base risk, then evaluates the maximum risk reduction that could be expected from implementing a risk reduction strategy. Consideration of SAMDAs includes identifying a broad range of potential alternatives, then determining whether or not implementation of those alternatives is feasible or would be beneficial on a cost-risk reduction basis. This report also documents the identification, screening, and evaluation of SAMDAs for the APR1400 reactor design certification.

## 2. METHODOLOGY

Consideration of alternatives to mitigate severe accidents involves the following steps:

1. Determine the base risk presented to the surrounding population and environment by plant operation.
2. Calculate the monetary value of the unmitigated base risk. The monetized value of base risk is the maximum averted risk that is possible.
3. Identify potential SAMDAs.
4. Screen all potential SAMDAs for applicability to APR1400 and feasibility of implementation.
5. Evaluate potential SAMDAs not screened to determine the expected benefits of implementation for each.
6. Estimate the cost of implementing each SAMDA that is not screened.
7. Compare the estimated costs to the expected benefits to determine if implementation of any potential SAMDA would be cost-beneficial.
8. Evaluate how uncertainties could impact the cost-benefit analyses.
9. Perform sensitivity studies on the results.

# 3. BASE RISK

Base risk is defined as the maximum possible averted risk. Determination of base risk, as well as the overall SAMDA evaluation process, is described below. The first step to determine base risk is to develop and quantify the risk that could be presented by operation of an APR1400 reactor. Risk is calculated using a Level 1 and Level 2 probabilistic risk assessment (PRA) model. The results of that model provide overall risk measured by core damage frequency (CDF) and the characteristics of any expected radionuclide release following a severe accident.

The APR1400 Level 1 PRA model quantified at-power internal events, at-power internal fire, at-power internal flooding, and low power and shutdown (LPSD) internal events, LPSD fire events, and LPSD internal flooding events. Risk from other external events, for example, high winds, seismic events, etc., was determined to be negligible. From Table 19.1-30 of Reference 5, total CDF from the at-power internal events PRA is 1.0E-06 per year and is calculated as the sum of the 21 source term categories (STCs) calculated from the Level 2 PRA model. From Table 19.1-30b of Reference 5, total CDF from internal flooding events is 3.8E-07 per year. From Table 19.1-30a of Reference 5, fire-induced accident sequences had a calculated CDF of 2.8E-06 per year. LPSD internal event accident sequences had a calculated CDF of 1.9E-06 per year (Reference 6). LPSD flooding events had a CDF of 8.1E-08 per year (Reference 6) and LPSD fire had a CDF of 1.5E-06 per year (Reference 6). Summing these values gives a total CDF of 7.7E-06 per year.

Using the results of the Level 1 PRA, the second step in determining base risk is to identify the characteristics of any expected radionuclide release following a severe accident and then to quantify the expected frequency of release. The APR1400 Level 2 PRA model characterizes releases into 21 STCs. Each of the STCs is distinguished by the magnitude of fission products released, the timing of the fission product release, and the pathway for the release. The STC definitions and contributions to risk are presented in Tables 1a and 1b.

A subset of the STCs is considered to result in “large” releases. DCD Section 19.1.4.2.1.3 presents the definition of a “large” release and Table 19.1-29 delineates the STCs that are considered “large” release. All fission product releases are included in the SAMDA analysis regardless of whether the release is large or not. Therefore, the definition of “large” is not germane to this analysis. Details of how accident sequences are binned into each STC are provided in that section of the DCD as well as the criteria used to select the accident sequence used to represent each STC. The representative accident sequence for each STC, taken from Reference 6, are presented in Table 2.

The principal phenomena considered in WinMACCS are atmospheric transport, mitigative actions based on dose projections, dose accumulation by a number of pathways including food and water ingestion, early and latent health effects, and economic costs. The specific atmospheric, surface water and groundwater pathways inputs to the model for this representative site location are those specified in the Surry site data file documented in the Level 3 analysis (see Appendix A) and provided with WinMACCS.

The results with respect to the above pathways are documented in the WinMACCS analysis output files (see Appendix A).

For each STC, representative releases are determined. References 6 through 8 analyze representative sequences from each STC and develop timing and release characteristic information for representative fission product groups. The representative sequences for each STC are summarized in Table 5-5 of Reference 6 as is the STC frequency for at-power internal events. STC frequency for at-power flooding events is listed in Table 5-6 and Table 5-9 of Reference 6 for a-power fire events. Table 4.6-6 of Reference lists the STC frequency for LPSD internal event and flooding hazards. The STC frequency for LPSD fire events is shown in Table 4.5-6 of Reference 8. This information is then used to approximate the radiological release plumes used in the Level 3 analysis. The Level 3 analysis uses the MACCS code while the Level 2 PRA used the MAAP code to develop fission product releases. Mapping of the

MAAP fission product release categories to the MACCS fission product release categories is shown in Reference 9. Also shown in Reference 9 is the basis and development of the plume segments for input to the MACCS code.

Offsite consequences are calculated from the Level 3 PRA analysis. The Level 3 (WinMACCS) model has been prepared for a representative year when the APR1400 design could be operated. If the design certification (DC) is received in 2020, a combined operating license application (COLA) could be received within several years of the DC. To be conservative, however, this analysis assumes that any licensing action with respect to a COLA would not occur for ten years after the date that the DC is received thus allowing for larger population growth. The year 2030 is considered reasonable for being within five years of any licensing action with respect to the APR1400 design.

Thus the Level 3 PRA model was prepared using projected year 2030 demographic data from the 2010 US Census and 2007 Agricultural Census for the area around the Surry site and APR1400-DC source term results from the Level 2 MAAP analysis.

The Level 3 PRA is based on the Surry site model documented in NUREG-1150 as a representative site. The model uses the following meteorological, population, and land use data inputs to represent the reference site location for the analysis (see Appendix A):

- The meteorological data file used was the sample meteorological data file provided with the WinMACCS software NRC sample problems. The data describes one year's (1988) worth of hourly meteorological data for the site as recorded at the site meteorological tower. The data is considered representative of any year for the Surry reference site.

- This analysis uses the Surry 80.47 km (50 mile) population data projected for year 2030, which were obtained from the 2010 Census data for the region surrounding the site.

- SECPOP was used to calculate the land fraction for each rosette section as explained in the manual for the code. The code contains a county-level database with the land fractions for each county obtained from the 2010 Census data files. The calculated values are used directly in these analyses. Due to the way in which SECPOP allocates population from the census blocks, certain radial blocks near the plant are shown as all water. These segments have zero population so that the effect on the results is not significant.

- The region indexes were selected to allow unique region numbers for the sectors with large areas, that is, the very small regions of the rosette near the plant were assigned to similar regions.

- For the representative site at Surry, the original watershed indexes for the Surry site were used directly in this analysis. These values were chosen to more accurately model the landmass and bodies of water surrounding the site up to the 50 mile radius of this analysis.

- The crop season data was taken from the NUREG-1150 analysis for the Surry reference site. Agricultural data available in the 1997 Census of Agriculture was used to produce the land fraction used for each crop.

- The watershed definition data was assumed to be the same as for the Surry site and is taken from the NUREG-1150 analysis for Surry.

- The regional economic data was calculated by SECPOP from data provided to it in a data file named County1997RG.dat. This file was updated (a pre-processing step) to 2007 for the 45 counties and independent cities that are all or in part within 50 miles of the Surry site. The other some 3000 county data sets in the file for the rest of the US were left unchanged.

- The selected SECPOP regional economic values were updated to 2007 using data from the Bureau of the Census and the Department of Agriculture 2007 Census of Agriculture.

For each STC, the Level 3 PRA provides values for the conditional offsite dose and conditional offsite property damage that would result given that a fission product release with the plume characteristics used to represent the source term occurred (Reference 4). The total expected dose consequence is obtained by multiplying the conditional offsite dose by the expected frequency for each STC, then summing the expected doses for all STCs. The conditional dose and expected dose for each STC along with the total expected dose are shown in Tables 3a through 3f. Similarly, the total expected property damage is obtained by multiplying the conditional property damage value by the expected frequency for each STC, then summing the expected property damage values for all STCs. The conditional property costs and expected property costs for each STC along with the total expected property costs are shown in Tables 4a through 4f.

Details of the socioeconomic, individual, and population health risks attributed to the postulated APR1400-DC severe accident analysis are documented in the WinMACCS output files (see Appendix A).

# 4. UNMITIGATED RISK MONETARY VALUE

The unmitigated risk monetary value is calculated using the methodology given in Reference 1 for the performance of cost-benefit analyses. The value of unmitigated risk can be used to represent the maximum benefit that could be achieved if all risk was eliminated for operation of an APR1400 reactor events. The methodology of Reference 1 determines the present worth net value of public risk according to the following formula:

$$NPV = (APE + AOC + AOE + AOSC) - COE \quad (1)$$

Where:

NPV = present value of current risk ($),

APE = present value of averted public exposure ($),

AOC = present value of averted offsite property damage costs ($),

AOE = present value of averted occupational exposure ($),

AOSC= present value of averted onsite costs ($),

COE = cost of any enhancement implemented to reduce risk ($).

The derivation of each of these costs is described in the subsections below. All equations used in the subsections below are taken from Reference 2, which is the basis for the equations given in Reference 1.

The following specific values were used for various terms in the analyses:

**Present Worth**

The present worth was determined by:

$$PW = [1 - e^{(-rt)}]/r \quad (2)$$

Where:

r is the discount rate= 7% per year (assumed throughout these analyses)

t is the years remaining until end of plant life = 60 years

PW is the present worth of a string of annual payments of one dollar = $14.07

**Dollars per REM**

The conversion factor used for assigning a monetary value to on-site and off-site exposures was $2,000/person-rem averted. This is consistent with the U.S. NRC's regulatory analysis guidelines presented in and used throughout Reference 1.

## 4.1. Averted Public Exposure (APE)

Expected offsite doses from the internal events PRA accident sequences are presented in Tables 3a

through 3f. Costs associated with these doses were calculated using the following equation:

$$\text{APE} = (F_S D_{PS} - F_A D_{PA}) \times R \times [1 - \mathrm{e}^{(-\mathrm{r t_f})}]/\mathrm{r} \quad (3)$$

Where:

APE = present value of averted public exposure ($),

R = monetary equivalent of unit dose ($2,000/person-rem),

$F_S$ = baseline accident frequency (events per year from Tables 3a through 3f),

$F_A$ = accident frequency after mitigation (0 events per year),

$F_S D_{PS}$ = baseline accident offsite frequency (person-rem per year from Tables 2a through 2f),

$F_A D_{PA}$ = accident offsite dose frequency after mitigation (0 person-rem per year),

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, APE is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.1.1. APE for At-Power Internal Events

$APE_{(IE)}$ = (5.33×$10^{-1}$ person-rem per year – 0)×($2,000/person-rem)×((1 – $e^{-(0.07\times60)}$)/(0.07 per year))

= $15,000

#### 4.1.2. APE for At-Power Internal Flooding Events

$APE_{(Fld)}$ = (5.51×$10^{-2}$ person-rem per year – 0)×($2,000/person-rem)×((1 – $e^{-(0.07\times60)}$)/(0.07 per year))

= $1,551

#### 4.1.3. APE for At-Power Internal Fire Events

$APE_{(Fire)}$ = (5.79×$10^{-1}$ person-rem per year – 0)×($2,000/person-rem)×((1 – $e^{-(0.07\times60)}$)/(0.07 per year))

= $16,294

#### 4.1.4. APE for LPSD Internal Events

$APE_{(SDIE)}$ = (3.34×$10^{-1}$ person-rem per year – 0)×($2,000/person-rem)×((1 – $e^{-(0.07\times60)}$)/(0.07 per year))

= $9,399

#### 4.1.5. APE for LPSD Flooding Events

$APE_{(SDFld)}$ = (1.40×10$^{-1}$ person-rem per year – 0)×($2,000/person-rem)×((1 – e$^{-(0.07×60)}$)/(0.07 per year))

= $3,946

#### 4.1.6. APE for LPSD Fire Events

$APE_{(SDFire)}$ = (1.31×10$^{-1}$ person-rem per year – 0)×($2,000/person-rem)×((1 – e$^{-(0.07×60)}$)/(0.07 per year))

= $3,687

#### 4.1.7. Total APE

$APE_{Tot}$ = $APE_{(IE)}$ + $APE_{(Fld)}$ + $APE_{(Fire)}$ + $APE_{(SDIE)}$ + $APE_{(SDFld)}$ + $APE_{(SDFire)}$

= $ 15,000 + $ 1,551 + $ 16,294 + $ 9,399 + $ 3,946 + $ 3,687

= $ 49,877

### 4.2. Averted Public Offsite Property Damage Costs (AOC)

Annual expected offsite economic risk is shown in Tables 4a through 4f. The costs associated with AOC were calculated using the following equation:

$$\mathrm{AOC} = (F_S D_{DS} - F_A D_{DA}) \times [1 - \mathrm{e}^{(-\mathrm{r t_f})}]/\mathrm{r} \quad (4)$$

Where:

AOC = present value of averted offsite property damage costs ($),

$F_S D_{DS}$ = baseline accident frequency x property damage (cost per year from Tables 4a through 4f),

$F_A D_{DA}$ = accident frequency x property damage after mitigation (0 events per year),

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, AOC is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.2.1. AOC for At-Power Internal Events

$AOC_{(IE)}$ = ($1,534 per year – 0) × (1 – e$^{-(0.07 × 60)}$) / (0.07 per year) = $21,580

#### 4.2.2. AOC for At-Power Internal Flooding Events

AOC(Fld) = ($142 per year – 0) × (1 – e – $^{(0.07 × 60)}$) / (0.07 per year) = $1,992

#### 4.2.3. AOC for At-Power Internal Fire Events

$AOC_{(Fire)}$ = ($1,355 per year – 0) × (1 – $e^{-(0.07 \times 60)}$) / (0.07 per year) = $19,070

#### 4.2.4. AOC for LPSD Internal Events

$AOC_{(SDIE)}$ = ($883 per year – 0) × (1 – $e^{-(0.07 \times 60)}$) / (0.07 per year) = $12,422

#### 4.2.5. AOC for LPSD Flooding Events

$AOC_{(SDFld)}$ = ($314 per year – 0) × (1 – $e^{-(0.07 \times 60)}$) / (0.07 per year) = $4,423

#### 4.2.6. AOC for LPSD Fire Events

$AOC_{(SDFire)}$ = ($316 per year – 0) × (1 – $e^{-(0.07 \times 60)}$) / (0.07 per year) = $4,446

#### 4.2.7. Total AOC

$AOC_{Tot}$ = $AOC_{(IE)} + AOC_{(Fld)} + AOC_{(Fire)} + AOC_{(SDIE)} + AOC_{(SDFld)} + AOC_{(SDFire)}$

= $ 21,580 + $ 1,992 + $ 19,070 + $ 12,422 + $ 4,423 + $ 4,446

= $ 63,933

### 4.3. Averted Occupational Exposure (AOE)

There are two types of occupational exposure due to accidents: immediate and long-term. Immediate exposure occurs at the time of the accident and during the immediate management of the emergency. Long-term exposure is associated with the cleanup and refurbishment or decommissioning of the damaged facility. The value of avoiding both types of exposure must be considered when evaluating risk.

The occupational exposure associated with severe accidents was assumed to be 23,300 person-rem/accident. This value includes a short-term component of 3,300 person-rem/accident and a long-term component of 20,000 person-rem/accident. These estimates are consistent with the best-estimate values presented in Section 5.7.3 of Reference 2. In calculating base risk, the accident-related on-site exposures were calculated using the best-estimate exposure components applied over the on-site cleanup period. For on-site cleanup, the accident-related onsite exposures were calculated over a 10-year cleanup period. Costs associated with immediate dose, long-term dose, and total dose are calculated below for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events.

#### 4.3.1. Averted Immediate Occupational Exposure Costs

Per the guidance of Reference 1, costs associated with immediate occupational doses from an accident were calculated using the following equation:

$$W_{IO} = (F_S D_{IOS} - F_A D_{IOA}) \times R \times [1 - e^{(-rt_f)}]/r \quad (5)$$

Where:

$W_{IO}$ = present value of averted immediate occupational exposure ($),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

$D_{IOS}$ = baseline expected immediate onsite dose (3,300 person-rem/event),

$D_{IOA}$ = expected occupational exposure after mitigation (3,300 person-rem/event),

R = monetary equivalent of unit dose ($2,000/person-rem),

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, WIO is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.3.1.1. $W_{IO}$ for At-Power Internal Events

$W_{IO(IE)}$ = ((1.00×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $93

#### 4.3.1.2. $W_{IO}$ for At-Power Internal Flooding Events

$W_{IO\ (Fld)}$ = ((3.82×10$^{-7}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $35

#### 4.3.1.3. $W_{IO}$ for At-Power Internal Fire Events

$W_{IO\ (Fire)}$ = ((2.79×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $259

#### 4.3.1.4. $W_{IO}$ for LPSD Internal Events

$W_{IO\ (SDIE)}$ = ((1.94×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $180

#### 4.3.1.5. $W_{IO}$ for LPSD Flooding Events

$W_{IO\ (SDFld)}$ = ((8.06×10$^{-8}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $7

#### 4.3.1.6. $W_{IO}$ for LPSD Fire Events

$W_{IO(SDFire)}$ = ((1.48×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= $137

### 4.3.2. Averted Long-Term Occupational Exposure Costs

Per the guidance of Reference 2, costs associated with long-term occupational doses from an accident were calculated using the following equation:

$$W_{LTO} = (F_S D_{LTOS} - F_A D_{LTOS}) \times R \times [1 - \mathrm{e}^{(-\mathrm{rt_f})}]/\mathrm{r} \times [1 - \mathrm{e}^{(-\mathrm{rm})}]/\mathrm{r}\,m \quad (6)$$

Where:

$W_{LTO}$ = present value of averted long-term occupational exposure ($),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

$D_{LTOS}$ = baseline expected long-term onsite dose (20,000 person-rem/event),

$D_{LTOA}$ = expected occupational exposure after mitigation (20,000 person-rem/event),

R = monetary equivalent of unit dose ($2,000/person-rem),

r = real discount rate (7% per year),

m = years over which long-term doses accrue (10 years from Reference 2),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $W_{LTO}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.3.2.1. $W_{LTO}$ for At-Power Internal Events

$W_{LTO(IE)}$ = ((1.00×10$^{-6}$ events per year) × (20,000 person-rem/event) – 0) × ($2,000/person-rem) × ((1 – e$^{-(0.07 \times 60)}$) / (0.07 per year) × ((1 – e$^{-(0.07 \times 10)}$) / ((0.07 per year) × (10 years))

= $405

#### 4.3.2.2. $W_{LTO}$ for At-Power Internal Flooding Events

$W_{LTO\ (Fld)}$ = ((3.82×10$^{-7}$ events per year) × (20,000 person-rem/event) – 0) × ($2,000/person-rem) × ((1 – e$^{-(0.07 \times 60)}$) / (0.07 per year) × ((1 – e$^{-(0.07 \times 10)}$) / ((0.07 per year) × (10 years))

= $155

#### 4.3.2.3. $W_{LTO}$ for At-Power Internal Fire Events

$$W_{LTO\ (Fire)} = ((2.79\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.07 \times 60)}) / (0.07 \text{ per year}) \times ((1 - e^{-(0.07 \times 10)}) / ((0.07 \text{ per year}) \times (10 \text{ years}))$$

$$= \$1{,}129$$

#### 4.3.2.4. $W_{LTO}$ for LPSD Internal Events

$$W_{LTO\ (SDIE)} = ((1.94\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.07 \times 60)}) / (0.07 \text{ per year}) \times ((1 - e^{-(0.07 \times 10)}) / ((0.07 \text{ per year}) \times (10 \text{ years}))$$

$$= \$785$$

#### 4.3.2.5. $W_{LTO}$ for LPSD Flooding Events

$$W_{LTO\ (SDFld)} = ((8.06\times10^{-8} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.07 \times 60)}) / (0.07 \text{ per year}) \times ((1 - e^{-(0.07 \times 10)}) / ((0.07 \text{ per year}) \times (10 \text{ years}))$$

$$= \$33$$

#### 4.3.2.6. $W_{LTO}$ for LPSD Fire Events

$$W_{LTO\ (SDFire)} = ((1.48\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.07 \times 60)}) / (0.07 \text{ per year}) \times ((1 - e^{-(0.07 \times 10)}) / ((0.07 \text{ per year}) \times (10 \text{ years}))$$

$$= \$599$$

### 4.3.3. Total Averted Occupational Exposure Costs

As described in Section 4.3, the total cost associated with averted occupational exposure (AOE) is the sum of the costs associated with averted immediate exposure and the costs associated with the averted long-term exposure, or:

$$AOE = W_{IO} + W_{LTO} \tag{7}$$

Total averted onsite exposure costs are calculated for at-power internal events, internal flooding events, and fires, along with LPSD internal events, internal flooding events, and fire events. Each of these calculations is detailed below.

#### 4.3.3.1. AOE for At-Power Internal Events

$$AOE_{(IE)} = \$93 + \$405 = \$498$$

#### 4.3.3.2. AOE for At-Power Internal Flooding Events

$$AOE(_{Fld}) = \$35 + \$155 = \$190$$

#### 4.3.3.3. AOE for At-Power Internal Fire Events

$$AOE\ (_{Fire}) = \$259 + \$1{,}129 = \$1{,}388$$

#### 4.3.3.4. AOE for LPSD Internal Events

$AOE_{(SDIE)}$ = \$180 + \$785 = \$965

#### 4.3.3.5. AOE for LPSD Flooding Events

$AOE_{(SDFld)}$ = \$7 + \$33 = \$40

#### 4.3.3.6. AOE for LPSD Fire Events

$AOE_{(SDFire)}$ = \$137 + \$599 = \$736

#### 4.3.3.7. Total AOE

$AOE_{Tot} = AOE_{(IE)} + AOE_{(Fld)} + AOE_{(Fire)} + AOE_{(SDIE)} + AOE_{(SDFld)} + AOE_{(SDFire)}$

= \$ 498 + \$ 190 + \$ 1,388 + \$ 965 + \$ 40 + \$ 736

= \$3,817

### 4.4. Averted Onsite Costs (AOSC)

Reference 2 defines three types of costs associated with onsite property damage from an accident: cleanup and decontamination, long-term replacement power, and repair and refurbishment. The value of avoiding each of these types of costs must be considered when evaluating risk. Total averted onsite property damage costs are the sum of the three types of costs. Calculation of onsite property damage costs is detailed in the sections that follow.

#### 4.4.1. Averted Cleanup and Decontamination Costs

The estimated cleanup cost for severe accidents was defined in Reference 2, Section 5.7.6.1, to be \$1. $\times 10^9$ /accident (undiscounted). Using the value of \$1.5$\times 10^9$ /event and assuming, as in Reference 2, that the total sum is paid in equal installments over a 10-year period, the present value of those ten payments for cleanup and decontamination costs for the cleanup period can be calculated as follows:

$$PV_{CD} = C_{CD}/m \times \{ \left[1 - e^{(-rm)}\right]/r\} \quad (8)$$

Where:

$PV_{CD}$ = net present value of cleanup and decontamination for a single event (dollars),

$C_{CD}$ = total undiscounted cost for single accident with constant-year basis (dollars),

r = real discount rate (7% per year),

m = years over which long-term doses accrue (10 years).

$PV_{CD}$ = ((\$1.5$\times 10^9$ /event) / (10 years)) × ((1 – $e^{-(0.07 \times 10)}$) / 0.07)

= \$1.0787$\times 10^9$

The present value of the costs over the cleanup period must be considered over the period of plant life. The net present value of averted cleanup costs over the plant life can be calculated using the following equation:

$$U_{CD} = (F_A - F_S) \times PV_{CD} \times [1 - e^{(-rt_f)}]/r \qquad (9)$$

Where:

$U_{CD}$ = present value of averted onsite cleanup costs (dollars),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $U_{CD}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.4.1.1. $U_{CD}$ for At-Power Internal Events

$U_{CD(IE)}$ = $(1.00\times10^{-6}$ events per year – 0) × ($\$1.0787\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})$ / (0.07 per year)

= \$15,178

#### 4.4.1.2. $U_{CD}$ for At-Power Internal Flooding Events

$U_{CD\ (Fld)}$ = $(3.82\times10^{-7}$ events per year – 0) × ($\$1.0787\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})$ / (0.07 per year)

= \$5,798

#### 4.4.1.3. $U_{CD}$ for At-Power Internal Fire Events

$U_{CD\ (Fire)}$ = $(2.79\times10^{-6}$ events per year – 0) × ($\$1.0787\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})$ / (0.07 per year)

= \$42,348

#### 4.4.1.4. $U_{CD}$ for LPSD Internal Events

$U_{CD\ (SDIE)}$ = $(1.94\times10^{-6}$ events per year – 0) × ($\$1.0787\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})$ / (0.07 per year)

= \$29,446

#### 4.4.1.5. $U_{CD}$ for LPSD Flooding Events

$U_{CD\ (SDFld)}$ = $(8.06\times10^{-8}$ events per year – 0) × ($\$1.0787\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})$ / (0.07 per year)

= \$1,223

#### 4.4.1.6. $U_{CD}$ for LPSD Fire Events

$U_{CD\ (SDFire)}$ = (1.48×10$^{-6}$ events per year – 0) × (\$1.0787×10$^{9}$) × (1 – e$^{-(0.07 \times 60)}$) / (0.07 per year)

= \$22,464

### 4.4.2. Averted Replacement Power Costs

Replacement power costs, URP, are an additional contributor to onsite costs and can be calculated in accordance with Reference 2, Section 5.7.6.2. Since replacement power will be needed for that time period following a severe accident until the end of the expected generating plant life, long-term power replacement calculations have been used. APR1400 is expected to have a net electrical output of 1400 MWe.

Replacement power cost calculations performed in Reference 2 are based on the 910 MWe reference plant. In applying the methodology used in Reference 2 to the APR1400 design, the equation was scaled for the 1400 MWe output of APR1400 plant. For discount rates between 5 and 10 percent, Reference 2 recommends that the present value of replacement power be calculated as follows:

$$\mathrm{PV_{RP}} = \left[\frac{\$1.2x10^{8}\frac{Rated\ Power}{910MWe}}{r}\right] \times \left[1 - \mathrm{e}^{(-\mathrm{rt_f})}\right]^{2} \qquad (10)$$

Where:

$PV_{RP}$ = net present value of replacement power for a single event (dollars),

Rated Power = 1400 MWe,

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above:

$PV_{RP}$ = (1.2x10$^{8}$ × (1400 MWe / 910 MWe)) / (0.07 per year) × (1 – e$^{-(0.07 \times 60)}$)$^{2}$

= \$2.559 x10$^{9}$

The replacement power costs "$PV_{RP}$" (\$2.559 x10$^{9}$) was adjusted to 2016 dollars by applying a ratio of the average Bureau of Labor Statistics (BLS) Producer Price Index for Electric Power from years 1993 and 2016. The Producer Price Index for Electric Power for 2016 is 201.4, and the Producer Price Index for Electric Power for 1993 is 128.6 (Reference 3). The 2016 dollars scaling factor is calculated as 201.4/128.6, which equals 1.57.

The replacement power costs "$PV_{RP}$" was also adjusted to reflect the true need for replacement capacity availability based on current operations. A more realistic capacity factor of 95% is used in lieu of the suggested 60%–65% range reported in Reference 2. This adjustment was applied as a simple multiplier derived by dividing 95% by 60% to get a value of 1.58.

$PV_{RP}$ = \$2.559x10$^{9}$ × (1.57) × (1.58)

= \$6.348x10$^{9}$

To obtain the expected costs of a single event over the plant life, the following equation is used:

$$U_{RP} = [F_S - F_A] \times PV_{RP} \times [1 - e^{(-rt_f)}]^2/r \quad (11)$$

Where:

$U_{RP}$ = net present value of replacement power over life of facility (dollars),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

$PV_{RP}$ = net present value of replacement power for a single event (dollars),

r = real discount rate (7% per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $U_{RP}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 4.4.2.1. $U_{RP}$ for At-Power Internal Events

$U_{RP(IE)}$ = $(1.00\times10^{-6}$ events per year – 0) × ($6.348\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})^2$ / (0.07 per year)

= $87,986

#### 4.4.2.2. $U_{RP}$ for At-Power Internal Flooding Events

$U_{RP\ (Fld)}$ = $(3.82\times10^{-7}$ events per year – 0) × ($6.348\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})^2$ / (0.07 per year)

= $33,611

#### 4.4.2.3. $U_{RP}$ for At-Power Internal Fire Events

$U_{RP\ (Fire)}$ = $(2.79\times10^{-6}$ events per year – 0) × ($6.348\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})^2$ / (0.07 per year)

= $245,482

#### 4.4.2.4. $U_{RP}$ for LPSD Internal Events

$U_{RP\ (SDIE)}$ = $(1.96\times10^{-6}$ events per year – 0) × ($6.348\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})^2$ / (0.07 per year)

= $170,693

#### 4.4.2.5. $U_{RP}$ for LPSD Flooding Events

$U_{RP\ (SDFld)}$ = $(8.06\times10^{-8}$ events per year – 0) × ($6.348\times10^{9}$) × $(1 - e^{-(0.07 \times 60)})^2$ / (0.07 per year)

= $7,092

#### 4.4.2.6. $U_{RP}$ for LPSD Fire Events

$$U_{RP\ (SDFire)} = (1.48\times10^{-6} \text{ events per year} - 0) \times (\$6.348\times10^{9}) \times (1 - e^{-(0.07 \times 60)})^{2} / (0.07 \text{ per year})$$

$$= \$130,220$$

### 4.4.3. Averted Repair and Refurbishment Costs

It is assumed that the plant would not be repaired or refurbished; therefore, these costs are zero.

### 4.4.4. Total Averted Onsite Costs (AOSC)

Total averted onsite cost (AOSC) is the sum of cleanup and decontamination costs, replacement power costs, and the repair and refurbishment costs. Total averted onsite costs are calculated as follows:

$$AOSC = U_{CD} + U_{RP} + 0 \tag{12}$$

Total averted onsite costs are calculated for at-power internal events, internal flooding events, and fires, along with LPSD internal events, internal flooding events, and fire events. Each of these calculations is detailed below.

#### 4.4.4.1. AOSC for At-Power Internal Events

$$AOSC_{(IE)} = \$\ 15,178 + \$\ 87,986 = \$103,164$$

#### 4.4.4.2. AOSC for At-Power Internal Flooding Events

$$AOSC_{(Fld)} = \$\ 5,798 + \$\ 33,611 = \$39,409$$

#### 4.4.4.3. AOSC for At-Power Internal Fire Events

$$AOSC_{(Fire)} = \$\ 42,348 + \$\ 245,482 = \$\ 287,830$$

#### 4.4.4.4. AOSC for LPSD Internal Events

$$AOSC_{(SDIE)} = \$\ 29,446 + \$\ 170,693 = \$\ 200,139$$

#### 4.4.4.5. AOSC for LPSD Flooding Events

$$AOSC_{(SDFld)} = \$\ 1,223 + \$\ 7,092 = \$\ 8,315$$

#### 4.4.4.6. AOSC for LPSD Fire Events

$$AOSC_{(SDFire)} = \$\ 22,464 + \$\ 130,220 = \$\ 152,684$$

#### 4.4.4.7. Total AOSC

$$AOSC_{Tot} = AOSC_{(IE)} + AOSC_{(Fld)} + AOSC_{(Fire)} + AOSC_{(SDIE)} + AOSC_{(SDFld)} + AOSC_{(SDFire)}$$

$$= \$\ 103,164 + \$\ 39,409 + \$\ 287,830 + \$\ 200,139 + \$\ 8,315 + \$\ 152,684$$

$$= \$\ 791,541$$

### 4.5. Cost Enhancement (COE)

The cost of enhancement (COE) is used when measures are taken to reduce risk. By definition, such measures are taken at the beginning of any period considered, so no discounting is performed for the COE. For baseline risk, no measures have been taken to reduce risk, so:

COE = $0

### 4.6. Total Unmitigated Baseline Risk

As described in Section 4, the total present worth net value of public risk is calculated according to the following formula:

$$NPV = (APE + AOC + AOE + AOSC) - COE \quad (13)$$

Using the values calculated in Sections 4.1 to 4.5, total baseline risk is calculated:

NPV = ($49,877 + $ 63,933 + $ 3,817 + $ 791,541) – $0

= $ 909,168

This value can be viewed as the maximum risk benefit attainable if all core damage scenarios from internal events are eliminated over the the 60-years plant life.

## 5. IDENTIFICATION OF SAMDAS

The list of SAMDA items evaluated for the APR1400 design is given in Table 5.

The first source used to identify SAMDA items is Reference 1. Generic industry SAMDAs that are to be considered are the 153 items that are identified in Table 14 of Reference 1.

The second source used to identify SAMDA items is the results of PRA for APR1400. Evaluation of APR1400-specific items began with an importance analysis of the core damage cutsets documented in Reference 5.

The ASME PRA Standard (ASME/ANS RA-Sb-2009) defines a significant basic event as a basic event that contributes significantly to the computed risks for a specific hazard group. This definition includes any basic event that has a FV importance greater than 0.005 (0.5%) or a RAW importance greater than 2. The purpose of the SAMDA analysis is to consider ways to reduce risk. The RAW importance parameter does not provide indication of potential risk reduction and is not germane to a SAMDA analysis for risk reduction. Therefore, the RAW importance measure is not used.

Each basic event with a Fussell-Vesely importance of greater than 0.5%, a total of 126 basic events for At-Power internal events (Reference 5 – Table 19.1-21), 110 for At-Power internal flooding events (Reference 5 – Table 19.1-69), 120 for At-Power fire events (Reference 5 – Table 19.1-52), 79 for LPSD internal events (Reference 5 – Table 19.1-100), 75 for LPSD internal flooding events (Reference 5 – Table 19.1-113), and 98 for LPSD fire events (Reference 5 – Table 19.1-126), were reviewed to identify any potential SAMDAs. Basic events, such as or constants, have no physical meaning are identified and can be excluded as having no impact on the SAMDA analysis. A listing of the basic events, their importance, and their disposition with respect to SAMDA items is given in Tables 6a through 6f.

In addition to the basic event importance review, the top 100 cutsets for each analysis were reviewed to identify any basic events that were not included as part of the importance analysis review. Basic events identified in the top 100 cutsets that are not included as part of the importance analysis review are shown in Tables 7a through 7f. The top 100 cutsets for At-Power internal events are taken from Reference 5 – Table 19.1-19. The top 100 cutsets for At-Power internal flooding are taken from Reference 5 – Table 19.1-66. The top 100 cutsets for At-Power internal fire are taken from Reference 5 – Table 19.1-49. The top 100 cutsets for LPSD internal events are taken from Reference 5 – Table 19.1-96. The top 100 cutsets for LPSD internal flooding are taken from Reference 5 – Table 19.1-109. The top 100 cutsets for LPSD internal fires are taken from Reference 5 – Table 19.1-122.

## 6. SAMDA SCREENING

The initial list of potential SAMDAs was developed from a generic list of sources related to many plant designs. Some of the items on the list were identified relatively recently, while others were identified some time ago. Given the wide diversity in age and sources of the potential SAMDAs, an initial screening is performed to identify the subset of potential SAMDAs that warranted a detailed evaluation.

Potential SAMDAs to be examined in detail are identified by exception. That is, a screening process is used to remove potential SAMDAs from consideration. Any potential SAMDAs not screened will undergo more detailed evaluation.

As described in Reference 1, SAMDA items can be screened for several reasons. First, items were screened that were not applicable to the APR1400. For example, some items are associated with specific equipment that is not present in the APR1400 design. Items screened as not applicable are indicated as “Not Applicable” in the “Qualitative Screening” column of Table 5.

Next, items were identified that were effectively implemented in the APR1400 DC design. Items screened as effectively implemented are indicated with the letter “Already Implemented” in the “Qualitative Screening” column of Table 5. The reason for screening as “Already Implemented” is provided in Table 5.

Other SAMDA items were screened because they would not be feasible to implement. An item would not be feasible if the cost to implement the SAMDA clearly would exceed the maximum benefit possible (calculated in Section 4.6). Items screened as infeasible to implement are indicated with “Excessive Imp. Cost” in the “Qualitative Screening” column of Table 5.

Reference 1 allows items to be screened if they would be of low benefit. An item is of low benefit if it is from a non-risk-significant system and a change in reliability would have negligible impact on the risk profile. As this analysis is for the APR1400 design certification, any items listed as potentially being of low benefit are indicated as “Needs Further Evaluation / Potentially Very Low Benefit” in the “Qualitative Screening” column of Table 5. This assumption is based on engineering judgment and experience with other SAMDA analyses. The reason for screening as “Very Low Benefit” is provided in Table 5.

Finally, one SAMDA can be “Combined” with others, per the guidelines of Reference 1. SAMDA 151 is described as “Increase training and operating experience feedback to improve operator response.” As this analysis is for the APR1400 design certification, SAMDAs regarding operator actions are designated as “N/A - Enhancements due to procedures/training are not applicable to the design certification stage of plant development.” For this analysis, all other items not screened as above were retained in Table 5. The benefit and cost evaluations in the sections that follow then examine the impacts of the items. If appropriate, the items are combined during the benefit or cost evaluations. When items were combined as providing the same benefit, a note indicating which were analyzed together is provided in Table 5.

Items not screened are indicated with “Needs Further Eval” in the “Qualitative Screening” column of Table 5.

## 7. SAMDA BENEFIT EVALUATION

Each of the potential SAMDAs not screened was evaluated to determine the potential benefits that could be achieved if implemented. In evaluating the benefits, a precisely described modification was not necessarily considered because exact design details would only be defined once an option is chosen. Rather, SAMDA benefit evaluation was performed using bounding techniques to estimate any risk reduction that would be possible. For example, evaluation of the SAMDA to install an additional component cooling water pump bounded the risk reduction possible by assuming that implementation of the SAMDA would entirely eliminate the unavailability of component cooling water pumps.

Evaluation of potential benefits would be performed using the methodology described in Reference 1 and, in general, would be performed as follows. First, the potential reduction in CDF, if any, was estimated. Next, the reduction in source term release was estimated. Finally, the potential benefit to offsite consequences was determined and presented in monetary terms.

Based on the information provided in Sections 4 and Tables 5, 6a through 6f, and 7a through 7f, the total maximum cost reduction calculated for any of the important basic events (FV > 0.5 percent) would be much lower than described in Tables 5, 6a through 6f, and 7a through 7f, because in reality, all offsite consequences would not be eliminated. Therefore, a design change would be expected to cost more than this amount and, as a result, not provide a positive benefit.

The following sections describe the cost benefits of the important basic events and why no further SAMDA cost-benefit evaluation is needed. The important basic events are grouped by the associated component to contribute to an overall maximum benefit. For components that can be considered identical, like EDGs or identical system pumps, a total of the components benefits are evaluated for overall maximum benefit.

### 7.1. Emergency Diesel Generator Events

The generic SAMDA items evaluated for the APR1400 design related to emergency diesel generators are listed in Table 5 and include items 9, 19, 20, and 29.

#### 7.1.1. EDG DG001A Events

Basic events for the unavailability of EDG A are present in nearly all of the cutset file FV importance analyses and include: Table 6a (Items 14, 30, 56, 61, and 80), Table 6b (Items 70 and 96), Table 6c (Items 18, 36, 37, and 115), Table 6d (Items 14, 54, 67, and 73), Table 6e (Items 2, 17, 19, and 64), and Table 7d (Item 60). A maximum of 16% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG A unavailability in the At-Power internal events analysis, or approximately $16,400. A maximum of 1.7% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG A unavailability in the At-Power internal flooding events analysis, or approximately $670. A maximum of 9.4% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG A unavailability in the At-Power fire events analysis, or approximately $27,200.

A maximum of 7.6% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG A unavailability in the LPSD internal events analysis, or approximately $15,200. A maximum of 42% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG A unavailability in the LPSD flooding events analysis, or approximately $3,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 or the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG, then an estimated maximum total benefit of approximately $168,700 would occur.

The total maximum benefit would be much lower than $168,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an EDG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.1.2. EDG DG001B Events

Basic events for the unavailability of EDG B are present in nearly all of the cutset file FV importance analyses and include: Table 6a (Items 15, 35, 56, 62, and 86), Table 6b (Items 63 and 78), Table 6c (Items 15, 32, 36, and 106), Table 6d (Items 15, 55, 68, and 73), Table 6e (Items 26 and 64), Table 6f (Item 57), Table 7d (Item 60). A maximum of 15% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the At-Power internal events analysis, or approximately $15,000. A maximum of 1.7% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the At-Power internal flooding events analysis, or approximately $8600. A maximum of 9.4% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the At-Power fire events analysis, or approximately $30,400.

A maximum of 7.6% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the LPSD internal events analysis, or approximately $15,200. A maximum of 2.9% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the LPSD flooding events analysis, or approximately $240. A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG B unavailability in the LPSD fire events analysis, or approximately $2,100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($49,877) and AOC ($63,933), total only $113,810 or the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG, then an estimated maximum total benefit of approximately $177,700 would occur.

The total maximum benefit would be much lower than $177,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an EDG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.1.3. EDG DG001C Events

Basic events for the unavailability of EDG C are present in all of the cutset file FV importance analyses, except LPSD internal fire events and include: Table 6a (Items 31, 37, 56, 105, and 124), Table 6b (Items 45 and 66), Table 6c (Items 37, 51, and 93), Table 6d (Item 73), and Table 6e (Item 64). A maximum of 9.8% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG C unavailability in the At-Power internal events analysis, or approximately $10,200. A maximum of 3.8% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG C unavailability in the At-Power internal flooding events analysis, or approximately $1,500. A maximum of 4.7% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG C unavailability in the At-Power fire events analysis, or approximately $13,600.

A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG C unavailability in the LPSD internal events analysis, or approximately $1,100. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG C unavailability in the LPSD flooding events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190)

and AOC ($59,487), total only $105,677 or the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG, then an estimated maximum total benefit of approximately $132,000 would occur.

The total maximum benefit would be much lower than $132,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an EDG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.1.4. EDG DG001D Events

Basic events for the unavailability of EDG D are present in all of the cutset file FV importance analyses except LPSD internal fire events and include: Table 6a (Items 32, 43, 56, and 110), Table 6b (Items 43 and 59), Table 6c (Items 35, 42, and 74), Table 6d (Item 73), Table 6e (Items 8, 34, 43, and 64). A maximum of 8.9% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG D unavailability in the At-Power internal events analysis, or approximately $9,200. A maximum of 4.0% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG D unavailability in the At-Power internal flooding events analysis, or approximately $1,600. A maximum of 5.2% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG D unavailability in the At-Power fire events analysis, or approximately $15,100.

A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG D unavailability in the LPSD internal events analysis, or approximately $1,100. A maximum of 12.5% reduction in AOE and AOSC costs is possible by eliminating the effect of EDG D unavailability in the LPSD flooding events analysis, or approximately $1,100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 or the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG, then an estimated maximum total benefit of approximately $133,600 would occur.

The total maximum benefit would be much lower than $133,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an EDG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.1.5. Load Sequencer Events

Basic events for the unavailability of diesel generator load sequencer are present in the at-power internal events, at-power internal fire events, LPSD internal events, and LPSD internal flooding events cutset file FV importance analysis and include: Table 6a (Items 68, 72, 116, and 120), Table 6c (Item 113), Table 6d (Items 63 and 64), Table 6e (Items 18 and 36). And Table 7c (Items 1 and 11). A maximum of 3.8% reduction in AOE and AOSC costs is possible by eliminating the effect of load sequencer unavailability in the At-Power internal events analysis, or approximately $4,000. A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of load sequencer unavailability in the At-Power fire events analysis, or approximately $4,300.

A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of load sequencer unavailability in the LPSD internal events analysis, or approximately $2,800. A maximum of 5.6% reduction in AOE and AOSC costs is possible by eliminating the effect of load sequencer unavailability in the LPSD flooding events analysis, or approximately $470.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($44,639) and AOC ($57, 495), total only $102,134 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the load sequencer, then an estimated maximum total benefit of approximately $34,600 would occur.

The total maximum benefit would be much lower than $34,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a load sequencer would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.1.6. Total EDG Event Summary

Evaluating all four EDGs above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all EDG unavailability is approximately $181,200. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE and AOC, total only $113,800. Therefore, an estimated maximum total benefit of approximately $295,000 is achievable.

The total maximum benefit would be much lower than $295,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an EDG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.2. AAC Combustion Turbine Generator Events

The generic SAMDA items evaluated for the APR1400 design related to CTG are listed in Table 5 and include item 15.

#### 7.2.1. AAC CTG Events

Basic events for the unavailability of the AAC CTG are present in all of the cutset file FV importance analyses for At-Power internal events, At-Power internal fire, LPSD flooding events and include: Table 6a (Items 20 and 59), Table 6c (Items 13 and 57), and Table 6d (Items 38 and 66). A maximum of 7.5% reduction in AOE and AOSC costs is possible by eliminating the effect of AAC CTG unavailability in the At-Power internal events analysis, or approximately $7,800. A maximum of 6.4% reduction in AOE and AOSC costs is possible by eliminating the effect of AAC CTG unavailability in the At-Power fire events analysis, or approximately $18,600.

A maximum of 2.7% reduction in AOE and AOSC costs is possible by eliminating the effect of the AAC CTG unavailability in the LPSD internal events analysis, or approximately $5,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($40,693) and AOC ($53,072), total only $93,765 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the AAC CTG, then an estimated maximum total benefit of approximately $125,600 would occur.

The total maximum benefit would be much lower than $193,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the AAC CTG would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.3. Auxiliary Feedwater Events

The generic SAMDA items evaluated for the APR1400 design related to auxiliary feedwater are listed in Table 5 and include items 66, 67, 71, 75, 77, and 78.

#### 7.3.1. AFW Isolation Valve MOV-45 Events

Basic events for the unavailability of AFW isolation valve MOV-45 are present in the At-Power internal events, At-Power internal fire, and At-Power internal flooding cutset file FV importance analyses and include: Table 6a (Items 24 and 25), Table 6b (Items 9 and 10), and Table 6c (Items 10 and 11). A maximum of 10.3% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-45 unavailability in the At-Power internal events analysis, or approximately $10,600. A maximum of 19.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-45 unavailability in the At-Power internal flooding events analysis, or approximately $7,600. A maximum of 10.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-45 unavailability in the At-Power fire events analysis, or approximately $29,600.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the AFW MOV, then an estimated maximum total benefit of approximately $123,400 would occur.

The total maximum benefit would be much lower than $123,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of MOV-45 would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.3.2. AFW Isolation Valve MOV-46 Events

Basic events for the unavailability of AFW isolation valve MOV-46 are present in the At-Power internal events, At-Power internal flooding events, and At-Power internal events cutset file FV importance analyses and include: Table 6a (Items 22 and 23), Table 6b (Items 12 and 13), and Table 6c (Items 26 and 27). A maximum of 10.6% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-46 unavailability in the At-Power internal events analysis, or approximately $11,100. A maximum of 17.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-46 unavailability in the At-Power internal flooding events analysis, or approximately $6,800. A maximum of 16.1% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-46 unavailability in the At-Power fire events analysis, or approximately $17,600.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the AFW MOV, then an estimated maximum total benefit of approximately $111,000 would occur.

The total maximum benefit would be much lower than $111,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of MOV-46 would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.3.3. Turbine-Driven AFW Pump PP01A Events

Basic events for the unavailability of AFW turbine driven pump PP01A are present in At-Power cutset file

FV importance analyses and include: Table 6a (Items 8, 10, 55, 58, 67, and 83), Table 6b (Items 18, 72, 75, 83, and 86), Table 6c (Items 17, 69, 100, and 109), and Table 7a (Item 12). A maximum of 26.8% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP A unavailability in the At-Power internal events analysis, or approximately $27,800. A maximum of 9.3% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP A unavailability in the At-Power internal flooding events analysis, or approximately $3,700. A maximum of 6.8% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP A unavailability in the At-Power fire events analysis, or approximately $19,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the TDAFP, then an estimated maximum total benefit of approximately $126,500 would occur.

The total maximum benefit would be much lower than $126,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the TDAFP would affect only induced SGTR events.

### 7.3.4. Turbine-Driven AFW Pump PP01B Events

Basic events for the unavailability of AFW turbine driven pump PP01B are present in the At-Power cutset file FV importance analyses and include: Table 6a (Items 10, 11, 55, 66, 81, 93), Table 6b (Items 20, 73, 79, 83, and 97), Table 6c (Items 31 and 69), and Table 7a (Item 12). A maximum of 24.5% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP B unavailability in the At-Power internal events analysis, or approximately $25,400. A maximum of 8.6% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP B unavailability in the At-Power internal flooding events analysis, or approximately $3,400. A maximum of 3.9% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW TDP B unavailability in the At-Power fire events analysis, or approximately $11,400.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the TDAFP, then an estimated maximum total benefit of approximately $115,700 would occur.

The total maximum benefit would be much lower than $115,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the TDAFP would affect only induced SGTR events.

### 7.3.5. Motor-Driven AFW Pump PP02A Events

Basic events for the unavailability of AFW motor driven pump PP02A are present in n in the At-Power cutset file FV importance analyses and include: Table 6a (Items 10 and 57), Table 6b (Item 30 and 83), Table 6c (Items 19 and 69), Table 7a (Item 12). A maximum of 12.2% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP A unavailability in the At-Power internal events analysis, or approximately $12,600. A maximum of 4.5% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP A unavailability in the At-Power internal flooding events analysis, or approximately $1,800. A maximum of 5.3% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP A unavailability in the At-Power fire events analysis, or approximately $15,400.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the

affected hazards were abated by eliminating any risk contribution from the MDAFP, then an estimated maximum total benefit of approximately $105,400 would occur.

The total maximum benefit would be much lower than $105,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFP would affect only induced SGTR events.

#### 7.3.6. Motor-Driven AFW Pump PP02B Events

Basic events for the unavailability of AFW motor driven pump PP02B are present in the At-Power cutset file FV importance analyses and include: Table 6a (Item 10 and 99), Table 6b (Items 37 and 83), and Table 6c (Items 43 and 69), and Table 7a (Item 12). A maximum of 11.2% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP B unavailability in the At-Power internal flooding events analysis, or approximately $11,600. A maximum of 3.9% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP B unavailability in the At-Power internal flooding events analysis, or approximately $1,600. A maximum of 3.0% reduction in AOE and AOSC costs is possible by eliminating the effect of AFW MDP B unavailability in the At-Power fire events analysis, or approximately $8,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the MDAFP, then an estimated maximum total benefit of approximately $97,300 would occur.

The total maximum benefit would be much lower than $97,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFP would affect only induced SGTR events.

#### 7.3.7. Startup FW Pump PP07 Events

Basic events for the unavailability of startup FW pump PP07 are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 73). A maximum of 1.3% reduction in AOE and AOSC costs is possible by eliminating the effect of startup FW pump PP07 unavailability in the At-Power internal events analysis, or approximately $1,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the MDAFP, then an estimated maximum total benefit of approximately $37,900 would occur.

The total maximum benefit would be much lower than $37,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the startup FW pump would affect only induced SGTR events.

#### 7.3.8. Total AFW Isolation Valve Event Summary

Evaluating all AFW isolation valve events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all AFW isolation valve unavailability is approximately $83,400. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences were abated by eliminating any risk contribution from the AFW MOVs, then an estimated maximum total benefit of

approximately $158,900 would occur.

The total maximum benefit would be much lower than $158,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 3a through 3f. Improved performance of the AFW MOVs would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.3.9. Total Turbine-Driven AFW Pump Event Summary

Evaluating all AFW turbine driven pump events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all AFW turbine driven pump unavailability is approximately $91,300. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences were abated by eliminating any risk contribution from the TDAFPs, then an estimated maximum total benefit of approximately $166,800 would occur.

The total maximum benefit would be much lower than $166,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the TDAFPs would affect only induced SGTR events.

### 7.3.10. Total Motor-Driven AFW Pump Event Summary

Evaluating all AFW motor driven pump events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all AFW motor driven pump unavailability is approximately $51,700. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. Therefore, an estimated maximum total benefit of approximately $127,100 is achievable.

The total maximum benefit would be much lower than $127,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFP would affect only induced SGTR events.

## 7.4. Fire Barrier Failure Events

The generic SAMDA items evaluated for the APR1400 design related to barrier failure are listed in Table 5 and includes item 143.

### 7.4.1. Fire Barrier Unavailability

Basic events for the unavailability of fire barriers are present in the At-Power and LPSD fire event cutset file FV importance analyses and include: Table 6c (Items 41, 83, and 119), Table 6f (Item 87), Table 7c (Items 7, 19, and 21), and Table 7f (Items 1, 2, 7, 8, 15, and 20). A maximum of 3.7% reduction in AOE and AOSC costs is possible by eliminating the effect of all barrier unavailability in the At-Power fire events analysis, or approximately $10,700. A maximum of 2.5% reduction in AOE and AOSC costs is possible by eliminating the effect of all barrier unavailability in the LPSD fire events analysis, or approximately $3,800.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($19,981) and AOC ($23,516), total only $43,497 for all fire events. If all offsite consequences were abated by eliminating any offsite risk contribution from failure of fire barriers, then an estimated maximum total benefit of approximately $58,000 would occur.

The total maximum benefit would be much lower than $58,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the fire barrier would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5. Component Cooling Water (CCW) Events

The generic SAMDA items evaluated for the APR1400 design related to CCW are listed in Table 5 and includes item 59.

#### 7.5.1. CCW Pump PP02A Events

Basic events for the unavailability of CCW pump PP02A are present in the At-Power internal events, At-Power internal flooding, and At-Power internal fire cutset file FV importance analysis and include: Table 6a (Item 102), Table 6b (Item 58), and Table 7c (Item 23). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump A unavailability in the At-Power internal flooding events analysis, or approximately $730. A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump A unavailability in the At-Power internal flooding events analysis, or approximately $590. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump A unavailability in the At-Power fire events analysis, or approximately $520.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $77,300 would occur.

The total maximum benefit would be much lower than $77,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.5.2. CCW Pump PP02B Events

Basic events for the unavailability of CCW pump PP02B are present in the At-Power internal events, At-Power internal flooding, At-Power internal fire, and LPSD internal flood cutset file FV importance analyses and include: Table 6a (Item 109), Table 6b (Item 62), and Table 6e (Item 66), and Table 7c (Item 23). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump B unavailability in the At-Power internal flooding events analysis, or approximately $670. A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump B unavailability in the At-Power internal flooding events analysis, or approximately $570. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump B unavailability in the At-Power fire events analysis, or approximately $520.

A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of CCW pump B unavailability in the LPSD internal flooding events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($36,791) and AOC ($47,065), total only $83,856 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $85,700 would occur.

The total maximum benefit would be much lower than $85,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5.3. Containment Spray Heat Exchanger HE01A CCW Inlet Valve MOV-97

Basic events for the unavailability of CS heat exchanger HE01A CCW inlet valve MOV-97 are present only in the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 97) and Table 7a (Item 22). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CS heat exchanger HE01A CCW inlet valve MOV-97 unavailability in the At-Power internal events analysis, or approximately $1,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the valve, then an estimated maximum total benefit of approximately $37,800 would occur.

The total maximum benefit would be much lower than $37,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW valve would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5.4. Containment Spray Heat Exchanger HE01B CCW Inlet Valve MOV-98

Basic events for the unavailability of CS heat exchanger HE01B CCW inlet valve MOV-98 are present in only the At-Power internal events cutset file FV importance analyses and include: Table 6a (Item 97) and Table 7a (Item 22). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CS heat exchanger HE01A CCW inlet valve MOV-97 unavailability in the At-Power internal events analysis, or approximately $1,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the valve, then an estimated maximum total benefit of approximately $37,800 would occur.

The total maximum benefit would be much lower than $37,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW valve would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5.5. DG001A CCW Inlet Valve MOV-191

Basic events for the unavailability of DG001A CCW inlet valve MOV-191 are present in only the LPSD internal flooding cutset file FV importance analyses and include: Table 6e (Item 37). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-191 unavailability in the LPSD internal flooding analysis, or approximately $100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($3,946) and AOC ($4,423), total only $8,369 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the valve, then an estimated maximum total

benefit of approximately $8,500 would occur.

The total maximum benefit would be much lower than $8,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW valve would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5.6. Total CCW Pump Event Summary

Evaluating all CCW pump events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all CCW pump unavailability is approximately $3,600. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($36,791) and AOC ($47,065), total only $83,856 for the hazards impacted. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $87,500 would occur.

The total maximum benefit would be much lower than $87,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.5.7. Total Containment Spray Heat Exchanger CCW Inlet Valve Event Summary

Evaluating all CS heat exchanger CCW inlet valve events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all CCW pump unavailability is approximately $2,400. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the impacted hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $40,000 would occur.

The total maximum benefit would be much lower than $40,0 00 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CCW valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.6. Containment Spray (CS) Events

### 7.6.1. Containment Spray Pump PP01A Events

Basic events for the unavailability of containment spray pump PP01A are present in the At-Power internal events, At-Power internal flooding, and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 71), Table 6b (Item 92), Table 6d (Item 72), Table 7a (Item 10), Table 7d (Items 28 and 30). A maximum of 1.6% reduction in AOE and AOSC costs is possible by eliminating the effect of CS pump A unavailability in the At-Power internal events analysis, or approximately $1,600. A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of CS pump A unavailability in the At-Power internal flooding events analysis, or approximately $250. A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of CS pump A unavailability in the LPSD internal events analysis, or approximately $1,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($25,950) and AOC ($35,994), total only $61,944 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $65,400 would occur.

The total maximum benefit would be much lower than $65,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.2. Containment Spray Pump PP01B Events

Basic events for the unavailability of containment spray pump PP01B are present in the At-Power internal events and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 65), Table 6d (Item 72), Table 7a (Item 10), and Table 7d (Items 28 and 30). A maximum of 1.7% reduction in AOE and AOSC costs is possible by eliminating the effect of CS pump B unavailability in the At-Power internal events analysis, or approximately $1,700. A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of CS pump B unavailability in the LPSD internal events analysis, or approximately $1,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($24,399) and AOC ($34,002), total only $58,401 for the hazards affected. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CCW pump, then an estimated maximum total benefit of approximately $361,800 would occur.

The total maximum benefit would be much lower than $361,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.3. Containment Spray Isolation Valve MOV-003 Events

Basic events for the unavailability of containment spray isolation valve MOV-003 are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 111). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-003 unavailability in the At-Power internal events analysis, or approximately $660.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000)

and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS valve, then an estimated maximum total benefit of approximately $37,200 would occur.

The total maximum benefit would be much lower than $35,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.4. Containment Spray Isolation Valve MOV-004 Events

Basic events for the unavailability of containment spray isolation valve MOV-004 are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 111) and Table 7a (Item 24). A maximum of 1.0% reduction in AOE and AOSC costs is possible by eliminating the effect of MOV-004 unavailability in the At-Power internal events analysis, or approximately $1,100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS valve, then an estimated maximum total benefit of approximately $37,700 would occur.

The total maximum benefit would be much lower than $37,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 3a through 4f. Improved performance of the CS valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.5. Containment Spray Heat Exchanger HE-01B Events

Basic events for the unavailability of containment spray heat exchanger HE-01B are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 82). A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of HE-01B unavailability in the At-Power internal events analysis, or approximately $1,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS heat exchanger, then an estimated maximum total benefit of approximately $37,800 would occur.

The total maximum benefit would be much lower than $37,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.6. Containment Spray Heat Exchanger HE-01A Events

Basic events for the unavailability of containment spray heat exchanger HE-01A are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 84). A maximum of 1.12 % reduction in AOE and AOSC costs is possible by eliminating the effect of HE-01A unavailability in the At-Power internal events analysis, or approximately $1,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000)

and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS heat exchanger, then an estimated maximum total benefit of approximately $37,800 would occur.

The total maximum benefit would be much lower than $37,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.7. Total Containment Spray Pump Event Summary

Evaluating all CS pump events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all CS pump unavailability is approximately $6,900. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($25,950) and AOC ($35,994), total only $61,944 for the hazards impacted. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the CS pumps, then an estimated maximum total benefit of approximately $68,900 would occur.

The total maximum benefit would be much lower than $68,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.8. Total Containment Spray Isolation Valve Event Summary

Evaluating both CS isolation valve events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all CS isolation valve unavailability is approximately $1,700. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS valves, then an estimated maximum total benefit of approximately $38,300 would occur.

The total maximum benefit would be much lower than $38,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS valves would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.6.9. Total Containment Spray Heat Exchanger Event Summary

Evaluating both CS heat exchanger events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all CS heat exchanger unavailability is approximately $2,300. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the CS heat exchangers, then an estimated maximum total benefit of approximately $38,900 would occur.

The total maximum benefit would be much lower than $39,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the CS heat exchangers would have a negligible effect on

reducing risk from SGTR and ISLOCA events.

### 7.7. 125 VDC Power Events

The generic SAMDA items evaluated for the APR1400 design related to DC power are listed in Table 4 and include items 1, 2, 3, 5, and 74.

#### 7.7.1. 125 VDC Power Battery BT01A Events

Basic events for the unavailability of 125 VDC battery BT01A are present in the At-Power internal events, At-Power internal flooding, and At-Power internal fire cutset file FV importance analyses and include: Table 6a (Item 21), Table 6b (Item 55), and Table 6c (Item 61). A maximum of 5.4% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01A unavailability in the At-Power internal events analysis, or approximately $6,200. A maximum of 1.7% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01A unavailability in the At-Power internal flooding events analysis, or approximately $680. A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01A unavailability in the At-Power internal fire analysis, or approximately $4,000.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affaeced hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the battery, then an estimated maximum total benefit of approximately $85,800 would occur.

The total maximum benefit would be much lower than $85,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the battery would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.7.2. 125 VDC Power Battery BT01B Events

Basic events for the unavailability of 125 VDC battery BT01B are present in the At-Power internal events, At-Power internal flooding, and At-Power internaql fire cutset file FV importance analyses and include: Table 6a (Item 17), Table 6b (Item 56), and Table 6c (Item 39). A maximum of 6.0% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01B unavailability in the At-Power internal events analysis, or approximately $6,200. A maximum of 1.7% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01B unavailability in the At-Power internal flooding events analysis, or approximately $680. A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01B unavailability in the At-Power internal fire events analysis, or approximately $4,000.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affaeced hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the battery, then an estimated maximum total benefit of approximately $85,400 would occur.

The total maximum benefit would be much lower than $85,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the battery would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.7.3. 125 VDC Power Battery BT01C Events

Basic events for the unavailability of 125 VDC battery BT01C are present in only the At-Power internal events cutset file FV importance analyses and include: Table 6a (Item 74). A maximum of 1% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01C unavailability in the At-Power internal events analysis, or approximately $1,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the battery, then an estimated maximum total benefit of approximately $37,900 would occur.

The total maximum benefit would be much lower than $37,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the battery would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.7.4. 125 VDC Power Battery BT01D Events

Basic events for the unavailability of 125 VDC battery BT01D are present in only the At-Power internal events cutset file FV importance analyses and include: Table 6a (Item 74). A maximum of 1% reduction in AOE and AOSC costs is possible by eliminating the effect of battery BT01D unavailability in the At-Power internal events analysis, or approximately $1,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events. If all offsite consequences were abated by eliminating any risk contribution from the battery, then an estimated maximum total benefit of approximately $37,900 would occur.

The total maximum benefit would be much lower than $37,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the battery would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.7.5. Total 125 VDC Power Battery Event Summary

Evaluating all 125 VDC power battery events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all battery unavailability is approximately $10,300. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the batteries, then an estimated maximum total benefit of approximately $101,200 would occur.

The total maximum benefit would be much lower than $101,200 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the battery would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.8. 120 VAC Power Events

The generic SAMDA items evaluated for the APR1400 design related to 120V AC power are listed in Table 5 and include items 6, 7, and 16).

#### 7.8.1. 120V Inverter IN01A

Basic events for the unavailability of 120V inverter IN01A are present in the At-Power internal events, At-Power internal flooding events, and At-Power internal fire cutset file FV importance analyses and include: Table 6a (Item 36), Table 6b (Item 76), Table 6c (Item 110). A maximum of 3.1% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01A unavailability in the At-Power internal events analysis, or approximately $3,200. A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01A unavailability in the At-Power internal flooding events analysis, or approximately $320. A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01A unavailability in the At-Power internal fire analysis, or approximately $1,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the inverter, then an estimated maximum total benefit of approximately $80,700 would occur.

The total maximum benefit would be much lower than $80,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the inverter would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.8.2. 120V Inverter IN01B

Basic events for the unavailability of 120V inverter IN01B are present in the At-Power internal events, At-Power internal flooding events, and At-Power internal fire events cutset file FV importance analyses and include: Table 6a (Item 33), Table 6b (Item 81), Table 6c (Item 107). A maximum of 3.5% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01B unavailability in the At-Power internal events analysis, or approximately $3,600. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01B unavailability in the At-Power internal flooding events analysis, or approximately $1,600. A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01B unavailability in the At-Power internal fire analysis, or approximately $1,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the inverter, then an estimated maximum total benefit of approximately $80,700 would occur.

The total maximum benefit would be much lower than $95,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the inverter would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.8.3. 120V Inverter IN01C

Basic events for the unavailability of 120V inverter IN01C are present in the At-Power internal events

cutset file FV importance analyses and include: Table 6a (Item 98). A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01C unavailability in the At-Power internal events analysis, or approximately $780.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events, at-power internal flooding, and LPSD fire events. If all offsite consequences were abated by eliminating any risk contribution from the inverter, then an estimated maximum total benefit of approximately $37,400 would occur.

The total maximum benefit would be much lower than $37,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the inverter would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.8.4. 120V Inverter IN01D

Basic events for the unavailability of 120V inverter IN01D are present in the At-Power internal events and LPSD fire events cutset file FV importance analyses and include: Table 6a (Item 101). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of inverter IN01D unavailability in the At-Power internal events analysis, or approximately $750.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for at-power internal events, at-power internal flooding, and LPSD fire events. If all offsite consequences were abated by eliminating any risk contribution from the inverter, then an estimated maximum total benefit of approximately $37,400 would occur.

The total maximum benefit would be much lower than $37,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the inverter would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.8.5. Total 120V inverter Event Summary

Evaluating all 120V inverter events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all 120V inverter unavailability is approximately $12,500. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the inverter, then an estimated maximum total benefit of approximately $88,000 would occur.

The total maximum benefit would be much lower than $106,900 because all offsite consequences would not be eliminated. As can be seen from Tables 2a through 2f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 3a through 3f. Improved performance of the inverter would have a negligible effect on reducing risk from SGTR and ISLOCA events. Therefore, a design change to improve performance of the inverters would have a negligible benefit.

### 7.9. AC Power Events

The generic SAMDA items evaluated for the APR1400 design related to AC power are listed in Table 5 and include item 16.

### 7.9.1. Standby Auxiliary Transformer (SAT) 02M Events

Basic events for the unavailability of SAT transformer 02M are present in the At-Power internal flooding events and At-Power internal fire cutset file FV importance analysis and include: Table 6b (Item 61), and Table 6c (Item 50). A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of SAT transformer 2M in the At-Power internal flooding events analysis, or approximately $570. A maximum of 1.6% reduction in AOE and AOSC costs is possible by eliminating the effect of SAT transformer 2M in the At-Power internal fire events analysis, or approximately $4,700.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($17,845) and AOC ($21,062), total only $38,907 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated maximum total benefit of approximately $44,200 would occur.

The total maximum benefit would be much lower than $44,200 because all offsite consequences would not be eliminated. As can be seen from Tables 2a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the transformer would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.2. Standby Auxiliary Transformer 02N Events

Basic events for the unavailability of SAT transformer 02N are present in the At-Power internal flooding events and At-Power internal fire events cutset files FV importance analysis and include: Table 6b (Item 64) and Table 6c (Item 20). A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of SAT transformer 2N in the At-Power internal flooding events analysis, or approximately $540. A maximum of 3.5% reduction in AOE and AOSC costs is possible by eliminating the effect of SAT transformer 2M in the At-Power internal fire events analysis, or approximately $10,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($17,845) and AOC ($21,062), total only $38,907 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated maximum total benefit of approximately $49,700 would occur.

The total maximum benefit would be much lower than $49,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the transformer would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.3. PCB SW01A-A2 To 4.16KV Switchgear SW01A Events

Basic events for the unavailability of PCB SW01A-A2 To 4.16KV Switchgear SW01A are present in only the At-Power internal flooding and At-Power internal fire events cutset file FV importance analyses and include: Table 6b (Item 57) and Table 6c (Item 55). A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-A2 in the At-Power internal flooding events analysis, or approximately $540. A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-A2 in the At-Power internal flooding events analysis, or approximately $4,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($17,845) and AOC ($21,062), total only $38,907 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $43,800 would occur.

The total maximum benefit would be much lower than $43,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.4. PCB SW01B-A2 To 4.16KV Switchgear SW01B Events

Basic events for the unavailability of PCB SW01B-A2 To 4.16KV Switchgear SW01B are present in the At-Power internal flooding events, At-Power internal fire, and LPSD internal events cutset file FV importance analysis and include: Table 6b (Item 65), Table 6c (Item 70), and Table 7d (Item 35). A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-A2 in the At-Power internal flooding events analysis, or approximately $540. A maximum of 1.5% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-A2 in the At-Power internal flooding events analysis, or approximately $3,300. A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-A2 in the LPSD internal events analysis, or approximately $720.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $65,300 would occur.

The total maximum benefit would be much lower than $65,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.5. PCB SW01C-A2 To 4.16KV Switchgear SW01C Events

Basic events for the unavailability of PCB SW01C-A2 To 4.16KV Switchgear SW01A are present in only the At-Power and LPSD internal flooding events cutset file FV importance analyses and include: Table 6b (Item 99). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01C-A2 in the At-Power internal flooding events analysis, or approximately $230.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($1,551) and AOC ($1,992), total only $3,543 for internal flooding events. If all offsite consequences were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $3,800 would occur.

The total maximum benefit would be much lower than $3,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.6. PCB SW01A-H2 To 4.16KV Switchgear SW01A From UAT Events

Basic events for the unavailability of PCB SW01A-H2 To 4.16KV Switchgear SW01A from the UAT are present in the At-Power internal events, At-Power internal flooding, LPSD internal events, and LPSD internal flooding cutset file FV importance analyses and include: Table 6a (Items 40 and 103), Table 6b (Items 2, 8, 34, 35, 54, 58, 71, and 109), Table 6e (Items 9 and 73), and Table 7d (Items 25 and 41). A maximum of 3.6% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB

SW01A-H2 in the At-Power internal events analysis, or approximately $3,800. A maximum of 41% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-H2 in the At-Power internal flooding events analysis, or approximately $16,300. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-H2 in LPSD internal events analysis, or approximately $1,300. A maximum of 9.2% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-H2 in LPSD internal flooding analysis, or approximately $770.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($29,896) and AOC ($40,417), total only $70,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $92,600 would occur.

The total maximum benefit would be much lower than $92,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.7. PCB SW01B-H2 To 4.16KV Switchgear SW01B From UAT Events

Basic events for the unavailability of PCB SW01B-H2 To 4.16KV Switchgear SW01B from the UAT are present in only the At-Power internal events, At-Power internal flood, LPSD internal events, and LPSD internal flood cutset file FV importance analyses and include: Table 6a (Items 42 and 103), Table 6b (Items 5, 8, 35, 38, 41, 54, 71, and 110), Table 6e (Items 61 and 73), and Table 7d (Items 25 and 41). A maximum of 3.6% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-H2 in the At-Power internal events analysis, or approximately $3,700. A maximum of 41% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-H2 in the At-Power internal flooding events analysis, or approximately $16,300. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01B-H2 in LPSD internal events analysis, or approximately $1,300. A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01A-H2 in LPSD internal flooding analysis, or approximately $90.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($29,896) and AOC ($40,417), total only $70,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $91,800 would occur.

The total maximum benefit would be much lower than $91,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.9.8. PCB SW01C-C2 To 4.16KV Switchgear SW01C From UAT Events

Basic events for the unavailability of PCB SW01C-C2 To 4.16KV Switchgear SW01C from the UAT are present in only the At-Power internal events, At-Power internal flood, LPSD internal events, and LPSD internal flood cutset file FV importance analyses and include: Table 6a (Items 77 and 103), Table 6b (Items 8, 23, 34, 35, 38, 54, and 110), Table 6e (Item 73), and Table 7d (Items 25 and 41). A maximum of 1.9% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01C-C2 in the At-Power internal events analysis, or approximately $2,000. A maximum of 29% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01C-C2 in the At-Power internal flooding events analysis, or approximately $11,300. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01C-C2 in LPSD internal events analysis, or approximately

$1,300. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01C-C2 in LPSD internal flooding analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($29,896) and AOC ($40,417), total only $70,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $85,000 would occur.

The total maximum benefit would be much lower than $85,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.9.9. PCB SW01D-G2 To 4.16KV Switchgear SW01D From UAT Events

Basic events for the unavailability of PCB SW01D-G2 To 4.16KV Switchgear SW01D from the UAT are present in the At-Power internal events, At-Power internal flooding, LPSD internal events, and LPSD internal flood cutset file FV importance analyses and include: Table 6a (Items 78 and 103), Table 6b (Items 8, 31, 35, 38, 41, 71, and 109), Table 6e (Items 25 and 73), and Table 7d (Items 25 and 41). A maximum of 1.9% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01D-G2 in the At-Power internal events analysis, or approximately $2,000. A maximum of 26% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01D-G2 in the At-Power internal flooding events analysis, or approximately $10,200. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01D-G2 in LPSD internal events analysis, or approximately $1,300. A maximum of 3.0% reduction in AOE and AOSC costs is possible by eliminating the effect of PCB SW01D-G2 in LPSD internal flooding analysis, or approximately $250.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($29,896) and AOC ($40,417), total only $70,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the circuit breaker, then an estimated maximum total benefit of approximately $84,100 would occur.

The total maximum benefit would be much lower than $84,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.9.10. Standby Auxiliary Transformer (SAT) Event Summary

Evaluating both SAT transformer events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all SAT transformer unavailability is approximately $16,100. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($17,845) and AOC ($21,062), total only $38,907 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated maximum total benefit of approximately $55,000 would occur.

The total maximum benefit would be much lower than $55,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the transformer would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.9.11. 4.16kV Circuit Breaker Event Summary

Evaluating all 4.16KV circuit breaker events above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all 4.16KV circuit breakers unavailability is approximately $81,900. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677. If all offsite consequences were abated by eliminating any risk contribution from 4.16kV breakers, then an estimated maximum total benefit of approximately $187,500 would occur.

The total maximum benefit would be much lower than $187,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the circuit breaker would have a negligible effect on reducing risk from SGTR and ISLOCA events. Furthermore, the change would need to be applied to all seven circuit breakers considered in this estimate.

### 7.10. Pilot-Operated Safety Relief Valve (POSRV) Events

#### 7.10.1. POSRV V200 Events

Basic events for the unavailability of POSRV V200 are present in the At-Power internal flooding events, At-Power internal fire events, and LPSD internal event cutset file FV importance analyses and include: Table 6b (Item 84), Table 6c (Item 90), and Table 7d (Item 61). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V200 unavailability in the At-Power internal flooding events analysis, or approximately $270. A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V200 unavailability in the At-Power fire events analysis, or approximately $2,400. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V200 unavailability in the LPSD internal events analysis, or approximately $360.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the POSRV, then an estimated maximum total benefit of approximately $63,800 would occur.

The total maximum benefit would be much lower than $63,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a POSRV would affect only induced SGTR events.

#### 7.10.2. POSRV V201 Events

Basic events for the unavailability of POSRV V201 are present in the At-Power internal flooding events, At-Power internalfire events, and LPSD internal events cutset file FV importance analyses and include: Table 6b (Item 85), Table 6c (Item 91), and Table 7d (Item 61). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V201 unavailability in the At-Power internal flooding events analysis, or approximately $270. A maximum of 0.8% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V201 unavailability in the At-Power fire events analysis, or approximately $2,400. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V201 unavailability in the LPSD internal events analysis, or approximately $360.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences for the

affected hazards were abated by eliminating any risk contribution from the POSRV, then an estimated maximum total benefit of approximately $63,800 would occur.

The total maximum benefit would be much lower than $63,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a POSRV would affect only induced SGTR events.

### 7.10.3. POSRV V202 Events

Basic events for the unavailability of POSRV V202 are present in the At-Power internal flooding events and LPSD internal events cutset file FV importance analyses and include: Table 6b (Item 88) and Table 7d (Item 61). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V202 unavailability in the At-Power internal flooding events analysis, or approximately $260. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V202 unavailability in the LPSD internal events analysis, or approximately $360.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($10,950) and AOC ($14,414), total only $25,364 for the affected hazrds. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the POSRV, then an estimated maximum total benefit of approximately $26,000 would occur.

The total maximum benefit would be much lower than $26,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a POSRV would affect only induced SGTR events.

### 7.10.4. POSRV V203 Events

Basic events for the unavailability of POSRV V203 are present in the At-Power internal flooding events and LPSD internal events cutset file FV importance analyses and include: Table 6b (Item 88) and Table 7d (Item 61). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V203 unavailability in the At-Power internal flooding events analysis, or approximately $260. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of POSRV V203 unavailability in the LPSD internal events analysis, or approximately $360.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($10,950) and AOC ($14,414), total only $25,364 for the affected hazrds. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the POSRV, then an estimated maximum total benefit of approximately $26,000 would occur.

The total maximum benefit would be much lower than $26,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a POSRV would affect only induced SGTR events.

### 7.10.5. Total POSRV Event Summary

Evaluating all four POSRV above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all POSRV unavailability is approximately $7,400. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences were abated by eliminating any risk contribution from the POSRVs, then an estimated maximum total benefit of approximately $68,100 would occur.

The total maximum benefit would be much lower than $68,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of a POSRVs would affect only induced SGTR events.

## 7.11. Chiller/Cooler Events

### 7.11.1. ECW Chiller CH01A Events

Basic events for the unavailability of ECW chiller CH01A are present in At-Power internal events, At-Power internal flooding, At-Power internal fire events, LPSD internal events, and LPSD internal flood cutset file FV importance analyses and include: Table 6a (Items 46, 60, and 96), Table 6b (Item 74), Table 6c (Items 56, 62, 81, and 118), Table 6d (Item 61), and Table 6e (Item 50). A maximum of 5.0% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01A unavailability in the At-Power internal events analysis, or approximately $5,200. A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01A unavailability in the At-Power internal flooding analysis, or approximately $360. A maximum of 4.3% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01A unavailability in the At-Power fire events analysis, or approximately $12,600.

A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01A unavailability in the LPSD internal events analysis, or approximately $1,500. A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01A unavailability in the LPSD internal events analysis, or approximately $80.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated maximum total benefit of approximately $125,400 would occur.

The total maximum benefit would be much lower than $125,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an ECW chiller would have a minimal effect of SGTR and ISLOCA events.

### 7.11.2. ECW Chiller CH01B Events

Basic events for the unavailability of ECW chiller CH01B are present in At-Power internal events, At-Power internal flood, At-Power internal fire, LPSD internal events cutset file FV importance analyses and include: Table 6a (Items 47, 60, 96), Table 6b (Item 101), Table 6c (Items 56, 75 and 118), and Table 6d (Item 61). A maximum of 4.8% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01B unavailability in the At-Power internal events analysis, or approximately $5,000. A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01B unavailability in the At-Power internal flooding analysis, or approximately $230. A maximum of 3.0% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01B unavailability in the At-Power fire events analysis, or approximately $8,700.

A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH01B unavailability in the LPSD internal events analysis, or approximately $1,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated

maximum total benefit of approximately $112,700 would occur.

The total maximum benefit would be much lower than $112,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an ECW chiller would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.3. ECW Chiller CH02A Events

Basic events for the unavailability of ECW chiller CH03a are present in nearly all of the cutset file FV importance analyses and include: Table 6a (Items 28, 60, 79, and 96), Table 6b (Items 16, and 48), Table 6c (Items 24, 56, 77, and 118), and Table 6d (Item 61). A maximum of 7.8% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02A unavailability in the At-Power internal events analysis, or approximately $8,100. A maximum of 9.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02A unavailability in the At-Power internal flooding events analysis, or approximately $3,600. A maximum of 6.2% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02A unavailability in the At-Power fire events analysis, or approximately $18,200.

A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02A unavailability in the LPSD internal events analysis, or approximately $1,500.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the transformer, then an estimated maximum total benefit of approximately $128,600 would occur.

The total maximum benefit would be much lower than $128,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an ECW chiller would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.4. ECW Chiller CH02B Events

Basic events for the unavailability of ECW chiller CH02B are present in nearly all of the cutset file FV importance analyses and include: Table 6a (Items 29, 60, 85, and 96), Table 6b (Items 17 and 50), Table 6c (Items 30, 56, 87, and 118), Table 6d (Item 61), and Table 6e (Item 16). A maximum of 7.4% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02B unavailability in the At-Power internal events analysis, or approximately $7,800. A maximum of 8.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02B unavailability in the At-Power internal flooding events analysis, or approximately $3,400. A maximum of 5.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02B unavailability in the At-Power fire events analysis, or approximately $16,500.

A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02B unavailability in the LPSD internal events analysis, or approximately $1,500. A maximum of 5.0% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW chiller CH02B unavailability in the LPSD internal flooding analysis, or approximately $420.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the chiler, then an estimated

maximum total benefit of approximately $135,200 would occur.

The total maximum benefit would be much lower than $135,200 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of an ECW chiller would have a minimal effect of SGTR and ISLOCA events.

### 7.11.5. EDG Room Cubicle Cooler HV12A Events

Basic events for the unavailability of EDG room cubical cooler HV12A are present in the At-Power internal events, At-Power internal fire, LPSD internal events, and LPSD internal flood cutset file FV importance analysis and include: Table 6a (Items 118), Table 6e (Items 23 and 46), Table 7c (Items 10), and Table 7d (Item 51). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12A unavailability in the At-Power internal events analysis, or approximately $580. A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12A unavailability in the At-Power internal fire analysis, or approximately $1,100.

A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12A unavailability in the LPSD internal events analysis, or approximately $920. A maximum of 4.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12A unavailability in the LPSD internal flooding analysis, or approximately $340.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($44,639) and AOC ($57,495), total only $102,134 for the at-power events. If all offsite consequences were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $105,100 would occur.

The total maximum benefit would be much lower than $105,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

### 7.11.6. EDG Room Cubicle Cooler HV12B Events

Basic events for the unavailability of EDG room cubical cooler HV12B are present in the At-Power internal event, At-Power internal fire, and LPSD internal events cutset file FV importance analysis and include: Table 6a (Items 122), Table 7c (Item 10), and Table 7d (Item 49). A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12B unavailability in the At-Power internal events analysis, or approximately $540. A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12B unavailability in the At-Power internal fire analysis, or approximately $1,100. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12B unavailability in the LPSD internal events analysis, or approximately $920.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($40,693) and AOC ($53,072), total only $93,765 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $96,300 would occur.

The total maximum benefit would be much lower than $96,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a

through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

### 7.11.7. EDG Room Cubicle Cooler HV12D Events

Basic events for the unavailability of EDG room cubical cooler HV12D are present in only the LPSD internal fflooding cutset file FV importance analysis and include: Table 6e (Item 55). A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV12D unavailability in the LPSD internal floodinig analysis, or approximately $80.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($3,946) and AOC ($4,423), total only $8,369 for the LPSD internal events. If all offsite consequences were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $8,400 would occur.

The total maximum benefit would be much lower than $8,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

### 7.11.8. EDG Room Cubicle Cooler HV13A Events

Basic events for the unavailability of EDG room cubical cooler HV13A are present in the At-Power internal event, At-power internal fire, LPSD internal events, and LPSD internal flood cutset file FV importance analysis and include: Table 6a (Items 119) Table 6e (Items 24 and 47), Table 7c (Item 10), and Table 7d (Item 52). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13A unavailability in the At-Power internal events analysis, or approximately $580. A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13A unavailability in the At-Power internal fire analysis, or approximately $1,100.

A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13A unavailability in the LPSD internal events analysis, or approximately $920. A maximum of 4.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13A unavailability in the LPSD internal flood analysis, or approximately $340.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($44,639) and AOC ($57,495), total only $102,134 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $105,100 would occur.

The total maximum benefit would be much lower than $105,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

### 7.11.9. EDG Room Cubicle Cooler HV13B Events

Basic events for the unavailability of EDG room cubical cooler HV13B are present in the At-Power internal events, At-Power internal fire, and LPSD internal events cutset file FV importance analysis and include: Table 6a (Items 123), Table 7c (Item 10), and Table 7d (Item 50). A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13B unavailability in the At-Power internal events analysis, or approximately $540. A maximum of 0.4% reduction in AOE and

AOSC costs is possible by eliminating the effect of cubical cooler HV13B unavailability in the At-Power internal fire analysis, or approximately $1,100. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13B unavailability in the LPSD internal events analysis, or approximately $930.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($40,693) and AOC ($53,072), total only $93,765 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $96,300 would occur.

The total maximum benefit would be much lower than $96,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.10. EDG Room Cubicle Cooler HV13D Events

Basic events for the unavailability of EDG room cubical cooler HV13D are present in only the LPSD internal flood cutset file FV importance analysis and include: Table 6e (Item 56). A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV13D unavailability in the LPSD internal flood analysis, or approximately $80.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($3,946) and AOC ($4,423), total only $8,369 for the LPSD flooding events. If all offsite consequences were abated by eliminating any risk contribution from the EDG room cooler, then an estimated maximum total benefit of approximately $8,400 would occur.

The total maximum benefit would be much lower than $8,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room cooler would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.11. Motor-Driven AFW Pump Room A Cubicle Cooler HV33A Events

Basic events for the unavailability of motor driven AFW pump room A cubical cooler HV33A are present in the At-Power internal events, At-Power internal flood, At-Power internal fire, and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 89), Table 6b (Items 46 and 82), Table 6c (Items 33 and 89) and Table 7d (Item 44). A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33A unavailability in the At-Power internal events analysis, or approximately $1,100. A maximum of 3.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33A unavailability in the At-Power internal flooding events analysis, or approximately $1,400. A maximum of 3.5% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33A1 unavailability in the At-Power fire events analysis, or approximately $10,000.

A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33A unavailability in the LPSD internal events analysis, or approximately $180.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the MDAFW pump room cooler, then an estimated maximum total benefit of approximately $110,000 would occur.

The total maximum benefit would be much lower than $110,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFW pump room cooler would have a minimal effect only induced SGTR events by increasing availability of the associated AFW pump.

### 7.11.12. Motor-Driven AFW Pump Room B Cubicle Cooler HV33B Events

Basic events for the unavailability of motor driven AFW pump room B cubical cooler HV33B are present in the At-Power internal flooding, At-Poweer internal fire, and LPSD internal events cutset file FV importance analyses and include: Table 6b (Items 51 and 94), Table 6c (Items 71), and Table 7d (Item 44). A maximum of 2.6% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the At-Power internal flooding events analysis, or approximately $1,000. A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the At-Power fire events analysis, or approximately $3,300. A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the LPSD events analysis, or approximately $180.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences for the affected hhazards were abated by eliminating any risk contribution from the MDAFW pump room cooler, then an estimated maximum total benefit of approximately $65,200 would occur.

The total maximum benefit would be much lower than $65,200 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFW pump room cooler would have a minimal effect only induced SGTR events by increasing availability of the associated AFW pump.

### 7.11.13. ECW Chiller B Cubical Cooler HV32B Events

Basic events for the unavailability of ECW Chiller room cubical cooler HV32B are present in the LPSD internal events and LPSD internal flooding cutset file FV importance analyses and include: Table 6e (Item 49), and Table 7d (Item 44). A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV32B unavailability in the LPSD internal events analysis, or approximately $180. A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV32B unavailability in the LPSD internal flood events analysis, or approximately $80.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($13,345) and AOC ($16,845), total only $30,190 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ECW chiller cubical cooler, then an estimated maximum total benefit of approximately $30,400 would occur.

The total maximum benefit would be much lower than $30,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW chiller cubical cooler would have a minimal effect on SGTR and ISLOCA events.

### 7.11.14. Air Handling Unit AH02A Events

Basic events for the unavailability of air hadling unit AH02A are present in the At-Power internal flooding

and LPSD internal events FV importance analyses and include: Table 6b (Items 102 and 105) and Table 7d (Item 42). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the At-Power internal flooding events analysis, or approximately $460. A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the LPSD internal events analysis, or approximately $180.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($10,950) and AOC ($14,414), total only $25,364 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ECW chiller cubical cooler, then an estimated maximum total benefit of approximately $26,000 would occur.

The total maximum benefit would be much lower than $26,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW chiller cubical cooler would have a minimal effect only induced SGTR and ISLOCA events.

### 7.11.15. Air Handling Unit AH02B Events

Basic events for the unavailability of air hadling unit AH02B are present in the At-Power internal flooding, LPSD internal events, and LPSD internal flood FV importance analyses and include: Table 6b (Items 104 and 106), Table 6e (Item 33), and Table 7d (Item 42). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the At-Power internal flooding events analysis, or approximately $460. A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of cubical cooler HV33B unavailability in the LPSD internal events analysis, or approximately $180.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($14,896) and AOC ($18,837), total only $33,733 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ECW chiller cubical cooler, then an estimated maximum total benefit of approximately $34,500 would occur.

The total maximum benefit would be much lower than $34,5000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW chiller cubical cooler would have a minimal effect only induced SGTR and ISLOCA events.

### 7.11.16. Total ECW Chiller Event Summary

Evaluating all four ECW chillers above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all ECW chiller unavailability is approximately $95,900. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 for the affected hazards. If all offsite consequences were abated by eliminating any risk contribution from the ECW chillers, then an estimated maximum total benefit of approximately $201,600 would occur.

The total maximum benefit would be much lower than $201,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW chillers would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.17. Total EDG Room Cubicle Cooler Event Summary

Evaluating all six EDG room cubical coolers above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all EDG room cooler unavailability is approximately $8,600. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($44,639) and AOC ($57,495), total only $102,134 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG room coolers, then an estimated maximum total benefit of approximately $110,700 would occur.

The total maximum benefit would be much lower than $110,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the EDG room coolers would have a minimal effect of SGTR and ISLOCA events.

#### 7.11.18. Total Motor Driven AFW Pump Room Cubical Cooler Event Summary

Evaluating both motor-driven AFW pump room cubical coolers above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all MDAFW pump room cooler unavailability is approximately $17,200. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308. If all offsite consequences were abated by eliminating any risk contribution from the MDAFW pump room coolers, then an estimated maximum total benefit of approximately $114,500 would occur.

The total maximum benefit would be much lower than $114,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MDAFW pump room coolers would affect only induced SGTR events by increasing availability of the associated AFW pump.

#### 7.11.19. Total Air Handling Unit Event Summary

Evaluating the two air handling units above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all AHU unavailability is approximately $1,400. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($14,896) and AOC ($18,837), total only $33,733 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the EDG room coolers, then an estimated maximum total benefit of approximately $35,100 would occur.

The total maximum benefit would be much lower than $35,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the air handling units would have a minimal effect of SGTR and ISLOCA events.

### 7.12. Safety Injection (SI) Events

The generic SAMDA items evaluated for the APR1400 design related to safety injection are listed in Table 4 and include items 26, 29, 37, 38, and 39.

### 7.12.1. SI Pump PP02A Events

Basic events for the unavailability of SI pump PP02A are present only the LPSD internal flooding cutset file FV importance analyses and include: Table 6e (Item 48). A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02A unavailability in the LPSD internal flooding events analysis, or approximately $90.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($3,946) and AOC ($4,423), total only $8,369 for LPSD flooding events. If all offsite consequences were abated by eliminating any risk contribution from the SI pump, then an estimated maximum total benefit of approximately $8,500 would occur.

The total maximum benefit would be much lower than $8,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SI pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.2. SI Pump PP02B Events

Basic events for the unavailability of SI pump PP02B are present only the At-Power internal events, At-Power internal fire, and LPSD internal flooding cutset file FV importance analyses and include: Table 6a (Item 106), Table 6c (Item 114), and Table 6e (Item 48). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02B unavailability in the At-Power internal events analysis, or approximately $700. A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02B unavailability in the At-Power internal events analysis, or approximately $700. A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02B unavailability in the At-Power internal fire analysis, or approximately $1,600. A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02B unavailability in the LPSD internal flooding analysis, or approximately $90.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($35,240) and AOC ($45,073), total only $80,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the SI pump, then an estimated maximum total benefit of approximately $82,800 would occur.

The total maximum benefit would be much lower than $82,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SI pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.3. SI Pump PP02C Events

Basic events for the unavailability of SI pump PP02C are present in only the the At-Power internal events, At-power internal fire, and LPSD internal events cutset file FV importance analyses and include: Table 6a (Items 95 and 121), Table 6c (Item 108), and Table 6d (Item 74). A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02C unavailability in the At-Power internal events analysis, or approximately $1,400. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02C unavailability in the LPSD internal events analysis, or approximately $1,100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($24,399) and AOC ($34,002), total only $58,401 for the affected hazards. If all offsite consequences for the

affected hazards were abated by eliminating any risk contribution from the SI pump, then an estimated maximum total benefit of approximately $60,900 would occur.

The total maximum benefit would be much lower than $60,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SI pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.4. SI Pump PP02D Events

Basic events for the unavailability of SI pump PP02D are present only the At-Power internal fire cutset file FV importance analyses and include: Table 6c (Item 108). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of SI pump PP02D unavailability in the At-Power internal fire events analysis, or approximately $1,800.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($16,294) and AOC ($19,070), total only $35,364 for At-Power internal fire. If all offsite consequences were abated by eliminating any risk contribution from the SI pump, then an estimated maximum total benefit of approximately $37,200 would occur.

The total maximum benefit would be much lower than $37,200 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SI pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.5. Total SI Pump Event Summary

Evaluating all four SI pumps above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all SI pump unavailability is approximately $6,800. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($35,240) and AOC ($45,073), total only $80,313. If all offsite consequences were abated by eliminating any risk contribution from the SI pumps, then an estimated maximum total benefit of approximately $87,100 would occur.

The total maximum benefit would be much lower than $87,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SI pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.6. IRWST Strainer Events

Basic events for the unavailability of IRWST sump are present in only the At-Power and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 34) and Table 6d (Item 13). A maximum of 3.4% reduction in AOE and AOSC costs is possible by eliminating the effect of IRWST sump unavailability in the At-Power internal events analysis, or approximately $3,500.

A maximum of 5.4% reduction in AOE and AOSC costs is possible by eliminating the effect of IRWST sump unavailability in the LPSD internal events analysis, or approximately $10,900.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($24,399) and AOC ($34,002), total only $58,401 for the affected hazards. If all offsite consequences for the

affected hazards were abated by eliminating any risk contribution from the IRWST sump, then an estimated maximum total benefit of approximately $72,800 would occur.

The total maximum benefit would be much lower than $72,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the IRWST sump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.12.7. SI Valve V-959 Events

Basic events for the unavailability of SI pump min-flow recirculatin valve V-959 are present only the At-Power fire cutset file FV importance analyses and include: Table 6c (Item 68). A maximum of 1.2% reduction in AOE and AOSC costs is possible by eliminating the effect of the recirculation valve unavailability in the At-Power internal fire events analysis, or approximately $3,400.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($16,294) and AOC ($19,070), total only $35,364 for the At-Power fire events. If all offsite consequences were abated by eliminating any risk contribution from the valve, then an estimated maximum total benefit of approximately $38,700 would occur.

The total maximum benefit would be much lower than $38,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the recirculation valve would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.13. Essential Service Water (ESW) Events

### 7.13.1. ESW Pump PP02A Events

Basic events for the unavailability of ESW pump PP02A are present in the At-Power internal events, At-Power internal flooding events, At-Power internal fire, and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 49), Table 6b (Item 28), Table 6c (Item 64), and Table 7d (Item 63). A maximum of 2.2% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02A unavailability in the At-Power internal events analysis, or approximately $2,300. A maximum of 4.3% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02A unavailability in the At-Power internal flooding events analysis, or approximately $1,700. A maximum of 1.3% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02A unavailability in the At-Power internal fire events analysis, or approximately $3,700. A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02A unavailability in the LPSD internal events analysis, or approximately $140.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308 for the affected hazards. If all offsite consequences for the affecgted hazards were abated by eliminating any risk contribution from the ECW pump, then an estimated maximum total benefit of approximately $105,100 would occur.

The total maximum benefit would be much lower than $105,100 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ESW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.2. ESW Pump PP02B Events

Basic events for the unavailability of ESW pump PP02B are present in the At-Power internal events, At-Power internal flooding events, At-Power internal fire, LPSD internal events, and LPSD internal flood cutset file FV importance analyses and include: 6a (Item 53), Table 6b (Item 29), Table 6c (Item 60), Table 6e (Item 67), and Table 7d (Item 63). A maximum of 2.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02B unavailability in the At-Power internal events analysis, or approximately $2,100. A maximum of 4.2% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02B unavailability in the At-Power internal flooding events analysis, or approximately $1,600. A maximum of 1.4% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02B unavailability in the At-Power internal fire analysis, or approximately $4,000. A maximum of 0.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02B unavailability in the LPSD internal events analysis, or approximately $140. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW pump PP02B unavailability in the LPSD internal flooding events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ESW pump, then an estimated maximum total benefit of approximately $113,700 would occur.

The total maximum benefit would be much lower than $113,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ESW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.3. ESW Filter Plugging Events

Basic events for plugging of all ESW filters are present in the At-Power internal events, At-Power internal fire, and LPSD internal flood cutset file FV importance analysis and include: Table 6a (Item 48), Table 6c (Item 35), and Table 6e (Item 69). A maximum of 2.4% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW filter unavailability in the At-Power internal events analysis, or approximately $2,400. A maximum of 2.4% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW filter unavailability in the At-Power internal fire analysis, or approximately $7,000. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of ESW filter unavailability in the LPSD internal flkoodiing analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($35,240) and AOC ($45,073), total only $80,313 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ESW filters, then an estimated maximum total benefit of approximately $89,800 would occur.

The total maximum benefit would be much lower than $89,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ESW filters would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.4. ESW CT01A Events

Basic events for the unavailability of ESW Cooling Tower CT01A are present in the At-Power internal fire and LPSD internal events cutset file FV importance analysis and include: Table 7c (Item 15) and Table

7d (Item 27). A maximum of 0.3% reduction in AOE and AOSC costs is possible by eliminating the effect of CT01A unavailability in the At-Power internal fire analysis, or approximately $750. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CT01A unavailability in the LPSD internal events analysis, or approximately $320.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($25,693) and AOC ($31,492), total only $57,185 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from CT01A, then an estimated maximum total benefit of approximately $58,300 would occur.

The total maximum benefit would be much lower than $58,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of CT01A would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.13.5. ESW CT01B Events

Basic events for the unavailability of ESW Cooling Tower CT01B are present in the At-Power internal fire and LPSD internal events cutset file FV importance analysis and include: Table 7c (Item 15) and Table 7d (Item 27). A maximum of 0.3% reduction in AOE and AOSC costs is possible by eliminating the effect of CT01B unavailability in the At-Power internal fire analysis, or approximately $750. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CT01B unavailability in the LPSD internal events analysis, or approximately $320.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($25,693) and AOC ($31,492), total only $57,185 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from CT01B, then an estimated maximum total benefit of approximately $58,300 would occur.

The total maximum benefit would be much lower than $58,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of CT01B would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.13.6. ESW CT02A Events

Basic events for the unavailability of ESW Cooling Tower CT02A are present in the At-Power internal flooding, At-Power internal fire, and LPSD internal events cutset file FV importance analysis and include: Table 6b (Item 100), Table 7c (Item 15), and Table 7d (Item 27). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02A unavailability in the At-Power internal flooding analysis, or approximately $230. A maximum of 0.3% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02A unavailability in the At-Power internal fire analysis, or approximately $750. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02A unavailability in the LPSD internal events analysis, or approximately $320.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($27,244) and AOC ($33,484), total only $60,728 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from CT02A, then an estimated maximum total benefit of approximately $62,000 would occur.

The total maximum benefit would be much lower than $62,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR

and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of CT02A would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.7. ESW CT02B Events

Basic events for the unavailability of ESW Cooling Tower CT02B are present in the At-Power internal flooding, At-Power internal fire, LPSD internal events, and LPSD internal flooding cutset file FV importance analysis and include: Table 6b (Item 103), Table 6e (Items 30 and 53), Table 7c (Item 15), and Table 7d (Item 27). A maximum of 0.6% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02B unavailability in the At-Power internal flooding analysis, or approximately $230. A maximum of 0.3% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02B unavailability in the At-Power internal fire analysis, or approximately $750. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02B unavailability in the LPSD internal events analysis, or approximately $320. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of CT02B unavailability in the LPSD internal flooding analysis, or approximately $200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($31,190) and AOC ($37,907), total only $69,097 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from CT02B, then an estimated maximum total benefit of approximately $70,600 would occur.

The total maximum benefit would be much lower than $70,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of CT02B would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.8. ESW HOV-074 Events

Basic events for the unavailability of ESW Hydraulic-operated valve HOV-074 are present in the LPSD internal flooding cutset file FV importance analysis and include: Table 6e (Item 76). A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of HOV-074 unavailability in the LPSD internal flooding events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($3,946) and AOC ($4,423), total only $8,369 for LPSD flooding events. If all offsite consequences were abated by eliminating any risk contribution from HOV-074, then an estimated maximum total benefit of approximately $8,400 would occur.

The total maximum benefit would be much lower than $8,400 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of HOV-074 would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.13.9. Total ESW Pump Events Summary

Evaluating all both ESW pumps above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all ESW pump unavailability is approximately $15,800. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($46,190) and AOC ($59,487), total only $105,677. If all offsite consequences were abated by eliminating any risk contribution from the

ESW pumps, then an estimated maximum total benefit of approximately $121,500 would occur.

The total maximum benefit would be much lower than $121,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ESW pumps would have a minimal effect of SGTR and ISLOCA events.

#### 7.13.10. Total ESW Cooling Tower Events Summary

Evaluating all four ESW cooling towers above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all ESW cooling tower unavailability is approximately $5,000. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($31,190) and AOC ($37,907), total only $69,097. If all offsite consequences were abated by eliminating any risk contribution from the ESW pumps, then an estimated maximum total benefit of approximately $74,000 would occur.

The total maximum benefit would be much lower than $74,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ESW cooling towers would have a minimal effect of SGTR and ISLOCA events.

### 7.14. Essential Chilled Water (ECW) System Events

#### 7.14.1. ECW Pump PP02A Events

Basic events for the unavailability of ECW pump PP02A are present in the At-Power internal events, At-Power internal flooding, and At-Power intenal fire event cutset file FV importance analyses and include: Table 6a (Item 70), Table 6b (Item 44), Table 6c (Item 82), and Table 7c (Item 24). A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02A unavailability in the At-Power internal events analysis, or approximately $1,100. A maximum of 2.5% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02A unavailability in the At-Power internal flooding events analysis, or approximately $1,000. A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02A unavailability in the At-Power internal fire analysis, or approximately $3,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($32,845) and AOC ($42,642), total only $75,487 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the ECW pump, then an estimated maximum total benefit of approximately $80,800 would occur.

The total maximum benefit would be much lower than $80,800 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.14.2. ECW Pump PP02B Events

Basic events for the unavailability of ECW pump PP02B are present in the At-Power internal events, At-Power internal flooding, and At-Power internal fire, and LPSD internal flood event cutset file FV importance analyses and include: Table 6a (Item 76) Table 6b (Item 47), Table 6c (Item 92), Table 6e (Item 68), and Table 7c (Item 24). A maximum of 1.2% reduction in AOE and AOSC costs is possible by

eliminating the effect of ECW pump PP02B unavailability in the At-Power internal events analysis, or approximately $1,300. A maximum of 2.2% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02B unavailability in the At-Power internal flooding events analysis, or approximately $880. A maximum of 1.0% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02B unavailability in the At-Power internal fire analysis, or approximately $3,000. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of ECW pump PP02B unavailability in the LPSD internal flooding events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($36,791) and AOC ($47,065), total only $83,856 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the ECW pump, then an estimated maximum total benefit of approximately $89,000 would occur.

The total maximum benefit would be much lower than $89,000 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

#### 7.14.3. Total ECW Pump Event Summary

Evaluating all both ECW pumps above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all ECW pump unavailability is approximately $10,400. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($36,791) and AOC ($47,065), total only $83,856 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the ECW pumps, then an estimated maximum total benefit of approximately $94,300 would occur.

The total maximum benefit would be much lower than $94,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW pumps would have a minimal effect of SGTR and ISLOCA events.

### 7.15. Scram due to Mechanical Failure Events

The generic SAMDA items evaluated for the APR1400 design related to the ATWS system are listed in Table 5 and include items 130, 131, 132, and 136.

Basic events for SCRAM failure caused by mechanical failures are present in only the At-Power internal events cutset file FV importance analysis and include: Table 6a (Item 50). A maximum of 2.2% reduction in AOE and AOSC costs is possible by eliminating the mechanical SCRAM failures in the At-Power internal events analysis, or approximately $2,200.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for At-Power internal events. If all offsite consequences were abated by eliminating any risk contribution from the mechanical failures that prevent a SCRAM, then an estimated maximum total benefit of approximately $38,900 would occur.

The total maximum benefit would be much lower than $38,900 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the ECW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.16. Control Software Events

### 7.16.1. PPS Loop Controller Application Software Events

Basic events for the common cause failure of PPS loop controller application software are present in the At-Power internal events, At-Power internal flooding, At-Power intenal fire event, and LPSD internal events cutset file FV importance analyses and include: Table 6a (Item 41), Table 6b (Item 21), Table 6c (Item 12), and Table 6d (Item 21). A maximum of 2.9% reduction in AOE and AOSC costs is possible by eliminating the effect of loop controller application software failures in the At-Power internal events analysis, or approximately $3,000. A maximum of 5.3% reduction in AOE and AOSC costs is possible by eliminating the effect of loop application controller software failures in the At-Power internal flooding events analysis, or approximately $2,100. A maximum of 5.0% reduction in AOE and AOSC costs is possible by eliminating the effect of loop controller application software failures in the At-Power internal fire analysis, or approximately $14,500. A maximum of 4.1% reduction in AOE and AOSC costs is possible by eliminating the effect of loop controller application software failures in the LPSD internal events analysis, or approximately $8,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($42,244) and AOC ($55,064), total only $97,308 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from loop controller application software failures, then an estimated maximum total benefit of approximately $125,300 would occur.

The total maximum benefit would be much lower than $125,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the loop controller application software would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.16.2. PPS Group Controller Application Software Events

Basic events for the common cause failure of PPS group controller application software are present in the At-Power internal events cutset file FV importance analyses and include: Table 6a (Item 92). A maximum of 0.9% reduction in AOE and AOSC costs is possible by eliminating the effect of group controller application software failures in the At-Power internal events analysis, or approximately $1,000.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from group controller application software failures, then an estimated maximum total benefit of approximately $37,500 would occur.

The total maximum benefit would be much lower than $37,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the group controller application software would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.16.3. PPS Loop Controller Opperating System Software Events

Basic events for the common cause failure of PPS loop controller operating system software are present in the At-Power internal fire event and LPSD internal events cutset file FV importance analyses and include: Table 6c (Item 120) and Table 7d (Item 29). A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of loop controller operating system software failures in the At-Power internal fire analysis, or approximately $1,400. A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating the effect of loop controller operating system software failures in the LPSD

internal events analysis, or approximately $800.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($25,693) and AOC ($31,492), total only $57,185 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from loop controller operating system software failures, then an estimated maximum total benefit of approximately $59,500 would occur.

The total maximum benefit would be much lower than $59,500 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the loop controller operating system software would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.17. Main Steam Events

### 7.17.1. Main Steam Atmospheric Dump Valve (V-102)

Basic events for the unavailability of MS ADV V-102 are present in the At-Power internal events and LPSD internal fire event cutset file FV importance analyses and include: Table 7a (Item 9) and Table 7f (Item 17). A maximum of 0.3% reduction in AOE and AOSC costs is possible by eliminating the effect of MS ADV V-102 unavailability in the At-Power internal events analysis, or approximately $300. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of MS ADV V-102 unavailability in the LPSD internal fire analysis, or approximately $780.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($18,687) and AOC ($26,026), total only $44,713 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the ADV, then an estimated maximum total benefit of approximately $45,800 would occur.

The total maximum benefit would be much lower than $45,800 because all offsite consequences would not be eliminated.

### 7.17.2. Main Steam Isolation Valves

Basic events for the common cause failure of all MSIVs to close are present in the At-Power internal events cutset file FV importance analyses and include: Table 6a (Items112, 113, 114, and 115) and Table 7a (Items 5, 6, 7, 8, and 11). A maximum of 4.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MSIVs in the At-Power internal events analysis, or approximately $4,300.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($15,000) and AOC ($21,580), total only $36,580 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the MSIVs, then an estimated maximum total benefit of approximately $40,900 would occur.

The total maximum benefit would be much lower than $40,900 because all offsite consequences would not be eliminated.

### 7.17.3. Main Steam Safety Valves

Basic events for the common cause failure of all MSSVs to open are present in the At-Power internal events and At-Power internal flooding cutset file FV importance analyses and include: Table 7a (Item 3) and Table 7b (Item 2). A maximum of 0.4% reduction in AOE and AOSC costs is possible by eliminating

the effect of MSSVs in the At-Power internal events analysis, or approximately $430. A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of MSSVs in the At-Power internal flooding analysis, or approximately $60.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($16,551) and AOC ($23,572), total only $40,123 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the MSSVs, then an estimated maximum total benefit of approximately $40,600 would occur.

The total maximum benefit would be much lower than $40,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the MSSVs to open would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.18. TGBCCW Events

### 7.18.1. TGBCCW Pump Train 2 Events

Basic events for the unavailability of TGB CCW pump PP02 are present in the At-Power internal fire event cutset file FV importance analyses and include: Table 6c (Item 105). A maximum of 0.7% reduction in AOE and AOSC costs is possible by eliminating the effect of TGBCW pump PP02 unavailability in the At-Power internal fire analysis, or approximately $1,900.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($16,294) and AOC ($19,070), total only $35,364 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the TGBCCW pump, then an estimated maximum total benefit of approximately $37,300 would occur.

The total maximum benefit would be much lower than $37,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the TGBCW pump would have a negligible effect on reducing risk from SGTR and ISLOCA events.

## 7.19. Shutdown Cooling System (SDC) Events

### 7.19.1. SDC Pump PP01A Events

Basic events for the unavailability of SDC PP01A are present in the At-Power and LPSD internal events cutset file FV importance analyses and include: Table 6d (Item 72), Table 7a (Item 10), and Table 7d (Items 28, 30, and 37). A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of SDC PP01A unavailability in the At-Power internal events analysis, or approximately $240. A maximum of 1.0% reduction in AOE and AOSC costs is possible by eliminating the effect of SDC PP01A unavailability in the LPSD internal events analysis, or approximately $2,100.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($24,399) and AOC ($34,002), total only $58,401 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the SDC pump, then an estimated maximum total benefit of approximately $60,700 would occur.

The total maximum benefit would be much lower than $60,700 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR

and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SDC pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.19.2. SDC Pump PP01B Events

Basic events for the unavailability of SDC PP01B are present in the At-Power internal events, LPSD internal events, and LPSD internal flooding cutset file FV importance analyses and include: Table 6d (Item 72), Table 6e (Item 65), Table 7a (Item 10), and Table 7d (Items 28, 30, and 37). A maximum of 0.2% reduction in AOE and AOSC costs is possible by eliminating the effect of SDC PP01B unavailability in the At-Power internal events analysis, or approximately $240. A maximum of 1.1% reduction in AOE and AOSC costs is possible by eliminating the effect of SDC PP01B unavailability in the LPSD internal events analysis, or approximately $2,200. A maximum of 0.5% reduction in AOE and AOSC costs is possible by eliminating the effect of SDC PP01B unavailability in the LPSD internal events analysis, or approximately $40.

Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($28,345) and AOC ($38,425), total only $66,770 for the affected hazards. If all offsite consequences for the affected hazards were abated by eliminating any risk contribution from the SDC pump, then an estimated maximum total benefit of approximately $69,300 would occur.

The total maximum benefit would be much lower than $69,300 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SDC pumps would have a negligible effect on reducing risk from SGTR and ISLOCA events.

### 7.19.3. Total SDC Pump Event Summary

Evaluating all both SDC pumps above together, the maximum reduction in AOE and AOSC costs possible by eliminating the effects of all SDC pump unavailability is approximately $4,800. Although the benefit of the change to offsite risks is not calculated explicitly, these costs, APE ($28,345) and AOC ($38,425), total only $66,770 for the affected hazards. If all offsite consequences from the affected hazards were abated by eliminating any risk contribution from the ECW pumps, then an estimated maximum total benefit of approximately $71,600 would occur.

The total maximum benefit would be much lower than $71,600 because all offsite consequences would not be eliminated. As can be seen from Tables 3a through 3f, the majority of APE is caused by SGTR and ISLOCA events. SGTR and ISLOCA events also cause the majority of AOC, as shown in Tables 4a through 4f. Improved performance of the SDC pumps would have a minimal effect of SGTR and ISLOCA events.

# 8. SAMDA COST EVALUATION

For each of the potential SAMDAs discussed in Section 7, an estimate of the minimum costs associated with implementation was made. These cost estimates were based on publically available information related to nuclear power plant design. Detailed cost estimates are not performed fot SAMDA items that show only a small potential benefit. Rather, once the cost estimates show that a change would exceed the calculated benefit, the evaluations were stopped. Therefore, the costs below may underestimate, greatly, the actual costs of implementing the related mmodificaiton.

## 8.1. Emergency Diesel Generator Events

The contribution to risk from diesel generator unqvailability is related either to station blackout (SBO) scenarios or from the inability to cross-tie containment cooling systems between trains. Much of the risk from these scenarios could be reduced if an alternate means was available to supply power to 480 VAC buses.

As shown in the Palo Verde SAMA analysis (Reference 10), the cost of implementing a 480V portable generator for SBO scenarios would be $1,832,954. Assuming that engineering and procedure updates make up 50% of the cost, such a change would cost at least $900,000.

## 8.2. AAC CTG Events

The costs identified estimated the SAMDAs related to the EDGs in Section 8.1 would apply to SAMDA items for the AAC CTG. Therefore, the minimum costs to eliminate risk from the CTG would be at least $900,000.

## 8.3. Auxiliary Feedwater Events

SAMDA items for the AFW system relate to two types of improvements, isolation valves and pumps. Each of these two types is described below.

### 8.3.1. AFW Isolation Valve Events

The AFW isolation valves are needed for level control when their associated modulating valves become unavailable. The dominant scenarios where this occurs are SBO scenarios where offsite power is not recovered and batteries deplete. Provision of a long-term power supply for the AFW modulating valves would obviate the need for the AFW isolation valves to cycle for level control.

Operation of an AFW modulating valve requires power for the control signal as well as power for valve operation. Both the control signal as well as the valve operator rely on the same DC power supply. Therefore, provision of the ability to supply DC power to the train supporting each TDAFPs would eliminate the need for the isolation valves to cycle. The Vermont Yankee SAMA analysis (Reference 11) estimated the cost for implementing a portable 125V DC generator would be $712,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $350,000. Estimates for providing redundant valves provide even higher costs.

### 8.3.2. AFW Pump Events

Mitigation of AFW pump failure requires that an additional means of steam generator makeup, other than the startup feedwater pump and the four AFW pumps. Feed and bleed cooling is already credited in the PRA so elimination of the risk from AFW pump failure would require either an additional diverse heat removal method or an additional AFW pump.

The Millstone SAMA analysis (Reference 12) estimates the cost of implementing an additional AFW pump to be $12M - $16M. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $6,000,000.

### 8.4. Fire Barrier Failure Events

The PRA results show failure of fire barriers contributing to risk. The barriers of concern are all three-hour rated fire barriers. Therefore, any change to compensate for failure of these barriers would require an additional, diverse method of preventing fires from spreading between the fire areas.

One method of reducing the potential for fires spreading between two areas is to provide an additional active fire detection and suppression system for barriers between zones. For example, a water curtain or deluge system which would spray the area of failed barriers could reduce the potential for inter-area fire propagation.

Brunswick SAMA number 32 (Reference 13) specifically estimated the cost of adding additional automatic fire suppression systems. The estimated cost of implementation is $750,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $350,000.

### 8.5. CCW Events

SAMDA items for the CCW system relate to two types of improvements, pumps and containment spray heat exchanger isolation valves. Each of these two types is described below.

#### 8.5.1. CCW Pump Events

Mitigation of CCW pump failure requires that an additional means of providing flow through the CCW system. For this item, the simplest means of implementation would be to be to provide an additional CCW pump that could be aligned to either division of CCW thereby using much of the existing piping. For this item, only the costs of the additional pump and driver are estimated. Costs for the switchgear, circuit breakers, and any valves need to operate the pump are neglected.

The Callaway SAMA analysis (Reference 14) estimates the cost of adding an additional CCW pump to cost $1,000,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $500,000.

#### 8.5.2. CS Heat Exchanger Isolation Valves

Isolation valves for CCW flow through the containment spray heat exchangers must open to provide long-term containment heat removal. For these scenarios, several hours would be available from the time that the need for containment heat removal has been identified until containment failure would be expected. During this time, manual actions to compensate for failure of the valves could take place.

Addition of a manual valve to provide a bypass around each of the two containment spray heat exchanger CCW isolation valves would allow operator action to compensate for failure of the motor-operated isolation valves to open.

Brunswick SAMA 27 (Reference 13) estimates the cost of a service water cross-tie modification to be $100,000. This modification would involve similar piping and valve installation as required for the CCW heat exchanger valves. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $50,000.

### 8.6. Containment Spray Events

SAMDA items for the containment spray system relate to three types of improvements, pumps, containment spray header isolation valves, and containment spray heat exchangers. Each of these three types is described below.

#### 8.6.1. Containment Spray Pump Events

Mitigation of containment spray pump failure requires that an additional means of providing flow through the containment spray system. The APR1400 PRA model credits the shutdown cooling pumps as a means of providing containment spray flow. Therefore, an additional means of providing containment spray flow must be provided. For this item, the simplest means of implementation would be to be to provide an additional containment spray pump that could be aligned to either division of thereby using much of the existing piping.

The Callaway SAMA analysis (Reference 14) estimated the cost for implementing a redundant containment spray system as $2,000,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $1,000,000.

#### 8.6.2. Containment Spray Header Isolation Valves

Containment spray header isolation valves must open to allow flow through the containment spray nozzles in order to provide long-term containment heat removal. For these scenarios, several hours would be available from the time that the need for containment heat removal has been identified until containment failure would be expected. During this time, manual actions to compensate for failure of the valves could take place.

Addition of a manual valve to provide a bypass around each of the two containment spray header isolation valves would allow operator action to compensate for failure of the motor-operated isolation valves.

Brunswick SAMA 27 (Reference 13) estimated the cost of a service water cross-tie modification to be $100,000. This modification would involve similar piping and valve installation as required for the CS bypass valves but would rovide for only one valve, not two as would be needed to fully implement the SAMDA on each of the two CS headers. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $50,000.

#### 8.6.3. Containment Spray Heat Exchangers

Containment spray heat exchangers are used to provide for long-term containment heat removal. For these scenarios, several hours would be available from the time that the need for containment heat removal has been identified until containment failure would be expected. During this time, manual actions to compensate for failure of the heat exchangers could take place. The APR1400 PRA model credits the shutdown cooling system as a means of heat removal. Therefore, an additional means of providing containment spray heat removal flow must be provided. For this item, the simplest means of implementation would be to be to provide an additional containment spray heat exchanger that could be aligned to either division of thereby using much of the existing piping.

The Callaway SAMA analysis (Reference 14) estimated the cost for implementing a redundant containment spray system as $2,000,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $1,000,000.

### 8.7. 125 VDC Power Events

Availability of the station batteries is needed to actuate equipment and maintain instrumentation when normal AC power is lost. For the APR1400 PRA, the leading cause of battery failure is maintenance unavailability. Having a maintenance battery that could be aligned to any one of the four DC trains during battery maintenance would eliminate this contribution to core damage.

As shown in the Fitzpatrick SAMA analysis (Reference 15), the cost of providing additional DC battery capacity is estimated to be $500,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $250,000.

### 8.8. 120 VAC Power Events

The contribution to risk from the 120 VAC inverters is caused by test and maintenance unavailability of the inverters. Two ways of eliminating the maintenance unavailability were investigated. The first is to provide a separate 120 VAC regulating transformer that would bypass the existing inverters when powering the 120 VAC bus. This alternative would provide continuous power for scenarios where offsite power remains available but is lost but the EDGs repower the emergency AC buses. Power would be lost for station blackout scenarios. The second method is to provide a spare inverter that would replace the out of service inverter through temporary connections. The spare inverter would be moved to the affected bus and connected as needed. This alternative would, ensure that 120 VAC power is available for all scenarios until station 125 VDC batteries are depleted.

Fitzpatrick SAMA analysis (Reference 15), estimated the cost of DC bus cross-ties to be $300,000. Connections similar to those for bus cross-ties would be needed to allow for connection of a spare inverter. The cost of spare inverter is not included in the above costs so the cost of implementation is expected to be much greater.

### 8.9. AC Power Events

SAMDA items for the AC power system relate to two types of improvements, estation auxiliary transformers (SATs) and operation of 4kVAC circuit breakers. Each of these two types is described below.

#### 8.9.1. SAT Events

The contribution to risk from the SATs is caused by test and maintenance unavailability of the transformers. To compensate for that unavailability, a redundant means of providing AC power would be required. Addition of a transformer large enough to supply required loads along with the associated buses and breakers woujld be expected to cost several million dollars. Even neglecting engineering costs, such a plant change is estimated to cost at least $3,000,000.

#### 8.9.2. 4.16KV Circuit Breaker Events

The contribution of circuit breaker failure to risk involves failure of power supply breakers to close when needed and load shed circuit breakers to open when required. To compensate for failure of circuit breakers to open when needed requires that the cause of the fault be cleared and that the load be stripped by some other means. Because such failures must be cleared quickly, it is considered impractical that any changes could be made to compensate for such failures.

Failure of power supply breaker to close could be mitigated by providing an inter-bus cross-tie which would allow one bus on a division to supply power to the other bus on that division. Implementation of this alternative would require an additional breaker on each of the two buses on each division.

The Susquehanna SAMA (Reference 16) estimated the cost of 4kV bus cross-ties to be $656,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $328,000.

### 8.10. POSRV Events

Failure to depressurize the RCS when needed contributes to risk by causing failure of feed and bleed cooling. Addition of one more POSRV would provide additional relief capacity thereby minimizing the impact of any single POSRV failure.

The Callaway SAMA analysis (Reference 14) estimated the cost for adding a new PORV at $500,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $250,000.

### 8.11. Chiller/Cooler Events

Failure to provide cooling to the pump rooms and emergency diesel rooms can result in failure of the components due to high temperatures. Addition of a redundant train of ventilation could prevent failure of a single chiller or room cooler from resulting in failure of the affected equipment pumps or diesel generator.

As shown in the Vermont Yankee SAMA (Reference 11), the estimated cost to implement a redundant train or means of ventilation is $2,202,725. A ssuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $1,100,000.

### 8.12. Safety Injection System Events

SAMDA items for the safety injection system relate to three types of improvements, pumps, IRWST strainers, and a manual recirculation valve. Each of these three types is described below.

#### 8.12.1. Safety Injection Pump Events

Mitigation of safety injection pump failures requires an additional means of providing flow through the safety injection system. The simplest method of implementation would be to add an additional safety injection pump that could be aligned to either division of safety injection using the existing piping and valves.

The Callaway SAMA analysis (Reference 14) estimated the cost of replacing two safety injection pumps to be greater than $1,000,000. The cost for a single pump would be greater than $500,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $500,000.

#### 8.12.2. IRWST Strainer

Recent initiatives to improve reliability of ECCS strainers have been implemented throughout the US nuclear industry. These changes have cost several million dollars per plant. Costs to improve the IRWST strainer poformmance for the APR1400 would be similar in cost to these projects. Therefore, the cost to improve performance of IRWST strainers is taken to be at least $1,000,000.

#### 8.12.3. Safety Injection Recirculation Valve

Failure of a single manual valve could cause minimum flow recirculation to fail for two pumps on a division.

Addition of a separate flow path for each pump would prevent such failures. To iimplenent this option, two additona l manuall valves and lines would be needed.

Brunswick SAMA 27 (Reference 13) estimates the cost of a service water cross-tie modification to be $100,000. This modification would involve one valve and minimal piping. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $50,000 for a single valve or $100,000 for two valves and lines.

### 8.13. ESW Events

SAMDA items for the ESW system relate to three types of improvements, pumps, cooling towers, and return vavle. Each of these three types is described below.

#### 8.13.1. ESW Filter Events

Mitigation of common cause failure of ESW filters failure requires that an additional means of providing flow through the ESW system if the in-service filters plug. For this item, the simplest means of implementation would be to be to provide an additional ESW filter that could be aligned to either division of ESW given plugging of the in-service filters. Because the fiteer would need to be placed in serice rapidly, remotely-operated valves would be required. For this item, only the costs of the additional pump and driver are estimated. Costs for the switchgear, circuit breakers, and any valves need to operate the pump are neglected.

Brunswick SAMA 27 (Reference 13) estimated the cost of a service water cross-tie modification to be $100,000. This modification would involve one valve and minimal piping. Providing an additional filter would be more complex. However, costs of $100,000 are used as the minimum potential implementaitn costs.

#### 8.13.2. ESW Pump Events

Mitigation of ESW pump failure requires that an additional means of providing flow through the ESW system. For this item, the simplest means of implementation would be to be to provide an additional ESW pump that could be aligned to either division of ESW thereby using much of the existing piping. For this item, only the costs of the additional pump and driver are estimated. Costs for the switchgear, circuit breakers, and any valves need to operate the pump are neglected.

The Callaway SAMA analysis (Reference 14) estimated the cost of adding an additional service water pump to be $5,000,000. Assuming engineering and procedure updates make up 50% of the cost, addition of a spare ESW pump would cost at least $2,500,000.

#### 8.13.3. ESW Cooling Towers

Addition of a redundant cooling tower would require additional valves, piping and a cooling tower structure. Two remotely operated valves are estimated to cost at least $100,000. This cost alone exceeds the potential benefit estimated previously. Therefore, neglecting thee tower structure, piping, and instrumentation, addition of a redundant ESW cooling tower would cost at least $100,000.

#### 8.13.4. ESW Cooling Tower Return Valve

ESW flow to the standby cooling tower requires that an automatic valve open to allow flow to the tower. For these scenarios, several hours would be available from the time that the need for flow has been identified until heat removal is needed. During this time, manual actions to compensate for failure of the valves could take place.

Addition of a manual valve to provide a bypass around each of the four automatic return valves would allow operator action to compensate for failure of the motor-operated isolation valves.

Brunswick SAMA 27 (Reference 13) estimated the cost of a service water cross-tie modification to be $100,000. This modification would involve similar piping and valve installation as required for the ESW bypass valves but would provide for only one valve, not four as would be needed to fully implement the SAMDA on each of the four cooling towers. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $50,000 for each of the four towers.

### 8.14. ECW Pumps

Mitigation of ECW pump failure requires that an additional means of providing flow through the ECW system. For this item, the simplest means of implementation would be to be to provide an additional ECW pump that could be aligned to either division of ECW thereby using much of the existing piping. For this item, only the costs of the additional pump and driver are estimated. Costs for the switchgear, circuit breakers, and any valves need to operate the pump are neglected.

The Callaway SAMA analysis (Reference 14) estimates the cost of adding an additional CCW pump to cost $1,000,000. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $500,000. While a CCW pump is much larger than would be required for an ECW pump, the costs for CCW provide insight into the costs of an ECW pump. Assuming that an ECW pump costs half of a CCW pump, the costs of a spare ECW pump would be about $250,000 neglecting costs for circuit breakers, controls, piping and valves.

### 8.15. SCRAM Due To Mechanical Failure Events

The benefit for eliminating mechanical scram failures is calculated to be only Basic events for SCRAM failure caused by mechanical failures are present in only $38,900. It is considered incredible that any change could be made to the reactor core and associated structures for less than that amount. Therefore, no specific cost estimates are performed.

### 8.16. Control Software Events

Mitigation of control software failures would require addition of a redundant and diverse control system for key plant equipment iin addition to the three methods in the current design. Providing an additinaql diverse and redundant control system is estimated to cost at least $1,000,000 when considering the additional circuits, panels, and displays needed.

### 8.17. Main Steam Events

SAMDA items for the main steam system relate to three types of improvements, ADVs, MSIVs, and MSSVs. Each of these three types is described below.

#### 8.17.1. ADVs

Mitigation of ADV failure requires that an additional means of removing steam from a steam generator be provided. Removal of steam requires that the valve allow cooling to atmospheric pressure. For this item, the simplest means of implementation would be to be to provide an additional ADV for each steam generator.

The Callaway SAMA analysis (Reference 14) estimated the cost for adding a new PORV to be $500,000. Such a valve would be similar in design and function to an ADV. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $250,000.

### 8.17.2. MSIVs

Elimination of common cause failure of MSIVs to close would require an additional means to isolate the main steam lines. Considering the minimum costs above for a simple manual valve on the service water system, $50,000, costs of four valves would be $200,000. Valves that could function at main steam pressures would cost substantially more.

### 8.17.3. MSSVs

Mitigation of the common cause MSSV failure to open failure requires that a diverse means of relieving steam be provided.

The Callaway SAMA analysis (Reference 14) estimated the cost for adding anew PORV to be $500,000. Such a valve would be similar in design and function to an ADV. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $250,000.

## 8.18. TGBCCW Pump

The cost of a TGBCCW pump would be similar to the cost for an ECW pump estimated in Section 8.13 or $250,000.

## 8.19. Shutdown Cooling System Pumps

Mitigation of SDC pump failure requires that an additional means of providing flow through the SDC spray system. The APR1400 PRA model credits the containment spray pumps as a means of providing SDC flow. Therefore, an additional means of providing SDC flow must be provided. For this item, the simplest means of implementation would be to be to provide an additional SDC pump that could be aligned to either division of thereby using much of the existing piping.

The Callaway SAMA analysis (Reference 14) estimated the cost for implementing a redundant containment spray system as $2,000,000. Such a change would be similar in scope to providing a redundant SDC pump and, therefore, the costs are considered representative. Assuming engineering and procedure updates make up 50% of the cost, such a change would cost at least $1,000,000.

# 9. SAMDA COST-BENEFIT EVALUATION

For each of the potential SAMDAs discussed in Section 7, a cost-benefit evaluation is performed. Equation 1 of Section 4.0 defines the present worth of averted public risk by implementing a plant enhancement as:

NPV = (APE + AOC + AOE + AOSC) – COE.

Total averted costs (TAC) are represented by the expression:

TAC = (APE + AOC + AOE + AOSC).

Each of the terms is defined in Sections 4.1, 4.2, 4.3, and 4.4 respectively.

For each of the potential SAMDAs evaluated, total averted costs are developed and documented in Section 7. Cost estimates that can be used to screen each of the potential SAMDAs were developed and documented in Section 8. Using those values a cost-benefit analysis is performed for each of the potential SAMDAs.

An enhancement is considered beneficial if the present worth is positive.

## 9.1. Emergency Diesel Generator Events

As quantified in Section 7.1.5 and 7.1.6, the total benefit of eliminating any EDG-related failures was $295,000. From Section 8.1, implementation of this alternative would cost a minimum of $900,000. Therefore, the present worth can be calculated as:

NPV = $295,000 - $900,000.

NPV = (-)$605,000.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.2. AAC Combustion Turbine Generator Events

As quantified in Section 7.2, the total benefit of eliminating any AAC CTG-related failures was $125,600. As discussed in Section 8.2, the costs for SAMDA items related to the AAC CTG would be similar to those for the EDG presented above. Therefore, the present worth can be calculated as:

NPV = $125,600 - $900,000.

NPV = (-)$774,400.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.3. Auxiliary Feedwater Events

### 9.3.1. AFW Isolation Valve Events

As quantified in Section 7.3.8, the total benefit of eliminating any AFW isolation valve-related failures was $158,900. From Section 8.3.1, implementation of this alternative would cost a minimum of $350,000. Therefore, the present worth can be calculated as:

NPV = $158,900 - $350,000.

NPV = (-)$191,100.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

#### 9.3.2. AFW Pumps

As quantified in Section 7.3.9 and 7.3.10, the total benefit of eliminating any AFW pump-related failures was $166,800. From Section 8.3.2, implementation of this alternative would cost a minimum of $6,000,000. Therefore, the present worth can be calculated as:

NPV = $166,800 - $6,000,000.

NPV = (-)$5,833,200.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

#### 9.3.3. Startup FW Pump PP07 Events

As quantified in Section 7.3.7, the total benefit of eliminating any startup FW pump-related failures was $37,900. From Section 8.3.2, implementation of this alternative would cost a minimum of $6,000,000. Therefore, the present worth can be calculated as:

NPV = $37,900 - $6,000,000.

NPV = (-)$5,962,100.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.4. Fire Barrier Failure Events

As quantified in Section 7.4.1, the total benefit of eliminating any fire barrier-related failures was $58,000. From Section 8.4, implementation of this alternative would cost a minimum of $350,000. Therefore, the present worth can be calculated as:

NPV = $58,000 - $350,000.

NPV = (-)$292,000.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.5. Component Cooling Water (CCW) Events

#### 9.5.1. DG001A CCW Inlet Valve MOV-191

As quantified in Section 7.5.5, the total benefit of eliminating any DG inlet valve-related failure was $8,500. Costs to implement an improvement for this item would be similar or more than calculated in Section 8.5.2 or a minimum of $50,000. Therefore, the present worth can be calculated as:

NPV = $8,500 - $50,000.

NPV = (-)$41,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

#### 9.5.2. CCW Pumps

As quantified in Section 7.5.6, the total benefit of eliminating any CCW pump-related failure was $87,500. From Section 8.5.1, implementation of this alternative would cost a minimum of $500,000. Therefore, the present worth can be calculated as:

NPV = $87,500 - $500,000.

NPV = (-)$412,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

#### 9.5.3. CS Heat Exchanger Isolation Valves

As quantified in Section 7.5.7, the total benefit of eliminating any CS heat exchanger CCW isolation valve-related failure was $40,500. From Section 8.5.2, implementation of this alternative would cost a minimum of $50,000. Therefore, the present worth can be calculated as:

NPV = $40,500 - $50,000.

NPV = (-)$9,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.6. Containment Spray (CS) Events

#### 9.6.1. Containment Spray Pumps

As quantified in Section 7.6.7, the total benefit of eliminating any CS pump-related failure was $68,900. From Section 8.6.1, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $68,900 - $1,000,000.

NPV = (-)$931,100.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

#### 9.6.2. Total Containment Spray Isolation Valve Event Summary

As quantified in Section 7.6.8, the total benefit of eliminating any CS header isolation valve-related failure was $38,300. From Section 8.6.2, implementation of this alternative would cost a minimum of $50,000. Therefore, the present worth can be calculated as:

NPV = $38,300 - $50,000.

NPV = (-)$11,700.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.6.3. Containment Spray Heat Exchangers

As quantified in Section 7.6.9, the total benefit of eliminating any CS pump-related failure was $39,300. From Section 8.6.3, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $39,300 - $1,000,000.

NPV = (-)$960,700.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.7. 125 VDC Power Events

As quantified in Section 7.7.5, the total benefit of eliminating any battery-related failure was $101,200. From Section 8.7, implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV = $101,200 - $250,000.

NPV = (-)$148,800.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.8. 120 VAC Power Events

As quantified in Section 7.8.5, the total benefit of eliminating any 120 VAC inverter-related failure was $106,900. From Section 8.8, implementation of this alternative would cost a minimum of $300,000. Therefore, the present worth can be calculated as:

NPV = $106,900 - $300,000.

NPV = (-)$193,100.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.9. AC Power Events

### 9.9.1. SAT Transformers

As quantified in Section 7.9.10, the total benefit of eliminating any SAT-related failure was $55,000. From Section 8.9.1, implementation of this alternative would cost a minimum of $3,000,000. Therefore, the present worth can be calculated as:

NPV = $55,000 - $3,000,000.

NPV = (-)$2,945,000.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.9.2. 4.16KV Circuit Breakers

As quantified in Section 7.9.11, the total benefit of eliminating any 4kV breaker-related failure was $187,500. From Section 8.9.2, implementation of this alternative would cost a minimum of $328,000. Therefore, the present worth can be calculated as:

NPV = $187,500 - $328,000.

NPV = (-)$140,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.10. POSRVs

As quantified in Section 7.10.5, the total benefit of eliminating any POSRV-related failure was $68,100. From Section 8.9.2, implementation of this alternative would cost a minimum of $328,000. Therefore, the present worth can be calculated as:

NPV = $68.100 - $250,000.

NPV = (-)$181,900.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.11. Chiller/Cooler Events

### 9.11.1. ECW Chiller Summary

As quantified in Section 7.11.16, the total benefit of eliminating any chiller-related failure was $201,600. From Section 8.11, implementation of this alternative would cost a minimum of $1,100,000. Therefore, the present worth can be calculated as:

NPV = $201,600 - $1,100,000.

NPV = (-)$898,400.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.11.2. EDG Room Cubical Coolers

As quantified in Section 7.11.17, the total benefit of eliminating any chiller-related failure was $110,700. From Section 8.11, implementation of this alternative would cost a minimum of $1,100,000. Therefore, the present worth can be calculated as:

NPV = $110,700 - $1,100,000.

NPV = (-)$989,300.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.11.3. Motor Driven AFW Pump Room Cubical Coolers

As quantified in Section 7.11.18, the total benefit of eliminating any chiller-related failure was $114,500. From Section 8.11, implementation of this alternative would cost a minimum of $1,100,000. Therefore, the present worth can be calculated as:

NPV = $114,500 - $1,100,000.

NPV = (-)$985,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.11.4. Air Handling Units

As quantified in Section 7.11.19, the total benefit of eliminating any air handling unit-related failure was $35,100. From Section 8.11, implementation of this alternative would cost a minimum of $1,100,000. Therefore, the present worth can be calculated as:

NPV = $35,100 - $1,100,000.

NPV = (-)$1,064,900.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.12. Safety Injection (SI) Events

### 9.12.1. SI Pumps PP02D Events

As quantified in Section 7.12.5, the total benefit of eliminating any SI pump-related failure was $87,100. From Section 8.12.1, implementation of this alternative would cost a minimum of $500,000. Therefore, the present worth can be calculated as:

NPV = $87,100 - $500,000.

NPV = (-)$412,900.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.12.2. IRWST Strainer Events

As quantified in Section 7.12.6, the total benefit of eliminating any IRWST strainer-related failure was $72,800. From Section 8.12.2, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $72,800 - $1,000,000.

NPV = (-)$927,200.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.12.3. SI Valve V-959 Events

As quantified in Section 7.12.7, the total benefit of eliminating any SI pump recirculation valve-related failure was $38,700. From Section 8.12.3, implementation of this alternative would cost a minimum of $50,000. Therefore, the present worth can be calculated as:

NPV = $38,700 - $50,000.

NPV = (-)$11,300.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.13. ESW Events

The generic SAMDA items evaluated for the APR1400 design related to the ESW system are listed in Table 5 and include items 42 and 47.

### 9.13.1. ESW Filter Plugging Events

As quantified in Section 7.13.3, the total benefit of eliminating any ESW filter plugging-related failure was $89,800. From Section 8.13.1, implementation of this alternative would cost a minimum of $100,000. Therefore, the present worth can be calculated as:

NPV = $89,800 - $100,000.

NPV = (-)$10,200.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.13.2. ESW HOV-074

As quantified in Section 7.13.8, the total benefit of eliminating any ESW return valve-related failure was $8,400. From Section 8.13.4, implementation of this alternative would cost a minimum of $200,000. Therefore, the present worth can be calculated as:

NPV = $8,400 - $200,000.

NPV = (-)$191,600.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.13.3. ESW Pumps

As quantified in Section 7.13.9, the total benefit of eliminating any ESW pump-related failure was $121,500. From Section 8.13.2, implementation of this alternative would cost a minimum of $2,500,000. Therefore, the present worth can be calculated as:

NPV = $121,500 - $2,500,000.

NPV = (-)$2,378,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.13.4. Total ESW Cooling Tower Events Summary

As quantified in Section 7.13.10, the total benefit of eliminating any ESW cooling tower-related failure was $74,000. From Section 8.13.3, implementation of this alternative would cost a minimum of $100,000. Therefore, the present worth can be calculated as:

NPV = $74,000 - $100,000.

NPV = (-)$26,000.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.14. ECW Pumps

As quantified in Section 7.14.3, the total benefit of eliminating any ECW pump-related failure was $94,300. From Section 8.14, implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV = $94,300 - $250,000.

NPV = (-)$155,700.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.15. SCRAM Due To Mechanical Failure

As discussed in Section 8.15, the costs to improve the mechanical scram system are considered much greater than the potential benefit and no specific costs are estimated. However, improvements are considered to show a negative cost-benefit.

## 9.16. Control Software

### 9.16.1. PPS Loop Controller Application Software

As quantified in Section 7.16.1, the total benefit of eliminating any loop controller application software-related failure was $125,300. From Section 8.16, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $125,300 - $1,000,000.

NPV = (-)$874,700.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.16.2. PPS Group Controller Application Software

As quantified in Section 7.16.2, the total benefit of eliminating any group controller application software-related failure was $37,500. From Section 8.16, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $37,500 - $1,000,000.

NPV = (-)$962,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.16.3. PPS Loop Controller Opperating System Software

As quantified in Section 7.16.3, the total benefit of eliminating any PPS loop controller application software-related failure was $59,500. From Section 8.16, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $59,500 - $1,000,000.

NPV = (-)$940,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.17. Main Steam Events

### 9.17.1. Main Steam Atmospheric Dump Valve (V-102)

As quantified in Section 7.17.1, the total benefit of eliminating any MS ADV-related failure was $45,800. From Section 8.17.1, implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV = $48,500 - $250,000.

NPV = (-)$201,500.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.17.2. Main Steam Isolation Valves

As quantified in Section 7.17.2, the total benefit of eliminating any MSIV-related failure was $40,900. From Section 8.17.2, implementation of this alternative would cost a minimum of $200,000. Therefore, the present worth can be calculated as:

NPV = $40,900 - $200,000.

NPV = (-)$159,100.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

### 9.17.3. Main Steam Safety Valves

As quantified in Section 7.17.3, the total benefit of eliminating any MSSV-related failure was $40,600. From Section 8.17.3, implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV = $40,600 - $250,000.

NPV = (-)$209,400.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.18. TGBCCW Events

### 9.18.1. TGBCCW Pump Train 2 Events

As quantified in Section 7.18, the total benefit of eliminating any TGBCCW pump-related failure was $37,300. From Section 8.18, implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV = $37,300 - $250,000.

NPV = (-)$212,700.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

## 9.19. Shutdown Cooling System (SDC) Events

### 9.19.1. SDC Pumps

As quantified in Section 7.19.3, the total benefit of eliminating any SDC pump-related failure was $71,600. From Section 8.19, implementation of this alternative would cost a minimum of $1,000,000. Therefore, the present worth can be calculated as:

NPV = $71,600 - $1,000,000.

NPV = (-)$928,400.

Since the present worth is negative, implementation of a SAMDA for this item would not be cost beneficial.

# 10. SENSITIVITY ANALYSIS (3 PERCENT DISCOUNT RATE)

The parameters that influence the cost-benefit analyses of the SAMDA evaluations were examined to determine if a change in value for one of the parameters would change the conclusions of the evaluation. Equations for each of the four types of averted costs (see Sections 4.1 to 4.4) each contain a term for the real discount rate and evaluation period. Therefore, a change in either of those terms would have a direct impact on the averted costs calculated.

Reference 1 recommends using a 7 percent discount rate for cost-benefit analyses and suggests that a 3 percent discount rate should be used for sensitivity analyses on the maximum benefit and unscreened SAMDAs to indicate the sensitivity of the results to the choice of discount rate. This sensitivity case is discussed below.

The methodology of Reference 1 determines the present worth net value of public risk according to the following formula:

$$NPV = (APE + AOC + AOE + AOSC) - COE \tag{1}$$

Where:

NPV = present value of current risk ($),

APE = present value of averted public exposure ($),

AOC = present value of averted offsite property damage costs ($),

AOE = present value of averted occupational exposure ($),

AOSC= present value of averted onsite costs ($),

COE = cost of any enhancement implemented to reduce risk ($).

The derivation of each of these costs is described in the subsections below. All equations used in the subsections below are taken from Reference 2, which is the basis for the equations given in Reference 1.

The following specific values were used for various terms in the analyses:

**Present Worth**

The present worth was determined by:

$$\mathrm{PW} = [1 - \mathrm{e}^{(-\mathrm{rt})}]/\mathrm{r} \tag{2}$$

Where:

r is the discount rate = 3 percent per year (assumed throughout these analyses)

t is the years remaining until end of plant life= 60 years

PW is the present worth of a string of annual payments of one dollar = $27.823

**Dollars per REM**

The conversion factor used for assigning a monetary value to on-site and off-site exposures was $2,000/person-rem averted. This is consistent with the NRC's regulatory analysis guidelines presented in and used throughout Reference 1.

### 10.1. Averted Public Exposure (APE)

Expected offsite doses from the internal events PRA accident sequences are presented in Tables 2a through 2f. Costs associated with these doses were calculated using the following equation:

$$\mathrm{APE} = (F_S D_{PS} - F_A D_{PA}) \times R \times [1 - \mathrm{e}^{(-\mathrm{r t_f})}]/\mathrm{r} \quad (3)$$

Where:

APE = present value of averted public exposure ($),

R = monetary equivalent of unit dose ($2,000/person-rem),

$F_S$ = baseline accident frequency (events per year from Tables 3a through 3f),

$F_A$ = accident frequency after mitigation (0 events per year),

$F_S D_{PS}$ = baseline accident offsite frequency (person-rem per year from Tables 2a through 2f),

$F_A D_{PA}$ = accident offsite dose frequency after mitigation (0 person-rem per year),

r = real discount rate (3 percent per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, APE is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.1.1. APE for At-Power Internal Events

$APE_{(IE)}$ = $(5.33\times10^{-1}$ person-rem per year – 0)×($2,000/person-rem)× $((1 – e^{-(0.03\times60)})$/(0.03 per year))

= $29,659

#### 10.1.2. APE for At-Power Internal Flooding Events

$APE_{(Fld)}$ = $(5.51\times10^{-2}$ person-rem per year – 0)×($2,000/person-rem)× $((1 – e^{-(0.03\times60)})$/(0.03 per year))

= $3,066

#### 10.1.3. APE for At-Power Internal Fire Events

$APE_{(Fire)}$ = $(5.79\times10^{-1}$ person-rem per year – 0)×($2,000/person-rem)× $((1 – e^{-(0.03\times60)})$/(0.03 per year))

= \$32,219

### 10.1.4. APE for LPSD Internal Events

$APE_{(SDIE)}$ = (3.34×10$^{-1}$ person-rem per year – 0)×(\$2,000/person-rem)× ((1 – e$^{-(0.03×60)}$)/(0.03 per year))

= \$18,586

### 10.1.5. APE for LPSD Flooding Events

$APE_{(SDFld)}$ = (1.40×10$^{-1}$ person-rem per year – 0)×(\$2,000/person-rem)×((1 – e$^{-(0.03×60)}$)/(0.03 per year))

= \$7,802

### 10.1.6. APE for LPSD Fire Events

$APE_{(SDFire)}$ = (1.31×10$^{-1}$ person-rem per year – 0)×(\$2,000/person-rem)×((1 – e$^{-(0.03×60)}$)/(0.03 per year))

= \$7,290

### 10.1.7. Total APE

$APE_{Tot}$ = $APE_{(IE)} + APE_{(Fld)} + APE_{(Fire)} + APE_{(SDIE)} + APE_{(SDFld)} + APE_{(SDFire)}$

= \$29,659 + \$3,066 + \$32,219 + \$18,586 + \$7,802 + \$7,290

= \$98,622

## 10.2. Averted Public Offsite Property Damage Costs (AOC)

Annual expected offsite economic risk is shown in Tables 4a through 4f. The costs associated with AOC were calculated using the following equation:

$$\mathrm{AOC} = (F_S D_{DS} - F_A D_{DA}) \times [1 - \mathrm{e}^{(-\mathrm{r}t_f)}]/\mathrm{r} \quad (4)$$

Where:

AOC = present value of averted offsite property damage costs (\$),

$F_S D_{DS}$ = baseline accident frequency x property damage (cost per year from Tables 4a through 4f),

$F_A D_{DA}$ = accident frequency x property damage after mitigation (0 events per year),

r = real discount rate (3 percent per year),

$t_f$ = years remaining until end of plant life (60 years)

Using the values given above, AOC is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.2.1. AOC for At-Power Internal Events

$AOC_{(IE)}$ = (\$1,534 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$42,671

#### 10.2.2. AOC for At-Power Internal Flooding Events

$AOC_{(Fld)}$ = (\$142 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$3,938

#### 10.2.3. AOC for At-Power Internal Fire Events

$AOC_{(Fire)}$ = (\$1,355 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$37,707

#### 10.2.4. AOC for LPSD Internal Events

$AOC_{(SDIE)}$ = (\$883 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$24,563

#### 10.2.5. AOC for LPSD Flooding Events

$AOC_{(SDFld)}$ = (\$314 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$8,746

#### 10.2.6. AOC for LPSD Fire Events

$AOC_{(SDFire)}$ = (\$316 per year – 0) × (1 – $e^{-(0.03 \times 60)}$) / (0.03 per year)

= \$8,792

#### 10.2.7. Total AOC

$AOC_{Tot}$ = $AOC_{(IE)} + AOC_{(Fld)} + AOC_{(Fire)} + AOC_{(SDIE)} + AOC_{(SDFld)} + AOC_{(SDFire)}$

= \$42,671 + \$3,938 + \$37,707 + \$24,563 + \$8,746 + \$8,792

= \$126,417

### 10.3. Averted Occupational Exposure (AOE)

There are two types of occupational exposure due to accidents: immediate and long-term. Immediate exposure occurs at the time of the accident and during the immediate management of the emergency. Long-term exposure is associated with the cleanup and refurbishment or decommissioning of the damaged facility. The value of avoiding both types of exposure must be considered when evaluating risk.

The occupational exposure associated with severe accidents was assumed to be 23,300 person-rem/accident. This value includes a short-term component of 3,300 person-rem/accident and a long-term component of 20,000 person-rem/accident. These estimates are consistent with the best-estimate

values presented in Reference 2. In calculating base risk, the accident-related on-site exposures were calculated using the best-estimate exposure components applied over the on-site cleanup period. For on-site cleanup, the accident-related onsite exposures were calculated over a 10-year cleanup period. Costs associated with immediate dose, long-term dose, and total dose are calculated below for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events.

### 10.3.1. Averted Immediate Occupational Exposure Costs

Per the guidance of Reference 1, costs associated with immediate occupational doses from an accident were calculated using the following equation:

$$W_{IO} = (F_S D_{IOS} - F_A D_{IOA}) \times R \times [1 - e^{(-rt_f)}]/r \quad (5)$$

Where:

$W_{IO}$ = present value of averted immediate occupational exposure ($),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

$D_{IOS}$ = baseline expected immediate onsite dose (3,300 person-rem/event),

$D_{IOA}$ = expected occupational exposure after mitigation (3,300 person-rem/event),

R = monetary equivalent of unit dose ($2,000/person-rem),

r = real discount rate (3 percent per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $W_{IO}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.3.1.1. $W_{IO}$ for At-Power Internal Events

$W_{IO(IE)}$ = ((1.00×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $184

#### 10.3.1.2. $W_{IO}$ for At-Power Internal Flooding Events

$W_{IO\ (Fld)}$ = ((3.82×10$^{-7}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $70

#### 10.3.1.3. $W_{IO}$ for At-Power Internal Fire Events

$W_{IO\ (Fire)}$ = ((2.79×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $512

#### 10.3.1.4. $W_{IO}$ for LPSD Internal Events

$W_{IO\ (SDIE)}$ = ((1.94×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $356

#### 10.3.1.5. $W_{IO}$ for LPSD Flooding Events

$W_{IO\ (SDFld)}$ = ((8.06×10$^{-8}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $15

#### 10.3.1.6. $W_{IO}$ for LPSD Fire Events

$W_{IO\ (SDFire)}$ = ((1.48×10$^{-6}$ events per year) × (3,300 person-rem/event) – 0) × ($2,000/person-rem) × (1 – e$^{-(0.03 \times 60)}$) / (0.03 per year)

= $272

### 10.3.2. Averted Long-Term Occupational Exposure Costs

Per the guidance of Reference 1, costs associated with long-term occupational doses from an accident were calculated using the following equation:

$$W_{LTO} = (F_S D_{LTOS} - F_A D_{LTOS}) \times R \times [1 - e^{(-rt_f)}]/r \times [1 - e^{(-rm)}]/r\,m \quad (6)$$

Where:

$W_{LTO}$ = present value of averted long-term occupational exposure ($),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

$D_{LTOS}$ = baseline expected long-term onsite dose (20,000 person-rem/event),

$D_{LTOA}$ = expected occupational exposure after mitigation (20,000 person-rem/event),

R = monetary equivalent of unit dose ($2,000/person-rem),

r = real discount rate (3 percent per year),

m = years over which long-term doses accrue (10 years from Reference 2),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $W_{LTO}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.3.2.1. $W_{LTO}$ for At-Power Internal Events

$$W_{LTO(IE)} = ((1.00\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$962$$

#### 10.3.2.2. $W_{LTO}$ for At-Power Internal Flooding Events

$$W_{LTO\ (Fld)} = ((3.82\times10^{-7} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$367$$

#### 10.3.2.3. $W_{LTO}$ for At-Power Internal Fire Events

$$W_{LTO\ (Fire)} = ((2.79\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$2{,}683$$

#### 10.3.2.4. $W_{LTO}$ for LPSD Internal Events

$$W_{LTO\ (SDIE)} = ((1.94\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$1{,}865$$

#### 10.3.2.5. $W_{LTO}$ for LPSD Flooding Events

$$W_{LTO\ (SDFld)} = ((8.06\times10^{-8} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$78$$

#### 10.3.2.6. $W_{LTO}$ for LPSD Fire Events

$$W_{LTO\ (SDFire)} = ((1.48\times10^{-6} \text{ events per year}) \times (20{,}000 \text{ person-rem/event}) - 0) \times (\$2{,}000/\text{person-rem}) \times ((1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year}) \times ((1 - e^{-(0.03 \times 10)}) / ((0.03 \text{ per year}) \times (10 \text{ years}))$$

$$= \$1{,}423$$

### 10.3.3. Total Averted Occupational Exposure Costs

As described in Subsection 4.3.3, the total cost associated with averted occupational exposure, AOE, is the sum of the costs associated with averted immediate exposure and the costs associated with the averted long-term exposure, or:

$$AOE = W_{IO} + W_{LTO} \quad (7)$$

Total averted onsite exposure costs are calculated below.

#### 10.3.3.1. AOE for At-Power Internal Events

$AOE_{(IE)}$ = \$184 + \$962

= \$1,146

#### 10.3.3.2. AOE for At-Power Internal Flooding Events

$AOE_{(Fld)}$ = \$70 + \$367

= \$437

#### 10.3.3.3. AOE for At-Power Internal Fire Events

$AOE_{(Fire)}$ = \$512 + \$2,683

= \$3,195

#### 10.3.3.4. AOE for LPSD Internal Events

$AOE_{(SDIE)}$ = \$356 + \$1,865

= \$2,221

#### 10.3.3.5. AOE for LPSD Flooding Events

$AOE_{(SDFld)}$ = \$15 + \$78

= \$93

#### 10.3.3.6. AOE for LPSD Fire Events

$AOE_{(SDFire)}$ = \$272 + \$1,423

= \$1,695

#### 10.3.3.7. Total AOE

Total averted occupational exposure costs are the sum of the four individual costs calculated above or:

$AOE_{Tot}$ = $AOE_{(IE)} + AOE_{(Fld)} + AOE_{(Fire)} + AOE_{(SDIE)} + AOE_{(SDFld)} + AOE_{(SDFire)}$

= \$1,146 + \$437 + \$3,195 + \$2,221 + \$93 + \$1,695

= \$8,787

### 10.4. Averted Onsite Costs (AOSC)

Reference 2 defines three types of costs associated with onsite property damage from an accident: cleanup and decontamination, long-term replacement power, and repair and refurbishment. The value of

avoiding each of these types of costs must be considered when evaluating risk. Total averted onsite property damage costs are the sum of the three types of costs. Calculation of onsite property damage costs is detailed in the subsections that follow.

### 10.4.1. Averted Cleanup and Decontamination Costs

The estimated cleanup cost for severe accidents is defined in Reference 2, to be $\$1 \times 10^9$ /accident (undiscounted). Using the value of $\$1.5\times10^9$ /event and assuming, as in Reference 2, that the total sum is paid in equal installments over a 10-year period, the present value of those ten payments for cleanup and decontamination costs for the cleanup period can be calculated as follows:

$$\mathrm{PV_{CD}} = \mathrm{C_{CD}}/\mathrm{m} \times \{ \left[1 - \mathrm{e}^{(-\mathrm{rm})}\right]/\mathrm{r}\} \quad (8)$$

Where:

$PV_{CD}$ = net present value of cleanup and decontamination for a single event (dollars),

$C_{CD}$ = total undiscounted cost for single accident with constant-year basis (dollars),

r = real discount rate (3 percent per year),

m = years over which long-term doses accrue (10 years).

$PV_{CD}$ = $((\$1.5\times10^9 \text{ /event}) / (10 \text{ years})) \times ((1 - e^{-(0.03 \times 10)}) / 0.03)$

= $\$1.2959 \times10^9$

The present value of the costs over the cleanup period must be considered over the period of plant life. The net present value of averted cleanup costs over the plant life can be calculated using the following equation:

$$\mathrm{U_{CD}} = (F_A - F_S) \times \mathrm{PV_{CD}} \times [1 - \mathrm{e}^{(-\mathrm{rt_f})}]/\mathrm{r} \quad (9)$$

Where:

$U_{CD}$ = present value of averted onsite cleanup costs (dollars),

$F_S$ = baseline accident frequency (events per year from Tables 1a and 1b),

$F_A$ = accident frequency after mitigation (0 events per year),

r = real discount rate (3 percent per year),

$t_f$ = years remaining until end of plant life (60 years).

Using the values given above, $U_{CD}$ is calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.4.1.1. $U_{CD}$ for At-Power Internal Events

$U_{CD(IE)}$ = $(1.00\times10^{-6} \text{ events per year} - 0) \times (\$1.2959\times10^9) \times (1 - e^{-(0.03 \times 60)}) / (0.03 \text{ per year})$

= \$36,056

#### 10.4.1.2. $U_{CD}$ for At-Power Internal Flooding Events

$U_{CD\ (Fld)}$ = $(3.82\times10^{-7}$ events per year – 0) × (\$$1.2959\times10^{9}$) × $(1 - e^{-(0.03 \times 60)})$ / (0.03 per year)

= \$13,773

#### 10.4.1.3. $U_{CD}$ for At-Power Internal Fire Events

$U_{CD\ (Fire)}$ = $(2.79\times10^{-6}$ events per year – 0) × (\$$1.2959\times10^{9}$) × $(1 - e^{-(0.03 \times 60)})$ / (0.03 per year)

= \$100,596

#### 10.4.1.4. $U_{CD}$ for LPSD Internal Events

$U_{CD\ (SDIE)}$ = $(1.94\times10^{-6}$ events per year – 0) × (\$$1.2959\times10^{9}$) × $(1 - e^{-(0.03 \times 60)})$ / (0.03 per year)

= \$69,948

#### 10.4.1.5. $U_{CD}$ for LPSD Flooding Events

$U_{CD\ (SDFld)}$ = $(8.06\times10^{-8}$ events per year – 0) × (\$$1.2959\times10^{9}$) × $(1 - e^{-(0.03 \times 60)})$ / (0.03 per year)

= \$2,906

#### 10.4.1.6. $U_{CD}$ for LPSD Fire Events

$U_{CD\ (SDFire)}$ = $(1.48\times10^{-6}$ events per year – 0) × (\$$1.2959\times10^{9}$) × $(1 - e^{-(0.03 \times 60)})$ / (0.03 per year)

= \$53,363

### 10.4.2. Averted Replacement Power Costs

Calculation of replacement power costs, however, requires a change in the equation in Subsection 4.4.2. Instead of using the equations shown in Subsection 4.4.2 to calculate $U_{RP}$, Reference 2 recommends using a linear interpolation between \$$1.9\text{x}10^{10}$ for a discount rate of one percent and $1.2\text{x}10^{10}$ for a discount rate of 5 percent. These values are based on a 24 year average remaining life and need to be adjusted to be applied to the APR1400 design. The averted replacement power costs ($U_{RP}$) was adjusted for average reactor years remaining. The replacement power cost must also be adjusted to 2016 dollars and again for the more realistic capacity factor of 95 percent. As detailed in Subsection 4.4.2, two multipliers are added to account for these adjustments:

2016 Dollars Scaling Factor Multiplier: 1.57

95% Capacity Factor Multiplier: 1.58

For the 3% discounted rate sensitivity case, the URP was adjusted for average reactor years remaining:

60 year / 24 year plant life: 2.50

These multipliers are applied to equations documented in Subsections 10.4.2.1 through 10.4.2.6.

Replacement power costs are calculated as detailed below.

#### 10.4.2.1. $U_{RP}$ for At-Power Internal Events

$$U_{RP(IE)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (1.00x10^{-6} \text{ events per year} - 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$147,883$$

#### 10.4.2.2. $U_{RP}$ for At-Power Internal Flooding Events

$$U_{RP\ (Fld)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (3.82\times10^{-7} \text{ events per year} – 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$56,490$$

#### 10.4.2.3. $U_{RP}$ for At-Power Internal Fire Events

$$U_{RP\ (Fire)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (2.79\times10^{-6} \text{ events per year} – 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$412,590$$

#### 10.4.2.4. $U_{RP}$ for LPSD Internal Events

$$U_{RP\ (SDIE)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (1.94\times10^{-6} \text{ events per year} – 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$286,890$$

#### 10.4.2.5. $U_{RP}$ for LPSD Flooding Events

$$U_{RP\ (SDFld)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (8.06\times10^{-8} \text{ events per year} – 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$11,920$$

#### 10.4.2.6. $U_{RP}$ for LPSD Fire Events

$$U_{RP\ (SDFire)} = \{\$1.9x10^{10} - [(\$1.9x10^{10} - 1.2x10^{10}) / (1\% - 5\%)] \times (1\% - 3\%)\} \times (1400 \text{ MWe} / 910 \text{ MWe}) \times (1.48\times10^{-6} \text{ events per year} – 0) \times (1.57) \times (1.58) \times (2.50)$$

$$= \$218,865$$

### 10.4.3. Averted Repair and Refurbishment Costs

It is assumed that the plant would not be repaired or refurbished; therefore, these costs are zero.

### 10.4.4. Total Averted Onsite Costs (AOSC)

Total averted onsite cost is the sum of cleanup and decontamination costs, replacement power costs, and the repair and refurbishment costs. Total averted onsite costs are calculated as follows:

$$AOSC = U_{CD} + U_{RP} + 0 \quad (10)$$

Total averted onsite costs are calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events. Each of these calculations is detailed below.

#### 10.4.4.1. AOSC for At-Power Internal Events

$AOSC_{(IE)}$ = \$36,056 + \$147,883

= \$183,939

#### 10.4.4.2. AOSC for At-Power Internal Flooding Events

$AOSC_{(Fld)}$ = \$13,773 + \$56,490

= \$70,263

#### 10.4.4.3. AOSC for At-Power Internal Fire Events

$AOSC_{(Fire)}$ = \$100,596 + \$412,590

= \$513,186

#### 10.4.4.4. AOSC for LPSD Internal Events

$AOSC_{(SDIE)}$ = \$69,948 + \$286,890

= \$356,838

#### 10.4.4.5. AOSC for LPSD Flooding Events

$AOSC_{(SDFld)}$ = \$2,906 + \$11,920

= \$14,826

#### 10.4.4.6. AOSC for LPSD Fire Events

$AOSC_{(SDFire)}$ = \$53,363 + \$218,865

= \$272,228

#### 10.4.4.7. Total AOSC

$AOSC_{Tot} = AOSC_{(IE)} + AOSC_{(Fld)} + AOSC_{(Fire)} + AOSC_{(SDIE)} + AOSC_{(SDFld)} + AOSC_{(SDFire)}$

= \$183,939 + \$70,263 + \$513,186 + \$356,838 + \$14,826 + \$272,228

= \$1,411,280

### 10.5. Cost Enhancement (COE)

The cost of enhancement is used when measures are taken to reduce risk. By definition, such measures are taken at the beginning of any period considered, so no discounting is performed for the COE. For baseline risk, no measures have been taken to reduce risk, so:

COE = $0

### 10.6. Total Unmitigated Baseline Risk

As described in Section 10, the total present worth net value of public risk is calculated according to the following formula:

$$NPV = (APE + AOC + AOE + AOSC) - COE \tag{11}$$

Using the values calculated in Sections 10.1 to 10.5, total baseline risk is calculated:

NPV = ($98,622 + $126,417 + $8,787 + $1,411,280) – $0

= $1,645,106

This value can be viewed as the maximum risk benefit attainable if all core damage scenarios from internal events are eliminated over the the 60-year plant life.

## 11. CONCLUSIONS

The analyses described in the Sections 4 through 9 analyzed the base case for the cost-benefit analyses at a 7 percent discounted rate along with the benefit associated with important contributors to risk for the APR1400 plant design. Preliminary screening eliminated SAMDA candidates from further consideration, based on inapplicability to APR1400 design features, design features that have already been incorporated into the APR1400 design, or extremely high cost of the alternatives considered.

The analysis using a 7 percent discount rate showed that no design changes to reduce risk associated with contributors to plant risk would be cost-beneficial to implement. A second baseline maximum benefit calculation using a 3 percent discount rate showed an approximate$736,000 increase in the calculated benefits if all core damage scenarios from internal events are eliminated over the 60-year plant life. Therefore, it is concluded that no design changes would provide a positive cost-benefit if included in the APR1400 design.

## 12. REFERENCES

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11. Vermont Yankee Nuclear Power Station, Applicant’s Environmental Report, Operating License Renewal Stage, Attachment E - Severe Accident Mitigation Alternatives Analysis.

12. Millstone Power Station, Units 2 and 3, Application for Renewed Operating Licenses, Appendix F MPS2 Severe Accident Mitigation Alternatives Analysis.

13. Brunswick Steam Electric Plant, License Renewal Application, Environmental Report, Appendix F Severe Accident Mitigation Alternatives.

14. Callaway Plant Unit 1, Environmental Report for License Renewal, Appendix F Severe Accident Mitigation Alternatives.

15. James A. FitzPatrick Nuclear Power Plant, Applicant's Environmental Report, Operating License Renewal Stage, Appendix E Severe Accident Mitigation Alternatives.

16. Susquehanna Steam Electric Station Units 1 & 2, License Renewal Application, Environmental Report, Appendix E Severe Accident Mitigation Alternatives.

Table 1a

Base Case – Source Term Category Summary for At-Power Events

| STC | Description | STC Frequency (per year) | | |
|---|---|---|---|---|
| | | **Internal** | **Flood** | **Fire** |
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 7.13E-08 | 2.32E-09 | 2.59E-08 |
| 2 | SGTR bypass of containment with fission product scrubbing | 3.79E-08 | 0.00E+00 | 0.00E+00 |
| 3 | ISLOCAs without fission product scrubbing | 5.31E-11 | 0.00E+00 | 0.00E+00 |
| 4 | ISLOCAs with fission product scrubbing | 6.49E-11 | 0.00E+00 | 0.00E+00 |
| 5 | Containment isolation failure with containment spray (CS) | 1.82E-09 | 4.39E-09 | 1.15E-08 |
| 6 | Containment isolation failure without CS | 8.73E-10 | 2.95E-09 | 6.22E-08 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 7.51E-09 | 2.47E-09 | 6.61E-09 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 8.24E-09 | 2.84E-09 | 7.37E-09 |
| 9 | Core melt arrested in the reactor vessel | 5.43E-07 | 1.76E-07 | 5.36E-07 |
| 10 | No containment failure after core melt | 2.90E-07 | 1.52E-07 | 1.92E-06 |
| 11 | Containment basemat failure | 1.94E-08 | 2.50E-08 | 1.14E-07 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 13 | Early containment failure with large (rupture) failure of containment | 5.20E-10 | 1.87E-10 | 6.42E-08 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 5.14E-11 | 6.87E-11 | 2.73E-10 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 7.31E-12 | 3.82E-12 | 2.73E-11 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 9.01E-09 | 5.78E-09 | 1.57E-08 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 5.53E-10 | 8.29E-10 | 3.34E-09 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 1.63E-09 | 9.96E-10 | 2.11E-09 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.68E-11 | 1.15E-11 | 1.25E-10 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 1.17E-08 | 6.38E-09 | 2.36E-08 |
| | **Total** | **1.00E-06** | **3.82E-07** | **2.79E-06** |

Table 1b

Base Case – Source Term Category Summary for Low Power and Shutdown Events

| STC | Description | STC Frequency (per year) | | |
|---|---|---|---|---|
| | | Internal | Flood | Fire |
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.89E-08 | 0.00E+00 | 3.74E-10 |
| 2 | SGTR bypass of containment with fission product scrubbing | 1.54E-08 | 0.00E+00 | 0.00E+00 |
| 3 | ISLOCAs without fission product scrubbing | 2.01E-09 | 0.00E+00 | 1.90E-09 |
| 4 | ISLOCAs with fission product scrubbing | 2.63E-11 | 0.00E+00 | 0.00E+00 |
| 5 | Containment isolation failure with containment spray (CS) | 7.38E-10 | 0.00E+00 | 1.66E-10 |
| 6 | Containment isolation failure without CS | 1.69E-08 | 8.06E-08 | 4.73E-08 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 3.05E-09 | 0.00E+00 | 9.55E-11 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 7.14E-09 | 0.00E+00 | 3.66E-10 |
| 9 | Core melt arrested in the reactor vessel | 2.20E-07 | 0.00E+00 | 7.74E-09 |
| 10 | No containment failure after core melt | 1.49E-06 | 0.00E+00 | 1.34E-06 |
| 11 | Containment basemat failure | 9.65E-08 | 0.00E+00 | 5.16E-08 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 13 | Early containment failure with large (rupture) failure of containment | 2.11E-10 | 0.00E+00 | 9.28E-10 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 2.08E-11 | 0.00E+00 | 3.94E-12 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 2.96E-12 | 0.00E+00 | 3.94E-13 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 3.65E-09 | 0.00E+00 | 2.27E-10 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 2.24E-10 | 0.00E+00 | 4.83E-11 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 6.61E-10 | 0.00E+00 | 3.05E-11 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 5.37E-08 | 0.00E+00 | 2.15E-08 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 4.74E-09 | 0.00E+00 | 3.41E-10 |
| | **Total** | **1.94E-06** | **8.06E-08** | **1.48E-06** |

Table 2 Representative Accident Sequences for each STC

| TC | Frequency for Internal Events (/ry) | Percent (%) | Representative CET Sequence (PDS) |
|---|---|---|---|
| 1 | 7.13E-08 | 7.1% | SGTR CET-02 (PDS-02) |
| 2 | 3.79E-08 | 3.8% | SGTR CET-01 (PDS-01) |
| 3 | 5.31E-11 | 0.0% | ISLOCA CET-02 (PDS-03) |
| 4 | 6.49E-11 | 0.0% | ISLOCA CET-01 (PDS-03) |
| 5 | 1.82E-09 | 0.2% | CONISOF CET-01 (PDS-05) |
| 6 | 8.73E-10 | 0.1% | CONISOF CET-02 (PDS-06) |
| 7 | 7.51E-09 | 0.7% | RBCM CET-01 (PDS-07) |
| 8 | 8.24E-09 | 0.8% | RBCM CET-02 (PDS-07) |
| 9 | 5.43E-07 | 54.1 | GEN CET-04 (PDS-04) |
| 10 | 2.90E-07 | 28.9 | GEN CET-34 (PDS-14) |
| 11 | 1.94E-08 | 1.9% | GEN CET-41 (PDS 33) |
| 12 | - | - | - |
| 13 | 5.20E-10 | 0.1 | GEN CET-05/07 (PDS-14) |
| 14 | 5.14E-11 | 0.0% | GEN CET-39 (PDS-33) |
| 15 | - | - | - |
| 16 | 7.31E-12 | 0.0% | GEN CET-29 (PDS-33) |
| 17 | 9.01E-09 | 0.9 | GEN CET-27/25 (PDS-14) |
| 18 | 5.53E-10 | 0.1 | GEN CET-40 (PDS-33) |
| 19 | 1.63E-09 | 0.2 | GEN CET-33/36 (PDS-14) |
| 20 | 1.68E-11 | 0.0% | GEN CET-30 (PDS-33) |
| 21 | 1.17E-08 | 1.2 | GEN CET-26/28 (PDS-14) |

Table 3a

Offsite Exposure by Source Term Category for At-Power Internal Events

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 7.13E-08 | 6.12E+04 | 6.12E+06 | 4.36E-01 |
| 2 | SGTR bypass of containment with fission product scrubbing | 3.79E-08 | 3.03E+02 | 3.03E+04 | 1.15E-03 |
| 3 | ISLOCAs without fission product scrubbing | 5.31E-11 | 9.16E+04 | 9.16E+06 | 4.86E-04 |
| 4 | ISLOCAs with fission product scrubbing | 6.49E-11 | 7.80E+04 | 7.80E+06 | 5.06E-04 |
| 5 | Containment isolation failure with containment spray (CS) | 1.82E-09 | 3.45E+03 | 3.45E+05 | 6.28E-04 |
| 6 | Containment isolation failure without CS | 8.73E-10 | 1.74E+04 | 1.74E+06 | 1.52E-03 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 7.51E-09 | 4.35E+04 | 4.35E+06 | 3.27E-02 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 8.24E-09 | 5.59E+04 | 5.59E+06 | 4.61E-02 |
| 9 | Core melt arrested in the reactor vessel | 5.43E-07 | 1.71E+01 | 1.71E+03 | 9.29E-04 |
| 10 | No containment failure after core melt | 2.90E-07 | 4.12E+01 | 4.12E+03 | 1.19E-03 |
| 11 | Containment basemat failure | 1.94E-08 | 1.87E+02 | 1.87E+04 | 3.63E-04 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 5.20E-10 | 3.22E+04 | 3.22E+06 | 1.67E-03 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 5.14E-11 | 1.75E+03 | 1.75E+05 | 9.00E-06 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 7.31E-12 | 4.95E+03 | 4.95E+05 | 3.62E-06 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 9.01E-09 | 1.19E+02 | 1.19E+04 | 1.07E-04 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 5.53E-10 | 2.84E+03 | 2.84E+05 | 1.57E-04 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 1.63E-09 | 4.30E+03 | 4.30E+05 | 7.01E-04 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.68E-11 | 7.81E+03 | 7.81E+05 | 1.31E-05 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 1.17E-08 | 7.66E+03 | 7.66E+05 | 8.96E-03 |
| | **Total** | **1.00E-06** | | | **5.33E-01** |

Table 3b

Offsite Exposure by Source Term Category for At-Power Internal Flooding

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.32E-09 | 6.12E+04 | 6.12E+06 | 1.42E-02 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 3.03E+02 | 3.03E+04 | 0.00E+00 |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | 9.16E+04 | 9.16E+06 | 0.00E+00 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 7.80E+04 | 7.80E+06 | 0.00E+00 |
| 5 | Containment isolation failure with containment spray (CS) | 4.39E-09 | 3.45E+03 | 3.45E+05 | 1.51E-03 |
| 6 | Containment isolation failure without CS | 2.95E-09 | 1.74E+04 | 1.74E+06 | 5.13E-03 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 2.47E-09 | 4.35E+04 | 4.35E+06 | 1.07E-02 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 2.84E-09 | 5.59E+04 | 5.59E+06 | 1.59E-02 |
| 9 | Core melt arrested in the reactor vessel | 1.76E-07 | 1.71E+01 | 1.71E+03 | 3.01E-04 |
| 10 | No containment failure after core melt | 1.52E-07 | 4.12E+01 | 4.12E+03 | 6.26E-04 |
| 11 | Containment basemat failure | 2.50E-08 | 1.87E+02 | 1.87E+04 | 4.68E-04 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 1.87E-10 | 3.22E+04 | 3.22E+06 | 6.02E-04 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 6.87E-11 | 1.75E+03 | 1.75E+05 | 1.20E-05 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 3.82E-12 | 4.95E+03 | 4.95E+05 | 1.89E-06 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 5.78E-09 | 1.19E+02 | 1.19E+04 | 6.88E-05 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 8.29E-10 | 2.84E+03 | 2.84E+05 | 2.35E-04 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 9.96E-10 | 4.30E+03 | 4.30E+05 | 4.28E-04 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.15E-11 | 7.81E+03 | 7.81E+05 | 8.98E-06 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 6.38E-09 | 7.66E+03 | 7.66E+05 | 4.89E-03 |
| | **Total** | 3.82E-07 | | | **5.51E-02** |

Table 3c

Offsite Exposure by Source Term Category for At-Power Internal Fire

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.59E-08 | 6.12E+04 | 6.12E+06 | 1.59E-01 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 3.03E+02 | 3.03E+04 | 0.00E+00 |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | 9.16E+04 | 9.16E+06 | 0.00E+00 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 7.80E+04 | 7.80E+06 | 0.00E+00 |
| 5 | Containment isolation failure with containment spray (CS) | 1.15E-08 | 3.45E+03 | 3.45E+05 | 3.97E-03 |
| 6 | Containment isolation failure without CS | 6.22E-08 | 1.74E+04 | 1.74E+06 | 1.08E-01 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 6.61E-09 | 4.35E+04 | 4.35E+06 | 2.88E-02 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 7.37E-09 | 5.59E+04 | 5.59E+06 | 4.12E-02 |
| 9 | Core melt arrested in the reactor vessel | 5.36E-07 | 1.71E+01 | 1.71E+03 | 9.17E-04 |
| 10 | No containment failure after core melt | 1.92E-06 | 4.12E+01 | 4.12E+03 | 7.91E-03 |
| 11 | Containment basemat failure | 1.14E-07 | 1.87E+02 | 1.87E+04 | 2.13E-03 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 6.42E-08 | 3.22E+04 | 3.22E+06 | 2.07E-01 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 2.73E-10 | 1.75E+03 | 1.75E+05 | 4.78E-05 |
| | | | | | |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 2.73E-11 | 4.95E+03 | 4.95E+05 | 1.35E-05 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 1.57E-08 | 1.19E+02 | 1.19E+04 | 1.87E-04 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 3.34E-09 | 2.84E+03 | 2.84E+05 | 9.49E-04 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 2.11E-09 | 4.30E+03 | 4.30E+05 | 9.07E-04 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.25E-10 | 7.81E+03 | 7.81E+05 | 9.76E-05 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 2.36E-08 | 7.66E+03 | 7.66E+05 | 1.81E-02 |
| | **Total** | 2.79E-06 | | | **5.79E-01** |

Table 3d

Offsite Exposure by Source Term Category for Low Power and Shutdown Internal Events

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.89E-08 | 6.12E+04 | 6.12E+06 | 1.77E-01 |
| 2 | SGTR bypass of containment with fission product scrubbing | 1.54E-08 | 3.03E+02 | 3.03E+04 | 4.66E-04 |
| 3 | ISLOCAs without fission product scrubbing | 2.01E-09 | 9.16E+04 | 9.16E+06 | 1.84E-02 |
| 4 | ISLOCAs with fission product scrubbing | 2.63E-11 | 7.80E+04 | 7.80E+06 | 2.05E-04 |
| 5 | Containment isolation failure with containment spray (CS) | 7.38E-10 | 3.45E+03 | 3.45E+05 | 2.55E-04 |
| 6 | Containment isolation failure without CS | 1.69E-08 | 1.74E+04 | 1.74E+06 | 2.93E-02 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 3.05E-09 | 4.35E+04 | 4.35E+06 | 1.32E-02 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 7.14E-09 | 5.59E+04 | 5.59E+06 | 3.99E-02 |
| 9 | Core melt arrested in the reactor vessel | 2.20E-07 | 1.71E+01 | 1.71E+03 | 3.76E-04 |
| 10 | No containment failure after core melt | 1.49E-06 | 4.12E+01 | 4.12E+03 | 6.13E-03 |
| 11 | Containment basemat failure | 9.65E-08 | 1.87E+02 | 1.87E+04 | 1.80E-03 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 2.11E-10 | 3.22E+04 | 3.22E+06 | 6.79E-04 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 2.08E-11 | 1.75E+03 | 1.75E+05 | 3.65E-06 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 2.96E-12 | 4.95E+03 | 4.95E+05 | 1.47E-06 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 3.65E-09 | 1.19E+02 | 1.19E+04 | 4.35E-05 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 2.24E-10 | 2.84E+03 | 2.84E+05 | 6.37E-05 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 6.61E-10 | 4.30E+03 | 4.30E+05 | 2.84E-04 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 5.37E-08 | 7.81E+03 | 7.81E+05 | 4.19E-02 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 4.74E-09 | 7.66E+03 | 7.66E+05 | 3.63E-03 |
| | **Total** | 1.94E-06 | | | **3.34E-01** |

Table 3e

Offsite Exposure by Source Term Category for Low Power and Shutdown Internal Flooding

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 0.00E+00 | - | - | - |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | - | - | - |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | - | - | - |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | - | - | - |
| 5 | Containment isolation failure with containment spray (CS) | 0.00E+00 | - | - | - |
| 6 | Containment isolation failure without CS | 8.06E-08 | 1.74E+04 | 1.74E+06 | 1.40E-01 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 0.00E+00 | - | - | - |
| 8 | Containment failure before core damage with large (rupture failure of containment | 0.00E+00 | - | - | - |
| 9 | Core melt arrested in the reactor vessel | 0.00E+00 | - | - | - |
| 10 | No containment failure after core melt | 0.00E+00 | - | - | - |
| 11 | Containment basemat failure | 0.00E+00 | - | - | - |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | - | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 0.00E+00 | - | - | - |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | - | - | - |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | - | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 0.00E+00 | - | - | - |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 0.00E+00 | - | - | - |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 0.00E+00 | - | - | - |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 0.00E+00 | - | - | - |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 0.00E+00 | - | - | - |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 0.00E+00 | - | - | - |
| | **Total** | 8.06E-08 | | | **1.40E-01** |

Table 3f

Offsite Exposure by Source Term Category for Low Power and Shutdown Internal Fire

| STC | Description | STC Frequency (per year) | Conditional Person-Sv Offsite | Conditional Person-REM Offsite | Expected Person-REM/yr Offsite |
|---|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 3.74E-10 | 6.12E+04 | 6.12E+06 | 2.29E-03 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 3.03E+02 | 3.03E+04 | 0.00E+00 |
| 3 | ISLOCAs without fission product scrubbing | 1.90E-09 | 9.16E+04 | 9.16E+06 | 1.74E-02 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 7.80E+04 | 7.80E+06 | 0.00E+00 |
| 5 | Containment isolation failure with containment spray (CS) | 1.66E-10 | 3.45E+03 | 3.45E+05 | 5.73E-05 |
| 6 | Containment isolation failure without CS | 4.73E-08 | 1.74E+04 | 1.74E+06 | 8.24E-02 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 9.55E-11 | 4.35E+04 | 4.35E+06 | 4.15E-04 |
| 8 | Containment failure before core damage with large (rupture failure of containment | 3.66E-10 | 5.59E+04 | 5.59E+06 | 2.05E-03 |
| 9 | Core melt arrested in the reactor vessel | 7.74E-09 | 1.71E+01 | 1.71E+03 | 1.32E-05 |
| 10 | No containment failure after core melt | 1.34E-06 | 4.12E+01 | 4.12E+03 | 5.53E-03 |
| 11 | Containment basemat failure | 5.16E-08 | 1.87E+02 | 1.87E+04 | 9.65E-04 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 9.28E-10 | 3.22E+04 | 3.22E+06 | 2.99E-03 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 3.94E-12 | 1.75E+03 | 1.75E+05 | 6.90E-07 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 3.94E-13 | 4.95E+03 | 4.95E+05 | 1.95E-07 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 2.27E-10 | 1.19E+02 | 1.19E+04 | 2.70E-06 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 4.83E-11 | 2.84E+03 | 2.84E+05 | 1.37E-05 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 3.05E-11 | 4.30E+03 | 4.30E+05 | 1.31E-05 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 2.15E-08 | 7.81E+03 | 7.81E+05 | 1.68E-02 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 3.41E-10 | 7.66E+03 | 7.66E+05 | 2.61E-04 |
| | **Total** | 1.48E-06 | | | **1.31E-01** |

Table 4a

Offsite Property Damage Costs by Source Term Category for At-Power Internal Events

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 7.13E-08 | 1.80E+10 | 1283 |
| 2 | SGTR bypass of containment with fission product scrubbing | 3.79E-08 | 5.26E+07 | 2 |
| 3 | ISLOCAs without fission product scrubbing | 5.31E-11 | 2.68E+10 | 1 |
| 4 | ISLOCAs with fission product scrubbing | 6.49E-11 | 2.02E+10 | 1 |
| 5 | Containment isolation failure with containment spray (CS) | 1.82E-09 | 3.91E+08 | 1 |
| 6 | Containment isolation failure without CS | 8.73E-10 | 3.90E+09 | 3 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 7.51E-09 | 9.82E+09 | 74 |
| 8 | Containment failure before core damage with large (rupture failure of | 8.24E-09 | 1.51E+10 | 124 |
| 9 | Core melt arrested in the reactor vessel | 5.43E-07 | 3.50E+07 | 19 |
| 10 | No containment failure after core melt | 2.90E-07 | 3.32E+07 | 10 |
| 11 | Containment basemat failure | 1.94E-08 | 4.68E+07 | 1 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 13 | Early containment failure with large (rupture) failure of containment | 5.20E-10 | 5.55E+09 | 3 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 5.14E-11 | 6.19E+07 | 0 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 7.31E-12 | 3.52E+08 | 0 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 9.01E-09 | 3.69E+07 | 0 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 5.53E-10 | 1.07E+08 | 0 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 1.63E-09 | 3.26E+08 | 1 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.68E-11 | 6.78E+08 | 0 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 1.17E-08 | 8.43E+08 | 10 |
| | **Total** | | | **1534** |

Table 4b

Offsite Property Damage Costs by Source Term Category for At-Power Internal Flooding

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.32E-09 | 1.80E+10 | 42 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 5.26E+07 | 0 |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | 2.68E+10 | 0 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 2.02E+10 | 0 |
| 5 | Containment isolation failure with containment spray (CS) | 4.39E-09 | 3.91E+08 | 2 |
| 6 | Containment isolation failure without CS | 2.95E-09 | 3.90E+09 | 12 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 2.47E-09 | 9.82E+09 | 24 |
| 8 | Containment failure before core damage with large (rupture failure of | 2.84E-09 | 1.51E+10 | 43 |
| 9 | Core melt arrested in the reactor vessel | 1.76E-07 | 3.50E+07 | 6 |
| 10 | No containment failure after core melt | 1.52E-07 | 3.32E+07 | 5 |
| 11 | Containment basemat failure | 2.50E-08 | 4.68E+07 | 1 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 13 | Early containment failure with large (rupture) failure of containment | 1.87E-10 | 5.55E+09 | 1 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 6.87E-11 | 6.19E+07 | 0 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 3.82E-12 | 3.52E+08 | 0 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 5.78E-09 | 3.69E+07 | 0 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 8.29E-10 | 1.07E+08 | 0 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 9.96E-10 | 3.26E+08 | 0 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.15E-11 | 6.78E+08 | 0 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 6.38E-09 | 8.43E+08 | 5 |
| | **Total** | | | **142** |

Table 4c

Offsite Property Damage Costs by Source Term Category for At-Power Internal Fire

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.59E-08 | 1.80E+10 | 466 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 5.26E+07 | 0 |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | 2.68E+10 | 0 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 2.02E+10 | 0 |
| 5 | Containment isolation failure with containment spray (CS) | 1.15E-08 | 3.91E+08 | 4 |
| 6 | Containment isolation failure without CS | 6.22E-08 | 3.90E+09 | 243 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 6.61E-09 | 9.82E+09 | 65 |
| 8 | Containment failure before core damage with large (rupture failure of | 7.37E-09 | 1.51E+10 | 111 |
| 9 | Core melt arrested in the reactor vessel | 5.36E-07 | 3.50E+07 | 19 |
| 10 | No containment failure after core melt | 1.92E-06 | 3.32E+07 | 64 |
| 11 | Containment basemat failure | 1.14E-07 | 4.68E+07 | 5 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 13 | Early containment failure with large (rupture) failure of containment | 6.42E-08 | 5.55E+09 | 356 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 2.73E-10 | 6.19E+07 | 0 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 2.73E-11 | 3.52E+08 | 0 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 1.57E-08 | 3.69E+07 | 1 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 3.34E-09 | 1.07E+08 | 0 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 2.11E-09 | 3.26E+08 | 1 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 1.25E-10 | 6.78E+08 | 0 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 2.36E-08 | 8.43E+08 | 20 |
| | **Total** | | | **1355** |

Table 4d

Offsite Property Damage Costs by Source Term Category for Low Power and Shutdown Internal Events

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 2.89E-08 | 1.80E+10 | 520 |
| 2 | SGTR bypass of containment with fission product scrubbing | 1.54E-08 | 5.26E+07 | 1 |
| 3 | ISLOCAs without fission product scrubbing | 2.01E-09 | 2.68E+10 | 54 |
| 4 | ISLOCAs with fission product scrubbing | 2.63E-11 | 2.02E+10 | 1 |
| 5 | Containment isolation failure with containment spray (CS) | 7.38E-10 | 3.91E+08 | 0 |
| 6 | Containment isolation failure without CS | 1.69E-08 | 3.90E+09 | 66 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 3.05E-09 | 9.82E+09 | 30 |
| 8 | Containment failure before core damage with large (rupture failure of | 7.14E-09 | 1.51E+10 | 108 |
| 9 | Core melt arrested in the reactor vessel | 2.20E-07 | 3.50E+07 | 8 |
| 10 | No containment failure after core melt | 1.49E-06 | 3.32E+07 | 49 |
| 11 | Containment basemat failure | 9.65E-08 | 4.68E+07 | 5 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 13 | Early containment failure with large (rupture) failure of containment | 2.11E-10 | 5.55E+09 | 1 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 2.08E-11 | 6.19E+07 | 0 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 2.96E-12 | 3.52E+08 | 0 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 3.65E-09 | 3.69E+07 | 0 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 2.24E-10 | 1.07E+08 | 0 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 6.61E-10 | 3.26E+08 | 0 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 5.37E-08 | 6.78E+08 | 36 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 4.74E-09 | 8.43E+08 | 4 |
| | **Total** | | | **883** |

Table 4e

Offsite Property Damage Costs by Source Term Category for Low Power and Shutdown Internal Flooding

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 0.00E+00 | - | - |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | - | - |
| 3 | ISLOCAs without fission product scrubbing | 0.00E+00 | - | - |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | - | - |
| 5 | Containment isolation failure with containment spray (CS) | 0.00E+00 | - | - |
| 6 | Containment isolation failure without CS | 8.06E-08 | 3.90E+09 | 314 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 0.00E+00 | - | - |
| 8 | Containment failure before core damage with large (rupture failure of | 0.00E+00 | - | - |
| 9 | Core melt arrested in the reactor vessel | 0.00E+00 | - | - |
| 10 | No containment failure after core melt | 0.00E+00 | - | - |
| 11 | Containment basemat failure | 0.00E+00 | - | - |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | - | - |
| 13 | Early containment failure with large (rupture) failure of containment | 0.00E+00 | - | - |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | - | - |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | - | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 0.00E+00 | - | - |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 0.00E+00 | - | - |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 0.00E+00 | - | - |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 0.00E+00 | - | - |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 0.00E+00 | - | - |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 0.00E+00 | - | - |
| | **Total** | | | **314** |

Table 4f

Offsite Property Damage Costs by Source Term Category for Low Power and Shutdown Internal Fire

| STC | Description | STC Frequency (per year) | Conditional Property Costs ($) | Expected Property Costs ($) |
|---|---|---|---|---|
| 1 | Steam generator tube rupture (SGTR) bypass of containment without fission product scrubbing | 3.74E-10 | 1.80E+10 | 7 |
| 2 | SGTR bypass of containment with fission product scrubbing | 0.00E+00 | 5.26E+07 | 0 |
| 3 | ISLOCAs without fission product scrubbing | 1.90E-09 | 2.68E+10 | 51 |
| 4 | ISLOCAs with fission product scrubbing | 0.00E+00 | 2.02E+10 | 0 |
| 5 | Containment isolation failure with containment spray (CS) | 1.66E-10 | 3.91E+08 | 0 |
| 6 | Containment isolation failure without CS | 4.73E-08 | 3.90E+09 | 185 |
| 7 | Containment failure before core damage with small (leak) failure of containment | 9.55E-11 | 9.82E+09 | 1 |
| 8 | Containment failure before core damage with large (rupture failure of | 3.66E-10 | 1.51E+10 | 6 |
| 9 | Core melt arrested in the reactor vessel | 7.74E-09 | 3.50E+07 | 0 |
| 10 | No containment failure after core melt | 1.34E-06 | 3.32E+07 | 45 |
| 11 | Containment basemat failure | 5.16E-08 | 4.68E+07 | 2 |
| 12 | Early containment failure with small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 13 | Early containment failure with large (rupture) failure of containment | 9.28E-10 | 5.55E+09 | 5 |
| 14 | Late containment failure with a dry cavity, CS operation, and a small (leak) failure of containment | 3.94E-12 | 6.19E+07 | 0 |
| 15 | Late containment failure with a wet cavity, CS operation, and a small (leak) failure of containment | 0.00E+00 | 0.00E+00 | - |
| 16 | Late containment failure with a dry cavity, no CS, and a small (leak) failure of containment | 3.94E-13 | 3.52E+08 | 0 |
| 17 | Late containment failure with a wet cavity, no CS, and a small (leak) failure of containment | 2.27E-10 | 3.69E+07 | 0 |
| 18 | Late containment failure with a dry cavity, CS operation, and a large (rupture) failure of containment | 4.83E-11 | 1.07E+08 | 0 |
| 19 | Late containment failure with a wet cavity, CS operation, and a large (rupture) failure of containment | 3.05E-11 | 3.26E+08 | 0 |
| 20 | Late containment failure with a dry cavity, no CS, and a large (rupture) failure of containment | 2.15E-08 | 6.78E+08 | 15 |
| 21 | Late containment failure with a wet cavity, no CS, and a large (rupture) failure of containment | 3.41E-10 | 8.43E+08 | 0 |
| | **Total** | | | **316** |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (1 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| **Improvements Related to AC and DC Power** | | | |
| 1 | Provide additional DC battery +capacity. | Extended DC power availability during an SBO. | Sections 7.7, 8.7, and 9.7 evaluate the potential maximum benefit for 125 VDC power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 2 | Replace lead-acid batteries with fuel cells | Extended DC Power availability during an SBO | Sections 7.7, 8.7, and 9.7 evaluate the potential maximum benefit for 125 VDC power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 3 | Add additional battery charger or portable diesel-driven battery charger to existing DC system | Improved availability of DC power system | Sections 7.7, 8.7, and 9.7 evaluate the potential maximum benefit for 125 VDC power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 5 | Provide DC bus cross-ties. | Improved availability of DC power system. | Sections 7.7, 8.7, and 9.7 evaluate the potential maximum benefit for 125 VDC power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 6 | Provide additional DC power to the 120/240V vital AC system. | Increased availability of the 120 V vital AC bus. | Sections 7.8, 8.8, and 9.8 evaluate the potential maximum benefit for 120V power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 7 | Add an automatic feature to transfer the 120V vital AC bus from normal to standby power. | Increased availability of the 120 V vital AC bus. | Sections 7.8, 8.8, and 9.8 evaluate the potential maximum benefit for 120V power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 8 | Increase training on response to loss of two 120V AC buses which causes inadvertent actuation signals. | Improved chances of successful response to loss of two 120V AC buses. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (2 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 9 | Provide an additional diesel generator. | Increased availability of on-site emergency AC power. | Sections 7.1, 8.1, and 9.1 evaluate the potential maximum benefit for EDG power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 10 | Revise procedure to allow bypass of diesel generator trips. | Extended diesel generator operation. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 11 | Improve 4.16-kV bus cross-tie ability. | Increased availability of on-site AC power. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 12 | Create AC power cross-tie capability with other unit (multi-unit site) | Increased availability of on-site AC power. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. Also, Design Certification does not consider duel unit capability |
| 13 | Install an additional, buried off-site power source. | Reduced probability of loss of off-site power. | N/A – This is a site-specific issue and not applicable to the design certification stage of plant development. |
| 14 | Install a gas turbine generator. | Increased availability of on-site AC power. | Already Implemented In Design. The alternate AC power source is a gas turbine generator. |
| 15 | Install tornado protection on gas turbine generator. | Increased availability of on-site AC power. | Sections 7.2, 8.2, and 9.2 evaluate the potential maximum benefit for CTG events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 16 | Improve uninterruptible power supplies. | Increased availability of power supplies supporting front-line equipment. | Sections 7.8, 8.8, and 9.8 evaluate the potential maximum benefit for 120V power events. Sections 7.9, 8.9, and 9.9 evaluate the potential maximum benefit for 4.16kV power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 17 | Create a cross-tie for diesel fuel oil (multiunit site). | Increased diesel generator availability. | N/A - Design Certification does not consider duel unit capability |
| 18 | Develop procedures for replenishing diesel fuel oil. | Increased diesel generator availability. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (3 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 19 | Use fire water system as a backup source for diesel cooling. | Increased diesel generator availability. | Sections 7.1, 8.1, and 9.1 evaluate the potential maximum benefit for EDG power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 20 | Add a new backup source of diesel cooling. | Increased diesel generator availability. | Sections 7.1, 8.1, and 9.1 evaluate the potential maximum benefit for EDG power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 21 | Develop procedures to repair or replace failed 4 KV breakers. | Increased probability of recovery from failure of breakers that transfer 4.16 kV nonemergency buses from unit station service transformers. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 22 | In training, emphasize steps in recovery of off-site power after an SBO. | Reduced human error probability during off-site power recovery. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |
| 23 | Develop a severe weather conditions procedure. | Improved off-site power recovery following external weather-related events. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 24 | Bury off-site power lines. | Improved off-site power reliability during severe weather. | N/A – This is a site-specific issue and not applicable to the design certification stage of plant development. |
| **Improvements Related to Core Cooling Systems** | | | |
| 25 | Install an independent active or passive high pressure injection system. | Improved prevention of core melt sequences. | Already Implemented In Design. The plant design has four trains of safety injection along with two charging pumps and an alternate charging pump. |
| 26 | Provide an additional high pressure injection pump with independent diesel. | Reduced frequency of core melt from small LOCA and SBO sequences. | Sections 7.12, 8.12, and 9.12 evaluate the potential maximum benefit for high-pressure injection events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 27 | Revise procedure to allow operators to inhibit automatic vessel depressurization in non-ATWS scenarios. | Extended HPCI and RCIC operation. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (4 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 28 | Add a diverse low pressure injection system. | Improved injection capability. | Already Implemented In Design. Plant design has two trains of SDC pumps that can be used for injection and two containment spray pumps that can be aligned to the SDC system for injection. Therefore, four pumps are available for low-pressure injection. |
| 29 | Provide capability for alternate injection via diesel-driven fire pump. | Improved injection capability. | Sections 7.1, 8.1, and 9.1 evaluate the potential maximum benefit for EDG power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit.<br><br>Sections 7.12, 8.12, and 9.12 evaluate the potential maximum benefit for high-pressure injection events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 30 | Improve ECCS suction strainers. | Enhanced reliability of ECCS suction. | Already Implemented In Design. Insights from GSI-191 considered in the APR1400 design, the strainers are designed to minimize a potential plugging, and the trash rack located at the ingress of the holdup volume tank (HVT) pre-screens any larger size debris entering the in-containment refueling water storage tank. |
| 31 | Add the ability to manually align emergency core cooling system recirculation. | Enhanced reliability of ECCS suction. | Already Implemented In Design. The IRWST eliminates the need to switch to recirculation. |
| 32 | Add the ability to automatically align emergency core cooling system to recirculation mode upon refueling water storage tank depletion. | Enhanced reliability of ECCS suction. | Already Implemented In Design. The IRWST eliminates the need to switch to recirculation. |
| 33 | Provide hardware and procedure to refill the reactor water storage tank once it reaches a specified low level. | Extended reactor water storage tank capacity in the event of a steam generator tube rupture. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (5 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 34 | Provide an in-containment reactor water storage tank. | Continuous source of water to the safety injection pumps during a LOCA event, since water released from a breach of the primary system collects in the in-containment reactor water storage tank, and thereby eliminates the need to realign the safety injection pumps for long-term post-LOCA recirculation. | Already Implemented In Design. The design includes an in-containment reactor water storage tank |
| 35 | Throttle low pressure injection pumps earlier in medium or large-break LOCAs to maintain reactor water storage tank inventory. | Extended reactor water storage tank capacity. | Already Implemented – The discharged water through the break collects in the holdup volume tank (HVT) which is then transferred to the in-containment reactor water storage tank which eliminates the need to throttle low pressure injection pumps. |
| 36 | Emphasize timely recirculation alignment in operator training. | Reduced human error probability associated with recirculation failure. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |
| 37 | Upgrade the chemical and volume control system to mitigate small LOCAs. | For a plant like the Westinghouse AP600, where the chemical and volume control system cannot mitigate a small LOCA, an upgrade would decrease the frequency of core damage. | Sections 7.12, 8.12, and 9.12 evaluate the potential maximum benefit for high-pressure injection events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 38 | Change the in-containment reactor water storage tank suction from four check valves to two check and two air-operated valves. | Reduced common mode failure of injection paths. | Sections 7.12, 8.12, and 9.12 evaluate the potential maximum benefit for high-pressure injection events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 39 | Replace two of the four electric safety injection pumps with diesel-powered pumps. | Reduced common cause failure of the safety injection system. This SAMA was originally intended for the Westinghouse-CE System 80+, which has four trains of safety injection. However, the intent of this SAMA is to provide diversity within the high- and low-pressure safety injection systems. | Sections 7.12, 8.12, and 9.12 evaluate the potential maximum benefit for high-pressure injection events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 40 | Provide capability for remote, manual operation of secondary side pilot-operated relief valves in a station blackout. | Improved chance of successful operation during station blackout events in which high area temperatures may be encountered (no ventilation to main steam areas). | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (6 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 41 | Create a reactor coolant depressurization system. | Allows low pressure emergency core cooling system injection in the event of small LOCA and high-pressure safety injection failure. | Already Implemented In Design - Safety Depressurization and Vent System (CDM 3.4.1) |
| 42 | Make procedure changes for reactor coolant system depressurization. | Allows low pressure emergency core cooling system injection in the event of small LOCA and high-pressure safety injection failure. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| **Improvements Related to Cooling Water** | | | |
| 43 | Add redundant DC control power for SW pumps. | Increased availability of SW. | Sections 7.13, 8.13, and 9.13 evaluate the potential maximum benefit for ESW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 44 | Replace ECCS pump motors with air-cooled motors. | Elimination of ECCS dependency on component cooling system. | Already Implemented / SI Pump Motors are air cooled by room coolers |
| 45 | Enhance procedural guidance for use of cross-tied component cooling or service water pumps. | Reduced frequency of loss of component cooling water and service water. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 46 | Add a service water pump. | Increased availability of cooling water. | Sections 7.13, 8.13, and 9.13 evaluate the potential maximum benefit for ESW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 47 | Enhance the screen wash system. | Reduced potential for loss of SW due to clogging of screens. | Sections 7.13, 8.13, and 9.13 evaluate the potential maximum benefit for ESW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 48 | Cap downstream piping of normally closed component cooling water drain and vent valves. | Reduced frequency of loss of component cooling water initiating events, some of which can be attributed to catastrophic failure of one of the many single isolation valves. | Already Implemented – The design includes the caps for downstream piping of normally closed component cooling water drain and vent valves. See 1-461 series drawings. |
| 49 | Enhance loss of component cooling water (or loss of service water) procedures to facilitate stopping the reactor coolant pumps. | Reduced potential for reactor coolant pump seal damage due to pump bearing failure. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (7 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 50 | Enhance loss of component cooling water procedure to underscore the desirability of cooling down the reactor coolant system prior to seal LOCA. | Reduced probability of reactor coolant pump seal failure. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 51 | Additional training on loss of component cooling water. | Improved success of operator actions after a loss of component cooling water. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |
| 52 | Provide hardware connections to allow another essential raw cooling water system to cool charging pump seals. | Reduced effect of loss of component cooling water by providing a means to maintain the charging pump seal injection following a loss of normal cooling water. | N/A - 2 Charging Pumps are Air Cooled. Additional Aux Charging Pump is a positive displacement type and requires no external cooling. |
| 53 | On loss of essential raw cooling water, proceduralize shedding component cooling water loads to extend the component cooling water heat-up time. | Increased time before loss of component cooling water (and reactor coolant pump seal failure) during loss of essential raw cooling water sequences. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 54 | Increase charging pump lube oil capacity. | Increased time before charging pump failure due to lube oil overheating in loss of cooling water sequences. | Excessive Implementation Cost – Basic events related to charging pump failure do not appear in the cutset importance analysis shown in Tables 6a through 6f or 7a through 7f. Therefore, failure of a charging pump has minimal affect on plant risk and, as a result, negligible potential for immprovament to risk. |
| 55 | Install an independent reactor coolant pump seal injection system, with dedicated diesel. | Reduced frequency of core damage from loss of component cooling water, service water, or station blackout. | Excessive Implementation Cost – Basic events related to RCP seal failure do not appear in the cutset importance analysis shown in Tables 6a through 6f or 7a through 7f. Therefore, failure of a charging pump has minimal affect on plant risk and, as a result, negligible potential for immprovament to risk. |
| 56 | Install an independent reactor coolant pump seal injection system, without dedicated diesel. | Reduced frequency of core damage from loss of component cooling water or service water, but not a station blackout. | Already implemented in design – an alternate charging pump is provided that can be aligned for seal injection in the event that the two normal charging pumps fail. |
| 57 | Use existing hydro test pump for reactor coolant pump seal injection. | Reduced frequency of core damage from loss of component cooling water or service water, but not a station blackout. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (8 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 58 | Install improved reactor coolant pump seals. | Reduced likelihood of reactor coolant pump seal LOCA. | Already Implemented /The APR1400 will use advanced RCP seal design |
| 59 | Install an additional component cooling water pump. | Reduced likelihood of loss of component cooling water leading to a reactor coolant pump seal LOCA. | Sections 7.5, 8.5, and 9.5 evaluate the potential maximum benefit for CCW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 60 | Prevent makeup pump flow diversion through the relief valves. | Reduced frequency of loss of reactor coolant pump seal cooling if spurious high pressure injection relief valve opening creates a flow diversion large enough to prevent reactor coolant pump seal injection. | Excessive Implementation Cost – Basic events related to RCP seal failure do not appear in the cutset importance analysis shown in Tables 6a through 6f or 7a through 7f. Therefore, failure of a charging pump has minimal affect on plant risk and, as a result, negligible potential for immprovament to risk. |
| 61 | Change procedures to isolate reactor coolant pump seal return flow on loss of component cooling water, and provide (or enhance) guidance on loss of injection during seal LOCA. | Reduced frequency of core damage due to loss of seal cooling. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 62 | Implement procedures to stagger high pressure safety injection pump use after a loss of service water. | Extended high pressure injection prior to overheating following a loss of service water. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 63 | Use fire prevention system pumps as a backup seal injection and high pressure makeup source. | Reduced frequency of reactor coolant pump seal LOCA. | Excessive Implementation Cost – Basic events related to RCP seal failure do not appear in the cutset importance analysis shown in Tables 6a through 6f or 7a through 7f. Therefore, failure of a charging pump has minimal affect on plant risk and, as a result, negligible potential for immprovament to risk. |
| 64 | Implement procedure and hardware modifications to allow manual alignment of the fire water system to the component cooling water system, or install a component cooling water header cross-tie. | Improved ability to cool residual heat removal heat exchangers. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (9 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| **Improvements Related to Feedwater and Condensate** | | | |
| 65 | Install a digital feed water upgrade. | Reduced chance of loss of main feed water following a plant trip. | Very Low Benefit |
| 66 | Create ability for emergency connection of existing or new water sources to feedwater and condensate systems. | Increased availability of feedwater. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 67 | Install an independent diesel for the condensate storage tank makeup pumps. | Extended inventory in CST during an SBO. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 68 | Add a motor-driven feedwater pump. | Increased availability of feedwater. | Already Implemented / APR1400 has 2 TDAFP and 2 MDAFP |
| 69 | Install manual isolation valves around auxiliary feedwater turbine-driven steam admission valves. | Reduced dual turbine-driven pump maintenance unavailability. | Already Implemented / See 1-526 series P&IDs, manual valves installed up and downstream of Steam Inlet Stop Valve (HP/LP) |
| 70 | Install accumulators for turbine-driven auxiliary feedwater pump flow control valves. | Eliminates the need for local manual action to align nitrogen bottles for control air following a loss of off-site power. | N/A - Steam Control Valves are Electro-Hydraulic operated |
| 71 | Install a new condensate storage tank (auxiliary feedwater storage tank). | Increased availability of the auxiliary feedwater system. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 72 | Modify the turbine-driven auxiliary feedwater pump to be self-cooled. | Improved success probability during a station blackout. | Already Implemented / TDAFPs are designed to operate in severe environments |
| 73 | Proceduralize local manual operation of auxiliary feedwater system when control power is lost. | Extended auxiliary feedwater availability during a station blackout. Also provides a success path should auxiliary feedwater control power be lost in non-station blackout sequences. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (10 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 74 | Provide hookup for portable generators to power the turbine-driven auxiliary feedwater pump after station batteries are depleted. | Extended auxiliary feedwater availability. | Sections 7.7, 8.7, and 9.7 evaluate the potential maximum benefit for 125 VDC power events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 75 | Use fire water system as a backup for steam generator inventory. | Increased availability of steam generator water supply. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 76 | Change failure position of condenser makeup valve if the condenser makeup valve fails open on loss of air or power. | Allows greater inventory for the auxiliary feedwater pumps by preventing condensate storage tank flow diversion to the condenser. | Already Implemented / Condensate Storage Tank Makeup to Condenser AOVs Fail Closed (1-531 (1/5) P&ID) |
| 77 | Provide a passive, secondary-side heat rejection loop consisting of a condenser and heat sink. | Reduced potential for core damage due to loss-of-feedwater events. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 78 | Modify the startup feedwater pump so that it can be used as a backup to the emergency feedwater system, including during a station blackout scenario. | Increased reliability of decay heat removal. | Sections 7.3, 8.3, and 9.3 evaluate the potential maximum benefit for AFW events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 79 | Replace existing pilot-operated relief valves with larger ones, such that only one is required for successful feed and bleed. | Increased probability of successful feed and bleed. | Already Implemented / Success criteria for feed and bleed cooling is 1 POSRV |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (11of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| **Improvements Related to Heating, Ventilation, and Air Conditioning** | | | |
| 80 | Provide a redundant train or means of ventilation. | Increased availability of components dependent on room cooling. | Sections 7.11, 8.11, and 9.11 evaluate the potential maximum benefit for HVAC events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 81 | Add a diesel building high temperature alarm or redundant louver and thermostat. | Improved diagnosis of a loss of diesel building HVAC. | Sections 7.11, 8.11, and 9.11 evaluate the potential maximum benefit for HVAC events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 82 | Stage backup fans in switchgear rooms. | Increased availability of ventilation in the event of a loss of switchgear ventilation. | Sections 7.11, 8.11, and 9.11 evaluate the potential maximum benefit for HVAC events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 83 | Add a switchgear room high temperature alarm. | Improved diagnosis of a loss of switchgear HVAC. | Already implemented – The temperature switch is provided in the switchgear room. The cubicle cooler in the switchgear room operates automatically by the temperature switch to provide additional cooling as needed. The temperature in the switchgear room is indicated and high-high temperature is announced in the MCR and RSR.N/A – HVAC |
| 84 | Create ability to switch emergency feedwater room fan power supply to station batteries in a station blackout. | Continued fan operation in a station blackout. | Already Implemented / TDAFPs are designed to operate in severe environments |
| **Improvements Related to Instrument Air and Nitrogen Supply** | | | |
| 85 | Provide cross-unit connection of uninterruptible compressed air supply. | Increased ability to vent containment using the hardened vent. | N/A – The submitted design is a single-unit design and enhancement due to a cross-unit connection is not a part of the design certification design. |
| 86 | Modify procedure to provide ability to align diesel power to more air compressors. | Increased availability of instrument air after a LOOP. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (12 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 87 | Replace service and instrument air compressors with more reliable compressors which have self-contained air cooling by shaft driven fans. | Elimination of instrument air system dependence on service water cooling. | Instrument air is a negligible contribution to plant risk. Therefore, any design change related to instrument air would provide a negligible benefit. |
| 88 | Install nitrogen bottles as backup gas supply for safety relief valves. | Extended SRV operation time. | Not applicable – the APR1400 uses pilot operated safety relief valves that do not require air to operate. |
| 89 | Improve SRV and MSIV pneumatic components. | Improved availability of SRVs and MSIVs. | Sections 7.17, 8.17, and 9.17 evaluate the potential maximum benefit for main steam events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| **Improvements Related to Containment Phenomena** | | | |
| 90 | Create a reactor cavity flooding system. | Enhanced debris cool ability, reduced core concrete interaction, and increased fission product scrubbing. | Already Implemented / Cavity Flooding System |
| 91 | Install a passive containment spray system. | Improved containment spray capability. | Implementation of this SAMDA does not affect CDF and would only cause a reduction in offsite risk costs, which limits potential benefit, or a maximum of $113,810.<br><br>In reality, the total maximum benefit would be much lower because all offsite consequences would not be eliminated. Therefore, this design change would be expected to cost more than this amount and, as a result, not provide a positive benefit. |
| 92 | Use the fire water system as a backup source for the containment spray system. | Improved containment spray capability. | Already Implemented / ECSBS. |
| 93 | Install an unfiltered, hardened containment vent. | Increased decay heat removal capability for non-ATWS events, without scrubbing released fission products. | Excessive Implementation Cost |
| 94 | Install a filtered containment vent to remove decay heat Option 1: Gravel Bed Filter Option 2: Multiple Venturi Scrubber | Increased decay heat removal capability for non-ATWS events, with scrubbing of released fission products. | Excessive Implementation Cost |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (13 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 95 | Enhance fire protection system and standby gas treatment system hardware and procedures. | Improved fission product scrubbing in severe accidents. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 96 | Provide post-accident containment inerting capability. | Reduced likelihood of hydrogen and carbon monoxide gas combustion. | Excessive Implementation Cost |
| 97 | Create a large concrete crucible with heat removal potential to contain molten core debris. | Increased cooling and containment of molten core debris. Molten core debris escaping from the vessel is contained within the crucible and a water cooling mechanism cools the molten core in the crucible, preventing melt-through of the base mat. | Excessive Implementation Cost |
| 98 | Create a core melt source reduction system. | Increased cooling and containment of molten core debris. Refractory material would be placed underneath the reactor vessel such that a molten core falling on the material would melt and combine with the material. Subsequent spreading and heat removal from the vitrified compound would be facilitated, and concrete attack would not occur. | Excessive Implementation Cost |
| 99 | Strengthen primary/secondary containment (e.g., add ribbing to containment shell). | Reduced probability of containment over-pressurization. | Excessive Implementation Cost |
| 100 | Increase depth of the concrete base mat or use an alternate concrete material to ensure melt-through does not occur. | Reduced probability of base mat melt-through. | Excessive Implementation Cost |
| 101 | Provide a reactor vessel exterior cooling system. | Increased potential to cool a molten core before it causes vessel failure, by submerging the lower head in water. | Excessive Implementation Cost |
| 102 | Construct a building to be connected to primary/secondary containment and maintained at a vacuum. | Reduced probability of containment over-pressurization. | Excessive Implementation Cost |
| 103 | Institute simulator training for severe accident scenarios. | Improved arrest of core melt progress and prevention of containment failure. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (14 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 104 | Improve leak detection procedures. | Increased piping surveillance to identify leaks prior to complete failure. Improved leak detection would reduce LOCA frequency. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 105 | Delay containment spray actuation after a large LOCA. | Extended reactor water storage tank availability. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 106 | Install automatic containment spray pump header throttle valves. | Extended time over which water remains in the reactor water storage tank, when full containment spray flow is not needed. | Already Implemented / All ECCS pumps taks suction from the IRWST |
| 107 | Install a redundant containment spray system. | Increased containment heat removal ability. | Sections 7.6, 8.6, and 9.6 evaluate the potential maximum benefit for containment spray events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 108 | Install an independent power supply to the hydrogen control system using either new batteries, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies, such as the security system diesel. | Reduced hydrogen detonation potential. | Already Implemented / H2 Control System includes 2 redundant passive autocatalytic recombiners system. |
| 109 | Install a passive hydrogen control system. | Reduced hydrogen detonation potential. | Already Implemented / H2 Control System includes 2 redundant passive autocatalytic recombiners system. |
| 110 | Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at high pressure. | Reduced probability of containment failure. | Implementation of this SAMDA does not affect CDF and would only cause a reduction in offsite risk costs, which limits potential benefit, or a maximum of $113,810.<br>In reality, the total maximum benefit would be much lower because all offsite consequences would not be eliminated. Therefore, this design change would be expected to cost more than this amount and, as a result, not provide a positive benefit. |

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| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| **Improvements Related to Containment Bypass** | | | |
| 111 | Install additional pressure or leak monitoring instruments for detection of ISLOCAs. | Reduced ISLOCA frequency. | Already implemented. Refer to 441-series P&ID. |
| 112 | Add redundant and diverse limit switches to each containment isolation valve. | Reduced frequency of containment isolation failure and ISLOCAs. | Already implemented. Refer to 441-series P&ID. |
| 113 | Increase leak testing of valves in ISLOCA paths. | Reduced ISLOCA frequency. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 114 | Install self-actuating containment isolation valves. | Reduced frequency of isolation failure. | Already Implemented / Containment Isolation System provides automatic and leaktight closure of those valves required to close for containment integrity |
| 115 | Locate residual heat removal (RHR) inside containment | Reduced frequency of ISLOCA outside containment. | Excessive Implementation Cost |
| 116 | Ensure ISLOCA releases are scrubbed. One method is to plug drains in potential break areas so that break point will be covered with water. | Scrubbed ISLOCA releases. | Implementation of this SAMDA does not affect CDF and would only cause a reduction in offsite risk costs, which limits potential benefit, or a maximum of $113,810.<br>In reality, the total maximum benefit would be much lower because all offsite consequences would not be eliminated. Therefore, this design change would be expected to cost more than this amount and, as a result, not provide a positive benefit. |
| 117 | Revise EOPs to improve ISLOCA identification. | Increased likelihood that LOCAs outside containment are identified as such. A plant had a scenario in which an RHR ISLOCA could direct initial leakage back to the pressurizer relief tank, giving indication that the LOCA was inside containment. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 118 | Improve operator training on ISLOCA coping. | Decreased ISLOCA consequences. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (16 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 119 | Institute a maintenance practice to perform a 100% inspection of steam generator tubes during each refueling outage. | Reduced frequency of steam generator tube ruptures. | Excessive Implementation Cost |
| 120 | Replace steam generators with a new design. | Reduced frequency of steam generator tube ruptures. | Excessive Implementation Cost |
| 121 | Increase the pressure capacity of the secondary side so that a steam generator tube rupture would not cause the relief valves to lift. | Eliminates release pathway to the environment following a steam generator tube rupture. | Excessive Implementation Cost |
| 122 | Install a spray system to depressurize the primary system during a steam generator tube rupture | Enhanced depressurization capabilities during steam generator tube rupture. | Excessive Implementation Cost |
| 123 | Proceduralize use of pressurizer vent valves during steam generator tube rupture sequences. | Backup method to using pressurizer sprays to reduce primary system pressure following a steam generator tube rupture. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 124 | Provide improved instrumentation to detect steam generator tube ruptures, such as Nitrogen-16 monitors). | Improved mitigation of steam generator tube ruptures. | Already Implemented / H2 Control System includes 2 redundant passive autocatalytic recombiners system. |
| 125 | Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove most of the fission products. | Reduced consequences of a steam generator tube rupture. | Already Implemented / See APR1400-CDM Table 3.8.2-2 #11 |
| 126 | Install a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources | Reduced consequences of a steam generator tube rupture. | Excessive Implementation Cost |
| 127 | Revise emergency operating procedures to direct isolation of a faulted steam generator. | Reduced consequences of a steam generator tube rupture. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (17 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 128 | Direct steam generator flooding after a steam generator tube rupture, prior to core damage. | Improved scrubbing of steam generator tube rupture releases. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 129 | Vent main steam safety valves in containment. | Reduced consequences of a steam generator tube rupture. | Excessive Implementation Cost |
| **Improvements Related to ATWS** | | | |
| 130 | Add an independent boron injection system. | Improved availability of boron injection during ATWS. | Sections 7.15, 8.15, and 9.15 evaluate the potential maximum benefit for ATWS events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 131 | Add a system of relief valves to prevent equipment damage from pressure spikes during an ATWS. | Improved equipment availability after an ATWS. | Sections 7.15, 8.15, and 9.15 evaluate the potential maximum benefit for ATWS events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 132 | Provide an additional control system for rod insertion (e.g., AMSAC). | Improved redundancy and reduced ATWS frequency. | Sections 7.15, 8.15, and 9.15 evaluate the potential maximum benefit for ATWS events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 133 | Install an ATWS sized filtered containment vent to remove decay heat. | Increased ability to remove reactor heat from ATWS events. | Excessive Implementation Cost |
| 134 | Revise procedure to bypass MSIV isolation in turbine trip ATWS scenarios. | Affords operators more time to perform actions. Discharge of a substantial fraction of steam to the main condenser (i.e., as opposed to into the primary containment) affords the operator more time to perform actions (e.g., SLC injection, lower water level, depressurize RPV) than if the main condenser was unavailable, resulting in lower human error probabilities. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (18 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 135 | Revise procedure to allow override of low pressure core injection during an ATWS event. | Allows immediate control of low pressure core injection. On failure of high pressure core injection and condensate, some plants direct reactor depressurization followed by five minutes of automatic low pressure core injection. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 136 | Install motor generator set trip breakers in control room. | Reduced frequency of core damage due to an ATWS. | Sections 7.15, 8.15, and 9.15 evaluate the potential maximum benefit for ATWS events. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 137 | Provide capability to remove power from the bus powering the control rods. | Decreased time required to insert control rods if the reactor trip breakers fail (during a loss of feedwater ATWS which has rapid pressure excursion). | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| **Improvements Related to Internal Flooding** | | | |
| 138 | Improve inspection of rubber expansion joints on main condenser. | Reduced frequency of internal flooding due to failure of circulating water system expansion joints. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 139 | Modify swing direction of doors separating turbine building basement from areas containing safeguards equipment. | Prevents flood propagation. | N/A - This item relates to a specific vulnerability at one station. |
| **Improvements to Reduce Seismic Risk** | | | |
| 140 | Increase seismic ruggedness of plant components. | Increased availability of necessary plant equipment during and after seismic events. | Seismic risk is considered negligible to the APR1400 plant design. |
| 141 | Provide additional restraints for CO2 tanks. | Increased availability of fire protection given a seismic event. | Seismic risk is considered negligible to the APR1400 plant design. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (19 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| **Improvements to Reduce Fire Risk** | | | |
| 142 | Replace mercury switches in fire protection system. | Decreased probability of spurious fire suppression system actuation. | N/A – No mercury switches are identified in the APR1400 design. |
| 143 | Upgrade fire compartment barriers. | Decreased consequences of a fire. | Sections 7.4, 8.4, and 9.4 evaluate the potential maximum benefit for fire barriers. A design change would be expected to cost more than any potential benefit and, as a result, would not provide a positive benefit. |
| 144 | Install additional transfer and isolation switches. | Reduced number of spurious actuations during a fire. | Implementation of this SAMDA would only affect fire risk (at-power and LPSD) which limits potential benefit, or a maximum of $486,000. Because multiple switches would need to be added, the potential costs are considered excessive. |
| 145 | Enhance fire brigade awareness. | Decreased consequences of a fire. | N/A - Enhancement due to procedures/training are not applicable to the design certification stage of plant development. |
| 146 | Enhance control of combustibles and ignition sources. | Decreased fire frequency and consequences. | N/A - Enhancement due to procedures/training are not applicable to the design certification stage of plant development. |
| **Other Improvements** | | | |
| 147 | Install digital large break LOCA protection system. | Reduced probability of a large break LOCA (a leak before break). | Large break LOCAs are a negligible contribution to plant risk. Therefore, any design change related to instrument air would provide a negligible benefit. |
| 148 | Enhance procedures to mitigate large break LOCA. | Reduced consequences of a large break LOCA. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 149 | Install computer aided instrumentation system to assist the operator in assessing post-accident plant status. | Improved prevention of core melt sequences by making operator actions more reliable. | N/A – Enhancements to improve procedural compliance are not applicable to the design certification stage of plant development. |
| 150 | Improve maintenance procedures. | Improved prevention of core melt sequences by increasing reliability of important equipment. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |

Table 5 Initial List of Candidate Improvements for the APR1400 SAMDA Analysis (20 of 20)

| SAMA ID (NEI-05-01) | Potential Enhancement (SAMA Title) | Result of Potential Enhancement | Qualitative Screening |
|---|---|---|---|
| 151 | Increase training and operating experience feedback to improve operator response. | Improved likelihood of success of operator actions taken in response to abnormal conditions. | N/A - Enhancement due to training is not applicable to the design certification stage of plant development SAMDA. (Combined into the specific operator action SAMDAs) |
| 152 | Develop procedures for transportation and nearby facility accidents. | Reduced consequences of transportation and nearby facility accidents. | N/A - Enhancement due to procedure revisions are not applicable to the design certification stage of plant development. |
| 153 | Install secondary side guard pipes up to the main steam isolation valves. | Prevents secondary side depressurization should a steam line break occur upstream of the main steam isolation valves. Also guards against or prevents consequential multiple steam generator tube ruptures following a main steam line break event. | Secondary line breaks are a negligible contribution to plant risk. Therefore, any design change related to instrument air would provide a negligible benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (1 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | RCOPH-S-SDSE-FW | 1.41E-02 | 28.76% | Operator Fails to Open POSRVs in Early Phase for F&B Operation | Procedural changes are not in the scope of this SAMDA analysis |
| 2 | PFLOOP-SI | 2.00E-02 | 19.93% | CONDITIONAL LOOP AFTER INITIATORS WHICH INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |
| 3 | %LOOP-GR | 1.16E-02 | 13.38% | GRID-RELATED LOOP | Initiating event - no impact on SAMDA analysis |
| 4 | FWOPH-S-ERY | 2.11E-02 | 11.97% | Operate Fails to Align Startup Feedwater pump PP07 (Early Phase) | Procedural changes are not in the scope of this SAMDA analysis |
| 5 | %MLOCA | 4.85E-04 | 11.61% | MEDIUM LOSS OF COOLANT ACCIDENT | Initiating event - no impact on SAMDA analysis |
| 6 | %GTRN | 6.56E-01 | 11.35% | GENERAL TRANSIENT | Initiating event - no impact on SAMDA analysis |
| 7 | %LOOP-SW | 9.88E-03 | 10.73% | SWITCHYARD-CENTERED LOOP | Initiating event - no impact on SAMDA analysis |
| 8 | AFTPR1A-TDP01A | 3.52E-02 | 10.22% | AFW TDP PP01A FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 9 | %LOOP-WE | 3.71E-03 | 9.89% | WEATHER-RELATED LOOP | Initiating event - no impact on SAMDA analysis |
| 10 | AFPVKQ4-TP01A/B/MP02A/B | 1.11E-05 | 9.72% | 4/4 CCF OF AFW TDP01A/B/MDP02A/B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.3.3 through 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 11 | AFTPR1B-TDP01B | 3.52E-02 | 8.64% | AFW TDP PP01B FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 12 | COMBINATION_130 | 3.60E+01 | 8.41% | HEP dependency factor for FWOPH-S-ERY, RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 13 | %LSSB-D | 7.32E-03 | 7.59% | LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM) | Initiating event - no impact on SAMDA analysis |
| 14 | DGDGM-A-DGA | 1.44E-02 | 7.27% | DG 01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 15 | DGDGM-B-DGB | 1.44E-02 | 6.87% | DG 01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 16 | %SGTR | 1.31E-03 | 6.81% | STEAM GENERATOR TUBE RUPTURE | Initiating event - no impact on SAMDA analysis |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (2 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 17 | DCBTM-B-BT01B | 2.72E-03 | 5.97% | CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 18 | RAC-16H-WE | 1.59E-01 | 5.89% | NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED) | This event represents characteristics of the site at which the plant will be located and the probability is based on generic industry data. Design changes to affect the risk from site characteristics are not applicable to the SAMDA analysis and this event is not considered further. |
| 19 | %SLOCA | 2.40E-03 | 5.83% | SMALL LOSS OF COOLANT ACCIDENT | Initiating event - no impact on SAMDA analysis |
| 20 | DATGR-S-AACTG | 1.57E-01 | 5.83% | FAILS TO RUN AAC GAS TURBINE GENERATOR | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 21 | DCBTM-A-BT01A | 2.72E-03 | 5.43% | CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 22 | AFMVC1B-046 | 5.78E-02 | 5.32% | AFW ISOL. MOV V046 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 23 | AFMVO1B-046 | 5.78E-02 | 5.32% | AFW ISOL. MOV V046 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 24 | AFMVC1A-045 | 5.78E-02 | 5.14% | AFW ISOL. MOV V045 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 25 | AFMVO1A-045 | 5.78E-02 | 5.14% | AFW ISOL. MOV V045 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 26 | %FWLB | 1.74E-03 | 4.80% | FEEDWATER LINE BREAK | Initiating event - no impact on SAMDA analysis |
| 27 | PI-SGTR | 2.70E-02 | 4.40% | PRESSURE INDUECD SGTR PROBABILITY UNDER LSSB, ATWS, FWLB | This event would affect a portion of offsite consequences only. The benefit of eliminating this failure mode would be negligible. |
| 28 | WOCHM2A-CH02A | 4.00E-02 | 4.16% | ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (3 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 29 | WOCHM2B-CH02B | 4.00E-02 | 3.90% | ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 30 | DGDGR-A-DGA | 2.50E-02 | 3.83% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 31 | DGDGR-C-DGC | 2.50E-02 | 3.76% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01C | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 32 | DGDGR-D-DGD | 2.50E-02 | 3.49% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01D | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 33 | IPINM-B-IN01B | 2.00E-03 | 3.48% | CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 34 | SISPP-S-IRWST | 1.22E-05 | 3.36% | CCF OF IRWST SUMPS DUE TO PLUGGING | The component associated with this basic event is evaluated in Section 7.12.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 35 | DGDGR-B-DGB | 2.50E-02 | 3.12% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 36 | IPINM-A-IN01A | 2.00E-03 | 3.08% | CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 37 | DGDGM-C-DGC | 1.44E-02 | 2.97% | DG 01C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 38 | %TLOCCW | 2.34E-04 | 2.95% | TOTAL LOSS OF COMPONANT COOLING WATER | Initiating event - no impact on SAMDA analysis |
| 39 | %TLOESW | 2.34E-04 | 2.95% | TOTAL LOSS OF ESSENTIAL SERVICE WATER | Initiating event - no impact on SAMDA analysis |
| 40 | PFHBO1A-SW01A-H2 | 6.66E-03 | 2.94% | PCB SW01A-H2 4.16KV SWGR SW01A FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (4 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 41 | PPSO-AP-LC | 1.20E-05 | 2.92% | CCF OF PPS LC APPLICATION SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 42 | PFHBO1B-SW01B-H2 | 6.66E-03 | 2.91% | PCB SW01B-H2 4.16KV SWGR SW01B FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 43 | DGDGM-D-DGD | 1.44E-02 | 2.81% | DG 01D UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 44 | %RVR | 3.06E-08 | 2.79% | REACTOR VESSEL RUPTURE | Initiating event - no impact on SAMDA analysis |
| 45 | PFLOOP-NO-SI | 2.00E-03 | 2.62% | CONDITIONAL LOOP AFTER INITIATORS WHICH DO NOT INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |
| 46 | WOCHS1A-CH01A | 1.30E-02 | 2.61% | FAILS TO START ECW CHILLER CH01A | The component associated with this basic event is evaluated in Section 7.11.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 47 | WOCHS1B-CH01B | 1.30E-02 | 2.38% | FAILS TO START ECW CHILLER CH01B | The component associated with this basic event is evaluated in Section 7.11.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 48 | SXFLP-S-FT0123AB | 5.57E-05 | 2.35% | CCF OF ALL ESW DERIS FILTERS DUE TO PLUGGING | The component associated with this basic event is evaluated in Section 7.13.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 49 | SXMPM2A-PP02A | 2.64E-02 | 2.18% | ESW PUMP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 50 | I-ATWS-RPMCF | 2.98E-07 | 2.17% | CCF TO SCRAM DUE TO MECHANICAL FAILURES (1HR MT) | The component associated with this basic event is evaluated in Section 7.15. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 51 | MSOPV-S-MSIS | 1.00E-01 | 2.13% | OPERATOR FAILS TO RECOVERY FOR MSIS | Procedural changes are not in the scope of this SAMDA analysis |
| 52 | %LOCV | 5.57E-02 | 2.08% | LOSS OF CONDENCER VACCUM | Initiating event - no impact on SAMDA analysis |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (5 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 53 | SXMPM2B-PP02B | 2.64E-02 | 2.05% | ESW PUMP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 54 | %LOFW | 6.55E-02 | 2.00% | LOSS OF MAIN FEEDWATER | Initiating event - no impact on SAMDA analysis |
| 55 | AFTPKD2-TDP01A/B | 6.89E-04 | 1.95% | 2/2 CCF OF AFW TDP PP01/A/B FAILS TO RUN > 1 HR | The components associated with this basic event are evaluated in Sections 7.3.3 and 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 56 | DGDGKQ4-DG01ABCD | 5.95E-05 | 1.90% | 4/4 CCF OF EDG 01A/01B/01C/01D FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.1.1 through 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 57 | AFMPM2A-MDP02A | 3.98E-03 | 1.72% | AFW MDP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 58 | AFTPS1A-TDP01A | 6.49E-03 | 1.70% | AFW TDP PP01A FAILS TO START | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 59 | DATGM-S-AACTG | 5.00E-02 | 1.70% | AAC DG UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 60 | WOCHWQ4-CH01A/2A/1B/2B | 3.86E-05 | 1.63% | 4/4 CCF OF ECW CHILLERS 1A/2A/1B/2B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.11.1 through 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 61 | DGDGL-A-DGA | 3.78E-03 | 1.61% | DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | DGDGL-B-DGB | 3.78E-03 | 1.51% | DG B FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 63 | %LOOP-PL | 1.83E-03 | 1.49% | PLANT-CENTERED LOOP | Initiating event - no impact on SAMDA analysis |
| 64 | MSOPH-S-SGADV-HW | 7.45E-02 | 1.47% | OPERATOR FAILS TO OPEN ADVS USING HAND WHEEL | Procedural changes are not in the scope of this SAMDA analysis |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (6 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 65 | CSMPM2B-PP01B | 7.12E-03 | 1.42% | CS PUMP PP01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.6.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 66 | AFTPS1B-TDP01B | 6.49E-03 | 1.41% | AFW TDP PP01B FAILS TO START | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 67 | AFTPM1A-TDP01A | 5.39E-03 | 1.40% | AFW TDP PP01A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 68 | DGSQA-A-LOADSQ | 3.33E-03 | 1.39% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 69 | RAC-16H-GR | 1.01E-02 | 1.37% | NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (GRID RELATED) | This event represents characteristics of the site at which the plant will be located and the probability is based on generic industry data. Design changes to affect the risk from site characteristics are not applicable to the SAMDA analysis and this event is not considered further. |
| 70 | WOMPM2A-PP02A | 1.42E-02 | 1.36% | ECW PP02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 71 | CSMPM2A-PP01A | 7.12E-03 | 1.33% | CS PUMP 1 PP01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.6.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 72 | DGSQA-B-LOADSQ | 3.33E-03 | 1.29% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 73 | FWMPM-S-PP07 | 7.12E-03 | 1.26% | START-UP FW PUMP PP07 UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.3.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 74 | DCBTM-C-BT01C | 2.72E-03 | 1.24% | CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (7 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 75 | DCBTM-D-BT01D | 2.72E-03 | 1.24% | CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 76 | WOMPM2B-PP02B | 1.42E-02 | 1.23% | ECW PP02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 77 | PFHBO2A-SW01C-C2 | 6.66E-03 | 1.23% | PCB SW01C-C2 4.16KV SWGR SW01C FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 78 | PFHBO2B-SW01D-G2 | 6.66E-03 | 1.21% | PCB SW01D-G2 4.16KV SWGR SW01D FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 79 | WOCHS2A-CH02A | 1.30E-02 | 1.19% | FAILS TO START ECW CHILLER CH02A | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 80 | DGDGS-A-DGA | 2.89E-03 | 1.17% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 81 | AFTPM1B-TDP01B | 5.39E-03 | 1.15% | AFW TDP PP01B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 82 | CSHEM2B-HE01B | 2.50E-03 | 1.13% | CS HX HE01B FAILS DUE TO TEST/MAINTENANCE | The component associated with this basic event evaluated in Section 7.6.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 83 | AFTPL1A-TDP01A | 4.42E-03 | 1.13% | AFW TDP PP01A FAILS TO RUN FOR < 1HR | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 84 | CSHEM2A-HE01A | 2.50E-03 | 1.12% | CS HX HE01A FAILS DUE TO T&M | The component associated with this basic event evaluated in Section 7.6.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 85 | WOCHS2B-CH02B | 1.30E-02 | 1.11% | FAILS TO START ECW CHILLER CH02B | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (8 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 86 | DGDGS-B-DGB | 2.89E-03 | 1.09% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 87 | COMBINATION_2038 | 7.10E+01 | 1.08% | HEP dependency factor for MSOPV-S-MSIS, RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 88 | %LSSB-U | 3.49E-04 | 1.05% | LARGE SECONDARY SIDE BREAK (MSIV UPSTREAM) | Initiating event - no impact on SAMDA analysis |
| 89 | VOHVM2A-HV33A | 2.50E-03 | 1.05% | CUBICLE COOLER HV33A UAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.11. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 90 | AFOPH-S-ALT-LT | 7.10E-04 | 0.96% | Operator Fails to Transfer AFW Source from AFWST to RWT/CST | Procedural changes are not in the scope of this SAMDA analysis |
| 91 | RCOPH-S-SDSL | 8.10E-03 | 0.95% | OPERATOR FAILS TO OPEN 1 OF 4 SDS VALVE LATE PHASE | Procedural changes are not in the scope of this SAMDA analysis |
| 92 | PPSO-AP-GC | 1.20E-05 | 0.93% | CCF OF PPS GC APPLICATION SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 93 | AFTPL1B-TDP01B | 4.42E-03 | 0.93% | AFW TDP PP01B FAILS TO RUN FOR < 1HR | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 94 | COMBINATION_7 | 7.12E+00 | 0.81% | HEP dependency factor for AFOPH-S-ALT-LT, RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 95 | SIMPM2A-PP02C | 3.88E-03 | 0.81% | SI PUMP PP02C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.12.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 96 | WOCHKQ4-CH01A/1B/2A/2B | 4.86E-06 | 0.80% | 4/4 CCF OF ECW CHILLERS 1A/2A/1B/2B FAIL TO RUN | The components associated with this basic event are evaluated in Section 7.11.1 through 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 97 | CCMVWD2-097/8 | 1.70E-05 | 0.76% | 2/2 CCF OF CCW MOV V097/098 FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.5.3 and 7.5.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 98 | IPINM-C-IN01C | 2.00E-03 | 0.75% | CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (9 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 99 | AFMPM2B-MDP02B | 3.98E-03 | 0.75% | AFW MDP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 100 | %LLOCA-HL2 | 5.05E-07 | 0.73% | LARGE LOCA IN HOT LEG 2 (SDC LOOP2) | Initiating event - no impact on SAMDA analysis |
| 101 | IPINM-D-IN01D | 2.00E-03 | 0.72% | CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 102 | CCMPM2A-PP02A | 9.58E-03 | 0.70% | CCW PUMP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.5.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 103 | PFHBWQ4-SW2OUAT | 2.73E-05 | 0.70% | 4/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1C/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 104 | MTC-UET-TTS-0PF | 2.70E-02 | 0.70% | ADVERSE MTC UET PERCENTAGE GIVEN TURBINE TRIP WHEN NO POSRVS FAIL | Quantification factor - no impact on SAMDA analysis |
| 105 | DGDGL-C-DGC | 3.78E-03 | 0.69% | DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 106 | SIMPM2B-PP02D | 3.88E-03 | 0.68% | SI PUMP 4 (PP02D) UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.12.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 107 | %PLOCCW | 2.10E-03 | 0.67% | PARTIAL LOSS OF COMPONANT COOLING WATER | Initiating event - no impact on SAMDA analysis |
| 108 | RAC-12H-WE | 1.97E-01 | 0.66% | NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 9.5HR (WEATHER RELATED) | This event represents characteristics of the site at which the plant will be located and the probability is based on generic industry data. Design changes to affect the risk from site characteristics are not applicable to the SAMDA analysis and this event is not considered further. |
| 109 | CCMPM2B-PP02B | 9.58E-03 | 0.65% | CCW PUMP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.5.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (10 of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 110 | DGDGL-D-DGD | 3.78E-03 | 0.65% | DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 111 | CSMVWD2-003/004 | 1.43E-05 | 0.64% | 2/2 CCF OF ISOL. MOV 003/004 IN CS TRS HX DISCH. PATH FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.6.3 and 7.6.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 112 | MSEVXQ2-011/13 | 2.25E-05 | 0.63% | 2/2 CCF OF 2/4 MSIV 011/013 FAIL TO CLOSE | The components associated with this basic event are evaluated in Sections 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 113 | MSEVXQ2-011/14 | 2.25E-05 | 0.63% | 2/2 CCF OF 2/4 MSIV 011/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Sections 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 114 | MSEVXQ2-012/13 | 2.25E-05 | 0.63% | 2/2 CCF OF 2/4 MSIV 012/013 FAIL TO CLOSE | The components associated with this basic event are evaluated in Sections 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 115 | MSEVXQ2-012/14 | 2.25E-05 | 0.63% | 2/2 CCF OF 2/4 MSIV 012/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Sections 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 116 | DGSQA-C-LOADSQ | 3.33E-03 | 0.60% | LOAD SEQUNCER C FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 117 | VKOPH-S-ECCS | 1.00E-01 | 0.60% | OPERATOR FAILS TO ACTUATE ECCS EXHAUST FAN AH01A/B | Procedural changes are not in the scope of this SAMDA analysis |
| 118 | VDHVL-A-HV12A | 2.28E-03 | 0.56% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 119 | VDHVL-A-HV13A | 2.28E-03 | 0.56% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 120 | DGSQA-D-LOADSQ | 3.33E-03 | 0.56% | LOAD SEQUNCER D FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6a List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Events) (11of 11)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 121 | SIMPR2A-PP02C | 2.83E-03 | 0.56% | FAILS TO RUN SI PUMP PP02C | The component associated with this basic event is evaluated in Section 7.12.3 total maximum cost reduction and, as a result, not provide a positive benefit. |
| 122 | VDHVL-B-HV12B | 2.28E-03 | 0.52% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12B FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 123 | VDHVL-B-HV13B | 2.28E-03 | 0.52% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13B FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 124 | DGDGS-C-DGC | 2.89E-03 | 0.51% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01C | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 125 | WOOPH-A-CROSSTIE | 5.00E-01 | 0.50% | OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH | Procedural changes are not in the scope of this SAMDA analysis |
| 126 | %PLOESW | 1.63E-03 | 0.50% | PARTIAL LOSS OF ESSENTIAL SERVICE WATER | Initiating event - no impact on SAMDA analysis |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (1of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | RCOPH-S-SDSE-FW | 1.41E-02 | 22.82% | Operator Fails to Open POSRVs in Early Phase for F&B Operation | Procedural changes are not in the scope of this SAMDA analysis |
| 2 | PFHBO1A-SW01A-H2 | 6.66E-03 | 19.73% | PCB SW01A-H2 4.16KV SWGR SW01A FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 3 | %IE-078-19B-FP-X | 3.32E-04 | 18.52% | MAJ BRK OF FP PIPING IN RM 078-A19B, 078-A20B, 100-A10B OR 120-A11B | Initiating event - no impact on SAMDA analysis |
| 4 | %IE-100-20A-FP-X | 3.18E-04 | 17.88% | MAJ BRK OF FP PIPING IN A QUAD 100 FT EL RM 100-A20A AND OTHERS | Initiating event - no impact on SAMDA analysis |
| 5 | PFHBO1B-SW01B-H2 | 6.66E-03 | 17.25% | PCB SW01B-H2 4.16KV SWGR SW01B FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 6 | %IE-078-19A-FP-X | 2.83E-04 | 16.03% | MAJ BRK (VARIOUS GPM) IN FP PIPING IN 078-A19A AND OTHER A QUAD RMS | Initiating event - no impact on SAMDA analysis |
| 7 | %IE-078-44B-FP-X | 2.07E-04 | 12.03% | MAJ BRK IN FP PIPING IN B QUAD 78 FT EL RM 078-A44B AND OTHER B QUAD RMS | Initiating event - no impact on SAMDA analysis |
| 8 | PFHBWQ4-SW2OUAT | 2.73E-05 | 11.68% | 4/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1C/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 9 | AFMVC1A-045 | 5.78E-02 | 9.62% | AFW ISOL. MOV V045 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 10 | AFMVO1A-045 | 5.78E-02 | 9.62% | AFW ISOL. MOV V045 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 11 | FPOPH-1-ISO-FL | 9.48E-03 | 8.83% | Operator fails to isolate FP break with less than 20 minutes available | Procedural changes are not in the scope of this SAMDA analysis |
| 12 | AFMVC1B-046 | 5.78E-02 | 8.62% | AFW ISOL. MOV V046 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 13 | AFMVO1B-046 | 5.78E-02 | 8.62% | AFW ISOL. MOV V046 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (2 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 14 | FPOPH-2-ISO-FL | 8.00E-03 | 7.71% | Operator fails to isolate FP break with between 20 and 40 minutes available | Procedural changes are not in the scope of this SAMDA analysis |
| 15 | COMBINATION_60 | 7.10E+01 | 7.24% | HEP dependency factor for FPOPH-1-ISO-FL,RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 16 | WOCHM2A-CH02A | 4.00E-02 | 6.93% | ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 17 | WOCHM2B-CH02B | 4.00E-02 | 6.62% | ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 18 | AFTPR1A-TDP01A | 3.52E-02 | 6.18% | AFW TDP PP01A FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 19 | %IE-078-19B-FP-M | 1.27E-04 | 5.88% | MOD BRK OF FP PIPING IN RM 078-A19B, 078-A20B, 100-A10B OR 120-A11B | Initiating event - no impact on SAMDA analysis |
| 20 | AFTPR1B-TDP01B | 3.52E-02 | 5.60% | AFW TDP PP01B FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 21 | PPSO-AP-LC | 1.20E-05 | 5.26% | CCF OF PPS LC APPLICATION SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 22 | %IE-078-01D-FP-X | 1.62E-04 | 5.18% | MAJ BRK (VARIOUS GPM) IN FP PIPING IN 078-A01D AND OTHER B QUAD RMS | Initiating event - no impact on SAMDA analysis |
| 23 | PFHBO2A-SW01C-C2 | 6.66E-03 | 5.02% | PCB SW01C-C2 4.16KV SWGR SW01C FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 24 | AFOPH-1-ISO-FL | 1.00E+00 | 4.70% | Operator faills to isolate major break of AF pioping in TDAFP room. | Procedural changes are not in the scope of this SAMDA analysis |
| 25 | %IE-078-15D-AF-X | 1.88E-05 | 4.60% | MAJ BRK (>3200 GPM) IN AF PIPING IN D QUAD 78 FT EL RM 078-A15D | Initiating event - no impact on SAMDA analysis |
| 26 | %IE-078-10C-FP-X | 3.33E-04 | 4.42% | MAJ BRK (>3700 GPM) IN FP PIPING IN C QUAD 78 FT EL RM 078-A10C | Initiating event - no impact on SAMDA analysis |
| 27 | COMBINATION_62 | 7.10E+01 | 4.33% | HEP dependency factor for FPOPH-2-ISO-FL,RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (3 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 28 | SXMPM2A-PP02A | 2.64E-02 | 4.28% | ESW PUMP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 29 | SXMPM2B-PP02B | 2.64E-02 | 4.15% | ESW PUMP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 30 | AFMPM2A-MDP02A | 3.98E-03 | 3.78% | AFW MDP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 31 | PFHBO2B-SW01D-G2 | 6.66E-03 | 3.62% | PCB SW01D-G2 4.16KV SWGR SW01D FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 32 | %IE-078-19A-FP-M | 7.89E-05 | 3.62% | MOD BRK (VARIOUS GPM) IN FP PIPING IN 078-A19A AND OTHER A QUAD RMS | Initiating event - no impact on SAMDA analysis |
| 33 | WOOPH-B-1/2B | 2.06E-02 | 3.42% | OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B | Procedural changes are not in the scope of this SAMDA analysis |
| 34 | PFHBWQ2-SW2OUATAC | 6.03E-05 | 3.38% | 2/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1C FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 35 | PFHBWQ3-SW2OUATACD | 1.65E-05 | 3.26% | 3/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1C/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 36 | AFOPH-S-ALT-LT | 7.10E-04 | 3.24% | Operator Fails to Transfer AFW Source From AFWST to RWT/CST | Procedural changes are not in the scope of this SAMDA analysis |
| 37 | AFMPM2B-MDP02B | 3.98E-03 | 3.22% | AFW MDP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 38 | PFHBWQ3-SW2OUATBCD | 1.65E-05 | 2.91% | 3/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01B/1C/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 39 | WOOPH-A-1/2A | 2.06E-02 | 2.76% | OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A | Procedural changes are not in the scope of this SAMDA analysis |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (4 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 40 | %IE-100-10B-FP-X | 5.42E-05 | 2.74% | MAJ BRK (>1445 GPM) IN FP PIPING IN B QUAD 100 FT EL RM 100-A10B | Initiating event - no impact on SAMDA analysis |
| 41 | PFHBWQ2-SW2OUATBD | 6.03E-05 | 2.74% | 2/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01B/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 42 | RCOPH-S-SDSL | 8.10E-03 | 2.73% | OPERATOR FAILS TO OPEN 1 OF 4 SDS VALVE LATE PHASE | Procedural changes are not in the scope of this SAMDA analysis |
| 43 | DGDGR-D-DGD | 2.50E-02 | 2.58% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01D | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 44 | WOMPM2A-PP02A | 1.42E-02 | 2.50% | ECW PP02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 45 | DGDGR-C-DGC | 2.50E-02 | 2.40% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01C | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 46 | VOHVM2A-HV33A | 2.50E-03 | 2.34% | CUBICLE COOLER HV33A UAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.11. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 47 | WOMPM2B-PP02B | 1.42E-02 | 2.22% | ECW PP02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 48 | WOCHS2A-CH02A | 1.30E-02 | 2.15% | FAILS TO START ECW CHILLER CH02A | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 49 | COMBINATION_110 | 1.10E+01 | 2.10% | HEP dependency factor for AFOPH-1-ISO-FL,RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 50 | WOCHS2B-CH02B | 1.30E-02 | 2.05% | FAILS TO START ECW CHILLER CH02B | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 51 | VOHVM1B-HV33B | 2.50E-03 | 2.00% | CUBICLE COOLER HV33B UAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.12. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (5 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 52 | %IE-078-31A-FP-X | 2.37E-04 | 1.97% | MAJ BRK (> 3900 GPM) IN FP PIPING IN A QUAD 78 FT EL RM 078-A31A | Initiating event - no impact on SAMDA analysis |
| 53 | FPOPH-3DEP-ISO-FL | 2.93E-03 | 1.97% | Operator fails to isolate major break of FP piping in 078-A31A before 18-inches of accumulation. | Procedural changes are not in the scope of this SAMDA analysis |
| 54 | PFHBWQ3-SW2OUATABC | 1.65E-05 | 1.86% | 3/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1C FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 55 | DCBTM-A-BT01A | 2.72E-03 | 1.71% | CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 56 | DCBTM-B-BT01B | 2.72E-03 | 1.56% | CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 57 | PFHBC1A-SW01A-A2 | 6.66E-03 | 1.50% | PCB SW01A-A2 OF 4.16KV SWGR SW01A FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 58 | CCMPM2A-PP02A | 9.58E-03 | 1.49% | CCW PUMP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.5.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 59 | DGDGM-D-DGD | 1.44E-02 | 1.45% | DG 01D UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 60 | COMBINATION_64 | 2.42E+04 | 1.45% | HEP dependency factor for FPOPH-2-ISO-FL,RCOPH-S-SDSE-FW,FPOPH-3DEP-ISO-FL | Procedural changes are not in the scope of this SAMDA analysis |
| 61 | NPXHM-M-SAT02M | 1.75E-03 | 1.45% | SAT TR02M UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.9.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | CCMPM2B-PP02B | 9.58E-03 | 1.44% | CCW PUMP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.5.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (6 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 63 | DGDGR-B-DGB | 2.50E-02 | 1.38% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 64 | NPXHM-N-SAT02N | 1.75E-03 | 1.37% | SAT TR02N UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.9.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 65 | PFHBC1B-SW01B-A2 | 6.66E-03 | 1.37% | PCB SW01B-A2 OF 4.16KV SWGR SW01B FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 66 | DGDGM-C-DGC | 1.44E-02 | 1.35% | DG 01C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 67 | CDOPH-S-ALIGN | 8.60E-04 | 1.27% | Operator Fails to Align the Manual Valves and start CD pumps for Hotwell Makeup | Procedural changes are not in the scope of this SAMDA analysis |
| 68 | %IE-078-01D-FP-M | 5.24E-05 | 1.22% | MOD BRK (VARIOUS GPM) IN FP PIPING IN 078-A01D AND OTHER B QUAD RMS | Initiating event - no impact on SAMDA analysis |
| 69 | %IE-TB-MISC | 1.17E-02 | 1.17% | ANY TB FLOOD <400,000 GPM | Initiating event - no impact on SAMDA analysis |
| 70 | DGDGR-A-DGA | 2.50E-02 | 1.07% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 71 | PFHBWQ3-SW2OUATABD | 1.65E-05 | 1.05% | 3/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 72 | AFTPS1A-TDP01A | 6.49E-03 | 1.01% | AFW TDP PP01A FAILS TO START | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 73 | AFTPS1B-TDP01B | 6.49E-03 | 0.93% | AFW TDP PP01B FAILS TO START | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 74 | WOCHR1A-CH01A | 7.32E-04 | 0.90% | FAILS TO RUN ECW CHILLER CH01A FOR 24 HOURS | The component associated with this basic event is evaluated in Section 7.11.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (7 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 75 | AFTPM1A-TDP01A | 5.39E-03 | 0.83% | AFW TDP PP01A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 76 | IPINM-A-IN01A | 2.00E-03 | 0.81% | CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 77 | %IE-120-11B-FP-X | 1.70E-05 | 0.81% | MAJ BRK (>1180 GPM) OF FP PIPING IN B QUAD 120 FT EL RM 120-A11B OR 120-A13B | Initiating event - no impact on SAMDA analysis |
| 78 | DGDGM-B-DGB | 1.44E-02 | 0.79% | DG 01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 79 | AFTPM1B-TDP01B | 5.39E-03 | 0.76% | AFW TDP PP01B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 80 | %IE-100-37B-FP-X | 9.44E-05 | 0.74% | MOD BRK OF FP PIPING IN B QUAD 100 FT EL RM 100-A37B AND OTHERS | Initiating event - no impact on SAMDA analysis |
| 81 | IPINM-B-IN01B | 2.00E-03 | 0.74% | CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 82 | VOHVS2A-HV33A | 8.29E-04 | 0.74% | FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A | The component associated with this basic event is evaluated in Section 7.11.11. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 83 | AFPVKQ4-TP01A/B/MP02A/B | 1.11E-05 | 0.70% | 4/4 CCF OF AFW TDP01A/B/MDP02A/B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.3.3 through 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 84 | RCPVO-A-200 | 3.54E-03 | 0.68% | POSRV V200 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 85 | RCPVO-C-201 | 3.54E-03 | 0.68% | POSRV V201 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (8 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 86 | AFTPL1A-TDP01A | 4.42E-03 | 0.66% | AFW TDP PP01A FAILS TO RUN FOR < 1HR | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 87 | FWOPH-S-LNG | 3.00E-03 | 0.66% | OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (LATE PHASE) | Procedural changes are not in the scope of this SAMDA analysis |
| 88 | RCPVO-B-202 | 3.54E-03 | 0.66% | POSRV V202 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 89 | RCPVO-D-203 | 3.54E-03 | 0.66% | POSRV V203 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 90 | COMBINATION_61 | 4.50E+00 | 0.65% | HEP dependency factor for WOOPH-B-1/2B,RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 91 | COMBINATION_7 | 7.12E+00 | 0.65% | HEP dependency factor for AFOPH-S-ALT-LT,RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 92 | CSMPM2A-PP01A | 7.12E-03 | 0.64% | CS PUMP 1 PP01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.6.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 93 | FWOPH-S-ERY | 2.11E-02 | 0.64% | Operator Fails to Align Startup Feedwater pump PP07 (Early Phase) | Procedural changes are not in the scope of this SAMDA analysis |
| 94 | VOHVS2B-HV33B | 8.29E-04 | 0.63% | FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B | The component associated with this basic event is evaluated in Section 7.11.12. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 95 | COMBINATION_1 | 4.21E+02 | 0.61% | HEP dependency factor for AFOPH-S-ALT-LT,CDOPH-S-ALIGN,RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 96 | DGDGM-A-DGA | 1.44E-02 | 0.61% | DG 01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 97 | AFTPL1B-TDP01B | 4.42E-03 | 0.61% | AFW TDP PP01B FAILS TO RUN FOR < 1HR | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 98 | COMBINATION_63 | 4.50E+00 | 0.61% | HEP dependency factor for WOOPH-A-1/2A,RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (9 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 99 | PFHBC2A-SW01C-A2 | 6.66E-03 | 0.59% | PCB SW01C-A2 OF 4.16KV SWGR SW01C FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 100 | SXCTM-2A-CT02A | 4.00E-03 | 0.59% | SXCT CT02A UNAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 101 | WOCHR1B-CH01B | 7.32E-04 | 0.59% | FAILS TO RUN ECW CHILLER 01B FOR 24 HOURS | The components associated with this basic event are evaluated in Sections 7.11.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 102 | VGAHM2A-AH02A | 4.00E-03 | 0.59% | ESW PUMP A FAN 605-VG-AH02A UNAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.11.19. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 103 | SXCTM-2B-CT02B | 4.00E-03 | 0.57% | SXCT CT02B UNAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 104 | VGAHM2B-AH02B | 4.00E-03 | 0.57% | ESW PUMP B FAN 605-VG-AH02B UNAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.11.19. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 105 | VGAHS2A-AH02A | 3.86E-03 | 0.56% | FAILS TO START OF EWS PUMP ROOM I. SUPPLY FAN AH02A | The components associated with this basic event are evaluated in Sections 7.11.19. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 106 | VGAHS2B-AH02B | 3.86E-03 | 0.54% | FAILS TO START EWS PUMP ROOM II. SUPPLY FAN AH02B | The components associated with this basic event are evaluated in Sections 7.11.19. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 107 | PFLOOP-NO-SI | 2.00E-03 | 0.54% | CONDITIONAL LOOP AFTER INITIATORS WHICH DO NOT INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |
| 108 | PPSO-OS-PPS | 1.20E-06 | 0.53% | CCF OF PPS OPERATING SYSTEM SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 109 | PFHBWQ2-SW2OUATAD | 6.03E-05 | 0.51% | 2/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |

Table 6b List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Internal Flooding Events) (10 of 10)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 110 | PFHBWQ2-SW2OUATBC | 6.03E-05 | 0.50% | 2/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01B/1C FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (1 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | ASD-CDF | 1.00E-01 | 27.66% | FAILURE OF ALTERNATE SHUTDOWN AFTER MCR EVACUATION (CORE DAMAGE) | This event represents operator actions and procedural changes are not in the scope of this SAMDA analysis |
| 2 | RCOPH-S-SDSE-FW | 2.59E-02 | 13.92% | Operator Fails to Open POSRVs in Early Phase for F&B Operation | Procedural changes are not in the scope of this SAMDA analysis |
| 3 | %F157-AMCR-4-4 | 2.36E-06 | 10.63% | FIRE IN F157-AMCR - TRANSIENT FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 4 | %F000-TB-LOOP2 | 3.52E-04 | 8.13% | FIRE IN F000-TB-LOOP2 - TB FIRES LEADING TO LOOP (SEVERE) | Initiating event - no impact on SAMDA analysis |
| 5 | AFOPH-S-ALT-LT | 3.86E-03 | 7.54% | Operator Fails to Transfer AFW Source From AFWST to RWT/CST | Procedural changes are not in the scope of this SAMDA analysis |
| 6 | %F157-AMCR-3-4 | 1.51E-06 | 6.83% | FIRE IN F157-AMCR - SAFETY CONSOLE FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 7 | RCOPH-S-SDSL | 8.99E-03 | 5.53% | OPERATOR FAILS TO OPEN 1 OF 4 SDS VALVE LATE PHASE | Procedural changes are not in the scope of this SAMDA analysis |
| 8 | RCOPH-S-RCPTRIP | 5.63E-02 | 5.52% | Operator Fails to Trip RCPs Following Loss of Seal Cooling | Procedural changes are not in the scope of this SAMDA analysis |
| 9 | %F078-A19B-U | 7.27E-04 | 5.23% | FIRE IN F078-A19B - CORRIDOR - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 10 | AFMVC1A-045 | 5.78E-02 | 5.12% | AFW ISOL. MOV V045 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 11 | AFMVO1A-045 | 5.78E-02 | 5.12% | AFW ISOL. MOV V045 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 12 | PPSO-AP-LC | 1.20E-05 | 5.03% | CCF OF PPS LC APPLICATION SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 13 | DATGR-S-AACTG | 1.57E-01 | 4.96% | FAILS TO RUN AAC GAS TURBINE GENERATOR | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 14 | %F000-ADGC | 1.44E-03 | 4.89% | FIRE IN F000-ADGC - DG01C DIESEL GENERATOR ROOM | Initiating event - no impact on SAMDA analysis |
| 15 | DGDGR-B-DGB | 2.50E-02 | 4.83% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 16 | %F122-T01-U | 7.61E-04 | 4.66% | FIRE IN F122-T01-U - F122-T01 Unsuppressed Fires | Initiating event - no impact on SAMDA analysis |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (2 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 17 | AFTPR1A-TDP01A | 3.52E-02 | 4.26% | AFW TDP PP01A FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 18 | DGDGR-A-DGA | 2.50E-02 | 4.21% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 19 | AFMPM2A-MDP02A | 3.98E-03 | 4.19% | AFW MDP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 20 | NPXHM-N-SAT02N | 1.75E-03 | 3.54% | SAT TR02N UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.9.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 21 | %F157-AMCR-1-4 | 7.57E-07 | 3.42% | FIRE IN F157-AMCR - CCTV FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 22 | %F157-AMCR-2-4 | 7.57E-07 | 3.42% | FIRE IN F157-AMCR - FIRE CONTROL PANEL FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 23 | FWOPH-S-LNG | 6.15E-03 | 3.28% | OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (LATE PHASE) | Procedural changes are not in the scope of this SAMDA analysis |
| 24 | WOCHM2A-CH02A | 4.00E-02 | 3.27% | ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 25 | %F100-T15-U | 5.39E-04 | 3.20% | FIRE IN F100-T15 - SWITCHGEAR RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 26 | AFMVC1B-046 | 5.78E-02 | 3.05% | AFW ISOL. MOV V046 FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 27 | AFMVO1B-046 | 5.78E-02 | 3.05% | AFW ISOL. MOV V046 FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.3.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 28 | COMBINATION_2-F | 5.91E+01 | 2.90% | HEP dependency factor for AFOPH-S-ALT-LT, FWOPH-S-LNG, RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 29 | PFLOOP-NO-SI | 2.00E-03 | 2.83% | CONDITIONAL LOOP AFTER INITIATORS WHICH DO NOT INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (3 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 30 | WOCHM2B-CH02B | 4.00E-02 | 2.82% | ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 31 | AFTPR1B-TDP01B | 3.52E-02 | 2.78% | AFW TDP PP01B FAILS TO RUN FOR > 1HR | The component associated with this basic event is evaluated in Section 7.3.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 32 | DGDGM-B-DGB | 1.44E-02 | 2.75% | DG 01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 33 | VOHVM2A-HV33A | 2.50E-03 | 2.62% | CUBICLE COOLER HV33A UAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.11. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 34 | FWOPH-S-ERY | 7.77E-03 | 2.54% | Operate Fails to Align Startup Feedwater pump PP07 (Early Phase) | Procedural changes are not in the scope of this SAMDA analysis |
| 35 | SXFLP-S-FT0123AB | 5.57E-05 | 2.41% | CCF OF ALL ESW DERIS FILTERS DUE TO PLUGGING | The component associated with this basic event is evaluated in Section 7.13.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 36 | DGDGM-A-DGA | 1.44E-02 | 2.36% | DG 01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 37 | DGDGKQ4-DG01ABCD | 5.95E-05 | 2.29% | 4/4 CCF OF EDG 01A/01B/01C/01D FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.1.1 through 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 38 | COMBINATION_11-F | 1.98E+01 | 2.24% | HEP dependency factor for FWOPH-S-ERY, RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 39 | DCBTM-B-BT01B | 2.72E-03 | 2.10% | CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 40 | COMBINATION_3-F | 6.51E+00 | 2.10% | HEP dependency factor for AFOPH-S-ALT-LT, RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 41 | BF_F120-AGAC_F120-AGAD | 1.20E-03 | 1.92% | BARRIER FAILURE BETWEEN FIRE COMPS F120-AGAC & F120-AGAD | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (4 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 42 | DGDGR-D-DGD | 2.50E-02 | 1.90% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01D | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 43 | AFMPM2B-MDP02B | 3.98E-03 | 1.84% | AFW MDP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 44 | %F157-AMCR-5-4 | 4.04E-07 | 1.82% | FIRE IN F157-AMCR - TRANSIENT W/C FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 45 | %F078-A19A | 3.93E-04 | 1.81% | FIRE IN F078-A19A - CORRIDOR | Initiating event - no impact on SAMDA analysis |
| 46 | %F100-A08C-U | 5.02E-04 | 1.79% | FIRE IN F100-A08C - N1E DC & IP EQUIPMENT RM C - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 47 | %F000-AFHL | 1.75E-03 | 1.76% | FIRE IN F000-AFHL - FUEL HANDLING LOWER AREA | Initiating event - no impact on SAMDA analysis |
| 48 | %F120-AGAC | 2.86E-04 | 1.71% | FIRE IN F120-AGAC - GENERAL ACCESS AREA-120' C | Initiating event - no impact on SAMDA analysis |
| 49 | %F067-T02-U | 7.75E-05 | 1.68% | FIRE IN F067-T02 - UNDERGROUND COMMON TUNNEL - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 50 | NPXHM-M-SAT02M | 1.75E-03 | 1.63% | SAT TR02M UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.9.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 51 | DGDGR-C-DGC | 2.50E-02 | 1.57% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01C | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 52 | %F157-AMCR-6-4 | 3.43E-07 | 1.55% | FIRE IN F157-AMCR - CABLE W/C FIRE - UNSUPPRESSED - ASD | Initiating event - no impact on SAMDA analysis |
| 53 | %F120-A09D | 2.15E-04 | 1.53% | FIRE IN F120-A09D - ELECTRICAL PENETRATION ROOM D | Initiating event - no impact on SAMDA analysis |
| 54 | %F000-ADGD-U | 3.63E-04 | 1.52% | FIRE IN F000-ADGD - DG01D ROOM - UNSUPPRESSED FIRES | Initiating event - no impact on SAMDA analysis |
| 55 | PFHBC1A-SW01A-A2 | 6.66E-03 | 1.48% | PCB SW01A-A2 OF 4.16KV SWGR SW01A FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 56 | WOCHWQ4-CH01A/2A/1B/2B | 3.86E-05 | 1.48% | 4/4 CCF OF ECW CHILLERS 1A/2A/1B/2B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.11.1 through 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (5 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 57 | DATGM-S-AACTG | 5.00E-02 | 1.47% | AAC DG UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 58 | %F078-A52D-U | 3.48E-04 | 1.45% | FIRE IN F078-A52D - 480V N1E MCC RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 59 | %F120-A05C-U | 2.98E-04 | 1.42% | FIRE IN F120-A05C - ELECTRICAL EQUIPMENT RM C - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 60 | SXMPM2B-PP02B | 2.64E-02 | 1.40% | ESW PUMP PP02B UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 61 | DCBTM-A-BT01A | 2.72E-03 | 1.39% | CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.7.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | WOCHR1A-CH01A | 7.32E-04 | 1.37% | FAILS TO RUN ECW CHILLER CH01A FOR 24 HOURS | The component associated with this basic event is evaluated in Section 7.11.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 63 | %F120-AGAD-U | 2.42E-04 | 1.29% | FIRE IN F120-AGAD - GENERAL ACCESS AREA-120' D - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 64 | SXMPM2A-PP02A | 2.64E-02 | 1.29% | ESW PUMP PP02A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.13.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 65 | %F100-AEEB-U | 3.02E-04 | 1.28% | FIRE IN F100-AEEB - 480V CLASS 1E MCC 01B RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 66 | %F073-T11 | 1.61E-03 | 1.21% | FIRE IN F073-T11 - SWITCHGEAR AREA | Initiating event - no impact on SAMDA analysis |
| 67 | %F120-A09C-U | 1.96E-05 | 1.18% | FIRE IN F120-A09C - ELECTRICAL PENETRATION RM C - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 68 | SIVVT1B-V959 | 9.22E-05 | 1.16% | SI PUMP PP02B/D MINI. FLOW LINE MANUAL VALVE 959 FAILS TO REMAIN OPEN | The component associated with this basic event is evaluated in Section 7.12.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 69 | AFPVKQ4-TP01A/B/MP02A/B | 1.11E-05 | 1.16% | 4/4 CCF OF AFW TDP01A/B/MDP02A/B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.3.3 through 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (6 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 70 | PFHBC1B-SW01B-A2 | 6.66E-03 | 1.15% | PCB SW01B-A2 OF 4.16KV SWGR SW01B FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 71 | VOHVM1B-HV33B | 2.50E-03 | 1.14% | CUBICLE COOLER HV33B UAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.11.12. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 72 | PFLOOP-SI | 2.00E-02 | 1.13% | CONDITIONAL LOOP AFTER INITIATORS WHICH INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |
| 73 | %F055-AGAC-U | 2.05E-04 | 1.04% | FIRE IN F055-AGAC - GENERAL ACCESS AREA-55' C - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 74 | DGDGM-D-DGD | 1.44E-02 | 1.02% | DG 01D UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 75 | WOCHS1B-CH01B | 1.30E-02 | 1.01% | FAILS TO START ECW CHILLER CH01B | The component associated with this basic event is evaluated in Section 7.11.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 76 | %F078-AGAC-U | 1.39E-04 | 1.01% | FIRE IN F078-AGAC - GENERAL ACCESS AREA-78' C - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 77 | WOCHS2A-CH02A | 1.30E-02 | 1.01% | FAILS TO START ECW CHILLER CH02A | The component associated with this basic event is evaluated in Section 7.11.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 78 | %F000-ACV | 6.04E-04 | 1.00% | FIRE IN F000-ACV - CVCS ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 79 | %F100-AGAC | 1.26E-04 | 0.97% | FIRE IN F100-AGAC - GENERAL ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 80 | %F078-AEEB-U | 1.36E-04 | 0.96% | FIRE IN F078-AEEB - CLASS 1E SWITCHGEAR 01B ROOM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 81 | WOCHS1A-CH01A | 1.30E-02 | 0.96% | FAILS TO START ECW CHILLER CH01A | The component associated with this basic event is evaluated in Section 7.11.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 82 | WOMPM2A-PP02A | 1.42E-02 | 0.91% | ECW PP02A TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (7 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 83 | BF_F078-AGAC_F078-AGAD | 9.80E-03 | 0.90% | BARRIER FAILURE BETWEEN FIRE COMPS F078-AGAC & F078-AGAD | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 84 | %F137-A05D | 1.55E-04 | 0.90% | FIRE IN F137-A05D - PCS RM | Initiating event - no impact on SAMDA analysis |
| 85 | ASD-CDF-MCA | 1.00E-02 | 0.87% | FAILURE OF ALTERNATE SHUTDOWN AFTER MCR EVACUATION (CORE DAMAGE) - MC EVENT | This event represents operator actions and procedural changes are not in the scope of this SAMDA analysis |
| 86 | %F000-TB-GTRN | 3.08E-02 | 0.86% | FIRE IN F000-TB-GTR - TB FIRES LEADING TO GTRN | Initiating event - no impact on SAMDA analysis |
| 87 | WOCHS2B-CH02B | 1.30E-02 | 0.86% | FAILS TO START ECW CHILLER CH02B | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 88 | CDOPH-S-ALIGN | 9.43E-03 | 0.86% | Operator Fails to Align the Manual Valves and start CD pumps for Hotwell Makeup | Procedural changes are not in the scope of this SAMDA analysis |
| 89 | VOHVS2A-HV33A | 8.29E-04 | 0.85% | FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A | The component associated with this basic event is evaluated in Section 7.11.11. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 90 | RCPVO-A-200 | 3.54E-03 | 0.84% | POSRV V200 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 91 | RCPVO-C-201 | 3.54E-03 | 0.84% | POSRV V201 FAILS TO OPEN (HARDWARE FAIL) | The component associated with this basic event is evaluated in Section 7.10.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 92 | WOMPM2B-PP02B | 1.42E-02 | 0.84% | ECW PP02B TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.14.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 93 | DGDGM-C-DGC | 1.44E-02 | 0.83% | DG 01C UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.1.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 94 | %F120-A01D | 2.62E-05 | 0.79% | FIRE IN F120-A01D - PIPING CABLE AREA | Initiating event - no impact on SAMDA analysis |
| 95 | %F157-ACPX-U | 9.36E-05 | 0.75% | FIRE IN F157-ACPX - COMPUTER ROOM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 96 | %F000-ACVU-U | 2.13E-04 | 0.75% | FIRE IN F000-ACVU - CVCS SYSTEM AREA - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 97 | COMBINATION_26-F | 1.78E+01 | 0.74% | HEP dependency factor for CVOPH-S-RCPSEAL, RCOPH-S-RCPTRIP | Procedural changes are not in the scope of this SAMDA analysis |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (8 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 98 | CVOPH-S-RCPSEAL | 5.64E-02 | 0.74% | Operator Fails to Operate Auxiliary Charging Pump for RCP Seal Injection | Procedural changes are not in the scope of this SAMDA analysis |
| 99 | %F157-A01D-U | 1.69E-04 | 0.74% | FIRE IN F157-A01D - I & C EQUIP. RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 100 | AFTPS1A-TDP01A | 6.49E-03 | 0.73% | AFW TDP PP01A FAILS TO START | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 101 | %F120-A15B-U | 1.73E-04 | 0.72% | FIRE IN F120-A15B - 480V CLASS 1E MCC 03B RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 102 | %F078-A05C | 3.24E-04 | 0.71% | FIRE IN F078-A05C - CHANNEL-C DC & IP EQUIP RM | Initiating event - no impact on SAMDA analysis |
| 103 | PGOPH-S-LC01B | 1.00E+00 | 0.71% | OPERATOR FAILS TO TRANSFER SOURCE FROM LC01A TO LC01B | Procedural changes are not in the scope of this SAMDA analysis |
| 104 | COMBINATION_27-F | 1.00E+00 | 0.70% | HEP dependency factor for RCOPH-S-RCPTRIP, PGOPH-S-LC01B | Procedural changes are not in the scope of this SAMDA analysis |
| 105 | WTMPM-B-PP02 | 1.42E-02 | 0.66% | TGBCCW PUMP P02 TRAIN UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.18.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 106 | DGDGL-B-DGB | 3.78E-03 | 0.65% | DG B FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 107 | IPINM-B-IN01B | 2.00E-03 | 0.62% | CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 108 | SIMPM2B-PP02D | 3.88E-03 | 0.62% | SI PUMP 4 (PP02D) UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.12.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 109 | AFTPM1A-TDP01A | 5.39E-03 | 0.60% | AFW TDP PP01A UNAVAILABLE DUE TO T/M | The component associated with this basic event is evaluated in Section 7.3.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 110 | IPINM-A-IN01A | 2.00E-03 | 0.60% | CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.8.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 111 | %F078-A02D | 8.39E-05 | 0.58% | FIRE IN F078-A02D - CLASS 1E SWITCHGEAR 01D RM | Initiating event - no impact on SAMDA analysis |

Table 6c List of Basic Events from APR1400 PRA CDF Importance Analysis (At-Power Fire Events) (9 of 9)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 112 | %F078-A25A-U | 1.27E-04 | 0.57% | FIRE IN F078-A25A - CLASS 1E SWITCHGEAR 01A RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 113 | DGSQA-B-LOADSQ | 3.33E-03 | 0.56% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 114 | SIMPM1B-PP02B | 3.88E-03 | 0.56% | SI PUMP PP02B UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.12.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 115 | DGDGL-A-DGA | 3.78E-03 | 0.55% | DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 116 | %F157-A25C-U | 1.69E-04 | 0.53% | FIRE IN F157-A25C - I & C EQUIP. RM - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 117 | %F137-ANEA | 6.92E-04 | 0.53% | FIRE IN F137-ANEA - ELECTRICAL EQUIPMENT ROOM | Initiating event - no impact on SAMDA analysis |
| 118 | WOCHKQ4-CH01A/1B/2A/2B | 4.86E-06 | 0.53% | 4/4 CCF OF ECW CHILLERS 1A/2A/1B/2B FAIL TO RUN | The components associated with this basic event are evaluated in Section 7.11.1 through 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 119 | BF_F100-A06D_F100-AGAC | 9.80E-03 | 0.52% | BARRIER FAILURE BETWEEN FIRE COMPS F100-A06D & F100-AGAC | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 120 | PPSO-OS-PPS | 1.20E-06 | 0.50% | CCF OF PPS OPERATING SYSTEM SOFTWARE | The components associated with this basic event are evaluated in Sections 7.16.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6d List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Events) (1 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | %SO | 2.90E-03 | 49.10% | RCS Overdraining due to SCS | Initiating event - no impact on SAMDA analysis |
| 2 | BE-RATE-OT-05 | 6.67E-01 | 43.47% | Conv. factor (Outage-yr -> Cal. yr, 1/(18mon/12mon)) for Demand Failure during POS 05 | Quantification factor - no impact on SAMDA analysis |
| 3 | HR-FB-SOP05-01 | 3.49E-04 | 36.69% | Operator Fails to Feed during SO POS 5 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 4 | COMBINATION_1-LP | 1.44E+02 | 36.46% | HEP dependency factor for HR-RS-SOP05, HR-FB-SOP05-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 5 | HR-RS-SOP05 | 6.76E-03 | 36.46% | Operator Fails to Restore SCS during SO POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 6 | BE-RATE-P03A | 3.36E-04 | 16.27% | Conversion factor (SD-yr -> Calendar yr) for POS03A duration | Quantification factor - no impact on SAMDA analysis |
| 7 | BE-RATE-P05 | 1.23E-03 | 15.61% | Conversion factor (SD-yr -> Calendar yr) for POS5 duration | Quantification factor - no impact on SAMDA analysis |
| 8 | %SL | 2.90E-01 | 8.83% | Failure to Maintain Water Level at Reduced Inventory | Initiating event - no impact on SAMDA analysis |
| 9 | HR-FB-SLP05-01 | 3.49E-04 | 6.77% | Operator Fails to Feed during SL POS 5 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 10 | COMBINATION_8-LP | 1.44E+02 | 6.72% | HEP dependency factor for HR-RS-SLP05, HR-FB-SLP05-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 11 | HR-RS-SLP05 | 6.76E-03 | 6.72% | Operator Fails to Restore SCS during SL POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 12 | BE-RATE-OT-11 | 6.67E-01 | 5.64% | Conv. factor (Outage-yr -> Cal. yr, 1/(18mon/12mon)) for Demand Failure during POS 11 | Quantification factor - no impact on SAMDA analysis |
| 13 | SISPP-S-IRWST | 1.22E-05 | 5.43% | CCF OF IRWST SUMPS DUE TO PLUGGING | The component associated with this basic event is evaluated in Section 7.12.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 14 | DGDGR-A-DGA | 2.50E-02 | 5.40% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 15 | DGDGR-B-DGB | 2.50E-02 | 5.39% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 16 | BE-RATE-P10 | 6.26E-03 | 5.32% | Conversion factor (SD-yr -> Calendar yr) for POS10 duration | Quantification factor - no impact on SAMDA analysis |
| 17 | %SL1 | 1.60E-01 | 4.90% | Small LOCA at Reduced Inventory | Initiating event - no impact on SAMDA analysis |
| 18 | %TC | 2.34E-04 | 4.48% | Total Loss of Component Cooling Water | Initiating event - no impact on SAMDA analysis |
| 19 | %TS | 2.34E-04 | 4.48% | Total Loss of Essential Service Water | Initiating event - no impact on SAMDA analysis |

Table 6d List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Events) (2 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 20 | %LPSW | 6.39E-02 | 4.44% | Loss of offsite power of Switchyard-centered for LPSD | Initiating event - no impact on SAMDA analysis |
| 21 | PPSO-AP-LC | 1.20E-05 | 4.13% | CCF OF PPS LC APPLICATION SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 22 | %PL | 3.66E-03 | 4.07% | STUCK OPEN OF POSRV | Initiating event - no impact on SAMDA analysis |
| 23 | BE-RATE-OT-02 | 6.67E-01 | 4.07% | Conv. factor (Outage-yr -> Cal. yr, 1/(18mon/12mon)) for Demand Failure during POS 02 | Quantification factor - no impact on SAMDA analysis |
| 24 | COMBINATION_2-LP | 1.93E+01 | 4.05% | HEP dependency factor for HR-MI-SOP05, HR-FB-SOP05-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 25 | HR-FB-SOP05-02 | 2.72E-03 | 4.05% | Operator Fails to Feed during SO POS 5 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 26 | HR-MI-SOP05 | 7.18E-04 | 4.05% | Operator Fails to Isolate and Makeup SO at POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 27 | COMBINATION_4-LP | 9.41E+01 | 3.89% | HEP dependency factor for HR-MI-SOP11, HR-FB-SOP11-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 28 | HR-FB-SOP11-02 | 5.37E-04 | 3.89% | Operator Fails to Feed during SO POS 11 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 29 | HR-MI-SOP11 | 7.18E-04 | 3.89% | Operator Fails to Isolate and Makeup SO at POS 11 | Procedural changes are not in the scope of this SAMDA analysis |
| 30 | BE-RATE-P06 | 4.01E-03 | 3.88% | Conversion factor (SD-yr -> Calendar yr) for POS6 duration | Quantification factor - no impact on SAMDA analysis |
| 31 | HR-FB-JLP05-01 | 5.37E-04 | 3.88% | Operator Fails to Feed during JL POS 5 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 32 | COMBINATION_19-LP | 9.41E+01 | 3.84% | HEP dependency factor for HR-RS-JLP05, HR-FB-JLP05-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 33 | HR-RS-JLP05 | 6.76E-03 | 3.84% | Operator Fails to Restore SCS during JL POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 34 | %SL2 | 3.50E-02 | 3.81% | Small LOCA above Reduced Inventory | Initiating event - no impact on SAMDA analysis |
| 35 | %LPWE | 3.67E-02 | 3.74% | Loss of offsite power of Weather-related for LPSD | Initiating event - no impact on SAMDA analysis |
| 36 | %LPPL | 5.28E-02 | 3.48% | Loss of offsite power of Plant-centered for LPSD | Initiating event - no impact on SAMDA analysis |
| 37 | %S1 | 1.40E-01 | 3.46% | Loss of SCS (S1) | Initiating event - no impact on SAMDA analysis |
| 38 | DATGR-S-AACTG | 1.57E-01 | 2.08% | FAILS TO RUN AAC GAS TURBINE GENERATOR | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 39 | HR-FB-JLP10-01 | 5.37E-04 | 1.50% | Operator Fails to Feed during JL POS 10 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |

Table 6d List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Events) (3 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 40 | BE-RATE-P11 | 9.66E-04 | 1.48% | Conversion factor (SD-yr -> Calendar yr) for POS11 duration | Quantification factor - no impact on SAMDA analysis |
| 41 | COMBINATION_16-LP | 9.41E+01 | 1.46% | HEP dependency factor for HR-RS-JLP10, HR-FB-JLP10-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 42 | HR-RS-JLP10 | 2.08E-03 | 1.46% | Operator Fails to Restore SCS during JL POS 10 | Procedural changes are not in the scope of this SAMDA analysis |
| 43 | HR-RS-S1P05 | 4.18E-01 | 1.44% | Operator Fails to Restore SCS during S1 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 44 | COMBINATION_21-LP | 1.00E+00 | 1.39% | HEP dependency factor for HR-RS-S1P05, HR-FB-S1P05 | Procedural changes are not in the scope of this SAMDA analysis |
| 45 | HR-FB-S1P05 | 3.49E-04 | 1.39% | Operator Fails to Feed during S1 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 46 | BE-RATE-P03B | 2.74E-03 | 1.38% | Conversion factor (SD-yr -> Calendar yr) for POS03B duration | Quantification factor - no impact on SAMDA analysis |
| 47 | %KV | 3.50E-02 | 1.19% | Loss of Class 1E 4.16KV | Initiating event - no impact on SAMDA analysis |
| 48 | HR-FB-JLP06-01 | 2.72E-03 | 1.12% | Operator Fails to Feed during JL POS 6 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 49 | COMBINATION_26-LP | 1.93E+01 | 0.97% | HEP dependency factor for HR-RS-JLP06, HR-FB-JLP06-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 50 | HR-RS-JLP06 | 2.08E-03 | 0.97% | Operator Fails to Restore SCS during JL POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 51 | BE-RATE-P4B | 1.49E-03 | 0.97% | Conversion factor (SD-yr -> Calendar yr) for POS4B duration | Quantification factor - no impact on SAMDA analysis |
| 52 | RAC-LXP10-AC-WE | 4.78E-01 | 0.93% | Recovery Offsite Power within 3.0hr at SBO POS10 AC WE | This event represents characteristics of the site at which the plant will be located and the probability is based on generic industry data. Design changes to affect the risk from site characteristics are not applicable to the SAMDA analysis and this event is not considered further. |
| 53 | %LPGR | 1.15E-02 | 0.89% | Loss of offsite power of Grid-related for LPSD | Initiating event - no impact on SAMDA analysis |
| 54 | DGDGL-A-DGA | 3.78E-03 | 0.79% | DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 55 | DGDGL-B-DGB | 3.78E-03 | 0.79% | DG B FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 56 | BE-RATE-P13 | 2.44E-03 | 0.78% | Conversion factor (SD-yr -> Calendar yr) for POS13 duration | Quantification factor - no impact on SAMDA analysis |
| 57 | %ES | 1.86E-02 | 0.77% | Loss of Essential Service Water | Initiating event - no impact on SAMDA analysis |
| 58 | COMBINATION_9-LP | 1.93E+01 | 0.75% | HEP dependency factor for HR-MI-SLP05, HR-FB-SLP05-02 | Procedural changes are not in the scope of this SAMDA analysis |

Table 6d List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Events) (4 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 59 | HR-FB-SLP05-02 | 2.72E-03 | 0.75% | Operator Fails to Feed during SL POS 5 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 60 | HR-MI-SLP05 | 7.18E-04 | 0.75% | Operator Fails to Isolate and Makeup SL at POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 61 | WOCHKQ4-CH01A/1B/2A/2B | 4.86E-06 | 0.73% | 4/4 CCF OF ECW CHILLERS 1A/2A/1B/2B FAIL TO RUN | The components associated with this basic event are evaluated in Section 7.11.1 through 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | %JL | 5.00E-03 | 0.69% | Unrecoverable LOCA | Initiating event - no impact on SAMDA analysis |
| 63 | DGSQA-B-LOADSQ | 3.33E-03 | 0.69% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 64 | DGSQA-A-LOADSQ | 3.33E-03 | 0.69% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 65 | %S2 | 2.20E-02 | 0.66% | Loss of SCS (S2) | Initiating event - no impact on SAMDA analysis |
| 66 | DATGM-S-AACTG | 5.00E-02 | 0.63% | AAC DG UNAVAILABLE DUE TO T&M | The component associated with this basic event is evaluated in Section 7.2.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 67 | DGDGS-A-DGA | 2.89E-03 | 0.60% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 68 | DGDGS-B-DGB | 2.89E-03 | 0.60% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 69 | COMBINATION_13-LP | 9.41E+01 | 0.56% | HEP dependency factor for HR-MI-SLP11, HR-FB-SLP11-02 | Quantification factor - no impact on SAMDA analysis |
| 70 | HR-FB-SLP11-02 | 5.37E-04 | 0.56% | Operator Fails to Feed during SL POS 11 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 71 | HR-MI-SLP11 | 7.18E-04 | 0.56% | Operator Fails to Isolate and Makeup SL at POS 11 | Procedural changes are not in the scope of this SAMDA analysis |
| 72 | SIMPWQ4-CSP1A/B/SCP1A/B | 4.14E-06 | 0.56% | 4/4 CCF OF CSP PP01A/PP01B AND SCP PP01A/PP01B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.6.1, 7.6.2, 7.19.1, and 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |

Table 6d List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Events) (5 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 73 | DGDGKQ4-DG01ABCD | 5.95E-05 | 0.54% | 4/4 CCF OF EDG 01A/01B/01C/01D FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.1.1 through 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 74 | SIMPR2A-PP02C | 2.83E-03 | 0.53% | FAILS TO RUN SI PUMP PP02C | The component associated with this basic event is evaluated in Section 7.12.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 75 | BE-RATE-P12A | 3.07E-04 | 0.52% | Conversion factor (SD-yr -> Calendar yr) for POS12A duration | Quantification factor - no impact on SAMDA analysis |
| 76 | COMBINATION_17-LP | 9.41E+01 | 0.50% | HEP dependency factor for HR-MI-JLP10, HR-FB-JLP10-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 77 | HR-FB-JLP10-02 | 5.37E-04 | 0.50% | Operator Fails to Feed during JL POS 10 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 78 | HR-MI-JLP10 | 7.18E-04 | 0.50% | Operator Fails to Isolate and Makeup JL at POS 10 | Procedural changes are not in the scope of this SAMDA analysis |
| 79 | RAC-LXP10-AC-SW | 1.50E-01 | 0.50% | Recovery Offsite Power within 3.0hr at SBO POS10 AC SW | This event represents characteristics of the site at which the plant will be located and the probability is based on generic industry data. Design changes to affect the risk from site characteristics are not applicable to the SAMDA analysis and this event is not considered further. |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (1 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | BE-RATE-P10 | 6.26E-03 | 75.8% | Conversion factor (SD-yr -> Calendar yr) for POS10 duration | Quantification factor - no impact on SAMDA analysis |
| 2 | DGDGR-A-DGA | 2.50E-02 | 32.7% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 3 | %IE-078-44B-FP-X-LP | 3.42E-04 | 23.3% | MAJ BRK IN FP PIPING IN B QUAD 78 FT EL RM 078-A44B AND OTHER B QUAD RMS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 4 | %IE-078-19B-FP-X-LP | 3.49E-04 | 19.1% | MAJ BRK (VARIOUS GPM) IN FP PIPING IN 078-A19B AND OTHER B QUAD RMS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 5 | %IE-055-22A-IW-S-LP | 2.08E-05 | 16.1% | BREAK OF UNISOLABLE IW PIPING IN A QUAD 55 FT EL RM 055-A22A (LPSD) | Initiating event - no impact on SAMDA analysis |
| 6 | BE-RATE-P05 | 1.23E-03 | 16.0% | Conversion factor (SD-yr -> Calendar yr) for POS5 duration | Quantification factor - no impact on SAMDA analysis |
| 7 | HR-RS-S2P05 | 4.18E-01 | 15.1% | Operator Fails to Restore SCS during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 8 | DGDGR-D-DGD | 2.50E-02 | 9.5% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01D | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 9 | PFHBO1A-SW01A-H2 | 6.66E-03 | 8.7% | PCB SW01A-H2 4.16KV SWGR SW01A FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 10 | AFOPH-1-ISO-FL | 1.00E+00 | 8.3% | Operaotr faills to isolate major break of AF pioping in TDAFP room. | Procedural changes are not in the scope of this SAMDA analysis |
| 11 | %IE-078-15D-AF-X-LP | 1.98E-05 | 8.3% | MAJ BRK (>3200 GPM) IN AF PIPING IN D QUAD 78 FT EL RM 078-A15D (LPSD) | Initiating event - no impact on SAMDA analysis |
| 12 | WOOPH-B-1/2B | 2.06E-02 | 7.9% | OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B | Procedural changes are not in the scope of this SAMDA analysis |
| 13 | %IE-137-13B-FP-X-LP | 1.71E-05 | 7.0% | MAJ BRK (> 1180 GPM) OF FP PIPING IN B QUAD 137 FT EL RM 137-A13B & OTHERS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 14 | %IE-078-19B-FP-M-LP | 1.34E-04 | 6.8% | MOD BRK (VARIOUS GPM) IN FP PIPING IN 078-A19B AND OTHER B QUAD RMS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 15 | %IE-078-01D-FP-X-LP | 1.71E-04 | 5.3% | MAJ BRK (VARIOUS GPM) IN FP PIPING IN 078-A01D AND OTHER B QUAD RMS (LPSD) | Initiating event - no impact on SAMDA analysis |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (2 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 16 | WOCHS2B-CH02B | 1.30E-02 | 5.0% | FAILS TO START ECW CHILLER CH02B | The component associated with this basic event is evaluated in Section 7.11.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 17 | DGDGL-A-DGA | 3.78E-03 | 4.9% | DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 18 | DGSQA-A-LOADSQ | 3.33E-03 | 4.3% | LOAD SEQUNCER A FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 19 | DGDGS-A-DGA | 2.89E-03 | 3.8% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 20 | FPOPH-2-ISO-FL | 8.00E-03 | 3.3% | Operator fails to isolate FP break with between 20 and 40 minutes available | Procedural changes are not in the scope of this SAMDA analysis |
| 21 | BE-RATE-P06 | 4.01E-03 | 3.2% | Conversion factor (SD-yr -> Calendar yr) for POS6 duration | Quantification factor - no impact on SAMDA analysis |
| 22 | %IE-100-10B-FP-X-LP | 5.71E-05 | 3.0% | MAJ BRK (>1445 GPM) IN FP PIPING IN B QUAD 100 FT EL RM 100-A10B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 23 | VDHVL-A-HV12A | 2.28E-03 | 3.0% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 24 | VDHVL-A-HV13A | 2.28E-03 | 3.0% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 25 | PFHBO2B-SW01D-G2 | 6.66E-03 | 2.5% | PCB SW01D-G2 4.16KV SWGR SW01D FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 26 | DGDGR-B-DGB | 2.50E-02 | 2.4% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 27 | FPOPH-1-ISO-FL | 9.48E-03 | 2.0% | Operator fails to isolate FP break with less than 20 minutes available | Procedural changes are not in the scope of this SAMDA analysis |
| 28 | HR-FB-S2P05 | 3.49E-04 | 1.8% | Operator Fails to Feed during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (3 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 29 | %IE-055-21B-SI-M-LP | 2.05E-07 | 1.7% | MOD BRK (500 - 3000 GPM) OF SI PIPING IN B QUAD 55-FT EL RM 055-A21B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 30 | SXCTM-2B-CT02B | 4.00E-03 | 1.5% | SXCT CT02B UNAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 31 | %IE-078-01D-FP-M-LP | 5.51E-05 | 1.5% | MOD BRK (VARIOUS GPM) IN FP PIPING IN 078-A01D AND OTHER B QUAD RMS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 32 | BE-RATE-P03A | 3.36E-04 | 1.5% | Conversion factor (SD-yr -> Calendar yr) for POS03A duration | Quantification factor - no impact on SAMDA analysis |
| 33 | VGAHS2B-AH02B | 3.86E-03 | 1.5% | FAILS TO START EWS PUMP ROOM II. SUPPLY FAN AH02B | The components associated with this basic event are evaluated in Sections 7.11.19. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 34 | DGDGL-D-DGD | 3.78E-03 | 1.4% | DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 35 | BE-RATE-P03B | 2.74E-03 | 1.3% | Conversion factor (SD-yr -> Calendar yr) for POS03B duration | Quantification factor - no impact on SAMDA analysis |
| 36 | DGSQA-D-LOADSQ | 3.33E-03 | 1.3% | LOAD SEQUNCER D FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 37 | CCMVO-A-191 | 9.63E-04 | 1.2% | CCW MOV V191 FAILS TO OPEN | The components associated with this basic event are evaluated in Sections 7.5.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 38 | %IE-137-29B-FP-M-LP | 2.66E-06 | 1.2% | MOD BRK (1690 - 2500 GPM) OF FP PIPING IN B QUAD 137 FT EL RM 137-A29B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 39 | BE-RATE-P4B | 1.49E-03 | 1.2% | Conversion factor (SD-yr -> Calendar yr) for POS4B duration | Quantification factor - no impact on SAMDA analysis |
| 40 | HR-SG-S2P03B | 6.06E-04 | 1.2% | Operator Fails to Remove Steam during S2 at POS 3B | Procedural changes are not in the scope of this SAMDA analysis |
| 41 | HR-RS-S2P03B | 2.88E-01 | 1.2% | Operator Fails to Restore SCS during S2 POS 3B | Procedural changes are not in the scope of this SAMDA analysis |
| 42 | COMBINATION_150-LP | 8.34E+01 | 1.1% | HEP dependency factor for HR-RS-S2P03B, HR-SG-S2P03B | Procedural changes are not in the scope of this SAMDA analysis |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (4 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 43 | DGDGS-D-DGD | 2.89E-03 | 1.1% | FAILS TO START OF EMERGENCY DIESEL GENERATOR DG01D | The component associated with this basic event is evaluated in Section 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 44 | HR-FB-S2P10 | 3.49E-04 | 1.1% | Operator Fails to Feed during S2 POS 10 | Procedural changes are not in the scope of this SAMDA analysis |
| 45 | SIMPR2B-PP02D | 2.83E-03 | 1.1% | FAILS TO RUN SI PUMP PP02D | The component associated with this basic event is evaluated in Section 7.12.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 46 | VDHVS-A-HV12A | 8.29E-04 | 1.1% | FAILS TO START EDG ROOM CUBICLE COOLER HV12A | The component associated with this basic event is evaluated in Section 7.11.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 47 | VDHVS-A-HV13A | 8.29E-04 | 1.1% | FAILS TO START EDG ROOM CUBICLE COOLER HV13A | The component associated with this basic event is evaluated in Section 7.11.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 48 | SIMPR1A-PP02A | 2.83E-03 | 1.1% | FAILS TO RUN SI PUMP PP02A | The component associated with this basic event is evaluated in Section 7.12.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 49 | VOHVM2B-HV32B | 2.50E-03 | 0.9% | CUBICLE COOLER HV32B UAVAILABLE DUE TO T&M | The components associated with this basic event are evaluated in Sections 7.11.13. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 50 | WOCHR1A-CH01A | 7.32E-04 | 0.9% | FAILS TO RUN ECW CHILLER CH01A FOR 24 HOURS | The component associated with this basic event is evaluated in Section 7.11.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 51 | %IE-120-11B-FP-X-LP | 1.79E-05 | 0.9% | MAJ BRK (>1180 GPM) OF FP PIPING IN B QUAD 120 FT EL RM 120-A11B OR 120-A13B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 52 | %IE-100-20A-FP-X-LP | 3.35E-04 | 0.9% | MAJ BRK OF FP PIPING IN A QUAD 100 FT EL RM 100-A20A AND OTHERS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 53 | SXCTS-2B-CT02B | 2.32E-03 | 0.9% | SX CT02B FANS (ANY 1 OF 3) FAIL TO START | The components associated with this basic event are evaluated in Sections 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 54 | HR-SG-S2P03A | 6.06E-04 | 0.9% | Operator Fails to Remove Steam during S2 at POS 3A | Procedural changes are not in the scope of this SAMDA analysis |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (5 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 55 | VDHVL-D-HV12D | 2.28E-03 | 0.9% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12D FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 56 | VDHVL-D-HV13D | 2.28E-03 | 0.9% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13D FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 57 | COMBINATION_354-LP | 1.04E+03 | 0.8% | HEP dependency factor for HR-RS-S2P05, FPOPH-2-ISO-FL, HR-FB-S2P05 | Procedural changes are not in the scope of this SAMDA analysis |
| 58 | HR-RS-S2P03A | 8.20E-01 | 0.7% | Operator Fails to Restore SCS during S2 POS 3A | Procedural changes are not in the scope of this SAMDA analysis |
| 59 | COMBINATION_175-LP | 8.34E+01 | 0.7% | HEP dependency factor for HR-RS-S2P03A, HR-SG-S2P03A | Procedural changes are not in the scope of this SAMDA analysis |
| 60 | HR-FB-S2P06 | 3.49E-04 | 0.6% | Operator Fails to Feed during S2 POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 61 | PFHBO1B-SW01B-H2 | 6.66E-03 | 0.6% | PCB SW01B-H2 4.16KV SWGR SW01B FROM UAT FAILS TO OPEN | The component associated with this basic event is evaluated in Section 7.9.7. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | %IE-078-20B-AF-X-LP | 1.43E-06 | 0.6% | MAJ BRK (>690 GPM) IN AF OR AX PIPING IN B QUAD 78 FT EL RM 078-A20B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 63 | %IE-055-21A-SI-X-LP | 3.13E-08 | 0.6% | MAJ BRK (>3000 GPM) OF SI PIPING IN A QUAD 55-FT EL RM 055-A21A (LPSD) | Initiating event - no impact on SAMDA analysis |
| 64 | DGDGKQ4-DG01ABCD | 5.95E-05 | 0.5% | 4/4 CCF OF EDG 01A/01B/01C/01D FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.1.1 through 7.1.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 65 | SIMPR1B-SCPP01B | 2.83E-03 | 0.5% | FAILS TO RUN SC PUMP 2 PP01B | The component associated with this basic event is evaluated in Section 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 66 | CCMPS2B-PP02B | 1.36E-03 | 0.5% | FAILS TO START CCW PUMP PP02B | The component associated with this basic event is evaluated in Section 7.5.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 67 | SXMPS2B-PP02B | 1.36E-03 | 0.5% | FAIL TO START ESW PUMP PP02B | The component associated with this basic event is evaluated in Section 7.13.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6e List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Flooding Events) (6 of 6)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 68 | WOMPS2B-PP02B | 1.36E-03 | 0.5% | FAILS TO START OF ECW PUMP 02B | The component associated with this basic event is evaluated in Section 7.14.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 69 | SXFLP-S-FT0123AB | 5.57E-05 | 0.5% | CCF OF ALL ESW DERIS FILTERS DUE TO PLUGGING | The component associated with this basic event is evaluated in Section 7.13.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 70 | %IE-078-31A-FP-X-LP | 2.49E-04 | 0.5% | MAJ BRK (> 3900 GPM) IN FP PIPING IN A QUAD 78 FT EL RM 078-A31A (LPSD) | Initiating event - no impact on SAMDA analysis |
| 71 | FPOPH-3DEP-ISO-FL | 2.93E-03 | 0.5% | Operator fails to isolate major break of FP piping in 078-A31A before 18-inches of accumulation. | Procedural changes are not in the scope of this SAMDA analysis |
| 72 | COMBINATION_339-LP | 3.54E+05 | 0.5% | HEP dependency factor for HR-RS-S2P05, FPOPH-2-ISO-FL, FPOPH-3DEP-ISO-FL, HR-FB-S2P05 | Procedural changes are not in the scope of this SAMDA analysis |
| 73 | PFHBWQ2-SW2OUATAD | 6.03E-05 | 0.5% | 2/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 74 | %IE-100-37B-FP-X-LP | 9.94E-05 | 0.5% | MOD BRK OF FP PIPING IN B QUAD 100 FT EL RM 100-A37B AND OTHERS (LPSD) | Initiating event - no impact on SAMDA analysis |
| 75 | %IE-055-21B-SI-X-LP | 2.54E-08 | 0.5% | MAJ BRK (>3000 GPM) OF SI PIPING IN B QUAD 55-FT EL RM 055-A21B (LPSD) | Initiating event - no impact on SAMDA analysis |
| 76 | SXHVO-2B-074 | 1.20E-03 | 0.5% | LOSS OF SX CT02B DUE TO FAILURE TO OPEN OF 2B SXCT SUPPLY HOV SX-074 | The components associated with this basic event are evaluated in Sections 7.13.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 6f List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Fire Events) (1 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | BE-RATE-P05 | 1.23E-03 | 68.21% | Conversion factor (SD-yr -> Calendar yr) for POS5 duration | Quantification factor - no impact on SAMDA analysis |
| 2 | HR-FB-KVP05 | 2.01E-03 | 32.56% | Operator Fails to Feed during KV POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 3 | HR-RS-KVP05 | 8.43E-01 | 32.56% | Operator Fails to Restore SCS during KV POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 4 | COMBINATION_23-LPF | 2.58E+01 | 32.55% | HEP dependency factor for HR-RS-KVP05, HR-FB-KVP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 5 | %F000-ADGC-LP | 4.65E-03 | 24.51% | FIRE IN DIESEL GENERATOR ROOM | Initiating event - no impact on SAMDA analysis |
| 6 | HR-FB-LPP05 | 2.01E-03 | 16.97% | Operator Fails to Feed during LP POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 7 | HR-RS-LPP05 | 8.43E-01 | 16.96% | Operator Fails to Restore SCS during LP POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 8 | COMBINATION_24-LPF | 2.58E+01 | 16.96% | HEP dependency factor for HR-RS-LPP05, HR-FB-LPP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 9 | BE-RATE-P06 | 4.01E-03 | 14.52% | Conversion factor (SD-yr -> Calendar yr) for POS6 duration | Quantification factor - no impact on SAMDA analysis |
| 10 | HR-FB-CCP05 | 2.01E-03 | 8.94% | Operator Fails to Feed during CC POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 11 | HR-RS-CCP05 | 8.43E-01 | 8.94% | Operator Fails to Restore SCS during CC POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 12 | COMBINATION_47-LPF | 2.58E+01 | 8.94% | HEP dependency factor for HR-RS-CCP05, HR-FB-CCP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 13 | HR-RS-S2P05 | 8.43E-01 | 8.50% | Operator Fails to Restore SCS during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 14 | HR-FB-S2P05 | 2.01E-03 | 8.50% | Operator Fails to Feed during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 15 | COMBINATION_43-LPF | 2.58E+01 | 8.50% | HEP dependency factor for HR-RS-S2P05, HR-FB-S2P05 | Procedural changes are not in the scope of this SAMDA analysis |
| 16 | BE-RATE-P10 | 6.26E-03 | 6.77% | Conversion factor (SD-yr -> Calendar yr) for POS10 duration | Quantification factor - no impact on SAMDA analysis |
| 17 | BE-RATE-P4B | 1.49E-03 | 5.98% | Conversion factor (SD-yr -> Calendar yr) for POS4B duration | Quantification factor - no impact on SAMDA analysis |
| 18 | %F137-ANEA-LP | 7.34E-04 | 4.26% | FIRE IN ELECTRICAL EQUIPMENT ROOM | Initiating event - no impact on SAMDA analysis |
| 19 | %F120-AGAC-LP | 6.14E-04 | 4.17% | FIRE IN GENERAL ACCESS AREA-120' C | Initiating event - no impact on SAMDA analysis |
| 20 | HR-FB-KVP06 | 5.96E-03 | 3.72% | Operator Fails to Feed during KV POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 21 | %FK-K01-LP | 7.29E-04 | 3.70% | FIRE IN ESW STRUCTURE "A" BUILDING | Initiating event - no impact on SAMDA analysis |
| 22 | COMBINATION_4-LPF | 9.34E+00 | 3.64% | HEP dependency factor for HR-RS-KVP06, HR-FB-KVP06 | Procedural changes are not in the scope of this SAMDA analysis |

Table 6f List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Fire Events) (2 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 23 | HR-RS-KVP06 | 2.69E-02 | 3.64% | Operator Fails to Restore SCS during KV POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 24 | HR-FB-JLP06-01 | 3.03E-03 | 3.39% | Operator Fails to Feed during JL POS 6 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 25 | %F055-AGAC-LP | 6.26E-04 | 3.18% | FIRE IN GENERAL ACCESS AREA-55' C | Initiating event - no impact on SAMDA analysis |
| 26 | %F078-A04C-LP | 5.26E-04 | 2.77% | FIRE IN MISC. ELECTRICAL EQUIP RM | Initiating event - no impact on SAMDA analysis |
| 27 | %F078-AGAC-LP | 4.94E-04 | 2.58% | FIRE IN GENERAL ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 28 | %F078-A19A-LP | 4.74E-04 | 2.54% | FIRE IN CORRIDOR | Initiating event - no impact on SAMDA analysis |
| 29 | PROB-NON-SUPP-MCR | 4.65E-02 | 2.43% | PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION | This event represents operator actions and procedural changes are not in the scope of this SAMDA analysis |
| 30 | %F157-AMCR-LP | 1.22E-04 | 2.36% | FIRE IN MAIN CONTROL ROOM | Initiating event - no impact on SAMDA analysis |
| 31 | COMBINATION_11-LPF | 1.75E+01 | 2.29% | HEP dependency factor for HR-MI-JLP06, HR-FB-JLP06-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 32 | HR-FB-JLP06-02 | 3.03E-03 | 2.29% | Operator Fails to Feed during JL POS 6 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 33 | HR-MI-JLP06 | 2.29E-02 | 2.29% | Operator Fails to Isolate and Makeup JL at POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 34 | BE-RATE-P03A | 3.36E-04 | 2.16% | Conversion factor (SD-yr -> Calendar yr) for POS03A duration | Quantification factor - no impact on SAMDA analysis |
| 35 | %F120-AGAD-LP | 6.49E-04 | 2.12% | FIRE IN GENERAL ACCESS AREA-120' D | Initiating event - no impact on SAMDA analysis |
| 36 | %FD-D01A-LP | 4.14E-04 | 2.10% | FIRE IN CCW HEAT EXCHANGER "A" BUILDING | Initiating event - no impact on SAMDA analysis |
| 37 | %F100-AGAC-LP | 2.30E-04 | 2.06% | FIRE IN GENERAL ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 38 | %F078-A19B-LP | 9.26E-04 | 2.06% | FIRE IN CORRIDOR | Initiating event - no impact on SAMDA analysis |
| 39 | DGDGR-A-DGA | 2.50E-02 | 2.00% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01A | The component associated with this basic event is evaluated in Section 7.1.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 40 | %F078-A05C-LP | 3.92E-04 | 1.98% | FIRE IN CHANNEL-C DC & IP EQUIP RM | Initiating event - no impact on SAMDA analysis |
| 41 | HR-FB-LPP06 | 5.96E-03 | 1.97% | Operator Fails to Feed during LP POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 42 | %F000-ACVU-LP | 3.43E-04 | 1.94% | FIRE IN CVCS SYSTEM AREA | Initiating event - no impact on SAMDA analysis |
| 43 | COMBINATION_5-LPF | 9.34E+00 | 1.90% | HEP dependency factor for HR-RS-LPP06, HR-FB-LPP06 | Procedural changes are not in the scope of this SAMDA analysis |
| 44 | HR-RS-LPP06 | 2.69E-02 | 1.90% | Operator Fails to Restore SCS during LP POS 6 | Procedural changes are not in the scope of this SAMDA analysis |

Table 6f List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Fire Events) (3 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 45 | %F078-A25A-LP | 3.55E-04 | 1.90% | FIRE IN CLASS 1E SWITCHGEAR 01A RM | Initiating event - no impact on SAMDA analysis |
| 46 | HR-FB-S2P04B | 2.01E-03 | 1.88% | Operator Fails to Feed during S2 POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 47 | COMBINATION_39-LPF | 2.58E+01 | 1.88% | HEP dependency factor for HR-RS-S2P04B, HR-FB-S2P04B | Procedural changes are not in the scope of this SAMDA analysis |
| 48 | HR-RS-S2P04B | 1.48E-01 | 1.88% | Operator Fails to Restore SCS during S2 POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 49 | AS-CCDP-ST | 5.00E-01 | 1.87% | SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HRS FOR RS OR <= 3 HRS FOR SG) | This event represents operator actions and procedural changes are not in the scope of this SAMDA analysis |
| 50 | %F100-AEEA-LP | 3.21E-04 | 1.83% | FIRE IN 480V CLASS 1E MCC 01A RM | Initiating event - no impact on SAMDA analysis |
| 51 | %F120-A05C-LP | 3.38E-04 | 1.81% | FIRE IN ELECTRICAL EQUIP. RM | Initiating event - no impact on SAMDA analysis |
| 52 | HR-FB-KVP04B | 2.01E-03 | 1.67% | Operator Fails to Feed during KV POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 53 | COMBINATION_21-LPF | 2.58E+01 | 1.66% | HEP dependency factor for HR-RS-KVP04B, HR-FB-KVP04B | Procedural changes are not in the scope of this SAMDA analysis |
| 54 | HR-RS-KVP04B | 3.54E-02 | 1.66% | Operator Fails to Restore SCS during KV POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 55 | %F078-A03C-LP | 3.14E-04 | 1.64% | FIRE IN CLASS 1E LOADCENTER 01C RM | Initiating event - no impact on SAMDA analysis |
| 56 | %F120-A09C-LP | 2.46E-04 | 1.55% | FIRE IN ELECTRICAL PENETRATION ROOM (C) | Initiating event - no impact on SAMDA analysis |
| 57 | DGDGR-B-DGB | 2.50E-02 | 1.38% | FAILS TO RUN EMERGENCY DIESEL GENERATOR DG01B | The component associated with this basic event is evaluated in Section 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 58 | %F137-AEPA-LP | 2.34E-04 | 1.36% | FIRE IN ELECTRICAL PENETRATION ROOM (A) | Initiating event - no impact on SAMDA analysis |
| 59 | BF_F120-AGAC_F120-AGAD | 1.20E-03 | 1.36% | BARRIER FAILURE BETWEEN FIRE COMPS F120-AGAC & F120-AGAD | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 60 | %F137-A11C-LP | 2.09E-04 | 1.21% | FIRE IN ELECTRICAL PENETRATION RM (C) | Initiating event - no impact on SAMDA analysis |
| 61 | %F157-A19C-LP | 2.02E-04 | 1.16% | FIRE IN I & C EQUIP. RM | Initiating event - no impact on SAMDA analysis |
| 62 | HR-FB-JLP10-01 | 6.96E-04 | 1.16% | Operator Fails to Feed during JL POS 10 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 63 | %F137-A10C-LP | 1.81E-04 | 1.05% | FIRE IN 480V CLASS 1E MCC 03C RM | Initiating event - no impact on SAMDA analysis |
| 64 | %F157-A25C-LP | 1.81E-04 | 1.02% | FIRE IN I & C EQUIP. RM | Initiating event - no impact on SAMDA analysis |

Table 6f List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Fire Events) (4 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 65 | HR-FB-CCP06 | 5.96E-03 | 1.02% | Operator Fails to Feed during CC POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 66 | HR-FB-S2P06 | 5.96E-03 | 1.01% | Operator Fails to Feed during S2 POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 67 | COMBINATION_20-LPF | 9.34E+00 | 1.00% | HEP dependency factor for HR-RS-CCP06, HR-FB-CCP06 | Procedural changes are not in the scope of this SAMDA analysis |
| 68 | HR-RS-CCP06 | 2.69E-02 | 1.00% | Operator Fails to Restore SCS during CC POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 69 | COMBINATION_14-LPF | 9.34E+00 | 0.99% | HEP dependency factor for HR-RS-S2P06, HR-FB-S2P06 | Procedural changes are not in the scope of this SAMDA analysis |
| 70 | HR-RS-S2P06 | 2.69E-02 | 0.99% | Operator Fails to Restore SCS during S2 POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 71 | %F120-AGAA-LP | 1.71E-04 | 0.97% | FIRE IN GENERAL ACCESS AREA-120' A | Initiating event - no impact on SAMDA analysis |
| 72 | HR-FB-LPP04B | 4.73E-03 | 0.93% | Operator Fails to Feed during LP POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 73 | %F078-AEEB-LP | 4.12E-04 | 0.91% | FIRE IN CLASS 1E SWITCHGEAR 01B ROOM | Initiating event - no impact on SAMDA analysis |
| 74 | COMBINATION_22-LPF | 1.15E+01 | 0.91% | HEP dependency factor for HR-RS-LPP04B,HR-FB-LPP04B | Procedural changes are not in the scope of this SAMDA analysis |
| 75 | HR-RS-LPP04B | 3.54E-02 | 0.91% | Operator Fails to Restore SCS during LP POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 76 | COMBINATION_9-LPF | 7.28E+01 | 0.90% | HEP dependency factor for HR-MI-JLP10, HR-FB-JLP10-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 77 | HR-FB-JLP10-02 | 6.96E-04 | 0.90% | Operator Fails to Feed during JL POS 10 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 78 | HR-MI-JLP10 | 6.14E-03 | 0.90% | Operator Fails to Isolate and Makeup JL at POS 10 | Procedural changes are not in the scope of this SAMDA analysis |
| 79 | %F000-ACVL-LP | 9.52E-04 | 0.88% | FIRE IN CVCS ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 80 | %F100-A08C-LP | 6.06E-04 | 0.85% | FIRE IN N1E DC & IP EQUIPMENT RM | Initiating event - no impact on SAMDA analysis |
| 81 | %F000-AC-LP | 7.78E-03 | 0.76% | FIRE IN ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 82 | %F078-A11C-LP | 1.48E-04 | 0.76% | FIRE IN ESSENTIAL CHILLER RM | Initiating event - no impact on SAMDA analysis |
| 83 | %F050-A04A-LP | 1.48E-04 | 0.75% | FIRE IN SC PUMP & MINI FLOW HX RM | Initiating event - no impact on SAMDA analysis |
| 84 | %F055-A02C-LP | 1.48E-04 | 0.75% | FIRE IN CCW PUMP RM | Initiating event - no impact on SAMDA analysis |
| 85 | %F055-A02A-LP | 1.45E-04 | 0.73% | FIRE IN CCW PUMP RM | Initiating event - no impact on SAMDA analysis |
| 86 | %F000-RW-LP | 1.45E-02 | 0.71% | FIRE IN ACCESS AREA | Initiating event - no impact on SAMDA analysis |

Table 6f List of Basic Events from APR1400 PRA CDF Importance Analysis (LPSD Internal Fire Events) (5 of 5)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 87 | BF_F000-ACVU_F000-RW | 8.60E-03 | 0.71% | BARRIER FAILURE BETWEEN FIRE COMPS F000-ACVU & F000-RW | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 88 | %F100-AEEB-LP | 3.21E-04 | 0.70% | FIRE IN 480V CLASS 1E MCC 01B ROOM | Initiating event - no impact on SAMDA analysis |
| 89 | BE-RATE-P11 | 9.66E-04 | 0.69% | Conversion factor (SD-yr -> Calendar yr) for POS11 duration | Quantification factor - no impact on SAMDA analysis |
| 90 | BE-RATE-P13 | 2.44E-03 | 0.69% | Conversion factor (SD-yr -> Calendar yr) for POS13 duration | Quantification factor - no impact on SAMDA analysis |
| 91 | %F055-AGAA-LP | 1.20E-04 | 0.68% | FIRE IN GENERAL ACCESS AREA-55' A | Initiating event - no impact on SAMDA analysis |
| 92 | %F000-ACV-LP | 1.88E-03 | 0.66% | FIRE IN CVCS ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 93 | %F157-AMAX-LP | 1.09E-04 | 0.63% | FIRE IN MEETING ROOM | Initiating event - no impact on SAMDA analysis |
| 94 | %F100-A06D-LP | 1.80E-04 | 0.63% | FIRE IN GENERAL ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 95 | AS-CCDP-LT | 1.00E-01 | 0.56% | LONG TERM ALTERNATE SHUTDOWN CCDP EST. (> 1.5 HRS FOR RS OR > 3 HRS FOR SG) | This event represents operator actions and procedural changes are not in the scope of this SAMDA analysis |
| 96 | BE-RATE-P03B | 2.74E-03 | 0.55% | Conversion factor (SD-yr -> Calendar yr) for POS03B duration | Quantification factor - no impact on SAMDA analysis |
| 97 | %F000-ADGD-LP | 4.65E-03 | 0.55% | FIRE IN DIESEL GENERATOR ROOM | Initiating event - no impact on SAMDA analysis |
| 98 | MSEVO-A-102 | 5.56E-03 | 0.51% | MS ADV 102 ON SG1 FAILS TO OPEN | The components associated with this basic event are evaluated in Sections 7.17.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 7a List of Additional Basic Events from APR1400 PRA Cutset Review (At-Power Internal Events) (1 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | PELXKD2-LX09A11B | 3.37E-06 | 0.24% | 2/2 CCF OF LOOP CONTROLLER LX09A 12/LX11B 12 FAILURE | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 2 | MSOPH-S-SGADV | 5.57E-03 | 0.41% | Operator Fails to Open MSADV to remove steam from SGs | Procedural changes are not in the scope of this SAMDA analysis |
| 3 | MSSVWQ4-1A1B2A2B | 7.66E-06 | 0.41% | CCF OF MSSVS ON SG LINES 1A, 1B, 2A AND 2B | The components associated with this basic event are evaluated in Section 7.17.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 4 | COMBINATION_65 | 7.10E+01 | 0.39% | HEP dependency factor for MSOPH-S-SGADV, RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 5 | MSEVXQ3-011/12/13 | 1.20E-05 | 0.34% | 2/2 CCF OF 3/4 MSIV 011/012/013 FAIL TO CLOSE | The components associated with this basic event are evaluated in Section 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 6 | MSEVXQ3-011/12/14 | 1.20E-05 | 0.34% | 2/2 CCF OF 3/4 MSIV 011/012/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Section 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 7 | MSEVXQ3-011/13/14 | 1.20E-05 | 0.34% | 2/2 CCF OF 3/4 MSIV 011/013/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Section 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 8 | MSEVXQ3-012/13/14 | 1.20E-05 | 0.34% | 2/2 CCF OF 3/4 MSIV 012/013/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Section 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 9 | MSEVWQ4-101/2/3/4 | 7.76E-05 | 0.25% | 4/4 CCF OF MS ADVs 101/102/103/104 FAIL TO OPEN | The components associated with this basic event are evaluated in Section 7.17.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 10 | SIMPWQ4-CSP1A/B/SCP1A/B | 4.14E-06 | 0.23% | 4/4 CCF OF CSP PP01A/PP01B AND SCP PP01A/PP01B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.6.1, 7.6.2, 7.19.1, and 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 11 | MSEVXQ4-011/12/13/14 | 1.01E-05 | 0.28% | 2/2 CCF OF 4/4 MSIV 011/012/013/014 FAIL TO CLOSE | The components associated with this basic event are evaluated in Section 7.17.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 12 | AFPVKQ3-TP01A/MP02A/B | 6.70E-06 | 0.37% | 3/4 CCF OF AFW TDP01A/MDP02A/B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.3.3 through 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 7a List of Additional Basic Events from APR1400 PRA Cutset Review (At-Power Internal Events) (2 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 12 | AFPVKQ3-TP01B/MP02A/B | 6.70E-06 | 0.34% | 3/4 CCF OF AFW TDP01B/MDP02A/B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.3.3 through 7.3.6. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 13 | WMVVT-S-V1700 | 5.53E-04 | 0.37% | WM MANUAL VALVE 1700 TRANSFER CLOSED | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 14 | CVOPV-S-MV509 | 1.00E-01 | 0.19% | LOCAL MANUAL FTO MV-509 FOR IRWST REFILL AFTER SIGNAL FAILURE | Procedural changes are not in the scope of this SAMDA analysis |
| 15 | SIMVWQ4-616/26/36/46 | 2.73E-06 | 0.23% | 4/4 CCF OF DVI LINE MOV 616/626/636/646 FAIL TO OPEN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 16 | CVOPH-S-IRWST | 9.94E-04 | 0.29% | OPERATOR FAILS TO REFILL THE IRWST VIA CVCS | Procedural changes are not in the scope of this SAMDA analysis |
| 17 | HR-RCSCD1-ISOL | 3.72E-04 | 0.36% | Operator Fails to Take Action for SG Cooldown, RC Depressurization and SG Isolation | Procedural changes are not in the scope of this SAMDA analysis |
| 18 | SIOPH-S-LTC-SC | 5.36E-05 | 0.14% | Operator Fails to Align SCS For Long Term Cooling | Procedural changes are not in the scope of this SAMDA analysis |
| 19 | HR-RCSCD2 | 1.30E-03 | 0.23% | Operator Fails to Take Action for SG Cooldown, RC Depressurization | Procedural changes are not in the scope of this SAMDA analysis |
| 20 | COMBINATION_2032 | 5.04E+04 | 0.14% | HEP dependency factor for HR-RCSCD1-ISOL, SIOPH-S-LTC-SC, CVOPH-S-IRWST | Procedural changes are not in the scope of this SAMDA analysis |
| 21 | COMBINATION_2031 | 2.08E+03 | 0.14% | HEP dependency factor for HR-RCSCD1-ISOL, HR-RCSCD2, CVOPH-S-IRWST | Procedural changes are not in the scope of this SAMDA analysis |
| 22 | CCMVO-A-097 | 9.63E-04 | 0.40% | CCW MOV V097 FAILS TO OPEN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 23 | CCMVO-B-098 | 9.63E-04 | 0.40% | CCW MOV V098 FAILS TO OPEN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 24 | CSMVO1B-004 | 9.63E-04 | 0.40% | CS ISOL. MOV 004 IN CS TR. B HX DISCH. PATH FAILS TO OPEN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |

Table 7b List of Additional Basic Events from APR1400 PRA Cutset Review (At-Power Internal Flooding Events)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | MSOPH-S-SGADV | 5.57E-03 | 0.15% | Operator Fails to Open MSADV to remove steam from SGs | Procedural changes are not in the scope of this SAMDA analysis |
| 2 | MSSVWQ4-1A1B2A2B | 7.66E-06 | 0.15% | CCF OF MSSVS ON SG LINES 1A, 1B, 2A AND 2B | The components associated with this basic event are evaluated in Section 7.17.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 3 | COMBINATION_65 | 7.10E+01 | 0.15% | HEP dependency factor for MSOPH-S-SGADV, RCOPH-S-SDSE-FW | Procedural changes are not in the scope of this SAMDA analysis |
| 4 | DCBCM-M-BC01M | 2.00E-03 | 0.15% | NON-CLASS 1E 125V DC BATT. CHARGER BC01M UNAVAILABLE DUE TO T&M | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 5 | DCOPH-S-NSBC-ALIGN | 5.00E-01 | 0.16% | OPERATOR FAILS TO TRANSFER SOURCE FROM BC01M/N TO BC05N | Procedural changes are not in the scope of this SAMDA analysis |
| 6 | COMBINATION_56 | 6.35E+04 | 0.13% | HEP dependency factor for DCOPH-S-NSBC-ALIGN, FPOPH-2-ISO-FL, AFOPH-S-ALT-LT, RCOPH-S-SDSL | Procedural changes are not in the scope of this SAMDA analysis |
| 7 | %IE-120-11B-FP-X | 1.70E-05 | 0.81% | MAJ BRK (>1180 GPM) OF FP PIPING IN B QUAD 120 FT EL RM 120-A11B OR 120-A13B | Initiating event - no impact on SAMDA analysis |

Table 7c List of Additional Basic Events from APR1400 PRA Cutset Review (At-Power Internal Fire Events) (1 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | DGSQA-B-LOADSQ | 3.33E-03 | 0.56% | LOAD SEQUNCER B FAILS TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 2 | %F000-C01-156-1 | 7.40E-05 | 0.40% | FIRE IN F000-C01 - CONTAINMENT - UNSUPPRESSED TRANS FIRES EL 156'-0" AREA 1 | Initiating event - no impact on SAMDA analysis |
| 3 | %F000-C01-100-1 | 6.73E-05 | 0.36% | FIRE IN F000-C01 - CONTAINMENT - UNSUPPRESSED TRANS FIRES EL 100'-0" AREA 1 | Initiating event - no impact on SAMDA analysis |
| 4 | %F000-C01-114-1 | 6.73E-05 | 0.36% | FIRE IN F000-C01 - CONTAINMENT - UNSUPPRESSED TRANS FIRES EL 114'-0" AREA 1 | Initiating event - no impact on SAMDA analysis |
| 5 | %F000-C01-136-1 | 6.73E-05 | 0.36% | FIRE IN F000-C01 - CONTAINMENT - UNSUPPRESSED TRANS FIRES EL 136'-6" AREA 1 | Initiating event - no impact on SAMDA analysis |
| 6 | %F137-A02D | 3.64E-04 | 0.49% | FIRE IN F137-A02D - ELECTRICAL EQUIP. RM | Initiating event - no impact on SAMDA analysis |
| 7 | BF_F137-A02D_F157-AMCR | 1.20E-03 | 0.20% | BARRIER FAILURE BETWEEN FIRE COMPS F137-A02D & F157-AMCR | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 8 | %F000-AFHU | 3.42E-04 | 0.32% | FIRE IN F000-AFHU - FUEL HANDLING UPPER AREA | Initiating event - no impact on SAMDA analysis |
| 9 | %F120-A05D-U | 3.01E-04 | 0.27% | FIRE IN F120-A05D - ELECTRICAL EQUIPMENT RM D - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 10 | VDHVZO8-HV12/13ABCD | 9.96E-06 | 0.38% | 8/8 CCF OF EDG ROOM CUBICLE COOLER HV12A/12B/12C/12D 13A/13B/13C/14D FAIL TO RUN FOR 1HR | The components associated with this basic event are evaluated in Sections 7.11.5 through 7.11.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 11 | DGSQWQ4-LOADSQABCD | 9.89E-06 | 0.38% | 4/4 CCF OF LOAD SEQUNCER A/B/C/D FAIL TO OPERATE | The component associated with this basic event is evaluated in Section 7.1.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 12 | WMVVT-S-V1700 | 5.53E-04 | 0.29% | WM MANUAL VALVE 1700 TRANSFER CLOSED | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |

Table 7c List of Additional Basic Events from APR1400 PRA Cutset Review (At-Power Internal Fire Events) (2 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 13 | SIMVT-B-303 | 3.71E-05 | 0.47% | SI PUMP PP02B/D MINI. FLOW LINE MOV V303 FAILS TO REMAIN OPEN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added |
| 14 | %F100-A05C | 2.06E-04 | 0.28% | FIRE IN F100-A05C - ELECTRICAL EQUIPMENT RM C | Initiating event - no impact on SAMDA analysis |
| 15 | SXCTWQ4-CT01A/02A/01B/02B | 6.89E-06 | 0.26% | 4/4 CCF OF SXCT 1A, 2A, 1B AND 2B TO START | The components associated with this basic event are evaluated in Section 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 16 | %F100-A05D-U | 1.91E-04 | 0.24% | FIRE IN F100-A05D - ELECTRICAL EQUIPMENT RM D - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 17 | %F120-A08D | 1.87E-04 | 0.15% | FIRE IN F120-A08D - 480V N1E MCC RM | Initiating event - no impact on SAMDA analysis |
| 18 | %F137-ASTD | 2.37E-05 | 0.09% | FIRE IN F137-ASTD - STAIR | Initiating event - no impact on SAMDA analysis |
| 19 | BF_F137-ASTD_F157-AMCR | 8.60E-03 | 0.09% | BARRIER FAILURE BETWEEN FIRE COMPS F137-ASTD & F157-AMCR | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 20 | %F078-AGAD-U | 5.05E-05 | 0.35% | FIRE IN F078-AGAD - GENERAL ACCESS AREA-78' D - UNSUPPRESSED | Initiating event - no impact on SAMDA analysis |
| 21 | BF_F137-A05D_F157-AMCR | 1.20E-03 | 0.08% | BARRIER FAILURE BETWEEN FIRE COMPS F137-A05D & F157-AMCR | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 22 | %F120-A08C | 1.44E-04 | 0.18% | FIRE IN F120-A08C - 480V N1E MCC RM | Initiating event - no impact on SAMDA analysis |
| 23 | CCMPWQ4-PP01A/2A/1B/2B | 4.76E-06 | 0.18% | 4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.5.1 and 7.5.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 24 | WOMPWQ4-PP01A/2A/1B/2B | 4.76E-06 | 0.18% | 4/4 CCF OF ECW PUMPS 1A/2A/1B/2B FAIL TO START | The components associated with this basic event are evaluated in Sections 7.14.1 and 7.14.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 25 | %F100-AEEA | 3.14E-04 | 0.40% | FIRE IN F100-AEEA - 480V CLASS 1E MCC 01A RM | Initiating event - no impact on SAMDA analysis |

Table 7d List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Events) (1 of 4)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | HR-FB-JLP05-02 | 2.72E-03 | 0.43% | Operator Fails to Feed during JL POS 5 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 2 | HR-MI-JLP05 | 7.18E-04 | 0.43% | Operator Fails to Isolate and Makeup JL at POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 3 | COMBINATION_20-LP | 1.93E+01 | 0.43% | HEP dependency factor for HR-MI-JLP05, HR-FB-JLP05-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 4 | HR-FB-KVP05 | 3.49E-04 | 0.35% | Operator Fails to Feed during KV POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 5 | HR-RS-KVP05 | 4.18E-01 | 0.36% | Operator Fails to Restore SCS during KV POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 6 | COMBINATION_52-LP | 1.00E+00 | 0.35% | HEP dependency factor for HR-RS-KVP05, HR-FB-KVP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 7 | HR-FB-JLP11-02 | 5.37E-04 | 0.32% | Operator Fails to Feed during JL POS 11 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 8 | HR-MI-JLP11 | 7.18E-04 | 0.32% | Operator Fails to Isolate and Makeup JL at POS 11 | Procedural changes are not in the scope of this SAMDA analysis |
| 9 | COMBINATION_24-LP | 9.41E+01 | 0.32% | HEP dependency factor for HR-MI-JLP11, HR-FB-JLP11-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 10 | HR-FB-JLP06-02 | 2.72E-03 | 0.34% | Operator Fails to Feed during JL POS 6 w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 11 | HR-MI-JLP06 | 7.18E-04 | 0.34% | Operator Fails to Isolate and Makeup JL at POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 12 | COMBINATION_27-LP | 1.93E+01 | 0.34% | HEP dependency factor for HR-MI-JLP06, HR-FB-JLP06-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 13 | HR-FB-S1P12A | 3.49E-04 | 0.27% | Operator Fails to Feed during S1 POS 12A | Procedural changes are not in the scope of this SAMDA analysis |
| 14 | HR-RS-S1P12A | 3.23E-01 | 0.28% | Operator Fails to Restore SCS during S1 POS 12A | Procedural changes are not in the scope of this SAMDA analysis |
| 15 | COMBINATION_53-LP | 1.00E+00 | 0.27% | HEP dependency factor for HR-RS-S1P12A,HR-FB-S1P12A | Procedural changes are not in the scope of this SAMDA analysis |
| 16 | HR-FB-S2P05 | 3.49E-04 | 0.22% | Operator Fails to Feed during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 17 | HR-RS-S2P05 | 4.18E-01 | 0.23% | Operator Fails to Restore SCS during S2 POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 18 | COMBINATION_62-LP | 1.00E+00 | 0.22% | HEP dependency factor for HR-RS-S2P05, HR-FB-S2P05 | Procedural changes are not in the scope of this SAMDA analysis |
| 19 | HR-FB-SOP11-01 | 3.49E-04 | 0.06% | Operator Fails to Feed during SL POS 11 w/makeup established | Procedural changes are not in the scope of this SAMDA analysis |
| 20 | HR-RS-SOP11 | 5.76E-03 | 0.22% | Operator Fails to Restore SCS during SO POS 11 | Procedural changes are not in the scope of this SAMDA analysis |
| 21 | COMBINATION_3-LP | 1.00E+00 | 0.22% | HEP dependency factor for HR-RS-SOP11, HR-FB-SOP11-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 22 | HR-FB-ESP05 | 3.49E-04 | 0.19% | Operator Fails to Feed during ES POS 5 | Procedural changes are not in the scope of this SAMDA analysis |

Table 7d List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Events) (2 of 4)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 23 | HR-RS-ESP05 | 4.18E-01 | 0.19% | Operator Fails to Restore SCS during ES POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 24 | COMBINATION_63-LP | 1.00E+00 | 0.19% | HEP dependency factor for HR-RS-ESP05, HR-FB-ESP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 25 | PFHBWQ4-SW2OUAT | 2.73E-05 | 0.43% | 4/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1C/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 26 | VKOPH-S-ECCS | 1.00E-01 | 0.18% | OPERATOR FAILS TO ACTUATE ECCS EXHAUST FAN AH01A/B | Procedural changes are not in the scope of this SAMDA analysis |
| 27 | SXCTKQ4-CT01A/02A/01B/02B | 1.10E-06 | 0.16% | 4/4 CCF OF SXCT 1A, 2A, 1B AND 2B TO RUN | The components associated with this basic event are evaluated in Section 7.13.10. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 28 | SIMPZQ4-CSP1A/B/SCP1A/B | 1.06E-06 | 0.14% | 4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A, PP01B TO RUN FOR 1HR | The components associated with this basic event are evaluated in Sections 7.6.1, 7.6.2, 7.19.1, and 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 29 | PPSO-OS-PPS | 1.20E-06 | 0.41% | CCF OF PPS OPERATING SYSTEM SOFTWARE | The component associated with this basic event is evaluated in Section 7.16.3. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 30 | SIMPKQ4-CSP1A/B/SCP1A/B | 9.21E-07 | 0.13% | 4/4 CCF OF CSP PP01A/PP01B AND SCP PP01A /PP01B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.6.1, 7.6.2, 7.19.1, and 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 31 | HR-FB-S1P03B-01 | 3.55E-04 | 0.11% | Operator Fails to F&B during S1 POS 3B (LTOP re-closed) | Procedural changes are not in the scope of this SAMDA analysis |
| 32 | HR-RS-S1P03B | 2.88E-01 | 0.19% | Operator Fails to Restore SCS during S1 POS 3B | Procedural changes are not in the scope of this SAMDA analysis |
| 33 | HR-SG-S1P03B | 6.06E-04 | 0.11% | Operator Fails to Remove Steam during S1 at POS 3A | Procedural changes are not in the scope of this SAMDA analysis |
| 34 | COMBINATION_10-LP | 8.34E+01 | 0.11% | HEP dependency factor for HR-RS-S1P03B, HR-SG-S1P03B,HR-FB-S1P03B-01 | Procedural changes are not in the scope of this SAMDA analysis |
| 35 | PFHBC1B-SW01B-A2 | 6.66E-03 | 0.36% | PCB SW01B-A2 OF 4.16KV SWGR SW01B FAILS TO CLOSE | The component associated with this basic event is evaluated in Section 7.9.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 36 | SIMPR1B-SCPP01B | 2.83E-03 | 0.28% | FAILS TO RUN SC PUMP 2 PP01B | The component associated with this basic event is evaluated in Section 7.19.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 7d List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Events) (3 of 4)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 37 | SIMPR1A-SCPP01A | 2.83E-03 | 0.21% | FAILS TO RUN SC PUMP PP01A | The component associated with this basic event is evaluated in Section 7.19.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 38 | HR-FB-JLP04B-02 | 5.37E-04 | 0.12% | Operator Fails to Feed during JL POS 4B w/makeup failed | Procedural changes are not in the scope of this SAMDA analysis |
| 39 | HR-MI-JLP04B | 7.18E-04 | 0.12% | Operator Fails to Isolate and Makeup JL at POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 40 | COMBINATION_49-LP | 9.41E+01 | 0.12% | HEP dependency factor for HR-MI-JLP04B, HR-FB-JLP04B-02 | Procedural changes are not in the scope of this SAMDA analysis |
| 41 | PFHBWQ3-SW2OUATABD | 1.65E-05 | 0.22% | 3/4 CCF OF PCB BETWEEN UAT & 4.16KV SW01A/1B/1D FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.9.6 through 7.9.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit |
| 42 | VGAHKQ4-AH01A/1B/2A/2B | 6.06E-07 | 0.09% | 4/4 CCF OF ESW PUMP ROOM FAN AH01A/B/02A/B FAIL TO RUN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 43 | VKHVKQ4-HV13A/13B/14A/14B | 6.06E-07 | 0.09% | 4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A/13B/14A/14B FAIL TO RUN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 44 | VOHVKQ4-HV32A/32B/31A/31B | 6.06E-07 | 0.09% | 4/4 CCF OF RUN FOR CUBICLE COOLER HV32A/32B/31A/31B FAIL TO RUN | Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added. |
| 45 | %TLOCCW | 2.34E-04 | 0.16% | TOTAL LOSS OF COMPONANT COOLING WATER | Initiating event - no impact on SAMDA analysis |
| 46 | BE-RATE-P14 | 3.12E-03 | 0.27% | Conversion factor (SD-yr -> Calendar yr) for POS14 duration | Quantification factor - no impact on SAMDA analysis |
| 47 | PFLOOP-NO-SI | 2.00E-03 | 0.31% | CONDITIONAL LOOP AFTER INITIATORS WHICH DO NOT INITIATE AN SI SIGNAL | Conditional LOOP event - no impact on SAMDA analysis |
| 48 | %TLOESW | 2.34E-04 | 0.16% | TOTAL LOSS OF ESSENTIAL SERVICE WATER | Initiating event - no impact on SAMDA analysis |
| 49 | VDHVL-B-HV12B | 2.28E-03 | 0.46% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12B FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.16. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 50 | VDHVL-B-HV13B | 2.28E-03 | 0.46% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13B FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.9. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 51 | VDHVL-A-HV12A | 2.28E-03 | 0.46% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV12A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.5. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 7d List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Events) (4 of 4)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 52 | VDHVL-A-HV13A | 2.28E-03 | 0.46% | FAILS TO RUN EDG ROOM CUBICLE COOLER HV13A FOR 1HR | The component associated with this basic event is evaluated in Section 7.11.8. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 53 | HR-FB-KVP12A | 3.49E-04 | 0.07% | Operator Fails to Feed during KV POS 12A | Procedural changes are not in the scope of this SAMDA analysis |
| 54 | HR-RS-KVP12A | 3.23E-01 | 0.07% | Operator Fails to Restore SCS during KV POS 12A | Procedural changes are not in the scope of this SAMDA analysis |
| 55 | COMBINATION_75-LP | 1.00E+00 | 0.07% | HEP dependency factor for HR-RS-KVP12A, HR-FB-KVP12A | Procedural changes are not in the scope of this SAMDA analysis |
| 56 | %CC | 6.75E-03 | 0.28% | Loss of Component Cooling Water | Initiating event - no impact on SAMDA analysis |
| 57 | HR-FB-CCP05 | 3.49E-04 | 0.07% | Operator Fails to Feed during CC POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 58 | HR-RS-CCP05 | 4.18E-01 | 0.07% | Operator Fails to Restore SCS during CC POS 5 | Procedural changes are not in the scope of this SAMDA analysis |
| 59 | COMBINATION_87-LP | 1.00E+00 | 0.07% | HEP dependency factor for HR-RS-CCP05, HR-FB-CCP05 | Procedural changes are not in the scope of this SAMDA analysis |
| 60 | DGDGKQ2-DG01AB | 5.55E-05 | 0.25% | 2/4 CCF OF EDG 01A/01B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.1.1 and 7.1.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 61 | RCPVWQ4-200/1/2/3 | 2.10E-04 | 0.18% | 4/4 CCF OF RC PV V200/201/202/203 FAIL TO OPEN | The components associated with this basic event are evaluated in Sections 7.10.1 through 7.10.4. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 62 | COMBINATION_120-LP | 8.34E+01 | 0.07% | HEP dependency factor for HR-RS-S1P03B, HR-SG-S1P03B | Procedural changes are not in the scope of this SAMDA analysis |
| 63 | SXMPKQ4-PP01A/B/2A/B | 4.63E-07 | 0.07% | 4/4 CCF OF ESW PUMPS PP01A/2A/PP01B/2B FAIL TO RUN | The components associated with this basic event are evaluated in Sections 7.13.1 and 7.13.2. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 64 | BE-RATE-P02 | 2.40E-03 | 0.21% | Conversion factor (SD-yr -> Calendar yr) for POS02 duration | Quantification factor - no impact on SAMDA analysis |

Table 7e List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Flooding Events)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | HR-FB-S2P04B | 3.49E-04 | 0.24% | Operator Fails to Feed during S2 POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 2 | HR-RS-S2P06 | 2.04E-03 | 0.23% | Operator Fails to Restore SCS during S2 POS 6 | Procedural changes are not in the scope of this SAMDA analysis |
| 3 | %IE-137-29B-FP-X-LP | 1.22E-05 | 0.27% | MAJ BRK (> 2500 GPM) OF FP PIPING IN B QUAD 137 FT EL RM 137-A29B (LPSD) | Initiating event - no impact on SAMDA analysis |

Table 7f List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Fire Events) (1 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 1 | BF_F000-AC_F120-AGAA | 8.60E-03 | 0.38% | BARRIER FAILURE BETWEEN FIRE COMPS F000-AC & F120-AGAA | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 2 | BF_F000-AC_F137-A20A | 8.60E-03 | 0.39% | BARRIER FAILURE BETWEEN FIRE COMPS F000-AC & F137-A20A | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 3 | %F157-ATOC-LP | 5.54E-05 | 0.31% | FIRE IN TSC EQUIP. REPAIR & MAINT ROOM | Initiating event - no impact on SAMDA analysis |
| 4 | %F157-A16C-LP | 5.52E-05 | 0.32% | FIRE IN GENERAL ACCESS AREA | Initiating event - no impact on SAMDA analysis |
| 5 | %F120-A15B-LP | 1.85E-04 | 0.40% | FIRE IN 480V CLASS 1E MCC 03B RM | Initiating event - no impact on SAMDA analysis |
| 6 | %F157-A01D-LP | 1.82E-04 | 0.40% | FIRE IN I & C EQUIP. RM | Initiating event - no impact on SAMDA analysis |
| 7 | BF_F000-ADGC_F078-A01C | 8.60E-03 | 0.21% | BARRIER FAILURE BETWEEN FIRE COMPS F000-ADGC & F078-A01C | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 8 | BF_F000-ADGC_F078-A02C | 8.60E-03 | 0.21% | BARRIER FAILURE BETWEEN FIRE COMPS F000-ADGC & F078-A02C | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 9 | HR-FB-CCP04B | 2.01E-03 | 0.46% | Operator Fails to Feed during CC POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 10 | HR-RS-CCP04B | 3.54E-02 | 0.46% | Operator Fails to Restore SCS during CC POS 4B | Procedural changes are not in the scope of this SAMDA analysis |
| 11 | COMBINATION_44-LPF | 2.58E+01 | 0.46% | HEP dependency factor for HR-RS-CCP04B,HR-FB-CCP04B | Procedural changes are not in the scope of this SAMDA analysis |
| 12 | %F120-A14A-LP | 3.65E-05 | 0.21% | FIRE IN SG BLOWDOWN REGEN HX RM | Initiating event - no impact on SAMDA analysis |
| 13 | %F050-A04B-LP | 1.48E-04 | 0.32% | FIRE IN SC PUMP & MINI FLOW HX RM | Initiating event - no impact on SAMDA analysis |
| 14 | %F122-T01-LP | 1.33E-03 | 0.48% | FIRE IN SWITCHGEAR RM | Initiating event - no impact on SAMDA analysis |
| 15 | BF_F000-ADGD_F100-A06D | 2.40E-03 | 0.30% | BARRIER FAILURE BETWEEN FIRE COMPS F000-ADGD & F100-A06D | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 16 | %FY-SAT1-LP | 1.29E-03 | 0.33% | FIRE IN STAND-BY AUX. TRANSFORMER 1 AREA | Initiating event - no impact on SAMDA analysis |
| 17 | MSEVO-A-102 | 5.56E-03 | 0.51% | MS ADV 102 ON SG1 FAILS TO OPEN | The components associated with this basic event are evaluated in Section 7.17.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |

Table 7f List of Additional Basic Events from APR1400 PRA Cutset Review (LPSD Internal Fire Events) (2 of 2)

| Item No. | Event Name | Probability | Fussell-Vesely Importance | Description | Disposition |
|---|---|---|---|---|---|
| 18 | MSOPH-S-SGADV-HW | 1.00E+00 | 0.39% | OPERATOR FAILS TO OPEN ADVS USING HAND WHEEL | Procedural changes are not in the scope of this SAMDA analysis |
| 19 | %F137-ANEC-LP | 3.43E-03 | 0.46% | FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM | Initiating event - no impact on SAMDA analysis |
| 20 | BF_F137-A01C_F137-ANEC | 9.00E-03 | 0.26% | BARRIER FAILURE BETWEEN FIRE COMPS F137-A01C & F137-ANEC | The component associated with this basic event is evaluated in Section 7.4.1. A design change would be expected to cost more than the total maximum cost reduction and, as a result, not provide a positive benefit. |
| 21 | %F157-ACPX-LP | 1.28E-04 | 0.30% | FIRE IN COMPUTER RM PACU RM | Initiating event - no impact on SAMDA analysis |
| 22 | %F120-A11B-LP | 1.23E-04 | 0.27% | FIRE IN GENERAL ACCESS AREA-120' B | Initiating event - no impact on SAMDA analysis |

# APPENDIX A

## Quantification Results of Level 3 PRA Using WinMACCS Code

**(This appendix is proprietary in its entirety)**