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NUREG-1122, Rev. 3

Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors

Draft Report for Comment

Office of Nuclear Reactor Regulation

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Draft Report for Comment

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Office of Nuclear Reactor Regulation

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ABSTRACT

The "Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors" (PWRs) (NUREG-1122, Revision 3; also known as the PWR Catalog) provides the basis for the development of content-valid licensing examinations for reactor operators (ROs) and senior reactor operators (SROs). The examinations developed using the PWR Catalog and the "Operator Licensing Examination Standards for Power Reactors" (NUREG-1021) will sample the topics listed under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 55, "Operators' Licenses."

The PWR Catalog is organized into six major sections: (1) Organization of the Catalog, (2) Generic Knowledge and Abilities, (3) Plant Systems, (4) Emergency and Abnormal Plant Evolutions, (5) Components, and (6) Theory.

Revision 1 to the PWR Catalog modified the form and content of the original catalog. The knowledge and abilities (K/As) were linked to their applicable item numbers in 10 CFR Part 55. SRO-level K/As were identified by their item numbers from 10 CFR 55.43, "Written Examination; Senior Operators." The revision combined the plant-wide generic and system generic K/As in one section. Systems were organized into nine safety functions, and the emergency and abnormal evolutions were reorganized and expanded.

Revision 2 incorporated corrections to Revision 1 of the catalog that were identified during a pilot testing program associated with revision of 10 CFR Part 55 and the implementation of Interim Revision 8 of NUREG-1021. Corrections to the catalog included:

1. Addition of K/As that had been omitted in Revision 1 (approximately 70)
2. Deletion of duplicate K/As (approximately 15)
3. Correction of the importance ratings of consolidated K/As to reflect the highest previously assigned values (approximately 75)
4. Correction of typographical errors
5. Addition of importance rating modifiers that had been omitted in Revision 1 (approximately 225)

Revision 2, Supplement 1, included the following changes:

1. Total replacement of Section 2, "Generic Knowledge and Abilities"
2. Inclusion of one additional abnormal plant evolution (APE), APE 077, "Generator Voltage and Electric Grid Disturbances," in Section 4.2, "Generic Abnormal Plant Evolutions"

Revision 3 includes the following changes:

1. Clarification of numerous K/A statements and elimination of duplicate K/As.
2. The addition of the integrated control and control room ventilation systems.
3. The addition of reactor coolant system leak to the abnormal plant evolutions.
3. All importance ratings (IRs) were re-rated, and except for A2 and generic K/As (which can be the basis for both RO and SRO-only questions), all RO and SRO IRs were replaced with a single IR.

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SUMMARY OF SIGNIFICANT CHANGES

The changes to Revision 3 include:

1. Correctly linked each K/A to the areas and evolutions identified in 10 CFR 55.41, “Written Examination: Operators”; 10 CFR 55.43, “Written Examination: Senior Operators”; and 10 CFR 55.45, “Operating Tests.”

2. Provided clear and specific guidance in the K/A statement(s) that identifies the expectation for use of a procedure reference, and labeled applicable open-reference question K/As with “reference potential.”

3. Enhanced K/A stem statements to more clearly define the level of detail and content to support consistent evaluation (i.e., similar to the new plant K/A catalog statements).

4. Idenitifed K/A statements that apply to specific plant designs as applicable to that design within the actual statement.

5. Clearly identified K/A statements that apply to only the Senior Operator position as “SRO Only.”

6. Eliminated RO/SRO importance ratings (IRs) and replaced with a single IR, except for the A2, G, and fuel-handling categories.

7. Deleted K/A statements in the plant systems sections that were redundant with the K/As contained in Section 5, “Components.”

8. Reviewed and deleted “Definition” K/As where appropriate.

9. Standardized common systems between the PWR and BWR catalogs.

10. Re-rated all importance ratings.

11. Removed K/As that are part of general employee training (basic tasks that a general nuclear worker is already evaluated on with some periodicity).

12. Added K/A statements for the integrated control and control room ventilation systems.

13. Added K/A statements for reactor coolant system leak to the abnormal plant evolutions.

14. Eliminated the overlap in the A3 and A4 statements and redundancy in the K3 statements related to the specific system.

15. Removed the list of tasks provided for each system.

1 ORGANIZATION OF THE CATALOG

1.1 Introduction

The “Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors” (PWRs) (NUREG-1122, Revision 3; also known as the PWR Catalog) provides the basis for development of content-valid written and operating licensing examinations for reactor operators (ROs) and senior reactor operators (SROs). The PWR Catalog is designed to ensure equitable and consistent examinations.

1.2 10 CFR Part 55

The catalog is used in conjunction with NUREG-1021, “Operator Licensing Examination Standards for Power Reactors.” NUREG-1021 provides policy and guidance and establishes the procedures and practices for examining licensees and applicants for RO and SRO licenses pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Part 55, “Operators’ Licenses.” All knowledge and abilities (K/As) in this catalog are directly linked by item number to 10 CFR Part 55.

1.3 Reactor Operator Written Examination

The guidance for the preparation of the RO written examination is presented in NUREG- 1021. The specific items for RO written examinations appear in 10 CFR 55.41(b).

1.4 Senior Reactor Operator Written Examination

The guidance for the preparation of the SRO written examination is presented in NUREG- 1021. In addition to the RO items specified in 10 CFR 55.41(b), additional items for SRO written examinations are presented in 10 CFR 55.43(b).

1.5 Reactor Operator and Senior Reactor Operator Operating Test Items

The items for operating tests for ROs and SROs are presented 10 CFR 55.45(a). The guidance for the preparation of operating tests appears in NUREG-1021. The operating test should include a representative selection of K/As derived from those items listed in 10 CFR 55.45(a).

1.6 Senior Reactor Operators Limited to Fuel Handling

The specifications for examinations for Senior Operators Limited to Fuel Handling (LSRO) are provided in Examination Standards (ES)-701 and -702, NUREG 1021. The LSRO examination process includes both a written examination and an operating test. These examinations and tests include, but are not limited to, items associated with 10 CFR 55.43(b), items 5 through 7, and 10 CFR 55.45(a), items 5 and 6.

1.7 Organization of the PWR Catalog

The “Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors” is organized into six major sections. Knowledge and abilities (K/As) are grouped according to the major section to which they pertain. This organization is shown schematically below.

1 **ORGANIZATION OF THE CATALOG**

2 **GENERIC KNOWLEDGE AND ABILITIES (120)**

Conduct of Operations K/As
Equipment Control K/As
Radiation Control K/As
Emergency Procedures/Plan K/As

3 **PLANT SYSTEMS**

Knowledge Categories (K1–K6)
Ability Categories (A1–A4)

4 **EMERGENCY AND ABNORMAL PLANT EVOLUTIONS**

Knowledge Categories (E/A K1–E/A K3)
Ability Categories (E/A A1–E/A A2)

5 **COMPONENTS**

Component Knowledge Categories

6 **THEORY**

Reactor Theory Knowledge Categories
Thermodynamics Knowledge Categories

1.8 Generic Knowledge and Abilities

Generic knowledge and abilities (K/As) are generally administrative K/As with broad application across systems and operations. They are listed in Section 2 of the catalog. The four categories of generic K/As are listed below:

2.1 Conduct of Operations K/As
2.2 Equipment Control K/As
2.3 Radiation Control K/As
2.4 Emergency Procedures/Plan K/As

The generic K/As for "Conduct of Operations" are used to evaluate the applicant's knowledge of the daily operation of the facility. The types of information covered under this category may include, for example, shift turnover, operator responsibilities, and procedure usage.

The generic K/As for "Equipment Control" are used to evaluate the administrative requirements associated with the management and control of plant systems and equipment. Examples of the types of information evaluated under this topic include maintenance and temporary modifications of systems.

The generic K/As for "Radiation Control" are used to evaluate the applicant's knowledge and abilities with respect to radiation hazards and protection (personnel and public). Examples of the types of information that should be evaluated under this topic are knowledge of significant radiation hazards or radiation work permits.

The generic K/As for "Emergency Procedures/Plan" are used to evaluate the applicant's general knowledge of emergency operations. The K/As are designed to evaluate knowledge of the emergency procedures use. The emergency plan K/As may be used to evaluate the applicant's knowledge of the plan, including, as appropriate, the RO's or SRO's responsibility to decide whether it should be executed and the duties assigned under the plan.

1.9 Plant Systems

Plant Systems Organization by Safety Function

Nine major safety functions must be maintained to ensure safe PWR nuclear power plant operation. The safety functions are:

1. Reactivity Control
2. Reactor Water Inventory Control
3. Reactor Pressure Control
4. Heat Removal from the Reactor Core
5. Containment Integrity
6. Electrical
7. Instrumentation
8. Plant Service Systems
9. Radioactivity Release

Plant systems have been included in the PWR Catalog based on their relationship and importance to safety functions. Table 1 contains a list of these plant systems, arranged within safety function. It should be noted that some plant systems contribute to more than one safety function. See Section 3 of the PWR Catalog for the delineation of K/As for the plant systems.

Table 1. Plant Systems by Safety Functions

Safety Function 1: Reactivity Control

001	Control Rod Drive System
004	Chemical and Volume Control System
014	Rod Position Indication System
053	Integrated Control System

Safety Function 2: Reactor Coolant System Inventory Control

002	Reactor Coolant System
004	Chemical and Volume Control System
006	Emergency Core Cooling System
011	Pressurizer Level Control System
013	Engineered Safety Features Actuation System

Safety Function 3: Reactor Pressure Control

006	Emergency Core Cooling System
010	Pressurizer Pressure Control System

Safety Function 4: Heat Removal from the Reactor Core

PRIMARY SYSTEM

002	Reactor Coolant System
003	Reactor Coolant Pump System
005	Residual Heat Removal System
053	Integrated Control System
035	Steam Generator System

SECONDARY SYSTEM

039	Main and Reheat Steam System
041	Steam Dump System and Turbine Bypass Control
045	Main Turbine Generator System
055	Condenser Air Removal System
056	Condensate System
059	Main Feedwater System
061	Auxiliary/Emergency Feedwater System
076	Service Water System

Safety Function 5: Containment Integrity

007	Pressurizer Relief Tank/Quench Tank System
022	Containment Cooling System
025	Ice Condenser System
026	Containment Spray System
027	Containment Iodine Removal System
028	Hydrogen Recombiner and Purge Control System
103	Containment System

Safety Function 6: Electrical

062	Alternating Current Electrical Distribution
063	Direct Current Electrical Distribution
064	Emergency Diesel Generators

Safety Function 7: Instrumentation

012	Reactor Protection System
015	Nuclear Instrumentation System
016	Nonnuclear Instrumentation System
017	In-Core Temperature Monitor System
072	Area Radiation Monitoring System
073	Process Radiation Monitoring System

Safety Function 8: Plant Service Systems

008	Component Cooling Water System
029	Containment Purge System
033	Spent Fuel Pool Cooling System
034	Fuel-Handling Equipment System
075	Circulating Water System
078	Instrument Air System
079	Station Air System - DELETED
086	Fire Protection System

Safety Function 9: Radioactivity Release

068	Liquid Radwaste System
071	Waste Gas Disposal System
050	Control Room Ventilation

Knowledge and Ability Stem Statements for Plant Systems

The information delineated within each plant system is organized into six different types of knowledge and four different types of ability. If there are no knowledge or ability statements following a stem statement there is no applicable K/A.

The applicable 10 CFR 55.41 / 43 / and 45 item numbers are included with each stem statement. In most cases the K/As associated with the stem statements can be used for both the written examination and the operating test. See Table 2 below for stem statements and basis.

Table 2. K/A Stem Statements for Plant Systems

K1. Knowledge of the physical connections and/or cause and effect relationships between the (SYSTEM) and the following systems: (CFR: 41.2 to 41.9 / 45.7 to 45.8)

Basis – K1 contains the systems that have a connection to (SYSTEM). The “concepts” will move from K1 to K5 where the stem statement covers concepts. “Cause and effect relationship” will remain so that questions to that effect can be written in K1. The specific controls and interlocks are listed in K4. Electrical systems typically were not included in K1; instead, they are addressed in K2.

K2. Knowledge of electrical power supplies to the following: (CFR: 41.7)

Basis – K2 lists the power supplies to system components for which knowledge of power supplies is testable. The intent is to include the required knowledge for power supplies to components that are important to safe plant operation and/or are operationally significant. When determining importance and/or significance, consider plant-specific probabilistic risk assessment, technical specifications, plant-specific operating experience, emergency operating procedures, and abnormal operating procedures.

K3. Knowledge of the effect that a loss or malfunction of the (SYSTEM) will have on the following systems or system parameters: (CFR: 41.7 / 45.4)

Basis – K3 lists the systems included in K1 that will be affected by a loss of (SYSTEM).

K4. Knowledge of the (SYSTEM) design feature(s) and/or interlock(s), which provide for the following: (CFR: 41.7)

Basis – K4 contains the plant protection/control design features and interlocks.

K5. Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the (SYSTEM): (CFR: 41.5 / 45.3)

Basis – The stem for K5 was revised to include cause and effect relationships and concepts. K5 contains theoretical concepts related to the operation of the system.

K6. Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the (SYSTEM): (CFR: 41.7 / 45.7)

Basis – The stem for K6 was modified to address plant conditions, system malfunctions, and component malfunctions on the (SYSTEM). K6 lists the systems included in K1 that will have an effect on the (SYSTEM) if the listed system is not operating according to design. It also lists the components of the (SYSTEM) whose failure can affect the operation of the (SYSTEM). Power supplies from K2 should be considered.

A1. Ability to predict and/or monitor changes in parameters associated with operation of the (SYSTEM), including: (CFR: 41.5 / 45.5)

Basis – The stem for A1 was revised by removing reference to exceeding design limits. It now includes any departure beyond normal operating characteristics. A1 lists the parameters monitored to verify proper operation of the system.

A2. Ability to (a) predict the impacts of the following on the (SYSTEM) and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 45.6)

Basis – A2 is the ability to predict and mitigate the consequences of selected items from K6.

A3. Ability to monitor automatic features of the (SYSTEM), including: (CFR: 41.7 / 45.7)

Basis – A3 includes the automatic features of the (SYSTEM) identified in K4 that can be monitored from the control room.

A4. Ability to manually operate and/or monitor in the control room: (CFR: 41.7 / 45.5 to 45.8)

Basis – A4 includes the features of the (SYSTEM) that can be manually performed in the control room or manually performed locally that are important to plant safety and monitored in the control room. This also includes automatic features listed in A3 that can be performed manually. A4 includes system monitoring associated with the listed manual actions. A4 for the fuel-handling system includes manual operation of refueling equipment from the equipment location.

1.10 Emergency and Abnormal Plant Evolutions

Generic and Vendor Specific EPEs and APEs

Section 4 of the PWR Catalog contains emergency plant evolutions (EPEs) and abnormal plant evolutions (APEs). An EPE is any condition, event, or symptom that leads to entry into the plant-specific emergency operating procedures (EOPs). An APE is any degraded condition, event, or symptom that does not directly lead to an EOP entry condition but that, nonetheless, adversely affects a safety function. The listing of EPEs and APEs was developed to include those integrative situations crossing several plant systems and/or safety functions.

Table 3, below, contains a list of the emergency plant evolutions and the abnormal plant evolutions covered by this catalog.

Table 3. Emergency and Abnormal Plant Evolutions

GENERIC EPEs

007	Reactor Trip
009	Small-Break Loss-of-Coolant Accident (LOCA)
011	Large-Break LOCA
029	Anticipated Transient without Scram (ATWS)
038	Steam Generator Tube Rupture
055	Station Blackout
074	Inadequate Core Cooling

GENERIC APEs

001	Continuous Rod Withdrawal
003	Dropped Control Rod
005	Inoperable/Stuck Control Rod
008	Pressurizer Vapor Space Accident
015	Reactor Coolant Pump Malfunctions
017	Reactor Coolant Pump Malfunctions (Loss of RC Flow) – DELETED
022	Loss of Reactor Coolant Makeup
024	Emergency Boration
025	Loss of Residual Heat Removal System
026	Loss of Component Cooling Water
027	Pressurizer Pressure Control System Malfunction
028	Pressurizer (PZR) Level Control Malfunction
032	Loss of Source-Range Nuclear Instrumentation
033	Loss of Intermediate-Range Nuclear Instrumentation
036	Fuel-Handling Incidents
037	Steam Generator Tube Leak
040	Steamline Rupture
051	Loss of Condenser Vacuum
054	Loss of Main Feedwater
056	Loss of Offsite Power

057	Loss of Vital Alternating Current (AC) Electrical Instrument Bus
058	Loss of Direct Current (DC) Power
059	Accidental Liquid Radwaste Release
060	Accidental Gaseous Radwaste Release
061	Area Radiation Monitoring System Alarms
062	Loss of Service Water
065	Loss of Instrument Air
067	Plant Fire on Site
068	Control Room Evacuation
069	Loss of Containment Integrity
076	High Reactor Coolant Activity
077	Generator Voltage and Electric Grid Disturbances
078	Reactor Coolant System (RCS) Leak

Babcock and Wilcox (BW) EPEs and APEs

E02	Vital System Status Verification
E03	Inadequate Subcooling Margin
E04	Inadequate Heat Transfer
E05	Excessive Heat Transfer
E08	LOCA Cooldown
E09	Natural Circulation Cooldown
E10	Post-Trip Stabilization
E13	EOP Rules
E14	EOP Enclosures
A01	Plant Runback
A02	Loss of Nonnuclear Instrumentation (NNI)-X
A03	Loss of NNI-Y
A04	Turbine Trip
A05	Emergency Diesel Actuation
A06	Shutdown Outside Control Room
A07	Flooding
A08	Refueling Canal Level Decrease

Combustion Engineering (CE) EPEs and APEs

E02	Reactor Trip Recovery
E05	Excess Steam Demand
E06	Loss of Feedwater
E09	Functional Recovery
E13	Loss of Forced Circulation and/or LOOP and/or a Blackout
A11	RCS Overcooling – DELETED and incorporated into CE E05
A13	Natural Circulation Operations – DELETED and incorporated into CE E13
A16	Excess RCS Leakage

Westinghouse (W) EPEs and APEs

E01	Rediagnosis
E02	Safety Injection (SI) Termination
E03	LOCA Cooldown and Depressurization
E04	LOCA Outside Containment

E05 Loss of Secondary Heat Sink
E06 Degraded Core Cooling
E07 Saturated Core Cooling
E08 Pressurized Thermal Shock
E09 Natural Circulation Operations
E10 Natural Circulation with Steam Void in Vessel with/without Reactor Vessel Level Indicating System
E11 Loss of Emergency Coolant Recirculation
E12 Uncontrolled Depressurization of All Steam Generators
E13 Steam Generator Overpressure
E14 High Containment Pressure
E15 Containment Flooding
E16 High Containment Radiation

Knowledge and Ability Stem Statements for Emergency and Abnormal Plant Evolutions

The information delineated within each emergency or abnormal plant evolution is organized into three types of knowledge and two types of ability. If there are no knowledge or ability statements following a stem statement there is no applicable K/A.

Each stem statement includes the applicable 10 CFR 55.41 / 43 / 45 item numbers. In most cases, the K/As associated with the stem statements can be used for both the written and the operating examinations, as shown in Table 4.

Table 4. K/A Stem Statements for EPEs and APEs

E/AK1 Knowledge of the operational implications and/or cause and effect relationships of the following concepts as they apply to the [EVENT]: (CFR: 41.5 / 41.7 / 45.7 / 45.8)

Basis – Lists the operationally based theoretical concepts applicable to the procedure. These items typically come from the procedure bases, probabilistic risk assessment, operating experience, procedure notes, and cautions.

E/AK2 Knowledge of the relationship between the [EVENT] and the following systems or components: (CFR: 41.8 / 41.10 / 45.3)

Basis – Lists the systems required to be monitored and/or operated by the procedure.

E/AK3 Knowledge of the reasons for the following responses and/or actions as they apply to the [EVENT]: (CFR: 41.5 / 41.10 / 45.6 / 45.13)

Basis – Lists the reasons responses and/or actions are taken in the procedure.

E/AA1 Ability to operate and/or monitor the following as they apply to the [EVENT]: (CFR: 41.5 / 41.7 / 45.5 to 45.8)

Basis – Lists the system and/or components required to be monitored and/or operated by the procedure. E/AA1 may include systems from E/AK2.

E/AA2 Ability to determine and/or interpret the following as they apply to the [EVENT]: (CFR: 41.10 / 43.5 / 45.13)

Basis – Lists the parameters and/or conditions that are monitored to verify successful implementation of the procedure.

1.11 Components

Basic components such as valves and pumps are found in many systems. NUREG- 1021, Section ES-205, “Procedure for Administering the General Fundamentals Examination Program,” lists eight categories of components. The component knowledge statements are more detailed than those provided in the system listing, yet at the same time they are generic to the component types. Each of the eight catgeories of components has a unique six-digit code number and 10 CFR 55.41(b) item number, for which additional knowledge statements are necessary. Components are delineated in Section 5 of the PWR Catalog, and listed in Table 5 below.

Table 5. Components

191001	Valves (CFR: 41.3)
191002	Sensors and Detectors (CFR: 41.7)
191003	Controllers and Positioners (CFR: 41.7)
191004	Pumps (CFR: 41.3)
191005	Motors and Generators (CFR: 41.7)
191006	Heat Exchangers and Condensers (CFR: 41.4)
191007	Demineralizers and Ion Exchangers (CFR: 41.3)
191008	Breakers, Relays, and Disconnects (CFR: 41.7)

1.12 Theory

NUREG-1021, Section ES-205, “Procedure for Administering the General Fundamentals Examination Program,” lists theory items. General fundamental knowledge which underlies safe performance on the job is delineated in Section 6 of the PWR Catalog. These theory topics represent general fundamental concepts related to plant operation. Each theory topic has a unique six-digit code number. The applicable 10 CFR 41(b) item number is provided for Reactor Theory and Thermodynamics Theory.

Reactor Theory (CFR: 41.1)

192001 Neutrons
192002 Neutron Life Cycle
192003 Reactor Kinetics and Neutron Sources
192004 Reactivity Coefficients
192005 Control Rods
192006 Fission Product Poisons
192007 Fuel Depletion and Burnable Poisons
192008 Reactor Operational Physics

Thermodynamics Theory (CFR: 41.14)

193001	Thermodynamic Units and Properties
193002	Basic Energy Concepts
193003	Steam
193004	Thermodynamic Processes
193005	Thermodynamic Cycles
193006	Fluid Statics and Dynamics
193007	Heat Transfer
193008	Thermal Hydraulics
193009	Core Thermal Limits
193010	Brittle Fracture and Vessel Thermal Stress

1.13 Importance Ratings

Importance, in this context, considers the direct and indirect impact of the K/A on safe plant operation in a manner that ensures personnel and public health and safety. Importance ratings of the K/As are next to each K/A in the catalog. These ratings reflect average ratings of individual NRC and utility panel members. Table 6 presents the rating scale.

Table 6. RO and SRO Importance Ratings

Rating	Importance for Safe Operation
5	Essential
4	Very important
3	Fairly important
2	Of limited importance
1	Insignificant importance

Therefore, a rating of 2.0 or below represents a statement of limited or insignificant importance for the safe operation of a plant. Such statements are generally considered as inappropriate content for NRC licensing examinations, and will be considered for deletion in a future revision to this catalog. (See below for qualifications of importance ratings related to variability of the ratings and plant-specific data.)

1.14 Rules of Use

To ensure consistency in applying this catalog the following terms are interpreted as shown:

- “Parameters” include any characteristic of a system or component that is measured.
- “Actuation” includes actuation logic, signals, blocks, bypasses, permissives, interlocks, and resets

1.15 General Guidance

This catalog uses the following strategies and principles:

- The use of setpoints is minimized. Values included are specific to titles or procedures. If a value included in the catalog changes, the statement is still testable if it meets the intent of the statement.

- When referencing a system or component, the associated indications, controls, and alarms that support the system function are applicable.

- K/A statement overlap in multiple sections is minimized. K/As are assigned to the most appropriate section.

- All importance ratings are in a single-column format except A2 and generic K/As and fuel handling. Fuel handling is not an RO license activity and will have N/A (not applicable) marked in the RO column.

- The K/As use generic terminology. If the specific design uses comparable but different terminology, the concept is still applicable. Examples of comparable terms include the following:

  - Safety injection tanks may be comparable to core flood tanks.

  - Engineered safety feature actuation system may be comparable to engineered safety actuation system.

  - Auxiliary feedwater may be comparable to emergency feedwater.

  - Component cooling water may be comparable to intermediate cooling water.

- Subsystems, where applicable, are listed before each associated system.

1.16 Acronyms and Terms

AC	alternating current
AFW	auxiliary feedwater
AMSAC	ATWS mitigation system actuation circuitry
AOP	abnormal operating procedure
APE	abnormal plant evolution
ARM	area radiation monitor
ARM	area radiation monitoring system
ATWS	anticipated transient without scram
BIT	boron injection tank
BTU	British thermal unit
BW	Babcock and Wilcox
BWST	borated water storage tank
CARS	condenser air removal system
CCS	containment cooling system
CCW	component cooling water
CCWS	component cooling water system
CDS	condensate system
CE	Combustion Engineering
CEA	control element assembly (CE)
CET	core exit thermocouple
CFR	Code of Federal Regulations
CFT	core flood tanks
CIRS	containment iodine removal system
CNT	containment system
COLSS	core operating limit support system
CPS	containment purge system
CRDM	control rod drive motor
CRDS	control rod drive system
Crud	corrosion product material floating in system
CRV	control room ventilation
CRW	control rod worth
CSS	containment spray system
CVCS	chemical and volume control system
CWS	circulating water system
DC	direct current
D/G	diesel generator
DNB	departure from nucleate boiling
DNBR	departure from nucleate boiling ratio
D/P	differential pressure
EAL	emergency action level
ECA	emergency contingency action
ECCS	emergency core cooling system
ECP	estimated critical position
EDG	emergency diesel generator
EFIC	emergency feedwater initiation and control
EFW	emergency feedwater
EHC	electrohydraulic control
EOP	emergency operating procedure

EPE	emergency plant evolution
ERV	emergency relief valve
ES	engineering safeguards
ESAS	engineered safety actuation system (BW)
ESF	engineered safety feature
ESFAS	engineered safety features actuation system
FHES	fuel-handling equipment system
FPS	fire protection system
HPI	high-pressure injection
HPSI	high-pressure safety injection
HRPS	hydrogen recombiner and purge control system
HVAC	heating, ventilation, and air conditioning
IAS	instrument air system
ICS	integrated control system (BW)
ICW	intermediate cooling water
ITMS	in-core temperature monitor system
K/A	knowledge and ability
K-eff	subcritical multiplication factor (K-effective)
LCS	level control system
LOCA	loss-of-coolant accident
LPI	low-pressure injection
LPSI	low-pressure safety injection
LRS	liquid radwaste system
LSRO	limited senior reactor operator
LVDT	linear variable differential transformer
M/G	motor generator
MFIV	main feedwater isolation valve
MFW	main feedwater
MOV	motor-operated valve
MRSS	main and reheat steam system
MSIV	main steam isolation valve
MSLI	main steamline isolation
MSR	moisture separator reheater
MT/G	main turbine generator
MTC	moderator temperature coefficient
N/A	not applicable
NaOH	sodium hydroxide
NI	nuclear instrumentation
NIS	nuclear instrumentation system
NNI	nonnuclear instrumentation system
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
NSSS	nuclear steam supply system
ORG	optimal recovery guideline
PCS	pressure control system
POAH	point of adding heat
PORV	power-operated relief valves
PPAS	plant performance analysis system
PRM	process radiation monitor
PRMS	process radiation monitoring system
PRT	pressurizer relief tank

psig	pounds per square inch, gauge
PTS	pressurized thermal shock
PVS	plant ventilation system
PWR	pressurized-water reactor
PZR	pressurizer
PZR LCS	pressurizer level control system
PZR PCS	pressurizer pressure control system
QPTR	quadrant power tilt ratio
QSPDS	qualified safety parameter display system
RCP	reactor coolant pump
RCPS	reactor coolant pump system
RCS	reactor coolant system
RHR	residual heat removal
RHRS	residual heat removal system
RMS	radiation monitoring system
RO	reactor operator
RPI	rod position indication
RPIS	rod position indication system
RPS	reactor protection system
RVLIS	reactor vessel level indicating system
RWST	refueling water storage tank
RXS	reactor system
S/G	steam generator
S/GB	steam generator blowdown
SAS	station air system
SASS	smart automatic signal selection system
SBCS	steam bypass control system
SCM	subcooling margin
SDM	shutdown margin
SDS	steam dump system
SFPCS	spent fuel pool cooling system
SGFP	steam generator feedwater pump
SGS	steam generator system
SI	safety injection
SIS	safety injection system
SPDS	safety parameter display system
SRO	senior reactor operator
SWS	service water system
T	temperature
T/G	turbine generator
T-ave.	average reactor coolant temperature
T-cold	measured temperature of inlet
T-ref.	reference temperature for the RCS
TRM	Technical Requirements Manual
TS	technical specification(s)
UHI	upper head injection
ULD	unit load demand
V	volt
VAR	volt-amperes reactive
VCT	volume control tank
WGDS	waste gas disposal system

2 GENERIC KNOWLEDGE AND ABILITIES

2.0 Generic Knowledge and Abilities

2.0.1 Technical Requirements Manual (TRM)—For the purpose of this catalog, K/As that reference technical specifications (TS) may include the TRM, where applicable.

2.0.2 K/A Clarifying Examples—K/As that include the words “such as” list suggested topical areas as examples and are not intended to be all inclusive.

2.1 Conduct of Operations

2.1.1 Knowledge of conduct of operations requirements.
(CFR: 41.10 / 43.10 / 45.13)
IMPORTANCE RO 3.8 SRO 4.2

2.1.2 Knowledge of operator responsibilities during any mode of plant operation.
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 4.1 SRO 4.4

2.1.3 Knowledge of shift or short-term relief turnover practices.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.7 SRO 3.9

2.1.4 Knowledge of individual licensed operator responsibilities related to shift staffing, such as medical requirements, “no-solo” operation, and maintenance of active license status, 10 CFR Part 55.
(CFR: 41.10 / 43.2)
IMPORTANCE RO 3.3 SRO 3.8

2.1.5 Ability to use procedures related to shift staffing, such as minimum crew complement or overtime limitations. (Reference Potential)
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.9 SRO 3.9

2.1.6 Ability to manage the control room crew during plant transients. (SRO Only)
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO N/A SRO 4.8

2.1.7 Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation.
(CFR: 41.5 / 43.5 / 45.12 / 45.13)
IMPORTANCE RO 4.4 SRO 4.7

2.1.8 Ability to coordinate personnel activities outside the control room.
(CFR: 41.10 / 43.1 / 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3.4 SRO 4.1

2.1.9 Ability to direct licensed personnel activities inside the control room. (SRO Only)
(CFR: 43.1 / 45.5 / 45.12 / 45.13)
IMPORTANCE RO N/A SRO 4.5

2.1.10 Moved to 2.2.38
2.1.11 Moved to 2.2.39
2.1.12 Moved to 2.2.40

2.1.13 Knowledge of facility requirements for controlling vital / controlled access.
(CFR: 41.10 / 43.5 / 45.9 / 45.10)
IMPORTANCE RO 2.5 SRO 3.2

2.1.14 Knowledge of criteria or conditions that require plant-wide announcements, such as pump starts, reactor trips, and mode changes.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3.1 SRO 3.1

2.1.15 Knowledge of administrative requirements for temporary management direction, such as standing orders, night orders, or operations memorandums.
(CFR: 41.10 / 45.12)
IMPORTANCE RO 2.7 SRO 3.4

2.1.16 DELETED

2.1.17 Ability to make accurate, clear, and concise verbal reports.
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 3.9 SRO 4.0

2.1.18 Ability to make accurate, clear, and concise logs, records, status boards, and
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 3.6 SRO 3.8

2.1.19 Ability to use available indications to evaluate system or component
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3.9 SRO 3.8

2.1.20 Ability to interpret and execute procedure steps.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4.6 SRO 4.6

2.1.21 Ability to verify that a copy of a controlled procedure is the proper revision.
(CFR: 41.10 / 45.10 / 45.13)
IMPORTANCE RO 3.5 SRO 3.6

2.1.22 Revised and moved to 2.2.35

2.1.23 Ability to perform general and/or normal operating procedures during any plant condition.
(CFR: 41.10 / 43.5 / 45.2 / 45.6)
IMPORTANCE RO 4.3 SRO 4.4

2.1.24 Moved to 2.2.41

2.1.25 Ability to interpret reference materials, such as graphs, curves, and tables. (Reference Potential)
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3.9 SRO 4.2

2.1.26 Knowledge of industrial safety procedures, such as rotating equipment, electrical, high temperature, high pressure, caustic, chlorine, oxygen, and
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3.4 SRO 3.6

2.1.27 Knowledge of system purpose and/or function.
(CFR: 41.7)
IMPORTANCE RO 3.9 SRO 4.0

2.1.28 Knowledge of the purpose and function of major system components and
(CFR: 41.7)
IMPORTANCE RO 4.1 SRO 4.1

2.1.29 Knowledge of how to conduct system lineups, such as valves, breakers, or
(CFR: 41.10 / 45.1 / 45.12)
IMPORTANCE RO 4.1 SRO 4.0

2.1.30 Ability to locate and operate components, including local controls.
(CFR: 41.7 / 45.7)
IMPORTANCE RO 4.4 SRO 4.0

2.1.31 Ability to locate control room switches, controls, and indications and to determine whether they correctly reflect the desired plant lineup.
(CFR: 41.10 / 45.12)
IMPORTANCE RO 4.6 SRO 4.3

2.1.32 Ability to explain and apply system precautions, limitations, notes, or cautions.
(CFR: 41.10 / 43.2 / 45.12)
IMPORTANCE RO 3.8 SRO 4.0

2.1.33 Moved to 2.2.42

2.1.34 Knowledge of reactor coolant system or balance-of-plant chemistry controls, including parameters measured and reasons for the control.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.7 SRO 3.5

2.1.35 Knowledge of the fuel-handling responsibilities of SROs. (SRO Only)
(CFR: 43.7)
IMPORTANCE RO N/A SRO 3.9

2.1.36 Knowledge of procedures and limitations involved in core alterations.
(CFR: 41.10 / 43.6 / 45.7)
IMPORTANCE RO 3.0 SRO 4.1

2.1.37 Knowledge of procedures, guidelines, or limitations associated with reactivity management.
(CFR: 41.1 / 41.5 / 41.10 / 43.6 / 45.6)
IMPORTANCE RO 4.3 SRO 4.6

2.1.38 Knowledge of the station's requirements for verbal communications when implementing procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.7 SRO 3.8

2.1.39 Knowledge of conservative decisionmaking practices.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3.6 SRO 4.3

2.1.40 Knowledge of refueling administrative requirements.
(CFR: 41.10 / 43.5 / 43.6 / 45.13)
IMPORTANCE RO 2.8 SRO 3.9

2.1.41 Knowledge of the refueling process.
(CFR: 41.2 / 41.10 / 43.6 / 45.13)
IMPORTANCE RO 2.8 SRO 3.7

2.1.42 Knowledge of new and spent fuel movement procedures. (SRO Only)
(CFR: 43.7 / 45.13)
IMPORTANCE RO N/A SRO 3.4

2.1.43 Ability to use an online power distribution monitoring system and/or procedures to determine the effects on reactivity of plant changes, such as reactor coolant system temperature, secondary plant, or fuel depletion.
CFR: 41.10 / 43.6 / 45.6)
IMPORTANCE RO 4.1 SRO 4.3

2.1.44 Knowledge of RO duties in the control room during fuel handling, such as responding to alarms from the fuel-handling area, communicating with fuel-handling personnel, operating systems from the control room to support fueling operations, or supporting instrumentation.
(CFR: 41.10 / 43.7 / 45.12)
IMPORTANCE RO 3.9 SRO 3.8

2.1.45 Ability to identify and interpret diverse indications to validate the response of another indication.
(CFR: 41.7 / 43.5 / 45.4)
IMPORTANCE RO 4.3 SRO 4.3

2.1.46 Ability to use integrated control systems to operate plant systems or components.
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 4.0 SRO 3.3

2.1.47 Ability to direct non-licensed personnel activities inside the control room.
(CFR: 41.10 / 43.5 / 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3.2 SRO 3.2

2.2 Equipment Control

2.2.1 Ability to perform pre-startup procedures for the facility, including operating those controls associated with plant equipment that could affect reactivity.
(CFR: 41.5 / 41.10 / 43.5 / 43.6 / 45.1)
IMPORTANCE RO 4.5 SRO 4.4

2.2.2 Ability to manipulate the console controls as required to operate the facility between shutdown and designated power levels.
(CFR: 41.6 / 41.7 / 45.2)
IMPORTANCE RO 4.6 SRO 4.1

2.2.3 (Multi-unit License) Knowledge of the design, procedural, and/or operational differences between units.
(CFR: 41.5 / 41.6 / 41.7 / 41.10 / 45.12)
IMPORTANCE RO 3.8 SRO 3.9

2.2.4 (Multi-unit License) Ability to explain the variations in control room layouts, systems, instrumentation, and/or procedural actions between units at a facility.
(CFR: 41.6 / 41.7 / 41.10 / 45.1 / 45.13)
IMPORTANCE RO 3.6 SRO 3.6

2.2.5 Knowledge of the process for making design or operating changes to the facility, such as 10 CFR 50.59, "Changes, Tests and Experiments," screening and evaluation processes, administrative processes for temporary modifications, disabling annunciators, or installation of temporary equipment.
(CFR: 41.10 /43.3 / 45.13)
IMPORTANCE RO 2.2 SRO 3.2

2.2.6 Knowledge of the process for making changes to procedures.
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 3.0 SRO 3.6

2.2.7 Knowledge of the process for conducting infrequently preformed tests or
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 2.9 SRO 3.6

2.2.8 DELETED
2.2.9 DELETED
2.2.10 DELETED
2.2.11 DELETED

2.2.12 Knowledge of surveillance procedures.
(CFR: 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3.7 SRO 4.1

2.2.13 Knowledge of tagging and clearance procedures.
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 4.1 SRO 4.3

2.2.14 Knowledge of the process for controlling equipment configuration or status.
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 3.9 SRO 4.3

2.2.15 Ability to determine the expected plant configuration using design and configuration control documentation, such as drawings, lineups, or tag-outs. (Reference Potential)
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 3.9 SRO 4.3

2.2.16 DELETED

2.2.17 Knowledge of the process for managing maintenance activities during power operations, such as risk assessments, work prioritization, and coordination the transmission system operator.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.18 Knowledge of the process for managing maintenance activities during shutdown operations, such as risk assessments and work prioritization.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.6 SRO 3.9

2.2.19 Knowledge of maintenance work order requirements.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.4

2.2.20 Knowledge of the process for managing troubleshooting activities.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.21 Knowledge of pre- and post-maintenance operability requirements.
(CFR: 41.10 / 43.2)
IMPORTANCE RO 2.9 SRO 4.1

2.2.22 Knowledge of limiting conditions for operations and safety limits.
(CFR: 41.5 / 43.2 / 45.2)
IMPORTANCE RO 4.0 SRO 4.7

2.2.23 Ability to track TS limiting conditions for operations.
(CFR: 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3.1 SRO 4.6

2.2.24 Moved to 2.2.36

2.2.25 Knowledge of the bases in TS for limiting conditions for operations and safety limits. (SRO Only)
(CFR: 43.2)
IMPORTANCE RO N/A SRO 4.2

2.2.26 Moved to 2.1.40

2.2.27 Moved to 2.1.41

2.2.28 Moved to 2.1.42

2.2.29 Moved to 2.1.35

2.2.30 Moved to 2.1.44

2.2.31 Revised and moved to 2.1.36

2.2.32 DELETED

2.2.33 DELETED

2.2.34 Revised and moved to 2.1.43

2.2.35 Ability to determine TS for mode of operation.
(CFR: 41.7 / 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3.6 SRO 4.5

2.2.36 Ability to analyze the effect of maintenance activities, such as degraded power sources, on the status of limiting conditions for operations.
(CFR: 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3.1 SRO 4.2

2.2.37 Ability to determine operability or availability of safety-related equipment. (SRO Only)
(CFR: 43.2 / 43.5 / 45.12)
IMPORTANCE RO N/A SRO 4.6

2.2.38 Knowledge of conditions and limitations in the facility license.
(CFR: 41.7 / 41.10 / 43.1 / 45.13)
IMPORTANCE RO 3.6 SRO 4.5

2.2.39 Knowledge of less than or equal to 1-hour TS action statements. (This K/A does not include action statements of 1 hour or less that follow the expiration of a completion time for a TS condition for which an action statement has already been entered.)
(CFR: 41.7 / 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3.9 SRO 4.5

2.2.40 Ability to apply TS with action statements of less than or equal to 1 hour.
(CFR: 41.10 / 43.2 / 43.5 / 45.3)
IMPORTANCE RO 3.4 SRO 4.7

2.2.41 Ability to obtain and interpret station electrical and mechanical drawings. (Reference Potential)
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 3.5 SRO 3.9

2.2.42 Ability to recognize system parameters that are entry-level conditions for TS.
(CFR: 41.7 / 41.10 / 43.2 / 43.3 / 45.3)
IMPORTANCE RO 3.9 SRO 4.6

2.2.43 Knowledge of the process used to track inoperable alarms.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 3.3

2.2.44 Ability to interpret control room indications to verify the status and operation of a system and understand how operator actions and directives affect plant and system conditions.
(CFR: 41.5 / 43.5 / 45.12)
IMPORTANCE RO 4.2 SRO 4.4

2.2.45 Ability to determine and/or interpret TS with action statements of greater than 1 hour. (SRO Only)
(CFR: 43.2 / 43.5 / 45.3)
IMPORTANCE RO N/A SRO 4.7

2.3 Radiation Control

2.3.1 DELETED
2.3.2 DELETED
2.3.3 DELETED
2.3.4 DELETED
2.3.5 Ability to use radiation monitoring systems, such as fixed radiation monitors and alarms or personnel monitoring equipment.
(CFR: 41.11 / 41.12 / 43.4 / 45.9)
IMPORTANCE RO 2.9 SRO 2.9
2.3.6 Ability to approve liquid or gaseous release permits.
(CFR: 41.13 / 43.4 / 45.10)
IMPORTANCE RO 2.0 SRO 3.8
2.3.7 DELETED
2.3.8 DELETED
2.3.9 DELETED
2.3.10 DELETED
2.3.11 Ability to control radiation releases.
(CFR: 41.11 / 43.4 / 45.10)
IMPORTANCE RO 3.8 SRO 4.3
2.3.12 Knowledge of radiological safety principles pertaining to licensed operator duties, such as containment entry requirements, fuel-handling responsibilities, access to locked high-radiation areas, or alignment of filters.
(CFR: 41.12 / 45.9 / 45.10)
IMPORTANCE RO 3.2 SRO 3.7
2.3.13 Knowledge of radiological safety procedures pertaining to licensed operator duties, such as response to radiation monitor alarms, containment entry requirements, fuel-handling responsibilities, access to locked high-radiation areas, or alignment of filters.
(CFR: 41.12 / 43.4 / 45.9 / 45.10)
IMPORTANCE RO 3.4 SRO 3.8
2.3.14 Knowledge of radiation or contamination hazards that may arise during normal, abnormal, or emergency conditions or activities, such as analysis and interpretation or radiation and activity readings as they pertain to administrative, normal, abnormal, and emergency procedures or to analysis and interpretation of coolant activity, including comparison to emergency plan or regulatory limits. (SRO Only)
(CFR: 43.4 / 45.10)
IMPORTANCE RO N/A SRO 3.8
2.3.15 DELETED

2.4 Emergency Procedures/Plan

2.4.1 Knowledge of emergency and abnormal operating procedure entry conditions.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4.6 SRO 4.8

2.4.2 Knowledge of system setpoints, interlocks, and automatic actions associated with emergency and abnormal operating procedure entry conditions.
(CFR: 41.7 / 45.7 / 45.8)
IMPORTANCE RO 4.5 SRO 4.6

2.4.3 Ability to identify postaccident instrumentation.
(CFR: 41.6 / 45.4)
IMPORTANCE RO 3.7 SRO 3.9

2.4.4 Ability to recognize abnormal indications for system operating parameters that are entry-level conditions for emergency and abnormal operating procedures.
(CFR: 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.5 SRO 4.7

2.4.5 Knowledge of the organization of the operating procedures network for normal, abnormal, and emergency evolutions.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.7 SRO 4.3

2.4.6 Knowledge of emergency and abnormal operating procedures major action categories.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.7 SRO 4.7

2.4.7 DELETED

2.4.8 Knowledge of how abnormal operating procedures are used in conjunction with emergency operating procedures.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 4.5

2.4.9 Knowledge of low-power / shutdown implications in accident (e.g., loss-of-coolant accident or loss of residual heat removal) mitigation strategies.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 4.2

2.4.10 DELETED

2.4.11 DELETED

2.4.12 Knowledge of operating crew responsibilities during emergency and abnormal operations.
(CFR: 41.10 / 45.12)
IMPORTANCE RO 4.0 SRO 4.3

2.4.13 DELETED

2.4.14 Knowledge of general guidelines for emergency and abnormal operating procedures usage.
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 3.8 SRO 4.5

2.4.15 Revised and moved to 2.1.38.

2.4.16 Knowledge of emergency and abnormal operating procedures implementation hierarchy and coordination with other support procedures or guidelines, such as operating procedures, abnormal operating procedures, or severe accident management guidelines.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.5 SRO 4.4

2.4.17 Knowledge of emergency and abnormal operating procedures terms and definitions.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.9 SRO 4.3

2.4.18 Knowledge of the specific bases for emergency and abnormal operating procedures
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.19 Knowledge of emergency and abnormal operating procedures layout, symbols, and icons.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.4 SRO 4.1

2.4.20 Knowledge of the operational implications of emergency and abnormal operating procedures warnings, cautions, and notes.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 4.3

2.4.21 Knowledge of the parameters and logic used to assess the status of emergency operating procedures for critical safety functions or shutdown
(CFR: 41.7 / 43.5 / 45.12)
IMPORTANCE RO 4.0 SRO 4.6

2.4.22 Knowledge of the bases for prioritizing safety functions during abnormal and emergency operations.
(CFR: 41.7 / 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3.6 SRO 4.4

2.4.23 Knowledge of the bases for prioritizing emergency operating procedures Implementation.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.4 SRO 4.4

2.4.24 DELETED

2.4.25 Knowledge of fire protection procedures.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.3 SRO 3.7

2.4.26 Knowledge of facility protection requirements, including fire brigade and portable firefighting equipment usage.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3.1 SRO 3.6

2.4.27 DELETED

2.4.28 Knowledge of procedures relating to a security event (nonsafeguards information)
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.2 SRO 4.1

2.4.29 Knowledge of the emergency plan implementing procedures.
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO 3.1 SRO 4.4

2.4.30 Knowledge of events related to system operation / status that must be reported to internal organizations or external agencies, such as the State, the NRC, or the transmission system operator.
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO 2.7 SRO 4.1

2.4.31 Knowledge of annunciator alarms, indications, or response procedures.
(CFR: 41.10 / 45.3)
IMPORTANCE RO 4.2 SRO 4.1

2.4.32 Knowledge of operator response to loss of all annunciators.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.6 SRO 4.0

2.4.33 Moved to 2.2.43

2.4.34 Knowledge of RO tasks performed outside the main control room during an emergency and the resultant operational effects.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4.2 SRO 4.1

2.4.35 Knowledge of nonlicensed operator tasks during an emergency and the resultant operational effects.
(CFR: 41.10 / 43.1 / 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 4.0

2.4.36 DELETED

2.4.37 Knowledge of the lines of authority during implementation of the emergency plan implementing procedures.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 4.1

2.4.38 Ability to take actions required by the facility emergency plan implementing procedures, including supporting or acting as emergency coordinator if
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO 2.4 SRO 4.4

2.4.39 Knowledge of RO responsibilities in emergency plan implementing procedures.
(CFR: 41.10 / 45.11)
IMPORTANCE RO 3.9 SRO 3.8

2.4.40 Knowledge of SRO responsibilities in emergency plan implementing procedures. (SRO Only)
(CFR: 43.5 / 45.11)
IMPORTANCE RO N/A SRO 4.5

2.4.41 Knowledge of the emergency action level thresholds and classifications. (SRO Only)
(CFR: 43.5 / 45.11)
IMPORTANCE RO N/A SRO 4.6

2.4.42 Knowledge of emergency response facilities.
(CFR: 41.10 / 45.11)
IMPORTANCE RO 2.6 SRO 3.8

2.4.43 Knowledge of emergency communications systems and techniques.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.2 SRO 3.8

2.4.44 Knowledge of emergency plan implementing procedures protective action recommendations. (SRO Only)
(CFR: 41.10 / 41.12 / 43.5 / 45.11)
IMPORTANCE RO N/A SRO 4.4

2.4.45 Ability to prioritize and interpret the significance of each annunciator or alarm.
(CFR: 41.10 / 43.5 / 45.3 / 45.12)
IMPORTANCE RO 4.1 SRO 4.3

2.4.46 Ability to verify that the alarms are consistent with the plant conditions.
(CFR: 41.10 / 43.5 / 45.3 / 45.12)
IMPORTANCE RO 4.2 SRO 4.2

2.4.47 Ability to diagnose and recognize trends in an accurate and timely manner using the appropriate control room reference material.
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4.2 SRO 4.2

2.4.48 Revised and moved to 2.2.44

2.4.49 Ability to perform without reference to procedures those actions that require immediate operation of system components and controls.
(CFR: 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.6 SRO 4.4

2.4.50 Ability to verify system alarm setpoints and operate controls identified in the alarm response procedure.
(CFR: 41.10 / 43.5 / 45.3)
IMPORTANCE RO 4.2 SRO 4.0

2.4.51 Knowledge of emergency operating procedure exit conditions, such as an emergency condition no longer exists or severe accident guideline entry is required.
(CFR: 41.10 / 43.5 /45.13)
IMPORTANCE RO 3.0 SRO 4.0

2.4.52 Knowledge of the lines of authority during implementation of the emergency plan, emergency plan implementing procedures, emergency operating procedures, or severe accident guidelines.
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 4.0

3 PLANT SYSTEMS

3.1 Safety Function 1: Reactivity Control

SYSTEM: 001 SF1 CRDS Control Rod Drive System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Control Rod Drive System and the following systems:** (CFR: 41.2 / 41.3 / 41.5 to 41.7 / 45.5 to 45.8)	
K1.01	Control rod drive motor (CRDM) cooling (CCW or CRDM fans)	3.3
K1.02	Chemical and volume control system (CVCS)	2.4
K1.03	CRDM	3.7
K1.04	Reactor coolant system (RCS)	3.4
K1.05	Nuclear instrumentation system (NIS)	3.5
K1.06	DELETED	
K1.07	Quench tank	1.6
K1.08	DELETED	
K1.09	DELETED	
K1.10	Reactor protection system (RPS)	3.9
K1.11	Pressurizer (PZR) pressure or level control	2.6
K1.12	Rod position indication system (RPIS)	3.8
K2	**Knowledge of bus power supplies to the following Control Rod Drive System components:** (CFR: 41.6)	
K2.01	Motor generator (M/G) sets	3.6
K2.02	Reactor trip breakers	4.1
K2.03	Logic circuits	3.5
K2.04	Control rod lift coil	3.1
K2.05	DELETED	
K2.06	DELETED	
K2.07	DELETED	
K2.08	DELETED	
K2.09	CRDM fans (vender specific)	2.8
K3	**Knowledge of the effect that a loss or malfunction of the Control Rod Drive System will have on the following systems or system parameters:** (CFR: 41.6)	
K3.01	CVCS	2.6
K3.02	RCS	3.4
K3.03	Component cooling water (CCW)	2.5
K3.04	NIS	3.5
K3.05	RPS	3.8
K3.06	RPIS	3.7

K4 **Knowledge of Control Rod Drive System design feature(s) and/or interlock(s), which provide for the following:**
(CFR: 41.6)

K4.01	Rod position indication	3.9
K4.02	Control rod mode select control (movement control)	3.9
K4.03	Rod control logic, circuitry, or principle of operation	3.7
K4.04	Linear variable differential transformer (LVDT) or reed switches	3.2
K4.05	DELETED	
K4.06	Indication of what caused a reactor trip (first-out panel)	3.5
K4.07	Rod control stops and permissives	4.0
K4.08	DELETED	
K4.09	Recovery of dropped rod	3.6
K4.10	DELETED	
K4.11	Reset of reactor trip breakers	3.3
K4.12	Re-zeroing rod demand position counters	2.7
K4.13	Operation of CRDS controls for withdrawing lingering rods and transferring rods and rod groups	3.3
K4.14	DELETED	
K4.15	Operation of latching controls for groups and individual rods	3.0
K4.16	Synchronization of power supplies to CRDS	2.9
K4.17	Override (bypass) for rod bank motion when one rod is bottomed	3.1
K4.18	Configuration of control/shutdown rods in core	3.3
K4.19	DELETED	
K4.20	The permissives and interlocks associated with an increase from zero power	3.7
K4.21	DELETED	
K4.22	Seismic considerations	2.2
K4.23	Rod motion inhibit	3.6
K4.24	Control bank sequence and overlap	3.7
K4.25	Transferring rods and rod groups to hold bus	2.7
K4.26	Reactor cutback/setback	3.4

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Control Rod Drive System:**
(CFR: 41.1 / 41.2 / 41.5 / 41.6 / 45.7)

K5.01	Understanding and application of individual and overlapped rod bank curves	3.3
K5.02	Application of differential rod worth and integral rod worth	3.3
K5.03	Principles of operation of rod drive motor (magnetic jack or roller nut)	2.7
K5.04	Rod insertion limits	4.0
K5.06	Effects of control rod motion on axial offset	3.8
K5.07	Effects of an asymmetric rod configuration on power distribution	3.6

K5.08	Reasons for rod insertion limits and their effect on shutdown margin (SDM)	4.1
K5.09	Relationships between reactivity due to boron and reactivity due to control rod	3.9
K5.10	Effect of rod motion on core power distribution and RCS temperatures	4.1
K5.11	DELETED	
K5.12	Effects on power of inserting axial shaping rods	3.6
K5.13	Effects of past power history on xenon concentration and samarium concentration	3.6
K5.14	Interpretation of isothermal temperature coefficient and the ability to apply it with respect to isothermal	2.9
K5.15	Relationship between RCS temperature and moderator temperature coefficient (MTC)	3.7
K5.16	DELETED	
K5.17	Sources for adding positive reactivity	4.1
K5.18	Anticipation of criticality at any time when adding positive reactivity during startup	4.3
K5.19	DELETED	
K5.20	DELETED	
K5.21	DELETED	
K5.22	Sources for adding positive reactivity samarium in SDM	2.6
K5.23	DELETED	
K5.24	DELETED	
K5.25	DELETED	
K5.26	DELETED	
K5.27	Interpretation of isothermal temperature coefficient and the ability to apply it with respect to the isothermal	2.7
K5.28	Boron reactivity worth versus boron concentration (i.e., amount of boron needed (parts per million) to change core reactivity to the desired amount)	3.6
K5.29	DELETED	
K5.30	DELETED	
K5.31	DELETED	
K5.32	DELETED	
K5.33	DELETED	
K5.34	DELETED	
K5.35	DELETED	
K5.36	DELETED	
K5.37	DELETED	
K5.38	DELETED	
K5.39	DELETED	
K5.40	DELETED	
K5.41	DELETED	
K5.42	DELETED	
K5.43	DELETED	
K5.44	DELETED	
K5.45	DELETED	
K5.46	DELETED	
K5.47	DELETED	
K5.48	DELETED	

K5.49	DELETED	
K5.50	DELETED	
K5.51	DELETED	
K5.52	DELETED	
K5.53	DELETED	
K5.54	DELETED	
K5.55	DELETED	
K5.56	DELETED	
K5.57	Interpretation of rod drop test data	2.3
K5.58	DELETED	
K5.59	Reasons for overlap of control rod banks for withdrawal and insertion	3.4
K5.60	Reason for using M/G sets to power rod control system	3.0
K5.61	Operational theory for M/G sets	2.5
K5.62	DELETED	
K5.63	DELETED	
K5.64	Reason for withdrawing shutdown group: to provide adequate SDM	3.7
K5.65	CRDS circuitry, including effects of primary/secondary power mismatch on rod motion	3.4
K5.66	Not used	
K5.67	Nucleonics associated with startup	3.4
K5.68	Understanding of “cold-water” (startup) accidents	3.4
K5.69	Purpose of overlap between source and intermediate-range instrumentation	3.6
K5.70	Method used to parallel the rod control M/G sets	2.6
K5.71	Reason for maintaining cross-tie breaker between rod drive M/G sets; reliability of control rod drive trip breakers during operation of one M/G set	2.7
K5.72	Reactivity balance (shutdown withdrawal precedes dilution) (Reference Potential)	3.4
K5.73	Need for maintenance of stable plant conditions during rod exercising	3.0
K5.74	Reactor may <u>not</u> go critical upon withdrawal of a shutdown group	3.5
K5.75	Definition, uses, and calculation of I/m plot (Reference Potential)	3.3
K5.76	DELETED	
K5.77	Determination of the amount of boron needed to back out rods from the core, including effects of xenon (Reference Potential)	3.5
K5.78	Response effects on T-ave. (average reactor coolant temperature) of dilution without rod motion	3.7
K5.79	Effects of positioning of axial shape rods on SDM	3.3
K5.80	Prediction of changes in boron concentration due to power operation, dilution, or boration (Reference Potential)	3.5
K5.81	Determination (using plant curve book) of reactivity change associated with the difference in boron concentration	3.5

K5.82	Interpretation of differential and integral boron worth curves	3.2
K5.83	Approximation of change in reactivity due to change in boron concentration (using differential boron thumb rule)	3.3
K5.84	Significance of sign change (plus or minus) in reactivity due to change in boron concentration	3.4
K5.85	Estimation of xenon reactivity based on time to reach peak xenon after trip/shutdown, approximate peak xenon reactivities after shutdown from various power levels, and approximate xenon worth during the decay process following peak worth	3.5
K5.86	Significance of sign change (plus or minus) in reactivity due to change in samarium level	2.8
K5.87	DELETED	
K5.88	DELETED	
K5.89	Relationships of axial offset to estimated critical position (ECP), a method of recovery from a high power trip, allowing for xenon transient, with minimum boron movement	2.8
K5.90	Estimation of core life based on RCS boron concentration (correlation of estimated critical boron concentration with time in core life)	2.8
K5.91	DELETED	
K5.92	DELETED	
K5.93	Axial offset problems caused by xenon oscillations (and their application to technical specification (TS) power limitations)	3.2
K5.94	DELETED	
K5.95	Effect of reactor power changes on RCS temperature	3.7
K5.96	Sign changes (plus or minus) in reactivity obtained when positive reactivities are added to negative reactivities	3.3
K5.97	Relationship of T-ave. to T-ref. (reference temperature for RCS)	3.9
K5.98	Effect of adding high or low boron concentration to maintain T-ave. equal to T-ref.	3.5
K5.99	Component cooling water system (CCWS)—must be shut down to prevent condensation on CRDM stators	2.6
K5.100	Control rod configuration and construction material (from K6)	2.6
K5.101	Purpose and operation of sensors feeding into the CRDS	3.0
K5.102	Effect of positive or negative MTC on reactor control	4.1
K5.103	Dropped or misaligned control rod effect on core poisons	3.4
K5.104	Effect of core poisons on dropped or misaligned control rod recovery	3.2
K5.105	Axial flux difference response to reactor power maneuvers	3.6
K5.106	Core poison redistribution effect on quadrant power tilt ratio (QPTR)	3.0
K5.107	Control rod position change effect on integral control rod worth	3.1
K5.108	Control rod position change effect on differential control rod worth	3.0
K5.109	Rod bank positions not within the control rod insertion limit	3.6
K5.110	CCWS must be cut in before energizing CRDS	2.8

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Control Rod Drive System**: (CFR: 41.1 / 41.2 / 41.5 / 41.6 / 45.7)	
K6.01	DELETED	
K6.02	DELETED	
K6.03	Reactor trip breakers, including controls	4.1
K6.04	DELETED	
K6.05	DELETED	
K6.06	Rod drive M/G set(s)	3.8
K6.07	DELETED	
K6.08	Purpose and position switch of alarm for high flux at shutdown	2.9
K6.09	DELETED	
K6.10	Location and operation of rod control M/G sets and control panel, including trips	3.2
K6.11	Location and operation of CRDS fault detection (trouble alarms) and reset system, including rod control annunciator	3.1
K6.12	DELETED	
K6.13	RPIS	3.7
K6.14	DELETED	
K6.15	Main turbine system	3.0
K6.16	NIS	3.6
K6.17	RCS	3.3
K6.18	RPS	3.8
K6.19	CRDM cooling	3.1
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Control Rod Drive System, including:** (CFR: 41.5 / 45.5)	
A1.01	T-ave. and no-load T-ave.	3.7
A1.02	Tref	3.4
A1.03	Steam generator (S/G) level and pressure	3.1
A1.04	PZR level and pressures	3.2
A1.05	DELETED	
A1.06	Reactor power	4.0
A1.07	DELETED	
A1.08	Verification that CRDS temperatures are within limits before starting	2.7
A1.09	DELETED	
A1.10	Location and operation of controls and indications for CRDS cooling	2.9
A1.11	DELETED	
A1.12	DELETED	
A1.13	“Prepower-dependent insertion limit” and power dependent insertion limit	3.3
A1.14	Rod insertion limit	3.7

A1.15	Axial flux imbalance	3.6	
A1.16	Quadrant Power Tilt Ratio (QPTR)	3.6	
A1.17	Control bank sequence and overlap	3.7	
A1.18	NIS	3.8	
A1.19	Reactor power	4.1	
A1.20	Rod height	3.6	
A1.21	Radial imbalance	3.2	
A1.22	Individual versus group rod position	3.6	

A2 **Ability to (a) predict the impacts of the following on the Control Rod Drive System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	SRO
A2.01	CRDM cooling	3.3	3.3
A2.02	Power source to reactor trip breakers, including trip breaker failure	3.6	3.9
A2.03	Stuck rod or misaligned rod	3.8	4.2
A2.04	Positioning of rods and their effect on SDM	3.5	3.9
A2.05	Fractured split pins	2.0	2.3
A2.06	Xenon transient	3.3	3.4
A2.07	DELETED		
A2.08	DELETED		
A2.09	Station blackout	2.9	3.1
A2.10	One or more M/G sets	3.0	3.2
A2.11	DELETED		
A2.12	Erroneous ECP calculation	3.4	3.8
A2.13	Anticipated transient without scram (ATWS)	4.3	4.3
A2.14	Rod control alarm, including rod-out-of-sequence and motion-inhibit alarms	3.4	3.6
A2.15	Quadrant power tilt	3.1	3.7
A2.16	Misaligned control rods	3.6	4.0
A2.17	DELETED		
A2.18	Incorrect rod stepping sequence	3.3	3.6
A2.19	Axial flux difference/imbalance	3.1	3.7
A2.20	Abnormal coil voltage	2.2	2.7
A2.21	Rods below the rod insertion limit	3.7	4.0
A2.22	NIS	3.3	3.8
A2.23	RPS	3.5	3.8
A2.24	Dropped rod	3.5	4.1
A2.25	CRDM cooling	3.0	3.3
A2.26	Main turbine control	2.7	3.1

A3 **Ability to monitor automatic operation of the Control Rod Drive System, including:**
(CFR: 41.6 / 45.13)

A3.01	DELETED
A3.02	DELETED

A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	Rod speed and direction	4.0
A3.10	Control bank sequence and overlap	3.8
A3.11	Reactor cutback/setback	3.7

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.6 / 45.5 to 45.8)

A4.01	CRDM cooling	2.9
A4.02	DELETED	
A4.03	CRDS mode control	3.7
A4.04	Part-length rod position (plant specific)	2.9
A4.05	DELETED	
A4.06	Control rod drive disconnect/connect	2.8
A4.07	Power source transfer check	2.4
A4.08	Mode select for CRDS; operation of rod control M/G sets and control panel	3.3
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	Stopping turbine generator (T/G) load changes; making only minor adjustments to prevent coil burnout	2.7
A4.13	Stopping other changes in plant (e.g., turbine, S/G, SDBCS, and boration) before adjusting rods	3.4
A4.14	Resetting rod control logic while recovering from misaligned rod	3.2
A4.15	Stopping boration/dilution or other means of reactivity change while adjusting either rod position or T-ave.	3.7
A4.16	Rod speed and direction	3.8
A4.17	Rod position	4.0

System: 004 SF1 CVCS Chemical and Volume Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Chemical and Volume Control System and the following systems:** (CFR: 41.3 / 41.5 to 41.8 / 41.10)	
K1.01	PZR level control system (LCS)	4.3
K1.02	RCS	4.2
K1.03	Main turbine generator (MT/G)	2.3
K1.04	Reactor coolant pump system (RCPS), including seal injection flows	4.1
K1.05	CRDS	2.7
K1.06	Makeup system to volume control tank (VCT)	3.8
K1.07	NIS	2.4
K1.08	DELETED	
K1.09	RPIS	2.3
K1.10	DELETED	
K1.11	DELETED	
K1.12	Nitrogen system	2.5
K1.13	Hydrogen system	2.7
K1.14	Instrument air system (IAS)	3.0
K1.15	Emergency core cooling system (ECCS)	4.0
K1.16	Boric acid storage tank	3.8
K1.17	PZR/pressurizer relief tank (PRT)	3.7
K1.18	CCWS	3.3
K1.19	Primary grade water supply	3.2
K1.20	Sampling system	2.2
K1.21	Waste gas disposal system (WGDS)	2.6
K1.22	Borated water storage tank (BWST)	3.4
K1.23	Refueling water storage tank (RWST)	3.5
K1.24	Residual heat removal system (RHRS)	3.4
K1.25	Interface between high-pressure injection (HPI) flowpath and excess letdown flowpath	3.5
K1.26	Liquid radwaste system (LRS)	2.9
K1.27	DELETED	
K1.28	DELETED	
K1.29	DELETED	
K1.30	DELETED	
K1.31	DELETED	
K1.32	DELETED	
K1.33	DELETED	
K1.34	PZR pressure control system (PCS)	3.5
K1.35	DELETED	
K1.36	DELETED	
K1.37	Service water system (SWS)	2.4

K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.6 / 41.7)	
K2.01	DELETED	
K2.02	CVCS makeup pumps	3.0
K2.03	Charging pumps	3.9
K2.04	DELETED	
K2.05	DELETED	
K2.06	Control instrumentation	3.3
K2.07	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Chemical and Volume Control System will have on the following systems or system parameters:** (CFR: 41.5 to 41.7)	
K3.01	CRDS	2.4
K3.02	DELETED	
K3.03	CCWS	2.7
K3.04	RCPS	3.7
K3.05	PZR LCS	4.0
K3.06	RCS	3.9
K3.07	PZR PCS	3.4
K3.08	DELETED	
K3.09	LRS	2.8
K3.10	Nitrogen system	1.9
K3.11	Hydrogen system	1.9
K3.12	IAS	2.4
K3.13	ECCS	3.8
K4	**Knowledge of Chemical and Volume Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.6 / 41.7)	
K4.01	Oxygen control in RCS	2.9
K4.02	Control of pH and range of acceptability	2.7
K4.03	Protection of ion exchangers	3.2
K4.04	Manual/automatic transfers of control	3.5
K4.05	Interrelationships and design basis, including fluid flow splits in branching networks (e.g., charging and seal injection flow)	3.6
K4.06	Isotopic control	2.4
K4.07	Makeup to the VCT	3.6
K4.08	Hydrogen control in RCS	3.0
K4.09	DELETED	
K4.10	Minimum temperature requirements on borated systems	3.0
K4.11	Temperature/pressure control in letdown line	3.7
K4.12	Automatic action(s), which occur based on level of VCT	3.9

K4.13	DELETED	
K4.14	Control interlocks on letdown system	3.8
K4.15	DELETED	
K4.16	DELETED	
K4.17	RCS boration and/or dilution	4.1
K4.18	Minimum VCT pressure effect on reactor coolant pump (RCP) seals	3.5
K4.19	Design characteristics of boric acid transfer pump	2.3
K4.20	Purpose of centrifugal pump miniflows (recirculation)	3.1
K4.21	Design and purpose of charging pump desurger	2.7
K4.22	Design minimum and maximum flow rates for letdown system	3.2

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Chemical and Volume Control System:**
(CFR: 41.5 / 45.7)

K5.01	Importance of oxygen control in RCS	2.9
K5.02	Explosion hazard associated with hydrogen containing systems	3.1
K5.03	Definition of pH, reasons for importance, and range of acceptability in RCS	2.7
K5.04	Reason for hydrogen cover gas in VCT (oxygen scavenge)	3.0
K5.05	Source of neutrons (leakage and their effect of core life) and NIS indications	2.7
K5.06	Boron “worth”	3.2
K5.07	Relationship between startup rate and reactivity during a dilution to criticality	3.4
K5.08	Estimation of subcritical multiplication factor (K-eff) by means other than the six-factor formula: relationship of count rate changes to reactivity changes	2.9
K5.09	Thermal shock: high component stress due to rapid temperature change	3.2
K5.10	DELETED	
K5.11	Thermal stress, brittle fracture, and pressurized thermal shock	3.4
K5.12	Effects of temperature on corrosion	2.5
K5.13	DELETED	
K5.14	Reduction process of gas concentration in RCS: vent-accumulated noncondensable gases from PZR bubble space, depressurized during cooldown or by alternately heating and cooling (spray) within the allowed pressure band (which drives more gas out of solution)	2.8
K5.15	Boron and control rod reactivity effects as they relate to MTC	3.2
K5.16	DELETED	
K5.17	DELETED	
K5.18	Relationship between neutron flux and reactivity	3.1
K5.19	Concept of SDM	3.7

K5.20	Reactivity effects of xenon, boration, and dilution	3.8
K5.21	PPM and weight percent for boron	3.0
K5.22	Ion bead degradation by temperature	3.0
K5.23	Radioactive decay of crud	2.3
K5.24	Decontamination factors	2.3
K5.25	Channeling of ion exchanger	2.7
K5.26	Relationship between VCT pressure and net positive suction head (NPSH) for charging pumps	3.5
K5.27	Reason for nitrogen purge of CVCS	2.8
K5.28	Reason for "burping" noncondensable gases from VCT	2.8
K5.29	Reason for sampling for chloride, fluoride, sodium, and solids in RCS	2.6
K5.30	Relationship between temperature and pressure in CVCS components during solid plant operation	4.0
K5.31	Purpose of flowpath around boric acid storage tank	3.0
K5.32	Purpose and control of heat tracing	2.8
K5.33	DELETED	
K5.34	For ion exchangers: demineralization, boration / deboration, thermal regeneration, and lithium control	2.8
K5.35	Heat exchanger principles and the effects of flow, temperature, and other parameters (such as temperature effect of the solubility of boron)	3.1
K5.36	DELETED	
K5.37	Effects of boron saturation on ion exchanger behavior	3.2
K5.38	DELETED	
K5.39	DELETED	
K5.40	Response of PRT during bubble formation in PZR: an increase in quench tank pressure when cycling power-operated relief valves (PORVs) shows that complete steam bubbles do not exist and that significant noncondensable gas is still present.	2.8
K5.41	Solubility of gases in solution: temperature and pressure effects	2.6
K5.42	DELETED	
K5.43	DELETED	
K5.44	Pressure response in PZR during in-and-out surge	3.6
K5.45	Resistance heating: power/current relations	2.3
K5.46	DELETED	
K5.47	DELETED	
K5.48	Purpose of hydrogen purging and sampling processes	2.8
K5.49	Purpose and method of hydrogen removal from RCS before opening the system: explosion hazard and nitrogen purge	3.0
K5.50	DELETED	
K5.51	DELETED	
K5.52	Reason for reducing letdown rate when filling PZR; collapse steam bubble	3.0
K5.53	Reason for keeping VCT pressure as low as possible during degas	2.9
K5.54	Calculation of the rate of boron change in the RCS as a function of flow rate	2.8

K5.55	Factors that effect changes in letdown temperature	3.3
K5.56	Sources of radioiodine in RCS (hazards when changing filters)	2.5
K5.57	Relationship between seal filter and letdown filter	2.6
K5.58	Recirculation valve on boric acid storage tank (the reason the valve is closed during functional test)	2.4
K5.59	Function of demineralizer, including boron loading and temperature limits	2.8
K5.60	Capacity of boron recovery tanks: plan not to exceed by inefficient boron movement; interface with boron recovery system	2.3
K5.61	Relationship between VCT vent rate and vent header pressure	2.4

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Chemical and Volume Control System:**
(CFR: 41.5 to 41.7 / 45.7)

K6.01	Spray/heater combination in PZR to ensure uniform boron concentration	3.1
K6.02	Mixed bed and deborating demineralizers	2.9
K6.03	DELETED	
K6.04	Charging pumps	4.0
K6.05	Sensors and detectors	3.4
K6.06	DELETED	
K6.07	Regen and nonregenerative heat exchangers	3.4
K6.08	DELETED	
K6.09	VCT divert valve	3.4
K6.10	Boric acid storage tank/ boron injection tank (BIT) recirculation flowpath	3.2
K6.11	DELETED	
K6.12	Principle of recirculation valve: the valve permits emergency flow even if it is blocked by crystallized boric acid	2.9
K6.13	Boration/dilution batch controller	3.6
K6.14	Recirculation path for charging pumps	3.4
K6.15	Reason for venting VCT and pump casings while filling: vents must connect to LRS	3.1
K6.16	Loss of VCT spray nozzle	2.7
K6.17	Flowpaths for emergency boration	4.2
K6.18	DELETED	
K6.19	DELETED	
K6.20	DELETED	
K6.21	DELETED	
K6.22	DELETED	
K6.23	DELETED	
K6.24	Controllers and positioners	3.6
K6.25	DELETED	

K6.26	Methods of pressure control of solid plant (PZR relief and water inventory)	3.9
K6.27	Residual heat removal (RHR) relief and isolation valves	2.9
K6.28	Interface between high-activity waste tank and letdown filter drain	2.5
K6.29	DELETED	
K6.30	DELETED	
K6.31	Seal injection system	3.9
K6.32	Malfunction of VCT venting capability: reduce concentration of gases in solution and keep stress in tank down	2.8
K6.33	DELETED	
K6.34	DELETED	
K6.35	DELETED	
K6.36	Letdown pressure control	3.7
K6.37	DELETED	
K6.38	DELETED	
K6.39	PZR PCS	3.7
K6.40	RCPS	3.6
K6.41	CRDS	2.7
K6.42	Nitrogen system	2.3
K6.43	Hydrogen system	2.5
K6.44	IAS	3.0
K6.45	ECCS	3.8
K6.46	PZR LCS	4.0
K6.47	CCWS	3.3
K6.48	WGDS	2.5
K6.49	LRS	2.5
K6.50	SWS	2.4
K6.51	Relationship between letdown flow and RCS pressure	3.4
K6.52	Flow control valve malfunction	3.6
K6.53	Containment isolation valves malfunction	3.7
K6.54	Temperature control valve malfunction	3.6

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Chemical and Volume Control System, including**:
(CFR: 41.5 to 41.7 / 45.5)

A1.01	Activity levels in primary system	2.9
A1.02	T-ave. and T-ref.	3.6
A1.03	RCS pressure	3.7
A1.04	PZR pressure and level	4.2
A1.05	S/G pressure and level	2.6
A1.06	VCT level	3.8
A1.07	Maximum specified letdown flow	3.3
A1.08	Normal operating band for letdown flow rate	3.3
A1.09	RCS temperature	3.7
A1.10	Reactor power	3.8
A1.11	Letdown and charging flows	3.8

A1.12	Rate of boron concentration reduction in RCS as a function of letdown flow while the deborating demineralizer is in service	3.3	

A2	**Ability to (a) predict the impacts of the following on the Chemical and Volume Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 to 41.7 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	RCS pressure allowed to exceed limits	3.8	3.9
A2.02	Loss of PZR level	4.3	4.2
A2.03	Boundary isolation valve leak	3.6	3.2
A2.04	Unplanned gas release	2.5	3.0
A2.05	RCP seal failures	3.5	4.1
A2.06	Inadvertent boration/dilution	3.9	4.1
A2.07	Isolation of letdown/makeup	3.8	3.8
A2.08	Loss of heat tracing	2.2	2.6
A2.09	High primary and/or secondary activity	2.5	3.0
A2.10	Inadvertent boration/dilution	3.8	4.0
A2.11	Loss of IAS	3.3	3.4
A2.12	Containment isolation actuation signal and safety injection (SI) actuation signal	3.6	3.8
A2.13	Low RWST	3.6	3.5
A2.14	Emergency boration	4.0	4.2
A2.15	High or low PZR level (actual)	3.7	4.0
A2.16	T-ave. and T-ref. deviations	3.0	3.5
A2.17	Low PZR pressure	3.2	3.6
A2.18	High VCT level	3.5	3.4
A2.19	High primary concentrations of chloride, fluoride, sodium, and solids	2.4	2.6
A2.20	Shifting demineralizer while divert valve is lined up to VCT	2.7	2.8
A2.21	Excessive letdown flow, pressure, and temperatures on ion exchange resins	2.9	3.0
A2.22	Mismatch of letdown and charging flows	3.4	3.5
A2.23	High filter differential pressure (D/P)	2.7	2.9
A2.24	Isolation of both letdown filters at one time: downstream relief lifts	3.4	3.3
A2.25	Uncontrolled boration or dilution	4.1	3.9
A2.26	Low VCT pressure	3.3	3.2
A2.27	Improper RWST boron concentration	3.6	3.4
A2.28	Depressurizing of RCS while it is hot	2.5	3.1
A2.29	Indication by increased letdown flow that demineralizers are bypassed	2.5	2.6
A2.30	Reduction of boron concentration in the letdown flow and its effects on reactor operation	3.5	3.5
A2.31	Potential for RCS chemical contamination when placing CVCS demineralizer in service	2.7	2.8

A2.32	Expected reactivity changes after valving in a new mixed-bed demineralizer that has not been preborated	3.8	3.6
A2.33	The fact that isolating cation demineralizer stops boron dilution and enables restoration of normal boron concentration	2.9	2.8
A2.34	Predict how deborating demineralizers function near the end of an operating cycle with low RCS boron concentrations	3.1	3.0
A2.35	Reactor trip	3.5	3.7
A2.36	ECP and related boration/dilution/reactivity relationships	3.3	3.4

A3 **Ability to monitor automatic operation of the Chemical and Volume Control System, including:**
(CFR: 41.7 / 45.5)

A3.01	Water and boron inventory	3.7
A3.02	Letdown isolation	3.8
A3.03	Ion exchange bypass	3.0
A3.04	VCT pressure control	3.2
A3.05	RCS pressure and temperature	3.7
A3.06	T-ave. and T-ref.	3.6
A3.07	DELETED	
A3.08	Reactor power	3.8
A3.09	VCT level	3.7
A3.10	PZR level and pressure	4.0
A3.11	Charging/letdown	3.9
A3.12	Interpretation of letdown demineralizer flow-divert valve position indicating lights	3.1
A3.13	DELETED	
A3.14	DELETED	
A3.15	PZR pressure and temperature	3.5
A3.16	DELETED	
A3.17	Interpretation of ion exchanger status light	2.7
A3.18	Interpretation of letdown orifice isolation valve position indicators	3.4

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.5 to 41.7 / 45.5 to 45.8)

A4.01	Boron reactivity effects	4.2
A4.02	ECP and related boration / dilution / reactivity relationships	3.8
A4.03	Construction and use of 1/M plots (inverse multiplication and criticality prediction method)	3.4
A4.04	Calculation of boron concentration changes	3.6
A4.05	Letdown pressure and temperature control valves	3.7
A4.06	Letdown isolation and flow control valves	3.8
A4.07	Boration / dilution	4.0
A4.08	Charging	4.0
A4.09	DELETED	

A4.10	Boric acid pumps	3.7
A4.11	RCP seal injection	3.9
A4.12	DELETED	
A4.13	VCT level control and pressure control	3.7
A4.14	Ion exchangers and demineralizers	3.0
A4.15	Boron concentration	3.7
A4.16	Activity levels of RCS and letdown	2.9
A4.17	Deborating demineralizer	2.9
A4.18	Emergency borate valve	4.2
A4.19	CVCS letdown orifice isolation valve and valve control switches	3.6
A4.20	DELETED	
A4.21	Letdown demineralizer flow-divert valve control switch	3.2
A4.22	DELETED	
A4.23	Calculation of the required volume through the deborating demineralizer, using the appropriate equation	3.0

System: 014 SF1 RPI Rod Position Indication System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Rod Position Indication System and the following systems:** (CFR: 41.2 to 41.8 / 45.2 / 45.4 to 45.7)	
K1.01	CRDS	4.0
K1.02	NIS	3.5
K1.03	Plant computer system	3.4
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K2.04	Rod position main control room display panel	3.0
K3	**Knowledge of the effect that a loss or malfunction of the Rod Position Indication System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	CRDS	3.4
K3.02	Plant computer	3.2
K4	**Knowledge of Rod Position Indication System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.2 / 41.5 / 41.7 / 45.7)	
K4.01	Upper electrical limit (Combustion Engineering (CE) specific)	3.5
K4.02	Lower electrical limit (CE specific)	3.5
K4.03	Rod bottom lights	3.8
K4.04	Zone reference lights (Babcock and Wilcox (BW) specific)	3.2
K4.05	DELETED	
K4.06	Individual and group misalignment	3.9
K4.07	Group demand position indication (Westinghouse)	3.6
K4.08	Rod position indication (Westinghouse)	3.6
K4.09	Rod position indication accuracy (Westinghouse)	3.5
K4.10	Rod Stop, C-11 (Westinghouse)	3.4

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Rod Position Indication System:** (CFR: 41.6 / 41.7 / 45.7)		
K5.01	Reasons for differences between RPIS and step counter	3.4	
K5.02	RPIS independent of demand position	3.5	
K5.03	Differences in accuracy of reed switches and pulse counters	2.9	
K5.04	Concepts of magnetic flux and permeability of stainless steel housing	2.5	
K5.05	Misaligned / dropped control rod effect on rod position indication and group demand position indication	3.7	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Rod Position Indication System:** (CFR: 41.6 / 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DELETED		
K6.03	Metroscope	3.3	
K6.04	CRDS	3.6	
K6.05	Rod position indication data cabinet	3.3	
K6.06	Group demand position indication	3.4	
K6.07	Non-urgent failure	3.1	
K6.08	Urgent failure	3.5	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Rod Position Indication System, including:** (CFR: 41.5 to 41.7 / 45.5)		
A1.01	Metroscope reed switch display	3.5	
A1.02	Rod position indication	3.7	
A1.03	Power-dependent insertion limit and prepower-dependent insertion limit (CE)	4.0	
A1.04	Axial and/or radial power distribution	3.8	
A1.05	Rod bottom lights	3.8	
A1.06	Group demand position indication	3.4	
A2	**Ability to (a) predict the impacts of the following on the Rod Position Indication System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 to 41.7 / 43.5 / 43.6 / 45.3 / 45.12 / 45.13)	**RO**	**SRO**
A2.01	Loss of offsite power	3.2	3.5
A2.02	Loss of power to the RPIS	3.3	3.5

A2.03	Dropped rod	4.0	4.0
A2.04	Inoperable or misaligned rod	3.9	3.9
A2.05	Reactor trip	3.9	3.9
A2.06	Loss of LVDT	2.5	3.3
A2.07	Loss of reed switch	3.6	3.1
A2.08	Non-urgent alarm	2.7	3.2
A2.09	Urgent alarm	3.3	3.5
A2.10	Failed rod position indication data cabinet	3.4	3.3
A2.11	Failed group demand position indication	3.0	3.3

A3 **Ability to monitor automatic operation of the Rod Position Indication System, including:**
(CFR: 41.6 / 41.7 / 45.5)

A3.01	Rod position indication accuracy	3.4

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.6 / 41.7 / 45.5 to 45.8)

A4.01	DELETED	
A4.02	DELETED	
A4.03	DELETED	
A4.04	DELETED	
A4.05	Rod position indication accuracy mode selection (Westinghouse)	3.1

System: **053 SF1 ICS Integrated Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Integrated Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Nonnuclear instrumentation (NNI) system (includes the smart automatic signal selection system (SASS))	3.3
K1.02	NIS	3.6
K1.03	RCS (e.g., RCP, T-ave., delta Tc, and tilt)	3.7
K1.04	Main steam system (e.g., TBV and header pressure)	3.5
K1.05	Main feedwater (MFW) system (includes MFW pump controls)	3.6
K1.06	Electrohydraulic control (EHC)	3.1
K1.07	CRDS	3.6
K1.08	Electrical distribution system	3.3
K1.09	RPS (e.g., reactor trip confirm)	3.8
K1.10	Plant computer (e.g., unit load demand (ULD) and plant performance analysis system (PPAS))	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	ICS alternating current (AC) power	3.3
K2.02	ICS direct current (DC) power	3.3
K3	**Knowledge of the effect that a loss or malfunction of the ICS will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Main steam system (e.g., TBV or header pressure)	3.5
K3.02	MFW system (includes MFW pump controls)	3.6
K3.03	EHC	3.1
K3.04	CRDS	3.7
K3.05	RCS	3.6
K4	**Knowledge of Integrated Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	T-ave. control	3.5
K4.02	MFW control (e.g., rapid feedwater reduction, MFW pumps, or MFW valves)	3.6
K4.03	Generated megawatt electric control	3.4
K4.04	Control rod motion	3.9

K4.05	Neutron power	3.7
K4.06	Steam header pressure control	3.7
K4.07	Delta Tc control	3.5
K4.08	Runbacks (e.g., MFW pump trip, condensate pump trip, RCP trip, or dropped rod)	3.9
K4.09	High-load limit or low-load limit	3.5
K4.10	Cross limits (heat balance)	3.8
K4.11	S/G level control	3.5
K4.12	British thermal unit (BTU) limits (alarm only)	3.1

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Integrated Control System:**
(CFR: 41.5 / 45.7)

K5.01	Open loop control system (integrated mode and borrowing/storing energy)	3.4
K5.02	Closed loop control system (calibrating integral control)	3.3
K5.03	Thermodynamic principles to control S/G heat transfer (e.g., Constant T-ave. control, ramping T-ave. at low power, or low-level limits)	3.4

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Integrated Control System:**
(CFR: 41.7 / 45.7)

K6.01	RCP trip	3.7
K6.02	Feedwater pump trip	3.5
K6.03	Condensate pump trip	3.1
K6.04	Dropped control rod	3.8
K6.05	Instrument failure (nuclear instrumentation (NI) or NNI)	3.9
K6.06	ICS AC power	3.6
K6.07	ICS DC power	3.6
K6.08	Plant computer (ULD)	3.4
K6.09	Steamline break	3.6
K6.10	EHC	3.2
K6.11	MFW (valves or pumps)	3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Integrated Control System, including:**
(CFR: 41.5 / 45.5)

A1.01	T-ave.	3.9
A1.02	Rod position (rod motion)	3.8
A1.03	Neutron error	3.7
A1.04	Reactor power	3.9
A1.05	Steam header pressure and/or S/G pressure	3.7
A1.06	Feedwater flow	3.7
A1.07	S/G level	3.7

A1.08	Delta Tc	3.6	
A1.09	RCS flow (RCP status)	3.6	
A1.10	Generated megawatt electric	3.5	

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the Integrated Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Instrument failure (NI or NNI)	3.6	3.8
A2.02	RCP trip	3.4	3.7
A2.03	MFW pump trip	3.4	3.6
A2.04	Condensate pump trip	3.0	3.4
A2.05	Dropped rod	4.0	3.7
A2.06	ICS AC power loss	3.1	3.6
A2.07	ICS DC power loss	2.9	3.5
A2.08	Plant computer failure	2.9	3.2

A3	**Ability to monitor automatic features of the Integrated Control System, including:** (CFR: 41.7 / 45.5)	
A3.01	ULD correction factor	3.2
A3.02	Neutron error	3.6
A3.03	Runbacks	3.8
A3.04	Feedwater re-ratio	3.7
A3.05	Low-level limits	3.5
A3.06	Rapid feedwater reduction	3.7
A3.07	TBV control (biases)	3.5
A3.08	Reactivity	4.0
A3.09	MFW block valves	3.6
A3.10	MFW pump controls (speed control or delta P control)	3.6

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Feedwater (e.g., loop demand, delta Tc, MFW pumps, startup control valves, or low-load control valves)	3.7
A4.02	Reactor demand	3.9
A4.03	S/G / reactor demand	3.9
A4.04	ULD	3.5

3.2	**Safety Function 2: Reactor Coolant System Inventory Control**	**Page**

System: **002 SF2 RCS Reactor Coolant System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Reactor Coolant System and the following systems:** (CFR: 41.2 to 41.8 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	CRDS	3.5
K1.03	DELETED	
K1.04	RCS vent system	3.2
K1.05	DELETED	
K1.06	CVCS	4.1
K1.07	RCS level indication system	3.8
K1.08	ECCS	4.3
K1.09	PZR system	4.2
K1.10	LRS	3.1
K1.11	S/Gs	3.9
K1.12	NIS	3.6
K1.13	RCPS	4.0
K1.14	DELETED	
K1.15	DELETED	
K1.16	DELETED	
K1.17	DELETED	
K1.18	RHRS	4.1
K1.19	Spent fuel pool cooling system (SFPCS)	2.6
K1.20	Radiation monitoring system (RMS)	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
	None	
K3	**Knowledge of the effect that a loss or malfunction of the Reactor Coolant System will have on the following systems or system parameters:** (CFR: 41.7)	
K3.01	LRS	2.8
K3.02	Fuel	4.3
K3.03	Containment system	4.0
K3.04	RMS	3.6
K3.05	CVCS	3.9
K3.06	ECCS	4.3
K3.07	PZR	4.1
K3.08	RHRS	4.0

K4	**Knowledge of Reactor Coolant System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7 / 41. 3)	
K4.01	Filling and draining the RCS, the refueling cavity, and/or refueling canal	3.2
K4.02	RCS level indication system	3.7
K4.03	Venting the RCS	3.3
K4.04	DELETED	
K4.05	Detection of RCS leakage	3.9
K4.06	Prevention of missile hazards	2.7
K4.07	Contraction and expansion during heatup and cooldown	3.3
K4.08	Anchoring of components (i.e., loops, vessel, S/Gs, and coolant pumps)	2.3
K4.09	Operation of loop isolation valves	2.9
K4.10	Overpressure protection	4.1
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Reactor Coolant System:** (CFR: 41.5 / 45.7)	
K5.01	DELETED	
K5.02	Purpose of vent flowpath when draining	3.6
K5.03	DELETED	
K5.04	Reason the plant is required to be in a steady-state condition during RCS water inventory balance	3.4
K5.05	DELETED	
K5.06	Pressure, temperature, and volume relationships of nitrogen gas in association with water	2.8
K5.07	DELETED	
K5.08	The reason why the PZR level should be kept within the programmed band	3.5
K5.09	DELETED	
K5.10	Relationship between reactor power and RCS differential temperature	3.8
K5.11	Relationship between effects of the primary coolant system and the secondary coolant system	3.7
K5.12	Relationship of temperature average and loop differential temperature to loop hot-leg and cold-leg temperature indications	3.5
K5.13	Causes of circulation	3.6
K5.14	Consequences of forced circulation loss	3.9
K5.15	Reasons for maintaining subcooling margin (SCM) during natural circulation	3.9
K5.16	Reason for automatic features of the feedwater control system during total loss of reactor coolant flow	3.3
K5.17	Need for monitoring in-core thermocouples during natural circulation	3.8

K5.18	Brittle fracture	3.5
K5.19	Neutron embrittlement	3.1
K5.20	DELETED	
K5.21	Contraction and expansion during heatup and cooldown	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Reactor Coolant System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	RCP	4.0
K6.03	RCS level indication system	3.7
K6.04	RCS vent systems	3.3
K6.05	Valves	3.2
K6.06	Sensors and detectors	3.3
K6.07	Pumps	3.5
K6.08	Controllers and positioners	3.4
K6.09	Motors	3.2
K6.10	Breakers, relays, and disconnects	3.2
K6.11	DELETED	
K6.12	PZR system	3.8
K6.13	Reactor vessel and internals	3.3
K6.14	Core components	3.3
K6.15	Postaccident sampling	2.6

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Reactor Coolant System, including:**
(CFR: 41.5 / 45.7)

A1.01	Primary and secondary pressure	3.9
A1.02	PZR and makeup tank level	3.9
A1.03	Temperature	4.0
A1.04	SCM	4.1
A1.05	RCS flow	3.7
A1.06	Reactor power	4.2
A1.07	Reactor differential temperature	3.8
A1.08	RCS average temperature	3.9
A1.09	DELETED	
A1.10	RCS T-ref.	3.7
A1.11	Relative level indications in the RWST, the refueling cavity, the PZR, and the reactor vessel during preparation for refueling	3.3
A1.12	Radioactivity level when venting CRDS	2.8
A1.13	Core exit thermocouples	3.8
A1.14	Loose parts monitoring	2.9

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the Reactor Coolant System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)		
A2.01	Loss of coolant inventory	4.4	4.5
A2.02	Loss of coolant pressure	4.3	4.4
A2.03	Loss of forced circulation	4.3	4.2
A2.04	Loss of heat sinks	4.5	4.5

A3	**Ability to monitor automatic operation of the Reactor Coolant System, including:** (CFR: 41.7 / 45.5)	
A3.01	Reactor coolant leak detection system	3.9
A3.02	DELETED	
A3.03	Overpressure protection	4.1
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	RCS leakage calculation program using the computer	3.7
A4.02	Indications necessary to verify natural circulation from appropriate level, flow, and temperature indications and valve positions upon loss of forced circulation	4.0
A4.03	Indications and controls necessary to recognize and correct saturation conditions	4.0
A4.04	The filling / draining of low-pressure injection (LPI) pumps during refueling	3.0
A4.05	The HPI system when it is used to refill the refueling cavity	3.0
A4.06	Overflow level of the RWST	2.7
A4.07	Flowpath linking the RWST through the RHRS to the RCS hot legs for gravity refilling of the refueling cavity	3.2
A4.08	Safety parameter display systems (SPDSs)	3.5

System: 004 SF2 CVCS Chemical and Volume Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Chemical and Volume Control System and the following systems:** (CFR: 41.3 / 41.5 to 41.8 / 41.10)	
K1.01	PZR LCS	4.3
K1.02	RCS	4.2
K1.03	MT/G	2.3
K1.04	RCPS, including seal injection flows	4.1
K1.05	CRDS	2.7
K1.06	Makeup system to VCT	3.8
K1.07	NIS	2.4
K1.08	DELETED	
K1.09	RPIS	2.3
K1.10	DELETED	
K1.11	DELETED	
K1.12	Nitrogen system	2.5
K1.13	Hydrogen system	2.7
K1.14	IAS	3.0
K1.15	ECCS	4.0
K1.16	Boric acid storage tank	3.8
K1.17	PZR / PRT	3.7
K1.18	CCWS	3.3
K1.19	Primary grade water supply	3.2
K1.20	Sampling system	2.2
K1.21	WGDS	2.6
K1.22	BWST	3.4
K1.23	RWST	3.5
K1.24	RHRS	3.4
K1.25	Interface between HPI flowpath and excess letdown flowpath	3.5
K1.26	LRS	2.9
K1.27	DELETED	
K1.28	DELETED	
K1.29	DELETED	
K1.30	DELETED	
K1.31	DELETED	
K1.32	DELETED	
K1.33	DELETED	
K1.34	PZR PCS	3.5
K1.35	DELETED	
K1.36	DELETED	
K1.37	SWS	2.4

K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.6 / 41.7)	
K2.01	DELETED	
K2.02	CVCS makeup pumps	3.0
K2.03	Charging pumps	3.9
K2.04	DELETED	
K2.05	DELETED	
K2.06	Control instrumentation	3.3
K2.07	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Chemical and Volume Control System will have on the following systems or system parameters:** (CFR: 41.5 / 41.7)	
K3.01	CRDS	2.4
K3.02	DELETED	
K3.03	CCWS	2.7
K3.04	RCPS	3.7
K3.05	PZR LCS	4.0
K3.06	RCS	3.9
K3.07	PZR PCS	3.4
K3.08	DELETED	
K3.09	LRS	2.8
K3.10	Nitrogen system	1.9
K3.11	Hydrogen system	1.9
K3.12	IAS	2.4
K3.13	ECCS	3.8
K4	**Knowledge of Chemical and Volume Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.6, 41.7)	
K4.01	Oxygen control in RCS	2.9
K4.02	Control of pH and range of acceptability	2.7
K4.03	Protection of ion exchangers	3.2
K4.04	Manual/automatic transfers of control	3.5
K4.05	Interrelationships and design basis, including fluid flow splits in branching networks (e.g., charging and seal injection flow)	3.6
K4.06	Isotopic control	2.4
K4.07	Makeup to the VCT	3.6
K4.08	Hydrogen control in RCS	3.0
K4.09	DELETED	
K4.10	Minimum temperature requirements on borated systems	3.0
K4.11	Temperature/pressure control in letdown line	3.7
K4.12	Automatic action(s) that occurs based on level of VCT	3.9

K4.13	DELETED	
K4.14	Control interlocks on letdown system	3.8
K4.15	DELETED	
K4.16	DELETED	
K4.17	RCS boration and/or dilution	4.1
K4.18	Minimum VCT pressure effect on RCP seals	3.5
K4.19	Design characteristics of boric acid transfer pump	2.3
K4.20	Purpose of centrifugal pump miniflows (recirculation)	3.1
K4.21	Design and purpose of charging pump desurger	2.7
K4.22	Design minimum and maximum flow rates for the letdown system	3.2

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Chemical and Volume Control System:**
(CFR: 41.5 / 45.7)

K5.01	Importance of oxygen control in RCS	2.9
K5.02	Explosion hazard associated with hydrogen containing systems	3.1
K5.03	Definition of pH, reasons for importance and range of acceptability in RCS	2.7
K5.04	Reason for hydrogen cover gas in VCT (oxygen scavenge)	3.0
K5.05	Source of neutrons (leakage and effect of core life) and NIS indications	2.7
K5.06	Boron “worth”	3.2
K5.07	Relationship between startup rate and reactivity during a dilution to criticality	3.4
K5.08	Estimation of subcritical multiplication factor (K-eff) by means other than the six-factor formula: relationship of count rate changes to reactivity changes	2.9
K5.09	Thermal shock: high component stress due to rapid temperature change	3.2
K5.10	DELETED	
K5.11	Thermal stress, brittle fracture, and pressurized thermal shock	3.4
K5.12	Effects of temperature on corrosion	2.5
K5.13	DELETED	
K5.14	Reduction process of gas concentration in RCS: vent-accumulated noncondensable gases from PZR bubble space, depressurized during cooldown or by alternately heating and cooling (spray) within allowed pressure band (which drives more gas out of solution)	2.8
K5.15	Boron and control rod reactivity effects as they relate to MTC	3.2
K5.16	DELETED	
K5.17	DELETED	
K5.18	Relationship between neutron flux and reactivity	3.1
K5.19	Concept of SDM	3.7

K5.20	Reactivity effects of xenon, boration, and dilution	3.8
K5.21	PPM and weight % for boron	3.0
K5.22	Ion bead degradation by temperature	3.0
K5.23	Radioactive decay of crud	2.3
K5.24	Decontamination factors	2.3
K5.25	Channeling of ion exchanger	2.7
K5.26	Relationship between VCT pressure and NPSH for charging pumps	3.5
K5.27	Reason for nitrogen purge of CVCS	2.8
K5.28	Reason for “burping” noncondensable gases from VCT	2.8
K5.29	Reason for sampling for chloride, fluoride, sodium, and solids in RCS	2.6
K5.30	Relationship between temperature and pressure in CVCS components during solid plant operation	4.0
K5.31	Purpose of flowpath around boric acid storage tank	3.0
K5.32	Purpose and control of heat tracing	2.8
K5.33	DELETED	
K5.34	For ion exchangers: demineralization, boration / deboration, thermal regeneration, and lithium control	2.8
K5.35	Heat exchanger principles and the effects of flow, temperature, and other parameters (such as temperature effect on the solubility of boron)	3.1
K5.36	DELETED	
K5.37	Effects of boron saturation on ion exchanger behavior	3.2
K5.38	DELETED	
K5.39	DELETED	
K5.40	Response of PRT during bubble formation in PZR: An increase in the quench tank pressure when cycling PORVs shows that a complete steam bubble does not exist and that significant noncondensable gas is still present.	2.8
K5.41	Solubility of gases in solution: temperature and pressure effects	2.6
K5.42	DELETED	
K5.43	DELETED	
K5.44	Pressure response in PZR during in-and-out surge	3.6
K5.45	Resistance heating: power / current relations	2.3
K5.46	DELETED	
K5.47	DELETED	
K5.48	Purpose of hydrogen purging and sampling processes	2.8
K5.49	Purpose and method of hydrogen removal from RCS before opening the system: explosion hazard and nitrogen purge	3.0
K5.50	DELETED	
K5.51	DELETED	
K5.52	Reason for of reducing the letdown rate when filling the PZR; collapse steam bubble	3.0
K5.53	Reason for keeping VCT pressure as low as possible during degas	2.9
K5.54	Calculation of the rate of boron change in the RCS as a function of flow rate	2.8
K5.55	Factors that effect changes in letdown temperature	3.3

K5.56	Sources of radioiodine in RCS (hazards when changing filters)	2.5
K5.57	Relationship between seal filter and letdown filter	2.6
K5.58	Recirculation valve on boric acid storage tank (the reason why it is closed during functional test)	2.4
K5.59	Function of demineralizer, including boron loading and temperature limits	2.8
K5.60	Capacity of boron recovery tanks: plan not to exceed by inefficient boron movement; interface with boron recovery system	2.3
K5.61	Relationship between VCT vent rate and vent header pressure	2.4

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Chemical and Volume Control System:**
(CFR: 41.5 to 41.7 / 45.7)

K6.01	Spray/heater combination in PZR to ensure uniform boron concentration	3.1
K6.02	Mixed bed and deborating demineralizers	2.9
K6.03	DELETED	
K6.04	Charging pumps	4.0
K6.05	Sensors and detectors	3.4
K6.06	DELETED	
K6.07	Regen and nonregenerative heat exchangers	3.4
K6.08	DELETED	
K6.09	VCT divert valve	3.4
K6.10	Boric acid storage tank / BIT recirculation flowpath	3.2
K6.11	DELETED	
K6.12	Principle of recirculation valve: The valve permits emergency flow even if it is blocked by crystallized boric acid.	2.9
K6.13	Boration / dilution batch controller	3.6
K6.14	Recirculation path for charging pumps	3.4
K6.15	Reason for venting VCT and pump casings while filling: vents must connect to LRS	3.1
K6.16	Loss of VCT spray nozzle	2.7
K6.17	Flowpaths for emergency boration	4.2
K6.18	DELETED	
K6.19	DELETED	
K6.20	DELETED	
K6.21	DELETED	
K6.22	DELETED	
K6.23	DELETED	
K6.24	Controllers and positioners	3.6
K6.25	DELETED	
K6.26	Methods of pressure control for solid plant (PZR relief and water inventory)	3.9

K6.27	RHR relief and isolation valves	2.9
K6.28	Interface between high-activity waste tank and letdown filter drain	2.5
K6.29	DELETED	
K6.30	DELETED	
K6.31	Seal injection system	3.9
K6.32	Malfunction of VCT venting capability: reduce concentration of gases in solution and keep stress in tank down	2.8
K6.33	DELETED	
K6.34	DELETED	
K6.35	DELETED	
K6.36	Letdown pressure control	3.7
K6.37	DELETED	
K6.38	DELETED	
K6.39	PZR PCS	3.7
K6.40	RCPS	3.6
K6.41	CRDS	2.7
K6.42	Nitrogen system	2.3
K6.43	Hydrogen system	2.5
K6.44	IAS	3.0
K6.45	ECCS	3.8
K6.46	PZR LCS	4.0
K6.47	CCWS	3.3
K6.48	WGDS	2.5
K6.49	LRS	2.5
K6.50	SWS	2.4
K6.51	Relationship between letdown flow and RCS pressure	3.4
K6.52	Flow control valve malfunction	3.6
K6.53	Containment isolation valves malfunction	3.7
K6.54	Temperature control valve malfunction	3.6

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the CVCS, including:**
(CFR: 41.5 to 41.7 / 45.5)

A1.01	Activity levels in primary system	2.9
A1.02	T-ave. and T-ref.	3.6
A1.03	RCS pressure	3.7
A1.04	PZR pressure and level	4.2
A1.05	S/G pressure and level	2.6
A1.06	VCT level	3.8
A1.07	Maximum specified letdown flow	3.3
A1.08	Normal operating band for letdown flow rate	3.3
A1.09	RCS temperature	3.7
A1.10	Reactor power	3.8
A1.11	Letdown and charging flows	3.8
A1.12	Rate of boron concentration reduction in RCS as a function of letdown flow while the deborating demineralizer is in service	3.3

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the Chemical and Volume Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 to 41.7 / 43.5 / 45.3 / 45.5)		
A2.01	RCS pressure allowed to exceed limits	3.8	3.9
A2.02	Loss of PZR level	4.3	4.2
A2.03	Boundary isolation valve leak	3.6	3.2
A2.04	Unplanned gas release	2.5	3.0
A2.05	RCP seal failures	3.5	4.1
A2.06	Inadvertent boration/dilution	3.9	4.1
A2.07	Isolation of letdown/makeup	3.8	3.8
A2.08	Loss of heat tracing	2.2	2.6
A2.09	High primary and/or secondary activity	2.5	3.0
A2.10	Inadvertent boration/dilution	3.8	4.0
A2.11	Loss of IAS	3.3	3.4
A2.12	Containment isolation actuation signal and SI actuation signal	3.6	3.8
A2.13	Low RWST	3.6	3.5
A2.14	Emergency boration	4.0	4.2
A2.15	High or low PZR level (actual)	3.7	4.0
A2.16	T-ave. and T-ref. deviations	3.0	3.5
A2.17	Low PZR pressure	3.2	3.6
A2.18	High VCT level	3.5	3.4
A2.19	High primary concentrations of chloride, fluoride, sodium, and solids	2.4	2.6
A2.20	Shifting demineralizer while the divert valve is lined up to VCT	2.7	2.8
A2.21	Excessive letdown flow, pressure, and temperatures on ion exchange resins	2.9	3.0
A2.22	Mismatch of letdown and charging flows	3.4	3.5
A2.23	High filter D/P	2.7	2.9
A2.24	Isolation of both letdown filters at one time: downstream relief lifts	3.4	3.3
A2.25	Uncontrolled boration or dilution	4.1	3.9
A2.26	Low VCT pressure	3.3	3.2
A2.27	Improper RWST boron concentration	3.6	3.4
A2.28	Depressurizing RCS while it is hot	2.5	3.1
A2.29	Indication by increased letdown flow that demineralizers are bypassed	2.5	2.6
A2.30	Reduction of boron concentration in the letdown flow and its effects on reactor operation	3.5	3.5
A2.31	Potential for RCS chemical contamination when placing CVCS demineralizer in service	2.7	2.8
A2.32	Expected reactivity changes after valving in a new mixed-bed demineralizer that has not been preborated	3.8	3.6
A2.33	The fact that isolating cation demineralizer stops boron dilution and enables restoration of normal boron concentration	2.9	2.8

A2.34	Predict how deborating demineralizers function near the end of an operating cycle with low RCS boron concentrations	3.1		3.0
A2.35	Reactor trip	3.5		3.7
A2.36	ECP and related boration/dilution/reactivity relationships	3.3		3.4
A3	**Ability to monitor automatic operation of the Chemical and Volume Control System, including:** (CFR: 41.7 / 45.5)			
A3.01	Water and boron inventory		3.7	
A3.02	Letdown isolation		3.8	
A3.03	Ion exchange bypass		3.0	
A3.04	VCT pressure control		3.2	
A3.05	RCS pressure and temperature		3.7	
A3.06	T-ave. and T-ref		3.6	
A3.07	DELETED			
A3.08	Reactor power		3.8	
A3.09	VCT level		3.7	
A3.10	PZR level and pressure		4.0	
A3.11	Charging/letdown		3.9	
A3.12	Interpretation of letdown demineralizer flow-divert valve position indicating lights		3.1	
A3.13	DELETED			
A3.14	DELETED			
A3.15	PZR pressure and temperature		3.5	
A3.16	DELETED			
A3.17	Interpretation of ion-exchanger status light		2.7	
A3.18	Interpretation of letdown orifice isolation valve position indicators		3.4	
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.5 to 41.7 / 45.5 to 45.8)			
A4.01	Boron reactivity effects		4.2	
A4.02	ECP and related boration / dilution / reactivity relationships		3.8	
A4.03	Construction and use of 1/M plots (inverse multiplication and criticality prediction method)		3.4	
A4.04	Calculation of boron concentration changes		3.6	
A4.05	Letdown pressure and temperature control valves		3.7	
A4.06	Letdown isolation and flow control valves		3.8	
A4.07	Boration / dilution		4.0	
A4.08	Charging		4.0	
A4.09	DELETED			
A4.10	Boric acid pumps		3.7	
A4.11	RCP seal injection		3.9	
A4.12	DELETED			
A4.13	VCT level control and pressure control		3.7	
A4.14	Ion exchangers and demineralizers		3.0	

A4.15	Boron concentration	3.7
A4.16	Activity levels of RCS and letdown	2.9
A4.17	Deborating demineralizer	2.9
A4.18	Emergency borate valve	4.2
A4.19	CVCS letdown orifice isolation valve and valve control switches	3.6
A4.20	DELETED	
A4.21	Letdown demineralizer flow-divert valve control switch	3.2
A4.22	DELETED	
A4.23	Calculation of the required volume through the deborating demineralizer, using the appropriate equation. (Operating exam preferred.)	3.0

System: 006 SF2 ECCS Emergency Core Cooling System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Emergency Core Cooling System and the following systems:** (CFR: 41.2 to 41.8 / 45.3 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	Engineered safety features actuation system (ESFAS)	4.4
K1.03	RCS	4.3
K1.04	DELETED	
K1.05	RCP seal injection and return systems	3.4
K1.06	LRS	2.6
K1.07	DELETED	
K1.08	CVCS	3.7
K1.09	Nitrogen system	2.6
K1.10	DELETED	
K1.11	CCWS	3.7
K1.12	Accumulator system	3.8
K1.13	Containment spray system (CSS)	3.8
K1.14	IAS	3.1
K1.15	DELETED	
K1.16	ECCS support ventilation systems	3.0
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)	
K2.01	ECCS pumps	4.1
K2.02	Valve operators for accumulators	3.2
K2.03	DELETED	
K2.04	ESFAS-operated valves	3.7
K3	**Knowledge of the effect that a loss or malfunction of the Emergency Core Cooling System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6 / 45.3 / 45.4)	
K3.01	RCS	4.1
K3.02	Fuel	4.4
K3.03	CSS	3.8
K4	**Knowledge of Emergency Core Cooling System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7 / 41.8)	
K4.01	Cooling of centrifugal pump bearings	3.2
K4.02	Relieving shutoff head (recirculation)	3.5

K4.03	Flushing of piping following transfer of highly concentrated boric acid	2.9
K4.04	System venting	3.1
K4.05	Autostart of HPI/LPI/SIP	4.2
K4.06	Recirculation of minimum flow through pumps	3.6
K4.07	Normal water supply for the safety injection system (SIS)	3.8
K4.08	Recirculation flowpath of reactor building sump	3.9
K4.09	Valve positioning on SI signal	4.2
K4.10	Redundant pressure and/or flow meters	3.3
K4.11	Reset of SIS	3.7
K4.12	HPI flow throttling	4.0
K4.13	Reset of containment isolation	3.7
K4.14	Cross-connection of HPI/LPI/SIP	3.8
K4.15	RHR pump test flowpath	2.9
K4.16	DELETED	
K4.17	ECCS valve interlocks	3.8
K4.18	Valves normally isolated from their control power	3.3
K4.19	Interlocks to storage tank makeup valve	3.2
K4.20	Automatic closure of common drain line and fill valves to accumulator	2.9
K4.21	Bypassing/blocking ESFAS/ engineered safety actuation system (ESAS) channels	3.9
K4.22	DELETED	
K4.23	Demineralized water supply to RWST	3.0
K4.24	Water inventory control	3.3
K4.25	Concentrated boric acid supply to RWST	3.1
K4.26	Parallel redundant systems	3.4
K4.27	Alarm for misalignment of the ECCS valves	3.4
K4.28	RHR	3.7
K4.29	BIT recirculation	3.0
K4.30	Containment isolation	3.9
K4.31	Five ECCS design criteria from 10 CFR 50.46	3.7

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Emergency Core Cooling System:** (CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Brittle fracture, including causes and preventative actions	3.6
K5.05	DELETED	
K5.06	Relationship between ECCS flow and RCS pressure	3.9
K5.07	Expected temperature values in various locations of the RCS due to different break locations during all ECCS injection modes	3.1
K5.08	DELETED	
K5.09	DELETED	
K5.10	DELETED	

K5.11	DELETED	
K5.12	DELETED	
K5.13	Hot-leg injection	3.6
K5.14	Vortexing from RWST	3.1
K5.15	ECCS piping gas accumulation	3.5
K5.16	LPI ECCS pumps for CSS	3.7
K5.17	“Piggy back” mode	3.7

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Emergency Core Cooling System:**
(CFR: 41.7 / 45.7)

K6.01	BIT/borated water sources	3.7
K6.02	Core flood tanks (accumulators)	3.9
K6.03	ECCS pump(s)	4.2
K6.04	DELETED	
K6.05	ECCS pump cooling water	3.6
K6.06	ECCS Isolation valves	3.8
K6.07	Drain and fill valves	2.8
K6.08	Accumulator and sample system	3.0
K6.09	RWST purification system	2.3
K6.10	Valves	3.3
K6.11	Sensors and detectors	3.2
K6.12	Controllers and positioners	3.3
K6.13	DELETED	
K6.14	DELETED	
K6.15	DELETED	
K6.16	DELETED	
K6.17	Heat exchangers and condensers	3.3
K6.18	SCM indicators	3.6
K6.19	DELETED	
K6.20	ESFAS/ESAS	4.1
K6.21	RCS	3.9
K6.22	CVCS	3.5
K6.23	CCW	3.7
K6.24	CSS	3.7
K6.25	IAS	3.1
K6.26	Nitrogen	3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Emergency Core Cooling System including:**
(CFR: 41.5 / 45.5 / 45.3 / 45.4)

A1.01	Thermal and pressure stresses during pump startup	2.8
A1.02	Boron concentration in accumulator and boron storage tanks	3.4
A1.03	Flow rates in BWST/BW recirculation pumps	2.8
A1.04	DELETED	

A1.05	CCW flow	3.2	
A1.06	SCM	3.9	
A1.07	ECCS pressure(s)	3.8	
A1.08	ECCS pump temperature	3.1	
A1.09	ECCS pump amperage	3.2	
A1.10	CVCS letdown flow	3.0	
A1.11	Boron concentration	3.3	
A1.12	DELETED		
A1.13	Accumulator pressure (level and boron concentration)	3.5	
A1.14	Reactor vessel level	3.9	
A1.15	RWST level and temperature	3.6	
A1.16	RCS temperature, including superheat, saturation, and subcooled	3.9	
A1.17	ECCS flow rate	4.0	
A1.18	PZR level and pressure	3.8	
A1.19	DELETED		

A2 **Ability to (a) predict the impacts of the following on the Emergency Core Cooling System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 45.5 / 45.3 / 45.4)

		RO	**SRO**
A2.01	High bearing temperature	3.3	3.1
A2.02	Loss of flowpath	3.9	3.8
A2.03	System leakage	3.4	3.5
A2.04	Improper discharge pressure	3.8	3.5
A2.05	Improper amperage to the pump motor	3.5	3.3
A2.06	Water hammer	3.1	3.2
A2.07	Loss of heat tracing	2.3	2.6
A2.08	ECCS valve failure mode	3.2	3.5
A2.09	Radioactive release from venting RWST to atmosphere	2.6	3.1
A2.10	Low boron concentration in ECCS	3.6	3.5
A2.11	Rupture of ECCS header	3.4	3.7
A2.12	Conditions requiring actuation of ECCS	4.1	4.5
A2.13	Inadvertent ECCS actuation	3.6	4.0
A2.14	Gas accumulation	2.8	3.2
A2.15	Vortex/cavitation	3.3	3.5

A3 **Ability to monitor automatic operation of the Emergency Core Cooling System, including:**
(CFR: 41.7 / 45.5)

A3.01	Accumulators	3.7	
A3.02	ECCS pumps	4.2	
A3.03	ECCS ESFAS/ESAS-operated valves	4.2	
A3.04	Cooling water systems	3.7	
A3.05	DELETED		

A3.06	Valve lineups	3.7
A3.07	DELETED	
A3.08	Automatic transfer of ECCS flowpaths	3.9

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	ECCS pumps	4.3
A4.02	ECCS valves	4.2
A4.03	Transfer from boron storage tank to BIT	3.4
A4.04	RHRS	3.9
A4.05	Transfer of ECCS flowpaths	4.1
A4.06	ESFAS/ESAS control panel	4.1
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	SPDSs	3.6
A4.11	Overpressure protection system	3.7

System: 011 SF2 PZR LCS Pressurizer Level Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Pressurizer Level Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	CVCS	4.2
K1.02	RCS	4.1
K1.03	PZR PCS	3.9
K1.04	RPS	3.8
K1.05	Reactor regulating system (CE)	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	PZR heaters	3.3
K2.03	Level channels and controllers	3.3
K3	**Knowledge of the effect that a loss or malfunction of the Pressurizer Level Control System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	CVCS	3.9
K3.02	RCS	4.0
K3.03	PZR PCS	3.7
K3.04	RPS	3.7
K4	**Knowledge of Pressurizer Level Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Operation of PZR heater cutout at low PZR level	3.8
K4.02	PZR level controller	3.9
K4.03	Density compensation of PZR level	3.1
K4.04	PZR level inputs	3.6
K4.05	PZR level inputs to RPS	3.8
K4.06	Letdown isolation	3.7
K4.07	Cold-calibrated channel	3.1
K4.08	Prevention of uncovering PZR heaters	3.4
K4.09	Sizing of the PZR for maximum in-surge/out-surge in relation to the PZR level program	2.8

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the PZR LCS:**
(CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	Interrelation of indicated charging flow rate with volume of water required to bring the PZR level back to programmed level hot/cold	3.2
K5.06	Indicated charging flow: seal flow plus actual charging flow	3.6
K5.07	DELETED	
K5.08	Relative flow rate through letdown subsystem as a function of flow control	3.2
K5.09	Reason for manually controlling PZR level	3.4
K5.10	Indications of reactor vessel bubble	3.9
K5.11	Reasons for selecting “manual” on letdown control valve controller	3.3
K5.12	Criteria and purpose of PZR level program	3.3
K5.13	Impact of a high/low PZR level on interrelated system	3.4
K5.14	DELETED	
K5.15	PZR level indication when RCS is saturated	3.7
K5.16	PZR level indication with flashing in the reference leg	3.5
K5.17	PZR level indication when voiding in the reactor head	4.0
K5.18	Reasons for starting charging pump while increasing letdown flow rate	3.3
K5.19	Relationship of makeup flow rate to control valve position	3.0
K5.20	Relationship between PZR level and PZR heater control circuit	3.5
K5.21	Operation of PZR level controllers	3.7
K5.22	Function of PZR level instrumentation as post-accident monitors	3.5
K5.23	Correlation of demand signal indication on charging pump flow valve controller to the valve position	3.0
K5.24	Correlation of demand signal indication with letdown Pressure valve controller position	3.1
K5.25	Increased level effect in PZR due to the opening of PORVs or safety	3.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Pressurizer Level Control System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	

K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	DELETED		
K6.08	DELETED		
K6.09	DELETED		
K6.10	DELETED		
K6.11	DELETED		
K6.12	DELETED		
K6.13	DELETED		
K6.14	CVCS	3.9	
K6.15	RCS	3.9	
K6.16	PZR PCS	3.6	
K6.17	Pressure relief system	3.6	
K6.18	Reactor regulating system	3.3	
K6.19	ESFAS	3.8	
K6.20	Flow control valves	3.5	
K6.21	PZR heaters	3.4	
K6.22	Head voiding	3.9	
K6.23	Level channels	3.6	
K6.24	Level detectors	3.5	
K6.25	RPS	3.6	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Pressurizer Level Control System, including:**
(CFR: 41.5 / 45.5)

A1.01	PZR level and pressure	4.0
A1.02	Charging and letdown flows	3.9
A1.03	VCT level	3.6
A1.04	T-ave.	3.5
A1.05	Reactor vessel level	3.5
A1.06	PZR temperature	3.3
A1.07	RCS leak rate	3.9
A1.08	Power level	3.3
A1.09	Seal flow	3.3
A1.10	Lights and alarms	3.2

A2 **Ability to (a) predict the impacts of the following on the Pressurizer Level Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Excessive letdown	4.0	3.5
A2.02	Excessive charging	3.8	3.5
A2.03	Loss of PZR level	4.4	3.9
A2.04	Loss of one, two, or three charging pumps	3.7	3.9
A2.05	Loss of PZR heaters	3.3	3.5

A2.06	Inadvertent PZR spray actuation	4.3	3.7
A2.07	Isolation of letdown	3.5	3.7
A2.08	Loss of level compensation	3.3	3.0
A2.09	DELETED		
A2.10	Failure of PZR level instrument—high	3.9	3.7
A2.11	Failure of PZR level instrument—low	3.9	3.8
A2.12	Operation of auxiliary spray	3.4	3.3
A2.13	ESFAS	4.1	3.9
A2.14	RPS	3.6	3.8

A3 **Ability to monitor automatic features of the Pressurizer Level Control System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	Charging and letdown	3.8
A3.04	PZR heaters	3.5

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Charging pump and flow controls	4.0
A4.02	Operation of the letdown pressure control valve, using manual controller	3.8
A4.03	PZR heaters	3.5
A4.04	Transfer of PZR LCS from automatic to manual control	3.5
A4.05	Letdown flow controller	3.6

System: **013 SF2 ESFAS Engineered Safety Features Actuation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Engineered Safety Features Actuation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Engineered safety feature (ESF) initiation signals	4.5
K1.02	RCP	3.5
K1.03	Containment cooling system (CCS)	3.9
K1.04	DELETED	
K1.05	CSS	4.2
K1.06	ECCS	4.3
K1.07	Auxiliary feedwater (AFW) system	4.1
K1.08	CCWS	3.8
K1.09	DELETED	
K1.10	Containment purge system (CPS)	3.6
K1.11	CVCS	3.8
K1.12	Emergency diesel generator (EDG)	4.3
K1.13	Heating, ventilation, and air conditioning (HVAC) for ESF equipment	3.2
K1.14	IAS	3.2
K1.15	MFW system	3.4
K1.16	Main and reheat steam system (MRSS)	3.1
K1.17	LRS	2.9
K1.18	DELETED	
K1.19	WGDS	2.6
K1.20	SGBD	2.8
K1.21	Fuel	3.5
K1.22	RCS	3.9
K1.23	Containment	4.1
K1.24	Control room HVAC	3.5
K1.25	Auxiliary building HVAC	2.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	ESFAS/safeguards train power supplies	4.0
K3	**Knowledge of the effect that a loss or malfunction of the Engineered Safety Features Actuation System will have on the following systems or system parameters:** (CFR: 41.3 / 41.4 / 41.5 / 41.6 / 41.7 / 45.6)	
K3.01	Fuel	3.9
K3.02	RCS	3.9
K3.03	Containment	4.1

K3.04	RCP	3.5
K3.05	CCS	3.9
K3.06	CSS	4.1
K3.07	ECCS	4.3
K3.08	AFW system	4.1
K3.09	CCWS	3.8
K3.10	CPS	3.2
K3.11	CVCS	3.7
K3.12	EDG	4.2
K3.13	IAS	3.2
K3.14	MFW system	3.3
K3.15	MRSS	3.1
K3.16	LRS	2.9
K3.17	WGDS	2.7
K3.18	S/GB	2.9
K3.19	Control room HVAC	3.5
K3.20	Auxiliary building HVAC	3.0

K4 **Knowledge of Engineered Safety Features Actuation System design feature(s) and/or interlock(s), which provide for the following:**
(CFR: 41.2 / 41.6 / 41.7)

K4.01	SI signal actuation/reset	4.2
K4.02	Containment isolation signal actuation/reset	4.3
K4.03	Main steam isolation actuation/reset	4.2
K4.04	Auxiliary feed actuation/reset	4.1
K4.05	Core spray actuation/reset	4.3
K4.06	Recirculation actuation/reset	4.1
K4.07	DELETED	
K4.08	Redundancy	3.7
K4.09	Spurious trip protection	3.4
K4.10	Safeguards equipment control reset	3.7
K4.11	Load sequencer	4.0
K4.12	SI block/reset	4.2
K4.13	MFW isolation/reset	3.7
K4.14	Upper head injection (UHI) accumulator isolation	3.5
K4.15	Automatic circuit continuity testing	3.0
K4.16	DELETED	
K4.17	DELETED	
K4.18	DELETED	
K4.19	DELETED	
K4.20	DELETED	
K4.21	DELETED	
K4.22	DELETED	
K4.23	DELETED	
K4.24	DELETED	
K4.25	Interlocks and permissives	4.0
K4.26	ESF HVAC start/stop	3.4
K4.27	Remote/auxiliary shutdown	3.4

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Engineered Safety Features Actuation System:** (CFR: 41.3 / 41.4 / 41.5 / 45.7)	
K5.01	Definitions of safety train and ESF channel	3.7
K5.02	Safety system logic and reliability	3.8
K5.03	Avoidance of pressurized thermal shock	3.7
K5.04	Reason for stopping air coolers on the train being tested	2.7
K5.05	Reason for installing a jumper for containment high-pressure signal to containment spray pump on the train being tested	2.8
K5.06	Reason for opening the breaker on the high-head injection pump	3.1
K5.07	Reason for stopping CCW pump on train being tested	2.7
K5.08	Reason for starting an additional service water booster pump for the train not being tested and for stopping the pump on train undergoing testing	3.0
K5.09	Reason for shutting SI pump discharge valve of the train to be tested	3.1
K5.10	Reason for disabling of EDG during ESF sequencer test	3.0
K5.11	Reason for disabling of BIT so it will not function during ESF sequencer test	2.8
K5.12	Reactor trip actuation	4.1
K5.13	Anticipated transient without trip	4.1
K5.14	Placing a channel bypass	3.7
K5.15	Placing a channel trip	3.7
K5.16	ESAS signal with one train in test	3.8
K5.17	Partial trip	3.6
K5.18	Loss-of-coolant accident (LOCA)	4.3
K5.19	S/G tube rupture	4.2
K5.20	Main steamline break	4.2
K5.21	Feed water line break	4.2
K5.22	Loss of heat sink	4.2
K5.23	Inadequate core cooling	4.2
K5.24	Inadvertent ESAS actuation	4.0
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Engineered Safety Features Actuation System:** (CFR: 41.6 / 41.7 / 41.8 / 45.5 to 45.8)	
K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	
K6.04	Trip setpoint calculators	3.5
K6.05	Inadvertent safeguards actuation	3.8
K6.06	IAS	3.0
K6.07	EDG	3.9

K6.08	ECCS		3.9
K6.09	Main steamline break		4.0
K6.10	Feedline break		4.0
K6.11	S/G tube rupture		4.1
K6.12	LOCA		4.1
K6.13	ESF bistable(s)/relays		3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Engineered Safety Features Actuation System, including:**
(CFR: 41.3 to 41.7 / 45.5)

A1.01	RCS temperature	3.8
A1.02	Containment pressure, temperature, and humidity	3.9
A1.03	Feedwater header differential	3.0
A1.04	S/G level	3.8
A1.05	Main steam pressure	3.6
A1.06	RWST level	3.8
A1.07	Containment radiation	3.7
A1.08	Containment sump level	3.9
A1.09	DELETED	
A1.10	DELETED	
A1.11	AFW flow	3.9
A1.12	RCS pressure	4.1
A1.13	ECCS flow	4.1
A1.14	EDG	3.8
A1.15	Main control room HVAC filtration system status	3.4
A1.16	Auxiliary building HVAC system status	2.9

A2 **Ability to (a) predict the impacts of the following on the Engineered Safety Features Actuation System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 41.7 / 41.10 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	LOCA	4.0	4.4
A2.02	Excess steam demand	3.6	4.1
A2.03	Rapid depressurization	3.6	4.2
A2.04	Loss of instrument bus	3.5	3.7
A2.05	Loss of DC control power	3.4	3.8
A2.06	Inadvertent ESFAS actuation	3.5	4.0
A2.07	Loss of IAS	2.6	3.5
A2.08	Loss of EDG	3.5	4.1
A2.09	Loss of ECCS	3.5	4.3
A2.10	Feedline break	3.5	4.2
A2.11	S/G tube rupture	3.6	4.3
A2.12	Malfunction of ESF bistable(s)/relays	3.3	3.7

A3	**Ability to monitor automatic operation of the Engineered Safety Features Actuation System, including:** (CFR: 41.6 / 41.7 / 41.8 / 45.5)	
A3.01	Input channels and logic	3.7
A3.02	Operation of actuated equipment	3.9
A3.03	Continuous testing feature	2.9
A3.04	ESF HVAC	3.1
A3.05	SI actuation	4.1
A3.06	Containment integrity system isolation	4.0
A3.07	Main steam isolation system actuation	4.1
A3.08	Auxiliary feed actuation signal	4.1
A3.09	Core spray actuation/signal	4.1
A3.10	Recirculation actuation/signal	4.2
A3.11	Safeguards equipment control	3.9
A3.12	SI block	3.9
A3.13	MFW isolation	3.9
A3.14	UHI accumulator isolation	3.9
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.6 / 41.7 / 45.5 to 45.8)	
A4.01	ESFAS-initiated equipment that fails to actuate	4.4
A4.02	Reset of ESFAS channels	3.9
A4.03	ESFAS initiation	4.4
A4.04	ESF HVAC	3.3
A4.05	SI signal actuation/reset	4.0
A4.06	Containment integrity system isolation Phase A actuation/reset	4.0
A4.07	Containment integrity system isolation Phase B actuation/reset	4.1
A4.08	Main steam isolation system actuation/reset	4.0
A4.09	Auxiliary feed actuation/reset signal	4.1
A4.10	Core spray actuation/signal reset	4.2
A4.11	Recirculation actuation/signal reset	4.2
A4.12	Safeguards equipment control reset	4.0
A4.13	SI block	3.9
A4.14	MFW isolation/reset	3.9
A4.15	UHI accumulator isolation	3.7
A4.16	ESF testing	3.3

System: 006 SF3 ECCS Emergency Core Cooling System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Emergency Core Cooling System and the following systems:** (CFR: 41.2 to 41.8 / 45.3 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	ESFAS	4.4
K1.03	RCS	4.3
K1.04	DELETED	
K1.05	RCP seal injection and return systems	3.4
K1.06	LRS	2.6
K1.07	DELETED	
K1.08	CVCS	3.7
K1.09	Nitrogen system	2.6
K1.10	DELETED	
K1.11	CCWS	3.7
K1.12	Accumulator system	3.8
K1.13	CSS	3.8
K1.14	IAS	3.1
K1.15	DELETED	
K1.16	ECCS support ventilation systems	3.0
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)	
K2.01	ECCS pumps	4.1
K2.02	Valve operators for accumulators	3.2
K2.03	DELETED	
K2.04	ESFAS-operated valves	3.7
K3	**Knowledge of the effect that a loss or malfunction of the Emergency Core Cooling System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6 / 45.3 / 45.4)	
K3.01	RCS	4.1
K3.02	Fuel	4.4
K3.03	CSS	3.8
K4	**Knowledge of Emergency Core Cooling System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7 / 41.8)	
K4.01	Cooling of centrifugal pump bearings	3.2
K4.02	Relieving shutoff head (recirculation)	3.5

K4.03	Flushing of piping following transfer of highly concentrated boric acid	2.9
K4.04	System venting	3.1
K4.05	Autostart of HPI/LPI/SIP	4.2
K4.06	Recirculation of minimum flow through pumps	3.6
K4.07	Normal water supply for SIS	3.8
K4.08	Recirculation flowpath of reactor building sump	3.9
K4.09	Valve positioning on SI signal	4.2
K4.10	Redundant pressure and/or flow meters	3.3
K4.11	Reset of SIS	3.7
K4.12	HPI flow throttling	4.0
K4.13	Reset of containment isolation	3.7
K4.14	Cross-connection of HPI/LPI/SIP	3.8
K4.15	RHR pump test flowpath	2.9
K4.16	DELETED	
K4.17	ECCS valve interlocks	3.8
K4.18	Valves normally isolated from their control power	3.3
K4.19	Interlocks to storage tank makeup valve	3.2
K4.20	Automatic closure of common drain line and fill valves to accumulator	2.9
K4.21	Bypassing/blocking ESFAS/ESAS channels	3.9
K4.22	DELETED	
K4.23	Demineralized water supply to RWST	3.0
K4.24	Water inventory control	3.3
K4.25	Concentrated boric acid supply to RWST	3.1
K4.26	Parallel redundant systems	3.4
K4.27	Alarm for misalignment of the ECCS valves	3.4
K4.28	RHR	3.7
K4.29	BIT recirculation	3.0
K4.30	Containment isolation	3.9
K4.31	Five ECCS design criteria from 10 CFR 50.46	3.7

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Emergency Core Cooling System:** (CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Brittle fracture, including causes and preventative actions	3.6
K5.05	DELETED	
K5.06	Relationship between ECCS flow and RCS pressure	3.9
K5.07	Expected temperature values in various locations of the RCS due to different break locations during all ECCS injection modes	3.1
K5.08	DELETED	
K5.09	DELETED	
K5.10	DELETED	
K5.11	DELETED	

K5.12	DELETED	
K5.13	Hot-leg Injection	3.6
K5.14	Vortexing from RWST	3.1
K5.15	ECCS piping gas accumulation	3.5
K5.16	LPI ECCS pumps for CSS	3.7
K5.17	“Piggy back” mode	3.7

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Emergency Core Cooling System:**
(CFR: 41.7 / 45.7)

K6.01	BIT/borated water sources	3.7
K6.02	Core flood tanks (accumulators)	3.9
K6.03	ECCS pump(s)	4.2
K6.04	DELETED	
K6.05	ECCS pump cooling water	3.6
K6.06	ECCS Isolation valves	3.8
K6.07	Drain and fill valves	2.8
K6.08	Accumulator and sample system	3.0
K6.09	RWST purification system	2.3
K6.10	Valves	3.3
K6.11	Sensors and detectors	3.2
K6.12	Controllers and positioners	3.3
K6.13	DELETED	
K6.14	DELETED	
K6.15	DELETED	
K6.16	DELETED	
K6.17	Heat exchangers and condensers	3.3
K6.18	SCM indicators	3.6
K6.19	DELETED	
K6.20	ESFAS/ESAS	4.1
K6.21	RCS	3.9
K6.22	CVCS	3.5
K6.23	CCW	3.7
K6.24	CSS	3.7
K6.25	IAS	3.1
K6.26	Nitrogen	3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Emergency Core Cooling System, including:**
(CFR: 41.5 / 45.5 / 45.3 / 45.4)

A1.01	Thermal and pressure stresses during pump startup	2.8
A1.02	Boron concentration in accumulator and boron storage tanks	3.4
A1.03	Flow rates in BWST/BW recirculation pumps	2.8
A1.04	DELETED	
A1.05	CCW flow	3.2

A1.06	SCM	3.9	
A1.07	ECCS pressure(s)	3.8	
A1.08	ECCS pump temperature	3.1	
A1.09	ECCS pump amperage	3.2	
A1.10	CVCS letdown flow	3.0	
A1.11	Boron concentration	3.3	
A1.12	DELETED		
A1.13	Accumulator pressure (level and boron concentration)	3.5	
A1.14	Reactor vessel level	3.9	
A1.15	RWST level and temperature	3.6	
A1.16	RCS temperature, including superheat, saturation, and subcooled	3.9	
A1.17	ECCS flow rate	4.0	
A1.18	PZR level and pressure	3.8	
A1.19	DELETED		

A2 **Ability to (a) predict the impacts of the following on the Emergency Core Cooling System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 45.5 / 45.3 / 45.4)

		RO	**SRO**
A2.01	High bearing temperature	3.3	3.1
A2.02	Loss of flowpath	3.9	3.8
A2.03	System leakage	3.4	3.5
A2.04	Improper discharge pressure	3.8	3.5
A2.05	Improper amperage to the pump motor	3.5	3.3
A2.06	Water hammer	3.1	3.2
A2.07	Loss of heat tracing	2.3	2.6
A2.08	ECCS valve failure mode	3.2	3.5
A2.09	Radioactive release from venting RWST to atmosphere	2.6	3.1
A2.10	Low boron concentration in ECCS	3.6	3.5
A2.11	Rupture of ECCS header	3.4	3.7
A2.12	Conditions requiring actuation of ECCS	4.1	4.5
A2.13	Inadvertent ECCS actuation	3.6	4.0
A2.14	Gas accumulation	2.8	3.2
A2.15	Vortex/cavitation	3.3	3.5

A3 **Ability to monitor automatic operation of the Emergency Core Cooling System, including:**
(CFR: 41.7 / 45.5)

A3.01	Accumulators	3.7
A3.02	ECCS pumps	4.2
A3.03	ECCS ESFAS/ ESAS-operated valves	4.2
A3.04	Cooling water systems	3.7
A3.05	DELETED	
A3.06	Valve lineups	3.7

A3.07	DELETED	
A3.08	Automatic transfer of ECCS flowpaths	3.9

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	ECCS pumps	4.3
A4.02	ECCS valves	4.2
A4.03	Transfer from boron storage tank to BIT	3.4
A4.04	RHRS	3.9
A4.05	Transfer of ECCS flowpaths	4.1
A4.06	ESFAS/ESAS control panel	4.1
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	SPDS	3.6
A4.11	Overpressure protection system	3.7

System: 010 SF3 PZR PCS Pressurizer Pressure Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Pressurizer Pressure Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RPS	4.2
K1.02	ESFAS	4.3
K1.03	RCS	4.1
K1.04	AFW	2.8
K1.05	PRTS	3.5
K1.06	CVCS	3.7
K1.07	Containment	3.1
K1.08	PZR LCS	3.6
K1.09	Supplementary protection system (CE)	3.4
K1.10	Diverse auxiliary feedwater actuation system (CE)	2.9
K1.11	Steam bypass control system (SBCS) (CE)	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	PZR heaters	3.4
K2.02	PZR pressure controller	3.1
K2.03	PORV and block valves	3.4
K2.04	DELETED	
K2.05	Pressure channels	3.3
K3	**Knowledge of the effect that a loss or malfunction of the Pressurizer Pressure Control System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RCS	4.1
K3.02	RPS	4.0
K3.03	ESFAS	4.2
K3.04	Supplementary protection system (CE)	3.7
K3.05	Diverse auxiliary feedwater actuation system (CE)	2.9
K3.06	SBCS (CE)	2.7
K4	**Knowledge of Pressurizer Pressure Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Spray valve warmup	2.8
K4.02	DELETED	
K4.03	Over pressure control	3.9

K4.04	Bias signals for SBCS (CE)	3.1
K4.05	Low-temperature overpressure protection	3.8
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Pressurizer Pressure Control System:** (CFR: 41.5 / 45.7)	
K5.01	Determination of condition of fluid in PZR, using steam tables (Reference Potential)	3.6
K5.02	Constant enthalpy expansion through PORV or safety valve	3.5
K5.03	Using PZR heater kilowatt usage to trend spray valve leakage	2.4
K5.04	Effects of temperature change during solid operation	3.9
K5.05	RCS heatup and cooldown effect on pressure	3.7
K5.06	Hard PZR bubble	3.4
K5.07	Rx trip	4.0
K5.08	RCP combination affecting spray flow	3.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Pressurizer Pressure Control System:** (CFR: 41.7 / 45.7)	
K6.01	PZR pressure channels	3.9
K6.02	PZR	3.6
K6.03	PZR sprays and heaters	3.8
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	DELETED	
K6.08	PZR LCS	3.4
K6.09	CVCS	3.4
K6.10	RCS	3.7
K6.11	Loss of pressure controller	3.8
K6.12	RPS	3.8
K6.13	ESFAS	4.0
K6.14	AFW	2.9
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Pressurizer Pressure Control System, including:** (CFR: 41.5 / 45.5)	
A1.01	PZR and RCS boron concentrations equalization	3.2
A1.02	DELETED	
A1.03	PRT pressure and temperature	3.2
A1.04	DELETED	

A1.05	DELETED		
A1.06	DELETED		
A1.07	RCS or PZR pressure	3.9	
A1.08	Spray nozzle DT	3.1	
A1.09	Tail pipe temperature and acoustic monitors	3.6	
A1.10	PZR liquid temperature	3.3	
A1.11	PZR steam temperature	3.3	
A1.12	Alarms and lights	3.3	
A1.13	PZR level	3.4	
A1.14	RCS temperature	3.3	

A2	**Ability to (a) predict the impacts of the following on the Pressurizer Pressure Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Heater failures	3.6	3.4
A2.02	Spray valve failures	4.5	3.8
A2.03	PORV failures	4.3	4.0
A2.04	Loss of charging flow to auxiliary spray valves	3.4	3.1
A2.05	Loss of RCPs to normal spray valves	3.5	3.4
A2.06	Failure of PZR LCS	3.5	3.6
A2.07	ESFAS actuations	4.3	4.0
A2.08	Safety valves failure to reseat	4.5	3.9
A2.09	RPS failure	4.4	3.8

A3 **Ability to monitor automatic features of the Pressurizer Pressure Control System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	PZR heater operation	3.3
A3.04	PZR normal spray valve operation	3.6
A3.05	PORV and block valve operation	3.8
A3.06	SBCS operation (CE)	3.3

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	PZR spray valve	3.8
A4.02	PZR heaters	3.6
A4.03	PORVs and block valves	3.8
A4.04	SBCS valves (CE)	3.5
A4.05	PZR auxiliary spray valves	3.2
A4.06	Cycling PORVs, including PRT parameters	3.5

3.4 Safety Function 4: Heat Removal from the Reactor Core

System: 002 SF4 RCS Reactor Coolant System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Reactor Coolant System and the following systems:** (CFR: 41.2 to 41.8 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	CRDS	3.5
K1.03	DELETED	
K1.04	RCS vent system	3.2
K1.05	DELETED	
K1.06	CVCS	4.1
K1.07	RCS level indication system	3.8
K1.08	ECCS	4.3
K1.09	PZR system	4.2
K1.10	LRS	3.1
K1.11	S/Gs	3.9
K1.12	NIS	3.6
K1.13	RCPS	4.0
K1.14	DELETED	
K1.15	DELETED	
K1.16	DELETED	
K1.17	DELETED	
K1.18	RHRS	4.1
K1.19	SFPCS	2.6
K1.20	RMS	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
	None	
K3	**Knowledge of the effect that a loss or malfunction of the Reactor Coolant System will have on the following systems or system parameters:** (CFR: 41.7)	
K3.01	LRS	2.8
K3.02	Fuel	4.3
K3.03	Containment system	4.0
K3.04	RMS	3.6
K3.05	CVCS	3.9
K3.06	ECCS	4.3
K3.07	PZR	4.1
K3.08	RHRS	4.0

K4	**Knowledge of Reactor Coolant System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7 / 41.3)	
K4.01	Filling and draining the RCS, the refueling cavity, and/or refueling canal	3.2
K4.02	RCS level indication system	3.7
K4.03	Venting the RCS	3.3
K4.04	DELETED	
K4.05	Detection of RCS leakage	3.9
K4.06	Prevention of missile hazards	2.7
K4.07	Contraction and expansion during heatup and cooldown	3.3
K4.08	Anchoring of components (i.e., loops, vessel, S/Gs, and coolant pumps)	2.3
K4.09	Operation of loop isolation valves	2.9
K4.10	Overpressure protection	4.1

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Reactor Coolant System:** (CFR: 41.5 / 45.7)	
K5.01	DELETED	
K5.02	Purpose of vent flowpath when draining	3.6
K5.03	DELETED	
K5.04	Reason the plant is required to be in a steady-state condition during RCS water inventory balance	3.4
K5.05	DELETED	
K5.06	Pressure, temperature, and volume relationships of nitrogen gas in association with water	2.8
K5.07	DELETED	
K5.08	Why PZR level should be kept within the programmed band	3.5
K5.09	DELETED	
K5.10	Relationship between the reactor power and the RCS differential temperature	3.8
K5.11	Relationship between effects of the primary coolant system and the secondary coolant system	3.7
K5.12	Relationship of the temperature average and loop differential temperature to loop hot-leg and cold-leg temperature indications	3.5
K5.13	Causes of circulation	3.6
K5.14	Consequences of forced circulation loss	3.9
K5.15	Reasons for maintaining SCM during natural circulation	3.9
K5.16	Reason for automatic features of the feedwater control system during total loss of reactor coolant flow	3.3
K5.17	Need for monitoring in-core thermocouples during natural circulation	3.8

K5.18	Brittle fracture	3.5
K5.19	Neutron embrittlement	3.1
K5.20	DELETED	
K5.21	Contraction and expansion during heatup and cooldown	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Reactor Coolant System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	RCP	4.0
K6.03	RCS level indication system	3.7
K6.04	RCS vent systems	3.3
K6.05	Valves	3.2
K6.06	Sensors and detectors	3.3
K6.07	Pumps	3.5
K6.08	Controllers and positioners	3.4
K6.09	Motors	3.2
K6.10	Breakers, relays, and disconnects	3.2
K6.11	DELETED	
K6.12	PZR system	3.8
K6.13	Reactor vessel and internals	3.3
K6.14	Core components	3.3
K6.15	Postaccident sampling	2.6

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Reactor Coolant System, including:**
(CFR: 41.5 / 45.7)

A1.01	Primary and secondary pressure	3.9
A1.02	PZR and makeup tank level	3.9
A1.03	Temperature	4.0
A1.04	SCM	4.1
A1.05	RCS flow	3.7
A1.06	Reactor power	4.2
A1.07	Reactor differential temperature	3.8
A1.08	RCS average temperature	3.9
A1.09	DELETED	
A1.10	RCS T-ref.	3.7
A1.11	Relative level indications in the RWST, the refueling cavity, the PZR, and the reactor vessel during preparation for refueling	3.3
A1.12	Radioactivity level while venting CRDS	2.8
A1.13	Core exit thermocouples	3.8
A1.14	Loose parts monitoring	2.9

A2	**Ability to (a) predict the impacts of the following on the Reactor Coolant System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	Loss of coolant inventory	4.4	4.5
A2.02	Loss of coolant pressure	4.3	4.4
A2.03	Loss of forced circulation	4.3	4.2
A2.04	Loss of heat sinks	4.5	4.5

A3	**Ability to monitor automatic operation of the Reactor Coolant System, including:** (CFR: 41.7 / 45.5)	
A3.01	Reactor coolant leak detection system	3.9
A3.02	DELETED	
A3.03	Overpressure protection	4.1

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	RCS leakage calculation program using the computer	3.7
A4.02	Indications necessary to verify natural circulation from appropriate level, flow, and temperature indications and valve positions upon loss of forced circulation	4.0
A4.03	Indications and controls necessary to recognize and correct saturation conditions	4.0
A4.04	The filling/draining of LPI pumps during refueling	3.0
A4.05	The HPI system when it is used to refill the refueling cavity	3.0
A4.06	Overflow level of the RWST	2.7
A4.07	Flowpath linking the RWST through the RHRS to the RCS hot legs for gravity refilling of the refueling cavity	3.2
A4.08	SPDSs	3.5

System: 003 SF4P RCP Reactor Coolant Pump System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Reactor Coolant Pump System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RCP lift oil pumps and lube oil pumps	3.4
K1.02	RCP motor cooling and ventilation	3.4
K1.03	RCP seal system	4.3
K1.04	CVCS	3.8
K1.05	CCS	3.4
K1.06	DELETED	
K1.07	RCP vibration monitoring	3.4
K1.08	ESAS	3.6
K1.09	LRS	2.3
K1.10	RCS	3.9
K1.11	Sound monitoring	2.6
K1.12	CCWS	3.7
K1.13	DELETED	
K1.14	S/G	3.5
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RCPS	3.7
K2.02	DELETED	
K2.03	RCP lube oil pumps and RCP bearing lift oil pumps	2.9
K2.04	Containment isolation valves for RCP cooling water	3.4
K2.05	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Reactor Coolant Pump System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RCS	4.2
K3.02	S/G	3.9
K3.03	DELETED	
K3.04	RPS	4.2
K3.05	DELETED	
K3.06	DELETED	

K4	**Knowledge of Reactor Coolant Pump System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Minimizing power peaking	3.1
K4.02	Prevention of coldwater accidents or transients	3.3
K4.03	Adequate lubrication of the RCP	3.2
K4.04	Adequate cooling of RCP motor and seals	3.8
K4.05	Prevention of reverse rotation	3.0
K4.06	Handling axial thrust (thrust bearing)	2.7
K4.07	Minimizing RCS leakage (mechanical seals)	3.8
K4.08	Anchoring the RCP and its associated piping	2.3
K4.09	Seal and pump venting	2.6
K4.10	Increasing pump inertia (flywheel)	2.9
K4.11	Isolation valve interlocks	3.2
K4.12	ICS	3.0
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Reactor Coolant Pump System:** (CFR: 41.5 / 45.7)	
K5.01	The relationship between the RCPS flow rate and the nuclear reactor core operating parameters (quadrant power tilt, imbalance, departure from nucleate boiling (DNB) rate, local power density, and difference in loop T-hot pressure)	3.9
K5.02	Effects of RCP coastdown on RCS parameters	3.4
K5.03	Effects of RCP shutdown on T-ave., including the reason for the unreliability of T-ave. in the shutdown loop	3.5
K5.04	Effects of RCP shutdown on secondary parameters, such as steam pressure, steam flow, and feed flow	3.5
K5.05	The dependency of RCS flow rates upon the number of operating RCPs	3.2
K5.06	DELETED	
K5.07	Starting one or more RCPs under various plant conditions	3.5
K5.08	DELETED	
K5.09	Effects of RCP operation on D/P, especially at lower temperatures	3.2
K5.10	Starting an RCP	3.7
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Reactor Coolant Pump System:** (CFR: 41.7 / 45/5)	
K6.01	DELETED	
K6.02	RCP seal system	4.1

K6.03	RCP lift oil pumps and lube oil pumps	3.2	
K6.04	Containment isolation valves affecting RCP operation	3.8	
K6.05	DELETED		
K6.06	Thermal barrier	3.6	
K6.07	Thrust and radial bearing	3.0	
K6.08	Antireverse rotation device	2.8	
K6.09	DELETED		
K6.10	DELETED		
K6.11	DELETED		
K6.12	DELETED		
K6.13	DELETED		
K6.14	DELETED		
K6.15	CCWS	3.7	
K6.16	CVCS	3.4	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Reactor Coolant Pump System, including:**
(CFR: 41.5 / 45.5)

A1.01	RCP vibration	3.5
A1.02	RCP pump and motor bearing temperatures	3.7
A1.03	RCP motor stator winding temperatures	3.5
A1.04	RCP oil reservoir levels	3.4
A1.05	RCS flow	3.4
A1.06	RCS flow or motor current	3.5
A1.07	RCS temperature and pressure	3.7
A1.08	Seal water temperature	3.6
A1.09	Seal flow and D/P	3.7
A1.10	RCP standpipe levels	3.0
A1.11	RCP cooling water flow	3.5
A1.12	RCP seal leakage	3.9
A1.13	RCP motor parameters	3.5
A1.14	Lights and alarms	3.5

A2 **Ability to (a) predict the impacts of the following on the Reactor Coolant Pump System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Problems with RCP seals, especially seal leakoff rates	4.0	4.0
A2.02	Conditions that exist for an abnormal shutdown of an RCP in comparison to a normal shutdown of an RCP	3.5	3.8
A2.03	Problems associated with RCP motors, including faulty motors and current, and winding and bearing temperature problems	3.4	3.4
A2.04	Effects of fluctuation of VCT pressure on RCP seal injection flow	3.1	3.2

A2.05	Effects of VCT pressure on RCP seal leakoff flows	3.1	3.2
A2.06	CCWS	3.5	3.5

A3 **Ability to monitor automatic features of the Reactor Coolant Pump System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	RCP lube oil and bearing lift pumps	3.0
A3.06	RCP trip actuation due to engineered safeguards actuation	4.0

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Seal injection	3.8
A4.02	DELETED	
A4.03	RCP lift oil pump and lube oil pump motor controls	3.2
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	RCP seal bypass	2.9
A4.08	RCP cooling water supplies	3.5
A4.09	RCS flow, motor current, or seal D/P	3.6

System: 005 SF4P RHR Residual Heat Removal System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Residual Heat Removal System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	CCWS	4.1
K1.02	DELETED	
K1.03	SFPCS	3.1
K1.04	CVCS	3.6
K1.05	RCPS	3.1
K1.06	ECCS	4.4
K1.07	DELETED	
K1.08	SWS	3.7
K1.09	RCS	4.4
K1.10	CSS	3.7
K1.11	DELETED	
K1.12	DELETED	
K1.13	SIS	4.2
K1.14	ESFAS	4.2
K1.15	IAS	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RHR pumps	4.1
K2.02	Containment isolation valves	3.3
K2.03	RCS pressure boundary motor-operated valves (MOVs)	3.4
K3	**Knowledge of the effect that a loss or malfunction of the Residual Heat Removal System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RCS	4.5
K3.02	RCPS	2.9
K3.03	CVCS	3.2
K3.04	DELETED	
K3.05	ECCS	4.3
K3.06	CSS	3.6
K3.07	DELETED	
K3.08	CCWS	3.1

K4	**Knowledge of Residual Heat Removal System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Overpressure mitigation system	4.1
K4.02	DELETED	
K4.03	RHR heat exchanger bypass flow control	3.9
K4.04	DELETED	
K4.05	DELETED	
K4.06	RHR pump miniflow recirculation	3.6
K4.07	System protection logics, including high-pressure interlock, reset controls, and valve interlocks	4.1
K4.08	Lineup for “piggy-back” mode with HPI	4.0
K4.09	DELETED	
K4.10	Control of RHR heat exchanger outlet flow	3.9
K4.11	Lineup for low head recirculation mode (external and internal)	4.0
K4.12	Lineup for “piggy-back” mode with CSS	3.7
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Residual Heat Removal System:** (CFR: 41.5 / 45.7)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	Reactivity effects of RHR water under varying conditions	3.3
K5.04	Heat load on the RHRS during shutdown, cooldown, and refueling operations	3.5
K5.05	Plant response to RCS temperature changes during solid plant operations	3.7
K5.06	DELETED	
K5.07	DELETED	
K5.08	DELETED	
K5.09	DELETED	
K5.10	RHRS suction vortexing during reduced RCS inventory	4.2
K5.11	Modes of operation	3.8
K5.12	Relation between the RHR flowpath and refueling cavity	3.4
K5.13	Noncondensable gas buildup in system	3.3
K5.14	Refueling operations	3.5
K5.15	Time to boil (Reference Potential)	3.0

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Residual Heat Removal System:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DELETED		
K6.03	RHR heat exchanger	3.7	
K6.04	RCS and containment isolation valves	3.9	
K6.05	RHR Pumps and motors	4.0	
K6.06	DELETED		
K6.07	Temperature, flow, and/or pressure sensors/detectors	3.4	
K6.08	RHR flow controllers	3.7	
K6.09	DELETED		
K6.10	DELETED		
K6.11	Flow control valves	3.8	
K6.12	CCWS	4.0	
K6.13	IAS	3.5	
K6.14	ECCS	4.1	
K6.15	CVCS	3.3	
K6.16	Injection and/or recirculation valves	3.9	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Residual Heat Removal System, including:** (CFR: 41.5 / 45.5)		
A1.01	Heatup/cooldown rates	3.9	
A1.02	RHR flow rate	3.8	
A1.03	CCW or CCWS flow rate and temperature	3.3	
A1.04	Refueling cavity level	3.4	
A1.05	Detection of RHR leak	3.7	
A1.06	DELETED		
A1.07	DELETED		
A1.08	RHR temperature	3.7	
A1.09	RCS temperature	3.9	
A1.10	RWST level	3.4	
A2	**Ability to (a) predict the impacts of the following on the Residual Heat Removal System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	RHR instrumentation failure	3.5	3.6
A2.02	Pressure transient protection during cold shutdown	4.0	3.9
A2.03	RHR pump/motor malfunction	3.8	3.9
A2.04	RHR valve malfunction	3.9	3.7
A2.05	RHR heat exchanger malfunction	3.6	3.5

A3	**Ability to monitor automatic features of the Residual Heat Removal System, including:** (CFR: 41.7 / 45.5)	
A3.01	Automatic RHR suction swap-over	4.1
A3.02	RHRS actuation	4.2
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Controls and indication for RHR pumps	4.0
A4.02	RHR heat exchanger temperature/bypass control valves	3.9
A4.03	DELETED	
A4.04	DELETED	
A4.05	Raising or lowering refueling cavity level	3.4
A4.06	RCS and containment isolation valves	3.8

System: **035 SF4P S/G Steam Generator System**

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Steam Generator System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	MFW/AFW systems	4.3
K1.02	MRSS	3.5
K1.03	Steam generator blowdown (S/GB) system	3.3
K1.04	DELETED	
K1.05	Compressed gas (e.g., nitrogen)	2.2
K1.06	Sample system	2.4
K1.07	S/G recirculation system	2.3
K1.08	Chemical addition system	2.2
K1.09	RCS	4.0
K1.10	RMS	3.7
K1.11	DELETED	
K1.12	RPS	4.0
K1.13	DELETED	
K1.14	ESFAS	4.1
K1.15	Steam dump system (SDS)	3.5
K1.16	ATWS	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Steam Generator System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RCS	4.3
K3.02	ESFAS	4.2
K3.03	MRSS	3.4
K3.04	RMS	3.3
K3.05	MFW/AFW systems	4.1
K3.06	S/GB system	3.0
K4	**Knowledge of Steam Generator System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	S/G level control	4.2
K4.02	S/G level indication ranges (NR and WR)	3.8

K4.03	Automatic S/GB system and sample line isolation and reset	3.1
K4.04	DELETED	
K4.05	Amount of reserve water in S/G for decay heat removal	3.4
K4.06	S/G pressure measurement or control	3.5
K4.07	DELETED	
K4.08	DELETED	
K4.09	DELETED	
K4.10	Steam flow measurement	3.3
K4.11	Main steam and feed line Isolations	4.1
K4.12	Secondary side overpressure protection	3.7
K4.13	S/G outlet flow restrictor	3.1
K4.14	Ensuring steam quality	2.8

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Steam Generator System:**
(CFR: 41.5 / 45.7)

K5.01	Effect of secondary parameters, pressure, and temperature on reactivity	4.1
K5.02	Chemistry control	2.9
K5.03	S/G level shrink and swell	3.6
K5.04	DELETED	
K5.05	DELETED	
K5.06	S/G tube leakage detection	4.1
K5.07	S/G wide and narrow range level during startup, shutdown, and normal operations	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Steam Generator System:**
(CFR: 41.7 / 45.7)

K6.01	Main steam isolation valves (MSIVs)	3.9
K6.02	S/G atmospheric relief, secondary PORV, main steam safety valves, or MAD valves	4.1
K6.03	S/G level, S/G pressure, or steam flow detector	3.8
K6.04	Feedwater pumps	3.8
K6.05	DELETED	
K6.06	AFW, MFW, or S/GB valves	3.9
K6.07	DELETED	
K6.08	DELETED	
K6.09	DELETED	
K6.10	Steam generator water level control	4.0
K6.11	MRSS	3.3
K6.12	RCS	3.8
K6.13	MFW	3.8
K6.14	RPS	3.8

K6.15	ESFAS	3.9	
K6.16	ATWS	3.7	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Steam Generator System, including:**
(CFR: 41.5 / 45.5)

A1.01	S/G level	4.1	
A1.02	S/G pressure	3.9	
A1.03	Feed flow/steam flow	4.0	
A1.04	RCS pressure, temperature, flow, and/or subcooling	4.0	
A1.05	Radiation monitors	3.4	

A2 **Ability to (a) predict the impacts of the following on the Steam Generator System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.5)

		RO	**SRO**
A2.01	Faulted, leaking, or ruptured S/G	4.6	4.4
A2.02	Reactor trip/turbine trip	4.4	4.2
A2.03	Pressure/level transmitter failure	3.8	3.8
A2.04	Steam flow/feed flow mismatch	3.8	3.9
A2.05	Unbalanced RCS flows to the S/Gs	3.7	3.5
A2.06	Small-break LOCA	3.8	3.9
A2.07	Feedwater failures	4.2	3.9
A2.08	Recognition that increasing radiation levels in secondary systems may mean leaking and possibly ruptured S/G tubes	4.2	4.3

A3 **Ability to monitor automatic features of the Steam Generator System, including:**
(CFR: 41.7 / 45.5)

A3.01	S/G water level control	3.9	
A3.02	MAD valves, S/G atmospheric relief valves, or the SDS	3.9	
A3.03	DELETED		
A3.04	DELETED		
A3.05	Automatic S/GB system and sample line isolation	3.1	

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Shift of S/G controls between manual and automatic control	3.9	
A4.02	Filling S/G	3.1	
A4.03	DELETED		
A4.04	DELETED		

A4.05	Control of SGS parameters to enhance natural circulation	3.7
A4.06	S/G isolation on steam leak or tube rupture/leak	4.2
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	MAD valves, S/G atmospheric relief valves, or the SDS	3.9
A4.12	Steam flow	3.4
A4.13	Secondary side overpressure protection	3.4

System: 053 SF4P ICS Integrated Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Integrated Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	NNI (includes SASS)	3.3
K1.02	NI	3.6
K1.03	RCS (e.g., RCP, T-ave., delta Tc, tilt)	3.7
K1.04	Main Steam System (e.g., TBV and header pressure)	3.5
K1.05	MFW system (includes MFW pump controls)	3.6
K1.06	EHC	3.1
K1.07	CRDS	3.6
K1.08	Electrical distribution system	3.3
K1.09	RPS (e.g., reactor trip confirmation)	3.8
K1.10	Plant computer (e.g., ULD and PPAS)	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	ICS AC power	3.3
K2.02	ICS DC power	3.3
K3	**Knowledge of the effect that a loss or malfunction of the ICS will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Main steam system (e.g., TBV or header pressure)	3.5
K3.02	MFW system (includes MFW pump controls)	3.6
K3.03	EHC	3.1
K3.04	CRDS	3.7
K3.05	RCS	3.6
K4	**Knowledge of Integrated Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	T-ave. control	3.5
K4.02	MFW control (e.g., rapid feedwater reduction, MFW pumps, or MFW valves)	3.6
K4.03	Generated megawatt electric control	3.4
K4.04	Rod motion control	3.9
K4.05	Neutron power	3.7
K4.06	Steam header pressure control	3.7
K4.07	Delta Tc control	3.5

K4.08	Runbacks (e.g., MFW pump trip, condensate pump trip, RCP trip, or dropped rod)	3.9
K4.09	High-load limit or low-load limit	3.5
K4.10	Cross limits (heat balance)	3.8
K4.11	S/G level control	3.5
K4.12	BTU limits (alarm only)	3.1

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Integrated Control System:**
(CFR: 41.5 / 45.7)

K5.01	Open loop control system (integrated mode and borrowing / storing energy)	3.4
K5.02	Closed loop control system (Calibrating integral control)	3.3
K5.03	Thermodynamic principles to control S/G heat transfer (e.g., constant T-ave. control, ramping T-ave. at low power, or low-level limits)	3.4

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Integrated Control System:**
(CFR: 41.7 / 45.7)

K6.01	RCP trip	3.7
K6.02	FW pump trip	3.5
K6.03	Condensate pump trip	3.1
K6.04	Dropped control rod	3.8
K6.05	Instrument failure (NI or NNI)	3.9
K6.06	ICS AC power	3.6
K6.07	ICS DC power	3.6
K6.08	Plant computer (ULD)	3.4
K6.09	Steamline break	3.6
K6.10	EHC	3.2
K6.11	MFW (valves or pumps)	3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Integrated Control System, including:**
(CFR: 41.5 / 45.5)

A1.01	T-ave.	3.9
A1.02	Rod position (rod motion)	3.8
A1.03	Neutron error	3.7
A1.04	Reactor power	3.9
A1.05	Steam header pressure and/or S/G pressure	3.7
A1.06	Feedwater flow	3.7
A1.07	S/G level	3.7
A1.08	Delta Tc	3.6

A1.09	RCS flow (RCP status)	3.6	
A1.10	Generated megawatt electric	3.5	

A2 **Ability to (a) predict the impacts of the following on the Integrated Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	SRO
A2.01	Instrument failure (NI or NNI)	3.6	3.8
A2.02	RCP trip	3.4	3.7
A2.03	MFW pump trip	3.4	3.6
A2.04	Condensate pump trip	3.0	3.4
A2.05	Dropped rod	4.0	3.7
A2.06	ICS AC power loss	3.1	3.6
A2.07	ICS DC power loss	2.9	3.5
A2.08	Plant computer failure	2.9	3.2

A3 **Ability to monitor automatic features of the ICS, including:**
(CFR: 41.7 / 45.5)

A3.01	ULD correction factor	3.2
A3.02	Neutron error	3.6
A3.03	Runbacks	3.8
A3.04	Feedwater re-ratio	3.7
A3.05	Low level limits	3.5
A3.06	Rapid feedwater reduction	3.7
A3.07	TBV control (biases)	3.5
A3.08	Reactivity	4.0
A3.09	MFW block valves	3.6
A3.10	MFW pump controls (speed control or delta P control)	3.6

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Feedwater (e.g., loop demand, delta Tc, MFW pumps, startup control valves, or low load control valves)	3.7
A4.02	Reactor demand	3.9
A4.03	S/G/reactor demand	3.9
A4.04	ULD	3.5

System: **039 SF4S MRSS Main and Reheat Steam System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Main and Reheat Steam System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	S/G	3.8
K1.02	DELETED	
K1.03	IAS	3.1
K1.04	RCS	3.8
K1.05	T/G	3.6
K1.06	SDS	3.5
K1.07	AFW	3.6
K1.08	MFW	3.6
K1.09	RMS	3.2
K1.10	Auxiliary steam system	2.7
K1.11	Condensate	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Safety-related MRSS valves	3.1
K2.02	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Main and Reheat Steam System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	T/G	3.6
K3.02	DELETED	
K3.03	AFW system	3.3
K3.04	MFW system	3.4
K3.05	RCS	3.9
K3.06	SDS	3.3
K3.07	Auxiliary steam system	2.6
K3.08	Condensate system (CDS)	2.8
K3.09	S/G system	3.4
K4	**Knowledge of Main and Reheat Steam System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	DELETED	

K4.03	Main condenser, including steam dump valves, operating limits, controls, and indications	3.6
K4.04	DELETED	
K4.05	Automatic isolation of steamline	4.0
K4.06	Prevent reverse steam flow on steamline break	3.5
K4.07	Containment isolation	3.7
K4.08	Interlocks on MSIVs and bypass valves	3.5
K4.09	Main steamline drains	2.6
K4.10	Auxiliary steam	2.5
K4.11	Gland steam	2.7
K4.12	Moisture separation and reheater steam supply	3.0

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Main and Reheat Steam System:**
(CFR: 41.5 / 45.7)

K5.01	Water hammer	3.5
K5.02	DELETED	
K5.03	Steam blanketing on moisture separator reheater	2.6
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	
K5.07	DELETED	
K5.08	Effect of steam removal on reactivity	4.0
K5.09	Expected values of main steam temperature downstream of MSIVs during warmup	2.6
K5.10	Utilization of T-ave. program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits	3.6
K5.11	Temperature heatup rate limit for main steam or moisture separator reheaters (MSRs)	2.9
K5.12	Primary system temperature indications and required values during main steam system warmup	3.3
K5.13	Indications and alarms for main steam and area radiation monitors (during S/G tube rupture (SGTR))	4.0
K5.14	Utilization of steam pressure program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Main and Reheat Steam System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	
K6.04	DELETED	

K6.05	DELETED		
K6.06	S/G system	3.6	
K6.07	Atmospheric relief dump valves	3.7	
K6.08	IAS	3.2	
K6.09	RCS	3.6	
K6.10	T/G	3.4	
K6.11	SDS	3.4	
K6.12	MSIVs	3.8	
K6.13	CDS	2.9	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Main and Reheat Steam System, including:**
(CFR: 41.5 / 45.5)

A1.01	MSR temperature or pressure	2.7
A1.02	DELETED	
A1.03	DELETED	
A1.04	DELETED	
A1.05	RCS T-ave.	3.9
A1.06	Main steam pressure	3.7
A1.07	Main steam temperature	3.0
A1.08	Reheater steam pressure	2.6
A1.09	Main steamline radiation monitors	3.6
A1.10	Air ejector process radiation monitor (PRM)	3.1
A1.11	Lights and alarms	2.9
A1.12	MT/G temperatures	2.7

A2 **Ability to (a) predict the impacts of the following on the Main and Reheat Steam System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Decrease in turbine load as it relates to steam escaping from relief valves	3.8	3.4
A2.02	LOCA	4.1	3.5
A2.03	DELETED		
A2.04	Malfunctioning steam dump	4.0	3.7
A2.05	Increasing steam demand and its relationship to increases in reactor power	4.5	4.0
A2.06	Atmospheric relief valve malfunctions	4.2	3.7
A2.07	IAS malfunctions	3.3	3.2
A2.08	T/G malfunctions	3.7	3.1

A3 **Ability to monitor automatic operation of the Main and Reheat Steam System, including:**
(CFR: 41.5 / 45.5)

A3.01	Moisture separator reheater steam supply	2.8

A3.02	Isolation of the MRSS	3.3
A3.03	Atmospheric relief valves	3.7
A3.04	Main steam to auxiliary steam reducer	2.3

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	MSIVs and bypass valves	3.9
A4.02	Remote operators to auxiliary steam	2.3
A4.03	MFW pump turbines	3.4
A4.04	Emergency feedwater pump turbines	4.1
A4.05	MSR startup	2.6
A4.06	Main steam drains	2.4
A4.07	DELETED	

System: 041 SF4S SDS Steam Dump System and Turbine Bypass Control

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Steam Dump System and Turbine Bypass Control and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Circulating water system (CWS)	3.3
K1.02	S/G system	3.7
K1.03	MFW system	3.0
K1.04	DELETED	
K1.05	RCS	3.7
K1.06	CDS	3.0
K1.07	RPS	3.3
K1.08	IAS	3.1
K1.09	MT/G system	3.0
K1.10	MRSS	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	Turbine bypass control loop and valve power	2.9
K3	**Knowledge of the effect that a loss or malfunction of the Steam Dump System and Turbine Bypass Control will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	S/G	3.7
K3.02	RCS	4.0
K3.03	T/G	3.2
K3.04	Reactor power	4.1
K3.05	CDS	2.7
K4	**Knowledge of Steam Dump System and Turbine Bypass Control design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Reactor regulating system (CE)	3.3
K4.02	Condenser	3.2
K4.03	Load change	3.4
K4.04	Operation at power	3.3

K4.05	Plant startup	3.7
K4.06	MFW and AFW systems	3.0
K4.07	Relationship of vacuum to condenser availability	3.6
K4.08	DELETED	
K4.09	Relationship of low / low T-ave. setpoint in SDS to primary cooldown	3.6
K4.10	PZR LCS	2.7
K4.11	T-ave./T-ref. program	3.5
K4.12	DELETED	
K4.13	Relationship of S/G pressure to steam flow	3.0
K4.14	Operation of loss-of-load bistable upon turbine load loss	3.4
K4.15	DELETED	
K4.16	DELETED	
K4.17	Reactor trip	3.8
K4.18	Turbine trip	3.8
K4.19	ICS (BW)	3.2

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Steam Dump System and Turbine Bypass Control:**
(CFR: 41.5 / 45.7)

K5.01	Relationship of no-load T-ave. to atmospheric dump valve setpoint on an Rx trip	3.5
K5.02	DELETED	
K5.03	Steam dump valve flow characteristics	2.7
K5.04	Basis for plant cooldown rates	3.4
K5.05	Basis for RCS design pressure limits	3.3
K5.06	DELETED	
K5.07	Reactivity feedback effects	3.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Steam Dump System and Turbine Bypass Control:**
(CFR: 41.7 / 45.7)

K6.01	Condenser	3.3
K6.02	Valves, including main and bypass feedwater valves	2.9
K6.03	Controller and positioners, including ICS, S/G, and CRDS	3.2
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	CWS	3.1
K6.08	S/G system	3.4
K6.09	MFW system	2.8
K6.10	RCS	3.5
K6.11	CDS	2.8
K6.12	MT/G system	3.0

K6.13	IAS	3.1	
K6.14	RPS	3.4	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Steam Dump System and Turbine Bypass Control, including:**
(CFR: 41.5 / 45.5)

A1.01	DELETED		
A1.02	Steam pressure	3.7	
A1.03	RCS temperature	3.9	
A1.04	RCS pressure	3.6	
A1.05	Reactor power	4.0	
A1.06	Condenser vacuum	3.3	

A2 **Ability to (a) predict the impacts of the following on the Steam Dump System and Turbine Bypass Control and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	SRO
A2.01	DELETED		
A2.02	Steam valve stuck open	4.3	3.8
A2.03	Loss of IAS	3.6	3.3
A2.04	Loss of condenser vacuum	3.8	3.5
A2.05	Malfunction of the RPS	3.9	3.5
A2.06	MT/G system	3.3	2.9
A2.07	Failure of the steam dump controller	4.0	3.7

A3 **Ability to monitor automatic features of the Steam Dump System and Turbine Bypass Control, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED		
A3.02	RCS temperature	3.9	
A3.03	Steam flow	3.2	
A3.04	DELETED		
A3.05	DELETED		
A3.06	Steam pressure mode	3.5	
A3.07	Load rejection	3.7	
A3.08	Plant trip	4.0	
A3.09	Steam dump arming	3.5	
A3.10	Steam dump blocking	3.5	

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	ICS voltage inverter (BW)	3.3	

A4.02	Steam dump/cooldown valves	3.6
A4.03	DELETED	
A4.04	Pressure mode	3.5
A4.05	Main steam header pressure	3.5
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	

System: 045 SF4S MT/G Main Turbine Generator System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Main Turbine Generator System and the following systems:** (CFR: 41.4 to 41.7 / 45.7 / 45.8)	
K1.01	MRSS	3.1
K1.02	CDS	3.1
K1.03	AC distribution system	3.4
K1.04	Extraction steam system	3.1
K1.05	Generator cooling	3.4
K1.06	RCS	3.4
K1.07	DELETED	
K1.08	DELETED	
K1.09	DELETED	
K1.10	DELETED	
K1.11	DELETED	
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	DELETED	
K1.16	Vibration and eccentricity monitoring system	2.9
K1.17	DELETED	
K1.18	RPS	3.8
K1.19	ESFAS	3.6
K1.20	DELETED	
K1.21	Main turbine and generator bearing oil system	3.1
K1.22	Generator and hydrogen seal oil system	3.2
K1.23	Stator cooling system	3.2
K1.24	MFW	3.1
K1.25	Generator hydrogen/gas system	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	T/G lube oil pumps	2.7
K2.03	Generator excitation breaker power supply	2.6
K3	**Knowledge of the effect that a loss or malfunction of the Main Turbine Generator System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	DELETED	
K3.02	MRSS	3.0

K3.03	CDS	2.9
K3.04	Main and startup feedwater system	2.9
K3.05	Heater drain system	2.8
K3.06	Main turbine and generator bearing oil system	3.1
K3.07	Generator and hydrogen seal oil system	3.0
K3.08	Stator cooling system	3.0
K3.09	ESAS	3.3
K3.10	RPS	3.7

K4 **Knowledge of Main Turbine Generator System design feature(s) and/or interlock(s), which provide for the following:**
(CFR: 41.7)

K4.01	Programmed controller for relationship between steam pressure at T/G inlet (impulse and first stage) and plant power level	3.5
K4.02	Automatic shutting of reheat stop valves and main control valves when tripping turbine	3.5
K4.03	Voltage regulation mode	2.9
K4.04	Turbine load-following mode of operation	2.7
K4.05	Acceptable loading rate for T/G	2.8
K4.06	Interlocks to prevent paralleling out of phase	3.1
K4.07	EHC for response to load changes	2.9
K4.08	The reactor bailey station and reactor diamond station in integrated control circuitry	3.1
K4.09	Generator capability, including power factor, volt amperes reactive (VAR), and hydrogen pressure	3.2
K4.10	Programmed controller for T-ref. signal generation from first stage (impulse) pressure in turbine	3.4
K4.11	T/G reactor trip	3.9
K4.12	Automatic turbine runback	3.8
K4.13	Overspeed protection	3.5
K4.14	Measurement of valve stroke times	2.3
K4.15	DELETED	
K4.16	DELETED	
K4.17	DELETED	
K4.18	DELETED	
K4.19	Low-speed rotation by turbine turning gear to prevent “set” in shaft	2.4
K4.20	Quenching of steam at entrance to exhaust hood by sprays	2.5
K4.21	Change-over from bearing oil pump to shaft pump as turbine speed increases	2.6
K4.22	Field excitation breakers in generator	2.6
K4.23	Shift from manual to automatic voltage regulation when the system is within limits (bumpless transfer)	2.7
K4.24	Closure of motor-operated disconnects before closure of main generator breakers	2.7
K4.25	Adjustment of EHC to maintain minimum load on T/G when paralleled with system	2.8

K4.26	Shifting of auxiliary buses between unit auxiliary transformer and service transformer during loading of main T/G (function of reactor power)	2.9
K4.27	DELETED	
K4.28	DELETED	
K4.29	DELETED	
K4.30	DELETED	
K4.31	Operation of auto-synchronous system	2.8
K4.32	DELETED	
K4.33	DELETED	
K4.34	DELETED	
K4.35	Operation of reactor in the load-following mode above 15-percent power	3.2
K4.36	T/G coastdown and connection to the turning gear at zero T/G speed	2.7
K4.37	Automatic functions associated with turbine trip: reactor trip, station power switched to offsite source, and removal of air to extraction steam nonreturn valves	3.6
K4.38	DELETED	
K4.39	Load limiters/runback	3.5
K4.40	DELETED	
K4.41	Lockout of command relay to generator breaker	2.7
K4.42	Operation of SDS (turbine bypass) in event of load loss or plant trip	3.7
K4.43	T-ave. program in relation to SDS controller	3.5
K4.44	Impulse pressure mode control of steam dumps	3.4
K4.45	Operation of low-pressure steam dump to prevent T/G overspeed	3.1
K4.46	Defeat of reactor trip by overspeed trip test lever	3.1
K4.47	Turbine trip upon reactor trip	4.0
K4.48	Trip of T/G and lube oil pumps by fire protection system (FPS)	2.7
K4.49	Turbine trip causing a reactor power cutback	3.6
K4.50	Load control circuit	2.9
K4.51	Turbine latching (reset) controls	2.7
K4.52	RPS	3.8
K4.53	ESFAS	3.7
K4.54	T/G protection system	3.4
K4.55	Turbine supervisory instrumentation	3.0
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Main Turbine Generator System:** (CFR: 41.5 / 45.7)	
K5.01	Possible presence of explosive mixture in generator if hydrogen purity deteriorates	3.6
K5.02	Effects of moisture in steam on the turbine	3.3
K5.03	Purpose of extraction steam system	3.1
K5.04	Basic design of turbine blades	2.4

K5.05	Effect of steam reheating, feedwater heating, and condenser vacuum on plant efficiency	3.2
K5.06	Understanding of the principle of operation of voltage regulator null meter	2.5
K5.07	Reasons why the rotation of synchroscope must be slow in the fast direction before its connection to the grid	3.3
K5.08	Even heatup/cooldown of turbine	3.0
K5.09	Maneuvering limits for T/G	2.9
K5.10	Reasons for different procedures in hot and cold starts (temperature differential limits)	2.6
K5.11	Purpose of turning gear	2.7
K5.12	Role of field excitation in generator	2.8
K5.13	Reason for having the generator voltage slightly higher than system voltage when paralleling	3.1
K5.14	Reason for reactive load adjustment after paralleling	3.0
K5.15	Reason for paralleling both generator breaker circuits	2.8
K5.16	Need for heat balance as T/G load increases	2.9
K5.17	Relationship between MTC and boron concentration in RCS as T/G load increases	3.3
K5.18	Purpose of low-power reactor trips (limited to 25-percent power)	3.6
K5.19	Reason for minimum T/G load (to cool low-pressure turbine blade tips)	2.8
K5.20	Effect of temperature on lube oil viscosity	2.4
K5.21	Purpose of turbine lube oil lift pump (to hold T/G off main bearing at low rotation speeds)	2.7
K5.22	Operation of synchroscope	2.8
K5.23	Relationship between rod position and RCS boron concentration during T/G load increases	3.2
K5.24	Steam blanketing (atmospheric pressure) moisture separator reheater to drive out air and noncondensables before startup	2.5
K5.25	Recognition of unusual sounds during startup of turbine (vibration monitoring)	2.9
K5.26	Relationship between governor and throttle valves	2.8
K5.27	Use of T/G balance voltmeter before placing voltage regulator in service	2.6
K5.28	Governor and load limits	2.9
K5.29	Quenching of steam at entrance to exhaust hood by sprays	2.6
K5.30	Chemical and health physics sampling as power is reduced	2.4
K5.31	Load sharing between the high- and low-pressure turbine (shifts to the low-pressure turbine as T/G load increases also affects interface with moisture separator reheater)	2.4
K5.32	Time required to effect load changes	2.6
K5.33	Paralleling of generator to grid when one of the generator breakers is closed	2.7
K5.34	Operation of CRDS in manual mode at a T/G power below 15 percent	3.2

K5.35	Lube oil pump needs to be on before engagement of turning gear	2.8
K5.36	Avoidance of T/G critical speeds	3.1

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Main Turbine Generator System:**
(CFR: 41.7 / 45.7)

K6.01	Generator stator cooling (turbine building CCW)	3.2
K6.02	DELETED	
K6.03	DELETED	
K6.04	AC electrical distribution	3.4
K6.05	Hydrogen purity analyzer	2.7
K6.06	Voltage regulator	3.1
K6.07	Hydrogen oil seal system on generator	3.2
K6.08	Turbine lube oil system	3.1
K6.09	Steam gland seal system on turbine	3.1
K6.10	DELETED	
K6.11	DELETED	
K6.12	DELETED	
K6.13	MFW, cooling water, heater drains, and demineralizers (manual adjustment of flows during power decrease operation unless automatic controls are provided)	2.9
K6.14	DELETED	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Main Turbine Generator System, including:**
(CFR: 41.5 / 45.5)

A1.01	Physical parameters of the M/TG (such as speed, sound, vibration, expansion, temperature, pressure, and flow)	3.0
A1.02	Electrical parameters for the T/G	3.1
A1.03	DELETED	
A1.04	DELETED	
A1.05	RCS pressure and temperature	3.5
A1.06	Secondary plant parameters	3.0
A1.07	Lights and alarms	3.1
A1.08	Reactor power	3.7
A1.09	Turbine first stage pressure/power	3.5
A1.10	Turbine valve indicators (throttle, governor, control, stop, and intercept)	3.2

A2	**Ability to (a) predict the impacts of the following on the Main Turbine Generator System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	Condensate backing up in drains and reheaters	3.1	2.8
A2.02	Loss of stator water cooling	3.4	3.6
A2.03	Mismatch between generator output and unit demand	2.9	3.2
A2.04	Improperly operating steam and turbine drains	2.8	2.8
A2.05	Changing extraction steaming rates	2.3	2.6
A2.06	Cold and hot starts	2.4	2.7
A2.07	Unsuccessful turbine latching	2.5	2.6
A2.08	Steam dumps are not cycling properly at low load, or stick open at higher load: isolate and use atmospheric reliefs when necessary	3.0	3.3
A2.09	If exciter fails, trip the T/G	3.0	3.1
A2.10	Voltage regulator malfunction	3.3	3.2
A2.11	Control problems in primary (e.g., axial flux imbalance); need to reduce load on secondary	3.1	3.3
A2.12	Control rod insertion limits exceeded (stabilize secondary)	3.0	3.5
A2.13	Opening of the steam dumps at low pressure	2.9	3.3
A2.14	DELETED		
A2.15	Turbine overspeed	3.5	3.3
A2.16	Turbine blade failure	3.3	3.3
A2.17	Malfunction of EHC	3.5	3.4

A3	**Ability to monitor automatic features of the Main Turbine Generator System, including:** (CFR: 41/7 / 45.5)	
A3.01	Load control	3.2
A3.02	DELETED	
A3.03	DELETED	
A3.04	T/G trip	3.8
A3.05	EHC	3.3
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	DELETED	
A3.10	Voltage regulation	3.2
A3.11	Generator trip	3.7

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	T/G controls, including breakers	3.5
A4.03	DELETED	

A4.04	Exhaust hood spray system for temperature control	2.7
A4.05	Electrical (T/G) and steam system adjustments	3.3
A4.06	Turbine stop valves	3.3
A4.07	Voltage regulation	3.2
A4.08	Valve freedom test	2.6
A4.09	DELETED	
A4.10	Startup T/G	3.2
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	Turbine trip	3.6
A4.15	Paralleling to the grid	3.4

System: 055 SF4S CARS Condenser Air Removal System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Condenser Air Removal System and the following systems:** (CFR: 41.4 to 41.7 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	Main condenser	3.5
K1.03	Condensate	3.1
K1.04	S/G	2.8
K1.05	Polishing demineralizers	2.3
K1.06	Process radiation monitoring system (PRMS)	3.0
K1.07	DELETED	
K1.08	DELETED	
K1.09	Auxiliary steam	2.7
K1.10	HVAC systems	2.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Condenser Air Removal System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Main condenser	3.8
K3.02	DELETED	
K3.03	DELETED	
K3.04	DELETED	
K3.05	DELETED	
K4	**Knowledge of Condenser Air Removal System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Draw main condenser vacuum	3.3
K4.02	Effluent control and monitoring	3.3

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Condenser Air Removal System:** (CFR: 41.5 / 45.7)		
K5.01	DELETED		
K5.02	DELETED		
K5.03	DELETED		
K5.04	S/G chemistry related to main condenser air in-leakage	2.9	
K5.05	Sources and impacts of high radiation related to S/G tube leakage	3.7	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Condenser Air Removal System:** (CFR: 41.7 / 45.7)		
K6.01	Air ejectors	3.2	
K6.02	Vacuum pumps	3.2	
K6.03	Main condenser	3.4	
K6.04	Flow sensors	2.5	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Condenser Air Removal System, including:** (CFR: 41.5 / 45.5)		
A1.01	Condenser vacuum	3.5	
A1.02	DELETED		
A1.03	Alarms and lights	3.1	
A2	**Ability to (a) predict the impacts of the following on the Condenser Air Removal System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Loss of circulating/cooling water system	3.8	3.3
A2.02	Loss of gland seal/gland exhaust	3.5	3.0
A2.03	Loss of air ejector cooling water	3.2	2.9
A2.04	Air in-leakage	3.6	3.3
A3	**Ability to monitor automatic features of the Condenser Air Removal System, including:** (CFR: 41.7 / 45.5)		
A3.01	Air removal pump	3.0	

A3.02	Steam to CARS	2.9
A3.03	Automatic diversion of CARS exhaust	3.0

A4 **Ability to manually operate and monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Sealing steam	2.9
A4.02	Vacuum pumps	3.0
A4.03	Steam to CARS	2.8
A4.04	Realign CARS exhaust path	3.0

System: **056 SF4S CDS Condensate System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Condensate System and the following systems:** (CFR: 41.4 to 41.8 / 45.7 / 45.8)	
K1.01	Feedwater cleanup system	2.6
K1.02	DELETED	
K1.03	MFW	3.8
K1.04	DELETED	
K1.05	Secondary sealing water system	2.7
K1.06	Heater drains system	3.3
K1.07	Gland seal system	2.9
K1.08	CARS	3.0
K1.09	Extraction steam system	2.9
K1.10	Chemical treatment system	2.4
K1.11	Stator water cooling system	2.6
K1.12	Secondary plant component cooling	2.6
K1.13	AFW	3.6
K1.14	Demineralizer water makeup system	2.7
K1.15	DELETED	
K1.16	DELETED	
K1.17	Polishing demineralizer system	2.7
K1.18	Secondary sampling system	2.3
K1.19	Steam dump system	3.2
K1.20	Main steam and reheat system	3.2
K1.21	Auxiliary steam system	2.8
K1.22	IAS	2.6
K1.23	Condenser tube cleaning system	2.3
K1.24	CWS	3.0
K1.25	S/GB system	2.9
K1.26	Hydrogen cooling system	2.5
K1.27	Demineralized water system	2.5
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Condensate pumps and/or booster pumps	3.1
K3	**Knowledge of the effect that a loss or malfunction of the Condensate System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	MFW	3.8
K3.02	DELETED	
K3.03	MFW pumps	3.8

K3.04	Heater drain system	3.1
K3.05	DELETED	
K3.06	DELETED	
K3.07	Stator water cooling system	2.3
K3.08	Hydrogen cooling system	2.3

K4 **Knowledge of Condensate System design feature(s) and/or interlock(s), which provide for the following:**
(CFR: 41.7)

K4.01	Feedwater heating	3.0
K4.02	Condensate demineralizer resin regenerative process	2.1
K4.03	Restricting hotwell level range	2.6
K4.04	Moving condensate to and from storage tank and hotwell	2.7
K4.05	Securing steam seals on main turbine during shutdown	2.6
K4.06	DELETED	
K4.07	Cooling condensate pumps seals using makeup water	2.5
K4.08	Venting condensate pump seals	2.3
K4.09	Feedwater pump turbine windmill protection	2.5
K4.10	Flow control valve for the gland exhaust condenser	2.3
K4.11	Bypass of heater stream	2.8
K4.12	Condensate minimum flow recirculation valve	2.9
K4.13	Condensate pump runout capacity	2.8
K4.14	MFW pump NPSH	3.6
K4.15	Booster pump starting interlock	2.9
K4.16	Low- and high-level heater	2.9
K4.17	DELETED	
K4.18	Interlocks between booster pumps and auxiliary oil pumps	2.7
K4.19	Setpoints and trip levels for condensate pump and booster pump operations	3.0
K4.20	DELETED	
K4.21	DELETED	
K4.22	Feed pump and booster pump NPSH protection	3.3
K4.23	Demineralizer bypass valve (prevent water impact on resin beds during pump startup)	2.7
K4.24	Condenser vacuum interlocks/permissives	3.2
K4.25	Approximate time necessary to regenerate one condensate demineralizer resin bed	1.8

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Condensate System:**
(CFR: 41.5 / 45.7)

K5.01	Principle of vacuum drag	2.5
K5.02	DELETED	
K5.03	Water hammer and methods of prevention	3.3

K5.04	Function of lubricating oil and its application to pump and motor bearings	2.6
K5.05	DELETED	
K5.06	Purpose of condensate demineralizer	2.6
K5.07	Purpose and principle of de-aeration of oxygen removal from condensate	2.6
K5.08	Chemistry specifications for secondary system	2.7
K5.09	Water quality requirements for demineralizer water	2.3
K5.10	Effects of leaks (on plant efficiency and personnel)	2.6
K5.11	Reasons for venting all high points in CDS	2.6
K5.12	Reason and methods for breaking main condenser vacuum before removing turbine seals	2.9
K5.13	Purpose of low-pressure cleanup valve	2.5
K5.14	Purpose of valve between upper surge tank and hotwell	2.3
K5.15	Stabilization of piping system parameters after changes in chemistry	2.3
K5.16	Limits of condensate pump ability to feed S/G	3.3
K5.17	DELETED	
K5.18	Proper sequencing of hotwell pumps and condensate	2.6
K5.19	Adjustment of automatic setpoint and polish demineralizer bypass valves	2.5
K5.20	Flow rate limits of condensate piping system	2.5
K5.21	Operation of hotwell pump and air ejector recirculation line isolation valve to maintain header pressure	2.4
K5.22	Decreased effectiveness of condensate demineralizer due to increased flow through it	2.2
K5.23	Normal sequence of alarms on startup of condensate pumps, including the low suction pressure alarm	2.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Condensate System:**
(CFR: 41.7 / 45.7)

K6.01	Condensate pumps	3.5
K6.02	Booster pumps	3.5
K6.03	Main feed pumps	3.6
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	Main condenser	3.4
K6.08	DELETED	
K6.09	DELETED	
K6.10	DELETED	
K6.11	DELETED	
K6.12	Demineralizer water system	2.5
K6.13	Low-pressure feedwater heaters	2.8
K6.14	Steam dumps	3.2
K6.15	Main steam and reheat system	3.0
K6.16	Auxiliary steam system	2.4

K6.17	IAS	2.7	
K6.18	Heater drain system	2.9	
K6.19	CWS	2.9	
K6.20	S/GB system	2.8	
K6.21	Condensate polisher	2.7	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Condensate System, including:**
(CFR: 41.5 / 45.5)

A1.01	Pressure, flow, and amperage for condensate, booster, and main feed pumps	3.2	
A1.02	DELETED		
A1.03	DELETED		
A1.04	Hotwell level alarms and flow indicators	3.0	
A1.05	D/P indicators (across pumps and demineralizers)	2.6	
A1.06	Heater parameters (temperature, pressure, flow, and level)	2.7	
A1.07	DELETED		
A1.08	MFW pump suction pressure	3.7	
A1.09	Long-cycle recirculation parameters (temperature, pressure, and flow level)	2.5	
A1.10	Hotwell and condensate storage tank level indicators	2.9	
A1.11	Monitoring of steam jet air ejector airflow	2.5	
A1.12	Upper surge tank flowmeter	2.3	
A1.13	Lights and alarms	2.8	

A2 **Ability to (a) predict the impacts of the following on the Condensate System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	DELETED		
A2.02	Bad chemistry	3.1	2.8
A2.03	Demineralizer D/P	2.6	2.7
A2.04	Loss of condensate pumps	4.0	3.7
A2.05	Condenser tube leakage	3.7	3.3
A2.06	Abnormal hotwell pump discharge pressure	2.8	2.7
A2.07	Removal of condensate demineralizer from service	2.6	2.5
A2.08	Feedwater heater tube leak	3.3	2.8
A2.09	Feedwater level high or low	3.3	2.8
A2.10	DELETED		
A2.11	DELETED		
A2.12	Opening of the heater string bypass valve	3.2	3.0
A2.13	Opening of the condensate recirculation valve	3.3	2.9
A2.14	Opening of the condensate spill valve	2.8	2.6
A2.15	Condenser malfunction	3.6	3.2
A2.16	Main steam system malfunction	3.6	2.9
A2.17	IAS malfunction	3.0	2.9

A2.18	CWS malfunction	3.6	3.0
A2.19	S/GB malfunction	2.6	2.8
A2.20	Condensate polisher malfunction	2.6	2.7

A3 **Ability to monitor automatic features of the Condensate System, including:**
(CFR: 41.7 / 45.5)

A3.01	Automatic hotwell level control	2.9
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Determination that the D/P of the condensate demineralizer is within limits	2.5
A3.08	Flow through stator coolant and hydrogen coolers	2.5
A3.09	Automatic protection of MFW pump low suction pressure	3.6
A3.10	DELETED	

A4 **Ability to manually operate and monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Condensate pump controls	3.3
A4.02	Condensate demineralizer bypass valve and precoat by pass valve	2.7
A4.03	Hotwell high-level dump	2.8
A4.04	Cleanup valve	2.5
A4.05	Valve between upper surge tank and hotwell	2.5
A4.06	Condensate demineralizer bypass valve controller	2.7
A4.07	Hotwell pumps	2.8
A4.08	Condensate automatic makeup valve controller	2.8
A4.09	Demineralizer flow control valve	2.4
A4.10	Low- and high-pressure cleanup valves	2.6
A4.11	Setpoints on polish demineralizer bypass valve controllers	2.5
A4.12	Condensate pump, including verification of proper startup from parameter readings	3.2
A4.13	DELETED	
A4.14	Auxiliary oil pumps for booster pumps	2.8
A4.15	Turbine and feedwater pump turbine exhaust temperature during shutdown	2.6
A4.16	Heater unit controls and control valves during heater startup/shutdown	2.7
A4.17	DELETED	
A4.18	DELETED	

System: **059 SF4S MFW Main Feedwater System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Main Feedwater System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	CDS	3.6
K1.02	AFW system	3.9
K1.03	S/Gs	3.9
K1.04	S/G water-level control system	4.1
K1.05	RCS	3.6
K1.06	Chemical treatment	2.5
K1.07	ICS	3.1
K1.08	Heater drains	3.0
K1.09	Secondary cooling water	2.9
K1.10	Extraction steam	3.0
K1.11	Main steam system	3.5
K1.12	Auxiliary steam system	2.9
K1.13	S/GB system	2.9
K1.14	ESFAS	3.8
K1.15	Secondary sampling system	2.3
K1.16	IAS	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	MFW system pumps	3.2
K2.02	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Main Feedwater System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	CDS	3.2
K3.02	AFW system	3.8
K3.03	S/Gs	3.8
K3.04	RCS	3.8
K3.05	Extraction steam	2.7
K3.06	ESFAS	3.8
K4	**Knowledge of Main Feedwater System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	MFW and startup feedwater valve combination	3.2

K4.02	Automatic turbine / reactor trip runback	3.8
K4.03	Adequate condensate flow	3.2
K4.04	Heating of feedwater	3.1
K4.05	Control of speed of MFW pump turbine	3.6
K4.06	DELETED	
K4.07	Closing MFW pump drains	2.5
K4.08	Feedwater regulatory valve operation (on basis of steam flow and feed flow mismatch)	3.9
K4.09	DELETED	
K4.10	Bearing oil signal to the turning gear start sequence	2.6
K4.11	DELETED	
K4.12	DELETED	
K4.13	DELETED	
K4.14	Start permissives for MFW pumps	3.2
K4.15	Automatic starts for MFW pumps	2.6
K4.16	Automatic trips for MFW pumps	3.5
K4.17	DELETED	
K4.18	Automatic feedwater reduction on plant trip	3.5
K4.19	Automatic feedwater isolation of MFW	3.8
K4.20	Automatic feed pump recirculation flow	3.0
K4.21	ICS (BW)	3.7
K4.22	S/G water-level control system	3.8

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Main Feedwater System:**
(CFR: 41.5 / 45.7)

K5.01	Relationship between variable speed, flow, and discharge pressure of the main feed pumps	3.4
K5.02	Shrink and swell	3.5
K5.03	Reason for maintenance of minimum D/P between main steam and MFW pump discharge pressure	3.3
K5.04	DELETED	
K5.05	Reason for balancing MFW pump loads	3.0
K5.06	Characteristics of level, flow, and pressure indications	3.1
K5.07	Relationship between feedwater pump speed and feedwater regulating valve position	3.4
K5.08	Reason for matching steam flow and feedwater flow when recovering from an S/G level transient in manual control	3.9
K5.09	DELETED	
K5.10	DELETED	
K5.11	MFP windmilling on recirculating flow	2.5
K5.12	Increased MFW pump discharge with increased turbine speed	3.2
K5.13	Reasons for monitoring feedwater pump suction flow / pressure	3.3
K5.14	Quadrant power tilt	2.5

K5.15	S/G level control upon loss of RCP	3.4
K5.16	Sources of cooling water for MFW pump lube oil cooler comparison of actual D/P, between main steam and MFW pump discharge pressure, to programmed D/P when placing MFW pump in automatic mode	3.3
K5.17	MFW pump speed and flow regulating valves (reason for adjusting position of both)	3.5
K5.18	Power level restrictions for operation of MFW pumps and valves	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Main Feedwater System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	DELETED	
K6.08	DELETED	
K6.09	DELETED	
K6.10	DELETED	
K6.11	High and low feedwater discharge header pressure	3.1
K6.12	S/G controller logic for MFW regulating valve	3.6
K6.13	MFW pump turbine	3.3
K6.14	Main feed isolation valve malfunction	3.7
K6.15	Feed flow transmitters	3.2
K6.16	Feed pump suction pressure transmitters	3.1
K6.17	Feedwater control system failures	3.6
K6.18	MFW pump malfunctions	3.7
K6.19	Feed-Preheating malfunctions	2.8
K6.20	Feedwater heaters	2.9
K6.21	Heater string bypass valves	2.8
K6.22	Steam generator feedwater pump (SGFP) discharge pressure	3.1
K6.23	SGFP lube oil pumps	2.9
K6.24	Startup feed pumps	2.6
K6.25	Motor-driven main feed pumps	3.0
K6.26	SGFP oil coolers	2.6

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Main Feedwater System, including:**
(CFR: 41.5 / 45.5)

A1.01	DELETED	
A1.02	MFW pump oil temperatures and MFW pump vibrations	2.9

A1.03	DELETED	
A1.04	Main steam pressure	3.2
A1.05	S/G level and comparison with normal values	3.5
A1.06	Abnormal noises or vibrations of MFW pump	3.0
A1.07	Feed pump speed, including normal control speed for ICS	3.4
A1.08	Oil pressure indications for MFW pumps	2.8
A1.09	Feedwater pump bearing temperatures	2.7
A1.10	Feedwater pump seal leak-off temperature	2.5
A1.11	Feedwater regulating valve D/P	3.2
A1.12	Lights and alarms	3.1
A1.13	Condenser vacuum	3.3
A1.14	Feedwater discharge header pressure	3.1
A1.15	MFW pump lube oil system	2.9

A2	**Ability to (a) predict the impacts of the following on the Main Feedwater System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Feedwater actuation of AFW system	4.0	4.1
A2.02	Loss of feedwater heater	3.1	3.2
A2.03	Overfeeding event	3.4	3.5
A2.04	DELETED		
A2.05	DELETED		
A2.06	Loss of steam flow to MFW system	3.8	3.4
A2.07	Tripping of MFW pump turbine	4.0	3.8
A2.08	Extremely low MFW pump control lube oil or bearing oil pressure	3.4	3.1
A2.09	DELETED		
A2.10	Secondary cooling water	2.7	2.7
A2.11	Failure of feedwater control system	3.9	3.5
A2.12	Failure of feedwater regulating valves	3.9	3.6
A2.13	Loss of condensate / heater draining flow	3.0	2.8

A3 **Ability to monitor automatic features of the Main Feedwater System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	Programmed levels of the S/G system	3.8
A3.03	Feedwater pump suction flow pressure	3.3
A3.04	Turbine-driven feed pump	3.4
A3.05	DELETED	
A3.06	Feedwater isolation	3.8
A3.07	ICS (BW)	3.6
A3.08	S/G water-level control system	3.8
A3.09	MFW pump trips	3.6

A4	**Ability to manually operate and monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Null out MFW pump D/P differences	2.9
A4.03	Feedwater control during power increase and decrease	3.6
A4.04	Reset MFW overspeed trip	2.9
A4.05	DELETED	
A4.06	MFW pump turbine reset switch	2.9
A4.07	DELETED	
A4.08	Feed regulating valve controller	3.6
A4.09	Remote determination of operating feedwater pump turning gear	2.5
A4.10	ICS	3.6
A4.11	Recovery from automatic feedwater isolation	3.6
A4.12	Initiation of automatic feedwater isolation	3.8
A4.13	S/G water-level control system	3.9
A4.14	Starts and stops on the main feed pumps	3.1

System: 061 SF4S AFW Auxiliary/Emergency Feedwater System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Auxiliary/Emergency Feedwater System and the following systems:** (CFR: 41.2 to 41.8 / 45.7 / 45.8)	
K1.01	S/G system	4.4
K1.02	MFW system	3.9
K1.03	MRSS	3.1
K1.04	RCS	3.9
K1.05	CDS	3.2
K1.06	Cooling water for AFW components	3.4
K1.07	Emergency water source	4.2
K1.08	Chemical treatment	2.2
K1.09	PRMS	3.0
K1.10	Diesel fuel oil system	2.5
K1.11	DELETED	
K1.12	ESFAS	4.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	AFW system MOVs	3.6
K2.02	AFW electric-driven pumps	4.1
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Auxiliary/Emergency Feedwater System will have on the following systems or system parameters:** (CFR: 41.5, 41.7 / 45.6)	
K3.01	RCS	4.3
K3.02	S/G system	4.3
K4	**Knowledge of the Auxiliary/Emergency Feedwater System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Water sources and/or priority of use	4.0
K4.02	AFW automatic start signals	4.4
K4.03	Automatic blowdown / sample isolation	3.2
K4.04	Prevention of AFW runout by limiting AFW flow	3.5
K4.05	AFW / MFW suction pressure logic	3.7
K4.06	AFW manual start permissives	3.6
K4.07	AFW pump trip	3.7

K4.08	AFW recirculation	3.3
K4.09	Crossties between multi-unit stations	3.8
K4.10	DELETED	
K4.11	Automatic level control	3.6
K4.12	DELETED	
K4.13	Initiation of cooling water and lube oil	3.1
K4.14	AFW automatic isolation	4.0

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Auxiliary/Emergency Feedwater System:**
(CFR: 41.5 / 45.7)

K5.01	Relationship between AFW flow and RCS heat transfer	4.3
K5.02	Decay heat sources and magnitude	3.9
K5.03	DELETED	
K5.04	DELETED	
K5.05	Feed line voiding and water hammer	3.4
K5.06	Natural circulation flow	3.8
K5.07	Back leakage through discharge check valves	3.1
K5.08	Expected AFW flow rates based on plant conditions	3.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Auxiliary/Emergency Feedwater System:**
(CFR: 41.7 / 45.5 to 45.8)

K6.01	AFW flow controller	3.9
K6.02	AFW pump	4.0
K6.03	DELETED	
K6.04	DELETED	
K6.05	AFW discharge control valve	3.8
K6.06	DELETED	
K6.07	AFW pump lube oil system and cooling	3.0
K6.08	Bearing oil supply for turbine drive pumps	2.8
K6.09	AFW turbine drain(s) or heat tracing	2.5
K6.10	ESFAS	4.0
K6.11	Water source	4.0

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Auxiliary/Emergency Feedwater System, including:**
(CFR: 41.5 / 45.5)

A1.01	S/G level	4.2
A1.02	S/G pressure	3.8
A1.03	DELETED	

A1.04	AFW source tank level	3.8	
A1.05	AFW flow and/or motor amperage	3.8	
A1.06	DELETED		
A1.07	Reactor power	3.8	
A1.08	RCS temperature	3.9	
A1.09	Natural circulation flow	3.8	
A1.10	AFW pump discharge temperature	2.7	
A1.11	Lights and alarms	3.5	

A2	**Ability to (a) predict the impacts of the following on the Auxiliary/Emergency Feedwater System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 45.6)	**RO**	**SRO**
A2.01	Inadvertent actuation of AFW at power	3.9	3.3
A2.02	DELETED		
A2.03	Loss of DC power	4.0	3.8
A2.04	AFW pump failure or improper operation	4.1	4.0
A2.05	Automatic control malfunction	3.8	3.8
A2.06	Back leakage of MFW	2.7	3.0
A2.07	Air-operated valve, SOV, or MOV failure	4.0	3.5
A2.08	Improper flow rates	3.8	3.5
A2.09	Total loss of feedwater	4.0	4.2

A3	**Ability to monitor automatic features of the Auxiliary/Emergency Feedwater System, including:** (CFR: 41.7 / 45.7)	
A3.01	AFW system automatic start	4.2
A3.02	DELETED	
A3.03	Automatic AFW S/G level control	3.8
A3.04	Automatic AFW isolation	4.0
A3.05	DELETED	
A3.06	S/GB and sampling isolation	2.9

A4	**Ability to manually operate and monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	AFW pump	4.2
A4.02	AFW flow	4.2

System: **076 SF4S SW Service Water System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Service Water System and the following systems:** (CFR: 41.4 to 41.8 / 45.7 / 45.8)	
K1.01	CCWS	3.6
K1.02	Turbine lube oil system	2.9
K1.03	DELETED	
K1.04	DELETED	
K1.05	EDG	4.1
K1.06	Switch gear room coolers	3.0
K1.07	Secondary CCW	2.7
K1.08	RHRS	3.6
K1.09	Reactor building CCW	3.5
K1.10	Turbine building CCW	2.6
K1.11	Domestic water and raw water	2.2
K1.12	Intake screen system	2.8
K1.13	LRS	2.5
K1.14	Condenser circulating water	2.7
K1.15	FPS	2.9
K1.16	ESF	3.7
K1.17	PRMS	2.7
K1.18	SWS normal heat loads	3.2
K1.19	SWS emergency heat loads	3.7
K1.20	AFW system	3.5
K1.21	DELETED	
K1.22	DELETED	
K1.23	SFPCS	3.2
K1.24	Chemical addition system	2.1
K1.25	Heat sink	3.6
K1.26	Flood alarm system	2.7
K1.27	IAS	2.8
K1.28	ECCS	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	SWS pumps (Class 1E)	3.8
K2.02	DELETED	
K2.03	DELETED	
K2.04	DELETED	
K2.05	DELETED	
K2.06	DELETED	
K2.07	Cooling tower fans	2.5
K2.08	ESF-actuated MOVs	3.5
K2.09	Intake screens	2.6

K3	**Knowledge of the effect that a loss or malfunction of the Service Water System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	DELETED	
K3.02	DELETED	
K3.03	Reactor building CCW	3.5
K3.04	Turbine building CCW	2.7
K3.05	RHRS	3.6
K3.06	Turbine lube oil system	2.8
K3.07	ESF loads	3.8
K3.08	Radioactive liquid waste discharges	2.8
K3.09	Normal process heat loads	2.9
K3.10	CCWS	3.6
K3.11	EDG	4.1
K3.12	Switch gear room coolers	3.0
K3.13	Intake screen system	2.6
K3.14	LRS	2.4
K3.15	FPS	2.7
K3.16	AFW	3.4
K3.17	IAS	2.8
K4	**Knowledge of Service Water System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Conditions initiating isolation of safety-related SWS from nonsafety headers.	3.8
K4.02	Automatic startup features associated with SWS pump controls	3.8
K4.03	Automatic opening features associated with SWS isolation valves	3.8
K4.04	Intake water level recorders	2.8
K4.05	Service water train flow and discharge pressure when service water flow to heat exchanger for CCW is throttled	3.3
K4.06	Service water train separation	3.4
K4.07	ESFAS	3.8
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Service Water System:** (CFR: 41.4 / 41.7 / 45.5)	
K5.01	Water hammer	2.9
K5.02	Pump run out	3.2
K5.03	Pump cavitation	3.1
K5.04	SWS intake screen high D/P	3.1
K5.05	Radiation alarms on SWS	3.1
K5.06	Line losses in SWS	2.4

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Service Water System:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	CCWS heat exchangers	3.4	
K6.07	DELETED		
K6.08	Cooling towers	2.5	
K6.09	Intake screens	2.8	
K6.10	Strainers	2.9	
K6.11	Transmission switchyard and offsite power system	2.9	
K6.12	AC electrical distribution	3.4	
K6.13	Automatically positioned valves	3.4	
K6.14	System leakage	2.9	
K6.15	Service water pumps	3.7	
K6.16	Ultimate heat sink	3.5	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Service Water System, including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	Reactor and turbine building CCW temperatures	3.2	
A1.03	SWS header pressures	3.3	
A1.04	SWS temperatures	3.3	
A1.05	CCW heat exchanger outlet temperature	3.4	
A1.06	Lights and alarms	3.2	
A1.07	Intake screen D/P	2.9	
A1.08	Strainer D/P	2.9	
A2	**Ability to (a) predict the impacts of the following on the Service Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 41.1 / 43.5 / 45.3 / 45.6 / 45.13)	**RO**	**SRO**
A2.01	DELETED		
A2.02	DELETED		
A2.03	Pump(s) and/or motor(s) failure	3.9	3.7
A2.04	ESF actuated MOV(s) failure	3.0	3.7
A2.05	Sensor(s) and detector(s) failure	2.6	3.1
A2.06	Controller(s) and positioner(s) failure	3.3	3.2
A2.07	Heat exchanger(s) and condenser(s) failure	3.6	3.2
A2.08	Breakers, relays, and disconnects	3.5	3.1

A2.09	Cooling tower(s) failure	1.3	2.8
A2.10	Intake screen(s) failure	3.3	3.0
A2.11	Strainer(s) failure	3.5	2.9

A3 **Ability to monitor automatic features of the Service Water System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	Automatic closure of CCW auxiliary building header supply and return valves	3.5
A3.04	Automatic start features associated with SWS pump controls	3.7
A3.05	Automatic opening features associated with SWS isolation valves	3.7
A3.06	ESFAS	3.9

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	SWS pumps	3.9
A4.02	SWS valves	3.7
A4.03	DELETED	
A4.04	DELETED	
A4.05	Intake screen	2.9

System: 007 SF5 PRTS Pressurizer Relief Tank/Quench Tank System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Pressurizer Relief Tank/Quench Tank System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Containment system	3.5
K1.02	WGDS	2.7
K1.03	RCS	3.7
K1.04	Nitrogen system	2.6
K1.05	Makeup/fill water	2.7
K1.06	LRS	2.6
K1.07	Leakage collection	2.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
	None	
K3	**Knowledge of the effect that a loss or malfunction of the Pressurizer Relief Tank/Quench Tank System will have on the following systems or system parameters:** (CFR: 41.7 and 41.9)	
K3.01	Containment	3.4
K4	**Knowledge of Pressurizer Relief Tank/Quench Tank System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Quench tank cooling	2.9
K4.02	Source of makeup/fill water	2.7
K4.03	Nitrogen cover gas	2.7
K4.04	Relief tank/quench tank rupture disk	3.7
K4.05	Draining PRT	2.6
K4.06	Venting PRT	2.6
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Pressurizer Relief Tank/Quench Tank System:** (CFR: 41.5 / 45.7)	
K5.01	Principles of steam quenching	3.0
K5.02	Method of forming a steam bubble in the PZR	3.4

K5.03	DELETED		
K5.04	DELETED		
K5.05	DELETED		
K5.06	DELETED		
K5.07	PZR safety tailpipe temperature variations with quench tank pressure	3.7	
K5.08	Recognition of leaking PORVs/code	4.0	
K5.09	Effects of rupture disc rupture on containment parameters	3.7	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Pressurizer Relief Tank/Quench Tank System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	WGDS	2.4	
K6.07	Nitrogen system	2.4	
K6.08	RCS	3.3	
K6.09	Makeup/fill water	2.5	
K6.10	LRS	2.6	
K6.11	Leakage collection	2.8	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Pressurizer Relief Tank/Quench Tank System including:**
(CFR: 41.5 / 45.5)

A1.01	Quench tank water level	3.0	
A1.02	Quench tank pressure	3.1	
A1.03	Quench tank temperature	3.0	
A1.04	PZR tail pipe temperatures	3.9	
A1.05	Containment radiation levels	3.2	

A2 **Ability to (a) predict the impacts of the following on the Pressurizer Relief Tank/Quench Tank System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**

	(CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	A PORV that is stuck open, or code safety	2.5	4.1
A2.02	Abnormal pressure in the PRT	3.6	3.1
A2.03	Overpressurization of the PZR	4.3	3.4
A2.04	DELETED		

A2.05	Exceeding PRT high-pressure limits	3.9	3.1
A2.06	DELETED		
A2.07	Recirculating quench tank	2.8	2.4
A2.08	Abnormal level in the PRT	3.1	2.8

A3 **Ability to monitor automatic features of the Pressurizer Relief Tank/Quench Tank System, including:**
(CFR: 41.5 / 41.7 / 45.5)

A3.01	Components that discharge to the PRT	3.4

A4 **Ability to manually operate and/or monitor in the control room**:
(CFR: 41.5 / 41.7 / 45.5 / 45.7 / 45.8)

A4.01	PRT makeup valve	2.9
A4.02	PRT drain valve	2.8
A4.03	Nitrogen block valve	2.6
A4.04	PZR vent valve	3.2
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	

System: 022 SF5 CCS Containment Cooling System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Containment Cooling System and the following systems:** (CFR: 41.9 / 45.7 / 45.8)	
K1.01	Cooling water system	3.6
K1.02	DELETED	
K1.03	Auxiliary steam	1.9
K1.04	DELETED	
K1.05	ESFAS	4.1
K1.06	Containment system	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Containment cooling fans	3.6
K2.02	Chillers	2.8
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Containment Cooling System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	DELETED	
K3.02	DELETED	
K3.03	DELETED	
K3.04	Containment system	3.9
K4	**Knowledge of Containment Cooling System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	Correlation of fan speed and flowpath changes with containment pressure	3.4
K4.03	Containment isolation	3.9
K4.04	Cooling of CRDMs	3.1
K4.05	Containment cooling after LOCA	4.0
K4.06	Containment pipe chase cooling	2.8

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Containment Cooling System:** (CFR: 41.5 / 45.7)		
K5.01	Pressure reduction postaccident	2.8	
K5.02	Shift in fan speed related to postaccident conditions	3.6	
K5.03	Containment equipment subject to damage by high or low temperature, humidity, and pressure	3.1	
K5.04	Effects on containment instrumentation	3.6	
K5.05	Effects on electrical insulation	3.0	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Containment Cooling System:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	DELETED		
K6.08	Heat exchangers and/or coolers	3.3	
K6.09	ESFAS	4.0	
K6.10	Cooling water system	3.5	
K6.11	CCS components	3.5	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Containment Cooling System, including:** (CFR: 41.5 / 45.5)		
A1.01	Containment temperature	3.8	
A1.02	Containment pressure	3.9	
A1.03	Containment humidity	3.2	
A1.04	Cooling water flow	3.3	
A1.05	Lights and alarms	3.3	
A2	**Ability to (a) predict the impacts of the following on the Containment Cooling System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	CCS components	3.7	3.6
A2.02	DELETED		
A2.03	DELETED		
A2.04	Cooling water system	3.7	3.4

A2.05	DELETED			
A2.06	DELETED			
A2.07	ESFAS	4.0		4.0
A3	**Ability to monitor automatic features of the Containment Cooling System, including:** (CFR: 41.7 / 45.5)			
A3.01	Initiation of ESFAS mode of operation		4.2	
A3.02	Containment cooling coolers cooling water flow		3.6	
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)			
A4.01	CCS fans		3.7	
A4.02	CCS pumps		3.6	
A4.03	DELETED			
A4.04	Valves in the CCS		3.5	
A4.05	DELETED			

System: 025 SF5 ICE Ice Condenser System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Ice Condenser System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Containment ventilation	3.9
K1.02	Refrigerant systems	3.7
K1.03	Containment sump system	3.6
K1.04	Ice makers	3.4
K1.05	Borated makeup source	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Containment ventilation fans and dampers	3.7
K2.02	Refrigerant systems	3.7
K2.03	Isolation valves	3.0
K3	**Knowledge of the effect that a loss or malfunction of the Ice Condenser System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Containment	4.3
K4	**Knowledge of Ice Condenser System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Glycol expansion tank levels and ice condenser system containment isolation valves	3.3
K4.02	System control	3.6
K4.03	Logic for containment fans	3.6
K4.04	Containment air flowpath on high containment pressure actuation	4.0
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Ice Condenser System:** (CFR: 41.5 / 45.7)	
K5.01	Containment temperature and pressure	4.1
K5.02	DELETED	
K5.03	DELETED	
K5.04	Ice meltdown effect on pH and Iodine	3.7

K5.05	Motive force required for Ice condenser doors	3.7	
K5.06	Borated ice	3.6	

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Ice Condenser System:** (CFR: 41.7 / 45.7)		
K6.01	Upper and lower doors of the ice condenser	3.9	
K6.02	Refrigerant components	3.7	

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Ice Condenser System, including:** (CFR: 41.5 / 45.5)		
A1.01	Temperature chart recorders	3.1	
A1.02	Glycol expansion tank level	3.4	
A1.03	Glycol flow to ice condenser air-handling units	3.7	
A1.04	Ice condenser doors status	3.9	

A2	**Ability to (a) predict the impacts of the following on the Ice Condenser System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Trip of glycol circulation pumps	2.9	3.6
A2.02	High/low floor cooling temperature	3.9	3.6
A2.03	Opening of ice condenser doors	3.7	3.9
A2.04	Containment isolation	3.5	3.7
A2.05	Abnormal glycol expansion tank level	3.4	3.7
A2.06	Decreasing ice condenser temperature	3.4	3.7
A2.07	Failure of the chiller package	3.7	3.9

A3	**Ability to monitor automatic features of the Ice Condenser System, including:** (CFR: 41.7 / 45.5)		
A3.01	Refrigerant system	3.7	
A3.02	Isolation valves	3.9	
A3.03	Ice condenser doors	3.7	
A3.04	Ice condenser air-handling units	3.9	

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Ice condenser isolation valves	3.6
A4.02	Containment vent fans	3.8
A4.03	Glycol circulation pumps	3.6

System: 026 SF5 CSS Containment Spray System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Containment Spray System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	ECCS	4.1
K1.02	Cooling water	3.6
K1.03	DELETED	
K1.04	Fill / makeup water (BW)	3.1
K1.05	ESFAS	4.1
K1.06	RHRS	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Containment spray pumps	3.9
K2.02	MOVs	3.6
K3	**Knowledge of the effect that a loss or malfunction of the Containment Spray System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	CCS	3.8
K3.02	DELETED	
K4	**Knowledge of Containment Spray System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Source of water for CSS, including recirculation phase after LOCA	4.2
K4.02	Corrosion control and/or iodine reduction/scavenging via the CSS	3.5
K4.03	Not used	
K4.04	Reduction of temperature and pressure in containment after a LOCA by condensing steam to reduce radiological hazard and protect equipment from corrosion damage (spray)	3.7
K4.05	Prevention of material from clogging nozzles during recirculation	3.4
K4.06	DELETED	
K4.07	Adequate level in containment sump for suction	3.8
K4.08	Automatic features of the CSS valves that provide injection and/or recirculation	3.9

K4.09	Prevention of path for escape of radioactivity from containment to the outside (interlock on RWST isolation after swapover)	3.8
K4.10	Automatic start of CSS	4.1
K4.11	Containment spray actuation signal actuation and/or RESET	4.0

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Containment Spray System:**
(CFR: 41.5 / 45.7)

K5.01	Water chemistry relationship to corrosion control	2.8
K5.02	DELETED	
K5.03	Stratification of liquids: concentrated sodium hydroxide (NaOH) solution has a higher specific gravity than weak boric acid solution; therefore, they must be vigorously mixed to make an effective spray	2.5
K5.04	DELETED	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Containment Spray System:**
(CFR: 41.7 / 45.7)

K6.01	CCS MOVs	3.6
K6.02	CSS pumps	3.9
K6.03	DELETED	
K6.04	DELETED	
K6.05	Heat exchangers	3.4
K6.06	ECCS	4.0
K6.07	ESFAS	4.1
K6.08	RHRS	3.5

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Containment Spray System, including:**
(CFR: 41.5 / 45.5)

A1.01	Containment pressure	4.0
A1.02	Containment temperature and/or humidity	3.8
A1.03	Containment sump level	3.9
A1.04	DELETED	
A1.05	Chemical additive tank level and concentration	3.0
A1.06	Containment spray pump cooling	3.3

A2	**Ability to (a) predict the impacts of the following on the Containment Spray System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	DELETED		
A2.02	Failure of automatic recirculation transfer (BW)	4.5	4.0
A2.03	Failure of ESF	3.9	4.1
A2.04	Failure of spray pump	3.9	4.0
A2.05	Failure of chemical addition tanks to inject	3.0	3.4
A2.06	DELETED		
A2.07	Loss of containment spray pump suction when in recirculation mode	4.0	3.9
A2.08	When to secure CSS	4.0	3.7
A2.09	Radiation hazard potential of BWST/RWST	2.8	3.0

A3	**Ability to monitor automatic features of the Containment Spray System, including:** (CFR: 41.7 / 45.5)	
A3.01	Pump starts and correct MOV positioning	4.1
A3.02	Verification that cooling water is supplied to the containment spray heat exchanger	3.5
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	CSS controls	3.9
A4.02	The remote location and use of spool pieces and other equipment to set up portable recirculation pump for additive tank, including a power supply (BW)	2.5
A4.03	The remote location and use of the special tank needed for draining CSS (BW)	2.5
A4.04	The remote sampling of the NaOH tank and RWST/BWST for chemical analysis (BW)	2.5
A4.05	Containment spray actuation and/or reset switches	4.0

System: 027 SF5 CIRS Containment Iodine Removal System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Containment Iodine Removal System and the following systems:** (CFR: 41.7 to 41.9 / 45.7 / 45.8)	
K1.01	CSS	3.2
K1.02	Containment	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Containment Iodine Removal System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Containment iodine	3.1
K4	**Knowledge of Containment Iodine Removal System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
	None	
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Containment Iodine Removal System:** (CFR: 41.7 / 45.7)	
K5.01	Purpose of charcoal filters	2.9
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Containment Iodine Removal System:** (CFR: 41.7 / 45.7)	
K6.01	CSS	2.9

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Containment Iodine Removal System, including:** (CFR: 41.5 / 45.5)		
A1.01	Filter temperature	2.5	
A2	**Ability to (a) predict the impacts of the following on the Containment Iodine Removal System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	High temperature in the filter system	2.2	2.7
A3	**Ability to monitor automatic features of the Containment Iodine Removal System, including:** (CFR: 41.7 / 45.5)		
	None		
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	CIRS controls	2.8	
A4.02	DELETED		
A4.03	DELETED		
A4.04	DELETED		

System: **028 SF5 HRPS Hydrogen Recombiner and Purge Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Hydrogen Recombiner and Purge Control System and the following systems:** (CFR: 41.9 / 45.7 / 45.8)	
K1.01	Containment annulus ventilation system	2.6
K1.02	IAS	2.5
K1.03	Containment system	3.1
K1.04	Containment isolation system	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Hydrogen recombiners	2.4
K3	**Knowledge of the effect that a loss or malfunction of the Hydrogen Recombiner and Purge Control System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Hydrogen concentration in containment	3.1
K3.02	Containment system	2.9
K4	**Knowledge of Hydrogen Recombiner and Purge Control System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Reduction of containment hydrogen concentration	3.0
K4.02	Containment hydrogen concentration monitoring	2.8
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Hydrogen Recombiner and Purge Control System:** (CFR: 41.5 / 45.7)	
K5.01	Explosive hydrogen concentration	3.5
K5.02	Flammable hydrogen concentration	3.4
K5.03	Sources of hydrogen within containment	3.2
K5.04	DELETED	

K5.05	Containment annulus ventilation system pressure limitations	2.7	
K5.06	Location and interpretation of containment pressure indications	3.1	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Hydrogen Recombiner and Purge Control System:**
(CFR: 41.7 / 45.7)

K6.01	Hydrogen recombiner components	2.6	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Hydrogen Recombiner and Purge Control System including:**
(CFR: 41.5 / 45.5)

A1.01	Hydrogen concentration	3.2	
A1.02	Containment pressure	3.2	
A1.03	Recombiner temperature	2.8	
A1.04	Lights and alarms	2.8	

A2 **Ability to (a) predict the impacts of the following on the Hydrogen Recombiner and Purge Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Hydrogen recombiner power setting	3.0	2.6
A2.02	LOCA with significant hydrogen production	3.2	3.4
A2.03	The hydrogen air concentration in excess of limit flame propagation or detonation with resulting equipment damage in containment	3.5	3.0

A3 **Ability to monitor automatic features of the Hydrogen Recombiner and Purge Control System, including:**
(CFR: 41.7 / 45.8)

A3.01	Containment isolation	3.0	

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	HRPS controls	2.8	
A4.02	DELETED		
A4.03	Hydrogen sampling	2.7	

System: 103 SF5 CNT Containment System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Containment System and the following systems:** (CFR: 41.9 / 45.7 / 45.8)	
K1.01	CCS	3.7
K1.02	DELETED	
K1.03	Shield building vent system	3.3
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	Containment vacuum system	3.3
K1.08	SIS	3.8
K1.09	CPS	3.5
K1.10	CSS	4.1
K1.11	RCS	3.8
K1.12	Fuel-handling equipment system (FHES)	3.0
K1.13	ESFAS	4.1
K1.14	MRSS	3.2
K1.15	MFW	3.3
K1.16	HRPS	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
	None	
K3	**Knowledge of the effect that a loss or malfunction of the Containment System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	DELETED	
K3.02	DELETED	
K3.03	DELETED	
K3.04	Shield building vent system	3.0
K4	**Knowledge of Containment System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Vacuum breaker protection	3.2
K4.02	Containment penetration cooling	2.7
K4.03	Prevention of radiation streaming	2.9
K4.04	Personnel access hatch and emergency access hatch	3.3
K4.05	Containment construction	2.8

K4.06	Containment isolation	4.1	
K4.07	Electrical penetrations	3.0	
K4.08	Subsurface drain	2.3	

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Containment System:**
(CFR: 41.5 / 45.7)

K5.01	Containment isolation / containment integrity	4.1	
K5.02	Hydrogen concentration inside containment	3.5	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Containment System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	CCS	3.6	
K6.08	Containment vacuum system	3.4	
K6.09	CPS	3.4	
K6.10	CSS	3.9	
K6.11	RCS	3.8	
K6.12	FHES	2.7	
K6.13	MFW	3.2	
K6.14	HRPS	3.1	
K6.15	MRSS	3.1	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Containment System, including:**
(CFR: 41.5 / 45.5)

A1.01	Containment pressure, temperature, and/or humidity	3.9	

A2 **Ability to (a) predict the impacts of the following on the Containment System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**

	(CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	DELETED		
A2.02	DELETED		
A2.03	Containment isolation signal	4.4	4.0

A2.04	Conditions requiring containment evacuation (including recognition of the alarm)	3.8	3.4
A2.05	DELETED		
A2.06	High containment pressure	4.5	4.1
A2.07	Containment vacuum system malfunctions	3.3	3.2
A2.08	CPS malfunctions	3.6	3.1
A2.09	HRPS failure	3.0	3.0
A2.10	FHES malfunctions	2.6	2.9

A3 **Ability to monitor automatic features of the Containment System, including:**
(CFR: 41.7 / 45.5)

A3.01	Containment isolation	4.2

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	DELETED	
A4.02	DELETED	
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	Containment vacuum system	3.0

System: 062 SF6 ED AC AC Electrical Distribution

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the AC Electrical Distribution and the following systems:** (CFR: 41.4 to 41.8)	
K1.01	FPS	2.9
K1.02	EDG system	4.4
K1.03	Class 1E DC distribution system	4.2
K1.04	Offsite power	4.1
K1.05	Vital AC electrical instrument buses	4.2
K1.06	ESAS	4.2
K1.07	MT/G system	3.4
K1.08	Onsite standby power systems	3.8
K1.09	Non-Class 1E DC distribution system	3.1
K1.10	Non-Class 1E AC distribution system	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Major bus or motor control center power supplies	3.8
K2.02	Breaker control power	3.5
K3	**Knowledge of the effect that a loss or malfunction of the AC Electrical Distribution will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Offsite power	4.1
K3.02	EDG	4.4
K3.03	Class 1E DC distribution system	4.2
K3.04	Vital AC electrical instrument buses	4.3
K3.05	ESAS	4.3
K3.06	Main turbine/generator	3.3
K3.07	Non-class 1E AC distribution system	3.2
K4	**Knowledge of AC Electrical Distribution System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Bus lockouts	3.6
K4.02	Circuit breaker automatic trips	3.6
K4.03	Interlocks between automatic bus transfer and breakers	3.6
K4.04	Protective relaying	3.3
K4.05	Paralleling of AC sources (synchroscope)	3.6

K4.06	DELETED	
K4.07	DELETED	
K4.08	DELETED	
K4.09	DELETED	
K4.10	Redundant power sources to vital buses (including vital instrument buses)	3.8
K4.11	Load shedding	3.7
K4.12	Ground detection	2.9
K4.13	Load sequencing	3.6

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the AC Electrical Distribution:**
(CFR: 41.5 / 45.7)

K5.01	Transformer tap changer	2.9
K5.02	DELETED	
K5.03	Paralleling between two AC sources	3.5
K5.04	Operation of a static inverter	3.1
K5.05	Fault on a bus	3.5
K5.06	Fault on a load	3.5
K5.07	Fault on a unit transformer	3.5
K5.08	Energizing a faulted or grounded bus or motor control center	3.8
K5.09	Consequence of paralleling out-of-phase/mismatch in volts	3.7
K5.10	Keeping the safeguards buses electrically separate	3.8
K5.11	Opening a disconnect under load	3.5
K5.12	Exceeding voltage limitations	3.4
K5.13	Exceeding current limitations	3.4
K5.14	Effects of switching power supplies on instruments and controls	3.2

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the AC Electrical Distribution:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	Breakers, relays, and disconnects	3.4
K6.03	Control power	3.6
K6.04	FPS	2.8
K6.05	EDGs	4.3
K6.06	Class 1E DC distribution system	4.1
K6.07	Offsite power sources	4.0
K6.08	Vital AC electrical instrument buses	4.0
K6.09	ESAS	4.1
K6.10	Main turbine/generator	3.2
K6.11	Grounds	3.1
K6.12	Non-Class 1E DC distribution system	2.9
K6.13	Onsite standby power systems	3.4

K6.14	Major on site loads	3.4	
K6.15	Non-Class 1E AC distribution system	3.0	

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the AC Electrical Distribution, including:** (CFR: 41.5 / 45.5)		
A1.01	Diesel generator (D/G) load limits	4.0	
A1.02	Load and generator voltage	3.4	
A1.03	Instrumentation and controls when switching power supplies	3.5	
A1.04	Loads when energizing a bus	3.4	
A1.05	Bus voltages	3.5	
A1.06	Load currents	3.3	
A1.07	Inverter outputs	3.2	
A1.08	Vital AC bus amperage	3.3	
A1.09	Transformer parameters	3.1	
A1.10	Lights and alarms	3.4	

A2	**Ability to (a) predict the impacts of the following on the AC Electrical Distribution and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	DELETED		
A2.02	Grounds	3.3	3.1
A2.03	DELETED		
A2.04	DELETED		
A2.05	DELETED		
A2.06	DELETED		
A2.07	DELETED		
A2.08	DELETED		
A2.09	DELETED		
A2.10	DELETED		
A2.11	DELETED		
A2.12	DELETED		
A2.13	DELETED		
A2.14	DELETED		
A2.15	DELETED		
A2.16	Degraded system voltages	3.7	3.5
A2.17	Loss of control power	3.7	3.5
A2.18	Malfunction/loss of EDGs	4.0	4.3
A2.19	Loss of Class 1E DC distribution system	4.1	4.1
A2.20	Loss of offsite power sources	3.8	4.1
A2.21	Loss of vital AC electrical instrument buses	4.0	4.3
A2.22	Actuation of ESAS	3.9	4.2
A2.23	Failure of main turbine/generator	3.0	3.4

A2.24	Fault on a bus	3.4	3.5
A2.25	Fault on a motor control center	3.3	3.4

A3 **Ability to monitor automatic operation of the AC Electrical Distribution, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	Safety-related actuations	4.1
A3.06	Tripping of loads, buses, or transformers due to protective relaying	3.7
A3.07	Automatic bus transfer	3.6
A3.08	Load shedding	3.6
A3.09	Load sequencing	3.7
A3.10	Automatic transfer from auxiliary to reserve transformer	3.3

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	All breakers (including available switchyard)	3.5
A4.02	Racking in and out of breakers	2.9
A4.03	DELETED	
A4.04	Local operation of breakers	3.2
A4.05	DELETED	
A4.06	DELETED	
A4.07	Synchronizing and paralleling of different AC supplies	3.7
A4.08	Safety-related actuations that have failed or require manual actions to complete/restore	4.0

System: 063 SF6 ED DC DC Electrical Distribution

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the DC Electrical Distribution and the following systems:** (CFR: 41.3 to 41.8 / 45.7 / 45.8)	
K1.01	Ground detection system	2.6
K1.02	AC electrical system	4.0
K1.03	DELETED	
K1.04	Battery ventilation system	2.7
K1.05	EDG	4.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Major DC loads	3.5
K2.02	Battery room ventilation	2.5
K2.03	Battery chargers	4.0
K3	**Knowledge of the effect that a loss or malfunction of the DC Electrical System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	EDG	4.5
K3.02	Systems using DC control power	4.0
K3.03	AC distribution system	4.0
K4	**Knowledge of DC Electrical System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Manual/automatic transfers of control	3.4
K4.02	Breaker interlocks, permissives, bypasses, and cross-ties	3.5
K4.03	DELETED	
K4.04	Battery charger trip/shutdown (high voltage)	3.1
K4.05	Ground detection	2.6
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the DC Electrical System:** (CFR: 41.5 / 45.7)	
K5.01	DELETED	
K5.02	Hydrogen generation during battery charging	2.8
K5.03	Effect of jumpering out battery cells	2.4

K5.04	System ground	2.9	
K5.05	Battery capacity as it is affected by discharge rate / individual cell voltages	3.1	

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the DC Electrical System:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	Battery room ventilation	2.6	
K6.05	Battery chargers	3.9	
K6.06	Battery	4.0	
K6.07	Loss of all AC power	4.3	

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the DC Electrical System, including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	DELETED		
A1.03	Battery bus voltage and/or current	3.5	
A1.04	Battery charger voltage and/or current	3.3	

A2	**Ability to (a) predict the impacts of the following on the DC Electrical System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Grounds	2.7	2.8
A2.02	Loss of ventilation during battery charging	2.4	2.8
A2.03	Battery chargers	3.9	3.6
A2.04	Battery	3.9	3.8
A2.05	Loss of all AC	4.2	4.3

A3	**Ability to monitor automatic features of the DC Electrical System, including:** (CFR: 41.7 / 45.5)		
A3.01	DELETED		
A3.02	Battery charger undervoltage stripping	3.1	
A3.03	Inverter swap to backup	3.3	

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Load shedding	3.6
A4.03	Battery discharge rate	3.5

System: 064 SF6 EDG Emergency Diesel Generators

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Emergency Diesel Generators and the following systems:** (CFR: 41.3 to 41.8 / 45.7 / 45.8)	
K1.01	AC distribution system	4.4
K1.02	EDG cooling water system	4.1
K1.03	DELETED	
K1.04	DC distribution system	3.9
K1.05	DELETED	
K1.06	FPS	2.9
K1.07	D/G building ventilation system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Starting air compressor	3.0
K2.02	Fuel oil pumps	3.2
K2.03	Control power	3.7
K3	**Knowledge of the effect that a loss or malfunction of the Emergency Diesel Generators will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Systems controlled by automatic loader/sequencer	4.2
K3.02	ESFAS controlled or actuated systems	4.3
K3.03	EDG (manual loads)	3.8
K3.04	AC distribution system	4.2
K4	**Knowledge of Emergency Diesel Generators design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Trips while loading the EDG (frequency, voltage, and speed)	4.0
K4.02	Trips for EDG while operating (normal or emergency)	4.1
K4.03	Governor operation	3.4
K4.04	Overload ratings	3.6
K4.05	Incomplete-start relay	3.2
K4.06	Speed droop control	3.3
K4.07	Field flashing	3.1
K4.08	EDG fuel oil supply	3.6
K4.09	Field on EDG	3.1
K4.10	Automatic load sequencer: blackout	4.1

K4.11	Automatic load sequencer: safeguards	4.1
K4.12	Diesel engine starting	3.9
K4.13	Prelubing engine and keeping it warm	3.2
K4.14	Basis for the volume of air available to start an EDG	3.1

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Emergency Diesel Generators:**
(CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Operating over/under loaded	3.6
K5.05	Parallel operation of EDGs	3.9
K5.06	Unloading before securing an EDG	3.5
K5.07	Loading the EDG	3.7
K5.08	Synchronization of the EDG with other electric power supplies	3.9
K5.09	Consequences of opening auxiliary feeder bus (EDG subsupply)	3.5
K5.10	Effects (verification) of stopping an EDG under load on an isolated bus	3.4
K5.11	Consequences of not shedding loads during nonoperability test	3.2
K5.12	Consequences of the premature opening of a breaker under load	3.3
K5.13	Consequences of a high VAR on EDG integrity	3.4
K5.14	Identification and analysis of loads not shed during test	3.1

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Emergency Diesel Generators:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	Starting air system	3.9
K6.08	Diesel fuel oil system	3.9
K6.09	D/G building ventilation	3.2
K6.10	AC distribution system	4.1
K6.11	DC distribution system	3.9
K6.12	FPS	3.0
K6.13	ESFAS	4.1
K6.14	Water buildup in cylinders	3.2
K6.15	Exciter (over/under excitation)	3.3
K6.16	EDG output breaker	3.9

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Emergency Diesel Generators, including:** (CFR: 41.5 / 45.5)	
A1.01	DELETED	
A1.02	DELETED	
A1.03	DELETED	
A1.04	DELETED	
A1.05	DELETED	
A1.06	DELETED	
A1.07	DELETED	
A1.08	DELETED	
A1.09	Diesel engine operating parameters	3.6
A1.10	Generator operating parameters	3.6
A1.11	Fuel oil storage, day tank levels, and/or temperatures	3.3
A1.12	Lights and alarms	3.5

A2	**Ability to (a) predict the impacts of the following on the Emergency Diesel Generators and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	DELETED		
A2.02	DELETED		
A2.03	DELETED		
A2.04	DELETED		
A2.05	DELETED		
A2.06	DELETED		
A2.07	Overexcitation/underexcitation	3.2	3.5
A2.08	DELETED		
A2.09	DELETED		
A2.10	DELETED		
A2.11	DELETED		
A2.12	DELETED		
A2.13	DELETED		
A2.14	DELETED		
A2.15	Water buildup in cylinders	3.4	3.1
A2.16	DELETED		
A2.17	DELETED		
A2.18	DELETED		
A2.19	DELETED		
A2.20	DELETED		
A2.21	DELETED		
A2.22	DELETED		
A2.23	Starting air system failure	3.4	3.8
A2.24	Fuel oil storage system failure	3.2	3.7
A2.25	D/G building ventilation failure	2.9	3.3
A2.26	Loss of AC power	3.8	4.2

A2.27	Loss of DC power	3.8	3.9
A2.28	FPS actuation	2.6	3.1
A2.29	ESFAS actuation	4.3	4.3
A2.30	EDG output breaker failure	3.4	4.0

A3 **Ability to monitor automatic features of the Emergency Diesel Generators, including:**
(CFR: 41.7 / 45.5)

A3.01	Start of the EDG	4.0
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	Frequency and voltage control in parallel operation	3.8
A3.06	Stop	3.6
A3.07	Load sequencing	3.9
A3.08	DELETED	
A3.09	DELETED	
A3.10	DELETED	
A3.11	DELETED	
A3.12	DELETED	
A3.13	Opening/closing EDG output breaker	3.8

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Local and remote operation of the EDG	4.0
A4.02	Adjustment of exciter voltage (using voltage control switch)	3.8
A4.03	Synchroscope	3.8
A4.04	Remote operation of the air compressor switch (different modes)	3.2
A4.05	Transfer of EDG control between manual and automatic	3.6
A4.06	Manual start, loading, and stopping of the EDG	3.9
A4.07	Transfer EDG (with load) to grid	3.8
A4.08	Opening of the ring bus	3.4
A4.09	Establishing power from the ring bus (to relieve EDG)	3.5
A4.10	Manually shedding (loads) safeguards bus	3.5
A4.11	The setting of droop voltage to zero	3.1
A4.12	DELETED	

3.7	**Safety Function 7: Instrumentation**	**Page**

System: 012 SF7 RPS Reactor Protection System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Reactor Protection System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	DELETED	
K1.03	CRDS	4.1
K1.04	RPIS	3.8
K1.05	ESFAS	4.2
K1.06	T/G	3.6
K1.07	SDS	3.3
K1.08	MFW	3.3
K1.09	RCPS	3.8
K1.10	ECCS	4.0
K1.11	Core protection calculator (CE)	3.5
K1.12	Core operating limit support system (COLSS) (CE)	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RPS channels, components, and interconnections	4.0
K3	**Knowledge of the effect that a loss or malfunction of the Reactor Protection System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	CRDS	4.2
K3.02	T/G	3.6
K3.03	SDS	3.3
K3.04	ESFAS	3.9
K3.05	RCPS	3.5
K3.06	ECCS	3.9
K4	**Knowledge of Reactor Protection System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Trip logic when one channel OOC or in test	4.2
K4.02	Automatic reactor trip when RPS setpoints are exceeded for each RPS function; functional basis for each	4.5
K4.03	Protection and control signals	4.1
K4.04	Redundancy	4.0

K4.05	Spurious trip protection	3.7
K4.06	Automatic or manual enable/disable of RPS trips	4.1
K4.07	First-out indication	3.6
K4.08	Logic matrix testing	3.3
K4.09	Separation of control and protection circuits	3.5

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Reactor Protection System:**
(CFR: 41.5 / 45.7)

K5.01	DNB	3.9
K5.02	Power density	3.7

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Reactor Protection System:**
(CFR: 41.7 / 45/7)

K6.01	Bistables and bistable test equipment	3.7
K6.02	Redundant channels	3.9
K6.03	Trip logic circuits	4.0
K6.04	Bypass-block circuits	3.9
K6.05	Test circuits	3.3
K6.06	Sensors and detectors	3.7
K6.07	Core protection calculator (CE)	3.4
K6.08	COLSS (CE)	3.2
K6.09	CEAC (CE)	3.3
K6.10	Permissive circuits	3.8
K6.11	Trip setpoint calculators	3.5
K6.12	120 volt (V) vital/instrument power system	3.9

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Reactor Protection System, including:**
(CFR: 41.5 / 45.5)

A1.01	Trip setpoint adjustment	3.5
A1.02	SSPS testing / one train in test	3.7
A1.03	Individual channels	3.6
A1.04	Single and multiple channel trip indicators	3.8

A2 **Ability to (a) predict the impacts of the following on the Reactor Protection System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.5)

		RO	**SRO**
A2.01	Faulty bistable operation	3.8	3.6
A2.02	Loss of instrument power	3.9	4.0

A2.03	Incorrect channel bypassing	3.9		3.8
A2.04	Erratic power supply operation	3.4		3.2
A2.05	Faulty or erratic operation of detectors and function generators	3.6		3.4
A2.06	Failure of RPS signal to trip the reactor	4.8		4.7
A2.07	Loss of DC control power	3.8		3.9
A3	**Ability to monitor automatic features of the Reactor Protection System, including:** (CFR: 41.6 / 41.7 / 45.5)			
A3.01	DELETED			
A3.02	DELETED			
A3.03	DELETED			
A3.04	DELETED			
A3.05	DELETED			
A3.06	Trip logic		4.1	
A3.07	Trip breakers		4.1	
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)			
A4.01	Manual trip button or handswitch		4.4	
A4.02	Components for individual channels		3.8	
A4.03	Channel blocks and bypasses		3.8	
A4.04	Bistable, trips, reset, and test switches		3.9	
A4.05	Channel defeat controls		3.8	
A4.06	Reactor trip breakers		4.2	
A4.07	M/G set breakers		3.8	

System: 015 SF7 NI Nuclear Instrumentation System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Nuclear Instrumentation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RPS	4.2
K1.02	AC distribution system	3.5
K1.03	CRDS	3.6
K1.04	ESAS	3.8
K1.05	ICS (BW)	3.9
K1.06	Reactor regulating system (CE)	4.0
K1.07	DELETED	
K1.08	RCS	3.4
K1.09	Auxiliary, remote, or hot shutdown panel	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	NIS channels	3.7
K3	**Knowledge of the effect that a loss or malfunction of the Nuclear Instrumentation System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RPS	4.2
K3.02	CRDS	3.7
K3.03	Fuel-handling system	2.9
K3.04	ICS (BW)	3.9
K3.05	DELETED	
K3.06	Reactor regulating system (CE)	3.8
K4	**Knowledge of Nuclear Instrumentation System design feature(s) and/or interlock(s) provide for the following:** (CFR: 41.7)	
K4.01	Source-range detector power shutoff at high powers	3.5
K4.02	Rod motion inhibits	3.9
K4.03	Reading of source range/intermediate range/power range outside control room	3.3
K4.04	Slow response time of self-powered nuclear detector	3.0
K4.05	Reactor trip	4.2
K4.06	Reactor trip bypasses	4.0
K4.07	Permissives	3.9
K4.08	Automatic rod motion on demand signals	3.9

K4.09	Redundant sources of information on axial flux density distribution	3.2
K4.10	Redundant sources of information on power level	3.6
K4.11	Audible indication of neutron flux in containment and the control room (related to operating experience)	3.4

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Nuclear Instrumentation System:**
(CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	Discriminator/compensation operation	3.1
K5.03	Calibration adjustments	3.2
K5.04	Factors affecting accuracy and reliability of calorimetric calibrations	3.3
K5.05	Criticality and its indications	4.3
K5.06	Subcritical multiplications and NIS indications	3.7
K5.07	DELETED	
K5.08	DELETED	
K5.09	In-core detector operation	3.2
K5.10	Ex-core detector operation	3.5
K5.11	Axial flux imbalance over core life	3.3
K5.12	Quadrant power tilt over core life	3.3
K5.13	Peaking and hot-channel factor	3.3
K5.14	DELETED	
K5.15	Effects of xenon on local flux and factors affecting xenon concentrations	3.6
K5.16	Calculation of quadrant tilt ratio	3.6
K5.17	DELETED	
K5.18	DELETED	
K5.19	DELETED	
K5.20	Maximum disagreement allowed between channels	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Nuclear Instrumentation System:**
(CFR: 41.7 / 45.7)

K6.01	DELETED	
K6.02	Discriminator/compensation circuits	3.2
K6.03	DELETED	
K6.04	Bistables and logic circuits	3.5
K6.05	Audio indication, including deaf spots in control room and containment	2.8
K6.06	Scaler timers	2.8
K6.07	DELETED	
K6.08	DELETED	
K6.09	AC electrical distribution system	3.2
K6.10	T-cold RTD	3.1

A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Nuclear Instrumentation System, including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	Startup rate	3.9	
A1.03	NIS power indication	4.0	
A1.04	QPTR	3.5	
A1.05	Imbalance (axial shape)	3.6	
A1.06	DELETED		
A1.07	Boron concentration	3.6	
A1.08	RCS temperature	3.7	
A1.09	Lights and alarms	3.5	

A2	**Ability to (a) predict the impacts of the following on the Nuclear Instrumentation System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	Power supply loss or erratic operation	3.5	3.7
A2.02	Faulty or erratic operation of detectors or compensating components	3.5	3.6
A2.03	Xenon oscillations	3.0	3.6
A2.04	Effects on axial flux density of control rod alignment and sequencing, xenon production and decay, and boron versus control rod reactivity changes	3.0	3.7
A2.05	Core void formation	3.2	3.6

A3	**Ability to monitor automatic features of the Nuclear Instrumentation System, including:** (CFR: 41.7 / 45.5)		
A3.01	DELETED		
A3.02	DELETED		
A3.03	DELETED		
A3.04	DELETED		
A3.05	Recognition of audio output expected for a given plant condition	3.1	
A3.06	DELETED		
A3.07	Permissives	3.9	
A3.08	Reactor trip	4.2	
A3.09	Rod motion inhibits	3.9	
A3.10	Source-range detector power shutoff at high powers	3.2	

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Selection of controlling NIS channel	3.5
A4.02	NIS indicators	3.6
A4.03	Trip bypasses	3.7
A4.04	NIS calibration by heat balance	3.6

System: 016 SF7 NNI Nonnuclear Instrumentation System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Nonnuclear Instrumentation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RCS	3.6
K1.02	PZR LCS	3.7
K1.03	SDS	3.4
K1.04	MFW system	3.4
K1.05	Condensate	3.0
K1.06	AFW system	3.7
K1.07	ECCS	3.8
K1.08	PZR PCS	3.6
K1.09	ESFAS	3.8
K1.10	CCS	3.4
K1.11	MT/G	3.0
K1.12	S/G	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	Secondary system control circuits	3.0
K2.03	Primary system control circuits	3.4
K3	**Knowledge of the effect that a loss or malfunction of the Nonnuclear Instrumentation System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	RCS	3.6
K3.02	PZR LCS	3.6
K3.03	SDS	3.2
K3.04	MFW system	3.3
K3.05	Condensate	3.0
K3.06	AFW system	3.7
K3.07	ECCS	3.7
K3.08	PZR PCS	3.7
K3.09	ESFAS	3.8
K3.10	CCS	3.3
K3.11	MT/G	3.0
K3.12	S/G	3.4

K4	**Knowledge of Nonnuclear Instrumentation System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)		
K4.01	Reading of NNI system channel values outside control room	3.0	
K4.02	Sensing, signal processing, display, recording, and alarms	2.9	
K4.03	Input to control systems	3.3	
K4.04	Outputs from control systems	3.3	
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Nonnuclear Instrumentation System:** (CFR: 41.5 / 45.7)		
K5.01	Separation of control and protection circuits	3.3	
K5.02	Relationship between meter readings and actual parameter value	3.2	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Nonnuclear Instrumentation System:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	Secondary system input sensors and detectors	3.1	
K6.03	Primary system input sensors and detectors	3.2	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Nonnuclear Instrumentation System, including:** (CFR: 41.5 / 45.5)		
A1.01	Lights and alarms	3.2	
A2	**Ability to (a) predict the impacts of the following on the Nonnuclear Instrumentation System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	Detector/transmitter failure	3.3	3.4
A2.02	Loss of power supply	3.0	3.3
A2.03	DELETED		
A2.04	DELETED		

A3	**Ability to monitor automatic features of the Nonnuclear Instrumentation System, including:** (CFR: 41.7 / 45.5)	
A3.01	Automatic selection of NNIS inputs to control systems	3.3
A3.02	DELETED	
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	NNI channel select controls	3.3
A4.02	DELETED	
A4.03	Removing a failed channel from the circuit logic	3.4

System: 017 SF7 ITM In-Core Temperature Monitor System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the In-Core Temperature Monitor System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	Plant computer	3.4
K1.02	RCS	3.7
K1.03	Qualified safety parameter display system (QSPDS)	3.8
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.5)	
K2.01	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the In-Core Temperature Monitor System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	DELETED	
K3.02	Plant computer	3.2
K3.03	SPDS	3.6
K4	**Knowledge of In-Core Temperature Monitor System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Input to subcooling monitors	3.9
K4.02	Sensing and determination of location core hot spots	3.4
K4.03	Range of temperature indication	3.1
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the In-Core Temperature Monitor System:** (CFR: 41.5 / 45.7)	
K5.01	Temperature at which cladding and fuel melt	3.8
K5.02	DELETED	
K5.03	DELETED	
K5.04	Calculated core limits (CE)	3.5
K5.05	Thermocouple open and short circuits	3.3

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the In-Core Temperature Monitor System:** (CFR: 41.7 / 45.7)		
K6.01	Temperature measuring device (for example thermocouple)	3.2	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the In-Core Temperature Monitor System, including:** (CFR: 41.5 / 45.7)		
A1.01	Core exit temperature	4.0	
A1.02	Lights and alarms	3.2	
A2	**Ability to (a) predict the impacts of the following on the In-Core Temperature Monitor System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)	**RO**	**SRO**
A2.01	DELETED		
A2.02	Elevated in-core temperatures that can cause or have caused core damage	4.1	4.2
A3	**Ability to monitor automatic features of the In-Core Temperature Monitor System, including:** (CFR: 41.7 / 45.5)		
A3.01	DELETED		
A3.02	DELETED		
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	DELETED		
A4.02	DELETED		
A4.03	Defeating a degraded in-core thermocouple	2.7	

System: 072 SF7 ARM Area Radiation Monitoring System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Area Radiation Monitoring System and the following systems:** (CFR: 41.7 to 41.9 / 45.8 / 9 / 11)	
K1.01	Plant ventilation system (PVS)	3.3
K1.02	Containment isolation	3.8
K1.03	Fuel building isolation	3.6
K1.04	Control room ventilation	3.9
K1.05	MRSS	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7 / 41.8)	
K2.01	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Area Radiation Monitoring System will have on the following systems or system parameters:** (CFR: 41.7 / 41.8 / 45.8 / 45.9)	
K3.01	Containment ventilation isolation	3.6
K3.02	Fuel-handling operations	3.6
K3.03	PVS	3.2
K4	**Knowledge of Area Radiation Monitoring System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Containment ventilation isolation	3.6
K4.02	Fuel building isolation	3.5
K4.03	PVS isolation	3.2
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Area Radiation Monitoring System:** (CFR: 41.5 / 45.8 / 45.9)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	Containment isolation	3.6

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Area Radiation Monitoring System:** (CFR: 41.7 / 45.8 / 45.9)		
K6.01	PRM components	3.1	
K6.02	DELETED		
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Area Radiation Monitoring System, including:** (CFR: 41.5 / 45.5 / 45.9)		
A1.01	Radiation levels	3.4	
A2	**Ability to (a) predict the impacts of the following on the Area Radiation Monitoring System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 43.3 / 45.13 / 9)	**RO**	**SRO**
A2.01	Area radiation monitor components	3.3	3.3
A2.02	DELETED		
A2.03	DELETED		
A3	**Ability to monitor automatic features of the Area Radiation Monitoring System, including:** (CFR: 41.7 / 45.8 / 45.9)		
A3.01	Changes in system alignment	3.3	
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.8 / 45.9)		
A4.01	Alarm and interlock setpoint checks and adjustments	3.3	
A4.02	Radiation monitor function	3.4	
A4.03	Check source for operability demonstration	2.9	

System: 073 SF7 PRM Process Radiation Monitoring System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Process Radiation Monitoring System and the following systems:** (CFR: 41.7 to 41.9 / 41.11 / 45.8 / 45.9)	
K1.01	Systems served by PRMs	3.6
K1.02	LRS	3.3
K1.03	WGDS	3.2
K1.04	S/GB	3.4
K1.05	CCWS	3.1
K1.06	CVCS	3.3
K1.07	Postaccident sampling system	2.7
K1.08	PSS	3.1
K1.09	SWS	3.1
K1.10	PVS	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Process Radiation Monitoring System will have on the following systems or system parameters:** (CFR: 41.7 / 41.8 / 45.6 / 45.8 / 45.9)	
K3.01	DELETED	
K3.02	Systems served by PRMs	3.5
K3.03	WGDS	3.3
K3.04	LRS	3.4
K3.05	S/GB	3.4
K3.06	CCWS	3.2
K4	**Knowledge of Process Radiation Monitoring System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Release termination	3.9
K4.02	System actuations based on PRM signals	3.7

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Process Radiation Monitoring System:** (CFR: 41.5 / 8-9)		
K5.01	DELETED		
K5.02	DELETED		
K5.03	DELETED		
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Process Radiation Monitoring System:** (CFR: 41.7 / 8-9)		
K6.01	PRM component failures	3.2	
K6.02	DELETED		
K6.03	DELETED		
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Process Radiation Monitoring System, including:** (CFR: 41.5 / 8-9)		
A1.01	Radiation levels	3.5	
A1.02	Lights and alarms	3.2	
A2	**Ability to (a) predict the impacts of the following on the Process Radiation Monitoring System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13 / 8-9)	**RO**	**SRO**
A2.01	PRM components failures	3.9	3.1
A2.02	DELETED		
A2.03	DELETED		
A3	**Ability to monitor automatic features of the Process Radiation Monitoring System, including:** (CFR: 41.7 / 8-9)		
	None		

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.8 / 45.9)	
A4.01	DELETED	
A4.02	RMS control panel	3.6
A4.03	Check source for operability demonstration	2.9
A4.04	Alarm and/or interlock setpoint checks and adjustments	3.2

3.8	**Safety Function 8: Plant Service Systems**	**Page**

System: 008 SF8 CCW Component Cooling Water System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Component Cooling Water System and the following systems:** (CFR: 41.2 (BW) / 41.3 to 41.9 / 45.7 to 45.9)	
K1.01	SWS	4.0
K1.02	Loads cooled by CCWS	4.0
K1.03	PRMS	3.2
K1.04	RCS to determine source(s) of RCS leakage into the CCWS	3.8
K1.05	Sources of makeup water	3.4
K1.06	EDGs	3.8
K1.07	CCS	3.6
K1.08	RHRS	4.3
K1.09	CVCS	3.6
K1.10	SFPCS	3.6
K1.11	ECCS	4.2
K1.12	CSS	3.8
K1.13	CRDS (BW)	3.2
K1.14	RCPS	4.0
K1.15	LRS	2.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	CCW valves	3.0
K2.02	CCW pumps	3.9
K3	**Knowledge of the effect that a loss or malfunction of the Component Cooling Water System will have on the following systems or system parameters:** (CFR: 41.4 to 41.7 / 45.7 to 45.9)	
K3.01	Loads cooled by CCWS	4.0
K3.02	CRDS (BW)	3.1
K3.03	RCP	4.2
K3.04	RCS	3.6
K3.05	EDGs	3.4
K3.06	CCS	3.4
K3.07	RHRS	4.3
K3.08	CVCS	3.5
K3.09	SFPCS	3.6
K3.10	ECCS	4.2
K3.11	CSS	3.7
K3.12	LRS	2.1

K4	**Knowledge of Component Cooling Water System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	Operation and/or design of the surge tank, including the associated valves and controls	3.2
K4.03	Total CCW flow rate and flow rates to the components	2.6
K4.04	DELETED	
K4.05	DELETED	
K4.06	CCWS isolation (e.g., containment isolation, tank levels, and radiation monitors)	3.5
K4.07	Operation of the CCW swing-bus power supply and its associated breakers and controls	3.4
K4.08	DELETED	
K4.09	The “standby” feature for the CCW pumps	3.5
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Component Cooling Water System:** (CFR: 41.5 / 45.7)	
K5.01	Chemistry control	2.3
K5.02	DELETED	
K5.03	DELETED	
K5.04	Gas accumulation	2.5
K5.05	DELETED	
K5.06	DELETED	
K5.07	DELETED	
K5.08	DELETED	
K5.09	DELETED	
K5.10	Requirements on and for the CCWS for different conditions of the power plant	3.1
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Component Cooling Water System:** (CFR: 41.7 / 45.7)	
K6.01	DELETED	
K6.02	DELETED	
K6.03	DELETED	
K6.04	CCW pump(s)	3.9
K6.05	DELETED	
K6.06	DELETED	
K6.07	DELETED	
K6.08	Power supply to CCWS pumps and/or valves	3.7
K6.09	SWS	3.8
K6.10	PRMS	2.7

K6.11	CCW pump discharge pressure instrument	2.6	
K6.12	CCW system flow instrument	2.6	
K6.13	RCP cooling water flow instrument	3.1	
K6.14	Temperature control valves for loads cooled by CCW	3.3	
K6.15	Sources of makeup water	3.0	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Component Cooling Water System, including:**
(CFR: 41.7 / 45.7)

A1.01	CCW flow rate	3.2
A1.02	CCW temperature	3.4
A1.03	CCW pressure	3.1
A1.04	Surge tank level	3.4

A2 **Ability to (a) predict the impacts of the following on the Component Cooling Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**

	(CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Loss of CCW pump	4.3	4.0
A2.02	High/low surge tank level	3.8	3.7
A2.03	High/low CCW temperature	3.7	3.4
A2.04	PRMS alarm	2.7	3.1
A2.05	Effect of loss of instrument and control air on the position of the CCW valves that are air operated	3.2	3.3
A2.06	DELETED		
A2.07	Consequences of high/low CCW flow rates	2.9	3.1
A2.08	Effects of shutting (automatically or otherwise) the isolation valves of the letdown cooler	3.4	3.4
A2.09	DELETED		
A2.10	SWS malfunction	3.4	3.8
A2.11	RCP thermal barrier heat exchanger leak	3.9	4.0

A3 **Ability to monitor automatic features of the Component Cooling Water System, including:**
(CFR: 41.7 / 45.5)

A3.01	Setpoints for normal operations, warnings, and trips that are applicable to the CCWS	3.6
A3.02	Operation of the CCW pumps, including interlocks	3.7
A3.03	DELETED	
A3.04	DELETED	
A3.05	Automatic isolation valves in the CCWS	3.6
A3.06	Typical CCW pump operating conditions, including vibration and sound levels and motor current	2.7
A3.07	Effects of recirculation within the CCWS	2.4

A3.08	Automatic actions associated with the CCWS that occur as a result of a SI signal	4.1
A3.09	DELETED	
A3.10	CCW pump instruments and their respective sensors, including flow, pressure, oil level, and discharge temperature	2.9

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5)

A4.01	CCW indications and controls	3.7
A4.02	Filling and draining operations of the CCWS, including the proper venting of the components	2.7
A4.03	DELETED	
A4.04	Startup of a CCW pump when the system is shut down	2.8
A4.05	DELETED	
A4.06	DELETED	
A4.07	Control of minimum level in the CCWS surge tank	3.2
A4.08	CCW pump control switch	3.4
A4.09	CCW temperature control valve	3.2
A4.10	DELETED	
A4.11	DELETED	
A4.12	CRDM temperatures	2.9

System: **029 SF8 CPS Containment Purge System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Containment Purge System and the following systems:** (CFR: 41.7 to 41.9 / 45.8)	
K1.01	PRMS	3.4
K1.02	ARM	3.3
K1.03	ESFAS	3.5
K1.04	DELETED	
K1.05	Containment air cleanup and recirculation system	2.9
K1.06	Containment system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7 / 41.8)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K2.04	DELETED	
K2.05	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Containment Purge System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6 / 45.8)	
K3.01	Containment system	3.1
K3.02	DELETED	
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)	
K4.01	Use of filters for purging to the atmosphere	3.0
K4.02	Negative pressure in containment	3.0
K4.03	Automatic purge isolation	3.6
K4.04	Prevention of damage to fans from lack of flow rate	2.6
K4.05	Temperature limits on dampers	2.3
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Containment Purge System:** (CFR: 41.5 / 45.8)	
K5.01	DELETED	

K5.02	DELETED		
K5.03	Containment entry	2.9	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Containment Purge System:**
(CFR: 41.7 / 45.8)

K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	DELETED		
K6.08	CPS components	3.0	
K6.09	ESFAS	3.5	
K6.10	Containment air cleanup and recirculation system	2.6	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Containment Purge System, including:**
(CFR: 41.5 / 45.5 / 45.8)

A1.01	Containment temperature	2.8	
A1.02	Radiation levels	3.2	
A1.03	Containment pressure	3.3	

A2 **Ability to (a) predict the impacts of the following on the Containment Purge System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13 / 45.8)

		RO	**SRO**
A2.01	Maintenance or other activity taking place inside containment	2.3	2.8
A2.02	Adverse environmental conditions affecting radioactive release	3.0	3.0
A2.03	DELETED		
A2.04	DELETED		
A2.05	ESFAS	3.4	3.6
A2.06	CPS component malfunction	2.9	3.0

A3 **Ability to monitor automatic features of the Containment Purge System, including:**
(CFR: 41.7 / 45.5 / 45.8)

A3.01	CPS isolation	3.4	
A3.02	CPS valve operation	3.1	

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 / 45.8)	
A4.01	Containment purge flow rate	2.7
A4.02	DELETED	
A4.03	Inlet filtration and heating system	2.5
A4.04	DELETED	
A4.05	Manual isolation of the CPS	3.1

System: 033 SF8 SFPCS Spent Fuel Pool Cooling System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Spent Fuel Pool Cooling System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RCS	2.9
K1.02	RHRS	3.0
K1.03	SIS	2.6
K1.04	BWST (BW)	3.1
K1.05	DELETED	
K1.06	DELETED	
K1.07	Emergency makeup water systems	3.6
K1.08	LRS	2.6
K1.09	RMS	3.1
K1.10	PVS	2.6
K1.11	CCWS	3.4
K1.12	CVCS	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Spent fuel pool pumps	3.1
K3	**Knowledge of the effect that a loss or malfunction of the Spent Fuel Pool Cooling System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	PVS	2.5
K3.02	RMS	2.9
K3.03	DELETED	
K3.04	RCS	2.6
K4	**Knowledge of design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Maintaining spent fuel level at specified levels	3.6
K4.02	Maintaining spent fuel pool water cleanliness	2.9
K4.03	DELETED	
K4.04	DELETED	
K4.05	Adequate SDM	3.6
K4.06	K-eff	3.3

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Spent Fuel Pool Cooling System:** (CFR: 41.5 / 45.7)		
K5.01	DELETED		
K5.02	DELETED		
K5.03	DELETED		
K5.04	DELETED		
K5.05	Decay heat	3.8	
K5.06	Shielding (water level)	3.7	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Spent Fuel Pool Cooling System:** (CFR: 41.7 / 45.7)		
K6.01	SFPCS pumps	3.6	
K6.02	SFPCS heat exchanger	3.5	
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	Filters and demineralizers	2.8	
K6.08	RWST	3.2	
K6.09	BWST	2.8	
K6.10	PVS	2.5	
K6.11	CCWS	3.4	
K6.12	Emergency makeup water systems	3.5	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Spent Fuel Pool Cooling System, including:** (CFR: 41.5 / 45.5)		
A1.01	Spent fuel pool water level	3.7	
A1.02	Radiation levels	3.5	
A1.03	Lights and alarms	3.1	
A1.04	Spent fuel pool temperature	3.5	
A1.05	Boron concentration	3.4	
A2	**Ability to (a) predict the impacts of the following on the Spent Fuel Pool Cooling System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Inadequate SDM	3.8	3.6

A2.02	SFPCS	3.8	3.2
A2.03	Abnormal water level	3.9	3.7
A2.04	Station blackout	3.4	3.5

A3 **Ability to monitor automatic features of the Spent Fuel Pool Cooling System, including:**
(CFR: 41.7 / 45.5)

A3.01 DELETED
A3.02 DELETED

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	SFPCS pumps	3.0
A4.02	SFPCS valves	2.9
A4.03	Support systems for fill and transfer of SFPCS water	3.0
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	

System: **034 SF8 FHS Fuel Handling Equipment System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Fuel-Handling Equipment System and the following systems:** (CFR: 41.2 to 41.7 / 41.9 / 43.6 / 43.7 / 45.7 / 45.8)	
K1.01	RCS	3.0
K1.02	RHRS	2.8
K1.03	CVCS	2.4
K1.04	NIS	3.3
K1.05	Shutdown monitor system	3.3
K1.06	SFPCS	3.2
K1.07	IAS	2.6
K1.08	Containment system	2.9
K1.09	Reactor components	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7 / 43.7)	
K2.01	All fuel-handling equipment from safety-related power supplies	2.5
K2.02	DELETED	
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Fuel-Handling Equipment System will have on the following systems or system parameters:** (CFR: 41.2 to 41.7 / 43.6 / 43.7 / 45.6 to 45.8)	
K3.01	DELETED	
K3.02	Spent fuel pool	3.0
K3.03	Reactor components	2.7
K4	**Knowledge of Fuel-Handling Equipment System design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.6 / 41.7 / 43.7 / 45.8)	
K4.01	Fuel protection from binding and dropping	3.2
K4.02	Fuel movement	3.0
K4.03	Overload and/or underload protection	3.0
K4.04	Containment integrity	3.1

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Fuel-Handling Equipment System:** (CFR: 41.4 / 41.5 / 43.7 /45.7)		
K5.01	DELETED		
K5.02	Load limitations	3.0	
K5.03	DELETED		
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Fuel-Handling Equipment System:** (CFR: 41.6 / 41.7 / 43.5 / 45 .7)		
K6.01	Fuel-handling equipment failures	3.1	
K6.02	RMS	2.9	
K6.03	IAS	2.6	
K6.04	CNT system	2.9	
K6.05	SFPCS	2.9	
K6.06	Mechanically bound fuel assembly	3.1	
K6.07	RHRS	2.7	
K6.08	NIS	3.0	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Fuel-Handling Equipment System, including:** (CFR: 41.5 / 41.6 / 43.7 / 45.5 / 45.8)		
A1.01	Fuel-handling equipment load limits	2.9	
A1.02	Refueling water level	3.4	
A1.03	Fuel handling equipment position, direction, and/or speed	2.9	
A1.04	Reactor neutron levels	3.4	
A1.05	Radiation levels	3.3	
A2	**Ability to (a) predict the impacts of the following on the Fuel-Handling Equipment System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 43.7 / 45.3 / 45.8 / 45.13)	**RO**	**SRO**
A2.01	Dropped and/or damaged fuel element	4.0	3.6
A2.02	Dropped fuel cask	3.2	3.1
A2.03	Mispositioned fuel element	3.2	3.2
A2.04	Transfer car stuck in the fuel transfer tube	2.8	3.1
A2.05	High area radiation in containment or spent fuel pool	3.3	3.5
A2.06	Loss of RHR cooling flow	3.7	3.7
A2.07	Loss of refueling cavity or spent fuel pool level	3.7	3.8

A2.08	Refueling/fuel-handling machine malfunction	2.6	2.9
A2.09	Refueling/fuel-handling machine overload / underload	2.4	2.8
A2.10	High flux alarm	3.4	3.6

A3 **Ability to monitor automatic operation of the Fuel-Handling Equipment System, including:**
(CFR: 41.7 / 45.5)

A3.01	Travel limits	2.8
A3.02	Load limits	2.8
A3.03	DELETED	

A4 **Ability to manually operate and/or monitor at the equipment location:**
(CFR: 41.4 / 41.7 / 43.7 / 45.5 /45.6 / 45.8)

A4.01	DELETED	
A4.02	DELETED	
A4.03	Containment refueling machine operation	3.0
A4.04	Spent fuel-handling machine operation	2.9
A4.05	Fuel elevator operation	2.6
A4.06	Fuel transfer system operation	2.8

System: 075 SF8 CW Circulating Water System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Circulating Water System and the following systems:** (CFR: 41.4 / 41.5 / 41.7 / 45.8)	
K1.01	SWS	2.9
K1.02	LRS	2.7
K1.03	DELETED	
K1.04	SGBD	2.6
K1.05	MRSS and SDS	2.8
K1.06	Cooling towers	3.0
K1.07	Recirculation spray system	2.5
K1.08	Emergency/essential SWS	2.9
K1.09	Vacuum priming	2.5
K1.10	CDS	2.9
K1.11	CARS	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Circulating water pumps	2.8
K2.02	DELETED	
K2.03	DELETED	
K2.04	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Circulating Water System will have on the following systems or system parameters:** (CFR: 41.4 / 41.5 / 41.7 / 45.8)	
K3.01	SWS	2.7
K3.02	DELETED	
K3.03	SDS	2.4
K3.04	MT/G	2.9
K3.05	Recirculation spray system	2.2
K3.06	Plant efficiency	3.2
K3.07	DELETED	
K3.08	CDS	2.9
K3.09	CARS	2.4
K3.10	Condenser availability	3.5

K4	**Knowledge of Circulating Water System design feature(s) and interlock(s), which provide for the following:** (CFR: 41.4 / 41.7 / 45 .8)	
K4.01	DELETED	
K4.02	Interlocks between CWS pumps and system valves	2.9
K4.03	Interlocks between CWS pumps and cooling tower pumps	2.6
K4.04	Automatic pickup of backup lube oil pumps (AC and DC)	2.5
K4.05	DELETED	
K4.06	Traveling screen operation	2.8
K4.07	DELETED	
K4.08	Prevention of system freezing/ice melt operation	2.7
K4.09	Condenser availability/C-9	3.4
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Circulating Water System:** (CFR: 41.5 / 45.8)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	
K5.07	Relationship of seawater temperature to marine growth	2.5
K5.08	Purpose of the vacuum priming system	2.6
K5.09	Relationship between circulating water conductivity and corrosion	2.4
K5.10	Damage to piping and components from hydraulic shock	2.7
K5.11	Frazil ice formation	2.6
K5.12	Isolation of a condenser waterbox at power	2.9
K5.13	Condenser tube leakage	3.1
K5.14	Required number of circulating water pumps operating for all plant conditions	3.2
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Circulating Water System:** (CFR: 41.4 / 41.7 / 45. 8)	
K6.01	CWS valve malfunctions	2.7
K6.02	DELETED	
K6.03	DELETED	
K6.04	CWS pump malfunctions	2.9
K6.05	DELETED	
K6.06	DELETED	
K6.07	Intake structure malfunction	2.9
K6.08	Vacuum priming malfunction	2.4

K6.09	Traveling screens malfunction	2.8	
K6.10	Cooling tower or spray pond malfunction	2.5	
K6.11	Condenser malfunction	3.1	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Circulating Water System, including:**
(CFR: 41.5 / 45.5)

A1.01	DELETED		
A1.02	Intake levels	3.1	
A1.03	DELETED		
A1.04	Pump oil levels and seal flows (normal range and limitations)	2.5	
A1.05	Lube oil temperature and pressure	2.3	
A1.06	Circulating water temperature (inlet and outlet)	2.6	
A1.07	Circulating water pump motor current and pump discharge pressure	2.6	
A1.08	Circulating water makeup pump motor current (within limits)	2.3	
A1.09	DELETED		
A1.10	Main condenser vacuum	3.4	
A1.11	Condenser availability/C-9	3.3	
A1.12	Lights and alarms	3.0	

A2 **Ability to (a) predict the impacts of the following on the Circulating Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**

	(CFR: 41.5 / 43.5 / 45.3 / 45.13)	**RO**	**SRO**
A2.01	Loss of intake structure	3.6	3.1
A2.02	Loss of circulating water pumps	3.9	3.4
A2.03	DELETED		
A2.04	Effects of extremes in ambient temperature on cooling tower operation	2.7	2.8
A2.05	Potential damage to condenser from high discharge pressures of circulating water pump	2.3	2.7
A2.06	DELETED		
A2.07	DELETED		
A2.08	Ice buildup on intake structure	3.1	3.1
A2.09	DELETED		
A2.10	DELETED		
A2.11	DELETED		
A2.12	Main condenser tube leak	3.5	3.3
A2.13	Loss of condenser vacuum	4.0	3.7

A3	**Ability to monitor automatic operation of the Circulating Water System, including:** (CFR: 41.4 / 41.7 / 45 .5)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	Verification that the pump discharge valve closes when the circulating water pump stops	2.9
A3.06	DELETED	
A3.07	Makeup flow control valve controller and indicator	2.6
A3.08	Condenser availability/C-9	3.4
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.4 / 41.7 / 45.5 / 45 .8)	
A4.01	DELETED	
A4.02	Circulating water pump	3.1
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	Water box vacuum priming isolation valves, control switches, and indicators	2.3
A4.07	DELETED	
A4.08	Gland seal water supply system	2.4
A4.09	Circulating water box inlet and outlet valves	2.6
A4.10	DELETED	
A4.11	DELETED	
A4.12	Discharge valve interlock system	2.6
A4.13	Cooling tower operations	2.6
A4.14	DELETED	
A4.15	Operation of the vacuum priming system	2.3
A4.16	Traveling screens in manual operation	2.6
A4.17	DELETED	
A4.18	DELETED	
A4.19	Deicing valve	2.4
A4.20	DELETED	

System: 078 SF8 IAS Instrument Air System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Instrument Air System and the following systems:** (CFR: 41.3 to 41.8 / 45.7 / 45.8)	
K1.01	DELETED	
K1.02	Service air system	3.1
K1.03	Containment air	3.4
K1.04	Cooling water to compressor	2.9
K1.05	DELETED	
K1.06	Valves controlled by instrument air	3.6
K1.07	PVSs	2.8
K1.08	CWS	2.4
K1.09	CDS	2.7
K1.10	CARS	2.5
K1.11	Containment airlock system	2.6
K1.12	Extraction steam system	2.5
K1.13	Feedwater system	3.3
K1.14	FPS	2.7
K1.15	FHES	2.6
K1.16	Fuel pool cooling cleanup system	2.4
K1.17	Generator hydrogen system	2.3
K1.18	Heater drain system	2.5
K1.19	LRS	2.5
K1.20	Main steam system	2.9
K1.21	Main turbine lube oil system	2.3
K1.22	Postaccident monitoring system	2.4
K1.23	CVCS	3.3
K1.24	SWS	2.9
K1.25	Waste gas system	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Instrument air compressor	3.3
K2.02	Emergency air compressor	3.4
K3	**Knowledge of the effect that a loss or malfunction of the Instrument Air System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Containment air system	3.2
K3.02	Systems having pneumatic valves and controls	3.4
K3.03	Cross-tied units	3.1
K3.04	PVSs	2.6

K3.05	CWS	2.4
K3.06	CCWS	3.2
K3.07	CDS	2.7
K3.08	CARS	2.4
K3.09	Containment airlock system	2.5
K3.10	Extraction steam system	2.4
K3.11	Feedwater system	3.3
K3.12	FPS	2.6
K3.13	FHES	2.6
K3.14	Fuel pool cooling cleanup system	2.5
K3.15	Generator hydrogen system	2.4
K3.16	Heater drain system	2.6
K3.17	LRS	2.5
K3.18	Main steam system	3.1
K3.19	Main turbine lube oil system	2.4
K3.20	Postaccident monitoring system	2.3
K3.21	CVCS	3.3
K3.22	SWS	2.8
K3.23	Waste gas system	2.5

K4 **Knowledge of the Instrument Air System design feature(s) and/or interlock(s), which provide for the following:**
(CFR: 41.7)

K4.01	Modes of control	2.9
K4.02	Crossover to other pneumatic systems	3.1
K4.03	DELETED	
K4.04	IAS compressor loading/unloading/starts/trips	2.9
K4.05	Isolation of instrument air to containment	3.2
K4.06	Maintaining dry air	2.9
K4.07	Maintaining normal instrument air pressure	3.1

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Instrument Air System:**
(CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	Diesel effect	2.8
K5.03	Loss of instrument air	3.9
K5.04	High moisture content in instrument air	2.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Instrument Air System:**
(CFR: 41.7 / 45.7)

K6.01	Air compressors	3.4
K6.02	DELETED	
K6.03	DELETED	

K6.04	DELETED		
K6.05	Air dryers	3.2	
K6.06	Cross-tie valve	3.0	
K6.07	Valves	2.8	
K6.08	DELETED		
K6.09	Controllers and positioners	2.9	
K6.10	DELETED		
K6.11	DELETED		
K6.12	DELETED		
K6.13	DELETED		
K6.14	Service air cross-connect valve	3.0	
K6.15	CCWS	2.8	
K6.16	Low instrument air pressure	3.4	
K6.17	Backwashing condensate filters/demineralizers	2.4	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Instrument Air System, including:**
(CFR: 41.5 / 45.5)

A1.01	Instrument air pressure	3.5
A1.02	Instrument air compressor parameters	2.9
A1.03	Dryer dew point	2.4
A1.04	Lights and alarms	3.1
A1.05	Service air pressure	2.9

A2 **Ability to (a) predict the impacts of the following on the Instrument Air System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Air dryer and filter malfunctions	3.3	3.2
A2.02	Low instrument air pressure	3.9	3.8
A2.03	CCWS malfunction	2.5	3.1

A3 **Ability to monitor automatic features of the Instrument Air System, including:**
(CFR: 41.7 / 45.5)

A3.01	DELETED	
A3.02	DELETED	
A3.03	Air compressor loading/unloading	2.9
A3.04	Isolation of instrument air from service air	3.1
A3.05	Isolation of instrument air to containment	3.3

A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Instrument air compressors	3.2
A4.03	Isolation/restoration of instrument air to isolated components/systems	3.2

System: 079 SF8 SAS Station Air System

K/A NO.	KNOWLEDGE	IMPORTANCE

This system was DELETED to be consistent with NUREG-1123, “Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors.” Applicable K/As from System 079 we moved to System 078, “Instrument Air System.”

System: 086 SF8 FPS Fire Protection System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Fire Protection System and the following systems:** (CFR: 41.4 / 41.7 / 41.8 / 45.7 / 45.8)	
K1.01	Service water	3.0
K1.02	Raw water	2.5
K1.03	AFW system	3.2
K1.04	CCWS	2.5
K1.05	MT/G	2.5
K1.06	EDG systems	3.1
K1.07	AC distribution	3.0
K1.08	IAS	2.5
K1.09	PVSs	2.4
K1.10	Control room ventilation	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Fire pumps	3.2
K3	**Knowledge of the effect that a loss or malfunction of the Fire Protection System will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Contingency capability for safe shutdown	3.4
K3.02	MT/G	2.4
K3.03	EDG systems	3.0
K3.04	AC distribution	2.8
K4	**Knowledge of design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Adequate supply of water for FPS	3.4
K4.02	Maintaining fire header pressure	3.3
K4.03	Detection and location of fires	3.5
K4.04	Personnel safety	3.4
K4.05	Halon	3.2
K4.06	Carbon dioxide	3.2
K4.07	Protection of plant areas and equipment	3.3
K4.08	Foam	2.8
K4.09	Water	3.1

K5 **Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Fire Protection System:**
(CFR: 41.5 / 45.7)

K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Hazards to personnel as a result of fire type and methods of protection	3.4
K5.05	Detection methods	3.2
K5.06	Types of fire, extinguishing agents, and extinguishing mechanism	3.1

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Fire Protection System:**
(CFR: 41.7 / 45.7)

K6.01	Fire pump failure	3.4
K6.02	DELETED	
K6.03	DELETED	
K6.04	Fire, smoke, or heat detector malfunction	3.0
K6.05	Service water	2.7
K6.06	Raw water	2.4
K6.07	CCWS	2.3
K6.08	Fire suppression activation valve	3.1
K6.09	Fire damper failure	2.9

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Fire Protection System, including:**
(CFR: 41.5 / 45.5)

A1.01	Fire header pressure	3.3
A1.02	Fire water storage tank level	3.2
A1.03	Fire doors	3.1
A1.04	Fire dampers	3.0
A1.05	DELETED	
A1.06	Lights and alarms	3.0

A2 **Ability to (a) predict the impacts of the following on the Fire Protection System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

		RO	**SRO**
A2.01	Manual shutdown of the FPS	3.1	2.7
A2.02	Low FPS header pressure	3.4	3.1
A2.03	Inadvertent actuation of the FPS	3.1	2.9

A2.04	Failure to actuate the FPS when required	3.8	3.2
A2.05	Fire in the plant	4.0	3.8

A3	**Ability to monitor automatic features of the Fire Protection System, including:** (CFR: 41.7 / 45.5)	
A3.01	Starting of fire pumps	3.3
A3.02	Actuation of the FPS	3.3
A3.03	Actuation of fire detectors	3.2
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Fire water pumps	3.4
A4.02	Fire detection panels	3.2
A4.03	Fire alarm switch	2.9
A4.04	Fire water storage tank makeup pumps	2.7
A4.05	Fire suppression actuation valves	3.0
A4.06	DELETED	

3.9	Safety Function 9: Radioactivity Release	Page

System: 068 SF9 LRS Liquid Radwaste System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Liquid Radwaste System and the following systems:** (CFR: 41.7 to 41.9 / 45.8 / 45.9)	
K1.01	RCS	2.8
K1.02	WGDS	2.8
K1.03	PRT	3.0
K1.04	DELETED	
K1.05	CWS	2.7
K1.06	Boron recovery system	2.4
K1.07	Sources of liquid wastes for LRS	2.8
K1.08	Auxiliary steam	2.2
K1.09	CVCS	2.9
K1.10	CCWS	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7 & 8)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Liquid Radwaste System will have on the following systems or system parameters:** (CFR: 41.7 / 45.8 to 45.9)	
K3.01	CVCS	2.9
K3.02	DELETED	
K3.03	Sources of LRS	2.7
K4	**Knowledge of design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	Automatic release termination	3.6
K4.03	Automatic system realignments	3.0
K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Liquid Radwaste System:** (CFR: 41.5 / 45.7 - 9)	
K5.01	DELETED	

K5.02	DELETED		
K5.03	DELETED		
K5.04	DELETED		
K5.05	DELETED		
K5.06	DELETED		
K5.07	Loss of secondary mixing water system	2.6	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Liquid Radwaste System:**
(CFR: 41.7 / 45.7 - 9)

K6.01	DELETED		
K6.02	DELETED		
K6.03	DELETED		
K6.04	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	DELETED		
K6.08	DELETED		
K6.09	DELETED		
K6.10	Radiation monitors	3.4	
K6.11	DELETED		
K6.12	WDGS	2.8	
K6.13	CWS	2.6	
K6.14	CCWS	2.5	
K6.15	RCDT	2.9	

A1 **Ability to predict and/or monitor changes in parameters associated with operation of the Liquid Radwaste System, including:**
(CFR: 41.5 / 45.8 to 45.9)

A1.01	DELETED		
A1.02	DELETED		
A1.03	LRS discharge rate	3.1	
A1.04	LRS radiation levels	3.1	

A2 **Ability to (a) predict the impacts of the following on the Liquid Radwaste System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.8 / 45.9 / 45.13)

		RO	SRO
A2.01	DELETED		
A2.02	Failure to comply with the conditions in release permit	3.8	3.8
A2.03	DELETED		
A2.04	Failure of automatic isolation	3.3	3.8
A2.05	CWS malfunction	2.6	2.8
A2.06	CCWS malfunction	2.5	2.6

A3	**Ability to monitor automatic features of the Liquid Radwaste System, including:** (CFR: 41.7 / 45.8 / 45.9)	
A3.01	DELETED	
A3.02	Automatic isolation	3.6
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.8 / 45.9)	
A4.01	DELETED	
A4.02	Remote radwaste release	3.1
A4.03	Stoppage of release if limits exceeded	3.5
A4.04	DELETED	

System: 071 SF9 WGS Waste Gas Disposal System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Waste Gas Disposal System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.11)	
K1.01	Nitrogen system	2.7
K1.02	DELETED	
K1.03	LRS	2.6
K1.04	PVS	2.8
K1.05	DELETED	
K1.06	RMS	3.0
K1.07	DELETED	
K1.08	CVCS	3.1
K1.09	Plant sampling system	2.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the Waste Gas Disposal System will have on the following systems or system parameters:** (CFR: 41.7 / 45.8 to 45.9)	
K3.01	LRS	2.5
K3.02	CVCS	3.1
K3.03	DELETED	
K3.04	PVS	2.8
K3.05	DELETED	
K4	**Knowledge of design feature(s) and/or interlock(s), which provide for the following:** (CFR: 41.7)	
K4.01	Pressure capability of the waste gas decay tank	2.7
K4.02	Sealing water around the shaft of the gas compressor	2.4
K4.03	Tank loop seals	2.3
K4.04	Isolation of waste gas release tanks	3.1
K4.05	Point of release	3.3
K4.06	Sampling and monitoring of waste gas release tanks	3.0

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Waste Gas Disposal System:** (CFR: 41.5 / 45.8 / 45.9)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	Sources of hydrogen that could accumulate in the decay tank	3.0
K5.04	Relationship of hydrogen/oxygen concentrations to flammability	3.5
K5.05	DELETED	
K5.06	DELETED	
K5.07	Sampling oxygen, hydrogen, and nitrogen concentrations in WDGS decay tank; knowledge of limits	3.3
K5.08	Waste gas header pressure versus compressor operation	2.6
K5.09	Decay tank pressure versus CVCS HUT liquid levels	2.6
K5.10	Nitrogen addition to the decay tank	2.4
K5.11	Time response of radiation levels to release of waste gas	2.7
K5.12	Use of WGDS to prevent entry of oxygen into holdup tanks during liquid transfers	2.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Waste Gas Disposal System:** (CFR: 41.7 /45.8 - 9)	
K6.01	Waste gas discharge release valve	3.2
K6.02	DELETED	
K6.03	DELETED	
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	
K6.07	Waste gas compressors	2.6
K6.08	Rupture disks or relief valves	2.9
K6.09	Waste gas header	2.7
K6.10	Surge and/or decay tanks	2.6
K6.11	Nitrogen system	2.5
K6.12	PVS	2.7
K6.13	RMS	2.8
K6.14	Sealing water	2.3
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Waste Gas Disposal System, including:** (CFR: 41.5 / 45.8 / 45.9)	
A1.01	DELETED	
A1.02	DELETED	
A1.03	Holdup tank pressure and level	2.6
A1.04	Waste gas header pressure	2.7

A1.05	DELETED	
A1.06	PVS	2.7
A1.07	Surge tank pressure and level	2.3
A1.08	Waste gas tank discharge rate and/or volume	2.7
A1.09	Waste gas tank discharge radiation levels	3.2

A2 **Ability to (a) predict the impacts of the following on the Waste Gas Disposal System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13 / 8-9)

		RO	**SRO**
A2.01	High O2 concentration	3.6	3.0
A2.02	DELETED		
A2.03	WGDS component malfunctions	3.0	2.7
A2.04	Loss of cover gas	2.9	2.6
A2.05	RMS alarms and/or malfunctions	3.5	3.1
A2.06	DELETED		
A2.07	Loss of meteorological tower	3.3	2.3
A2.08	Meteorological changes	3.1	2.1
A2.09	DELETED		
A2.10	PVS malfunctions	3.1	2.5

A3 **Ability to monitor automatic features of the Waste Gas Disposal System, including:**
(CFR: 41.7 / 45.8 / 45.9)

A3.01	DELETED	
A3.02	Pressure-regulating system for waste gas vent header	2.5
A3.03	DELETED	
A3.04	WGDT automatic isolation	3.0

A4 **Ability to manually operate and/or monitor in the control room:**
(CFR: 41.7 / 45.8 / 45.9)

A4.01	Holdup tank operations	2.4
A4.02	Waste gas compressor	2.4
A4.03	DELETED	
A4.04	DELETED	
A4.05	Gas decay tanks	2.4
A4.06	Meteorological data	2.7
A4.07	Waste gas release flow	2.7
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	DELETED	

A4.15	DELETED	
A4.16	DELETED	
A4.17	DELETED	
A4.18	DELETED	
A4.19	DELETED	
A4.20	DELETED	
A4.21	DELETED	
A4.22	DELETED	
A4.23	DELETED	
A4.24	DELETED	
A4.25	DELETED	
A4.26	Securing release on high radiation	3.6
A4.27	DELETED	
A4.28	DELETED	
A4.29	DELETED	
A4.30	DELETED	

System: 050 SF9 CRV Control Room Ventilation

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections and/or cause and effect relationships between the Control Room Ventilation and the following systems:** (CFR: 41.2 to 41.9 / 45.7 / 45.8)	
K1.01	RMS	3.5
K1.02	DELETED	
K1.03	DELETED	
K1.04	Nuclear steam supply system (NSSS)/PCIS	2.8
K1.05	CCWS	2.7
K1.06	Plant pneumatic system	2.6
K1.07	Fire protection system (FPS)	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Fans	3.0
K2.02	Chiller units	3.1
K2.03	DELETED	
K2.04	Control room heating, ventilation, and air conditioning (HVAC); logic	3.1
K3	**Knowledge of the effect that a loss or malfunction of the Control Room Ventilation will have on the following systems or system parameters:** (CFR: 41.7 /45.6)	
K3.01	DELETED	
K3.02	DELETED	
K3.03	Control room temperature	3.4
K3.04	Control room pressure	3.4
K3.05	Control room humidity	2.7
K3.06	Control room radioactivity	3.5
K4	**Knowledge of Control Room Ventilation design feature(s) and/or interlocks, which provide for the following:** (CFR: 41.7)	
K4.01	System initiation / reconfiguration	3.8
K4.02	Control room temperature / humidity control	2.9
K4.03	D/P control	3.1
K4.04	Chlorine ammonia detection	3.3
K4.05	Remote air intake	2.9
K4.06	Fire protection	2.7

K5	**Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the Control Room Ventilation:** (CFR: 41.5 / 45.3)		
K5.01	Airborne contamination (e.g., radiological, toxic gas, and smoke) control	3.6	
K5.02	DELETED		
K5.03	DELETED		
K5.04	Control room habitability	3.7	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Control Room Ventilation:** (CFR: 41.7 / 45.7)		
K6.01	AC electrical distribution	3.4	
K6.02	CCWS	2.9	
K6.03	Plant pneumatic system	2.7	
K6.04	FPS	2.7	
K6.05	RMS	3.4	
K6.06	NSSS/PCIS	3.0	
A1	**Ability to predict and/or monitor changes in parameters associated with operation of the Control Room Ventilation, including:** (CFR: 41.5 / 45.5)		
A1.01	Filter D/P	2.5	
A1.02	Fan D/P	2.3	
A1.03	Control room temperature	3.0	
A1.04	Control room pressure	3.0	
A1.05	Airborne radioactivity levels	3.4	
A1.06	Control room humidity	2.3	
A1.07	Lights and alarms	3.3	
A1.08	Toxic gas	3.2	
A2	**Ability to (a) predict the impacts of the following on the Control Room Ventilation and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.5 / 43.5 / 45.6)	**RO**	**SRO**
A2.01	Initiation / reconfiguration	3.3	3.8
A2.02	Extreme environmental conditions (fire, toxic gas, smoke, and radiation)	3.5	3.7
A2.03	Initiation / reconfiguration failure	3.5	3.8
A2.04	Initiation / failure of FPS	3.0	3.0
A2.05	Loss of chillers	3.2	3.1
A2.06	Breeches of control room envelope	3.2	3.7

A3	**Ability to monitor automatic features of the Control Room Ventilation, including:** (CFR: 41.7 / 45.7)	
A3.01	Initiation/reconfiguration	3.7
A3.02	Initiation/failure of FPS	3.0
A3.03	Plant process computer/parameter display systems	2.4
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Initiate/reset system	3.8
A4.02	Fans	3.3
A4.03	Dampers	3.0
A4.04	DELETED	
A4.05	Heaters	2.5
A4.06	Chillers	3.0

4 EMERGENCY AND ABNORMAL PLANT EVOLUTIONS

4.1 GENERIC EMERGENCY PLANT EVOLUTIONS (EPEs)

EPE: **007 Reactor Trip**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Reactor Trip:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	Principles of neutron detection	3.3
EK1.02	Shutdown margin	3.8
EK1.03	DELETED	
EK1.04	Decrease in reactor power following reactor trip (prompt drop and subsequent decay)	3.7
EK1.05	DELETED	
EK1.06	Decay heat removal capability of emergency feedwater	3.9
EK2	**Knowledge of the relationship between the Reactor Trip and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	Reactor trip status panel	4.1
EK2.04	DELETED	
EK2.05	Nuclear instrumentation	4.1
EK2.06	Control rod drive system (CRDS)	3.6
EK2.07	Reactor protection system (RPS)	4.3
EK2.08	Emergency core cooling system (ECCS)	3.4
EK2.09	Alternating current (AC) distribution system	3.5
EK2.10	SI	3.3
EK2.11	Engineered safety features (ESFs) actuation system (ESFAS)	3.7
EK2.12	Reactor coolant system (RCS)	3.5
EK2.13	Chemical and volume control system (CVCS)	3.5
EK2.14	Power-operated relief valves (PORVs)	3.3
EK2.15	Pressurizer (PZR) spray	3.4
EK2.16	Reactor coolant pumps (RCPs)	3.5
EK2.17	Steam generator system (SGS)	3.6
EK2.18	Auxiliary feedwater (AFW)	3.8
EK2.19	Main feedwater (MFW)	3.1
EK2.20	Main turbine generator (MT/G)	3.1
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Reactor Trip:** (CFR: 41.5 /41.10 / 45.6 / 45.13)	
EK3.01	Actions contained in an emergency operating procedure (EOP) for reactor trip	4.3
EK3.02	Verifying a reactor trip	4.5

EK3.03	Verifying a turbine trip	4.3	
EK3.04	Verifying power to AC buses	4.2	
EK3.05	Verifying status of safety injection (SI)	4.1	
EK3.06	Stopping an RCP	3.5	
EK3.07	ECCS flow reduction	3.3	

EA1 **Ability to operate and/or monitor the following as they apply to a Reactor Trip:**
(CFR: 41.7 / 45.5 / 45.6)

EA1.01	DELETED		
EA1.02	MFW system	3.3	
EA1.03	RCS	3.4	
EA1.04	RCPs	3.4	
EA1.05	Nuclear instrumentation	3.9	
EA1.06	CRDS	3.5	
EA1.07	MT/G	3.3	
EA1.08	AFW system	3.8	
EA1.09	CVCS	3.5	
EA1.10	SGS	3.5	
EA1.11	Rod position indication system (RPIS)	3.7	
EA1.12	MSIVs	3.3	
EA1.13	AC distribution system	3.7	
EA1.14	RPS	3.8	
EA1.15	ECCS	3.6	
EA1.16	SI	3.6	
EA1.17	ESFAS	3.6	
EA1.18	Main feedwater isolation valves (MFIVs)	3.3	

EA2 **Ability to determine and/or interpret the following as they apply to a Reactor Trip:**
(CFR: 41.7 / 45.5 / 45.6)

		RO	**SRO**
EA2.01	Rx power	4.2	4.3
EA2.02	Failure of an automatic safety function to operate	4.3	4.4
EA2.03	DELETED		
EA2.04	Interpret plant conditions, take immediate actions, and determine when transition requirements are met for the anticipated transient without scram (ATWS) emergency procedure.	4.0	4.4
EA2.05	Lights and alarms	3.7	3.6
EA2.06	Occurrence of a reactor trip	3.7	4.2
EA2.07	RCS pressure and temperature	3.8	3.9
EA2.08	RCS loop flow rates	3.0	3.7
EA2.09	Steam generator (S/G) pressure	3.5	3.7
EA2.10	AFW flow	3.8	3.9
EA2.11	Charging flow	3.2	3.6
EA2.12	AC distribution availability	3.7	3.8
EA2.13	ECCS flows	3.0	3.7

EPE: 009 Small Break LOCA

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Small-Break LOCA:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	Natural circulation and cooling, including reflux boiling	3.8
EK1.02	DELETED	
EK1.03	RCS heat removal	4.0
EK2	**Knowledge of the relationship between the Small-Break LOCA and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	ECCS valves	3.9
EK2.02	ECCS pumps	4.0
EK2.03	S/Gs	3.9
EK2.04	RCS pressure, PZR level, ECCS flow or subcooling indications	3.9
EK2.05	Reactor coolant pump system (RCPS)	3.7
EK2.06	AFW system	3.8
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Small-Break LOCA:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	Component cooling water system (CCWS) automatic isolation on high delta flow/ temperature to RCP thermal barrier	3.2
EK3.02	DELETED	
EK3.03	DELETED	
EK3.04	Starting additional charging pumps	3.7
EK3.05	DELETED	
EK3.06	DELETED	
EK3.07	DELETED	
EK3.08	DELETED	
EK3.09	DELETED	
EK3.10	DELETED	
EK3.11	Inadequate core cooling	4.0
EK3.12	DELETED	
EK3.13	DELETED	
EK3.14	DELETED	
EK3.15	DELETED	
EK3.16	Adverse containment parameters	3.9
EK3.17	Containment isolation	3.8
EK3.18	DELETED	

EK3.19	DELETED		
EK3.20	DELETED		
EK3.21	Actions contained in an EOP for a small-break loss-of-coolant accident (LOCA)	4.1	
EK3.22	Maintenance of heat sink	3.9	
EK3.23	RCP tripping requirements	4.0	
EK3.24	ECCS throttling or termination criteria	3.9	
EK3.25	Monitoring of in-core T-cold	3.5	
EK3.26	Maintenance of RCS subcooling	3.8	
EK3.27	Manual depressurization or high-pressure injection (HPI) recirculation for sustained high pressure	3.7	
EK3.28	Manual ESFAS initiation requirements	4.0	

EA1 **Ability to operate and/or monitor the following as they apply to a Small-Break LOCA:**
(CFR: 41.7 / 45.5 / 45.6)

EA1.01	RCS pressure and temperature	4.0
EA1.02	Containment or reactor building sump level	3.7
EA1.03	DELETED	
EA1.04	CVCS	3.3
EA1.05	CCWS	3.3
EA1.06	DELETED	
EA1.07	Containment cooling system (CCS)	3.5
EA1.08	Containment isolation system	3.7
EA1.09	RCP	3.6
EA1.10	Safety parameter display system (SPDS)	3.4
EA1.11	AFW / MFW	3.8
EA1.12	DELETED	
EA1.13	ESFAS	3.9
EA1.14	Secondary pressure control	3.4
EA1.15	PORV and PORV block valve	3.6
EA1.16	Subcooling margin (SCM) monitors	3.8
EA1.17	Pressurizer relief tank (PRT)	3.2
EA1.18	Balancing of HPI loop flows	3.2
EA1.19	Liquid radwaste system (LRS)	2.8

EA2 **Ability to determine and/or interpret the following as they apply to a Small-Break LOCA:**

		RO	SRO
	(CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Actions to be taken, based on RCS temperature and pressure, saturated, and superheated	4.0	4.1
EA2.02	DELETED		
EA2.03	DELETED		
EA2.04	PZR level	3.5	3.9
EA2.05	The time available for action before PZR is empty given the rate of decrease of PZR level	2.8	3.4
EA2.06	DELETED		
EA2.07	DELETED		
EA2.08	DELETED		

EA2.09	DELETED		
EA2.10	DELETED		
EA2.11	DELETED		
EA2.12	DELETED		
EA2.13	Charging pump parameters	3.2	3.3
EA2.14	DELETED		
EA2.15	RCS parameters	3.7	3.8
EA2.16	CCWS	3.2	3.3
EA2.17	Total ECCS flow meter	3.5	3.5
EA2.18	DELETED		
EA2.19	Containment air cooler run indication	2.6	3.1
EA2.20	Containment vent damper position indicator	2.6	3.1
EA2.21	DELETED		
EA2.22	DELETED		
EA2.23	RCP operating parameters and limits	3.7	3.7
EA2.24	RCP temperature setpoints	3.2	3.4
EA2.25	DELETED		
EA2.26	DELETED		
EA2.27	DELETED		
EA2.28	DELETED		
EA2.29	CVCS pump indicating lights for determining pump status	3.2	3.2
EA2.30	DELETED		
EA2.31	DELETED		
EA2.32	DELETED		
EA2.33	DELETED		
EA2.34	Conditions for throttling or stopping HPI	3.8	3.7
EA2.35	DELETED		
EA2.36	Difference between overcooling and LOCA indications	3.7	3.7
EA2.37	Existence of adequate natural circulation	3.8	3.9
EA2.38	Existence of head bubble	4.0	4.0
EA2.39	Adequate core cooling	3.5	4.2

EPE: 011 Large-Break LOCA

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Large-Break LOCA:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	Core Heat removal mechanisms	4.2
EK1.02	Long term cooling of the core	4.3
EK1.03	Long-term containment of radioactivity	4.1
EK1.04	Consequences to residual heat removal (RHR) of not resetting the SI	3.5
EK1.05	Loss/degraded CCWs	3.6
EK1.06	Containment cooling fan speed and/or damper alignment	3.6
EK1.07	ECCS pump operation	4.3
EK1.08	Containment hydrogen concentration	3.6
EK2	**Knowledge of the relationship between the Large-Break LOCA and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	RCS	4.3
EK2.04	RCPS	3.9
EK2.05	ECCS	4.3
EK2.06	ESFAS	4.2
EK2.07	RHR	4.1
EK2.08	CVCS	3.5
EK2.09	CCS	3.6
EK2.10	Containment spray system (CSS)	4.0
EK2.11	Hydrogen recombiner and purge control system (HRPS)	3.5
EK2.12	Service water system (SWS)	3.6
EK2.13	Emergency diesel generators (EDGs)	4.0
EK2.14	In-core instrumentation	3.7
EK2.15	Radiation monitoring system (RMS)	3.6
EK2.16	Plant computer and/or SPDS	3.6
EK2.17	Component cooling water (CCW)	3.6
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Large-Break LOCA:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	Verifying main steam isolation valve (MSIV) position	3.4
EK3.02	Feedwater isolation	3.4
EK3.03	Starting auxiliary feed pumps and flow	3.6

EK3.04	Placing containment fan cooler and/or damper in accident position	3.6	
EK3.05	Injection into cold leg	4.1	
EK3.06	Actuation of containment isolation signals	4.2	
EK3.07	Stopping charging pump bypass flow	3.6	
EK3.08	Containment sump recirculation	4.3	
EK3.09	Maintaining diesel generators available to provide standby power	3.9	
EK3.10	DELETED		
EK3.11	DELETED		
EK3.12	Actions contained in an EOP for large-break LOCA	4.2	
EK3.13	Hot-leg injection / recirculation	3.9	
EK3.14	RCP tripping requirement	4.0	
EK3.15	Shifting to recirculation mode	4.3	
EK3.16	Starting EDGs	3.8	
EK3.17	Starting service water pumps	3.8	
EA1	**Ability to operate and/or monitor the following as they apply to a Large-Break LOCA:** (CFR: 41.7 / 45.5 / 45.6)		
EA1.01	RCS	3.9	
EA1.02	DELETED		
EA1.03	RCPs	3.9	
EA1.04	ESFAS, manual or automatic	4.3	
EA1.05	CVCS	3.5	
EA1.06	EDGs	3.9	
EA1.07	Containment isolation system	4.1	
EA1.08	DELETED		
EA1.09	Accumulators/core flood tank (CFT) initiation	4.0	
EA1.10	AFW pumps	3.7	
EA1.11	DELETED		
EA1.12	DELETED		
EA1.13	ECCS	4.3	
EA1.14	SCM monitors	3.9	
EA1.15	DELETED		
EA1.16	Balancing of HPI loop flows	3.4	
EA1.17	SPDS	3.7	
EA1.18	Service water pumps	3.7	
EA1.19	CCS	3.8	
EA1.20	CSS	4.0	
EA1.21	HRPS	3.3	
EA1.22	In-core Instrumentation	3.6	
EA1.23	RMS	3.6	
EA2	**Ability to determine and/or interpret the following as they apply to a Large-Break LOCA:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.01	RCS temperature and/or pressure	4.0	3.9
EA2.02	DELETED		

EA2.03	CCW temperatures	3.1	3.4
EA2.04	DELETED		
EA2.05	Significance of ECCS pump operation	4.4	4.1
EA2.06	DELETED		
EA2.07	ECCS pump water seal parameters	3.1	3.3
EA2.08	DELETED		
EA2.09	DELETED		
EA2.10	Adequate core cooling	4.6	4.2
EA2.11	Throttling or stopping HPI	4.1	3.9
EA2.12	Throttling or stopping reflux boiling spray	3.8	3.6
EA2.13	DELETED		
EA2.14	DELETED		
EA2.15	Sump level	4.1	4.0
EA2.16	ECCS flow	4.3	4.2
EA2.17	Containment pressure, leakage, and/or temperature	4.0	4.1

EPE: 029 Anticipated Transient Without Scram

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Anticipated Transient Without Scram:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	Reactor nucleonic and thermohydraulic behavior	3.8
EK1.02	DELETED	
EK1.03	Addition of negative reactivity	4.2
EK1.04	DELETED	
EK1.05	DELETED	
EK2	**Knowledge of the relationship between the Anticipated Transient Without Scram and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	DELETED	
EK2.04	DELETED	
EK2.05	DELETED	
EK2.06	DELETED	
EK2.07	CVCS	3.5
EK2.08	ECCS	3.7
EK2.09	ESFAS	3.9
EK2.10	AFW system	3.7
EK2.11	MT/G	3.5
EK2.12	CRDS	3.9
EK2.13	RPS	4.2
EK2.14	ATWS/mitigation system actuation circuitry (AMSAC)	4.2
EK2.15	MFW system	3.3
EK2.16	Nuclear instrumentation system (NIS)	3.5
EK2.17	Diverse scram system (BW)	4.4
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to an Anticipated Transient Without Scram:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	Verifying a reactor trip; methods	4.3
EK3.02	Starting a specific charging pump	3.1
EK3.03	Opening boron injection tank inlet and outlet valves	3.7
EK3.04	Closing the normal charging header isolation valves	3.0
EK3.05	Closing the centrifugal charging pump recirculation valve	3.6
EK3.06	Verifying a main turbine trip; methods	4.0
EK3.07	Using local turbine trip lever	3.6
EK3.08	Closing the MSIVs	3.7

EK3.09	Opening centrifugal charging pump suction valves from refueling water storage tank (RWST)	3.9	
EK3.10	Manual rod insertion	4.1	
EK3.11	Initiating emergency boration	4.3	
EK3.12	Actions contained in an EOP for ATWS	4.3	
EK3.13	Establishing minimum required AFW flow	3.9	

EA1 **Ability to operate and/or monitor the following as they apply to an Anticipated Transient Without Scram:**
(CFR: 41.7 / 45.5 / 45.6)

EA1.01	DELETED	
EA1.02	DELETED	
EA1.03	DELETED	
EA1.04	DELETED	
EA1.05	DELETED	
EA1.06	DELETED	
EA1.07	DELETED	
EA1.08	Reactor trip actuation switch	4.4
EA1.09	DELETED	
EA1.10	DELETED	
EA1.11	DELETED	
EA1.12	DELETED	
EA1.13	DELETED	
EA1.14	DELETED	
EA1.15	AFW system	3.8
EA1.16	CVCS	3.6
EA1.17	ECCS	3.8
EA1.18	ESFAS	4.0
EA1.19	MT/G	3.6
EA1.20	CRDS	4.0
EA1.21	AMSAC	3.9
EA1.22	RPS	4.1
EA1.23	NIS	3.7

EA2 **Ability to determine and/or interpret the following as they apply to an Anticipated Transient Without Scram:**

	(CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Reactor power	4.4	4.1
EA2.02	DELETED		
EA2.03	DELETED		
EA2.04	DELETED		
EA2.05	DELETED		
EA2.06	DELETED		

EA2.07	DELETED		
EA2.08	DELETED		
EA2.09	Occurrence of a main turbine trip	4.1	4.1
EA2.10	DELETED		
EA2.11	Whether rapid/emergency boration is occurring	4.1	4.2
EA2.12	Emergency feedwater (EFW)/AFW flow	3.5	4.0
EA2.13	RCS cooldown or heat up	3.9	3.9
EA2.14	Occurrence of a reactor trip	4.6	4.3

EPE: 038 Steam Generator Tube Rupture

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Steam Generator Tube Rupture:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.01	DELETED	
EK1.02	Leak rate versus pressure drop	3.7
EK1.03	Natural circulation	3.6
EK1.04	DELETED	
EK1.05	S/G PORV or main steam safety valve failing open or main steamline break on the ruptured S/G	4.1
EK1.06	Initiating an RCS cooldown before isolating the ruptured S/G	4.1
EK1.07	Continuing to feed a ruptured S/G to prevent exceeding the low level limit	3.7
EK1.08	Depressurizing the RCS	4.1
EK1.09	Releasing steam from a S/G that has water in the steamline	3.5
EK1.10	Nitrogen-16 detector behavior after a trip or during plant shutdown	3.6
EK1.11	Maximum controlled depressurization rate for affected S/G	3.8
EK1.12	Drawing secondary fluid into the RCS, using the “feed and bleed” method	3.4
EK1.13	Isolating a ruptured S/G	4.5
EK1.14	Viable alternatives for placing the plant in safe condition when condenser is not available	3.7
EK2	**Knowledge of the relationship between a Steam Generator Tube Rupture and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	DELETED	
EK2.04	DELETED	
EK2.05	DELETED	
EK2.06	DELETED	
EK2.07	DELETED	
EK2.08	Steam generator blowdown (S/GB) system	3.1
EK2.09	CVCS	3.3
EK2.10	ECCS	4.1
EK2.11	ESFAS	4.1
EK2.12	MFW system	3.3
EK2.13	Main steam system	3.6
EK2.14	PZR level control system	3.5
EK2.15	PZR pressure control system	3.6
EK2.16	RCP	3.3
EK2.17	RCS	3.8

EK2.18	RMS	3.8
EK2.19	Steam dump control system	3.6
EK2.20	SGS	3.8

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Steam Generator Tube Rupture:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	Controlling RCS pressure for equalizing pressure on primary and secondary sides of ruptured S/G	4.1
EK3.02	Actions taken in procedures for PORV operation	3.7
EK3.03	Automatic actions associated with high radioactivity in S/Gs	3.6
EK3.04	DELETED	
EK3.05	DELETED	
EK3.06	DELETED	
EK3.07	Operation of RCS loop isolation valves	2.8
EK3.08	Securing RCPs	3.6
EK3.09	Securing and/or throttling ECCS flow	4.1
EK3.10	Initiating RCS cooldown	4.2
EK3.11	Isolating the ruptured S/G	4.3
EK3.12	Maintaining isolated / ruptured S/G pressure less than maximum pressure limits	4.1
EK3.13	Maintaining isolated / ruptured S/G level within limits	4.0
EK3.14	Restoring instrument air to containment	3.1
EK3.15	Cooling and depressurizing isolated S/G	3.9
EK3.16	Actions necessary if S/G goes solid and water enters steamline	3.7

EA1	**Ability to operate and/or monitor the following as they apply to a Steam Generator Tube Rupture:** (CFR: 41.7 / 45.5 / 45.6)	
EA1.01	SGS	3.8
EA1.02	DELETED	
EA1.03	DELETED	
EA1.04	PZR pressure control system	3.8
EA1.05	DELETED	
EA1.06	DELETED	
EA1.07	DELETED	
EA1.08	Core cooling monitor	3.3
EA1.09	PZR level control system	3.7
EA1.10	RMS	3.6
EA1.11	DELETED	
EA1.12	S/GB system	3.1
EA1.13	DELETED	
EA1.14	AFW	3.8
EA1.15	DELETED	
EA1.16	Main Steam System	3.6
EA1.17	DELETED	
EA1.18	DELETED	

EA1.19	MFW System	3.3
EA1.20	DELETED	
EA1.21	CVCS	3.6
EA1.22	DELETED	
EA1.23	DELETED	
EA1.24	ECCS	4.0
EA1.25	DELETED	
EA1.26	DELETED	
EA1.27	Steam dump control system	3.7
EA1.28	DELETED	
EA1.29	DELETED	
EA1.30	Containment isolation systems	3.4
EA1.31	ESFAS	4.1
EA1.32	DELETED	
EA1.33	DELETED	
EA1.34	DELETED	
EA1.35	DELETED	
EA1.36	RCS	3.8
EA1.37	DELETED	
EA1.38	DELETED	
EA1.39	DELETED	
EA1.40	DELETED	
EA1.41	DELETED	
EA1.42	DELETED	
EA1.43	DELETED	
EA1.44	DELETED	
EA1.45	Safely parameter display system	3.5

EA2 **Ability to determine and/or interpret the following as they apply to a Steam Generator Tube Rupture:**
(CFR: 43.5 / 45.13)

		RO	SRO
EA2.01	DELETED		
EA2.02	DELETED		
EA2.03	DELETED		
EA2.04	Radiation levels	3.2	4.0
EA2.05	DELETED		
EA2.06	DELETED		
EA2.07	Plant conditions from survey of control room indications	4.0	4.0
EA2.08	DELETED		
EA2.09	Parameters used to verify natural circulation	4.2	3.8
EA2.10	DELETED		
EA2.11	DELETED		
EA2.12	DELETED		
EA2.13	DELETED		
EA2.14	DELETED		
EA2.15	RCS pressure	4.0	3.9
EA2.16	DELETED		
EA2.17	RCP restart criteria	3.6	3.1
EA2.18	Steam and/or feedwater flow for mismatched condition	3.0	3.3
EA2.19	S/G level	3.2	4.0

EA2.20	S/G pressure	3.6	3.9
EA2.21	PZR level	3.8	3.9
EA2.22	Charging / letdown flow	3.2	3.7
EA2.23	RCP operating parameters	3.0	3.2
EA2.24	Reactor coolant temperature / core exit temperature	4.0	3.6
EA2.25	PRT temperature, pressure, and setpoints	2.8	3.0

EPE: 055 Station Blackout

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Station Blackout:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	Effect of battery discharge rates on capacity	3.8
EK1.02	Natural circulation cooling	4.3
EK1.03	Turbine- and diesel-driven AFW pump availability	4.4
EK1.04	ESFAS actuation and subsequent restoration after power is restored	4.0
EK1.05	Load shedding	3.8
EK1.06	Long-term shutdown margin (SDM) management (recriticality)	3.4
EK1.07	RCP seal leakage and inventory control	4.0
EK2	**Knowledge of the relationship between the Station Blackout and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	Letdown isolation, RCP seal return, PORVs, or secondary PORVs (ARVs)	3.9
EK2.02	DELETED	
EK2.03	DELETED	
EK2.04	AFW system	4.2
EK2.05	DELETED	
EK2.06	DELETED	
EK2.07	DELETED	
EK2.08	RCS	3.8
EK2.09	AC distribution system	4.0
EK2.10	Direct current (DC) distribution system	4.0
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Station Blackout:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	Length of time for which battery capacity is designed	4.1
EK3.02	Actions contained in EOPs	4.2
EA1	**Ability to operate and/or monitor the following as they apply to a Station Blackout:** (CFR: 41.7 / 45.5 / 45.6)	
EA1.01	DELETED	
EA1.02	Manual EDG start	4.3
EA1.03	DELETED	
EA1.04	Load shedding	4.0
EA1.05	DELETED	
EA1.06	Restoration of power with one EDG	4.3

EA1.07	Restoration of power from off site	4.1	
EA1.08	PORVs or secondary PORVs (ARVs)	3.8	
EA1.09	AFW system	4.4	
EA1.10	CVCS	3.6	
EA1.11	AC electrical distribution system	4.0	

EA2	**Ability to determine and/or interpret the following as they apply to a Station Blackout:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Existing valve positioning	3.5	3.6
EA2.02	RCS core cooling through natural circulation	4.2	4.2
EA2.03	DELETED		
EA2.04	Instruments and controls operable with only DC battery power available	4.1	3.9
EA2.05	When battery is approaching a fully discharged state	4.1	3.9
EA2.06	Faults and lockouts that must be cleared before reenergizing buses	3.9	4.0
EA2.07	AFW flow	4.1	4.2
EA2.08	In-core thermocouple temperatures	3.6	4.0

EPE: 074 Inadequate Core Cooling

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Inadequate Core Cooling:** (CFR: 41.8 / 41.10 / 45.3)	
EK1.01	DELETED	
EK1.02	Potential consequences of uncovering the core	4.5
EK1.03	Processes for removing decay heat from the core	4.5
EK1.04	DELETED	
EK1.05	DELETED	
EK1.06	DELETED	
EK1.07	DELETED	
EK1.08	DELETED	
EK1.09	Calculation of volume of water added to the RCS using tank level indicators	3.3
EK1.10	RCP operation	3.7
EK1.11	Loss/degraded CCW	3.5
EK1.12	Adequate ECCS flow	4.3
EK1.13	Relationships between core exit thermocouple (CET) temperature, RCS pressure, RCP status, and Rx vessel water level	4.3
EK1.14	Containment hydrogen concentration	3.2
EK1.15	Nitrogen injection into RCS when depressurizing S/Gs	3.4
EK2	**Knowledge of the relationship between Inadequate Core Cooling and the following systems or components:** (CFR: 41.7 / 45.7)	
EK2.01	RCP	3.8
EK2.02	RCS system	4.0
EK2.03	AFW system	4.1
EK2.04	ECCS system	4.3
EK2.05	Residual heat removal system (RHRS)	3.9
EK2.06	Steam dump system (SDS)	3.6
EK2.07	Main steam system	3.4
EK2.08	DELETED	
EK2.09	DELETED	
EK2.10	DELETED	
EK2.11	DELETED	
EK2.12	DELETED	
EK2.13	DELETED	
EK2.14	CVCS	3.4
EK2.15	S/Gs	3.9
EK2.16	ESFAS	4.2
EK2.17	In-core temperature monitoring system	4.2

EK2.18	CCW	3.4
EK2.19	HRPS	3.1
EK2.20	MFW (BW)	3.5

EK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Inadequate Core Cooling:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

EK3.01	Maintaining cooldown rates within specified limits	3.7
EK3.02	Maintaining S/G level and/or pressure within specified limits	3.8
EK3.03	DELETED	
EK3.04	Stopping RCPs	3.9
EK3.05	Actuating the ECCS	4.3
EK3.06	Confirming that the PORV cycles open at the specified setpoint	3.7
EK3.07	Starting up EFW and RCPs	4.0
EK3.08	DELETED	
EK3.09	Opening the cross-connect valve from low-pressure injection (LPI) to HPI suction	3.7
EK3.10	Isolating CFTs/accumulators after discharge	3.6
EK3.11	Guidance contained in EOPs for inadequate core cooling	4.1

EA1 **Ability to operate and/or monitor the following as they apply to Inadequate Core Cooling:**
(CFR: 41.7 / 45.5 / 45.6)

EA1.01	RCS	4.0
EA1.02	DELETED	
EA1.03	DELETED	
EA1.04	Turbine bypass or atmospheric dump valves	3.8
EA1.05	PORV and/or block valve	3.9
EA1.06	RCPs	3.8
EA1.07	AFW system	4.1
EA1.08	ECCS	4.3
EA1.09	CVCS	3.5
EA1.10	Accumulators/core flood system	3.7
EA1.11	Containment/reactor building sump and its interlocks	3.5
EA1.12	DELETED	
EA1.13	SCM indicators	4.1
EA1.14	DELETED	
EA1.15	DELETED	
EA1.16	RCS CET	4.1
EA1.17	DELETED	
EA1.18	DELETED	
EA1.19	DELETED	
EA1.20	DELETED	
EA1.21	Secondary inventory makeup tank	3.3
EA1.22	DELETED	

EA1.23	PORV block valve indicators discharge control valve controllers, indicators, and lights RCS or S/G	3.8
EA1.24	DELETED	
EA1.25	DELETED	
EA1.26	DELETED	
EA1.27	DELETED	
EA1.28	DELETED	
EA1.29	Quench tank temperature, pressure, and level instrumentation	3.4
EA1.30	Reactor head vent valves	3.6
EA1.31	RHRS	3.8
EA1.32	ESFAS	4.3
EA1.33	CCWS	3.5
EA1.34	HRPS	3.4

EA2	**Ability to determine and/or interpret the following as they apply to Inadequate Core Cooling:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.01	SCM	4.3	4.3
EA2.02	Availability of main or auxiliary feedwater	4.1	4.1
EA2.03	Availability of turbine bypass valves for cooldown	3.5	3.7
EA2.04	Relationship between RCS temperature and main steam pressure (BW)	5.0	4.0
EA2.05	Trends in water levels of PZR and makeup storage tank caused by various-sized leaks in the RCS	3.8	3.6
EA2.06	Changes in PZR level due to PZR steam bubble transfer to the RCS during inadequate core cooling	4.4	4.0
EA2.07	The difference between a LOCA and inadequate core cooling from trends and indicators	4.0	4.0
EA2.08	CET and/or RCS pressure	4.1	4.2
EA2.09	RCS Th and/or Tc indication	3.9	3.9
EA2.10	Rx vessel level	4.3	4.1
EA2.11	RCP status	3.6	3.9
EA2.12	RCS cooldown rate	3.9	3.8
EA2.13	S/G pressure and level indicators	3.6	3.7

4.2 GENERIC ABNORMAL PLANT EVOLUTIONS (APEs)

APE: 001 Continuous Rod Withdrawal

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Continuous Rod Withdrawal:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Prompt criticality	3.8
AK1.02	Startup rate	4.0
AK1.03	Relationship of reactivity and reactor power to rod movement	4.1
AK1.04	Effect of continuous rod withdrawal on insertion limits and SDM	4.0
AK1.05	Effects of turbine-reactor power mismatch on rod control	3.7
AK1.06	DELETED	
AK1.07	Effects of power level and control position on flux	3.6
AK1.08	Control rod motion on S/G pressure	3.3
AK1.09	Reason for use of pulse/analog converter (determination of actual rod positions)	2.9
AK1.10	DELETED	
AK1.11	DELETED	
AK1.12	DELETED	
AK1.13	DELETED	
AK1.14	Interaction of integrated control system (ICS) control stations and the purpose, function, and modes of operation of the ICS (BW)	3.7
AK1.15	DELETED	
AK1.16	DELETED	
AK1.17	DELETED	
AK1.18	DELETED	
AK1.19	Voids coefficient	2.6
AK1.20	DELETED	
AK1.21	DELETED	
AK1.22	DELETED	
AK1.23	DELETED	
AK1.24	Effect of rod motion on PZR level	3.0
AK2	**Knowledge of the relationship between the Continuous Rod Withdrawal and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Rod bank step counters	3.4
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	Rod motion lights	3.3
AK2.06	T-ave./T-ref. deviation meter	3.4
AK2.07	Boric acid pump running lights	3.0
AK2.08	Individual rod display lights and indications	3.5

AK2.09	RCS	3.3
AK2.10	PZR	3.2
AK2.11	MT/G	3.0
AK2.12	SDS	3.0
AK2.13	NIS	3.8
AK2.14	CRDS	3.7

AK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Continuous Rod Withdrawal:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

AK3.01	DELETED	
AK3.02	TS limits on rod operability	3.8
AK3.03	Tripping the reactor	4.3
AK3.04	Matching T-ave. T-ref.	3.5

AA1 **Ability to operate and/or monitor the following as they apply to a Continuous Rod Withdrawal:**
(CFR: 41.7 / 45.5 / 45.6)

AA1.01	Bank select switch	3.7
AA1.02	Rod in-out-hold switch	4.0
AA1.03	Boric acid pump control switch	3.2
AA1.04	Operating switch for emergency boration motor-operated valve operating switch	3.4
AA1.05	Reactor trip switches	4.2
AA1.06	Rod transfer switches	3.2
AA1.07	Rod position indication (RPI)	3.7
AA1.08	RCS	3.4
AA1.09	PZR	3.3
AA1.10	MT/G	3.0
AA1.11	SDS	3.2
AA1.12	NIS	3.7
AA1.13	CRDS	3.7

AA2 **Ability to determine and/or interpret the following as they apply to Continuous Rod Withdrawal:**
(CFR: 43.5 / 45.13)

		RO	**SRO**
AA2.01	DELETED		
AA2.02	DELETED		
AA2.03	DELETED		
AA2.04	Reactor power	3.8	4.3
AA2.05	Uncontrolled rod withdrawal	4.2	4.1
AA2.06	T-ave.	3.2	3.8
AA2.07	PZR level	3.2	3.6
AA2.08	Megawatt electric	2.6	3.2
AA2.09	Rod position	3.8	3.8
AA2.10	Lights and alarms	3.4	3.4
AA2.11	PZR pressure	3.0	3.4

APE: 003 Dropped Control Rod

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Dropped Control Rod:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Turbine load reduction	3.7
AK1.02	Effects of turbine-reactor power mismatch on rod control	3.6
AK1.03	DELETED	
AK1.04	Effect on power level and/or flux	4.0
AK1.05	CVCS response to dropped rod	3.0
AK1.06	DELETED	
AK1.07	Effect of a dropped rod on insertion limits and SDM	3.8
AK1.08	DELETED	
AK1.09	DELETED	
AK1.10	DELETED	
AK1.11	DELETED	
AK1.12	DELETED	
AK1.13	ICS response	3.6
AK1.14	DELETED	
AK1.15	DELETED	
AK1.16	DELETED	
AK1.17	DELETED	
AK1.18	DELETED	
AK1.19	Rod worth	3.2
AK1.20	DELETED	
AK1.21	DELETED	
AK1.22	DELETED	
AK1.23	Multiple rod drops	4.1
AK1.24	Rod recovery rate	3.4
AK1.25	Dropped rod effect on reactor poisons and/or fuel	3.4
AK1.26	Dropped control rod during reactor startup	3.6
AK2	**Knowledge of the relationship between a Dropped Control Rod and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	Metroscope	2.9
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	CRDS	3.6
AK2.07	RPI	3.7
AK2.08	NIS	3.9
AK2.09	CVCS	3.0
AK2.10	MT/G	3.1

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to the Dropped Control Rod:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)		
AK3.01	Manual power reduction on ICS failure	3.8	
AK3.02	Automatic runback with a dropped rod (BW)	4.0	
AK3.03	DELETED		
AK3.04	Contained in procedures	3.7	
AK3.05	Limits for reduction of load	3.5	
AK3.06	Reset of demand position counter to zero	3.4	
AK3.07	DELETED		
AK3.08	DELETED		
AK3.09	DELETED		
AK3.10	Insertion limits	3.6	
AK3.11	Tripping the reactor	4.1	
AA1	**Ability to operate and/or monitor the following as they apply to a Dropped Control Rod:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	DELETED		
AA1.02	DELETED		
AA1.03	DELETED		
AA1.04	DELETED		
AA1.05	DELETED		
AA1.06	DELETED		
AA1.07	DELETED		
AA1.08	CRDS	3.7	
AA1.09	NIS	3.8	
AA1.10	RPI	3.8	
AA1.11	CVCS	2.9	
AA1.12	MT/G	3.1	
AA2	**Ability to determine and/or interpret the following as they apply to a Dropped Control Rod:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	RPI	3.7	4.0
AA2.02	DELETED		
AA2.03	DELETED		
AA2.04	Rod stop due to dropped rod (BW)	2.0	3.5
AA2.05	DELETED		
AA2.06	Ex-core NIS	3.6	3.8
AA2.07	In-core NIS	3.5	3.4
AA2.08	RPI	3.7	3.9
AA2.09	CET	2.7	3.2
AA2.10	Reactor power	3.8	4.0
AA2.11	RCS pressure and temperature	3.5	3.8

APE: 005 Inoperable/Stuck Control Rod

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to an Inoperable/Stuck Control Rod:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Axial power imbalance	4.0
AK1.02	Flux tilt	4.0
AK1.03	Xenon transient	3.7
AK1.04	Neutron error, power demand, and/or actual power tracking mode (BW)	3.7
AK1.05	SDM	4.0
AK1.06	Bases for power limit, for rod misalignment	3.8
AK1.07	Reactor Cutback (CE)	3.8
AK2	**Knowledge of the relationship between the Inoperable/Stuck Control Rod and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	Metroscope	3.1
AK2.04	DELETED	
AK2.05	CRDS	3.7
AK2.06	RPI	3.8
AK2.07	NIS	3.9
AK2.08	CVCS	2.8
AK2.09	MT/G	2.9
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to an Inoperable/Stuck Control Rod:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Boration and/or emergency boration in the event of a stuck rod during trip or normal evolutions	4.1
AK3.02	Rod insertion limits	3.9
AK3.03	Rod mismatch	3.7
AK3.04	Inoperable rods	3.9
AK3.05	Power limits on rod misalignment	3.9
AK3.06	Actions contained in procedures for inoperable/stuck control rod	4.0

AA1	**Ability to operate and/or monitor the following as they apply to an Inoperable/Stuck Control Rod:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	CRDS	3.7	
AA1.02	DELETED		
AA1.03	Metroscope	2.9	
AA1.04	NIS	3.9	
AA1.05	RPI	3.8	
AA1.06	CVCS	3.0	
AA1.07	MT/G	2.9	

AA2	**Ability to determine and/or interpret the following as they apply to Inoperable/Stuck Control Rod:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	In-core NIS	3.4	3.6
AA2.02	Rod speed	2.3	2.9
AA2.03	DELETED		
AA2.04	CET	3.3	3.1
AA2.05	Ex-core NIS	3.8	3.9
AA2.06	Axial flux difference and/or quadrant power tilt ratio	3.8	4.0
AA2.07	RPI	3.7	3.7

APE: 008 Pressurizer Vapor Space Accident

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Pressurizer Vapor Space Accident:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Thermodynamics and flow characteristics of open or leaking PZR PORV or safety valves	4.1
AK1.02	DELETED	
AK1.03	Consequences due to a PZR vapor space leak	4.0
AK1.04	Expected RCS response from an open PORV or code safety	4.1
AK1.05	Probable PZR steam space leakage paths other than PORV or code safety	3.6
AK1.06	Effects on indicated PZR pressure and/or level of sensing line leakage	3.7
AK1.07	Expected RCS response from an open PORV or code safety	3.7
AK2	**Knowledge of the relationship between the Pressurizer Vapor Space Accident and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	RCS	3.9
AK2.06	CVCS/makeup and purification system	3.3
AK2.07	PZR level control system (LCS)	3.6
AK2.08	PZR pressure control system (PCS)	3.8
AK2.09	PRT/quench tank	3.8
AK2.10	PZR PORVs	4.0
AK2.11	PZR safeties	4.0
AK2.12	Safety parameter display system	3.5
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Pressurizer Vapor Space Accident:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	DELETED	
AK3.02	DELETED	
AK3.03	Actions contained in EOPs/abnormal operating procedures (AOPs) for a PZR vapor space accident or LOCA	4.1
AK3.04	RCP tripping requirements	3.5
AK3.05	ECCS termination or throttling criteria	3.9

AA1	**Ability to operate and/or monitor the following as they apply to a Pressurizer Vapor Space Accident:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	PZR spray block valve and PORV block valve	4.0	
AA1.02	CVCS system to control PZR level/pressure	3.6	
AA1.03	DELETED		
AA1.04	DELETED		
AA1.05	ECCS	4.0	
AA1.06	PZR LCS	3.5	
AA1.07	DELETED		
AA1.08	DELETED		

AA2	**Ability to determine and/or interpret the following as they apply to Pressurizer Vapor Space Accident:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	RCS pressure and temperature	4.0	4.1
AA2.02	PZR spray valve position	3.0	3.6
AA2.03	PZR PORV and/or safety valve position	3.5	4.0
AA2.04	Tailpipe temperature	4.0	4.1
AA2.05	PORV block valve position	3.5	3.9
AA2.06	PORV logic control under low-pressure conditions	3.0	3.4
AA2.07	DELETED		
AA2.08	DELETED		
AA2.09	DELETED		
AA2.10	DELETED		
AA2.11	DELETED		
AA2.12	PZR level	3.5	3.8
AA2.13	DELETED		
AA2.14	Subcooling	4.0	3.9
AA2.15	ECCS status	3.5	3.9
AA2.16	RCS in-core thermocouples	3.0	3.6
AA2.17	DELETED		
AA2.18	DELETED		
AA2.19	DELETED		
AA2.20	The effect of an open PORV or code safety based on observation of plant parameters	3.0	4.0
AA2.21	DELETED		
AA2.22	DELETED		
AA2.23	Controlling high-pressure makeup for maintaining inventory	2.5	3.8
AA2.24	DELETED		
AA2.25	DELETED		
AA2.26	DELETED		
AA2.27	PZR pressure and/or level due to sensing line leakage	3.5	3.6
AA2.28	DELETED		
AA2.29	DELETED		
AA2.30	DELETED		
AA2.31	Reseating of code safety and PORV	3.5	3.5
AA2.32	PRT level, pressure, and temperature	3.5	3.5

APE: 015 Reactor Coolant Pump Malfunctions

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Reactor Coolant Pump Malfunctions:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Natural circulation	3.9
AK1.02	Consequences of an RCP failure	3.9
AK1.03	The basis for operating at a reduced power level when one RCP is out of service	3.4
AK1.04	Basic steady-state thermodynamic relationship between RCS loops and S/Gs resulting from unbalanced RCS flow	3.4
AK1.05	Effects of unbalanced RCS flow on in-core average temperature, core imbalance, and quadrant power tilt	3.4
AK1.06	RCP flywheel	3.3
AK2	**Knowledge of the relationship between the Reactor Coolant Pump Malfunctions and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	RCP seals	3.8
AK2.08	CCWS	3.5
AK2.09	RCP flywheel	3.2
AK2.10	DELETED	
AK2.11	AC electrical distribution (transformer)	3.2
AK2.12	RCS pressure control valves	3.5
AK2.13	Seal return and injection valves	3.5
AK2.14	Thermal barrier valves	3.4
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Reactor Coolant Pump Malfunctions:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	RCP trip criteria	4.1
AK3.02	DELETED	
AK3.03	Sequence of events for manually tripping reactor and RCP as a result of an RCP malfunction	3.9
AK3.04	Reduction of power to below the steady-state power-to-flow limit	3.2

AK3.05	Shift of T-ave. sensors to the loop with the highest flow (BW)	3.2	
AK3.06	Performance of a core power map, calculations of quadrant power tilt, and monitoring of core imbalance (BW)	3.2	
AK3.07	Ensuring that S/G levels are controlled properly for natural circulation enhancement	3.7	
AK3.08	Actions contained in AOPs for RCP malfunction	3.8	
AA1	**Ability to operate and/or monitor the following as they apply to Reactor Coolant Pump Malfunctions:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	RCP lube oil system	3.1	
AA1.02	RCP oil reservoir level and alarm indicators	3.2	
AA1.03	Reactor trip alarms, switches, or indicators	3.9	
AA1.04	RCP ventilation	2.9	
AA1.05	DELETED		
AA1.06	CCWS	3.5	
AA1.07	RCP seal water injection	3.7	
AA1.08	S/G level control system	3.3	
AA1.09	DELETED		
AA1.10	DELETED		
AA1.11	RCP lights or alarms	3.4	
AA1.12	DELETED		
AA1.13	DELETED		
AA1.14	DELETED		
AA1.15	High-power/low-flow reactor trip block status	3.4	
AA1.16	Low-power reactor trip block status	3.3	
AA1.17	DELETED		
AA1.18	Station auxiliary power supply breakers and indicators	3.0	
AA1.19	DELETED		
AA1.20	DELETED		
AA1.21	DELETED		
AA1.22	RCP seal failure	4.0	
AA1.23	DELETED		
AA1.24	RCP seal cooling	3.8	

AA2	**Ability to determine and/or interpret the following as they apply to Reactor Coolant Pump Malfunctions:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Cause of RCP failure	3.8	3.5
AA2.02	RCP oil system temperature and pressure	3.4	3.0
AA2.03	DELETED		
AA2.04	DELETED		
AA2.05	Relationship between RCP ammeter readings and RCS average temperature	2.6	2.6
AA2.06	DELETED		
AA2.07	Expected values of flow or temperature in the loop with the RCP secured	3.0	3.2
AA2.08	RCP high bearing temperature	3.4	3.4
AA2.09	RCP high stator temperature	3.3	3.4

AA2.10	Loss of cooling or seal injection	3.4	3.8
AA2.11	DELETED		
AA2.12	RCS flow	3.8	3.5
AA2.13	RCS and/or loop temperature	3.6	3.4
AA2.14	RCP ammeter	3.3	2.9
AA2.15	Reactor power	3.0	3.6
AA2.16	Natural circulation flow	3.2	3.8
AA2.17	RCP vibration	3.2	3.5

APE: 017 Reactor Coolant Pump Malfunctions (Loss of RC Flow)

K/A NO.	KNOWLEDGE	IMPORTANCE

This APE was DELETED, with applicable K/As moved to APE 015, “Reactor Coolant Pump Malfunctions”

APE: **022 Loss of Reactor Coolant Makeup**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Reactor Coolant Makeup:** (CFR: 41.8 / 41.10 / 45.3 / 45.5)	
AK1.01	Consequences of thermal shock to RCP seals	3.6
AK1.02	Relationship of charging flow to pressure differential between charging and RCS	3.3
AK1.03	Relationship between charging flow and PZR level	3.6
AK1.04	Changing from manual to automatic control of charging flow valve controller	3.3
AK1.05	How long a PZR level can be maintained within limits	3.5
AK2	**Knowledge of the relationship between the Loss of Reactor Coolant Makeup and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	CCWS	3.2
AK2.08	RCS	3.8
AK2.09	CVCS	3.9
AK2.10	PZR LCS	3.8
AK2.11	RCPS	3.5
AK2.12	RWST	3.3
AK2.13	ECCS	3.5
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Reactor Coolant Makeup:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Adjustment of RCP seal backpressure regulator valve to obtain normal flow	3.4
AK3.02	Actions contained in AOPs	3.7
AK3.03	Establishing excess letdown	3.3
AK3.04	Isolating letdown	3.7
AK3.05	Avoiding plant transients	3.5
AK3.06	DELETED	
AK3.07	Isolating charging	3.4

AA1	**Ability to operate and/or monitor the following as they apply to a Loss of Reactor Coolant Makeup:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	CVCS	3.8	
AA1.02	DELETED		
AA1.03	DELETED		
AA1.04	Speed demand controller and running indicators (positive displacement pump)	3.5	
AA1.05	RCP seal back pressure regulator valves	3.3	
AA1.06	DELETED		
AA1.07	Excess letdown containment isolation valves	3.1	
AA1.08	DELETED		
AA1.09	DELETED		

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Reactor Coolant Makeup:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Whether charging line leak exists	3.3	3.8
AA2.02	Charging pump problems	3.5	3.7
AA2.03	Failures of flow control valve or controller	3.5	3.6
AA2.04	PZR level	3.8	3.8
AA2.05	RCP seal flow	3.3	3.7
AA2.06	CVCS charging pump ammeters	3.0	3.3
AA2.07	Volume control tank (VCT) level	3.8	3.7
AA2.08	RCP seal flows, temperatures, pressures, and vibrations	3.0	3.7

APE: **024 Emergency Boration**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Emergency Boration:** (CFR: 41.6 / 41.7 / 41.8 / 41.10 / 45.3)	
AK1.01	Relationship between boron addition and change in T-ave.	3.9
AK1.02	Relationship between boron addition and reactor power	4.1
AK1.03	DELETED	
AK1.04	Low-temperature limits for boron concentration	3.2
AK2	**Knowledge of the relationship between the Emergency Boration and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	CVCS	4.1
AK2.08	RWST	3.8
AK2.09	RCS	3.9
AK2.10	RPIS	3.2
AK2.11	Spent fuel pool	3.0
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Emergency Boration:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	When emergency boration is required	4.4
AK3.02	Actions contained in EOPs/AOPs for emergency boration	4.1
AA1	**Ability to operate and/or monitor the following as they apply to Emergency Boration:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Use of the spent fuel pool as backup to the borated water storage tank (BWST)	2.8
AA1.02	Boric acid pump	3.7
AA1.03	Boric acid controller	3.5
AA1.04	Manual boration valve	3.7
AA1.05	Letdown system	3.3
AA1.06	DELETED	
AA1.07	DELETED	

AA1.08	DELETED		
AA1.09	SI	3.5	
AA1.10	CVCS centrifugal charging pumps	3.9	
AA1.11	Boron injection tank inlet, outlet, and recirculation valves	3.3	
AA1.12	DELETED		
AA1.13	DELETED		
AA1.14	RCS makeup isolation valve	3.3	
AA1.15	DELETED		
AA1.16	DELETED		
AA1.17	Emergency borate control valve	4.1	
AA1.18	DELETED		
AA1.19	Makeup control system selector switch for CVCS isolation valve	3.3	
AA1.20	DELETED		
AA1.21	DELETED		
AA1.22	DELETED		
AA1.23	DELETED		
AA1.24	DELETED		
AA1.25	DELETED		
AA1.26	Boric acid storage tank	3.7	
AA1.27	CVCS	3.9	
AA1.28	RWST	3.7	
AA1.29	RCS	3.7	
AA1.30	RPIS	3.1	
AA1.31	Spent fuel pool	2.9	

AA2	**Ability to determine and/or interpret the following as they apply to Emergency Boration:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Whether boron flow and/or motor-operated valves are malfunctioning from plant conditions	3.7	4.0
AA2.02	When use of manual boration valve is needed	3.8	4.0
AA2.03	Correlation between boric acid controller setpoint and boric acid flow	3.0	3.5
AA2.04	Availability of the BWST	3.3	3.7
AA2.05	Amount of boron to add to achieve required SDM	3.3	3.9
AA2.06	When boron dilution is taking place	3.5	3.9
AA2.07	Calculation of boration time	3.0	3.4
AA2.08	BWST temperature	2.8	3.1
AA2.09	BWST level	3.0	3.3
AA2.10	Normal boron flow	2.8	3.4
AA2.11	T-ave.	3.2	3.6
AA2.12	Emergency boron flow	3.5	4.0

APE: 025 Loss of Residual Heat Removal System

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of the Residual Heat Removal System:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Core cooling	4.2
AK1.03	RHR pump cavitation	3.8
AK1.04	Loss of inventory while at reduced inventory	4.3
AK1.05	RHR gas binding	3.8
AK1.06	Time to boiling determinations	3.8
AK1.07	RHR pump flow versus level	3.7
AK1.08	Decay heat removal	3.9
AK2	**Knowledge of the relationship between the Loss of the Residual Heat Removal System and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	RHR	4.0
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	LRS	3.3
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	DELETED	
AK2.09	DELETED	
AK2.10	DELETED	
AK2.11	DELETED	
AK2.12	DELETED	
AK2.13	RCS	3.9
AK2.14	PRT	2.9
AK2.15	Process radiation monitor (PRM)	3.0
AK2.16	Area radiation monitor (ARM)	2.9
AK2.17	SGS	3.2
AK2.18	AFW	3.2
AK2.19	CVCS	3.4
AK2.20	ECCS	3.8
AK2.21	CCWS	3.7
AK2.22	PZR, RCS, and reactor head vent valves	3.2
AK2.23	AC electrical system	3.5
AK2.24	PZR pressure and LCS	3.3

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of the Residual Heat Removal System:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Shift to alternate flowpath	3.8
AK3.02	Isolating potential leakage paths	3.6
AK3.03	DELETED	
AK3.04	Securing RHR pumps	3.7
AK3.05	Isolating containment	3.8
AK3.06	Start an RHR pump	3.8
AK3.07	Restoring RHR flow	4.0
AK3.08	Verifying capability for ECCS while in RHR cooling mode	3.5
AK3.09	Verification of natural circulation	3.6
AA1	**Ability to operate and/or monitor the following as they apply to a Loss of the Residual Heat Removal System:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	CETs	3.8
AA1.02	RCS	3.7
AA1.03	RHR	4.0
AA1.04	DELETED	
AA1.05	DELETED	
AA1.06	Not Used	
AA1.07	Not Used	
AA1.08	DELETED	
AA1.09	DELETED	
AA1.10	DELETED	
AA1.11	LRS	3.1
AA1.12	DELETED	
AA1.13	DELETED	
AA1.14	DELETED	
AA1.15	DELETED	
AA1.16	DELETED	
AA1.17	DELETED	
AA1.18	DELETED	
AA1.19	DELETED	
AA1.20	ECCS	
AA1.21	DELETED	
AA1.22	Obtaining water from the BWST for the LPI system	3.3
AA1.23	DELETED	
AA1.24	PRT	2.9
AA1.25	PRM	2.9
AA1.26	ARM	2.9
AA1.27	SGS	3.3
AA1.28	AFW	3.4
AA1.29	CVCS	3.6
AA1.30	CCWS	3.6
AA1.31	Containment	3.5

		RO	SRO
AA2	**Ability to determine and/or interpret the following as they apply to Loss of the Residual Heat Removal System:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	Leakage of reactor coolant from RHR into closed cooling water system or into reactor building atmosphere	3.6	3.8
AA2.03	Increasing reactor building sump level	3.6	3.9
AA2.04	Location of leaks and ability to isolate them	2.8	3.9
AA2.05	Limitations on LPI flow and temperature rates of change	3.4	3.5
AA2.06	RHR overpressure protection valve status	3.4	3.8
AA2.07	Pump cavitation	3.6	4.0
AA2.08	RHR heat exchange inlet and outlet temperatures	3.0	3.5
AA2.09	Lights and alarms	3.0	3.5
AA2.10	RCS and/or core temperature	3.6	4.0
AA2.11	Letdown flow	2.8	3.3
AA2.12	Reactor vessel level	4.0	4.1
AA2.13	RHR flow	3.8	3.9
AA2.14	Mid loop level	3.8	4.1
AA2.15	Refueling water cavity level	3.8	3.7
AA2.16	Secondary heat sink status	2.8	3.7
AA2.17	Applicable to technical specifications (TS)	3.2	4.1
AA2.18	Implement emergency plan as applicable	3.4	4.2
AA2.19	Conditions requiring evacuation of personnel from containment	3.6	4.1

APE: 026 Loss of Component Cooling Water

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Component Cooling Water:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.01	Leakage into or out of the CCWS	3.6
AK1.02	Loss of cooling to the CCWS	3.8
AK1.03	Loss of CCWS to CVCS charging pumps and/or letdown heat exchanger	3.7
AK1.04	Loss of CCWS to RCPs	4.1
AK1.05	Loss of CCWS to RHR	3.8
AK1.06	Loss of CCWS to the spent fuel pool cooling system (SFPCS)	3.6
AK1.07	The effect a loss of CCW has on CCW header flow	3.3
AK2	**Knowledge of the relationship between the Loss of Component Cooling Water and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.01	CVCS	3.6
AK2.02	RCPs	4.2
AK2.03	RHR	3.8
AK2.04	SFPCS	3.6
AK2.05	RMS	3.0
AK2.06	Chilled water system	2.7
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Component Cooling Water:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	The conditions that will initiate the automatic opening and closing of the SWS isolation valves to the CCWS coolers	3.3
AK3.02	The automatic actions (alignments) within the CCWS resulting from the actuation of the ESFAS	3.9
AK3.03	Guidance actions contained in EOPs for loss of CCW	3.8
AK3.04	DELETED	
AK3.05	Tripping the reactor	4.1
AK3.06	Reducing CCW loads	3.4
AK3.07	Verifying CCW temperature below high temperature limit	3.4
AK3.08	Verifying CCW adequate surge tank level	3.4
AK3.09	Stopping RCPs	4.1
AK3.10	Verifying adequate and stable CCWS surge tank level	3.4
AK3.11	Isolating CVCS letdown heat exchanger	3.4

AA1	**Ability to operate and/or monitor the following as they apply to a Loss of Component Cooling Water:** (CFR: 41.5 / 41.7 / 45.5 to 45.8)		
AA1.01	CCW temperature indications	3.3	
AA1.02	Loads on the CCWS in the control room	3.5	
AA1.03	SWS as a backup to the CCWS	3.3	
AA1.04	Control rod drive motor (CRDM) high-temperature alarm system (BW)	3.6	
AA1.05	The CCWS surge tank, including level control, level alarms, and a radiation alarm	3.5	
AA1.06	Control of flow rates to components cooled by the CCWS	3.1	
AA1.07	DELETED		

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Component Cooling Water:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Location of a leak in the CCWS	3.4	3.5
AA2.02	The cause of possible CCW loss	3.6	3.5
AA2.03	The valve lineups necessary to restart the CCWS while bypassing the portion of the system causing the abnormal condition	3.0	3.1
AA2.04	The normal values and upper limits for the temperatures of the components cooled by CCW	2.8	3.3
AA2.05	The normal values for CCW-header flow rate and the flow rates to the components cooled by the CCWS	3.0	3.1
AA2.06	The length of time after the loss of CCW flow to a component before that component may be damaged	3.8	3.3

APE: 027 Pressurizer Pressure Control System Malfunction

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Pressurizer Pressure Control System Malfunction:** (CFR: 41.8 / 41.10 / 41.7 / 45.3)	
AK1.01	Saturation temperature	3.4
AK1.02	Expansion of liquids as temperature increases	3.2
AK1.03	Latent heat of vaporization / condensation	3.2
AK1.04	Why, if the PZR level is lost and then restored, that pressure recovers much more slowly	3.2
AK1.05	Tech Spec limits for RCS pressure	4.1
AK2	**Knowledge of the relationship between the Pressurizer Pressure Control System Malfunction and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	RCS	3.8
AK2.07	PZR LCS	3.6
AK2.08	PZR heaters	3.9
AK2.09	PZR spray	4.0
AK2.10	PZR pressure transmitters	3.7
AK2.11	PZR relief valves (PORVs)	3.9
AK2.12	PZR code safety valves	3.7
AK2.13	PZR master pressure controller	3.9
AK2.14	RCP	3.4
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Pressurizer Pressure Control System Malfunction:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Isolation of PZR spray following loss of PZR heaters	3.8
AK3.02	DELETED	
AK3.03	Actions contained in AOPs for a PZR PCS malfunction	3.9
AK3.04	DELETED	
AK3.05	Actions to be taken if the PZR pressure instrument fails high	4.0
AK3.06	Actions to be taken if the PZR pressure instrument fails low	3.9

AA1	**Ability to operate and/or monitor the following as they apply to a Pressurizer Pressure Control System Malfunction:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	PZR heaters, sprays, and PORVs	3.8	
AA1.02	DELETED		
AA1.03	Pressure control when on a steam bubble	3.8	
AA1.04	Pressure recovery using emergency-only heaters	3.5	
AA1.05	Transfer of heaters to a backup power supply	3.3	
AA1.06	Operable control channel	3.6	

AA2	**Ability to determine and/or interpret the following as they apply to a Pressurizer Pressure Control System Malfunction:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Conditions that will cause an increase in the PZR level	3.5	3.5
AA2.02	DELETED		
AA2.03	Effects of RCS pressure changes on key components in the plant	3.3	3.4
AA2.04	DELETED		
AA2.05	DELETED		
AA2.06	DELETED		
AA2.07	Makeup flow indication	3.3	3.4
AA2.08	Letdown flow indication	3.3	3.4
AA2.09	Reactor power	4.0	3.4
AA2.10	PZR heater energized/deenergized condition	3.8	3.5
AA2.11	RCS pressure	4.0	3.8
AA2.12	PZR level	3.5	3.7
AA2.13	Seal return flow	3.3	3.1
AA2.14	RCP seal injection flow	3.0	3.3
AA2.15	DELETED		
AA2.16	DELETED		
AA2.17	DELETED		
AA2.18	DELETED		

APE: 028 Pressurizer Level Control Malfunction

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Pressurizer Level Control Malfunction:** (CFR: 41.7 / 41.8 / 41.10 / 45.3)	
AK1.01	PZR reference leg leak abnormalities	3.5
AK1.02	Cause for PZR level deviation alarm: controller malfunction or other instrumentation malfunction	3.6
AK2	**Knowledge of the relationship between the Pressurizer Level Control Malfunction and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	RCS	3.4
AK2.09	PZR PCS	3.5
AK2.10	Normal PZR level instrumentation	3.7
AK2.11	Cold calibration PZR level instrumentation	3.0
AK2.12	CVCS	3.7
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Pressurizer Level Control Malfunction:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	Relationship between the letdown flow rate and capacity rating of orifices	3.2
AK3.02	PZR pressure change from reactor makeup/letdown imbalance	3.2
AK3.03	False indication of PZR level when PORV or spray valve is open and RCS is saturated	3.8
AK3.04	Change in PZR level with power change even though RCS	3.5
AK3.05	Actions contained in AOPs for PZR level malfunction	3.9
AA1	**Ability to operate and/or monitor the following as they apply to a Pressurizer Level Control Malfunction:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	PZR level reactor protection bistables	3.7
AA1.02	DELETED	

AA1.03	RCP and seal water system	3.1	
AA1.04	Regenerative heat exchanger and temperature limits	3.0	
AA1.05	Initiation of excess letdown	3.1	
AA1.06	DELETED		
AA1.07	DELETED		
AA1.08	Selection of an alternate PZR level channel if one has failed	3.8	
AA1.09	Auto/manual control of PZR level	3.7	
AA1.10	Ammeters and running indicators for CVCS charging pumps	2.9	
AA1.11	PZR B/U heater status based on PZR level above / below program	3.4	

AA2	**Ability to determine and/or interpret the following as they apply to a Pressurizer Level Control Malfunction:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	PZR level	4.0	3.8
AA2.02	PZR level as a function of power level, T-ave., Tc, or the appropriate parameter from which the PZR level is programmed	3.2	3.7
AA2.03	Charging flow	3.4	3.6
AA2.04	DELETED		
AA2.05	DELETED		
AA2.06	Letdown flow	3.2	3.6
AA2.07	Seal water flow	2.7	3.5
AA2.08	DELETED		
AA2.09	DELETED		
AA2.10	DELETED		
AA2.11	Leak in PZR	4.0	3.7
AA2.12	DELETED		
AA2.13	The actual PZR level, given an uncompensated level with an appropriate graph	2.6	3.3
AA2.14	DELETED		
AA2.15	PZR level reactor protection bistables	3.0	3.9
AA2.16	RCS leaks	3.4	3.7
AA2.17	Evaluate the TS for PZR level control malfunction	3.2	3.8

APE: 032 Loss of Source Range Nuclear Instrumentation

K/A NO.	KNOWLEDGE	IMPORTANCE	
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Source Range Nuclear Instrumentation:** (CFR: 41.8 / 41.10 / 45.3)		
AK1.01	Effects of voltage changes on performance	2.9	
AK1.02	Expected change in source-range count rate when rods are moved	3.7	
AK2	**Knowledge of the relationship between the Loss of Source Range Nuclear Instrumentation and the following systems or components:** (CFR: 41.7 / 45.7)		
AK2.01	Power supplies	3.2	
AK2.02	Intermediate/log power detectors	3.2	
AK2.03	RPS	3.9	
AK2.04	Rod control system	3.2	
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Source Range Nuclear Instrumentation:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)		
AK3.01	Termination of startup following loss of source-range instrumentation	3.9	
AK3.02	Guidance contained in procedures for loss of source range nuclear instrumentation	3.5	
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Source Range Nuclear Instrumentation:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	Manual restoration of power	2.9	
AA1.02	RPS	3.7	
AA1.03	Rod control system	3.3	
AA2	**Ability to determine and/or interpret the following as they apply to Loss of Source Range Nuclear Instrumentation:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Normal and/or abnormal power supply operation	2.7	3.0
AA2.02	DELETED		

AA2.03	Expected values of source-range indication when high voltage is automatically removed	2.5	2.9
AA2.04	Satisfactory source-range/intermediate-range overlap	3.7	3.7
AA2.05	DELETED		
AA2.06	Confirmation of reactor trip	3.7	4.1
AA2.07	Maximum allowable channel disagreement	3.5	3.3
AA2.08	DELETED		
AA2.09	Effect of improper high voltage setting	3.2	3.0
AA2.10	Source-range level	3.0	3.4

APE: 033 Loss of Intermediate Range Nuclear Instrumentation

K/A NO.	KNOWLEDGE	IMPORTANCE	
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Intermediate Range Nuclear Instrumentation:** (CFR: 41.8 / 41.10 / 45.3)		
AK1.01	Effects of voltage changes on performance	2.9	
AK1.02	Equivalency and/or overlap between source-range, intermediate-range, and power-range channel readings	3.5	
AK2	**Knowledge of the relationship between a Loss of Intermediate Range Nuclear Instrumentation and the following systems or components:** (CFR: 41.7 / 45.7)		
AK2.01	Power supplies	3.1	
AK2.02	Sensors and detectors	2.9	
AK2.03	RPS	3.8	
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Intermediate Range Nuclear Instrumentation:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)		
AK3.01	Termination of startup following loss of intermediate range instrumentation	3.6	
AK3.02	Guidance contained in procedures for loss of intermediate-range nuclear instrumentation	3.5	
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Intermediate Range Nuclear Instrumentation:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	DELETED		
AA1.02	Level trip bypass	3.3	
AA1.03	Manual restoration of power	2.9	
AA2	**Ability to determine and/or interpret the following as they apply to Loss of Intermediate Range Nuclear Instrumentation:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Equivalency between source range, intermediate range, and power range channel readings	3.0	3.4
AA2.02	Intermediate range detector failure	3.3	3.5
AA2.03	Normal and/or abnormal power supply operation	2.7	3.0
AA2.04	DELETED		

AA2.05	DELETED		
AA2.06	DELETED		
AA2.07	Confirmation of reactor trip	3.9	4.1
AA2.08	Intermediate range channel operability	3.3	3.6
AA2.09	Conditions that allow the bypass of an intermediate range level trip switch	3.5	3.4
AA2.10	TS limits if both intermediate range channels have failed	4.2	3.9
AA2.11	DELETED		
AA2.12	Maximum allowable channel disagreement	3.1	3.2
AA2.13	Testing required if power is lost and then restored	2.3	2.9
AA2.14	Intermediate range level	3.0	3.2

APE: 036 Fuel Handling Incidents

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Fuel-Handling Incidents:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Radiation exposure hazards	3.7
AK1.02	SDM	3.5
AK1.03	Indications of approaching criticality	3.9
AK1.04	Refueling water level	3.6
AK1.05	Damage to irradiated fuel in the fuel storage building	3.7
AK1.06	Damage to irradiated fuel in the containment	3.7
AK2	**Knowledge of the relationship between the Fuel-Handling Incidents and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Fuel-handling equipment system	3.3
AK2.02	Radiation monitoring equipment (portable and installed)	3.6
AK2.03	Containment isolation valves	3.7
AK2.04	Containment equipment and personnel hatches	3.4
AK2.05	Fuel-handling building air filtration equipment	3.4
AK2.06	RHRS	3.3
AK2.07	Fuel-handling area normal ventilation equipment	3.1
AK2.08	Containment purge ventilation system	3.4
AK2.09	Spent fuel pool makeup	3.5
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Fuel-Handling Incidents:** (CFR: 41.10 / 45.6 / 45.13)	
AK3.01	Containment and/or fuel-handling building evacuation	3.8
AK3.02	DELETED	
AK3.03	DELETED	
AK3.04	Establishing containment isolation or closure	3.9
AK3.05	Establishing ventilation alignments	3.6
AK3.06	Placing fuel in a safe location	3.9
AK3.07	Refueling water level	3.6
AA1	**Ability to operate and/or monitor the following as they apply to a Fuel-Handling Incidents:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Containment purge ventilation system	3.4
AA1.02	ARM system	3.3
AA1.03	Containment evacuation alarm	3.5

AA1.04	Fuel-handling equipment during an incident	3.3	
AA1.05	Fuel-handling building air filtration equipment	3.2	
AA1.06	Containment isolation valves and/or hatches	3.6	

AA2	**Ability to determine and/or interpret the following as they apply to Fuel-Handling Incidents:** (CFR: 41.7 / 43.5 / 43.7 / 45.13)	**RO**	**SRO**
AA2.01	Radiation monitoring equipment indications	3.1	3.7
AA2.02	Occurrence of a fuel-handling incident	3.3	3.8
AA2.03	Magnitude of potential radioactive release	3.5	3.5
AA2.04	Containment ventilation isolation	3.4	3.7
AA2.05	Containment isolation/closure	3.6	3.8
AA2.06	Refueling water level	3.4	3.6

APE: 037 Steam Generator Tube Leak

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Steam Generator Tube Leak:** (CFR: 41. 5 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Leak rate versus differential pressure (D/P) across the tube	3.8
AK1.03	Maintaining PZR level within limits	3.7
AK1.04	Magnitude of the tube leakage	3.8
AK1.05	Cooldown rate and/or depressurization rate limits (Reference Potential)	3.6
AK1.06	Failure to maintain S/G water level above S/G tubes	3.7
AK1.07	When to isolate S/Gs	4.2
AK1.08	Effect on magnitude of atmospheric radioactive release if cooldown must be completed using steam dump or atmospheric reliefs	3.7
AK2	**Knowledge of the relationship between the Steam Generator Tube Leak and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	Auxiliary steam system	2.9
AK2.09	Blowdown system	3.2
AK2.10	Condensate system (CDS)	3.1
AK2.11	CVCS	3.4
AK2.12	Engineered safeguard actuation system (ESAS)	4.0
AK2.13	MFW system	3.3
AK2.14	Main steam system	3.6
AK2.15	PZR LCS	3.7
AK2.16	PZR PCS	3.6
AK2.17	RCS	3.7
AK2.18	RMS	3.7
AK2.19	SGS	3.6
AK2.20	LRS	3.0
AK2.21	Secondary sampling system	3.1
AK2.22	Steam dumps	3.5
AK2.23	Main turbine	2.6
AK2.24	AFW system	3.7

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Steam Generator Tube Leak:** (CFR: 41.5 / 41.7 /41.10 / 45.6 / 45.13)	
AK3.01	DELETED	
AK3.02	Reset and check of condensate air ejector exhaust monitor	3.3
AK3.03	Comparison of makeup flow and letdown flow for various modes of operation	3.5
AK3.04	Use of “feed and bleed” process	3.2
AK3.05	Actions contained in procedures for radiation monitoring, RCS water inventory balance, S/G tube failure, and plant shutdown	3.8
AK3.06	Procedural actions to preclude or minimize S/G tube rupture	3.9
AK3.07	Actions contained in procedures for S/G tube leak	4.0
AK3.08	DELETED	
AK3.09	Selecting rate of load reduction	3.2
AK3.10	Automatic actions associated with high radioactivity in S/G sample lines	3.5
AK3.11	Maintaining PZR level above minimum program level	3.6
AK3.12	Checking charging pump suction aligned to the VCT	3.0
AK3.13	Actions to minimize spread of secondary contamination	3.5
AK3.14	Isolation of affected S/G	4.3
AK3.15	Blocking the SI before cooldown	3.8
AK3.16	Depressurizing RCS to match leaking S/G pressure	4.2
AA1	**Ability to operate and/or monitor the following as they apply to a Steam Generator Tube Leak:** (CFR: 41.7 / 41.10 / 45.5 / 45.6)	
AA1.01	Maximum controlled depressurization rate for the affected S/G	3.8
AA1.02	Condensate exhaust system	3.0
AA1.03	Loop isolation valves	3.0
AA1.04	Condensate air ejector exhaust radiation monitor	3.6
AA1.05	Radiation monitor for auxiliary building exhaust processes	3.1
AA1.06	Main steamline radiation monitor	3.8
AA1.07	CVCS letdown flow	3.4
AA1.08	Charging flow	3.4
AA1.09	RCS loop pressure	3.3
AA1.10	CVCS makeup tank level	3.1
AA1.11	PZR level control system	3.6
AA1.12	Control panel power-range channel recorders	2.4
AA1.13	S/GB radiation monitors	3.4
AA1.14	PZR pressure control system	3.5
AA1.15	Main Steam System	3.4
AA1.16	RCS	3.5
AA1.17	SGS	3.5
AA1.18	ESAS blocking	4.0
AA1.19	Main and/or AFW system	3.8

		RO	SRO
AA2	**Ability to determine and/or interpret the following as they apply to a Steam Generator Tube Leak:** (CFR: 41.7 / 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Unusual readings of the radiation monitors; steps needed to verify readings	3.6	3.6
AA2.02	Agreement/disagreement among diverse radiation monitors	3.7	3.6
AA2.03	Verification that the expected indication on main steam lines from the S/Gs should show increasing radiation levels	4.0	3.7
AA2.04	Comparison of RCS fluid inputs and outputs to detect leaks	3.7	3.6
AA2.05	Past history of leakage with current problem	3.4	3.0
AA2.06	S/G tube failure	4.1	4.1
AA2.07	Flowpath for dilution of ejector exhaust air	2.3	2.8
AA2.08	DELETED		
AA2.09	DELETED		
AA2.10	TS limits for RCS leakage (Reference Potential)	4.0	4.2
AA2.11	When to isolate one or more S/Gs	4.3	4.1
AA2.12	Flow rate of leak	3.4	3.6
AA2.13	Determination of which S/G is leaking	4.3	4.3
AA2.14	Actions to be taken if S/G goes solid and water enters steamlines	3.9	3.8
AA2.15	Magnitude of atmospheric radioactive release if cooldown must be completed using steam dump or atmospheric reliefs	3.1	3.6
AA2.16	DELETED		
AA2.17	PZR level and/or pressure	3.9	3.8
AA2.18	RCS subcooling	3.7	4.0
AA2.19	S/G level and/or pressure	3.9	2.9
AA2.20	T-cold and/or RCS cooldown rate	4.0	3.8

APE: **040 Steamline Rupture**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Steamline Rupture:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Consequences of pressurized thermal shock (PTS)	4.0
AK1.02	Leak rate versus pressure change	3.3
AK1.03	RCS shrink and consequent depressurization	3.6
AK1.04	DELETED	
AK1.05	Reactivity effects of cooldown	3.9
AK1.06	High-energy steamline break considerations	3.6
AK1.07	Effects of feedwater introduction on dry S/G	4.0
AK1.08	S/G pressure response in intact S/Gs as faulted S/G depressurizes	3.8
AK1.09	RCS temperature control after the faulted S/G dries out	4.0
AK1.10	System response if faulted S/G also has tube leakage	4.1
AK1.11	Unisolating a faulted S/G	3.4
AK1.12	Normal operating steam parameters as a function of power	3.5
AK1.13	Consequences of ATWS during steamline rupture event	3.6
AK2	**Knowledge of the relationship between the Steamline Rupture and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	NIS	3.2
AK2.08	Containment system	3.7
AK2.09	SGS	3.7
AK2.10	MFW system	3.4
AK2.11	RCS	3.7
AK2.12	Main and reheat steam system (MRSS)	3.0
AK2.13	RMS	3.1
AK2.14	Main turbine system	2.8
AK2.15	S/GB system	2.6
AK2.16	ESAS	4.1
AK2.17	CVCS	3.2
AK2.18	PZR LCS	3.4
AK2.19	PZR PCS	3.4
AK2.20	AFW system	3.8
AK2.21	CDS	2.9

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Steamline Rupture:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Operation of steamline isolation valves	4.1
AK3.02	Reactor trip and/or ESFAS initiation	4.2
AK3.03	Steamline nonreturn valves operation	3.1
AK3.04	Actions contained in procedures for steamline rupture	4.0
AK3.05	DELETED	
AK3.06	Containment temperature and pressure considerations	3.7
AK3.07	RCS temperature control	3.8
AK3.08	Maintaining reactor power within limits	3.8
AK3.09	Checking secondary system radiation normal	3.4
AA1	**Ability to operate and/or monitor the following as they apply to a Steamline Rupture:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Manual and automatic ESFAS initiation	4.3
AA1.02	Feedwater isolation	4.0
AA1.03	Operate various steamline valves to isolate steamlines, headers, or branches in the main steam piping to isolate the leak	3.9
AA1.04	DELETED	
AA1.05	Manual and automatic RPS trip initiation	4.2
AA1.06	S/G and steamline pressures and flows	3.8
AA1.07	Steam pressures and flow rates via computer, safety parameter display system, and other indications	3.5
AA1.08	DELETED	
AA1.09	Confirmation of main steam safety and/or PORVs leakage	3.6
AA1.10	AFW system	3.9
AA1.11	MFW system	3.4
AA1.12	RCS pressure and temperature	3.9
AA1.13	Steamline isolation valve indications	3.7
AA1.14	Nuclear instrumentation	3.4
AA1.15	T-ave. protection indicators	3.2
AA1.16	Reactor coolant loop delta temperature indication	3.4
AA1.17	Reactor trip breaker indicators	3.5
AA1.18	Control rod position indicators	3.4
AA1.19	Postaccident monitoring panel indicators	3.1
AA1.20	Containment pressure and temperature trends	3.8
AA1.21	Vibration alarm	2.4
AA1.22	DELETED	
AA1.23	DELETED	
AA1.24	Main steam header pressure gauges	3.4
AA1.25	S/G level indication	3.7
AA1.26	PZR LCS	3.6
AA1.27	PZR PCS	3.6
AA1.28	RMS	3.3

AA2	**Ability to determine and/or interpret the following as they apply to a Steamline Rupture:** (CFR: 41.10 / 43.5 / 45 .13)	**RO**	**SRO**
AA2.01	Occurrence and location of a steamline rupture from pressure and flow indications	3.6	4.0
AA2.02	Conditions requiring a reactor trip	4.4	4.3
AA2.03	Difference between a steamline rupture and LOCA	4.1	4.2
AA2.04	Conditions requiring ESFAS initiation	4.1	4.4
AA2.05	When ESFAS systems may be secured	3.8	3.9
AA2.06	Increasing radiation levels on main steamline or blowdown	3.4	3.7
AA2.07	Occurrence of an ATWS during a steamline rupture event	3.1	3.8

APE: 051 Loss of Condenser Vacuum

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Condenser Vacuum:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Relationship of condenser vacuum to circulating water, flow rate, and temperature	3.3
AK1.02	Relationship of condenser and turbine generator operation	3.7
AK2	**Knowledge of the relationship between the Loss of Condenser Vacuum and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Valves	2.7
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	Steam jet air ejectors and vacuum pumps	3.3
AK2.08	Condenser vacuum breaker	3.0
AK2.09	Condenser air removal system	3.2
AK2.10	Main turbine system	3.3
AK2.11	S/GB system	2.5
AK2.12	MFW pumps	3.2
AK2.13	SDS	3.5
AK2.14	CDS	3.0
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Condenser Vacuum:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	Loss of steam dump capability upon loss of condenser vacuum	3.5
AK3.02	Tripping the reactor and/or turbine	4.2
AK3.03	Reducing turbine load	3.6
AK3.04	Major actions contained in AOPs for Loss of Condenser Vacuum	3.7
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Condenser Vacuum:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Condenser vacuum pump	3.1
AA1.02	DELETED	

AA1.03	DELETED	
AA1.04	DELETED	
AA1.05	Turbine load	3.5
AA1.06	DELETED	
AA1.07	DELETED	
AA1.08	Air ejectors	3.2
AA1.09	Circulating water system	3.3
AA1.10	SDS	3.5

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Condenser Vacuum:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Condenser vacuum	4.0	3.7
AA2.02	Conditions requiring reactor and/or turbine trip	4.1	4.2
AA2.03	Circulating water flow	3.0	3.2
AA2.04	Gland steam header pressure	2.7	2.9

APE: 054 Loss of Main Feedwater

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Main Feedwater:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	MFW line break depressurizing the S/G (similar to a steamline break)	4.0
AK1.02	Effects of feedwater introduction on a dry S/G	4.0
AK1.03	Containment responses to an MFW break versus a steamline break	3.5
AK1.04	RCS parameters on a complete loss of feedwater (all S/Gs dried out)	3.9
AK1.05	Effects of depressurizing S/Gs to feed with condensate pumps	3.6
AK1.06	Differentiation between loss of all MFW and a trip of one MFW pump	3.3
AK2	**Knowledge of the relationship between Loss of Main Feedwater and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Valves effected by loss of MFW	3.0
AK2.02	Controllers effected by loss of MFW	3.0
AK2.03	Main feed pumps	3.3
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	CDS	3.0
AK2.09	AFW	3.9
AK2.10	RCS	3.8
AK2.11	SGS	3.7
AK2.12	RCPS	3.0
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Main Feedwater:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	Reactor and/or turbine trip, manual and automatic	4.3
AK3.02	Matching of feedwater and steam flows	3.6
AK3.03	Manual control of AFW flow control valves	3.5
AK3.04	Actions contained in EOPs for loss of MFW	3.9
AK3.05	HPI / PORV cycling upon total feedwater loss	3.8
AK3.06	Tripping all RCPs	3.8
AK3.07	Feeding a hot, dry S/G	3.9

AA1	**Ability to operate and/or monitor the following as they apply to Loss of Main Feedwater:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	AFW system	4.2	
AA1.02	DELETED		
AA1.03	DELETED		
AA1.04	HPI under total feedwater loss conditions	3.8	
AA1.05	MFW regulating control valves	3.3	
AA1.06	CDS pumps	3.0	
AA1.07	MFW pumps	3.4	
AA1.08	Alternate AFW source alignment	3.6	

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Main Feedwater:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Occurrence of reactor and/or turbine trip	3.7	4.2
AA2.02	DELETED		
AA2.03	Conditions and reasons for AFW pump startup	4.3	4.0
AA2.04	Proper operation of AFW pumps and regulating valves	4.0	4.0
AA2.05	Status of MFW pumps, regulating and stop valves	3.0	3.5
AA2.06	DELETED		
AA2.07	DELETED		
AA2.08	Steam flow feed	3.4	3.4
AA2.09	S/G dry-out conditions	4.1	3.8
AA2.10	RCS pressure and temperature	3.7	4.0

APE: **056 Loss of Offsite Power**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Offsite Power:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Principle of cooling by natural circulation	4.3
AK1.02	DELETED	
AK1.03	DELETED	
AK1.04	DELETED	
AK1.05	Load shedding/sequencer	3.9
AK1.06	Under voltage/degraded voltage effects on electrical loads	3.7
AK1.07	Long-term core cooling	4.0
AK1.08	Long-term spent fuel pool cooling	3.6
AK2	**Knowledge of the relationship between the Loss of Offsite Power and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	DELETED	
AK2.09	EDGs	4.6
AK2.10	AC distribution system	4.3
AK2.11	AFW	4.4
AK2.12	RCS	3.9
AK2.13	MRSS/ADVs	3.9
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Offsite Power:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	Order and time to initiation of power for the load sequencer	3.6
AK3.02	Actions contained in AOPs for loss of offsite power	4.1
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Offsite Power:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Secondary PORV controllers to maintain a no-load T-ave	3.8
AA1.02	ESF bus synchronization select switch to close bus tie breakers	3.6

AA1.03	Adjustment of EDG load	3.7	
AA1.04	Adjustment of speed of EDG to maintain frequency and voltage levels	3.7	
AA1.05	Initiation (manual) of SI	3.8	
AA1.06	SI pump	3.7	
AA1.07	Service water pump	3.7	
AA1.08	HVAC chill water pump and unit	2.9	
AA1.09	CCW pump	3.4	
AA1.10	AFW/EFW pump (motor driven)	3.9	
AA1.11	HPI system	3.7	
AA1.12	Reactor building (containment) cooling unit	3.3	
AA1.13	Fuel-handling building exhaust fan	2.6	
AA1.14	Relay room cooling unit	2.7	
AA1.15	Service water booster pump	2.7	
AA1.16	ESF (vital) switch gear room cooling unit	3.0	
AA1.17	Service water building normal ventilation supply fan	2.4	
AA1.18	Control room ventilation	3.3	
AA1.19	Battery room ventilation exhaust fan	2.9	
AA1.20	Speed switch room ventilation fan	2.6	
AA1.21	Reset of the load sequencers	3.3	
AA1.22	Main turbine lube oil system	2.7	
AA1.23	Manually engage turbine turning gear	2.4	
AA1.24	Plant computer to call up in-core temperature monitoring group	3.3	
AA1.25	Main steam supply valve control switch	2.9	
AA1.26	AC distribution circuit breakers	3.3	
AA1.27	Letdown isolation valve	3.2	
AA1.28	SWS flow control valve for the CCW cooler to control CCW outlet temperature	3.1	
AA1.29	CCW heat exchanger temperature control valves	3.0	
AA1.30	AFW flow control valve	3.8	
AA1.31	PZR heater group	3.3	
AA1.32	PZR PORV	3.4	
AA1.33	PORV block valve	3.4	
AA1.34	Normal makeup (charging) flow controller	3.3	
AA1.35	Reactor makeup water (charging) pump	3.4	
AA1.36	Gland seal and condenser air removal systems	2.3	
AA1.37	Instrument air	3.4	
AA1.38	Auxiliary building ventilation system	2.7	

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Offsite Power:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	PZR pressure controller	3.4	3.5
AA2.02	Status of load sequencer	3.2	3.4
AA2.03	Status of SI	3.5	3.9
AA2.04	Status of service water	3.4	3.7
AA2.05	Status of HVAC chill water	2.3	2.8
AA2.06	Status of CCW	3.4	3.5
AA2.07	Status of EFW/AFW	4.2	4.2

AA2.08	Status of fuel-handling building exhaust fan	1.9	2.6
AA2.09	Status of reactor building (containment) cooling unit	2.6	3.1
AA2.10	Status of relay room cooling unit	2.3	2.6
AA2.11	DELETED		
AA2.12	Status of ESF/vital switch gear room cooling unit	2.5	2.8
AA2.13	Status of ventilation fans for the service water building, control room, or battery room	2.8	2.9
AA2.14	Status of EDGs	4.3	4.4
AA2.15	Status of main generator emergency bearing oil	2.8	2.9
AA2.16	Status of feedwater pump turbine emergency oil	2.8	2.9
AA2.17	Status of PZR backup heaters	3.5	3.3
AA2.18	Reactor coolant temperature, pressure, and/or PZR level	3.8	4.0
AA2.19	DELETED		
AA2.20	DELETED		
AA2.21	DELETED		
AA2.22	DELETED		
AA2.23	DELETED		
AA2.24	DELETED		
AA2.25	DELETED		
AA2.26	DELETED		
AA2.27	DELETED		
AA2.28	DELETED		
AA2.29	DELETED		
AA2.30	DELETED		
AA2.31	DELETED		
AA2.32	DELETED		
AA2.33	Status of bus voltage indication	3.5	3.7
AA2.34	DELETED		
AA2.35	Reactor trip indication	3.8	3.9
AA2.36	Turbine trip indication	3.7	3.7
AA2.37	DELETED		
AA2.38	DELETED		
AA2.39	DELETED		
AA2.40	DELETED		
AA2.41	DELETED		
AA2.42	DELETED		
AA2.43	DELETED		
AA2.44	Indications of loss of offsite power	4.1	4.1
AA2.45	DELETED		
AA2.46	DELETED		
AA2.47	DELETED		
AA2.48	DELETED		
AA2.49	Nonessential equipment to be secured to avoid overload of EDGs	3.6	3.5
AA2.50	DELETED		
AA2.51	DELETED		
AA2.52	DELETED		
AA2.53	Status of emergency bus under voltage relays	3.2	3.3
AA2.54	Breaker position (remote and local)	3.2	3.5
AA2.55	DELETED		
AA2.56	DELETED		

AA2.57	DELETED		
AA2.58	Status of air compressors	3.3	3.2
AA2.59	Status of gland seal pressure	2.1	2.4
AA2.60	Status of MSIVs	3.2	3.3
AA2.61	Status of condensate pumps	2.2	2.6
AA2.62	Status of feedwater pumps	2.4	2.9
AA2.63	Status of feedwater heater drain pump trip	2.1	2.5
AA2.64	Status of circulating water	2.4	2.6
AA2.65	Status of screen wash	1.8	2.1
AA2.66	Status of CVCS charging flow	3.2	3.4
AA2.67	Status of seal injection flow (for the RCPs)	3.2	3.8
AA2.68	Status of CVCS letdown flow	3.2	3.3
AA2.69	DELETED		
AA2.70	DELETED		
AA2.71	Turbine service water heat exchanger	2.2	2.3
AA2.72	DELETED		
AA2.73	DELETED		
AA2.74	Status of PZR PORVs	3.3	3.6
AA2.75	CVCS boron/dilution makeup	3.3	3.5
AA2.76	Status of reactor makeup/charging	3.3	3.5
AA2.77	DELETED		
AA2.78	DELETED		
AA2.79	Turbine turning gear status	2.2	2.5
AA2.80	DELETED		
AA2.81	S/G level and pressure	3.8	3.7
AA2.82	DELETED		
AA2.83	DELETED		
AA2.84	Turbine bearing pressure	2.1	2.4
AA2.85	DELETED		
AA2.86	Main steam pressure	3.4	3.3
AA2.87	DELETED		
AA2.88	Conditions necessary for natural circulation	4.3	4.0
AA2.89	Status of auxiliary building ventilation	2.2	2.6

APE: 057 Loss of Vital AC Electrical Instrument Bus

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Vital AC Electrical Instrument Bus:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Effect of a loss of power to instruments powered by a vital instrument bus on plant operation	4.3
AK2	**Knowledge of the relationship between the Loss of Vital AC Electrical Instrument Bus and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	RCS instrumentation	4.0
AK2.07	Secondary system instrumentation	3.3
AK2.08	Nuclear instrumentation	4.1
AK2.09	RPS	4.4
AK2.10	ESFAS	4.4
AK2.11	CVCS instrumentation	3.6
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Vital AC Electrical Instrument Bus:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Actions contained in AOPs for loss of a vital AC electrical instrument bus	4.1
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Vital AC Electrical Instrument Bus:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Inverter transfer to backup power supply	3.7
AA1.02	Manual control of PZR level	3.8
AA1.03	Feedwater pump speed to control pressure and level in S/G	3.8
AA1.04	RWST and VCT valves	3.8
AA1.05	Backup instrument indications	3.7
AA1.06	Manual control of components for which automatic control is lost	3.8
AA1.07	Interlocks in effect on loss of AC vital electrical instrument bus that must be bypassed to restore normal equipment operation	3.7

AA2	**Ability to determine and/or interpret the following as they apply to Loss of Vital AC Electrical Instrument Bus:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	SI tank pressure and level	3.0	3.2
AA2.02	CFT/accumulators pressure and level	2.9	3.2
AA2.03	RPS panel alarm annunciators and trip	3.4	3.8
AA2.04	ESF system panel alarm annunciators and channel status	3.6	3.8
AA2.05	S/G pressure and level	3.7	3.7
AA2.06	AC instrument bus alarms for the inverter and alternate power source	3.7	3.8
AA2.07	DELETED		
AA2.08	Reactor power	3.8	3.9
AA2.09	T-ave. and T-ref.	3.3	3.8
AA2.10	Turbine load limiter control	2.6	3.0
AA2.11	Main feed pump running	3.0	3.3
AA2.12	PZR level controller, instrumentation, and heater	3.8	3.7
AA2.13	VCT level and pressure	3.5	3.3
AA2.14	Verification that substitute power sources have come on line on a loss of initial AC	3.7	3.7
AA2.15	Verification that a loss of AC has occurred	4.1	4.0
AA2.16	DELETED		
AA2.18	System and component status using local or remote controls	3.5	3.5
AA2.19	DELETED		
AA2.20	The plant automatic actions that will occur on the loss of a vital AC electrical instrument bus	3.4	4.0
AA2.21	RWST level	3.1	3.4
AA2.22	RCS pressure	4.0	3.8

APE: 058 Loss of DC Power

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of DC Power:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	Effect of battery discharge rate on capacity	3.7
AK1.04	Loss of breaker protection	3.7
AK1.05	Prevention of inadvertent system(s) actuation upon restoration of DC power	3.6
AK1.06	Loss of remote or automatic operation	3.7
AK2	**Knowledge of the relationship between the Loss of DC Power and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	Battery	3.7
AK2.04	Battery charger	3.6
AK2.05	AC distribution system	3.6
AK2.06	EDGs	4.1
AK2.07	AFW	3.8
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of DC Power:** (CFR: 41.5 / 41.10 / 45.6 / 45.1)	
AK3.01	Operation of the EDGs	4.0
AK3.02	Actions contained in AOPs or EOPs for loss of DC power	4.1
AA1	**Ability to operate and/or monitor the following as they apply to Loss of DC Power:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Alternate supply	3.6
AA1.02	DELETED	
AA1.03	Vital bus and battery bus components	3.8
AA1.04	AC distribution system breakers	3.6
AA1.05	Valves or components affected by loss of DC	3.9
AA1.06	DC distribution system	3.7

AA2	**Ability to determine and/or interpret the following as they apply to Loss of DC Power:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Verification that alternate power sources have come on line	3.4	3.7
AA2.02	125-V DC bus voltage	3.6	3.8
AA2.03	Impact on ability to operate and monitor plant systems	4.0	4.0

APE: 059 Accidental Liquid Radwaste Release

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to an Accidental Liquid Radwaste Release:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	DELETED	
AK1.04	The relationship between background radiation intensity and the alarm setpoints on a radioactive liquid monitor	3.0
AK1.05	The calculation of offsite doses due to a release from the power plant	3.0
AK1.06	Loss of the circulating water system on discharge	3.2
AK2	**Knowledge of the relationship between an Accidental Liquid Radwaste Release and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Radioactive-liquid monitors	3.5
AK2.02	DELETED	
AK2.03	Liquid radwaste release isolation and/or flow control valves	3.6
AK2.04	Liquid radwaste flow instruments	3.2
AK2.05	S/GB	2.8
AK2.06	LRS	3.1
AK2.07	Circulating system	2.9
AK2.08	Process radiation monitoring system (PRMS)	3.4
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to an Accidental Liquid Radwaste Release:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Termination of a release of radioactive liquid	3.7
AK3.02	Implementation of emergency plan	3.9
AK3.03	DELETED	
AK3.04	Guidance contained in procedures for accidental liquid radwaste release	3.6
AA1	**Ability to operate and/or monitor the following as they apply to an Accidental Liquid Radwaste Release:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Radioactive-liquid monitor	3.5
AA1.02	ARM system	3.3

AA1.03	Flow rate controller	3.0	
AA1.04	Circulating water system	3.0	
AA1.05	S/GB	2.9	
AA1.06	LRS	3.1	
AA1.07	PRMS	3.4	

AA2	**Ability to determine and/or interpret the following as they apply to an Accidental Liquid Radwaste Release:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	The permit for liquid radwaste release	3.6	3.6
AA2.03	Failure modes, symptoms, and/or indications of a radioactive-liquid monitor failure	3.2	3.3
AA2.04	The valve lineup for a release of radioactive liquid	3.6	3.4
AA2.05	The occurrence of automatic safety actions as a result of a high radiation signal	3.6	3.9
AA2.06	Verification that the flow rate of the liquid being released is less than or equal to that specified on the release permit	3.0	3.6
AA2.07	Radiation levels in the effluent	2.6	3.3
AA2.08	Dilution flow rate in the effluent stream	2.8	3.2
AA2.09	Implement TS and/or Technical Requirements Manual (TRM) actions (whatever is applicable) for an inoperable radioactive-liquid monitor	3.8	3.8

APE: 060 Accidental Gaseous Radwaste Release

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to an Accidental Gaseous Radwaste Release:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	DELETED	
AK1.04	Calculation of offsite doses due to a release from the power plant	2.8
AK2	**Knowledge of the relationship between an Accidental Gaseous Radwaste Release and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Radioactive-gas monitors	2.6
AK2.02	Plant ventilation system (PVS)	3.5
AK2.03	Gaseous radwaste release isolation and/or flow control valves	3.6
AK2.04	Gaseous radwaste flow instruments	3.2
AK2.05	PRMS	3.4
AK2.06	Radwaste gas system	3.3
AK2.07	CVCS	2.8
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to an Accidental Gaseous Radwaste Release:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Implementation of emergency plan	3.9
AK3.02	Isolation of the PVS	3.6
AK3.03	Guidance contained in procedures for accidental gaseous radwaste release	3.6
AK3.04	Startup of the gas treatment system	2.9
AK3.05	Termination of a release of radioactive gas	3.8
AK3.06	Implement emergency plan for accidental gaseous radwaste release	3.8
AA1	**Ability to operate and/or monitor the following as they apply to an Accidental Gaseous Radwaste Release:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	PRMS	3.4
AA1.02	PVS	3.5
AA1.03	Flow rate controller/indication	3.2
AA1.04	Gaseous radwaste release isolation valve	3.7

		RO	SRO
AA2	**Ability to determine and/or interpret the following as they apply to an Accidental Gaseous Radwaste Release:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	A radiation-level alarm as to whether the cause was due to a gradual (in time) signal increase or due to a sudden increase (a “spike”), including the use of strip chart recorders, meter, and alarm observations	3.3	3.4
AA2.02	Detection of the possible location of a radioactive gas leak and/or the effect of isolating that leak	3.2	3.4
AA2.03	The steps necessary to isolate a given radioactive-gas leak using piping and instrumentation diagrams	3.6	3.4
AA2.04	DELETED		
AA2.05	The occurrence of automatic safety actions as a result of a high radiation signal	3.8	3.8
AA2.06	Valve lineup for release of radioactive gases	3.2	3.3
AA2.07	Failure modes, symptoms, and/or indications of a radioactive-gaseous monitor failure	3.4	3.2
AA2.08	TS and/or TRM actions for accidental liquid radwaste release (as applicable)	2.8	3.8

APE: 061 Area Radiation Monitoring System Alarms

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Area Radiation Monitoring System Alarms:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Adverse containment conditions	3.6
AK2	**Knowledge of the relationship between the Area Radiation Monitoring System Alarms and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Areas or systems monitored by ARMs	3.1
AK2.02	RCS	3.2
AK2.03	CVCS	3.1
AK2.04	RHR	3.0
AK2.05	SFPCS	3.3
AK2.06	Refueling pool	3.4
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Area Radiation Monitoring System Alarms:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Effect of temperature inversion on the ARM system channel indications	2.5
AK3.02	Guidance contained in alarm response for the ARM system	3.4
AA1	**Ability to operate and/or monitor the following as they apply to Area Radiation Monitoring System Alarms:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Systems or components automatically actuated by ARM signals	3.5
AA1.02	Control room radiation monitoring displays	3.3
AA1.03	Local radiation monitoring units	2.9
AA1.04	RCS	3.2
AA1.05	CVCS	3.2
AA1.06	RHR	3.1
AA1.07	SFPCS	3.2
AA1.08	Refueling pool	3.4

AA2	**Ability to determine and/or interpret the following as they apply to Area Radiation Monitoring System Alarms:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	Normal operating characteristics	3.0	3.1
AA2.03	Alarm conditions	3.2	3.4
AA2.04	DELETED		
AA2.05	DELETED		
AA2.06	Required actions if the alarm channel is out of service	3.4	3.3

APE: **062 Loss of Service Water**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Service Water:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Effect on loads cooled by service water	3.8
AK1.02	Knowledge of backup cooling water systems	3.5
AK2	**Knowledge of the relationship between the Loss of Service Water and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	CCW	3.7
AK2.02	Instrument air system (IAS)	3.0
AK2.03	CVCS	3.5
AK2.04	Chilled water systems	3.0
AK2.05	SFPCS	3.6
AK2.06	RHR	3.7
AK2.07	EDG system	4.0
AK2.08	PRMS	3.0
AK2.09	AFW system	3.3
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Service Water:** (CFR: 41.4 / 41.8 / 45.7)	
AK3.01	The conditions that will initiate the automatic opening and closing of the SWS isolation valves to the service water coolers	3.5
AK3.02	The automatic actions (alignments) within the service water resulting from the actuation of the ESFAS	3.9
AK3.03	Guidance actions contained in AOPs for loss of service water	3.9
AK3.04	Effect on the service water discharge flow header of a loss of CCW	3.3
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Service Water:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Service water temperature indications	3.4
AA1.02	Loads on the SWS in the control room	3.6
AA1.03	SWS as a backup to the CCWS	3.1
AA1.04	CRDM high-temperature alarm system	3.1
AA1.05	CCWS	3.4
AA1.06	Control of flow rates to components cooled by the SWS	3.2

AA1.07	DELETED		
AA1.08	Alignment/cross-connection of backup systems	3.5	
AA1.09	The valve lineups necessary to restart the SWS while bypassing the portion of the system causing the abnormal condition	3.3	

AA2 **Ability to determine and/or interpret the following as they apply to Loss of Service Water:**
(CFR: 43.5 / 45.13)

		RO	**SRO**
AA2.01	Location of a leak in the SWS	3.5	3.5
AA2.02	The cause of possible SWS loss	3.8	3.3
AA2.03	DELETED		
AA2.04	The normal values and upper limits for the temperatures of the components cooled by SWS	3.0	3.1
AA2.05	The normal values for the SWS-header flow rate and the flow rates to the components cooled by the SWS	3.3	3.0
AA2.06	The length of time after the loss of SWS flow to a component before that component may be damaged	3.3	3.2
AA2.07	Implementation of TS requirements for loss of service water	3.0	4.0

APE: 065 Loss of Instrument Air

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Instrument Air:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Understanding units of flow and pressure standard cubic foot per minute; linear; meter; and pounds per square inch, gauge (psig)	2.6
AK1.02	Effects of water and/or particulate matter in instrument air lines (operating experience)	3.1
AK1.03	Failure modes of air-operated equipment	3.7
AK2	**Knowledge of the relationship between Loss of Instrument Air and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	Instrument air dryers, filters, and/or heat exchangers	3.1
AK2.06	Backup air sources for components operated by instrument air	3.6
AK2.07	RCS	3.2
AK2.08	CVCS	3.5
AK2.09	ECCS	3.5
AK2.10	PZR PCS	3.6
AK2.11	RHRS	3.6
AK2.12	MRSS	3.0
AK2.13	MT/G system	2.8
AK2.14	CDS (operating experience)	2.9
AK2.15	MFW system	3.4
AK2.16	AFW / EFW system	3.8
AK2.17	SWS	3.0
AK2.18	PZR relief tank/quench tank system	2.8
AK2.19	CSS	3.2
AK2.20	PRMS	2.7
AK2.21	CCWS	3.2
AK2.22	Containment purge system	3.0
AK2.23	Spent fuel pool	2.9
AK2.24	Circulating water system	2.5
AK2.25	LRS	2.8
AK2.26	Waste gas disposal system	2.7

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Instrument Air:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)		
AK3.01	DELETED		
AK3.02	DELETED		
AK3.03	Knowing effects on plant operation of isolating certain equipment from instrument air	3.6	
AK3.04	DELETED		
AK3.05	Checking electric loads on a running compressor	2.5	
AK3.06	Blocking open certain valves during recovery	2.9	
AK3.07	Backup of compressor cooling water	3.0	
AK3.08	Actions contained in procedures for loss of instrument air	3.7	
AK3.09	Restarting and/or realigning instrument air compressors	3.4	
AK3.10	Isolation of leaking components or headers	3.3	
AK3.11	Aligning air-operated equipment to pressurized header with cross-connects	3.2	
AK3.12	Manual operation of air-operated components if air pressure is lost	3.2	
AK3.13	When to commence plant shutdown if instrument air pressure is decreasing	3.9	
AK3.14	When to trip reactor if instrument air pressure is decreasing	4.2	
AA1	**Ability to operate and/or monitor the following as they apply to Loss of Instrument Air:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	Remote manual loaders	2.9	
AA1.02	Components served by instrument air to minimize drain on the system	2.9	
AA1.03	Restoration of systems served by instrument air when pressure is regained	3.1	
AA1.04	Emergency air compressor	3.4	
AA1.05	RPS	3.2	
AA1.06	Instrument air header cross-connect valves	3.3	
AA1.07	Instrument and/or service air compressors	3.3	
AA1.08	Instrument and/or service air dryers	3.2	
AA2	**Ability to determine and/or interpret the following as they apply to Loss of Instrument Air:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Low-pressure instrument air alarm	3.8	3.5
AA2.02	Airflow readings	2.7	2.7
AA2.03	Location and isolation of leaks	4.0	3.2
AA2.04	Typical conditions that could cause a compressor trip (e.g., high temperature)	3.5	2.9
AA2.05	DELETED		
AA2.06	DELETED		

AA2.07	Determination of whether backup nitrogen supply is controlling the valve position	3.3	3.2
AA2.08	DELETED		
AA2.09	Automatic IAS responses as air header pressure lowers	3.3	3.3
AA2.10	Instrument air pressure	3.8	3.5
AA2.11	Instrument airflows	3.3	2.7
AA2.12	Implementation of TS and/or TRM as appropriate for loss of, or degraded, IAS	3.0	3.7

APE: 067 Plant Fire on Site

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Plant Fire on Site:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	Fire classifications by type	2.9
AK1.02	Fire-fighting methods for each type of fire	3.0
AK2	**Knowledge of the relationship between the Plant Fire on Site and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	Fire alarm panels	3.6
AK2.06	Fire pumps	3.7
AK2.07	Electrical distribution system	3.3
AK2.08	Portable fire suppression equipment	2.8
AK2.09	Installed fire suppression equipment	3.3
AK2.10	PVS	3.2
AK2.11	Auxiliary building gas treatment system	2.9
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Plant Fire on Site:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	DELETED	
AK3.02	Steps called out in the site fire protection plan, FPS manual, and fire zone manual	3.3
AK3.03	DELETED	
AK3.04	Actions contained in AOPs and EOPs for a plant fire on site	3.7
AA1	**Ability to operate and/or monitor the following as they apply to a Plant Fire on Site:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	Respirator air pack	3.3
AA1.02	Fire detectors/heat detectors	3.0
AA1.03	DELETED	
AA1.04	DELETED	
AA1.05	Plant and control room ventilation systems	3.5
AA1.06	Fire alarm	3.3
AA1.07	Fire alarm reset panel	3.1

AA1.08	Fire-fighting equipment used on each class of fire	2.8	
AA1.09	Plant fire zone panel (including detector location)	3.2	

AA2	**Ability to determine and/or interpret the following as they apply to Plant Fire on Site:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	Damper position	2.8	3.1
AA2.03	Fire alarm	3.7	3.7
AA2.04	The fire's extent of potential operational damage to plant equipment	3.8	3.8
AA2.05	Ventilation alignment necessary to secure affected area	3.2	3.4
AA2.06	Need for pressurizing control room (recirculation mode)	3.4	3.4
AA2.07	Determination of whether malfunction is due to common mode electrical failures	2.8	3.0
AA2.08	DELETED		
AA2.09	DELETED		
AA2.10	Time limit of long-term-breathing air system for control room	3.8	3.3
AA2.11	Time limit for use of respirators	3.6	3.2
AA2.12	Location of vital equipment within fire zone	3.3	3.6
AA2.13	Need for emergency plant shutdown	3.5	4.0
AA2.14	Equipment that will be affected by fire suppression activities in each zone	3.2	3.3
AA2.15	DELETED		
AA2.16	Vital equipment and control systems to be maintained and operated during a fire	3.7	3.4
AA2.17	Systems that may be affected by the fire	3.3	3.5
AA2.18	Control room habitability (SRO Only)	4.5	3.8
AA2.19	Implement emergency plan for a plant fire on site	3.7	4.1

APE: 068 Control Room Evacuation

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Control Room Evacuation:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Control room habitability	4.1
AK1.03	Loss of equipment control due to fire damage	4.0
AK1.04	SI	3.9
AK1.05	Reactor and/or turbine trip	4.2
AK1.06	ATWS	3.9
AK2	**Knowledge of the relationship between the Control Room Evacuation and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	Auxiliary shutdown panel	4.1
AK2.02	Reactor trip system	4.1
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	EDG	4.0
AK2.08	SWS	3.5
AK2.09	CVCS	3.7
AK2.10	MFW and startup feedwater system	2.9
AK2.11	AFW	4.0
AK2.12	MRSS	3.0
AK2.13	SDS	3.2
AK2.14	MT/G	2.7
AK2.15	CDS	2.8
AK2.16	Electrical distribution system	3.7
AK2.17	Vital area ventilation	3.1
AK2.18	Reactor trip breakers	3.6
AK2.19	Motor control centers	3.3
AK2.20	RCS	3.6
AK2.21	CCWS	3.6
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Control Room Evacuation:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	System response to reactor trip	4.0
AK3.02	DELETED	
AK3.03	DELETED	

AK3.04	Filling the feedwater system and closing the AFW pump discharge valve	3.4
AK3.05	DELETED	
AK3.06	Transfer of S/G atmospheric relief valves to local control; operation to maintain specified T-ave.	3.8
AK3.07	Maintenance of S/G level using AFW flow control valves	4.0
AK3.08	Trip of the MFW and necessary condensate pumps	3.1
AK3.09	Transfer of equipment to local control	4.0
AK3.10	Maintenance of PZR level using pumps and heaters	3.8
AK3.11	DELETED	
AK3.12	DELETED	
AK3.13	Performing an SDM calculation, including boron needed and/or boration time (Reference Potential)	3.5
AK3.14	DELETED	
AK3.15	DELETED	
AK3.16	Fail-open of the control room doors for personnel evacuation	2.9
AK3.17	Injection of boric acid into the RCS	3.8
AK3.18	Actions contained in AOPs for control room evacuation emergency task	3.9
AK3.19	Disabling selected equipment	3.6
AK3.20	Local alignments for system instrumentation	3.6
AK3.21	Aligning equipment to alternate power supply	3.6

AA1 **Ability to operate and/or monitor the following as they apply to Control Room Evacuation:**
(CFR: 41.7 / 45.5 / 45.6)

AA1.01	S/G atmospheric relief valve	3.8
AA1.02	AFW emergency pump	4.0
AA1.03	DELETED	
AA1.04	MFW pump trip	2.8
AA1.05	Condensate pump trip	2.8
AA1.06	Charging pump	3.7
AA1.07	DELETED	
AA1.08	DELETED	
AA1.09	DELETED	
AA1.10	Power distribution: AC and DC	3.7
AA1.11	Emergency borate valve	3.7
AA1.12	Auxiliary shutdown panel	4.2
AA1.13	PZR level controllers	3.7
AA1.14	DELETED	
AA1.15	DELETED	
AA1.16	DELETED	
AA1.17	DELETED	
AA1.18	DELETED	
AA1.19	Boric acid transfer pump	3.4
AA1.20	DELETED	
AA1.21	DELETED	
AA1.22	Flow control valve for RCS charging header	3.5
AA1.23	DELETED	

AA1.24	DELETED		
AA1.25	DELETED		
AA1.26	AFW valves	4.0	
AA1.27	DELETED		
AA1.28	PZR level control and pressure control	3.6	
AA1.29	DELETED		
AA1.30	Operation of the letdown system	3.2	
AA1.31	EDG	3.8	
AA1.32	DELETED		
AA1.33	RPS	3.5	
AA1.34	Main turbine/generator	2.6	

AA2	**Ability to determine and/or interpret the following as they apply to Control Room Evacuation:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	S/G level	4.1	3.9
AA2.02	Local boric acid flow	2.5	3.4
AA2.03	T-hot, T-cold, and in-core temperatures	3.7	3.9
AA2.04	S/G pressure	3.4	3.8
AA2.05	Availability of heat sink	3.4	4.1
AA2.06	RCS pressure	3.6	3.8
AA2.07	PZR level	3.6	3.8
AA2.08	DELETED		
AA2.09	Saturation margin	3.3	3.8
AA2.10	Source-range count rate	3.3	3.7
AA2.11	Indications of natural circulation	3.7	4.0
AA2.12	Cooldown rate limits	3.4	3.5
AA2.13	Lights and alarms	3.7	3.2

APE: 069 Loss of Containment Integrity

K/A NO.	KNOWLEDGE	IMPORTANCE	
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Containment Integrity:** (CFR: 41.8 / 41.10 / 45.3)		
AK1.01	Effect of pressure on leak rate	3.3	
AK2	**Knowledge of the relationship between the Loss of Containment Integrity and the following systems or components:** (CFR: 41.7 / 45.7)		
AK2.01	Automatic and/or manual containment Isolation valves	3.9	
AK2.02	Containment pressure sensors/detectors	3.6	
AK2.03	Containment hatches	3.5	
AK2.04	Containment system	3.6	
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Containment Integrity:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)		
AK3.01	Guidance contained in procedures for loss of containment integrity	3.9	
AA1	**Ability to operate and/or monitor the following as they apply to a Loss of Containment Integrity:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	Containment isolation valves, dampers, and/or other devices	4.0	
AA1.02	Blind flanges that serve a containment isolation function	2.9	
AA1.03	Fluid systems penetrating containment	3.5	
AA1.04	Containment system	3.7	
AA2	**Ability to determine and/or interpret the following as they apply to Loss of Containment Integrity:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Loss of containment integrity	4.3	4.1
AA2.02	Verification of automatic and/or manual means of restoring integrity	4.1	4.0
AA2.03	Containment pressure	4.1	3.8

APE: 076 High Reactor Coolant Activity

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to High Reactor Coolant Activity:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Radiation source and/or transport pathway	3.3
AK1.03	DELETED	
AK1.04	DELETED	
AK1.05	DELETED	
AK1.06	Crud burst	3.2
AK1.07	DELETED	
AK1.08	DELETED	
AK1.09	DELETED	
AK2	**Knowledge of the relationship between the High Reactor Coolant Activity and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	PRMs	3.5
AK2.02	CCWS	3.0
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	RCS	3.3
AK2.08	CVCS	3.4
AK2.09	RHR	3.2
AK2.10	Control room ventilation	3.1
AK2.11	PVS	2.9
AK2.12	S/GB	2.8
AK2.13	Main steam system	2.8
AK2.14	Auxiliary steam system	2.7
AK2.15	Main condenser	2.8
AK2.16	Radwaste systems	3.1
AK2.17	LRS	3.1
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to High Reactor Coolant Activity:** (CFR: 41.5,41.10 / 45.6 / 45.13)	
AK3.01	RCS differentiating activity due to fission products and due to corrosion products from chemistry report	3.1
AK3.02	DELETED	
AK3.03	Reducing letdown flow rates	2.9

AK3.04	Maximizing demineralizer flow rates	3.3	
AK3.05	DELETED		
AK3.06	Actions contained in EOPs or AOPs for high reactor coolant activity	3.5	

AA1	**Ability to operate and/or monitor the following as they apply to High Reactor Coolant Activity:** (CFR: 41.7 / 45.5 / 45.6)		
AA1.01	DELETED		
AA1.02	CCWS	3.0	
AA1.03	CVCS	3.4	
AA1.04	ARM	3.2	
AA1.05	PRM	3.2	
AA1.06	RCS	3.3	
AA1.07	RHR	3.3	
AA1.08	PVS	2.9	
AA1.09	SGBD	2.8	
AA1.10	MRSS	2.8	
AA1.11	Auxiliary steam system	2.7	
AA1.12	Main condenser	2.8	
AA1.13	LRS	3.2	
AA1.14	Control room ventilation	3.1	

AA2	**Ability to determine and/or interpret the following as they apply to High Reactor Coolant Activity:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	DELETED		
AA2.03	High area radiation levels	3.0	3.5
AA2.04	High process radiation levels	3.2	3.5
AA2.05	CVCS letdown flow rate	2.8	3.3
AA2.06	Response of PZR LCS to changes in the letdown flow rate	3.0	3.2
AA2.07	DELETED		
AA2.08	Implement TS as applicable	2.6	3.9
AA2.09	Implement emergency plan for failed fuel	3.0	4.1

APE: 077 Generator Voltage and Electric Grid Disturbances

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.4 / 41.5 / 41.7 / 41.10 / 45.8)	
AK1.01	DELETED	
AK1.02	Overexcitation	3.3
AK1.03	Underexcitation	3.3
AK1.04	Declining grid frequency or voltage	3.6
AK1.05	Solar magnetic disturbance	2.3
AK1.06	Reactor power	3.4
AK2	**Knowledge of the relationship between Generator Voltage and Electric Grid Disturbances and the following systems or components:** (CFR: 41.4 / 41.5 / 41.7 / 41.10 / 45.8)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	MT/G	3.5
AK2.08	RCPs	3.5
AK2.09	Motors for ESF pumps	3.6
AK2.10	EDGs	4.0
AK2.11	Large electrical system transformers	3.3
AK2.12	AC electrical distribution	3.7
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.4 / 41.5 / 41.7 / 41.10 / 45.8)	
AK3.01	Reactor and turbine trip criteria	3.9
AK3.02	Actions contained in AOPs for voltage and grid disturbances	3.5
AA1	**Ability to operate and/or monitor the following as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.5 / 41.10 / 45.5 / 45.7 / 45.8)	
AA1.01	DELETED	
AA1.02	Turbine/generator controls	3.6
AA1.03	DELETED	

AA1.04	Reactor controls	3.6	
AA1.05	Engineered safety features	3.6	
AA1.06	AC electrical distribution	3.6	
AA1.07	EDG	4.0	

AA2	**Ability to determine and/or interpret the following as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.5 / 43.5 / 45.5 / 45.7 / 45.8)	**RO**	**SRO**
AA2.01	Operating point on the generator capability curve	3.7	3.3
AA2.02	Generator voltage	3.7	3.4
AA2.03	Generator current	3.4	3.2
AA2.04	Volt-amperes reactive (VAR)	3.6	3.4
AA2.05	Status of grid	3.7	3.6
AA2.06	Generator frequency	3.3	3.4
AA2.07	Status of ESFs	3.9	3.6
AA2.08	Criteria to trip the turbine or reactor	4.2	3.9
AA2.09	Status of EDGs	4.0	3.9
AA2.10	Generator overheating	3.7	3.3
AA2.11	Excessive step-up transformer neutral DC ground current	2.8	2.8
AA2.12	Lights and alarms	3.2	3.1

APE: 078 Reactor Coolant System Leak

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to a Reactor Coolant System Leak:** (CFR: 41.8 / 41.10 / 45.3)	
AK1.01	RCS leakage greater than the capacity of the makeup system	4.3
AK1.02	Leaking PZR safety valve or PORV	4.1
AK1.03	CCW system leaks	3.4
AK2	**Knowledge of the relationship between the Reactor Coolant System Leak and the following systems or components:** (CFR: 41.7 / 45.7)	
AK2.01	CVCS	3.9
AK2.02	CCWS	3.5
AK2.03	RMS	3.6
AK2.04	PZR systems	3.9
AK2.05	Reactor trip systems	4.2
AK2.06	LRS	2.9
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Reactor Coolant System Leak:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.01	Reactor trip and safety initiation	4.6
AK3.02	Starting makeup pump and isolating CVCS letdown	3.9
AK3.03	Determining the total RCS leak rate	4.0
AK3.04	Opening the RWST isolation valves	3.5
AK3.05	Observation of PZR level	4.0
AK3.06	CCWS radiation alarm	3.4
AK3.07	Containment temperature, pressure, humidity or sump level limits	3.6
AK3.08	Isolation of containment	4.0
AK3.09	TS leakage limits	4.2
AK3.10	Monitoring containment radiation levels	3.8
AA1	**Ability to operate and/or monitor the following as they apply to a Reactor Coolant System Leak:** (CFR: 41.7 / 45.5 / 45.6)	
AA1.01	PZR system	4.2
AA1.02	Reactor trip controls	4.3
AA1.03	Safeguards actuation controls	4.4
AA1.04	CVCS	3.9
AA1.05	RHRS	3.7

AA1.06	Containment or reactor building sump level	3.6	
AA1.07	Low-pressure SWS activity monitor	3.2	
AA1.08	CCWS	3.3	
AA1.09	RMS	3.6	
AA1.10	Containment isolation system	4.0	

AA2	**Ability to determine and/or interpret the following as they apply to a Reactor Coolant System Leak:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Possible leak paths	4.0	3.7
AA2.02	CCWS high-radiation alarm	3.5	3.4
AA2.03	PZR level or VCT level	5.0	4.1
AA2.04	CCWS surge tank vent isolation valve indication	2.7	3.2
AA2.05	Letdown isolation valve position indication	3.5	3.5
AA2.06	Low-pressure SWS activity monitor	3.0	3.0
AA2.07	Containment radiation	4.0	3.7
AA2.08	Containment temperature, pressure, humidity, or sump level limits	4.0	3.8
AA2.09	Reactor trip setpoints	4.8	4.4
AA2.10	Leak rate from change in various tank levels	4.3	3.6
AA2.11	SDM	3.0	3.4
AA2.12	RCS water inventory balance and TS limits	4.0	4.0

4.3 BABCOCK AND WILCOX (BW) EMERGENCY PLANT EVOLUTIONS (EPEs) AND ABNORMAL PLANT EVOLUTIONS (APEs)

BW EPE: E02 Reactor Trip

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and affect relationships of the following as they apply to the Reactor Trip:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	4.1
EK1.5	Secondary pressure control	4.0
EK1.6	Primary inventory control	4.3
EK1.7	Primary pressure control	4.2
EK1.8	SCM	4.2
EK1.9	Primary to secondary heat transfer	4.4
EK1.10	Reactor trip	4.3
EK1.11	Turbine trip	4.2
EK2	**Knowledge of the relationship between the Reactor Trip and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	CRDS	4.3
EK2.4	Makeup and purification system	3.4
EK2.5	Electrical distribution system	3.6
EK2.6	IAS	3.0
EK2.7	MFW system	3.6
EK2.8	Main steam system	3.7
EK2.9	PZR heaters and/or spray	3.6
EK2.10	ESAS	4.4
EK2.11	Emergency feedwater initiation and controls (EFICs) (EFW and/or main steamline isolation (MSLI))	4.2
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Reactor Trip:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Tripping the reactor	4.7
EK3.6	Tripping the turbine	4.5
EK3.7	Check adequate SCM	4.0
EK3.8	Minimize Letdown	3.2

EK3.9	Control RCS level	3.8	
EK3.10	Control RCS pressure within the limits	3.8	
EK3.11	Check for proper electrical response	3.3	
EK3.12	Check for proper S/G level control	3.6	
EK3.13	Check for proper instrument air pressure	3.3	
EK3.14	Check for proper S/G pressure control	3.5	
EK3.15	Check for proper ICS response	3.3	
EK3.16	Check normal cooling in service	3.1	
EK3.17	Check for no automatic actuation needed by ESAS or MSLI	4.2	
EK3.18	Check for adequate spent fuel pool cooling	2.7	
EK3.19	Check for PZR steam space integrity	3.5	
EK3.20	Control primary to secondary heat transfer	3.9	
EK3.21	Check for S/G tube integrity	4.0	
EK3.22	Check for RCS integrity	4.0	
EK3.23	Check for need to transition to the applicable EOP	4.3	

EA1 **Ability to operate and/or monitor the following as they apply to Reactor Trip:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	CRDS	4.3
EA1.5	Makeup and purification system	3.5
EA1.6	Electrical distribution system	3.6
EA1.7	IAS	3.2
EA1.8	MFW system	3.5
EA1.9	Main steam system	3.7
EA1.10	PZR heaters and/or spray	3.5
EA1.11	ESAS	4.3
EA1.12	EFICs (EFW and/or MSLI)	4.3

EA2 **Ability to determine and/or interpret the following as they apply to Reactor Trip:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	Control rod position	4.0	4.3
EA2.4	Reactor power	4.7	4.6
EA2.5	Turbine throttle and governor valve position	4.0	3.6
EA2.6	S/G pressure	4.1	3.8
EA2.7	SCM	4.7	4.1
EA2.8	Letdown flow	3.1	3.1
EA2.9	RCS pressure	3.9	3.9
EA2.10	RCS temperature	3.9	3.9
EA2.11	Proper electrical response	3.7	3.5

EA2.12	PZR level	4.1	3.8
EA2.13	S/G level	4.1	3.6
EA2.14	Feedwater flow	4.3	3.5
EA2.15	PZR steam space integrity	4.0	3.9
EA2.16	S/G tube integrity	4.4	4.3
EA2.17	RCS integrity	4.7	4.3

BW EPE: E03 Inadequate Subcooling Margin

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and affect relationships of the following as they apply to the Inadequate Subcooling Margin:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	3.8
EK1.5	Secondary pressure control	3.8
EK1.6	Primary inventory control	4.2
EK1.7	Primary pressure control	4.1
EK1.8	SCM	4.2
EK1.9	Primary to secondary heat transfer	3.9
EK1.10	Rapid RCS cooldown	3.9
EK1.11	Reflux boiling (boiler/condenser cooling)	3.5
EK1.12	LOCA	4.1
EK2	**Knowledge of the relationship between the Inadequate Subcooling Margin and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFW	4.0
EK2.4	Makeup and purification system	3.6
EK2.5	RCS	4.0
EK2.6	Nuclear intermediate cooling water (ICW)	3.0
EK2.7	MFW system	3.2
EK2.8	Main steam system	3.3
EK2.9	ESAS	4.0
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Inadequate Subcooling Margin:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Check adequate SCM	4.2
EK3.6	Trip RCPs	4.2
EK3.7	Initiate HPI	4.2
EK3.8	Verify EFW (including reflux boiling setpoint)	3.9
EK3.9	Check for no automatic actuation of ESAS	4.0

EK3.10	Check RCS greater than 150 psig (transition to ESAS)	3.3	
EK3.11	Check for indication of overcooling	3.6	
EK3.12	Isolate PZR spray	3.2	
EK3.13	Isolate emergency relief valve (ERV) if appropriate	3.6	
EK3.14	Check for leak into nuclear ICW	3.1	
EK3.15	Check for S/G tube integrity	3.8	
EK3.16	Control RCS pressure within appropriate limits	4.1	
EK3.17	Check S/G levels at appropriate setpoint	3.8	
EK3.18	Control primary to secondary heat transfer	3.6	
EK3.19	Check for indication of overheating	3.7	
EK3.20	Perform rapid cooldown if necessary	3.7	
EK3.21	Implement floating steps	3.3	

EA1 **Ability to operate and/or monitor the following as they apply to Inadequate Subcooling Margin:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	EFW	4.1	
EA1.5	Makeup and purification system	3.5	
EA1.6	RCS (including S/G tubes)	4.1	
EA1.7	Nuclear ICW	3.1	
EA1.8	MFW system	3.3	
EA1.9	Main steam system	3.5	
EA1.10	ESAS	4.3	

EA2 **Ability to determine and/or interpret the following as they apply to Inadequate Subcooling Margin:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	SCM	4.7	4.3
EA2.4	HPI flow	4.4	4.0
EA2.5	Makeup tank level	3.4	3.2
EA2.6	EFW flow	4.0	4.0
EA2.7	S/G pressure	4.0	3.8
EA2.8	S/G level	4.4	3.9
EA2.9	RCS pressure	4.3	4.2
EA2.10	RCS temperature	4.1	4.2
EA2.11	Control room annunciators	3.6	3.7
EA2.12	Primary to secondary heat transfer	4.1	3.6
EA2.13	PZR level	3.7	3.8

BW EPE: E04 Inadequate Heat Transfer

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Inadequate Heat Transfer:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	3.9
EK1.5	Secondary pressure control	4.0
EK1.6	Primary inventory control	3.9
EK1.7	Primary pressure control	4.0
EK1.8	Adequate SCM	4.0
EK1.9	Primary to secondary heat transfer	3.9
EK1.10	Tube-to-shell delta T	3.3
EK1.11	Criteria met for HPI cooling	4.0
EK1.12	Nil ductility transition temperature	3.4
EK1.13	Secondary heat sink	3.9
EK2	**Knowledge of the relationship between the Inadequate Heat Transfer and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFW	4.3
EK2.4	Makeup and purification system	3.6
EK2.5	RCS	3.9
EK2.6	Reactor building	3.3
EK2.7	MFW system	3.6
EK2.8	Main steam system	3.9
EK2.9	ESAS	4.6
EK2.10	EFICs	4.4
EK2.11	SWS	3.3
EK2.12	Secondary heat sink	3.9
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Inadequate Heat Transfer:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Check criteria for HPI cooling	3.9

EK3.6	Verify proper EFW actuation and control	4.3	
EK3.7	Refill S/G with main, auxiliary, or EFW	4.0	
EK3.8	Operate RCPs as required	3.9	
EK3.9	Check for adequate SCM; if not, take appropriate actions	4.1	
EK3.10	Operate ERV and HPI to control RCS pressure	4.0	
EK3.11	Continue efforts to restore feedwater	4.0	
EK3.12	Check ESAS for proper actuation if needed	4.3	
EK3.13	Verify letdown in service if conditions permit	3.3	
EK3.14	Determine whether CET temperature is stable or dropping	3.8	
EK3.15	Establish desired cooldown rate	3.7	
EK3.16	Check for primary to secondary heat transfer	3.9	
EK3.17	Restore normal makeup and purification (including letdown)	3.3	
EK3.18	Secure HPI cooling	3.6	
EK3.19	Establish PZR steam bubble	3.4	
EK3.20	Establish forced flow in both loops	3.4	
EK3.21	Establish flow to S/G via EFW, MFW, condensate pump, or service water pump	3.9	
EK3.22	Lower S/G pressure as required based on source of feed	4.1	
EA1	**Ability to operate and/or monitor the following as they apply to Inadequate Heat Transfer:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)		
EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	EFW	4.4	
EA1.5	Makeup and purification system	3.7	
EA1.6	RCS	3.9	
EA1.7	Reactor building	3.6	
EA1.8	MFW system	3.7	
EA1.9	Main steam system	3.9	
EA1.10	ESAS	4.4	
EA1.11	EFICs	4.4	
EA1.12	Service water pump, valves, and/or flows	3.6	
EA1.13	Secondary heat sink	4.0	
EA2	**Ability to determine and/or interpret the following as they apply to Inadequate Heat Transfer:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	4.1	4.3
EA2.2	Adherence to appropriate procedures and operation within the limitations in the facility license and amendments	4.6	4.3
EA2.3	SCM	4.0	4.1
EA2.4	PZR level and/or temperature	4.4	3.7
EA2.5	RCS pressure	4.3	3.9
EA2.6	RCS temperature	4.1	3.9
EA2.7	Main steam component positions	3.3	3.7
EA2.8	Reactor building pressure	3.3	4.0

EA2.9	S/G pressure	4.3	3.9
EA2.10	S/G level	4.4	3.9
EA2.11	MFW component positions	3.8	3.9
EA2.12	EFW pumps, valves, and/or flow	4.3	4.0
EA2.13	ERV/code safety valve position	4.1	4.0
EA2.14	Heatup and/or cooldown rates	3.9	3.6
EA2.15	Tube to shell delta T	3.9	3.6
EA2.16	Makeup pump, tank, valves, and/or flow	3.7	3.7
EA2.17	Heatup and/or cooldown rates (PZR or RCS)	3.7	3.6
EA2.18	Tube to shell delta T	3.9	3.6
EA2.19	CET temperatures	4.0	3.7

BW EPE: E05 Excessive Heat Transfer

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and affect relationships of the following as they apply to Excessive Heat Transfer:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	3.9
EK1.5	Secondary pressure control	3.8
EK1.6	Primary inventory control	3.8
EK1.7	Primary pressure control	3.7
EK1.8	SCM	3.7
EK1.9	Primary to secondary heat transfer	3.7
EK1.10	S/G tube leak	3.5
EK1.11	RCS T-cold greater than minimal required	3.8
EK1.12	PTS limits	3.8
EK2	**Knowledge of the relationship between Excessive Heat Transfer and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFW	4.2
EK2.4	Makeup and purification system	3.2
EK2.5	RCS	3.7
EK2.6	Containment	3.2
EK2.7	MFW system	3.8
EK2.8	Main steam system	3.8
EK2.9	ESAS	4.0
EK2.10	EFICs	4.1
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Excessive Heat Transfer:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Check SCM	3.7
EK3.6	Align BWST to running makeup pump	3.4
EK3.7	Control RCS level	3.8
EK3.8	Control RCS pressure	3.7
EK3.9	Control RCS temperature	3.8

EK3.10	Check for no automatic actuation needed by the ESAS or MSLI	4.0
EK3.11	Check for proper S/G pressure control	3.8
EK3.12	Check reactor building pressure stable and below ESAS setpoint	3.5
EK3.13	Determine whether the EFW is off or operating properly	3.9
EK3.14	Check for proper S/G level control	3.8
EK3.15	Check for proper ICS response	3.3
EK3.16	Check for S/G tube integrity	3.7
EK3.17	Check letdown in service	3.1
EK3.18	Implement floating steps	3.3

EA1 Ability to operate and/or monitor the following as they apply to Excessive Heat Transfer:
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	EFW	4.2
EA1.5	Makeup and purification system	3.5
EA1.6	RCS	3.8
EA1.7	Containment	3.5
EA1.8	MFW system	3.8
EA1.9	Main steam system	3.9
EA1.10	ESAS	4.2
EA1.11	EFICs	4.2
EA1.12	Reactor building spray system	3.2

EA2 Ability to determine and/or interpret the following as they apply to Excessive Heat Transfer:
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	SCM	4.4	3.8
EA2.4	PZR level	4.1	3.8
EA2.5	RCS pressure	4.1	3.9
EA2.6	RCS temperature	4.3	4.1
EA2.7	Main steam component positions	4.3	4.1
EA2.8	Reactor building pressure	3.6	3.7
EA2.9	S/G pressure	4.3	4.3
EA2.10	S/G level	3.9	4.1
EA2.11	MFW component positions	4.0	3.9
EA2.12	EFW pumps, valves, and/or flow	4.1	3.9
EA2.13	S/G tube integrity	4.3	3.8
EA2.14	Heatup and/or cooldown rates	4.1	4.0
EA2.15	Tube to shell delta T	4.0	3.7

BW EPE: E08 LOCA Cooldown

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to LOCA Cooldown:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	3.6
EK1.5	Secondary pressure control	3.6
EK1.6	Primary inventory control	4.1
EK1.7	Primary pressure control	4.1
EK1.8	Adequate SCM	4.3
EK1.9	Primary to secondary heat transfer	3.7
EK1.10	RCS leak (LOCA)	4.1
EK2	**Knowledge of the relationship between the LOCA Cooldown and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFW	4.0
EK2.4	Makeup and purification system	3.7
EK2.5	RCS (including S/G tubes)	3.9
EK2.6	Nuclear ICW	3.4
EK2.7	MFW system	3.3
EK2.8	Main steam system	3.4
EK2.9	ESAS	4.6
EK2.10	Decay heat removal system (LPI)	4.1
EK2.11	Hydrogen recombiner system	2.7
EK2.12	Spent fuel cooling system	2.8
EK2.13	SWS	3.3
EK2.14	Secondary heat sink	3.6
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to LOCA Cooldown:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Check adequate SCM	4.3
EK3.6	Verify proper ESAS actuation	4.4
EK3.7	Control RCS pressure	4.1
EK3.8	Check for leak into Nuclear ICW	3.3

EK3.9	Check for S/G tube integrity	4.0	
EK3.10	Check RCS greater than 150 psig (transition to DHR)	3.7	
EK3.11	Align DH system auxiliary spray before reactor building sump recirculation	3.5	
EK3.12	Check LPI flow meets flow criteria to secure HPI	4.0	
EK3.13	Securing unwanted injection sources and cooling or heat removal sources (which can include any of the following: HPI, RCPs, CFT outlet valves, MFIVs, and MSIVs)	3.6	
EK3.14	Throttle HPI	3.9	
EK3.15	Align decay heat removal discharge to HPI suction	3.7	
EK3.16	Align for reactor building sump recirculation	4.1	
EK3.17	Throttle reactor building spray flow	3.7	
EK3.18	Establish method for long-term cooling	3.7	
EK3.19	Verify hydrogen recombiner operation	2.6	
EK3.20	Check spent fuel cooling in service	2.7	
EK3.21	Perform actions to preclude boron precipitation	3.4	

EA1 **Ability to operate and/or monitor the following as they apply to a LOCA Cooldown:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	EFW	3.9
EA1.5	Makeup and purification system	3.6
EA1.6	RCS (including S/G tubes)	3.7
EA1.7	Nuclear ICW	3.3
EA1.8	MFW system	3.1
EA1.9	Main steam system	3.6
EA1.10	ESAS	4.3
EA1.11	Decay heat removal system (LPI)	4.0
EA1.12	Hydrogen recombiner system	2.6
EA1.13	Spent fuel cooling system	2.9
EA1.14	SWS	3.4
EA1.15	Reactor building ventilation	3.3

EA2 **Ability to determine and/or interpret the following as they apply to LOCA Cooldown:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.9	4.1
EA2.2	Adherence to appropriate procedures and operation within the limitations in the facility license and amendments	4.3	4.3
EA2.3	SCM	4.1	4.1
EA2.4	HPI flow	4.1	3.9
EA2.5	Makeup tank level	3.4	3.7
EA2.6	LPI flow	4.3	4.0
EA2.7	Reactor building pressure	2.9	4.0

EA2.8	BWST level	4.6	3.7
EA2.9	RCS pressure	4.1	4.0
EA2.10	RCS temperature	2.9	3.9
EA2.11	Control room annunciators	3.1	3.6
EA2.12	Primary to secondary heat transfer	3.6	3.9
EA2.13	Reactor building spray flow	4.0	3.9
EA2.14	Hydrogen concentration in reactor building	4.0	3.0
EA2.15	SWS	3.5	3.4
EA2.16	Reactor building ventilation	3.7	3.6

BW EPE: E09 Natural Circulation

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Natural Circulation Cooldown:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	3.6
EK1.5	Secondary pressure control	3.8
EK1.6	Primary inventory control	3.9
EK1.7	Primary pressure control	3.8
EK1.8	Adequate SCM	4.0
EK1.9	Primary to secondary heat transfer	3.8
EK1.10	SDM	3.6
EK1.11	Tube to shell delta T	3.3
EK1.12	Reactor vessel head voids	3.9
EK1.13	PTS	3.4
EK1.14	Secondary heat transfer	4.2
EK2	**Knowledge of the relationship between Natural Circulation Cooldown and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFIC (EFW/MSLI)	4.1
EK2.4	Makeup and purification system	3.4
EK2.5	RCS (including S/G tubes)	3.9
EK2.6	Electrical distribution/EDG	3.3
EK2.7	MFW system	3.1
EK2.8	Main steam system	3.3
EK2.9	ESAS	3.9
EK2.10	Decay heat removal system (LPI)	3.6
EK2.11	Secondary heat sink	4.5
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Natural Circulation Cooldown:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Control RCS pressure within limits	3.8

EK3.6	Control RCS temperature	3.8	
EK3.7	Prevent thermal binding of the ERV isolation valve	3.4	
EK3.8	Maintain SDM	3.8	
EK3.9	Maintain tube to shell delta T within limits	3.4	
EK3.10	Preventing and/or removing voids	3.9	
EK3.11	Control secondary inventory	3.8	
EK3.12	Verify diesel generator operation	3.8	
EK3.13	Control secondary pressure	3.6	
EK3.14	Use of PZR auxiliary spray	3.1	
EK3.15	Control RCS inventory with HPI	3.9	
EK3.16	Align for reactor building sump recirculation	3.8	
EK3.17	Prevent vector isolation	3.5	
EK3.18	Bypass ESAS	3.6	
EK3.19	Isolate CFTs	3.5	
EK3.20	Maintain RCS cooldown within limits	4.0	
EK3.21	Check for need to transition to applicable EOPs/AOPs (ESAS, degraded power, loss of SCM, and RCP and motor emergencies)	4.3	
EK3.22	Restore letdown	3.3	
EK3.23	Bypass MSLI	3.4	

EA1 **Ability to operate and/or monitor the following as they apply to Natural Circulation Cooldown:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	EFIC (EFW / MSLI)	4.0	
EA1.5	Makeup and purification system	3.6	
EA1.6	RCS (including S/G tubes)	4.1	
EA1.7	Electrical distribution/EDG	3.6	
EA1.8	MFW system	3.4	
EA1.9	Main steam system	3.6	
EA1.10	ESAS	4.1	
EA1.11	Decay heat removal system (LPI)	3.6	
EA1.12	Secondary heat sink	4.5	

EA2 **Ability to determine and/or interpret the following as they apply to Natural Circulation Cooldown:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.5	4.5
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	4.5	4.5
EA2.3	SCM	4.1	4.0
EA2.4	HPI flow	3.9	3.9
EA2.5	Makeup tank level	3.4	3.5
EA2.6	LPI flow	3.3	3.6

EA2.7	Cooldown rate	4.4	4.1
EA2.8	BWST level	3.6	3.6
EA2.9	RCS pressure	4.6	3.9
EA2.10	RCS temperature	4.6	3.9
EA2.11	SDM	4.3	3.9
EA2.12	Primary to secondary heat transfer	4.6	4.0
EA2.13	Reactor building spray flow	3.3	3.0
EA2.14	Primary side steam voids	4.4	3.8
EA2.15	Tube to shell delta T	3.9	3.4
EA2.16	Secondary inventory	4.3	3.8
EA2.17	Diesel generator loading	3.3	3.8
EA2.18	Secondary pressure	4.1	3.6
EA2.19	PZR level	4.0	3.6
EA2.20	Primary to secondary heat transfer	4.4	3.9

BW EPE: E10 Post-Trip Stabilization

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Post-Trip Stabilization:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Secondary inventory control	4.0
EK1.5	Secondary pressure control	4.0
EK1.6	Primary inventory control	4.0
EK1.7	Primary pressure control	4.0
EK1.8	Adequate SCM	4.3
EK1.9	Primary to secondary heat transfer	4.0
EK1.10	S/G tube leak	4.1
EK1.11	RCS leak (LOCA)	4.1
EK2	**Knowledge of the relationship between the Post-Trip Stabilization and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	CRDS	3.3
EK2.4	Makeup and purification system	3.9
EK2.5	Electrical distribution system (e.g., generator output breaker, exciter field breaker, NNI power, ICS power, and engineering safeguards (ES) buses energized)	3.9
EK2.6	IAS	3.6
EK2.7	MFW system	3.7
EK2.8	Main steam system	3.7
EK2.9	PZR heaters and/or spray	3.7
EK2.10	ESAS	4.3
EK2.11	EFICs (EFW and/or MSLI)	4.3
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Post-Trip Stabilization:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Tripping the reactor	4.1
EK3.6	Tripping the turbine	4.1
EK3.7	Check adequate SCM	4.3

EK3.8	Minimize letdown	3.3
EK3.9	Control RCS level	4.0
EK3.10	Control RCS pressure within the limits	4.1
EK3.11	Check for proper electrical response (e.g., generator output breaker, exciter field breaker, D01, diesel generators, vital and nonvital buses energized, NNI power, and ICS power)	3.9
EK3.12	Check for proper S/G level control	4.0
EK3.13	Check for proper instrument air pressure	3.3
EK3.14	Check for proper S/G pressure control (main steam safety valves, MSIV, and turbine bypass valves)	4.1
EK3.15	Check for proper ICS response (feedwater demands, MFW block valves, low load block valves, startup valves, and MFW pumps)	3.6
EK3.16	Check normal cooling in service (service water pump for Loop 1 and Loop 2, ICW pump for nuclear and nonnuclear loops, reactor building cooling fans, and main chiller)	3.1
EK3.17	Check for no automatic actuation needed by ESAS or MSLI	4.3
EK3.18	Check for adequate spent fuel pool cooling	3.0
EK3.19	Check for PZR steam space integrity	3.7
EK3.20	Control primary to secondary heat transfer	4.0
EK3.21	Check for S/G tube integrity	4.1
EK3.22	Check for RCS integrity	4.1
EK3.23	Check for need to transition to applicable EOPs (loss of SCM, overheating, overcooling, degraded power, blackout, ESAS, and S/G tube rupture)	4.4

EA1 Ability to operate and/or monitor the following as they apply to Post-Trip Stabilization:
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	CRDS	3.4
EA1.5	Makeup and purification system	4.0
EA1.6	Electrical distribution system (e.g., generator output breaker, exciter field breaker, NNI power, ICS power, and ES buses energized)	3.9
EA1.7	IAS	3.3
EA1.8	MFW system	3.7
EA1.9	Main steam system	3.9
EA1.10	PZR heaters and/or spray	3.7
EA1.11	ESAS	4.4
EA1.12	EFICs (EFW and/or MSLI)	4.4

		RO	SRO
EA2	**Ability to determine and/or interpret the following as they apply to Post-Trip Stabilization:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	Control rod position	4.0	3.9
EA2.4	Reactor power	4.7	4.3
EA2.5	Turbine throttle and governor valve position	4.3	3.9
EA2.6	S/G pressure	4.3	4.1
EA2.7	SCM	4.0	4.4
EA2.8	Letdown flow	3.3	3.3
EA2.9	RCS pressure	4.1	4.3
EA2.10	RCS temperature	4.3	3.9
EA2.11	Proper electrical response	3.9	3.9
EA2.12	PZR level	4.0	4.0
EA2.13	S/G level	4.1	3.9
EA2.14	Feedwater flow	3.9	4.0
EA2.15	PZR steam space integrity	3.7	4.3
EA2.16	S/G tube integrity	4.0	4.3
EA2.17	RCS integrity	4.1	4.3

BW EPE: E13 EOP Rules

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the EOP Rules:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Adequate SCM	4.3
EK1.5	Full HPI flow	4.3
EK1.6	Full LPI flow	4.3
EK1.7	Rapid cooldown	4.0
EK1.8	Reactor vessel pressure-temperature limit	4.1
EK1.9	Minimum LPI flow	4.1
EK1.10	PTS	4.1
EK1.11	Minimum MFW flow	3.7
EK1.12	Minimum EFW flow	4.0
EK1.13	Appropriate S/G level	3.7
EK1.14	Trickle feed	3.4
EK1.15	Tube to shell delta T	3.3
EK1.16	Reactivity	4.1
EK2	**Knowledge of the relationship between the EOP Rules and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	EFW	4.1
EK2.4	Makeup and purification system/HPI	3.9
EK2.5	RCS (including S/G tubes)	3.9
EK2.6	EFIC	4.0
EK2.7	MFW system	3.6
EK2.8	Main steam system	3.7
EK2.9	LPI	4.1
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to EOP Rules:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Check adequate SCM	4.1
EK3.6	Trip RCPs	4.3
EK3.7	Initiate full HPI	4.3

EK3.8	Verify EFW (including reflux boiling setpoint)	4.4	
EK3.9	Initiate full LPI	4.4	
EK3.10	Rapid cooldown	4.0	
EK3.11	Throttle HPI (prevent exceeding Rx vessel pressure-temperature limits and pump run out)	4.1	
EK3.12	Maintain SCM near minimum limit	4.1	
EK3.13	Raise S/G level to LOSM setpoint (automatic control or manual control)	3.9	
EK3.14	Secure RCS dilution	3.7	
EK3.15	Initiate emergency boration	4.4	
EK3.16	Stabilize RCS temperature	3.9	

EA1 **Ability to operate and/or monitor the following as they apply to EOP Rules:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	EFW	4.4
EA1.5	Makeup and purification system / HPI	4.0
EA1.6	RCS (including S/G tubes)	4.1
EA1.7	EFIC	4.0
EA1.8	MFW system	3.9
EA1.9	Main steam system	4.0
EA1.10	LPI	4.3

EA2 **Ability to determine and/or interpret the following as they apply to EOP Rules:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	SCM	4.9	4.3
EA2.4	HPI flow	4.7	4.4
EA2.5	LPI flow	4.7	4.4
EA2.6	EFW flow	4.7	4.4
EA2.7	MFW flow	4.3	3.9
EA2.8	S/G level	4.7	3.9
EA2.9	RCS pressure	4.4	4.0
EA2.10	RCS temperature	4.4	4.0
EA2.11	Tube to shell delta T	4.1	3.6
EA2.12	Primary to secondary heat transfer	4.6	4.0
EA2.13	Neutron flux	4.6	4.3

BW EPE: E14 EOP Enclosures

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the EOP Enclosures:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Adequate SCM	4.3
EK1.5	Full HPI flow	3.9
EK1.6	HPI flow balancing	3.3
EK1.7	HPI cooling	3.9
EK1.8	Primary to secondary heat transfer	4.0
EK1.9	RCS pressure-temperature limits	4.1
EK1.10	PTS	4.1
EK1.11	Secondary inventory control	3.9
EK1.12	Secondary pressure control	4.0
EK1.13	Primary inventory control	4.0
EK1.14	Primary pressure control	4.0
EK1.15	Reactivity	4.3
EK1.16	Tube to shell delta T	3.3
EK2	**Knowledge of the relationship between the EOP Enclosures and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	Containment/reactor building (including cooling and isolation)	3.9
EK2.4	Makeup and purification system/HPI	3.8
EK2.5	RCS (including S/G tubes)	4.0
EK2.6	EFIC (EFW and/or MSLI)	4.0
EK2.7	MFW system	3.4
EK2.8	Main steam system (including AFW and CDS)	3.6
EK2.9	LPI	4.1
EK2.10	SWS	3.7
EK2.11	Auxiliary cooling water system	3.8
EK2.12	Intermediate cooling water system	3.8
EK2.13	ESAS	4.4
EK2.14	Electrical distribution (e.g., EDGs, vital/nonvital 4,160-V buses, NNI power, ICS power, 125-V DC, generator output breakers, or exciter field breaker)	4.1
EK2.15	Reactor building spray system	4.0
EK2.16	Hydrogen sampling / recombiner	3.0

EK2.17	Chemical addition system (e.g., boric acid addition tank, boric acid pumps, BATCH controller, BWST, or sodium hydroxide (NaOH) tank)	3.4
EK2.18	RMS	3.7

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to EOP Enclosures:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Restore normal makeup	3.1
EK3.6	Restore seal injection	3.7
EK3.7	Restore letdown	3.4
EK3.8	Verify EFW (includes proper setpoint and rules for automatic control or manual control)	4.3
EK3.9	Initiate HPI or full HPI	4.3
EK3.10	Maximize reactor building cooling	3.6
EK3.11	Throttle HPI	4.0
EK3.12	Initiate HPI cooling	4.3
EK3.13	Verify MSLI	4.1
EK3.14	Verify adequate SCM (includes required actions SCM is not adequate)	4.3
EK3.15	Initiate emergency boration	4.3
EK3.16	Check primary to secondary heat transfer in progress	4.0
EK3.17	Monitor control room alarms	3.9
EK3.18	Override ES actuation	4.3
EK3.19	Check and/or restore RCP services	3.4
EK3.20	Verify proper ESAS actuation	4.7
EK3.21	Start or bump RCP	3.7
EK3.22	Initiate emergency boration	4.3
EK3.23	Determine actual required boration	3.7
EK3.24	Maintain SCM near minimum limit	4.1
EK3.25	Bypass ESAS	4.1
EK3.26	Control RCS pressure	4.0
EK3.27	Control PZR level	3.9
EK3.28	Shift to reactor building sump suction	4.3
EK3.29	Verify LPI	4.3
EK3.30	Secure HPI	4.0
EK3.31	Align piggy back	4.1
EK3.32	Throttle reactor building spray	3.7
EK3.33	Place DHR in service	4.0
EK3.34	Check for indications of reactor building sump blockage (includes required actions if blockage is indicated)	4.4
EK3.35	Feed intact S/G (EFW, MFW, or AFW)	4.3
EK3.36	Monitor/maintain tube to shell delta T within limits	3.6
EK3.37	Feed S/G with un-isolable steam leak (EFW, MFW, or AFW)	4.0
EK3.38	Check S/G tube integrity	4.1

EK3.39	Check proper electrical response (e.g., vital/nonvital 4, 160-V buses, 125-V DC, generator output breakers, or exciter field breaker)	4.0	
EK3.40	Check NNI and ICS power available	3.7	
EK3.41	Check EDG operation	4.3	
EK3.42	Restore ICW cooling	3.7	
EK3.43	Check for need to transition to applicable EOPs	4.4	

EA1 **Ability to operate and/or monitor the following as they apply to the EOP Enclosures:**
(CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)

EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	Containment/reactor building (including cooling and isolation)	4.0	
EA1.5	Makeup and purification system/HPI	3.9	
EA1.6	RCS (including S/G tubes)	4.0	
EA1.7	EFIC (EFW and/or MSLI)	4.3	
EA1.8	MFW system	3.6	
EA1.9	Main steam system (including AFW and CDS)	3.9	
EA1.10	LPI	4.3	
EA1.11	SWS	3.9	
EA1.12	Auxiliary cooling water system	3.6	
EA1.13	ICW system	3.7	
EA1.14	ESAS	4.4	
EA1.15	Electrical distribution (e.g., EDGs, vital/nonvital 4,160 V buses, NNI power, ICS power, 125 V DC, generator output breakers, or exciter field breaker)	4.3	
EA1.16	Reactor building spray system	4.0	
EA1.17	Hydrogen sampling/recombiner	3.0	
EA1.18	Chemical addition system (e.g., boric acid addition tank, boric acid pumps, BATCH controller, BWST, or NaOH tank)	3.3	
EA1.19	RMS	3.7	

EA2 **Ability to determine and/or interpret the following as they apply to EOP Enclosures:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.4	4.1
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	4.3	4.3
EA2.3	Seal injection flow	4.0	4.0
EA2.4	Seal bleedoff temperature	2.8	3.0
EA2.5	PZR level	4.1	3.7
EA2.6	RCS pressure	4.1	4.0
EA2.7	RCS temperature	4.1	3.9
EA2.8	Letdown flow	3.6	3.6
EA2.9	Letdown temperature	3.1	3.4

EA2.10	Makeup tank level	3.3	3.4
EA2.11	HPI flow	4.1	4.3
EA2.12	LPI flow	4.1	4.3
EA2.13	RCS leakage (LOCA)	4.4	4.1
EA2.14	SCM	4.7	4.4
EA2.15	S/G level (includes fill rate in inches/minute)	4.1	3.6
EA2.16	S/G pressure (includes delta P between S/Gs)	3.9	4.1
EA2.17	Tube to shell delta T	3.9	3.1
EA2.18	Primary to secondary heat transfer	4.1	3.7
EA2.19	EFW flow	4.1	4.3
EA2.20	Diesel generators (voltage, frequency, or load)	3.8	4.0
EA2.21	Auxiliary cooling water pressure	3.0	3.6
EA2.22	Reactor building hydrogen concentration	3.7	3.3
EA2.23	RCS hot-leg voiding	4.0	3.6
EA2.24	PZR temperature	3.4	3.4
EA2.25	Boric acid addition tank level	2.5	2.9
EA2.26	BWST level	4.3	3.6
EA2.27	Boric acid flow (BATCH controller)	2.8	3.1
EA2.28	PTS limits applicable	4.1	3.7
EA2.29	PZR steam space leak	3.4	3.9
EA2.30	Containment/reactor building spray flow	4.1	3.9
EA2.31	Containment/reactor building sump blockage	4.7	4.1
EA2.32	Containment/reactor building breach	4.7	3.9
EA2.33	NaOH tank level	2.0	3.0
EA2.34	Control room annunciators	3.1	3.6

BW APE: A01 Plant Runback

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Plant Runback:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	3.3
AK1.5	Secondary pressure control	3.3
AK1.6	Primary inventory control	3.3
AK1.7	Primary pressure control	3.3
AK1.8	Primary temperature control	3.3
AK1.9	Integrated plant response	3.7
AK1.10	Reactivity	3.8
AK2	**Knowledge of the relationship between the Plant Runback and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	MFW system (including MFW pump trip)	3.5
AK2.4	RCS (including RCP trip)	3.5
AK2.5	CRDS (including asymmetric/dropped control rod or axial power shaping rod (APSR) group manipulations)	3.8
AK2.6	Condensate pumps	2.8
AK2.7	ICS	3.5
AK2.8	Turbine electrohydraulic control (EHC) system	3.3
AK2.9	Heater drain system (including pumps and/or tank levels)	2.8
AK2.10	ATWS/AMSAC	3.5
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to the Plant Runback:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Monitor/control reactor power rate of change	3.7
AK3.6	Verify plant stabilizes at runback setpoint	3.8
AK3.7	Monitor ICS and/or EHC for proper integrated plant response	3.3

AK3.8	Control reactivity after plant runback (e.g., reduce power slightly below runback setpoint, adjust APSR group, reference the Core Operating Limits Report, boration, dilution, or maintain Rx power within a given band)	3.3
AK3.9	Secure/adjust applicable secondary systems (e.g., secondary chemicals, heater drain pumps, heater drain tank levels, or low level condenser spray)	3.0
AK3.10	Transfer plant auxiliaries to offsite power source	3.2
AK3.11	Verify that the ATWS/AMSAC bypassed	3.2

AA1	**Ability to operate and/or monitor the following as they apply to the Plant Runback:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	MFW system (including MFW pump trip)	3.5
AA1.5	RCS (including RCP trip)	3.5
AA1.6	CRDS (including asymmetric/dropped control rod or APSR group manipulations)	3.7
AA1.7	Condensate pumps	3.2
AA1.8	ICS	3.5
AA1.9	Turbine EHC system	3.5
AA1.10	Heater drain system (including pumps and/or tank levels)	3.3
AA1.11	ATWS/AMSAC	3.5

AA2	**Ability to determine and/or interpret the following as they apply to the Plant Runback:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency conditions	3.4	4.2
AA2.2	Adherence to appropriate procedures and operation within the limitations of the facilities license and amendments	4.0	4.2
AA2.3	Reactor power	4.3	4.2
AA2.4	PZR level	3.6	3.6
AA2.5	RCS temperature	3.9	3.6
AA2.6	RCS pressure	4.1	3.6
AA2.7	S/G level	3.6	3.6
AA2.8	S/G pressure (including main turbine header pressure)	4.0	3.6
AA2.9	Main turbine load (including VAR)	2.6	3.6
AA2.10	MFW flow	3.3	3.6
AA2.11	Heater drain tank level	2.3	3.0
AA2.12	Condenser vacuum	2.9	3.4
AA2.13	Tilt and/or imbalance	4.1	3.6

BW APE: A02 Loss of NNI-X

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of NNI-X:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	3.8
AK1.5	Secondary pressure control	3.8
AK1.6	Primary inventory control	3.9
AK1.7	Primary pressure control	3.9
AK1.8	Reactivity	4.0
AK2	**Knowledge of the relationship between Loss of NNI-X and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	MFW system	3.9
AK2.4	Makeup and purification system	3.6
AK2.5	RCS	3.5
AK2.6	Main steam system	3.8
AK2.7	ICS	3.4
AK2.8	EFW	3.8
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of NNI-X:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Trip reactor	4.4
AK3.6	Control RCS inventory	3.9
AK3.7	Control RCS pressure	3.9
AK3.8	Control secondary inventory	3.8
AK3.9	Control secondary pressure	3.9
AK3.10	Take manual control of control rods	4.1
AK3.11	Select NNI-Y instruments	3.8
AK3.12	Take manual control of seal injection	3.6
AK3.13	Actuate EFW	4.3

AA1	**Ability to operate and/or monitor the following as they apply to Loss of NNI-X:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)		
AA1.1	DELETED		
AA1.2	DELETED		
AA1.3	DELETED		
AA1.4	MFW system	3.8	
AA1.5	Makeup and purification system	3.8	
AA1.6	RCS	4.0	
AA1.7	Main steam system	3.8	
AA1.8	ICS	4.0	
AA1.9	EFW	4.3	

AA2	**Ability to determine and/or interpret the following as they apply to Loss of NNI-X:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	Reactor power	4.5	4.1
AA2.4	PZR level	4.0	4.1
AA2.5	Makeup tank level	3.3	3.8
AA2.6	Seal injection flow	3.5	3.6
AA2.7	Makeup flow/HPI flow	3.7	3.8
AA2.8	Seal bleedoff temperature	3.0	3.3
AA2.9	RCS pressure	4.2	4.1
AA2.10	RCS temperature	4.0	4.1
AA2.11	SCM	4.3	4.1
AA2.12	S/G level	4.2	4.0
AA2.13	S/G pressure	4.2	4.1
AA2.14	RCS flow	3.5	4.0
AA2.15	MFW flow	3.8	4.0

BW APE: A03 Loss of NNI-Y

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of NNI-Y:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	3.2
AK2	**Knowledge of the relationship between Loss of NNI-Y and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	MFW system	3.2
AK2.4	Makeup and purification system	3.2
AK2.5	ICS	3.6
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of NNI-Y:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Manually control MFW pumps	3.2
AK3.6	Select NNI-Y instruments	3.2
AA1	**Ability to operate and/or monitor the following as they apply to Loss of NNI-Y:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	MFW system	3.4
AA1.5	Makeup and purification system	3.4
AA1.6	ICS	3.8

		RO	SRO
AA2	**Ability to determine and/or interpret the following as they apply to Loss of NNI-Y:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	MFW flow	3.8	3.4
AA2.4	PZR level	3.6	3.6
AA2.5	Makeup tank level	3.0	3.2

BW APE: A04 Turbine Trip

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Turbine Trip:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	3.4
AK1.5	Secondary pressure control	3.4
AK1.6	Secondary chemistry control	2.6
AK1.7	Primary pressure control	4.0
AK1.8	Reactivity	4.1
AK2	**Knowledge of the relationship between the Turbine Trip and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	RCS	3.9
AK2.4	ICS	3.9
AK2.5	Electrical distribution	3.6
AK2.6	MFW system	3.8
AK2.7	Main turbine lube oil system	3.0
AK2.8	Main steam system	3.5
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Turbine Trip:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Verify turbine trip	3.8
AK3.6	Control RCS pressure	3.9
AK3.7	Control reactor power	3.9
AK3.8	Control S/G pressure	3.8
AK3.9	Verify electrical loads shift to offsite power source	3.1
AK3.10	Control S/G level	3.8
AK3.11	Verify turbine auxiliaries (e.g., main turbine bearing oil, main turbine lift oil, turning gear, vacuum, or HP turbine drains)	2.9
AK3.12	Secure all but one MFW pump	3.0
AK3.13	Secure moisture separator reheaters	2.8
AK3.14	Establish feedwater heating	2.9
AK3.15	Maintain secondary chemistry within limits	2.6

AA1	**Ability to operate and/or monitor the following as they apply to a Turbine Trip:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	RCS	3.5
AA1.5	ICS	3.7
AA1.6	Electrical distribution	3.1
AA1.7	MFW system	3.4
AA1.8	Main turbine lube oil system	2.8
AA1.9	Main steam system	3.1

AA2	**Ability to determine and/or interpret the following as they apply to a Turbine Trip:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	Reactor power	4.2	4.1
AA2.4	RCS pressure	4.2	3.9
AA2.5	RCS temperature	4.0	3.8
AA2.6	Condenser vacuum	3.0	3.3
AA2.7	S/G pressure	3.7	3.6
AA2.8	S/G level	3.7	3.8
AA2.9	Bus voltages	2.8	3.0
AA2.10	Turbine speed	2.5	3.0
AA2.11	Feedwater temperature	2.5	2.8
AA2.12	Secondary chemistry	2.5	2.5

BW APE: A05 Emergency Diesel Actuation

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Emergency Diesel Actuation:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	3.2
AK1.5	Secondary pressure control	3.0
AK1.6	Primary inventory control	3.3
AK1.7	Primary pressure control	3.5
AK1.8	Adequate SCM	3.2
AK1.9	Primary to secondary heat transfer	3.2
AK1.10	Tube to shell delta T	2.8
AK1.11	Criteria met for HPI cooling	3.0
AK1.12	Nil ductility transition temperature	2.7
AK1.13	Excessive heat transfer	3.5
AK1.14	Inadequate heat transfer	3.3
AK1.15	Full HPI	3.3
AK1.16	Rapid RCS cooldown	3.0
AK1.17	S/G tube leak	2.8
AK2	**Knowledge of the relationship between the Emergency Diesel Actuation and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	Electrical distribution system	4.1
AK2.4	Makeup and purification system	3.4
AK2.5	RCS (including S/G tubes)	3.1
AK2.6	Reactor building	3.4
AK2.7	MFW system (includes CDS and AFW)	3.0
AK2.8	Main steam system	3.3
AK2.9	ESAS	4.4
AK2.10	EFICs (EFW) and/or MSLI	4.3
AK2.11	SWS	3.9
AK2.12	Auxiliary cooling water	3.6
AK2.13	ICW / CCW	3.4

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Emergency Diesel Actuation:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Verify proper operation of both EDGs (including SW aligned for cooling)	4.3
AK3.6	Actuate MSLI for both S/Gs	3.7
AK3.7	Actuate EFW	4.0
AK3.8	Control S/G press using atmospheric dump valves in hand	3.3
AK3.9	Control RCS pressure and/or PZR level (e.g., HPI flow, normal makeup flow, or PZR heaters)	3.3
AK3.10	Isolate letdown	2.7
AK3.11	Isolate RCP seal bleedoff	3.0
AK3.12	Prepare for loss of instrument air	2.9
AK3.13	Prepare for a controlled restoration of offsite power (e.g., taking hand switches from pull to lock to prevent automatic closure of breakers for pumps) and/or bus feeds	3.6
AK3.14	Restore makeup via HPI	3.1
AK3.15	Restore seal injection and seal bleedoff	3.9
AK3.16	Check spent fuel pool cooling in service	3.1
AK3.17	Maximize reactor building cooling	2.9
AK3.18	Check adequate SCM	3.3
AK3.19	Check for signs of excessive heat transfer	3.3
AK3.20	Check for signs of inadequate heat transfer	3.3
AK3.21	Check for S/G tube integrity	3.1
AK3.22	Check status of offsite power (available, degraded, or not available)	4.0
AK3.23	Re-energize buses from offsite power source	3.9
AK3.24	Restore ICW	3.1
AK3.25	Restore letdown	2.9
AK3.26	Restore spent fuel pool cooling	3.0
AK3.27	Restore normal makeup	3.4
AK3.28	Check primary to secondary heat transfer in progress	3.1
AK3.29	Secure HPI cooling	2.9
AK3.30	Establish PZR bubble	2.7
AK3.31	Restart RCPs	2.6
AK3.32	Verify main turbine auxiliary support (e.g., bearing lube oil, generator seal oil, turning gear, or condenser vacuum)	3.0
AK3.33	Energize nonvital loads from degraded offsite power source	2.9
AK3.34	Energize essential nonvital loads from ES bus	3.3
AK3.35	Monitor diesel generator loading	4.1
AK3.36	Take actions to reduce DC loading on batteries	3.6

AA1	**Ability to operate and/or monitor the following as they apply to an Emergency Diesel Actuation:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	Electrical distribution system	4.3
AA1.5	Makeup and purification system	3.1
AA1.6	RCS (including S/G tubes)	3.3
AA1.7	Reactor building	3.3
AA1.8	MFW system (includes CDS and AFW)	3.3
AA1.9	Main steam system	3.3
AA1.10	ESAS	4.3
AA1.11	EFICs (EFW and/or MSLI)	4.1
AA1.12	SWS	3.6
AA1.13	Auxiliary cooling water	3.3
AA1.14	ICW/CCW	3.3

AA2	**Ability to determine and/or interpret the following as they apply to Emergency Diesel Actuation:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	SCM	3.2	3.1
AA2.4	Diesel generator operation (voltage, frequency, and/or loading)	3.9	4.3
AA2.5	RCS pressure	3.7	3.3
AA2.6	RCS temperature	2.7	3.1
AA2.7	Seal injection flow	2.7	3.4
AA2.8	S/G tube integrity	2.4	3.3
AA2.9	S/G pressure	2.7	3.1
AA2.10	S/G level	3.0	3.0
AA2.11	Offsite power (voltage)	4.0	4.1
AA2.12	Vital and/or nonvital bus voltage	3.0	4.1
AA2.13	EFW pumps, valves, and/or flow	3.0	3.4
AA2.14	Heatup and/or cooldown rates (PZR or RCS)	2.6	3.1
AA2.15	Tube to shell delta T	2.3	3.1
AA2.16	Makeup pump, tank, valves, and/or flow	3.0	3.0
AA2.17	Primary to secondary heat transfer	2.7	3.1
AA2.18	PZR level and/or temperature	2.7	3.0
AA2.19	Implement TS and/or TRM actions for emergency diesel generator actuation (as applicable)	3.2	4.0

BW APE: A06 Shutdown Outside Control Room

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Shutdown Outside Control Room:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Secondary inventory control	4.0
AK1.5	Secondary pressure control	4.0
AK1.6	Primary inventory control	4.3
AK1.7	Primary pressure control	4.2
AK1.8	Adequate SCM	4.3
AK1.9	Primary to secondary heat transfer	4.3
AK1.10	Natural circulation	4.2
AK1.11	Reactivity	4.3
AK2	**Knowledge of the relationship between the Shutdown Outside Control Room and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	CRDS	3.5
AK2.4	Makeup and purification system/HPI	3.8
AK2.5	Electrical distribution system (e.g., local AC and/or DC breaker operations, local EDG operations, local inverter operations)	3.8
AK2.6	Instrumentation	3.8
AK2.7	MFW system	2.9
AK2.8	Main steam system	3.7
AK2.9	PZR heaters and/or spray	3.7
AK2.10	SWS	3.6
AK2.11	EFICs (EFW and/or MSLI)	4.3
AK2.12	SPDS	2.8
AK2.13	RCS	3.7
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to the Shutdown Outside Control Room:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	

AK3.5	Trip the reactor	4.3	
AK3.6	Trip the turbine	4.3	
AK3.7	Close MSIVs	4.0	
AK3.8	Open DC control power to individual breakers	3.7	
AK3.9	Control PZR level	4.1	
AK3.10	Control RCS pressure within the limits	4.2	
AK3.11	Trip MFW pumps	3.7	
AK3.12	Control S/G level	4.1	
AK3.13	Control S/G pressure	4.1	
AK3.14	Control EFW (pumps and/or valves)	4.1	
AK3.15	Control makeup and purification / HPI	3.9	
AK3.16	Trip RCPs	3.6	
AK3.17	Start and/or control EDGs	4.0	
AK3.18	Verify proper inverter operations	3.3	
AK3.19	Isolate letdown	3.8	
AK3.20	Implement emergency action levels (EALs)	4.1	
AK3.21	Start AFW pump	4.3	
AK3.22	Align feedwater heating	2.6	
AA1	**Ability to operate and/or monitor the following as they apply to a Shutdown Outside Control Room:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)		
AA1.1	DELETED		
AA1.2	DELETED		
AA1.3	DELETED		
AA1.4	CRDS	3.2	
AA1.5	Makeup and purification system/HPI	3.9	
AA1.6	Electrical distribution system (e.g., local AC and/or DC breaker operations, local EDG operations, and local inverter operations)	3.9	
AA1.7	Instrumentation	3.9	
AA1.8	MFW system	3.2	
AA1.9	Main steam system	3.6	
AA1.10	PZR heaters and/or spray	3.9	
AA1.11	SWS	3.5	
AA1.12	EFICs (EFW and/or MSLI)	4.3	
AA1.13	SPDS	2.7	
AA1.14	RCS	3.9	
AA2	**Ability to determine and/or interpret the following as they apply to a Shutdown Outside Control Room:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	Reactor power	3.7	4.3
AA2.4	S/G pressure	4.6	4.2
AA2.5	S/G level	4.6	4.2
AA2.6	RCS pressure	4.6	4.2
AA2.7	PZR level	4.4	4.1

AA2.8	PZR temperature	3.6	3.8
AA2.9	RCS temperature	4.6	4.2
AA2.10	EDG (voltage, frequency, and/or loading)	4.0	4.2

BW APE: A07 Flooding

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Flooding:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Decay heat removal	3.4
AK1.5	Offsite power	3.3
AK1.6	Reactivity	3.3
AK1.7	Plant shutdown requirements	3.7
AK2	**Knowledge of the relationship between Flooding and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	Electrical distribution	3.4
AK2.4	Decay heat removal system	3.4
AK2.5	Flood barriers	3.6
AK2.6	SWS	3.4
AK2.7	Fire water system	3.3
AK2.8	EFW	3.6
AK2.9	Circulating water system	3.3
AK2.10	MFW system	3.3
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Flooding:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Monitor water level (lake or river)	3.7
AK3.6	Perform flood actions (e.g., compensatory actions for out of service or degraded flood barriers, bolt flood doors, isolate below-grade vaults, close dampers, close drain isolations, or relocate B.5.b equipment to higher elevations)	3.7
AK3.7	Commence plant shutdown or trip reactor	4.3
AK3.8	Implement EALs	4.0
AK3.9	Evaluate plant risk	3.6
AK3.10	Align offsite power for flood conditions	3.7
AK3.11	Align one train for LPI	3.4
AK3.12	Align one train for decay heat removal	3.4

AK3.13	Secure and deenergize below-grade equipment	3.4	
AK3.14	Secure nonessential electrical loads	3.1	
AK3.15	Determine source of leakage (e.g., circulating water system, SWS, feedwater system, and fire water system)	3.4	
AK3.16	Isolate source of leakage	3.6	
AK3.17	Secure pumps in leaking system	3.4	
AK3.18	Bypass leaking components (e.g., feedwater heater)	3.1	
AK3.19	Secure and/or declare components inoperable that are cooled by leaking system	3.3	

AA1	**Ability to operate and/or monitor the following as they apply to Flooding:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)		
AA1.1	DELETED		
AA1.2	DELETED		
AA1.3	DELETED		
AA1.4	Electrical distribution	3.9	
AA1.5	Decay heat removal system	3.9	
AA1.6	Flood barriers	3.6	
AA1.7	SWS	3.6	
AA1.8	Fire water system	3.4	
AA1.9	EFW	3.6	
AA1.10	Circulating water system	3.3	
AA1.11	MFW system	3.3	

AA2	**Ability to determine and/or interpret the following as they apply to Flooding:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.6	4.3
AA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	4.0	4.3
AA2.3	Water level (lake or river) and/or ultimate heat sink water source	4.0	4.0
AA2.4	Offsite power	3.6	3.8
AA2.5	Sump levels (e.g., auxiliary building sump, turbine building sump, and oil sumps)	3.3	3.5
AA2.6	Drain tank levels	3.2	3.3
AA2.7	Hotwell level	3.0	3.5
AA2.8	Spent fuel pool cooling	4.0	3.8
AA2.9	Flood levels that could impact electrical equipment	4.0	3.8

BW APE: A08 Refueling Canal Level Decrease

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Refueling Canal Level Decrease:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Containment closure	4.0
AK1.5	Decay heat removal	4.1
AK2	**Knowledge of the relationship between the Refueling Canal Level Decrease and the following systems or components:** (CFR: 41.8 / 41.10 / 45.3)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	Reactor building	3.8
AK2.4	Decay heat removal system	3.9
AK2.5	Fuel transfer system	4.0
AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Refueling Canal Level Decrease:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Set containment closure	4.4
AK3.6	Evacuate containment	4.4
AK3.7	Implement EALs	4.3
AK3.8	Ensure all fuel assemblies are in a safe location	4.1
AK3.9	Secure fuel transfer system/carriage	3.8
AK3.10	Close fuel transfer tube isolation	4.1
AK3.11	Perform actions for loss of decay heat removal	4.1
AA1	**Ability to operate and/or monitor the following as they apply to a Refueling Canal Level Decrease:** (CFR: 41.5 / 41.7 / 45.7 / 45.5 to 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	Reactor building	3.6

AA1.5	Decay heat removal system	3.9	
AA1.6	Fuel transfer system	3.6	

AA2	**Ability to determine and/or interpret the following as they apply to a Refueling Canal Level Decrease:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	DELETED		
AA2.2	DELETED		
AA2.3	Refueling canal level	4.0	4.0
AA2.4	Radiation levels	4.1	4.1
AA2.5	Containment closure	3.9	4.3

4.4 COMBUSTION ENGINEERING (CE) EMERGENCY PLANT EVOLUTIONS (EPEs) AND ABNORMAL PLANT EVOLUTIONS (APEs)

CE EPE: E02 Standard Post-Trip Actions and Reactor Trip Recovery

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Standard Post-Trip Actions and Reactor Trip Recovery:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Sequence of decisions for off-normal operations	3.6
EK1.5	Conditions requiring the implementation of an optimal recovery guideline (ORG)	4.1
EK1.6	Conditions requiring the implementation of the functional recovery guideline	4.2
EK1.7	Knowledge of the safety function hierarchy	4.1
EK1.8	Knowledge of checking safety functions against acceptance criteria along with contingency actions that can be performed for those safety functions that are not met	4.4
EK1.9	Knowledge of the following as it relates to each of the following five ORGs: purpose entry conditions exit conditions safety function status check bases	4.2
EK1.10	Knowledge of an acceptable bus alignment to satisfy the MVDC and MVAC safety function	4.2
EK1.11	Basis for tripping one RCP in each loop for a small-break LOCA	3.6
EK1.12	Basis for tripping all RCP’s for a large-break LOCA	3.6
EK2	**Knowledge of the relationship between the Standard Post-Trip Actions and Reactor Trip Recovery and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC and/or DC electrical distribution	4.2
EK2.4	Area and/or PRMS	3.6
EK2.5	CVCS	3.5
EK2.6	Containment system	3.9
EK2.7	ESFAS	4.5
EK2.8	MT/G system	3.2
EK2.9	NIS	3.7

EK2.10	PZR LCS	3.7
EK2.11	PZR PCS	3.6
EK2.12	RCS	3.7
EK2.13	RCP system	3.8
EK2.14	RPIS	3.8
EK2.15	RPS	4.2
EK2.16	SGS	3.9

EK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Standard Post-Trip Actions and Reactor Trip Recovery:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Actions and/or contingency actions to verify reactivity control during standard post-trip actions	4.6
EK3.6	Actions and/or contingency actions to verify maintenance of vital auxiliaries during standard post-trip actions	4.3
EK3.7	Actions and/or contingency actions to verify RCS inventory control during standard post-trip actions	4.2
EK3.8	Actions and/or contingency actions to verify RCS pressure control during standard post-trip actions	4.2
EK3.9	Actions and/or contingency actions to verify core heat removal during standard post-trip actions	4.3
EK3.10	Actions and/or contingency actions to verify RCS heat removal during standard post-trip actions	4.3
EK3.11	Actions and/or contingency actions to verify containment isolation during standard post-trip actions	4.1
EK3.12	Actions and/or contingency actions to verify containment temperature and pressure control during standard post-trip actions	4.1
EK3.13	Diagnostic actions and/or diagnosis conclusions	4.1
EK3.14	Actions to ensure PZR level control during reactor trip recovery	3.9
EK3.15	Actions to ensure PZR pressure control during reactor trip recovery	3.9
EK3.16	Actions to ensure RCS temperature control during reactor trip recovery	4.0
EK3.17	Actions to ensure RCS heat removal via S/Gs during reactor trip recovery	4.1
EK3.18	Other plant-specific significant actions for standard post-trip actions or reactor trip recovery	3.8

EA1	**Ability to operate and/or monitor the following as they apply to a Standard Post-Trip Actions and Reactor Trip Recovery:** (CFR: 41.7 / 45.5 / 45.6)		
EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	Rod control system		4.1
EA1.5	NIS		4.0
EA1.6	ESFAS		4.5
EA1.7	In-core temperature monitoring system		4.1
EA1.8	RCS		3.8
EA1.9	PZR PCS		3.9
EA1.10	PZR LCS		4.0
EA1.11	RCP system		3.9
EA1.12	CVCS		3.6
EA1.13	Containment isolation system		4.1
EA1.14	Containment temperature and pressure control system		4.1
EA1.15	CCWS		4.0
EA1.16	SGS		3.9
EA1.17	MFW system		3.4
EA1.18	AFW system		4.1
EA1.19	AC electrical distribution system		4.2
EA1.20	DC electrical distribution system		4.1
EA1.21	Main steam system		3.6

EA2	**Ability to determine and/or interpret the following as they apply to Standard Post-Trip Actions and Reactor Trip Recovery:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	4.0	4.2
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	4.5	4.1
EA2.3	Rod position	3.8	4.2
EA2.4	Negative startup rate	4.0	4.2
EA2.5	AC and DC bus voltage	4.0	3.9
EA2.6	PZR level and pressure	3.8	3.9
EA2.7	RCS subcooling	4.3	4.1
EA2.8	S/G level and pressure	4.0	4.0
EA2.9	RCS temperature	3.8	4.0
EA2.10	Containment temperature and pressure	3.8	4.1
EA2.11	ARMs	3.3	3.9
EA2.12	RCS vessel level	4.0	4.1

CE EPE: E05 Excess Steam Demand

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Excess Steam Demand:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Evaluating RCP trip strategy	3.7
EK1.5	Evaluating RCP operating limits	3.6
EK1.6	Determining and isolating the most affected S/G	4.5
EK1.7	RCS temperature control following blowdown using the least affected S/G	4.0
EK1.8	Evaluating high-pressure safety injection (HPSI) throttle/restart criteria	4.2
EK1.9	Evaluating low-pressure safety injection (LPSI) stop/restart criteria	3.3
EK1.10	Maintaining RCS within postaccident pressure-temperature limits	4.0
EK1.11	Recovery from RCS water solid conditions	3.5
EK1.12	Evaluating RCP restart criteria	3.0
EK1.13	Evaluating and eliminating voids	3.3
EK1.14	Evaluating adequate SDM	3.8
EK2	**Knowledge of the relationship between the Excess Steam Demand and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	RCS temperature, pressure, and subcooling	3.9
EK2.4	S/G pressure and level	3.8
EK2.5	ESFAS	3.8
EK2.6	HPSI and LPSI flow	3.8
EK2.7	PZR level, pressure, and temperature	3.6
EK2.8	Charging and letdown flow	3.2
EK2.9	Containment pressure and temperature	4.0
EK2.10	RCS void level	3.5
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to the Excess Steam Demand:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	

EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Verifying safety function status check acceptance criteria	4.0
EK3.6	Implementing RCP trip strategy	3.8
EK3.7	Operating RCPs within operating limits	3.7
EK3.8	Determining and isolating the most affected S/G	4.5
EK3.9	Stabilizing RCS temperature using the least affected S/G	4.2
EK3.10	Throttling HPSI flow	4.1
EK3.11	Restoring S/G levels	3.3
EK3.12	Restoring letdown	3.0
EK3.13	Drawing a bubble in the RCS	3.2
EK3.14	Cooldown to shutdown condition entry conditions	3.2

EA1 **Ability to operate and/or monitor the following as they apply to an Excess Steam Demand:**
(CFR: 41.7 / 45.5 / 45.6)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	ESFAS	4.2
EA1.5	RCS system	3.6
EA1.6	RCP system	3.5
EA1.7	PZR PCS and LCS	3.6
EA1.8	In-core temperature monitoring system	3.4
EA1.9	RCS void monitoring system	3.6
EA1.10	HPSI and LPSI systems	3.9
EA1.11	SGS	3.6
EA1.12	Main steam system	3.5
EA1.13	Main and auxiliary feed system	3.8
EA1.14	CVCS	3.2
EA1.15	Low-temperature overpressure protection system	3.2

EA2 **Ability to determine and/or interpret the following as they apply to an Excess Steam Demand:**
(CFR: 43.5 / 45.13)

		RO	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	4.0	4.2
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	3.8	4.3
EA2.3	RCS pressure and/or temperature	3.5	3.7
EA2.4	Reactor vessel level	3.5	3.7
EA2.5	S/G level and pressure	3.5	3.7
EA2.6	PZR level and pressure	3.3	3.6
EA2.7	CETs and/or subcooling	3.3	3.7
EA2.8	Feed flow to S/Gs	3.8	3.8
EA2.9	CCW flow to RCP seals	3.0	3.2
EA2.10	Charging and letdown flow	2.8	3.2
EA2.11	HPSI and LPSI flow	4.0	3.9
EA2.12	Containment temperature and pressure	3.3	3.9

EA2.13	Cooldown rate	3.0	3.9
EA2.14	AC and DC vital bus voltage	3.0	3.3
EA2.15	Reactor power	3.0	3.6
EA2.16	Control element assembly (CEA) position	3.3	3.5

CE EPE: E06 Loss of Feedwater

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Loss of Feedwater:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Stopping all RCPs	4.1
EK1.5	Conserving S/G inventory	4.0
EK1.6	Priorities while reestablishing feedwater when one or more S/Gs are dry	4.1
EK1.7	Protecting the main condenser	3.2
EK1.8	Preventing feed ring damage during feedwater restoration	3.5
EK1.9	Methods for restoring offsite power	3.4
EK1.10	Identification and elimination of RCS voids	3.3
EK1.11	Consequences of exceeding the TS cooldown rate	3.4
EK1.12	When to shift from loss of feed strategies to once-through cooling	4.3
EK2	**Knowledge of the relationship between the Loss of Feedwater and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	RCS	3.9
EK2.4	PZR PCS and LCS	3.7
EK2.5	S/G LCS and PCS	3.8
EK2.6	ESFAS	4.3
EK2.7	SGS	4.0
EK2.8	MFW and AFW systems	4.1
EK2.9	Main CDS	3.6
EK2.10	RCPs	3.7
EK2.11	ECCS	4.0
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to a Loss of Feedwater:** (CFR: 41.5 / 41.10, 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Stop all RCPs	4.1

EK3.6	Conserve S/G inventory	4.0	
EK3.7	Bypass automatic main steam isolation signal and SI actuation signal initiation	3.8	
EK3.8	Protect the main condenser	3.4	
EK3.9	Implement guidelines to prevent feed ring damage during feedwater restoration	3.5	
EK3.10	Restore letdown	2.9	
EK3.11	Maintain RCS within postaccident pressure-temperature limits	3.5	
EK3.12	Verify single-phase natural circulation	3.6	
EK3.13	Evaluate RCP restart criteria	3.0	
EK3.14	Evaluate the need for a cooldown	3.6	

EA1	**Ability to operate and/or monitor the following as they apply to a Loss of Feedwater:** (CFR: 41.7 / 45.5 / 45.6)		
EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	ESFAS	4.2	
EA1.5	RCS system	3.7	
EA1.6	RCP system	3.5	
EA1.7	PZR PCS and LCS	3.5	
EA1.8	In-core temperature monitoring system and qualified safety parameter display system (QSPDS)	3.6	
EA1.9	RCS void monitoring system	3.5	
EA1.10	SGS	3.6	
EA1.11	Main steam system	3.5	
EA1.12	MFW and AFW systems	4.0	
EA1.13	CVCS	3.4	
EA1.14	Low-temperature overpressure protection system	2.9	
EA1.15	Main CDS	3.4	
EA1.16	RCPs	3.5	
EA1.17	ECCS system	3.9	

EA2	**Ability to determine and/or interpret the following as they apply to Loss of Feedwater:** (CFR: 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.7	4.3
EA2.2	Adherence to appropriate procedures and operation within the limitations in the facility license and amendments	3.3	4.3
EA2.3	RCS pressure and/or temperature	3.7	3.9
EA2.4	Reactor vessel level	3.7	3.8
EA2.5	S/G level and pressure	4.0	4.0
EA2.6	PZR level and pressure	3.7	3.9

EA2.7	CETs and/or subcooling	4.0	3.9
EA2.8	Feed flow to S/Gs	4.3	3.9
EA2.9	Charging and letdown flow	2.7	3.3
EA2.10	AC and DC vital bus voltage	3.7	3.4
EA2.11	Reactor power	3.7	3.5
EA2.12	CEA position	3.0	3.4

CE EPE: E09 Functional Recovery

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Functional Recovery:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Evaluating the reactivity control safety function and implementing the correct success path for plant conditions	4.3
EK1.5	Evaluating the maintenance of vital axillaries safety function and implementing the correct success path for plant conditions (includes MVAC and MVDC)	4.3
EK1.6	Evaluating the RCS inventory control safety function and implementing the correct success path for plant conditions	4.3
EK1.7	Evaluating the RCS pressure control safety function and implementing the correct success path for plant conditions	4.3
EK1.8	Evaluating the RCS and core heat removal safety function and implementing the correct success path for plant conditions	4.3
EK1.9	Evaluating the containment temperature and pressure control safety function and implementing the correct success path for plant conditions	4.0
EK1.10	Prioritizing jeopardized safety functions	4.4
EK1.11	Strategies for mitigating multiple events	4.3
EK1.12	Feed rates associated with a faulted, ruptured S/Gs	3.7
EK2	**Knowledge of the relationship between Functional Recovery and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	RCS system	3.8
EK2.4	PZR LCS and PCS	3.9
EK2.5	Reactor vessel level monitoring system	4.0
EK2.6	In-core temperature monitoring system and QSPDS	3.8
EK2.7	Safety injection system (SIS)	4.4
EK2.8	Vital AC and DC electrical distribution systems	4.1
EK2.9	EDG cooling system	4.2
EK2.10	Containment system	3.9
EK2.11	CCS	3.9
EK2.12	CSS	4.0

EK2.13	Shutdown cooling system	3.5
EK2.14	CCWS	3.6
EK2.15	SGS	3.8
EK2.16	S/G LCS	3.4
EK2.17	MFW and AFW systems	3.8
EK2.18	Main steam system	3.5
EK2.19	CVCS	3.4
EK2.20	ARMs and PRMs	3.3
EK2.21	RCPs	3.1
EK2.22	HPSI	4.3
EK2.23	LPSI	4.1
EK2.24	ESFAS	4.3

EK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Functional Recovery:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Initiate RCP trip strategies	3.9
EK3.6	Identify and prioritize success paths	4.5
EK3.7	Perform operator instructions for all safety functions not satisfied	4.1
EK3.8	Stabilize RCS temperature (reactivity control safety function)	3.8
EK3.9	Verify that the energized vital DC bus has the associated AC bus energized	3.6
EK3.10	Steps for reenergizing a vital AC bus	3.6
EK3.11	Steps for protecting the RCP seals	3.3
EK3.12	Eliminating RCS voids	3.6
EK3.13	Post-RAS HPSI stop criteria	3.5
EK3.14	Minimizing RCS leakage	3.5
EK3.15	Optimizing SI	3.5
EK3.16	Early termination of containment spray pumps	3.6
EK3.17	Ensuring adequate suction for SI pumps	3.9
EK3.18	Establishing minimum SDC entry conditions and initiate SDC	3.3
EK3.19	Maintaining RCS within postaccident pressure and temperature limits	3.7
EK3.20	Maintaining SDM during an RCS cooldown	3.6
EK3.21	Verifying single phase natural circulation	3.7
EK3.22	Protecting the main condenser	2.8
EK3.23	Identifying and isolating the most affected ruptured S/Gs	4.3
EK3.24	Identifying and isolating the most affected faulted S/Gs	4.2
EK3.25	Actions to mitigate a LOAF	3.9
EK3.26	Establishing once-through cooling for RCS heat removal	4.2
EK3.27	Guidelines to prevent feed ring damage during feedwater restoration	3.3
EK3.28	Initiation of hot-leg injection	3.8

EK3.29	Actions to isolate containment	3.8	
EK3.30	Actions to control containment temperature and pressure	3.8	
EK3.31	Initiating long-term actions	3.4	

EA1 **Ability to operate and/or monitor the following as they apply to Functional Recovery:**
(CFR: 41.5 / 41.7 / 45.5 / 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	RCS system	3.7
EA1.5	PZR LCS and PCS	3.6
EA1.6	RCS vessel level monitoring system	3.7
EA1.7	In-core temperature monitoring system and QSPDS	3.8
EA1.8	ESFAS	4.1
EA1.9	SIS	4.3
EA1.10	Vital AC and DC electrical distribution systems	4.1
EA1.11	EDG system	4.3
EA1.12	EDG cooling system	3.9
EA1.13	Containment system	3.8
EA1.14	CCS	3.8
EA1.15	CSS	3.9
EA1.16	Shutdown cooling system	3.7
EA1.17	CCWS	3.6
EA1.18	SGS	3.6
EA1.19	SGS LCS	3.5
EA1.20	MFW and AFW systems	3.8
EA1.21	Main steam system	3.4
EA1.22	CVCS	3.5
EA1.23	ARMs and PRMs	3.5
EA1.24	RCPs	3.4
EA1.25	HPSI	4.1
EA1.26	LPSI	3.8
EA1.27	ESFAS	4.1

EA2 **Ability to determine and/or interpret the following as they apply to Functional Recovery:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.5	4.4
EA2.2	Adherence to appropriate procedures and operation within the limitations in the facility license and amendments	3.8	4.3
EA2.3	Reactor power and startup rate	3.3	3.9
EA2.4	CEA position	3.7	3.7
EA2.5	Charging and letdown flow	3.3	3.4
EA2.6	SI flow	4.0	4.3
EA2.7	Vital AC and DC bus voltage	3.8	4.0
EA2.8	PZR level and pressure	4.0	3.6

EA2.9	RCS subcooling	4.3	3.8
EA2.10	Reactor vessel level	4.3	3.9
EA2.11	S/G level and pressure	4.0	3.6
EA2.12	RCS loop delta T	3.0	3.6
EA2.13	Containment temperature and pressure	3.5	3.9
EA2.14	Area and process radiation levels	3.5	3.5
EA2.15	Hydrogen concentration in containment	3.3	3.3
EA2.16	Containment spray flow	4.0	3.9

CE EPE: E13 Loss of Forced Circulation and/or LOOP and/or a Blackout

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Loss of Forced Circulation and/or LOOP and/or a Blackout:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Strategies for protecting RCP seals	3.5
EK1.5	Actions necessary to protect the main condenser	3.1
EK1.6	Prioritizing sources of power restoration	3.8
EK1.7	Methods for eliminating voids	3.4
EK1.8	Determining the actual PZR level during a cooldown and depressurization	3.3
EK1.9	Methods to control RCS pressure and temperature during a blackout	3.7
EK1.10	Strategy for restoration of AC and DC loads once power is restored	3.7
EK1.11	Minimizing RCS leakage during a blackout	3.7
EK1.12	Restoration of vital power	3.9
EK2	**Knowledge of the relationship between the Loss of Forced Circulation and/or LOOP and/or a Blackout and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	RCS system	3.7
EK2.4	PZR LCS and PCS	3.2
EK2.5	Reactor vessel level monitoring system	3.5
EK2.6	SGS	3.3
EK2.7	S/G LCS	3.3
EK2.8	AC and DC electrical distribution system	3.8
EK2.9	EGD system	4.0
EK2.10	AFW system	3.9
EK2.11	Main steam system	3.4
EK2.12	RCPs	3.3
EK2.13	MFW system	3.0

EK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Forced Circulation and/or LOOP and/or a Blackout:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Protecting RCP seals	3.7
EK3.6	Protecting the main condenser	3.1
EK3.7	Controlling PZR pressure and level	3.6
EK3.8	Verifying single-phase natural circulation	3.9
EK3.9	Preparing and reenergizing vital buses	3.8
EK3.10	Restoring offsite power	3.8

EA1 **Ability to operate and/or monitor the following as they apply to a Loss of Forced Circulation and/or LOOP and/or a Blackout:**
(CFR: 41.5 / 41.7 / 45.5 / 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	RCS	3.7
EA1.5	PZR LCS and PCS	3.5
EA1.6	Reactor vessel level monitoring system	3.6
EA1.7	SGS	3.5
EA1.8	S/G LCS	3.5
EA1.9	AC and DC electrical distribution system	3.7
EA1.10	EDG system	4.0
EA1.11	AFW system	4.1
EA1.12	Main steam system	3.3
EA1.13	RCPs	2.8
EA1.14	MFW system	2.7

EA2 **Ability to determine and/or interpret the following as they apply to Loss of Forced Circulation and/or LOOP and/or a Blackout:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.8	4.1
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility's license and amendments	4.0	4.1
EA2.3	Reactor power	3.5	3.4
EA2.4	CEA rod position	3.3	3.4
EA2.5	AC and DC bus voltage	3.5	3.8

EA2.6	PZR level and pressure	3.8	3.4
EA2.7	RCS subcooling	4.0	3.9
EA2.8	Reactor vessel level	3.8	3.6
EA2.9	RCS loop delta T	3.8	3.6
EA2.10	S/G level	3.8	3.6
EA2.11	Containment pressure and temperature	2.5	3.3
EA2.12	Area and process radiation levels	2.0	3.3

CE APE: A11 RCS Overcooling

K/A NO.	KNOWLEDGE	IMPORTANCE

DELETED and incorporated into CE EPE 05, “Excess Steam Demand.”

CE APE: A13 Natural Circulation Operations

K/A NO.	KNOWLEDGE	IMPORTANCE

DELETED and incorporated into CE EPE 13, “Loss of Forced Circulation and/or LOOP and/or a Blackout.”

CE APE: A16 Excess RCS Leakage

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to the Excess RCS Leakage:** (CFR: 41.5 / 41.7 / 45.7 / 45.8 / 45.9)	
AK1.1	DELETED	
AK1.2	DELETED	
AK1.3	DELETED	
AK1.4	Strategies for detecting and isolating an RCS leak outside containment	4.0
AK1.5	Strategies for detecting and isolating an RCS leak inside containment	3.5
AK1.6	Methods for quantifying an RCS leak	3.8
AK1.7	How RCS leakage isolation can affect other systems	3.3
AK1.8	Differentiating between an RCS leak and an S/G tube leak	3.8
AK1.9	Required actions for various calculated leak rates for S/G tube leaks	3.9
AK1.10	Effect of reactivity manipulations on RCS leak rate calculations	3.5
AK1.11	How RCS leakage isolation can affect TS	3.7
AK2	**Knowledge of the relationship between the Excess RCS Leakage and the following systems or components:** (CFR: 41.7 / 41.8 / 45.4 / 45.7 / 45.8)	
AK2.1	DELETED	
AK2.2	DELETED	
AK2.3	RCS	3.9
AK2.4	PZR LCS	3.9
AK2.5	SGS	3.4
AK2.6	S/G LCS	3.5
AK2.7	CVCS	3.7
AK2.8	RMS	3.7
AK2.9	Containment system	3.5
AK2.10	Radioactive sump systems	3.7
AK2.11	CCWS	3.4
AK2.12	RCPs	2.9
AK2.13	Primary water sampling system	3.1
AK2.14	PZR PORVs and safety valves	3.4
AK2.15	S/G nozzle dams	2.8
AK2.16	Shutdown cooling system / ECCS	3.4

AK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Excess RCS Leakage:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
AK3.1	DELETED	
AK3.2	DELETED	
AK3.3	DELETED	
AK3.4	DELETED	
AK3.5	Ensuring plant parameters are stable before calculating RCS leak rates	3.7
AK3.6	The importance of notifying the chemistry organization to sample the RCS and S/Gs for activity	3.5
AK3.7	Identifying the most affected S/Gs	4.1
AK3.8	Taking actions to minimize the spread of contamination of the most affected S/Gs	3.7
AK3.9	Identifying the RCS leak rate using charging-letdown mismatch	3.5
AK3.10	Identifying the RCS leak rate using tank or sump level changes	3.4
AK3.11	Identifying the RCS leak rate using RCS inventory balance	3.5
AA1	**Ability to operate and/or monitor the following as they apply to Excess RCS Leakage:** (CFR: 41.5 / 41.7 / 45.5 / 45.8)	
AA1.1	DELETED	
AA1.2	DELETED	
AA1.3	DELETED	
AA1.4	RCS system	3.6
AA1.5	PZR LCS and PCS	3.9
AA1.6	SGS	3.5
AA1.7	S/G LCS	3.4
AA1.8	S/GB system	3.3
AA1.9	Charging and volume control system	3.7
AA1.10	RMS	3.4
AA1.11	RCS and steam generating sample system	3.1
AA1.12	Main turbine control system	3.0
AA1.13	Rod control system	3.0
AA1.14	Leak detection / calculation systems	3.4
AA1.15	CCWS	3.0
AA1.16	RCPs	3.2
AA1.17	Primary water sampling system	2.9
AA1.18	PZR PORVs and safety valves	3.5
AA1.19	S/G nozzle dams	2.9
AA1.20	Shutdown cooling system/ECCS	3.5

		RO	SRO
AA2	**Ability to determine and/or interpret the following as they apply to Excess RCS Leakage:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.3	4.4
AA2.2	Adherence to appropriate procedures and operation operations within the limitations of the facility's license and amendments	3.3	4.4
AA2.3	Area and process radiation levels	2.7	3.9
AA2.4	PZR level and pressure	3.3	3.9
AA2.5	VCT level	3.7	3.5
AA2.6	RCS temperature and pressure	3.0	3.5
AA2.7	S/G level and pressure	3.3	3.5
AA2.8	RCS and S/G activity levels (from chemistry samples)	2.7	3.4
AA2.9	Various sump levels (inside and outside containment)	3.0	3.5
AA2.10	Charging and letdown flow	4.0	3.8
AA2.11	Reactor and main turbine power levels	3.0	3.3
AA2.12	RCS cooldown rate	3.7	3.3
AA2.13	RCS leak rate (signs of worsening leak or successful isolation)	4.3	3.9

4.5 WESTINGHOUSE (W) EMERGENCY PLANT EVOLUTIONS (EPEs) AND ABNORMAL PLANT EVOLUTIONS (APEs)

W EPE: E01 Rediagnosis

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Rediagnosis:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Plant operating conditions required to be met for use of the rediagnosis procedure	3.7
EK1.5	Determination of faulted S/G status using S/G pressure indication and/or uncontrolled cooldown	4.2
EK1.6	Determination of ruptured S/G status using uncontrolled level rise and/or high radiation	4.2
EK2	**Knowledge of the relationship between the Rediagnosis and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	SGS	3.7
EK2.4	MFW system	3.4
EK2.5	RCS	3.7
EK2.6	ESFAS	3.8
EK2.7	PRMS	3.6
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Rediagnosis:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EA1	**Ability to operate and/or monitor the following as they apply to a Rediagnosis:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	SGS	3.6
EA1.5	MFW system	3.5

EA1.6	RCS	3.7
EA1.7	ESFAS	3.7
EA1.8	PRMS	3.7

EA2 **Ability to determine and/or interpret the following as they apply to Rediagnosis:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	SI is actuated or required to be actuated	4.4	4.0
EA2.4	S/G pressure	3.7	3.8
EA2.5	Whether an uncontrolled RCS cooldown is in progress	3.9	3.8
EA2.6	Isolation status of faulted S/Gs	4.0	3.8
EA2.7	S/G level	3.6	3.7
EA2.8	S/G radiation	3.7	3.7
EA2.9	Which procedure or procedure set should be transitioned to	4.2	4.0

W EPE: E02 SI Termination

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to SI Termination:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	SI termination criteria	4.3
EK1.5	Effect on automatic start of safeguards equipment should loss of power occur after SI reset	3.9
EK1.6	Effect on automatic transfer of high-head SI pump suction from the boric acid tank (BAT) to the RWST after SI reset	3.6
EK1.7	Starting a charging pump with no CCW cooling to RCP thermal barrier	3.5
EK1.8	Conditions required to start an RCP	3.5
EK2	**Knowledge of the relationship between the Safety Injection Termination and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC electrical distribution system	3.5
EK2.4	EDGs	3.6
EK2.5	ESFAS	4.0
EK2.6	Control RPIS	2.6
EK2.7	RVLIS	3.5
EK2.8	In-Core temperature monitoring system	3.8
EK2.9	NIS	3.2
EK2.10	SDS	2.9
EK2.11	PZR PCS	3.4
EK2.12	RCS	3.7
EK2.13	RCP system	3.0
EK2.14	ECCS	4.0
EK2.15	RHRS	3.7
EK2.16	CCWS	3.5
EK2.17	CSS	3.5
EK2.18	Containment system	3.5
EK2.19	SGS	3.3
EK2.20	AFW system	3.6
EK2.21	Reactor makeup system	3.2
EK2.22	CVCS	3.3
EK2.23	IAS	2.9

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to SI Termination:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Implementing procedure foldout page actions	3.8
EK3.6	Resetting SI and/or containment isolation signal(s)	3.9
EK3.7	Establishing instrument air to containment	3.1
EK3.8	Manually transferring high-head SI pump suction source from BAT to RWST	3.5
EK3.9	Stopping ECCS pumps and placing them in standby	3.8
EK3.10	Establishing normal charging flow	3.6
EK3.11	Manually re-initiating SI flow	4.0
EK3.12	Stopping containment spray pumps	3.5
EK3.13	Initiating emergency boration (Reference Potential)	3.7
EK3.14	Establishing letdown	3.4
EK3.15	Aligning reactor makeup system and/or charging pump suction	3.3
EK3.16	Transferring condenser steam dumps to pressure control mode	2.7
EK3.17	Controlling PZR pressure	3.6
EK3.18	Maintaining adequate intact S/G level and/or feed flow	3.7
EK3.19	Ensuring RCPs are properly cooled	3.4
EK3.20	Aligning RCP seal return flow	3.1
EK3.21	Restoring offsite power to all AC buses	3.7
EK3.22	Starting RCP(s) to provide normal forced circulation and/or normal PZR spray	3.3
EK3.23	Energizing source-range detectors	3.1
EA1	**Ability to operate and/or monitor the following as they apply to SI Termination:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	AC electrical distribution system	3.4
EA1.5	EDGs	3.7
EA1.6	ESFAS	4.0
EA1.7	Control RPIS	2.7
EA1.8	RVLIS	3.5
EA1.9	In-core temperature monitoring system	3.7
EA1.10	NIS	3.3
EA1.11	SDS	2.9
EA1.12	PZR PCS	3.5
EA1.13	RCS	3.7
EA1.14	RCP system	3.2

EA1.15	ECCS	3.9	
EA1.16	RHRS	3.6	
EA1.17	CCWS	3.4	
EA1.18	CSS	3.4	
EA1.19	Containment system	3.4	
EA1.20	SGS	3.3	
EA1.21	AFW system	3.7	
EA1.22	Reactor makeup system	3.1	
EA1.23	CVCS	3.3	
EA1.24	IAS	2.8	

EA2	**Ability to determine and/or interpret the following as they apply to SI Termination:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	RCS pressure, temperature, and/or PZR level	4.5	4.1
EA2.4	Control rod insertion	2.8	2.9
EA2.5	BAT level	2.7	3.0
EA2.6	Instrument air header pressure	2.8	2.8
EA2.7	CCW flow to RCPs and/or seal water heat exchanger	3.3	3.1
EA2.8	Charging flow	3.5	3.4
EA2.9	Core exit temperatures and/or subcooling	4.5	3.9
EA2.10	RCP seal flow (supply and/or return)	3.0	3.3
EA2.11	Containment pressure	3.9	3.5
EA2.12	VCT level	2.4	3.2
EA2.13	Condenser availability	2.5	2.7
EA2.14	S/G level, pressure, and/or feedwater flow	3.4	3.5
EA2.15	Reactor vessel level	4.2	3.5

W EPE: E03 LOCA Cooldown and Depressurization

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to LOCA Cooldown and Depressurization:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Starting a charging pump with no CCW cooling to RCP thermal barrier	3.7
EK1.5	Positive PZR level-measurement error for plants without sealed reference legs	3.3
EK1.6	Blocking low steamline pressure SI when the PZR pressure lowers less than P-11 setpoint during cooldown	3.9
EK1.7	MSLI on high steam pressure rate during cooldown	3.6
EK1.8	Upper head voiding during RCS depressurization	4.1
EK1.9	RTD bypass manifold temperature inaccuracy on natural circulation	3.0
EK2	**Knowledge of the relationship between the LOCA Cooldown and Depressurization and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC electrical distribution system	3.3
EK2.4	EDGs	3.5
EK2.5	ESFAS	4.0
EK2.6	RVLIS	3.6
EK2.7	In-core temperature monitoring system	3.7
EK2.8	NIS	3.1
EK2.9	SDS	3.3
EK2.10	PZR PCS	3.5
EK2.11	PZR LCS	3.6
EK2.12	RCS	3.6
EK2.13	RCP system	3.3
EK2.14	ECCS	3.9
EK2.15	RHRS	3.6
EK2.16	CCWS	3.5
EK2.17	Containment system	3.5
EK2.18	SGS	3.4
EK2.19	AFW system	3.6
EK2.20	CVCS	3.3
EK2.21	MRSS	2.8

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to LOCA Cooldown and Depressurization:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Implementing procedure foldout page actions	3.8
EK3.6	Restoring offsite power to all AC buses	3.5
EK3.7	Stopping low-head SI pumps	3.2
EK3.8	Establishing maximum charging flow	3.7
EK3.9	Maintaining adequate intact S/G level and/or feed flow	3.8
EK3.10	Initiating RCS cooldown to cold shutdown	3.7
EK3.11	Depressurizing the RCS to refill the PZR	3.8
EK3.12	Starting a RCP to provide normal forced circulation and/or normal PZR spray	3.3
EK3.13	Determining required conditions to stop an SI pump (Reference Potential)	3.7
EK3.14	Depressurizing the RCS to minimize RCS subcooling (Reference Potential)	3.8
EK3.15	Manually re-initiating SI flow	3.8
EK3.16	Isolating or venting SI accumulators	3.3
EK3.17	Ensuring RCPs are properly cooled	3.2
EK3.18	Aligning RCP seal return flow	3.0
EK3.19	Energizing source-range detectors	3.0
EK3.20	Stopping RCPs when minimum operating conditions are not met	3.8

EA1	**Ability to operate and/or monitor the following as they apply to a LOCA Cooldown and Depressurization:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	AC electrical distribution system	3.3
EA1.5	EDGs	3.6
EA1.6	ESFAS	4.1
EA1.7	RVLIS	3.5
EA1.8	In-core temperature monitoring system	3.7
EA1.9	NIS	3.1
EA1.10	SDS	3.2
EA1.11	PZR PCS	3.5
EA1.12	PZR LCS	3.6
EA1.13	RCS	3.6
EA1.14	RCP system	3.4
EA1.15	ECCS	3.9
EA1.16	RHRS	3.6
EA1.17	CCWS	3.3

EA1.18	Containment system	3.4	
EA1.19	SGS	3.4	
EA1.20	AFW system	3.7	
EA1.21	CVCS	3.3	
EA1.22	MRSS	2.9	

EA2	**Ability to determine and/or interpret the following as they apply to LOCA Cooldown and Depressurization:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	RCS pressure, temperature, and/or PZR level	4.0	4.2
EA2.4	CCW flow to RCPs and/or seal water heat exchanger	2.7	3.2
EA2.5	Charging flow	3.3	3.6
EA2.6	Core exit temperatures and/or subcooling	4.0	4.1
EA2.7	RCP seal flow (supply and/or return)	3.1	3.2
EA2.8	RCP No. 1 Seal D/P	2.9	3.1
EA2.9	Containment pressure	3.7	3.6
EA2.10	VCT level	2.5	3.0
EA2.11	Condenser availability	2.6	2.9
EA2.12	S/G level, pressure, and/or feedwater flow	3.2	3.7
EA2.13	Reactor vessel level	3.7	3.7
EA2.14	SDM	3.0	3.9
EA2.15	Containment hydrogen concentration	3.1	3.1

W EPE: E04 LOCA Outside Containment

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to LOCA Outside Containment:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Component failures required to establish a LOCA outside containment	3.8
EK1.5	Leakage accumulation in RHR pump area	3.6
EK2	**Knowledge of the relationship between the LOCA Outside Containment and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	RCS	3.8
EK2.4	RHRS	3.9
EK2.5	RCS leakage paths to outside containment	4.0
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to LOCA Outside Containment:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Verifying proper valve alignment	3.8
EK3.6	Identifying and isolating the break	4.3
EA1	**Ability to operate and/or monitor the following as they apply to a LOCA Outside Containment:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	RCS	3.8
EA1.5	RHRS	3.8

		RO	SRO
EA2	**Ability to determine and/or interpret the following as they apply to LOCA Outside Containment:** (CFR: 41.10 / 43.5 / 45.13)		
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	RCS pressure	3.9	3.8

W EPE: E05 Loss of Secondary Heat Sink

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Secondary Heat Sink:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Total feed flow less than minimum AFW requirement due to operator action	3.9
EK1.5	Reestablishing feed flow to a faulted S/G	3.9
EK1.6	Delaying establishment of bleed and feed when it is required	3.9
EK1.7	RTD bypass manifold temperature inaccuracy on natural circulation	3.2
EK1.8	Effect on automatic start of safeguards equipment should a loss of power occur after SI reset	3.7
EK1.9	MSLI on high steam pressure rate during cooldown	3.6
EK1.10	RHR pump operation without CCW cooling to RHR heat exchanger	3.5
EK1.11	Controlling feed flow rate	4.0
EK2	**Knowledge of the relationship between the Loss of Secondary Heat Sink and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC electrical distribution system	3.5
EK2.4	EDGs	3.8
EK2.5	ESFAS	4.0
EK2.6	In-core temperature monitoring system	3.7
EK2.7	SDS	3.6
EK2.8	PZR PCS	3.4
EK2.9	PZR LCS	3.3
EK2.10	RCS	3.5
EK2.11	RCP system	3.3
EK2.12	ECCS	3.8
EK2.13	RHRS	3.5
EK2.14	CCWS	3.2
EK2.15	CSS	2.8
EK2.16	Containment system	3.1
EK2.17	SGS	3.8
EK2.18	AFW system	4.3
EK2.19	MFW system	3.9
EK2.20	CDS	3.8

EK2.21	IAS	3.0
EK2.22	CVCS	2.9
EK2.23	MRSS	3.1
EK2.24	SWS	3.1
EK2.25	FPS	2.6

EK3 **Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Secondary Heat Sink:**
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Checking for RCS bleed and feed criteria	4.1
EK3.6	Establishing AFW to at least one S/G	4.4
EK3.7	Stopping all RCPs	4.0
EK3.8	Establishing MFW flow to at least one S/G	4.0
EK3.9	Depressurizing a S/G and establishing feed flow from the CDS	4.0
EK3.10	Actuating SI and/or verifying RCS feed path	4.1
EK3.11	Resetting SI and/or containment isolation	3.5
EK3.12	Establishing instrument air to containment	3.2
EK3.13	Establishing RCS bleed path	4.0
EK3.14	Establishing any available low-pressure water source to the S/Gs	3.8
EK3.15	Performing verification of automatic SI actuation	3.5
EK3.16	Establishing maximum charging flow	3.5
EK3.17	Stopping containment spray pumps	2.9
EK3.18	Shutting RCS vent valves	3.1
EK3.19	Coordinated sequence for terminating RCS bleed and feed (Reference Potential)	3.4
EK3.20	Controlling or reestablishing feed flow	3.9
EK3.21	Stopping RHR pumps	3.1

EA1 **Ability to operate and/or monitor the following as they apply to Loss of Secondary Heat Sink:**
(CFR: 41.5 to 41.8 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	AC electrical distribution system	3.5
EA1.5	EDGs	3.7
EA1.6	ESFAS	3.9
EA1.7	In-core temperature monitoring system	3.7
EA1.8	SDS	3.4
EA1.9	PZR PCS	3.3
EA1.10	PZR LCS	3.3
EA1.11	RCS	3.5

EA1.12	RCP system	3.4	
EA1.13	ECCS	3.9	
EA1.14	RHRS	3.2	
EA1.15	CCWS	3.2	
EA1.16	CSS	2.9	
EA1.17	Containment system	3.0	
EA1.18	SGS	3.8	
EA1.19	AFW system	4.3	
EA1.20	MFW system	3.9	
EA1.21	CDS	3.8	
EA1.22	IAS	3.1	
EA1.23	CVCS	3.0	
EA1.24	MRSS	3.1	
EA1.25	SWS	3.1	
EA1.26	FPS	2.6	

EA2 **Ability to determine and/or interpret the following as they apply to Loss of Secondary Heat Sink:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	Feed flow to S/Gs	3.9	4.3
EA2.4	S/G pressure and/or level	3.9	4.2
EA2.5	RCS pressure, temperature, and/or PZR level	3.6	4.0
EA2.6	RCS delta T	3.1	3.6
EA2.7	CST level	3.7	3.6
EA2.8	CETs and/or subcooling	3.7	3.9
EA2.9	Instrument air header pressure	2.3	3.0
EA2.10	High-head SI flow	3.8	3.7
EA2.11	CCW flow to RCPs	2.6	3.0
EA2.12	Charging flow	2.7	3.3
EA2.13	RWST level	3.1	3.1
EA2.14	Containment pressure	3.1	3.1
EA2.15	CCW flow to RHR heat exchangers	2.9	3.2

W EPE: E06 Degraded Core Cooling

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Degraded Core Cooling:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.01	DELETED	
EK1.02	DELETED	
EK1.03	DELETED	
EK1.04	Conditions requiring implementation of containment sump recirculation	4.1
EK1.05	Maintaining RCPs running even though trip criteria are met or normal support conditions are not met	3.8
EK1.06	Feeding a faulted S/G or steaming a ruptured S/G	3.9
EK1.07	Blocking low steamline pressure SI when PZR pressure lowers less than P-11 setpoint during cooldown	3.6
EK1.08	MSLI on high steam pressure rate during cooldown	3.7
EK1.09	RHR pump operation without CCW cooling to RHR heat exchanger	3.5
EK1.10	Potential for red path on core cooling after stopping all RCPs	3.9
EK2	**Knowledge of the relationship between the Degraded Core Cooling and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	ESFAS	4.1
EK2.04	In-core temperature monitoring system	3.9
EK2.05	SDS	3.4
EK2.06	PZR PCS	3.5
EK2.07	RCS	3.8
EK2.08	RCP system	3.6
EK2.09	ECCS	4.1
EK2.10	RHRS	3.8
EK2.11	CCWS	3.3
EK2.12	SGS	3.6
EK2.13	AFW system	3.7
EK2.14	IAS	2.9
EK2.15	CVCS	3.1
EK2.16	MRSS	2.8
EK2.17	AC electrical distribution system	3.3

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Degraded Core Cooling:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	DELETED	
EK3.02	DELETED	
EK3.03	DELETED	
EK3.04	DELETED	
EK3.05	Establishing high-head ECCS flow or alternate high-pressure makeup source	3.9
EK3.06	Establishing low-head ECCS flow or alternate low-pressure makeup source	3.8
EK3.07	Closing any open RCS vent paths	3.6
EK3.08	Resetting SI and/or containment isolation	3.5
EK3.09	Establishing instrument air to containment	3.1
EK3.10	Establishing support conditions for the operating RCPs	3.4
EK3.11	Determining effectiveness of SI in restoring RCS inventory (Reference Potential)	3.8
EK3.12	Depressurizing all intact S/Gs to inject accumulator water (Reference Potential)	3.6
EK3.13	Starting RHR pumps	3.6
EK3.14	Isolating or venting SI accumulators	3.3
EK3.15	Depressurizing all intact S/Gs to atmospheric pressure	3.8
EK3.16	Verifying the establishment of core cooling (Reference Potential)	4.0
EA1	**Ability to operate and/or monitor the following as they apply to Degraded Core Cooling:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.01	DELETED	
EA1.02	DELETED	
EA1.03	DELETED	
EA1.04	ESFAS	4.2
EA1.05	In-core temperature monitoring system	3.8
EA1.06	SDS	3.3
EA1.07	PZR PCS	3.4
EA1.08	RCS	3.6
EA1.09	RCP system	3.6
EA1.10	ECCS	4.1
EA1.11	RHRS	3.8
EA1.12	CCWS	3.3
EA1.13	SGS	3.6
EA1.14	AFW system	3.9
EA1.15	IAS	2.9
EA1.16	CVCS	3.2
EA1.17	MRSS	2.8

EA2	**Ability to determine and/or interpret the following as they apply to Degraded Core Cooling:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	DELETED		
EA2.02	DELETED		
EA2.03	RWST level	3.6	3.6
EA2.04	RCS pressure and/or temperature	4.0	3.9
EA2.05	CCW flow to RCPs	3.0	3.2
EA2.06	RCP No. 1 seal D/P	3.2	3.2
EA2.07	RCP seal flow (supply and/or return)	3.0	3.3
EA2.08	VCT pressure	2.8	3.0
EA2.09	Instrument air header pressure	2.8	2.6
EA2.10	Reactor vessel level	3.8	3.7
EA2.11	ECCS flow	4.0	4.2
EA2.12	CETs and/or subcooling	4.0	4.1
EA2.13	CST level	3.4	3.2
EA2.14	Feed flow to S/Gs	3.6	3.7
EA2.15	S/G pressure and/or level	3.6	3.6
EA2.16	SI accumulator pressure	3.0	3.1
EA2.17	CCW flow to RHR heat exchangers	2.8	3.1
EA2.18	Red path condition on integrity after accumulator injection	3.7	3.8

W EPE: E07 Saturated Core Cooling

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Saturated Core Cooling:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.01	DELETED	
EK1.02	DELETED	
EK1.03	DELETED	
EK1.04	Conditions requiring implementation of containment sump recirculation	4.1
EK2	**Knowledge of the relationship between the Saturated Core Cooling and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.01	DELETED	
EK2.02	DELETED	
EK2.03	PZR PCS	3.6
EK2.04	RCS	3.6
EK2.05	ECCS	4.1
EK2.06	RHRS	3.7
EK2.07	SGS	3.5
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Saturated Core Cooling:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.01	DELETED	
EK3.02	DELETED	
EK3.03	DELETED	
EK3.04	DELETED	
EK3.05	Establishing and/or verifying ECCS flow	4.2
EK3.06	Closing any open RCS vent paths	3.7
EK3.07	Priority for action if Emergency Contingency Action (ECA)-3.2, SGTR WITH LOSS OF REACTOR COOLANT—SATURATED RECOVERY, is in effect	3.6
EK3.08	Establishing normal heat removal to cool the RCS	3.8
EA1	**Ability to operate and/or monitor the following as they apply to Saturated Core Cooling:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.01	DELETED	
EA1.02	DELETED	
EA1.03	DELETED	

EA1.04	PZR PCS	3.7	
EA1.05	RCS	3.6	
EA1.06	ECCS	4.0	
EA1.07	RHRS	3.8	

EA2	**Ability to determine and/or interpret the following as they apply to Saturated Core Cooling:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	DELETED		
EA2.02	DELETED		
EA2.03	RWST level	3.5	3.5
EA2.04	RCS pressure	4.0	3.9
EA2.05	ECCS flow	4.3	4.0
EA2.06	RCS vent path status	3.5	3.7

W EPE: E08 Pressurized Thermal Shock

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Pressurized Thermal Shock:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Maintaining steam supply to turbine-driven AFW pump if it is the only available source of feed flow	3.9
EK1.5	Upper head voiding during RCS depressurization	3.9
EK1.6	Minimizing reactor vessel stress	4.1
EK1.7	Minimizing RCS cooldown	4.1
EK1.8	RCS temperature soak requirements	3.9
EK1.9	Reactor vessel vulnerability to PTS	3.9
EK2	**Knowledge of the relationship between the Pressurized Thermal Shock and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	ESFAS	4.0
EK2.4	RVLIS	3.5
EK2.5	In-core temperature monitoring system	3.7
EK2.6	SDS	3.3
EK2.7	PZR PCS	3.6
EK2.8	RCS	3.8
EK2.9	RCP system	3.4
EK2.10	ECCS	3.9
EK2.11	RHRS	3.4
EK2.12	CCWS	3.1
EK2.13	SGS	3.4
EK2.14	AFW system	3.6
EK2.15	Reactor makeup system	3.1
EK2.16	CVCS	3.1
EK2.17	IAS	2.8
EK2.18	MRSS	2.7
EK2.19	NIS	2.7

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Pressurized Thermal Shock:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Eliminating secondary-side or RHR-instigated cooldown	3.8
EK3.6	Ensuring proper alignment of PZR PORVs	3.7
EK3.7	Terminating ECCS flow (Reference Potential)	3.9
EK3.8	Manually transferring high-head SI pump suction source from BAT to RWST	3.0
EK3.9	Establishing charging flow	3.3
EK3.10	Manually re-initiating SI flow (Reference Potential)	3.3
EK3.11	Isolating or venting SI accumulators	3.1
EK3.12	Depressurizing the RCS to reduce RCS subcooling	3.8
EK3.13	Establishing normal CVCS lineups	3.4
EK3.14	RCS temperature soak and/or subsequent cooldown (Reference Potential)	3.7
EA1	**Ability to operate and/or monitor the following as they apply to Pressurized Thermal Shock:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	ESFAS	3.9
EA1.5	RVLIS	3.5
EA1.6	In-core temperature monitoring system	3.8
EA1.7	NIS	2.9
EA1.8	SDS	3.3
EA1.9	PZR PCS	3.6
EA1.10	RCS	3.6
EA1.11	RCP system	3.3
EA1.12	ECCS	3.9
EA1.13	RHRS	3.6
EA1.14	CCWS	3.2
EA1.15	SGS	3.3
EA1.16	AFW system	3.5
EA1.17	Reactor makeup system	3.1
EA1.18	CVCS	3.2
EA1.19	IAS	2.7
EA1.20	MRSS	2.7

		RO	SRO
EA2	**Ability to determine and/or interpret the following as they apply to Pressurized Thermal Shock:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	Indications of large-break LOCA	3.3	3.9
EA2.4	RCS subcooling and/or reactor vessel level	4.0	3.8
EA2.5	RCS pressure, temperature, and/or PZR level	3.7	3.9
EA2.6	RCP seal flow (supply and/or return)	2.3	3.1
EA2.7	RCP No. 1 seal D/P	2.7	3.0
EA2.8	CCW flow to RCPs	3.0	3.0
EA2.9	Charging flow	3.7	3.5
EA2.10	VCT level and/or pressure	3.0	3.1
EA2.11	S/G level, pressure, and/or feedwater flow	3.3	3.5
EA2.12	Instrument air header pressure	2.3	2.8

W EPE: E09 Natural Circulation Operations

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Natural Circulation Operations:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	RTD bypass manifold temperature inaccuracy on natural circulation	3.3
EK1.5	Loss of RCP seal cooling	3.1
EK1.6	Controlling reactor vessel head voids	3.7
EK2	**Knowledge of the relationship between the Natural Circulation Operations and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC electrical distribution system	3.1
EK2.4	ESFAS	3.6
EK2.5	RVLIS	3.8
EK2.6	In-core temperature monitoring system	3.9
EK2.7	SDS	3.5
EK2.8	PZR PCS	3.5
EK2.9	PZR LCS	3.4
EK2.10	RCS	3.6
EK2.11	RCP system	3.0
EK2.12	ECCS	3.5
EK2.13	RHRS	3.4
EK2.14	CCWS	3.1
EK2.15	SGS	3.6
EK2.16	AFW system	3.8
EK2.17	Reactor makeup system	3.2
EK2.18	CVCS	3.2
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Natural Circulation Operations:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Implementing procedure foldout page actions	3.6

EK3.6	Starting an RCP	3.4	
EK3.7	Borating to cold shutdown boron concentration	3.7	
EK3.8	Starting CRDM fans	3.2	
EK3.9	Cooling down to cold shutdown (Reference Potential)	3.4	
EK3.10	Depressurizing RCS and/or blocking SI actuation (Reference Potential)	3.5	
EK3.11	Maintaining stable conditions during cooldown (Reference Potential)	3.4	
EK3.12	Repressurizing RCS to collapse voids in RCS (Reference Potential)	3.6	
EK3.13	Holding RCS temperature stable for a waiting period if no CRDM fans are running	3.5	
EK3.14	Isolating SI accumulators and/or locking out SI	3.6	
EK3.15	Placing the RHR system in service	3.7	
EK3.16	Cooling inactive portions of RCS and/or depressurizing to atmospheric pressure	3.3	
EA1	**Ability to operate and/or monitor the following as they apply to Natural Circulation Operations:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)		
EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	AC electrical distribution system	3.2	
EA1.5	ESFAS	3.6	
EA1.6	RVLIS	3.7	
EA1.7	In-core temperature monitoring system	3.8	
EA1.8	SDS	3.6	
EA1.9	PZR PCS	3.5	
EA1.10	PZR LCS	3.5	
EA1.11	RCS	3.6	
EA1.12	RCP system	3.1	
EA1.13	ECCS	3.5	
EA1.14	RHRS	3.6	
EA1.15	CCWS	3.2	
EA1.16	SGS	3.6	
EA1.17	AFW system	3.9	
EA1.18	Reactor makeup system	3.3	
EA1.19	CVCS	3.2	
EA1.20	CRDM cooling fans	3.0	

EA2	**Ability to determine and/or interpret the following as they apply to Natural Circulation Operations:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	RCS pressure, temperature, and/or PZR level	3.0	4.0
EA2.4	CCW flow to RCPs	2.3	2.9
EA2.5	Charging and/or letdown flow	2.7	3.3

EA2.6	Core exit temperatures and/or subcooling	3.7	4.0
EA2.7	RCP seal flow (supply and/or return)	2.7	3.1
EA2.8	RCP No. 1 seal D/P	2.0	3.0
EA2.9	VCT level and/or pressure	2.3	3.0
EA2.10	Condenser availability	2.3	3.1
EA2.11	S/G level, pressure, and/or feedwater flow	3.0	3.7
EA2.12	Reactor vessel level	3.0	3.7
EA2.13	SDM	3.0	3.8
EA2.14	Indications of SI actuation	3.3	3.6

W EPE: E10 Natural Circulation with Steam Void in the Vessel with/without the RVLIS

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Natural Circulation with Steam Void in the Vessel with/without the RVLIS:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	RTD bypass manifold temperature inaccuracy on natural circulation	3.3
EK1.5	Loss of RCP seal cooling	3.0
EK1.6	Control of reactor vessel head voids (with and/or without RVLIS)	3.8
EK2	**Knowledge of the relationship between Natural Circulation with Steam Void in the Vessel with/without the RVLIS and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	ESFAS	3.8
EK2.4	RVLIS	3.9
EK2.5	In-core temperature monitoring system	3.9
EK2.6	SDS	3.3
EK2.7	PZR PCS	3.5
EK2.8	PZR LCS	3.4
EK2.9	RCS	3.6
EK2.10	RCP system	3.0
EK2.11	ECCS	3.7
EK2.12	RHRS	3.6
EK2.13	CCWS	3.2
EK2.14	SGS	3.5
EK2.15	AFW system	3.8
EK2.16	CVCS	3.7
EK2.17	CRDM cooling fans	3.1
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Natural Circulation with Steam Void in the Vessel with/without the RVLIS:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	

EK3.4	DELETED	
EK3.5	Implementing procedure foldout page actions	3.8
EK3.6	Starting an RCP (Reference Potential)	3.6
EK3.7	Establishing PZR level to accommodate void growth	3.7
EK3.8	Continue cooling down and depressurizing the RCS (Reference Potential)	3.7
EK3.9	Repressurizing the RCS to limit RCS void growth (Reference Potential)	3.8
EK3.10	Isolating SI accumulators and/or locking out SI	3.3
EK3.11	Placing the RHR system in service	3.7
EK3.12	Cooling inactive portions of the RCS and/or depressurizing them to atmospheric pressure	3.4

EA1 Ability to operate and/or monitor the following as they apply to Natural Circulation with Steam Void in the Vessel with/without the RVLIS:
(CFR: 41.5 to 41.8 / 45.5 to 45.8)

EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	ESFAS	3.8
EA1.5	RVLIS	3.8
EA1.6	In-core temperature monitoring system	3.9
EA1.7	SDS	3.3
EA1.8	PZR PCS	3.4
EA1.9	PZR LCS	3.4
EA1.10	RCS	3.6
EA1.11	RCP system	3.0
EA1.12	ECCS	3.7
EA1.13	RHRS	3.7
EA1.14	CCWS	3.2
EA1.15	SGS	3.5
EA1.16	AFW system	3.7
EA1.17	CVCS	3.3
EA1.18	CRDM cooling fans	3.1

EA2 Ability to determine and/or interpret the following as they apply to Natural Circulation with Steam Void in the Vessel with/without the RVLIS:

	(CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	RCS pressure, temperature, and/or PZR level	3.0	4.0
EA2.4	CCW flow to RCPs	2.5	3.0
EA2.5	Charging and/or letdown flow	3.0	3.4
EA2.6	Core exit temperatures and/or subcooling	3.5	4.0

EA2.7	RCP seal flow (supply and/or return)	2.0	3.1
EA2.8	RCP No. 1 seal D/P	2.0	3.1
EA2.9	VCT level and/or pressure	2.5	3.0
EA2.10	S/G level, pressure, and/or feedwater flow	3.5	3.7
EA2.11	Reactor vessel level	3.5	3.9
EA2.12	Indications of SI actuation	4.0	3.7

W EPE: E11 Loss of Emergency Coolant Recirculation

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Loss of Emergency Coolant Recirculation:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	LOCA outside containment	4.0
EK1.5	Blocking low steamline pressure SI when PZR pressure lowers less than P-11 setpoint during cooldown	3.4
EK1.6	MSLI on high steam pressure rate during cooldown	3.4
EK1.7	Upper head voiding during RCS depressurization	3.7
EK1.8	RTD bypass manifold temperature inaccuracy on natural circulation	3.2
EK1.9	ECCS pump cavitation caused by sump blockage	4.2
EK2	**Knowledge of the relationship between the Loss of Emergency Coolant Recirculation and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	ESFAS	4.0
EK2.4	In-core temperature monitoring system	3.8
EK2.5	SDS	3.0
EK2.6	PZR PCS	3.2
EK2.7	RCS	3.7
EK2.8	RCP system	3.1
EK2.9	ECCS	4.1
EK2.10	RHRS	3.8
EK2.11	CCS	3.6
EK2.12	CSS	3.7
EK2.13	Containment system	3.4
EK2.14	HRPS	2.9
EK2.15	SGS	3.1
EK2.16	AFW system	3.2
EK2.17	IAS	2.9
EK2.18	Reactor makeup system	3.1
EK2.19	CVCS	3.2

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Loss of Emergency Coolant Recirculation:** (CFR: 41.5 / 41.10, 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Restoring containment sump recirculation capability	4.3
EK3.6	Stopping or realigning containment spray pumps (Reference Potential)	4.0
EK3.7	Making up to the RWST	3.9
EK3.8	Maintaining adequate intact S/G level and/or feed flow	3.5
EK3.9	Initiating RCS cooldown to cold shutdown	3.6
EK3.10	Starting an RCP to provide normal PZR spray	3.1
EK3.11	Terminating SI flow or establishing the minimum to remove decay heat (Reference Potential)	3.6
EK3.12	Manually transferring high-head SI pump suction source from BAT to RWST	3.5
EK3.13	Establishing charging flow	3.4
EK3.14	Depressurizing the RCS to minimize RCS subcooling	3.6
EK3.15	Isolating or venting SI accumulators	3.3
EK3.16	Stopping all pumps taking suction from the RWST	3.9
EK3.17	Adding makeup to the RCS from an alternate source	3.6
EK3.18	Depressurizing all intact S/Gs to control accumulator injection	3.5
EK3.19	Stopping RCPs	3.5
EK3.20	Depressurizing all intact S/Gs to atmospheric pressure	3.5
EK3.21	Placing RHR system in operation and maintaining RCS heat removal	3.8
EK3.22	Assessing and responding to excessive containment hydrogen concentration	3.2
EA1	**Ability to operate and/or monitor the following as they apply to a Loss of Emergency Coolant Recirculation:** (CFR: 41.5 TO 41.8 / 45.5 TO 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	ESFAS	3.9
EA1.5	RVLIS	3.8
EA1.6	In-core temperature monitoring system	3.9
EA1.7	SDS	3.2
EA1.8	PZR PCS	3.3
EA1.9	PZR LCS	3.3
EA1.10	RCS	3.6
EA1.11	RCP system	3.2
EA1.12	ECCS	4.1
EA1.13	RHRS	3.9

EA1.14	CCS	3.7
EA1.15	CSS	3.8
EA1.16	Containment system	3.6
EA1.17	HRPS	3.0
EA1.18	SGS	3.2
EA1.19	AFW system	3.5
EA1.20	IAS	2.9
EA1.21	Reactor makeup system	3.2
EA1.22	CVCS	3.3

EA2 Ability to determine and/or interpret the following as they apply to Loss of Emergency Coolant Recirculation:
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	Indications of sump blockage	3.0	4.3
EA2.4	RCS pressure, temperature, and/or PZR level	3.0	3.8
EA2.5	RWST level	3.5	3.8
EA2.6	ECCS flow	3.5	4.0
EA2.7	Containment pressure	3.0	3.6
EA2.8	Containment sump level	4.0	4.0
EA2.9	Condensate storage tank level	3.0	3.1
EA2.10	S/G level, pressure, and/or feedwater flow	3.0	3.3
EA2.11	Core exit temperatures and/or subcooling	3.5	3.9
EA2.12	RCP seal flow (supply and/or return)	2.0	3.1
EA2.13	RCP No. 1 seal D/P	2.0	2.9
EA2.14	CCW flow to RCPs	3.0	2.9
EA2.15	Instrument air header pressure	1.5	2.8
EA2.16	Reactor vessel level	3.0	3.7
EA2.17	Alternate makeup source to RCS flow	3.5	3.5
EA2.18	Containment hydrogen concentration	3.0	3.1

W EPE: E12 Uncontrolled Depressurization of All Steam Generators

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Uncontrolled Depressurization of All Steam Generators:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Maintaining steam supply to turbine-driven AFW pump if it is the only available source of feed flow	4.1
EK1.5	Effect on automatic start of safeguards equipment if loss of power after SI reset	3.8
EK1.6	Effect on automatic transfer of high-head SI pump suction from BAT to RWST after SI reset	3.5
EK2	**Knowledge of the relationship between the Uncontrolled Depressurization of All Steam Generators and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	AC electrical distribution system	3.2
EK2.4	EDGs	3.6
EK2.5	ESFAS	4.1
EK2.6	RVLIS	3.3
EK2.7	In-core temperature monitoring system	3.7
EK2.8	NIS	3.3
EK2.9	PZR PCS	3.4
EK2.10	PZR LCS	3.5
EK2.11	RCS	3.7
EK2.12	RCP system	3.3
EK2.13	ECCS	3.9
EK2.14	RHRS	3.3
EK2.15	CSS	3.8
EK2.16	Containment system	3.7
EK2.17	CCWS	3.1
EK2.18	SGS	3.9
EK2.19	AFW system	4.0
EK2.20	MFW system	3.2
EK2.21	CVCS	3.0
EK2.22	MRSS	3.0
EK2.23	IAS	2.7
EK2.24	PRMS	2.7

EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Uncontrolled Depressurization of All Steam Generators:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Implementing procedure foldout page actions	3.8
EK3.6	Establishing a secondary pressure boundary	4.0
EK3.7	Controlling S/G feed flow	4.1
EK3.8	Tripping RCPs if conditions are met	3.8
EK3.9	Ensuring PZR PORVs are properly aligned	3.5
EK3.10	Determining whether an S/G tube rupture exists	4.0
EK3.11	Stopping and/or restarting RHR pumps	3.1
EK3.12	Stopping containment spray pumps	3.4
EK3.13	Resetting SI and/or containment isolation	3.5
EK3.14	Establishing instrument air to containment	3.1
EK3.15	Isolating or venting SI accumulators	3.1
EK3.16	Establishing charging flow	3.4
EK3.17	Terminating ECCS flow (Reference Potential)	3.9
EK3.18	Establishing normal CVCS lineups	3.2
EK3.19	Restoring offsite power to all AC buses	3.3
EK3.20	Aligning support systems and starting an RCP (Reference Potential)	3.1
EK3.21	Energizing source-range detectors	2.9
EK3.22	Stopping RCPs when minimum operating conditions are not met	3.8
EK3.23	Placing the RHR system in service	3.2
EK3.24	Acceptable cooldown rate/cooldown strategy in accordance with emergency procedures	3.6
EA1	**Ability to operate and/or monitor the following as they apply to an Uncontrolled Depressurization of All Steam Generators:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	AC electrical distribution system	3.3
EA1.5	EDGs	3.5
EA1.6	ESFAS	4.1
EA1.7	RVLIS	3.5
EA1.8	In-core temperature monitoring system	3.6
EA1.9	NIS	3.4
EA1.10	PZR PCS	3.5
EA1.11	PZR LCS	3.4
EA1.12	RCS	3.6

EA1.13	RCP system	3.5
EA1.14	ECCS	4.0
EA1.15	RHRS	3.3
EA1.16	CSS	3.7
EA1.17	Containment system	3.6
EA1.18	CCWS	3.0
EA1.19	SGS	3.8
EA1.20	AFW system	4.0
EA1.21	MFW system	3.3
EA1.22	CVCS	3.0
EA1.23	MRSS	3.0
EA1.24	IAS	2.9
EA1.25	PRMS	2.7

		RO	SRO
EA2	**Ability to determine and/or interpret the following as they apply to Uncontrolled Depressurization of All Steam Generators:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	DELETED		
EA2.2	DELETED		
EA2.3	SDM	4.0	3.8
EA2.4	S/G level, pressure, and/or feedwater flow	4.0	4.0
EA2.5	RCS pressure, temperature, and/or PZR level	3.9	4.0
EA2.6	Core exit temperatures and/or subcooling	3.9	3.8
EA2.7	Secondary radiation level	2.7	3.4
EA2.8	BAT level	2.6	2.7
EA2.9	Containment pressure	3.6	3.9
EA2.10	RWST level	3.6	3.3
EA2.11	Instrument air header pressure	2.6	2.8
EA2.12	RCP seal flow (supply and/or return)	2.4	2.8
EA2.13	RCP No. 1 seal D/P	2.0	2.8
EA2.14	CCW flow to RCPs	2.6	2.9
EA2.15	Charging flow	3.0	3.1
EA2.16	VCT level	2.4	2.9
EA2.17	Reactor vessel level	3.6	3.4
EA2.18	Nuclear flux level	3.3	3.4
EA2.19	PTS	3.9	3.9

W EPE: E13 Steam Generator Overpressure

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Steam Generator Overpressure:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Conditions required to cause overpressurization of an S/G	3.2
EK2	**Knowledge of the relationship between Steam Generator Overpressure and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	SDS	3.5
EK2.4	RCS	3.3
EK2.5	SGS	3.4
EK2.6	AFW system	3.6
EK2.7	MFW system	3.2
EK2.8	MRSS	3.3
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Steam Generator Overpressure:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Identification of affected S/G	3.8
EK3.6	Isolating feedwater to the affected S/G	3.7
EK3.7	Actions if affected S/G level is above the upper level tap	3.5
EK3.8	Dumping steam from the affected S/G	3.7
EK3.9	Isolating AFW from the affected S/G	3.7
EK3.10	Cooling down the RCS by dumping steam from unaffected S/G	3.7
EA1	**Ability to operate and/or monitor the following as they apply to Steam Generator Overpressure:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	

EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	SDS	3.7
EA1.5	RCS	3.4
EA1.6	SGS	3.5
EA1.7	AFW system	3.6
EA1.8	MFW system	3.0
EA1.9	MRSS	3.3

EA2	**Ability to determine and/or interpret the following as they apply to Steam Generator Overpressure:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.0	3.8
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility’s license and amendments	3.7	3.9
EA2.3	S/G level, pressure and/or feedwater flow	3.3	3.7
EA2.4	Feedwater isolation	3.3	3.7
EA2.5	Steam dump flowpath	3.0	3.6
EA2.6	RCS temperature	3.0	3.5

W EPE: E14 High Containment Pressure

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to High Containment Pressure:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Maintaining containment building integrity and ensuring it is properly isolated	4.1
EK1.5	Priority for containment spray pump operation if ECA-1.1, loss of emergency recirculation, is in effect	3.9
EK1.6	Maintaining minimum flow to each S/G if all S/Gs are faulted	3.9
EK1.7	Critical safety function status	4.2
EK1.8	Loss of secondary heat sink	3.8
EK2	**Knowledge of the relationship between High Containment Pressure and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	ESFAS	4.4
EK2.4	RCP system	3.3
EK2.5	CSS	4.1
EK2.6	Containment system	4.0
EK2.7	CCS	4.0
EK2.8	SGS	3.5
EK2.9	AFW system	3.5
EK2.10	MFW system	3.2
EK2.11	MRSS	3.0
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to High Containment Pressure:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Establishing containment and/or containment ventilation isolation	4.0
EK3.6	Establishing containment Spray	4.1
EK3.7	Tripping RCPs	3.5
EK3.8	Containment fan coolers running in emergency mode	3.9

EK3.9	Ensuring that MSLI has occurred	3.8	
EK3.10	Isolating feed to faulted S/Gs	4.0	

EA1	**Ability to operate and/or monitor the following as they apply to High Containment Pressure:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)		
EA1.1	DELETED		
EA1.2	DELETED		
EA1.3	DELETED		
EA1.4	ESFAS	4.3	
EA1.5	RCP system	3.4	
EA1.6	CSS	4.2	
EA1.7	Containment system	4.2	
EA1.8	CCS	4.0	
EA1.9	SGS	3.6	
EA1.10	AFW system	3.6	
EA1.11	MFW system	3.3	
EA1.12	MRSS	3.1	

EA2	**Ability to determine and/or interpret the following as they apply to High Containment Pressure:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.7	4.1
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility's license and amendments	3.3	4.1
EA2.3	Containment pressure	4.3	4.0
EA2.4	ESFAS status indication	4.0	3.9
EA2.5	S/G pressure and/or feed flow indication	3.0	3.8

W EPE: E15 Containment Flooding

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Containment Flooding:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	DELETED	
EK1.2	DELETED	
EK1.3	DELETED	
EK1.4	Design-basis flood level in containment	3.1
EK2	**Knowledge of the relationship between Containment Flooding and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	Service water	3.3
EK2.4	CCW	3.2
EK2.5	Primary makeup water	2.9
EK2.6	Demineralized water	2.7
EK2.7	RHRS	3.3
EK2.8	Containment sump sampling	2.9
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to Containment Flooding:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Determining the source of the water in the sump	3.4
EK3.6	Determining the containment sump activity level	3.1
EA1	**Ability to operate and/or monitor the following as they apply to Containment Flooding:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	Service water	3.5
EA1.5	CCW	3.3
EA1.6	Primary makeup water	3.1
EA1.7	Demineralized water	2.8
EA1.8	RHRS	3.5

EA1.9	Containment sump sampling	3.0
EA1.10	AFW system	3.2
EA1.11	MFW system	2.9
EA1.12	Ventilation chill water system	2.9
EA1.13	FPS	2.8
EA1.14	CVCS	3.1

EA2	**Ability to determine and/or interpret the following as they apply to Containment Flooding:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	2.5	3.8
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility's license and amendments	3.0	3.7
EA2.3	Containment sump water level	3.0	3.7
EA2.4	Tank levels and/or system flow indications for systems that supply components inside containment	2.5	3.4
EA2.5	Containment sump activity level	2.0	3.1

W EPE: E16 High Containment Radiation

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to High Containment Radiation:** (CFR: 41.5 / 41.7 / 45.7 / 45.8)	
EK1.1	Value(s) of High Radiation and/or associated radiation monitors that require entry into the FRZ EOP for high radiation	3.4
EK1.2	DELETED	
EK1.3	DELETED	
EK2	**Knowledge of the relationship between High Containment Radiation and the following systems or components:** (CFR: 41.7 / 41.8 / 45.2 / 45.4)	
EK2.1	DELETED	
EK2.2	DELETED	
EK2.3	Containment ventilation isolation	3.7
EK2.4	Containment atmosphere filtration system	3.2
EK2.5	ARM system	3.4
EK3	**Knowledge of the reasons for the following responses and/or actions as they apply to High Containment Radiation:** (CFR: 41.5 / 41.10 / 45.6 / 45.13)	
EK3.1	DELETED	
EK3.2	DELETED	
EK3.3	DELETED	
EK3.4	DELETED	
EK3.5	Verifying containment ventilation isolation	3.7
EK3.6	Placing containment atmosphere filtration system in service	3.3
EA1	**Ability to operate and/or monitor the following as they apply to a High Containment Radiation:** (CFR: 41.5 to 41.8 / 45.5 to 45.8)	
EA1.1	DELETED	
EA1.2	DELETED	
EA1.3	DELETED	
EA1.4	Containment ventilation isolation	3.7
EA1.5	Containment atmosphere filtration system	3.2
EA1.6	ARM system	3.4

EA2	**Ability to determine and/or interpret the following as they apply to High Containment Radiation:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.1	Facility conditions and selection of appropriate procedures during abnormal and emergency operations	3.3	3.7
EA2.2	Adherence to appropriate procedures and operation within the limitations of the facility's license and amendments	3.3	3.7
EA2.3	Containment radiation level	3.3	3.7
EA2.4	Containment ventilation isolation status	3.3	3.7
EA2.5	Containment atmosphere filtration system status	2.7	3.3

5	COMPONENTS	Page

COMPONENT: 191001 Valves

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	The function and operation of safety valves	3.7	3.7
K1.02	The function and operation of relief valves	3.7	3.6
K1.03	The relationship of valve position to flow rate and back pressure	3.4	3.1
K1.04	The failed-valve positions for different operators (open, closed, and as-is positions; spring-loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves)	3.0	3.3
K1.05	Equipment protection/safety concerns in the use of gate valves (protect valve seals/open slowly)	3.0	2.6
K1.06	Emergency/manual operation of motor-operated valves with motor inoperable	3.1	3.5
K1.07	Principles of operation and purpose of check valves	3.0	3.0
K1.08	Operation of valves and verification of their position	3.1	3.2
K1.09	Reason for using a globe valve versus a gate valve for throttling	2.9	2.9
K1.10	The significance of stem position (valve status) for gate valves	3.1	3.0
K1.11	The stroke test for a valve, including the use of a stopwatch	2.9	2.7

COMPONENT: 191002 Sensors and Detectors

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	<u>Flow</u>		
K1.01	Operational characteristics of venturis and orifices	2.9	2.8
K1.02	Temperature/density compensation requirements	2.7	2.9
K1.03	Effects of gas or steam on liquid flow rate indications (erroneous reading)	3.0	2.9
K1.04	Modes of failure	3.1	3.0
K1.05	Operation of a differential pressure (D/P) cell type flow detector	2.9	3.0
	<u>Level</u>		
K1.06	Temperature/pressure compensation requirements	3.0	2.9
K1.07	Theory and operation of level detectors	3.3	3.2
K1.08	Effects of operating environment (pressure, temperature, and/or radiation)	3.3	3.2
K1.09	Modes of failure	3.3	3.2
	<u>Pressure</u>		
K1.10	Theory and operation of pressure detectors (bourdon tubes, diaphragms, bellows, forced balance, variable capacitance, and D/P cell)	3.1	2.9
K1.11	Effects of operating environment (pressure, temperature, and/or radiation)	3.1	3.0
K1.12	Modes of failure	3.0	3.1
	<u>Temperature</u>		
K1.13	Theory and operation of T/C, RTD, thermostats, and/or thermometers (expanding fluid)	2.9	2.8
K1.14	Failure modes of T/C, RTD, and/or thermometers	3.3	3.0
	<u>Position Detectors</u>		
K1.15	Failure modes of reed switches, linear variable differential transformers (LVDTs), limit switches, and potentiometers	2.9	2.8
K1.16	Applications of reed switches, magnets, LVDT's, potentiometers, and limit switches	2.9	2.7
	<u>Nuclear Instrumentation</u>		
K1.17	Effects of core voiding on neutron detection	3.1	3.0
K1.18	Theory and operation of fission chambers and ion chambers	3.0	3.0

K1.19	Neutron monitoring indication units	3.0	3.0
K1.20	Effects of voltage changes on neutron detector performance	2.9	2.9
K1.21	Failure modes of fission chambers, ion chambers, and proportional counters	3.1	3.0
	<u>Radiation Detection</u>		
K1.22	Theory and operation of ion chambers, Geiger-Müller tubes, and scintillation detectors	2.9	2.9
K1.23	Use of portable and personal radiation monitoring instruments	3.1	2.8
K1.24	Theory and operation of failed-fuel detectors	2.5	2.7
	<u>Electrical</u>		
K1.25	Theory and operation of voltmeters, ammeters, frequency detectors, and ground detectors	2.7	2.7

COMPONENT: 191003 Controllers and Positioners

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Function and operation of flow controller in manual and automatic modes	3.4	3.5
K1.02	Function and operation of a speed controller	2.9	3.0
K1.03	Operation of valve controllers in manual and automatic modes, including seal-in features	3.1	3.3
K1.04	Function and operation of pressure and temperature controllers, including pressure and temperature control valves	3.0	3.1
K1.05	Function and characteristics of valve positioners	2.9	2.8
K1.06	Function and characteristics of governors and other mechanical controllers	2.7	2.9
K1.07	Safety precautions with respect to the operation of controllers and positioners	3.0	2.7
K1.08	Theory of operation of the following types of controllers: electronic, electrical, and pneumatic	2.7	2.6
K1.09	Effects on operation of controllers due to proportional, integral (reset), derivative (rate), and their combinations	2.9	2.7
K1.10	Function and characteristics of air-operated valves, including failure modes	2.9	3.1
K1.11	Cautions for placing a valve controller in manual mode	3.4	3.0

COMPONENT: 191004 Pumps

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	<u>Centrifugal</u>		
K1.01	Identification, symptoms, and consequences of cavitation	3.3	3.3
K1.02	Reasons for venting a centrifugal pump	3.0	3.1
K1.03	Consequences of air/steam binding	3.3	3.1
K1.04	Consequences of operating a pump dead headed or for extended times without adequate recirculation	3.6	3.1
K1.05	Discussion on relationships among head, flow, and power as related to pump speed	2.9	3.0
K1.06	Need for net positive suction head; effects of loss of suction	3.3	3.1
K1.07	DELETED		
K1.08	Purpose for starting a pump with discharge valve closed	3.0	2.9
K1.09	Pressure and flow relationship of pumps in parallel	2.9	2.9
K1.10	Pressure and flow relationship of pumps in series	3.0	2.9
K1.11	Definition of pump shutoff head	2.7	3.0
K1.12	"Runout" of a centrifugal pump (definition, indications, causes, effects, and corrective measures)	3.3	3.1
K1.13	Theory of operation of a centrifugal pump	2.7	2.8
K1.14	Use of a centrifugal pump characteristic curve and a system characteristic curve; illustration of how the system operating point changes due to system changes	2.4	2.6
K1.15	Relationship between flow from a pump and suction heads	3.0	2.8
K1.16	Safety procedures and precautions associated with centrifugal pumps	3.1	3.0
K1.17	DELETED		
K1.18	DELETED		
K1.19	Given the characteristic curve for a typical centrifugal pump, explanation of the reason for its shape.	2.4	2.5
K1.20	Description of how a centrifugal pump characteristic curve will change with pump speed	2.6	2.6
	<u>Positive Displacement</u>		
K1.21	Discussion of the relationship among head, flow, speed, and power	2.9	3.0
K1.22	Net positive suction head requirements for a positive displacement pump	2.9	3.0
K1.23	Consequences of operating a positive displacement pump against a closed flowpath	3.7	3.2
K1.24	Functions and characteristics of positive displacement pumps	2.9	3.0
K1.25	Reason for starting a positive displacement pump with the discharge valve open; need to clear the flowpath	3.3	3.0

K1.26	Safety procedures and precautions associated with positive displacement pumps	3.1	3.0
K1.27	DELETED		
K1.28	Theory of operation of positive displacement pumps	2.6	2.9
K1.29	Discussion on the characteristic curve for a typical positive displacement pump and explanation of the its shape	2.4	2.7
	Jet Pumps		
K1.30	Describe the principles of operation of a jet pump	3.3	3.0

COMPONENT: 191005 Motors and Generators

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Indication of a locked rotor	3.0	2.9
K1.02	Potential consequences of overheating motor insulation or motor bearings	3.3	2.8
K1.03	Causes of excessive current in motors and generators, such as low voltage, overloading, and mechanical binding	3.3	2.9
K1.04	Relationship between pump motor current (ammeter reading) and the following: pump fluid flow, head, speed, and stator temperature	3.0	3.0
K1.05	Explanation of the difference between starting current and operating (running) current in a motor	3.1	3.0
K1.06	Reason for limiting the number of motor starts in a given time period	3.3	3.0
K1.07	Electrical units: volts, amperes, volt-amperes reactive (VAR), watts, and hertz	2.7	3.0
K1.08	Consequences of overexcited/underexcited	2.9	2.8
K1.09	Interrelations of the following: VAR, watts, amperage, volts, power factor	2.6	2.9
K1.10	Load sharing with parallel generators	3.0	3.1
K1.11	Motor and generator protective devices	2.9	2.9
K1.12	Basic alternating current electrical theory	2.9	3.1
K1.13	Basic direct current electrical theory	2.9	3.0

COMPONENT: 191006 Heat Exchangers and Condensers

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Startup/shutdown of a heat exchanger	2.9	2.9
K1.02	Proper filling of a shell-and-tube heat exchanger	3.1	2.8
K1.03	Basic heat transfer in a heat exchanger	3.1	2.8
K1.04	Effects of heat exchanger flow rates that are too high or too low and methods of proper flow adjustment	3.0	2.9
K1.05	Flowpaths for the heat exchanger (counterflow and U-types)	2.7	2.7
K1.06	Components of a heat exchanger (e.g., shells, tubes, plates)	2.6	2.6
K1.07	Control of heat exchanger temperatures	3.3	3.1
K1.08	Relationship between flow rates and temperatures	3.1	2.9
K1.09	Definition of thermal shock	2.9	2.9
K1.10	Principle of operation of condensers	3.3	2.9
K1.11	Relationship between condenser vacuum and backpressure	3.3	3.0
K1.12	Effects of tube fouling on heat exchanger operation	3.0	2.9
K1.13	Consequences of heat exchanger tube failure	3.3	3.0
K1.14	Reasons for noncondensable gas removal	3.3	3.0
K1.15	Effects of scaling on heat exchanger operation	2.9	2.8

COMPONENT: 191007 Demineralizers and Ion Exchangers

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Effect of excessive D/P on demineralizer performance	3.0	2.9
K1.02	Effects of channeling in a demineralizer	3.0	2.8
K1.03	Reason for sampling inlet and outlet of demineralizer	3.1	2.8
K1.04	Reason for demineralizer temperature and flow limits	3.1	3.0
K1.05	Principles of demineralizer operation	2.7	2.7
K1.06	Demineralizer D/P to determine condition of demineralizer resin bed	2.7	2.7
K1.07	Effects of demineralizer operation on water conductivity	2.9	2.9
K1.08	Demineralizer characteristics that can cause a change in boron concentration	3.2	3.1
K1.09	Reasons for bypassing demineralizers	2.9	2.8
K1.10	Reasons for using mixed-bed demineralizers to process primary water	2.9	2.6
K1.11	Plant evolutions that can cause crud bursts and the effect on demineralizers	3.1	2.9
K1.12	Definition of “boron saturated” as it relates to a demineralizer	2.7	2.9
K1.13	Definition of “lithium saturated” as it relates to a demineralizer	2.1	2.1
K1.14	Effect of temperature on saturated ion exchangers	2.4	2.6
K1.15	Purpose of a demineralizer	3.0	2.8

COMPONENT: 191008 Breakers, Relays, and Disconnects

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Purpose of racking out breakers (deenergize components and associated control and indication circuits)	3.6	3.4
K1.02	Local indication that breaker is open, closed, or tripped	3.3	3.5
K1.03	Meaning and/or loss of power supply circuit breaker indicator lights and capability to remotely open and close	3.3	3.3
K1.04	Operation of various push buttons, switches, and handles and the resulting action on breakers	3.6	3.1
K1.05	Function of thermal overload protection device	3.1	3.0
K1.06	Interpreting a one-line diagram of control circuitry	3.3	3.4
K1.07	Safety procedures and precautions associated with breakers, including MCC bus breakers; high-, medium-, and low-voltage breakers; relays; and disconnects	3.6	3.3
K1.08	Effects of closing breakers with the current out of phase, different frequencies, high-voltage differential, low current, or too much load	3.6	3.4
K1.09	Effect of racking out breakers on control and indicating circuits and removal of control power on breaker operation	3.3	3.3
K1.10	Function, control, and precautions associated with disconnects	3.3	3.1
K1.11	Control room indication of a breaker status	3.3	3.5
K1.12	Trip indicators for circuit breakers and protective relays	3.1	3.2

6 THEORY

REACTOR THEORY: 192001 Neutrons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define fast, intermediate, and slow neutrons.	3.0	3.0
K1.02	Define prompt and delayed neutrons.	3.3	3.1
K1.03	Define thermal neutrons.	3.3	3.3
K1.04	Describe neutron moderation.	3.4	3.3
K1.05	Identify characteristics of good moderators.	3.1	2.9
K1.06	Define neutron lifetime.	2.9	2.8
K1.07	Define neutron generation time.	3.1	2.7
K1.08	Describe fast flux, thermal flux, and flux distribution.	2.9	2.9
K1.09	Describe sources of neutrons.	3.1	2.9

REACTOR THEORY: 192002 Neutron Life Cycle

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Describe the neutron life cycle using the following terms:		
K1.01	-- fast fission factor	2.9	2.6
K1.02	-- fast nonleakage probability factor	2.9	2.6
K1.03	-- resonance escape probability factor	2.9	2.6
K1.04	-- thermal nonleakage probability factor	2.9	2.6
K1.05	-- thermal utilization factor	2.9	2.6
K1.06	-- reproduction factor	2.9	2.6
K1.07	Define effective multiplication factor (K-effective) and discuss its relationship to the state of a reactor (critical, subcritical, and supercritical).	3.2	3.4
K1.08	DELETED		
K1.09	Define K-excess (excess reactivity).	3.1	3.1
K1.10	Define shutdown margin.	3.2	3.8
K1.11	Define reactivity.	3.2	3.7
K1.12	State the relationship between reactivity and effective multiplication factor.	3.1	3.0
K1.13	Calculate shutdown margin using procedures and given plant parameters.	2.4	2.8
K1.14	Evaluate change in shutdown margin due to changes in plant parameters.	2.8	3.1

REACTOR THEORY: 192003 Reactor Kinetics and Neutron Sources

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Explain the concept of subcritical multiplication.	3.0	3.0
K1.02	Given the simplified formula for subcritical multiplication, perform calculations involving steady-state count rate and source count rate.	2.4	2.4
K1.03	Describe the production of delayed neutrons.	3.1	2.9
K1.04	Define delayed neutron fraction and effective delayed neutron fraction and state the reasons for the variation.	2.8	2.9
K1.05	Define the startup rate.	3.6	3.8
K1.06	Describe the factors affecting the startup rate.	3.4	3.3
K1.07	Explain the effect of delayed neutrons on reactor control.	3.3	3.4
K1.08	Explain the prompt critical, prompt jump, and prompt drop.	3.3	3.2
K1.09	Given the power equation, solve problems for power changes.	2.8	2.8
K1.10	Define doubling time and calculate it using the power equation.	3.2	3.3
K1.11	Explain the necessity for installed neutron sources in a reactor core.	2.7	2.5
K1.12	Explain why installed sources are not needed after one cycle of core operation.	2.7	2.3

REACTOR THEORY: 192004 Reactivity Coefficients

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define the MTC of reactivity.	3.2	3.5
	Describe the effect on the magnitude of the temperature coefficient of reactivity from changes in the following:		
K1.02	-- moderator temperature	3.0	3.2
K1.03	-- core age	3.0	3.2
K1.04	-- boron concentration	3.1	3.1
K1.05	DELETED		
K1.06	Define fuel temperature (Doppler) coefficient of reactivity.	2.8	2.8
K1.07	Explain resonance absorption.	2.8	2.6
K1.08	Explain Doppler broadening and self-shielding.	2.8	2.8
K1.09	DELETED		
	Describe the effects on fuel temperature (Doppler) coefficient of reactivity for changes in the following:		
K1.10	-- moderator temperature	2.9	2.7
K1.11	-- fuel temperature	2.9	2.7
K1.12	-- core age	2.8	2.5
K1.13	Describe the components of the power coefficient.	3.1	3.1
	Describe the effect on boron reactivity worth from changes in the following:		
K1.14	-- boron concentration	2.8	2.9
K1.15	-- moderator temperature	2.9	2.9
K1.16	Explain the change in reactivity addition rate due to boration/dilution over core life.	2.9	3.1
K1.17	Explain differences between reactivity coefficients and reactivity defects.	2.7	2.7
K1.18	Explain and describe the effect of power defect and Doppler defect on reactivity.	2.7	2.8

REACTOR THEORY: 192005 Control Rods

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Name the material used for thermal neutron absorption in control rods.	2.8	2.9
K1.02	Describe nuclear properties of active neutron absorber material in the control rod.	2.9	2.7
K1.03	Predict direction of change in reactor power for a change in control rod position.	3.7	3.8
K1.04	Define reactor trip.	3.6	3.8
K1.05	Define control rod worth, differential control rod worth (CRW), and integral control rod worth.	3.0	3.1
K1.06	Explain the shape of curves for differential and integral CRW versus rod position.	2.6	2.9
	<u>Describe the effect on the magnitude of CRW for a change in the following:</u>		
K1.07	-- moderator temperature	2.5	2.8
K1.08	-- boron concentration	2.5	2.8
K1.09	-- fission product poisons	2.5	2.8
K1.10	State the purpose of flux shaping.	3.0	3.0
K1.11	State the purpose of rod sequencing and overlap.	2.8	3.0
K1.12	DELETED		
K1.13	DELETED		
K1.14	DELETED		
K1.15	DELETED		
K1.16	Explain the effects of full and/or part length rods on delta I (flux distribution).	3.2	3.6
K1.17	Discuss rod insertion limits.	3.4	3.9
K1.18	DELETED		

REACTOR THEORY: 192006 Fission Product Poisons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define fission product poison.	3.1	3.1
K1.02	State the characteristics of xenon-135 as a fission product poison.	3.3	3.2
K1.03	Describe the production of xenon-135.	3.1	3.2
K1.04	Describe the removal of xenon-135.	3.1	3.2
	<u>Describe the following processes and state their effect on reactor operations:</u>		
K1.05	-- equilibrium xenon	3.3	3.5
K1.06	-- transient xenon	3.4	3.6
K1.07	-- xenon following a trip	3.3	3.5
K1.08	Describe the effects that xenon concentration has on flux shape and control rod patterns.	3.1	3.4
	<u>Plot the curve and explain the reasoning for the reactivity insertion by xenon 135 versus time for the following:</u>		
K1.09	-- initial reactor startup and ascension to rated power	3.1	3.2
K1.10	-- reactor startup with xenon-135 already present in the core	3.2	3.2
K1.11	-- power changes from steady-state power to another	3.3	3.6
K1.12	-- reactor trip	3.1	3.3
K1.13	-- reactor shutdown	3.1	3.3
K1.14	Explain the methods and reasons for the reactor operator to compensate for the time-dependent behavior of xenon-135 concentration in the reactor.	3.4	3.5
K1.15	State the characteristics of samarium-149 as a fission product poison.	2.8	2.5
K1.16	Describe the production of samarium-149.	2.8	2.3
K1.17	Describe the removal of samarium-149.	2.8	2.3
K1.18	Define equilibrium samarium.	2.7	2.6
	<u>Plot the curve and explain the reasoning for reactivity insertion by samarium 149 versus time for the following:</u>		
K1.19	-- initial reactor startup and ascension to rated power	2.8	2.4
K1.20	-- reactor shutdown	2.6	2.4
K1.21	Describe the effects of power changes on the samarium concentration.	2.7	2.4
K1.22	Compare effects of samarium-149 on reactor operation with those of xenon-135.	2.7	2.6

REACTOR THEORY: 192007 Fuel Depletion and Burnable Poisons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define burnable poison and state its use in the reactor.	3.3	3.2
K1.02	Describe and explain distribution of burnable poisons in the core.	2.8	2.9
K1.03	Given a curve of K-effective versus core age, state the reasons for maximum, minimum, and inflection points.	2.8	3.0
K1.04	Describe how and why boron concentration changes over core life.	3.1	3.4
K1.05	Describe the effects of boration/dilution on reactivity during forced-flow and natural circulation conditions.	3.0	3.2

REACTOR THEORY: 192008 Reactor Operational Physics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	<u>Startup and Approach to Criticality</u>		
K1.01	List parameters that should be monitored and controlled during the approach to criticality.	4.1	4.1
K1.02	List reactivity control mechanisms that exist for plant conditions during the approach to criticality.	4.0	4.1
K1.03	Describe count rate and instrument response, which should be observed for rod withdrawal during the approach to criticality.	3.9	4.0
K1.04	Relate the concept of subcritical multiplication to predicted count rate and startup rate response for control rod withdrawal during the approach to critical.	3.6	3.9
K1.05	Explain characteristics to be observed when the reactor is very close to criticality.	3.8	4.2
K1.06	Calculate estimated critical position (ECP) using a 1/M plot.	2.9	3.1
K1.07	Calculate ECP using procedures and given plant procedures.	3.5	3.6
	<u>Criticality</u>		
K1.08	List parameters that should be monitored and controlled upon reaching criticality.	4.1	4.1
K1.09	Define criticality as related to a reactor startup.	3.7	3.8
K1.10	Describe reactor power and startup rate response once criticality is reached.	4.0	4.0
	<u>Intermediate Range Operation</u>		
K1.11	DELETED		
K1.12	List parameters that should be monitored and controlled during the intermediate phase of startup (from criticality to the point of adding heat (POAH)).	4.1	4.1
K1.13	Discuss the concept of the POAH and its impact on reactor power.	4.1	4.1
K1.14	Describe reactor power and startup rate response prior to reaching the POAH.	4.0	4.0
K1.15	Explain characteristics to look for when the POAH is reached.	4.1	4.0
	<u>Power Operation</u>		
K1.16	Describe the monitoring and control of reactor power and primary temperature during 0% to 15%.	3.2	3.3
K1.17	Describe reactor power and startup rate response after reaching the POAH.	3.3	3.4

K1.18	Describe the monitoring and control of T-ave., T-ref., and power during power operation.	3.6	3.5
K1.19	Describe means by which reactor power will be increased to rated power.	3.8	4.0
K1.20	Explain the effects of control rod motion or boration/dilution on reactor power.	3.8	3.9
K1.21	Explain the relationship between steam flow and reactor power given specific conditions.	3.7	3.7
	<u>Reactor Response on a Trip</u>		
K1.22	DELETED		
K1.23	Explain the shape of a curve of reactor power versus time after a trip.	3.1	3.4
	<u>Normal Reactor Shutdown</u>		
K1.24	Explain reactor power response to a control rod insertion.	3.6	3.9
K1.25	Explain the necessity for inserting control rods in a predetermined sequence during normal shutdown.	3.7	3.7
K1.26	Define decay heat.	3.6	3.7
K1.27	Explain the relationship between decay heat generation and (a) power level history, (b) power production, and (c) time since reactor shutdown.	3.4	3.6

6.2 Thermodynamics Theory (CFR: 41.14)

THERMODYNAMICS: 193001 Thermodynamic Units and Properties

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Convert between absolute and gauge pressure and vacuum scales.	3.0	3.1
K1.02	Recognize the difference between absolute and relative (Kelvin) temperature scales.	2.1	2.1
K1.03	DELETED		
K1.04	Explain relationships between work, power, and energy.	2.6	2.6
K1.05	DELETED		

THERMODYNAMICS: 193002 Basic Energy Concepts

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define energy and work.	2.4	2.4
K1.02	Explain the law of conservation of energy.	2.2	2.4
K1.03	Explain the difference between the state and phase of a working substance.	2.4	2.3
K1.04	Define enthalpy.	2.3	2.6
K1.05	Explain the application of enthalpy in the monitoring of plant processes.	2.7	2.7
K1.06	Identify the relationship between heat flow during a process and a T-s diagram representation of the process.	2.6	2.6
K1.07	Define specific heat.	2.2	2.5
K1.08	Apply specific heat in solving heat-transfer problems.	2.2	2.3

THERMODYNAMICS: 193003 Steam

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	DELETED		
K1.02	Describe effects of pressure and temperature on density or specific volume of a liquid.	3.1	3.1
K1.03	Describe the effects of pressure and temperature on density or specific volume of a gas.	2.8	2.8
	<u>Define the following terms:</u>		
K1.04	-- latent heat of vaporization	2.7	2.8
K1.05	-- vaporization line	2.4	2.3
K1.06	-- critical point	2.4	2.3
K1.07	-- vapor dome	2.3	2.4
K1.08	-- saturated liquid	2.8	3.1
K1.09	-- wet vapor	2.4	2.6
K1.10	-- saturated vapor	2.6	2.8
K1.11	-- vapor pressure	2.3	2.4
K1.12	-- moisture content	2.7	3.1
K1.13	-- quality	2.7	3.2
K1.14	-- superheated vapor	2.4	2.6
K1.15	-- supersaturated vapor	2.3	2.5
K1.16	-- subcooled and compressed liquids	2.4	2.8
K1.17	-- subcooling	2.9	3.2
K1.18	DELETED		
K1.19	DELETED		
	<u>Identify the following terms on a T-s diagram:</u>		
K1.20	-- critical point	2.4	2.3
K1.21	-- saturated liquid line	2.7	2.7
K1.22	-- saturated vapor line	2.7	2.7
K1.23	-- solid, liquid, gas, vapor, and fluid regions	2.6	2.5
K1.24	Explain the usefulness of steam tables to the control room operator.	3.0	3.3
K1.25	Explain and use saturated and superheated steam tables.	2.9	3.1
K1.26	DELETED		

THERMODYNAMICS: 193004 Thermodynamic Processes

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Explain the relationship between real and ideal processes.	2.2	2.4
K1.02	Explain the shape of the T-s diagram process line for a typical secondary system.	2.4	2.5
	Nozzles:		
K1.03	Describe the functions of nozzles in flow restrictors.	2.9	2.8
K1.04	Describe the functions of nozzles in air ejectors.	3.0	2.9
	Turbines:		
K1.05	Explain the function of nozzle fixed blading and moving blading in the turbine.	2.7	2.7
K1.06	Explain the reason turbines are multistaged.	2.9	2.5
K1.07	Define turbine efficiency.	3.0	2.7
K1.08	Explain the difference between real and ideal turbine efficiency.	2.6	2.4
	Pumps:		
K1.09	Define pump efficiency.	2.6	2.5
K1.10	Explain the difference between ideal and real pumping processes.	2.6	2.3
	Condensers:		
K1.11	Describe the process of condensate depression (subcooling) and its effect on plant operation.	3.3	3.0
K1.12	Explain vacuum formation in condenser processes.	3.2	3.0
K1.13	Explain the condensing process.	2.8	2.9
	Throttling and the Throttling Process:		
K1.14	Define throttling.	2.6	2.7
K1.15	Explain the reduction of process pressure from throttling.	2.7	2.7
K1.16	Determine the exit conditions for a throttling process based on the use of steam and/or water.	2.3	2.6

THERMODYNAMICS: 193005 Thermodynamic Cycles

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define the thermodynamic cycle.	2.9	2.7
K1.02	Define thermodynamic cycle efficiency in terms of net work produced and energy applied.	2.7	2.5
K1.03	Describe how changes in system parameters affect thermodynamic efficiency.	2.9	2.8
K1.04	Describe the steam quality/moisture effects on turbine integrity and efficiency.	3.2	3.1
K1.05	State the advantages of moisture separators/reheaters and feedwater heaters for a typical steam cycle.	3.2	3.0

THERMODYNAMICS: 193006 Fluid Statics and Dynamics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Distinguish between static pressure, dynamic pressure, and total pressure.	2.9	2.6
K1.02	Define head loss.	3.0	3.0
K1.03	Discuss operational considerations of viscosity as related to head loss.	2.6	2.2
K1.04	Explain operational implications of fluid/water hammer.	3.4	3.3
K1.05	Discuss methods of prevention of fluid/water hammer.	3.7	3.3
	<u>Define or explain the following terms and concepts:</u>		
K1.05	-- mass flow rate	2.9	3.0
K1.06	-- two-phase flow	2.9	2.9
K1.07	-- pressure spike	2.9	2.7
K1.08	-- gas binding	2.8	2.8
K1.09	-- recirculation ratio	2.7	2.6
K1.10	-- water hammer	3.3	3.4
K1.11	-- cavitation	3.1	3.3
K1.12	Explain why flow measurements must be corrected for density changes.	2.8	2.7
K1.13	Explain the relationship between pressure head and velocity head in a fluid system.	2.7	2.7
K1.14	Discuss the velocity profiles for laminar flow and turbulent flow.	2.4	2.2
K1.15	Describe the methods of controlling system flow rates.	3.0	3.1

THERMODYNAMICS: 193007 Heat Transfer and Heat Exchangers

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	<u>Heat Transfer</u>		
K1.01	Describe three mechanisms of heat transfer.	3.2	3.3
K1.02	Define thermal conductivity.	3.1	2.9
K1.03	Explain the manner in which fluid films affect heat transfer.	3.1	2.7
K1.04	Describe how the presence of gases or steam can affect heat transfer and fluid flow in heat exchangers.	3.2	3.1
	<u>Core Thermal Power</u>		
K1.05	Define core thermal power.	3.6	3.6
K1.06	Explain methods of calculating core thermal power.	3.2	3.5
K1.07	Define percent reactor power.	3.4	3.5
K1.08	Calculate core thermal power using a simplified heat balance.	3.1	3.2

THERMODYNAMICS: 193008 Thermal Hydraulics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Departure from Nucleate Boiling		
K1.01	Distinguish between boiling processes and other heat transfer mechanisms.	3.2	3.0
K1.02	Describe the means by which boiling affects convection heat transfer.	2.8	3.0
K1.03	Describe the processes of nucleate boiling, subcooled nucleate boiling, and bulk boiling.	2.8	3.1
K1.04	Describe departure from nucleate boiling (DNB).	3.1	3.3
K1.05	List the parameters that affect DNR and departure from nucleate boiling ratio (DNBR) and describe their effect(s).	3.4	3.6
K1.06	Describe critical heat flux.	2.8	2.9
K1.07	Describe transition (partial film) boiling.	2.6	2.6
K1.08	Describe film boiling.	2.6	2.6
K1.09	Describe burnout and burnout heat flux.	2.3	2.4
K1.10	Define DNBR.	2.9	3.1
	Two-Phase Flow		
K1.11	Classify slug flow region along a fuel pin experiencing two-phase flow.	2.7	2.5
K1.12	Describe the annular flow region along a hypothetical fuel pin experiencing two-phase flow.	2.6	2.6
K1.13	Describe a dryout region or mist-flow region along a hypothetical fuel pin experiencing two-phase flow.	2.7	2.6
K1.14	Describe the effects of flow rate and phase change on the heat transfer coefficient.	2.9	2.8
K1.15	Define and describe subcooling margin.	3.6	3.8
K1.16	Draw the temperature profile from the centerline of a fuel pellet to the centerline of the flow channel.	2.4	2.6
K1.17	Explain the necessity of determining core coolant flow.	2.9	3.2
K1.18	Describe the factors affecting single- and two-phase flow resistance.	2.3	2.5
K1.19	Describe core bypass flow.	2.5	2.8
K1.20	Explain the need for adequate core bypass flow.	2.9	2.9
	Natural Circulation		
K1.21	Explain the conditions that must exist to establish natural circulation.	3.9	4.2
K1.22	Describe means to determine whether natural circulation flow exists.	4.2	4.2
K1.23	Describe means by which natural circulation can be enhanced.	3.9	4.1

K1.24	Describe the process of reflux boiling (boiler condenser process).	2.7	3.1
K1.25	Describe how gas binding affects natural circulation.	3.3	3.4
	<u>Sketch the axial temperature and enthalpy profiles for a typical reactor coolant channel and describe how they are affected by the following:</u>		
K1.26	-- onset of nucleate boiling	2.6	2.6
K1.27	-- axial core flux	2.6	2.6
K1.28	-- inlet temperature	2.6	2.5
K1.29	-- heat generation rate	2.7	2.5
K1.30	-- flow rate in the channel	2.7	2.5

THERMODYNAMICS: 193009 Core Thermal Limits

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Explain radial peaking factor.	2.4	2.8
K1.02	Explain axial peaking factor.	2.4	2.8
K1.03	Explain local peaking factor.	2.4	2.8
K1.04	Explain total peaking factor.	2.4	2.8
K1.05	State the reason thermal limits are necessary.	3.7	3.6
K1.06	Describe the function of the core protection calculator (thermal margin calculator).	2.8	3.7
K1.07	Describe factors that affect peaking and hot channel factors.	2.9	3.3
K1.08	Describe axial flux imbalance, including long-range effects.	3.0	3.3
K1.09	Describe the effects of quadrant power tilt (symmetric offset), including long-range effects.	2.8	3.2
K1.10	Define and calculate quadrant tilt (symmetric offset) ratio.	2.9	3.3

THERMODYNAMICS: 193010 Brittle Fracture and Vessel Thermal Stress

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	State the brittle fracture made of failure.	3.0	3.2
K1.02	State the definition of the nil-ductility transition temperature.	2.7	3.0
K1.03	Define reference temperature.	2.8	2.8
K1.04	State how the possibility of brittle fracture is minimized by operating limitations.	3.1	3.2
K1.05	State the effect of fast neutron irradiation on reactor vessel metals.	2.8	2.8
K1.06	Define pressurized thermal shock.	3.6	3.8
K1.07	State the operational concerns of uncontrolled cooldown.	3.2	3.3

NRC FORM 335
(12-2010)
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NUREG-1122, "Knowledge and Abilities Catalog for Nuclear Plant Operators: Pressurized Water Reactors," provides the basis for the development of content-valid licensing examinations for reactor operators and senior reactor operators. The examinations developed using the Pressurized Water Reactor Catalog along with the Operator Licensing Examination Standards for Power Reactors (NUREG-1021) will sample the topics listed under Title 10 of the Code of Federal Regulations (10 CFR), Part 55, "Operators' Licenses."

Draft Revision 3 of NUREG-1122 is being issued for comment and was developed to (1) clarify and enhance K/A statements, (2) delete duplication of redundant K/As, (3) add K/As for new selected systems/evolutions, and (4) re-rate the importance of all K/As.

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