APR1400
DESIGN CONTROL DOCUMENT TIER 2

CHAPTER 17
QUALITY ASSURANCE
AND RELIABILITY ASSURANCE

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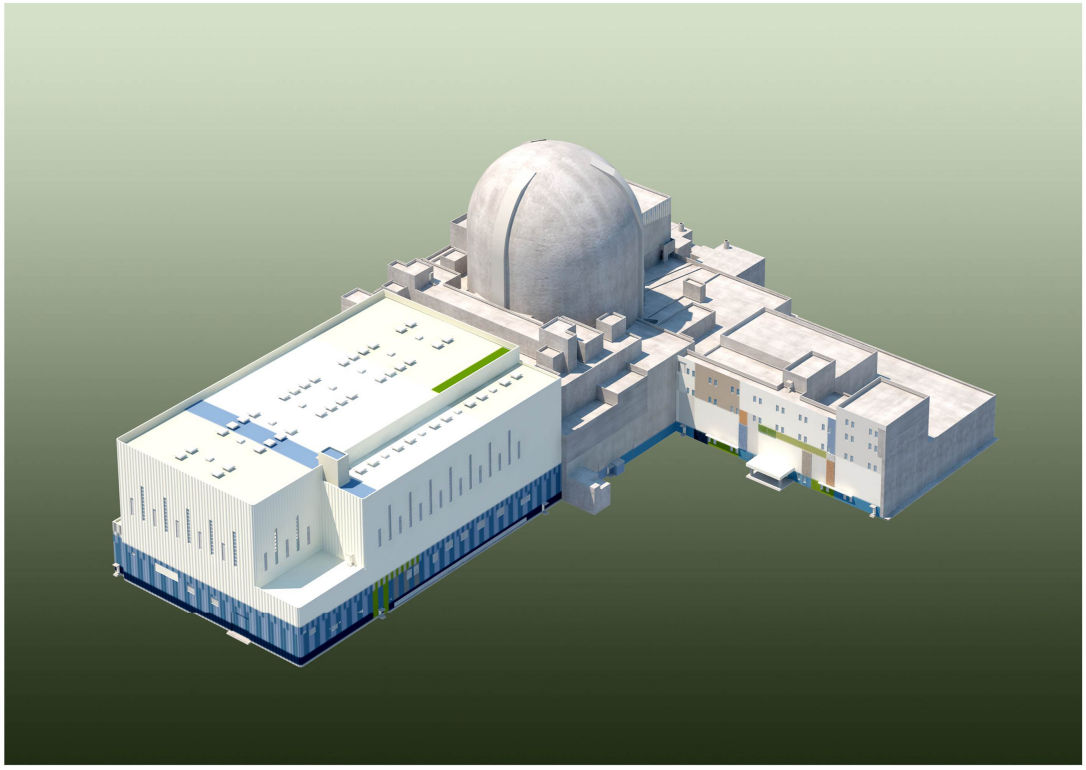

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CHAPTER 17 – QUALITY ASSURANCE AND RELIABILITY ASSURANCE

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ACRONYM AND ABBREVIATION LIST

CAP	corrective action program
CCF	common cause failure
FV	Fussell-Vesely
HSS	high-safety-significant
ITAAC	inspections, tests, analyses, and acceptance criteria
NEI	Nuclear Energy Institute
PRA	probabilistic risk assessment
QA	quality assurance
QAPD	quality assurance program description
RAP	reliability assurance program
RAW	risk achievement worth
RTNSS	regulatory treatment of non-safety systems
SMA	seismic margin analysis
SRM	staff requirements memorandum
SSCs	systems, structures, and components

CHAPTER 17 – QUALITY ASSURANCE AND RELIABILITY ASSURANCE

17.0 Quality Assurance and Reliability Assurance

The quality assurance (QA) program for the APR1400 during the design certification phase is described in Sections 17.1, 17.2, 17.3, and 17.5. The design reliability assurance program for the APR1400 is described in Section 17.4. Information on the APR1400 Maintenance Rule is provided in Section 17.6.

17.1 Quality Assurance during the Design Certification Phase

Quality assurance (QA) during the design certification phase of the APR1400 is described in Section 17.5.

17.1.1 Combined License Information

COL 17.1(1) The COL applicant is to establish and implement a QA program that is applicable to site-specific design activities during the plant construction and operation phases.

17.2 Quality Assurance during the Operations Phase

17.2.1 Combined License Information

COL 17.2(1) The COL applicant establishes and implements a QA program that is applicable to site-specific design activities during the plant construction and operation phases.

17.3 Quality Assurance Program Description

Quality Assurance Program Description during the design certification phase of the APR1400 is described in Section 17.5.

17.3.1 Combined License Information

COL 17.3(1) The COL applicant is to establish and implement a QA program that is applicable to site-specific design activities during the plant construction and operation phases.

17.4 Reliability Assurance Program Guidance

17.4.1 Overview

The APR1400 Reliability Assurance Program (RAP) identifies Systems, Structures and Components (SSCs) that are risk-significant, or significant contributors to plant safety. This determination is based upon a review of all available quantitative and qualitative information about each SSC. These risk-significant components are tabled on the RAP list, which is issued to the Design Engineering, Operations, Maintenance and Quality Assurance departments. These organizations utilize the RAP list of risk-significant SSCs to provide reasonable assurance of the following:

1) The APR1400 is designed, constructed, and operated in a manner that is consistent with the risk insights and key assumptions (e.g., SSC design, reliability, and availability) from the probabilistic, deterministic, and other methods of analysis used to identify and quantify risk.

2) The RAP SSCs do not degrade to an unacceptable level of reliability, availability or condition during plant operations.

3) The frequency of transients that challenge these SSCs is minimized.

4) These SSCs will function reliably when challenged.

This section describes the RAP as it has been established for the design phase of the APR1400, and identifies those program elements that will be developed in the Combined License phase.

17.4.2 Reliability Assurance Program Scope, Stages, and Goals

Scope. The APR1400 Reliability Assurance Program identifies risk-significant components for the departments that are tasked to achieve the RAP objectives summarized above. The RAP scope includes all plant Systems, Structures and Components that have been identified by the RAP Expert Panel as risk-significant, based upon a review of all available quantitative and qualitative risk information. This information is presented in the RAP list (Table 17.4-1).

Stages. The RAP is implemented in two stages. The first stage, the Design Reliability Assurance Program (D-RAP), encompasses the reliability-assurance activities that occur

before initial fuel load. The D-RAP is applicable during the APR1400 design certification, licensing and plant construction phase. The second stage comprises the reliability-assurance activities conducted during the operations phase of the plant's license.

Goals. The goal of the RAP during the design stage is to ensure that the reactor design meets the purposes identified in Section 17.4.1 above, through the reactor design, procurement, fabrication, construction and preoperational testing activities and programs.

The goal of the RAP during the operations stage is to ensure that the reliability of the SSCs within the RAP scope (i.e., all risk-significant components) is maintained.

17.4.3 Reliability Assurance Program Implementation

17.4.3.1 Description

The RAP is implemented in three phases. These include the following:

1) Design certification (DC) phase

2) Combined License (COL) application, including construction phase

3) Operation phase

Once the COL applicant phase is complete and fuel load commences, the RAP ends and its functions are assumed by specific plant programs such as the Maintenance Rule.

During the design phase, the APR1400 designer, Korea Hydro & Nuclear Power Co., Ltd. (KHNP), implemented the Design Reliability Assurance Program. At the same time, KHNP developed and updates the quantitative probabilistic risk model and generates importance statistics for all modeled components. These results were provided to the Expert Panel, which supplemented the quantitative PRA results with all available qualitative information and established the RAP scope of components. The RAP list of risk-significant components is maintained, updated and issued to all interfacing organizations, each of which has a role in achieving the RAP goals. As a design certification activity, this phase is the responsibility of KHNP.

17.4.3.2 Programmatic Controls

17.4.3.2.1 Organizations

The D-RAP is implemented by the following departments:

1) The Design Engineering department holds the lead responsibility for implementing the Reliability Assurance Program. Duties include RAP oversight and the issuance of the RAP SSC list to impacted organizations.

2) The Risk Management department includes the Probabilistic Risk Analysis staff, which maintains the PRA model and provides risk input for the Reliability Assurance Program. The PRA engineer also provides risk input during design reviews.

3) The Operations department participates in the Expert Panel's duties and minimizes RAP component unavailability.

4) The Site Engineering department provides system engineering expertise for the Expert Panel.

5) The Maintenance department participates in the Expert Panel's duties, ensures that RAP component maintenance is effective and unavailability is minimized.

6) The Safety Engineering department provides safety analysis expertise for the Expert Panel.

7) The Quality Assurance department participates in the Expert Panel's duties. The QA department focuses on RAP components in audits and other activities.

All organizations are expected to proactively identify new issues and concerns that may affect the RAP scope and impact any aspect of plant design and operation.

17.4.3.2.2 Design Control

Plant changes and D-RAP updates. Proposed design changes include a risk review to ensure that reliability is reasonably optimized and risk significance is minimized.

The Reliability Assurance Program evaluates plant changes also. Following each PRA modelupdate, the PRA engineer reviews the new importance statistics for all modeled components. These results are provided to the Expert Panel. The Panel supplements the PRA input with qualitative insights in order to update the RAP scope.

The scope may be reviewed, between PRA model updates, if warranted by important design changes or new information. Interim reviews may be requested by any member of the Expert Panel. Interim reviews are entirely qualitative, pending a PRA model update when applicable.

RAP Scope Update Notifications. Following each revision of the RAP list, the Expert Panel provides a timely, written update to all interfacing organizations.

Quality Controls. Section 19.1.2 of the APR1400 Design Certification Document (Reference 11) discusses PRA model quality, including personnel qualification requirements, procedures and corrective action. This text summarizes the PRA model quality bases as required by SRP Sections 19.0 (Reference 12) and 17.4 (Reference 13). These quality controls govern PRA model revisions, quantification and the generation of the importance measures that are used as key input data for the RAP risk classification. Issues are tracked by the Corrective Action Program.

Configuration Control. The RAP list of risk-significant components is established and maintained by the Expert Panel. Potential changes include both the scope of systems, structures and components, as well as their dominant failure modes.

17.4.3.2.3 Implementing Procedures

The Reliability Assurance Program is implemented via procedures which control the following:

1) RAP duties and responsibilities.

2) Expert Panel activities.

3) Design changes.

4) Risk Management.

5) Inspections and audits.

17.4.3.2.4 Corrective Action Program

The Corrective Action Program (CAP) is a web-based reporting and tracking system. It is used to document any D-RAP activities that are determined to be in error, deficient, or nonconforming. CAP issues are tracked to resolution and documented.

17.4.3.2.5 Records

Required RAP documentation includes the following:

1) Panel membership requirements and qualifications

2) Component Risk Significance Evaluation sheets

3) RAP Scope Table

4) Expert Panel meeting minutes

5) Design change request reviews

6) General quality requirements, design control, personnel training and qualification

17.4.3.2.6 Audits

Reference 1 describes the APR1400 Quality Assurance program in general, and Section 18 specifically addresses audit requirements. Section 18.1 notes that, in general, the audit requirements for all programs include, at a minimum, verification of compliance and effectiveness of implementation of internal rules, procedures (e.g., design, procurement, surveillance, and test), regulations, programs for training, retraining, qualification, and corrective actions, including associated record keeping. During the early portions of the APR1400 DC activities, audits will focus on areas including, but not limited to, design control, procurement, and corrective action. The scope of the audit is determined by the quality status and safety importance of the activities being performed. Management addresses all audit findings and initiates corrective action where indicated.

All applicable QA program elements are audited at least once a year. Additional audits may be performed as deemed necessary by management.

These audits are the responsibility of KHNP during the design certification phase. The responsibility transfers to the COL applicant during the Combined License phase.

17.4.3.3 RAP SSC Identification

The process for identifying RAP systems, structures and components typically begins with a PRA review of importance statistics following model revision. A review can also be initiated at the request of any Expert Panel member. This review includes all available APR1400 PRA models: internal events, fire and flood; at full power and shutdown; Level 1 (core damage) and Level 2 (large, offsite radionuclide release). The PRA staff identifies potentially risk-significant components and their failure modes. The PRA criteria for consideration include the Risk Achievement Worth (RAW > 2) and the Fussell-Vesely (FV > 0.005) for individual components. If at least one train meets any of these criteria, all redundant trains are retained for further evaluation.

In addition, the PRA Engineer reviews common cause failures (CCFs) with a RAW > 20. If the individual components in these CCFs are not RAP list candidates already, then these SSCs are added to the list for Expert Panel review as potentially risk-significant.

The PRA staff provides the list of recommendations for risk-significant components to the Expert Panel. The PRA representative provides interpretations and background information as needed to support the Expert Panel's classification process.

The Expert Panel supplements the quantitative PRA input with the following qualitative information, when available:

1) PRA model assumptions and limitations

2) Qualitative risk analyses (e.g., seismic margins analyses, etc.)

3) Deterministic safety analyses

4) Root cause analyses

5) Failure modes & effects analyses

6) Severe accident evaluations

7) Operating experience (e.g., industry LERs, etc.)

8) SSC risk significance at other, similar plants

9) Expert Panel judgment

All available quantitative and qualitative sources of information are considered during the review process. The panel reviews these sources and classifies each SSC as risk-significant or low risk. All risk-significant components are placed on the RAP list in Table 17.4-1.

The Expert Panel (1) can designate a component as risk-significant even if the PRA engineer did not make that recommendation; or (2) can designate components as low risk, even if the PRA engineer recommended it as risk-significant.

The panel also evaluates components that are not modeled. These determinations are solely qualitative. The RAP scope therefore includes SSCs that are not modeled in the PRA.

The panel revisits the RAP scope following each revision of the PRA model. If prompt action is warranted, the panel shall review design changes between PRA model updates, and perform an interim, qualitative evaluation until new PRA model results are available.

Certain passive components, such as pipes or electrical cables, are omitted from the review process. These SSCs are generally associated with an active, risk-significant component, such as a pump or a valve, which is included within the RAP scope. The reliability of the passive components is typically much higher than that for an active component. In addition, the passive component reliability implicitly falls under the "umbrella" of its corresponding, active risk significant component. Therefore these passive components are omitted from the RAP scope.

17.4.3.4 Expert Panel

The RAP Expert Panel organization, qualifications and duties are defined in Reference 8. The panel includes personnel with experience in PRA, safety analysis, operations, maintenance, design engineering and systems engineering. These disciplines are selected

to ensure that the panel membership breadth of experience will be sufficient to properly evaluate SSC risk significance.

The panel membership consists of the following:

1) RAP Coordinator

2) PRA Engineer

3) Safety Engineer (provides safety analysis expertise)

4) Operations representative

5) Maintenance representative

6) Design Engineer

7) Site Engineer (provides system engineering expertise)

8) Quality Assurance representative

Each member must have at least 6 years of nuclear industry experience. Except for the RAP Coordinator, all members must also have a minimum of 4 years of position-specific experience. The RAP Coordinator must meet this qualification for at least one specific discipline. All members are trained by the PRA Engineer on importance measures.

17.4.3.5 RAP Scope

Components within the D-RAP scope are listed in Table 17.4-1. This list includes the following information:

1) List of RAP systems, structures and components (SSCs), including identification numbers and descriptions

2) Basis for inclusion, including the analysis or evaluation (e.g., internal events or fire) that resulted in the risk-significant classification

3) Dominant Failure Modes

Component boundaries are not reproduced in the RAP list. SSC boundaries have been defined in the DCD Section 19.1, Table 19.1-18.

The RAP list of risk-significant components and their DFMs is revisited following each PRA model revision. The scope, or any part thereof, can also be re-evaluated between model revisions if new information is obtained concerning design changes, modeling assumptions or possible errors.

17.4.3.6 Dominant Failure Modes (DFMs)

In addition to the list of components, Table 17.4-1 also lists the Dominant Failure Modes for each SSC. A failure mode is "dominant" if it is a basis for a risk-significant classification. For example, the DFMs for a specific valve might include a failure-to-open if that valve is required to open to perform a risk-significant function. These failure modes may be based upon quantitative PRA results or qualitative reviews.

The PRA model itself has been designed to be in conformance with the PRA quality requirements of Reference 19. These requirements include a comprehensive scope of initiating events, systems, components and failure modes in order to ensure that plant risk is effectively analyzed and quantified. These failure modes (e.g., a standby pump start in a risk-significant system would typically be included, as would any necessary valve re-alignments, etc.) are analyzed as a starting point in identifying the Dominant Failure Modes. Most DFMs will be identified in this manner. Additional DFMs can be identified by Expert Panel judgment.

DFMs are reviewed following each PRA model update, or upon request by any Expert Panel member.

17.4.3.7 QA Associated with Design Activities

The Quality Assurance (QA) program for the APR1400 design certification is described in Reference 1. The QA program is based on the requirements of Reference 3 and other, applicable regulatory documents or guides.

The overall QA program is described in Section 2 of Reference 1 and Design Control is specifically addressed in Section 3. The Reliability Assurance Program is not explicitly addressed but the RAP design activities fall under the general oversight of Section 3. See also DCD Sections 17.1, 17.2 & 17.3.

Appropriate QA controls for the nonsafety-related RAP SSCs are addressed in Section 17.5 and COL 17.4(2).

The APR1400 design process controls design inputs, outputs, changes, interfaces, records, and organizational interfaces.

Section 3.1 of Reference 1 notes that design processes ensure that items and activities under QA control are suitable for their intended application, consistent with their effect on safety. The extent of the design verification required is a function of the importance to safety.

Section 3.2 of Reference 1 requires that important design steps, including input sources, are documented.

Part III of Reference 1 specifically addresses quality control for non-safety-related components. It notes, for example, that "The specific program controls … are targeted at those characteristics ... that render the SSC a significant contributor to plant safety." Risk-significant SSCs that are non-safety-related will be subject to augmented quality requirements, above and beyond those for non-safety-related, low risk SSCs. These requirements include corrective actions for potential design and pre-operational errors that could degrade the SSCs.

17.4.3.8 ITAAC

Inspections, Tests, Analysis and Acceptance Criteria (ITAAC) are developed to meet multiple requirements, including the Design RAP. The ITAAC requirements verify the as-built configuration and performance characteristics of SSCs as identified in Tier 1 design descriptions. The ITAAC is described in Reference 14. DCD Sections 14.3.2.13 and 2.13 specifically address the Design Reliability Assurance Program. The D-RAP ITAAC requirements ensure that the various test requirements of the ITAAC reflect the latest available list of RAP components.

RAP components are addressed by the ITAAC to ensure that their performance is consistent with the key assumptions and risk insights that resulted in their classification.

17.4.3.9 The RAP During the COL Applicant Phase

During this phase, the Combined License applicant assumes RAP responsibilities. The RAP procedures are reviewed to ensure that they remain applicable. The COL applicant updates the RAP list of risk-significant SSCs and their DFMs with site-specific design information. The RAP list is then distributed to the affected organizations.

The COL applicant is also responsible for describing how it will integrate reliability assurance activities into existing programs (e.g., Maintenance Rule, surveillance testing, ISI, IST, maintenance and QA). Program procedures are developed for the operation phase, at which time the RAP functions will be assumed by the regulatory programs identified below. Procedures are developed to ensure that maintenance will be timely and effective for RAP equipment. QA procedures are developed for appropriate oversight of these programs.

17.4.3.10 The RAP During the Operations Phase

Once construction ends and the initial fuel load begins, the RAP also ends. However, its functions are assumed by specific operational programs including the Maintenance Rule, surveillance testing, ISI, IST, maintenance and quality assurance.

17.4.4 Reliability Assurance Program Information Included in the COL Application

The Combined License applicant shall provide the following in Chapter 17 of the safety analysis report:

COL 17.4(1) An updated description of the D-RAP to include relevant site- and plant-specific information (e.g., design, program, procedural, and organizational information). This includes identifying the SSCs within the scope of the plant-specific RAP (i.e., the RAP SSCs identified in the DC, updated using COL site- and plant-specific information) and establishing the programmatic controls of D-RAP to be applied during the COL design and construction activities prior to initial fuel load.

COL 17.4(2) Appropriate QA controls for the non-safety-related RAP SSCs in accordance with the provisions in Part V, "Non-safety-Related SSC Quality Controls," of SRP Section 17.5. This includes providing corrective actions for potential design and pre-operational errors that could degrade non-safety-related RAP SSCs. These controls are not applicable to SSCs that are not on the RAP list.

COL 17.4(3) The process for integrating the RAP into operational programs (e.g., maintenance rule program, QA program, inservice inspection, inservice testing, surveillance testing, and maintenance programs). The process should also address the (1) establishment of reliability, availability, or

condition performance goals for the RAP SSCs, (2) establishment of performance and condition monitoring requirements to provide reasonable assurance that RAP SSCs do not degrade to an unacceptable level of reliability, availability, or condition during plant operations, (3) for non-safety-related RAP SSCs, establishment of QA controls for activities during the operations phase in accordance with the provisions in Part V of SRP Section 17.5, and (4) consideration of dominant failure modes of RAP SSCs in meeting the objectives of the RAP during plant operation.

17.4.5 References

1. APR1400-K-Q-TR-11005-NP-A, "KHNP Quality Assurance Program Description (QAPD) for the APR1400 Design Certification," Rev. 2, KHNP, October 2016.

2. 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission.

3. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," U.S. Nuclear Regulatory Commission.

4. NUREG-0800, Standard Review Plan, Section 17.5, "Quality Assurance Program Description – Design Certification, Early Site Permit and New License Applicants," U.S. Nuclear Regulatory Commission, March 2007.

5. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Rev. 4a, April 2011.

6. Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Rev. 3, U.S. Nuclear Regulatory Commission, May 2012.

7. KHNP Procedure DC-DG-03-09, "Implementation of the Reliability Assurance Program (RAP)."

8. KHNP Procedure DC-DG-03-10, "Expert Panel Roles and Responsibilities."

9. KHNP Procedure DC-DG-03-11, "Risk Significance Determination of RAP SSCs."

10. KHNP Procedure DC-DG-03-24, "Risk Management Procedure."

11. APR1400-K-X-FS-14002-P, Tier 2, Chapter 19, "Probabilistic Risk Assessment and Severe Accident Evaluation," Rev. 3, KHNP, July 2018.

12. NUREG-0800, Standard Review Plan, Section 19.0, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors," Rev. 3, U.S. Nuclear Regulatory Commission, December 2015.

13. NUREG-0800, Standard Review Plan, Section 17.4, "Reliability Assurance Program," Rev. 1, U.S. Nuclear Regulatory Commission, May 2014.

14. APR1400-K-X-FS-14002-NP, Tier 2, Chapter 14, "Verification Programs," Rev. 1, KHNP, March 2017.

15. KHNP Procedure DC-DG-03-01, "Design Change Control."

16. KHNP Procedure DC-DG-16-01, "Corrective Action Program."

17. KHNP Procedure DC-DG-03-05, "Technical Audit at Supplier's Facility."

18. KHNP Procedure DC-DG-03-23, "Implementation of Severe Accident Mitigation Design Alternatives."

19. ASME/ANS RA-Sa-2009, Addenda to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk for Nuclear Power Plant Applications," The American Society of Mechanical Engineers, 2009.

Table 17.4-1 (1 of 32)

Reliability Assurance Program Systems, Structures & Components [8]

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Motor-Driven Auxiliary Feedwater Pump trains				
AF	PP02A/B	Motor-Driven Pumps	Level 1 AP: IE, FIRE, FLD, SMA Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, FLD, SMA Level 2 SD:	Test & Maintenance Fail to start Fail to run
MDP Normal Discharge to Steam Generators				
AF	CV1003A/B	Motor-Driven Pump Discharge Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FLD Level 2 SD:	Fail to open
AF	SOV0035/0036	Motor-Driven Pump Discharge Modulation Solenoid-Operated Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE Level 2 SD:	Spurious closure Fail to operate
AF	MV043/044	Motor-Driven Pump Discharge Isolation Motor-Operated Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: FLD Level 2 AP: IE, FLD Level 2 SD:	Spurious operation Fail to open Fail to close
AF	CV1007A/B	Motor-Driven Pump Discharge Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FLD Level 2 SD:	Fail to open

Table 17.4-1 (2 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
MDP Recirculation Discharge				
AF	CV1012A/B	Motor-Driven Pump Mini-flow Line Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FLD Level 2 SD:	Fail to open
Turbine-Driven Auxiliary Feedwater Pump trains				
AF	PP01A/B	Turbine-Driven Pumps	Level 1 AP: IE, FIRE, FLD, SMA Level 1 SD: IE Level 2 AP: IE, FIRE, FLD, SMA Level 2 SD: Expert Panel : seismic	Test & Maintenance Fail to start Fail to run
TDP Normal Discharge to Steam Generators				
AF	CV1004A/B	Turbine-Driven Pump Discharge Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE Level 2 AP: Level 2 SD:	Fail to open
AF	SOV0037/0038	Turbine-Driven Pump Discharge Modulation Valves	Expert Panel	Spurious closure
AF	MV045/046	Turbine-Driven Pump Discharge Isolation Motor-Operated Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE, FIRE, FLD Level 2 SD:	Spurious operation Fail to open Fail to close
AF	CV1008A/B	Turbine-Driven Pump Discharge Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE Level 2 AP: Level 2 SD:	Fail to open
TDP Recirculation Discharge				
AF	CV1014A/B	Turbine-Driven Pump Mini-flow Line Check Valves	Level 1 AP: IE Level 1 SD: IE Level 2 AP: Level 2 SD:	Fail to open

Table 17.4-1 (3 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Steam Supply to the Turbine-Driven AF Pumps				
AT	CV1020A/B	AF Turbine-Driven Pump Steam Supply Check Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to open
AT	AV009/010	AF Turbine-Driven Pump Steam Supply Isolation Air-Operated Valves	Level 1 AP: IE, FLD Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to open
Auxiliary Feedwater Storage & Transfer Normal Suction to AF Pumps				
AX	TK01A/B	Auxiliary Feedwater Storage Tanks	Expert Panel	Leak or rupture
Alternate AF suction from CST				
AX	CV1630	CST Suction Check Valve	Expert Panel	Fail to open
AX	CV1628/1629	CST Suction Check Valves	Level 1 AP: FIRE Level 1 SD: Level 2 AP: Level 2 SD:	CCF to open
AF Tank Refill				
AX	CV1600	Demineralized Water Common Header Check Valve	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fail to open
Condenser Vacuum System				
CA	CV1023	Containment Isolation Check Valve	Level 1 AP: Level 1 SD: Level 2 AP: Level 2 SD: FIRE	Fail to close

Table 17.4-1 (4 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Component Cooling System				
CC	TK01A/B	Component Cooling Water Surge Tanks	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE Level 2 SD: IE, FIRE, SMA	Leak or rupture
CC	V1121/1122/1123/1124	CC Pump Suction Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
CC	PP01A/B PP02A/B	Component Cooling Water Pumps	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA Expert Panel : seismic	Test & Maintenance Fail to start Fail to run
CC	CV1001/1002/1003/1004	Component Cooling Water Pump Discharge Check Valves	Level 1 AP: IE Level 1 SD: FLD Level 2 AP: FIRE, FLD Level 2 SD: SMA	Fail to open Fail to close
CC	V1007/1008/1009/1010	CC Pump Discharge Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
CC	V1013/1014	HE Header Inlet Isolation Manual Valves	Expert Panel	Spurious closure
CC	HE01A/B HE02A/B	Component Cooling Water Heat Exchangers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Loss of heat transfer
CC	HE03A/B	Component Cooling Water Heat Exchangers	Expert Panel (should be same as HE01A/B & HE02A/B)	Loss of heat transfer

Table 17.4-1 (5 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Component Cooling (cont.)				
CC	V1211/1212	HE01A/B Outlet Manual Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	Spurious closure
CC	MV021/022/023 MV024/025/026	Component Cooling Water Heat Exchanger Discharge Motor-Operated Valves	Expert Panel	Fail to operate
CC	MV027/028	Component Cooling Water Heat Exchanger Bypass Motor-Operated Valves	Expert Panel	Fail to operate
Various CC Loads				
CC	MV097/098	CS Heat Exchanger 1A/1B CC Inlet Motor-Operated Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: IE, FLD Level 2 SD:	Fail to open
CC	MV131/132	Essential Chiller 2A/B CC Outlet Motor-Operated Valves	Level 1 AP: FLD Level 1 SD: FLD Level 2 AP: FLD Level 2 SD:	Fail to open
CC	MV143/145/147/149 MV144/146/148/150	Non-Safety Load Supply and Return Isolation Motor-Operated Valves	Level 1 AP: IE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FLD Level 2 SD: IE, FIRE	CCF to close
CC	MV181/182 MV191/192	EDG CC Inlet Motor-Operated Valves	Level 1 AP: IE Level 1 SD: IE, FLD, SMA Level 2 AP: FIRE Level 2 SD: IE, FIRE, SMA	Fail to open

Table 17.4-1 (6 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Various CC Loads (cont.)				
CC	MV351/352	Shutdown Cooling Heat Exchanger 1A/B CC Inlet Motor-Operated Valves	Level 1 AP: Level 1 SD: FLD, SMA Level 2 AP: Level 2 SD: IE	Fail to open
CC	MV383/384	Essential Chiller 1A/1B CC Outlet Motor-Operated Valves	Expert Panel	Fail to operate
CC	V1561/1562	Essential Water Chiller Condenser CH01A/B Iutlet Manual Valves	Expert Panel (similar to CH02A/B valve)	Spurious closure
CC	V1563/1564	Essential Water Chiller Condenser CH01A/B Outlet Manual Valves	Expert Panel (similar to CH02A/B vlave)	Spurious closure
CC	V1261/1262	Essential Water Chiller Condenser CH02A/B Inlet Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
CC	V1263/1264	Essential Water Chiller Condenser CH02A/B Outlet Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
CC	V1281/1282 V1291/1292	DG 01A/B/C/D Outlet Manual Valves	Level 1 AP: IE Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: FIRE, SMA	Spurious closure
Containment Spray System				
CS	PP01A/B	Containment Spray Pumps	Level 1 AP: IE, FLD, SMA Level 1 SD: IE Level 2 AP: IE, FLD, SMA Level 2 SD: IE, SMA	Test & Maintenance Fail to start CCF to run
CS	CV1001/1002	Containment Spray Pump Discharge Check Valves	Level 1 AP: IE, FLD Level 1 SD: IE Level 2 AP: IE Level 2 SD:	CCF to open

Table 17.4-1 (7 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Containment Spray System (cont.)				
CS	HE01A/B	Containment Spray Heat Exchangers	Level 1 AP: IE, SMA Level 1 SD: Level 2 AP: IE, FLD, SMA Level 2 SD:	Loss of heat transfer Test & Maintenance
CS	MV001/002	Containment Spray Heat Exchanger Discharge Isolation Motor-Operated Valves	Level 1 AP: IE Level1SD: Level 2 AP: IE Level 2 SD:	Spurious closure
CS	MV003/004	Containment Spray Heat Exchanger Discharge Isolation Motor-Operated Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: IE, FLD Level 2 SD:	Fail to open
CS	CV1007/1008	Containment Spray Heat Exchanger Discharge Check Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to open
CS	Pumping Device Connections Water Source	Key Components in Emergency Containment Spray Backup System (ECSBS)[10]	Expert Panel	Fail to operate
CS Mini-flow Recirculation				
CS	HE02A/B	Containment Spray Mini-flow Line Heat Exchangers	Level 1 AP: IE Level 1 SD: Level 2 AP: IE, FLD Level 2 SD:	Test & Maintenance

Table 17.4-1 (8 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Chemical & Volume Control System				
CV	CV189	IRWST Return Line Check Valve	Level 1 AP: Level 1 SD: Level 2 AP: Level 2 SD: FIRE	Fail to open
CV	AV505/506	Containment Isolation RCP to VCT AOVs	Level 1 AP: Level 1 SD: Level 2 AP: FLD Level 2 SD: FIRE	Fail to close
CV	AV522/523	Regenerative HX outlet AOVs	Expert Panel	Fail to close
CV	AV560/561	Reactor Drain Tank outlet AOVs	Expert Panel	Fail to close
Alternate AC Diesel Generator				
DA	TK01	AAC Fuel Oil Storage Tank	Expert Panel (SBO)	Leak or rupture
DA	PP01/02	AAC Fuel Oil Transfer Pumps	Expert Panel (SBO)	Test & Maintenance Fail to start Fail to run
DA	CV1005/1007	AAC Fuel Oil Transfer Pump Discharge Check Valves	Expert Panel (SBO)	Fail to open
DA	TK02	AAC Fuel Oil Day Tank	Expert Panel (SBO)	Leak or rupture
DA	AACTG	AAC Gas Turbine Generator	Level 1 AP: IE, FIRE Level 1 SD: IE Level 2 AP: IE, FIRE Level 2 SD: IE	Test & Maintenance Fail to run

Table 17.4-1 (9 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
DC Buses & Batteries				
DC	BC01A/B/C/D BC02A/B/C/D	Class 1E 125V DC Battery Chargers	Level 1 AP: IE, FIRE Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to operate
DC	BT01A/B/C/D	Class 1E 125V DC Batteries	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD, SMA Level 2 SD: IE, FIRE, SMA Expert Panel : seismic	Test & Maintenance Fail to operate
DC	MC01A/B/C/D	Class 1E 125V DC Buses	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD, SMA Level 2 SD: IE, FIRE, SMA	Fail to operate
DC	MC01M/01N	Non-Class 1E 125V DC Buses	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
Radioactive Drains System				
DE	AV006	Radioactive Drain System - Containment Isolation Valve	Level 1 AP: Level 1 SD: Level 2 AP: FIRE, FLD Level 2 SD: IE, FIRE	Fail to close
DE	MV005	Radioactive Drain System - Containment Isolation Valve	Expert Panel	Fail to close

Table 17.4-1 (10 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Emergency Diesel Generators				
DG	DG A/B/C/D	Emergency Diesel Generators, including the day tanks (DOTK02A/B/C/D)	Level 1 AP: IE, FIRE, FLD, SMA Level 1 SD: IE, FIRE, FLD, SMA Level 2 AP: IE, FIRE, FLD, SMA Level 2 SD: IE, FIRE, SMA Expert Panel : seismic	Test & Maintenance Fail to start Fail to run
DG	SEQ A/B/C/D	DG Load Sequencers	Level 1 AP: IE, FIRE, SMA Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, SMA Level 2 SD: IE, FIRE, SMA	Fail to operate
Diesel Fuel Oil Transfer System				
DO	TK 01A/B/C/D	Diesel Fuel Oil Storage Tanks	Level 1 AP: Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: FIRE	Leak or rupture
DO	LS3025A/B/C/D	Fuel Oil Tank Level Switches	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD: IE	Fail to operate
DO	V1002A/B/C/D V1009A/B/C/D V1010A/B/C/D	FOTP Suction Manual Valves	Level 1 AP: IE Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: FIRE, SMA	Spurious closure
DO	PP01A/B/C/D PP02A/B/C/D	Diesel Fuel Oil Transfer Pumps	Level 1 AP: IE, FIRE Level 1 SD: IE, FLD Level 2 AP: IE Level 2 SD: IE, FIRE	CCF to start CCF to run

Table 17.4-1 (11 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Diesel Fuel Oil Transfer System (cont.)				
DO	CV1005A/B/C/D CV1007A/B/C/D	FOTP Discharge Manual Valves	Level 1 AP: IE, FIRE Level 1 SD: IE Level 2 AP: Level 2 SD:	CCF to open
DO	V1015A/B/C/D V4011A/B/C/D	FOTP Discharge Manual Valves	Level 1 AP: IE Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: FIRE, SMA	Spurious closure
Diverse Protection System				
DP	HS071A/B	Diverse Protection System Manual Trip Push Buttons	ATWS, Expert Panel	Fail to operate
DP	PLC1/PLC2	Diverse Protection System (DPS) Signal Processors	ATWS, Expert Panel	Fail to operate
Fire Protection System				
FP	Fire barriers between rooms:			
	Fire suppression subsystems	Control Room & Switchgear Room fire suppression	Expert Panel	Fail to operate
	F000-ADGD & F100-A06D	Diesel Generator room D and General access area at 100’ D	Level 1 AP: FIRE Level 1 SD: FIRE Level 2 AP: FIRE Level 2 SD: FIRE	Barrier Failure
	F078-AGAC & F078-AGAD	General access areas 78’ C and 78’ D		
	F100-A06D & F100-AGAC	General access areas 100’ D and 100’ C		
	F120-A05D & F120-AGAD	Electrical equipment room 120’ D and general access area 120’ D		
	F120-AGAC & F120-AGAD	General access areas 120’ C and 120’ D		
	F137-A02D & F157-AMCR	Electrical equipment room 137’ D and Main control room		

Table 17.4-1 (12 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Feedwater System				
FW	V1025	Startup Feedwater Pump Suction Valve	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Spurious closure
FW	PP07	Startup Feedwater Motor-Driven Pump	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	Test & Maintenance Fail to start Fail to run
FW	CV1026	Startup Feedwater Pump Discharge Check Valve	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to open
FW	CV058	Startup Feedwater Pump Discharge Stop Check Valve	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to open
FW	MV093	Startup Feedwater Pump Discharge Isolation Motor-Operated Valve	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to open

Table 17.4-1 (13 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Gaseous Radwaste System				
GW	SV002	Gaseous Radwaste System - Containment Isolation Valve	Level 1 AP: Level 1 SD: Level 2 AP: FIRE, FLD Level 2 SD: IE, FIRE	Fail to open
GW	MV001	Containment Isolation Valve	Level 1 AP: Level 1 SD: Level 2 AP: Level 2 SD: FIRE	Fail to close
Hydrogen Control System				
HG	HI01 through 10	Hydrogen Igniters	Expert Panel	Fail to operate
HG	PARs	Passive Autocatalytic Recombiners	Level 1 AP: Level 1 SD: Level 2 AP: Level 2 SD: IE, FIRE	Fail to operate
Instrument Power (120 VAC) System				
IP	IN01A/B/C/D	Class 1E 120V AC Inverters	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE, FIRE, FLD Level 2 SD:	Test & Maintenance Fail to operate
In-Containment Refueling Water Storage Tank System				
IW [11]	HVT trash racks ST01A/B/C/D	In-containment Refueling Water Storage Tank (IRWST) Holdup Volume Tank (HVT) trash racks IRWST sump strainers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE Expert Panel (confirms both racks and strainers)	Plugged

Table 17.4-1 (14 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Main Steam System				
MS	ADV101/102/103/104	Main Steam Atmospheric Dump Valves	Level 1 AP: IE Level 1 SD: FIRE Level 2 AP: IE Level 2 SD:	CCF to open (mechanical, electrical or I&C faults)
MS	SV1301 through 1320	Main Steam Safety Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE Level 2 SD:	CCF to open
MS	MSIV011/012/013/014	Main Steam Isolation Valves	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to close
MS	AV109/110	Auxiliary Feedwater Pump Turbine Steam Supply Air-Operated Valves	Level 1 AP: IE, FLD Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to open
Non-Class 1E 4.16 kV System				
NB	SW01M	Non-1E 4.16KV Switchgear	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate

Table 17.4-1 (15 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Non-Class 1E 480V Load Center System				
NG	LC05N/10M	Non-1E 480V Load Centers	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
NG	TR05N/10M	Non-1E 480V Load Center Transformers	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
Non-Class 1E 480V MCC & Low Voltage System				
NH	MC03M/20N	Non-1E 480V MCCs	Level 1 AP: IE, FIRE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
13.8 kV Power System				
NP	SW02N	Non-1E 13.8 kV Switchgear for FW PP07	Level 1 AP: IE Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
NP	TR01/02/03	Main Transformers	Level 1 AP: IE, FLD Level 1 SD: IE, FIRE Level 2 AP: IE, FLD Level 2 SD: IE, FIRE	Fail to operate
NP	TR01M/01N	Unit Auxiliary Transformers	Level 1 AP: IE, FLD Level 1 SD: IE, FIRE Level 2 AP: IE, FLD Level 2 SD: IE, FIRE	Fail to operate

Table 17.4-1 (16 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
13.8 kV Power System (cont.)				
NP	TR02M/02N	Standby Auxiliary Transformers	Level 1 AP: FIRE, FLD Level 1 SD: FIRE Level 2 AP: FIRE, FLD Level 2 SD: FIRE	Test & Maintenance Fail to operate
NP	IPB43000A	Iso-Phase Bus	Level 1 AP: IE, FLD Level 1 SD: IE, FIRE Level 2 AP: IE, FLD Level 2 SD: IE, FIRE	Fail to operate
I&C Equipment Rm & Computer Room Panels & Cabinets				
PA (listed as EF in the last RAP list)	PA06C/D	Digital Output Modules (PA06C/D branches 01/02/03/04) Primary Loop Controller (PA06C/D)	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Fail to operate
ESF Component Control System (All PE components were identified as LOOP CONTROLLERS in the last RAP list revision)				
PE	LX01A/B/C/D LX02C/D LX05A/B	Analog Input Modules	Level 1 AP: IE, FIRE Level 1 SD: FLD Level 2 AP: IE, FLD Level 2 SD: SMA	Fail to operate
PE	LX03D	Digital Input Module	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Fail to operate

Table 17.4-1 (17 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
ESF Component Control System (cont.)				
PE	LX001A/B/C/D LX02B/D LX03C/D LX04B LX05A/B/C/D LX08A LX09B	Digital Output Modules	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Fail to operate
PE	LX01A/B/C/D LX02B/D LX03A/B/C/D LX04B LX05A/B/C/D LX08A LX09B	Primary Loop Controllers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Fail to operate
Class 1E 4.16 kV Subsystem				
PF	SW01A/B/C/D	Class 1E 4.16 kV Switchgear	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Fail to operate
PF	SW01A/B-A2	Class 1E 4.16 kV Switchgear PCB from SAT	Level 1 AP: FIRE, FLD Level 1 SD: FLD Level 2 AP: FIRE, FLD Level 2 SD:	Fail to close
PF	SW01A-H2 SW01B-H2 SW01C-C2 SW01D-G2	Class 1E 4.16 kV Switchgear PCB (UAT)	Level 1 AP: IE, FLD, SMA Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FLD, SMA Level 2 SD: IE, FIRE	Fail to open

Table 17.4-1 (18 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Class 1E 480V Load Center Subsystem				
PG	LC01A/B/C/D	Class 1E 480V Load Centers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Fail to operate
PG	TR01A/B/C/D	Class 1E 480V Load Center Transformers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Fail to operate
Class 1E 480V MCC & Low Voltage Subsystem				
PH	MC01A/B/C/D	Class 1E 480V Motor Control Centers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: FIRE, SMA	Fail to operate
PH	MC02A/B/C/D	Class 1E 480V Motor Control Centers	Level 1 AP: FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: FLD Level 2 SD: FIRE, SMA	Fail to operate
PH	MC03A/B/C/D	Class 1E 480V Motor Control Centers	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD: FIRE	Fail to operate

Table 17.4-1 (19 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Class 1E 480V MCC & Low Voltage Subsystem (cont.)				
PH	MC04A/B/C/D	Class 1E 480V Motor Control Centers	Level 1 AP: IE, FIRE Level 1 SD: FLD Level 2 AP: Level 2 SD:	Fail to operate
PH	MC05A/B	Class 1E 480V Motor Control Centers	Level 1 AP: Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: FIRE, SMA	Fail to operate
Process-Component Control System				
PO	LX-54/58/70	P-CCS Loop Controllers	Level 1 AP: IE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fail to operate
Plant Protection System				
PP	-	BPM, GC, LC, LCL application software and Operating system software	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	CCF to operate
Reactor Coolant System				
RC	SRV200/201/202/203	Pressurizer Pilot-Operated Safety Relief Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE, FIRE, FLD Level 2 SD:	Fail to open Fail to close
RC	MV130/131/132/133 134/135/136/137	POSRV Pilot Motor-Operated Valves	Level 1 AP: FIRE, FLD Level 1 SD: Level 2 AP: FIRE, FLD Level 2 SD:	Fail to open

Table 17.4-1 (20 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Reactor Coolant System (cont.)				
RC	INV01A/B/C/D	Inverters for Motor Operated POSRVs	Level 1 AP: FIRE, FLD Level 1 SD: FIRE, FLD Level 2 AP: Level 2 SD:	Fail to operate
RC	PP01A/B PP02A/B	RC Pump trip circuits	Expert Panel	Fail to operate
RC		Core Exit Thermocouples	Expert Panel	Fail to operate
RC	LT 40 LET 41	Shutdown Level Transmitters LT 40 (spool piece) LET 41 (ultrasonic level measurement)	Expert Panel	Fail to operate
Reactor Coolant Gas Vent System				
RG	SOV410/411/412/413	Pressurizer Gas Vent Line Isolation Solenoid-Operated Valves	Expert Panel	Fail to operate
RG	SOV414/415/416/417	Reactor Vessel Gas Vent Line Isolation Solenoid-Operated Valves	Expert Panel	Fail to open
RG	SOV418	Reactor Vessel Gas Vent Line RDT Discharge Isolation Solenoid-Operated Valve	Expert Panel	Fail to operate
RG	SOV419/420	Reactor Vessel Gas Vent Line IRWST Discharge Isolation Solenoid-Operated Valves	Expert Panel	Fail to operate
Reactor Protection System				
RP	PA14A/B/C/D	Plant Protection System Cabinets (Analog input modules Bistable process modules Digital output modules Protection relays)	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	CCF to operate
RP	SW01A/B/C/D	Reactor Trip Switchgear (UV/shunt trip devices)	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	CCF to energize
RP	TCB A-1/B-1/C-1/D-1 TCB A-2/B-2/C-2/D-2	Reactor Trip Circuit Breakers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE Level 2 AP: IE, FIRE, FLD Level 2 SD:	CCF to open

Table 17.4-1 (21 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Safety Injection Normal Suction and Discharge				
SI	CV157/158	IRWST Suction Check Valves	Level 1 AP: IE, FLD Level 1 SD: IE Level 2 AP: IE Level 2 SD:	CCF to open
SI	MV304/305/308/309	IRWST Suction MOVs to SI/SC Pumps	Level 1 AP: FIRE Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: IE, FIRE	Spurious closure
SI	V130/131/402/470	Safety Injection Pump Suction Manual Valves	Level 1 AP: FIRE Level 1 SD: IE, FLD Level 2 AP: Level 2 SD: IE	Spurious closure
SI	PP02A/B/C/D	Safety Injection Pumps	Level 1 AP: IE, FIRE, FLD, SMA Level 1 SD: IE, FIRE, FLD, SMA Level 2 AP: IE, SMA Level 2 SD: IE, FIRE, SMA	Test & Maintenance Fail to start Fail to run
SI	CV404/405/434/446	Safety Injection Pump Discharge Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE Level 2 SD: IE, FIRE	Fail to open
SI	V435/447/476/478	Safety Injection Pump Discharge Manual Valves	Level 1 AP: IE, FIRE Level 1 SD: IE, FIRE, FLD Level 2 AP: Level 2 SD: IE	Spurious closure

Table 17.4-1 (22 of 32)

System (1)	SSC ID(s) (2)	SSC Description	Risk Significance Basis (3), (4), (5)	Dominant Failure Modes (6),(7)
Safety Injection Normal Suction and Discharge (cont.)				
SI	MV616/626/636/646	Safety Injection Pump Discharge Isolation Motor-Operated Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE Level 2 SD: IE, FIRE, SMA	Fail to open
SI	CV113/123/133/143	Safety Injection Pump 2A/B/C/D Injection Line Check Valves	Level 1 AP: FIRE Level 1 SD: IE, FIRE, FLD Level 2 AP: Level 2 SD: IE, FIRE, SMA	Fail to open
SI	CV540/541/542/543	Safety Injection Pump Discharge Check Valves	Level 1 AP: FIRE Level 1 SD: IE, FIRE, FLD Level 2 AP: Level 2 SD: IE, FIRE, SMA	Fail to open
SI	CV217/227/237/247	Safety Injection Line DVI Nozzle Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE Level 2 SD: IE, FIRE, SMA	Fail to open
Safety Injection Recirculation to IRWST				
SI	CV424/426/448/451	Safety Injection Mini-flow Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE Level 2 SD:	Fail to open
SI	V410/411/412/413	Safety Injection Pump Mini-flow Line Manual Valves	Level 1 AP: FIRE Level 1 SD: Level 2 AP: Level 2 SD:	Spurious closure

Table 17.4-1 (23 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Safety Injection Recirculation to IRWST (cont.)				
SI	MV302/303	Safety Injection Pump 2A/B/C/D Mini-flow Line Isolation Motor-Operated Valves	Level 1 AP: Level 1 SD: Level 2 AP: FIRE Level 2 SD:	Spurious closure
SI	CV100/101	Safety Injection Pump 2A/B/C/D IRWST Return Line Check Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: IE, FIRE Level 2 SD:	Fail to open
Shutdown Cooling Subsystem				
SDC Alternate Suction from IRWST				
SI	CV159/160	IRWST Suction Check Valves	Level 1 AP: IE, FLD Level 1 SD: IE Level 2 AP: IE Level 2 SD: SMA	CCF to open
SDC Pump Suction and Discharge				
SI	PP01A/B	Shutdown Cooling Pumps	Level 1 AP: IE, FLD, SMA Level 1 SD: IE, FLD, SMA Level 2 AP: SMA Level 2 SD: SMA	CCF to start Fail to run
SI	CV568/569	Shutdown Cooling Pump Discharge Check Valves	Level 1 AP: Level 1 SD: IE, FLD Level 2 AP: IE Level 2 SD: SMA	Fail to open
SI	HE01A/B	Shutdown Cooling Heat Exchangers	Level 1 AP: SMA Level 1 SD: FLD Level 2 AP: SMA Level 2 SD:	Loss of heat transfer
SI	CV168/178	Shutdown Cooling Heat Exchanger Discharge Check Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD: SMA	Fail to open

Table 17.4-1 (24 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Shutdown Cooling Mini-flow Lines				
SI	HE02A/B	Shutdown Cooling Mini-flow Line Heat Exchangers	Level 1 AP : SMA Level 2 AP : SMA Expert Panel	Loss of heat transfer
SDC Recirculation to IRWST				
SI	MV395	Shutdown Cooling Pump PP01A Mini-flow Isolation Valve (the redundant valve opposite 395 is manual valve 959)	Level 1 AP: IE, FIRE Level 1 SD: Level 2 AP: Level 2 SD:	Spurious closure
SI	V959	Shutdown Cooling Pump PP01B Mini-flow Isolation Valve (the redundant valve opposite V959 is motor-operated valve MV395)	Level 1 AP: IE, FIRE Level 1 SD: Level 2 AP: FIRE Level 2 SD:	Spurious closure
Essential Service Water System				
SX [9]	PP01A/B PP02A/B	Essential Service Water Pumps	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Test & Maintenance Fail to start Fail to run
SX [9]	CV1001/1002 CV1003/1004	Essential Service Water Pump 1A/B & 2A/B Discharge Check Valves	Level 1 AP: IE Level 1 SD: FLD Level 2 AP: FLD Level 2 SD: SMA	Fail to open Fail to close
SX [9]	MV045/046/047/048	Essential Service Water Pump Discharge Motor-Operated Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure

Table 17.4-1 (25 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Essential Service Water System (cont.)				
SX [9]	FT01A/B FT02A/B FT03A/B	Essential Service Water Debris Filters	Level 1 AP: IE, FIRE, FLD Level 1 SD: FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: FIRE	CCF plugging
SX [9]	MV071/072/073/074	Ultimate Heat Sink Cooling Tower Control Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: FIRE, SMA	Fail to open Spurious closure
SX [9]	MV075/076/077/078	Ultimate Heat Sink Cooling Tower Line Bypass Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FLD Level 2 SD: IE, FIRE, SMA	Spurious opening
SX [9]	AH01A/B AH02A/B	Ultimate Heat Sink Cooling Tower Fans	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Test & Maintenance Fail to start Fail to run
Control Room HVAC System				
VC	AH01A/B AH02A/B HV01A/B AU01A/B	Main Control Room Air Handling Units (AHs), Chillers (HVs) and Air Cleaning Units (AUs)	Expert Panel	Fail to operate
Emergency Diesel Generator Area HVAC System				
VD	HV12A/B/C/D HV13A/B/C/D	DG Room Emergency Cubicle Coolers	Level 1 AP: IE Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE Level 2 SD: IE, FIRE, SMA	Test & Maintenance Fail to start Fail to run

Table 17.4-1 (26 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
ESW Intake Structure/CCHX Bldg HVAC System				
VG [7]	AH01A/B AH02A/B	ESW Pump Room Supply Fans	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Test & Maintenance Fail to start Fail to run
VG [7]	Y1011A/B	ESW Pump Room Fans 2A/B - Exhaust Dampers	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Fail to open
Auxiliary Building Controlled Area HVAC System				
VK	HV13A/B HV14A/B	CC Pump Cubicle Coolers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Test & Maintenance Fail to start Fail to run
Auxiliary Building Clean Area HVAC System				
VO	HV31A/B	Essential Chiller 1A/B Room Coolers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Fail to start Fail to run
VO	HV32A/B	Essential Chiller 2A/B Room Coolers	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Test & Maintenance Fail to start CCF to run
VO	HV33A/B	Auxiliary Feedwater Motor-Driven Pump 2A/B Room Coolers	Level 1 AP: IE, FIRE, FLD Level 1 SD: FLD Level 2 AP: IE, FIRE, FLD Level 2 SD:	Test & Maintenance Fail to start Fail to run

Table 17.4-1 (27 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Makeup Demineralizer System				
WM	V1201A	Raw Water Pump Supply Isolation Manual Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Spurious closure
WM	V1205A/1220/1700	Raw Water Pump Discharge Isolation Manual Valves	Level 1 AP: IE, FIRE, FLD Level 1 SD: Level 2 AP: Level 2 SD:	Spurious closure
Essential Chilled Water System				
WO	V1008A/B	Quadrant Return Header Isolation Manual Valves	Expert Panel	Spurious closure
WO	TK01A/B	Essential Chilled Water Compression Tanks	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Leak or rupture
WO	TK02A/B	Essential Chilled Water Air Separator Tanks	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FIRE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Leak or rupture
WO	V1009A/B V1013A/B	ECW Pumps 01A/B & 02A/B Suction Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure

Table 17.4-1 (28 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Essential Chilled Water System (cont.)				
WO	PP01A/B PP02A/B	Essential Chilled Water Pumps	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Test & Maintenance Fail to start Fail to run
WO	CV1010A/B CV1014A/B	ECW Pump Discharge Check Valves	Level 1 AP: IE Level 1 SD: FLD Level 2 AP: FIRE Level 2 SD: SMA	Fail to open
WO	V1012A/B V1016A/B	ECS Pump Discharge Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
WO	V1019A/B V1023A/B	Essential Chiller 01A & B and 02A & B Inlet Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
WO	CH01A/B CH02A/B	Essential Chilled Water Chillers (includes evaporator, compressor, condenser and associated piping)	Level 1 AP: IE, FIRE, FLD Level 1 SD: IE, FLD, SMA Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE, SMA	Test & Maintenance Fail to start Fail to run
WO	V1020A/B V1024A/B	Essential Chiller 01A & B and 02A & B Outlet Manual Valves	Level 1 AP: Level 1 SD: FLD Level 2 AP: Level 2 SD:	Spurious closure
WO	V1027A/B V1028A/B	Quadrant Header Supply Isolation Manual Valves	Expert Panel	Spurious closure

Table 17.4-1 (29 of 32)

System [1]	SSC ID(s) [2]	SSC Description	Risk Significance Basis [3], [4], [5]	Dominant Failure Modes [6],[7]
Turbine Generator Building Closed Cooling Water System				
WT	TK01	Turbine Generator Building Closed Cooling Water Tank	Level 1 AP: IE Level 1 SD: Level 2 AP: IE Level 2 SD:	Leak or rupture
WT	PP01/02	Turbine Generator Building Closed Cooling Water Pumps	Level 1 AP: FIRE Level 1 SD: Level 2 AP: Level 2 SD:	Test & Maintenance
WT	PT04	PP01 & 02 Pump Discharge PT Interlock	Level 1 AP: FLD Level 1 SD: Level 2 AP: Level 2 SD:	Fails to operate
Miscellaneous				
-	-	Control Room Emergency Lighting Remote Shutdown Console Emergency Lighting	Expert Panel	Fail to operate
-	-	Containment Building	Expert Panel	Integrity failure
-	-	Containment Equipment Hatch	Level 1 AP: Level 1 SD: Level 2 AP: IE, FIRE, FLD Level 2 SD: IE, FIRE	Fail to close
-	-	Remote Shutdown Console (RSC)	Expert Panel	Fail to operate

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NOTES:
(1) System codes are defined below.
(2) In some cases, additional SSCs may have been added by symmetry; i.e., if at least one train or division met the PRA importance criteria but the redundant trains did not, then those trains may have been added to the current RAP list. These are not specifically identified for purposes of brevity.
(3) AP = Full power; SD = Low Power & Shutdown; IE = Internal Events; FLD = Internal Flooding; FIRE = Internal Fires; SMA = PRA-based SMA.
(4) Individual components are included if any modeled basic event (a failure event or a maintenance unavailability) has a Risk Achievement Worth (RAW) > 2, or a Fussell-Vesely (FV) > 0.005, for at least one redundant train, for any of the available AP or SD analyses of Internal Events, Fire or Flood initiating events, for Level 1 (CDF) or Level 2 (LRF). Components are also included if they are part of a Common Cause Failure (CCF) event with a RAW > 20. If the basis is listed as the "Expert Panel" then the SSC has been included on the basis of professional judgment or another qualitative consideration. By definition, all SSCs within the RAP scope have been designated as risk-significant by the RAP Expert Panel
(5) Due to PRA model changes, the individual bases for risk-significance may have changed. These changes are not identified. However, if individual rows of SSCs have been added or deleted, these are identified in Tables 2 and 3 below.
(6) All run, run-first-hour, run-after-first-hour and load-and-run failure events are listed as "Fail to run" in this column.
(7) Battery failures between tests or following an initiating event are both classified as "Fail to operate" in this column.
(8) Potential RAP SSCs associated with loss of large area (LOLA) and aircraft impact assessment (AIA) described in DCD Sections 19.4 and 19.5 are not included in this table.
(9) The SX (including UHS) and VG systems are parts of the conceptual design information (CDI), and the SSC applicability will follow the conditions specified in DC Section 1.8.
(10) The ECSBS design has not been finalized. However, the function has been qualitatively determined to be risk significant.
(11) In earlier versions of the RAP notebook, the IW strainers were classified as risk significant. However, the September 2017 panel designated the coarse filtration trash racks as risk significant, but excluded the fine filtration strainers. Upon subsequent review of the strainer design report, the November 2017 panel determined that both the trash racks and the sump strainers should be designated as risk significant. PRA has an action to clarify the description of the associated basic event.

System Codes:
AF - Auxiliary Feedwater System
AT – Auxiliary Feedwater Pump Turbined System
AX –Auxiliary Feedwater Storage and Transfer
CA – Condenser Vacuum System
CC – Component Cooling Water System
CS – Containment Spray System
CV – Chemical and Volume Control System
DA – Alternate AC Diesel Generator System
DC – DC Distribution System
DE – Radioactive Drain System
DG – Emergency Diesel Generator System
DO – Diesel Fuel Oil Transfer System
NH – Non Class 1E 480V MCC & Low Voltage System
NP – 13.8 kV Power System
PA – I&C Equipment Room Panel System
PE – ESF Component Control System
PF – Class 1E 4.16 kV System
PG – Class 1E 480V Load Center System
PH – Class 1E 480V MCC & Low Voltage System
PO – Process-Component Control System
RC – Reactor Coolant System
RG – Reactor Coolant Gas Vent System
RP – Reactor Protection System
SI – Safety Injection/Shutdown Cooling System

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System Codes (cont.) :
DP – Diverse Protection System
FP – Fire Protection System
FW – Feedwater System
GC – Group Controller Cabinet
GW – Gaseous Radwaste System
HG – Containment Hydrogen Control System
IP – Instrument Power System
IW – In-Containment Water Storage System
LX – Loop Controller Cabinet
MS – Main Steam System
NB – Non Class 1E 4.16 kV System
NG – Non Class 1E 480V Load Center System
SX – Essential Service Water System
VC – Control Room HVAC System
VD – Emergency Diesel Generator Area HVAC System
VG – ESW Pump Building/CCW HX Building HVAC System
VK – Auxiliary Building Controlled Area HVAC System
VO – Auxiliary Building Clean Area HVAC System
VU – Miscellaneous Building HVAC System
WM – Makeup Demineralizer System
WO – Essential Chilled Water System
WT – Turbine Generator Building Closed Cooling Water System
WV – Liquid Radwaste System

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Component Codes:
ADV – Atmospheric Dump Valve
AH – Air Handler (fan)
AV – Air-Operated Valve
BC – Battery Charger
BT – DC Battery
CH (or HV) – Chillers or Coolers
CV – Check Valves
DG – Emergency Diesel Generator
FT – Filter
HE – Heat Exchanger
HS – Handswitch
HV (or CH) – Chillers or Coolers
IN – Inverter
IPB – Iso-Phase Bus
LC – Load Center (bus)
LIS – Level Indicating Switch
MC – Motor Control Center (bus)
MSIV – Main Steam Isolation Valve
MV – Motor-Operated Valve
PP – Pump
PT – Pressure Transmitter
RV – Relief Valve
SEQ – Diesel Generator Load Sequencer
SW – Switchgear
SOV – Solenoid-Operated Valve
SRV – Pilot-Operated Safety Relief Valve
SV – Safety Valve
TA – Turbine
TCB – Trip Circuit Breaker
TK – Tank
TR – Transformer
V – Manual Valve
Y – Damper

17.5 Quality Assurance Program Description – Design Certification

KHNP is the applicant for the APR1400 design certification. The QA program for the APR1400 design certification is described in Topical Report APR1400-K-Q-TR-11005-NP-A, Rev. 2, "KHNP Quality Assurance Program Description (QAPD) for the APR1400 Design Certification" (Reference 1). The QAPD is based on the requirements of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" ASME NQA-1-2008, and NQA-1a-2009 Addenda, "Quality Assurance Program Requirements for Nuclear Facilities," as endorsed by NRC RG 1.28, Rev. 4, "Quality Assurance Program Criteria (Design and Construction)" (References 2, 3, 4, and 5).

The QAPD has been prepared to comply with the guidance in SRP 17.5 (Reference 6). The Nuclear Energy Institute (NEI) 06-14, Rev. 9, "Quality Assurance Program Description (QAPD)" template has been used as a reference in preparing the QAPD (Reference 7).

The QAPD is a top-level document that describes the quality assurance policy, functional responsibilities, and administration control among organizations that perform the design activities for the APR1400 project. The applicant and its suppliers commit to conform to the QAPD. The QAPD applies the requirements of 10 CFR Part 50, Appendix B, for safety-related SSCs.

Selected elements of the QAPD are applied to SSCs that are important to safety but are not considered safety-related SSCs. These SSCs are defined as non-safety-related SSCs. The controls applied to non-safety-related SSCs are defined as augmented quality assurance controls. Representative examples of augmented SSCs are anticipated transients without scram (ATWS), station blackout, fire protection, seismic Category II SSCs, and risk-significant non-safety-related SSCs determined by the design RAP described in Section 17.4. Specific elements of the QAPD are applied to each augmented SSC in a selective manner to accommodate its characteristics or critical attributes for plant safety.

Procedures establish practices for certain activities that are common to KHNP organizations that perform these activities. Procedures are developed to provide reasonable assurance that activities are controlled and performed in a manner that meets the requirements of the QAPD. Organization-specific procedures establish implementation requirements and may be used to implement particular work activities.

17.5.1 Combined License Information

COL 17.5(1) The COL applicant is to establish and implement a QA program that is applicable to site-specific design activities related to the plant construction and operation phases.

17.5.2 References

1. APR1400-K-Q-TR-11005-NP-A, "KHNP Quality Assurance Program Description (QAPD) for the APR1400 Design Certification," Rev. 2, KHNP, October 2016.

2. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," U.S. Nuclear Regulatory Commission.

3. ASME NQA-1-2008, "Quality Assurance Program Requirements for Nuclear Facilities," The American Society of Mechanical Engineers, 2008.

4. ASME NQA-1a-2009, "Addenda to ASME NQA-1-2008 Quality Assurance Program Requirements for Nuclear Facilities," The American Society of Mechanical Engineers, 2009.

5. Regulatory Guide 1.28, "Quality Assurance Program Criteria (Design and Construction)," Rev. 4, U.S. Nuclear Regulatory Commission, June 2010.

6. NUREG-0800, Standard Review Plan, Section 17.5, "Quality Assurance Program Description - Design Certification, Early Site Permit and New License Applicants," U.S. Nuclear Regulatory Commission, March 2007.

7. NEI 06-14, "Quality Assurance Program Description (QAPD)," Rev. 9, Nuclear Energy Institute, May 2010.

17.6 Maintenance Rule

The combined license applicant is responsible for the establishment and implementation of a Maintenance Rule according to 10 CFR 50.65.

17.6.1 Combined License Information

COL 17.6(1) The COL applicant is to provide in its Final Safety Analysis Report a description of the Maintenance Rule program and a plan for implementing it to meet the requirements of 10 CFR 50.65.