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NUREG-1123, Rev. 3

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

Draft Report for Comment

Office of Nuclear Reactor Regulation

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Draft Report for Comment

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ABSTRACT

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors (BWRs) (NUREG-1123, Revision 3) 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 BWR 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.”

The BWR catalog is organized into six major sections: Organization of the Catalog, Generic Knowledge and Abilities, Plant Systems, Emergency and Abnormal Plant Evolutions, Components, and Theory.

Revision 1 to the BWR Catalog modified the form and content of the original catalog. The knowledge and abilities (K/As) were linked to their applicable 10 CFR Part 55 item numbers. SRO-level K/As were identified by 10 CFR 55.43, “Written Examination: Senior Operators,” item numbers. The plant-wide generic and system generic K/As were combined in one section. Component Cooling Water and Instrument Air Systems were added to the Systems Section. Finally, High Containment Hydrogen Concentration and Plant Fire On Site evolutions were added to the Emergency and Abnormal Plant Evolutions section.

Revision 2 incorporated corrections to the Revision 1 catalog that were identified during a pilot testing program associated with revision of 10 CFR Part 55 and implementation of NUREG-1021, Interim Revision. 8, “Operator Licensing Examination Standards for Power Reactors.” Corrections to the catalog included:

1. Addition of seven K/As that had been omitted in Revision 1.
2. Correction of typographical errors.
3. Addition of importance value modifiers that had been omitted in Revision 1.

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), 700000, “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 circulating water and service water systems.

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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CONTENTS

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. Identified 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 all “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 circulating water and service water systems, which were previously overlooked
13. Eliminated the overlap in the A3 and A4 statements and redundancy in the K3 statements related to the specific system.
14. Removed the list of tasks at the beginning of systems.

1 ORGANIZATION OF THE CATALOG

1.1 Introduction

The “Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors (BWR),” NUREG-1123, Revision 3, provides the basis for development of content-valid written and operating licensing examinations for reactor operators (ROs) and senior reactor operators (SROs). The catalog is designed to ensure equitable and consistent examinations.

1.2 Part 55 of Title 10 of the Code of Federal Regulations

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 under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 55. All knowledge and abilities (K/As) in this catalog are directly linked by item number to 10 CFR Part 55.

1.3 RO Written Examination

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

1.4 SRO Written Examination

The guidance for 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 RO and SRO Operating Test Items

The items for operating tests for ROs and SROs are presented in 10 CFR 55.45(a). The guidance for the preparation of operating tests is presented 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 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 BWR Catalog

The “Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors” is organized into six major sections. 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 BWR 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 BWR Catalog based on their relationship and importance to safety functions. Table 1 contains a list of these plant systems, arranged by safety function. It should be noted that some plant systems contribute to more than one safety function.

Each plant system has a six-digit code number. The words “Plant Specific” after the system title indicate that the knowledge or ability does not apply to all plants.

See Section 3 of the BWR catalog for the delineation of K/As for the plant systems.

Table 1: Plant Systems by Safety Functions

Safety Function 1: Reactivity Control

201001	Control Rod Drive Hydraulic System
201003	Control Rod and Drive Mechanism
201002	Reactor Manual Control System
202002	Recirculation Flow Control System
202001	Recirculation System
201005	Rod Control and Information System
211000	Standby Liquid Control System

Safety Function 2: Reactor Water Inventory Control

206000	High Pressure Coolant Injection System
209002	High Pressure Core Spray System
209001	Low Pressure Core Spray System
256000	Condensate System
217000	Reactor Core Isolation Cooling System
259001	Feedwater System
204000	Reactor Water Cleanup System
259002	Reactor Water Level Control System
203000	Residual Heat Removal/Low Pressure Coolant Injection: Injection Mode

Safety Function 3: Reactor Pressure Control

218000	Automatic Depressurization System
239001	Main and Reheat Steam System
241000	Reactor/Turbine Pressure Regulating System
239002	Safety Relief Valves

Safety Function 4: Heat Removal from the Reactor Core

206000	High Pressure Coolant Injection System
209002	High Pressure Core Spray System
207000	Isolation (Emergency) Condenser
209001	Low Pressure Core Spray System
239001	Main and Reheat Steam System
245000	Main Turbine Generator and Auxiliary Systems
217000	Reactor Core Isolation Cooling System
202001	Recirculation System
203000	Residual Heat Removal/Low Pressure Coolant Injection: Injection Mode
205000	Shutdown Cooling System (RHR Shutdown Cooling Mode)
290002	Reactor Vessel and Internals
510000	Service Water System (Normal and Emergency)

Safety Function 5: Containment Integrity

223001	Primary Containment System and Auxiliaries
223002	Primary Containment Isolation System /Nuclear Steam Supply Shut-Off
219000	RHR/LPCI: Torus/Suppression Pool Cooling Mode
226001	RHR/LPCI: Containment Spray System Mode
230000	RHR/LPCI: Torus/Suppression Pool Spray Mode
290001	Secondary Containment

Safety Function 6: Electrical

262001	AC Electrical Distribution
263000	DC Electrical Distribution
264000	Emergency Generators (Diesel/Jet)
262002	Uninterruptable Power Supply (AC/DC)

Safety Function 7: Instrumentation

215005	Average Power Range Monitor/Local Power Range Monitor
215003	Intermediate Range Monitor System
216000	Nuclear Boiler Instrumentation
272000	Radiation Monitoring System
212000	Reactor Protection System
215002	Rod Block Monitor System
201005	Rod Control and Information System
214000	Rod Position Information System
201004	Rod Sequence Control System
201006	Rod Worth Minimizer System
215004	Source Range Monitor System
215001	Traversing In-Core Probe

Safety Function 8: Plant Service Systems

286000	Fire Protection System
234000	Fuel Handling
300000	Instrument Air System
400000	Component Cooling Water System
510001	Circulating Water System

Safety Function 9: Radioactivity Release

239003	Main Steam Isolation Valve Leakage Control System
271000	Offgas System
288000	Plant Ventilation Systems
272000	Radiation Monitoring System
268000	Radwaste System
290003	Control Room Ventilation
233000	Fuel Pool Cooling and Clean-up
261000	Standby Gas Treatment System

Knowledge and Ability Stem Statements for Plant Systems

The information delineated within each plant system is organized into six (6) 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 item numbers from 10 CFR 55.41, “Written Examination: Operators”; 10 CFR 55.43, “Written Examination: Senior Operators”; and 10 CFR 55.45, “Operating Tests” 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: Knowledge and Ability Stem Statements for Plant Systems

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K1. Knowledge of the physical connections or cause-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, 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 or operationally significant. When determining importance or significance, consider plant specific PRA, technical specifications, plant specific operating experience, emergency procedures, and abnormal 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 (SYSTEM) design feature(s) or interlock(s) that 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-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-effect relationships and concepts. 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 (SYSTEM). K6 lists the systems included in K1 that will have an effect on (SYSTEM) if the listed system is not operating according to design. It also lists the components of (system) whose failure can affect the operation of the (SYSTEM). Power supplies from K2 should be considered.

A1. Ability to predict 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, and 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 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 (FHS) includes manual operation of refueling equipment from the equipment location.

1.10 Emergency and Abnormal Plant Evolutions

Section 4 of the BWR catalog contains emergency plant evolutions (EPEs) and abnormal plant evolutions (APEs). An emergency plant evolution is any condition, event, or symptom which leads to entry into the plant-specific emergency operating procedures (EOPs). An abnormal plant evolution is any degraded condition, event, or symptom not directly leading to an EOP entry condition, but, nonetheless, adversely affecting a safety function. The listing of EPEs and APEs was developed to include those integrative situations crossing several plant systems or safety functions.

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

Table 3: Emergency and Abnormal Plant Evolutions

EPEs

295024	High Drywell Pressure
295025	High Reactor Pressure
295026	Suppression Pool High Water Temperature
295027	High Containment Temperature (Mark III Containment Only)
295028	High Drywell Temperature (Mark I and II only)

295029	High Suppression Pool Water Level
295030	Low Suppression Pool Water Level
295031	Reactor Low Water Level
295032	High Secondary Containment Area Temperature
295033	High Secondary Containment Area Radiation Levels
295034	Secondary Containment Ventilation High Radiation
295035	Secondary Containment High Differential Pressure
295036	Secondary Containment High Sump / Area Water Level
295037	SCRAM Condition Present and Reactor Power above APRM Downscale or Unknown
295038	High Off-Site Radioactivity Release Rate
500000	High Containment Hydrogen Concentration

APEs

295001	Partial or Complete Loss of Forced Core Flow Circulation
295002	Loss of Main Condenser Vacuum
295003	Partial or Complete Loss of AC Power
295004	Partial or Complete Loss of DC Power
295005	Main Turbine Generator Trip
295006	SCRAM
295007	High Reactor Pressure
295008	High Reactor Water Level
295009	Low Reactor Water Level
295010	High Drywell Pressure
295011	High Containment Temperature (Mark III Containment Only)
295012	High Drywell Temperature
295013	High Suppression Pool Water Temperature
295014	Inadvertent Reactivity Addition
295015	Incomplete SCRAM
295016	Control Room Abandonment
295017	High Off-Site Radioactivity Release Rate
295018	Partial or Complete Loss of Component Cooling Water
295019	Partial or Complete Loss of Instrument Air
295020	Inadvertent Containment Isolation
295021	Loss of Shutdown Cooling
295022	Loss of Control Rod Drive Pumps
295023	Refueling Accidents
600000	Plant Fire on Site
700000	Generator Voltage and Electric Grid Disturbances

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.

The applicable 10 CFR 55.41/ 55.43/ 55.45 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 and operating examinations. See Table 4, below.

Table 4: Knowledge and Ability Stem Statements for Emergency and Abnormal Plant Evolutions

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E/AK1 Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to [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, PRA, OE, 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 or operated by the procedure.

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

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

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

Basis – Lists the system or components required to be monitored or operated by the procedure. EA1 may include systems from EK2.

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

Basis – Lists the parameters 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 categories 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 BWR catalog, and listed in Table 5 below.

Table 5: Components

291001	Valves (CFR: 41.3)
291002	Sensors and Detectors (CFR: 41.7)
291003	Controllers and Positioners (CFR: 41.7)
291004	Pumps (CFR: 41.3)
291005	Motors and Generators (CFR: 41.7)
291006	Heat Exchangers and Condensers (CFR: 41.4)
291007	Demineralizers and Ion Exchangers (CFR: 41.3)
291008	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 that underlies safe performance on the job is delineated in Section 6 of the BWR 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)

292001	Neutrons
292002	Neutron Life Cycle
292003	Reactor Kinetics and Neutron Sources
292004	Reactivity Coefficients
292005	Control Rods
292006	Fission Product Poisons
292007	Fuel Depletion and Burnable Poisons
292008	Reactor Operational Physics

Thermodynamics Theory (CFR: 41.14)

293001	Thermodynamic Units and Properties
293002	Basic Energy Concepts
293003	Steam
293004	Thermodynamic Processes
293005	Thermodynamic Cycles
293006	Fluid Statics and Dynamics
293007	Heat Transfer
293008	Thermal Hydraulics
293009	Core Thermal Limits
293010	Brittle Fracture and Vessel Thermal Stress

1.13 Importance Ratings

Importance, in this context, considers direct and indirect effect of the K/A on safe plant operation in a manner ensuring personnel and public health and safety. Importance Ratings of the K/As are next to each knowledge and ability in the catalog. These ratings reflect average ratings of individual U.S. Nuclear Regulatory Commission (NRC) and utility panel members.

The rating scale is presented in Table 6, below.

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, the 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:

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

1.15 General Guidance

The following strategies and principles are utilized in this catalog:

- The use of set points 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 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 marked in the RO column.

- The K/As use generic terminology. If the specific design utilizes comparable but different terminology, the concept is still applicable. Examples of comparable terms include:
  - Safety Injection Tanks (SIT) may be comparable to Core Flood Tanks (CFT)
  - Engineering Safety Feature Actuation System (ESFAS) may be comparable to Engineering Safety Actuation System (ESAS)
  - Auxiliary Feed Water (AFW) may be comparable to Emergency Feed Water (EFW)
  - Component Cooling Water (CCW) may be comparable to interface Cooling Water (ICW)
- Subsystems, where applicable, are listed prior to each associated system.

1.16 Acronyms and Terms

ADS	automatic depressurization system
AFW	auxiliary feedwater system
APE	abnormal plant evolution
APRM	average power range monitor
ARI	alternate rod insertion system
ARM	area radiation monitoring system
ATWS	anticipated transient without SCRAM
CCWS	component cooling water system
CFR	code of federal regulations
CRAC	control room heating, ventilation and air conditioning
CRD	control rod drive
CRDM	control rod drive mechanism
CRIDS	control room integrated display computer system
CRV	control room ventilation
D/G	diesel generator
ECCS	emergency core cooling system
EHC	electrohydraulic control system
EPE	emergency plant evolution
ERIS	emergency response information system
FRVS	filtration, recirculation ventilation system
GDS	graphical display system
HPCI	high pressure coolant injection
HPCS	high pressure core spray
HVAC	heating, ventilation and air conditioning
IAS	instrument air system
IRM	intermediate range monitor
K/A	knowledge and ability
LCO	limiting condition for operation
LPRM	local power range monitor
LPCI	low pressure coolant injection
LPCS	low pressure core spray
LSRO	senior reactor operator limited to fuel handling
M/G	motor generator
MFW	main feedwater
MSIV	main steam isolation valve
NIS	nuclear instrumentation system
OPRM	oscillation power range monitor
PCIOMR	pre conditioning interim operating management recommendations
PCIS	primary containment isolation signal
PRMS	power range monitoring system (includes APRM, LPRM and OPRM)
RCIC	reactor coolant isolation system
RCIS	rod control and information system
RCS	reactor coolant system

RHR	residual heat removal
RMCS	reactor manual control system
RO	reactor operator
RPIS	rod position information system
RPS	reactor protection system
RPV	reactor pressure vessel
RSCS	rod sequence control system
RWCU	reactor water cleanup system
RWM	rod worth minimizer
SBGT	standby gas treatment system
SLC	standby liquid control
SPDS	safety parameter display system
SPTMS	suppression pool temperature monitoring system
SRM	source range monitoring
SRO	senior reactor operator
SRV	safety relief valve
TIPS	traversing in-core probe system
VFD	variable frequency drive

2 GENERIC KNOWLEDGE AND ABILITIES

2.0 GENERIC KNOWLEDGE AND ABILITIES

2.0.1 Technical Requirements Manual (TRM)—For the purpose of this catalog, knowledge and abilities (K/As) that reference Technical Specifications (TS) may include the Technical Requirements Manual, 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, 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, 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 memos
(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 reports
(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 status
(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 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, 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 hydrogen)
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3.4 SRO 3.6

2.1.27 Knowledge of system purpose 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 controls
(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 switches
(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 that 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 decision making 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 On-Line Power Distribution Monitoring System 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, communication with fuel handling personnel, systems operated from the control room in support of 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, 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, 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 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 Evolutions
(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, line-ups 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 with 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, work prioritization, etc.
(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 Technical Specification 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 Technical Specifications 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 Technical Specification 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 one hour Technical Specification action statements (This K/A does not include Action Statements of one hour or less that follow the expiration of a completion time for a Technical Specification 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 Technical Specifications with action statements of less than or equal to one 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 Technical Specifications
(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 or interpret Technical Specifications with action statements of greater than one 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 aligning 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 aligning 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 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/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 set points, interlocks and automatic actions associated with Emergency/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 post-accident 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/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/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/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/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/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/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/Abnormal Operating Procedures
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.19 Knowledge of Emergency/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/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 Critical Safety Functions or Shutdown Critical Safety Functions
(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/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 (non-safeguards 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 U.S. Nuclear Regulatory Commission (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 Non-Licensed 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 called for in the facility Emergency Plan Implementing Procedures, including supporting or acting as emergency coordinator if required
(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 utilizing 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

3.1	**Safety Function 1: Reactivity Control**	**Page**

System:	**201001 SF1 CRDH Control Rod Drive Hydraulic System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the control rod drive hydraulic system and the following systems:** (CFR: 41.1-3 to 41.5-8 / 45.1-6 / 45.8)	
K1.01	Condensate system	3.1
K1.02	Condensate storage tanks	3.2
K1.03	Recirculation pumps seal purge	3.3
K1.04	Head spray: BWR-2	2.6
K1.05	CRD return to the Vessel	3.2
K1.06	Component cooling water systems	3.0
K1.07	Reactor protection system	4.3
K1.08	Reactor manual control system	4.2
K1.09	IAS	3.6
K1.10	Control rod drive mechanisms	3.8
K1.11	Reactor water cleanup pumps	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	3.5
K2.02	Scram valve solenoids	4.2
K2.03	Backup SCRAM valve solenoids	4.1
K2.04	Scram discharge volume vent and drain valve solenoids	3.8
K2.05	Alternate rod insertion valve solenoids	3.9
K2.06	Motor operated valves	2.9
K2.07	Breaker control	3.0
K3	**Knowledge of the effect that a loss or malfunction of the control rod drive hydraulic system will have on the following systems or system parameters:** (CFR: 41.5-7 / 45.10 / 45.1-3 / 45.5-6 / 45.8 / 45.12)	
K3.01	Recirculation pumps	3.2
K3.02	Reactor water level	3.2
K3.03	Control rod drive mechanisms	3.7
K3.04	Head spray: BWR-2	2.5
K3.05	Reactor water cleanup pumps	2.5

K4	**Knowledge of CONTROL ROD DRIVE HYDRAULIC SYSTEM design feature(s) or interlocks that provide for the following:** (CFR: 41.2-3 / 41.6-7 / 41.10 / 45.1-6 / 41.12)	
K4.01	Protection against pump runout during SCRAM conditions (location of the CRD system flow element and a restricting orifice in the accumulator charging water line)	3.1
K4.02	Stable system flow when moving control rods using stabilizing valves	3.3
K4.03	Control rod drive mechanism cooling water flow	3.3
K4.04	Scramming control rods with inoperative SCRAM solenoid valves (back-up SCRAM valves)	4.0
K4.05	Control rod SCRAM	4.4
K4.06	Isolation of the SCRAM discharge volumes during SCRAM conditions	4.1
K4.07	Testing SCRAM discharge volume isolation valves	2.9
K4.08	Controlling control rod drive header pressure	3.6
K4.09	Controlling control rod drive cooling header pressure	3.3
K4.10	Control of rod movement with HCU directional control valves	3.8
K4.11	Protection against filling the SDV during non-SCRAM conditions	3.7
K4.12	Controlling CRD system flow	3.5
K4.13	Motor cooling	2.7
K4.14	Alternate control rod insertion	4.3
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the control rod drive hydraulic system:** (CFR: 41.5-7 / 41.10 / 45.1-6 / 45.12-13)	
K5.01	Pump operation	3.2
K5.02	Flow indication	3.3
K5.03	Pressure indication	3.3
K5.04	DELETED	
K5.05	DELETED	
K5.06	Differential pressure indication	3.4
K5.07	Air operated control valves	3.1
K5.08	Solenoid operated valves	3.3
K5.09	System venting	2.7

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the control rod drive hydraulic system:** (CFR: 41.6-7 / 41.10 / 45.1-6 / 45.8 / 45.12-13)		
K6.01	Condensate system	2.9	
K6.02	Condensate storage tanks	3.0	
K6.03	IAS	3.6	
K6.04	RPS	4.2	
K6.05	AC power	3.9	
K6.06	Component cooling water systems	3.1	
K6.07	Reactor manual control system	3.9	
K6.08	SDIV instrumentation	3.7	
A1	**Ability to predict or monitor changes in parameters associated with operation of the control rod drive hydraulic system including:** (CFR: 41.1-2 / 41.5-7 / 41.10 / 45.1-6 / 45.12)		
A1.01	CRD drive water header pressure	3.7	
A1.02	CRD cooling water header pressure	3.3	
A1.03	CRD system flow	3.5	
A1.04	Head spray flow: BWR-2	2.6	
A1.05	SDV isolation valve position	3.6	
A1.06	HCU pressure or level	3.6	
A1.07	Reactor water level	3.4	
A1.08	Pump amps	2.8	
A1.09	CRD drive water flow	3.3	
A1.10	CRD cooling water flow	3.2	
A1.11	System lights and alarms	3.5	
A2	**Ability to (a) predict the impacts of the following on the control rod drive hydraulic system and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.2 / 41.5-7 / 41.10 / 45.1-6 / 41.12-13)	**RO**	**SRO**
A2.01	Pumps trips	4.4	3.9
A2.02	Valve closures	3.8	3.5
A2.03	Power supply failures	4.0	3.5
A2.04	Scram conditions	4.7	4.2
A2.05	Discharge strainer(s) becoming plugged	3.5	3.1
A2.06	Suction strainer(s) becoming plugged	3.7	3.1
A2.07	Flow control valve failure	4.0	3.6
A2.08	Inadequate system flow	3.8	3.4

A2.09	Loss of applicable plant air systems	3.9	3.5
A2.10	Low HCU accumulator pressure or high level	3.7	3.7
A2.11	Valve openings	3.4	3.1
A2.12	High cooling water flow	3.5	3.1
A2.13	Low cooling water flow	3.5	3.1
A2.14	Low drive header pressure	3.9	3.4
A2.15	Pressure control valve failure	4.0	3.5

A3 **Ability to monitor automatic features of the control rod drive hydraulic system including:**
(CFR: 41.1-2 / 41.5-7 / 41.9 / 45.1-6 / 45.8 / 45.12-13)

A3.01	Valve operation	3.3
A3.02	Pump start	3.2
A3.03	System pressure	3.5
A3.04	System flow	3.4
A3.05	Reactor water level	3.4
A3.06	Reactor power	3.6
A3.07	HCU accumulator pressure or level	3.4
A3.08	Drive water flow	3.3
A3.09	Cooling water flow	3.2
A3.10	System lights and alarms	3.4
A3.11	SDV level	3.7

A4 **Ability to manually operate or monitor in the control room:**
(CFR: 41.5-7 / 41.9 / 41.10 / 45.1-6 / 45.8 / 45.12-13)

A4.01	CRD pumps	3.7
A4.02	CRD pump discharge valve	2.9
A4.03	CRD system flow control valve	3.6
A4.04	Drive water header pressure control valve	3.6
A4.05	Cooling water header pressure control valve	3.3
A4.06	SDV isolation valve test switch	2.8
A4.07	Stabilizing valve selector switch	2.5

System: 201003 SF1 CRDM Control Rod and Drive Mechanism

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the control rod and drive mechanism and the following systems:** (CFR: 41.1 to 41.10 / 45.1 to 45.8)	
K1.01	Control rod drive hydraulic system	3.9
K1.02	DELETED	
K1.03	Rod position indicating system (BWR 2-5)	3.8
K1.04	Reactor vessel and internals	3.3
K1.05	DELETED	
K1.06	Reactor control and information system (BWR 6)	3.9
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 control rod and drive mechanism will have on the following systems or system parameters:** (CFR: 41.1-2 / 41.7 / 41.10 / 45.1-6 / 4)	
K3.01	Reactor power	4.1
K3.02	DELETED	
K3.03	DELETED	
K3.04	Rod position and indicating system (BWR 2-5)	3.8
K3.05	Reactor control and information system (BWR 6)	3.8
K4	**Knowledge of control rod and drive mechanism design feature(s) or interlocks that provide for the following:** (CFR: 41.1-7 / 41.10 / 45.1-6)	
K4.01	Limiting control rod velocity in the event of a rod drop	3.6
K4.02	DELETED	
K4.03	Slowing the drive mechanism near the end of its travel following a SCRAM	2.9
K4.04	Scramming of the control rod with accumulator or RPV pressure	4.0
K4.05	Rod position indication	3.7
K4.06	Uncoupling/coupling of the control rod from the drive mechanism	3.3
K4.07	Maintaining the control rod at a given position	3.7

K4.08	CRD mechanism temperature	3.1	
K4.09	Movement of a control rod	4.0	
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the control rod and drive mechanism:** (CFR: 41.1-6 / 45.1-6)		
K5.01	Hydraulics	3.6	
K5.02	DELETED		
K5.03	DELETED		
K5.04	DELETED		
K5.05	DELETED		
K5.06	DELETED		
K5.07	DELETED		
K5.08	How control rods affect shutdown margin	3.4	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the control rod and drive mechanism:** (CFR: 41.1-6 / 45.1-6)		
K6.01	Control rod drive hydraulic system	3.8	
K6.02	Reactor pressure	3.5	
K6.03	Reactor manual control system (BWR 2-5)	3.7	
K6.04	Reactor control and information system (BWR 6)	3.7	
A1	**Ability to predict or monitor changes in parameters associated with operation of the control rod and drive mechanism including:** (CFR: 41.1-6 / 45.1-6)		
A1.01	DELETED		
A1.02	DELETED		
A1.03	DELETED		
A1.04	CRD mechanism temperature	3.0	
A2	**Ability to (a) predict the impacts of the following on the control rod and drive mechanism and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations:** (CFR: 41.1-6 / 45.1-6)	**RO**	**SRO**
A2.01	Stuck rod	4.0	4.0
A2.02	Uncoupled rod	4.4	4.1

A2.03	Drifting rod	4.7	4.2
A2.04	Single control rod SCRAM	4.2	3.8
A2.05	Reactor SCRAM	4.5	4.3
A2.06	Abnormal CRD cooling water flow	3.5	3.2
A2.07	Abnormal CRD drive water flow	3.6	3.3
A2.08	Low HCU accumulator pressure or high level	3.8	3.4
A2.09	Low reactor pressure	4.0	3.4
A2.10	Excessive SCRAM time	3.7	3.7

A3 **Ability to monitor automatic features of the control rod and drive mechanism including:**
(CFR: 41.1-6 / 45.1-6)

A3.01 DELETED

A4 **Ability to manually operate or monitor in the control room:**
(CFR: 41.1-7 / 45.1-8)

A4.01	CRD mechanism temperature	3.0	
A4.02	DELETED		

System: 201002 SF1 RMCS Reactor Manual Control System (BWR-2, 3, 4, & 5)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor manual control system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Control rod drive hydraulic system	3.9
K1.02	Control rod and drive mechanism	3.6
K1.03	Fuel handling systems	3.2
K1.04	Rod block monitor	3.8
K1.05	Rod worth minimizer	3.7
K1.06	Rod sequence control system	3.1
K1.07	Plant process computer/parameter display systems	2.9
K1.08	DELETED	
K1.09	RPIS	3.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	RMCS	3.0
K3	**Knowledge of the effect that a loss or malfunction of the reactor manual control system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Control rod drive hydraulic system	3.6
K3.02	Rod block monitor	3.2
K3.03	Automatic rod block	3.4
K3.04	Rod worth minimizer	3.2
K3.05	Fuel handling systems	2.9
K3.06	Rod deselect block (BWR-2)	3.0
K4	**Knowledge of reactor manual control system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Detection of sequence timer malfunction	3.1
K4.02	Control rod blocks	3.8
K4.03	Detection of drifting control rods	3.9
K4.04	“Single notch” rod withdrawal and insertion	3.7
K4.05	“Notch override” rod withdrawal	3.6

K4.06	"Emergency In" rod insertion	3.7	
K4.07	Timing of rod insert and withdrawal cycles (rod movement sequence timer)	3.2	
K4.08	"Continuous In" rod insertion	3.7	
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor manual control system:** (CFR: 41.5 / 45.3)		
K5.01	Control rod blocks	3.9	
K5.02	Refueling equipment interlocks	3.3	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor manual control system:** (CFR: 41.7 / 45.7)		
K6.01	Loss of power to RMCS	3.3	
K6.02	Rod block monitor	3.4	
K6.03	Rod worth minimizer	3.4	
K6.04	RPIS	3.5	
A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor manual control system including:** (CFR: 41.5 / 45.5)		
A1.01	CRD drive water flow	3.5	
A1.02	Control rod position	4.0	
A1.03	DELETED		
A1.04	Reactor power	4.1	
A1.05	DELETED		
A1.06	Lights and alarms	3.3	
A2	**Ability to (a) predict the impacts of the following on the reactor manual 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 / 45.6)	**RO**	**SRO**
A2.01	Rod movement sequence timer malfunctions	4.0	3.2
A2.02	Rod drift	4.4	4.0
A2.03	Select block	3.1	3.2
A2.04	Control rod block	3.5	3.5

A3	**Ability to monitor automatic features of the reactor manual control system including:** (CFR: 41.7 / 45.7)	
A3.01	Control rod block actuation	3.6
A3.02	DELETED	
A3.03	DELETED	
A3.04	Rod movement sequence timer	3.1
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Rod movement control switch	4.1
A4.02	Emergency in/notch override switch	4.1
A4.03	Rod drift test switch	2.7
A4.04	Timer malfunction test switch	2.5
A4.05	Rod select matrix	3.8
A4.06	Rod select matrix power switch	3.3

System: **202002 SF1 RSCTL Recirculation Flow Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the recirculation flow control system and the following systems:** (CFR: 41.2 to 41.8 / 45.7 to 45.8)	
K1.01	Recirculation system	4.2
K1.02	DELETED	
K1.03	DELETED	
K1.04	Reactor/turbine pressure regulating system	3.5
K1.05	DELETED	
K1.06	DELETED	
K1.07	DELETED	
K1.08	Reactor feedwater system	3.7
K1.09	Reactor water level control system	3.8
K1.10	DELETED	
K1.11	Average power range monitor/local power range monitor system	4.1
K1.12	DELETED	
K1.13	Primary containment isolation system/nuclear steam supply shutoff	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Recirculation flow control system	3.2
K2.02	Hydraulic power unit	2.8
K2.03	AC electrical distribution system	3.6
K2.04	DC electrical distribution system	3.3
K3	**Knowledge of the effect that a loss or malfunction of the recirculation flow control system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Core flow	4.4
K3.02	Reactor power	4.6
K3.03	Reactor water level	4.1
K3.04	Reactor/turbine pressure regulation system	3.6
K3.05	Recirculation pump speed	3.8
K3.06	Recirculation flow control valve position	3.9
K3.07	APRM/LPRM	4.1

K4	**Knowledge of recirculation flow control system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Scoop tube brake	3.5
K4.02	Recirculation pump speed control	3.8
K4.03	Signal failure detection	3.3
K4.04	DELETED	
K4.05	Limiting recirculation pump speed/loop flow mismatch	3.9
K4.06	Recirculation pump adequate NPSH	3.5
K4.07	Minimum and maximum pump speed setpoints	3.2
K4.08	Recirc loop flow control	3.8
K4.09	Minimum and maximum flow control valve position: BWR-5,6	3.7
K4.10	Flow control valve speed (BWR 5, 6)	3.4
K4.11	Adjustable speed drives/variable frequency drives	3.5
K4.12	Flow control valve runback	4.1
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the recirculation flow control system:** (CFR: 41.5 / 45.3)	
K5.01	Fluid coupling: BWR-2,3,4	3.3
K5.02	Feedback signals	3.3
K5.03	Error signals	3.1
K5.04	Rod pattern	3.2
K5.05	Reactor power	4.3
K5.06	Reactor core flow	4.2
K5.07	Feedwater flow	3.6
K5.08	Reactor water level	3.7
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the recirculation flow control system:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution system	3.7
K6.02	DC electrical distribution system	3.4
K6.03	Recirculation system	3.8
K6.04	Feedwater flow inputs: BWR-3,4,5,6	3.6
K6.05	Reactor water level	3.6
K6.06	Reactor/turbine pressure regulating system	3.2
K6.07	APRM signal input	3.6

K6.08	Primary containment/drywell pressure	3.0
K6.09	Flow control valves	3.7
K6.10	MG sets/variable frequency drives/adjustable speed drives	3.7
K6.11	Flow controller failure	3.9

A1 **Ability to predict or monitor changes in parameters associated with operation of the recirculation flow control system including:**
(CFR: 41.5 / 45.5)

A1.01	Recirculation pump speed	3.9
A1.02	MG set drive motor amps	3.1
A1.03	MG set generator current, power, voltage	2.9
A1.04	Reactor water level	3.7
A1.05	Reactor power	4.4
A1.06	Reactor core flow	4.2
A1.07	Recirculation loop flow	4.1
A1.08	Recirculation FCV position: BWR-5,6	3.8
A1.09	Lights and alarms	3.6
A1.10	Recirculation pump speed	3.7
A1.11	Recirculation system flow	3.9
A1.12	Core flow	4.0

A2 **Ability to (a) predict the impacts of the following on the recirculation flow 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 / 45.6)

		RO	**SRO**
A2.01	Recirculation pump trip	4.4	4.3
A2.02	Loss of AC electrical power	4.0	3.6
A2.03	Loss of DC electrical power	3.6	3.3
A2.04	Recirculation pump speed/loop flow mismatch	3.8	3.8
A2.05	Scoop tube lockup: BWR-2,3,4	3.3	3.7
A2.06	Low reactor water level	4.0	3.6
A2.07	Loss of feedwater signal inputs	3.5	3.4
A2.08	FCV lockup: BWR-5,6	4.0	3.7
A2.09	Recirculation flow instrumentation	3.8	3.3
A2.10	High primary containment/drywell pressure	4.0	3.1
A2.11	Reactor/turbine pressure regulating system	3.6	3.1
A2.12	APRM/LPRM	3.8	3.4
A2.13	Loss of loop flow signal	3.8	3.5

A3	**Ability to monitor automatic features of the recirculation flow control system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	System lockups/lockouts	3.9
A3.05	System runbacks	4.3
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	MG sets	3.5
A4.02	Hydraulic power unit: BWR-5,6	3.4
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	Flow control valve	4.0
A4.11	System lockups/lockouts	3.8

System: **202001 SF1 RS Recirculation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the recirculation system and the following systems:** (CFR: 41.2 to 41.8 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	DELETED	
K1.03	DELETED	
K1.04	Reactor/turbine pressure regulating system	3.4
K1.05	DELETED	
K1.06	DELETED	
K1.07	Component cooling water systems	3.2
K1.08	DELETED	
K1.09	DELETED	
K1.10	Control rod drive system	3.0
K1.11	Drywell equipment/floor drain sump system	2.8
K1.12	DELETED	
K1.13	DELETED	
K1.14	Rod block monitor system	3.0
K1.15	Nuclear boiler instrumentation	3.3
K1.16	Residual heat removal/low pressure coolant injection	3.5
K1.17	DELETED	
K1.18	Shutdown cooling system (RHR shutdown cooling mode)	3.5
K1.19	Reactor feedwater system	3.1
K1.20	Instrument air system	2.6
K1.21	Reactor water cleanup system	2.8
K1.22	DELETED	
K1.23	APRM/LPRM	3.5
K1.24	Isolation condenser	3.1
K1.25	Reactor water sampling system	2.6
K1.26	Recirculation flow control system	3.9
K1.27	Reactor protection system	3.7
K1.28	DELETED	
K1.29	Redundant reactivity control system (BWR 4, 5, 6)	3.8
K1.30	Reactor vessel internals	3.3
K1.31	Primary containment isolation system	3.3

K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Recirculation pumps	3.5
K2.02	MG sets	3.5
K2.03	Recirculation system valves	3.3
K2.04	DELETED	
K2.05	DELETED	
K2.06	VFDs	3.8
K2.07	VFD cooling water pumps	3.4
K3	**Knowledge of the effect that a loss or malfunction of the recirculation system will have on the following systems or system parameters:** (CFR: 41.5 to 41.7 / 45.4)	
K3.01	Core flow	4.2
K3.02	DELETED	
K3.03	Reactor power	4.4
K3.04	Reactor water level	4.0
K3.05	DELETED	
K3.06	Residual heat removal/low pressure coolant injection logic	3.3
K3.07	Vessel bottom head drain temperature	3.2
K3.08	Shutdown cooling system (RHR shutdown cooling mode)	3.5
K3.09	Reactor water cleanup system	2.9
K3.10	APRM/LPRM	3.5
K3.11	Component cooling water systems	2.6
K3.12	Isolation condenser	3.1
K3.13	Reactor water sampling system	2.5
K3.14	Primary containment integrity	2.9
K3.15	Reactor moderator temperature	3.3
K3.16	Reactor pressure	3.5
K3.17	Drywell equipment/floor drain sump system	2.7
K4	**Knowledge of recirculation system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	2/3 core coverage	4.3
K4.02	Adequate recirculation pump NPSH	3.8
K4.03	Recirculation pump motor cooling	3.3
K4.04	Controlled seal flow	3.3
K4.05	Seal cooling	3.3
K4.06	Automatic voltage/frequency regulation	3.0

K4.07	Motor generator set trips	3.3
K4.08	Oil pump automatic starts	2.8
K4.09	Pump minimum flow limit	3.2
K4.10	Pump start permissives	3.4
K4.11	Limitation of recirculation pumps flow mismatch	3.8
K4.12	Minimization of reactor vessel bottom head temperature gradients	3.6
K4.13	End of cycle recirculation pump trip	3.6
K4.14	ATWS/RPT	4.0
K4.15	Slow speed pump start	3.2
K4.16	Recirculation pump downshift/runback	3.8
K4.17	Fast speed pump start	3.3
K4.18	Automatic MG set start sequencing	3.3
K4.19	VFD trips	3.7
K4.20	VFD start sequencing	3.4

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the recirculation system:**
(CFR: 41.5 / 45.3)

K5.01	Indications of pump cavitation	3.5
K5.02	Jet pump operation: BWR-3,4,5,6	3.7
K5.03	Pump/motor cooling	3.3
K5.04	DELETED	
K5.05	End of cycle recirculation pump trip	3.5
K5.06	ATWS RPT	3.8
K5.07	Natural circulation	3.6
K5.08	DELETED	
K5.09	Hydraulically operated valves	2.8
K5.10	Motor generator set operation	3.0
K5.11	Core flow	3.8
K5.12	Reactor power	4.1
K5.13	Reactor moderator temperature	3.4
K5.14	Reactor water level	3.8
K5.15	VFD operation	3.7

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

K6.01	Jet pumps	4.0
K6.02	Component cooling water systems	3.3
K6.03	AC electrical distribution system	3.5
K6.04	DC electrical distribution system	3.1

K6.05	Control rod drive system	2.9	
K6.06	Recirculation system motor-generator sets	3.2	
K6.07	Feedwater flow	3.1	
K6.08	Reactor water cleanup system	2.8	
K6.09	Reactor water level	3.7	
K6.10	Recirculation flow control system	3.8	
K6.11	Reactor protection system	3.4	
K6.12	APRMs	3.2	
K6.13	Redundant reactivity control system	3.4	
K6.14	Variable frequency drives	3.7	

A1 **Ability to predict or monitor changes in parameters associated with operation of the recirculation system including:**
(CFR: 41.5 / 45.5)

A1.01	Recirculation pump flow	3.1
A1.02	Jet pump flow	3.9
A1.03	Core flow	4.1
A1.04	Reactor water level	3.9
A1.05	Reactor power	4.4
A1.06	Recirculation pump motor amps	3.0
A1.07	Recirculation pump speed	3.2
A1.08	Recirculation FCV position: BWR-5,6	3.8
A1.09	Recirculation pump seal pressures	3.5
A1.10	Recirculation seal purge flows	2.9
A1.11	Vessel bottom head drain temperature	3.2
A1.12	Recirculation pump differential pressure	2.9
A1.13	Recirculation loop temperatures	3.4
A1.14	Recirculation drive motor temperature	3.0
A1.15	Recirculation MG set temperatures	2.8
A1.16	Recirculation MG drive motor amps	2.6
A1.19	VFD temperature	3.3
A1.20	VFD cooling water temperature	3.3
A1.21	VFD current, power, voltage	3.1

A2 **Ability to (a) predict the impacts of the following on the recirculation 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 / 45.6)

		RO	**SRO**
A2.01	Jet pump failure	3.9	4.1
A2.02	Recirculation system leak	4.1	4.0
A2.03	Single recirculation pump trip	4.1	4.2

A2.04	Multiple recirculation pump trip	4.5	4.3
A2.05	Inadvertent recirculation flow increase (reference potential)	4.3	4.2
A2.06	Inadvertent recirculation flow decrease	3.8	4.0
A2.07	Recirculation pump speed mismatch	3.5	3.2
A2.08	Recirculation flow mismatch	3.8	3.7
A2.09	DELETED		
A2.10	Recirculation pump seal failure (reference potential)	3.9	3.9
A2.11	Low reactor water level	4.0	3.8
A2.12	Loss of reactor feedwater	3.9	3.6
A2.13	Carryunder	3.4	2.7
A2.14	High reactor pressure (ATWS circuitry initiation)	3.9	3.8
A2.15	End of cycle trip circuitry	3.8	3.6
A2.16	Loss of seal purge flow (CRD)	3.4	3.1
A2.17	Loss of seal cooling water	3.8	3.3
A2.18	Loss of motor cooling	3.6	3.1
A2.19	Loss of AC power	3.9	3.4
A2.20	Loss of DC power	3.3	3.1
A2.21	Recirculation loop temperature out of spec	3.8	3.2
A2.22	Loss of component cooling water	3.8	3.2
A2.23	Valve closures	3.6	3.3
A2.24	Valve opening	3.4	3.3
A2.25	Recirculation flow control valve lockup	3.8	3.6
A2.26	Incomplete start sequence	3.0	2.9
A2.27	Failure of RPS end of cycle—recirculation pump trip circuitry (BWR 5, 6)	3.3	3.5
A2.28	Failure of redundant reactivity control system (BWR 4, 5, 6)	3.5	3.6
A2.29	VFD cell bypass	3.5	3.6
A2.30	VFD cooling system failure	3.5	3.4

A3 **Ability to monitor automatic features of the recirculation system including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3.6
A3.02	Pump/MG set start sequence	3.4
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	Flow control valve position: BWR-5,6	3.9
A3.07	Pump trips	4.0
A3.08	Pump downshift: BWR-5,6	3.8
A3.09	MG set trip	3.5
A3.10	VFD start sequence	3.4
A3.11	VFD trip	3.9

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Recirculation pumps	4.0
A4.02	System valves	3.8
A4.03	Reactor power	4.4
A4.04	System flow	4.1
A4.05	DELETED	
A4.06	Oil pumps	3.0
A4.07	Vent fans	2.8
A4.08	Motor-generator sets	3.1
A4.09	DELETED	
A4.10	Seal flow	3.1
A4.11	Seal pressures	3.6
A4.12	Core flow	4.1
A4.13	Core differential pressure	3.8
A4.14	Variable frequency drives	3.9
A4.15	VFD cooling water pumps	3.4

System: 201005 SF1 RCIS Rod Control and Information System: BWR-6

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the rod control and information system and the following systems:** (CFR: 41.2 to 41.7 / 45.8)	
K1.01	APRM/local power range monitor system	3.9
K1.02	Reactor/turbine pressure regulating system	3.5
K1.03	Control rod drive hydraulic system	3.7
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	DELETED	
K1.08	Intermediate range monitor system	3.6
K1.09	Source range monitor system	3.6
K1.10	Control rod and drive mechanism system	3.6
K1.11	Recirculation flow control system	3.2
K1.12	Fuel handling system	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.6 / 41.7)	
K2.01	RCIS	3.3
K3	**Knowledge of the effect that a loss or malfunction of the rod control and information system will have on the following systems or system parameters:** (CFR: 41.6 and 41.7 / 45.4–45.6)	
K3.01	Control rod drive hydraulic system	3.4
K3.02	DELETED	
K3.03	DELETED	
K3.04	FLUX shaping	3.1
K3.05	Control rod drive mechanism system	3.1
K3.06	Fuel handling system	3.0
K3.07	Reactor protection system	3.4
K4	**Knowledge of rod control and information system design feature(s) or interlocks that provide for the following:** (CFR: 41.5–41.7)	
K4.01	Limiting the effects of a control rod accident	3.9
K4.02	Bank position withdrawal sequence (BPWS)	3.7

K4.03	Rod withdrawal block signals	4.0
K4.04	Rod insertion block signals	3.9
K4.05	Rod withdrawal limiter	3.8
K4.06	DELETED	
K4.07	Rod position information (RPIS)	3.9
K4.08	Rod action control (RACS)	3.5
K4.09	Rod gang drive (RGDS)	3.5
K4.10	Rod interface (RIS)	3.6
K4.11	Rod pattern controller (RPC)	3.8
K4.12	Rod withdrawal limiter (RWL)	3.8
K4.13	Temperature monitoring	2.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod control and information system:**
(CFR: 41.5–41.7 / 45.3 / 45.5)

K5.01	DELETED	
K5.02	DELETED	
K5.03	Rod groups	3.3
K5.04	Rod sequences	3.7
K5.05	DELETED	
K5.06	Target rod pattern	3.3
K5.07	Low power alarm point	3.3
K5.08	Transition zone	3.2
K5.09	High power setpoints	3.7
K5.10	DELETED	
K5.11	Control rod motion	3.8
K5.12	RACS channel agreement and multiplexing	3.4
K5.13	Position indication	3.8
K5.14	Low power setpoint	3.6
K5.15	Changes in reactor power	4.2

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod control and information system:**
(CFR: 41.7 / 45.7)

K6.01	First stage shell pressure or opening of a bypass valve(s)	3.8
K6.02	Rod position signal	3.7
K6.03	AC electrical distribution system	3.3
K6.04	Intermediate range monitor system	3.7
K6.05	Source range monitor system	3.7
K6.06	APRM/local power range monitor system	3.7

K6.07	Fuel handling system	3.1	
K6.08	Gang misalignment	2.7	

A1 **Ability to predict or monitor changes in parameters associated with operation of the rod control and information system including:**
(CFR: 41.5 / 45.5)

A1.01	First stage shell pressure/turbine load	3.5	
A1.02	Reactor power	4.1	
A1.03	Lights and Alarms	3.6	

A2 **Ability to (a) predict the impacts of the following on the rod control and information 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 / 45.8)

		RO	**SRO**
A2.01	High flux (SRM, IRM, APRM)	4.3	4.0
A2.02	Position indication probe failure	3.3	3.9
A2.03	Insert block	3.4	3.7
A2.04	Withdraw block	3.7	3.8
A2.05	Insert required	3.4	3.4
A2.06	Insert inhibit	3.3	3.7
A2.07	Withdraw inhibit	3.3	3.7
A2.08	LPRM upscale/down scale	3.3	3.5
A2.09	Test display blinking	2.7	2.9
A2.10	Data fault	2.9	3.4
A2.11	DELETED		
A2.12	DELETED		
A2.13	Rod drift	4.4	4.2
A2.14	AC electrical distribution system	3.4	3.4
A2.15	Fuel handling system	3.1	3.3
A2.16	Gang misalignment	2.7	2.8

A3 **Ability to monitor automatic features of the rod control and information system including:**
(CFR: 41.7 / 45.7)

A3.01	Operator control module lights	3.6	
A3.02	Rod display module lights	3.7	
A3.03	Verification of proper functioning/operability	3.9	
A3.04	DELETED		

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Operator control module (lights and push buttons)	3.8
A4.02	Rod display module (lights and push buttons)	3.7
A4.03	Back panel indicating lights	3.3
A4.04	Bypassing rod position in rod action control system (RACC)	3.7
A4.05	Bypassing a rod drive in rod gang drive system (RGDS)	3.6

System: 211000 SF1 SLCS Standby Liquid Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the standby liquid control system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Leak detection system	2.6
K1.02	Nuclear boiler instrumentation	3.0
K1.03	Plant air systems	2.5
K1.04	Demineralized water/condensate storage system	2.4
K1.05	RWCU system	3.8
K1.06	Reactor vessel internals	3.3
K1.07	Reactor recirculation system	2.9
K1.08	CRD system	2.7
K1.09	Core spray system	3.0
K1.10	HPCI system	2.4
K1.11	Redundant reactivity control system	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	SLC pumps	3.6
K2.02	Squib valves	3.5
K2.03	Heater power	2.5
K3	**Knowledge of the effect that a loss or malfunction of the standby liquid control system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor power	4.0
K3.02	Leak detection system	2.4
K3.03	Core plate differential pressure	3.0
K3.04	Jet pump differential pressure (BWR-3,4,5,6)	2.8
K3.05	CRD drive and cooling water differential pressure	2.4
K4	**Knowledge of standby liquid control system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Zero leakage to the reactor (squib valves)	3.3
K4.02	Component and system testing	3.0
K4.03	Keeping sodium pentaborate in solution	3.6

K4.04	Indication of a fault in squib valves firing circuits	3.7
K4.05	Dispersal of boron upon injection into the vessel	3.3
K4.06	DELETED	
K4.07	RWCU isolation	4.0
K4.08	SLC system initiation	4.1
K4.09	Dampening of positive displacement pump discharge oscillations	2.7
K4.10	Over pressure protection	2.9
K4.11	Automatic system initiation	3.8
K4.12	SLC pump trips	3.3
K4.13	Tank heater operation	2.8

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the standby liquid control system:**
(CFR: 41.5 / 45.3)

K5.01	Effects of the moderator temperature coefficient of reactivity on boron	3.0
K5.02	DELETED	
K5.03	Shutdown margin	3.7
K5.04	Squib valves operation	3.7
K5.05	Accumulator operation	2.8
K5.06	DELETED	
K5.07	DELETED	
K5.08	SLC pressure/relief valve operation	2.9

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

K6.01	Plant air systems	2.5
K6.02	Demineralized water system	2.3
K6.03	AC power	3.7
K6.04	Core spray system	2.8
K6.05	HPCI system	2.2
K6.06	Redundant reactivity control system	3.6

A1 **Ability to predict or monitor changes in parameters associated with operation of the standby liquid control system including:**
(CFR: 41.5 / 45.5)

A1.01	Tank level	3.8
A1.02	Explosive squib valves status	4.0
A1.03	Pump discharge pressure	3.9

A1.04	Valve position	3.5	
A1.05	Pump amps	2.9	
A1.06	SLC pump/system flow	3.7	
A1.07	Reactor power	4.2	
A1.08	RWCU system lineup	3.9	
A1.09	SLC system lineup	3.8	
A1.10	Lights and alarms	3.6	

A2 **Ability to (a) predict the impacts of the following on the standby liquid 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 / 45.6)

		RO	**SRO**
A2.01	Pump trip	4.2	3.8
A2.02	Failure of squib valves to open	4.1	4.0
A2.03	AC power failures	3.9	3.7
A2.04	Inadequate SLC system flow	3.9	3.8
A2.05	Loss of SLC tank heaters	3.1	3.0
A2.06	Abnormal valve position	3.7	3.4
A2.07	DELETED		
A2.08	DELETED		
A2.09	Automatic or manual initiation failure	4.4	4.1

A3 **Ability to monitor automatic features of the standby liquid control system including:**
(CFR: 41.7 / 45.7)

A3.01	DELETED		
A3.02	DELETED		
A3.03	DELETED		
A3.04	DELETED		
A3.05	DELETED		
A3.06	RWCU system isolation	4.1	
A3.07	DELETED		
A3.08	System initiation	4.1	
A3.09	Pump trip	3.8	

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	SLC control switch	4.1
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	RWCU system isolation	4.0
A4.07	DELETED	
A4.08	System initiation	4.3

3.2 Safety Function 2: Reactor Water Inventory Control

System: **206000 SF2 HPCIS High Pressure Coolant Injection System: BWR 2,3,4**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the high pressure coolant injection system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.5
K1.02	DELETED	
K1.03	DELETED	
K1.04	Feedwater system	3.7
K1.05	Condensate system	3.0
K1.06	Primary containment	3.5
K1.07	DELETED	
K1.08	DELETED	
K1.09	DELETED	
K1.10	DELETED	
K1.11	DELETED	
K1.12	Nuclear boiler instrumentation	3.6
K1.13	DELETED	
K1.14	SBGT	2.7
K1.15	Instrument air system	2.6
K1.16	DELETED	
K1.17	Reactor protection system	2.8
K1.18	Main steam system	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	3.7
K2.02	Pumps	3.2
K2.03	Initiation/isolation logic	4.1
K2.04	Turbine control circuits	3.3
K3	**Knowledge of the effect that a loss or malfunction of the high pressure coolant injection system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	Reactor pressure	3.8
K3.03	Suppression pool level	3.4

K3.04	Reactor power	3.6
K3.05	Secondary containment parameters	3.1

K4 **Knowledge of high pressure coolant injection system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Turbine trips	3.8
K4.02	System isolations	4.2
K4.03	Resetting turbine trips	3.8
K4.04	Resetting system isolations	3.9
K4.05	Preventing water hammer in turbine exhaust line (vacuum breakers)	3.4
K4.06	Preventing water hammer in pump discharge line (keep fill)	3.3
K4.07	Automatic system initiation	4.4
K4.08	Manual system initiation	4.3
K4.09	Automatic flow control	3.9
K4.10	DELETED	
K4.11	Turbine speed control	3.7
K4.12	Condensation of shaft sealing steam	2.5
K4.13	Turbine and pump lubrication	3.2
K4.14	Control oil to turbine speed controls	3.1
K4.15	Low speed turning of the turbine rotor	2.5
K4.16	DELETED	
K4.17	DELETED	
K4.18	Pump minimum flow	3.2
K4.19	Automatic transfer of HPCI pump suction	3.7
K4.20	Testable check valve operation	2.3

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the high pressure coolant injection system:**
(CFR: 41.5 / 45.3)

K5.01	Turbine operation	3.5
K5.02	Turbine shaft sealing	2.6
K5.03	Flow control	3.7
K5.04	Indications of pump cavitation	3.2
K5.05	Turbine speed control	3.5
K5.06	Turbine speed measurement	2.7
K5.07	DELETED	
K5.08	DELETED	
K5.09	DELETED	
K5.10	Reactor pressure control	3.9

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the high pressure coolant injection system:** (CFR: 41.7 / 45.7)	
K6.01	Instrument air system	2.6
K6.02	DC electrical distribution system	3.9
K6.03	AC electrical distribution system	3.3
K6.04	Condensate storage tank low level	3.7
K6.05	Suppression pool level	3.7
K6.06	SBGTS	3.0
K6.07	Keep fill system	3.0
K6.08	Low reactor pressure	3.4
K6.09	DELETED	
K6.10	HPCI initiation/isolation logic	4.3
K6.11	Nuclear boiler instrumentation	3.6
K6.12	Reactor water level	4.0
K6.13	High suppression pool temperature	3.6
K6.14	Feedwater system	3.3
K6.15	Low pressure core spray system	2.5
K6.16	High turbine exhaust pressure	3.6
K6.17	High steam flow	3.7
K6.18	Area high temperature	3.9
K6.19	High drywell pressure	4.0
K6.20	Aux oil pump	3.8
K6.21	Component cooling water	3.0
A1	**Ability to predict or monitor changes in parameters associated with operation of the high pressure coolant injection system including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4.3
A1.02	Reactor pressure	4.1
A1.03	Condensate storage tank level	3.5
A1.04	Suppression pool level	3.6
A1.05	Suppression pool temperature	3.8
A1.06	System flow	3.9
A1.07	System discharge pressure	3.8
A1.08	DELETED	
A1.09	Turbine speed	3.5
A1.10	Lights and alarms	3.6
A1.11	Secondary containment parameters	3.1
A1.12	Turbine bearing temperature	3.0

A2	**Ability to (a) predict the impacts of the following on the high pressure coolant injection 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 / 45.6)	**RO**	**SRO**
A2.01	Turbine trips	4.3	4.1
A2.02	DELETED		
A2.03	Abnormal valve positions	4.0	3.7
A2.04	AC electrical distribution system failures	4.0	3.5
A2.05	DC electrical distribution system failures	4.3	3.9
A2.06	Inadequate system flow	4.3	3.6
A2.07	High/low suppression pool level	4.2	3.6
A2.08	High suppression pool temperature	4.3	3.6
A2.09	Low condensate storage tank level	3.8	3.5
A2.10	System isolation	4.7	4.0
A2.11	High/low reactor water level	4.3	4.1
A2.12	Loss of room cooling	3.3	2.8
A2.13	Loss of instrument air system	3.2	2.5
A2.14	Flow controller failure	4.3	3.6
A2.15	Loss of control oil pressure	4.3	3.7
A2.16	High drywell pressure	4.5	3.8
A2.17	Inadvertent initiation	4.3	3.9

A3	**Ability to monitor automatic features of the high pressure coolant injection system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	System initiation	4.4
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	System isolation	4.3
A3.10	Pump suction transfer	3.6
A3.11	Barometric condenser level control	2.5
A3.12	Turbine reset	3.8

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Turbine speed control	4.2
A4.02	Flow controller	4.3

A4.03	DELETED	
A4.04	Valves	3.8
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	Pumps	3.7
A4.11	Turning gear	2.4
A4.12	Turbine trip	4.1
A4.13	Initiation reset	4.0
A4.14	DELETED	
A4.15	Isolation reset	4.0

System: 209002 SF2 HPCS High Pressure Core Spray System (BWR 5,6)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the high pressure core spray system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate system	3.2
K1.02	Primary containment	3.6
K1.03	DELETED	
K1.04	Emergency generators	4.0
K1.05	Standby liquid control system	3.3
K1.06	Suppression pool cleanup system	2.8
K1.07	Plant ventilation systems (HPCS room coolers)	3.1
K1.08	Component cooling water systems	3.1
K1.09	Leak detection	3.2
K1.10	DELETED	
K1.11	DELETED	
K1.12	Reactor vessel and internals	3.7
K1.13	Instrument nitrogen	2.1
K1.14	Instrument air system	2.4
K1.15	Safety related service water	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.2
K2.02	Valves	3.9
K2.03	Initiation logic	4.2
K3	**Knowledge of the effect that a loss or malfunction of the high pressure core spray system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	Standby liquid control system	3.0
K3.03	DELETED	
K3.04	Suppression pool level	3.3
K3.05	Reactor power	3.6
K3.06	Reactor pressure	3.7
K3.07	Secondary containment parameters	2.9
K3.08	Condensate storage tank level	3.2
K3.09	Override of drywell pressure interlock	3.6

K4	**Knowledge of high pressure core spray system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of water hammer (keep fill)	3.5
K4.02	Prevention of over filling reactor vessel	4.0
K4.03	Prevention of pump over heating	3.2
K4.04	Testable check valve operation	2.4
K4.05	DELETED	
K4.06	DELETED	
K4.07	Override of reactor water level interlock	4.0
K4.08	Automatic system initiation	4.4
K4.09	Manual system initiation	4.2
K4.10	Uniform core spray coverage	3.1
K4.11	Prevention of piping over pressurization	3.2
K4.12	Automatic transfer of HPCS pump suction	3.8
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the high pressure core spray system:** (CFR: 41.5 / 45.3)	
K5.01	Indications of pump cavitation	3.5
K5.02	DELETED	
K5.03	DELETED	
K5.04	Adequate core cooling	4.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the high pressure core spray system:** (CFR: 41.7 / 45.7)	
K6.01	Loss of AC electrical distribution	4.2
K6.02	Abnormal condensate storage tank water level	3.6
K6.03	Component cooling water systems	3.1
K6.04	Suppression pool suction strainer	3.4
K6.05	Abnormal suppression pool water Level	3.7
K6.06	Keep fill system	3.3
K6.07	Plant ventilation systems (HPCS room coolers)	3.3
K6.08	Loss of DC electrical distribution	3.8
K6.09	Abnormal reactor water level	4.2
K6.10	High drywell pressure	4.1
K6.11	High suppression pool temperature	3.5

A1	**Ability to predict or monitor changes in parameters associated with operation of the high pressure core spray system including:** (CFR: 41.5 / 45.5)		
A1.01	System flow	4.0	
A1.02	System pressure	3.9	
A1.03	Reactor water level	4.3	
A1.04	Reactor pressure	3.9	
A1.05	Suppression pool level	3.6	
A1.06	DELETED		
A1.07	Diesel loading	3.8	
A1.08	System lineup	3.9	
A1.09	Condensate storage tank level	3.6	
A1.10	Lights and alarms	3.7	
A1.11	Suppression pool temperature	3.3	
A1.12	Reactor power	3.8	

A2	**Ability to (a) predict the impacts of the following on the high pressure core 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 / 45.6)	**RO**	**SRO**
A2.01	System initiation	4.5	4.4
A2.02	Pump trips	4.1	3.9
A2.03	Abnormal valve positions	4.1	3.9
A2.04	Loss of AC electrical distribution	4.1	4.0
A2.05	Loss of DC electrical distribution	4.0	3.9
A2.06	Core spray line break	4.0	3.6
A2.07	Pump seal failure	3.5	3.3
A2.08	Inadequate system flow	4.0	3.8
A2.09	Loss of plant ventilation (HPCS room cooler)	3.1	3.3
A2.10	DELETED		
A2.11	Low suppression pool level	3.8	3.5
A2.12	High suppression pool level	3.4	3.2
A2.13	Low condensate storage tank level	3.4	3.7
A2.14	High suppression pool temperature	3.4	3.4
A2.15	Clogged suppression pool suction strainers	3.8	3.4
A2.16	Emergency diesel generator failure	4.3	3.9
A2.17	Initiation logic failure	4.5	4.2
A2.18	Keep fill system failure	3.6	3.3
A2.19	Abnormal reactor water level	4.1	3.9
A2.20	High drywell pressure	4.3	3.9
A2.21	Inadvertent initiation	4.0	3.4

A3	**Ability to monitor automatic features of the high pressure core spray system including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4.2
A3.02	Pump start	4.1
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Emergency diesel generator operation	4.1
A3.08	Pump trip	4.0
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	HPCS pump	4.3
A4.02	Suction valves	4.0
A4.03	Injection valve	4.3
A4.04	Minimum flow valve	3.8
A4.05	Manual initiation controls	4.3
A4.06	Testable check valve	2.4
A4.07	Keep fill pump	3.2
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	Test return valve	3.3
A4.15	Initiation reset	3.9
A4.16	Emergency diesel generator operation	4.3

System:	**209001 SF2 LPCS Low Pressure Core Spray System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the low pressure core spray system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	Primary containment	3.7
K1.03	DELETED	
K1.04	Condensate system	2.6
K1.05	Automatic depressurization system	4.2
K1.06	Instrument air systems	2.4
K1.07	DELETED	
K1.08	DELETED	
K1.09	Nuclear boiler instrumentation	3.6
K1.10	Emergency generators	4.2
K1.11	Drywell coolers	2.4
K1.12	ECCS room coolers	3.1
K1.13	Leak detection	3.2
K1.14	Reactor vessel and internals	3.7
K1.15	Residual heat removal system	3.3
K1.16	High pressure coolant injection system	3.0
K1.17	Standby liquid control	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.2
K2.02	Valves	3.8
K2.03	Initiation logic	4.1
K3	**Knowledge of the effect that a loss or malfunction of the low pressure core spray system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	ADS logic	4.1
K3.03	Emergency generators	3.6
K3.04	DELETED	
K3.05	Drywell cooling	2.8

K4	**Knowledge of low pressure core spray system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of overpressurization of core spray piping	3.5
K4.02	Prevents water hammer	3.4
K4.03	Motor cooling	2.9
K4.04	Line break detection	3.4
K4.05	Pump minimum flow	3.4
K4.06	Adequate pump net positive suction head	3.4
K4.07	DELETED	
K4.08	Automatic system initiation	4.5
K4.09	Load sequencing	4.0
K4.10	DELETED	
K4.11	Override injection	3.9
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the low pressure core spray system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Abnormal differential pressure indication (leak detection)	3.4
K5.03	Testable check valve operation	2.5
K5.04	Heat removal (transfer) mechanisms	3.2
K5.05	DELETED	
K5.06	DELETED	
K5.07	Adequate core cooling	4.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the low pressure core spray system:** (CFR: 41.7 / 45.7)	
K6.01	Loss of AC electrical distribution system	4.2
K6.02	Loss of emergency generators	4.2
K6.03	Torus/suppression pool water level	3.7
K6.04	Loss of DC electrical distribution system	3.9
K6.05	ECCS room cooler(s)	3.4
K6.06	Pump motor cooler(s)	2.9
K6.07	Pump seal cooler(s)	2.9
K6.08	Keep fill system	3.4
K6.09	DELETED	
K6.10	ECCS room integrity	3.1
K6.11	ADS	4.1

K6.12	Suppression pool suction strainer	3.4	
K6.13	High drywell pressure	4.3	
K6.14	Low reactor water level	4.3	
K6.15	Condensate storage tank low level	2.8	

A1 **Ability to predict or monitor changes in parameters associated with operation of the low pressure core spray system including:**
(CFR: 41.5 / 45.5)

A1.01	Core spray flow	4.1	
A1.02	Core spray pressure	3.9	
A1.03	Reactor water level	4.4	
A1.04	Reactor pressure	4.1	
A1.05	Torus/suppression pool water level	3.6	
A1.06	DELETED		
A1.07	Emergency generator loading	3.9	
A1.08	System lineup	4.0	
A1.09	Lights and alarms	3.7	
A1.10	Suppression pool temperature	3.3	

A2 **Ability to (a) predict the impacts of the following on the low pressure core 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 / 45.6)

		RO	**SRO**
A2.01	Pump trips	4.1	3.9
A2.02	Valve closures	3.9	3.8
A2.03	AC failures	4.0	4.0
A2.04	DC failures	3.7	4.0
A2.05	Core spray line break	4.0	3.5
A2.06	Inadequate system flow	4.3	3.7
A2.07	Loss of room cooling	3.3	3.2
A2.08	Valve openings	3.9	3.5
A2.09	Low suppression pool level	3.8	3.5
A2.10	High suppression pool temperature	3.5	3.3
A2.11	Loss of fire protection	2.3	2.0
A2.12	System initiation	4.4	4.3

A3 **Ability to monitor automatic features of the low pressure core spray system including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	4.2	
A3.02	Pump start	4.3	
A3.03	DELETED		
A3.04	DELETED		
A3.05	DELETED		

A3.06	DELETED	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Core spray pump	4.3
A4.02	Valves	4.2
A4.03	DELETED	
A4.04	DELETED	
A4.05	Manual initiation controls	4.2
A4.06	DELETED	
A4.07	Keep Fill pump	3.0
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	DELETED	
A4.15	Initiation reset	3.6

System: **256000 SF2 CDS Condensate System**

Sub Systems: **Condensate Polishing Condensate Transfer Condenser Air Removal**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the condensate system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main turbine	2.9
K1.02	Reactor feedwater system	3.9
K1.03	HPCI	3.4
K1.04	RCIC	3.1
K1.05	CRD hydraulics system	3.3
K1.06	Extraction steam system	2.9
K1.07	SJAE condenser system	3.0
K1.08	Gland seal steam system	2.9
K1.09	Offgas condenser	2.9
K1.10	Exhaust hood spray system	2.8
K1.11	Instrument air system	3.0
K1.12	DELETED	
K1.13	Reactor water level control system	3.9
K1.14	RHR (LPCI)	2.6
K1.15	HPCS	2.9
K1.16	RWCU	2.2
K1.17	ECCS keep fill system	2.8
K1.18	Circulating water system	2.6
K1.19	Component cooling water systems	2.7
K1.20	Demineralized water storage and makeup system	2.5
K1.21	Steam seal evaporator	2.5
K1.22	Offgas system	2.8
K1.23	Auxiliary steam system	2.1
K1.24	Radwaste system	2.2
K1.25	Main steam system	2.7
K1.26	Condensate demineralizer system	3.3
K1.27	Condensate filter system	3.1
K1.28	Heater drains and vent system	3.0
K1.29	Hydrogen water chemistry system	2.8
K1.30	Oxygen injection system	2.7
K1.31	Noble metal injection system	2.2
K1.32	Zinc injection system	2.2

K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	System pumps	3.4
K2.02	Motor operated valves	2.7
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 / 45.4)	
K3.01	Main turbine/main generator	3.2
K3.02	CRD hydraulics system	3.1
K3.03	Extraction steam system	2.8
K3.04	Reactor feedwater system	4.1
K3.05	HPCI	2.9
K3.06	RCIC	2.8
K3.07	DELETED	
K3.08	SJAE system	3.0
K3.09	Offgas system	2.8
K3.10	Gland seal steam system	2.8
K3.11	Reactor water level	4.2
K3.12	HPCS	2.9
K3.13	Main steam system	2.8
K3.14	Exhaust hood spray system	2.5
K3.15	ECCS keep fill system	2.9
K3.16	Condensate demineralizer system	3.0
K3.17	Condensate filter system	2.8
K3.18	Heater drains and vent system	2.6
K3.19	Hydrogen water chemistry system	2.6
K3.20	Oxygen injection system	2.5
K4	**Knowledge of condensate system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Condensate or booster pump auto start	3.5
K4.02	CRD pump suction	3.3
K4.03	Condensate or booster pump protection	3.1
K4.04	Maintenance of water quality	3.0
K4.05	Maintenance of 100% system flow if a feedwater string isolates	3.3
K4.06	Control of extraction steam	2.8
K4.07	Cascading heater drains	3.0
K4.08	Dedicated ECCS water supply	3.1
K4.09	Initial main condenser vacuum	2.9

K4.10	Noncondensable gas removal	2.8
K4.11	Isolation of SJAEs	2.8
K4.12	Bypassing of condensate filters or demineralizers	3.0

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the condensate system:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	Water conductivity	3.0
K5.03	Heat exchanger level operation	2.9
K5.04	DELETED	
K5.05	De-aeration of condensate	2.4
K5.06	DELETED	
K5.07	Reactor water level	3.9
K5.08	DELETED	
K5.09	DELETED	
K5.10	Air ejection operation	2.8

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	Instrument air systems	3.5
K6.02	Circulating water system	2.9
K6.03	Extraction steam system	3.0
K6.04	AC electrical distribution	3.5
K6.05	Component cooling water systems	2.9
K6.06	Reactor feedwater system	3.7
K6.07	Demineralized water storage and makeup system	2.5
K6.08	Main turbine	2.8
K6.09	Offgas system	2.6
K6.10	Main steam system	2.7
K6.11	Condensate demineralizer system	3.3
K6.12	Condensate filter system	3.2
K6.13	Heater drains and vent system	2.8

A1 **Ability to predict or monitor changes in parameters associated with operation of the condensate system including:**
(CFR: 41.5 / 45.5)

A1.01	System flow	3.6
A1.02	Pump amps	2.9
A1.03	System pressure	3.4

A1.04	Hotwell level	3.5	
A1.05	Condensate storage tank level	3.0	
A1.06	Reactor water level	4.0	
A1.07	System lineup	3.3	
A1.08	System water quality	2.8	
A1.09	Feedwater temperature	3.5	
A1.10	Condenser vacuum	3.5	
A1.11	Lights and alarms	3.4	

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 / 45.6)	**RO**	**SRO**
A2.01	Pump trips	4.2	3.9
A2.02	Valve closures	3.9	3.6
A2.03	Valve openings	3.8	3.4
A2.04	AC power failures	3.9	3.7
A2.05	Inadequate system flow	3.9	3.7
A2.06	Low hotwell level	3.9	3.4
A2.07	High hotwell level	3.0	3.0
A2.08	High feedwater heater level	3.6	3.3
A2.09	Low feedwater heater level	3.6	3.2
A2.10	Main turbine trip	3.7	2.9
A2.11	Loss of circulating water system	3.6	3.1
A2.12	Loss of component cooling water systems	3.3	2.9
A2.13	Loss of Instrument air system	3.8	3.3
A2.14	Low condensate storage tank level	3.3	3.0
A2.15	Abnormal water quality	3.0	2.8
A2.16	High demineralizer differential pressure	3.2	3.0
A2.17	Feedwater heater string trip	3.6	3.5
A2.18	Loss of SJAE	3.6	3.1
A2.19	Condensate filter high differential pressure	3.1	2.9

A3	**Ability to monitor automatic features of the condensate system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	Pump starts	3.4
A3.03	System pressure	3.4
A3.04	System flow	3.5
A3.05	DELETED	
A3.06	Hotwell level	3.3
A3.07	Feedwater heater level	3.3

A3.08	DELETED	
A3.09	Feedwater heater drain tank level	3.0
A3.10	Pump trips	3.7
A3.11	Condensate filter/demineralizer auto bypass	3.0

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

A4.01	Condensate/condensate booster pumps	3.8
A4.02	System motor operated valves	3.3
A4.03	Hotwell level controls	3.3
A4.04	Minimum flow valves	3.4
A4.05	System flow	3.6
A4.06	System pressure	3.5
A4.07	DELETED	
A4.08	Reactor water level	4.2
A4.09	DELETED	
A4.10	DELETED	
A4.11	Condensate storage tank level	3.1
A4.12	Feedwater heater level	3.2
A4.13	DELETED	
A4.14	Feedwater heater drain tank level	3.1
A4.15	Air ejectors	3.0

System:	**217000 SF2 RCIC Reactor Core Isolation Cooling System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor core isolation cooling system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate system	3.1
K1.02	Nuclear boiler Instrumentation	3.7
K1.03	Suppression pool	3.8
K1.04	DELETED	
K1.05	Residual heat removal system	2.8
K1.06	Instrument air systems	2.5
K1.07	Leak detection	3.3
K1.08	DELETED	
K1.09	Reactor vessel and internals	3.3
K1.10	Main steam system	3.6
K1.11	Radwaste system	1.8
K1.12	Remote shutdown system	3.5
K1.13	Component cooling water	2.8
K1.14	Primary containment isolation system	3.9
K1.15	Feedwater system	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	3.3
K2.02	Initiation/isolation logic	3.7
K2.03	RCIC flow controller	3.5
K2.04	Gland seal compressor (vacuum pump)	2.6
K2.05	Water leg pump	2.6
K3	**Knowledge of the effect that a loss or malfunction of the reactor core isolation cooling system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.2
K3.02	Reactor vessel pressure	3.9
K3.03	DELETED	
K3.04	DELETED	
K3.05	Suppression pool level	3.3
K3.06	Condensate storage tank level	3.2
K3.07	Secondary containment parameters	3.4

K4	**Knowledge of reactor core isolation cooling system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevent water hammer	3.4
K4.02	Prevent over filling reactor vessel	3.8
K4.03	Prevents pump over heating	3.2
K4.04	Turbine trips	3.9
K4.05	DELETED	
K4.06	Manual system initiation	4.0
K4.07	Automatic transfer of RCIC pump suction	3.6
K4.08	Automatic system initiation	4.1
K4.09	Initiation reset	3.7
K4.10	System isolation	4.1
K4.11	Resetting system isolations	3.8
K4.12	Automatic flow control	3.7
K4.13	Turbine speed control	3.6
K4.14	Control oil to turbine speed controls	3.3
K4.15	Testable check valve operation	2.2
K4.16	Turbine shaft sealing	2.4
K4.17	Bypass trips and isolation logic	3.7
K4.18	Remote operation	3.7
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor core isolation cooling system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Flow control	3.8
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	Turbine operation	3.5
K5.07	Reactor pressure control	3.7
K5.08	Decay heat removal	3.8
K5.09	Adequate core cooling	4.2
K5.10	Reactor level control	4.2

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor core isolation cooling system:** (CFR: 41.7 / 45.7)	
K6.01	Electrical power	3.8
K6.02	Instrument air systems	2.6
K6.03	Suppression pool level	3.5
K6.04	Condensate storage tank low level	3.5
K6.05	Low reactor pressure	3.7
K6.06	Keep fill system	3.1
K6.07	Nuclear boiler instrumentation	3.6
K6.08	Reactor water level	4.1
K6.09	High suppression pool temperature	3.5
K6.10	High turbine exhaust pressure	3.7
K6.11	High steam flow	3.9
K6.12	High area temperature	4.0
K6.13	Low pump suction pressure	3.7
K6.14	Turbine control failure	3.7
K6.15	Lube oil pump	3.3
K6.16	Minimum flow valve	3.3
K6.17	Flow controller failure	3.9
A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor core isolation cooling system including:** (CFR: 41.5 / 45.5)	
A1.01	RCIC flow	4.1
A1.02	RCIC pressure	3.9
A1.03	Reactor water level	4.3
A1.04	Reactor pressure	4.1
A1.05	RCIC turbine speed	3.7
A1.06	Condensate storage tank level	3.2
A1.07	Suppression pool level	3.4
A1.08	Suppression pool temperature	3.5
A1.09	Lights and alarms	3.6

A2	**Ability to (a) predict the impacts of the following on the reactor core isolation 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 / 45.6)	**RO**	**SRO**
A2.01	System initiation signal	4.3	4.2
A2.02	Turbine trips	4.2	4.0
A2.03	Valve closures	3.8	3.7
A2.04	AC power loss	3.5	3.4
A2.05	DC power loss	4.1	3.9
A2.06	Loss of instrument air systems	2.9	2.5
A2.07	Loss of lube oil	3.6	3.3
A2.08	Loss of lube oil cooling	3.6	3.2
A2.09	Loss of vacuum pump	3.0	2.7
A2.10	Turbine control system failures	3.6	3.7
A2.11	Inadequate system flow	4.0	3.7
A2.12	Valve openings	3.3	3.6
A2.13	Loss of room cooling	3.2	3.1
A2.14	Rupture disc failure: exhaust-diaphragm	3.9	3.6
A2.15	Steam line break	4.0	4.0
A2.16	Low condensate storage tank level	3.5	3.3
A2.17	Abnormal suppression pool level	3.7	3.4
A2.18	DELETED		
A2.19	High suppression pool temperature	3.7	3.5

A3	**Ability to monitor automatic features of the reactor core isolation cooling system including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	3.9
A3.02	Turbine startup	4.0
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Trips and isolations	4.2
A3.08	Automatic flow control	4.0

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Turbine trip throttle valve reset	4.0
A4.03	System valves	3.8
A4.04	DELETED	

A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	Turbine speed control	3.9
A4.13	Manual initiation	4.1
A4.14	Resetting isolations	3.9

System: 259001 SF2 FWS Feedwater System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the feedwater system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.7
K1.02	HPCI system	3.6
K1.03	RWCU system	3.3
K1.04	Extraction steam system	3.0
K1.05	Condensate system	3.5
K1.06	Instrument air systems	3.3
K1.07	DELETED	
K1.08	Reactor water level control system	4.1
K1.09	DELETED	
K1.10	Component cooling water systems	3.0
K1.11	RFP lube oil system	3.1
K1.12	RFP turbine seal steam system: TDRFPs-only	2.8
K1.13	Main turbine generator	2.9
K1.14	RCIC system	3.5
K1.15	RHR system	2.9
K1.16	Recirculation system	3.1
K1.17	Heater drains system	2.8
K1.18	Fire protection system (emergency cooling)	2.5
K1.19	Redundant reactivity control system	3.3
K1.20	Main steam system: TDRFPs-Only	3.3
K1.21	DELETED	
K1.22	Feedwater control system	3.8
K1.23	Hydrogen water chemistry system	2.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor feedwater pump(s): motor-driven-only	3.8
K2.02	System motor operated valves	2.9
K2.03	RFP auxiliary oil pumps	2.8
K3	**Knowledge of the effect that a loss or malfunction of the feedwater system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.5
K3.02	Reactor water level control system	4.2

K3.03	HPCI	3.7
K3.04	RWCU	2.8
K3.05	Recirculation pump NPSH	3.3
K3.06	Core inlet subcooling	3.3
K3.07	Condensate system	3.2
K3.08	RCIC	3.4
K3.09	Extraction steam system	2.7
K3.10	HPCS	3.1
K3.11	RHR	3.0
K3.12	Reactor power	4.0
K3.13	Digital feedwater control system	4.0

K4 **Knowledge of feedwater system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Auto start of the RFPs	3.9
K4.02	Feedwater heating	3.3
K4.03	RFP minimum flow	3.3
K4.04	Dispersal of feedwater in the reactor vessel	3.0
K4.05	RFP protection	3.2
K4.06	RFP lubrication	3.0
K4.07	RFP motor cooling: motor-driven-only	3.0
K4.08	RFP turbine seals: TDRFPs-only	2.7
K4.09	System isolation from the reactor vessel (check valves, double valve isolation inside/outside containment)	3.2
K4.10	Feedpump runbacks	3.5
K4.11	Recirculation runbacks	3.7
K4.12	RFP start permissives	3.1
K4.13	Reactor water level control	4.0
K4.14	Digital feedwater control system	3.9

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the feedwater system:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	DELETED	
K5.03	Turbine operation: TDRFPs-only	3.5
K5.04	Rx water level	4.2
K5.05	Thermal power calculation	3.5
K5.06	Rod worth minimizer	2.7
K5.07	Reactor recirculation system	3.3
K5.08	Feedwater heaters, including heater drain pumps	3.0

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

K6.01	Instrument air system	3.5
K6.02	Condensate system	3.5
K6.03	AC electrical power	3.4
K6.04	Extraction steam	2.9
K6.05	Component cooling water systems	2.9
K6.06	DELETED	
K6.07	Reactor water level control system	4.0
K6.08	Reactor feedwater pump motor ventilation: Motor- Driven-Only	2.9
K6.09	Reactor feedwater pump lube oil system	3.1
K6.10	RFP turbine seal system: TDRFPs-Only	2.8
K6.11	Main steam: TDRFPs-Only	3.0
K6.12	DC electrical power	2.9
K6.13	Redundant reactivity control	3.1
K6.14	Feedwater heaters	3.1
K6.15	Digital feedwater control system	3.8

A1 Ability to predict or monitor changes in parameters associated with operation of the feedwater system including:
(CFR: 41.5 / 45.5)

A1.01	Feedwater flow/pressure	3.9
A1.02	Feedwater inlet temperature	3.4
A1.03	RFP motor amps: Motor-Driven-Only	3.0
A1.04	RFP turbine speed: Turbine-Driven-Only	3.3
A1.05	RFP turbine control valve position: Turbine-Driven- Only	2.8
A1.06	Feedwater heater level	2.9
A1.07	Reactor water level	4.3
A1.08	Feedwater control valve position	3.6

A2 Ability to (a) predict the impacts of the following on the 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 / 45.6)

		RO	**SRO**
A2.01	RFP trip	4.3	4.1
A2.02	Feedwater heater isolation	3.4	3.4
A2.03	Loss of condensate system pump(s)	3.9	3.9
A2.04	Loss of extraction steam	3.4	3.5
A2.05	Loss of Instrument air system	3.6	3.3
A2.06	Loss of AC electrical distribution	3.5	3.4

A2.07	Reactor water level control system malfunctions	4.1	4.1
A2.08	Loss of DC electrical distribution	3.3	2.9
A2.09	TDRFP steam inlet pressure flow	3.0	2.6
A2.10	Digital feedwater control malfunctions	3.8	3.7
A2.11	Component cooling water malfunctions	3.1	2.9
A2.12	Heater drain pump trip	3.0	3.0

A3 **Ability to monitor automatic features of the feedwater system including:**
(CFR: 41.7 / 45.7)

A3.01	RFP auto start	3.7
A3.02	DELETED	
A3.03	System flow	3.8
A3.04	Reactor water level	4.3
A3.05	DELETED	
A3.06	DELETED	
A3.07	FWRV position	3.8
A3.08	Turbine speed: TDRFPs-Only	3.4
A3.09	Lights and alarms	3.6
A3.10	Pump trips	3.9
A3.11	Reactor feedpump runbacks	4.0

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

A4.01	System flow	3.9
A4.02	Manually start/control an RFP	4.0
A4.03	Feedwater heater/drain controls	3.3
A4.04	System valves	3.4
A4.05	Reactor water level	4.2
A4.06	Feedwater inlet temperature	3.4
A4.07	Pump discharge pressure	3.5
A4.08	FWRV position	3.8

System: **204000 SF2 RWCU Reactor Water Cleanup System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor water cleanup system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.3
K1.02	Recirculation system	3.3
K1.03	Feedwater system	3.2
K1.04	Component cooling water system	3.2
K1.05	Instrument air systems	2.8
K1.06	Condensate system	2.4
K1.07	Radwaste	2.5
K1.08	SLC	3.6
K1.09	DELETED	
K1.10	DELETED	
K1.11	PCIS/NSSSS	3.8
K1.12	DELETED	
K1.13	RHR system	2.6
K1.14	DELETED	
K1.15	DELETED	
K1.16	Control rod drive hydraulic system	2.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	2.9
K2.02	Motor operated valves	3.0
K3	**Knowledge of the effect that a loss or malfunction of the reactor water cleanup system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water quality	3.5
K3.02	Reactor water level	3.2
K3.03	Component cooling water systems	2.7
K3.04	Heat balance	3.5
K3.05	Area temperature	3.0
K3.06	Area radiation levels	3.0
K3.07	Drywell temperature	2.7
K3.08	Drywell pressure	2.7

K4	**Knowledge of reactor water cleanup system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Pump protection	2.9
K4.02	Piping over-pressurization protection	2.9
K4.03	Over temperature protection for system components	3.0
K4.04	System isolation	3.9
K4.05	DELETED	
K4.06	Maximize plant efficiency (use of regenerative heat exchanger)	2.8
K4.07	Draining of reactor water	3.5
K4.08	DELETED	
K4.09	Leak detection	3.4
K4.10	Decay heat removal	2.9
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor water cleanup system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	
K5.07	Conductivity monitoring	3.2
K5.08	System temperatures	3.0
K5.09	System flow	3.1
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor water cleanup system:** (CFR: 41.7 / 45.7)	
K6.01	Component cooling water systems	3.3
K6.02	Main condenser	2.6
K6.03	Radwaste	2.4
K6.04	Instrument air systems	2.9
K6.05	DELETED	
K6.06	Feedwater system	2.7
K6.07	SLC logic	3.7
K6.08	PCIS/NSSSS	3.8
K6.09	Control rod drive hydraulics system	2.5

A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor water cleanup system including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor water level	3.4	
A1.02	Component cooling water temperature	3.0	
A1.03	Reactor water temperature	3.0	
A1.04	System flow	3.2	
A1.05	System pressure	2.9	
A1.06	System temperature	3.0	
A1.07	RWCU drain flow	3.1	
A1.08	Main condenser hotwell level	2.4	
A1.09	Reactor water conductivity	3.3	
A1.10	Lights and alarms	3.0	

A2	**Ability to (a) predict the impacts of the following on the reactor water cleanup 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 / 45.6)	**RO**	**SRO**
A2.01	Loss of component cooling water	3.4	3.2
A2.02	Pressure control valve failure	3.2	3.0
A2.03	Flow control valve failure	3.2	3.0
A2.04	Pump trips	3.2	3.1
A2.05	Abnormal valve position	3.2	3.0
A2.06	Loss of AC electrical distribution	3.1	3.1
A2.07	Loss of instrument air systems	2.9	2.9
A2.08	RWCU pump seal failure	3.2	3.0
A2.09	Loss of room coolers	2.8	2.3
A2.10	DELETED		
A2.11	Abnormal system flow	3.2	3.1
A2.12	DELETED		
A2.13	System isolation	3.5	3.9
A2.14	System high temperature	3.3	3.4
A2.15	Cleanup demineralizer high differential pressure	2.8	2.9
A2.16	Abnormal reactor water chemistry	3.2	3.3

A3	**Ability to monitor automatic features of the reactor water cleanup system including:** (CFR: 41.7 / 45.7)	
A3.01	System pressure control for low pressure piping	2.9
A3.02	DELETED	
A3.03	System isolations	4.0
A3.04	System interlocks and trips	3.8

A3.05	DELETED	
A3.06	DELETED	
A3.07	System flow	3.2

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	System pumps	3.3
A4.02	Valve controllers	3.3
A4.03	DELETED	
A4.04	Heat exchanger temperature	3.1
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	Motor operated valves	3.3

System: 259002 SF2 RWLCS Reactor Water Level Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor water level control system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RPS	3.9
K1.02	Main and reheat steam system	2.9
K1.03	Reactor water level	4.2
K1.04	Reactor feedwater flow	3.9
K1.05	Feedwater system	3.9
K1.06	DELETED	
K1.07	Rod worth minimizer	2.8
K1.08	DELETED	
K1.09	DELETED	
K1.10	Emergency generator(s): FWCI	2.9
K1.11	DELETED	
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	DELETED	
K1.16	ECCS	3.5
K1.17	RWCU	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor water level control system	3.3
K2.02	Feedwater coolant injection (FWCI) initiation logic	3.4
K2.03	Feedwater controllers	3.1
K3	**Knowledge of the effect that a loss or malfunction of the reactor water level control system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4 to 45.8)	
K3.01	Reactor water level	4.3
K3.02	Feedwater system	4.0
K3.03	Rod worth minimizer	2.7
K3.04	Recirculation system	3.3
K3.05	Recirculation flow control system	3.3
K3.06	Main turbine generator and auxiliaries	2.9

K3.07	DELETED	
K3.08	Main and reheat steam system	2.7
K3.09	Condensate system	3.0

K4 **Knowledge of reactor water level control system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	DELETED	
K4.02	Bypassing of the RWM	3.0
K4.03	Reactor feedpump runout protection	3.2
K4.04	Reactor water level setpoint setdown after a reactor SCRAM	3.5
K4.05	P sat/T sat (compensation)	2.7
K4.06	Control signal failure	3.2
K4.07	TDRFP 20% power interlock	3.0
K4.08	TDRFP speed control	3.2
K4.09	Single element control (reactor water level provides the only input)	3.5
K4.10	Three element control (main steam flow, reactor feedwater flow and reactor water level provide input)	3.6
K4.11	DP control	2.7
K4.12	Manual and automatic control of the system	3.9
K4.13	FWRV lockup	3.7
K4.14	Selection of various instruments to provide reactor water level input	3.8
K4.15	Automatic initiation of the feedwater system upon receipt of an ECCS initiation signal: FWCI	3.8
K4.16	Dedication of feedwater string(s) to ECCS: FWCI	3.4
K4.17	Simultaneous manual and auto operation of the system (i.e., 1 FP in auto, 1 FP in manual)	3.5
K4.18	Reactor level control at low power	3.8

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor water level control system:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	Controller operation	3.8
K5.03	Water level measurement	3.7
K5.04	Moisture carryover/carryunder	3.1
K5.05	DELETED	
K5.06	Pump runout	3.2
K5.07	Turbine speed control mechanisms: TDRFP	3.3
K5.08	DELETED	

K5.09	DELETED		
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor water level control system:** (CFR: 41.7 / 45.7)		
K6.01	Instrument air systems	3.3	
K6.02	AC power	3.3	
K6.03	Main steam flow input	3.7	
K6.04	Reactor feedwater flow input	3.7	
K6.05	Reactor water level input	3.8	
K6.06	Reactor pressure/temperature input (for water level input compensation)	2.9	
K6.07	High drywell pressure	2.9	
K6.08	Loss of dP across startup level control bypass valve	2.7	
A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor water level control system including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor water level	4.3	
A1.02	Reactor feedwater flow	4.0	
A1.03	Reactor power	4.0	
A1.04	Reactor water level control controller indications	3.9	
A1.05	FWRV/startup level control position	3.6	
A1.06	Feedwater string(s) selected for FWCI	3.5	
A1.07	TDRFP speed	3.3	
A1.08	Main steam flow	3.6	
A1.09	Lights and alarms	3.5	
A2	**Ability to (a) predict the impacts of the following on the reactor water 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 / 45.6)	**RO**	**SRO**
A2.01	Loss of any number of main steam flow inputs	3.8	3.5
A2.02	Loss of any number of reactor feedwater flow inputs	3.8	3.6
A2.03	Loss of reactor water level input	3.8	3.9
A2.04	RFP runout condition	3.4	3.0
A2.05	Loss of applicable plant air systems	3.3	3.2
A2.06	Loss of controller signal output	3.6	3.3
A2.07	Loss of comparator bias signal	3.0	2.7

A2.08	Receipt of an ECCS initiation signal: FWCI	4.0	3.7
A2.09	FWCI system failure alarm	3.3	3.6

A3 **Ability to monitor automatic features of the reactor water level control system including:**
(CFR: 41.7 / 45.7)

A3.01	Runout flow control	3.1
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	Reactor water level setpoint setdown following a reactor SCRAM	3.6
A3.07	FWRV lockup	3.5
A3.08	FWCI system initiation	3.7
A3.09	Transfer of system from flow control to level control mode: FWCI	3.6
A3.10	TDRFP lockup	3.1
A3.11	Automatic selection of feedflow/steam flow/level channel input	3.2
A3.12	Transfer from three element to one element	3.4

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

A4.01	All individual component controllers	3.9
A4.02	DELETED	
A4.03	All individual component controllers when transferring from manual to automatic modes	3.9
A4.04	FWRV lockup reset controls	3.7
A4.05	Runout flow control reset controls	3.4
A4.06	DP/single/three-element control selector switch	3.4
A4.07	All individual component controllers when transferring from automatic to manual mode	3.8
A4.08	Manually initiate FWCI	3.5
A4.09	TDRFP lockout reset	3.2
A4.10	Setpoint setdown reset controls	3.1
A4.11	High level lockout reset controls	3.4
A4.12	Instrument bypass switches	3.0

System: **203000 SF2 RHR/LPCI: Injection Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the RHR/LPCI: injection mode and the following systems:** (CFR: 41.2 to 41.9 / 43.5 / 45.7 to 45.8)	
K1.01	Condensate system	2.3
K1.02	Primary containment	3.5
K1.03	DELETED	
K1.04	DELETED	
K1.05	Recirculation system: BWR-3,4	3.7
K1.06	ADS	4.1
K1.07	DELETED	
K1.08	DELETED	
K1.09	Emergency generators	4.0
K1.10	Plant ventilation systems	2.5
K1.11	Nuclear boiler instrumentation	3.7
K1.12	Instrument air system	2.4
K1.13	DELETED	
K1.14	Shutdown cooling system	3.6
K1.15	Reactor building drain system	2.0
K1.16	Component cooling water systems	2.7
K1.17	DELETED	
K1.18	Reactor vessel	3.8
K1.19	Low pressure core spray system	3.5
K1.20	Service water	3.1
K1.21	Remote shutdown system	3.4
K1.22	Spent fuel pool cooling	2.9
K1.23	Primary containment isolation system	3.6
K1.24	Leak detection system	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.1
K2.02	Valves	3.7
K2.03	Initiation logic	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RHR/LPCI: injection mode will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.2

K3.02	Suppression pool level	3.4
K3.03	Automatic depressurization logic	4.0
K3.04	Adequate core cooling	4.3
K3.05	Drywell pressure	3.3
K3.06	Reactor pressure	3.5
K3.07	Primary containment	3.5

K4 **Knowledge of RHR/LPCI: injection mode design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Automatic system initiation/injection	4.4
K4.02	DELETED	
K4.03	Pump minimum flow protection	3.2
K4.04	Pump seal cooler	2.7
K4.05	Prevention of water hammer (keep fill)	3.4
K4.06	No-suction path pump trip	3.5
K4.07	Emergency generator load sequencing	3.8
K4.08	Pump operability testing	3.0
K4.09	Surveillance for all operable components	2.9
K4.10	Dedicated injection system during automatic system initiation (injection valve interlocks)	3.7
K4.11	Loop selection logic	3.4
K4.12	System redundancy	3.5
K4.13	The prevention of leakage to the environment through LPCI/RHR heat exchanger	3.0
K4.14	Operation from remote shutdown panel	3.6
K4.15	Pump runout protection	3.0
K4.16	Manual system initiation	4.1
K4.17	Testable check valve operation	2.6

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the RHR/LPCI: injection mode:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	Core cooling methods	4.2
K5.03	Vortex limits	3.3
K5.04	NPSH limits	3.4

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the RHR/LPCI: injection mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power	3.9
K6.02	DC electrical power	3.8
K6.03	Emergency generator	4.0
K6.04	Keep fill	3.2
K6.05	Condensate system	2.3
K6.06	Suppression pool water level	3.4
K6.07	Plant air systems	2.4
K6.08	ECCS room cooling	3.1
K6.09	Nuclear boiler instrumentation	3.5
K6.10	Component cooling water systems	2.8
K6.11	ADS	4.1
K6.12	ECCS room integrity	3.0
K6.13	High suppression pool temperature	3.5
K6.14	High drywell pressure	3.7
K6.15	Low reactor water level	4.0
K6.16	Service water system	3.0
K6.17	Suppression pool suction strainer clogging	3.4

A1	**Ability to predict or monitor changes in parameters associated with operation of the RHR/LPCI: injection mode including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4.4
A1.02	Reactor pressure	4.0
A1.03	System flow	4.0
A1.04	System pressure	3.8
A1.05	Suppression pool level	3.6
A1.06	Condensate storage tank level	2.5
A1.07	Motor amps	2.7
A1.08	Emergency generator loading	3.7
A1.09	Component cooling water systems	2.8
A1.10	Lights and alarms	3.5
A1.11	Suppression pool temperature	3.5

A2	**Ability to (a) predict the impacts of the following on the RHR/LPCI: injection mode 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	Inadequate net positive suction head	3.9	3.6
A2.02	Pump trips	4.0	3.9
A2.03	Valve closures	3.7	3.8
A2.04	AC failures	3.9	3.8
A2.05	DC failures	3.6	3.7
A2.06	Emergency generator failure	3.9	3.9
A2.07	Pump seal failure	3.1	2.9
A2.08	Inadequate room cooling	2.9	3.0
A2.09	Inadequate system flow	3.6	3.5
A2.10	Nuclear boiler instrument failure	3.4	3.5
A2.11	Motor operated valve failures	3.7	3.6
A2.12	Pump runout	3.7	3.1
A2.13	Valve openings	3.6	3.3
A2.14	Initiation logic failure	3.9	4.0
A2.15	Loop selection logic failure	4.3	3.9
A2.16	Loss of coolant accident	4.4	4.4
A2.17	Keep fill system failure	3.6	3.1
A2.18	High suppression pool temperature	3.6	3.4
A2.19	Low suppression pool level	3.7	3.5
A2.20	Surveillance acceptance criteria not being met	3.0	3.3

A3	**Ability to monitor automatic features of the RHR/LPCI: injection mode including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4.0
A3.02	Pump start	4.1
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Loop selection	4.1
A3.08	System initiation sequence	4.0
A3.09	DELETED	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Pumps	4.2
A4.02	System valves	4.2

A4.03	Keep fill system	3.1
A4.04	DELETED	
A4.05	Manual initiation controls	4.3
A4.06	System reset following automatic initiation	3.6
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	Testable check valves	2.6
A4.15	Room coolers	2.9

System: 218000 SF3 ADS Automatic Depressurization System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the automatic depressurization system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RHR/LPCI system	4.3
K1.02	LPCS system	4.2
K1.03	Nuclear boiler instrumentation	3.9
K1.04	DELETED	
K1.05	DELETED	
K1.06	Safety/relief valves	4.3
K1.07	Reactor vessel and internals	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	ADS logic	4.0
K3	**Knowledge of the effect that a loss or malfunction of the automatic depressurization system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.1
K3.02	Reactor pressure	4.3
K4	**Knowledge of automatic depressurization system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of an inadvertent initiation of ADS logic	4.0
K4.02	Allow manual initiation of ADS logic	4.1
K4.03	ADS logic control	4.2
K4.04	Ensure adequate pneumatic supply to ADS valves	3.8
K4.05	Inhibiting automatic initiation of ADS logic	4.2
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the automatic depressurization system:** (CFR: 41.5 / 45.3)	
K5.01	ADS logic operation	4.3

K5.02	Primary containment/drywell pressure	3.7	
K5.03	Reactor pressure	4.1	
K5.04	Suppression pool temperature	3.8	
K5.05	Suppression pool level	3.7	
K5.06	Reactor water level	4.0	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the automatic depressurization system:** (CFR: 41.7 / 45.7)		
K6.01	RHR/LPCI pump running permissive	4.2	
K6.02	Low pressure core spray pump running permissive	4.2	
K6.03	Reactor water level instrumentation	4.1	
K6.04	Pneumatic supply to ADS valves	3.7	
K6.05	AC power	3.5	
K6.06	DC power	4.0	
K6.07	Primary containment/drywell pressure instrumentation	3.7	
A1	**Ability to predict or monitor changes in parameters associated with operation of the automatic depressurization system including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	ADS valve position indications	4.0	
A1.03	ADS valve pneumatic supply pressure	3.5	
A1.04	Reactor pressure	4.2	
A1.05	Reactor water level	4.0	
A1.06	Suppression pool temperature	3.7	
A1.07	Suppression pool level	3.4	
A1.08	Primary containment/drywell pressure	3.7	
A1.09	Lights and alarms	3.8	
A2	**Ability to (a) predict the impacts of the following on the automatic depressurization 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 / 45.6)	**RO**	**SRO**
A2.01	Steam line break	3.6	3.2
A2.02	Loss of coolant accident	4.2	4.1
A2.03	Loss of pneumatic supply to ADS valves	3.9	3.8
A2.04	ADS failure to initiate	4.4	4.2

A2.05	Loss of electrical power to ADS	4.2	4.0
A2.06	ADS initiation signals present	4.5	4.3

A3 **Ability to monitor automatic features of the automatic depressurization system including:**
(CFR: 41.7 / 45.7)

A3.01	ADS valves	4.1
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	DELETED	
A3.10	ADS logic	4.1

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

A4.01	ADS valves	4.5
A4.02	ADS logic initiation	4.2
A4.03	ADS logic reset	3.9
A4.04	ADS inhibit	4.4
A4.05	ADS timer reset	4.0
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	

System: **239001 SF3 M&RSS Main and Reheat Steam System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the main and reheat steam system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.5
K1.02	Plant process computer/parameter display systems	2.6
K1.03	Main turbine generator and auxiliary systems	3.6
K1.04	DELETED	
K1.05	DELETED	
K1.06	Reactor/turbine pressure regulating system	4.0
K1.07	Offgas system	3.2
K1.08	DELETED	
K1.09	DELETED	
K1.10	Extraction steam system	3.2
K1.11	DELETED	
K1.12	Instrument air systems	3.0
K1.13	Main steam isolation valve leakage control system	3.0
K1.14	DELETED	
K1.15	DELETED	
K1.16	Radiation monitoring system	3.0
K1.17	Primary containment system and auxiliaries	3.2
K1.18	High pressure coolant injection system	3.3
K1.19	Reactor core isolation cooling system	3.4
K1.20	Residual heat removal system	2.7
K1.21	Isolation condenser system	3.6
K1.22	Feedwater system	3.3
K1.23	Reactor water level control system	3.7
K1.24	DELETED	
K1.25	DELETED	
K1.26	Safety relief valves	4.0
K1.27	Reactor protection system	4.1
K1.28	PCIS/NSSSS	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Main steam isolation valve solenoids	3.6
K2.02	Main steam line shutoff valves	3.3

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 / 45.4)	
K3.01	Main turbine generator and auxiliary systems	3.5
K3.02	Condenser vacuum	3.5
K3.03	Feedwater system	3.5
K3.04	Offgas system	3.1
K3.05	DELETED	
K3.06	Reactor/turbine pressure regulating system	3.7
K3.07	Primary containment system and auxiliaries	3.2
K3.08	DELETED	
K3.09	DELETED	
K3.10	High pressure coolant injection system	3.3
K3.11	Reactor core isolation cooling system	3.5
K3.12	Isolation condenser	3.7
K3.13	DELETED	
K3.14	Residual heat removal system	2.7
K3.15	Reactor water level	3.7
K3.16	Safety relief valves	3.9
K3.17	Reactor vessel and internals	3.2
K4	**Knowledge of main and reheat steam system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Steam line isolation	4.3
K4.02	Automatic isolation and opening of drain valves	3.3
K4.03	Ensures that steam released from a steam line break will not bypass suppression pool; BWR-6	3.7
K4.04	Limits steam flow during a steam line rupture	3.5
K4.05	Steam flow measurement	3.4
K4.06	Allows for removal or prevents escape of radioactive steam from systems that have leaky MSIVs	3.1
K4.07	Over pressure control	4.1
K4.08	Removal of noncondensable gases from reactor head area	2.6
K4.09	Equalization of pressure across the MSIVs before opening	3.2
K4.10	Moisture removal from steam lines prior to admitting steam	3.0
K4.11	Positive sealing of the MSIVs when shutdown	2.9
K4.12	MSIV testing	3.0
K4.13	Backup pneumatic source for MSIV closure	3.1

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the main and reheat steam system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Steam blanketing of the moisture separator reheater	2.0
K5.05	DELETED	
K5.06	Inadvertent MSIV operation	3.5
K5.07	DELETED	
K5.08	DELETED	
K5.09	Decay heat removal	3.5
K5.10	Steam bypass capability	3.8
K5.11	Non condensable gases in the reactor head area	2.5
K5.12	MSR heat up limitations	2.9
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	Electrical power	3.3
K6.02	Plant pneumatic systems	3.4
K6.03	Safety relief valves	3.9
K6.04	DELETED	
K6.05	Steam line leak	4.0
K6.06	MSIV isolation signal	4.3
K6.07	MSIV leakage control	2.9
K6.08	Main condenser vacuum	3.5
K6.09	PCIS/NSSSS	3.9
K6.10	DELETED	
K6.11	Moisture separator/reheaters	2.9
K6.12	Main turbine trip	3.6
K6.13	Reactor/turbine pressure regulating system	3.8
A1	**Ability to predict or monitor changes in parameters associated with operation of the main and reheat steam system including:** (CFR: 41.5 / 45.5)	
A1.01	Main steam pressure	3.8
A1.02	Main steam temperature	2.6
A1.03	Reheat steam pressure	2.7
A1.04	Reheater temperature	2.4
A1.05	Main steam line radiation	3.3
A1.06	Offgas process radiation	3.3

A1.07	Reactor water level	4.0	
A1.08	Reactor pressure	4.2	
A1.09	Main steam flow	3.7	
A1.10	Reactor power	4.1	
A1.11	Lights and alarms	3.3	

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 / 45.6)

		RO	**SRO**
A2.01	Malfunction of reactor turbine pressure regulating system	4.3	4.0
A2.02	Change in steam demand and its effect on reactor pressure and power	4.2	4.0
A2.03	MSIV closure	4.3	3.9
A2.04	Main steam line low pressure	4.2	3.7
A2.05	Main steam line high radiation	3.6	3.6
A2.06	Turbine trip without bypass valves	4.4	4.0
A2.07	Main steam area high temperature	3.9	3.8
A2.08	Low condenser vacuum	4.0	3.6
A2.09	DELETED		
A2.10	Closure of one or more MSIVs at power	4.2	3.7
A2.11	Steam line break	4.3	4.1
A2.12	PCIS/NSSSS actuation	3.9	4.2
A2.13	High reactor water level	4.1	3.6
A2.14	DELETED		

A3 **Ability to monitor automatic features of the main and reheat steam system including:**
(CFR: 41.7 / 45.7)

A3.01	Isolation of main steam system	4.2
A3.02	Opening and closing of drain valves as turbine load changes	2.6
A3.03	Moisture separator reheat steam supply	2.8
A3.04	Isolation of moisture separator reheater	3.0
A3.05	MSR drain tank level control	2.9

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

A4.01	MSIVs	4.4
A4.02	Main steam line drain valves	3.4
A4.03	DELETED	

A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	MSR steam admission valves	2.8

System: 241000 SF3 R/TPRS Reactor/Turbine Pressure Regulating System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor/turbine pressure regulating system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	DELETED	
K1.03	DELETED	
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	DELETED	
K1.08	DELETED	
K1.09	DELETED	
K1.10	DELETED	
K1.11	RPS	4.1
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	DELETED	
K1.16	Component cooling water systems	2.6
K1.17	DELETED	
K1.18	DELETED	
K1.19	DELETED	
K1.20	DELETED	
K1.21	DELETED	
K1.22	DELETED	
K1.23	Recirculation flow control system	3.2
K1.24	Main turbine generator and auxiliary systems	3.3
K1.25	DELETED	
K1.26	DELETED	
K1.27	DELETED	
K1.28	DELETED	
K1.29	DELETED	
K1.30	DELETED	
K1.31	DELETED	
K1.32	DELETED	
K1.33	DELETED	
K1.34	DELETED	
K1.35	DELETED	
K1.36	DELETED	

K1.37	DELETED	
K1.38	PCIS/NSSSS	3.4
K1.39	Main and reheat steam system	3.3
K1.40	Nuclear boiler instrumentation system	3.3

K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	2.9
K2.02	Controls	2.9

K3	**Knowledge of the effect that a loss or malfunction of the reactor/turbine pressure regulating system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor power	4.5
K3.02	Reactor pressure	4.5
K3.03	Reactor water level	3.9
K3.04	Reactor steam flow	3.9
K3.05	Main turbine steam flow	3.8
K3.06	DELETED	
K3.07	DELETED	
K3.08	DELETED	
K3.09	DELETED	
K3.10	DELETED	
K3.11	RPS	4.1
K3.12	DELETED	
K3.13	DELETED	
K3.14	Component cooling water systems	2.3
K3.15	DELETED	
K3.16	DELETED	
K3.17	Turbine acceleration	2.9
K3.18	Turbine speed	3.0
K3.19	Turbine inlet pressure	3.2
K3.20	DELETED	
K3.21	Recirculation flow control system	3.1
K3.22	Main turbine generator and auxiliary systems	3.1
K3.23	DELETED	
K3.24	Reactor heatup rate	3.8
K3.25	Reactor cooldown rate	3.9
K3.26	DELETED	
K3.27	DELETED	
K3.28	DELETED	

K3.29	PCIS/NSSSS	3.5
K3.30	DELETED	
K3.31	Main and reheat steam system	3.2

K4 **Knowledge of reactor/turbine pressure regulating system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Reactor pressure control	4.3
K4.02	Turbine inlet pressure control	3.5
K4.03	Turbine speed control	3.2
K4.04	Turbine acceleration control	3.1
K4.05	Reactor SCRAM	4.4
K4.06	Turbine trip	4.2
K4.07	Generator runback	3.9
K4.08	Feedwater heater isolation	3.2
K4.09	Turbine chest warming	2.8
K4.10	Turbine shell warming	2.8
K4.11	Load following	2.5
K4.12	Recirculation flow control	3.1
K4.13	Turbine trip testing	2.9
K4.14	DELETED	
K4.15	Automatic pump start	3.0
K4.16	Reactor cooldown	3.7
K4.17	DELETED	
K4.18	Turbine protection	3.6
K4.19	Main turbine bypass valve control	4.0

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor/turbine pressure regulating system:**
(CFR: 41.5 / 45.3)

K5.01	Accumulator operation	2.6
K5.02	DELETED	
K5.03	Reactor power vs. reactor pressure	4.2
K5.04	Turbine inlet pressure vs. reactor pressure	3.6
K5.05	Turbine inlet pressure vs. turbine load	3.3
K5.06	Turbine speed measurement	2.6
K5.07	DELETED	
K5.08	Valve position control	3.3

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor/turbine pressure regulating system:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power	3.4
K6.02	DC electrical power	3.2
K6.03	Component cooling water systems	2.6
K6.04	Recirculation flow control system	3.1
K6.05	Condenser vacuum	3.5
K6.06	Reactor pressure	4.0
K6.07	Turbine inlet pressure	3.3
K6.08	Reactor power	4.0
K6.09	Main turbine steam flow	3.4
K6.10	Bypass valves	4.0
K6.11	Main stop valves	3.7
K6.12	Control/governor valves	3.7
K6.13	Combined intermediate valves	3.3
K6.14	Bearing oil	3.0
K6.15	Turbine speed signal	3.0
K6.16	Stator water cooling system	3.2
K6.17	Main turbine PMG	2.8
K6.18	Low pressure stop and control valves	3.0
K6.19	DELETED	
K6.20	Main turbine generator and auxiliary systems	3.0
K6.21	Front standard trip system	3.4
K6.22	Turbine chest warming	2.7
K6.23	Turbine shell warming	2.7
K6.24	Turbine trip	3.9
K6.25	Reactor startup	3.8
A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor/turbine pressure regulating system including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor pressure	4.4
A1.02	Reactor power	4.4
A1.03	Reactor water level	3.8
A1.04	Main turbine inlet pressure	3.3
A1.05	Reactor steam flow	3.7
A1.06	Main turbine steam flow	3.5
A1.07	Main turbine bypass valve position	4.0
A1.08	Control/governor valve position	3.4
A1.09	Main stop valve position	3.4

A1.10	Combined intermediate valve position	3.2
A1.11	Hydraulic oil pressure	3.2
A1.12	Reactor/turbine pressure regulating system load set/reference	3.5
A1.13	Main turbine speed	3.0
A1.14	Pressure setpoint/pressure demand	3.7
A1.15	Maximum combined flow limit	3.3
A1.16	Load limit set	3.4
A1.17	Hydraulic oil pump current	2.1
A1.18	Hydraulic reservoir oil level	2.5
A1.19	Hydraulic reservoir oil temperature	2.4
A1.20	Servo valve position	2.5
A1.21	Main condenser vacuum	3.7
A1.22	Reactor cooldown	3.8
A1.23	Main turbine vibration	3.4
A1.24	Main turbine eccentricity	2.6
A1.25	Main turbine expansion	2.6
A1.26	Governor valve limit	2.6
A1.27	Lights and alarms	3.3
A1.28	Main generator output	3.4
A1.29	MSR cross-around pressure	2.7

A2 **Ability to (a) predict the impacts of the following on the reactor/turbine pressure regulating 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 / 45.6)

		RO	**SRO**
A2.01	Loss of turbine inlet pressure signal	3.3	3.4
A2.02	High reactor pressure	4.4	4.1
A2.03	Abnormal main turbine bypass valve position	4.0	3.9
A2.04	Abnormal control/governor valve position	3.8	3.7
A2.05	Abnormal main stop valve position	3.9	3.5
A2.06	Low hydraulic oil pressure	3.7	3.3
A2.07	Loss of condenser vacuum	4.3	3.8
A2.08	Main turbine overspeed	4.0	3.5
A2.09	Loss of generator load	4.2	3.6
A2.10	Loss of stator water cooling	4.0	3.6
A2.11	Loss of AC electrical power	3.5	3.3
A2.12	Loss of DC electrical power	3.6	3.2
A2.13	Loss of component cooling water systems	3.1	2.7
A2.14	Loss of main turbine PMG	3.1	2.7
A2.15	Loss of main turbine speed feedback	2.8	2.8
A2.16	Loss of steam pressure signal	3.7	3.3
A2.17	Turbine trip	4.3	4.0

A2.18	Generator trip	4.3	4.0
A2.19	Reactor SCRAM	4.4	4.2
A2.20	Abnormal reservoir oil level	3.4	2.8
A2.21	Hydraulic pump trip	3.4	3.2
A2.22	Turbine high vibration	3.8	3.4
A2.23	Turbine high eccentricity	2.8	2.7
A2.24	Turbine high differential expansion	2.8	2.5
A2.25	DELETED		

A3 **Ability to monitor automatic features of the reactor/turbine pressure regulating system including:**
(CFR: 41.7 / 45.7)

A3.01	Turbine speed control	3.2
A3.02	Turbine acceleration control	3.0
A3.03	Turbine inlet pressure control	3.2
A3.04	Hydraulic pump start	3.0
A3.05	Low hydraulic pressure turbine trip	3.4
A3.06	Low hydraulic pressure reactor SCRAM	3.7
A3.07	Hydraulic reservoir oil temperature control	2.6
A3.08	Main turbine bypass valve operation	4.0
A3.09	Control/governor valve operation	3.7
A3.10	Main stop valve operation	3.4
A3.11	Combined intermediate valve operation	3.3
A3.12	DELETED	
A3.13	FW heater isolation	3.3
A3.14	DELETED	
A3.15	Recirculation pump trip	3.6
A3.16	DELETED	
A3.17	Turbine runback	4.0
A3.18	Turbine startup	3.5
A3.19	Shell/chest warming	3.0
A3.20	Reactor cool down	3.8

A4 **Ability to manually operate 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	Bypass valves	4.2
A4.07	Main stop valves	3.6

A4.08	Control/governor valves	3.6
A4.09	Combined intermediate valves	3.4
A4.10	Hydraulic pumps	3.3
A4.11	Turbine speed	3.3
A4.12	Turbine acceleration	3.0
A4.13	DELETED	
A4.14	Turbine trip	4.1
A4.15	Generator load	3.7
A4.16	DELETED	
A4.17	Turbine chest warming	2.9
A4.18	Turbine shell warming	2.9
A4.19	Turbine panel controls	3.4
A4.20	Turbine trip testing	3.2

System: **239002 SF3 SRV Safety Relief Valves**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the safety relief valves and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.6
K1.02	Plant process computer/parameter display systems	3.0
K1.03	Nuclear boiler instrument system	3.6
K1.04	Main steam system	3.8
K1.05	Instrument air systems	3.1
K1.06	Drywell instrument air/drywell pneumatics	3.6
K1.07	Suppression pool	4.1
K1.08	Automatic depressurization system	4.5
K1.09	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	SRV solenoids	3.7
K3	**Knowledge of the effect that a loss or malfunction of the safety relief valves will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor pressure control	4.3
K3.02	Reactor over pressurization	4.4
K3.03	DELETED	
K3.04	Automatic depressurization system	4.5
K3.05	Suppression pool	3.9
K4	**Knowledge of safety relief valves design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Ensures that only one or two safety/relief valves reopen following the initial portion of a reactor isolation event (LLS logic)	3.7
K4.02	Minimizes containment fatigue duty cycles resulting from relief valve cycling during decay-heat-dominant period late in an isolation transient (LLS logic)	3.3
K4.03	Prevents siphoning of water into SRV discharge piping and limits loads on subsequent actuation of SRVs	3.5
K4.04	Ensures even distribution of heat load to suppression pool, and adequate steam condensing	3.5

K4.05	Allows for SRV operation from more than one location	3.7
K4.06	Detection of valve leakage	3.5
K4.07	Minimum steam pressure required to keep SRV open or to open SRV	3.6
K4.08	Opening of the SRV from either an electrical or mechanical signal	3.9
K4.09	Manual opening of the SRV	4.0
K4.10	Methods for determining position of SRV	4.1

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the safety relief valves:**
(CFR: 41.5 / 45.3)

K5.01	Relief function of SRV operation	4.0
K5.02	Safety function of SRV operation	4.0
K5.03	Acoustical monitoring	3.2
K5.04	Tail pipe temperature monitoring	3.6
K5.05	Discharge line quencher operation	3.2
K5.06	Vacuum breaker operation	3.3
K5.07	Rapid depressurization of the reactor	4.2

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the safety relief valves:**
(CFR: 41.7 / 45.5 to 45.8)

K6.01	Nuclear boiler instrument system (pressure indication)	3.8
K6.02	Pneumatics supply	3.8
K6.03	AC power	3.2
K6.04	DC power	3.9
K6.05	Discharge line vacuum breaker	3.4

A1 **Ability to predict or monitor changes in parameters associated with operation of the safety relief valves including:**
(CFR: 41.5 / 45.5)

A1.01	Tail pipe temperature	3.8
A1.02	Acoustical monitor noise	3.2
A1.03	Pneumatic supply	3.5
A1.04	Reactor pressure	4.3
A1.05	Reactor water level	4.2
A1.06	Reactor power	4.1
A1.07	Turbine load	3.4
A1.08	Suppression pool water temperature	4.0
A1.09	Indicated vs. actual steam flow	3.5

A1.10	Drywell pressure	3.6	
A1.11	Lights and alarms	3.7	

A2 **Ability to (a) predict the impacts of the following on the safety relief valves 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	Stuck open vacuum breakers	3.7	3.6
A2.02	Leaking SRV	3.7	3.6
A2.03	Stuck open SRV	4.6	4.4
A2.04	ADS actuation	4.6	4.5
A2.05	Low reactor pressure	3.9	3.5
A2.06	Reactor high pressure	4.6	4.2

A3 **Ability to monitor automatic features of the safety relief valves including:**
(CFR: 41.7 / 45.7)

A3.01	SRV operation after ADS actuation	4.1
A3.02	SRV operation on high reactor pressure	4.2
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	Low low set logic	3.8

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

A4.01	SRVs	4.4
A4.02	DELETED	
A4.03	DELETED	
A4.04	Suppression pool temperature	4.2
A4.05	Reactor pressure	4.4
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	

System: **206000 SF4 HPCIS High Pressure Coolant Injection System: BWR 2,3,4**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the high pressure coolant injection system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.5
K1.02	DELETED	
K1.03	DELETED	
K1.04	Feedwater system	3.7
K1.05	Condensate system	3.0
K1.06	Primary containment	3.5
K1.07	DELETED	
K1.08	DELETED	
K1.09	DELETED	
K1.10	DELETED	
K1.11	DELETED	
K1.12	Nuclear boiler instrumentation	3.6
K1.13	DELETED	
K1.14	SBGT	2.7
K1.15	Instrument air system	2.6
K1.16	DELETED	
K1.17	Reactor protection system	2.8
K1.18	Main steam system	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	3.7
K2.02	Pumps	3.2
K2.03	Initiation/isolation logic	4.1
K2.04	Turbine control circuits	3.3
K3	**Knowledge of the effect that a loss or malfunction of the high pressure coolant injection system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	Reactor pressure	3.8
K3.03	Suppression pool level	3.4

K3.04	Reactor power	3.6
K3.05	Secondary containment parameters	3.1

K4 **Knowledge of high pressure coolant injection system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Turbine trips	3.8
K4.02	System isolations	4.2
K4.03	Resetting turbine trips	3.8
K4.04	Resetting system isolations	3.9
K4.05	Preventing water hammer in turbine exhaust line (vacuum breakers)	3.4
K4.06	Preventing water hammer in pump discharge line (keep fill)	3.3
K4.07	Automatic system initiation	4.4
K4.08	Manual system initiation	4.3
K4.09	Automatic flow control	3.9
K4.10	DELETED	
K4.11	Turbine speed control	3.7
K4.12	Condensation of shaft sealing steam	2.5
K4.13	Turbine and pump lubrication	3.2
K4.14	Control oil to turbine speed controls	3.1
K4.15	Low speed turning of the turbine rotor	2.5
K4.16	DELETED	
K4.17	DELETED	
K4.18	Pump minimum flow	3.2
K4.19	Automatic transfer of HPCI pump suction	3.7
K4.20	Testable check valve operation	2.3

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the high pressure coolant injection system:**
(CFR: 41.5 / 45.3)

K5.01	Turbine operation	3.5
K5.02	Turbine shaft sealing	2.6
K5.03	Flow control	3.7
K5.04	Indications of pump cavitation	3.2
K5.05	Turbine speed control	3.5
K5.06	Turbine speed measurement	2.7
K5.07	DELETED	
K5.08	DELETED	
K5.09	DELETED	
K5.10	Reactor pressure control	3.9

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the high pressure coolant injection system:** (CFR: 41.7 / 45.7)	
K6.01	Instrument air system	2.6
K6.02	DC electrical distribution system	3.9
K6.03	AC electrical distribution system	3.3
K6.04	Condensate storage tank low level	3.7
K6.05	Suppression pool level	3.7
K6.06	SBGTS	3.0
K6.07	Keep fill system	3.0
K6.08	Low reactor pressure	3.4
K6.09	DELETED	
K6.10	HPCI initiation/isolation logic	4.3
K6.11	Nuclear boiler instrumentation	3.6
K6.12	Reactor water level	4.0
K6.13	High suppression pool temperature	3.6
K6.14	Feedwater system	3.3
K6.15	Low pressure core spray system	2.5
K6.16	High turbine exhaust pressure	3.6
K6.17	High steam flow	3.7
K6.18	Area high temperature	3.9
K6.19	High drywell pressure	4.0
K6.20	Aux oil pump	3.8
K6.21	Component cooling water	3.0
A1	**Ability to predict or monitor changes in parameters associated with operation of the high pressure coolant injection system including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4.3
A1.02	Reactor pressure	4.1
A1.03	Condensate storage tank level	3.5
A1.04	Suppression pool level	3.6
A1.05	Suppression pool temperature	3.8
A1.06	System flow	3.9
A1.07	System discharge pressure	3.8
A1.08	DELETED	
A1.09	Turbine speed	3.5
A1.10	Lights and alarms	3.6
A1.11	Secondary containment parameters	3.1
A1.12	Turbine bearing temperature	3.0

A2	**Ability to (a) predict the impacts of the following on the high pressure coolant injection 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 / 45.6)	**RO**	**SRO**
A2.01	Turbine trips	4.3	4.1
A2.02	DELETED		
A2.03	Abnormal valve positions	4.0	3.7
A2.04	AC electrical distribution system failures	4.0	3.5
A2.05	DC electrical distribution system failures	4.3	3.9
A2.06	Inadequate system flow	4.3	3.6
A2.07	High/low suppression pool level	4.2	3.6
A2.08	High suppression pool temperature	4.3	3.6
A2.09	Low condensate storage tank level	3.8	3.5
A2.10	System isolation	4.7	4.0
A2.11	High/low reactor water level	4.3	4.1
A2.12	Loss of room cooling	3.3	2.8
A2.13	Loss of instrument air system	3.2	2.5
A2.14	Flow controller failure	4.3	3.6
A2.15	Loss of control oil pressure	4.3	3.7
A2.16	High drywell pressure	4.5	3.8
A2.17	Inadvertent initiation	4.3	3.9

A3	**Ability to monitor automatic features of the high pressure coolant injection system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	System initiation	4.4
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	System isolation	4.3
A3.10	Pump suction transfer	3.6
A3.11	Barometric condenser level control	2.5
A3.12	Turbine reset	3.8

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Turbine speed control	4.2

A4.02	Flow controller	4.3
A4.03	DELETED	
A4.04	Valves	3.8
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	Pumps	3.7
A4.11	Turning gear	2.4
A4.12	Turbine trip	4.1
A4.13	Initiation reset	4.0
A4.14	DELETED	
A4.15	Isolation reset	4.0

System: 209002 SF4 HPCS High Pressure Core Spray System (BWR 5,6)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the high pressure core spray system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate system	3.2
K1.02	Primary containment	3.6
K1.03	DELETED	
K1.04	Emergency generators	4.0
K1.05	Standby liquid control system	3.3
K1.06	Suppression pool cleanup system	2.8
K1.07	Plant ventilation systems (HPCS room coolers)	3.1
K1.08	Component cooling water systems	3.1
K1.09	Leak detection	3.2
K1.10	DELETED	
K1.11	DELETED	
K1.12	Reactor vessel and internals	3.7
K1.13	Instrument nitrogen	2.1
K1.14	Instrument air system	2.4
K1.15	Safety related service water	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.2
K2.02	Valves	3.9
K2.03	Initiation logic	4.2
K3	**Knowledge of the effect that a loss or malfunction of the high pressure core spray system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	Standby liquid control system	3.0
K3.03	DELETED	
K3.04	Suppression pool level	3.3
K3.05	Reactor power	3.6
K3.06	Reactor pressure	3.7
K3.07	Secondary containment parameters	2.9
K3.08	Condensate storage tank level	3.2
K3.09	Override of drywell pressure interlock	3.6

K4	**Knowledge of high pressure core spray system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of water hammer (keep fill)	3.5
K4.02	Prevention of over filling reactor vessel	4.0
K4.03	Prevention of pump over heating	3.2
K4.04	Testable check valve operation	2.4
K4.05	DELETED	
K4.06	DELETED	
K4.07	Override of reactor water level interlock	4.0
K4.08	Automatic system initiation	4.4
K4.09	Manual system initiation	4.2
K4.10	Uniform core spray coverage	3.1
K4.11	Prevention of piping over pressurization	3.2
K4.12	Automatic transfer of HPCS pump suction	3.8
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the high pressure core spray system:** (CFR: 41.5 / 45.3)	
K5.01	Indications of pump cavitation	3.5
K5.02	DELETED	
K5.03	DELETED	
K5.04	Adequate core cooling	4.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the high pressure core spray system:** (CFR: 41.7 / 45.7)	
K6.01	Loss of AC electrical distribution	4.2
K6.02	Abnormal condensate storage tank water level	3.6
K6.03	Component cooling water systems	3.1
K6.04	Suppression pool suction strainer	3.4
K6.05	Abnormal suppression pool water Level	3.7
K6.06	Keep fill system	3.3
K6.07	Plant ventilation systems (HPCS room coolers)	3.3
K6.08	Loss of DC electrical distribution	3.8
K6.09	Abnormal reactor water level	4.2
K6.10	High drywell pressure	4.1
K6.11	High suppression pool temperature	3.5

A1	**Ability to predict or monitor changes in parameters associated with operation of the high pressure core spray system including:** (CFR: 41.5 / 45.5)		
A1.01	System flow	4.0	
A1.02	System pressure	3.9	
A1.03	Reactor water level	4.3	
A1.04	Reactor pressure	3.9	
A1.05	Suppression pool level	3.6	
A1.06	DELETED		
A1.07	Diesel loading	3.8	
A1.08	System lineup	3.9	
A1.09	Condensate storage tank level	3.6	
A1.10	Lights and alarms	3.7	
A1.11	Suppression pool temperature	3.3	
A1.12	Reactor power	3.8	

A2	**Ability to (a) predict the impacts of the following on the high pressure core 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 / 45.6)	**RO**	**SRO**
A2.01	System initiation	4.5	4.4
A2.02	Pump trips	4.1	3.9
A2.03	Abnormal valve positions	4.1	3.9
A2.04	Loss of AC electrical distribution	4.1	4.0
A2.05	Loss of DC electrical distribution	4.0	3.9
A2.06	Core spray line break	4.0	3.6
A2.07	Pump seal failure	3.5	3.3
A2.08	Inadequate system flow	4.0	3.8
A2.09	Loss of plant ventilation (HPCS room cooler)	3.1	3.3
A2.10	DELETED		
A2.11	Low suppression pool level	3.8	3.5
A2.12	High suppression pool level	3.4	3.2
A2.13	Low condensate storage tank level	3.4	3.7
A2.14	High suppression pool temperature	3.4	3.4
A2.15	Clogged suppression pool suction strainers	3.8	3.4
A2.16	Emergency diesel generator failure	4.3	3.9
A2.17	Initiation logic failure	4.5	4.2
A2.18	Keep fill system failure	3.6	3.3
A2.19	Abnormal reactor water level	4.1	3.9
A2.20	High drywell pressure	4.3	3.9
A2.21	Inadvertent initiation	4.0	3.4

A3	**Ability to monitor automatic features of the high pressure core spray system including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4.2
A3.02	Pump start	4.1
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Emergency diesel generator operation	4.1
A3.08	Pump trip	4.0
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	HPCS pump	4.3
A4.02	Suction valves	4.0
A4.03	Injection valve	4.3
A4.04	Minimum flow valve	3.8
A4.05	Manual initiation controls	4.3
A4.06	Testable check valve	2.4
A4.07	Keep fill pump	3.2
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	Test return valve	3.3
A4.15	Initiation reset	3.9
A4.16	Emergency diesel generator operation	4.3

System: 207000 SF4 IC Isolation (Emergency) Condenser (BWR- 2/3)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the Isolation (Emergency) Condenser and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.8
K1.02	DELETED	
K1.03	DELETED	
K1.04	Condensate system	2.8
K1.05	Demineralized water system	3.2
K1.06	Fire protection system	3.3
K1.07	DELETED	
K1.08	Recirculation system	3.7
K1.09	Main steam system	3.5
K1.10	Instrument air systems	3.2
K1.11	PCIS/NSSSS	3.7
K1.12	Reactor protection system	3.5
K1.13	Low pressure core spray system	2.7
K1.14	Shutdown cooling system	2.6
K1.15	Primary containment system and auxiliaries	3.2
K1.16	Service water system	2.5
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	3.5
K2.02	Initiation logic	3.7
K3	**Knowledge of the effect that a loss or malfunction of the isolation (emergency) condenser will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor pressure	3.8
K3.02	Reactor water level	3.6
K3.03	Reactor vessel and internals	3.0
K3.04	Recirculation system	3.2

K4	**Knowledge of isolation (emergency) condenser design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	System isolation	4.1
K4.02	Automatic initiation	4.3
K4.03	Filling of the system	3.3
K4.04	DELETED	
K4.05	Leak detection	3.3
K4.06	Throttling of system flow	3.2
K4.07	Manual operation of the system	3.5
K4.08	DELETED	
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the isolation (emergency) condenser:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	Assist core cooling	3.7
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	
K5.07	DELETED	
K5.08	DELETED	
K5.09	Cooldown rate	3.8
K5.10	System venting	3.2
K5.11	Incomplete steam condensation	2.8
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the isolation (emergency) condenser:** (CFR: 41.7 / 45.7)	
K6.01	Demineralized water system	3.2
K6.02	Fire protection system	3.0
K6.03	Condensate system	2.8
K6.04	Instrument air system	3.3
K6.05	PCIS/NSSSS	3.8
K6.06	Recirculation system	3.3
K6.07	AC electrical distribution	3.5
K6.08	DC electrical distribution	3.7
K6.09	Reactor protection system	3.3

K6.10	Low pressure core spray	2.7	
K6.11	Shutdown cooling system	2.8	
K6.12	Service water system	2.7	
K6.13	Main steam system	3.2	

A1 **Ability to predict or monitor changes in parameters associated with operation of the isolation (emergency) condenser including:**
(CFR: 41.5 / 45.5)

A1.01	Isolation condenser level	3.8	
A1.02	Shell side water temperature	3.4	
A1.03	Steam flow	3.2	
A1.04	Condensate flow	3.3	
A1.05	Reactor pressure	4.0	
A1.06	Reactor water level	3.5	
A1.07	Vent radiation level	3.9	
A1.08	Cooldown rate	3.8	
A1.09	DELETED		
A1.10	Primary side temperature	3.4	
A1.11	Lights and alarms	3.7	
A1.12	Steam line pressure	3.5	

A2 **Ability to (a) predict the impacts of the following on the isolation (emergency) condenser 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	Tube bundle leak	4.0	4.1
A2.02	Vent high radiation	4.0	4.1
A2.03	System isolation	4.0	3.9
A2.04	Abnormal system flow	3.3	3.6
A2.05	Insufficient shell side makeup	3.7	3.9
A2.06	Abnormal valve	3.7	3.7
A2.07	DELETED		
A2.08	System initiation	4.0	4.2

A3 **Ability to monitor automatic features of the isolation (emergency) condenser including:**
(CFR: 41.7 / 45.7)

A3.01	Isolation condenser level control	3.9	
A3.02	DELETED		
A3.03	DELETED		
A3.04	DELETED		
A3.05	System initiation	4.3	

A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	System isolation	4.2

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Isolation condenser level control	4.0
A4.02	DELETED	
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	System initiation	4.2
A4.08	System isolation	4.1

System: 209001 SF4 LPCS Low Pressure Core Spray System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the low pressure core spray system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	Primary containment	3.7
K1.03	DELETED	
K1.04	Condensate system	2.6
K1.05	Automatic depressurization system	4.2
K1.06	Instrument air systems	2.4
K1.07	DELETED	
K1.08	DELETED	
K1.09	Nuclear boiler instrumentation	3.6
K1.10	Emergency generators	4.2
K1.11	Drywell coolers	2.4
K1.12	ECCS room coolers	3.1
K1.13	Leak detection	3.2
K1.14	Reactor vessel and internals	3.7
K1.15	Residual heat removal system	3.3
K1.16	High pressure coolant injection system	3.0
K1.17	Standby liquid control	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.2
K2.02	Valves	3.8
K2.03	Initiation logic	4.1
K3	**Knowledge of the effect that a loss or malfunction of the low pressure core spray system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.3
K3.02	ADS logic	4.1
K3.03	Emergency generators	3.6
K3.04	DELETED	
K3.05	Drywell cooling	2.8

K4	**Knowledge of low pressure core spray system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of overpressurization of core spray piping	3.5
K4.02	Prevents water hammer	3.4
K4.03	Motor cooling	2.9
K4.04	Line break detection	3.4
K4.05	Pump minimum flow	3.4
K4.06	Adequate pump net positive suction head	3.4
K4.07	DELETED	
K4.08	Automatic system initiation	4.5
K4.09	Load sequencing	4.0
K4.10	DELETED	
K4.11	Override injection	3.9
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the low pressure core spray system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Abnormal differential pressure indication (leak detection)	3.4
K5.03	Testable check valve operation	2.5
K5.04	Heat removal (transfer) mechanisms	3.2
K5.05	DELETED	
K5.06	DELETED	
K5.07	Adequate core cooling	4.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the low pressure core spray system:** (CFR: 41.7 / 45.7)	
K6.01	Loss of AC electrical distribution system	4.2
K6.02	Loss of emergency generators	4.2
K6.03	Torus/suppression pool water level	3.7
K6.04	Loss of DC electrical distribution system	3.9
K6.05	ECCS room cooler(s)	3.4
K6.06	Pump motor cooler(s)	2.9
K6.07	Pump seal cooler(s)	2.9
K6.08	Keep fill system	3.4
K6.09	DELETED	
K6.10	ECCS room integrity	3.1
K6.11	ADS	4.1

K6.12	Suppression pool suction strainer	3.4	
K6.13	High drywell pressure	4.3	
K6.14	Low reactor water level	4.3	
K6.15	Condensate storage tank low level	2.8	

A1 **Ability to predict or monitor changes in parameters associated with operation of the low pressure core spray system including:**
(CFR: 41.5 / 45.5)

A1.01	Core spray flow	4.1	
A1.02	Core spray pressure	3.9	
A1.03	Reactor water level	4.4	
A1.04	Reactor pressure	4.1	
A1.05	Torus/suppression pool water level	3.6	
A1.06	DELETED		
A1.07	Emergency generator loading	3.9	
A1.08	System lineup	4.0	
A1.09	Lights and alarms	3.7	
A1.10	Suppression pool temperature	3.3	

A2 **Ability to (a) predict the impacts of the following on the low pressure core 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 / 45.6)

		RO	**SRO**
A2.01	Pump trips	4.1	3.9
A2.02	Valve closures	3.9	3.8
A2.03	AC failures	4.0	4.0
A2.04	DC failures	3.7	4.0
A2.05	Core spray line break	4.0	3.5
A2.06	Inadequate system flow	4.3	3.7
A2.07	Loss of room cooling	3.3	3.2
A2.08	Valve openings	3.9	3.5
A2.09	Low suppression pool level	3.8	3.5
A2.10	High suppression pool temperature	3.5	3.3
A2.11	Loss of fire protection	2.3	2.0
A2.12	System initiation	4.4	4.3

A3 **Ability to monitor automatic features of the low pressure core spray system including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	4.2	
A3.02	Pump start	4.3	
A3.03	DELETED		
A3.04	DELETED		
A3.05	DELETED		

A3.06	DELETED	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Core spray pump	4.3
A4.02	Valves	4.2
A4.03	DELETED	
A4.04	DELETED	
A4.05	Manual initiation controls	4.2
A4.06	DELETED	
A4.07	Keep Fill pump	3.0
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	DELETED	
A4.15	Initiation reset	3.6

System: 239001 SF4 M&RSS Main and Reheat Steam System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the main and reheat steam system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor vessel and internals	3.5
K1.02	Plant process computer/parameter display systems	2.6
K1.03	Main turbine generator and auxiliary systems	3.6
K1.04	DELETED	
K1.05	DELETED	
K1.06	Reactor/turbine pressure regulating system	4.0
K1.07	Offgas system	3.2
K1.08	DELETED	
K1.09	DELETED	
K1.10	Extraction steam system	3.2
K1.11	DELETED	
K1.12	Instrument air systems	3.0
K1.13	Main steam isolation valve leakage control system	3.0
K1.14	DELETED	
K1.15	DELETED	
K1.16	Radiation monitoring system	3.0
K1.17	Primary containment system and auxiliaries	3.2
K1.18	High pressure coolant injection system	3.3
K1.19	Reactor core isolation cooling system	3.4
K1.20	Residual heat removal system	2.7
K1.21	Isolation condenser system	3.6
K1.22	Feedwater system	3.3
K1.23	Reactor water level control system	3.7
K1.24	DELETED	
K1.25	DELETED	
K1.26	Safety relief valves	4.0
K1.27	Reactor protection system	4.1
K1.28	PCIS/NSSSS	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Main steam isolation valve solenoids	3.6
K2.02	Main steam line shutoff valves	3.3

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 / 45.4)	
K3.01	Main turbine generator and auxiliary systems	3.5
K3.02	Condenser vacuum	3.5
K3.03	Feedwater system	3.5
K3.04	Offgas system	3.1
K3.05	DELETED	
K3.06	Reactor/turbine pressure regulating system	3.7
K3.07	Primary containment system and auxiliaries	3.2
K3.08	DELETED	
K3.09	DELETED	
K3.10	High pressure coolant injection system	3.3
K3.11	Reactor core isolation cooling system	3.5
K3.12	Isolation condenser	3.7
K3.13	DELETED	
K3.14	Residual heat removal system	2.7
K3.15	Reactor water level	3.7
K3.16	Safety relief valves	3.9
K3.17	Reactor vessel and internals	3.2
K4	**Knowledge of main and reheat steam system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Steam line isolation	4.3
K4.02	Automatic isolation and opening of drain valves	3.3
K4.03	Ensures that steam released from a steam line break will not bypass suppression pool; BWR-6	3.7
K4.04	Limits steam flow during a steam line rupture	3.5
K4.05	Steam flow measurement	3.4
K4.06	Allows for removal or prevents escape of radioactive steam from systems that have leaky MSIVs	3.1
K4.07	Over pressure control	4.1
K4.08	Removal of noncondensable gases from reactor head area	2.6
K4.09	Equalization of pressure across the MSIVs before opening	3.2
K4.10	Moisture removal from steam lines prior to admitting steam	3.0
K4.11	Positive sealing of the MSIVs when shutdown	2.9
K4.12	MSIV testing	3.0
K4.13	Backup pneumatic source for MSIV closure	3.1

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the main and reheat steam system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	Steam blanketing of the moisture separator reheater	2.0
K5.05	DELETED	
K5.06	Inadvertent MSIV operation	3.5
K5.07	DELETED	
K5.08	DELETED	
K5.09	Decay heat removal	3.5
K5.10	Steam bypass capability	3.8
K5.11	Non condensable gases in the reactor head area	2.5
K5.12	MSR heat up limitations	2.9
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	Electrical power	3.3
K6.02	Plant pneumatic systems	3.4
K6.03	Safety relief valves	3.9
K6.04	DELETED	
K6.05	Steam line leak	4.0
K6.06	MSIV isolation signal	4.3
K6.07	MSIV leakage control	2.9
K6.08	Main condenser vacuum	3.5
K6.09	PCIS/NSSSS	3.9
K6.10	DELETED	
K6.11	Moisture separator/reheaters	2.9
K6.12	Main turbine trip	3.6
K6.13	Reactor/turbine pressure regulating system	3.8
A1	**Ability to predict or monitor changes in parameters associated with operation of the main and reheat steam system including:** (CFR: 41.5 / 45.5)	
A1.01	Main steam pressure	3.8
A1.02	Main steam temperature	2.6
A1.03	Reheat steam pressure	2.7
A1.04	Reheater temperature	2.4
A1.05	Main steam line radiation	3.3
A1.06	Offgas process radiation	3.3

A1.07	Reactor water level	4.0	
A1.08	Reactor pressure	4.2	
A1.09	Main steam flow	3.7	
A1.10	Reactor power	4.1	
A1.11	Lights and alarms	3.3	

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 / 45.6)	**RO**	**SRO**
A2.01	Malfunction of reactor turbine pressure regulating system	4.3	4.0
A2.02	Change in steam demand and its effect on reactor pressure and power	4.2	4.0
A2.03	MSIV closure	4.3	3.9
A2.04	Main steam line low pressure	4.2	3.7
A2.05	Main steam line high radiation	3.6	3.6
A2.06	Turbine trip without bypass valves	4.4	4.0
A2.07	Main steam area high temperature	3.9	3.8
A2.08	Low condenser vacuum	4.0	3.6
A2.09	DELETED		
A2.10	Closure of one or more MSIVs at power	4.2	3.7
A2.11	Steam line break	4.3	4.1
A2.12	PCIS/NSSSS actuation	3.9	4.2
A2.13	High reactor water level	4.1	3.6
A2.14	DELETED		

A3	**Ability to monitor automatic features of the main and reheat steam system including:** (CFR: 41.7 / 45.7)	
A3.01	Isolation of main steam system	4.2
A3.02	Opening and closing of drain valves as turbine load changes	2.6
A3.03	Moisture separator reheat steam supply	2.8
A3.04	Isolation of moisture separator reheater	3.0
A3.05	MSR drain tank level control	2.9

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	MSIVs	4.4
A4.02	Main steam line drain valves	3.4
A4.03	DELETED	
A4.04	DELETED	

A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	MSR steam admission valves	2.8

System: 245000 SF4 MTGEN Main Turbine Generator and Auxiliary Systems

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the main turbine generator and auxiliary systems and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical distribution	3.6
K1.02	Condensate system	2.9
K1.03	Main and reheat steam system	3.1
K1.04	Reactor protection system	3.8
K1.05	DELETED	
K1.06	Component cooling water systems	3.0
K1.07	Instrument air systems	2.6
K1.08	Reactor/turbine pressure regulating system	3.7
K1.09	DELETED	
K1.10	Feedwater system	2.9
K1.11	Hydrogen seal oil system	3.3
K1.12	Stator water cooling system	3.4
K1.13	Bus duct cooling system	3.2
K1.14	EHC system	3.6
K1.15	Core monitor system	2.5
K1.16	Lube oil system	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Stator water cooling pumps	2.9
K2.02	Lube oil pumps	2.9
K2.03	Amplidyne/exciter	2.6
K2.04	Hydrogen seal oil pumps	2.9
K2.05	DELETED	
K2.06	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the main turbine generator and auxiliary systems will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	AC electrical distribution	3.7
K3.02	Reactor pressure	4.0
K3.03	Reactor power	4.0
K3.04	Feedwater system	3.2

K3.05	DELETED	
K3.06	DELETED	
K3.07	Reactor protection system	3.9
K3.08	Reactor/turbine pressure regulating system	3.7
K3.09	RC&IS	3.1
K3.10	Rod worth minimizer	2.3

K4 **Knowledge of main turbine generator and auxiliary systems design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Bearing lubrication	2.9
K4.02	Generator cooling	3.1
K4.03	Limit hydrogen leakage	2.9
K4.04	DELETED	
K4.05	Turbine protection	3.5
K4.06	Generator protection	3.5
K4.07	Generator voltage regulation	3.1
K4.08	Moisture removal from turbine steam	2.7
K4.09	Turbine control	3.5
K4.10	DELETED	
K4.11	Limit steam leakage	2.8

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the main turbine generator and auxiliary systems:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	Turbine operation and limitations	3.5
K5.03	Hydraulically operated valve operation	2.9
K5.04	Turbine speed control	3.2
K5.05	DELETED	
K5.06	Turbine shaft sealing	2.8
K5.07	Generator operations and limitations (reference potential)	3.1
K5.08	Generator cooling	3.1

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the main turbine generator and auxiliary systems:**
(CFR: 41.7 / 45.7)

K6.01	Gland seal	3.1

K6.02	Reactor/turbine pressure regulating system	3.8	
K6.03	Hydrogen seal oil	3.1	
K6.04	Hydrogen cooling	3.1	
K6.05	Stator water cooling	3.1	
K6.06	Electrical distribution	3.3	
K6.07	DELETED		
K6.08	Main and reheat steam	3.1	
K6.09	Voltage regulator	3.2	
K6.10	Lube oil system	3.1	
K6.11	Reactor SCRAM	3.8	

A1 **Ability to predict or monitor changes in parameters associated with operation of the main turbine generator and auxiliary systems including:**
(CFR: 41.5 / 45.5)

A1.01	Generator megawatts	3.5	
A1.02	Turbine speed	3.1	
A1.03	Turbine valve position	3.2	
A1.04	Steam flow	3.3	
A1.05	Reactor pressure	3.8	
A1.06	Condenser vacuum	3.5	
A1.07	First stage turbine pressure	3.3	
A1.08	DELETED		
A1.09	Lights and alarms	3.2	
A1.10	Hydrogen gas temperature	2.7	
A1.11	Turbine lube oil pressure	2.9	
A1.12	Hydrogen seal oil pressure	2.9	

A2 **Ability to (a) predict the impacts of the following on the main turbine generator and auxiliary systems 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	Turbine trip	4.2	3.9
A2.02	Loss of lube oil	3.8	3.5
A2.03	Degraded/ Loss of condenser vacuum	4.1	3.7
A2.04	Reactor SCRAM	4.4	3.9
A2.05	Generator trip	4.3	3.9
A2.06	DELETED		
A2.07	Loss of reactor/turbine regulating control system	4.1	4.0
A2.08	DELETED		
A2.09	Turbine vibration	3.7	3.5

A3	**Ability to monitor automatic features of the main turbine generator and auxiliary systems including:** (CFR: 41.7 / 45.7)	
A3.01	Turbine trip	3.9
A3.02	Turbine roll to rated speed	3.1
A3.03	DELETED	
A3.04	DELETED	
A3.05	Control valve operation	3.2
A3.06	DELETED	
A3.07	DELETED	
A3.08	Hydrogen gas pressure control	2.9
A3.09	DELETED	
A3.10	Voltage regulator	3.1
A3.11	DELETED	
A3.12	Automatic turbine control	3.3
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Turbine lube oil pumps	2.9
A4.02	Generator controls	3.5
A4.03	Stator water cooling pumps	3.2
A4.04	Hydrogen seal oil pumps	3.2
A4.05	DELETED	
A4.06	Turbine speed	3.2
A4.07	Turbine valve position	3.3
A4.08	DELETED	
A4.09	DELETED	
A4.10	Hydrogen gas pressure control	2.9
A4.11	DELETED	
A4.12	Voltage regulator	3.3
A4.13	DELETED	
A4.14	DELETED	

System: 217000 SF4 RCIC Reactor Core Isolation Cooling System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor core isolation cooling system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate system	3.1
K1.02	Nuclear boiler Instrumentation	3.7
K1.03	Suppression pool	3.8
K1.04	DELETED	
K1.05	Residual heat removal system	2.8
K1.06	Instrument air systems	2.5
K1.07	Leak detection	3.3
K1.08	DELETED	
K1.09	Reactor vessel and internals	3.3
K1.10	Main steam system	3.6
K1.11	Radwaste system	1.8
K1.12	Remote shutdown system	3.5
K1.13	Component cooling water	2.8
K1.14	Primary containment isolation system	3.9
K1.15	Feedwater system	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	3.3
K2.02	Initiation/isolation logic	3.7
K2.03	RCIC flow controller	3.5
K2.04	Gland seal compressor (vacuum pump)	2.6
K2.05	Water leg pump	2.6
K3	**Knowledge of the effect that a loss or malfunction of the reactor core isolation cooling system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.2
K3.02	Reactor vessel pressure	3.9
K3.03	DELETED	
K3.04	DELETED	
K3.05	Suppression pool level	3.3
K3.06	Condensate storage tank level	3.2
K3.07	Secondary containment parameters	3.4

K4	**Knowledge of reactor core isolation cooling system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevent water hammer	3.4
K4.02	Prevent over filling reactor vessel	3.8
K4.03	Prevents pump over heating	3.2
K4.04	Turbine trips	3.9
K4.05	DELETED	
K4.06	Manual system initiation	4.0
K4.07	Automatic transfer of RCIC pump suction	3.6
K4.08	Automatic system initiation	4.1
K4.09	Initiation reset	3.7
K4.10	System isolation	4.1
K4.11	Resetting system isolations	3.8
K4.12	Automatic flow control	3.7
K4.13	Turbine speed control	3.6
K4.14	Control oil to turbine speed controls	3.3
K4.15	Testable check valve operation	2.2
K4.16	Turbine shaft sealing	2.4
K4.17	Bypass trips and isolation logic	3.7
K4.18	Remote operation	3.7
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor core isolation cooling system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Flow control	3.8
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	Turbine operation	3.5
K5.07	Reactor pressure control	3.7
K5.08	Decay heat removal	3.8
K5.09	Adequate core cooling	4.2
K5.10	Reactor level control	4.2

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor core isolation cooling system:** (CFR: 41.7 / 45.7)	
K6.01	Electrical power	3.8
K6.02	Instrument air systems	2.6
K6.03	Suppression pool level	3.5
K6.04	Condensate storage tank low level	3.5
K6.05	Low reactor pressure	3.7
K6.06	Keep fill system	3.1
K6.07	Nuclear boiler instrumentation	3.6
K6.08	Reactor water level	4.1
K6.09	High suppression pool temperature	3.5
K6.10	High turbine exhaust pressure	3.7
K6.11	High steam flow	3.9
K6.12	High area temperature	4.0
K6.13	Low pump suction pressure	3.7
K6.14	Turbine control failure	3.7
K6.15	Lube oil pump	3.3
K6.16	Minimum flow valve	3.3
K6.17	Flow controller failure	3.9
A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor core isolation cooling system including:** (CFR: 41.5 / 45.5)	
A1.01	RCIC flow	4.1
A1.02	RCIC pressure	3.9
A1.03	Reactor water level	4.3
A1.04	Reactor pressure	4.1
A1.05	RCIC turbine speed	3.7
A1.06	Condensate storage tank level	3.2
A1.07	Suppression pool level	3.4
A1.08	Suppression pool temperature	3.5
A1.09	Lights and alarms	3.6

A2	**Ability to (a) predict the impacts of the following on the reactor core isolation 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 / 45.6)	**RO**	**SRO**
A2.01	System initiation signal	4.3	4.2
A2.02	Turbine trips	4.2	4.0
A2.03	Valve closures	3.8	3.7
A2.04	AC power loss	3.5	3.4
A2.05	DC power loss	4.1	3.9
A2.06	Loss of instrument air systems	2.9	2.5
A2.07	Loss of lube oil	3.6	3.3
A2.08	Loss of lube oil cooling	3.6	3.2
A2.09	Loss of vacuum pump	3.0	2.7
A2.10	Turbine control system failures	3.6	3.7
A2.11	Inadequate system flow	4.0	3.7
A2.12	Valve openings	3.3	3.6
A2.13	Loss of room cooling	3.2	3.1
A2.14	Rupture disc failure: exhaust-diaphragm	3.9	3.6
A2.15	Steam line break	4.0	4.0
A2.16	Low condensate storage tank level	3.5	3.3
A2.17	Abnormal suppression pool level	3.7	3.4
A2.18	DELETED		
A2.19	High suppression pool temperature	3.7	3.5

A3	**Ability to monitor automatic features of the reactor core isolation cooling system including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	3.9
A3.02	Turbine startup	4.0
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Trips and isolations	4.2
A3.08	Automatic flow control	4.0

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Turbine trip throttle valve reset	4.0
A4.03	System valves	3.8
A4.04	DELETED	

A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	Turbine speed control	3.9
A4.13	Manual initiation	4.1
A4.14	Resetting isolations	3.9

System: **202001 SF4 RS Recirculation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the recirculation system and the following systems:** (CFR: 41.2 to 41.8 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	DELETED	
K1.03	DELETED	
K1.04	Reactor/turbine pressure regulating system	3.4
K1.05	DELETED	
K1.06	DELETED	
K1.07	Component cooling water systems	3.2
K1.08	DELETED	
K1.09	DELETED	
K1.10	Control rod drive system	3.0
K1.11	Drywell equipment/floor drain sump system	2.8
K1.12	DELETED	
K1.13	DELETED	
K1.14	Rod block monitor system	3.0
K1.15	Nuclear boiler instrumentation	3.3
K1.16	Residual heat removal/low pressure coolant injection	3.5
K1.17	DELETED	
K1.18	Shutdown cooling system (RHR shutdown cooling mode)	3.5
K1.19	Reactor feedwater system	3.1
K1.20	Instrument air system	2.6
K1.21	Reactor water cleanup system	2.8
K1.22	DELETED	
K1.23	APRM/LPRM	3.5
K1.24	Isolation condenser	3.1
K1.25	Reactor water sampling system	2.6
K1.26	Recirculation flow control system	3.9
K1.27	Reactor protection system	3.7
K1.28	DELETED	
K1.29	Redundant reactivity control system (BWR 4, 5, 6)	3.8
K1.30	Reactor vessel internals	3.3
K1.31	Primary containment isolation system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Recirculation pumps	3.5

K2.02	MG sets	3.5
K2.03	Recirculation system valves	3.3
K2.04	DELETED	
K2.05	DELETED	
K2.06	VFDs	3.8
K2.07	VFD cooling water pumps	3.4

K3 **Knowledge of the effect that a loss or malfunction of the recirculation system will have on the following systems or system parameters:**
(CFR: 41.5 to 41.7 / 45.4)

K3.01	Core flow	4.2
K3.02	DELETED	
K3.03	Reactor power	4.4
K3.04	Reactor water level	4.0
K3.05	DELETED	
K3.06	Residual heat removal/low pressure coolant injection logic	3.3
K3.07	Vessel bottom head drain temperature	3.2
K3.08	Shutdown cooling system (RHR shutdown cooling mode)	3.5
K3.09	Reactor water cleanup system	2.9
K3.10	APRM/LPRM	3.5
K3.11	Component cooling water systems	2.6
K3.12	Isolation condenser	3.1
K3.13	Reactor water sampling system	2.5
K3.14	Primary containment integrity	2.9
K3.15	Reactor moderator temperature	3.3
K3.16	Reactor pressure	3.5
K3.17	Drywell equipment/floor drain sump system	2.7

K4 **Knowledge of recirculation system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	2/3 core coverage	4.3
K4.02	Adequate recirculation pump NPSH	3.8
K4.03	Recirculation pump motor cooling	3.3
K4.04	Controlled seal flow	3.3
K4.05	Seal cooling	3.3
K4.06	Automatic voltage/frequency regulation	3.0
K4.07	Motor generator set trips	3.3
K4.08	Oil pump automatic starts	2.8
K4.09	Pump minimum flow limit	3.2
K4.10	Pump start permissives	3.4

K4.11	Limitation of recirculation pumps flow mismatch	3.8
K4.12	Minimization of reactor vessel bottom head temperature gradients	3.6
K4.13	End of cycle recirculation pump trip	3.6
K4.14	ATWS/RPT	4.0
K4.15	Slow speed pump start	3.2
K4.16	Recirculation pump downshift/runback	3.8
K4.17	Fast speed pump start	3.3
K4.18	Automatic MG set start sequencing	3.3
K4.19	VFD trips	3.7
K4.20	VFD start sequencing	3.4

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the recirculation system:**
(CFR: 41.5 / 45.3)

K5.01	Indications of pump cavitation	3.5
K5.02	Jet pump operation: BWR-3,4,5,6	3.7
K5.03	Pump/motor cooling	3.3
K5.04	DELETED	
K5.05	End of cycle recirculation pump trip	3.5
K5.06	ATWS RPT	3.8
K5.07	Natural circulation	3.6
K5.08	DELETED	
K5.09	Hydraulically operated valves	2.8
K5.10	Motor generator set operation	3.0
K5.11	Core flow	3.8
K5.12	Reactor power	4.1
K5.13	Reactor moderator temperature	3.4
K5.14	Reactor water level	3.8
K5.15	VFD operation	3.7

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

K6.01	Jet pumps	4.0
K6.02	Component cooling water systems	3.3
K6.03	AC electrical distribution system	3.5
K6.04	DC electrical distribution system	3.1
K6.05	Control rod drive system	2.9
K6.06	Recirculation system motor-generator sets	3.2
K6.07	Feedwater flow	3.1
K6.08	Reactor water cleanup system	2.8

K6.09	Reactor water level	3.7	
K6.10	Recirculation flow control system	3.8	
K6.11	Reactor protection system	3.4	
K6.12	APRMs	3.2	
K6.13	Redundant reactivity control system	3.4	
K6.14	Variable frequency drives	3.7	

A1 **Ability to predict or monitor changes in parameters associated with operation of the recirculation system including:**
(CFR: 41.5 / 45.5)

A1.01	Recirculation pump flow	3.1
A1.02	Jet pump flow	3.9
A1.03	Core flow	4.1
A1.04	Reactor water level	3.9
A1.05	Reactor power	4.4
A1.06	Recirculation pump motor amps	3.0
A1.07	Recirculation pump speed	3.2
A1.08	Recirculation FCV position: BWR-5,6	3.8
A1.09	Recirculation pump seal pressures	3.5
A1.10	Recirculation seal purge flows	2.9
A1.11	Vessel bottom head drain temperature	3.2
A1.12	Recirculation pump differential pressure	2.9
A1.13	Recirculation loop temperatures	3.4
A1.14	Recirculation drive motor temperature	3.0
A1.15	Recirculation MG set temperatures	2.8
A1.16	Recirculation MG drive motor amps	2.6
A1.17	Recirculation MG set generator current, power, voltage	2.6
A1.18	Lights and alarms	3.4
A1.19	VFD temperature	3.3
A1.20	VFD cooling water temperature	3.3
A1.21	VFD current, power, voltage	3.1

A2 **Ability to (a) predict the impacts of the following on the recirculation 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 / 45.6)

		RO	**SRO**
A2.01	Jet pump failure	3.9	4.1
A2.02	Recirculation system leak	4.1	4.0
A2.03	Single recirculation pump trip	4.1	4.2
A2.04	Multiple recirculation pump trip	4.5	4.3
A2.05	Inadvertent recirculation flow increase (reference potential)	4.3	4.2

A2.06	Inadvertent recirculation flow decrease	3.8	4.0
A2.07	Recirculation pump speed mismatch	3.5	3.2
A2.08	Recirculation flow mismatch	3.8	3.7
A2.09	DELETED		
A2.10	Recirculation pump seal failure (reference potential)	3.9	3.9
A2.11	Low reactor water level	4.0	3.8
A2.12	Loss of reactor feedwater	3.9	3.6
A2.13	Carryunder	3.4	2.7
A2.14	High reactor pressure (ATWS circuitry initiation)	3.9	3.8
A2.15	End of cycle trip circuitry	3.8	3.6
A2.16	Loss of seal purge flow (CRD)	3.4	3.1
A2.17	Loss of seal cooling water	3.8	3.3
A2.18	Loss of motor cooling	3.6	3.1
A2.19	Loss of AC power	3.9	3.4
A2.20	Loss of DC power	3.3	3.1
A2.21	Recirculation loop temperature out of spec	3.8	3.2
A2.22	Loss of component cooling water	3.8	3.2
A2.23	Valve closures	3.6	3.3
A2.24	Valve opening	3.4	3.3
A2.25	Recirculation flow control valve lockup	3.8	3.6
A2.26	Incomplete start sequence	3.0	2.9
A2.27	Failure of RPS end of cycle—recirculation pump trip circuitry (BWR 5, 6)	3.3	3.5
A2.28	Failure of redundant reactivity control system (BWR 4, 5, 6)	3.5	3.6
A2.29	VFD cell bypass	3.5	3.6
A2.30	VFD cooling system failure	3.5	3.4

A3 **Ability to monitor automatic features of the recirculation system including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3.6
A3.02	Pump/MG set start sequence	3.4
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	Flow control valve position: BWR-5,6	3.9
A3.07	Pump trips	4.0
A3.08	Pump downshift: BWR-5,6	3.8
A3.09	MG set trip	3.5
A3.10	VFD start sequence	3.4
A3.11	VFD trip	3.9

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Recirculation pumps	4.0
A4.02	System valves	3.8
A4.03	Reactor power	4.4
A4.04	System flow	4.1
A4.05	DELETED	
A4.06	Oil pumps	3.0
A4.07	Vent fans	2.8
A4.08	Motor-generator sets	3.1
A4.09	DELETED	
A4.10	Seal flow	3.1
A4.11	Seal pressures	3.6
A4.12	Core flow	4.1
A4.13	Core differential pressure	3.8
A4.14	Variable frequency drives	3.9
A4.15	VFD cooling water pumps	3.4

System: **203000 SF4 RHR/LPCI: Injection Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the RHR/LPCI: injection mode and the following systems:** (CFR: 41.2 to 41.9 / 43.5 / 45.7 to 45.8)	
K1.01	Condensate system	2.3
K1.02	Primary containment	3.5
K1.03	DELETED	
K1.04	DELETED	
K1.05	Recirculation system: BWR-3,4	3.7
K1.06	ADS	4.1
K1.07	DELETED	
K1.08	DELETED	
K1.09	Emergency generators	4.0
K1.10	Plant ventilation systems	2.5
K1.11	Nuclear boiler instrumentation	3.7
K1.12	Instrument air system	2.4
K1.13	DELETED	
K1.14	Shutdown cooling system	3.6
K1.15	Reactor building drain system	2.0
K1.16	Component cooling water systems	2.7
K1.17	DELETED	
K1.18	Reactor vessel	3.8
K1.19	Low pressure core spray system	3.5
K1.20	Service water	3.1
K1.21	Remote shutdown system	3.4
K1.22	Spent fuel pool cooling	2.9
K1.23	Primary containment isolation system	3.6
K1.24	Leak detection system	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pumps	4.1
K2.02	Valves	3.7
K2.03	Initiation logic	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RHR/LPCI: injection mode will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.2

K3.02	Suppression pool level	3.4
K3.03	Automatic depressurization logic	4.0
K3.04	Adequate core cooling	4.3
K3.05	Drywell pressure	3.3
K3.06	Reactor pressure	3.5
K3.07	Primary containment	3.5

K4 **Knowledge of RHR/LPCI: injection mode design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Automatic system initiation/injection	4.4
K4.02	DELETED	
K4.03	Pump minimum flow protection	3.2
K4.04	Pump seal cooler	2.7
K4.05	Prevention of water hammer (keep fill)	3.4
K4.06	No-suction path pump trip	3.5
K4.07	Emergency generator load sequencing	3.8
K4.08	Pump operability testing	3.0
K4.09	Surveillance for all operable components	2.9
K4.10	Dedicated injection system during automatic system initiation (injection valve interlocks)	3.7
K4.11	Loop selection logic	3.4
K4.12	System redundancy	3.5
K4.13	The prevention of leakage to the environment through LPCI/RHR heat exchanger	3.0
K4.14	Operation from remote shutdown panel	3.6
K4.15	Pump runout protection	3.0
K4.16	Manual system initiation	4.1
K4.17	Testable check valve operation	2.6

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the RHR/LPCI: injection mode:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	Core cooling methods	4.2
K5.03	Vortex limits	3.3
K5.04	NPSH limits	3.4

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the RHR/LPCI: injection mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power	3.9
K6.02	DC electrical power	3.8
K6.03	Emergency generator	4.0
K6.04	Keep fill	3.2
K6.05	Condensate system	2.3
K6.06	Suppression pool water level	3.4
K6.07	Plant air systems	2.4
K6.08	ECCS room cooling	3.1
K6.09	Nuclear boiler instrumentation	3.5
K6.10	Component cooling water systems	2.8
K6.11	ADS	4.1
K6.12	ECCS room integrity	3.0
K6.13	High suppression pool temperature	3.5
K6.14	High drywell pressure	3.7
K6.15	Low reactor water level	4.0
K6.16	Service water system	3.0
K6.17	Suppression pool suction strainer clogging	3.4

A1	**Ability to predict or monitor changes in parameters associated with operation of the RHR/LPCI: injection mode including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4.4
A1.02	Reactor pressure	4.0
A1.03	System flow	4.0
A1.04	System pressure	3.8
A1.05	Suppression pool level	3.6
A1.06	Condensate storage tank level	2.5
A1.07	Motor amps	2.7
A1.08	Emergency generator loading	3.7
A1.09	Component cooling water systems	2.8
A1.10	Lights and alarms	3.5
A1.11	Suppression pool temperature	3.5

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the RHR/LPCI: injection mode 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	Inadequate net positive suction head	3.9	3.6
A2.02	Pump trips	4.0	3.9
A2.03	Valve closures	3.7	3.8
A2.04	AC failures	3.9	3.8
A2.05	DC failures	3.6	3.7
A2.06	Emergency generator failure	3.9	3.9
A2.07	Pump seal failure	3.1	2.9
A2.08	Inadequate room cooling	2.9	3.0
A2.09	Inadequate system flow	3.6	3.5
A2.10	Nuclear boiler instrument failure	3.4	3.5
A2.11	Motor operated valve failures	3.7	3.6
A2.12	Pump runout	3.7	3.1
A2.13	Valve openings	3.6	3.3
A2.14	Initiation logic failure	3.9	4.0
A2.15	Loop selection logic failure	4.3	3.9
A2.16	Loss of coolant accident	4.4	4.4
A2.17	Keep fill system failure	3.6	3.1
A2.18	High suppression pool temperature	3.6	3.4
A2.19	Low suppression pool level	3.7	3.5
A2.20	Surveillance acceptance criteria not being met	3.0	3.3

A3	**Ability to monitor automatic features of the RHR/LPCI: injection mode including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4.0
A3.02	Pump start	4.1
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Loop selection	4.1
A3.08	System initiation sequence	4.0
A3.09	DELETED	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Pumps	4.2
A4.02	System valves	4.2

A4.03	Keep fill system	3.1
A4.04	DELETED	
A4.05	Manual initiation controls	4.3
A4.06	System reset following automatic initiation	3.6
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	Testable check valves	2.6
A4.15	Room coolers	2.9

System: 205000 SF4 SCS Shutdown Cooling System (RHR Shutdown Cooling Mode)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the shutdown cooling system (RHR shutdown cooling mode) and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	DELETED	
K1.03	DELETED	
K1.04	Fuel pool cooling and cleanup system	3.2
K1.05	Component cooling water systems	3.1
K1.06	DELETED	
K1.07	DELETED	
K1.08	RHR/LPCI	3.7
K1.09	DELETED	
K1.10	RWCU	2.8
K1.11	Plant pneumatic systems	2.5
K1.12	Isolation condenser	2.3
K1.13	Radwaste system	2.3
K1.14	DELETED	
K1.15	Service water	3.2
K1.16	PCIS/NSSSS	3.7
K1.17	Recirculation system	3.5
K1.18	Feedwater system (BWR-6)	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Pump motors	3.6
K2.02	Motor operated valves	3.3
K3	**Knowledge of the effect that a loss or malfunction of the shutdown cooling system (RHR shutdown cooling mode) will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor pressure	3.7
K3.02	Reactor water level	3.7
K3.03	Temperatures	4.2
K3.04	DELETED	
K3.05	Fuel pool cooling and cleanup	3.0

K4	**Knowledge of shutdown cooling system (RHR shutdown cooling mode) design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	High temperature isolation /protection	3.6
K4.02	High pressure isolation	3.9
K4.03	Low reactor water level	3.9
K4.04	Adequate pump NPSH	3.3
K4.05	Cooldown rate	3.9
K4.06	DELETED	
K4.07	SDC minimum flow	3.5
K4.08	Prevent inadvertent vessel draining	4.1
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the shutdown cooling system (RHR shutdown cooling mode):** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Valve operation	3.5
K5.03	Decay heat removal	3.9
K5.04	System venting	2.9
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the shutdown cooling system (RHR shutdown cooling mode):** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution	3.7
K6.02	DC electrical distribution	3.5
K6.03	Recirculation system	3.4
K6.04	Abnormal reactor water level	3.7
K6.05	Component cooling water systems	3.2
K6.06	DELETED	
K6.07	Plant pneumatic systems	2.5
K6.08	Service water	3.3
K6.09	Reactor water cleanup	2.8
K6.10	Fuel pool cooling and cleanup	3.0
A1	**Ability to predict or monitor changes in parameters associated with operation of the shutdown cooling system (RHR shutdown cooling mode) including:** (CFR: 41.5 / 45.5)	
A1.01	Heat exchanger cooling flow	3.6

A1.02	SDC/RHR pump flow	3.7	
A1.03	DELETED		
A1.04	SDC/RHR pump suction pressure	3.0	
A1.05	Reactor water level	3.9	
A1.06	Temperatures	3.9	
A1.07	DELETED		
A1.08	Heat exchanger temperatures	3.6	
A1.09	SDC/RHR pump/system discharge pressure	3.3	
A1.10	Throttle valve position	3.2	
A1.11	Lights and alarms	3.4	

A2 **Ability to (a) predict the impacts of the following on the shutdown cooling system (RHR shutdown cooling mode) 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	Recirculation loop high temperature	3.6	3.3
A2.02	Low shutdown cooling suction pressure	3.5	3.4
A2.03	Loss of AC power	3.9	3.8
A2.04	Loss of DC power	3.6	3.6
A2.05	System isolation	4.0	4.0
A2.06	Pump trips	4.0	3.8
A2.07	DELETED		
A2.08	Loss of heat exchanger cooling	4.0	3.8
A2.09	Reactor low water level	4.1	3.9
A2.10	Abnormal valve position	3.6	3.4
A2.11	DELETED		
A2.12	Inadequate system flow	3.6	3.6

A3 **Ability to monitor automatic features of the shutdown cooling system (RHR shutdown cooling mode) including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3.7
A3.02	Pump operation	3.7
A3.03	DELETED	

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

A4.01	SDC/RHR pumps	3.9
A4.02	SDC/RHR valves	3.9
A4.03	DELETED	
A4.04	DELETED	

A4.05	DELETED	
A4.06	Reactor water level	4.0
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	Heat exchanger cooling flow	3.6
A4.12	Recirculation loop temperatures	3.7

System: 290002 SF4 RVI Reactor Vessel and Internals

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor vessel and internals and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3.8
K1.02	Recirculation system	4.1
K1.03	Reactor feedwater system	3.8
K1.04	High pressure coolant injection system (BWR 3 & 4)	3.6
K1.05	Residual heat removal system	3.9
K1.06	High pressure core spray system (BWR 5 & 6)	4.0
K1.07	Isolation condenser system (BWR 2 & 3)	4.0
K1.08	Reactor core isolation cooling system (BWR 4/5/6)	3.8
K1.09	Low pressure coolant injection system	3.9
K1.10	Control rod drive hydraulic system	3.8
K1.11	Control rod drive mechanism system	3.7
K1.12	Standby liquid control system	3.9
K1.13	Relief/safety valve system	3.9
K1.14	Reactor water cleanup system	3.5
K1.15	Nuclear boiler instrumentation system	4.0
K1.16	Low pressure core spray system	3.9
K1.17	Automatic depressurization system	3.9
K1.18	DELETED	
K1.19	Traversing in-core probe system	3.0
K1.20	DELETED	
K1.21	Leak detection system	3.4
K1.22	Average power range monitor/local power range monitor system	3.5
K1.23	Intermediate range monitor system	3.5
K1.24	Source range monitor system	3.5
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 vessel and internals will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4.2
K3.02	Reactor pressure	4.0

K3.03	Reactor power	4.1
K3.04	DELETED	
K3.05	DELETED	
K3.06	DELETED	
K3.07	Nuclear boiler instrumentation	3.9
K3.08	Leak detection system	3.4
K3.09	Main steam system	3.6
K3.10	Recirculation system	4.0
K3.11	Reactor feedwater system	3.5
K3.12	High pressure coolant injection system (BWR 3 & 4)	3.4
K3.13	High pressure core spray system (BWR 5 & 6)	3.7
K3.14	Low pressure coolant injection system	3.8
K3.15	Low pressure core spray system	3.9
K3.16	Residual heat removal system	3.8
K3.17	Reactor core isolation cooling system (BWR 4/5/6)	3.6
K3.18	Control rod drive hydraulic system	3.5
K3.19	Control rod drive mechanism system	3.5
K3.20	Relief/safety valve system	3.6
K3.21	Standby liquid control system	3.7
K3.22	Average power range monitor/local power range monitor system	3.3
K3.23	Intermediate range monitor system	3.3
K3.24	Source range monitor system	3.3

K4 **Knowledge of reactor vessel and internals design feature(s) or interlocks that provide for the following:** (CFR: 41.7)

K4.01	2/3 core coverage following a DBA LOCA (BWR 3/4/5/6)	4.6
K4.02	Flow paths within the reactor vessel	3.9
K4.03	DELETED	
K4.04	Moisture removal from steam	3.3
K4.05	DELETED	
K4.06	Loose parts monitoring	2.3

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor vessel and internals:** (CFR: 41.5 / 45.3)

K5.01	Thermal limits	4.0
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	

K5.07	Safety limits	4.5	
K5.08	Natural circulation	3.9	
K5.09	Plant radiation levels	3.2	
K5.10	Off-site radiation levels	3.2	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the reactor vessel and internals:**
(CFR: 41.7 / 45.7)

K6.01	DELETED		
K6.02	DELETED		
K6.03	Recirculation system	3.9	
K6.04	Reactor feedwater system	3.5	
K6.05	Standby liquid control system	3.5	
K6.06	Relief/safety valves	3.9	
K6.07	Reactor water cleanup system	3.3	
K6.08	Nuclear boiler instrumentation	3.7	
K6.09	Low pressure core spray system	3.7	
K6.10	High pressure coolant injection system (BWR 3 & 4)	3.5	
K6.11	Residual heat removal system	3.7	
K6.12	Isolation condenser system (BWR 2 & 3)	3.6	
K6.13	Reactor core isolation cooling system (BWR 4/5/6)	3.5	
K6.14	Low pressure coolant injection system	3.6	
K6.15	Automatic depressurization system	3.8	
K6.16	DELETED		
K6.17	DELETED		
K6.18	DELETED		
K6.19	High pressure core spray system (BWR 5 & 6)	3.7	
K6.20	Main steam system	3.5	

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

None

A2 **Ability to (a) predict the impacts of the following on the reactor vessel and internals 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	LOCA	4.6	4.5
A2.02	DELETED		
A2.03	Control rod drop accident	4.4	3.8

A2.04	Excessive heatup/cooldown rate	4.4	4.1
A2.05	Exceeding thermal limits	4.4	4.1
A2.06	Exceeding safety limits	4.6	4.5

A3 **Ability to monitor automatic features of the reactor vessel and internals including:**
(CFR: 41.7 / 45.7)

None

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

None

System: **510000 SF4 SWS Service Water System (Normal and Emergency)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the service water system and the following systems:** (CFR: 41.4 to 41.8 / 45.7 to 45.8)	
K1.01	Component cooling water system	3.7
K1.02	Main turbine generator and auxiliary systems	3.3
K1.03	Circulating water system	2.7
K1.04	Emergency generators (diesel/jet)	3.4
K1.05	High pressure coolant injection system	3.0
K1.06	High pressure core spray system	2.8
K1.07	Residual heat removal/low pressure coolant injection	3.5
K1.08	Primary containment system and auxiliaries	3.0
K1.09	Fire protection system	2.9
K1.10	Radiation monitoring system	2.7
K1.11	Fuel pool cooling and clean-up system	3.3
K1.12	Radwaste system	2.4
K1.13	Feedwater system	2.7
K1.14	Condensate system	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Service water system pumps (Class 1E)	3.7
K2.02	Service water system valves (Class 1E)	3.4
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 / 45.4)	
K3.01	Component cooling water system	3.8
K3.02	Main turbine generator and auxiliary systems	3.4
K3.03	Circulating water system	2.5
K3.04	Emergency generators (diesel/jet)	3.6
K3.05	High pressure coolant injection system	3.1
K3.06	High pressure core spray system	2.8
K3.07	Residual heat removal/low pressure coolant injection	3.7
K3.08	Primary containment system and auxiliaries	3.1
K3.09	Fire protection system	2.7
K3.10	Radiation monitoring system	2.5
K3.11	Fuel pool cooling and clean-up system	3.4
K3.12	Radwaste system	2.3

K3.13	Feedwater system	2.7
K3.14	Condensate system	2.7
K3.15	Service water system pressure	3.7
K3.16	Service water system temperature	3.6
K3.17	Service water system flows	3.5

K4 **Knowledge of service water system design feature(s) or interlock(s) that provide for the following:**
(CFR: 41.7)

K4.01	Automatic pump starts	3.6
K4.02	Automatic valve alignments	3.5
K4.03	Cooling tower makeup water	2.9
K4.04	Low/high temperature operation	3.3
K4.05	Alternate intake pathway	2.9
K4.06	Alternate discharge pathway	2.9
K4.07	Discharge strainer backwashing	2.8
K4.08	Alternate cooling water supply to FPCC heat exchangers	3.1
K4.09	Trash and debris removal	3.0

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the service water system:**
(CFR: 41.4, 41.7 / 45.5)

K5.01	Intake/traveling screen high differential pressure/ differential level	3.3
K5.02	Radiation alarm response	3.0
K5.03	Flood prevention	3.1
K5.04	Pipe rupture	3.3

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	Pump trip	3.8
K6.02	Temperature control valve malfunction	3.5
K6.03	Entry/discharge path blockage	3.4
K6.04	Leakage to/from contaminated system	3.4
K6.05	Intake/traveling screen high differential pressure/ differential level	3.2
K6.06	Discharge strainers clogging	3.2
K6.07	Loss of AC electrical distribution	3.6
K6.08	Loss of coolant accident	3.7
K6.09	Loss of ultimate heat sink	3.9

A1	**Ability to predict or monitor changes in parameters associated with operation of the service water system including:** (CFR: 41.5 / 45.5)		
A1.01	Ultimate heat sink temperature	3.5	
A1.02	Temperature control valve position	3.3	
A1.03	Service water pressures	3.6	
A1.04	Service water temperatures	3.5	
A1.05	Service water flow	3.3	
A1.06	CCW heat exchanger outlet temperature	3.4	
A1.07	Lights and alarms	3.3	
A1.08	Intake screen differential pressure/level	3.1	
A1.09	Strainer differential pressure	3.0	
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	Pump/motor failure	3.6	3.7
A2.02	Abnormal valve positions	3.6	3.5
A2.03	Intake/discharge blockage	3.6	3.5
A2.04	Pipe leakage/rupture	3.6	3.5
A2.05	Intake/traveling screen failure	3.4	3.2
A2.06	Discharge strainer failure	3.3	3.2
A2.07	Abnormal intake water temperature	3.3	3.6
A2.08	Abnormal intake water level	3.7	3.6
A3	**Ability to monitor automatic features of the service water system including:** (CFR: 41.7 / 45.5)		
A3.01	Pump starts	3.5	
A3.02	Valve alignment	3.3	
A3.03	Traveling screen operation	2.8	
A3.04	Strainer operation	2.8	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Pumps operations	3.7	
A4.02	Valve operations	3.6	

System: 223001 SF5 PCS Primary Containment System and Auxiliaries

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the primary containment system and auxiliaries and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	PCIS	4.3
K1.02	DELETED	
K1.03	Containment/drywell atmosphere control system	3.7
K1.04	Drywell floor and equipment floor drain system	3.4
K1.05	Suppression pool makeup system: Mark III	3.4
K1.06	RHR/LPCI	3.9
K1.07	Suppression pool cleanup system	3.9
K1.08	Relief/safety valves	3.8
K1.09	Standby gas treatment system or filtration, recirculation and ventilation system	3.8
K1.10	Plant pneumatic systems	3.1
K1.11	Post-accident sampling system	2.8
K1.12	LPCS	3.9
K1.13	HPCS	3.8
K1.14	RCIC	3.8
K1.15	HPCI	3.9
K1.16	Containment and drywell atmosphere monitoring system	3.5
K1.17	Plant ventilation	3.2
K1.18	Drywell dP compressors	3.4
K1.19	Containment hardened venting	3.9
K1.20	Containment atmosphere dilution	3.5
K1.21	Penetration cooling system	2.8
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Atmosphere containment/ atmospheric dilution compressors	2.8
K2.02	Drywell compressors	3.1
K2.03	Pumpback compressors	2.9
K2.04	Combustible gas mixing compressors: Mark III	3.2
K2.05	Hydrogen recombiners	2.9
K2.06	Hydrogen igniters	3.3
K2.07	Containment atmosphere monitoring system	3.1
K2.08	Containment cooling air handling units	3.0
K2.09	Containment/drywell cooling fans	3.2

K2.10	Containment/drywell chillers	3.1
K2.11	Suppression pool cleanup pump	2.5
K2.12	Containment hardened vent isolation valves	3.5

K3 **Knowledge of the effect that a loss or malfunction of the primary containment system and auxiliaries will have on the following systems or system parameters:**
(CFR: 41.7 / 45.4)

K3.01	Secondary containment	3.8
K3.02	Containment/drywell temperature	3.8
K3.03	Containment/drywell pressure	3.8
K3.04	Containment/drywell hydrogen gas concentration	3.5
K3.05	Containment/drywell oxygen gas concentration	3.4
K3.06	Differential pressure between secondary and primary containment	3.5
K3.07	Differential pressure between suppression pool and drywell/containment	3.6
K3.08	Pneumatically operated valves internal to containment/drywell	3.4
K3.09	Nuclear boiler instrumentation	3.6
K3.10	Containment/drywell moisture content	2.7
K3.11	LPCS	3.8
K3.12	HPCS	3.9
K3.13	RCIC	3.8
K3.14	HPCI	3.7
K3.15	Containment hardened vent	3.7
K3.16	Suppression pool level	3.7
K3.17	Suppression pool temperature	3.6

K4 **Knowledge of primary containment system and auxiliaries design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Absorption of energy released during a LOCA	4.2
K4.02	Contains fission products after a LOCA	4.0
K4.03	Containment/drywell isolation	4.0
K4.04	Limiting hydrogen concentration	3.8
K4.05	Maintains proper suppression pool to drywell differential pressure	3.7
K4.06	Maintains proper containment/secondary containment to drywell differential pressure	3.7
K4.07	Prevents localized heating of suppression pool (SRV steam quenchers)	3.6
K4.08	Overpressure protection—containment hardened vent	3.8
K4.09	Containment integrity	4.1

K4.10	Penetration cooling	2.7
K4.11	Maintain minimum Suppression pool level (automatic suppression pool makeup) (Mark III)	3.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the primary containment system and auxiliaries:**
(CFR: 41.5 / 45.3)

K5.01	Vacuum breaker/relief operation	3.8
K5.02	Guard pipe operation: Mark III	2.8
K5.03	Down comer operation	3.6
K5.04	Horizontal vent operation: Mark III	3.4
K5.05	Hydrogen recombiner operation	3.4
K5.06	Hydrogen igniter operation	3.6
K5.07	Suppression pool clean-up	2.3
K5.08	Pressure	3.9
K5.09	Hydrogen production mechanisms	3.6
K5.10	Hydrogen combustibility versus hydrogen concentration and oxygen concentration	3.4
K5.11	Temperature	3.8
K5.12	Hydrogen concentration	3.8
K5.13	Oxygen concentration	3.6
K5.14	Differential pressure	3.7
K5.15	Moisture content	2.5
K5.16	Containment spray operation	4.1
K5.17	Suppression pool level	3.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the primary containment system and auxiliaries:**
(CFR: 41.7 / 45.7)

K6.01	Drywell cooling	3.8
K6.02	Containment cooling: Mark III	3.8
K6.03	Suppression pool makeup	3.4
K6.04	Combustible gas mixing	3.4
K6.05	Hydrogen recombiner	3.3
K6.06	Backup hydrogen purge	3.2
K6.07	Hydrogen igniter system	3.5
K6.08	Containment atmospheric control	3.4
K6.09	Drywell vacuum relief system	3.8
K6.10	Containment vacuum relief system: Mark III	3.6

K6.11	AC electrical distribution	3.5	
K6.12	DC electrical distribution	3.5	
K6.13	Applicable plant pneumatic systems	3.2	
K6.14	RHR/LPCI	3.7	
K6.15	Containment hardened vent	4.0	
K6.16	Standby gas treatment system or filtration, recirculation and ventilation system	3.7	
A1	**Ability to predict or monitor changes in parameters associated with operation of the primary containment system and auxiliaries including:** (CFR: 41.5 / 45.5)		
A1.01	Drywell temperature	4.1	
A1.02	Drywell pressure	4.2	
A1.03	Containment pressure	4.1	
A1.04	Containment temperature	4.0	
A1.05	Hydrogen concentration	3.7	
A1.06	Oxygen concentration	3.5	
A1.07	Drywell/suppression chamber differential pressure (drywell to containment building)	3.7	
A1.08	Suppression pool level	4.0	
A1.09	Suppression pool temperature	4.0	
A1.10	RCS leakage	3.8	
A1.11	Reactor building to suppression chamber differential pressure	3.5	
A1.12	Moisture concentration	2.4	
A1.13	System indicating light and alarms	3.6	
A1.14	Containment/drywell differential pressure: Mark III	3.8	
A2	**Ability to (a) predict the impacts of the following on the primary containment system and auxiliaries 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	Loss of coolant accident	4.4	4.5
A2.02	Steam bypass of suppression pool	4.1	4.1
A2.03	Safety/relief valve leaking or stuck open	4.3	4.0
A2.04	High containment/drywell hydrogen concentration	3.8	3.8
A2.05	High containment/drywell oxygen concentration	3.6	3.6
A2.06	High containment pressure: Mark III	4.0	4.1

A2.07	High drywell pressure	4.4	4.3
A2.08	Compressor trips (loss of air)	3.7	2.9
A2.09	Vacuum breaker malfunction	3.9	3.7
A2.10	High drywell temperature	4.0	3.8
A2.11	Abnormal suppression pool level	3.9	3.7
A2.12	Abnormal suppression pool temperature	4.0	3.8
A2.13	High containment temperature: Mark III	4.0	3.9
A2.14	Low containment to annulus pressure: Mark III	3.5	3.4
A2.15	Steam line break	4.0	4.0
A2.16	Opening of head vent to drywell equipment sump with pressure in the reactor vessel	3.9	3.5

A3 **Ability to monitor automatic features of the primary containment system and auxiliaries including:**
(CFR: 41.7 / 45.7)

A3.01	Suppression pool level makeup system: Mark III	3.5
A3.02	Vacuum breaker/relief valve operation	3.9
A3.03	DELETED	
A3.04	Containment/drywell response during LOCA	4.2
A3.05	DELETED	
A3.06	Drywell/suppression chamber differential pressure: Mark I, II	3.9
A3.07	DELETED	

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

A4.01	Containment relief valves: Mark III	4.2
A4.02	Air containment atmosphere dilution compressors	3.2
A4.03	Air dilution valves to drywell and suppression pool	3.1
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	SPDS/CRIDS/ERIS/GDS	3.5
A4.10	Drywell nitrogen makeup: Mark I, II	3.5
A4.11	Drywell pneumatics	3.5

A4.12	Drywell coolers/chillers	3.5
A4.13	Hydrogen recombiners	3.3
A4.14	Hydrogen igniters	3.5
A4.15	Suppression pool makeup systems	3.5
A4.16	Suppression pool cleanup system	2.5
A4.17	Hardened containment vent	3.8
A4.18	Containment spray system: Mark III	4.2

System: **223002 SF5 PCIS Primary Containment Isolation System/Nuclear Steam Supply Shut-Off**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the primary containment isolation system/nuclear steam supply shut-off and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	4.2
K1.02	Reactor water cleanup	3.8
K1.03	Plant ventilation	3.5
K1.04	HPCI	4.2
K1.05	Isolation condenser	4.1
K1.06	Recirculation system	3.1
K1.07	RCIC	4.1
K1.08	Shutdown cooling system/RHR	3.9
K1.09	Reactor vessel head spray	3.0
K1.10	Containment ventilation	3.4
K1.11	Containment atmosphere sampling	3.1
K1.12	SBGT	3.8
K1.13	Traversing in-core probe system	3.1
K1.14	Containment/drywell floor and equipment drain system	3.5
K1.15	HPCS	3.8
K1.16	DELETED	
K1.17	Plant process computer/parameter display systems	2.9
K1.18	Reactor building drainage system	2.8
K1.19	Component cooling water systems	3.1
K1.20	AC distribution	3.3
K1.21	Circulating water	2.0
K1.22	Containment nitrogen inerting system	3.2
K1.23	Condenser circulating water makeup	1.8
K1.24	Leak detection system	3.1
K1.25	RPS—reactor protection system	3.8
K1.26	DC distribution	3.2
K1.27	Plant pneumatic systems	3.3
K1.28	Process rad monitoring	3.3
K1.29	Nuclear boiler instrumentation	3.5
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Logic power supplies	3.6

K3	**Knowledge of the effect that a loss or malfunction of the primary containment isolation system/nuclear steam supply shut-off will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	3.9
K3.02	Fuel cladding temperature	3.7
K3.03	Off-site radioactive release rates	4.1
K3.04	Reactor building radiation level	3.8
K3.05	Containment/drywell floor and equipment drain system	3.4
K3.06	Turbine building radiation	3.4
K3.07	Reactor pressure	4.0
K3.08	Reactor vessel temperature	3.5
K3.09	Main steam system	4.0
K3.10	Reactor water cleanup	3.8
K3.11	Plant ventilation	3.4
K3.12	High pressure coolant injection	3.9
K3.13	Isolation condenser	4.0
K3.14	Recirculation system	3.1
K3.15	Reactor core isolation cooling	4.0
K3.16	Shutdown cooling system/RHR	3.8
K3.17	Reactor vessel head spray	3.1
K3.18	Containment ventilation	3.3
K3.19	Containment atmosphere sampling	3.0
K3.20	SBGT	3.8
K3.21	Traversing in-core probe system	3.0
K3.22	DELETED	
K3.23	High pressure core spray	3.6
K3.24	Reactor building drainage system	2.7
K3.25	Component cooling water systems	2.9
K3.26	AC distribution	3.0
K3.27	Circulating water	2.0
K3.28	Containment nitrogen inerting system	3.3
K3.29	Condenser circulating water makeup	1.8
K3.30	Leak detection system	3.1
K3.31	RPS—reactor protection system	3.6
K3.32	DC distribution	3.0
K3.33	Plant pneumatic systems	3.3
K3.34	Process rad monitoring	3.1
K3.35	Nuclear boiler instrumentation	3.4

K4	**Knowledge of primary containment isolation system/nuclear steam supply shut-off design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	3.8
K4.02	Testability	3.2
K4.03	Manual initiation capability	3.9
K4.04	Automatic bypassing of selected isolations during specified plant conditions	3.8
K4.05	Single failures will not impair the function ability of the system	3.6
K4.06	Once initiated, system reset requires deliberate operator action	3.8
K4.07	Physical separation of system components (to prevent localized environmental factors, electrical faults, and physical events from impairing system response)	3.3
K4.08	Manual defeating of selected isolations during specified emergency conditions	4.0
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the primary containment isolation system/nuclear steam supply shut-off:** (CFR: 41.5 / 45.3)	
K5.01	Primary containment integrity	4.1
K5.02	Secondary containment integrity	3.9
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the primary containment isolation system/nuclear steam supply shut-off:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution	3.8
K6.02	DC electrical distribution	3.7
K6.03	Process radiation monitoring system	3.5
K6.04	Nuclear boiler instrumentation	3.7
K6.05	Containment instrumentation	3.6
K6.06	Various process instrumentation	3.2
K6.07	DELETED	
K6.08	Reactor protection system	3.7
K6.09	Plant pneumatic systems	3.2
K6.10	Leak detection system	3.1

A1	**Ability to predict or monitor changes in parameters associated with operation of the primary containment isolation system/nuclear steam supply shut-off including:** (CFR: 41.5 / 45.5)		
A1.01	System indicating lights and alarms	4.0	
A1.02	DELETED		
A1.03	Plant process computer/parameter display systems	3.3	
A1.04	Individual system relay status	3.0	
A1.05	Containment/drywell pressure	4.0	
A1.06	Suppression chamber pressure	3.8	
A1.07	Reactor water level	4.2	
A1.08	Reactor pressure	4.2	
A1.09	Secondary containment temperature	3.6	
A1.10	Secondary containment pressure	3.6	
A1.11	Containment floor drain/equip drain sump levels	3.1	
A1.12	Condenser vacuum	3.1	

A2	**Ability to (a) predict the impacts of the following on the primary containment isolation system/nuclear steam supply shut-off 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	AC electrical distribution failures	3.8	3.8
A2.02	DC electrical distribution failures	3.8	3.6
A2.03	System logic failures	3.9	4.0
A2.04	Process radiation monitoring system failures	3.4	3.3
A2.05	Nuclear boiler instrumentation failures	3.8	3.8
A2.06	Containment instrumentation failures	3.8	3.6
A2.07	Various process instrumentation failures	3.6	3.1
A2.08	Surveillance testing	3.1	3.0
A2.09	System initiation	4.0	4.1
A2.10	Loss of coolant accidents	4.0	4.3
A2.11	Standby liquid initiation	4.0	3.7
A2.12	Plant pneumatic system failures	3.6	3.1
A2.13	Leak detection system failures	3.3	3.1
A2.14	Reactor protection system failures	4.0	4.0

A3	**Ability to monitor automatic features of the primary containment isolation system/nuclear steam supply shut-off including:** (CFR: 41.7 / 45.7)		
A3.01	System indicating lights and alarms	4.0	

A3.02	Valve closures	4.3
A3.03	DELETED	
A3.04	Verification of relay operation	3.2
A3.05	Group isolations	4.2

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

A4.01	System valve operations	4.2
A4.02	Initiate the system	4.3
A4.03	Reset system isolations	4.0
A4.04	System indicating lights and alarms	3.8
A4.05	DELETED	
A4.06	Confirm initiation to completion	4.2
A4.07	Reset system initiations	3.8
A4.08	Group isolations	4.2

System:	**219000 SF5 RHR SPC RHR/LPCI: Torus/Suppression Pool Cooling Mode**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the RHR/LPCI: torus/suppression pool cooling mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Primary containment	4.1
K1.02	Condensate system	2.4
K1.03	DELETED	
K1.04	DELETED	
K1.05	DELETED	
K1.06	Keep fill system	3.1
K1.07	DELETED	
K1.08	DELETED	
K1.09	Nuclear boiler instrumentation	3.3
K1.10	Reactor building drain system	2.2
K1.11	Component cooling water systems	2.8
K1.12	LPCI/RHR system	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Valves	3.6
K2.02	Pumps	3.9
K2.03	Valve control logic	3.6
K3	**Knowledge of the effect that a loss or malfunction of the RHR/LPCI: torus/suppression pool cooling mode will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Suppression pool temperature control	4.2
K3.02	Suppression chamber temperature	3.8
K3.03	Primary containment	3.9
K4	**Knowledge of RHR/LPCI: torus/suppression pool cooling mode design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	

K4.02	DELETED	
K4.03	Diverting flow from the RPV to the containment during accident conditions	4.1
K4.04	DELETED	
K4.05	DELETED	
K4.06	DELETED	
K4.07	DELETED	
K4.08	Adequate pump net positive suction head	3.5
K4.09	Heat exchanger cooling	3.5
K4.10	DELETED	

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the RHR/LPCI: torus/suppression pool cooling mode:**
(CFR: 41.5 / 45.3)

K5.01	DELETED	
K5.02	NPSH/vortex	3.4
K5.03	DELETED	
K5.04	Heat exchanger operation	3.4
K5.05	LOCA signal	4.1
K5.06	System lineup	3.9

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the RHR/LPCI: torus/suppression pool cooling mode:**
(CFR: 41.7 / 45.7)

K6.01	AC electrical distribution system	3.8
K6.02	DC electrical distribution system	3.5
K6.03	Emergency diesel generator	4.0
K6.04	Keep fill system	3.3
K6.05	Condensate system	2.3
K6.06	Suppression pool	3.6
K6.07	DELETED	
K6.08	ECCS room cooling	3.3
K6.09	Nuclear boiler instrumentation	3.4
K6.10	Component cooling water systems	3.0

A1 **Ability to predict or monitor changes in parameters associated with operation of the RHR/LPCI: torus/suppression pool cooling mode including:**
(CFR: 41.5 / 45.5)

A1.01	Suppression pool temperature	4.2
A1.02	System flow	4.1

A1.03	System pressure	3.7	
A1.04	Suppression pool level	3.8	
A1.05	Condensate storage tank level	2.7	
A1.06	Motor amps	3.1	
A1.07	Emergency generator loading	4.0	
A1.08	DELETED		
A1.09	Suppression chamber air temperature	3.3	
A1.10	Containment air temperature: Mark III	3.5	
A1.11	System lights and alarms	3.7	
A1.12	Heat exchanger cooling flow	3.6	

A2 **Ability to (a) predict the impacts of the following on the RHR/LPCI: torus/suppression pool cooling mode 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	Inadequate net positive suction head/vortex limits	3.9	3.7
A2.02	Pump trips	4.0	3.8
A2.03	Valve operation	3.7	3.7
A2.04	DELETED		
A2.05	AC electrical failures	3.7	3.8
A2.06	DC electrical failures	3.3	3.5
A2.07	Emergency generator failure	3.9	3.9
A2.08	Pump seal failure	3.1	2.9
A2.09	Inadequate room cooling	3.3	3.0
A2.10	Nuclear boiler instrument failures	3.4	3.4
A2.11	Motor operated valve failures	3.7	3.7
A2.12	Valve logic failure	3.6	3.9
A2.13	High suppression pool temperature	3.9	3.9
A2.14	Loss of coolant accident	3.9	4.2
A2.15	Loss of, or inadequate, heat exchanger cooling flow	3.9	3.7
A2.16	High suppression pool level	3.7	3.3
A2.17	Low suppression pool level	3.7	3.6

A3 **Ability to monitor automatic features of the RHR/LPCI: torus/suppression pool cooling mode including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3.9

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

A4.01	Pumps	4.2

A4.02	Valve lineup	4.2
A4.03	Keep fill system	3.3
A4.04	Minimum flow valves	3.5
A4.05	Heat exchanger cooling flow	3.7
A4.06	Valve logic reset following automatic initiation of LPCI/RHR in injection mode	3.8
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	DELETED	
A4.14	The overrides for suppression pool cooling valve logic	4.0

System: **226001 SF5 RHR CSS RHR/LPCI: Containment Spray System Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the RHR/LPCI: containment spray system mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Primary containment	4.2
K1.02	DELETED	
K1.03	DELETED	
K1.04	DELETED	
K1.05	Keep fill system	3.2
K1.06	Condensate system	2.4
K1.07	DELETED	
K1.08	Nuclear boiler instrumentation	3.5
K1.09	DELETED	
K1.10	DELETED	
K1.11	Component cooling water systems	3.0
K1.12	DELETED	
K1.13	Containment instrumentation	3.4
K1.14	LPCI/RHR System	4.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Valves	3.5
K2.02	Pumps	4.0
K2.03	Valve control logic	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RHR/LPCI: containment spray system mode will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Containment/drywell/suppression chamber pressure	4.3
K3.02	Containment/drywell/suppression chamber temperature	4.1
K3.03	Containment/drywell/suppression chamber components, continued operation with elevated pressure or temperature or level	3.7

K4	**Knowledge of RHR/LPCI: containment spray system mode design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	DELETED	
K4.03	Reduction in vessel injection flow during accident conditions	3.8
K4.04	DELETED	
K4.05	Pump minimum flow protection	3.2
K4.06	Pump motor cooling	2.8
K4.07	Prevention of water hammer	3.2
K4.08	Adequate pump net positive suction head	3.4
K4.09	Automatic containment spray initiation: BWR-6	4.2
K4.10	DELETED	
K4.11	Prevention of leakage to the environment through system heat exchanger	3.2
K4.12	Prevention of inadvertent containment spray activation	3.2
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the RHR/LPCI: containment spray system mode:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	Vacuum breaker operation	3.6
K5.07	Pressure suppression pressure	4.3
K5.08	Containment spray initiation pressure limit	4.3
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the RHR/LPCI: containment spray system mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution system	4.0
K6.02	DC electrical distribution system	3.5
K6.03	DELETED	
K6.04	Keep fill system	3.2
K6.05	Suppression pool (temperature level and pressure)	3.6
K6.06	Condensate transfer	2.5
K6.07	ECCS room cooling	2.9

K6.08	Nuclear boiler instrumentation	3.4	
K6.09	Reactor building to suppression chamber vacuum breakers	3.5	
K6.10	Suppression chamber to drywell vacuum breakers: Mark I, II	3.6	
K6.11	Component cooling water systems	2.8	
K6.12	Containment integrity	3.8	
K6.13	Suction flow path	3.5	
K6.14	Containment vacuum breakers Mark III	3.9	
A1	**Ability to predict or monitor changes in parameters associated with operation of the RHR/LPCI: containment spray system mode including:** (CFR: 41.5 / 45.5)		
A1.01	Containment/drywell pressure	4.5	
A1.02	Containment/drywell temperature	4.1	
A1.03	Suppression chamber pressure: Mark I, II	4.4	
A1.04	Suppression pool temperature: Mark I, II	3.9	
A1.05	DELETED		
A1.06	System flow	3.8	
A1.07	System pressure	3.6	
A1.08	Suppression pool level	3.5	
A1.09	DELETED		
A1.10	Emergency generator loading	3.7	
A1.11	Heat exchanger cooling flow	3.4	
A1.12	Lights and alarms	3.6	
A1.13	Pump discharge pressure	3.4	
A2	**Ability to (a) predict the impacts of the following on the RHR/LPCI: containment spray system mode 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	Inadequate net positive suction head	4.0	3.6
A2.02	Pumps trips	4.0	3.8
A2.03	Valve closures	3.8	3.8
A2.04	Valve openings	3.8	3.8
A2.05	AC electrical failures	3.8	3.8
A2.06	DC electrical failures	3.3	3.6
A2.07	DELETED		
A2.08	Pump seal failure	3.3	2.7
A2.09	Inadequate room cooling	3.0	2.9
A2.10	Nuclear boiler instrument failures	3.7	3.4
A2.11	Motor operated valve failures	3.7	3.8
A2.12	DELETED		

A2.13	Valve logic failure	3.8	3.8
A2.14	High suppression pool level	3.8	3.3
A2.15	High containment/drywell pressure	4.0	3.9
A2.16	Loss of, or inadequate heat exchanger cooling flow	3.5	3.5
A2.17	High containment/drywell temperature	3.7	3.7
A2.18	Low (or negative) containment/drywell pressure during system operation	4.0	3.8
A2.19	Low (or negative) suppression chamber pressure during system operation: Mark I, II	4.0	3.8
A2.20	Loss of coolant accident	3.8	4.2
A2.21	Loss of containment/drywell cooling system(s)	3.3	3.5

A3 **Ability to monitor automatic features of the RHR/LPCI: containment spray system mode including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3.8
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	Pump start	3.9

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

A4.01	Pumps	4.2
A4.02	Valves	4.1
A4.03	DELETED	
A4.04	Keep fill system	3.2
A4.05	DELETED	
A4.06	DELETED	
A4.07	Valve logic reset/bypass/override	3.8
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	Suppression pool spray valve logic override	3.9
A4.17	Manual initiation controls: BWR-6	4.2
A4.18	Automatic system initiation reset: BWR-6	4.1
A4.19	DELETED	
A4.20	DELETED	

System: **230000 SF5 RHR SPS RHR/LPCI: Torus/Suppression Pool Spray Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the RHR/LPCI: torus/suppression pool spray mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Primary containment	3.9
K1.02	Condensate system	2.3
K1.03	DELETED	
K1.04	DELETED	
K1.05	DELETED	
K1.06	Keep fill system	3.0
K1.07	DELETED	
K1.08	Nuclear boiler instrumentation	3.2
K1.09	Reactor building drain system	2.3
K1.10	Component cooling water systems	2.6
K1.11	LPCI/RHR system	4.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Valves	3.6
K2.02	Pumps	3.8
K2.03	Control logic	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RHR/LPCI: torus/suppression pool spray mode will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Suppression chamber pressure	4.0
K3.02	Suppression pool temperature	3.6
K3.03	Drywell pressure	3.7
K3.04	Suppression chamber air temperature	3.5
K3.05	Primary containment	3.7
K3.06	Primary containment pressure	3.7

K4	**Knowledge of RHR/LPCI: torus/suppression pool spray mode design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	DELETED	
K4.03	Diverting flow from the RPV to the containment during accident conditions	3.9
K4.04	Prevention of piping overpressurization	3.2
K4.05	Pump minimum flow protection	3.2
K4.06	Pump motor cooling	2.7
K4.07	Prevention of water hammer	3.2
K4.08	Adequate pump net positive suction head	3.4
K4.09	DELETED	
K4.10	Prevention of leakage to the environment through system heat exchanger	3.2
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the RHR/LPCI: torus/suppression pool spray mode:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Pump cavitation/vortex	3.3
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	Heat exchanger operation	3.2
K5.07	Vacuum breaker operation	3.4
K5.08	System lineup	3.5
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the RHR/LPCI: torus/suppression pool spray mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution	3.8
K6.02	DC electrical distribution	3.5
K6.03	Emergency diesel generator	3.8
K6.04	Keep fill system	3.1
K6.05	Suppression pool	3.5
K6.06	Condensate system	2.3
K6.07	ECCS room cooling	3.0
K6.08	Nuclear boiler instrumentation	3.3

K6.09	Reactor building to suppression pool vacuum breakers	3.7	
K6.10	Component cooling water systems	2.9	
K6.11	High drywell pressure	3.8	
K6.12	Low suppression pool level	3.7	
K6.13	High reactor pressure	3.3	

A1 **Ability to predict or monitor changes in parameters associated with operation of the RHR/LPCI: torus/suppression pool spray mode including:**
(CFR: 41.5 / 45.5)

A1.01	Suppression chamber pressure	4.0
A1.02	Suppression pool temperature	3.6
A1.03	Drywell pressure	3.9
A1.04	System flow	3.6
A1.05	System pressure	3.6
A1.06	Suppression pool level	3.6
A1.07	Condensate storage tank level	2.7
A1.08	DELETED	
A1.09	Emergency generator loading	3.5
A1.10	DELETED	
A1.11	Suppression chamber air temperature	3.2
A1.12	Lights and alarms	3.6
A1.13	Heat exchanger cooling flow	3.4

A2 **Ability to (a) predict the impacts of the following on the RHR/LPCI: torus/suppression pool spray mode 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	Inadequate net positive suction/vortex limits	3.4	3.8
A2.02	Pump trips	3.6	3.9
A2.03	Valve closures	3.6	3.7
A2.04	Valve openings	3.6	3.6
A2.05	AC electrical failures	3.7	3.8
A2.06	DC electrical failures	3.6	3.5
A2.07	Emergency generator failure	3.7	3.7
A2.08	Pump seal failure	2.7	2.9
A2.09	Inadequate room cooling	2.9	2.9
A2.10	Nuclear boiler instrument failures	3.6	3.3
A2.11	Motor operated valve failures	3.6	3.6
A2.12	Valve logic failure	3.4	3.7
A2.13	High suppression pool level	3.6	3.3
A2.14	Low (or negative) suppression pool pressure during system operation	3.0	3.6

A2.15	Loss of coolant accident	3.7	4.0
A2.16	Loss of, or inadequate, heat exchanger cooling flow	3.3	3.4
A3	**Ability to monitor automatic features of the RHR/LPCI: torus/suppression pool spray mode including:** (CFR: 41.7 / 45.7)		
A3.01	Valve operation	3.8	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Pumps	4.2	
A4.02	Valve lineup	4.1	
A4.03	Keep fill system	3.2	
A4.04	Minimum flow valves	3.3	
A4.05	Heat exchanger cooling flow	3.4	
A4.06	Valve logic reset following automatic initiation of LPCI/RHR in injection mode	3.6	
A4.07	DELETED		
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	The override for suppression pool spray valve logic	4.0	

System: 290001 SF5 SC Secondary Containment

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the secondary containment and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor building ventilation	3.9
K1.02	Primary containment system	3.7
K1.03	Fuel handling building ventilation	3.5
K1.04	SBGT/FRVS	4.0
K1.05	Auxiliary building ventilation BWR - 6	3.9
K1.06	DELETED	
K1.07	Turbine building ventilation (steam tunnel)	3.2
K1.08	Offgas system	2.8
K1.09	Plant pneumatic systems	3.2
K1.10	Auxiliary boiler system: BWR-2,3,4	2.6
K1.11	Process radiation monitoring system	3.7
K1.12	Area radiation monitoring	3.4
K1.13	Radwaste systems	2.5
K1.14	Fire protection system	2.9
K1.15	Nuclear boiler instrumentation	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Airlock door interlock	2.7
K2.02	HVAC isolation dampers	2.8
K3	**Knowledge of the effect that a loss or malfunction of the secondary containment will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Off-site radioactive release rates	4.1
K3.02	Secondary containment pressure	3.7
K3.03	Plant ventilation systems	3.4
K3.04	Primary containment system BWR-6	3.5
K3.05	Offgas system flow	2.7
K3.06	Secondary containment temperature	3.2

K4	**Knowledge of secondary containment design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Personnel access without breaching secondary containment	3.4
K4.02	Protection against over pressurization	3.3
K4.03	Fluid leakage collection	2.9
K4.04	Auxiliary building isolation: BWR-6	3.5
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the secondary containment:** (CFR: 41.5 / 45.3)	
K5.01	Vacuum breaker operation: BWR-4	3.6
K5.02	Flow measurement: BWR-3	2.9
K5.03	Building delta pressure control	3.5
K5.04	Secondary containment integrity	3.9
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the secondary containment:** (CFR: 41.7 / 45.7)	
K6.01	Reactor building ventilation	3.8
K6.02	Radwaste building ventilation	2.2
K6.03	SBGT/FRVS	4.0
K6.04	Primary containment system	3.6
K6.05	Auxiliary building ventilation BWR-6	3.5
K6.06	DELETED	
K6.07	DELETED	
K6.08	Plant pneumatic systems	3.1
K6.09	AC electrical distribution	3.3
K6.10	Radwaste systems	2.2
A1	**Ability to predict or monitor changes in parameters associated with operation of the secondary containment including:** (CFR: 41.5 / 45.5)	
A1.01	DELETED	
A1.02	High area temperature: BWR-6	3.8
A1.03	Reactor building differential pressure	3.9
A1.04	Reactor building area temperature	3.6
A1.05	Auxiliary building differential pressure BWR-6	3.6
A1.06	Auxiliary building area temperatures BWR-6	3.7

A1.07	Fuel building differential pressure	3.3	
A1.08	Fuel building area temperature	3.3	
A1.09	Radwaste building differential pressure	2.1	
A1.10	Radwaste building area temperature	2.0	
A1.11	System indicating lights and alarms	3.5	
A1.12	Offsite release rates	4.0	

A2	**Ability to (a) predict the impacts of the following on the secondary containment 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	Personnel airlock failure	3.8	3.3
A2.02	Excessive outleakage	3.6	3.6
A2.03	High area radiation	3.9	3.8
A2.04	High airborne radiation	3.9	3.7
A2.05	High area temperature	4.0	3.7
A2.06	Auxiliary building isolation: BWR-6	3.7	3.4
A2.07	Inadvertent fire suppression system initiation	2.8	2.7
A2.08	Loss of secondary containment integrity	4.0	3.9

A3	**Ability to monitor automatic features of the secondary containment including:** (CFR: 41.7 / 45.7)	
A3.01	Secondary containment isolation	4.1
A3.02	Normal building differential pressure	3.7
A3.03	Plant ventilation systems	3.3

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Reactor building differential pressure	3.9
A4.02	DELETED	
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	

A4.08	DELETED	
A4.09	DELETED	
A4.10	System lineups	3.7
A4.11	System reset	3.5
A4.12	Surveillance testing	2.9
A4.13	Secondary containment ventilation systems	3.6

System: 262001 SF6 AC A.C. Electrical Distribution

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the AC electrical distribution and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Emergency generators	4.7
K1.02	DC electrical distribution	4.1
K1.03	Off-site power system	4.4
K1.04	Uninterruptible power supply (switch yard UPS)	3.5
K1.05	Main turbine generator and auxiliaries system	3.5
K1.06	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	AC breaker control power	3.7
K2.03	Major motor control centers/buses (480V and higher)	3.8
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 / 45.4)	
K3.01	Operationally significant AC loads	4.1
K3.02	Emergency generators	4.6
K3.03	DC electrical distribution	3.9
K3.04	Uninterruptible power supply system	3.7
K3.05	Qualified off-site power sources	4.1
K3.06	DELETED	
K4	**Knowledge of AC electrical distribution design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Lockouts	3.5
K4.02	Circuit breaker automatic trips	3.5
K4.03	Automatic bus transfer	3.8
K4.04	Protective relaying	3.5
K4.05	Paralleling of AC sources	3.8
K4.06	Redundant power sources to vital buses	4.1
K4.07	Breaker closure permissives	3.6

K4.08	Alternate breaker control methods	3.2	
K4.09	Divisional separation	3.6	

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the AC electrical distribution:** (CFR: 41.5 / 45.3)		
K5.01	Paralleling AC sources	3.9	
K5.02	Breaker control power	3.5	
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	DC power	3.8	
K6.02	Off-site power	4.2	
K6.03	Generator trip	3.9	
K6.04	Emergency generators	4.5	
K6.05	Breaker malfunctions	3.6	
A1	**Ability to predict or monitor changes in parameters associated with operation of the AC electrical distribution including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	DELETED		
A1.03	Bus voltage	3.6	
A1.04	Load currents	3.2	
A1.05	DELETED		
A1.06	Lights and alarms	3.4	
A1.07	System frequency	3.2	
A1.08	System power	3.3	

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 / 45.6)	**RO**	**SRO**
A2.01	Turbine/generator trip	4.0	3.8
A2.02	Loss of coolant accident	4.3	4.2
A2.03	Loss of/degraded off-site power	4.5	4.3
A2.04	DELETED		
A2.05	Bus grounds /faults	3.8	3.6

A2.06	Loss of a plant bus	4.0	3.8
A2.07	DELETED		
A2.08	DELETED		
A2.09	Exceeding voltage limitations	3.8	3.4
A2.10	Exceeding current limitations	3.7	3.4
A2.11	Degraded bus voltages	3.9	3.9
A2.12	Station blackout	4.6	4.5

A3 **Ability to monitor automatic features of the AC electrical distribution including:**
(CFR: 41.7 / 45.7)

A3.01	Breaker tripping	3.6
A3.02	Bus transfer	3.7
A3.03	Load shedding	3.8
A3.04	Load sequencing	3.8
A3.05	Synchronization of AC sources	3.7
A3.06	Tap changers	2.9

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

A4.01	Breakers and disconnects	3.7
A4.02	DELETED	
A4.03	Local operation of breakers	3.0
A4.04	Synchronizing of AC sources	3.9
A4.05	DELETED	
A4.06	Instrumentation switches	3.2
A4.07	Tap changers	2.8

System: **263000 SF6 DC D.C. Electrical Distribution**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the DC electrical distribution and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical distribution	4.0
K1.02	DELETED	
K1.03	Plant ventilation systems	2.8
K1.04	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Operationally significant DC loads	4.0
K2.02	DELETED	
K2.03	Battery chargers	3.5
K2.04	Inverters	3.4
K3	**Knowledge of the effect that a loss or malfunction of the DC electrical distribution will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	DELETED	
K3.02	Operationally significant systems using DC control power	4.2
K3.03	Systems with DC components (e.g. valves, motors, solenoids, instruments, etc.)	3.8
K4	**Knowledge of DC electrical distribution design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Manual/ automatic transfers	3.5
K4.02	Breaker interlocks, permissives, bypasses, and cross ties	3.5
K4.03	Ground detection	2.9
K4.04	Battery charging methods	2.9
K4.05	Coping time	3.6
K4.06	Divisional separation	3.6

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the DC electrical distribution:** (CFR: 41.5 / 45.3)		
K5.01	Hydrogen generation	3.1	
K5.02	Battery charger and battery	3.4	
K5.03	Battery ventilation	2.9	
K5.04	Ground detection	2.9	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the DC electrical distribution:** (CFR: 41.7 / 45.7)		
K6.01	AC electrical distribution	3.8	
K6.02	Battery ventilation	2.9	
K6.03	Grounds	3.0	
K6.04	Station blackout	4.3	
K6.05	Degraded voltage	3.6	
K6.06	Breaker malfunctions	3.4	
A1	**Ability to predict or monitor changes in parameters associated with operation of the DC electrical distribution including:** (CFR: 41.5 / 45.5)		
A1.01	Battery charging/discharging rate	3.3	
A1.02	Lights and alarms	3.3	
A1.03	Voltage	3.5	
A2	**Ability to (a) predict the impacts of the following on the DC 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 / 45.6)	**RO**	**SRO**
A2.01	Grounds /faults	3.5	3.2
A2.02	Loss of ventilation during charging	2.9	3.0
A2.03	Abnormal battery parameters	3.4	3.2
A2.04	Station blackout	4.5	4.2
A3	**Ability to monitor automatic features of the DC electrical distribution including:** (CFR: 41.7 / 45.7)		
A3.01	DELETED		

A3.02	Breaker trips	3.5
A3.03	Transfers	3.3
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Operationally significant breakers and control power fuses	3.7
A4.02	DELETED	
A4.03	DELETED	
A4.04	Ground detection circuit	2.8
A4.05	Meters, dials, recorders, alarms, and indicating lights	3.3
A4.06	Transfers	3.2

System: 264000 SF6 EGE Emergency Generators (Diesel/Jet)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the emergency generators and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical distribution	4.5
K1.02	DELETED	
K1.03	Fire protection system	3.0
K1.04	Component cooling water system	3.4
K1.05	DELETED	
K1.06	DELETED	
K1.07	Emergency core cooling systems	4.4
K1.08	Plant ventilation systems	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Starting air compressor	2.8
K2.02	Fuel oil pumps	2.9
K2.03	Turning gear (jet engine)	2.6
K2.04	Ignition system (jet engine)	2.7
K2.05	Lube oil pumps	2.9
K2.06	Battery charger	3.0
K2.07	DC components	3.2
K2.08	Cooling water pumps	3.3
K2.09	Room ventilation fans	2.8
K3	**Knowledge of the effect that a loss or malfunction of the emergency generators will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	DELETED	
K3.02	AC electrical distribution	4.4
K3.03	Operationally significant loads	4.3
K3.04	Bus frequency/voltage	3.9
K4	**Knowledge of emergency generators design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Generator trips	4.0

K4.02	DELETED	
K4.03	Generator droop control	3.4
K4.04	Field flashing	3.2
K4.05	Load shedding and sequencing	4.1
K4.06	Governor control	3.6
K4.07	Local operation and control	3.5
K4.08	Automatic startup	4.2
K4.09	Standby readiness	3.8
K4.10	Auto start logic	4.2

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the emergency generators:**
(CFR: 41.5 / 45.3)

K5.01	Parallel vs. isochronous operation	3.6
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	Load sequencing	3.9
K5.07	DELETED	
K5.08	Generator load limits	4.1
K5.09	Fuel consumption rate	2.8

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

K6.01	Starting air components	3.8
K6.02	Fuel oil components	3.6
K6.03	Lube oil components	3.6
K6.04	Turning gear	2.2
K6.05	Ignition system	3.0
K6.06	Battery charger	3.2
K6.07	Cooling water system	3.7
K6.08	AC distribution system	4.0
K6.09	DC distribution system	4.0
K6.10	Jacket water components	3.3
K6.11	Turbo/super charger	3.2
K6.12	Room ventilation	3.1

A1	**Ability to predict or monitor changes in parameters associated with operation of the emergency generators including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	Fuel consumption rate	2.7	
A1.03	Operating voltages, currents, and temperatures	3.6	
A1.04	DELETED		
A1.05	DELETED		
A1.06	Emergency generator room temperature	2.8	
A1.07	Gas generator temperature	3.0	
A1.08	Gas generator speed	3.0	
A1.09	Generator load	3.9	
A1.10	Lights and alarms	3.5	

A2	**Ability to (a) predict the impacts of the following on the emergency 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 / 45.6)	**RO**	**SRO**
A2.01	DELETED		
A2.02	DELETED		
A2.03	DELETED		
A2.04	DELETED		
A2.05	DELETED		
A2.06	DELETED		
A2.07	Loss of off-site power	4.7	4.6
A2.08	Initiation of emergency generator room fire protection system	3.1	3.5
A2.09	Loss of safety bus	4.7	4.3
A2.10	LOCA	4.7	4.4
A2.11	Failure of emergency generator to start/load	4.6	4.3
A2.12	Loss of DC electrical distribution	3.5	4.0
A2.13	Loss of starting air	3.8	3.9

A3	**Ability to monitor automatic features of the emergency generators including:** (CFR: 41.7 / 45.7)		
A3.01	Starting/loading	4.2	
A3.02	DELETED		
A3.03	DELETED		
A3.04	Frequency and voltage control	4.0	
A3.05	Load shedding and sequencing	3.9	

A3.06	Cooling water system operation	3.6
A3.07	Room ventilation system	3.1

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

A4.01	Voltage/frequency	4.1
A4.02	Synchroscope	3.9
A4.03	Transfer of emergency control between manual and automatic	3.6
A4.04	Starting, loading, unloading, and stopping of emergency generator	4.1
A4.05	DELETED	
A4.06	Droop setting	3.3
A4.07	Transfer of control to local/remote panels	3.4

System: 262002 SF6 UPS Uninterruptable Power Supply (AC/DC)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the uninterruptable power supply (AC/DC) and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor water level control system	3.5
K1.02	Feedwater system	3.4
K1.03	Rod position information system	3.5
K1.04	Reactor manual control system	3.4
K1.05	Reactor/turbine pressure regulating system	3.3
K1.06	Plant process computer/parameter display systems	2.8
K1.07	Rod worth minimizer system	3.0
K1.08	Primary containment isolation system/nuclear steam supply shut-off	3.3
K1.09	Primary containment system and auxiliaries	3.1
K1.10	Fire protection system	2.6
K1.11	DELETED	
K1.12	Main turbine generator and auxiliary systems	2.8
K1.13	Recirculation flow control system	3.3
K1.14	Radiation monitoring system	2.9
K1.15	DELETED	
K1.16	Main and reheat steam system	2.5
K1.17	RPS	3.5
K1.18	DELETED	
K1.19	APRM/LPRM/OPRM system	3.4
K1.20	DELETED	
K1.21	RC&IS (BWR-6)	3.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Static switch/inverter	3.3
K2.02	Motor generator	3.3
K3	**Knowledge of the effect that a loss or malfunction of the uninterruptable power supply (AC/DC) will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level control system	3.5
K3.02	Recirculation flow control system	3.3
K3.03	Feedwater system	3.4

K3.04	Fire protection system	2.5
K3.05	Rod worth minimizer system	2.8
K3.06	Rod position indication system	3.4
K3.07	Reactor manual control system	3.4
K3.08	Plant process computer/parameter display systems	2.8
K3.09	Primary containment system and auxiliaries	3.0
K3.10	Primary containment isolation system/nuclear steam supply shut-off	3.3
K3.11	Main and reheat steam system	2.6
K3.12	DELETED	
K3.13	Rx pressure	3.1
K3.14	Rx power	3.3
K3.15	Main turbine generator and auxiliary systems	2.9
K3.16	DELETED	
K3.17	DELETED	
K3.18	RC&IS (BWR-6)	3.8
K3.19	Reactor/turbine pressure regulating system	3.2
K3.20	Radiation monitoring system	2.7
K3.21	APRM/LPRM/OPRM system	3.3
K3.22	RPS	3.3

K4 **Knowledge of uninterruptable power supply (AC/DC) design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Transfer of power supplies	3.5

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the uninterruptable power supply (AC/DC):**
(CFR: 41.5 / 45.3)

K5.01	Static switch/inverter operation	3.3
K5.02	Motor generator operation	3.1
K5.03	DELETED	
K5.04	DELETED	

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the uninterruptable power supply (AC/DC):**
(CFR: 41.7 / 45.7)

K6.01	AC electrical distribution	3.4
K6.02	DC electrical distribution	3.4

K6.03	Static switch/inverter	3.4	
K6.04	Motor generator	3.2	

A1 **Ability to predict or monitor changes in parameters associated with operation of the uninterruptable power supply (AC/DC) including:**
(CFR: 41.5 / 45.5)

A1.01	Inverter outputs	3.1	
A1.02	Motor generator outputs	3.1	
A1.03	Lights and alarms	3.1	

A2 **Ability to (a) predict the impacts of the following on the uninterruptable power supply (AC/DC) 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	Abnormal voltage	3.2	3.2
A2.02	DELETED		
A2.03	Frequency changes in the system	3.0	2.9
A2.04	DELETED		
A2.05	Loss of UPS	3.8	3.9

A3 **Ability to monitor automatic features of the uninterruptable power supply (AC/DC) including:**
(CFR: 41.7 / 45.7)

A3.01	Transfer of power sources	3.4	

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

A4.01	Transfer of power sources	3.1	

System: **215005 SF7 Average Power Range Monitor/Local Power Range Monitor System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the average power range monitor/local power range monitor system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RPS	4.4
K1.02	IRM system	3.7
K1.03	RBM system	3.9
K1.04	DELETED	
K1.05	DELETED	
K1.06	Plant process computer/parameter display systems	3.1
K1.07	DELETED	
K1.08	DELETED	
K1.09	Reactor recirculation system (BWR-5, 6)	3.6
K1.10	RMCS (BWR -2, 3, 4, & 5)	3.5
K1.11	RCIS (BWR -6)	3.8
K1.12	DELETED	
K1.13	TIPS	3.1
K1.14	Reactor vessel and internals	3.0
K1.15	Redundant reactivity control system	3.5
K1.16	DELETED	
K1.17	Recirculation flow control system	3.5
K1.18	OPRM	3.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	LPRM channels	3.2
K2.02	APRM channels	3.7
K2.03	OPRM channels	3.6
K3	**Knowledge of the effect that a loss or malfunction of the average power range monitor/local power range monitor system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	RPS	4.2
K3.02	Reactor recirculation system (BWR-5, 6)	3.6
K3.03	RMCS (BWR-2, 3, 4, & 5)	3.4
K3.04	RCIS (BWR-6)	3.8

K3.05	Reactor power indication	4.0
K3.06	IRM system	3.2
K3.07	Rod block monitor system	3.7
K3.08	Plant process computer parameter display systems	3.0
K3.09	Recirculation flow control system	3.3
K3.10	OPRM	3.7

K4 **Knowledge of average power range monitor/local power range monitor system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Rod withdrawal blocks	3.9
K4.02	Reactor SCRAM signals	4.4
K4.03	DELETED	
K4.04	LPRM detector replacement	2.5
K4.05	Alarm seal-in	2.9
K4.06	Effects of detector aging on LPRM/APRM readings	2.9
K4.07	Flow biased trip setpoints	3.9
K4.08	Sampling of overall core power in each APRM	3.5
K4.09	Core thermal calculations	3.6
K4.10	Bypassing an LPRM, APRM, or OPRM channel	3.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the average power range monitor/local power range monitor system:**
(CFR: 41.5 / 45.3)

K5.01	LPRM detector operation	3.5
K5.02	Effects of voids on LPRM indication	3.1
K5.03	Control rod symmetrical patterns	3.5
K5.04	LPRM detector location and core symmetry	3.3
K5.05	Core flow effects on APRM trip setpoints	3.8
K5.06	LPRM/OPRM/APRM channel assignments	3.2
K5.07	APRM operation	3.7
K5.08	OPRM operation	3.6

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the average power range monitor/local power range monitor system:**
(CFR: 41.7 / 45.7)

K6.01	RPS	3.9
K6.02	TIPS	2.9
K6.03	Detectors	3.3

K6.04	Trip units	3.6
K6.05	IRMs	3.1
K6.06	Recorder	2.6
K6.07	Flow converter/comparator network	3.5
K6.08	Uninterruptable power supply (AC/DC)	3.5
K6.09	Thermal hydraulic instability	3.9

A1 **Ability to predict or monitor changes in parameters associated with operation of the average power range monitor/local power range monitor system including:**
(CFR: 41.5 / 45.5)

A1.01	Reactor power indication	4.3
A1.02	RPS status	4.2
A1.03	Control rod block status	3.9
A1.04	Scram and rod block trip setpoints	4.0
A1.05	Lights and alarms	3.8
A1.06	Recirculation flow control valve position (BWR-5 and 6)	3.6
A1.07	APRM (gain adjustment factor)	3.7
A1.08	LPRM, APRM, or OPRM channel bypass status	3.7

A2 **Ability to (a) predict the impacts of the following on the power range monitoring systems 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	Power supply degradation	3.3	3.1
A2.02	Upscale or downscale trips	4.1	3.9
A2.03	INOP Trip	4.1	3.9
A2.04	Scram trip signals	4.4	4.3
A2.05	Loss of recirculation flow signal	4.0	3.9
A2.06	Recirculation flow channels upscale	3.8	3.8
A2.07	Recirculation flow channels flow mismatch	3.8	3.5
A2.08	Faulty or erratic operation of detectors/systems	3.5	3.4
A2.09	DELETED		
A2.10	Changes in void concentration	3.3	2.9
A2.11	Recirculation vortex event	3.3	2.7
A2.12	Operation of the OPRM enabled region of the power to flow map	4.0	3.9
A2.13	Thermal hydraulic instability	4.0	4.0

A3	**Ability to monitor automatic features of the average power range monitor/local power range monitor system system including:** (CFR: 41.7 / 45.7)	
A3.01	Four rod display	3.6
A3.02	DELETED	
A3.03	Meters and recorders	3.6
A3.04	DELETED	
A3.05	Flow converter/comparator signals	3.2
A3.06	Maximum disagreement between flow comparator channels	3.2
A3.07	DELETED	
A3.08	DELETED	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	IRM/APRM recorder	3.7
A4.02	DELETED	
A4.03	APRM back panel switches, meters and indicating lights	3.6
A4.04	LPRM back panel switches, meters and indicating lights	3.4
A4.05	Trip bypasses	3.7
A4.06	DELETED	
A4.07	OPRM back panel switches, and indicating lights	3.6

System: 215003 SF7 IRM Intermediate Range Monitor System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the intermediate range monitor system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RPS	4.3
K1.02	Reactor manual control system (BWR 2-5)	3.9
K1.03	Rod control and information system (BWR -6)	4.0
K1.04	Plant process computer/parameter display systems	3.0
K1.05	Display control system	3.2
K1.06	APRM system	3.7
K1.07	Reactor vessel and internals	3.0
K1.08	SRM system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	IRM channels/detectors	3.4
K3	**Knowledge of the effect that a loss or malfunction of the intermediate range monitor system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	RPS	4.2
K3.02	Reactor manual control	3.8
K3.03	Rod control and information system (BWR -6)	3.9
K3.04	Reactor power indication	4.0
K3.05	APRM system	3.4
K4	**Knowledge of intermediate range monitor system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	4.0
K4.02	Reactor SCRAM signals	4.2
K4.03	Gamma compensation	2.6
K4.04	Ranging IRMs	3.8
K4.05	Changing detector position	3.6
K4.06	Alarm seal-in	2.9
K4.07	Bypassing an IRM channel	3.6
K4.08	SRM-IRM overlap	3.5
K4.09	IRM-APRM overlap	3.6

K4.10	Automatically bypassing IRM rod block signals	3.6
K4.11	Automatically bypassing IRM SCRAM signals	3.6
K4.12	IRM INOP	3.7

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the intermediate range monitor system:** (CFR: 41.5 / 45.3)	
K5.01	Detector operation	3.0
K5.02	Gamma discrimination	2.6
K5.03	Changing detector position	3.3
K5.04	Reactor power indication response to rod position changes	3.8
K5.05	Downscale	3.7
K5.06	Inoperable	3.7
K5.07	High or upscale	3.8

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the intermediate range monitor system:** (CFR: 41.7 / 45.7)	
K6.01	Reactor protection system (power supply)	3.7
K6.02	24/48 volt DC power	3.6
K6.03	Detector drive motor	2.9
K6.04	Detectors	3.2
K6.05	Trip units	3.4
K6.06	DELETED	
K6.07	Recorder	2.9
K6.08	Changing mode switch position	3.8

A1	**Ability to predict or monitor changes in parameters associated with operation of the intermediate range monitor system including:** (CFR: 41.5 / 45.5)	
A1.01	Detector position	3.2
A1.02	Reactor power	4.1
A1.03	Reactor SCRAM signals	4.0
A1.04	Control rod block status	3.9
A1.05	Scram and rod block trip setpoints	3.9
A1.06	Lights and alarms	3.6
A1.07	Range	3.7
A1.08	IRM back panel switches	3.1

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the intermediate range 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 45.6)		
A2.01	Power supply degradation	3.1	3.0
A2.02	IRM inop condition	3.9	3.7
A2.03	Stuck detector	3.3	3.0
A2.04	Upscale or downscale trips	4.0	3.8
A2.05	Faulty or erratic operation of detectors/system	3.6	3.2
A2.06	Faulty range switch	3.4	3.2
A2.07	Failed recorder	3.0	2.8
A2.08	Improper overlap	3.8	3.5

A3	**Ability to monitor automatic features of the intermediate range monitor system including:** (CFR: 41.7 / 45.7)	
A3.01	Meters and recorders	3.6
A3.02	DELETED	
A3.03	Scram signals	4.1
A3.04	Control rod block signals	3.9
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	IRM recorder indication	3.6
A4.02	DELETED	
A4.03	IRM range switches	3.9
A4.04	IRM back panel switches, meters, and indicating lights	3.2
A4.05	Trip bypasses	3.5
A4.06	Detector drives	3.4
A4.07	DELETED	

System: 216000 SF7 NBI Nuclear Boiler Instrumentation

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the nuclear boiler instrumentation and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RPS	4.1
K1.02	PCIS/NSSSS	4.1
K1.03	RCIC	4.0
K1.04	HPCS system	4.0
K1.05	RHR system	4.0
K1.06	LPCS system	4.0
K1.07	ADS	4.1
K1.08	Relief/safety valves	3.7
K1.09	Redundant reactivity control/ alternate rod insertion system	3.5
K1.10	Recirculation flow control system	3.5
K1.11	MSIV leakage control system	2.9
K1.12	Reactor water level control system	4.0
K1.13	Feedwater system	3.6
K1.14	High pressure coolant injection system	4.1
K1.15	Isolation (emergency) condenser	4.2
K1.16	Main turbine generator and auxiliary systems	3.1
K1.17	Emergency generators (BWR 2)	3.7
K1.18	Analog trip system	3.6
K1.19	ATWS-alternate rod insertion (ARI) system	3.9
K1.20	Plant process computer/parameter display systems	3.1
K1.21	DELETED	
K1.22	Reactor vessel and internals	3.1
K1.23	Recirculation system	3.4
K1.24	RWCU	3.4
K1.25	Primary containment system and auxiliaries	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Analog trip system	3.6
K3	**Knowledge of the effect that a loss or malfunction of the nuclear boiler instrumentation will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	RPS	4.1

K3.02	PCIS/NSSSS	4.1
K3.03	RCIC	4.0
K3.04	HPCS	4.1
K3.05	RHR system	4.0
K3.06	LPCS	4.0
K3.07	ADS	4.0
K3.08	Relief/safety valves	3.8
K3.09	Redundant reactivity control/alternate rod insertion system	3.6
K3.10	Recirculation flow control system	3.4
K3.11	MSIV leakage control system	2.9
K3.12	Reactor water level control system	3.9
K3.13	Feedwater system	3.5
K3.14	HPCI system	4.1
K3.15	Isolation (emergency) condenser	4.1
K3.16	Main turbine generator and auxiliary systems	3.1
K3.17	Emergency generators (BWR 2)	3.6
K3.18	Analog trip system	3.7
K3.19	ATWS-alternate rod insertion (ARI) system	3.8
K3.20	Plant process computer/parameter display systems	3.0
K3.21	DELETED	
K3.22	Reactor vessel and internals	3.1
K3.23	Vessel temperature	3.0
K3.24	Vessel level	3.7
K3.25	Vessel pressure	3.6
K3.26	Core flow	3.5
K3.27	Core differential pressure	3.3
K3.28	DELETED	
K3.29	Jet pump flow	3.3
K3.30	Recirculation system	3.4
K3.31	Remote shutdown system	3.2

K4 **Knowledge of nuclear boiler instrumentation design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Reading of nuclear boiler parameters outside the control room	3.3
K4.02	Physical separation of sensors	3.2
K4.03	DELETED	
K4.04	Inputs to the RPS	4.0
K4.05	Initiation of the ECCS	4.1
K4.06	Initiation of the PCIS/NSSSS	4.1
K4.07	Recirculation pump protection	3.5

K4.08	Protection for the main turbine from high moisture carryover	3.3
K4.09	Protection against filling the main steam lines from the feed system	3.3
K4.10	Automatic recirculation pump speed control	3.2
K4.11	Inputs to the redundant reactivity control system/alternate rod insertion	3.4
K4.12	Reactor vessel overpressure protection	3.6
K4.13	Overpressure protection for various low-pressure systems	3.3
K4.14	Temperature compensation for reactor water level indication	3.1
K4.15	Level/pressure channel ranges	3.3
K4.16	RPV level instrumentation design calibration conditions	3.3

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the nuclear boiler instrumentation:** (CFR: 41.5 / 45.3)

K5.01	Vessel level measurement	3.9
K5.02	Vessel pressure measurement	3.8
K5.03	Vessel temperature measurement	3.3
K5.04	Vessel differential pressure measurement	3.0
K5.05	DELETED	
K5.06	Rapid vessel depressurization effects on vessel level indications	4.0
K5.07	Elevated containment temperature effects on level indication	3.8
K5.08	Steam flow effect on reactor water level	3.5
K5.09	Recirculation flow effects on level indications	3.4
K5.10	Indicated level versus actual vessel level during vessel heatups or cooldowns	3.5
K5.11	Indicated vessel temperature response during rapid heatups or cooldowns	3.4
K5.12	Effects on level indication due to rapid changes in void fraction	3.5
K5.13	Reference leg flashing	3.8
K5.14	Density compensation	3.2
K5.15	DELETED	
K5.16	DELETED	

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

K6.01	AC electrical distribution	3.4
K6.02	DC electrical distribution	3.4

K6.03	RPV temperature/pressure changes	3.5	
K6.04	Transmitters	3.3	
K6.05	Instrument channels	3.3	
K6.06	Reference leg or condensing pot	3.5	
K6.07	Loss of a recirc pump	3.1	

A1 **Ability to predict or monitor changes in parameters associated with operation of the nuclear boiler instrumentation including:**
(CFR: 41.5 / 45.5)

A1.01	DELETED		
A1.02	Removing or returning a sensor (transmitter) to service	3.1	
A1.03	Surveillance testing	3.0	
A1.04	System venting	3.0	
A1.05	Lights and alarms	3.3	
A1.06	RPV pressure	3.8	
A1.07	RPV Level	3.8	
A1.08	RPV temperature	3.4	

A2 **Ability to (a) predict the impacts of the following on the nuclear boiler instrumentation 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	Detector malfunctions	3.7	3.5
A2.02	DELETED		
A2.03	DELETED		
A2.04	DELETED		
A2.05	Surveillance testing	3.1	2.9
A2.06	Loss of power supply	3.3	3.4
A2.07	DELETED		
A2.08	Elevated containment temperature	3.4	3.4
A2.09	Jet pump flow	3.8	3.3
A2.10	DELETED		
A2.11	DELETED		
A2.12	DELETED		
A2.13	DELETED		
A2.14	Partial or complete loss of recirculation flow	3.6	3.3

A3 **Ability to monitor automatic features of the nuclear boiler instrumentation including:**
(CFR: 41.7 / 45.7)

A3.01 DELETED

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	Channel select controls	3.2
A4.03	Plant process computer/parameter display systems	3.0
A4.04	Analog trip units	3.3

System: **272000 SF7 RMS Radiation Monitoring System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the radiation monitoring system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3.6
K1.02	Offgas system (augmented offgas)	3.7
K1.03	Stack gas	3.7
K1.04	Component cooling water system	3.0
K1.05	Radwaste system	2.9
K1.06	Reactor building ventilation system	3.6
K1.07	Isolation condenser	3.3
K1.08	DELETED	
K1.09	Primary containment isolation system	3.9
K1.10	Fuel handling systems	3.4
K1.11	DELETED	
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	DELETED	
K1.16	Plant process computer/parameter display systems	3.0
K1.17	DELETED	
K1.18	Primary/secondary containment	3.6
K1.19	DELETED	
K1.20	DELETED	
K1.21	DELETED	
K1.22	DELETED	
K1.23	Continuous air monitoring/ post-accident air monitoring systems	3.3
K1.24	Plant ventilation system	3.4
K1.25	Standby gas treatment	3.8
K1.26	Safety related service water system	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K2.04	Process radiation monitoring system	2.8
K2.05	DELETED	
K2.06	Area radiation monitors	2.6

K2.07	DELETED	
K2.08	Continuous air monitoring/post-accident air monitoring systems	2.7

K3 **Knowledge of the effect that a loss or malfunction of the radiation monitoring system will have on the following systems or system parameters:**
(CFR: 41.5 / 45.3)

K3.01	Liquid effluent release monitoring	3.4
K3.02	Gaseous effluent release monitoring	3.6
K3.03	Area radiation monitoring	3.1
K3.04	Main steam system	3.2
K3.05	Offgas system	3.6
K3.06	Plant ventilations systems	3.3
K3.07	DELETED	
K3.08	DELETED	
K3.09	DELETED	
K3.10	DELETED	
K3.11	Standby gas treatment system	3.6
K3.12	Safety related service water system	3.0
K3.13	Continuous air monitoring/post-accident air monitoring systems	2.9

K4 **Knowledge of radiation monitoring system design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	DELETED	
K4.02	System isolations/initiations	4.1
K4.03	Fail safe tripping of process radiation monitoring logic during conditions of instrument failure	3.5
K4.04	Process radiation monitoring surveillance testing	2.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the radiation monitoring system:**
(CFR: 41.7 / 45.4)

K5.01	Hydrogen injection operation’s effect on process radiation indications	3.3
K5.02	Radiation level trends	3.3

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the radiation monitoring system:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DC power	3.0	
K6.03	AC power	3.1	
K6.04	Plant process computer/parameter display systems	2.7	
K6.05	DELETED		
K6.06	Continuous air monitoring/ post-accident radiation monitoring system	2.9	
A1	**Ability to predict or monitor changes in parameters associated with operation of the radiation monitoring system including:** (CFR: 41.5 / 45.5)		
A1.01	Lights and alarms	3.4	
A1.02	DELETED		
A1.03	Radiations levels	3.7	
A1.04	Sample flows	2.8	

A2	**Ability to (a) predict the impacts of the following on the 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 / 45.6)	**RO**	**SRO**
A2.01	Fuel element failure	4.1	4.2
A2.02	DELETED		
A2.03	AC electrical failure	3.1	3.3
A2.04	DC electrical failure	2.9	3.2
A2.05	Loss of dilution steam	2.9	2.8
A2.06	Downscale trips	3.0	3.1
A2.07	Hydrogen injection operation	3.4	3.0
A2.08	Offgas system failure	3.5	3.4
A2.09	Low fuel pool level	3.7	3.6
A2.10	Loss of coolant accident	4.2	4.0
A2.11	Leakage or breaks from contaminated systems to atmosphere or to other process systems	3.9	3.7
A2.12	Refuel floor handling accidents/operations	3.9	4.0
A2.13	Low reactor water level during refueling operations	3.9	3.7
A2.14	Loss of, or inadequate, shielding	3.4	3.5
A2.15	Maintenance operations	2.8	2.5
A2.16	Instrument malfunctions	2.9	3.0
A2.17	Plant ventilation systems abnormal radiation levels	3.4	3.3

A3	**Ability to monitor automatic features of the radiation monitoring system including:** (CFR: 41.7 / 45.7)	
A3.01	Main steam Radiation alarms	3.5
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	Containment isolation	4.1
A3.10	DELETED	
A3.11	DELETED	
A3.12	Process radiation monitor isolations	3.6
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Radiation monitoring system recorders	3.3
A4.02	Meter indications	3.2
A4.03	DELETED	
A4.04	Plant process computer/parameter display systems	3.2
A4.05	Process radiation monitor	3.3
A4.06	Process radiation monitor logic	2.9

System: 212000 SF7 RPS Reactor Protection System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the reactor protection system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Nuclear instrumentation	4.3
K1.02	Nuclear boiler instrumentation	4.1
K1.03	DELETED	
K1.04	DELETED	
K1.05	Process radiation monitoring system	3.2
K1.06	Control rod drive hydraulic system	3.9
K1.07	DELETED	
K1.08	DELETED	
K1.09	Plant process computer/parameter display systems	2.8
K1.10	Main turbine generator and auxiliary systems	3.5
K1.11	Condensate system	2.4
K1.12	Reactor/turbine pressure regulating system	3.5
K1.13	Primary containment and auxiliaries	3.6
K1.14	Main steam system	3.6
K1.15	DELETED	
K1.16	RC&IS (BWR-6)	3.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RPS motor-generator sets	3.8
K2.02	RPS logic	4.1
K2.03	RPS alternate power supplies	3.9
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 / 45.4)	
K3.01	Process radiation monitoring	3.1
K3.02	PCIS/NSSSS	3.9
K3.03	Nuclear instrumentation	3.7
K3.04	DELETED	
K3.05	DELETED	
K3.06	Scram air header solenoid operated valves	4.1
K3.07	Reactor power	4.1
K3.08	DELETED	
K3.09	DELETED	

K3.10	DELETED	
K3.11	DELETED	
K3.12	DELETED	

K4	**Knowledge of reactor protection system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	DELETED	
K4.03	Transferring RPS power supplies	3.7
K4.04	DELETED	
K4.05	DELETED	
K4.06	DELETED	
K4.07	Manual SCRAM	4.2
K4.08	Scram reset time delay	3.3
K4.09	DELETED	
K4.10	Individual rod testing	3.2
K4.11	DELETED	
K4.12	Bypassing SCRAM signals	3.8
K4.13	Under frequency, over voltage, and under voltage protection	3.5

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the reactor protection system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	Logic channel arrangements	4.1

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	AC electrical distribution	3.9
K6.02	Nuclear instrumentation	4.0
K6.03	Nuclear boiler instrumentation	3.9
K6.04	DC electrical distribution	3.4
K6.05	DELETED	
K6.06	Process radiation monitoring system	3.0
K6.07	Control rod drive hydraulic system	3.3
K6.08	Main turbine generator and auxiliaries systems	3.3
K6.09	Condensate system	2.5
K6.10	Reactor/turbine pressure regulating system	3.5

K6.11	Primary containment and auxiliaries	3.5	
K6.12	Main steam system	3.5	

A1	**Ability to predict or monitor changes in parameters associated with operation of the reactor protection system including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	DELETED		
A1.03	DELETED		
A1.04	RPS bus status	3.7	
A1.05	DELETED		
A1.06	DELETED		
A1.07	DELETED		
A1.08	Valve position	3.6	
A1.09	DELETED		
A1.10	DELETED		
A1.11	Lights and alarms	3.7	

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 / 45.6)	**RO**	**SRO**
A2.01	RPS motor-generator set failure	3.9	3.9
A2.02	RPS bus power supply failure	4.0	3.9
A2.03	DELETED		
A2.04	Nuclear instrument system failure	4.0	4.0
A2.05	Nuclear boiler instrument system failure	3.9	3.9
A2.06	High reactor power	4.2	4.3
A2.07	High reactor pressure	4.3	4.4
A2.08	Low reactor level	4.3	4.4
A2.09	High containment/drywell pressure	4.3	4.3
A2.10	Reactor/turbine pressure regulating system low hydraulic pressure	4.1	4.0
A2.11	Main steamline isolation valve closure	4.1	4.1
A2.12	Main turbine stop/control valve closure	4.1	4.1
A2.13	Low condenser vacuum	4.1	3.9
A2.14	High SCRAM discharge instrument volume water level	4.2	4.1
A2.15	Load rejection	3.9	3.8
A2.16	Mode switch position	4.0	4.1
A2.17	Main steamline high radiation	3.1	3.0
A2.18	Scram air header low pressure	3.9	3.9
A2.19	Partial RPS actuation	4.2	3.9

A2.20	Full RPS actuation	4.3	4.1
A2.21	DELETED		

A3 **Ability to monitor automatic features of the reactor protection system including:**
(CFR: 41.7 / 45.7)

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	System actuation	4.3
A3.10	Bypassing SCRAM signals	3.8

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

A4.01	System actuation	4.3
A4.02	DELETED	
A4.03	DELETED	
A4.04	Bypass SCRAM signals	3.7
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	DELETED	
A4.10	DELETED	
A4.11	DELETED	
A4.12	DELETED	
A4.13	Individual control rod SCRAM testing	3.2
A4.14	System reset	3.8
A4.15	DELETED	
A4.16	DELETED	
A4.17	DELETED	
A4.18	Transferring RPS power supplies	3.6

System: **215002 SF7 RBMS Rod Block Monitor System: BWR 3, 4, 5**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the rod block monitor system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	APRM	3.8
K1.02	LPRM	3.7
K1.03	Reactor manual control system	3.7
K1.04	Reactor recirculation system	3.4
K1.05	DELETED	
K1.06	DELETED	
K1.07	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RBM channels	3.1
K2.02	DELETED	
K2.03	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the rod block monitor system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor manual control system	3.9
K3.02	DELETED	
K4	**Knowledge of rod block monitor system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	3.9
K4.02	Allows manual or automatic setup of rod block setpoints during power ascension	3.4
K4.03	Initiation point (30%)	3.3
K4.04	Automatic setdown of rod block setpoints during power reduction	3.2
K4.05	Automatic and manual bypass of a RBM channel	3.3
K4.06	Transfer to alternate APRM when referenced APRM bypassed	3.4

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod block monitor system:** (CFR: 41.5 / 45.3)		
K5.01	Trip reference selection	2.8	
K5.02	Null sequence control	2.8	
K5.03	Control rod selection	3.3	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod block monitor system:** (CFR: 41.7 / 45.7)		
K6.01	RBM power supply	3.0	
K6.02	DELETED		
K6.03	DELETED		
K6.04	APRM reference channel	3.3	
K6.05	LPRM detectors	3.2	
K6.06	Reactor recirculation system	3.2	
A1	**Ability to predict or monitor changes in parameters associated with operation of the rod block monitor system including:** (CFR: 41.5 / 45.5)		
A1.01	Trip reference	3.0	
A1.02	Reactor power	3.5	
A1.03	Control rod block status	3.7	
A1.04	Lights and alarms	3.2	
A1.05	Meters and recorders	3.2	
A2	**Ability to (a) predict the impacts of the following on the rod block 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 / 45.6)	**RO**	**SRO**
A2.01	Withdrawal of control rod in high power region of core	3.8	3.6
A2.02	Loss or reduction in reactor recirculation system flow (flow comparator)	3.5	3.5
A2.03	Loss of associated reference APRM channel	3.3	3.4
A2.04	Loss of electrical power	2.8	3.2
A2.05	RBM upscale, downscale or inoperable	4.0	3.5
A2.06	Loss of associated LPRM detector(s)	3.5	3.2

A3	**Ability to monitor automatic features of the rod block monitor system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	Transfer to alternate APRM when referenced is APRM bypassed	2.8
A3.07	RBM initiation (30%)	3.2
A3.08	Rod withdrawal blocks	3.7
A3.09	Setup of rod block setpoints during power ascension	3.1
A3.10	Setdown of rod block setpoints during power reduction	3.1
A3.11	RBM channel bypass	3.2
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	IRM/RBM recorder/switch	3.0
A4.02	RBM back panel switches, meters and indicating lights	2.9
A4.03	Trip/channel bypasses	3.2
A4.04	“Push to Check” pushbutton	2.8
A4.05	“Setup” pushbutton	2.8
A4.06	DELETED	

System:	201005 SF7 RCIS Rod Control and Information System: BWR-6	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the rod control and information system and the following systems:** (CFR: 41.2 to 41.7 / 45.8)	
K1.01	APRM/local power range monitor system	3.9
K1.02	Reactor/turbine pressure regulating system	3.5
K1.03	Control rod drive hydraulic system	3.7
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	DELETED	
K1.08	Intermediate range monitor system	3.6
K1.09	Source range monitor system	3.6
K1.10	Control rod and drive mechanism system	3.6
K1.11	Recirculation flow control system	3.2
K1.12	Fuel handling system	3.0
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.6 / 41.7)	
K2.01	RCIS	3.3
K3	**Knowledge of the effect that a loss or malfunction of the rod control and information system will have on the following systems or system parameters:** (CFR: 41.6 and 41.7 / 45.4–45.6)	
K3.01	Control rod drive hydraulic system	3.4
K3.02	DELETED	
K3.03	DELETED	
K3.04	FLUX shaping	3.1
K3.05	Control rod drive mechanism system	3.1
K3.06	Fuel handling system	3.0
K3.07	Reactor protection system	3.4
K4	**Knowledge of rod control and information system design feature(s) or interlocks that provide for the following:** (CFR: 41.5–41.7)	
K4.01	Limiting the effects of a control rod accident	3.9
K4.02	Bank position withdrawal sequence (BPWS)	3.7

K4.03	Rod withdrawal block signals	4.0
K4.04	Rod insertion block signals	3.9
K4.05	Rod withdrawal limiter	3.8
K4.06	DELETED	
K4.07	Rod position information (RPIS)	3.9
K4.08	Rod action control (RACS)	3.5
K4.09	Rod gang drive (RGDS)	3.5
K4.10	Rod interface (RIS)	3.6
K4.11	Rod pattern controller (RPC)	3.8
K4.12	Rod withdrawal limiter (RWL)	3.8
K4.13	Temperature monitoring	2.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod control and information system:**
(CFR: 41.5–41.7 / 45.3 / 45.5)

K5.01	DELETED	
K5.02	DELETED	
K5.03	Rod groups	3.3
K5.04	Rod sequences	3.7
K5.05	DELETED	
K5.06	Target rod pattern	3.3
K5.07	Low power alarm point	3.3
K5.08	Transition zone	3.2
K5.09	High power setpoints	3.7
K5.10	DELETED	
K5.11	Control rod motion	3.8
K5.12	RACS channel agreement and multiplexing	3.4
K5.13	Position indication	3.8
K5.14	Low power setpoint	3.6
K5.15	Changes in reactor power	4.2

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod control and information system:**
(CFR: 41.7 / 45.7)

K6.01	First stage shell pressure or opening of a bypass valve(s)	3.8
K6.02	Rod position signal	3.7
K6.03	AC electrical distribution system	3.3
K6.04	Intermediate range monitor system	3.7
K6.05	Source range monitor system	3.7
K6.06	APRM/local power range monitor system	3.7

K6.07	Fuel handling system	3.1	
K6.08	Gang misalignment	2.7	

A1 **Ability to predict or monitor changes in parameters associated with operation of the rod control and information system including:**
(CFR: 41.5 / 45.5)

A1.01	First stage shell pressure/turbine load	3.5	
A1.02	Reactor power	4.1	
A1.03	Lights and Alarms	3.6	

A2 **Ability to (a) predict the impacts of the following on the rod control and information 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 / 45.8)

		RO	SRO
A2.01	High flux (SRM, IRM, APRM)	4.3	4.0
A2.02	Position indication probe failure	3.3	3.9
A2.03	Insert block	3.4	3.7
A2.04	Withdraw block	3.7	3.8
A2.05	Insert required	3.4	3.4
A2.06	Insert inhibit	3.3	3.7
A2.07	Withdraw inhibit	3.3	3.7
A2.08	LPRM upscale/down scale	3.3	3.5
A2.09	Test display blinking	2.7	2.9
A2.10	Data fault	2.9	3.4
A2.11	DELETED		
A2.12	DELETED		
A2.13	Rod drift	4.4	4.2
A2.14	AC electrical distribution system	3.4	3.4
A2.15	Fuel handling system	3.1	3.3
A2.16	Gang misalignment	2.7	2.8

A3 **Ability to monitor automatic features of the rod control and information system including:**
(CFR: 41.7 / 45.7)

A3.01	Operator control module lights	3.6	
A3.02	Rod display module lights	3.7	
A3.03	Verification of proper functioning/operability	3.9	
A3.04	DELETED		

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Operator control module (lights and push buttons)	3.8
A4.02	Rod display module (lights and push buttons)	3.7
A4.03	Back panel indicating lights	3.3
A4.04	Bypassing rod position in rod action control system (RACC)	3.7
A4.05	Bypassing a rod drive in rod gang drive system (RGDS)	3.6

System: 214000 SF7 RPIS Rod Position Information System (BWR 2,3,4,5)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the rod position information system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Rod worth minimizer	3.6
K1.02	Rod sequence control system	3.4
K1.03	Control rod drive mechanism	3.3
K1.04	Reactor manual control system	3.7
K1.05	DELETED	
K1.06	DELETED	
K1.07	Plant process computer/parameter display systems	3.1
K1.08	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Rod position information system	3.0
K3	**Knowledge of the effect that a loss or malfunction of the rod position information system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Rod worth minimizer	3.4
K3.02	Rod sequence control system	3.2
K3.03	Reactor manual control system	3.6
K3.04	DELETED	
K3.05	Plant process computer/parameter display systems	2.9
K3.06	DELETED	
K4	**Knowledge of rod position information system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Reed switch locations	3.2
K4.02	DELETED	
K4.03	Control rod position indication	3.6
K4.04	Detection of a drifting control rod	3.9
K4.05	Detection of an uncoupled control rod	4.0

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod position information system:** (CFR: 41.5 / 45.3)		
K5.01	Rod position indication failures	3.5	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod position information system:** (CFR: 41.7 / 45.7)		
K6.01	RPIS power supply	3.2	
K6.02	DELETED		
A1	**Ability to predict or monitor changes in parameters associated with operation of the rod position information system including:** (CFR: 41.5 / 45.5)		
A1.01	Control rod position	3.8	
A1.02	Lights and alarms	3.6	
A2	**Ability to (a) predict the impacts of the following on the rod position information 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 / 45.6)	**RO**	**SRO**
A2.01	Failed reed switches	3.3	3.3
A2.02	DELETED		
A2.03	DELETED		
A2.04	Power supply loss	3.3	3.3
A3	**Ability to monitor automatic features of the rod position information system including:** (CFR: 41.7 / 45.7)		
A3.01	DELETED		
A3.02	DELETED		
A3.03	DELETED		
A3.04	DELETED		

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)
A4.01	DELETED
A4.02	DELETED
A4.03	DELETED

System: 201004 SF7 RSCS Rod Sequence Control System: BWR- 4,5

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the rod sequence control system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor manual control system	3.5
K1.02	Main turbine generator and auxiliary systems	2.3
K1.03	Rod position information system	3.4
K1.04	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	RSCS logic power	2.7
K3	**Knowledge of the effect that a loss or malfunction of the rod sequence control system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor manual control system	3.5
K4	**Knowledge of rod sequence control system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Select blocks	3.4
K4.02	Insert rod blocks	3.4
K4.03	Withdraw rod blocks	3.4
K4.04	RSCS bypass as reactor power increases	3.1
K4.05	Rod movement, direction, and selection information	3.3
K4.06	Group notch control	3.1
K4.07	Minimizing rod worth	3.2
K4.08	Sequence control	3.3
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod sequence control system:** (CFR: 41.5 / 45.3)	
K5.01	Limiting the impacts of a control rod drop accident (CRDA)	3.5

K5.02	Sequences and groups	3.1	
K5.03	Group notch control limits and rod density	3.1	

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod sequence control system:** (CFR: 41.7 / 45.7)		
K6.01	Rod position information	3.5	
K6.02	Rod direction information	3.3	
K6.03	Rod movement information	3.4	
K6.04	Turbine generator (1st stage shell pressure)	2.9	

A1	**Ability to predict or monitor changes in parameters associated with operation of the rod sequence control system including:** (CFR: 41.5 / 45.5)		
A1.01	DELETED		
A1.02	Select blocks	3.2	
A1.03	Insert blocks	3.4	
A1.04	Withdraw blocks	3.5	
A1.05	Lights and alarms	3.2	
A1.06	Rod select switch light	3.1	
A1.07	Rod select bottom lamp dimmer logic	2.9	
A1.08	Back panel indicators	2.4	

A2	**Ability to (a) predict the impacts of the following on the rod sequence 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 / 45.6)	**RO**	**SRO**
A2.01	Loss of rod position information	3.6	3.6
A2.02	Stuck control rod	2.8	3.7
A2.03	Turbine trip	2.3	2.7

A3	**Ability to monitor automatic features of the rod sequence control system including:** (CFR: 41.7 / 45.7)		
A3.01	DELETED		
A3.02	DELETED		
A3.03	DELETED		
A3.04	DELETED		
A3.05	DELETED		
A3.06	Select blocks	3.3	

A3.07	Control rod blocks	3.4
A3.08	System bypass	3.1
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	System bypass switches	3.3
A4.02	RSCS console switches and indicators	3.3
A4.03	RSCS back panel switches and indicators	2.7

System: **201006 SF7 RWMS Rod Worth Minimizer System (Not-BWR 6)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the rod worth minimizer system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor manual control system	3.7
K1.02	Rod position information system	3.7
K1.03	Reactor water level control (feed flow/steam flow)	3.2
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	Process computer	2.9
K1.08	DELETED	
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Rod worth minimizer	2.8
K3	**Knowledge of the effect that a loss or malfunction of the rod worth minimizer system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor manual control system	3.7
K3.02	Rod pattern limit	3.6
K4	**Knowledge of rod worth minimizer system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Insert blocks/errors	3.7
K4.02	Withdraw blocks/errors	3.8
K4.03	Select blocks/errors	3.5
K4.04	System bypass	3.4
K4.05	Substitute rod position data	3.3
K4.06	Correction of out of sequence rod positions	3.5
K4.07	Display of out of position control rods without rod blocks (transition zone)	3.3
K4.08	System testing	2.8
K4.09	System initialization	2.8

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the rod worth minimizer system:** (CFR: 41.5 / 45.3)	
K5.01	Limiting the impacts of a control rod drop accident (CRDA)	3.7
K5.02	Low power set point (LPSP)	3.5
K5.03	Low power alarm point (LPAP)	3.2
K5.04	Transition zone	3.1
K5.05	High power set point	3.2
K5.06	Rod groups and steps	3.3
K5.07	Latch groups	3.2
K5.08	Rod pattern limits	3.3
K5.09	Select error	3.2
K5.10	Withdraw error	3.3
K5.11	Insert error	3.3
K5.12	Withdraw block	3.5
K5.13	Insert block	3.5
K5.14	Alternate withdraw and insert limits	3.2
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the rod worth minimizer system:** (CFR: 41.7 / 45.7)	
K6.01	RWM power supply	3.0
K6.02	Reactor water level control input	3.0
K6.03	Rod position information	3.4
K6.04	Process computer	2.8
K6.05	DELETED	
A1	**Ability to predict or monitor changes in parameters associated with operation of the rod worth minimizer system including:** (CFR: 41.5 / 45.5)	
A1.01	Rod position	3.7
A1.02	DELETED	
A1.03	Latched group	3.3
A1.04	Rod withdrawal blocks	3.6
A1.05	Rod insert blocks	3.6
A1.06	Rod withdrawal errors	3.4
A1.07	Rod insert errors	3.3
A1.08	Rod select errors	3.2
A1.09	Lights and alarms	3.3

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the rod worth minimizer 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 / 45.6)	**RO**	**SRO**
A2.01	Power supply loss	3.3	3.0
A2.02	DELETED		
A2.03	Rod drift	3.9	3.6
A2.04	Stuck rod	3.6	3.4
A2.05	Out of sequence rod movement	3.9	3.7
A2.06	Loss of reactor water level control input (steam flow/feed flow)	3.3	3.0
A2.07	RWM hardware/software failure	3.1	2.9
A2.08	Loss of rod position information	3.7	3.3
A2.09	Loss of process computer	3.3	3.0

A3	**Ability to monitor automatic features of the rod worth minimizer system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	DELETED	
A3.04	Control rod movement blocks	3.8
A3.05	Latching operation	3.3
A3.06	System bypass	3.3

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	System bypass switch	3.4
A4.02	Pushbutton indicating switches	3.2
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	Touch screen display	3.2

System: **215004 SF7 SRMS Source Range Monitor System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the source range monitor system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	RPS	3.5
K1.02	RMCS: BWR-2, 3, 4, 5	3.5
K1.03	RCIS: BWR-6	3.8
K1.04	DELETED	
K1.05	DELETED	
K1.06	Reactor vessel and internals	3.1
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	SRM channels/detectors	3.3
K2.02	Detector drive modules	2.7
K2.03	Detector drive module control	2.6
K3	**Knowledge of the effect that a loss or malfunction of the source range monitor system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	RPS	3.5
K3.02	RMCS: BWR-2, 3, 4, 5	3.5
K3.03	RCIS: BWR-6	3.9
K3.04	Reactor power indication	4.0
K4	**Knowledge of source range monitor system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	3.9
K4.02	Reactor SCRAM signals	3.6
K4.03	Gamma compensation	2.7
K4.04	Changing detector position	3.4
K4.05	Alarm seal-in	2.7
K4.06	IRM/SRM interlock	3.4
K4.07	SRM channel bypass	3.4
K4.08	SRM detector longevity	2.3

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the source range monitor system:** (CFR: 41.5 / 45.3)		
K5.01	Detector operation	2.8	
K5.02	DELETED		
K5.03	Changing detector position	3.2	
K5.04	SRM/IRM Overlap	3.5	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the source range monitor system:** (CFR: 41.7 / 45.7)		
K6.01	RPS	3.3	
K6.02	24/48 volt DC power	3.4	
K6.03	Detector drive motor	2.9	
K6.04	Detectors	3.2	
K6.05	Trip units	3.3	
K6.06	DELETED		
K6.07	Reactor vessel and internals	2.6	
A1	**Ability to predict or monitor changes in parameters associated with operation of the source range monitor system including:** (CFR: 41.5 / 45.5)		
A1.01	Detector position	3.3	
A1.02	Reactor power	4.0	
A1.03	RPS status	3.3	
A1.04	Control rod block status	3.6	
A1.05	Scram, rod block, and period alarm and trip setpoints	3.7	
A1.06	Lights and alarms	3.4	
A1.07	SRM count rate and period	4.0	

		RO	SRO
A2	**Ability to (a) predict the impacts of the following on the source range 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 / 45.6)	**RO**	**SRO**
A2.01	Degraded power supply	3.1	2.8
A2.02	SRM inop condition	3.4	3.7
A2.03	Stuck detector	3.1	3.2
A2.04	Upscale and downscale trips	4.0	3.7
A2.05	Faulty or erratic operation of detectors/system	3.7	3.4

A2.06	DELETED	
A3	**Ability to monitor automatic features of the source range monitor system including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	RPS status	3.5
A3.04	Control rod block status	3.7
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	SRM count rate and period	4.1
A4.02	SRM recorder	3.4
A4.03	DELETED	
A4.04	SRM drive control switches	3.5
A4.05	SRM back panel switches, meters, and indicating lights	3.0
A4.06	DELETED	
A4.07	DELETED	
A4.08	SRM channel bypass	3.4

System: 215001 SF7 TIP Traversing In-Core Probe

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the traversing in-core probe and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Local power range monitoring system	3.3
K1.02	Plant process computer/parameter display systems	2.9
K1.03	Nitrogen system (BWR-2,3,4,5)	2.5
K1.04	Instrument air system	2.4
K1.05	Primary containment isolation system (BWR-2,3,4,5)	3.7
K1.06	DELETED	
K1.07	DELETED	
K1.08	Reactor vessel and internals	3.2
K1.09	Primary containment and auxiliaries	2.9
K1.10	Radiation monitoring system	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Shear valves (BWR-2, 3, 4, 5)	3.1
K2.02	Ball valves (BWR-2, 3, 4, 5)	3.0
K3	**Knowledge of the effect that a loss or malfunction of the traversing in-core probe will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Local power range monitoring system	3.1
K4	**Knowledge of traversing in-core probe design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Primary containment isolation (BWR-2, 3, 4, 5)	3.7
K4.02	Corrosion prevention (Air/N2 purge)	2.3
K4.03	Radiation shielding	2.9
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the traversing in-core probe:** (CFR: 41.5 / 45.3)	
K5.01	Flux detection	3.2
K5.02	Area radiation monitor indications	2.8

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the traversing in-core probe:** (CFR: 41.7 / 45.7)		
K6.01	DC electrical distribution	2.7	
K6.02	AC electrical distribution	2.7	
K6.03	Plant process computer/parameter display systems	2.7	
K6.04	Primary containment isolation system (BWR-2, 3, 4, 5)	3.7	
K6.05	Instrument air system	2.4	
K6.06	Nitrogen system (BWR-2, 3, 4, 5)	2.5	
K6.07	Reactor water level (BWR-2, 3, 4, 5)	2.9	
K6.08	Containment/drywell pressure (BWR-2, 3, 4, 5)	3.0	
A1	**Ability to predict or monitor changes in parameters associated with operation of the traversing in-core probe including:** (CFR: 41.5 / 45.5)		
A1.01	Area radiation levels	3.1	
A1.02	Detector position	3.2	
A1.03	Valve status (BWR-2, 3, 4, 5)	3.3	
A1.04	Drive speed	2.5	
A1.05	Detector output	2.7	
A1.06	DELETED		
A1.07	Lights and alarms	2.8	
A2	**Ability to (a) predict the impacts of the following on the traversing in-core probe 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	Low reactor water level (BWR-2, 3, 4, 5)	3.3	3.2
A2.02	High primary containment/drywell pressure (BWR-2, 3, 4, 5)	3.5	3.3
A2.03	Drive mechanism failure	2.9	2.7
A2.04	Loss of AC electrical distribution	2.8	2.6
A2.05	Loss of DC electrical distribution	2.7	2.7
A2.06	Abnormal valve position (BWR-2,3,4,5)	3.5	3.1
A2.07	Failure to retract during accident conditions (BWR-2, 3, 4, 5)	3.8	3.5
A2.08	Failure to retract to shield (BWR-2, 3, 4, 5)	3.7	3.3

A3	**Ability to monitor automatic features of the traversing in-core probe including:** (CFR: 41.7 / 45.7)	
A3.01	DELETED	
A3.02	DELETED	
A3.03	Valve operation (BWR-2, 3, 4, 5)	3.3
A3.04	DELETED	
A3.05	DELETED	
A3.06	TIP detector insertion into the reactor core	2.9
A3.07	TIP detector withdrawal from the reactor core	2.9
A3.08	TIP detector retract during accident conditions (BWR-2, 3, 4, 5)	3.7
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	DELETED	
A4.02	DELETED	
A4.03	Isolation valves (BWR-2, 3, 4, 5)	3.6
A4.04	DELETED	
A4.05	DELETED	
A4.06	Drive mechanism operation	2.7

System: **286000 SF8 FPS Fire Protection System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the fire protection system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	CCWS	2.4
K1.02	Isolation condenser	3.3
K1.03	DELETED	
K1.04	DC electrical distribution	2.8
K1.05	Main generator hydrogen system	2.9
K1.06	Auxiliary boiler steam system	1.8
K1.07	AC electrical distribution system	2.9
K1.08	Intake canals	2.5
K1.09	DELETED	
K1.10	Main generator/exciter systems	2.7
K1.11	Screen wash system	2.1
K1.12	Emergency core cooling system	3.1
K1.13	Plant ventilation systems	2.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	Fire pumps	3.2
K2.03	DELETED	
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 / 45.4)	
K3.01	DELETED	
K3.02	Personnel protection	3.3
K3.03	Plant protection	3.6
K3.04	Component cooling water systems	2.4
K3.05	Isolation condenser system	3.3
K3.06	Main generator hydrogen system	2.8
K3.07	Main generator/exciter systems	2.7
K3.08	Auxiliary boiler steam system	1.7
K3.09	AC electrical distribution systems	2.8
K3.10	DC electrical distribution systems	2.7
K3.11	Plant ventilation systems	2.4

K3.12	Screen wash system	1.9
K3.13	Emergency core cooling systems	3.0

K4 **Knowledge of fire protection system design feature(s) or interlocks that provide for the following:**
(CFR:41.5 / 41.7 / 45.3 to 45.8)

K4.01	Adequate water supply system	3.4
K4.02	Automatic system initiation	3.5
K4.03	Maintenance of fire header pressure	3.1
K4.04	Personnel safety during halon/carbon dioxide system actuation	3.7
K4.05	Maintaining fire protection capability during loss of off-site power	3.5
K4.06	Fire suppression	3.4
K4.07	DELETED	
K4.08	Containment isolation	2.5
K4.09	Fire detection and alarm	3.4
K4.10	Spent fuel pool makeup and spray	3.5
K4.11	Alternate injection to the RPV or primary containment	3.8

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the fire protection system:**
(CFR: 41.5 / 45.3)

K5.01	Effect of carbon dioxide on fires	3.1
K5.02	Effect of halon on fires	3.0
K5.03	Effect of water spray on electrical components	3.4
K5.04	Valve operation	2.9
K5.05	Diesel operations	3.3
K5.06	Heat detection	3.1
K5.07	Smoke detection	3.1
K5.08	Gas refrigeration	2.3
K5.09	Reactor water level	3.0
K5.10	Equipment/rooms protected by FPS	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	AC electrical distribution	3.2
K6.02	DC electrical distribution	3.0
K6.03	Component cooling water system	2.1
K6.04	Diesel fuel transfer system	2.4
K6.05	Screen wash system	1.9

K6.06	Motor driven fire pump	3.4	
K6.07	Diesel driven fire pump	3.4	

A1 Ability to predict or monitor changes in parameters associated with operation of the fire protection system including:
(CFR: 41.5 / 45.5)

A1.01	System pressure	3.4
A1.02	System flow	3.1
A1.03	Fire doors	3.1
A1.04	Fire dampers	3.1
A1.05	System lineups	3.1
A1.06	Fire water tank pressure	2.5

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 / 45.6)

		RO	**SRO**
A2.01	System logic failure	2.8	3.1
A2.02	DC distribution failure	2.6	2.8
A2.03	AC distribution failure	2.8	3.0
A2.04	CCWS failure	2.0	2.0
A2.05	Fire protection pump trips	3.4	3.2
A2.06	Low fire main pressure	3.3	3.3
A2.07	Inadvertent system initiation	3.2	2.9
A2.08	Failure to actuate when required	3.7	3.3
A2.09	Valve closures	2.9	2.9
A2.10	Valve openings	2.9	2.9
A2.11	DELETED		
A2.12	Low diesel fuel supply	3.1	3.0

A3 Ability to monitor automatic features of the fire protection system including:
(CFR: 41.7 / 45.7)

A3.01	Fire water pump start	3.4
A3.02	Fire system keep-fill	2.8
A3.03	Actuation of fire detectors	3.3
A3.04	System initiation	3.5
A3.05	Fire doors	2.8
A3.06	Fire dampers	2.8

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	System alarms and indicating lights	3.3
A4.02	CCWS	2.1
A4.03	DELETED	
A4.04	Fire main pressure	3.0
A4.05	Motor driven fire pump start	3.2
A4.06	Diesel driven fire pump start	3.4

System: 234000 SF8 FH Fuel Handling

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the fuel handling system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Fuel	3.5
K1.02	DELETED	
K1.03	DELETED	
K1.04	Reactor manual control system	3.5
K1.05	Reactor vessel components	3.2
K1.06	Rod control and information system (BWR 6)	3.7
K1.07	Fuel transfer tube system: Mark III	3.1
K1.08	DELETED	
K1.09	Fuel pool ventilation	3.0
K1.10	Containment ventilation	2.9
K1.11	Primary containment system and auxiliaries	2.9
K1.12	Fuel pool cooling and cleanup system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Fuel handling equipment power	2.5
K3	**Knowledge of the effect that a loss or malfunction of the fuel handling system will have on the following systems or system parameters:** (CFR: 41.7 / 45.4)	
K3.01	Reactor manual control system	3.3
K3.02	RC&IS	3.1
K3.03	Fuel handling operations	3.3
K3.04	Core modifications/alterations	3.4
K3.05	Fuel pool level	3.1
K3.06	Fuel pool cooling and cleanup system	2.9
K4	**Knowledge of fuel handling system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Prevention of core alterations during control rod movements	3.8
K4.02	Prevention of control rod movement during core alterations	3.8

K4.03	Protection against inadvertently lifting radioactive components out of the water	3.7
K4.04	Movement of the spent fuel cask only over designated areas	3.0
K4.05	Movement of fuel via fuel transfer tube: Mark III	3.0
K4.06	Protection from dropping a fuel assembly	3.5
K4.07	Hoist overload or underload protection	3.1
K4.08	Prevent draining of water from the inclined fuel transfer system	3.3
K4.09	Determining refueling machine position, speed, or direction	2.8
K4.10	Maintaining a minimum water level in the spent fuel pool	3.7

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the fuel handling system:**
(CFR: 41.5 / 45.3)

K5.01	Crane/hoist operation	2.7
K5.02	Fuel handling equipment interlocks	3.6
K5.03	Minimum cavity/pool level as a shield against radiation	3.6
K5.04	Spent fuel pool design	3.0
K5.05	Fuel orientation	3.3
K5.06	Fuel	3.1
K5.07	Spent fuel cask	2.7
K5.08	Fuel pools configuration: Mark III	2.8
K5.09	Refuel floor ventilation	3.1
K5.10	Nuclear instrument system response to core offload/reload	3.5
K5.11	Area radiation monitors response to fuel handling event	3.6
K5.12	Containment closure requirements	3.3
K5.13	Loss of spent fuel pool or reactor cavity level	3.9

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

K6.01	Electrical power	2.9
K6.02	Reactor manual control system	3.3
K6.03	RC&IS	3.2
K6.04	Refueling platform air	2.9
K6.05	Upper fuel pool water inventory: Mark III	3.5
K6.06	Fuel transfer tube interlocks: Mark III	3.3
K6.07	Fuel pool ventilation	3.0
K6.08	Fuel pool cooling and cleanup system	3.2

K6.09	Bridge, trolley, or hoist encoder failure	2.7
K6.10	Mechanically bound fuel assembly	3.1

A1 **Ability to predict or monitor changes in parameters associated with operation of the fuel handling system including:**
(CFR: 41.5 / 45.5)

A1.01	Spent fuel pool level	3.4
A1.02	Refuel floor radiation levels/ airborne levels	3.5
A1.03	Core reactivity level	3.7
A1.04	Upper fuel pool water level	3.3
A1.05	Refueling machine position, speed, or direction	2.7

A2 **Ability to (a) predict the impacts of the following on the fuel handling 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	Interlock failure	3.2	3.4
A2.02	Loss of refueling platform air	2.8	2.9
A2.03	Loss of electrical power	2.9	2.9
A2.04	Reactor manual control system	3.3	3.4
A2.05	Rod control and information system	3.4	3.1
A2.06	Upper fuel pool water inventory: Mark III	3.7	3.4
A2.07	Fuel transfer tube interlocks: Mark III	2.7	3.4
A2.08	Fuel pool ventilation	3.3	3.0
A2.09	Fuel pool cooling and cleanup system	3.3	3.0
A2.10	Bridge, trolley, or hoist encoder failure	2.4	2.8
A2.11	Mechanically bound fuel assembly	2.8	3.1

A3 **Ability to monitor automatic features of the fuel handling system including:**
(CFR: 41.7 / 45.7)

A3.01	Crane/refuel bridge movement	2.9
A3.02	Interlock operation	3.4

A4 **Ability to manually operate or monitor at the equipment location/control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Neutron monitoring system	3.7
A4.02	Control rod drive system	3.6
A4.03	Mode switch	3.6

System: **300000 SF8 IA Instrument Air System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the instrument air system and the following systems:** (CFR: 41.4 to 41.5, 41.7 to 41.9 / 45.6 and 45.8)	
K1.01	DELETED	
K1.02	Service air system	3.5
K1.03	Drywell pneumatic system	3.1
K1.04	Component cooling water system	3.2
K1.05	DELETED	
K1.06	Plant ventilation systems	3.0
K1.07	Circulating water system	2.1
K1.08	Condensate system	3.2
K1.09	Condenser air removal system	2.8
K1.10	Containment airlock system	2.1
K1.11	Control rod drive hydraulic system	3.5
K1.12	Extraction steam system	3.0
K1.13	Feedwater system	3.4
K1.14	Fire protection system	2.2
K1.15	Fuel handling system	2.3
K1.16	Fuel pool cooling cleanup system	2.9
K1.17	Generator hydrogen system	2.2
K1.18	Heater drain system	3.1
K1.19	Liquid radwaste system	2.4
K1.20	Main steam system	3.6
K1.21	Main turbine lube oil system	2.3
K1.22	Neutron monitoring system	1.8
K1.23	Offgas system	3.0
K1.24	Post-accident monitoring system	2.4
K1.25	Reactor recirculation sample system	2.4
K1.26	Reactor water cleanup system	3.2
K1.27	Service water system	2.7
K1.28	Standby gas treatment system	3.0
K1.29	Suppression pool cleanup system	2.4
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Instrument air compressor	3.3
K2.02	Emergency air compressor	3.3

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	Drywell pneumatic system	3.1
K3.02	DELETED	
K3.03	DELETED	
K3.04	Plant ventilation systems	3.0
K3.05	Circulating water system	2.0
K3.06	Component cooling water system	3.0
K3.07	Condensate system	3.2
K3.08	Condenser air removal system	2.9
K3.09	Containment airlock system	2.1
K3.10	Control rod drive hydraulic system	3.6
K3.11	Extraction steam system	3.0
K3.12	Feedwater system	3.5
K3.13	Fire protection system	2.3
K3.14	Fuel handling system	2.3
K3.15	Fuel pool cooling cleanup system	2.9
K3.16	Generator hydrogen system	2.2
K3.17	Heater drain system	3.1
K3.18	Liquid radwaste system	2.2
K3.19	Main steam system	3.6
K3.20	Main turbine lube oil system	2.2
K3.21	Neutron monitoring system	1.8
K3.22	Offgas system	3.1
K3.23	Post-accident monitoring system	2.2
K3.24	Reactor recirculation sample system	2.3
K3.25	Reactor water cleanup system	3.2
K3.26	Service water system	2.7
K3.27	Standby gas treatment system	3.1
K3.28	Suppression pool cleanup system	2.3
K4	**Knowledge of instrument air system design feature(s) or interlock(s) that provide for the following:** (CFR: 41.7)	
K4.01	Modes of control	3.1
K4.02	Cross-over to other pneumatic systems	3.3
K4.03	Compressor automatic starts/trips	3.2
K4.04	Containment isolation	3.5
K4.05	Maintaining dry air	3.1
K4.06	Maintaining normal instrument air pressure	3.4

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the instrument air system:** (CFR: 41.5 / 45.3)	
K5.01	DELETED	
K5.02	DELETED	
K5.03	DELETED	
K5.04	DELETED	
K5.05	DELETED	
K5.06	DELETED	
K5.07	DELETED	
K5.08	DELETED	
K5.09	DELETED	
K5.10	DELETED	
K5.11	DELETED	
K5.12	DELETED	
K5.13	Low instrument air pressure	3.9
K5.14	Air leaks	3.3
K5.15	High moisture content in instrument air	3.1

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the instrument air system:** (CFR: 41.8 / 45.7)	
K6.01	Air compressors	3.7
K6.02	DELETED	
K6.03	DELETED	
K6.04	DELETED	
K6.05	Air dryers	3.3
K6.06	DELETED	
K6.07	DELETED	
K6.08	DELETED	
K6.09	DELETED	
K6.10	Heat exchangers and condensers	
K6.11	DELETED	
K6.12	DELETED	
K6.13	Service air cross-connect valve	3.4
K6.14	Component cooling water system	3.1
K6.15	Low instrument air pressure	3.6
K6.16	Backwashing condensate filter/demins	2.6

A1	**Ability to predict or monitor changes in parameters associated with operation of the instrument air system including:** (CFR: 41.5 / 45.5)		
A1.01	Instrument air supply pressure	3.7	
A1.02	Lights and alarms	3.4	
A1.03	Service air pressure	3.1	
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 / 45.6)	**RO**	**SRO**
A2.01	Air dryer and filter malfunctions	3.8	3.3
A2.02	Component cooling water system malfunction	3.4	3.2
A2.03	Low instrument air pressure	3.9	3.8
A3	**Ability to monitor automatic features of the instrument air system including:** (CFR: 41.8 / 45.7)		
A3.01	DELETED		
A3.02	DELETED		
A3.03	Compressor automatic starts/trips	3.5	
A3.04	Automatic isolation	3.4	
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.8 / 45.5 to 45.8)		
A4.01	DELETED		
A4.02	Instrument air compressors	3.5	
A4.03	Manual isolations	3.2	

System: **400000 SF8 CCS Component Cooling Water System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the component cooling water system and the following systems:** (CFR: 41.4 to 41.5 / 41.7 to 41.9 / 45.6 to 45.8)	
K1.01	Service water system	3.8
K1.02	Loads cooled by CCWS	3.8
K1.03	Radiation monitoring systems	3.1
K1.04	DELETED	
K1.05	Plant ventilation	2.3
K1.06	Instrument air system	3.0
K1.07	Control rod drive hydraulic system	3.2
K1.08	Recirculation system	3.7
K1.09	Recirculation flow control system	2.8
K1.10	Residual heat removal system	3.7
K1.11	Low pressure core spray system	3.1
K1.12	Reactor core isolation cooling system (BWR 4/5/6)	3.1
K1.13	Reactor water cleanup system	3.6
K1.14	Fuel pool cooling and cleanup system	3.8
K1.15	Turbine generator and auxiliary systems	3.2
K1.16	High pressure coolant injection system (BWR 3 & 4)	3.3
K1.17	High pressure core spray system (BWR 5 & 6)	3.2
K1.18	Reactor condensate system	3.1
K1.19	Reactor feedwater system	3.1
K1.20	Reactor/turbine pressure regulating system	2.8
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	CCW pumps	3.4
K2.02	CCW valves	2.8
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: 41.7 / 45.6)	
K3.01	Loads cooled by CCWS	3.9
K3.02	Plant ventilation systems	2.4
K3.03	Instrument air system	3.3
K3.04	Service water system	2.9
K3.05	Control rod drive hydraulic system	3.4
K3.06	Recirculation system	3.8

K3.07	Recirculation flow control system	2.7
K3.08	Residual heat removal system	3.7
K3.09	Low pressure core spray system	3.1
K3.10	Reactor core isolation cooling system (BWR 4/5/6)	3.1
K3.11	Reactor water cleanup system	3.5
K3.12	Fuel pool cooling and cleanup system	3.7
K3.13	Turbine generator and auxiliary systems	3.1
K3.14	Radiation monitoring systems	2.3
K3.15	High pressure coolant injection system (BWR 3 & 4)	3.0
K3.16	High pressure core spray system (BWR 5 & 6)	3.1
K3.17	Reactor condensate system	3.1
K3.18	Reactor feedwater system	3.1
K3.19	Reactor/turbine pressure regulating system	2.8

K4 **Knowledge of component cooling water system design feature(s) and or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Automatic start of standby pump	3.4
K4.02	Containment isolation	3.6
K4.03	Spent fuel pool cooling	3.6
K4.04	Pump trip on low surge tank level	3.1
K4.05	Surge tank level control	2.9
K4.06	System protection due to reactor coolant system in- leakage	3.2
K4.07	System response to LOCA signal	3.8
K4.08	System response to LOOP signal	3.8
K4.09	Operation from the remote shutdown panel	3.3

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the component cooling water system:**
(CFR: 41.5 / 45.3)

K5.01	Chemistry control	2.4
K5.02	Determine source(s) of RCS leakage into CCWS	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	DELETED		
K6.05	DELETED		
K6.06	DELETED		
K6.07	DELETED		
K6.08	Service water system	3.7	
K6.09	Radiation monitoring systems	2.4	
K6.10	Control rod drive hydraulic system	2.8	
K6.11	Recirculation system	2.9	
K6.12	Reactor water cleanup system	3.1	
K6.13	Fuel pool cooling and cleanup system	3.3	
K6.14	AC electrical distribution system	3.5	

A1 **Ability to predict or monitor changes in parameters associated with operation of the component cooling water system including:**
(CFR: 41.5 / 45.5)

A1.01	CCW flow rate	3.0
A1.02	CCW temperature	3.4
A1.03	CCW pressure	3.0
A1.04	Surge tank level	3.0

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 / 45.6)

		RO	SRO
A2.01	Loss of CCW pump	4.1	3.9
A2.02	High/low surge tank level	3.6	3.2
A2.03	High/low CCW temperature	3.8	3.5
A2.04	Radiation monitoring system alarm	3.0	2.7
A2.05	Loss of service water system	4.1	3.8
A2.06	Component cooling water system heat exchanger tube leak	3.3	3.1
A2.07	Loss of cooling to residual heat removal system heat exchangers	3.9	3.8
A2.08	Residual heat removal system heat exchanger tube leak	3.5	3.3
A2.09	Loss of cooling to spent fuel pool cooling system heat exchanger	4.2	3.8
A2.10	Spent fuel pool cooling system heat exchanger tube leak	3.6	3.2
A2.11	Loss of cooling to reactor recirculation pump	4.2	3.7
A2.12	Loss of cooling to reactor recirculation pump variable frequency drive	3.0	3.5
A2.13	Loss of Instrument air system	4.0	3.3
A2.14	Loss of AC electrical distribution system	3.9	3.7

A2.15	Loss of cooling to turbine lube oil system	3.4	2.9
A2.16	Loss of cooling to alternate decay heat removal system	3.7	3.3
A2.17	Loss of cooling to ECCS pump rooms	3.5	3.4

A3 **Ability to monitor automatic operations of the component cooling water system including:**
(CFR: 41.7 / 45.7)

A3.01	DELETED	
A3.02	Containment isolation	3.6
A3.03	Spent fuel pool cooling	3.8
A3.04	Pump trip	3.8
A3.05	System response due to a LOCA signal	3.8
A3.06	System response due to a LOOP signal	3.7
A3.07	System realignments	3.3

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

A4.01	CCW indications and control	3.8

System:	510001 SF8 Circulating Water Circulating Water System	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the circulating water system and the following systems:** (CFR: 41.4 to 41.8 / 45.7 to 45.8)	
K1.01	Condensate system	3.3
K1.02	Feedwater system	2.9
K1.03	Service water system	2.8
K1.04	Main turbine generator and auxiliary systems	3.1
K1.05	Recirculation flow control system	2.2
K1.06	Reactor/turbine pressure regulating system	2.7
K1.07	Fire protection system	2.2
K1.08	Radwaste system	2.1
K1.09	Radiation monitoring system	2.5
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	System pumps	3.1
K2.02	System valves	2.6
K2.03	Cooling tower fans	2.5
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: 41.7 / 45.4)	
K3.01	Main turbine generator and auxiliary systems	3.5
K3.02	Fire protection system	2.2
K3.03	Reactor/turbine pressure regulating system	2.9
K3.04	Condensate system	3.1
K3.05	Circulating water system temperature	3.1
K3.06	Recirculation flow control system	2.2
K3.07	Service water system	2.3
K3.08	Feedwater system	2.8
K3.09	Condenser vacuum	4.0
K3.10	Circulating water system pressure	3.1
K3.11	Circulating water system flow	3.3

K4	**Knowledge of circulating water system design feature(s) or interlock(s) that provide for the following:** (CFR: 41.7)	
K4.01	Automatic valve alignments	2.9
K4.02	Cooling tower cold weather operations	2.8
K4.03	Cooling tower blowdown	2.6
K4.04	Turbine load reduction	3.2
K4.05	Reactor power reduction	3.3
K4.06	Condenser mechanical cleaning	2.1
K4.07	Cooling tower basin level control	2.7
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the circulating water system:** (CFR: 41.4, 41.7 / 45.5)	
K5.01	Pump suction low level	3.0
K5.02	Flood detection/prevention	3.2
K5.03	Pipe rupture	3.3
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the circulating water system:** (CFR: 41.7 / 45.7)	
K6.01	Pump trip	3.5
K6.02	Cooling tower level control valve malfunction	2.9
K6.03	Cooling tower ice formation	2.7
K6.04	Valve malfunctions	3.0
A1	**Ability to predict or monitor changes in parameters associated with operation of the circulating water system including:** (CFR: 41.5 / 45.5)	
A1.01	Weather changes	3.0
A1.02	Circulating water flow	2.9
A1.03	Circulating water pressures	2.6
A1.04	Circulating water Temperatures	3.1
A1.05	Lights and alarms	3.1
A1.06	Condenser vacuum	3.9

		RO	SRO
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, 41.1 / 43.5 / 45.3, 45.6, 45.13)		
A2.01	Pump/Motor failure	3.5	3.3
A2.02	Abnormal valve positions	3.0	3.0
A2.03	Cooling tower ice formation	2.3	2.9
A2.04	System leakage/rupture	3.2	3.5

A3	**Ability to monitor automatic features of the circulating water system including:** (CFR: 41.7 / 45.5)	
A3.01	Pump starts/stops	3.0
A3.02	Valve alignment	2.9
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Circulating water pumps	3.3
A4.02	Circulating water valves	3.1
A4.03	Cooling tower basin level	2.8
A4.04	Cooling tower fans	2.4

System: **239003 SF9 MSVLCS Main Steam Isolation Valve Leakage Control System (BWR 4, 5, 6)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the main steam isolation valve leakage control system and the following systems: (BWR 4, 5, 6)** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3.4
K1.02	Standby gas treatment system	2.7
K1.03	DELETED	
K1.04	AC electrical distribution system	2.8
K1.05	DELETED	
K1.06	Radwaste system	2.0
K1.07	DELETED	
K1.08	Nuclear boiler instrumentation system	2.8
K1.09	Condensate system	2.5
K1.10	Radiation monitoring system	2.9
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Motor operated valves	2.7
K2.02	Leakage control system blowers	2.1
K2.03	Leakage control system heaters	2.1
K3	**Knowledge of the effect that a loss or malfunction of the main steam isolation valve leakage control system will have on the following systems or system parameters:** (CFR: 41.5 / 45.3)	
K3.01	Radiation monitoring system	3.0
K4	**Knowledge of main steam isolation valve leakage control system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Performance of its safety function following a loss of offsite power	3.2
K4.02	Performance of intended safety function following any single active component failure	3.0
K4.03	The prevention of inadvertent system operation	2.4

K4.04	DELETED	
K4.05	Assurance that any MSIV leakage will pass through the system and into standby gas treatment prior to release to the atmosphere	2.8
K4.06	The depressurization of main steam piping prior to routing leakage through system	2.8
K4.07	The reduction of MSIV leakage temperature	2.6
K4.08	Prevention of collected condensate in system bleed lines	2.5
K4.09	The dilution of MSIV leakage	2.5

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the main steam isolation valve leakage control system:**
(CFR: 41.7 / 45.4)

K5.01	Radiation release	3.2
K5.02	System lineup	3.0

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the main steam isolation valve leakage control system:**
(CFR: 41.7 / 45.7)

K6.01	AC electrical distribution system	2.8
K6.02	Standby gas treatment system	2.9
K6.03	Nuclear boiler instrumentation	2.6
K6.04	Main steam system	2.8
K6.05	Radwaste system	2.0
K6.06	Inboard MSIV valve leakage	2.8
K6.07	Outboard MSIV valves leakage	2.9
K6.08	Low dilution air flow (inboard or outboard)	2.4
K6.09	Outboard system logic failure	2.7
K6.10	Inboard system logic failure	2.7
K6.11	Blower failure	2.6
K6.12	Heater failure	2.4
K6.13	Motor operator valve failure(s)	2.8
K6.14	Outboard main steamline high pressure	2.8
K6.15	High reactor pressure	2.7
K6.16	MSIV valve failure to close	2.9
K6.17	Main steam line pressure instrumentation	

A1	**Ability to predict or monitor changes in parameters associated with operation of the main steam isolation valve leakage control system including:** (CFR: 41.5 / 45.5)		
A1.01	Main steam line pressure	2.8	
A1.02	Heater operation	2.4	
A1.03	Dilution air flow	2.8	
A1.04	Status indicating lights and alarms	2.7	
A1.05	DELETED		
A1.06	MSIV leakage flow leakage	2.9	
A1.07	Reactor building temperature	2.3	

A2	**Ability to (a) predict the impacts of the following on the main steam isolation valve leakage control 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	Inboard MSIV valve leakage	3.0	2.8
A2.02	Outboard MSIV valves leakage	3.0	2.8
A2.03	Low dilution air flow (inboard or outboard)	2.5	2.4
A2.04	Outboard system logic failure	2.5	2.7
A2.05	Inboard system logic failure	2.5	2.7
A2.06	Blower failure	2.5	2.6
A2.07	Heater failure	2.0	2.6
A2.08	Motor operator valve failure(s)	3.0	2.7
A2.09	Outboard main steamline high pressure	3.0	2.5
A2.10	AC distribution power failures	2.7	2.6
A2.11	High reactor pressure	3.0	2.5
A2.12	MSIV valve failure to close	3.0	2.5
A2.13	Standby gas treatment system	2.5	2.6
A2.14	Nuclear boiler instrumentation system	2.3	2.6
A2.15	Radwaste system	1.5	2.1
A2.16	Main steam system	3.0	2.6

A3	**Ability to monitor automatic features of the main steam isolation valve leakage control system including:** (CFR: 41.7 / 45.7)		
A3.01	System logic initiation	3.1	
A3.02	Main steamline pressures	2.5	
A3.03	Dilution air flows	2.6	
A3.04	MSIV leakage flows	2.7	
A3.05	Heater operation	2.4	
A3.06	DELETED		
A3.07	System lineups	2.6	

A3.08	Blower operation	2.6
A3.09	Reactor building temperature	2.4

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

A4.01	Manually initiate system operation	3.2
A4.02	DELETED	
A4.03	Main steamline pressures	2.8
A4.04	Dilution air flows	2.7
A4.05	MSIV leakage flows	2.7
A4.06	Heater operation	2.4
A4.07	DELETED	
A4.08	System lineups	2.6
A4.09	System reset	2.6

System:	**271000 SF9 OG Offgas System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K1	**Knowledge of the physical connections or cause-effect relationships between the offgas system and the following systems:** (CFR: 41.4 to 41.5 / 41.7 / 41.13 / 45.6 to 45.8)	
K1.01	Condenser air removal system	3.4
K1.02	Process radiation monitoring system	3.3
K1.03	DELETED	
K1.04	Reactor condensate system	3.0
K1.05	Radwaste system	3.1
K1.06	Main steam system	2.9
K1.07	Instrument air system	2.8
K1.08	DELETED	
K1.09	Component cooling water systems	2.5
K1.10	DELETED	
K1.11	DELETED	
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	Hydrogen water chemistry system	2.7
K1.16	Plant ventilation systems	2.3
K1.17	Fire protection system	2.3
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 offgas system will have on the following systems or system parameters:** (CFR: 41.5 / 45.3)	
K3.01	Condenser vacuum	4.0
K3.02	Off-site release rate	3.7
K3.03	Condenser air removal	3.6
K3.04	Hydrogen concentration	3.1
K3.05	Hydrogen water chemistry system	2.8
K3.06	Radiation monitoring system	3.2
K3.07	Offgas flow	3.6

K4	**Knowledge of offgas system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Dilution of hydrogen gas concentration	3.1
K4.02	Prevention of water entering the recombiner catalyst	2.8
K4.03	Sufficient oxygen providing for complete hydrogen recombination	2.9
K4.04	The prevention of hydrogen explosions or fires	3.5
K4.05	DELETED	
K4.06	Decay of fission product gases	3.2
K4.07	Maximizing charcoal bed efficiency	2.7
K4.08	Automatic system isolation	3.7
K4.09	Filtration of radioactive particulate	3.2
K4.10	Prevention of water intrusion into charcoal beds	3.0
K4.11	Elevated release point	3.3
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the offgas system:** (CFR: 41.5 / 41.7 / 45.4)	
K5.01	DELETED	
K5.02	Heat removal mechanisms	2.6
K5.03	Heat addition mechanisms	2.6
K5.04	Hydrogen concentration	3.3
K5.05	Oxygen concentration	3.0
K5.06	DELETED	
K5.07	Radioactive decay	3.1
K5.08	Charcoal adsorption of fission product gases	3.0
K5.09	Hydrogen and oxygen recombination	3.1
K5.10	DELETED	
K5.11	Reducing relative humidity for carbon bed filters	2.7
K5.12	Condenser vacuum	3.5
K5.13	Off-site release rate	3.6
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the offgas system:** (CFR: 41.5 / 41.7 / 45.7)	
K6.01	Instrument air system	3.0
K6.02	Radiation monitoring system	3.2
K6.03	Component cooling water systems	2.7
K6.04	DELETED	
K6.05	DELETED	
K6.06	DELETED	

K6.07	DELETED		
K6.08	Condenser air removal system	3.2	
K6.09	Fuel cladding integrity	3.2	
K6.10	Condensate system	2.9	
K6.11	Condenser vacuum	3.5	
K6.12	Glycol subsystem	2.5	
K6.13	DELETED		
K6.14	Plant ventilation systems	2.2	
K6.15	Main steam system	2.8	
K6.16	Hydrogen water chemistry system	2.7	

A1 **Ability to predict or monitor changes in parameters associated with operation of the offgas system including:**
(CFR: 41.5 / 45.3 / 45.5)

A1.01	Condenser vacuum	3.7
A1.02	Off-site release rate	3.7
A1.03	Preheater discharge temperature	2.5
A1.04	Recombiner catalyst temperature	2.7
A1.05	Cooler condenser discharge temperature	2.4
A1.06	Filter differential pressure	2.4
A1.07	Charcoal bed humidity	2.6
A1.08	System flow	3.2
A1.09	Charcoal bed temperature	2.7
A1.10	Charcoal vault temperature	2.4
A1.11	Offgas condenser temperatures	2.6
A1.12	Process radiation monitoring indications	3.3
A1.13	Hydrogen gas concentration	3.2
A1.14	Oxygen gas concentration	2.8
A1.15	Steam supply pressures	2.7
A1.16	Lights and alarms	3.0

A2 **Ability to (a) predict the impacts of the following on the offgas 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 / 43.5 / 45.8)

		RO	SRO
A2.01	Low condenser vacuum	4.1	3.3
A2.02	Low dilution steam flow	3.4	2.9
A2.03	Main steam line high radiation	3.8	3.3
A2.04	Offgas system high radiation	3.8	3.4
A2.05	High charcoal bed humidity	2.9	2.6
A2.06	Offgas system holdup volume explosion/ fire	3.9	3.3

A2.07	Low oxygen injection flow	2.9	2.5
A2.08	DELETED		
A2.09	Abnormal valve positions	3.5	2.8
A2.10	Offgas system high flow	3.6	3.2
A2.11	Offgas system low flow	3.5	3.0
A2.12	Recombiner high temperature	3.1	2.8
A2.13	Recombiner low temperature	3.2	2.7
A2.14	Offgas filter high differential pressure	3.0	2.5
A2.15	Air intrusion	3.5	2.8
A2.16	Loss of offgas system loop seals	3.5	3.2
A2.17	Reactor power changes	3.2	3.0

A3 **Ability to monitor automatic features of the offgas system including:**
(CFR: 41.7 / 45.7)

A3.01	System isolations	3.8
A3.02	System flow control	3.1
A3.03	System temperature control	2.8
A3.04	DELETED	
A3.05	DELETED	
A3.06	System differential pressure control	2.6
A3.07	DELETED	
A3.08	Fire suppression	2.7

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

A4.01	Reset system isolations	3.4
A4.02	System flows	3.3
A4.03	System temperatures	2.9
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	System differential pressures	2.7
A4.08	DELETED	
A4.09	Offgas system controls/components	3.0

System: 288000 SF9 PVS Plant Ventilation Systems

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the plant ventilation systems and the following systems:** CFR: 41.4 to 41.5 / 45.7 to 45.8)	
K1.01	AC electrical distribution system	3.0
K1.02	Secondary containment system	3.5
K1.03	Standby gas treatment system	3.6
K1.04	Component cooling water system	2.6
K1.05	Process radiation monitoring system	3.2
K1.06	Instrument air system	3.0
K1.07	Heating, ventilation, and air conditioning system cooling water systems	2.6
K1.08	Heating, ventilation, and air conditioning system heating water system	2.6
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Primary containment supply and exhaust fans	3.0
K2.02	Auxiliary building supply and exhaust fans (turbine building/radwaste building)	2.6
K3	**Knowledge of the effect that a loss or malfunction of the plant ventilation systems will have on the following systems or system parameters:** (CFR: 41.5 / 45.3)	
K3.01	Secondary containment temperature	3.5
K3.02	Primary containment temperature	3.4
K3.03	Auxiliary building temperature	2.8
K3.04	Secondary containment pressure	3.6
K3.05	Primary containment pressure	3.4
K3.06	Auxiliary building pressure	2.7
K3.07	Turbine building temperature	2.6
K3.08	Turbine building differential pressure	2.6
K3.09	Secondary containment system	3.4
K3.10	Standby gas treatment system	3.5
K3.11	Process radiation monitoring system	3.1

K4	**Knowledge of plant ventilation systems design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	Secondary containment isolation	3.8
K4.03	Automatic starting and stopping of fans	3.1
K4.04	Smoke removal	2.7
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the plant ventilation systems:** (CFR: 41.7 / 45.4)	
K5.01	Airborne contamination control	3.2
K5.02	Differential pressure control	3.3
K5.03	Temperature control	2.9
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the plant ventilation systems:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution system	3.1
K6.02	Component cooling water system	2.8
K6.03	Instrument air system	3.0
K6.04	Standby gas treatment system	3.5
K6.05	Heating, ventilation, and air conditioning system cooling water systems	2.6
K6.06	Heating, ventilation, and air conditioning system heating water system	2.7
K6.07	Process radiation monitoring system	3.1
A1	**Ability to predict or monitor changes in parameters associated with operation of the plant ventilation systems including:** (CFR: 41.5 / 45.5)	
A1.01	Filter differential pressure	2.4
A1.02	Fan differential pressure	2.4
A1.03	Area temperatures	3.1
A1.04	Secondary containment differential pressure	3.4

A2 **Ability to (a) predict the impacts of the following on the plant ventilation systems 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	High drywell pressure	3.5	3.6
A2.02	Low reactor water level	3.3	3.2
A2.03	Loss of coolant accident	3.4	3.6
A2.04	High radiation	3.6	3.7
A2.05	Extreme outside weather conditions	3.0	2.9
A2.06	Secondary containment differential pressure	3.5	3.4
A2.07	Loss of AC electrical distribution system	3.1	3.1
A2.08	Loss of component cooling water system	2.7	2.7
A2.09	Loss of instrument air system	3.1	3.0
A2.10	Loss of standby gas treatment system	3.2	3.7

A3 **Ability to monitor automatic features of the plant ventilation systems including:**
(CFR: 41.7 / 45.7)

A3.01	Isolation/initiation signals	3.7
A3.02	Differential pressure control	3.3

A4 **Ability to manually operate or monitor in the control room:**
(CFR: 41.4 / 41.7 / 45.5 to 45.8)

A4.01	Fans	3.2
A4.02	Area temperature	3.3
A4.03	Dampers	3.0
A4.04	Building differential pressure	3.3

System: 272000 SF9 RMS Radiation Monitoring System

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the radiation monitoring system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3.6
K1.02	Offgas system (augmented offgas)	3.7
K1.03	Stack gas	3.7
K1.04	Component cooling water system	3.0
K1.05	Radwaste system	2.9
K1.06	Reactor building ventilation system	3.6
K1.07	Isolation condenser	3.3
K1.08	DELETED	
K1.09	Primary containment isolation system	3.9
K1.10	Fuel handling systems	3.4
K1.11	DELETED	
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	DELETED	
K1.16	Plant process computer/parameter display systems	3.0
K1.17	DELETED	
K1.18	Primary/secondary containment	3.6
K1.19	DELETED	
K1.20	DELETED	
K1.21	DELETED	
K1.22	DELETED	
K1.23	Continuous air monitoring/ post-accident air monitoring systems	3.3
K1.24	Plant ventilation system	3.4
K1.25	Standby gas treatment	3.8
K1.26	Safety related service water system	3.2
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	DELETED	
K2.02	DELETED	
K2.03	DELETED	
K2.04	Process radiation monitoring system	2.8
K2.05	DELETED	
K2.06	Area radiation monitors	2.6

K2.07	DELETED	
K2.08	Continuous air monitoring/post-accident air monitoring systems	2.7

K3	**Knowledge of the effect that a loss or malfunction of the radiation monitoring system will have on the following systems or system parameters:** (CFR: 41.5 / 45.3)	
K3.01	Liquid effluent release monitoring	3.4
K3.02	Gaseous effluent release monitoring	3.6
K3.03	Area radiation monitoring	3.1
K3.04	Main steam system	3.2
K3.05	Offgas system	3.6
K3.06	Plant ventilations systems	3.3
K3.07	DELETED	
K3.08	DELETED	
K3.09	DELETED	
K3.10	DELETED	
K3.11	Standby gas treatment system	3.6
K3.12	Safety related service water system	3.0
K3.13	Continuous air monitoring/post-accident air monitoring systems	2.9

K4	**Knowledge of radiation monitoring system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	DELETED	
K4.02	System isolations/initiations	4.1
K4.03	Fail safe tripping of process radiation monitoring logic during conditions of instrument failure	3.5
K4.04	Process radiation monitoring surveillance testing	2.7

K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the radiation monitoring system:** (CFR: 41.7 / 45.4)	
K5.01	Hydrogen injection operation’s effect on process radiation indications	3.3
K5.02	Radiation level trends	3.3

K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the radiation monitoring system:** (CFR: 41.7 / 45.7)		
K6.01	DELETED		
K6.02	DC power	3.0	
K6.03	AC power	3.1	
K6.04	Plant process computer/parameter display systems	2.7	
K6.05	DELETED		
K6.06	Continuous air monitoring/ post-accident radiation monitoring system	2.9	
A1	**Ability to predict or monitor changes in parameters associated with operation of the radiation monitoring system including:** (CFR: 41.5 / 45.5)		
A1.01	Lights and alarms	3.4	
A1.02	DELETED		
A1.03	Radiations levels	3.7	
A1.04	Sample flows	2.8	

A2	**Ability to (a) predict the impacts of the following on the 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 / 45.6)	**RO**	**SRO**
A2.01	Fuel element failure	4.1	4.2
A2.02	DELETED		
A2.03	AC electrical failure	3.1	3.3
A2.04	DC electrical failure	2.9	3.2
A2.05	Loss of dilution steam	2.9	2.8
A2.06	Downscale trips	3.0	3.1
A2.07	Hydrogen injection operation	3.4	3.0
A2.08	Offgas system failure	3.5	3.4
A2.09	Low fuel pool level	3.7	3.6
A2.10	Loss of coolant accident	4.2	4.0
A2.11	Leakage or breaks from contaminated systems to atmosphere or to other process systems	3.9	3.7
A2.12	Refuel floor handling accidents/operations	3.9	4.0
A2.13	Low reactor water level during refueling operations	3.9	3.7
A2.14	Loss of, or inadequate, shielding	3.4	3.5
A2.15	Maintenance operations	2.8	2.5
A2.16	Instrument malfunctions	2.9	3.0
A2.17	Plant ventilation systems abnormal radiation levels	3.4	3.3

A3	**Ability to monitor automatic features of the radiation monitoring system including:** (CFR: 41.7 / 45.7)	
A3.01	Main steam Radiation alarms	3.5
A3.02	DELETED	
A3.03	DELETED	
A3.04	DELETED	
A3.05	DELETED	
A3.06	DELETED	
A3.07	DELETED	
A3.08	DELETED	
A3.09	Containment isolation	4.1
A3.10	DELETED	
A3.11	DELETED	
A3.12	Process radiation monitor isolations	3.6
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Radiation monitoring system recorders	3.3
A4.02	Meter indications	3.2
A4.03	DELETED	
A4.04	Plant process computer/parameter display systems	3.2
A4.05	Process radiation monitor	3.3
A4.06	Process radiation monitor logic	2.9

System: **268000 SF9 RW Radwaste System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the radwaste system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate system	2.6
K1.02	Plant pneumatic systems	2.4
K1.03	DELETED	
K1.04	DELETED	
K1.05	DELETED	
K1.06	DELETED	
K1.07	RWCU system	2.9
K1.08	Fuel pool	2.9
K1.09	DELETED	
K1.10	Auxiliary steam	1.9
K1.11	Component cooling water system	2.1
K1.12	DELETED	
K1.13	DELETED	
K1.14	DELETED	
K1.15	Condenser air removal/offgas system	2.2
K1.16	Circulating water system	1.8
K1.17	Secondary containment	2.6
K1.18	Primary containment	2.5
K1.19	Plant ventilation systems	2.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Radiological release isolation valves	2.7
K3	**Knowledge of the effect that a loss or malfunction of the radwaste system will have on the following systems or system parameters:** (CFR: 41.5 / 45.3)	
K3.01	RWCU system	2.6
K3.02	Condensate system	2.3
K3.03	DELETED	
K3.04	Primary containment drain sumps	3.0
K3.05	Fuel pools	2.6
K3.06	Secondary containment drain sumps	2.8

K4	**Knowledge of radwaste system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)		
K4.01	Automatic isolation of radiological release isolation valves	3.0	
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the radwaste system:** (CFR: 41.5 / 45.3)		
K5.01	DELETED		
K5.02	DELETED		
K5.03	Dilution flow for releases	2.9	
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the radwaste:** (CFR: 41.7)		
K6.01	Component cooling water system	2.1	
K6.02	Plant pneumatic systems	2.4	
K6.03	Plant ventilation systems	2.4	
K6.04	Circulating water	1.9	
A1	**Ability to predict or monitor changes in parameters associated with operation of the radwaste system including:** (CFR: 41.5 / 45.5)		
A1.01	Area radiation level	3.0	
A1.02	Off-site release (liquid/gaseous release)	3.2	
A1.03	Lights and alarms	2.6	

A2	**Ability to (a) predict the impacts of the following on the 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 / 45.6)	**RO**	**SRO**
A2.01	System rupture	2.8	3.1
A2.02	DELETED		
A2.03	Loss of evaporator steam supply	2.1	2.2
A2.04	Radiological release isolation valve failure	3.1	3.2
A2.05	Abnormal primary containment sump pump run time	3.4	3.3

A3	**Ability to monitor automatic features of the Radwaste system including:** (CFR: 41.7 / 45.7)	
A3.01	Radiological release isolation valves	3.2
A3.02	Primary/secondary containment sump pump operation	3.1
A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Sump integrators	3.2
A4.02	Primary containment sump pumps	3.1

System: 290003 SF9 CRV Control Room Ventilation

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the control room ventilation and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Radiation monitoring system	3.5
K1.02	DELETED	
K1.03	DELETED	
K1.04	Nuclear steam supply system (NSSSS/PCIS)	2.8
K1.05	Component cooling water system	2.7
K1.06	Plant pneumatic system	2.6
K1.07	Fire protection system	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 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) or interlocks that 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	Differential pressure 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-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, 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	Component cooling water system	2.9	
K6.03	Plant pneumatic system	2.7	
K6.04	Fire protection system	2.7	
K6.05	Radiation monitoring system	3.4	
K6.06	Nuclear steam supply system (NSSSS/PCIS)	3.0	
A1	**Ability to predict or monitor changes in parameters associated with operation of the control room ventilation including:** (CFR: 41.5 / 45.5)		
A1.01	Filter differential pressure	2.5	
A1.02	Fan differential pressure	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, radiation, etc.)	3.5	3.7
A2.03	Initiation/reconfiguration failure	3.5	3.8
A2.04	Initiation/failure of fire protection system	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 fire protection system	3.0
A3.03	Plant process computer/parameter display systems	2.4

A4 **Ability to manually operate 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

System: 233000 SF9 FPCCU Fuel Pool Cooling and Clean-up

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the fuel pool cooling and clean-up and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	DELETED	
K1.02	Residual heat removal system	3.3
K1.03	DELETED	
K1.04	Process sampling system	2.3
K1.05	Instrument air system	2.8
K1.06	DELETED	
K1.07	Condensate system	2.6
K1.08	DELETED	
K1.09	Component cooling water systems	3.2
K1.10	DELETED	
K1.11	DELETED	
K1.12	Radwaste systems	2.6
K1.13	Torus/suppression pool cleanup system	2.5
K1.14	Plant ventilation systems	2.7
K1.15	DELETED	
K1.16	Emergency cooling water system safety related service water	3.2
K1.17	Back-up fuel pool systems	3.3
K1.18	Alternate decay heat removal system	3.3
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Fuel pool cooling pumps	3.1
K2.02	DELETED	
K3	**Knowledge of the effect that a loss or malfunction of the fuel pool cooling and clean-up will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Fuel pool temperature	3.9
K3.02	Fuel pool water level	3.6
K3.03	Fuel pool water clarity	2.9
K3.04	Fuel pool water chemistry	2.7
K3.05	Fuel pool water fission product concentration	2.8
K3.06	Area radiation levels	3.4

K3.07	Suppression pool chemistry	2.1
K3.08	DELETED	

K4 **Knowledge of fuel pool cooling and clean-up design feature(s) or interlocks that provide for the following:**
(CFR: 41.7)

K4.01	Redundancy	3.1
K4.02	Pool clarity	2.7
K4.03	Maintenance of adequate pool temperature	3.6
K4.04	DELETED	
K4.05	Maintaining fuel pool cooling pump NPSH	3.2
K4.06	Maintenance of adequate pool level	3.7
K4.07	Supplemental heat removal capability	3.4
K4.08	Pool cooling during loss of coolant accident: BWR-6	3.6
K4.09	Maintenance of filter/demineralizer precoat during low flow conditions	2.6
K4.10	Fuel pool leak detection	3.0

K5 **Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the fuel pool cooling and clean-up:**
(CFR: 41.5 / 45.3)

K5.01	Heat removal mechanisms	3.3
K5.02	DELETED	
K5.03	Spent fuel decay heat generation	3.3
K5.04	DELETED	
K5.05	DELETED	
K5.06	Maximum heat load	3.3
K5.07	DELETED	
K5.08	Interconnections with storage pools/pits	3.2
K5.09	Refueling operations	3.4
K5.10	Abnormal fuel pool temperatures	3.5

K6 **Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the fuel pool cooling and clean- up:**
(CFR: 41.7 / 45.7)

K6.01	AC electrical power	3.3
K6.02	DELETED	
K6.03	Residual heat removal system	2.8
K6.04	DELETED	
K6.05	Condensate system	2.5
K6.06	DELETED	

K6.07	Component cooling water systems	3.2
K6.08	Instrument air system	2.9
K6.09	Radwaste systems	2.3
K6.10	Reactor cavity seal failure	3.1
K6.11	NSSSS/PCIS	2.9
K6.12	Alternate decay heat removal system	3.3
K6.13	Pump trip	3.5

A1 **Ability to predict or monitor changes in parameters associated with operation of the fuel pool cooling and clean-up including:**
(CFR: 41.5 / 45.5)

A1.01	Fuel pool surge tank level	3.6
A1.02	Fuel pool level	3.6
A1.03	Fuel pool temperature	3.8
A1.04	DELETED	
A1.05	DELETED	
A1.06	System flow	3.2
A1.07	DELETED	
A1.08	Fuel pool chemistry	2.4
A1.09	Fuel pool clarity	2.5
A1.10	Fuel pool activity levels	2.4
A1.11	DELETED	
A1.12	Lights and alarms	3.3
A1.13	Closed cooling water temperature	3.1

A2 **Ability to (a) predict the impacts of the following on the fuel pool cooling and clean-up 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	Abnormal fuel pool level	3.8	3.8
A2.02	DELETED		
A2.03	Abnormal surge tank level	3.6	3.5
A2.04	Pump trip	3.6	3.5
A2.05	Abnormal valve position	3.2	3.0
A2.06	DELETED		
A2.07	Abnormal fuel pool temperature	3.7	3.6
A2.08	Closed cooling water failure	3.3	3.4
A2.09	AC electrical power failures	3.4	3.3
A2.10	Refueling bellows seal high flow	3.4	2.9
A2.11	Fuel pool gate seal high flow	3.3	3.0
A2.12	Abnormal filter/demineralizer differential pressure	2.9	2.7
A2.13	DELETED		

A2.14	Low system flow	3.1	2.8
A2.15	DELETED		
A2.16	Loss of coolant accident signal	3.4	3.3
A2.17	Fuel transfer tube drain tank high level/low level: BWR-6	3.0	3.0
A2.18	Low pool clarity	2.7	2.4
A2.19	Inadequate system/pool chemistry	2.6	2.3

A3 **Ability to monitor automatic features of the fuel pool cooling and clean-up including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	2.9
A3.02	Pump trip(s)	3.3
A3.03	DELETED	

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

A4.01	DELETED	
A4.02	Fuel pool cooling system valves	2.8
A4.03	DELETED	
A4.04	DELETED	
A4.05	DELETED	
A4.06	DELETED	
A4.07	DELETED	
A4.08	DELETED	
A4.09	Fuel pool cooling system pumps	3.1
A4.10	DELETED	
A4.11	DELETED	

System: **261000 SF9 SGTS Standby Gas Treatment System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K1	**Knowledge of the physical connections or cause-effect relationships between the standby gas treatment system and the following systems:** (CFR: 41.4 to 41.9 / 45.7 to 45.8)	
K1.01	Plant ventilation systems	3.5
K1.02	Primary containment system and auxiliaries	3.7
K1.03	DELETED	
K1.04	Radiation monitoring system	3.6
K1.05	Radwaste system	2.1
K1.06	High pressure coolant injection system	2.8
K1.07	DELETED	
K1.08	DELETED	
K1.09	Primary containment isolation system/nuclear steam supply shut-off system	3.6
K1.10	Instrument air system	3.0
K1.11	DELETED	
K1.12	DELETED	
K1.13	Fire protection system	2.7
K2	**Knowledge of electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Standby gas treatment system fans	3.5
K2.02	Standby gas treatment system motor operated valves/dampers	3.1
K2.03	Standby gas treatment system initiation logic	3.5
K2.04	Standby gas treatment system heaters	2.9
K3	**Knowledge of the effect that a loss or malfunction of the standby gas treatment system will have on the following systems or system parameters:** (CFR: 41.7 / 45.6)	
K3.01	Secondary containment differential pressure	3.9
K3.02	Off-site release rate	4.0
K3.03	Primary containment pressure: Mark I and II	3.7
K3.04	High pressure coolant injection system (BWR 3 and 4)	2.8
K3.05	Secondary containment radiation/ contamination levels	3.5
K3.06	Primary containment oxygen content: Mark I and II	3.0

K4	**Knowledge of standby gas treatment system design feature(s) or interlocks that provide for the following:** (CFR: 41.7)	
K4.01	Automatic system initiation	4.0
K4.02	Charcoal bed decay heat removal	3.0
K4.03	Moisture removal	3.0
K4.04	Radioactive particulate filtration	3.4
K4.05	Fission product gas removal	3.3
K4.06	Charcoal bed retention	2.9
K4.07	Elevated release stack	3.4
K4.08	Fire suppression	2.7
K5	**Knowledge of the operational implications or cause-effect relationships of the following concepts as they apply to the standby gas treatment system:** (CFR: 41.5 / 45.3)	
K5.01	Heat removal mechanisms	3.0
K5.02	DELETED	
K5.03	Primary containment pressure changes	3.3
K5.04	Secondary containment pressure changes	3.4
K5.05	Fuel handling building pressure changes	3.0
K6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the standby gas treatment system:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution	3.5
K6.02	DC electrical distribution	3.2
K6.03	DELETED	
K6.04	Radiation monitoring system	3.4
K6.05	Reactor protection system	3.1
K6.06	Instrument air system	2.8
K6.07	DELETED	
K6.08	Reactor vessel level	3.4
K6.09	Primary containment high pressure	3.4
K6.10	Primary containment isolation system/nuclear steam supply shut-off system	3.4

A1	**Ability to predict or monitor changes in parameters associated with operation of the standby gas treatment system including:** (CFR: 41.5 / 45.5)		
A1.01	System flow	3.5	
A1.02	Primary containment pressure	3.5	
A1.03	Off-site radioactive release limits	3.7	
A1.04	Secondary containment differential pressure	3.7	
A1.05	Primary containment oxygen level: Mark I and II	3.0	
A1.06	Drywell and suppression chamber differential pressure: Mark I	3.2	
A1.07	SBGTS train temperature	3.0	

A2	**Ability to (a) predict the impacts of the following on the standby gas treatment 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 / 45.6)	**RO**	**SRO**
A2.01	Low system flow	3.4	3.5
A2.02	High system flow	3.0	3.2
A2.03	High train temperature	2.9	3.3
A2.04	High train moisture content	2.9	2.9
A2.05	Fan trips	3.6	3.8
A2.06	Valve/damper closures	3.6	3.6
A2.07	AC electrical distribution failure	3.3	3.5
A2.08	DELETED		
A2.09	Instrument air system	3.2	2.7
A2.10	Low reactor water level	3.4	3.4
A2.11	High containment pressure	3.6	3.2
A2.12	High fuel pool ventilation radiation	3.4	3.3
A2.13	High secondary containment ventilation exhaust radiation	3.7	3.6
A2.14	High system pressure	3.1	3.0
A2.15	High area radiation by refuel bridge	3.3	3.2

A3	**Ability to monitor automatic features of the standby gas treatment system including:** (CFR: 41.7 / 45.7)	
A3.01	System flow	3.6
A3.02	Fan start	3.8
A3.03	Valve/damper operation	3.7
A3.04	System temperature	3.1

A4	**Ability to manually operate or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Off-site radioactive release limits	3.9
A4.02	DELETED	
A4.03	Fan	3.7
A4.04	Primary containment pressure	3.6
A4.05	Drywell to suppression chamber/torus differential pressure: Mark I and II	3.5
A4.06	Reactor building differential pressure	3.6
A4.07	System flow	3.6
A4.08	System temperature	3.1
A4.09	SBGT valves/dampers	3.6

4.1	Generic Emergency Plant Evolutions (EPE)	Page
295024	High Drywell Pressure	4.1-3
295025	High Reactor Pressure	4.1-6
295026	Suppression Pool High Water Temperature	4.1-8
295027	High Containment Temperature (Mark III Containment Only)	4.1-10
295028	High Drywell Temperature (Mark I and II only)	4.1-12
295029	High Suppression Pool Water Level	4.1-14
295030	Low Suppression Pool Water Level	4.1-16
295031	Reactor Low Water Level	4.1-18
295032	High Secondary Containment Area Temperature	4.1-20
295033	High Secondary Containment Area Radiation Levels	4.1-22
295034	Secondary Containment Ventilation High Radiation	4.1-24
295035	Secondary Containment High Differential Pressure	4.1-26
295036	Secondary Containment High Sump / Area Water Level	4.1-27
295037	SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown	4.1-29
295038	High Off-Site Radioactivity Release Rate	4.1-32
500000	High Containment Hydrogen Concentration	4.1-34

EPE:	**295024 High Drywell Pressure**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high drywell pressure:** (CFR: 41.8 to 41.10)	
EK1.01	Drywell integrity	4.3
EK1.02	Containment building integrity (Mark III)	4.0
EK2	**Knowledge of the relationship between high drywell pressure and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	HPCI (FWCI)	4.2
EK2.02	HPCS	4.3
EK2.03	LPCS	4.4
EK2.04	RHR/LPCI	4.4
EK2.05	RPS	4.4
EK2.06	Emergency generators	4.2
EK2.07	PCIS/NSSSS	4.4
EK2.08	ADS	4.2
EK2.09	Suppression pool makeup	3.1
EK2.10	AC electrical distribution	3.3
EK2.11	Drywell spray (RHR) (Mark I & II)	4.2
EK2.12	Suppression pool cooling	3.7
EK2.13	Suppression pool spray	3.9
EK2.14	Containment (Mark III)	4.1
EK2.15	Containment spray (Mark III)	4.2
EK2.16	Plant process computer/parameter display systems	3.1
EK2.17	Secondary containment/Auxiliary building isolation	3.7
EK2.18	Plant ventilation systems	3.2
EK2.19	Feedwater and condensate	2.8
EK2.20	DC electrical distribution	2.9
EK2.21	RCIC	3.3
EK2.22	Standby gas treatment system	3.9
EK2.23	Hardened vent system (Mark I)	4.1
EK2.24	Safety/relief valves	3.6
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high drywell pressure:** (CFR: 41.5 / 45.6)	
EK3.01	Drywell spray (Mark I & II)	4.4

EK3.02	Suppression pool spray	4.1	
EK3.03	Containment venting (Mark III)	4.2	
EK3.04	Emergency depressurization	4.2	
EK3.05	Drywell flooding	3.7	
EK3.06	Reactor SCRAM	4.3	
EK3.07	Drywell venting	4.2	
EK3.08	Containment spray	4.3	
EK3.09	Secondary containment/Auxiliary building isolation	3.6	
EA1	**Ability to operate or monitor the following as they apply to high drywell pressure:** (CFR: 41.7 / 45.6)		
EA1.01	HPCI (FWCI)	4.1	
EA1.02	HPCS	4.2	
EA1.03	LPCS	4.2	
EA1.04	RHR/LPCI	4.2	
EA1.05	RPS	4.2	
EA1.06	Emergency generators	4.1	
EA1.07	PCIS/NSSSS	4.2	
EA1.08	ADS	4.1	
EA1.09	Suppression pool makeup	3.1	
EA1.10	AC electrical distribution	3.4	
EA1.11	Drywell spray (Mark I & II)	4.4	
EA1.12	Suppression pool spray (Mark I & II)	4.2	
EA1.13	Suppression pool cooling	3.8	
EA1.14	Drywell ventilation system	3.4	
EA1.15	Containment/drywell atmospheric monitoring	3.5	
EA1.16	Containment/drywell vacuum breakers	3.8	
EA1.17	Containment spray	4.3	
EA1.18	Containment ventilation system (Mark III)	3.5	
EA1.19	Containment atmosphere control	3.2	
EA1.20	Standby gas treatment/FRVS	3.8	
EA1.21	Recirculation system (LPCI loop select logic)	3.6	
EA1.22	DC electrical distribution	3.1	
EA1.23	RCIC	3.5	
EA1.24	Drywell cooling	3.6	
EA2	**Ability to determine or interpret the following as they apply to high drywell pressure:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Drywell pressure	4.4	4.4
EA2.02	Drywell temperature	4.4	4.3
EA2.03	Suppression pool level	4.1	4.0
EA2.04	Suppression chamber pressure	4.3	4.3
EA2.05	Suppression chamber air-space temperature	3.3	3.4

EA2.06	Suppression pool temperature	4.1	4.0
EA2.07	Containment radiation levels (Mark III)	3.4	3.6
EA2.08	Drywell radiation levels	3.5	3.6
EA2.09	Containment pressure (Mark III)	3.9	4.2
EA2.10	Containment temperature (Mark III)	3.9	4.0
EA2.11	Drywell integrity	4.2	4.4
EA2.12	Safety/relief valves	3.9	3.7

EPE: **295025 High Reactor Pressure**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high reactor pressure:** (CFR: 41.8 to 41.10)	
EK1.01	DELETED	
EK1.02	DELETED	
EK1.03	Safety/relief valve tailpipe temperature/pressure relationships	4.1
EK1.04	Decay heat	3.8
EK1.05	Exceeding safety limits	4.6
EK1.06	Pressure effects on reactor water level	3.8
EK1.07	Pressure control strategies	4.2
EK2	**Knowledge of the relationship between high reactor pressure and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	RPS	4.2
EK2.02	Isolation condenser	4.0
EK2.03	RRCS	3.9
EK2.04	ARI/RPT/ATWS	4.1
EK2.05	Safety/relief valves	4.4
EK2.06	HPCI	3.5
EK2.07	RCIC	3.6
EK2.08	Reactor/turbine pressure regulating system	3.7
EK2.09	DELETED	
EK2.10	Plant process computer/parameter display systems	2.9
EK2.11	DELETED	
EK2.12	Main and reheat steam system	3.1
EK2.13	Reactor water cleanup system	2.8
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high reactor pressure:** (CFR: 41.5 / 45.6)	
EK3.01	Safety/relief valve operation	4.3
EK3.02	ARI/RPT/ATWS	4.2
EK3.03	HPCI operation	3.5
EK3.04	Isolation condenser initiation	4.0
EK3.05	RCIC operation	3.5
EK3.06	DELETED	

EK3.07	RRCS initiation	3.8	
EK3.08	Reactor/turbine pressure regulating system operation	3.6	
EK3.09	Low-low set initiation	3.9	
EK3.10	Reactor SCRAM	4.3	

EA1 **Ability to operate or monitor the following as they apply to high reactor pressure:**
(CFR: 41.7 / 45.6)

EA1.01	Main and reheat steam	3.1
EA1.02	Reactor/turbine pressure regulating system	3.7
EA1.03	Safety/relief valves	4.4
EA1.04	HPCI	3.6
EA1.05	RCIC	3.6
EA1.06	Isolation condenser	4.1
EA1.07	ARI/RPT/ATWS	4.0
EA1.08	RRCS	3.9
EA1.09	RPS	4.2
EA1.10	Reactor water cleanup system	2.8

EA2 **Ability to determine or interpret the following as they apply to high reactor pressure:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.01	Reactor pressure	4.7	4.3
EA2.02	Reactor power	4.4	4.2
EA2.03	Suppression pool temperature	4.0	3.5
EA2.04	Suppression pool level	4.0	3.4
EA2.05	DELETED		
EA2.06	Reactor water level	4.2	3.7

EPE:	**295026 Suppression Pool High Water Temperature**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to suppression pool high water temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Pump NPSH	3.6
EK1.02	Heat capacity	4.1
EK1.03	Primary containment integrity	3.8
EK1.04	Suppression pool level	3.5
EK1.05	Suppression pool cooling	3.8
EK2	**Knowledge of the relationship between suppression pool high water temperature and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	RHR/LPCI	3.8
EK2.02	DELETED	
EK2.03	DELETED	
EK2.04	Plant process computer/parameter display systems	2.9
EK2.05	DELETED	
EK2.06	DELETED	
EK2.07	HPCI	3.8
EK2.08	RCIC	3.8
EK2.09	HPCS	3.6
EK2.10	LPCS	3.7
EK2.11	Safety/relief valves	3.9
EK2.12	Suppression pool makeup	2.8
EK3	**Knowledge of the reasons for the following responses or actions as they apply to suppression pool high water temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency/normal depressurization	4.3
EK3.02	Suppression pool cooling	3.8
EK3.03	Suppression pool spray	3.4
EK3.04	SLC injection	3.6
EK3.05	Reactor SCRAM	3.9

EA1	**Ability to operate or monitor the following as they apply to suppression pool high water temperature:** (CFR: 41.7 / 45.6)		
EA1.01	DELETED		
EA1.02	DELETED		
EA1.03	Suppression pool temperature monitoring (SPTMS)	3.8	
EA1.04	HPCI	3.7	
EA1.05	RCIC	3.9	
EA1.06	RHR/LPCI	4.0	
EA1.07	HPCS	3.6	
EA1.08	LPCS	3.8	
EA1.09	Safety/relief valves	4.1	

EA2	**Ability to determine or interpret the following as they apply to suppression pool high water temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Suppression pool water temperature	4.1	4.0
EA2.02	Suppression pool level	3.6	3.9
EA2.03	Reactor pressure	3.5	3.7

EPE: 295027 High Containment Temperature (Mark III Containment Only)

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high containment temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Equipment environmental qualifications	3.2
EK1.02	Reactor water level measurement	4.1
EK1.03	Primary containment integrity	4.0
EK2	**Knowledge of the relationship between high containment temperature and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	RHR/LPCI: containment spray system mode	4.0
EK2.02	Components internal to the containment	3.3
EK2.03	Containment ventilation/cooling	3.4
EK2.04	Plant process computer/parameter display systems.	2.9
EK2.05	Safety relief valves	3.4
EK2.06	Reactor/turbine pressure regulating system	2.7
EK2.07	Hydrogen recombiners	3.1
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high containment temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Anticipate /Emergency depressurization	4.0
EK3.02	Containment spray	4.2
EK3.03	Reactor SCRAM	3.9
EK3.04	Hydrogen recombiners	3.2
EA1	**Ability to operate or monitor the following as they apply to high containment temperature:** (CFR: 41.7 / 45.6)	
EA1.01	RHR/LPCI Containment spray system mode	4.2
EA1.02	Containment ventilation/cooling	3.7
EA1.03	Safety relief valves	3.7
EA1.04	Reactor/turbine pressure regulating system	3.0
EA1.05	Hydrogen recombiners	3.1

EA2	**Ability to determine or interpret the following as they apply to high containment temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Containment temperature	4.5	4.1
EA2.02	Containment pressure	4.5	4.1
EA2.03	Reactor pressure	4.1	3.6
EA2.04	DELETED		
EA2.05	Reactor water level	4.5	4.0

EPE:	**295028 High Drywell Temperature (Mark I & II Only)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high drywell temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Reactor water level measurement	3.8
EK1.02	Equipment environmental qualification	3.1
EK1.03	Primary containment integrity	3.6
EK1.04	Emergency depressurization	4.0
EK1.05	High drywell pressure	3.8
EK2	**Knowledge of the relationship between high drywell temperature and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	RHR/LPCI: containment spray system mode	3.9
EK2.02	Components internal to the drywell	3.2
EK2.03	DELETED	
EK2.04	Drywell ventilation	3.4
EK2.05	Plant process computer/parameter display systems	2.8
EK2.06	Safety relief valves	3.5
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high drywell temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	4.1
EK3.02	RPV flooding	3.7
EK3.03	Drywell spray	3.8
EK3.04	Increased drywell cooling	3.6
EK3.05	Reactor SCRAM	3.7
EK3.06	DELETED	
EA1	**Ability to operate or monitor the following as they apply to high drywell temperature:** (CFR: 41.7 / 45.6)	
EA1.01	Drywell spray	4.0
EA1.02	Drywell ventilation system	3.6
EA1.03	Drywell cooling system	3.7
EA1.04	DELETED	
EA1.05	Safety relief valves	3.8

EA2	**Ability to determine or interpret the following as they apply to high drywell temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Drywell temperature	4.0	4.2
EA2.02	Reactor pressure	3.6	3.7
EA2.03	Reactor water level	3.6	4.0
EA2.04	Drywell pressure	3.9	4.0
EA2.05	Torus/suppression chamber pressure	3.7	3.7
EA2.06	Torus/suppression chamber air space temperature	3.0	3.5

EPE: **295029 High Suppression Pool Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high suppression pool water level:** (CFR: 41.8 to 41.10)	
EK1.01	Containment integrity	3.8
EK1.02	Venting the suppression pool (Mark I containment)	4.0
EK2	**Knowledge of the relationship between the high suppression pool water level and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	RHR/LPCI	3.1
EK2.02	HPCI	3.7
EK2.03	HPCS	3.3
EK2.04	Suppression pool cleanup system	2.7
EK2.05	Containment/drywell vacuum breakers	3.6
EK2.06	SRVs and discharge piping	3.7
EK2.07	Drywell/containment water level	3.6
EK2.08	Drywell/suppression chamber ventilation	3.5
EK2.09	RCIC	3.4
EK2.10	Radwaste	2.3
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high suppression pool water level:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	4.1
EK3.02	Lowering suppression pool water level	3.7
EK3.03	Reactor SCRAM	3.5
EA1	**Ability to operate or monitor the following as they apply to a high suppression pool water level:** (CFR: 41.7 / 45.6)	
EA1.01	HPCI	3.5
EA1.02	HPCS	3.4
EA1.03	RHR/LPCI	3.3
EA1.04	RCIC	3.5
EA1.05	Suppression pool level	3.7

EA2	**Ability to determine or interpret the following as they apply to high suppression pool water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Suppression pool water level	4.0	4.0
EA2.02	Reactor pressure	3.5	3.3
EA2.03	Drywell/containment water level	3.8	3.6
EA2.04	Drywell/containment pressure	3.8	3.7

EPE: 295030 Low Suppression Pool Water Level

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to low suppression pool water level:** (CFR: 41.8 to 41.10)	
EK1.01	Steam condensation	3.9
EK1.02	Pump NPSH	3.9
EK1.03	Heat capacity	4.0
EK1.04	Downcomer/horizontal vent submergence	3.9
EK1.05	SRV discharge submergence	4.0
EK2	**Knowledge of the relationship between the low suppression pool water level and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	HPCI	4.0
EK2.02	RCIC	3.7
EK2.03	LPCS	3.8
EK2.04	RHR/LPCI	3.8
EK2.05	HPCS	3.8
EK2.06	Suppression pool make-up system(s)	3.5
EK2.07	DELETED	
EK2.08	Systems required to depressurize the reactor	3.9
EK2.09	DELETED	
EK2.10	Systems required to shut down the reactor	3.4
EK3	**Knowledge of the reasons for the following responses or actions as they apply to low suppression pool water level:** (CFR: 41.5 / 45.6)	
EK3.01	Anticipate/emergency depressurization	4.0
EK3.02	HPCI Shutdown	4.0
EK3.03	DELETED	
EK3.04	DELETED	
EK3.05	Suppression pool make-up system(s) operation	3.6
EK3.06	Reactor shutdown/SCRAM	4.0
EK3.07	NPSH/vortex limits	3.8

EA1	**Ability to operate or monitor the following as they apply to a low suppression pool water level:** (CFR: 41.7 / 45.6)		
EA1.01	ECCSs	4.0	
EA1.02	RCIC	3.8	
EA1.03	DELETED		
EA1.04	Suppression pool make-up system(s)	3.5	
EA1.05	DELETED		
EA1.06	DELETED		
EA1.07	Plant process computer/parameter display systems	2.9	
EA1.08	Systems required to shut down the reactor	3.4	

EA2	**Ability to determine or interpret the following as they apply to low suppression pool water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Suppression pool level	4.1	4.1
EA2.02	Suppression pool temperature	4.1	3.8
EA2.03	Reactor pressure	4.1	3.7
EA2.04	Drywell/suppression chamber differential pressure: Mark I & II	4.2	3.5
EA2.05	ECCS/RCIC pump flow	4.1	3.4
EA2.06	Suppression chamber pressure	4.1	3.5

EPE:	295031 Reactor Low Water Level	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to reactor low water level:** (CFR: 41.8 to 41.10)	
EK1.01	Adequate core cooling	4.7
EK1.02	DELETED	
EK1.03	DELETED	
EK2	**Knowledge of the relationship between reactor low water level and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Nuclear boiler instrumentation	4.2
EK2.02	DELETED	
EK2.03	Low pressure core spray	4.3
EK2.04	Reactor core isolation cooling	4.2
EK2.05	RHR/LPCI	4.3
EK2.06	High pressure coolant injection (HPCI)	4.1
EK2.07	High pressure core spray	4.5
EK2.08	Automatic depressurization system	4.3
EK2.09	Recirculation system	3.5
EK2.10	Redundant reactivity control	3.8
EK2.11	Reactor protection system	4.3
EK2.12	PCIS/NSSS	4.3
EK2.13	ARI/RPT/ATWS	4.1
EK2.14	Emergency generators	4.1
EK2.15	AC electrical distribution	3.6
EK2.16	Reactor water level control system	4.1
EK2.17	Feedwater system	3.9
EK2.18	Condensate system	3.5
EK2.19	Isolation condenser	3.6
EK2.20	Control rod drive hydraulic system	3.4
EK2.21	Alternate injection systems	3.8
EK2.22	Shutdown cooling system (RHR shutdown cooling mode)	3.6
EK2.23	Plant process computer/parameter display systems	2.9

EK3	**Knowledge of the reasons for the following responses or actions as they apply to reactor low water level:** (CFR: 41.5 / 45.6)	
EK3.01	Automatic depressurization system actuation	4.3
EK3.02	Core submergence	4.7
EK3.03	Spray cooling	4.4
EK3.04	Steam cooling	4.3
EK3.05	Emergency depressurization	4.4

EA1	**Ability to operate or monitor the following as they apply to reactor low water level:** (CFR: 41.7 / 45.6)	
EA1.01	Low pressure coolant injection (RHR)	4.3
EA1.02	High pressure coolant injection	4.2
EA1.03	Low pressure core spray	4.3
EA1.04	High pressure core spray	4.3
EA1.05	Reactor core isolation system	4.1
EA1.06	Automatic depressurization system	4.3
EA1.07	Safety/relief valves	4.1
EA1.08	Alternate injection systems	3.9
EA1.09	Isolation condenser	3.8
EA1.10	Control rod drive hydraulic system	3.6
EA1.11	Condensate system	3.6
EA1.12	Feedwater system	3.8
EA1.13	Reactor water level control system	4.1
EA1.14	PCIS/NSSS	4.1

EA2	**Ability to determine or interpret the following as they apply to reactor low water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Reactor water level	4.7	4.6
EA2.02	DELETED		
EA2.03	Reactor pressure	4.2	4.0
EA2.04	Adequate core cooling	4.9	4.7

EPE:	**295032 High Secondary Containment Area Temperature**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high secondary containment area temperature:** (CFR: 41.8 to 41.10)	
EK1.01	DELETED	
EK1.02	Radiation releases	3.5
EK1.03	Secondary containment leakage detection	3.7
EK1.04	Impact of operating environment on components	3.1
EK2	**Knowledge of the relationship between the high secondary containment area temperature and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Area/room coolers	3.5
EK2.02	Secondary containment ventilation	3.5
EK2.03	Fire protection system	2.8
EK2.04	PCIS/NSSSS	3.6
EK2.05	Temperature sensitive instrumentation	3.2
EK2.06	Area temperature monitoring system	3.4
EK2.07	Leak detection system	3.6
EK2.08	Systems required for safe shut-down	3.6
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high secondary containment area temperature:** (CFR: 41.5 / 45.6)	
EK3.01	RPV emergency/normal depressurization	4.0
EK3.02	Reactor SCRAM	4.0
EK3.03	Isolating affected systems	4.0
EA1	**Ability to operate or monitor the following as they apply to a high secondary containment area temperature:** (CFR: 41.7 / 45.6)	
EA1.01	Area temperature monitoring system	3.9
EA1.02	Leak detection system	3.8
EA1.03	Secondary containment ventilation	3.6
EA1.04	Fire protection system	2.9

EA1.05	Isolate damaged portions of affected systems	3.7	
EA1.06	PCIS/NSSSS	3.7	
EA1.07	Fire protection system	2.9	

EA2	**Ability to determine or interpret the following as they apply to high secondary containment area temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Area temperature	3.9	4.0
EA2.02	Equipment operability	3.2	3.5
EA2.03	Cause of high area temperature	3.7	3.6

EPE:	**295033 High Secondary Containment Area Radiation Levels**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high secondary containment area radiation levels:** (CFR: 41.8 to 41.10)	
EK1.01	DELETED	
EK1.02	DELETED	
EK1.03	Radiation releases	4.1
EK1.04	Maximum normal operating radiation limit	3.9
EK1.05	Maximum safe operating radiation limit	4.1
EK2	**Knowledge of the relationship between high secondary containment area radiation levels and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Area radiation monitoring system	3.7
EK2.02	Process radiation monitoring system	3.5
EK2.03	Secondary containment ventilation	3.6
EK2.04	SBGT/FRVS	4.0
EK2.05	Primary system discharging into secondary containment	4.2
EK2.06	Systems required to suppress a fire	3.5
EK2.07	Systems required for adequate core cooling	4.2
EK2.08	Systems required to shut down the reactor	4.1
EK2.09	Systems required to protect the containment	4.1
EK2.10	Systems required to depressurize the reactor	4.1
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high secondary containment area radiation levels:** (CFR: 41.5 / 45.6)	
EK3.01	Anticipate/emergency depressurization	4.1
EK3.02	Reactor shutdown/SCRAM	4.1
EK3.03	Isolating affected systems	4.2
EK3.04	DELETED	
EK3.05	DELETED	
EK3.06	Operating ventilation systems	3.6

EA1	**Ability to operate or monitor the following as they apply to high secondary containment area radiation levels:** (CFR: 41.7 / 45.6)		
EA1.01	Area radiation monitoring system	3.8	
EA1.02	Process radiation monitoring system	3.6	
EA1.03	Secondary containment ventilation	3.6	
EA1.04	SBGT/FRVS	4.0	
EA1.05	DELETED		
EA1.06	DELETED		
EA1.07	DELETED		
EA1.08	DELETED		
EA1.09	Systems required to depressurize the reactor	4.2	
EA1.10	Primary system discharging into secondary containment	4.3	
EA1.11	Systems required to suppress a fire	3.5	
EA1.12	Systems required for adequate core cooling	4.2	
EA1.13	Systems required to shut down the reactor	4.1	
EA1.14	Systems required to protect the containment	4.1	

EA2	**Ability to determine or interpret the following as they apply to high secondary containment area radiation levels:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Area radiation levels	4.1	4.1
EA2.02	DELETED		
EA2.03	Source of high area radiation	4.0	3.8
EA2.04	Emergency plan	3.6	4.3

EPE: **295034 Secondary Containment Ventilation High Radiation**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to secondary containment ventilation high radiation:** (CFR: 41.8 to 41.10)	
EK1.01	DELETED	
EK1.02	Radiation releases	3.9
EK2	**Knowledge of the relationship between the secondary containment ventilation high radiation and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Process radiation monitoring system	3.7
EK2.02	Area radiation monitoring system	3.3
EK2.03	SBGT/FRVS	4.0
EK2.04	Secondary containment ventilation	3.8
EK2.05	DELETED	
EK2.06	PCIS/NSSSS	3.7
EK3	**Knowledge of the reasons for the following responses or actions as they apply to secondary containment ventilation high radiation:** (CFR: 41.5 / 45.6)	
EK3.01	Isolating secondary containment ventilation	4.1
EK3.02	Starting SBGT/FRVS	4.0
EK3.03	Personnel evacuation	3.8
EK3.04	Secondary containment ventilation operation	3.6
EK3.05	Manual SCRAM	3.5
EA1	**Ability to operate or monitor the following as they apply to a secondary containment ventilation high radiation:** (CFR: 41.7 / 45.6)	
EA1.01	Area radiation monitoring system	3.5
EA1.02	Process radiation monitoring system	3.7
EA1.03	Secondary containment ventilation	3.8
EA1.04	SBGT/FRVS	4.0
EA1.05	DELETED	

EA2	**Ability to determine or interpret the following as they apply to secondary containment ventilation high radiation:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Ventilation radiation levels	3.9	4.0
EA2.02	Source of high radiation levels	3.6	3.6

EPE: **295035 Secondary Containment High Differential Pressure**

K/A NO.	KNOWLEDGE	IMPORTANCE	
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to secondary containment high differential pressure:** (CFR: 41.8 to 41.10)		
EK1.01	Secondary containment integrity	3.9	
EK1.02	Radiation release	3.8	
EK2	**Knowledge of the relationship between the secondary containment high differential pressure and the following systems or components:** (CFR: 41.7 / 45.8)		
EK2.01	Secondary containment ventilation	3.8	
EK2.02	SBGT/FRVS	3.9	
EK2.03	DELETED		
EK2.04	Blow-out panels	3.5	
EK3	**Knowledge of the reasons for the following responses or actions as they apply to secondary containment high differential pressure:** (CFR: 41.5 / 45.6)		
EK3.01	Blow-out panel operation	3.3	
EK3.02	Secondary containment ventilation alignment	3.7	
EA1	**Ability to operate or monitor the following as they apply to a secondary containment high differential pressure:** (CFR: 41.7 / 45.6)		
EA1.01	Secondary containment ventilation	3.7	
EA1.02	SBGT/FRVS	3.8	
EA1.03	Blowout panels	3.0	
EA2	**Ability to determine or interpret the following as they apply to secondary containment high differential pressure:** (CFR: 41.8 to 41.10)	**RO**	**SRO**
EA2.01	Secondary containment pressure	4.0	3.9
EA2.02	Radiation release rate	4.1	3.9
EA2.03	Lights and alarms	3.7	3.3

EPE:	295036 Secondary Containment High Sump/Area Water Level	
K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to secondary containment high sump/area water level:** (CFR: 41.8 to 41.10)	
EK1.01	Radiation releases	3.2
EK1.02	Electrical ground/circuit malfunction	2.7
EK1.03	Maximum normal operating limit	3.9
EK1.04	Maximum safe operating limit	4.1
EK1.05	Identification of a primary system discharging to secondary containment	4.2
EK2	**Knowledge of the relationship between the secondary containment high sump/area water level and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Equipment and floor drain sumps and pumps	3.4
EK2.02	DELETED	
EK2.03	Radwaste system	2.9
EK2.04	Area/room/Sump level indicators	3.5
EK3	**Knowledge of the reasons for the following responses or actions as they apply to secondary containment high sump/area water level:** (CFR: 41.5 / 41.10 / 45.6)	
EK3.01	Emergency depressurization	4.0
EK3.02	Reactor SCRAM	3.8
EK3.03	Isolating affected systems	3.9
EK3.04	Pumping secondary containment sumps	3.2
EK3.05	Allowance for continued operation of a system discharging into an area	3.6
EK3.06	Normal reactor shutdown	3.3
EA1	**Ability to operate or monitor the following as they apply to a secondary containment high sump/area water level:** (CFR: 41.7 / 45.6 / 45.8)	
EA1.01	Equipment and floor drain sumps and pumps	3.2
EA1.02	Affected systems so as to isolate damaged portions	3.6
EA1.03	Radwaste system	2.7
EA1.04	DELETED	
EA1.05	Systems for emergency depressurization	3.9

		RO	SRO
EA2	**Ability to determine or interpret the following as they apply to secondary containment high sump/area water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Operability of components within the affected area	3.3	3.7
EA2.02	Water level in the affected area	3.5	3.8
EA2.03	Cause of the high water level	3.6	3.6

EPE:	**295037 SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to SCRAM condition present and reactor power above APRM downscale or unknown:** (CFR: 41.8 to 41.10)	
EK1.01	Reactor pressure effects on reactor power	4.4
EK1.02	Reactor water level effects on reactor power	4.5
EK1.03	Boron effects on reactor power	4.3
EK1.04	Hot shutdown boron weight	3.7
EK1.05	Cold shutdown boron weight	3.7
EK1.06	Cooldown effects on reactor power	4.4
EK1.07	Shutdown conditions	4.2
EK2	**Knowledge of the relationship between the SCRAM condition present and reactor power above APRM downscale or unknown and the following systems or components:** (CFR: 41.7 41.8 / 45.8)	
EK2.01	RPS	4.3
EK2.02	Redundant reactivity control system	4.1
EK2.03	DELETED	
EK2.04	Standby liquid control system	4.3
EK2.05	CRD hydraulic system	3.9
EK2.06	CRD mechanisms	3.5
EK2.07	APRM/Local power range monitor system	4.0
EK2.08	Plant process computer/parameter display systems	3.1
EK2.09	DELETED	
EK2.10	DELETED	
EK2.11	RMCS (BWR 2, 3, 4, & 5)	3.9
EK2.12	Rod control and information system: (BWR-6)	3.9
EK2.13	Systems used for alternate boron injection	3.8
EK2.14	Rod position indication system (BWR 2, 3, 4, & 5)	3.9
EK2.15	Recirculation system	3.6
EK2.16	Recirculation flow control system	3.6
EK2.17	Reactor water level control system	4.0
EK2.18	Reactor feedwater system	3.7
EK2.19	High pressure coolant injection	3.7
EK2.20	High pressure core spray	3.8
EK2.21	Low pressure core spray	3.5
EK2.22	RHR/LPCI system	3.4

EK2.23	Relief/safety valves	3.9
EK2.24	Reactor/turbine pressure regulating system	3.9
EK2.25	Rod worth minimizer	3.9

EK3 **Knowledge of the reasons for the following responses or actions as they apply to SCRAM condition present and reactor power above APRM downscale or unknown:**
(CFR: 41.5 / 41.7 / 45.6)

EK3.01	Recirculation pump trip/runback	3.9
EK3.02	Boron injection	4.2
EK3.03	Reactor water level control strategies	4.5
EK3.04	DELETED	
EK3.05	DELETED	
EK3.06	Maintaining heat sinks external to the containment	4.1
EK3.07	Alternate control rod insertion methods	4.4
EK3.08	Initiation of ATWS circuitry	4.4
EK3.09	Bypassing rod insertion blocks	3.8

EA1 **Ability to operate or monitor the following as they apply to a SCRAM condition present and reactor power above APRM downscale or unknown:**
(CFR: 41.7 / 45.5 to 45.8)

EA1.01	Reactor protection system	4.3
EA1.02	Redundant reactivity control system	4.1
EA1.03	DELETED	
EA1.04	Standby liquid control system	4.3
EA1.05	CRD hydraulics systems	4.1
EA1.06	APRM/Local power range monitor system	3.9
EA1.07	RMCS (BWR 2, 3, 4, & 5)	4.0
EA1.08	Rod control and information system: (BWR -6)	3.9
EA1.09	Plant process computer/parameter display systems	3.0
EA1.10	Systems used for alternate boron injection	3.6
EA1.11	DELETED	
EA1.12	Recirculation system	3.8
EA1.13	Recirculation flow control system	3.8
EA1.14	Reactor feedwater system	3.9
EA1.15	Relief/safety valves	4.0
EA1.16	Reactor/turbine pressure regulating system	3.8
EA1.17	Rod worth minimizer	3.5
EA1.18	RPIS	3.8

EA2	**Ability to determine or interpret the following as they apply to SCRAM condition present and reactor power above APRM downscale or unknown:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	Reactor power	4.7	4.6
EA2.02	Reactor water level	4.6	4.4
EA2.03	Standby liquid control system tank level	4.0	3.8
EA2.04	Suppression pool temperature	4.1	4.1
EA2.05	Control rod position	4.3	4.0
EA2.06	Reactor pressure	4.4	4.1
EA2.07	Containment conditions/isolations	4.0	3.8
EA2.08	Scram discharge volume level	3.8	3.8
EA2.09	Scram air header pressure	3.8	3.8

EPE:	295038 High Off-Site Radioactivity Release Rate	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high off-site radioactivity release rate:** (CFR: 41.8 to 41.10)	
EK1.01	DELETED	
EK1.02	DELETED	
EK1.03	DELETED	
EK1.04	Elevated vs. ground level release	3.8
EK1.05	Exceeding limits for gaseous/liquid releases	4.1
EK1.06	Filtered vs. non-filtered release	3.8
EK2	**Knowledge of the relationship between high off-site radioactivity release rate and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Radwaste system	3.3
EK2.02	Offgas system	3.8
EK2.03	Plant ventilation systems	3.8
EK2.04	DELETED	
EK2.05	DELETED	
EK2.06	Process radiation monitoring system	3.8
EK2.07	Control room heating, ventilation and air conditioning	3.5
EK2.08	Plant process computer/parameter display systems	3.2
EK2.09	Post-accident sample system (PASS)	3.0
EK2.10	Condenser air removal system	3.2
EK2.11	MSIV leakage control	3.0
EK2.12	Feedwater leakage control	2.9
EK2.13	SBGT/FRVS	4.0
EK2.14	Main and reheat steam system	2.7
EK2.15	Primary containment system and auxiliaries	3.7
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high off-site radioactivity release rate:** (CFR: 41.5 / 45.6)	
EK3.01	DELETED	
EK3.02	System isolations	4.1
EK3.03	Control room ventilation system isolation	3.8
EK3.04	Emergency depressurization	4.1
EK3.05	Reactor shutdown/SCRAM	4.1
EK3.06	Elevated vs. ground level release	3.6

EA1	**Ability to operate or monitor the following as they apply to a high off-site radioactivity release rate:** (CFR: 41.7 / 45.6)		
EA1.01	DELETED		
EA1.02	Meteorological instrumentation	3.7	
EA1.03	Process radiation monitoring system	3.8	
EA1.04	Plant process computer/parameter display systems	3.4	
EA1.05	Post-accident sample system (PASS)	3.0	
EA1.06	Plant ventilation systems	3.6	
EA1.07	Control room heating, ventilation, and air conditioning	3.7	
EA1.08	MSIV leakage control	3.1	
EA1.09	Feedwater leakage control	2.9	
EA1.10	SBGT/FRVS	3.9	
EA1.11	Main and reheat steam system	2.9	
EA1.12	Primary containment system and auxiliaries	3.8	
EA1.13	Radwaste system	3.0	
EA1.14	Offgas system	3.6	
EA1.15	Condenser air removal system	3.3	
EA2	**Ability to determine or interpret the following as they apply to high off-site radioactivity release rate:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
EA2.01	DELETED		
EA2.02	Total number of curies released or release rate/duration	3.2	3.6
EA2.03	Radiation levels	3.4	4.0
EA2.04	Source of off-site release	3.8	3.9
EA2.05	Emergency plan implementation	3.6	4.5
EA2.06	Meteorological data	3.7	3.8

EPE: 500000 High Containment Hydrogen Concentration

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high containment hydrogen concentration:** (CFR: 41.8 to 41.10)	
EK1.01	Containment integrity	4.0
EK1.02	Hydrogen generation	3.7
EK1.03	Hydrogen ignition/deflagration	3.8
EK1.04	Drywell nitrogen purge	3.8
EK1.05	Venting	3.9
EK2	**Knowledge of the relationship between the high containment hydrogen concentration and the following systems or components:** (CFR: 41.7 / 45.8)	
EK2.01	Containment hydrogen monitors	3.8
EK2.02	Containment oxygen monitors	3.8
EK2.03	Containment atmosphere control system	3.5
EK2.04	Drywell recirculating fan	2.9
EK2.05	Hydrogen and oxygen recombiners	3.5
EK2.06	Wetwell spray	3.3
EK2.07	Drywell vent	3.7
EK2.08	Wetwell vent	3.7
EK2.09	Drywell nitrogen purge	3.6
EK2.10	Drywell hydrogen mixing compressors (BWR-6)	3.6
EK2.11	Hydrogen igniters (BWR-6)	3.7
EK3	**Knowledge of the reasons for the following responses or actions as they apply to high containment hydrogen concentration:** (CFR: 41.5 / 45.6)	
EK3.01	Initiation of containment atmosphere control	3.5
EK3.02	Operation of drywell recirculating fans	3.0
EK3.03	Operation of hydrogen and oxygen recombiners	3.4
EK3.04	Emergency depressurization	3.9
EK3.05	Operation of wet well (suppression pool) sprays	3.5
EK3.06	Operation of wet well vent	3.7
EK3.07	Operation of drywell vent	3.7
EK3.08	Operation of drywell nitrogen purge system	3.6

EK3.09	Operation of drywell hydrogen mixing compressors (BWR-6)	3.5	
EK3.10	Operation of the hydrogen igniters (BWR-6)	3.6	
EK3.11	Operation of the containment/drywell hydrogen monitors	3.8	
EK3.12	Initiation of containment venting	3.8	

EA1 **Ability to operate or monitor the following as they apply to a high containment hydrogen concentration:**
(CFR: 41.7 / 45.6)

EA1.01	Primary containment hydrogen instrumentation	3.7	
EA1.02	Primary containment oxygen instrumentation	3.6	
EA1.03	Containment atmosphere controls	3.4	
EA1.04	Drywell recirculating fans	3.2	
EA1.05	Wetwell sprays	3.5	
EA1.06	Drywell sprays	3.6	
EA1.07	Nitrogen purge	3.5	
EA1.08	Drywell vent	3.8	

EA2 **Ability to determine or interpret the following as they apply to high containment hydrogen concentration:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.01	Hydrogen monitoring availability	3.4	3.8
EA2.02	Oxygen monitoring availability	3.1	3.8
EA2.03	Hydrogen concentration limits for drywell	3.3	3.8
EA2.04	Hydrogen concentration limits for wetwell	3.2	3.9
EA2.05	Hydrogen concentration limits for containment	3.4	3.9

4.2 Generic Abnormal Plant Evolutions (APE)

APE:	**295001 Partial or Complete Loss of Forced Core Flow Circulation**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to partial or complete loss of forced core flow circulation:** (CFR: 41.8 to 41.10)	
AK1.01	Natural circulation	3.7
AK1.02	Power/flow distribution	3.7
AK1.03	Thermal limits	4.1
AK1.04	Thermal hydraulic instabilities	4.3
AK2	**Knowledge of the relationship between partial or complete loss of forced core flow circulation and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Recirculation system	4.1
AK2.02	Nuclear boiler instrumentation	3.6
AK2.03	Reactor water level control system	3.4
AK2.04	Reactor/turbine pressure regulating system	3.0
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	DELETED	
AK2.09	Reactor water cleanup system	2.8
AK2.10	Power range monitoring system	3.6
AK2.11	Reactor manual control system: BWR 2-5	3.1
AK2.12	Recirculation flow control system	3.5
AK2.13	Rod control and information system: BWR 6	3.2
AK2.14	Plant process computer/parameter display systems	2.9
AK3	**Knowledge of the reasons for the following responses or actions as they apply to partial or complete loss of forced core flow circulation:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor water level response	3.7
AK3.02	Reactor power response	4.0
AK3.03	Idle loop/reverse flow	3.8
AK3.04	Reactor SCRAM	4.1
AK3.05	Reduced loop operating requirements	3.7
AK3.06	Core flow response	3.7

AK3.07	Recirculation pump discharge/suction valve	3.3
AK3.08	manipulation	3.7
	Thermal stratification	

AA1 **Ability to operate or monitor the following as they apply to partial or complete loss of forced core flow circulation:**
(CFR: 41.7 / 45.6)

AA1.01	Recirculation system	4.0
AA1.02	RPS	3.8
AA1.03	Reactor manual control system: BWR 2-5	3.4
AA1.04	Rod control and information system: BWR 6	3.4
AA1.05	Recirculation flow control system	3.7
AA1.06	Power range monitoring system	3.6
AA1.07	Nuclear boiler instrumentation system	3.4
AA1.08	DELETED	
AA1.09	Reactor water level control system	3.6
AA1.10	Reactor/turbine pressure regulating system	2.9
AA1.11	Reactor water cleanup system	2.8

AA2 **Ability to determine or interpret the following as they apply to partial or complete loss of forced core flow circulation:**

	(CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Power/flow map	4.4	4.3
AA2.02	Neutron monitoring	4.0	4.0
AA2.03	Core flow	4.2	4.0
AA2.04	Individual jet pump flows	3.4	3.4
AA2.05	Jet pump operability	3.3	3.5
AA2.06	DELETED		
AA2.07	Reactor power	4.1	4.0
AA2.08	Reactor water level	4.1	3.6
AA2.09	Reactor pressure	3.8	3.4
AA2.10	Recirculation system/RPV differential temperatures	3.6	3.7
AA2.11	Individual loop flow(s)	3.6	3.6
AA2.12	Thermal hydraulic instabilities	4.2	4.2
AA2.13	Thermal limits	4.1	3.9

APE: **295002 Loss of Main Condenser Vacuum**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to loss of main condenser vacuum:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	Loss of heat sink	4.1
AK1.04	Offgas flow changes	3.4
AK2	**Knowledge of the relationship between loss of main condenser vacuum and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	RPS	3.8
AK2.02	Main turbine generator and auxiliaries	3.7
AK2.03	PCIS/NSSSS	3.5
AK2.04	Reactor/turbine pressure regulating system	3.6
AK2.05	Feedwater system	3.1
AK2.06	Condensate system	3.2
AK2.07	Offgas system	3.6
AK2.08	Circulating water system	3.5
AK2.09	DELETED	
AK2.10	Recirculation flow control system	2.7
AK2.11	DELETED	
AK2.12	Reactor manual control system: BWR 2-5	2.7
AK2.13	Rod control and information system: BWR 6	2.8
AK2.14	Condenser air removal system	3.6
AK3	**Knowledge of the reasons for the following responses or actions as they apply to loss of main condenser vacuum:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor SCRAM	3.9
AK3.02	Turbine trip	4.1
AK3.03	Reactor feedpump turbine trip	3.7
AK3.04	Bypass valve closure	4.0
AK3.05	Main steam isolation valve closure	3.8
AK3.06	DELETED	

AK3.07	DELETED		
AK3.08	Recirculation flow control system run-backs	3.5	
AK3.09	Reactor power reduction	3.7	
AK3.10	Steam jet air ejector operation	3.4	
AK3.11	Bypass augmented offgas system	3.1	

AA1 **Ability to operate or monitor the following as they apply to loss of main condenser vacuum:**
(CFR: 41.7 / 45.6)

AA1.01	Condensate system	2.9
AA1.02	Offgas system	3.5
AA1.03	RPS	3.7
AA1.04	PCIS/NSSSS	3.6
AA1.05	Main turbine generator and auxiliaries system	3.4
AA1.06	Reactor/turbine pressure regulating system	3.6
AA1.07	Circulating water system	3.4
AA1.08	Recirculation flow control system	3.2
AA1.09	Reactor manual control system: BWR 2-5	3.2
AA1.10	Feedwater system	3.2
AA1.11	Rod control and information system: BWR 6	3.0
AA1.12	Condenser air removal system	3.5

AA2 **Ability to determine or interpret the following as they apply to loss of main condenser vacuum:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
AA2.01	Condenser vacuum	4.3	4.2
AA2.02	Reactor power	4.1	3.7
AA2.03	Generator output	3.6	3.3
AA2.04	Offgas system flow	3.9	3.6
AA2.05	Condensate temperature	3.4	2.8
AA2.06	Condensate flow	3.3	2.7
AA2.07	Turbine limitations	3.7	3.4

APE:	295003 Partial or Complete Loss of AC Power	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to partial or complete loss of AC power:** (CFR: 41.8 to 41.10)	
AK1.01	Battery capacity	3.8
AK1.02	Load shedding	3.8
AK1.03	DELETED	
AK1.04	DELETED	
AK1.05	DELETED	
AK1.06	Station blackout	4.3
AK1.07	Load sequencing	3.8
AK1.08	EDG load limits	4.0
AK2	**Knowledge of the relationship between partial or complete loss of AC power and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Station batteries	4.0
AK2.02	Emergency generators	4.3
AK2.03	AC electrical distribution system	4.0
AK2.04	AC electrical loads	3.8
AK2.05	Decay heat removal systems	4.2
AK2.06	DC electrical loads	3.9
AK2.07	DC electrical distribution system	3.7
AK3	**Knowledge of the reasons for the following responses or actions as they apply to partial or complete loss of AC power:** (CFR: 41.5 / 45.6)	
AK3.01	Manual and auto bus transfer	3.7
AK3.02	DELETED	
AK3.03	Load shedding	3.8
AK3.04	DELETED	
AK3.05	DELETED	
AK3.06	Containment isolation	3.5
AK3.07	DELETED	
AK3.08	Reactor cooldown	3.8

AA1	**Ability to operate or monitor the following as they apply to partial or complete loss of AC power:** (CFR: 41.7 / 45.6)		
AA1.01	AC electrical distribution system	4.0	
AA1.02	Emergency generators	4.5	
AA1.03	Decay heat removal systems	4.2	
AA1.04	DC electrical distribution system	3.8	
AA1.05	Station batteries	3.8	
AA1.06	AC electrical loads	3.8	
AA1.07	DC electrical loads	3.8	
AA1.08	Station blackout instrumentation	4.3	

AA2	**Ability to determine or interpret the following as they apply to partial or complete loss of AC power:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Partial or complete loss of AC power	4.0	4.1
AA2.02	Reactor power, pressure, and level	4.4	4.3
AA2.03	Battery status	3.9	3.9
AA2.04	System lineups	3.6	3.6
AA2.05	DELETED		

APE:	295004 Partial or Complete Loss of DC Power	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to partial or complete loss of DC power:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK1.02	Redundant DC power supplies	3.8
AK1.03	DELETED	
AK1.04	Battery capacity	3.9
AK1.05	Loss of breaker protection	3.7
AK1.06	Prevention of inadvertent system(s) actuation upon restoration of DC power	3.7
AK2	**Knowledge of the relationship between partial or complete loss of DC power and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Battery charger	3.8
AK2.02	Batteries	4.1
AK2.03	DC electrical loads	3.8
AK2.04	AC Electrical distribution system	3.7
AK3	**Knowledge of the reasons for the following responses or actions as they apply to partial or complete loss of DC power:** (CFR: 41.5 / 45.6)	
AK3.01	Load shedding	3.9
AK3.02	Ground isolation/fault determination	3.3
AK3.03	DELETED	
AA1	**Ability to operate or monitor the following as they apply to a partial or complete loss of DC power:** (CFR: 41.7 / 45.6)	
AA1.01	DC electrical distribution	3.8
AA1.02	Systems necessary to assure safe plant shutdown	4.3
AA1.03	AC electrical distribution	3.5
AA1.04	DC electrical loads	3.7

AA2	**Ability to determine or interpret the following as they apply to partial or complete loss of DC power:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Partial or complete loss of DC power	4.0	4.1
AA2.02	DELETED		
AA2.03	Battery parameters	3.8	3.7
AA2.04	System lineups	3.2	3.5

APE:	295005 Main Turbine Generator Trip	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to main turbine generator trip:** (CFR: 41.8 to 41.10)	
AK1.01	Reactor pressure control	4.3
AK1.02	Core thermal limits	3.8
AK1.03	Reactor level control	3.8
AK2	**Knowledge of the relationship between the main turbine generator trip and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	RPS	4.1
AK2.02	DELETED	
AK2.03	Recirculation system	3.5
AK2.04	Main turbine generator and auxiliaries	3.1
AK2.05	Main and reheat steam system	2.9
AK2.06	DELETED	
AK2.07	Reactor/turbine pressure regulating system	4.0
AK2.08	AC electrical distribution	3.4
AK2.09	Feedwater: BWR 2	3.4
AK2.10	Reactor water level control system	3.4
AK2.11	Recirculation flow control system	3.0
AK2.12	Reactor manual control system: BWR 2-5	3.0
AK2.13	Rod control and information system: BWR 6	3.4
AK2.14	RCIC: BWR 6	3.6
AK3	**Knowledge of the reasons for the following responses or actions as they apply to main turbine generator trip:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor SCRAM	4.1
AK3.02	Recirculation pump downshift/trip	3.5
AK3.03	Feedwater temperature decrease	3.2
AK3.04	Main generator trip	3.2
AK3.05	Extraction steam/moisture separator isolations	2.8
AK3.06	Realignment of electrical distribution	3.6
AK3.07	Turbine bypass valve operation	4.0
AK3.08	DELETED	

AA1	**Ability to operate or monitor the following as they apply to a main turbine generator trip:** (CFR: 41.7 / 45.6)		
AA1.01	Recirculation system	3.3	
AA1.02	RPS	3.9	
AA1.03	Reactor manual control system	3.0	
AA1.04	Main turbine generator and auxiliaries	3.0	
AA1.05	Reactor/turbine pressure regulating system	3.9	
AA1.06	Condenser vacuum breaker(s)	2.7	
AA1.07	AC electrical distribution	3.4	
AA1.08	Rod control and information system	3.0	
AA1.09	Reactor water level control system	3.7	
AA1.10	Recirculation flow control system	3.0	
AA1.11	RCIC: BWR 6	3.5	

AA2	**Ability to determine or interpret the following as they apply to main turbine generator trip:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	DELETED		
AA2.02	DELETED		
AA2.03	Turbine valve position	4.4	3.6
AA2.04	Reactor pressure	4.5	4.3
AA2.05	Reactor power	4.4	4.1
AA2.06	Feedwater temperature	3.5	2.9
AA2.07	Reactor water level	4.4	3.9
AA2.08	Electrical distribution status	3.9	3.7
AA2.09	Turbine limitations	2.9	3.0

APE: **295006 SCRAM**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to SCRAM:** (CFR: 41.8 to 41.10)	
AK1.01	Decay heat generation and removal	4.0
AK1.02	Shutdown margin	3.6
AK1.03	Reactivity control	3.9
AK1.04	Pressure control	4.1
AK2	**Knowledge of the relationship between the SCRAM and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	RPS	4.5
AK2.02	Reactor water level control system	4.1
AK2.03	CRD hydraulic system	3.9
AK2.04	Turbine trip logic	3.7
AK2.05	CRD mechanism	3.4
AK2.06	DELETED	
AK2.07	DELETED	
AK3	**Knowledge of the reasons for the following responses or actions as they apply to SCRAM:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor water level response	4.0
AK3.02	Reactor power response	4.2
AK3.03	Reactor pressure response	4.0
AK3.04	Reactor water level setpoint setdown	3.7
AK3.05	Direct turbine generator trip	3.7
AK3.06	Recirculation pump speed reduction	3.7
AA1	**Ability to operate or monitor the following as they apply to a SCRAM:** (CFR: 41.7 / 45.6)	
AA1.01	RPS	4.3
AA1.02	Reactor water level control system	4.2
AA1.03	Reactor/turbine pressure regulating system	4.2
AA1.04	Recirculation system	3.8
AA1.05	Neutron monitoring system	3.9

AA1.06	CRD hydraulic system	3.7	
AA1.07	Control rod position	4.2	

AA2	**Ability to determine or interpret the following as they apply to SCRAM:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Reactor power	4.3	4.4
AA2.02	Control rod position	4.4	4.5
AA2.03	Reactor water level	4.3	4.1
AA2.04	Reactor pressure	4.3	4.1
AA2.05	Whether a reactor SCRAM has occurred	4.6	4.5
AA2.06	Cause of reactor SCRAM	3.6	3.7

APE:	295007 High Reactor Pressure	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high reactor pressure:** (CFR: 41.5 / 41.10)	
AK1.01	Pump shutoff head	3.6
AK1.02	Decay heat generation	3.1
AK1.03	Pressure effects on reactor power	4.1
AK1.04	Turbine load	3.3
AK2	**Knowledge of the relationship between the high reactor pressure and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor/turbine pressure regulating system	4.0
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	Shutdown cooling system (RHR shutdown cooling mode)	3.7
AK2.06	DELETED	
AK2.07	RPS	4.4
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high reactor pressure:** (CFR: 41.5 / 45.6)	
AK3.01	DELETED	
AK3.02	DELETED	
AK3.03	DELETED	
AK3.04	DELETED	
AK3.05	DELETED	
AK3.06	Reactor/turbine pressure regulating system operation	4.0
AK3.07	Shutdown cooling system (RHR shutdown cooling mode) operation	3.6
AK3.08	Reducing reactor power	4.0
AA1	**Ability to operate or monitor the following as they apply to a high reactor pressure:** (CFR: 41.7 / 45.6)	
AA1.01	DELETED	
AA1.02	DELETED	
AA1.03	DELETED	

AA1.04	DELETED		
AA1.05	Reactor/turbine pressure regulating system	3.9	
AA1.06	Shutdown cooling system (RHR shutdown cooling mode)	3.6	
AA1.07	Reactor manual control system	3.4	
AA1.08	Recirculation flow control system	3.5	
AA1.09	Rod control and information system	3.0	

AA2	**Ability to determine or interpret the following as they apply to high reactor pressure:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Reactor pressure	4.6	4.2
AA2.02	Reactor power	4.5	4.3
AA2.03	DELETED		
AA2.03	Bypass valve capacity	4.2	4.0

APE:	**295008 High Reactor Water Level**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high reactor water level:** (CFR: 41.8 to 41.10)	
AK1.01	Moisture carryover	3.3
AK1.02	Component erosion/damage	3.1
AK1.03	Feed flow/steam flow mismatch	3.6
AK1.04	Containment integrity	3.1
AK2	**Knowledge of the relationship between the high reactor water level and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	RPS	3.9
AK2.02	Reactor feedwater system	4.0
AK2.03	Reactor water level control	4.2
AK2.04	PCIS/NSSSS	3.6
AK2.05	HPCI	4.1
AK2.06	RCIC	4.0
AK2.07	HPCS	3.7
AK2.08	Main turbine	3.8
AK2.09	Reactor water cleanup system (ability to drain)	3.3
AK2.10	RHR (ability to drain)	3.3
AK2.11	Main steam	3.5
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high reactor water level:** (CFR: 41.5 / 45.6)	
AK3.01	Main turbine trip	4.0
AK3.02	Reactor SCRAM	4.0
AK3.03	PCIS/NSSSS initiation	3.5
AK3.04	Reactor feed pump trip	3.8
AK3.05	HPCI turbine trip	4.0
AK3.06	RCIC turbine trip	3.8
AK3.07	HPCS isolation	3.5
AK3.08	RCIC steam supply valve closure	3.5
AK3.09	HPCS injection valve closure	3.5

AA1	**Ability to operate or monitor the following as they apply to a high reactor water level:** (CFR: 41.7 / 45.6)		
AA1.01	Reactor water level control	4.4	
AA1.02	Reactor water cleanup (ability to drain)	3.4	
AA1.03	Main steam system	3.5	
AA1.04	HPCI	4.0	
AA1.05	RCIC	3.9	
AA1.06	HPCS	3.8	
AA1.07	Main turbine	3.6	
AA1.08	Feedwater system	4.1	
AA1.09	RHR (ability to drain)	3.3	

AA2	**Ability to determine or interpret the following as they apply to high reactor water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Reactor water level	4.4	4.4
AA2.02	Steam flow/feedflow mismatch	3.9	4.0
AA2.03	Reactor water cleanup blowdown flow	3.4	3.2
AA2.04	Heatup rate	3.3	3.3
AA2.05	Swell	3.8	3.5

APE: **295009 Low Reactor Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to low reactor water level:** (CFR: 41.8 to 41.10)	
AK1.01	Steam carryunder	3.0
AK1.02	Recirculation pump net positive suction head	3.4
AK1.03	Jet pump net positive suction head	3.2
AK1.04	Jet pump efficiency	2.8
AK1.05	Natural circulation	3.5
AK2	**Knowledge of the relationship between the low reactor water level and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	DELETED	
AK2.02	Reactor water level control	4.1
AK2.03	Recirculation system	3.5
AK2.04	Recirculation flow control system	3.5
AK2.05	PCIS/NSSSS system	4.1
AK2.06	RPS	4.3
AK2.07	Feedwater system	3.8
AK2.08	CRD system	2.9
AK3	**Knowledge of the reasons for the following responses or actions as they apply to low reactor water level:** (CFR: 41.5 / 45.6)	
AK3.01	Recirculation run back	3.7
AK3.02	DELETED	
AK3.03	Reactor SCRAM	4.2
AA1	**Ability to operate or monitor the following as they apply to a low reactor water level:** (CFR: 41.7 / 45.6)	
AA1.01	Feedwater system	4.0
AA1.02	Reactor water level control	4.2
AA1.03	Recirculation flow control system	3.5
AA1.04	Reactor water cleanup	3.0
AA1.05	PCIS/NSSSS system	3.9
AA1.06	CRD system	3.1
AA1.07	RPS	4.1

		RO	SRO
AA2	**Ability to determine or interpret the following as they apply to low reactor water level:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Reactor water level	4.1	4.5
AA2.02	Steam flow/feed flow mismatch	3.9	3.8
AA2.03	Reactor water cleanup blowdown rate	3.0	2.9

APE:	**295010 High Drywell Pressure**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high drywell pressure:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	Drywell temperature increase	3.8
AK2	**Knowledge of the relationship between the high drywell pressure and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	DELETED	
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	Primary containment and auxiliaries	3.8
AK2.07	Component cooling water	3.5
AK2.08	Plant ventilation systems	3.2
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high drywell pressure:** (CFR: 41.5 / 45.6)	
AK3.01	Drywell venting	4.1
AK3.02	Increased drywell cooling	3.5
AK3.03	Radiation level monitoring	3.4
AK3.04	Leak investigation	3.6
AK3.05	Temperature monitoring	3.6
AK3.06	Termination of drywell inerting	3.2
AA1	**Ability to operate or monitor the following as they apply to a high drywell pressure:** (CFR: 41.7 / 45.6)	
AA1.01	Primary containment and auxiliaries	3.7
AA1.02	DELETED	
AA1.03	DELETED	
AA1.04	Drywell sampling system	3.0
AA1.05	DELETED	
AA1.06	Leakage detection systems	3.4

AA1.07	DELETED		
AA1.08	Component cooling water		3.3
AA1.09	Plant ventilation systems		3.1
AA1.10	Suppression pool level		3.5
AA1.11	Drywell/suppression chamber differential pressure: Mark I & II		3.6
AA1.12	Drywell/containment differential pressure: Mark III		3.6

AA2	**Ability to determine or interpret the following as they apply to high drywell pressure:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
A2.01	Leak rates	3.4	3.7
AA2.02	Drywell pressure	4.0	4.3
AA2.03	Drywell radiation levels	3.4	3.6
AA2.04	Drywell humidity	2.7	2.7
AA2.05	Drywell air cooler drain flow	2.7	2.9
AA2.06	Drywell temperature	3.8	3.7
AA2.07	Drywell/containment or suppression chamber differential pressure	3.7	3.7

APE:	**295011 High Containment Temperature (Mark III Containment Only)**		
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**	
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high containment temperature:** (CFR: 41.8 to 41.10)		
AK1.01	Containment pressure	4.1	
AK2	**Knowledge of the relationship between the high containment temperature and the following systems or components:** (CFR: 41.7 / 45.8)		
AK2.01	Containment ventilation/cooling	3.8	
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high containment temperature:** (CFR: 41.5 / 45.6)		
AK3.01	Increased containment cooling	3.6	
AA1	**Ability to operate or monitor the following as they apply to a high containment temperature:** (CFR: 41.7 / 45.6)		
AA1.01	Containment ventilation/cooling system	3.7	
AA2	**Ability to determine or interpret the following as they apply to high containment temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Containment temperature	4.0	4.0
AA2.02	Containment pressure	3.8	4.3
AA2.03	Containment humidity	2.2	2.7
AA2.04	System/Component operating limitations	3.2	3.6

APE: **295012 High Drywell Temperature**

K/A NO.	KNOWLEDGE	IMPORTANCE	
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high drywell temperature:** (CFR: 41.8 to 41.10)		
AK1.01	Drywell pressure	4.0	
AK1.02	DELETED		
AK2	**Knowledge of the relationship between the high drywell temperature and the following systems or components:** (CFR: 41.7 / 45.8)		
AK2.01	Drywell ventilation	3.7	
AK2.02	Drywell cooling	3.9	
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high drywell temperature:** (CFR: 41.5 / 45.6)		
AK3.01	Increased drywell cooling	3.8	
AK3.02	Venting	3.9	
AA1	**Ability to operate or monitor the following as they apply to a high drywell temperature:** (CFR: 41.7 / 45.6)		
AA1.01	Drywell ventilation system	3.7	
AA1.02	Drywell cooling system	3.9	
AA1.03	Drywell pressure	4.2	
AA2	**Ability to determine or interpret the following as they apply to high drywell temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Drywell temperature	4.4	4.2
AA2.02	Drywell pressure	4.3	4.3
AA2.03	Drywell humidity	2.8	2.7
AA2.04	System/Component operating limitations	3.8	3.6

APE:	**295013 High Suppression Pool Water Temperature**		
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**	
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to high suppression pool water temperature:** (CFR: 41.8 to 41.10)		
AK1.01	DELETED		
AK1.02	DELETED		
AK1.03	Localized heating	3.2	
AK1.04	DELETED		
AK1.05	Containment integrity	4.1	
AK1.06	Surveillance testing	3.4	
AK2	**Knowledge of the relationship between the high suppression pool water temperature and the following systems or components:** (CFR: 41.7 / 45.8)		
AK2.01	Suppression pool cooling	4.0	
AK2.02	Safety/relief valve operation	4.2	
AK2.03	RCIC/HPCI operation	4.0	
AK3	**Knowledge of the reasons for the following responses or actions as they apply to high suppression pool water temperature:** (CFR: 41.5 / 45.6)		
AK3.01	Suppression pool cooling operation	4.1	
AK3.02	Limiting heat additions	3.9	
AA1	**Ability to operate or monitor the following as they apply to a high suppression pool water temperature:** (CFR: 41.7 / 45.6)		
AA1.01	Suppression pool cooling	4.3	
AA1.02	Systems that add heat to the suppression pool	4.1	
AA1.03	Suppression pool temperature monitoring system	4.0	
AA2	**Ability to determine or interpret the following as they apply to high suppression pool water temperature:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Suppression pool temperature	4.3	4.2
AA2.02	Localized heating/stratification	3.5	3.1
AA2.03	Open/leaking Safety relief valve	4.2	3.9

APE: **295014 Inadvertent Reactivity Addition**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to inadvertent reactivity addition:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK1.02	Reactivity anomaly	3.8
AK1.03	Shutdown margin	3.8
AK1.04	PCIOMR	3.1
AK1.05	Fuel thermal limits	4.1
AK1.06	Reactivity changes	4.3
AK1.07	Void concentration	3.7
AK1.08	Moderator temperature	3.7
AK1.09	Reactor power	4.4
AK1.10	Safety limits	4.3
AK1.11	Thermal-hydraulic instability	4.0
AK2	**Knowledge of the relationship between the inadvertent reactivity addition and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	RPS	4.1
AK2.02	DELETED	
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	Neutron monitoring system/OPRMs	4.2
AK2.06	DELETED	
AK2.07	DELETED	
AK2.08	RMCS	3.8
AK2.09	Rod control and information system (BWR-6)	3.6
AK2.10	DELETED	
AK2.11	Recirculation flow control	3.9
AK2.12	HPCI	3.6
AK2.13	RCIC	3.3
AK2.14	HPCS	3.3
AK3	**Knowledge of the reasons for the following responses or actions as they apply to inadvertent reactivity addition:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor SCRAM	4.3
AK3.02	Control rod blocks	4.0

AK3.03	Changing recirculation flow	4.1	
AK3.04	Changing control rod positions	4.0	

AA1 **Ability to operate or monitor the following as they apply to an inadvertent reactivity addition:**
(CFR: 41.7 / 45.6)

AA1.01	RPS	4.1
AA1.02	Recirculation flow control system	4.2
AA1.03	RMCS	4.0
AA1.04	Rod control and information system (BWR-6)	4.1
AA1.05	Neutron monitoring system/OPRMs	4.1
AA1.06	Reactor/turbine pressure regulating system	3.7
AA1.07	DELETED	
AA1.08	HPCI	3.7
AA1.09	RCIC	3.5
AA1.10	HPCS	3.5
AA1.11	Feedwater system	3.9

AA2 **Ability to determine or interpret the following as they apply to inadvertent reactivity addition:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
AA2.01	Reactor power	4.7	4.5
AA2.02	Reactor period	4.5	4.1
AA2.03	Cause of reactivity addition	4.1	4.2
AA2.04	Violation of fuel thermal limits	4.5	4.3
AA2.05	Violation of safety limits	4.8	4.4
AA2.06	Cold water injection	4.2	4.1

APE: **295015 Incomplete Scram**

K/A NO. **KNOWLEDGE** **IMPORTANCE**

DELETED – K/As moved to EPE 295037, “SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown”

APE:	**295016 Control Room Abandonment**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to control room abandonment:** (CFR: 41.8 to 41.10)	
	None	
AK2	**Knowledge of the relationship between the control room abandonment and the following systems or components :** (CFR: 41.7 / 45.8)	
AK2.01	Remote shutdown panel	4.4
AK2.02	Local control stations	3.9
AK2.03	DELETED	
AK2.04	AC electrical distribution	3.5
AK2.05	DC electrical distribution	3.5
AK2.06	Safety/relief valves	3.8
AK2.07	RCIC	4.1
AK2.08	Isolation condensers	3.9
AK2.09	RHR/LPCI: torus/suppression pool cooling mode	3.7
AK2.10	Shutdown cooling system (RHR shutdown cooling mode)	3.7
AK2.11	Main and reheat steam system	2.7
AK2.12	Emergency generators	3.9
AK2.13	RPS	3.4
AK2.14	Cooling water systems	3.4
AK2.15	Main turbine and auxiliaries	2.6
AK3	**Knowledge of the reasons for the following responses or actions as they apply to control room abandonment:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor SCRAM	4.0
AK3.02	Turbine trip	3.6
AK3.03	Disabling/transferring control room controls	4.0
AK3.04	Abandonment criteria	4.1
AA1	**Ability to operate or monitor the following as they apply to a control room abandonment:** (CFR: 41.7 / 45.6)	
AA1.01	RPS	3.8
AA1.02	DELETED	

AA1.03	DELETED		
AA1.04	AC electrical distribution	3.6	
AA1.05	DC electrical distribution	3.5	
AA1.06	DELETED		
AA1.07	Control room/local control transfer mechanisms	4.0	
AA1.08	DELETED		
AA1.09	Isolation condensers	4.0	
AA1.10	Safety/relief valves	3.9	
AA1.11	RCIC	4.2	
AA1.12	RHR/LPCI: torus/suppression pool cooling mode	3.8	
AA1.13	Shutdown cooling system (RHR shutdown cooling mode)	3.7	
AA1.14	Main and reheat steam system	2.7	
AA1.15	Emergency generators	3.8	
AA1.16	Cooling water systems	3.3	
AA1.17	Main turbine and auxiliaries	2.6	

AA2	**Ability to determine or interpret the following as they apply to control room abandonment:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Reactor power	4.3	3.7
AA2.02	Reactor water level	4.5	4.2
AA2.03	Reactor pressure	4.5	4.2
AA2.04	Suppression pool temperature	4.0	3.8
AA2.05	Drywell pressure	3.9	3.6
AA2.06	Cooldown rate	3.9	3.7
AA2.07	Suppression chamber pressure	3.7	3.4
AA2.08	Successful transfer	4.3	3.9

APE: **295017 Abnormal Off-Site Release Rate**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to abnormal off-site release rate:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK1.02	DELETED	
AK1.03	DELETED	
AK1.04	Elevated vs. ground level release	3.7
AK1.05	Exceeding limits for gaseous/liquid releases	4.0
AK1.06	Filtered vs. non-filtered release	3.6
AK2	**Knowledge of the relationship between abnormal off-site release rate and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	DELETED	
AK2.02	Radwaste system	3.0
AK2.03	Off-gas system	3.7
AK2.04	Plant ventilation systems	3.6
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	Control room heating, ventilation and air conditioning	3.3
AK2.08	Plant process computer/parameter display systems	3.1
AK2.09	Condenser air removal system	3.3
AK2.10	Process radiation monitoring system	3.7
AK2.11	DELETED	
AK2.12	SBGT/FRVS	3.8
AK2.13	RPS	3.4
AK2.14	PCIS/NSSSS	3.7
AK2.15	Fuel pool cooling and cleanup system	3.1
AK3	**Knowledge of the reasons for the following responses or actions as they apply to abnormal off-site release rate:** (CFR: 41.5 / 45.6)	
AK3.01	System isolations	4.0
AK3.02	Plant ventilation	3.6
AK3.03	DELETED	
AK3.04	Power reduction	3.7
AK3.05	Control room ventilation system operation	3.5

AA1	**Ability to operate or monitor the following as they apply to abnormal off-site release rate:** (CFR: 41.7 / 45.6)		
AA1.01	Radwaste	2.8	
AA1.02	Off-gas system	3.6	
AA1.03	Plant ventilation systems	3.5	
AA1.04	DELETED		
AA1.05	Plant process computer/parameter display systems	3.0	
AA1.06	Condenser air removal system	3.3	
AA1.07	Process radiation monitoring system	3.7	
AA1.08	DELETED		
AA1.09	SBGT/FRVS	3.9	
AA1.10	RPS	3.5	
AA1.11	PCIS/NSSSS	3.7	
AA1.12	DELETED		
AA1.13	Control room heating, ventilation and air conditioning	3.4	
AA1.14	Fuel pool cooling and cleanup system	3.0	

AA2	**Ability to determine or interpret the following as they apply to abnormal off-site release rate:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Off-site release rate	3.8	4.2
AA2.02	Total number of curies released or release rate/duration	3.4	3.3
AA2.03	Radiation levels	3.7	3.9
AA2.04	Source of off-site release	3.9	4.0
AA2.05	Meteorological data	3.8	3.9
AA2.06	Emergency plan implementation	3.4	4.3

APE: 295018 Partial or Complete Loss of Component Cooling Water

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to partial or complete loss of component cooling water:** (CFR: 41.8 to 41.10)	
AK1.01	DELETED	
AK2	**Knowledge of the relationship between partial or complete loss of component cooling water and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	DELETED	
AK2.02	Plant operations	4.0
AK2.03	Reactor water cleanup system	3.6
AK2.04	Reactor recirculation system	3.7
AK2.05	RHR/LPCI	3.3
AK2.06	Fuel pool cooling and cleanup system	3.8
AK3	**Knowledge of the reasons for the following responses or actions as they apply to partial or complete loss of component cooling water:** (CFR: 41.5 / 45.6)	
AK3.01	Isolation of non-essential heat loads	3.4
AK3.02	Reactor power reduction	3.6
AK3.03	Securing individual components (prevent equipment damage)	3.3
AK3.04	Starting standby pump	3.5
AK3.05	Placing standby heat exchanger in service	3.4
AK3.06	Increasing cooling water flow to heat exchangers	3.3
AK3.07	Cross-connecting with backup systems	3.1
AA1	**Ability to operate or monitor the following as they apply to partial or complete loss of component cooling water:** (CFR: 41.7 / 45.6)	
AA1.01	Backup systems	3.3
AA1.02	DELETED	
AA1.03	Affected systems so as to isolate damaged portions	3.3
AA1.04	Reactor water cleanup system	3.4
AA1.05	Reactor recirculation system	3.6
AA1.06	RHR/LPCI	3.2

AA1.07	Fuel pool cooling and cleanup system	3.6
AA1.08	Plant operations	3.6

		RO	SRO
AA2	**Ability to determine or interpret the following as they apply to partial or complete loss of component cooling water:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Component temperatures	3.7	3.5
AA2.02	Cooling water temperature	3.7	3.5
AA2.03	Partial or complete loss	3.7	3.5
AA2.04	System flow	3.4	3.2
AA2.05	System pressure	3.7	3.2
AA2.06	Surge tank level	3.6	3.0

APE: **295019 Partial or Complete Loss of Instrument Air**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to partial or complete loss of instrument air:** (CFR: 41.8 to 41.10)	
	None	
AK2	**Knowledge of the relationship between the partial or complete loss of instrument air and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	CRD hydraulics	4.0
AK2.02	Component cooling water	3.2
AK2.03	Feedwater system	3.7
AK2.04	Reactor water cleanup system	3.2
AK2.05	Main and reheat steam system	3.3
AK2.06	Offgas system	3.2
AK2.07	Condensate system	3.3
AK2.08	Plant ventilation	3.0
AK2.09	Primary containment and auxiliaries	3.4
AK2.10	Fuel pool cooling and cleanup system	3.2
AK2.11	Radwaste	2.5
AK2.12	Standby gas treatment/FRVS	3.1
AK2.13	Isolation condenser	3.1
AK2.14	Plant air systems	3.5
AK2.15	Standby liquid control system	2.8
AK2.16	Reactor core isolation cooling	3.0
AK2.17	High pressure coolant injection	2.8
AK2.18	Safety/relief valves	3.7
AK2.19	RHR/LPCI	2.6
AK2.20	Control room ventilation	3.1
AK2.21	Recirculation system	2.6
AK2.22	Circulating water	2.2
AK2.23	Service water	2.7
AK2.24	Shutdown cooling system	2.6
AK3	**Knowledge of the reasons for the following responses or actions as they apply to partial or complete loss of instrument air:** (CFR: 41.5 / 45.6)	
AK3.01	Alignment of backup air systems	3.6
AK3.02	Standby air compressor operation	3.7

AK3.03	Service air isolations	3.3	
AK3.04	Dryer/filter realignment	3.0	
AK3.05	Leak isolation	3.3	

AA1	**Ability to operate or monitor the following as they apply to a partial or complete loss of instrument air:** (CFR: 41.7 / 45.6)		
AA1.01	Backup air supply	3.4	
AA1.02	System valves	3.2	
AA1.03	Air compressors	3.5	
AA1.04	DELETED		

AA2	**Ability to determine or interpret the following as they apply to partial or complete loss of instrument air:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Instrument air pressure	4.1	3.9
AA2.02	DELETED		

APE:	295020 Inadvertent Containment Isolation	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to inadvertent containment isolation:** (CFR: 41.8 to 41.10)	
AK1.01	Loss of normal heat sink	4.1
AK1.02	Power/reactivity control	3.9
AK1.03	Water chemistry	2.8
AK1.04	Bottom head thermal stratification	3.3
AK1.05	Loss of drywell/containment cooling	3.5
AK1.06	Loss of reactor building HVAC	3.3
AK2	**Knowledge of the relationship between inadvertent containment isolation and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Main and reheat steam system	3.9
AK2.02	Sampling system	2.7
AK2.03	Drywell or containment ventilation	3.5
AK2.04	RWCU system	3.6
AK2.05	Isolation condenser	3.5
AK2.06	HPCI	3.6
AK2.07	RCIC	3.8
AK2.08	Traversing in-core probes	2.7
AK2.09	RHR/shutdown cooling	4.0
AK2.10	Drywell equipment/floor drain sumps	3.1
AK2.11	Standby gas treatment system/FRVS	3.5
AK2.12	Instrument air/nitrogen	3.1
AK2.13	Containment atmosphere control system	3.0
AK3	**Knowledge of the reasons for the following responses or actions as they apply to inadvertent containment isolation:** (CFR: 41.5 / 45.6)	
AK3.01	RPS actuation	3.9
AK3.02	Drywell/containment pressure response	3.9
AK3.03	Drywell/containment temperature response	3.9
AK3.04	Reactor pressure response	3.9
AK3.05	Reactor water level response	3.9
AK3.06	DELETED	
AK3.07	DELETED	
AK3.08	Suppression chamber pressure response	3.5

AA1	**Ability to operate or monitor the following as they apply to inadvertent containment isolation:** (CFR: 41.7 / 45.6)		
AA1.01	PCIS/NSSSS	3.9	
AA1.02	Drywell ventilation/cooling system	3.5	
AA1.03	Containment ventilation system	3.5	
AA1.04	Standby gas treatment system/FRVS	3.6	
AA1.05	RPS	3.8	
AA1.06	Secondary containment temperature/pressure	3.5	
AA1.07	Reactor pressure	3.8	
AA1.08	Reactor water level	3.8	

AA2	**Ability to determine or interpret the following as they apply to inadvertent containment isolation:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Drywell/containment pressure	3.9	3.7
AA2.02	Drywell/containment temperature	3.9	3.7
AA2.03	Reactor power	3.9	3.8
AA2.04	Reactor pressure	4.0	3.8
AA2.05	Reactor water level	4.0	3.8
AA2.06	Cause of isolation	3.4	3.7
AA2.07	Condenser vacuum	3.4	3.2
AA2.08	High energy line break	3.6	3.6
AA2.09	Area/delta temperatures	3.3	3.5
AA2.10	Reactor building radiation	3.6	3.5
AA2.11	RPS status	3.8	3.9

APE:	**295021 Loss of Shutdown Cooling**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to loss of shutdown cooling:** (CFR: 41.8 to 41.10)	
AK1.01	Decay heat	4.4
AK1.02	Thermal stratification	3.9
AK1.03	Adequate core cooling	4.4
AK1.04	Natural circulation	4.0
AK2	**Knowledge of the relationship between the loss of shutdown cooling and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	DELETED	
AK2.02	Reactor water cleanup	3.2
AK2.03	RHR/shutdown cooling	4.2
AK2.04	Component cooling water systems	3.4
AK2.05	Fuel pool cooling and cleanup system	3.4
AK2.06	DELETED	
AK2.07	Reactor recirculation	3.5
AK2.08	Alternate decay heat removal systems	3.9
AK3	**Knowledge of the reasons for the following responses or actions as they apply to loss of shutdown cooling:** (CFR: 41.5 / 45.6)	
AK3.01	Raising reactor water level	4.0
AK3.02	Feeding and bleeding reactor vessel	3.7
AK3.03	Increasing drywell cooling	2.9
AK3.04	Maximizing reactor water cleanup flow	3.5
AK3.05	Establishing alternate heat removal flow paths	4.0
AK3.06	Installing fuel pool gates	3.0
AA1	**Ability to operate or monitor the following as they apply to a loss of shutdown cooling:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor water cleanup system	3.4
AA1.02	RHR/shutdown cooling	4.3
AA1.03	Component cooling water systems	3.4
AA1.04	Alternate decay heat removal systems	4.0
AA1.05	Reactor recirculation	3.6

AA1.06	DELETED	
AA1.07	Fuel pool cooling and cleanup	3.4

AA2	**Ability to determine or interpret the following as they apply to loss of shutdown cooling:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Containment/ drywell temperature	3.6	2.8
AA2.02	RHR/shutdown cooling system flow	4.1	3.9
AA2.03	Reactor water level	4.4	4.0
AA2.04	Reactor water temperature	4.6	4.3
AA2.05	Reactor vessel metal temperature	3.9	3.7
AA2.06	Reactor pressure	4.2	3.8
AA2.07	Reactor recirculation flow	3.8	3.2

APE:	**295022 Loss of Control Rod Drive Pumps**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to loss of control rod drive pumps:** (CFR: 41.8 to 41.10)	
AK1.01	Reactor pressure vs. rod insertion capability	4.0
AK1.02	Reactivity control	4.0
AK2	**Knowledge of the relationship between the loss of control rod drive pumps and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Recirculation system	3.1
AK2.02	CRD mechanism	3.6
AK2.03	Accumulator	3.8
AK2.04	DELETED	
AK2.05	Reactor water cleanup	2.6
AK2.06	Shared components with other units	2.6
AK2.07	DELETED	
AK2.08	Condensate system	2.6
AK2.09	NBI	3.1
AK3	**Knowledge of the reasons for the following responses or actions as they apply to loss of control rod drive pumps:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor SCRAM	4.0
AK3.02	Restoring CRDM cooling/drive water flow	3.6
AK3.03	Swapping/bypassing filter	3.0
AK3.04	Closing flow control valve	3.1
AA1	**Ability to operate or monitor the following as they apply to a loss of control rod drive pumps:** (CFR: 41.7 / 45.6)	
AA1.01	CRD hydraulic system	3.7
AA1.02	RPS	3.4
AA1.03	Recirculation system	3.0
AA1.04	Reactor water cleanup system	2.7
AA1.05	NBI	3.4

		RO	SRO
AA2	**Ability to determine or interpret the following as they apply to loss of control rod drive pumps:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Accumulator pressure	4.0	3.7
AA2.02	CRD hydraulic system status	4.0	3.7
AA2.03	CRD mechanism temperatures	3.2	3.1
AA2.04	RX water level	3.7	3.0
AA2.05	RX pressure	3.7	3.2

APE: **295023 Refueling Accidents**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to refueling accidents:** (CFR: 41.8 to 41.10)	
AK1.01	Radiation exposure hazards	3.9
AK1.02	Shutdown margin	3.5
AK1.03	Inadvertent criticality	3.8
AK1.04	Fuel positioning	3.4
AK2	**Knowledge of the relationship between the refueling accidents and the following systems or components:** (CFR: 41.7 / 45.8)	
AK2.01	Fuel handling equipment	3.5
AK2.02	Fuel pool cooling and cleanup system	3.4
AK2.03	Radiation monitoring system	3.7
AK2.04	RMCS/RCIS	3.2
AK2.05	Secondary containment ventilation	3.7
AK2.06	Containment ventilation: Mark III	3.5
AK2.07	SBGT/FRVS	3.8
AK2.08	Fuel handling building ventilation (Mark III)	3.4
AK2.09	Incline fuel/horizontal fuel transfer system (Mark III)	3.2
AK2.10	Nuclear instrumentation	3.5
AK2.11	Alternate fuel pool makeup systems	3.5
AK3	**Knowledge of the reasons for the following responses or actions as they apply to refueling accidents:** (CFR: 41.5 / 45.6)	
AK3.01	Personnel evacuation	4.0
AK3.02	Refueling interlocks	3.7
AK3.03	Ventilation isolation	3.7
AK3.04	Non-coincident SCRAM function	2.8
AK3.05	DELETED	
AA1	**Ability to operate or monitor the following as they apply to a refueling accidents:** (CFR: 41.7 / 45.6)	
AA1.01	Secondary containment ventilation	3.8
AA1.02	Fuel pool cooling and cleanup system	3.4

AA1.03	Fuel handling equipment	3.1	
AA1.04	Radiation monitoring equipment	3.6	
AA1.05	Fuel transfer system	2.7	
AA1.06	Nuclear instrumentation	3.6	
AA1.07	SBGT/FRVS	4.0	
AA1.08	Containment building ventilation: Mark III	3.5	
AA1.09	Fuel handling building ventilation: Mark III	3.4	
AA1.10	Alternate fuel pool makeup systems	3.5	

AA2	**Ability to determine or interpret the following as they apply to refueling accidents:** (CFR: 41.10 / 43.5 / 45.13)	**RO**	**SRO**
AA2.01	Radiation levels	4.1	4.0
AA2.02	Fuel pool level	4.6	3.8
AA2.03	Airborne contamination levels	3.9	3.2
AA2.04	Occurrence of fuel handling accident	4.0	3.6
AA2.05	Emergency plan implementation	4.1	4.4

APE:	**600000 Plant Fire on Site**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-effect relationships of the following as they apply to plant fire on site:** (CFR 41.8 / 41.10 / 45.3)	
AK1.01	DELETED	
AK1.02	Firefighting methods for each type of fire	3.4
AK1.03	Fire brigade	3.6
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	3.4
AK2.06	Fire pumps	3.8
AK2.07	Electrical distribution system	3.3
AK2.08	Portable fire suppression systems	3.0
AK2.09	Installed fire suppression systems	3.5
AK2.10	Plant ventilation systems	3.2
AK2.11	Gas treatment system	3.0
AK3	**Knowledge of the reasons for the following responses 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 plant, fire protection system manual, and fire zone manual	3.3
AK3.03	DELETED	
AK3.04	Actions contained in the fire response procedures for a plant fire on site	3.6
AA1	**Ability to operate 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	3.5
AA1.02	Fire detectors/heat detectors	3.1
AA1.03	DELETED	
AA1.04	DELETED	

AA1.05	Plant and control room ventilation systems	3.3	
AA1.06	Fire alarm	3.5	
AA1.07	Fire alarm reset panel	3.2	
AA1.08	Firefighting equipment used on each class of fire	3.3	
AA1.09	Plant fire zone panel (including detector location)	3.3	

AA2	**Ability to determine 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	DELETED		
AA2.03	Fire alarm	3.8	3.7
AA2.04	The fire's extent of potential operational damage to plant equipment	3.9	3.6
AA2.05	Ventilation alignment necessary to secure affected area	3.2	3.2
AA2.06	Need for pressurizing control room (recirculating mode)	3.4	3.3
AA2.07	Whether malfunction is due to common-mode electrical failures	3.1	3.0
AA2.08	DELETED		
AA2.09	DELETED		
AA2.10	Time limit of long-term-breathing air system for control room	3.4	3.0
AA2.11	Time limit for use of respirators	3.9	3.1
AA2.12	Location of vital equipment within fire zone	3.3	3.5
AA2.13	Need for emergency plant shutdown	3.8	3.8
AA2.14	DELETED		
AA2.15	Requirements for establishing a fire watch (SRO only)	N/A	3.3
AA2.16	Vital equipment and control systems to be maintained and operated during a fire	3.3	3.4
AA2.17	DELETED		
AA2.18	Assessing control room habitability (SRO Only)	N/A	3.6

APE:	**700000 Generator Voltage and Electric Grid Disturbances**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1	**Knowledge of the operational implications or cause-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	Over-excitation	3.1
AK1.03	Under-excitation	3.2
AK1.04	Frequency changes	3.2
AK1.05	Voltage disturbance	3.5
AK2	**Knowledge of the relationship between the 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	Motors	3.0
AK2.02	Breakers, relays	3.2
AK2.03	DELETED	
AK2.04	DELETED	
AK2.05	DELETED	
AK2.06	DELETED	
AK2.07	Reactor/turbine pressure regulating system	3.3
AK2.08	Main turbine generator and auxiliary systems	3.1
AK2.09	AC electrical distribution system	3.5
AK2.10	Emergency generators (diesel/jet)	3.9
AK3	**Knowledge of the reasons for the following responses 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	3.8
AK3.02	Actions contained in abnormal operating procedure for voltage and grid disturbances	3.8
AA1	**Ability to operate or monitor the following as they apply to a 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	3.4
AA1.03	DELETED	

AA1.04	Reactor controls	3.6	
AA1.05	DELETED		
AA1.06	AC electrical distribution system	3.5	
AA1.07	Emergency generators (diesel/jet)	3.8	

AA2	**Ability to determine or interpret the following as they apply to generator voltage and electric grid disturbances:** (CFR: 41.5 and 43.5 / 45.5 / 45.7 / 45.8)	**RO**	**SRO**
AA2.01	Operating point on the generator capability curve	3.4	3.2
AA2.02	Generator voltage limitations	3.7	3.3
AA2.03	Generator current limitations	3.7	3.3
AA2.04	DELETED		
AA2.05	Operational status of offsite circuit	3.3	3.7
AA2.06	Generator frequency limitations	3.2	3.0
AA2.07	Operations status of safety related (vital) buses	4.1	4.0
AA2.08	DELETED		
AA2.09	Operational status of emergency diesel generators	4.2	4.2
AA2.10	Generator overheating and the required actions	3.7	3.5
AA2.11	Grid frequency and voltage	3.5	3.5

Component: 291001 Valves

K/A NO.	KNOWLEDGE	IMPORTANCE RO	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; hydraulically/ pneumatically controlled valves; electric motor-driven valves)	3.0	3.3
K1.05	The significance of stem position (valve status) for gate valves	3.1	3.0
K1.06	Equipment protection/safety concerns in the use of gate valves (protect valves seals, open slowly)	3.0	2.6
K1.07	DELETED		
K1.08	Emergency/manual operation of MOV with motor inoperable	3.1	3.5
K1.09	The stroke test for a valve, including the use of a stopwatch	2.9	2.7
K1.10	Principles of operation and purpose of check valves	3.0	3.0
K1.11	Operation of valves and verification of position	3.1	3.2
K1.12	Reason for using a globe valve versus a gate valve for throttling	2.9	2.9

Component: 291002 Sensors and Detectors

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Flow		
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 flow D/P cell type flow detector	2.9	3.0
	Level		
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, or radiation)	3.3	3.2
K1.09	Modes of failure	3.3	3.2
	Pressure		
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, or radiation)	3.1	3.0
K1.12	DELETED		
K1.13	Modes of failure	3.0	3.1
	Temperature		
K1.14	Theory and operation of T/C, RTD, thermostats, thermometers (expanding fluid)	2.9	2.8
K1.15	Failure modes and indications of T/C, RTD or, thermometers	3.3	3.0
	Position Detectors		
K1.16	Failure modes of reed switches, LVDTs, limit switches, and potentiometers	2.9	2.8
K1.17	Applications of reed switches, magnets, LVDTs, potentiometers, and limit switches	2.9	2.7
	Electrical		
K1.18	Theory and operation of voltmeters, ammeters, frequency, and ground detectors	2.7	2.7
	Nuclear Instrumentation		
K1.19	Theory and Operation of fission chambers, ion chambers	3.0	3.0
K1.20	Neutron monitoring indication units	3.0	3.0

K1.21	Effects of voltage changes on neutron detector performance	2.9	2.9
K1.22	Failure modes of fission chambers, ion chambers, and proportional counters	3.1	3.0
	<u>Radiation Detection</u>		
K1.23	Theory and operation of ion chambers, G-M tubes, and scintillation detectors	2.9	2.9
K1.24	Use of portable and personal radiation monitoring instruments	3.1	2.8
K1.25	Effects of core voiding on neutron detection	3.1	3.0

Component: 291003 Controllers and Positioners

K/A NO.	KNOWLEDGE	IMPORTANCE RO	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), as well as 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: 291004 Pumps

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Centrifugal		
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	Discuss relationships among head, flow, and power, as related to pump speed	2.9	3.0
K1.06	Need for net positive suction head (NPSH); effects of loss of suction	3.3	3.1
K1.07	Starting current and operating current interpretation	3.3	3.0
K1.08	Purpose of 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	Relationship between flow from a pump and suction heads	3.0	2.8
K1.15	DELETED		
K1.16	Given the characteristic curve for a typical centrifugal pump, explain the reason for its shape	2.4	2.5
K1.17	Using a centrifugal pump characteristic curve and a system characteristic curve, illustrate how the system operating point changes due to system changes	2.4	2.6
K1.18	Describe how a centrifugal pump characteristic curve will change with pump speed	2.6	2.6
K1.19	Safety procedure and precautions associated with centrifugal pumps	3.1	3.0
	Positive Displacement		
K1.20	Discuss relationship among head, flow, speed, and power	2.9	3.0
K1.21	Net positive suction head (NSPH) requirements for a positive displacement pump	2.9	3.0
K1.22	Consequences of operating a positive displacement pump against a closed flow path	3.7	3.2
K1.23	Functions and characteristics of positive displacement pumps	2.9	3.0
K1.24	Reason for starting a positive displacement pump with the discharge valve open; need to clear the flow path	3.3	3.0
K1.25	Safety procedures and precautions associated with positive displacement pumps	3.1	3.0

K1.26	Theory of operation of positive displacement pumps	2.6	2.9
K1.27	Discuss the characteristic curve for a typical positive displacement pump and explain the reason for its shape	2.4	2.7
	<u>Jet Pumps</u>		
K1.28	Describe the principles of operation of a jet pump	3.3	3.0

Component: 291005 Motors and Generators

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE 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	Explain 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, Amps, Vars, Watts and Hertz	2.7	3.0
K1.08	Consequences of overexcited/underexcited	2.9	2.8
K1.09	Interrelations of the following: VARs, Watts, Amps, 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 AC electrical theory	2.9	3.1
K1.13	Basic DC electrical theory	2.9	3.0

Component: 291006 Heat Exchangers and Condensers (CFR: 41.4)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE 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	Flow paths for the heat exchanger (counterflow and U-types)	2.7	2.7
K1.06	Components of a heat exchanger (shells, tubes, plates, etc.)	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	DELETED		
K1.13	DELETED		
K1.14	DELETED		
K1.15	Effects of heat exchanger tube fouling	3.0	2.9
K1.16	Effects of scaling on heat exchanger operation	2.9	2.8
K1.17	Consequences of heat exchanger tube failure	3.3	3.0
K1.18	Reasons for non-condensable gas removal	3.3	3.0

Component: 291007 Demineralizers and Ion Exchangers

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Effect of excessive differential pressure on demineralizer performance	3.0	2.9
K1.02	Reason for sampling inlet and outlet of demineralizer	3.1	2.8
K1.03	Effects of channeling in a demineralizer	3.0	2.8
K1.04	Purpose of a demineralizer	3.0	2.8
K1.05	DELETED		
K1.06	Reason for demineralizer temperature and flow limits	3.1	3.0
K1.07	Principles of demineralizer operation	2.7	2.7
K1.08	Demineralizer D/P to determine condition of demineralizer resin bed	2.7	2.7
K1.09	Effects of demineralizer operation on water conductivity	2.7	2.7
K1.10	Reasons for bypassing demineralizers	2.9	2.8
K1.11	Reasons for using mixed-bed demineralizers to process primary water	2.9	2.6
K1.12	Plant evolutions which can cause crud bursts and the effect on demineralizers	3.1	2.9

Component: 291008 Breakers, Relays, and Disconnects

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Purpose for racking out breakers (de-energize 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 of or the 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 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 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

6.1 Reactor Theory (CFR: 41.1)

6.1 Reactor Theory: 292001 Neutrons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	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

6.1 Reactor Theory: 292002 Neutron Life Cycle

K/A NO.	KNOWLEDGE	IMPORTANCE	
	<u>Describe the neutron life cycle using the following terms:</u>	**RO**	**SRO**
K1.01	--fast fission factor	2.9	2.6
K1.02	--fast non-leakage probability factor	2.9	2.6
K1.03	--resonance escape probability factor	2.9	2.6
K1.04	--thermal non-leakage 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

6.1 Reactor Theory: 292003 Reactor Kinetics and Neutron Sources

K/A NO.	KNOWLEDGE	IMPORTANCE RO	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 state 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; state the reasons for variation	2.8	2.9
K1.05	Define reactor period	3.6	3.8
K1.06	Explain the effect of delayed neutrons on reactor period	3.3	3.4
K1.07	Explain prompt critical, prompt jump, and prompt drop	3.3	3.2
K1.08	Given the power equation, solve problems for power changes and period	2.8	2.9
K1.09	Define doubling time and calculate it using the power equation	3.2	3.3
K1.10	Explain the necessity for installed neutron sources in a reactor core	2.7	2.5
K1.11	Explain why installed sources are not needed after one cycle of core operation	2.7	2.3
K1.12	Describe the factors affecting reactor period	3.4	3.3

6.1 Reactor Theory: 292004 Reactivity Coefficients

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define the moderator temperature coefficient of reactivity	3.2	3.5
K1.02	Describe the effect on the magnitude of the temperature coefficient of reactivity from changes in moderator temperature and core age	3.0	3.2
K1.03	Explain resonance absorption	2.8	2.6
K1.04	Explain Doppler broadening and self-shielding	2.8	2.8
K1.05	Define the fuel temperature (Doppler) coefficient of reactivity	3.1	2.9

Describe the effect on the magnitude of the Doppler coefficient of reactivity for changes in the following:

K1.06	--Moderator temperature	2.9	2.7
K1.07	--Core void fraction	2.9	2.6
K1.08	--Fuel temperature	2.9	2.7
K1.09	--Core age	2.8	2.5
K1.10	Define the void coefficient of reactivity	3.0	3.0

Describe the effect on the magnitude of void coefficient from changes in the following:

K1.11	--Core void fraction	3.0	2.9
K1.12	--Fuel temperature	3.0	2.7
K1.13	--Core age	3.0	2.6
K1.14	Compare the relative magnitudes of the temperature, Doppler, and void coefficients of reactivity	3.2	3.3
K1.15	Explain the differences between reactivity coefficients and reactivity defects	2.7	2.7
K1.16	Explain and describe the effect of power defect and Doppler defect on reactivity	2.7	2.8

6.1 Reactor Theory: 292005 Control Rods

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Relate notch and rod position	3.4	3.5
K1.02	Name the material used for thermal neutron absorption in control rods	2.8	2.9
K1.03	Describe nuclear properties of active neutron absorber material in the control rod	2.9	2.7
K1.04	Predict direction of change in reactor power for a change in control rod position	3.7	3.8
K1.05	Define rod density	2.8	3.2
K1.06	Define reactor SCRAM/trip	3.6	3.8
K1.07	Define control rod worth, differential control rod worth, and integral control rod worth	3.0	3.1
K1.08	Explain the shape of curves for differential and integral CRW versus rod position	2.6	2.9
K1.09	Explain direction of change in the magnitude of CRW for a change in moderator temperature, void fraction, and control rod density, and xenon	2.9	2.9
K1.10	State the purpose of flux shaping	3.0	3.0
K1.11	Define deep rods and shallow rods	3.2	3.2
K1.12	Describe effects of deep and shallow control rods on axial and radial flux distribution	3.1	3.1

6.1 Reactor Theory: 292006 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

Describe the following processes and state their effect on reactor operations:

K1.05	--Equilibrium xenon	3.3	3.5
K1.06	--Transient xenon	3.4	3.6
K1.07	--Xenon following a SCRAM	3.3	3.5
K1.08	Describe the effects that Xenon concentration has on flux shape and control rod patterns	3.1	3.4

Plot the curve and explain the reasoning for the reactivity insertion by Xenon-135 versus time for the following:

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 SCRAM	3.1	3.3
K1.13	--Reactor shutdown	3.1	3.3
K1.14	Explain the process 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

Plot the curve and explain the reasoning for reactivity insertion by Samarium-149 versus time for the following:

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 effects of power changes on 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

6.1 Reactor Theory: 292007 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

6.1 Reactor Theory: 292008 Reactor Operational Physics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
Startup and Approach to Criticality			
K1.01	List parameters which should be monitored and controlled during the approach to criticality	4.1	4.1
K1.02	List reactivity control mechanisms which exist for plant conditions during the approach to criticality	4.0	4.1
K1.03	Describe count rate and instrument response that 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/period 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
Criticality			
K1.06	List parameters which should be monitored and controlled upon reaching initial criticality	4.1	4.1
K1.07	Define criticality as related to a reactor startup	3.7	3.8
K1.08	Describe reactor power and start-up rate/period response once criticality is reached	4.0	4.0
Intermediate Range Operation			
K1.09	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
K1.10	Explain procedures for adjusting reactor period during the intermediate phase of startup	4.0	4.0
K1.11	Discuss the concept of the point of adding heat (POAH) and its impact on reactor power	4.1	4.1
K1.12	Describe reactor power and period response prior to reaching the POAH	4.0	4.0
K1.13	Explain characteristics to look for when the POAH is reached	4.1	4.0
Heatup Operation			
K1.14	Describe three parameters to be monitored and controlled during heatup	3.9	4.0
K1.15	Describe reactor power and startup rate/period response after reaching the POAH	3.9	4.0
K1.16	Explain procedures for establishing and controlling heatup rate	3.9	4.0
Power Operation			
K1.17	Describe three parameters to be monitored and controlled during power operation	3.9	4.1
K1.18	Describe means by which reactor power will be increased to rated power	3.8	4.0

K1.19	Explain transient and steady-state effects of a control rod withdrawal on reactor power and void fraction content	3.8	3.8
K1.20	Explain transient and steady-state effects of an increase in core flow on reactor power and void fraction	3.9	3.8
K1.21	Explain the relationship between steam production rate and reactor power given specific conditions	3.7	3.7
K1.22	Explain the effect that opening steam bypass valves, during power operation, will have on reactor power	3.8	3.7
K1.23	Explain the necessity for rod pattern exchanges	3.1	3.0
K1.24	Describe the parameters to be monitored and controlled during rod pattern exchanges	3.7	3.3

Reactor Response on a Scram

K1.25	Explain the shape of a curve of reactor power versus time after a SCRAM	3.1	3.4

Normal Reactor Shutdown

K1.26	Explain reactor power response to a decrease in core flow	3.7	3.8
K1.27	Explain reactor power response to a control rod insertion	3.6	3.9
K1.28	Explain the necessity for inserting control rods in a predetermined sequence during normal shutdown	3.7	3.7
K1.29	Define decay heat	3.6	3.7
K1.30	Explain the relationship between decay heat generation and: a) power level history, b) power production, and c) time since reaction shut down	3.4	3.6

6.2 Thermodynamics Theory (CFR: 41.14)

6.2 Thermodynamics Theory: 293001 Thermodynamic Units and Properties

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Convert between absolute and relative 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

6.2 Thermodynamics Theory: 293002 Basic Energy Concepts

K/A NO.	KNOWLEDGE	IMPORTANCE RO	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 state and phase of a working substance	2.4	2.3
K1.04	Explain the application of enthalpy in the monitoring of plant processes	2.7	2.7
K1.05	Identify the relationship between heat flow during a process and a T-s diagram representation of the process	2.6	2.6
K1.06	Define specific heat	2.2	2.5
K1.07	Apply specific heat in solving heat transfer problems	2.2	2.3
K1.08	Define enthalpy	2.3	2.6

6.2 Thermodynamics Theory: 293003 Steam

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Describe effects of pressure and temperature on density or specific volume of a liquid and gas	3.1	3.1
K1.02	Distinguish between liquids, vapors, gases, and fluids	2.8	2.8

Define the following terms:

K1.03	Latent heat of vaporization	2.7	2.8
K1.04	Vaporization line	2.4	2.3
K1.05	Critical point	2.4	2.3
K1.06	Vapor dome	2.3	2.4
K1.07	Saturated liquid	2.8	3.1
K1.08	Wet vapor	2.4	2.6
K1.09	Saturated vapor	2.6	2.8
K1.10	Vapor pressure	2.3	2.4
K1.11	Moisture content	2.7	3.1
K1.12	Quality	2.7	3.2
K1.13	Superheated vapor	2.4	2.5
K1.14	Supersaturated vapor	2.3	2.5
K1.15	Subcooled and compressed liquids	2.4	2.8
K1.16	Subcooling	2.9	3.2
K1.17	DELETED		

Identify the following terms on a T-s diagram:

K1.18	--Critical point	2.4	2.3
K1.19	--Saturated liquid line	2.7	2.7
K1.20	--Saturated vapor line	2.7	2.7
K1.21	--Solid, liquid, gas, vapor, and fluid regions	2.6	2.5
K1.22	Explain the usefulness of steam tables to the Control Room Operator	3.0	3.3
K1.23	Use saturated and superheated steam tables	2.9	3.1

6.2 Thermodynamics Theory: 293004 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 boiler	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
K1.05	DELETED		
Turbines:			
K1.06	Explain the function of nozzles, fixed blading, and moving blading in the turbine	2.7	2.7
K1.07	Explain the reason turbines are multistaged	2.9	2.5
K1.08	Define turbine efficiency	3.0	2.7
K1.09	Explain the difference between real and ideal turbine efficiency	2.6	2.4
Pumps:			
K1.10	Define pump efficiency	2.6	2.5
K1.11	Explain the difference between ideal and real pumping processes	2.6	2.3
Condensers:			
K1.12	Describe the process of condensate depression (subcooling) and its effect on plant operation	3.3	3.0
K1.13	Explain vacuum formation in condenser processes	3.2	3.0
K1.14	Explain the condensing process	2.8	2.9
Throttling and the throttling Process:			
K1.15	Define throttling	2.6	2.7
K1.16	Explain the reduction of process pressure from throttling	2.7	2.7
K1.17	Determine the exit conditions for a throttling process based on the use of steam or water	2.3	2.6

6.2 Thermodynamics Theory: 293005 Thermodynamic Cycles

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define 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

6.2 Thermodynamics Theory: 293006 Fluid Statics and Dynamics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Distinguish between fluids and other substances	2.7	2.3
K1.02	Distinguish between static pressure, dynamic pressure, and total pressure	2.9	2.6
K1.03	Define head loss	3.0	3.0
K1.04	Discuss operational considerations of viscosity as related to head loss	2.6	2.2
K1.05	Explain operational implications of fluid/water hammer	3.4	3.3
K1.06	Discuss methods of prevention of fluid/water hammer	3.7	3.3
Pumps and Pump Characteristics			
K1.07	--State the purpose of a pump	2.9	3.0
K1.08	--Discuss pump head	3.0	3.2
K1.09	--Discuss relationship between pump speed, head, flow, and power without using formulas or calculations	2.9	3.1
K1.10	--Define cavitation	3.2	3.3
K1.11	--Define net positive suction head (NPSH)	3.4	3.3
K1.12	--Define pump shut-off head, pump runout, and axial thrust	3.0	3.1
K1.13	--Explain the importance of proper system venting for pump operations	3.2	3.3
K1.14	--Explain the results of putting centrifugal pumps in parallel or series combinations	3.2	3.0
K1.15	--Given the characteristic curve for a typical centrifugal pump, explain the reason for its shape	2.9	2.6
K1.16	--Using a centrifugal pump characteristic curve and a system characteristic curve, illustrate how the system operating point changes due to system changes	2.9	2.7
K1.17	--Describe how a centrifugal pump characteristic curve will change with pump speed	2.7	2.7
K1.18	--Explain how operating a centrifugal pump at shutoff head may cause overheating of the pump and describe methods used to avoid overheating	3.1	3.2
K1.19	--Discuss the characteristic curve for a typical positive displacement pump and explain the reason for its shape	3.1	2.8
K1.20	--Describe the problems that will occur in emergency core cooling systems if the pumps are operated at lower than design flow for extended periods of time	3.3	3.3
Define or explain the following terms and concepts:			
K1.21	Mass flow rate	2.9	3.0
K1.22	Two-phase flow	2.9	2.9
K1.23	Pressure spike	2.9	2.7
K1.24	Gas binding	2.8	2.8
K1.25	Recirculation ratio	2.7	2.6

K1.26	Pipe whip	2.9	2.5
K1.27	Explain why flow measurements must be corrected for density changes	2.8	2.7
K1.28	Explain the relationship between pressure head and velocity head in a fluid system	2.7	2.7
K1.29	Discuss the velocity profiles for laminar flow and turbulent flow	2.4	2.2
K1.30	Describe the methods of controlling system flow rates	3.0	3.1

6.2 Thermodynamics Theory: 293007 Heat Transfer

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
Heat Transfer			
K1.01	Describe three mechanisms of heat transfer	3.2	3.3
K1.02	Describe thermal conductivity	3.1	2.9
K1.03	Explain the manner in which fluid films affects heat transfer	3.1	2.7
Heat Exchangers			
K1.04	Discuss parallel-flow heat	3.0	2.9
K1.05	Discuss counter-flow heat	3.0	2.9
K1.06	Discuss the factors which affect heat transfer rate in a heat exchanger	3.3	3.1
K1.07	Describe how the presence of gases or steam can affect heat transfer and fluid flow in heat exchangers	3.2	3.1
Condenser Applications of Heat Transfer			
K1.08	List functions of the main condenser in a power plant	3.3	3.2
K1.09	Discuss operational implications of condensate depression	3.1	3.1
Core Thermal Power			
K1.10	Define core thermal power	3.6	3.6
K1.11	Explain methods of calculating core thermal power	3.2	3.5
K1.12	Define percent reactor power	3.4	3.5
K1.13	Calculate core thermal power using a simplified heat balance	3.1	3.2

6.2 Thermodynamics Theory: 293008 Thermal Hydraulics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
Boiling Heat Transfer			
K1.01	Distinguish between boiling processes and other heat transfer mechanisms	3.2	3.0
K1.02	Describe surface or cavity nucleation	3.0	2.7
K1.03	List factors affecting bubble formation in a cavity	2.9	2.5
K1.04	Describe means by which boiling improves convection heat transfer	3.2	2.7
K1.05	Describe microconvection	2.4	2.1
Pool Boiling Curve (T vs. Q/A)			
K1.06	Define a natural convection heat transfer	2.9	2.7
K1.07	Define nucleate boiling, subcooled nucleate boiling, and bulk boiling	3.0	3.1
K1.08	Describe DNB (departure from nucleate boiling)	3.1	3.3
K1.09	Describe OTB (onset of transition boiling)	3.2	3.3
K1.10	Describe CHF (critical heat flux)	3.3	3.2
K1.11	Describe transition (partial film) boiling	3.0	3.1
K1.12	Describe stable film boiling	3.1	2.9
K1.13	Describe burnout and burnout heat flux	2.8	2.6
Two Phase Flow			
K1.14	Classify slug flow region along a fuel channel, experiencing two phase flow	2.7	2.5
K1.15	Describe annular flow region along a hypothetical fuel channel, experiencing two phase flow	2.6	2.6
K1.16	Describe dryout region or mist flow region along a hypothetical fuel channel, experiencing two phase flow	2.7	2.6
K1.17	Describe OTB point along a hypothetical fuel channel, experiencing two phase flow	2.8	2.7
K1.18	Describe effects of flowrate and phase change on the heat transfer coefficient	2.9	2.8
Core Inlet Subcooling			
K1.19	Define core inlet subcooling	3.0	3.0
K1.20	Define carryunder	3.0	2.8
Voids and Void Fraction			
K1.21	Define void fraction	3.1	3.0
K1.22	Explain the term void as applied to core operations	3.4	3.0
K1.23	Define quality	2.8	2.9
K1.24	Draw the temperature profile from the centerline of a fuel pellet to the centerline of the channel	2.7	2.7
Recirculation System			
K1.25	Explain the reason for forced core recirculation	3.6	3.3

K1.26	Explain the jet pump operating principle	3.3	3.1
K1.27	Explain the necessity of determining core coolant flow	3.4	3.3
K1.28	Describe the factors affecting single- and two-phase flow resistance	3.0	2.9

Core Orificing

K1.29	Describe the effects of increasing bundle power on bundle flow resistance	3.4	3.0
K1.30	Compare the flow resistance through high-powered bundles to that of low powered bundles	3.2	2.9
K1.31	Explain the necessity of core orificing	3.3	2.9
K1.32	Describe core bypass flow	3.3	2.8
K1.33	Explain the need for adequate core bypass flow	3.3	2.7

Natural Circulation

K1.34	Explain the causes of natural circulation in BWRs	3.3	3.2
K1.35	Describe problems that thermal stratification can cause	3.3	3.4
K1.36	Describe means by which the operator can determine if natural circulation flow exists	3.4	3.6
K1.37	Describe means by which the operator can enhance natural circulation	3.4	3.5

Sketch the axial temperature and enthalpy profiles for a typical reactor coolant channel and describe how they are affected by the following:

K1.38	--Onset of nucleate boiling	2.6	2.6
K1.39	--Axial core flux	2.6	2.6
K1.40	--Inlet temperature	2.6	2.5
K1.41	--Heat generation rate	2.7	2.5
K1.42	--Flow rate in the channel	2.7	2.5
K1.43	Sketch the temperature profile in the axial and radial directions for a typical fuel rod and explain the reason for its shape.	2.4	2.4

6.2 Thermodynamics Theory: 293009 Core Thermal Limits

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Explain radial peaking factor (RPF)	2.4	2.8
K1.02	Explain axial peaking factor (APF)	2.4	2.8
K1.03	Explain local peaking factor (LPF)	2.4	2.8
K1.04	Explain total peaking factor (TPF)	2.4	2.8
K1.05	State the reason thermal limits are necessary	3.7	3.6
LHGR			
K1.06	Define LHGR	3.2	3.5
K1.07	Explain the basis of the limiting condition of LHGR	3.4	3.6
K1.08	Describe the mode of fuel failure for LHGR	3.6	3.5
K1.09	Define FLPD and MFLPD	3.2	3.5
MAPLHGR			
K1.10	Define APLHGR	3.3	3.5
K1.11	Explain the basis of the limiting condition for APLGHR	3.4	3.7
K1.12	Describe the mode of fuel failure for APLHGR	3.6	3.5
K1.13	Define MAPLHGR	3.2	3.5
K1.14	Explain the mechanisms most limiting for each region of the MAPLHGR limit curves	2.9	3.4
K1.15	Describe conditions under which radiative heat transfer becomes the significant method of heat transfer within a fuel bundle	3.0	3.3
K1.16	Discuss how changes in the heat generation rate and thermal conductivity of the fuel rod affect fuel centerline temperature	3.0	3.2
MCPR			
K1.17	Define critical power	3.3	3.6
K1.18	Define critical power ratio	3.2	3.6
K1.19	Explain the basis of the limiting condition for CPR	3.3	3.6
K1.20	Describe the mode of fuel failure for CPR	3.6	3.5
K1.21	Define MCPR	3.2	3.7
K1.22	Describe the effects of subcooling on critical power	3.1	3.4
K1.23	Describe the effects of mass flow on critical power	3.1	3.4
K1.24	Describe the effects of pressure on critical power	3.1	3.4
K1.25	Describe the effects of local power distribution on critical power	3.2	3.3
K1.26	Describe the effects of axial power distribution on critical power	3.1	3.3
K1.27	Explain the purpose of the flow biasing correlation factor, (K), as it relates to MCPR limits	2.9	3.0
K1.28	Define FLCPR	3.0	3.1

Thermal Time Constant

K1.29	Define fuel thermal time constant	2.8	2.8
K1.30	Relate thermal time constant to transient operating condition	2.9	2.9

Pellet Clad Interaction

K1.31	Describe pellet-clad interaction (PCI)	3.0	3.3
K1.32	List the causes of PCI	2.9	3.1
K1.33	Describe the purpose of the pellet to clad gap	2.9	3.1
K1.34	Identify the possible effects of fuel densification	2.7	2.9
K1.35	Describe the effects of iodine and cadmium on PCI	2.7	2.7

Preconditioning Interim Operating management Recommendations (PCIOMR)

K1.36	Explain the purpose for PCIOMR	2.9	2.9
K1.37	Identify how the PCIOMR rules minimize the adverse effects of PCI	2.9	2.9
K1.38	State the items measured for each of the three core thermal limits	3.3	3.2

For the following plant operating or accident conditions, identify which of the three core thermal limits are most limiting:

K1.39	Full power operation	3.3	3.5
K1.40	Loss of reactor coolant	3.3	3.5
K1.41	Increase in core flow	3.3	3.5
K1.42	Increase in reactor pressure	3.3	3.5
K1.43	Cold water addition	3.3	3.5

6.2 Thermodynamics Theory: 293010 Brittle Fracture and Vessel Thermal Stress

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	State the brittle fracture mode of failure	3.0	3.2
K1.02	State the definition of 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	State the operational concerns of uncontrolled cooldown	3.2	3.3

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

NUREG-1123, "Knowledge and Abilities Catalog for Nuclear Plant Operators: Boiling 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 Boiling 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-1123 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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