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NUREG-2104

Knowledge and Abilities Catalog for Nuclear Power Plant Operators

Advanced Boiling Water Reactors

Draft Report for Comment

Office of New Reactors

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NUREG-2104

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Advanced Boiling Water Reactors

Draft Report for Comment

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Office of New Reactors

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ABSTRACT

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Advanced Boiling Water Reactors (NUREG-2104, Revision 0) 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 ABWR Catalog along with the Operator Licensing Examination Standards for Power Reactors (NUREG-1021) will sample the topics listed under Title 10, Code of Federal Regulations, Part 55 (10 CFR 55).

The catalog is organized into six major sections: Organization of the Catalog, Generic Knowledge and Ability Statements, Plant Systems grouped by Safety Functions, Emergency and Abnormal Plant Evolutions, Components and Theory.

This is a new Knowledge and Abilities catalog developed specifically to address the General Electric Advanced Boiling Water Reactor.

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1.0 ORGANIZATION OF THE CATALOG

1.1 Introduction

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Advanced Boiling Water Reactors, NUREG-2104, 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 pursuant to 10 CFR 55. All knowledge and abilities (K/As) in this catalog are directly linked by item number to 10 CFR 55. Throughout the catalog, 10 CFR 55 section references are shown in parentheses following the appropriate K/A statement, such as (CFR: 41.x / 43.x / 45.x).

1.3 RO Written Examination

The guidance for preparation of RO written examination is presented in NUREG-1021. The specific items for RO written examinations are specified 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 preparation of the 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 Reactor Operator Limited to Fuel Handling

The specifications for examinations for Senior Operators Limited to Fuel Handling (LSRO) are provided in NUREG 1021. The LSRO examination process includes both a written examination and an operating test. This examination and test 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 ABWR Catalog

This catalog is organized into 6 major sections. K/As are grouped according to the major section to which they pertain. This organization is outlined below.

1.0 ORGANIZATION OF THE ABWR CATALOG

2.0 GENERIC KNOWLEDGE AND ABILITIES
Conduct of Operations
Equipment Control
Radiation Control
Emergency Procedures / Emergency Plan

3.0 PLANT SYSTEMS
Knowledge Categories (K1 - K6)
Ability Categories (A1 - A4)

4.0 EMERGENCY PLANT AND ABNORMAL PLANT EVOLUTIONS
Knowledge Categories (EK/AK 1 - EK/AK 3)
Ability Categories (EA/AA 1 – EA/AA 2)

5.0 COMPONENTS
Component Knowledge Categories

6.0 THEORY
Reactor Theory Knowledge Categories
Thermodynamics Knowledge Categories

1.8 Generic Knowledge and Abilities

Generic knowledge and abilities are generally administrative knowledges and abilities with broad application across systems and operations. They are listed in Section 2 of the catalog. The four (4) categories of generic K/As are:

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

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

The K/As for "Equipment Control" are used to evaluate the applicant’s knowledge of the administrative issues associated with the management and control of plant systems and equipment. The types of information evaluated in this category include maintenance and temporary modifications of systems. Fuel handling and refueling K/As are organized into this topic area due to the equipment control aspect of fuel handling.

The generic K/As for "Radiation Control" are used to evaluate the applicant's knowledge of radiation protection and radiation (personnel and public). The types of information under in this category include radiation hazards, radiation work permits, and radiation monitoring systems.

The K/As for "Emergency Operating 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 operating procedures use. The emergency plan K/As are 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

1.9.1 Plant System Organization by Safety Function

Nine (9) major safety functions must be maintained to ensure safe nuclear power plant operation. The safety functions groups are:

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

Plant systems have been included in this catalog based on their relationship and importance to nine safety functions. Table 1 contains a list of these plant systems, arranged within each safety function. It should be noted that some plant systems contribute to more than one safety function.

Each plant system has been assigned a unique alphanumeric identifier. Plant systems K/As are in Section 3 of this catalog.

Table 1
Plant Systems by Safety Function

3.1 Safety Function 1: Reactivity Control

SF1CRD	Control Rod Drive System
SF1FMCRD	Fine Motion Control Rod and Drive Mechanism
SF1RFC	Recirculation Flow Control System
SF1RRS	Reactor Recirculation System
SF1RCIS	Rod Control and Information System
SF1SLC	Standby Liquid Control System

3.2 Safety Function 2: Reactor Water Inventory Control

SF2HPCF	High Pressure Core Flooder System
SF2CD	Condensate System
SF2RCIC	Reactor Core Isolation Cooling System
SF2FW	Feedwater System
SF2RWCU	Reactor Water Cleanup System
SF2FWC	Feedwater Control System
SF2RHRLPFL	Residual Heat Removal: Low Pressure Flooder Injection Mode
SF2AFI	Alternate Feedwater Injection System

3.3 Safety Function 3: Reactor Pressure Control

SF3ADS	Automatic Depressurization System
SF3NBS	Main and Reheat Steam System
SF3EHC	Turbine Pressure Control/Steam Bypass and Pressure Control System
SF3SRV	Safety/Relief Valves

3.4 Safety Function 4: Heat Removal From Reactor Core

SF4NBS	Main and Reheat Steam System
SF4MT	Main Turbine Generator and Auxiliary Systems
SF4RCIC	Reactor Core Isolation Cooling System
SF4RRS	Reactor Recirculation System
F3RHRSDC	Residual Heat Removal System: Shutdown Cooling Mode

3.5 Safety Function 5: Containment Integrity

SF5PCS	Primary Containment System and Auxiliaries
SF5LDIS	Leak Detection and Isolation System
SF5RPV	Reactor Vessel Internals
SF5RHRSPC	Residual Heat Removal System: Suppression Pool Cooling Mode
SF5RHRSPR	Residual Heat Removal System Drywell/Wetwell Spray Mode
SF5SEC	Secondary Containment

3.6 Safety Function 6: Electrical

SF6EPDS	AC Electrical Distribution System
SF6DC	Direct Current Power Supply System
SF6DGCTG	Emergency Generators (Diesel/Combustion Turbine Generators)
SF6VAC	Vital AC Power Supply System
SF6I&C	Instrumentation and Control Power Supply System

3.7 Safety Function 7: Instrumentation

SF7APR	Automatic Power Regulator System
SF7ATLM	Automated Thermal Limit Monitoring System
SF7APRM	Average Power Range Monitor/Local Power Range Monitor System
SF7NBI	Nuclear Boiler Instrumentation
SF7RMS	Radiation Monitoring System

SF7RTIS	Reactor Trip and Isolation System
SF7MRBM	Multi-Channel Rod Block Monitor System
SF7RWM	Rod Worth Minimizer System
SF7SRNM	Startup Range Neutron Monitor System
SF7ATIP	Automated Traversing In-Core Probe System
SF7ELCS	Engineered Safety Function Logic and Control System
SF7PICS	Plant Information and Control System
SF7SPTM	Suppression Pool Temperature Monitoring System
SF7RSS	Remote Shutdown System

3.8 Safety Function 8: Plant Service Systems

SF8FPS	Fire Protection System
SF8FH	Fuel Handling Equipment
SF8IAS	Instrument Air System
SF8RBCW	Reactor Building Cooling Water System
SF8RSW	Reactor Service Water System

3.9 Safety Function 9: Radioactivity Release

SF9OG	Offgas System
SF9HVAC	Plant Ventilation Systems
SF9RMS	Radiation Monitoring System
SF9RMS	Radwaste System
SF9RPV	Reactor Vessel Internals
SF9FPC	Fuel Pool Cooling and Clean-up System
SF9SGTS	Standby Gas Treatment System
SF9CRHVAC	Control Room Habitability Area Heating, Ventilation, and Air Conditioning System

1.9.2 Knowledge and Ability Stem Statements for Plant Systems

The knowledge and abilities for each plant system are organized into six types of knowledge and four types of ability. If there are no knowledge or ability statements following a stem statement, then there are no applicable knowledge or ability statements.

The applicable 10 CFR 55.41 / 43 / and 45 references 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 lists the Plant System Stem Statements:

Table 2
Knowledge and Ability Stem Statements for Plant Systems

Knowledge Stem Statements

K 1 Knowledge of the physical or control/protection logic relationships between the (SYSTEM) and the following systems:
(CFR: 41.2 to 41.9 / 45.7 to 45.8)

K 1 Contains the systems that have a connection to system XXS. The selected systems listed have either a plant protection/control logic relationship or physical piping relationship to system XXS. The electrical systems were not included in K 1 because they are addressed in K 2.

K 2 Knowledge of bus or division power supplies to the following:
(CFR: 41.7)

K 2 Lists the power supplies to system components for which knowledge of power supplies is testable.

K 3 Knowledge of the effect that a loss or malfunction of the (system) will have on the following:
(CFR: 41.7 / 45.4)

K 3 Lists the systems included in K1 that are directly affected by a loss of system XXS.

K 4 Knowledge of (SYSTEM) design feature(s) and or interlock(s) which provide for the following:
(CFR: 41.7)

K 4 Contains the plant protection/control design features and interlocks.

K 5 Knowledge of the operational implications or cause-effect relationships as they apply to the (SYSTEM):
(CFR: 41.5 / 45.3)

K 5 Contains theoretical concepts related to the operation of the system.

K 6 Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the (SYSTEM):
(CFR: 41.7 / 45.7)

K 6 Lists the systems included in K1 that will have an effect on system XXS if the listed system is lost. It also lists the components of system XXS whose failure can affect the operation of the system XXS.

Ability Stem Statements

A 1 Ability to predict and/or monitor changes in parameters associated with operating the (system) controls including:
(CFR: 41.5 / 45.5)

A 1 Lists the parameters monitored to verify proper operation of system XXS.

A 2 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)

A 2 Lists the ability to predict and mitigate the consequences of selected items from K 6.

A 3 Ability to monitor automatic operations of the (system) including:
(CFR: 41.7 / 45.7)

A 3 Contains the automatic features of system XXS identified in K 4 that can be monitored from the control room

A 4 Ability to manually operate and/or monitor in the control room:
(CFR: 41.7 / 45.5 to 45.8)

A 4 Contains the features of system XXS listed in A 3 that can also be manually performed as well as the features of system XXS system can only be manually performed and monitoring parameters. A4 includes system monitoring associated with the listed manual actions.

1.10 Emergency and Abnormal Plant Evolutions

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

The emergency plant evolution strategies described in the Boiling Water Reactor Owners Group Emergency Procedures Guidelines, cover five broad areas:

1. Reactor Pressure Vessel Control
2. Reactor Pressure Vessel Control with SCRAM Condition Present and Reactor Power >5% or Unknown.
3. Primary Containment Control
4. Secondary Containment Control
5. Radioactivity Release Control.

If the operator controls the five broad areas of emergency plant evolutions listed above, the plant safety functions will be safely maintained. Table 3 contains a list of the emergency plant evolutions and abnormal plant evolutions covered by this catalog. The emergency plant and abnormal plant evolutions each have a unique evolution designator.

Table 3
Emergency Plant and Abnormal Plant Evolutions

Emergency Plant Evolutions

EPE1001	High Drywell Pressure
EPE1002	High Reactor Pressure
EPE1003	Suppression Pool High Water Temperature
EPE1004	High Drywell Temperature
EPE1005	High Suppression Pool Water Level
EPE1006	Low Suppression Pool Water Level
EPE1007	Reactor Low Water Level
EPE1008	High Secondary Containment Area Temperature
EPE1009	High Secondary Containment Area Radiation Levels
EPE1010	Reactor Building Heating, Ventilation, and Air Conditioning Exhaust High Radiation
EPE1011	Secondary Containment High Differential Pressure
EPE1012	Secondary Containment High Floor Drain Sump / Area Water Level
EPE1013	Scram Condition and Reactor Power >5% or Unknown
EPE1014	High Off-Site Release Rate

Abnormal Plant Evolutions

APE2001	Partial or Complete Loss of Forced Core Flow Circulation
APE2002	Loss of Main Condenser Vacuum
APE2003	Partial or Complete Loss of AC Power
APE2004	Partial or Complete Loss of DC Power
APE2005	Main Turbine Trip
APE2006	Reactor Scram
APE2007	High Reactor Pressure
APE2008	High Reactor Water Level
APE2009	Low Reactor Water Level
APE2010	High Drywell Pressure
APE2011	High Drywell Temperature
APE2012	High Suppression Pool Water Temperature
APE2013	Inadvertent Reactivity Addition
APE2014	Incomplete Scram
APE2015	Control Room Evacuation
APE2016	High Off-Site Release Rate
APE2017	Partial or Complete Loss of Reactor Building Cooling Water
APE2018	Partial or Complete Loss of Instrument Air
APE2019	Inadvertent Containment Isolation
APE2019	Loss of Shutdown Cooling
APE2021	Loss of Control Rod Drive Pumps
APE2022	Refueling Accidents
APE2023	Plant Fire on Site
APE2024	Generator Voltage and Electric Grid Disturbances

1.10.1 Knowledge and Ability Stem Statements for Emergency and Abnormal Plant Evolutions

The information delineated within each emergency or abnormal evolution is organized into three (3) different types of knowledge and two (2) different types of ability. If there are no knowledge or ability statements following a stem statement there is no applicable K/A.

The applicable 10 CFR 55.41, 43, and 45 item numbers are included with each stem statement. In most cases the K/As associated with the stem statements can be used for both the written and operating examinations. See Table 4, below:

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

Knowledge Stem Statements

E/AK 1 Knowledge of the operational implications of the following concepts as they apply to the (Emergency Plant or Abnormal Plant Evolution):
(CFR: 41.8 to 41.10)

E/AK 1 Lists the operational implications applicable to the procedure. These items can come from the procedure bases, PRA, OE, procedure notes and cautions.

E/AK2 Knowledge of the interrelations between (Emergency Plant or Abnormal Plant Evolution) and the following:
(CFR: 41.7 / 45.8)

E/AK 2 Lists the systems required to be monitored and/or operated by the procedure.

E/AK 3 Knowledge of the reasons for the following responses as they apply to (Emergency Plant or Abnormal Plant Evolution):
(CFR: 41.5 / 45.6)

E/AK 3 Lists the actions and bases taken in the procedure.

Ability Stem Statements

E/AA 1 Ability to operate and / or monitor the following as they apply to (Emergency Plant or Abnormal Plant Evolution):
(CFR: 41.7 / 45.6)

EA 1 Lists the system and/or components required to be monitored and/or operated by the procedure.

E/AA 2 Ability to determine and / or interpret the following as they apply to (Emergency Plant or Abnormal Plant Evolution):
(CFR: 41.10 / 43.5 / 45.13)

EA 2 Lists the parameters and/or conditions that are monitored to verify successful implementation of the procedure.

1.11 Components

Basic components such as valves and pumps are found in many systems. NUREG-1021 lists 8 categories of components. The eight categories of components for which additional knowledge statements are necessary are listed below and delineated in Section 5 of the ABWR catalog.

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 component group has a numeric identifier and a 10 CFR 55.41(b) reference. See 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 lists theory items. General fundamental knowledge which underlies safe performance on the job is delineated in Section 6 of the ABWR Catalog. These theory topics represent general fundamental concepts related to plant operation. Each theory topic has a numeric identifier. The applicable 10 CFR 55.41(b) reference is provided for Reactor Theory and Thermodynamics Theory fundamental knowledge areas.

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 Process
293005	Thermodynamic Cycles
293006	Fluid Statics

293007 Heat Transfer and Heat Exchangers
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 impact 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 given for Reactor Operators, Senior Reactor Operators, and, as appropriate, for a combined RO/SRO (licensed operator) knowledge next to each knowledge or ability statement in the catalog. These ratings reflect ratings that were derived by concensus of a panel of utility experts. 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

A rating of 2.0 or below represents a statement of limited or insignificant importance for the safe operation of a plant. Such statements are generally not considered as appropriate content for NRC licensing examinations. The use of statements having importance ratings less than 2 can be used on an NRC licensing examination if justified based on plant-specific priorities.

1.14 Rules of Use

To ensure consistency in applying this catalog, the following terms are defined as:

- “Parameter” any characteristic of a system and/or 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.
- 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 A 2 and Generic K/As and fuel handling. Fuel handling is not a RO license activity and will have N/A marked in the RO column.

2.0 GENERIC KNOWLEDGES AND ABILITIES

2.0.1 Knowledge / Ability statements that reference Technical Specifications includes the Short Term Availability Controls, Core Operating Limits Report, and Offsite Dose Calculation Manual.

2.0.2 For Knowledge / Ability statements that reference Technical Specifications, the term "apply" for an RO means to perform the Technical Specifications actions.

2.0.3 Knowledge / Ability statements including 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 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1.2 **Knowledge of operator responsibilities during all modes of plant operation.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1.3 **Knowledge of shift or short-term relief turnover practices.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

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, 10CFR55, etc.**
(CFR: 41.10 / 43.2)
IMPORTANCE RO 3 SRO 4

2.1.5 **Ability to use procedures related to shift staffing, such as minimum crew complement, overtime limitations, etc.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3 SRO 4

2.1.6 **Ability to manage the control room crew during plant transients.**
(CFR: 41.10 / 43.5 / 45.12 / 45.13)
IMPORTANCE RO 4 SRO 5

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 SRO 5

2.1.8 **Ability to coordinate personnel activities outside the control room.**
(CFR: 41.10 / 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3 SRO 4

2.1 Conduct of Operations (continued)

2.1.9 **Ability to direct personnel activities inside the control room.**
(CFR: 41.10 / 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3 SRO 5

2.1.10 **Ability to direct non-licensed personnel activities inside the control room.**
(CFR: 41.10 / 43.5 / 45.9 / 45.10)
IMPORTANCE RO 3 SRO 3

2.1.11 **Knowledge of facility requirements for controlling vital / controlled access.**
(CFR: 41.10 / 43.5 / 45.9 / 45.10)
IMPORTANCE RO 3 SRO 3

2.1.12 **Knowledge of criteria or conditions that require plant-wide announcements, such as pump starts, reactor trips, and mode changes, etc.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3 SRO 3

2.1.13 **Knowledge of administrative requirements for temporary management directives, such as standing orders, night orders, operations memos, etc.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3 SRO 3

2.1.14 **Ability to make accurate, clear, and concise verbal reports.**
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1.15 **Ability to make accurate, clear, and concise logs, records, status boards, and reports.**
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1.16 **Ability to use Visual Display Units and other plant displays to evaluate system or component status.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.17 **Ability to use integrated control systems to operate plant systems or components**
(CFR: 41.10 /45.8 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.18 **Ability to interpret and execute procedure steps.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 5 SRO 5

2.1.19 **Ability to verify that a copy of a controlled procedure is the proper revision.**
(CFR: 41.10 / 45.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1 Conduct of Operations (continued)

2.1.20 **Ability to perform specific system and integrated plant procedures during all modes of plant operation.**
(CFR: 41.10 / 43.5 / 45.2 / 45.6)
IMPORTANCE RO 4 SRO 4

2.1.21 **Ability to interpret reference materials, such as graphs, curves, tables, etc.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.22 **Knowledge of industrial safety procedures such as rotating equipment, electrical, high temperature, high pressure, caustic, chlorine, oxygen and hydrogen, etc.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3 SRO 4

2.1.23 **Knowledge of system purpose and/or function.**
(CFR: 41.7)
IMPORTANCE RO 4 SRO 4

2.1.24 **Knowledge of the purpose and function of major system components and controls.**
(CFR: 41.7)
IMPORTANCE RO 4 SRO 4

2.1.25 **Knowledge of how to conduct system lineups, such as valves, breakers, switches, etc.**
(CFR: 41.10 / 45.1 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.26 **Ability to locate and operate components, including local controls**.
(CFR: 41.7 / 45.7)
IMPORTANCE RO 4 SRO 4

2.1.27 **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 5 SRO 4

2.1.28 **Ability to explain and apply system warnings, cautions, and precautions and limitations.**
(CFR: 41.10 / 43.2 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.29 **Knowledge of reactor coolant system and balance of plant chemistry controls including parameters measured and reasons for the control.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3 SRO 4

2.1 Conduct of Operations (continued)

2.1.30 **Knowledge of the fuel-handling responsibilities of Senior Reactor Operators such as assessment of fuel handling equipment surveillance requirement acceptance criteria, prerequisites for vessel disassembly and reassembly, decay heat assessment, assessment of surveillance requirement for the refueling mode, etc.**
(CFR: 41.10 / 43.7)
IMPORTANCE RO N/A SRO 4

2.1.31 **Knowledge of procedures and limitations involved in core alterations.**
(CFR: 41.10 / 43.6 / 45.7)
IMPORTANCE RO 3 SRO 4

2.1.32 **Knowledge of procedures, guidelines, or limitations associated with reactivity management.**
(CFR: 41.1 / 43.6 / 45.6)
IMPORTANCE RO 4 SRO 5

2.1.33 **Knowledge of the station's requirements for verbal communications when implementing procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.1.34 **Knowledge of conservative decision making practices.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1.35 **Knowledge of refueling administrative requirements such as approvals required to amend core loading sheets, etc.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.1.36 **Knowledge of the refueling process.**
(CFR: 41.2 / 41.10 / 43.6 / 45.13)
IMPORTANCE RO 3 SRO 4

2.1.37 **Knowledge of new and spent fuel movement procedures.**
(CFR: 41.10 / 43.7 / 45.13)
IMPORTANCE RO 3 SRO 3

2.1.38 **Ability to use procedures to determine the effects on reactivity of plant changes, such as reactor coolant system temperature, balance of plant, fuel depletion, etc.**
(CFR: 41.10 / 43.6 / 45.6)
IMPORTANCE RO 4 SRO 4

2.1.39 **Knowledge of Reactor Operator duties in the control room during fuel handling such as responding to alarms from the fuel handling area, communications with the refueling floor, systems operated from the control room in support of fueling operations, and supporting instrumentation.**
(CFR: 41.10 / 43.7 / 45.12)
IMPORTANCE RO 4 SRO 4

2.1 Conduct of Operations (continued)

2.1.40 **Ability to identify and interpret diverse indications to validate the response of another indication.**
(CFR: 41.7 / 43.5 / 45.4)
IMPORTANCE RO 4 SRO 4

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 SRO 4

2.2.2 **Ability to manipulate the controls as required to operate the facility between shutdown and designated power levels.**
(CFR: 41.6 / 41.7 / 45.2)
IMPORTANCE RO 5 SRO 4

2.2.3 (multi-unit license) **Knowledge of the design, procedural, and operational differences between units.**
(CFR: 41.5 / 41.6 / 41.7 / 41.10 / 45.12)
IMPORTANCE RO 4 SRO 4

2.2.4 (multi-unit license) **Ability to explain the variations in control station/control room layouts, systems, instrumentation, and procedural actions between units at a facility.**
(CFR: 41.6 / 41.7 / 41.10 / 45.1 / 45.13)
IMPORTANCE RO 4 SRO 4

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 process for temporary modifications, administrative processes for disabling annunciators, administrative processes for the installation of temporary instrumentation, etc.**
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 2 SRO 3

2.2.6 **Knowledge of the process for making changes to procedures.**
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 3 SRO 4

2.2.7 **Knowledge of the process for conducting special or infrequently performed tests or evolutions.**
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 3 SRO 4

2.2.8 **Knowledge of surveillance procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.2.9 **Knowledge of tagging and clearance procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.2.10 **Knowledge of the process for controlling equipment configuration or status**.
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 4 SRO 4

2.2 Equipment Control (continued)

2.2.11 **Ability to determine the expected plant configuration using design and configuration control documentation, such as drawings, line-ups, tag-outs, etc.**
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 4 SRO 4

2.2.12 **Knowledge of the process for managing maintenance activities during power operations, such as risk assessments, work prioritization, and coordination with the transmission system operator, etc.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.2.13 **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 3 SRO 4

2.2.14 **Knowledge of maintenance work order requirements.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2 SRO 3

2.2.15 **Knowledge of the process for managing troubleshooting activities.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.2.16 **Knowledge of pre- and post-maintenance operability requirements.**
(CFR: 41.10 / 43.2)
IMPORTANCE RO 3 SRO 4

2.2.17 **Knowledge of limiting conditions for operations and safety limits.**
(CFR: 41.5 / 43.2 / 45.2)
IMPORTANCE RO 4 SRO 5

2.2.18 **Ability to track Technical Specification limiting conditions for operations.**
(CFR: 41.10 / 43.2 / 45.13)
IMPORTANCE RO 3 SRO 5

2.2.19 **Knowledge of the bases in Technical Specifications for limiting conditions for operations and safety limits.**
(CFR: 41.5 / 41.7 / 43.2)
IMPORTANCE RO N/A SRO 5

2.2.20 **Ability to determine Technical Specification Mode of Operation.**
(CFR: 41.7 / 41.10 / 43.2 / 45.13)
IMPORTANCE RO 4 SRO 5

2.2 Equipment Control (continued)

2.2.21 **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 SRO 4

2.2.22 **Ability to determine operability and/or availability of safety related equipment.**
(CFR: 41.7 / 43.5 / 45.12)
IMPORTANCE RO N/A SRO 5

2.2.23 **Knowledge of conditions and limitations in the facility license such as reporting requirements when the maximum licensed thermal power output is exceeded, administration of fire protection program requirements such as compensatory actions associated with inoperable sprinkler systems or fire doors, processes for Technical Specification or FSAR changes, the required actions associated for not meeting administrative controls listed in Technical Specification Section 5, etc**
(CFR: 41.7 / 41.10 / 43.1 / 45.13)
IMPORTANCE RO 2 SRO 5

2.2.24 **Knowledge of less than or equal to one hour Technical Specification action statements.** (This Knowledge / Ability statement 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 4 SRO 5

2.2.25 **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

2.2.26 **Ability to determine and/or interpret Technical Specifications with action statements of greater than one hour.**
(CFR: 43.2 / 43.5 / 45.3)
IMPORTANCE RO N/A SRO 4.7

2.2.27 **Ability to apply Technical Specifications for a system, such as application of Required Actions and Surveillance Requirements in accordance with rules of application requirements, application of generic Limiting Condition for Operation (LCO) requirements (LCO 3.01 thru 3.0.7 and SR 3.01 thru 3.04), etc..**
(CFR: 41.10 / 43.2 / 43.5 / 45.3)
IMPORTANCE RO N/A SRO 5

2.2.28 **Ability to obtain and interpret station electrical and mechanical drawings.**
(CFR: 41.10 / 45.12 / 45.13)
IMPORTANCE RO 4 SRO 4

2.2 Equipment Control (continued)

2.2.29 **Ability to recognize system parameters that are Technical Specifications entry-level conditions.**
(CFR: 41.7 / 41.10 / 43.2 / 43.3 / 45.3)
IMPORTANCE RO 4 SRO 5

2.2.30 **Knowledge of the process used to track inoperable alarms.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 3

2.2.31 **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 SRO 4

2.3 Radiation Control

2.3.1 **Knowledge of radiation exposure limits under normal or emergency conditions.**
(CFR: 41.12 / 43.4 / 45.10)
IMPORTANCE RO 3 SRO 4

2.3.2 **Ability to use radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc.**
(CFR: 41.11 / 41.12 / 43.4 / 45.9)
IMPORTANCE RO 3 SRO 3

2.3.3 **Ability to approve liquid release permits.**
(CFR: 41.13 / 43.4 / 45.10)
IMPORTANCE RO N/A SRO 4

2.3.4 **Ability to comply with radiation work permit requirements during normal or abnormal conditions.**
(CFR: 41.12 / 45.10)
IMPORTANCE RO 4 SRO 4

2.3.5 **Knowledge of plant operational thresholds which requires radiation protection personnel to be informed such as plant mode changes, large power changes, radiological alarms, dosimeter alarms, etc.**
(CFR 41.12/43.4/45.10
IMPORTANCE RO 3 SRO 4

2.3.6 **Ability to control radiation releases.**
(CFR: 41.11 / 43.4 / 45.10)
IMPORTANCE RO 4 SRO 4

2.3.7 **Knowledge of radiological safety principles pertaining to licensed operator duties, such as containment entry requirements, fuel handling responsibilities, access to locked high-radiation areas, aligning filters, etc**.
(CFR: 41.12 / 45.9 / 45.10)
IMPORTANCE RO 3 SRO 4

2.3.8 **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, aligning filters, etc.**
(CFR: 41.12 / 43.4 / 45.9 / 45.10)
IMPORTANCE RO 3 SRO 4

2.3 Radiation Control (continued)

2.3.9 **Knowledge of radiation or contamination hazards that may arise during normal, abnormal, or emergency conditions or activities such as analysis and interpretation of radiation and activity readings as they pertain to selection of administrative, normal, abnormal, and emergency procedures, analysis and interpretation of coolant activity, including comparison to emergency plan/or regulatory limits.**
(CFR: 41.12 / 43.4 / 45.10)
IMPORTANCE RO 3 SRO 4

2.3.10 **Knowledge of radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc.**
(CFR: 41.12 / 43.4 / 45.9)
IMPORTANCE RO 3 SRO 3

2.4 Emergency Procedures / Emergency Plan

2.4.1 **Knowledge of Emergency / Abnormal Operating Procedure entry conditions.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 5 SRO 5

2.4.2 **Knowledge of system set points associated with Emergency / Abnormal Operating Procedure entry conditions.**
(CFR: 41.7 / 45.7 / 45.8)
IMPORTANCE RO 5 SRO 5

2.4.3 **Ability to identify post-accident instrumentation.**
(CFR: 41.6 / 45.4)
IMPORTANCE RO 4 SRO 4

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 5 SRO 5

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 4 SRO 4

2.4.6 **Knowledge of Emergency / Abnormal Operating Procedure mitigation strategies.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 5

2.4.7 **Knowledge of how abnormal operating procedures are used in conjunction with Emergency Operating Procedures.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 5

2.4.8 **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 4 SRO 4

2.4.9 **Knowledge of crew responsibilities during emergency / abnormal operations.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 4 SRO 4

2.4.10 **Knowledge of crew roles and responsibilities during Emergency / Abnormal Operating Procedure usage.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 4 SRO 5

2.4 Emergency Procedures / Emergency Plan (continued)

2.4.11 **Knowledge of general guidelines for Emergency / Abnormal Operating Procedure usage.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 5

2.4.12 **Knowledge of Emergency / Abnormal Operating Procedure implementation hierarchy and coordination with other support procedures or guidelines such as, operating procedures, abnormal operating procedures, and severe accident management guidelines, etc.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 4

2.4.13 **Knowledge of Emergency / Abnormal Operating Procedure terms and definitions.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 4 SRO 4

2.4.14 **Knowledge of the specific bases for Emergency / Abnormal Operating Procedures**.
(CFR: 41.10 / 43.1 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.15 **Knowledge of Emergency / Abnormal Operating Procedure layout, symbols, and icons.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.16 **Knowledge of the operational implications of Emergency / Abnormal Operating Procedure warnings, cautions, and notes.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 4

2.4.17 **Knowledge of the parameters and logic used to assess the status of Emergency / Abnormal Operating Procedure key parameters to ensure reactivity control, core cooling and heat removal, reactor coolant system integrity, containment conditions, radioactivity release control, etc.**
(CFR: 41.7 / 43.5 / 45.12)
IMPORTANCE RO 4 SRO 5

2.4.18 **Knowledge of the bases for prioritizing actions during emergency / abnormal operations.**
(CFR: 41.7 / 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4 SRO 4

2.4.19 **Knowledge of the bases for prioritizing emergency operating procedure implementation.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4 Emergency Procedures / Emergency Plan (continued)

2.4.20 **Knowledge of emergency operating procedure exit conditions such as an emergency condition no longer exists or severe accident guideline entry is required, etc.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.21 **Knowledge of fire protection procedures.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.22 **Knowledge of facility protection requirements, including fire brigade and portable firefighting equipment usage.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 3 SRO 4

2.4.23 **Knowledge of procedures relating to a security event (non-safeguards information).**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.24 **Knowledge of the emergency plan including emergency plan implementing procedures.**
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO 3 SRO 4

2.4.25 **Knowledge of events related to system operation/status that must be reported to internal organizations or external agencies, such as the State, the NRC, or the transmission system operator.**
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO 3 SRO 4

2.4.26 **Knowledge of annunciator alarms, indications, or response procedures**.
(CFR: 41.10 / 45.3)
IMPORTANCE RO 4 SRO 4

2.4.27 **Knowledge of operator response to a loss of all annunciators**.
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 4

2.4.28 **Knowledge of Reactor Operator 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 SRO 4

2.4.29 **Knowledge of non-license operator tasks during an emergency and the resultant operational effects.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4 SRO 4

2.4 Emergency Procedures / Emergency Plan (continued)

2.4.30 **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 SRO 4

2.4.31 **Ability to take actions called for in the facility emergency plan and emergency plan implementing procedures, including supporting or acting as emergency coordinator if required**.
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO N/A SRO 4

2.4.32 **Knowledge of Reactor Operator responsibilities in emergency plan implementation.**
(CFR: 41.10 / 45.11)
IMPORTANCE RO 4 SRO 4

2.4.33 **Knowledge of Senior Reactor Operator responsibilities in emergency plan implementation**.
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO N/A SRO 5

2.4.34 **Knowledge of the emergency action level thresholds and classifications.**
(CFR: 41.10 / 43.5 / 45.11)
IMPORTANCE RO N/A SRO 5

2.4.35 **Knowledge of emergency response facilities.**
(CFR: 41.10 / 45.11)
IMPORTANCE RO 3 SRO 4

2.4.36 **Knowledge of emergency communications systems and techniques.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3 SRO 4

2.4.37 **Knowledge of emergency plan protective action recommendations.**
(CFR: 41.10 / 41.12 / 43.5 / 45.11)
IMPORTANCE RO N/A SRO 4

2.4.38 **Ability to prioritize and interpret the significance of each annunciator or alarm.**
(CFR: 41.10 / 43.5 / 45.3 / 45.12)
IMPORTANCE RO 4 SRO 4

2.4.39 **Ability to verify that the alarms are consistent with the plant conditions.**
(CFR: 41.10 / 43.5 / 45.3 / 45.12)
IMPORTANCE RO 4 SRO 4

2.4 Emergency Procedures / Emergency Plan (continued)

2.4.40 **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 SRO 4

2.4.41 **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 5 SRO 4

2.4.42 **Ability to verify system alarm setpoints and operate controls identified in the alarm response manual.**
(CFR: 41.10 / 43.5 / 45.3)
IMPORTANCE RO 4 SRO 4

3.0 PLANT SYSTEMS

3.1 Safety Function 1: Reactivity Control

System: **SF1CRD Control Rod Drive System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between Control Rod Drive System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Condensate, feedwater and condensate air extraction system	3
K1.02	Makeup water condensate system	3
K1.03	Feedwater system - control rod drive system return to vessel	3
K1.04	Reactor building cooling water system	3
K1.05	Reactor trip and isolation system	3
K1.06	Instrument air system	3
K1.07	Rod control and information system	3
K1.08	Plant information and control system	2
K1.09	Reactor recirculation system	3
K1.10	AC electrical power distribution system	3
K1.11	Drywell cooling system	2
K1.12	Heating, ventilation, and air conditioning system	2
K1.13	Reactor pressure vessel system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Control rod drive pumps	3
K2.02	Scram valve solenoids	2
K2.03	Backup scram valve solenoids	4
K2.04	Alternate rod insertion valve solenoids	4
K 3	**Knowledge of the effect that a loss or malfunction of the Control Rod Drive System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor internal pumps	3
K3.02	Reactor water level	3
K3.03	Fine motion control rod drive mechanisms	3
K3.04	Reactor water cleanup pumps	3

3.1 Safety Function 1: Reactivity Control

System: SF1CRD Control Rod Drive System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Control Rod Drive System design feature(s) and/or interlocks which provide for the following:** (CFR 41.7)	
K4.01	Protection against pump runout during scram conditions (location of the control rod drive system flow element and a restricting orifice in the accumulator charging water line)	3
K4.02	Fine motion control rod drive mechanisms purge water flow	3
K4.03	Scramming control rods with inoperative scram solenoid valves (back-up scram valves)	4
K4.04	Control rod scram	4
K4.05	Controlling purge water flow during fine motion control rod drive mechanisms insertion	3
K4.06	Controlling control rod drive system flow	3
K4.07	Motor cooling	2
K4.08	Auto start of standby control rod drive pump due to low pump discharge pressure	3
K4.09	Auto stop of running control rod drive pump due to low pump suction pressure	3
K4.10	Auto stop of running control rod drive pump due to low lube oil pressure	3
K4.11	Auto start of lube oil pump during control rod drive pump running due to low lube oil pressure	3
K4.12	Controlling control rod drive pump discharge water temperature (minimum flow bypass valve)	2
K 5	**Knowledge of the operational implications of the following concepts or cause and effect relationships as they apply to Control Rod Drive System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor internal pumps purge water	3
K5.02	Fine motion control rod drive mechanisms	3
K5.03	Reactor water cleanup pump purge water	3
K5.04	Fine motion control rod drive purge water header	3

3.1 Safety Function 1: Reactivity Control

System: SF1CRD Control Rod Drive System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Control Rod Drive System:** (CFR: 41.7 / 45.7)		
K6.01	Condensate system	3	
K6.02	Condensate storage tank~~s~~	3	
K6.03	Plant information and control system	3	
K6.04	Instrument air system	3	
K6.05	Reactor trip and isolation system	4	
K6.06	AC electrical power distribution system	3	
K6.07	Reactor building cooling water system	3	
K6.08	Rod control and information system	3	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Control Rod Drive System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Control rod drive system flow	3	
A1.02	Hydraulic control unit pressure/level	3	
A1.03	Reactor water level	3	
A1.04	Pump amps	2	
A1.05	Fine motion control rod drive mechanisms purge water flow	3	
A1.06	Fine motion control rod drive mechanisms purge water to reactor differential pressure	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Control Rod Drive System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.5)		
		RO	**SRO**
A2.01	Pumps trips	3	3
A2.02	Valve closures	3	3
A2.03	Power supply failures	3	3
A2.04	Scram conditions	4	4
A2.05	Discharge filter becoming plugged	3	3
A2 06	Suction filter becoming plugged	3	3
A2.07	Flow control valve failure	3	3
A2.08	Inadequate system flow	3	3
A2.09	Loss of applicable plant air systems	3	3
A2.10	Low hydraulic control unit accumulator pressure/high level	4	4
A2.11	Valve openings	3	3
A2.12	Low fine motion control rod drive mechanisms purge water flow	3	3

3.1 Safety Function 1: Reactivity Control

System: SF1CRD Control Rod Drive System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Control Rod Drive System including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	3
A3.02	Pump start	3
A3.03	System pressure	3
A3.04	System flow	3
A3.05	Reactor water level	3
A3.06	Reactor power	3
A3.07	HCU accumulator pressure/level	3
A3.08	Fine motion control rod drive mechanisms purge water flow	3
A3.09	Indications and alarms	3
A3.10	Fine motion control rod drive mechanisms purge water to reactor differential pressure	3
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Control rod drive pumps	3
A4.02	Control rod drive system flow control valve	3

3.1 Safety Function 1: Reactivity Control

System: SF1FMCRD Fine Motion Control Rod Drive Mechanism

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Fine Motion Control Rod Drive Mechanism and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Control rod drive system	3
K1.02	Rod control and information system	3
K1.03	Reactor pressure vessel system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Fine motion control rod drive mechanism motor	3
K 3	**Knowledge of the effect that a loss or malfunction of the Fine Motion Control Rod Drive Mechanism will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor power	3
K3.02	Flux shaping	3
K3.03	Shutdown margin	4
K 4	**Knowledge of Fine Motion Control Rod Drive Mechanism design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Rod drop prevention function (fine motion control rod drive latches and rod block signal)	4
K4.02	Rod ejection accident prevention (fine motion control rod drive brake)	3
K4.03	Detection of an uncoupled rod	4
K4.04	Slowing the drive mechanism near the end of its travel following a scram	2
K4.05	The use of accumulator to scram the control rod	4
K4.06	Rod position indication	3
K4.07	Uncoupling the control rod from the drive mechanism	3
K4.08	Maintaining the control rod at a given location	3
K4.09	The use of fine motion control rod drive motor to auto insert control rod upon failure to insert hydraulically on a scram signal	4
K4.10	Detection of control rod drift	4

3.1 Safety Function 1: Reactivity Control

System: SF1FMCRD Fine Motion Control Rod Drive Mechanism (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Fine Motion Control Rod Drive Mechanism:** (CFR: 41.5 / 45.3)	
K5.01	Reactor pressure vessel water level	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Fine Motion Control Rod Drive Mechanism:** (CFR: 41.7 / 45.7)	
K6.01	Control rod drive system	3
K6.02	Loss of power to fine motion control rod drive motor	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Fine Motion Control Rod Drive Mechanism controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor power	4
A1.02	Control rod position	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Fine Motion Control Rod Drive Mechanism; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Stuck rod	3	4
A2.02	Uncoupled rod	4	4
A2.03	Drifting rod	3	4
A2.04	Control rod pair scram	4	4
A2.05	Reactor scram	4	4
A2.06	Loss of fine motion control rod drive charging water flow	3	3
A2.07	Loss of fine motion control rod drive purge water flow	3	3
A2.08	Low hydraulic control unit accumulator pressure/high water level	4	4
A2.09	Excessive scram time for a given drive mechanism	3	4

3.1 Safety Function 1: Reactivity Control

System: **SF1FMCRD Fine Motion Control Rod Drive Mechanism (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Fine Motion Control Rod Drive Mechanism including:** (CFR: 41.7 / 45.7)	
A3.01	Fine motion control rod position	4
A3.02	Control rod position following a scram	4
A 4	**Ability to manually operate and/or monitor the Fine Motion Control Rod Drive Mechanism in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
	None	

3.1	**Safety Function 1: Reactivity Control**	
System:	**SF1RFC Recirculation Flow Control System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Recirculation Flow Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor recirculation system	4
K1.02	Steam bypass and pressure control system	3
K1.03	AC electrical power distribution system	3
K1.04	Neutron monitoring system	3
K1.05	Rod control and information system	3
K1.06	Automatic power regulator system	3
K1.07	Feedwater control system	3
K1.08	Reactor trip and isolation system	3
K1.09	Control rod drive system	4
K1.10	Plant information and control system	3
K1.11	Reactor water cleanup system	3
K1.12	Engineered Safety Function logic and control system	4
K1.13	Reactor pressure vessel instrumentation system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor internal pump adjustable speed drives	3
K2.02	Reactor internal pump motor generator sets	3
K 3	**Knowledge of the effect that a loss or malfunction of the will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Core flow	4
K3.02	Reactor power	4
K3.03	Reactor water level	3
K3.04	Reactor internal pump speed	3

3.1	**Safety Function 1: Reactivity Control**	
System:	**SF1RFC Recirculation Flow Control System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 4	**Knowledge of Recirculation Flow Control System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Reactor internal pump speed control	3
K4.02	Signal failure detection	3
K4.03	Automatic load following	2
K4.04	Minimum and maximum pump speed setpoints	3
K4.05	Normal reactor internal pump speed runback	3
K4.06	Fast reactor internal pump speed runback	3
K4.07	Selected control rod run in	3
K4.08	Recirculation pump trip	3
K4.09	Reactor internal pump response to a momentary reactor internal pump -adjustable speed drive voltage drop	2
K4.10	Prevention of reactor internal pump speed increase for various core flow and/or reactor power conditions	3
K4.11	Prevention of reactor internal pump speed increase due to automated thermal limit monitor trip	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to the Recirculation Flow Control System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor power	4
K5.02	Reactor core flow	4
K5.03	Reactor internal pump MG set	4
K5.04	Feedwater flow	3
K5.05	Reactor water level	3
K5.06	Rod pattern	3
K5.07	Reactor internal pump-adjustable speed drives	3
K5.08	Technician interface unit	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Recirculation Flow Control System:** (CFR: 41.7 / 45.7)	
K6.01	Electrical power distribution system	3
K6.02	Recirculation system	3
K6.03	Feedwater control system	4
K6.04	Low reactor water level	3
K6.05	Neutron monitoring signal input	4
K6.06	Automatic power regulator system	4

3.1 Safety Function 1: Reactivity Control

System: SF1RFC Recirculation Flow Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE	
K6.07	Steam bypass and pressure control system	3	
K6.08	Reactor trip and isolation system	3	
K6.09	Reactor pressure vessel instrumentation	3	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Recirculation Flow Control System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor internal pump speed	3	
A1.02	MG set drive motor amps	3	
A1.03	MG set generator current, power, voltage	2	
A1.04	Reactor water level	3	
A1.05	Reactor power	4	
A1.06	Reactor core flow	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Recirculation Flow Control System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Reactor internal pump-adjustable speed drives trip	3	3
A2.02	Reactor internal pump-adjustable speed drives normal or fast speed runback	3	3
A2.03	Loss of AC electrical power distribution system	3	3
A2.04	Low reactor water level	3	3
A2.05	Loss of feedwater signal inputs	3	3
A 3	**Ability to monitor automatic operations of the Recirculation Flow Control System including:** (CFR: 41.7 / 45.7)		
A3.01	Indications and alarms	3	
A3.02	Reactor internal pump speed	3	

3.1 Safety Function 1: Reactivity Control

System: SF1RFC Recirculation Flow Control System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Recirculation Flow Control System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	MG sets	3
A4.02	Adjustable speed drives	3
A4.03	Indications and alarms	3
A4.04	Reactor internal pumps speed	3

3.1 Safety Function 1: Reactivity Control

System: SF1RRS Reactor Recirculation System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Recirculation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor building cooling water system	3
K1.02	AC electrical power distribution system	3
K1.03	Control rod drive system	3
K1.04	Recirculation flow control system	4
K1.05	Plant information and control system	3
K1.06	Makeup water purified system	2
K1.07	Reactor pressure vessel system	3
K1.08	Radioactive drain transfer system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor internal pumps	3
K2.02	Recirculation system MG sets	3
K2.03	Motor generator set oil pumps	2
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Recirculation System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Core flow	4
K3.02	Load following capabilities	3
K3.03	Reactor power	4
K3.04	Reactor water level	4
K3.05	Reactor recirculation system motor generator sets	3
K3.06	Vessel bottom head drain temperature	3
K3.07	Primary containment integrity	3

3.1 Safety Function 1: Reactivity Control

System: SF1RRS Reactor Recirculation System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Reactor Recirculation System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Adequate reactor internal pump NPSH	3
K4.02	Reactor internal pump motor cooling	3
K4.03	Controlled purge flow	3
K4.04	Automatic voltage/frequency regulation	3
K4.05	Motor generator set trips	3
K4.06	Pump minimum flow limit	3
K4.07	Pump start permissives	3
K4.08	Minimization of reactor vessel bottom head temperature gradients	3
K4.09	End of cycle recirculation pump trip	4
K4.10	Anticipated Transient without scram - Recirc pump trip	4
K4.11	Selected control rods run in circuitry	4
K4.12	Reactor internal pump-runback	4
K4.13	Reactor internal pump startup	3
K4.14	Automatic MG set start sequencing	3
K4.15	Core flow rapid reduction logic	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to the Reactor Recirculation System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor internal pump vibration characteristics	2
K5.02	Restart of reactor internal pumps while operating at power	3
K5.03	Core flow	4
K5.04	Reactor power	4
K5.05	Reactor moderator temperature	3
K5.06	Reactor pressure	3
K5.07	Recirculation flow control system motor-generator sets	4
K5.08	Nuclear boiler instrumentation (reactor water level/pressure/core plate d/p)	3
K5.09	Vessel bottom head drain temperature	3
K5.10	Residual heat removal shutdown cooling mode	3
K5.11	Reactor water level	4
K5.12	Anticipated transient without scram circuitry	4
K5.13	End-of-cycle recirculation pump trip circuitry	4
K5.14	Selected control rods run in circuitry	4
K5.15	Recirculation motor inflatable shaft seal subsystem	2
K5.16	Recirculation motor cooling subsystem	3
K5.17	Reactor internal pump adjustable speed drives	3

3.1	**Safety Function 1: Reactivity Control**	
System:	**SF1RRS Reactor Recirculation System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Recirculation System:** (CFR: 41.7 / 45.7)	
K6.01	Reactor building cooling water systems	3
K6.02	AC electrical power distribution system	3
K6.03	Control rod drive system	3
K6.04	Recirculation system motor-generator sets	3
K6.05	Low reactor water level	3
K6.06	Recirculation motor inflatable shaft seal subsystem	3
K6.07	Makeup water purified system	2
K6.08	Reactor internal pump motor cooling subsystem	3
K6.09	Turbine trip/load rejection	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Recirculation System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor internal pump flow	4
A1.02	Core flow	4
A1.03	Reactor water level	3
A1.04	Reactor power	4
A1.05	Reactor internal pump motor amps	3
A1.06	Reactor internal pump speed	3
A1.07	Recirculation cooling water flow	3
A1.08	Vessel bottom head drain temperature	3
A1.09	Reactor internal pump differential pressure	3
A1.10	Reactor internal pump motor temperature	2
A1.11	Reactor internal pump MG set temperatures	2
A1.12	Reactor internal pump MG drive motor amps	2
A1.13	Reactor internal pump MG set generator current, power, voltage	2
A1.14	Reactor internal pump motor purge flow	3
A1.15	Reactor internal pump vibration	2
A1.16	Core differential pressure	3

3.1	**Safety Function 1: Reactivity Control**
System:	**SF1RRS Reactor Recirculation System (continued)**

K/A NO.	**ABILITY**	**IMPORTANCE**	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Recirculation System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Recirculation system leak	4	4
A2.02	Single reactor internal pump trip	4	4
A2.03	Multiple-reactor internal pump trip	4	4
A2.04	Inadvertent recirculation flow increase	4	4
A2.05	Inadvertent recirculation flow decrease	4	4
A2.06	Reactor internal pump speed mismatch	3	3
A2.07	Reactor internal pump flow mismatch	3	3
A2.08	Low reactor water level	4	4
A2.09	Loss of reactor feedwater	4	4
A2.10	High reactor pressure (ATWS circuitry initiation)	4	4
A2.11	End of cycle recirculation pump trip circuitry initiation	4	4
A2.12	Selected control rods run in circuitry actuation	4	4
A2.13	Loss of motor cooling	3	3
A2.14	Loss of AC power	3	3
A2.15	Loss of reactor building cooling water	3	3
A2.16	Incomplete start sequence	3	3
A2.17	Loss of reactor internal pump purge flow	3	3
A2.18	Reactor internal pump speed runback	3	3
A2.19	Increase in reactor internal pump vibration	2	2
A 3	**Ability to monitor automatic operations of the Reactor Recirculation System including:** (CFR: 41.7 / 45.7)		
A3.01	Pump/MG set start sequence	3	
A3.02	System flow	3	
A3.03	Indications and alarms	3	
A3.04	Pump speed	3	
A3.05	Reactor internal pump trips	3	
A3.06	Reactor internal pump runbacks	3	
A3.07	Recirculation system motor generator set trip	3	
A 4	**Ability to manually operate and/or monitor the Reactor Recirculation System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Reactor internal pumps	4	
A4.02	System flow	4	
A4.03	Core flow	4	

3.1 Safety Function 1: Reactivity Control

System: SF1RCIS Rod Control and Information System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Rod Control and Information System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Neutron monitoring system	3
K1.02	Control rod drive system	4
K1.03	Recirculation flow control system	3
K1.04	Reactor trip and isolation system	3
K1.05	Plant information and control system	3
K1.06	Automatic power regulator system	3
K1.07	Refueling equipment	3
K1.08	AC electrical power distribution system	2
K1.09	Vital AC power supply system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	RCIS redundant controllers	2
K2.02	Stepping motor driver modules	3
K2.03	Rod brake controller cabinets	3
K 3	**Knowledge of the effect that a loss or malfunction of the Rod Control and Information System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor startup	4
K3.02	Reactor shutdown	3
K3.03	Flux shaping	3
K3.04	Recirculation flow control system	3
K3.05	Refueling equipment	3
K3.06	Automatic power regulator system	3
K3.07	Control rod drive system	4
K3.08	Reactor trip and isolation system	3
K 4	**Knowledge of Rod Control and Information System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Limiting the effects of a control rod accident	3
K4.02	Rod withdrawal block signals	4
K4.03	Rod insertion block signals	4
K4.04	Automatic control rod run-in following a scram	3

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.05	Insertion of selected control rods for core thermal-hydraulic stability control or loss of feedwater heating event	3
K4.06	Alternate control rod insertion on a failure to scram (control rod run-in on ARI)	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Rod Control and Information System:** (CFR: 41.5 / 45.3)	
K5.01	Ganged rod withdrawal sequence	3
K5.02	Rod gangs	2
K5.03	Fine motion control rod drive mechanism	4
K5.04	Target rod pattern	3
K5.05	Low power setpoint	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Rod Control and Information System:** (CFR: 41.7 / 45.7)	
K6.01	Rod position signal	3
K6.02	AC electrical power distribution system	3
K6.03	Reactor trip and isolation system	3
K6.04	Plant information and control system	3
K6.05	Neutron monitoring system	3
K6.06	Automatic power regulator system	3
K6.07	Vital AC power supply system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Rod Control and Information System controls including:** (CFR: 41.5 / 45.5)	
A1.01	First stage shell pressure/turbine load	3
A1.02	Reactor power	3
A1.03	Reactor water temperature	2

3.1 Safety Function 1: Reactivity Control

System: SF1RCIS Rod Control and Information System (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	High flux (neutron monitoring)	4	4
A2.02	Position indication failure	3	3
A2.03	Insert block	3	3
A2.04	Withdraw block	3	3
A2.05	Local Power Range Monitor upscale/down scale	3	3
A2.06	Accumulator fault	3	4
A2.07	Rod uncoupled	4	4
A2.08	Rod drift	4	4
A2.09	Emergency rod insertion (SCRRI, ARI, or scram-follow)	4	4
A2.10	Rod misalignment	3	3
A 3	**Ability to monitor automatic operations of the Rod Control and Information System including:** (CFR: 41.7 / 45.7)		
A3.01	Dedicated operator interface indications	4	
A3.02	Rod display module indications	4	
A3.03	Verification of proper functioning/operability	3	
A3.04	Annunciator and alarm signals	3	
A3.05	Emergency rod insertion (ARI, SCCRI, scram follow function)	4	
A3.06	Rod movement in automatic mode (step/notch/continuous)	3	
A3.07	Automatic self-bypass of RCIS protective features (Rod Worth Minimizer System and Automated Thermal Limit Monitoring System)	3	
A 4	**Ability to manually operate and/or monitor the Rod Control and Information System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Dedicated operator interface (switches or screen manipulations)	4	
A4.02	Back panel switches or screens	3	
A4.03	Initiation of SCRRI	3	
A4.04	Control rods in semi-automatic or manual mode step/notch/continuous)	3	
A4.05	Bypassing an inoperable control rod	3	
A4.06	Bypassing a single channel of RCIS	3	

3.1 Safety Function 1: Reactivity Control

System: SF1SLC Standby Liquid Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Standby Liquid Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Service air system	3
K1.02	Makeup water purified system	3
K1.03	Reactor pressure vessel system	4
K1.04	High pressure core flooder system	4
K1.05	Engineered Safety Function logic and control system	3
K1.06	Leak detection and isolation system	3
K1.07	Sampling system	2
K1.08	Neutron monitoring system	3
K1.09	AC electrical power distribution system	2
K1.10	Post accident monitoring system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Standby liquid control storage tank outlet valve	3
K2.02	Standby liquid control pumps	3
K2.03	Standby liquid control injection motor operated valves	3
K2.04	SLC tank heater power	2
K2.05	Standby liquid control lubricating pump	2
K 3	**Knowledge of the effect that a loss or malfunction of the Standby Liquid Control System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Ability to shutdown the reactor in certain conditions	4
K 4	**Knowledge of Standby Liquid Control System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Zero leakage to the reactor (demineralized water)	3
K4.02	Component and system testing	3
K4.03	Keeping sodium pentaborate in solution	4
K4.04	Dispersal of boron upon injection into the vessel	3
K4.05	Reactor water cleanup system isolation	4
K4.06	System initiation upon operation of SLC controls	4
K4.07	Over pressure protection	3
K4.08	Automatic standby liquid control system initiation	4

3.1	**Safety Function 1: Reactivity Control**	
System:	**SF1SLC Standby Liquid Control System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications and/or cause-effect relationships as they apply to Standby Liquid Control System:** (CFR: 41.5 / 45.3)	
K5.01	Effects of the moderator temperature coefficient of reactivity on the boron	3
K5.02	Chugging (as it pertains to boron mixing)	3
K5.03	Shutdown margin	3
K5.04	Tank heater operation	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Standby Liquid Control System:** (CFR: 41.7 / 45.7)	
K6.01	Service air system	2
K6.02	Makeup water purified system	3
K6.03	AC electrical power distribution system	3
K6.04	High pressure core flooder system	3
K6.05	Engineered Safety Function logic and control system	3
K6.06	Neutron monitoring system	3
K6.07	Leak detection and isolation system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Standby Liquid Control System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Tank level	4
A1.02	Pump discharge pressure	4
A1.03	Valve operations	4
A1.04	Pump amps	3
A1.05	Reactor power	4
A1.06	Reactor water cleanup system lineup	4
A1.07	Standby liquid control system lineup	4
A1.08	Indications and alarms	4

3.1	**Safety Function 1: Reactivity Control**		
System:	**SF1SLC Standby Liquid Control System (continued)**		
K/A NO.	**ABILITY**	**IMPORTANCE**	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Standby Liquid Control System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Standby liquid control pump trip	4	4
A2.02	AC electrical power failures	3	3
A2.03	Inadequate system flow	3	3
A2.04	Loss of standby liquid control tank heaters	3	3
A2.05	Failure to scram	4	4
A 3	**Ability to monitor automatic operations of the Standby Liquid Control System including:** (CFR: 41.7 / 45.7)		
A3.01	Pump discharge pressure	4	
A3.02	Tank level	4	
A3.03	Injection valve indications	4	
A3.04	Reactor power	4	
A3.05	Reactor water cleanup system isolation	4	
A3.06	Indications and alarms	4	
A3.07	System initiation	4	
A 4	**Ability to manually operate and/or monitor Standby Liquid Control System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Standby liquid control system controls	4	
A4.02	Reactor water cleanup system isolation	4	
A4.03	System initiation	4	

3.2 Safety function 2: Reactor Water Inventory Control

System: **SF2HPCF High Pressure Core Flooder System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the High Pressure Core Flooder System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Makeup water condensate system	3
K1.02	Standby liquid control system	3
K1.03	Suppression pool cleanup system	2
K1.04	Reactor building cooling water system	2
K1.05	Reactor pressure vessel system	4
K1.06	High pressure nitrogen gas supply system	2
K1.07	Instrument air system	2
K1.08	Automatic depressurization system	3
K1.09	Remote shutdown system	3
K1.10	Engineered Safety Function logic and control system	3
K1.11	Residual heat removal system	3
K1.12	Reactor core isolation cooling system	2
K1.13	AC electrical power distribution system	3
K1.14	Plant information and control system	2
K1.15	Post accident monitoring system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	High pressure core flooder pumps	3
K2.02	High pressure core flooder test return to suppression pool valves	3
K2.03	High pressure core flooder injection valves	3
K2.04	High pressure core flooder CST suction valves	3
K2.05	High pressure core flooder suppression pool suction valves	3
K2.06	Initiation logic	3
K 3	**Knowledge of the effect that a loss or malfunction of the High Pressure Core Flooder System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Standby liquid control system	3
K3.03	Adequate core cooling	4
K3.04	Automatic depressurization system	3

System: SF2HPCF High Pressure Core Flooder System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of High Pressure Core Flooder System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Prevents water hammer	3
K4.02	Prevents overfilling reactor vessel	3
K4.03	Prevents pump over heating	2
K4.04	Testable check valve operation	2
K4.05	Motor operated valve operation	2
K4.06	High pressure core flooder pump operation	4
K4.07	Override of reactor water level interlock	3
K 5	**Knowledge of the operational implications and/or cause and effect relationships as they apply to High Pressure Core Flooder System:** (CFR: 41.5 / 45.3)	
K5.01	Suppression Pool	4
K5.02	Emergency core cooling system room coolers	2
K5.03	Adequate core cooling	4
K5.04	Suppression pool suction strainers	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the High Pressure Core Flooder System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	4
K6.02	Makeup water condensate system	3
K6.03	Reactor building cooling water system	3
K6.04	Suppression pool suction strainer	3
K6.05	Suppression pool water level	3
K6.06	Engineered Safety Function logic and control system	3
K6.07	Remote shutdown system	3
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the High Pressure Core Flooder System controls including:** (CFR: 41.5 / 45.5)	
A1.01	High pressure core flooder flow	4
A1.02	High pressure core flooder pressure	3
A1.03	Reactor water level	4
A1.04	Reactor pressure	3
A1.05	Suppression pool water level	3

3.2 Safety function 2: Reactor Water Inventory Control

System: **SF2HPCF High Pressure Core Flooder System (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
A1.06	Motor amps	3
A1.07	System lineup	3
A1.08	Condensate storage tank level	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the High Pressure Core Flooder System ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	System initiation	4	4
A2.02	High pressure core flooder pump trip	4	4
A2.03	AC electrical failure	3	3
A2.04	High pressure core flooder line break	3	4
A2.05	Pump seal failure	3	3
A2.06	Inadequate system flow	3	3
A2.07	Loss of room cooling	2	3
A2.08	Low suppression pool level	3	4
A2.09	High suppression pool level	3	4
A2.10	Low condensate storage tank level	3	4
A2.11	High suppression pool temperature	3	3
A2.12	Clogged suppression pool suction strainers	3	3

A 3 **Ability to monitor automatic operations of the High Pressure Core Flooder System including:**
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3
A3.02	Pump start	4
A3.03	System pressure	3
A3.04	System flow	4
A3.05	Reactor water level	4
A3.06	Indications and alarms	4

A 4 **Ability to manually operate and/or monitor High Pressure Core Flooder System in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	High pressure core flooder pump	4
A4.02	High pressure core flooder suction valves	4
A4.03	High pressure core flooder injection valve	4
A4.04	High pressure core flooder minimum flow valve	3
A4.05	Manual initiation controls (PRA)	3
A4.06	High pressure core flooder testable check valve	2

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2HPCF High Pressure Core Flooder System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
A4.07	Line fill	3
A4.08	System flow	4
A4.09	High pressure core flooder test return valve	3
A4.10	High pressure core flooder initiation reset controls	4

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2CD Condensate System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Condensate System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main turbine	3
K1.02	Feedwater system	3
K1.03	Condensate demineralizer system	3
K1.04	Condensate filter system	3
K1.05	Control rod drive system	3
K1.06	Extraction steam system	3
K1.07	Exhaust hood spray system	2
K1.08	Instrument air system	2
K1.09	Circulating water system	3
K1.10	Turbine building cooling water system	3
K1.11	Makeup water condensate system	3
K1.12	Radwaste system	2
K1.13	Oxygen injection system	3
K1.14	Zinc injection system	2
K1.15	Hydrogen water chemistry system	3
K1.16	AC electrical power distribution system	3
K1.17	Heater drains and vent system	3
K1.18	Noble metal injection system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Condensate pumps	3
K2.02	Condensate booster pumps	3
K2.03	Condensate pump discharge valves	2
K2.04	Condensate booster pump discharge valves	2
K 3	**Knowledge of the effect that a loss or malfunction of the Condensate System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Main turbine/main generator	3
K3.02	Control rod drive system	3
K3.03	Feedwater system	4
K3.04	Steam jet air ejectors	3
K3.05	Gland seal steam system	3
K3.06	Reactor water level	4

System: SF2CD Condensate System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Condensate System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Condensate or condensate booster pump auto start	3
K4.02	CRD pump suction	3
K4.03	Condensate or condensate booster pump protection	3
K4.04	Maintenance of water quality	3
K4.05	Maintenance of 100% system flow if a feedwater string isolates	3
K4.06	Cascading heater drains	2
K4.07	Initial main condenser vacuum	3
K4.08	Non-condensable gas removal	3
K4.09	Auto condensate pump trip due to feedwater line break detection	4
K 5	**Knowledge of the operational implications and/or cause and effect relationships as they apply to Condensate System:** (CFR: 41.5 / 45.3)	
K5.01	Steam jet air ejector condenser	3
K5.02	Gland seal steam condenser	3
K5.03	Reactor water level	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Condensate System:** (CFR: 41.7 / 45.7)	
K6.01	Instrument air system	3
K6.02	Circulating water system	3
K6.03	Extraction steam system	3
K6.04	AC electrical power distribution system	3
K6.05	Turbine building cooling water systems	3
K6.06	Feedwater system	3
K6.07	Makeup water condensate system	2
K6.08	Main turbine	3
K6.09	Main steam system	3
K6.10	Condensate demineralizer system	3
K6.11	Condensate filter system	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2CD Condensate System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Condensate System controls including:** (CFR: 41.5 / 45.5)	
A1.01	System flow	3
A1.02	Pump amps	2
A1.03	System pressure	3
A1.04	Hotwell level	3
A1.05	Condensate storage tank level	3
A1.06	Reactor water level	4
A1.07	System lineup	3
A1.08	System water quality	3
A1.09	Feedwater temperature	3
A1.10	Condenser vacuum	3

K/A NO.	KNOWLEDGE	RO	SRO
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Condensate System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
A2.01	Pump trips	3	3
A2.02	Condensate pump discharge valve closures	3	3
A2.03	Condensate booster pump discharge valve closure	3	3
A2.04	Valve openings	3	3
A2.05	AC power failures	3	3
A2.06	Inadequate system flow	3	3
A2.07	Low hotwell level	3	3
A2.08	High hotwell level	3	3
A2.09	High feedwater heater level	3	3
A2.10	Low feedwater heater level	3	3
A2.11	Main turbine trip	3	3
A2.12	Loss of circulating water system	3	3
A2.13	Loss of turbine building cooling water systems	3	3
A2.14	Loss of instrument air system	3	3
A2.15	Low Condensate storage tank level	3	3
A2.16	Abnormal water quality	3	3
A2.17	High demineralizer differential pressure	3	3
A2.18	Feedwater heater string isolation	3	3
A2.19	Loss of SJAE	3	3
A2.20	Condensate filter high differential pressure	2	2

3.2	**Safety function 2: Reactor Water Inventory Control**	
System:	**SF2CD Condensate System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
A 3	**Ability to monitor automatic operations of the Condensate System including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	3
A3.02	Pump starts	3
A3.03	System pressure	3
A3.04	System flow	3
A3.05	Indications and alarms	3
A3.06	Hotwell level	3
A3.07	Feedwater heater level	3
A3.08	Feedwater temperature	3
A3.09	Feedwater heater drain tank level	3
A 4	**Ability to manually operate and/or monitor the Condensate System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Condensate/ condensate booster pumps	3
A4.02	System motor operated valves	3
A4.03	Hotwell level controls	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RCIC Reactor Core Isolation Cooling System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic 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	Makeup water condensate system	4
K1.02	Main steam system	4
K1.03	Residual heat removal system	3
K1.04	Instrument air system	2
K1.05	Leak detection and isolation system	3
K1.06	Engineered Safety Function logic and control system	3
K1.07	Feedwater system	4
K1.08	Suppression pool suction strainer	2
K1.09	AC electrical power distribution system	2
K1.10	DC power supply system	3
K1.11	High pressure core flooder system	2
K1.12	Radioactive drain transfer system	2
K1.13	Heating ventilation and air conditioning system	2
K1.14	Post accident monitoring system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	RCIC steam admission valves	3
K2.02	Condensate storage tank suction valve	3
K2.03	Suppression pool suction valve	3
K2.04	RCIC test return to suppression pool valves	2
K2.05	RCIC initiation signals (logic)	3
K2.06	Reactor core isolation cooling drain pump	2
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Core Isolation Cooling System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Reactor vessel pressure	4
K3.03	Decay heat removal	4
K3.04	Adequate core cooling	4

3.2	**Safety function 2: Reactor Water Inventory Control**	
System:	**SF2RCIC Reactor Core Isolation Cooling System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 4	**Knowledge of Reactor Core Isolation Cooling System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Prevent water hammer	3
K4.02	Prevent overfilling reactor vessel	3
K4.03	Override of high reactor water level interlock	3
K4.04	Prevents pump over heating	3
K4.05	Prevents turbine damage	3
K4.06	Manual initiation	4
K4.07	Alternate supplies of water	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Core Isolation Cooling System:** (CFR: 41.5 / 45.3)	
K5.01	Assist core cooling	4
K5.02	Suppression pool	4
K5.03	Main condenser	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Core Isolation Cooling System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Instrument air system	2
K6.03	Suppression pool water supply	4
K6.04	Makeup water condensate system	4
K6.05	Main steam system	4
K6.06	Suppression pool suction strainer	3
K6.07	DC power supply system	3
K6.08	Engineered Safety Function logic and control system	3
K6.09	High pressure core flooder system	2
K6.10	Radioactive drain transfer system	2
K6.11	Heating ventilation and air conditioning system	2
K6.12	Feedwater system	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RCIC Reactor Core Isolation Cooling System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Core Isolation Cooling System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor core isolation cooling flow	4	
A1.02	Reactor core isolation cooling pressure	3	
A1.03	Reactor water level	4	
A1.04	Reactor pressure	4	
A1.05	Reactor core isolation cooling turbine speed	4	
A1.06	Condensate storage tank level	3	
A1.07	Suppression pool level	3	
A1.08	Suppression pool temperature	4	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	System initiation signal	4	4
A2.02	Reactor core isolation cooling turbine trips	4	4
A2.03	Injection valve closure	3	3
A2.04	AC power loss	2	2
A2.05	DC power loss	3	3
A2.06	Loss of instrument air system	2	2
A2.07	Loss of reactor core isolation cooling drain pump	2	2
A2.08	Turbine control system failures	3	3
A2.09	Inadequate system flow	3	3
A2.10	Loss of room cooling	3	3
A2.11	Steam line break	4	4
A2.12	Low condensate storage tank level	4	3
A2.13	High suppression pool level	3	3
A2.14	Low suppression pool level	3	3
A2.15	High suppression pool temperature	4	4
A2.16	High drain tank level	2	2

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RCIC Reactor Core Isolation Cooling System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Reactor Core Isolation Cooling System including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4
A3.02	Turbine startup	4
A3.03	System pressure	4
A3.04	System flow	4
A3.05	Reactor water level	4
A3.06	Indications and alarms	4
A 4	**Ability to manually operate and/or monitor the Reactor Core Isolation Cooling System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Reactor core isolation cooling turbine speed	4
A4.02	Turbine trip throttle valve reset	4
A4.03	System valves	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2FW Feedwater System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Feedwater System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor pressure vessel system	4
K1.02	Reactor water cleanup system	3
K1.03	Extraction steam system	3
K1.04	Condensate system	3
K1.05	Instrument air system	3
K1.06	AC electrical power distribution system	3
K1.07	Feedwater control system	4
K1.08	Turbine building cooling water system	3
K1.09	Feedwater pump lube oil subsystem	3
K1.10	Reactor core isolation cooling system	4
K1.11	Residual heat removal system	4
K1.12	Heater drains and vent system	2
K1.13	Sampling system	2
K1.14	Control rod drive system	3
K1.15	Plant information and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Feedwater pump(s)	3
K2.02	Feedwater pump discharge valves	2
K2.03	Reactor feedwater pump auxiliary oil pumps	2
K 3	**Knowledge of the effect that a loss or malfunction of the Feedwater System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Feedwater control system	4
K3.03	Reactor water cleanup system	3
K3.04	Reactor internal pump NPSH	3
K3.05	Core inlet subcooling	3
K3.06	Condensate system	3
K3.07	Reactor core isolation cooling system	3
K3.08	Extraction steam system	3
K3.09	Residual heat removal system	3
K3.10	Reactor power	4

3.2	**Safety function 2: Reactor Water Inventory Control**	
System:	**SF2FW Feedwater System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 4	**Knowledge of Feedwater System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Auto start of the feedwater pumps	4
K4.02	Feedwater heating	3
K4.03	Feedwater pump minimum flow	3
K4.04	Dispersal of feedwater in the reactor vessel	3
K4.05	Feedwater pump protection	3
K4.06	Feedwater pump lubrication	3
K4.07	Feedwater pump motor cooling	3
K4.08	System isolation from the reactor vessel (check valves, double valve isolation inside/ outside containment)	3
K4.09	Feedwater pump runbacks due to ATWS	3
K4.10	Reactor internal pump speed runbacks	4
K4.11	Condensate pumps trip due to feedwater line break detection	3
K4.12	Selected control rod run-in (SCCRI) initiation	3
K4.13	Up-rate feedwater flow measurement	2
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Feedwater System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor water level	4
K5.02	Thermal power calculation	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Feedwater System:** (CFR: 41.7 / 45.7)	
K6.01	Instrument air system	3
K6.02	Condensate system	3
K6.03	AC electrical power	3
K6.04	Extraction steam	3
K6.05	Turbine building cooling water systems	3
K6.06	Feedwater control system	4
K6.07	Feedwater pump motor ventilation	2
K6.08	Feedwater pump lube oil system	3
K6.09	DC electrical power	2
K6.10	Engineered Safety Function logic and control system	3
K6.11	Heater drains	3
K6.12	Plant information and control system	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2FW Feedwater System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Feedwater System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Feedwater flow/pressure	3
A1.02	Feedwater inlet temperature	3
A1.03	FP motor amps	3
A1.04	Feedwater heater level	3
K1.05	Feedwater pump speed	3
K1.06	Feedwater control valve operation	2

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Feedwater System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	Feedwater heater isolation	3	3
A2.02	Loss of condensate or condensate booster pump(s)	4	4
A2.03	Loss of extraction steam	3	3
A2.04	Loss of instrument air system	3	3
A2.05	Loss of AC electrical power	3	3
A2.06	Feedwater control system malfunctions	4	4
A2.07	Loss of DC electrical power	3	3
A2.08	Loss of turbine building cooling water system	3	3
A2.09	Loss of feedwater pump	3	3
A2.10	Loss of high pressure drain pump	3	3

A 3 **Ability to monitor automatic operations of the Feedwater System including:**
(CFR: 41.7 / 45.7)

A3.01	Feedwater pump auto start	3
A3.02	Feedwater pump motor amps~~:~~	2
A3.03	System flow	3
A3.04	Reactor water level	4
A3.05	Feedwater inlet temperature	3
A3.06	Pump discharge pressure	3
A3.07	Indications and alarms	3
A3.08	Pump trips	3
A3.09	Feedwater pump runbacks due to ATWS	3
A3.10	Feedwater pump speed	3
A3.11	Feedwater pump minimum flow valve position	2

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2FW Feedwater System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Feedwater System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Manually start/control a feedwater pump	4
A4.02	Feedwater heater/drain controls	3
A4.03	System valves	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RWCU Reactor Water Cleanup System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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 pressure vessel system	3
K1.02	Feedwater system	3
K1.03	Reactor building cooling water system	3
K1.04	Instrument air system	3
K1.05	Service air system	2
K1.06	Low conductivity waste system	3
K1.07	Leak detection and isolation system	4
K1.08	Makeup water condensate system	3
K1.09	Residual heat removal system	3
K1.10	Sampling system	3
K1.11	Control rod drive system	3
K1.12	Feedwater control system	3
K1.13	Automatic power regulator	3
K1.14	Feedwater system	3
K1.15	Engineered Safety Function logic and control system	3
K1.16	High pressure nitrogen gas supply system	2
K1.17	Electrical power distribution system	3
K1.18	Plant information and control system	3
K1.19	Fuel pool cooling and cleanup system	2
K1.21	Post accident monitoring system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor water cleanup pumps	2
K2.02	Containment isolation valves	2
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Water Cleanup System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water quality	3
K3.02	Reactor water level	3
K3.03	Reactor building cooling water systems	2
K3.04	Reactor water temperature	3
K3.05	Area temperature	2
K3.06	Area radiation levels	3
K3.07	Drywell temperature	2
K3.08	Drywell pressure	2
K3.09	Automatic power regulator system	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RWCU Reactor Water Cleanup System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Reactor Water Cleanup System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Pump protection	3
K4.02	Piping over-pressurization protection	3
K4.03	Over temperature protection for system components	3
K4.04	System isolation upon-receipt of isolation signals	4
K4.05	Double valve isolation from the reactor	3
K4.06	Maximize plant efficiency (use of regenerative heat exchanger)	3
K4.07	Draining of reactor water to various locations	3
K4.08	Head spray to RPV vessel head for head removal prior to refueling operation	2
K4.09	Control of RPV water level during startup and shutdown	3
K4.10	Decay heat removal	2
K4.11	Control of reactor water quality	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Water Cleanup System:** (CFR: 41.5 / 45.3)	
K5.01	Main condenser	3
K5.02	Reactor water level	3
K5.03	Reactor water quality	3
K5.04	Initiation of standby liquid control system	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Water Cleanup System:** (CFR: 41.7 / 45.7)	
K6.01	Reactor building cooling water system~~s~~	3
K6.02	Main condenser	2
K6.03	Radwaste	2
K6.04	Instrument air system	3
K6.05	Service air system	2
K6.06	High pressure nitrogen gas supply system	2
K6.07	AC Electrical power distribution system	3
K6.08	Feedwater-system	2
K6.09	Standby liquid control system logic	3
K6.10	Leak detection and isolation system	4
K6.11	Control rod drive system	3
K6.12	Feedwater control system	3
K6.13	Engineered Safety Function logic and control system	3
K6.14	Plant information and control system	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RWCU Reactor Water Cleanup System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Water Cleanup System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor water level	3	
A1.02	Component cooling water temperature	3	
A1.03	Reactor water temperature	3	
A1.04	System flow	3	
A1.05	System pressure	3	
A1.06	System temperature	3	
A1.07	RWCU drain flow	3	
A1.08	Main condenser hotwell level	2	
A1.09	Reactor water conductivity	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Water Cleanup System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of reactor building cooling water	3	3
A2.02	Flow control valve failure	3	3
A2.03	RWCU pump trips	3	3
A2.04	AC failure	3	3
A2.05	Loss of instrument air system	3	3
A2.06	Loss of service air system	2	2
A2.07	Loss of room coolers	3	3
A2.08	Inadequate system flow	3	3
A2.09	Excessive drain flow rates	3	3
A2.10	Signal received which results in a system isolation	3	3
A2.11	System high temperature	3	3
A2.12	Cleanup demineralizer high differential pressure	3	3
A2.13	Loss of purge flow to reactor water cleanup pump	3	3
A 3	**Ability to monitor automatic operations of the Reactor Water Cleanup System including:** (CFR: 41.7 / 45.7)		
A3.01	Reactor water quality	3	
A3.02	Response to system isolations	4	
A3.03	Response to interlocks and trips designed to protect system components	3	
A3.04	Reactor water temperature	3	

System: SF2RWCU Reactor Water Cleanup System (continued)

K/A NO.	ABILITY	IMPORTANCE
A3.05	Indications and alarms	3
A3.06	Reactor water level control by feedwater control system	3

A 4 Ability to manually operate and/or monitor the Reactor Water Cleanup System in the control room:
(CFR: 41.7 / 45.5 to 45.8)

A4.01	System pumps	3
A4.02	Valve controls	3
A4.03	Heat exchanger operation	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2FWC Feedwater Control System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Feedwater Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor trip and isolation system	4
K1.02	Feedwater system	4
K1.03	Steam bypass and pressure control system	3
K1.04	Recirculation flow control system	3
K1.05	Main steam system	3
K1.06	Reactor water cleanup	3
K1.07	Plant information and control system	3
K1.08	Engineered Safety Function logic and control system	3
K1.09	Neutron monitoring system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Feedwater control system circuitry	2
K2.02	Feedwater pump adjustable speed drive	3
K 3	**Knowledge of the effect that a loss or malfunction of the Feedwater Control System will have on the following:** (CFR: 41.7 / 45.4 to 45.8)	
K3.01	Reactor water level	4
K3.02	Reactor feedwater system	4
K3.03	Recirculation flow control system	3
K3.04	Main turbine	3
K3.05	Reactor water level indication	3
K3.06	Recirculation flow control system	3
K3.07	Reactor water cleanup	3
K 4	**Knowledge of Feedwater Control System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4. 01	Feedwater pump runout protection	3
K4.02	Reactor water level setpoint setdown following a reactor scram	3
K4.03	Control signal failure	3
K4.04	Feedwater pump speed control	4
K4.05	Single element control (reactor water level provides the only input)	3
K4.06	Three element control (main steam flow, reactor feedwater flow and reactor water level provide input)	3
K4.07	Manual and automatic control of the system	4

3.2	**Safety function 2: Reactor Water Inventory Control**	
System:	**SF2FWC Feedwater Control System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K4.08	Feedwater pump speed lockup	4
K4.09	Selection of various instruments to provide reactor water level input	3
K4.10	Simultaneous Manual and Auto operation of the system (i.e. 1 FP in Auto, 1 FP in Manual)	3
K4.11	Feedwater runback due to ATWS	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Feedwater Control System:** (CFR: 41.5 / 45.3)	
K5.01	Moisture carryover	2
K5.02	Moisture carryunder	2
K5.03	Main steam flow	3
K5.04	Reactor water level	4
K5.05	Reactor feedwater flow	4
K5.06	Technician interface unit	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Feedwater Control System:** (CFR: 41.7 / 45.7)	
K6.01	AC power	3
K6.02	Main steam flow input	3
K6.03	Reactor feedwater flow input	3
K6.04	Reactor water level input	4
ABILITY		
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Feedwater Control System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4
A1.02	Reactor feedwater flow	4
A1.03	Reactor power	4
A1.04	Reactor water level control controller indications	4
A1.05	Low flow control position.	3
A1.06	Motor driven reactor feedwater pump speed	3

System: SF2FWC Feedwater Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Feedwater Control System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of any number of main steam flow inputs	3	3
A2.02	Loss of any number of reactor feedwater flow inputs	3	3
A2.03	Loss of reactor water level input	4	4
A2.04	Loss of controller signal output	3	3
A2.05	Feedwater runback due to ATWS	4	4
A 3	**Ability to monitor automatic operations of the Feedwater Control System including:** (CFR: 41.7 / 45.7)		
A3.01	Runout flow control	3	
A3.02	Changes in reactor water level	3	
A3.03	Changes in main steam flow	3	
A3.04	Changes in reactor feedwater flow	3	
A3.05	Changes in reactor power	3	
A3.06	Reactor water level setpoint setdown following a reactor scram	4	
A3.07	FWRV lockup	4	
A3.08	Motor driven feedwater pump speed lockup	4	
A 4	**Ability to manually operate and/or monitor the Feedwater Control System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	All individual component controllers in the manual mode	4	
A4.02	All individual component controllers when transferring from manual to automatic modes	4	
A4.03	Motor driven feedwater pump lockup reset controls	3	
A4.04	All individual component controllers when transferring from automatic to manual mode	4	
A4.05	Setpoint setdown reset controls	3	

3.2 Safety function 2: Reactor Water Inventory Control

System: **SF2RHRLPFL Residual Heat Removal System: Low Pressure Flooder Injection Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Residual Heat Removal System: Low Pressure Flooder Injection Mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Makeup water condensate system	3
K1.02	Automatic depressurization system	4
K1.03	AC electrical power distribution system	4
K1.04	Nuclear boiler instrumentation-system	4
K1.05	Instrument air	3
K1.06	Radioactive drain transfer system	2
K1.07	Reactor building cooling water system	3
K1.08	Reactor pressure vessel system	4
K1.09	Fire protection system (PRA)	3
K1.10	Remote shutdown system	3
K1.11	Reactor core isolation cooling	3
K1.12	High pressure core flooder system	3
K1.13	Fuel pool cooling and cleanup system	3
K1.14	Sampling system	2
K1.15	High pressure nitrogen gas supply system	2
K1.16	Suppression pool temperature monitoring system	3
K1.17	Engineered Safety Function logic and control system	4
K1.18	Plant information and control system	3
K1.19	Leak detection and isolation system	3
K1.20	Reactor water cleanup system	3
K1.21	Low conductivity waste system	2
K1.22	Atmosphere control system	2
K1.23	Heating, ventilation and air conditioning system	2
K1.24	Suppression pool water drainage system	2
K1.25	Post accident monitoring system	2
K1.26	Feedwater system	4
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Residual heat removal pumps	4
K2.02	Residual heat removal injection valves	3
K2.03	Residual heat removal pump minimum flow valves	2
K2.04	Residual heat removal test return valves	2
K2.05	Residual heat removal heat exchanger outlet valves	2
K2.06	Residual heat removal heat exchanger bypass valves	2
K2.07	Residual heat removal suppression pool suction valves	2
K2.08	Initiation logic	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RHRLPFL Residual Heat Removal System: Low Pressure Flooder Injection Mode (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 3	**Knowledge of the effect that a loss or malfunction of the Residual Heat Removal System: Low Pressure Flooder Injection Mode will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Suppression pool level	4
K3.03	Automatic depressurization logic	4
K3.04	Adequate core cooling	4
K 4	**Knowledge of Residual Heat Removal System: Low Pressure Flooder Injection Mode design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic system initiation/ injection	4
K4.02	Prevention of piping overpressurization	3
K4.03	Pump minimum flow protection	3
K4.04	Pump motor cooling	3
K4.05	Prevention of water hammer	3
K4.06	Adequate pump net positive suction head (interlock valve open)	4
K4.07	Emergency diesel generator load sequencing	4
K4.08	Pump operability testing	3
K4.09	Surveillance for all operable components	3
K4.10	Dedicated injection system during automatic system initiation (injection valve interlocks)	4
K4.11	System redundancy	4
K4.12	The prevention of leakage to the environment through Residual heat removal heat exchanger	3
K4.13	Operation from remote shutdown panel	4
K4.14	Pump runout protection	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Residual Heat Removal System: Low Pressure Flooder Injection Mode:** (CFR: 41.5 / 45.3)	
K5.01	Suppression pool	4
K5.02	Keep fill	3
K5.03	Reactor pressure	4
K5.04	Shutdown cooling	4
K5.05	Drywell or wetwell spray	4
K5.06	Drywell pressure	4
K5.07	Reactor water level	4

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RHRLPFL Residual Heat Removal System: Low Pressure Flooder Injection Mode (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Residual Heat Removal System: Low Pressure Flooder Injection Mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power	4
K6.02	Keep fill	3
K6.03	Makeup water condensate system	3
K6.04	Instrument air system	3
K6.05	ECCS room cooling	3
K6.06	Nuclear boiler instrumentation	3
K6.07	Reactor building cooling water system	3
K6.08	Automatic depressurization system	4
K6.09	ECCS room integrity	3
K6.10	Nuclear boiler system	3
K6.11	High pressure nitrogen gas supply system	2
K6.12	Engineered Safety Function logic and control system	4
K6.13	Remote shutdown system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Residual Heat Removal System: Low Pressure Flooder Injection Mode controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor water level	4
A1.02	Reactor pressure	4
A1.03	System flow	4
A1.04	System pressure	4
A1.05	Suppression pool level	4
A1.06	Motor amps	2
A1.07	Emergency diesel generator loading	3
A1.08	Reactor building cooling water systems	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2RHRLPFL Residual Heat Removal System: Low Pressure Flooder Injection Mode (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Residual Heat Removal System: Low Pressure Flooder Injection Mode; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Residual heat removal pump trips	4	4
A2.02	AC failures	4	4
A2.03	Pump seal failure	3	3
A2.04	Inadequate room cooling	3	3
A2.05	Inadequate system flow	3	3
A2.06	Nuclear boiler instrument failures	3	4
A2.07	Motor operated injection valve failures	3	4
A2.08	Pump runout	3	3
A2.09	Initiating logic failure	4	4
A2.10	Loss of coolant accident	4	5
A2.11	Keep fill failure	3	4
A 3	**Ability to monitor auto-Residual Heat Removal System: Low Pressure Flooder Injection Mode-automatic operations including:** (CFR: 41.7 / 45.7)		
A3.01	Valve operation	4	
A3.02	Pump start	4	
A3.03	Pump discharge pressure	4	
A3.04	System flow	4	
A3.05	Reactor water level	4	
A3.06	Indications and alarms	4	
A3.07	System initiation sequence	4	
A3.08	Emergency diesel generator load sequencing	4	
A 4	**Ability to manually operate and/or monitor the Residual Heat Removal System: Low Pressure Flooder Injection Mode in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Pumps	4	
A4.02	System valves	4	
A4.03	Keep fill	3	
A4.04	Heat exchanger cooling flow	4	
A4.05	Manual initiation controls	4	
A4.06	System reset following automatic initiation	4	
A4.07	Testable check valves	3	

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2AFI Alternate Feedwater Injection System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Alternate Feedwater Injection System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical power distribution system	3
K1.02	Reactor feedwater system (via RWCU return line)	3
K1.03	Radioactive drain transfer system	2
K1.04	Makeup water preparation system	3
K1.06	Plant information and control system	3
K1.07	Main steam system	2
K1.08	Atmosphere control system	3
K1.09	Nuclear boiler instrumentation system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Alternate feedwater injection pump	3
K2.02	Alternate feedwater injection system motor operated injection valves	2
K 3	**Knowledge of the effect that a loss or malfunction of the Alternate Feedwater Injection System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	3
K3.02	Reactor pressure	3
K 4	**Knowledge of Alternate Feedwater Injection System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Sufficient water capacity to maintain core covered for 24 hours following the beyond design basis event	3
K4.02	Ability for the AFI pumps to take a suction from numerous water sources	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Alternate Feedwater Injection System):** (CFR: 41.5 / 45.3)	
K5.01	Reactor pressure vessel water level	3
K5.02	Reactor pressure vessel pressure	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2AFI Alternate Feedwater Injection System (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 6	**Knowledge of the effect that following plant conditions, system malfunctions or component malfunctions will have on the Alternate Feedwater Injection System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Reactor feedwater system	3
K6.03	Radioactive drain transfer system	2
K6.04	Makeup water preparation system	3
K6.05	Main steam system	2
K6.06	Atmosphere control system	3
K6.07	Nuclear boiler instrumentation system	2

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Alternate Feedwater Injection System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor vessel water level	4
A1.02	Reactor vessel pressure	4
A1.03	Suppression chamber pressure	3
A1.04	Suppression chamber level	3
A1.05	Demineralized water storage tank level	3
A1.06	System flow	3
A1.07	Alternate feedwater pump discharge pressure	2

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Alternate Feedwater Injection System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Trip of a running alternate feedwater injection pump	4	4
A2.02	Low demineralized storage tank level	3	3

3.2 Safety function 2: Reactor Water Inventory Control

System: SF2AFI Alternate Feedwater Injection System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Alternate Feedwater Injection System including:** (CFR: 41.7 / 45.7)	
A3.01	Automatic closing of the solenoid operated vent valves when the respective motor operated injection valve opens	3
A 4	**Ability to manually operate and/or monitor the Alternate Feedwater Injection System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
	None	

3.3 Safety Function 3: Reactor Pressure Control

System: **SF3ADS Automatic Depressurization System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between Automatic Depressurization System and the following systems:** (CFR: 41.2 to 41.9 /45.7 to 45.8)	
K1.01	Residual heat removal system	4
K1.02	High pressure core flooder system	4
K1.03	Nuclear boiler instrumentation system	4
K1.04	High pressure nitrogen gas supply system	3
K1.05	Neutron monitoring system	3
K1.06	Engineered Safety Function logic and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	ADS logic	3
K2.02	ADS valve solenoids	3
K 3	**Knowledge of the effect that a loss or malfunction of the Automatic Depressurization System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Restoration of reactor water level after a break that does not depressurize the reactor when required	4
K3.02	Ability to rapidly depressurize the reactor	4
K 4	**Knowledge of Automatic Depressurization System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Allows manual initiation of ADS logic	4
K4.02	ADS logic initiation	4
K4.03	Insures adequate nitrogen supply to ADS valves	4
K4.04	Auto inhibit of ADS with power above Average Power Range Monitor downscale setpoint	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Automatic Depressurization System:** (CFR: 41.5 / 45.3)	
K5.01	ADS logic operation	4
K5.02	Drywell/containment pressure	4
K5.03	Safety/relief valves	4
K5.04	Suppression pool	3
K5.05	Reactor pressure vessel	3

System: SF3ADS Automatic Depressurization System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Automatic Depressurization System:** (CFR: 41.7 / 45.7)	
K6.01	RHR pump discharge pressure	4
K6.02	High pressure core flooder pump discharge pressure	4
K6.03	Nuclear boiler instrumentation system (level indication)	4
K6.04	Nitrogen supply to ADS valves	4
K6.05	Direct current power supply system	4
K6.06	Primary containment instrumentation	3
K6.07	Average Power Range Monitor downscale signal to ADS logic	4
K6.08	Engineered Safety Function logic and control system	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Automatic Depressurization System controls including:** (CFR: 41.5 / 45.5)	
A1.01	ADS valve tail pipe temperatures	3
A1.02	ADS valve nitrogen supply pressure	3
A1.03	Reactor pressure	4
A1.04	Reactor water level	4
A1.05	Suppression pool temperature	4
A1.06	Average Power Range Monitor indication	3
A1.07	Suppression pool level	3
A1.08	ADS valve position indication	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Automatic Depressurization System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	Small steam line break LOCA	4	4
A2.02	Large break LOCA	4	4
A2.03	Loss of nitrogen supply to ADS valves	3	4
A2.04	ADS failure to initiate	4	4
A2.05	Loss of DC power to ADS valves	3	4
A2.06	ADS initiation signals present	4	4
A2.07	Failure to auto inhibit	3	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3ADS Automatic Depressurization System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 3	**Ability to monitor automatic operations of the Automatic Depressurization System including:** (CFR: 41.7 / 45.7)	
A3.01	ADS valve operation	4
A3.02	ADS valve tail pipe temperatures	4
A3.03	Drywell/wetwell pressure	4
A3.04	Suppression pool level	4
A3.05	Suppression pool temperature	4
A3.06	Indication and alarms	4
A3.07	Reactor pressure	4
A3.08	Reactor vessel water level	4
A 4	**Ability to manually operate and/or monitor the Automatic Depressurization System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	ADS valves (PRA)	4
A4.02	ADS logic initiation controls (PRA)	4
A4.03	ADS logic reset controls	4
A4.04	ADS inhibit controls	4

3.3 Safety Function 3: Reactor Pressure Control

System: **SF3NBS Main and Reheat Steam System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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 pressure vessel system	3
K1.02	Main turbine	3
K1.03	Moisture separator reheaters	3
K1.04	Steam bypass and pressure control system	3
K1.05	Offgas system	3
K1.06	Condenser air removal system	3
K1.07	Steam seal/gland seal system	3
K1.08	Extraction steam system	3
K1.09	High pressure heater drains and vents	3
K1.10	Instrument air system	3
K1.11	High pressure nitrogen gas supply system	3
K1.12	Plant information and control system	3
K1.13	Process radiation monitoring system	3
K1.14	Containment system	3
K1.15	Reactor core isolation cooling system	3
K1.16	Feedwater control system	3
K1.17	Reactor trip and isolation system	4
K1.18	Leak detection and isolation system	4
K1.19	Main condenser	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Main steam isolation valve solenoids	3
K 3	**Knowledge of the effect that a loss or malfunction of the Main and Reheat Steam System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Turbine generator	3
K3.02	Condenser	3
K3.03	Containment	3
K3.04	Decay heat removal	3
K3.05	Reactor core isolation cooling system	3
K3.06	Moisture separator reheaters	2
K3.07	Feedwater control system	4
K3.08	Safety/relief valves	4
K3.09	Reactor vessel and internals	3
K3.10	Steam jet air ejectors	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3NBS Main and Reheat Steam System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Main and Reheat Steam System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic isolation of steam lines	4
K4.02	Automatic isolation and opening of drain valves	3
K4.03	Insures that steam released from a steam line break will not bypass suppression pool	3
K4.04	Limits steam flow during a steam line rupture to 200%	3
K4.05	Steam flow measurement	3
K4.06	Over pressure control	4
K4.07	Removal of non condensable gases from reactor head area	3
K4.08	Equalization of pressure across the MSIV's before opening	3
K4.09	Moisture removal from steam lines prior to admitting steam	3
K4.10	Turbine bypass valve inhibit when MSIVs are closed	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Main and Reheat Steam System:** (CFR: 41.5 / 45.3)	
K5.01	Definition and reason for steam blanketing of moisture separator reheater	2
K5.02	Air/nitrogen operated MSIV's	3
K5.03	Decay heat removal	3
K5.04	Safety/Relief valves	4
K5.05	Head vent	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Main and Reheat Steam System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Instrument air system	3
K6.03	High pressure nitrogen gas supply system	4
K6.04	Safety/relief valve safety function operability	3
K6.05	Relief valve operability	3
K6.06	Steam line integrity	4
K6.07	MSIV isolation signal	4
K6.08	Main condenser vacuum	3
K6.09	Leak detection and isolation system	4
K6.10	Plant information and control system	3
K6.11	Steam bypass and pressure control system	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3NBS Main and Reheat Steam System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Main and Reheat Steam System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Main steam pressure	4
A1.02	Main steam temperature	3
A1.03	Reheat steam pressure	2
A1.04	Reheater temperature	2
A1.05	Main steam line radiation monitors	4
A1.06	Air ejector process radiation monitor	3
A1.07	Reactor water level	4
A1.08	Reactor pressure	4
A1.09	Main steam flow	3
A1.10	Reactor power	4

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:**
(CFR: 41.5 / 45.6)

K/A NO.	ABILITY	RO	SRO
A2.01	Change in steam demand and its effect on reactor pressure and power	4	4
A2.02	MSIV closure	4	4
A2.03	Main steam line low pressure	4	4
A2.04	Main steam line high radiation	4	4
A2.05	Main steam tunnel high temperature or differential high temperature	4	4
A2.06	Closure of one or more MSIV's at power	4	4
A2.07	Steam line break	4	4
A2.08	Leak detection and isolation system actuation	4	4
A2.09	High reactor water level	4	4
A2.10	Inadvertent initiation of HPCF (steam quality and steam flow)	3	4

A 3 **Ability to monitor automatic operations of the Main and Reheat Steam System including:**
(CFR: 41.7 / 45.7)

K/A NO.	ABILITY	IMPORTANCE
A3.01	Isolation of main steam system	4
A3.02	Opening and closing of drain valves as turbine load changes	3
A3.03	Moisture separator reheat steam supply	3
A3.04	Isolation of moisture separator reheater	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3NBS Main and Reheat Steam System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 4	**Ability to manually operate and/or monitor the Main and Reheat Steam System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Main steam isolation valves	4
A4.02	Main steam line drain valves	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3EHC Turbine Pressure Control/Steam Bypass and Pressure Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Turbine Pressure Control/Steam Bypass and Pressure Control System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor trip and isolation system	4
K1.02	AC electrical power distribution system	3
K1.03	DC power supply system	3
K1.04	Turbine building cooling water systems	3
K1.05	Recirculation flow control system	3
K1.06	Automatic power regulator system	4
K1.07	Power generation control system	3
K1.08	Plant information and control system	3
K1.09	Feedwater control system	3
K1.10	Nuclear boiler instrumentation system	3
K1.11	Main turbine	4
K1.12	Main generator	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Hydraulic power unit pumps	2
K2.02	Turbine pressure control logic	2
K2.03	Steam bypass and pressure control logic	2
K 3	**Knowledge of the effect that a loss or malfunction of the Turbine Pressure Control/Steam Bypass and Pressure Control System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor power	4
K3.02	Reactor pressure vessel pressure	4
K3.03	Reactor pressure vessel water level	4
K3.04	Reactor steam flow	4
K3.05	Main turbine steam flow	4
K3.06	Main turbine bypass valves	4
K3.07	Main turbine stop valves	3
K3.08	Main turbine control valves	4
K3.09	Combined intermediate valves	3
K3.10	Reactor trip and isolation system	4
K3.11	Turbine chest warming	3
K3.12	Main turbine acceleration	3
K3.13	Main turbine speed	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3EHC Turbine Pressure Control/Steam Bypass and Pressure Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.14	Main turbine inlet pressure	3
K3.15	Main turbine trip	3
K3.16	Recirculation flow control system	3
K3.17	Main generator	3
K3.18	Turbine trip testing	3
K3.19	Reactor heatup	3
K3.20	Reactor cooldown	3
K3.21	Turbine protection	3
K3.23	Turbine monitoring	2
K3.24	Automatic power regulator system	4
K3.25	Plant information and control system	3
K 4	**Knowledge of Turbine Pressure Control/Steam Bypass and Pressure Control System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Reactor pressure control	4
K4.02	Turbine speed control	3
K4.03	Turbine acceleration control	3
K4.04	Reactor scram	4
K4.05	Turbine trip	4
K4.06	Turbine chest warming	2
K4.07	Turbine trip testing	3
K4.08	Automatic hydraulic power unit pump start	3
K4.09	Reactor cooldown	3
K4.10	Turbine protection	3
K4.11	Main turbine bypass valve control	4
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Turbine Pressure Control/Steam Bypass and Pressure Control System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor power vs. reactor pressure	4
K5.02	Turbine inlet pressure vs. reactor pressure	3
K5.03	Turbine speed measurement	2
K5.04	Reactor power	4
K5.05	Reactor pressure vessel pressure	4
K5.06	Reactor pressure vessel water level	4
K5.07	Reactor pressure vessel steam flow	4
K5.08	Main turbine steam flow	4
K5.09	Main turbine bypass valves	4
K5.10	Main turbine stop valves	4

3.3 Safety Function 3: Reactor Pressure Control

System: SF3EHC Turbine Pressure Control/Steam Bypass and Pressure Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K5.11	Main turbine control valves	4
K5.12	Combined intermediate valves	3
K5.13	Bearing oil	3
K5.14	Turbine chest warming	2
K5.15	Main turbine acceleration	3
K5.16	Main turbine speed	3
K5.17	Main turbine inlet pressure	3
K5.18	Main turbine trip	3
K5.19	Main condenser vacuum	3
K5.20	Reactor startup	3
K5.21	Reactor heatup	3
K5.22	Reactor cooldown	3
K5.23	Main turbine protection	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Turbine Pressure Control/Steam Bypass and Pressure Control System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Turbine building cooling water system	3
K6.03	Condenser vacuum	3
K6.04	Reactor pressure vessel pressure	4
K6.05	Reactor power	4
K6.06	Main turbine steam flow	3
K6.07	Main turbine bypass valves	4
K6.08	Main turbine stop valves	3
K6.09	Main turbine control valves	3
K6.10	Combined intermediate valves	3
K6.11	Main turbine speed signal	2
K6.12	Main generator	3
K6.13	Reactor trip and isolation system	3
K6.14	Power generation control system	3
K6.15	Nuclear boiler instrumentation system	3
K6.16	Feedwater control system	3
K6.17	Automatic power regulator system	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3EHC Turbine Pressure Control/Steam Bypass and Pressure Control System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Turbine Pressure Control/Steam Bypass and Pressure Control System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor pressure vessel pressure	4
A1.02	Reactor power	4
A1.03	Reactor vessel pressure water level	4
A1.04	Main turbine inlet pressure	3
A1.05	Reactor steam flow	4
A1.06	Ma in turbine steam flow	3
A1.07	Main turbine bypass valve position	4
A1.08	Main turbine control valve position	3
A1.09	Main turbine stop valve position	3
A1.10	Combined intermediate valve position.	3
A1.11	Reactor/turbine pressure regulating system oil pressure	3
A1.12	Reactor/turbine pressure regulating system load set/reference	3
A1.13	Main turbine speed	3
A1.14	Pressure setpoint/pressure demand	3
A1.15	Maximum combined flow limit	3
A1.16	Load limit set	3
A1.17	Main condenser vacuum	3
A1.18	Reactor cooldown	3
A1.19	Main turbine vibration	3
A1.20	Main turbine eccentricity	3
A1.21	Main turbine expansion	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Turbine Pressure Control/Steam Bypass and Pressure Control System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	High reactor pressure	4	4
A2.02	Failed open/closed bypass valve(s)	4	4
A2.03	Failed open/closed main turbine control valve(s)	4	4
A2.04	Failed open/closed main turbine stop valve(s)	4	4
A2.05	Loss of main condenser vacuum	4	4
A2.06	Main turbine overspeed	3	3
A2.07	Loss of generator load	3	4
A2.08	Loss of AC electrical power	3	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3EHC Turbine Pressure Control/Steam Bypass and Pressure Control System (continued)

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A2.09	Loss of turbine building cooling water system~~s~~	3	3
A2.10	Loss of main turbine speed feedback	2	2
A2.11	Loss of reactor pressure signal)	3	3
A2.12	Main turbine trip	4	4
A2.13	Main generator trip	4	4
A2.14	Reactor scram	4	4
A2.15	Main turbine high vibration	3	3
A2.16	Main turbine high eccentricity	3	3
A2.17	Main turbine high differential expansion	2	3

A 3 Ability to monitor automatic operations of the Turbine Pressure Control/Steam Bypass and Pressure Control System including:
(CFR: 41.7 / 45.7)

A3.01	Main turbine speed control	3	
A3.02	Main turbine acceleration control	3	
A3.03	Reactor pressure vessel pressure control	3	
A3.04	Main turbine bypass valve operation	4	
A3.05	Main turbine control valve operation	3	
A3.06	Main turbine stop valve operation	3	
A3.07	Combined intermediate valve operation	3	
A3.08	Turbine trip testing	3	
A3.09	Indications and alarms	3	
A3.10	Main turbine startup	3	

A 4 Ability to manually operate and/or monitor the Turbine Pressure Control/Steam Bypass and Pressure Control System in the control room:
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Main turbine bypass valves	4	
A4.02	Turbine trip	4	
A4.03	Turbine panel controls	4	

3.3 Safety Function 3: Reactor Pressure Control

System: SF3SRV Safety/Relief Valves

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Safety/Relief Valves and the following systems** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	4
K1.02	SPDS	3
K1.03	Nuclear boiler instrumentation system	4
K1.04	High pressure nitrogen gas supply system	3
K1.05	Automatic depressurization system	4
K1.06	Remote shutdown system	3
K1.07	Direct current power supply system	3
K1.08	Post accident monitoring system	2
K1.09	Primary containment system	3
K1.10	Alternate feedwater system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	SRV solenoids	3
K 3	**Knowledge of the effect that a loss or malfunction of the Safety/Relief Valves will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor pressure control	4
K3.02	Reactor over pressurization	4
K3.03	Ability to rapidly depressurize the reactor	4
K 4	**Knowledge of Safety/Relief Valves design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Prevents siphoning of water into SRV discharge piping and limits loads on subsequent actuation of SRV's	3
K4.02	Ensures even distribution of heat load to suppression pool, and adequate steam condensing	3
K4.03	Allows for SRV operation from more than one location	4
K4.04	Detection of valve leakage	4
K4.05	Minimum steam pressure required to keep SRV open or to open SRV	3
K4.06	Opening of the SRV from either an electrical or mechanical signal	4
K4.07	Manual opening of the SRV	4
K4.08	Methods for determining position of SRV	3

3.3 Safety Function 3: Reactor Pressure Control

System: SF3SRV Safety/Relief Valves (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Safety/Relief Valves:** (CFR: 41.5 / 45.3)	
K5.01	Relief function of SRV operation	3
K5.02	Safety function of SRV operation	4
K5.03	Tail pipe temperature monitoring	3
K5.04	Discharge line quencher operation	3
K5.05	Vacuum breaker operation	3
K5.06	Suppression pool	4
K5.07	Reactor pressure vessel overpressurization event	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Safety/Relief Valves:** (CFR: 41.7 / 45.7)	
K6.01	Nuclear boiler instrumentation system (pressure indication)	3
K6.02	High pressure nitrogen gas supply system	3
K6.03	Direct current power supply system	3
K6.04	Discharge line vacuum breaker	3
K6.05	Remote shutdown system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Safety/Relief Valves controls including:** (CFR: 41.5 / 45.5)	
A1.01	Tail pipe temperature	3
A1.02	Nitrogen supply	3
A1.03	Reactor pressure	4
A1.04	Reactor water level	4
A1.05	Reactor power	4
A1.06	Turbine load	3
A1.07	Suppression pool water temperature	4

3.3	**Safety Function 3: Reactor Pressure Control**	
System:	**SF3SRV Safety/Relief Valves (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Safety/Relief Valves; and b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	Stuck open vacuum breakers	3	3
A2.02	Leaky SRV	3	3
A2.03	Stuck open SRV	4	4
A2.04	ADS actuation	4	4
A2.05	Low reactor pressure	3	3
A2.06	Reactor high pressure	4	4

A 3 **Ability to monitor automatic operations of the Safety/Relief Valves including:**
(CFR: 41.7 / 45.7)

A3.01	SRV operation after ADS actuation	4
A3.02	SRV operation on high reactor pressure	4
A3.03	Tail pipe temperatures	4
A3.04	Suppression pool temperature	4
A3.05	Reactor pressure	4
A3.06	Reactor water level	4
A3.07	Indications and alarms	4

A 4 **Ability to manually operate and/or monitor the Safety/Relief Valves in the control room:**
(CFR: 41.7 / 45.5 to 45.8)

A4.01	SRV's	4

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4NBS Main and Reheat Steam System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic 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 pressure vessel system	3
K1.02	Main turbine	3
K1.03	Moisture separator reheaters	3
K1.04	Steam bypass and pressure control system	3
K1.05	Offgas system	3
K1.06	Condenser air removal system	3
K1.07	Steam seal/gland seal system	3
K1.08	Extraction steam system	3
K1.09	High pressure heater drains and vents	3
K1.10	Instrument air system	3
K1.11	High pressure nitrogen gas supply system	3
K1.12	Plant information and control system	3
K1.13	Process radiation monitoring system	3
K1.14	Containment system	3
K1.15	Reactor core isolation cooling system	3
K1.16	Feedwater control system	3
K1.17	Reactor trip and isolation system	4
K1.18	Leak detection and isolation system	4
K1.19	Main condenser	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Main steam isolation valve solenoids	3
K 3	**Knowledge of the effect that a loss or malfunction of the Main and Reheat Steam System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Turbine generator	3
K3.02	Condenser	3
K3.03	Containment	3
K3.04	Decay heat removal	3
K3.05	Reactor core isolation cooling system	3
K3.06	Moisture separator reheaters	2
K3.07	Feedwater control system	4
K3.08	Safety/relief valves	4
K3.09	Reactor vessel and internals	3
K3.10	Steam jet air ejectors	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4NBS Main and Reheat Steam System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Main and Reheat Steam System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic isolation of steam lines	4
K4.02	Automatic isolation and opening of drain valves	3
K4.03	Insures that steam released from a steam line break will not bypass suppression pool	3
K4.04	Limits steam flow during a steam line rupture to 200%	3
K4.05	Steam flow measurement	3
K4.06	Over pressure control	4
K4.07	Removal of non condensable gases from reactor head area	3
K4.08	Equalization of pressure across the MSIV's before opening	3
K4.09	Moisture removal from steam lines prior to admitting steam	3
K4.10	Turbine bypass valve inhibit when MSIVs are closed	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Main and Reheat Steam System:** (CFR: 41.5 / 45.3)	
K5.01	Definition and reason for steam blanketing of moisture separator reheater	2
K5.02	Air/nitrogen operated MSIVs	3
K5.03	Decay heat removal	3
K5.04	Safety/Relief valves	4
K5.05	Head vent	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Main and Reheat Steam System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Instrument air system	3
K6.03	High pressure nitrogen gas supply system	4
K6.04	Safety/relief valve safety function operability	3
K6.05	Relief valve operability	3
K6.06	Steam line integrity	4
K6.07	MSIV isolation signal	4
K6.08	Main condenser vacuum	3
K6.09	Leak detection and isolation system	4
K6.10	Plant information and control system	3
K6.11	Steam bypass and pressure control system	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4NBS Main and Reheat Steam System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Main and Reheat Steam System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Main steam pressure	4
A1.02	Main steam temperature	3
A1.03	Reheat steam pressure	2
A1.04	Reheater temperature	2
A1.05	Main steam line radiation monitors	4
A1.06	Air ejector process radiation monitor	3
A1.07	Reactor water level	4
A1.08	Reactor pressure	4
A1.09	Main steam flow	3
A1.10	Reactor power	4

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Change in steam demand and its effect on reactor pressure and power	4	4
A2.02	MSIV closure	4	4
A2.03	Main steam line low pressure	4	4
A2.04	Main steam line high radiation	4	4
A2.05	Main steam tunnel high temperature or differential high temperature	4	4
A2.06	Closure of one or more MSIV's at power	4	4
A2.07	Steam line break	4	4
A2.08	Leak detection and isolation system actuation	4	4
A2.09	High reactor water level	4	4
A2.10	Inadvertent initiation of HPCF/RCIC (steam quality and steam flow)	3	4

A 3 **Ability to monitor automatic operations of the Main and Reheat Steam System including:**
(CFR: 41.7 / 45.7)

A3.01	Isolation of main steam system	4
A3.02	Opening and closing of drain valves as turbine load changes	3
A3.03	Moisture separator reheat steam supply	3
A3.04	Isolation of moisture separator reheater	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4NBS Main and Reheat Steam System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Main and Reheat Steam System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Main steam isolation valves	4
A4.02	Main steam line drain valves	3

3.4	**Safety Function 4: Heat Removal from Reactor Core**	
System:	**SF4MT Main Turbine Generator and Auxiliary Systems**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic 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 power distribution system	3
K1.02	Condensate system	3
K1.03	Main steam system	3
K1.04	Reactor trip and isolation system	4
K1.05	Extraction steam system	3
K1.06	Turbine building cooling water system	3
K1.07	Instrument air system	3
K1.08	Steam bypass and pressure control system	3
K1.09	DC power supply system	3
K1.10	Generator cooling system	3
K1.11	Hydrogen gas cooling system	3
K1.12	Generator sealing oil system	3
K1.13	Turbine lubricating oil system	3
K1.14	Plant information and control system	3
K1.15	Turbine control system	3
K1.16	Turbine gland steam system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Generator cooling pumps	2
K2.02	Turbine lube oil pumps	2
K2.03	Generator sealing oil pumps	2
K2.04	Turbine supervisory instrumentation	2
K 3	**Knowledge of the effect that a loss or malfunction of the Main Turbine Generator and Auxiliary Systems will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	AC electrical power distribution system	4
K3.02	Reactor pressure	4
K3.03	Reactor power	4
K3.04	Feedwater system (feedwater heaters)	3
K3.05	Condensate system	3
K3.06	Reactor trip and isolation system	4
K3.07	Steam bypass and pressure control system	4
K3.08	Turbine control system	4

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4MT Main Turbine Generator and Auxiliary Systems (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Main Turbine Generator and Auxiliary Systems design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Bearing lubrication	2
K4.02	Generator cooling	2
K4.03	Sealing to prevent hydrogen leakage	3
K4.04	Hydrogen cooling	2
K4.05	Turbine protection	3
K4.06	Generator protection	3
K4.07	Generator voltage regulation	3
K4.08	Moisture removal from turbine steam	2
K4.09	Turbine control	3
K4.10	Extraction steam	**3**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Main Turbine Generator and Auxiliary Systems:** (CFR: 41.5 / 45.3)	
K5.01	Turbine operation and limitations	3
K5.02	Turbine speed measurement	2
K5.03	Relief valve operation	2
K5.04	Turbine shaft sealing	3
K5.05	Generator operations and limitations	3
K5.06	Generator cooling	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Main Turbine Generator and Auxiliary Systems:** (CFR: 41.7 / 45.7)	
K6.01	Gland seal	3
K6.02	Steam bypass and pressure control system	4
K6.03	Hydrogen seal oil	3
K6.04	Hydrogen gas cooling system	3
K6.05	Generator cooling water system	3
K6.06	Electrical distribution	3
K6.07	Extraction steam	2
K6.08	Main steam system	3
K6.09	Voltage regulation	2
K6.10	Turbine lube oil system	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4MT Main Turbine Generator and Auxiliary Systems (continued)

K/A NO.	ABILITY	IMPORTANCE
K6.11	Plant information and control system	3
K6.12	Turbine control system	3
K6.13	Moisture separator reheater	2
K6.14	Condenser vacuum	3

A 1 Ability to predict and/or monitor changes in parameters associated with operating the Main Turbine Generator and Auxiliary Systems controls including:
(CFR: 41.5 / 45.5)

A1.01	Generator megawatts	3
A1.02	Turbine speed	3
A1.03	Turbine valve position	3
A1.04	Steam flow	3
A1.05	Reactor pressure	4
A1.06	Condenser vacuum	3
A1.07	First stage turbine pressure	3
A1.08	Generator output voltage/reactive load	3

A 2 Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Turbine trip	4	4
A2.02	Loss of lube oil	3	4
A2.03	Loss of condenser vacuum	4	4
A2.04	Reactor scram	4	4
A2.05	Generator trip	4	4
A2.06	Loss of extraction steam	3	3
A2.07	Steam bypass and pressure control system	4	4
A2.08	Turbine rotor bow	2	3
A2.09	Turbine vibration	3	3
A2.10	Turbine pressure control system	3	3

A 3 Ability to monitor automatic operations of the Main Turbine Generator and Auxiliary Systems including:
(CFR: 41.7 / 45.7)

A3.01	Turbine trip	4
A3.02	Turbine roll to rated speed	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: **SF4MT Main Turbine Generator and Auxiliary Systems (continued)**

K/A NO.	ABILITY	IMPORTANCE
A3.03	Generator megawatt output	3
A3.04	Turbine speed	3
A3.05	Control valve operation	3
A3.06	Turbine lube oil pressure	3
A3.07	Hydrogen seal oil pressure	3
A3.08	Hydrogen gas pressure	3
A3.09	Generator output voltage	3
A3.10	Stator cooling	3
A3.11	Generator lockout	2
A3.12	Turbine lube oil temperature	2
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Turbine lube oil pumps	3
A4.02	Generator controls	3
A4.03	Stator water cooling pumps	3
A4.04	Hydrogen seal oil pumps	3
A4.05	Turbine controls	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4RCIC Reactor Core Isolation Cooling System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic 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	Makeup water condensate system	4
K1.02	Main steam system	4
K1.03	Residual heat removal system	3
K1.04	Instrument air system	2
K1.05	Leak detection and isolation system	3
K1.06	Engineered Safety Function logic and control system	3
K1.07	Feedwater system	4
K1.08	Suppression pool suction strainer	2
K1.09	AC electrical power distribution system	2
K1.10	DC power supply system	3
K1.11	High pressure core flooder system	2
K1.12	Radioactive drain transfer system	2
K1.13	Heating ventilation and air conditioning system	2
K1.14	Post accident monitoring system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	RCIC steam admission valves	3
K2.02	Condensate storage tank suction valve	3
K2.03	Suppression pool suction valve	3
K2.04	RCIC test return to suppression pool valves	2
K2.05	RCIC initiation signals (logic)	3
K2.06	Reactor core isolation cooling drain pump	2
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Core Isolation Cooling System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Reactor vessel pressure	4
K3.03	Decay heat removal	4
K3.04	Adequate core cooling	4

3.4	**Safety Function 4: Heat Removal from Reactor Core**	
System:	**SF4RCIC Reactor Core Isolation Cooling System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 4	**Knowledge of Reactor Core Isolation Cooling System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Prevent water hammer	3
K4.02	Prevent overfilling reactor vessel	3
K4.03	Override of high reactor water level interlock	3
K4.04	Prevents pump over heating	3
K4.05	Prevents turbine damage	3
K4.06	Manual initiation	4
K4.07	Alternate supplies of water	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Core Isolation Cooling System:** (CFR: 41.5 / 45.3)	
K5.01	Assist core cooling	4
K5.02	Suppression pool	4
K5.03	Main condenser	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Core Isolation Cooling System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Instrument air system	2
K6.03	Suppression pool water supply	4
K6.04	Makeup water condensate system	4
K6.05	Main steam system	4
K6.06	Suppression pool suction strainer	3
K6.07	DC power supply system	3
K6.08	Engineered Safety Function logic and control system	3
K6.09	High pressure core flooder system	2
K6.10	Radioactive drain transfer system	2
K6.11	Heating ventilation and air conditioning system	2
K6.12	Feedwater system	3

3.4	**Safety Function 4: Heat Removal from Reactor Core**	
System:	**SF4RCIC Reactor Core Isolation Cooling System (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Core Isolation Cooling System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor core isolation cooling flow	4
A1.02	Reactor core isolation cooling pressure	3
A1.03	Reactor water level	4
A1.04	Reactor pressure	4
A1.05	Reactor core isolation cooling turbine speed	4
A1.06	Condensate storage tank level	3
A1.07	Suppression pool level	3
A1.08	Suppression pool temperature	4

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	System initiation signal	4	4
A2.02	RCIC turbine trips	4	4
A2.03	Injection valve closure	3	3
A2.04	AC power loss	2	2
A2.05	DC power loss	3	3
A2.06	Loss of instrument air system	2	2
A2.07	Loss of RCIC drain pump	2	2
A2.08	Turbine control system failures	3	3
A2.09	Inadequate system flow	3	3
A2.10	Loss of room cooling	3	3
A2.11	Steam line break	4	4
A2.12	Low condensate storage tank level	4	3
A2.13	High suppression pool level	3	3
A2.14	Low suppression pool level	3	3
A2.15	High suppression pool temperature	4	4
A2.16	High drain tank level	2	2

A 3	**Ability to monitor automatic operations of the Reactor Core Isolation Cooling System including:** (CFR: 41.7 / 45.7)	
A3.01	Valve operation	4
A3.02	Turbine startup	4

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4RCIC Reactor Core Isolation Cooling System (continued)

K/A NO.	ABILITY	IMPORTANCE
A3.03	System pressure	4
A3.04	System flow	4
A3.05	Reactor water level	4
A3.06	Indications and alarms	4
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Reactor core isolation cooling turbine speed	4
A4.02	Turbine trip throttle valve reset	4
A4.03	System valves	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: **SF4RRS Reactor Recirculation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Recirculation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor building cooling water system	3
K1.02	AC electrical power distribution system	3
K1.03	Control rod drive system	3
K1.04	Recirculation flow control system	4
K1.05	Plant information and control system	3
K1.06	Makeup water purified system	2
K1.07	Reactor pressure vessel system	3
K1.08	Radioactive drain transfer system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor internal pumps	3
K2.02	Recirculation system MG sets	3
K2.03	Motor generator set oil pumps	2
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Recirculation System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Core flow	4
K3.02	Load following capabilities	3
K3.03	Reactor power	4
K3.04	Reactor water level	4
K3.05	Reactor recirculation system motor generator sets	3
K3.06	Vessel bottom head drain temperature	3
K3.07	Primary containment integrity	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: **SF4RRS Reactor Recirculation System (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Reactor Recirculation System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Adequate reactor internal pump NPSH	3
K4.02	Reactor internal pump motor cooling	3
K4.03	Controlled purge flow	3
K4.04	Automatic voltage/frequency regulation	3
K4.05	Motor generator set trips	3
K4.06	Pump minimum flow limit	3
K4.07	Pump start permissives	3
K4.08	Minimization of reactor vessel bottom head temperature gradients	3
K4.09	End of cycle recirculation pump trip	4
K4.10	Anticipated Transient without scram - Recirc pump trip	4
K4.11	Selected control rods run in circuitry	4
K4.12	Reactor internal pump-runback	4
K4.13	Reactor internal pump startup	3
K4.14	Automatic MG set start sequencing	3
K4.15	Core flow rapid reduction logic	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to the Reactor Recirculation System:** (CFR: 41.5 / 45.3)	
K5.01	Reactor internal pump vibration characteristics	2
K5.02	Restart of reactor internal pumps while operating at power	3
K5.03	Core flow	4
K5.04	Reactor power	4
K5.05	Reactor moderator temperature	3
K5.06	Reactor pressure	3
K5.07	Recirculation flow control system motor-generator sets	4
K5.08	Nuclear boiler instrumentation (reactor water level/pressure/core plate d/p)	3
K5.09	Vessel bottom head drain temperature	3
K5.10	Residual heat removal shutdown cooling mode	3
K5.11	Reactor water level	4
K5.12	Anticipated transient without scram circuitry	4
K5.13	End-of-cycle recirculation pump trip circuitry	4
K5.14	Selected control rods run in circuitry	4
K5.15	Recirculation motor inflatable shaft seal subsystem	2
K5.16	Recirculation motor cooling subsystem	3
K5.17	Reactor internal pump adjustable speed drives	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4RRS Reactor Recirculation System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Recirculation System:** (CFR: 41.7 / 45.7)	
K6.01	Reactor building cooling water systems	3
K6.02	AC electrical power distribution system	3
K6.03	Control rod drive system	3
K6.04	Recirculation system motor-generator sets	3
K6.05	Low reactor water level	3
K6.06	Recirculation motor inflatable shaft seal subsystem	3
K6.07	Makeup water purified system	2
K6.08	Reactor internal pump motor cooling subsystem	3
K6.09	Turbine trip/load rejection	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Recirculation System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor internal pump flow	4
A1.02	Core flow	4
A1.03	Reactor water level	3
A1.04	Reactor power	4
A1.05	Reactor internal pump motor amps	3
A1.06	Reactor internal pump speed	3
A1.07	Recirculation cooling water flow	3
A1.08	Vessel bottom head drain temperature	3
A1.09	Reactor internal pump differential pressure	3
A1.10	Reactor internal pump motor temperature	2
A1.11	Reactor internal pump MG set temperatures	2
A1.12	Reactor internal pump MG drive motor amps	2
A1.13	Reactor internal pump MG set generator current, power, voltage	2
A1.14	Reactor internal pump motor purge flow	3
A1.15	Reactor internal pump vibration	2
A1.16	Core differential pressure	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4RRS Reactor Recirculation System (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Recirculation System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Recirculation system leak	4	4
A2.02	Single reactor internal pump trip	4	4
A2.03	Multiple-reactor internal pump trip	4	4
A2.04	Inadvertent recirculation flow increase	4	4
A2.05	Inadvertent recirculation flow decrease	4	4
A2.06	Reactor internal pump speed mismatch	3	3
A2.07	Reactor internal pump flow mismatch	3	3
A2.08	Low reactor water level	4	4
A2.09	Loss of reactor feedwater	4	4
A2.10	High reactor pressure (ATWS circuitry initiation)	4	4
A2.11	End of cycle recirculation pump trip circuitry initiation	4	4
A2.12	Selected control rods run in circuitry actuation	4	4
A2.13	Loss of motor cooling	3	3
A2.14	Loss of AC power	3	3
A2.15	Loss of reactor building cooling water	3	3
A2.16	Incomplete start sequence	3	3
A2.17	Loss of reactor internal pump purge flow	3	3
A2.18	Reactor internal pump speed runback	3	3
A2.19	Increase in reactor internal pump vibration	2	2
A 3	**Ability to monitor automatic operations of the Reactor Recirculation System including:** (CFR: 41.7 / 45.7)		
A3.01	Pump/MG set start sequence	3	
A3.02	System flow	3	
A3.03	Indications and alarms	3	
A3.04	Pump speed	3	
A3.05	Reactor internal pump trips	3	
A3.06	Reactor internal pump runbacks	3	
A3.07	Recirculation system motor generator set trip	3	
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Reactor internal pumps	4	
A4.02	System flow	4	
A4.03	Core flow	4	

3.4 Safety Function 4: Heat Removal from Reactor Core

System SF4RHRSDC Residual Heat Removal System: Shutdown Cooling Mode

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Residual Heat Removal System: Shutdown Cooling Mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Fuel pool cooling assist	3
K1.02	Reactor building cooling water system	3
K1.03	AC electrical power distribution system	3
K1.04	Reactor water cleanup system	2
K1.05	Radioactive drain transfer system	1
K1.06	Reactor pressure vessel system	3
K1.07	Remote shutdown system	3
K1.08	Sampling system	2
K1.09	Feedwater system	3
K1.10	High pressure nitrogen gas supply system	2
K1.11	Instrument air system	2
K1.12	Plant information and control system	3
K1.13	Leak detection and isolation system	3
K1.14	Engineered Safety Function logic and control system	3
K1.15	Makeup water condensate system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Residual heat removal pumps	3
K2.02	RHR shutdown cooling suction valves	3
K 3	**Knowledge of the effect that a loss or malfunction of the Residual Heat Removal System: Shutdown Cooling Mode will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor pressure	3
K3.02	Reactor pressure vessel water level	3
K3.03	Reactor pressure vessel temperatures (moderator, vessel, flange)	4
K 4	**Knowledge of Residual Heat Removal System: Shutdown Cooling Mode design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	High RHR equipment area temperature isolation	3
K4.02	High reactor pressure vessel isolation	4
K4.03	Low reactor water level isolation	4
K4.04	Adequate pump NPSH	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System SF4RHRSDC Residual Heat Removal System: Shutdown Cooling Mode (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.05	Reactor pressure vessel cooldown rate	4
K4.06	RHR pump motor cooling	2
K4.07	Pump minimum flow	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Residual Heat Removal System: Shutdown Cooling Mode:** (CFR: 41.5 / 45.3)	
K5.01	Reactor pressure vessel pressure	4
K5.02	Reactor water level	4
K5.03	Fuel pool cooling assist	3
K5.04	Low pressure flooder injection	4
K5.05	Reactor pressure vessel temperatures (moderator, vessel, flange)	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Residual Heat Removal System: Shutdown Cooling Mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Low reactor water level	4
K6.03	High reactor pressure	4
K6.04	Reactor building cooling water system	3
K6.05	High pressure nitrogen gas supply system	2
K6.06	Reactor water cleanup system	3
K6.07	Reactor internal pump failure	2
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Residual Heat Removal System: Shutdown Cooling Mode controls including:** (CFR: 41.5 / 45.5)	
A1.01	Heat exchanger cooling flow	3
A1.02	SDC/RHR pump flow	3
A1.03	SDC/RHR pump suction pressure	3
A1.04	Reactor water level	3
A1.05	Reactor pressure vessel temperatures (moderator, vessel, flange)	4
A1.06	RHR pump motor amps	2
A1.07	Heat exchanger temperatures	3
A1.08	SDC/RHR pump/system discharge pressure	3
A1.09	Throttle valve position	3

3.4 Safety Function 4: Heat Removal from Reactor Core

System: SF4RHRSDC Residual Heat Removal System: Shutdown Cooling Mode (continued)

K/A NO. ABILITY IMPORTANCE

A 2 Ability to (a) predict the impacts of the following system/component malfunctions or operations on Residual Heat Removal System: Shutdown Cooling Mode; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	Low shutdown cooling suction pressure	3	3
A2.02	Electrical power distribution failure	3	3
A2.03	System isolation	4	4
A2.04	SDC/RHR pump trips	3	4
A2.05	Loss of RHR pump motor cooling	3	3
A2.06	Loss of heat exchanger cooling	3	4
A2.07	Reactor low water level	4	4
A2.08	Valve operation	3	3
A2.09	Reactor internal pump trips	3	3
A2.10	Inadequate system flow	3	3

A 3 Ability to monitor automatic operations of the Residual Heat Removal System: Shutdown Cooling Mode including:
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3
A3.02	RHR pump trips	3
A3.03	Control room indications and alarms	3
A3.04	Shutdown cooling initiation sequence	3

A 4 Ability to manually operate and/or monitor the Residual Heat Removal System: Shutdown Cooling Mode in the control room:
(CFR: 41.7 / 45.5 to 45.8)

A4.01	SDC/RHR pumps	4
A4.02	SDC/RHR suction valves	4
A4.03	SDC/RHR discharge valves	4
A4.04	Heat exchanger cooling water valves	3
A4.05	Minimum flow valves	3

3.5 Safety Function 5: Containment Integrity

System: **SF5PCS Primary Containment System and Auxiliaries**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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	Atmosphere control system	3
K1.02	Low and high conductivity waste system	3
K1.03	Residual heat removal system	4
K1.04	Suppression pool cleanup system	2
K1.05	Safety/relief valves	4
K1.06	Instrument air system	3
K1.07	Post accident sampling system	3
K1.08	High pressure core flooder system	4
K1.09	Reactor core isolation cooling system	4
K1.10	Containment and drywell atmosphere monitoring system	3
K1.11	Reactor building heating, ventilation, and air conditioning	3
K1.12	Standby gas treatment system	3
K1.13	Drywell cooling system	4
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Containment atmosphere monitoring system	2
K2.02	Drywell cooling fans	2
K 3	**Knowledge of the effect that a loss or malfunction of the Primary Containment System and Auxiliaries will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Secondary containment	4
K3.02	Drywell/wetwell temperature	3
K3.03	Drywell/wetwell pressure	3
K3.04	Drywell/wetwell hydrogen concentration	3
K3.05	Drywell/wetwell oxygen concentration	3
K3.06	Differential pressure between secondary and primary containment	4
K3.07	Differential pressure between wetwell and drywell	3
K3.08	Pneumatically operated valves internal to drywell	3
K3.09	Reactor pressure vessel instrumentation	3
K3.10	Offsite radioactivity release	3

3.5	**Safety Function 5: Containment Integrity**	
System:	**SF5PCS Primary Containment System and Auxiliaries (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 4	**Knowledge of Primary Containment System and Auxiliaries design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Allows for absorption of the energy released during a LOCA	4
K4.02	Contains fission products after a LOCA	4
K4.03	Containment isolation	4
K4.04	Maintains proper wetwell to drywell differential pressure	3
K4.05	Maintains proper secondary containment to drywell differential pressure	3
K4.06	Prevents localized heating of suppression pool (SRV steam quenchers)	3
K4.07	Containment overpressure protection	4
K4.08	Drywell vent pipes (vertical and horizontal)	4
K4.09	Lower drywell flooder	4
K4.10	Quenching of ex-vessel core debris	3
K4.11	Containment inerted by nitrogen	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Primary Containment System and Auxiliaries:** (CFR: 41.5 / 45.3)	
K5.01	Vacuum breaker/relief operation	3
K5.02	Hydrogen production mechanisms	3
K5.03	Hydrogen combustibility versus hydrogen concentration and oxygen concentration	3
K5.04	Hydrogen concentration measurement	3
K5.05	Oxygen concentration measurement	3
K5.06	Differential pressure measurement	3
K5.07	Containment isolation/integrity	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Primary Containment System and Auxiliaries:** (CFR: 41.7 / 45.7)	
K6.01	Drywell cooling	4
K6.02	Suppression pool makeup	4
K6.03	Containment atmospheric control	3
K6.04	Drywell vacuum relief system	4
K6.05	AC electrical distribution	3
K6.06	DC electrical distribution	3

3.5	**Safety Function 5: Containment Integrity**	
System:	**SF5PCS Primary Containment System and Auxiliaries (continued)**	

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K6.07	Atmospheric pressure control system	3
K6.08	Residual heat removal system	4
K6.09	Standby gas treatment system	3
K6.10	Instrument air system	3

ABILITY

AI. **Ability to predict and/or monitor changes in parameters associated with operating the Primary Containment System and Auxiliaries controls including:**
(CFR: 41.5 / 45.5)

A1.01	Drywell temperature	4
A1.02	Drywell pressure	4
A1.03	Wetwell air space temperature	4
A1.04	Wetwell pressure	4
A1.05	Drywell/wetwell oxygen concentration	3
A1.06	Drywell to wetwell differential pressure	3
A1.07	Suppression pool level	4
A1.08	Suppression pool temperature	4
A1.09	Drywell leak detection system	4
A1.10	Reactor building to wetwell differential pressure	3
A1.11	Inerting flow to both the drywell and wetwell	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations 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 conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Loss of coolant accident	4	4
A2.02	Steam bypass of suppression pool	4	4
A2.03	Safety/relief valve leaking or stuck open	4	4
A2.04	High drywell/wetwell hydrogen concentration	4	4
A2.05	High drywell/wetwell oxygen concentration	4	4
A2.06	High drywell pressure	4	4
A2.07	Vacuum breaker malfunction	4	4
A2.08	High drywell temperature	4	4
A2.09	Abnormal suppression pool level	4	4
A2.10	High suppression pool temperature	4	4

3.5 Safety Function 5: Containment Integrity

System: SF5PCS Primary Containment System and Auxiliaries (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Primary Containment System and Auxiliaries including:** (CFR: 41.7 / 45.7)	
A3.01	Vacuum breaker/relief valve operation	3
A3.02	System indications and alarms	3
A3.03	Drywell or wetwell response during LOCA	4
A3.04	Drywell pressure	4
A3.05	Drywell/wetwell differential pressure	3
A 4	**Ability to manually operate and/or monitor the Primary Containment System and Auxiliaries in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Containment overpressure protection system	3
A4.02	Drywell/wetwell nitrogen makeup and purge	3
A4.03	Drywell pneumatics	3
A4.04	Drywell coolers	4

3.5 Safety Function 5: Containment Integrity

System: **SF5LDIS Leak Detection and Isolation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Leak Detection and Isolation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	4
K1.02	Reactor water cleanup system	3
K1.03	Reactor building heating, ventilation, and air conditioning system	3
K1.04	Reactor core isolation cooling	4
K1.05	Residual heat removal system	4
K1.06	Atmosphere control system	3
K1.07	Sampling system	3
K1.08	Standby gas treatment system	3
K1.09	Automated traversing in-core probe system	3
K1.10	Radioactive drain transfer system	3
K1.11	Safety parameter display system	2
K1.12	Reactor building cooling water system	3
K1.13	Standby liquid control system	3
K1.14	Reactor trip and isolation system	3
K1.15	Process radiation monitoring system	3
K1.16	Fuel pool cooling and cleanup system	3
K1.17	Suppression pool clean-up system	2
K1.18	Heating, ventilation, and air conditioning normal cooling water system	2
K1.19	Feedwater system	2
K1.20	Engineered Safety Function logic and control system	3
K1.21	Plant information and control system	3
K1.22	Instrumentation and control power supply system	3
K1.23	Reactor pressure vessel instrumentation system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Logic power supplies	2
K 3	**Knowledge of the effect that a loss or malfunction of the Leak Detection and Isolation System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	4
K3.02	Fuel cladding temperature	4
K3.03	Off-site radioactivity release	4
K3.04	Reactor building radiation level	3
K3.05	Drainage sump levels	3
K3.06	Turbine building radiation	3

3.5 Safety Function 5: Containment Integrity

System: SF5LDIS Leak Detection and Isolation System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.07	Reactor pressure	4
K3.08	Reactor vessel temperature	3
K3.09	Main steam system	3
K3.10	Reactor water cleanup system	3
K3.11	Reactor building heating, ventilation, and air conditioning system	3
K3.12	Reactor core isolation cooling	3
K3.13	Residual heat removal system	3
K3.14	Atmosphere control system	3
K3.15	Containment atmosphere sampling	3
K3.16	Standby gas treatment system	3
K3.17	Automated traversing in-core probe system	3
K3.18	Radioactive drain transfer system	3
K3.19	Reactor building cooling water systems	2
K3.20	Primary containment integrity	3
K3.21	Secondary containment integrity	3
K3.22	Process radiation monitoring system	2
K3.23	Fuel pool cooling and cleanup system	2
K3.24	Condensate system	3
K 4	**Knowledge of Leak Detection and Isolation System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	3
K4.02	Testability	3
K4.03	Manual isolation capability	4
K4.04	Single failures will not impair the function ability of the system	3
K4.05	Once initiated, system reset requires deliberate operator action	3
K4.06	Physical separation of system components (to prevent localized environmental factors, electrical faults, and physical events from impairing system response)	3
K4.07	Manual defeating of selected isolations during specified emergency conditions	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Leak Detection and Isolation System:** (CFR: 41.5 / 45.3)	
K5.01	Primary containment integrity	3
K5.02	Secondary containment integrity	3

3.5 Safety Function 5: Containment Integrity

System: SF5LDIS Leak Detection and Isolation System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the LEAK DETECTION AND ISOLATION System:** (CFR: 41.7 / 45.7)	
K6.01	Instrumentation and control power supply system	3
K6.02	Process radiation monitoring system	3
K6.03	Reactor pressure vessel instrumentation	3
K6.04	Containment instrumentation	3
K6.05	Various process instrumentation	3
K6.06	Reactor trip and isolation system	4
K6.07	Engineered Safety Function logic and control system	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the LEAK DETECTION AND ISOLATION System controls including:** (CFR: 41.5 / 45.5)	
A1.01	System status indications and alarms	4
A1.02	Valve closures	4
A1.03	Safety parameter display system	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the LEAK DETECTION AND ISOLATION System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Electrical power failures	3	4
A2.02	System logic failures	3	3
A2.03	Process radiation monitoring system failures	3	3
A2.04	Reactor pressure vessel instrumentation failures	3	4
A2.05	Containment instrumentation failures	3	3
A2.06	Various process instrumentation failures	3	3
A2.07	Surveillance testing	3	3
A2.08	System initiation	4	4
A2.09	Loss of coolant accidents	4	4
A2.10	Standby liquid control system initiation	4	4

3.5 Safety Function 5: Containment Integrity

System: SF5LDIS Leak Detection and Isolation System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the LEAK DETECTION AND ISOLATION System including:** (CFR: 41.7 / 45.7)	
A3.01	System status indications and alarms	3
A3.02	Valve closures	4
A3.03	Safety parameter display system	3
A3.04	Standby gas treatment system initiation	3
A3.05	Reactor building heating, ventilation, and air conditioning isolation	3
A3.06	Condensate pump trip (feedwater line break)	3
A3.07	Control room habitability area Heating, Ventilation, and Air Conditioning initiation	3
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Valve closures	4
A4.02	Manually initiate isolations	4
A4.03	Reset isolations	4
A4.04	Safety parameter display system	3

3.5 Safety Function 5: Containment Integrity

System: SF5RPV Reactor Vessel Internals

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Vessel Internals and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3
K1.02	Reactor recirculation system	3
K1.03	Feedwater system	3
K1.04	Residual heat removal system	3
K1.05	High pressure core flooder system	3
K1.06	Reactor core isolation cooling system	3
K1.07	Control rod drive system	3
K1.08	Fine motion control rod drive mechanism	3
K1.09	Standby liquid control system	3
K1.10	Reactor water cleanup system	3
K1.11	Automatic depressurization system	3
K1.12	Loose parts monitoring system	2
K1.13	Automated Traversing In-core Probe system	3
K1.14	Neutron monitoring system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Vessel Internals will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	3
K3.02	Reactor pressure	3
K3.03	Reactor power	3
K3.04	Plant radiation levels	3
K3.05	Off-site radioactive release	3
K3.06	Leak detection and isolation system	3
K3.07	Nuclear boiler instrumentation	3
K 4	**Knowledge of Reactor Vessel Internals design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Separation of fluid flow paths within the vessel	3
K4.02	Core orificing	3
K4.03	Moisture removal from generated steam	3
K4.04	Natural circulation	4

3.5	**Safety Function 5: Containment Integrity**	
System:	**SF5RPV Reactor Vessel Internals (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Vessel Internals:** (CFR: 41.5 / 45.3)	
	None	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Vessel Internals:** (CFR: 41.7 / 45.7)	
K6.01	Control rod drive system	3
K6.02	Fine motion control rod drive mechanism	3
K6.03	Reactor recirculation system	3
K6.04	Feedwater system	3
K6.05	Standby Liquid Control system	3
K6.06	Safety/relief valves	3
K6.07	Reactor water cleanup system	3
K6.08	Nuclear boiler instrumentation	3
K6.09	High pressure core flooder system	3
K6.10	Residual heat removal system	3
K6.11	Reactor core isolation cooling system	3
K6.12	Automatic depressurization system	3
K6.13	Loose parts monitoring	2
K6.14	Automated traversing in-core probe system	3
K6.15	Neutron monitoring system	3
K6.16	Main steam system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Vessel Internals controls including:** (CFR:41.5/45.5)	
	None	

3.5 Safety Function 5: Containment Integrity

System: SF5RPV Reactor Vessel Internals (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Vessel Internals; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of coolant accident	4	4
A2.02	Overpressurization transient	4	4
A2.03	Control rod drop accident	4	4
A2.04	Excessive heatup/cooldown rate	4	4
A2.05	Exceeding thermal limits	4	4
A2.06	Exceeding safety limits	4	4
A 3	**Ability to monitor automatic operations of the Reactor Vessel Internals including:** (CFR: 41.7 / 45.7)		
	None		
A 4	**Ability to manually operate and/or monitor the Reactor Vessel Internals in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
	None		

3.5 **Safety Function 5: Containment Integrity**

System: **SF5RHRSPC Residual Heat Removal System: Suppression Pool Cooling Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Residual Heat Removal Systems: Suppression Pool Cooling Mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical power distribution system	4
K1.02	Reactor building cooling water system	3
K1.03	Suppression pool temperature monitoring system	4
K1.04	Remote shutdown system	3
K1.05	Engineered Safety Function logic and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	RHR heat exchanger inlet and outlet valves	3
K2.02	RHR heat exchanger bypass valve	2
K2.03	Residual heat removal system pumps	3
K2.04	Valve control logic	2
K 3	**Knowledge of the effect that a loss or malfunction of the Residual Heat Removal System: Suppression Pool Cooling Mode will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Suppression pool temperature control	4
K3.02	Residual heat removal system drain to radwaste	3
K 4	**Knowledge of Residual Heat Removal System: Suppression Pool Cooling Mode design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	4
K4.02	Unintentional reduction in vessel injection flow during accident conditions	4
K4.03	Pump minimum flow protection	3
K4.04	Pump motor cooling	3
K4.05	Prevention of water hammer	3
K4.06	Adequate pump net positive suction head	3
K4.07	Heat exchanger cooling	3
K4.08	Prevention of leakage to the environment through system heat exchanger	3
K4.09	Automatic initiation of suppression pool cooling	4

3.5	**Safety Function 5: Containment Integrity**	
System:	**SF5RHRSPC Residual Heat Removal System: Suppression Pool Cooling Mode (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Residual Heat Removal System: Suppression Pool Cooling Mode:** (CFR: 41.5 / 45.3)	
K5.01	Suppression pool	4
K5.02	Keep fill	3
K5.03	Residual heat removal system piping	4
K5.04	Residual heat removal system pumps	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Residual Heat Removal System: Suppression Pool Cooling Mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Keep fill	3
K6.03	Suppression pool	4
K6.04	ECCS room cooling	3
K6.06	Reactor pressure vessel instrumentation	3
K6.07	Reactor building cooling water system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Residual Heat Removal System: Suppression Pool Cooling Mode controls including:** (CFR: 41.5 / 45.5)	
A1.01	Suppression pool temperature	4
A1.02	System flow	4
A1.03	System pressure	3
A1.04	Suppression pool level	3
A1.05	Motor amps	2
A1.06	Emergency generator loading	3
A1.07	Wetwell air temperature	3

3.5 Safety Function 5: Containment Integrity

System: SF5RHRSPC Residual Heat Removal System: Suppression Pool Cooling Mode (continued)

K/A NO. ABILITY IMPORTANCE

A 2 Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Residual Heat Removal System: Suppression Pool Cooling Mode; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Inadequate net positive suction head	3	3
A2.02	Pump~~s~~ trips	3	3
A2.03	Valve closures	3	3
A2.04	Valve openings	3	3
A2.05	AC electrical power distribution system failure	3	4
A2.06	Pump seal failure	3	3
A2.07	Inadequate room cooling	3	3
A2.08	Reactor pressure vessel instrument failures	3	3
A2.09	Motor operated valve failures	3	3
A2.10	Valve logic failure	3	3
A2.11	High suppression pool temperature	4	4
A2.12	Loss of coolant accident	4	4
A2.13	Loss of, or inadequate, heat exchanger cooling flow	3	3
A2.14	High suppression pool level	3	3

A 3 Ability to monitor automatic operations of the Residual Heat Removal System: Suppression Pool Cooling Mode including:
(CFR: 41.7 / 45.7)

A3.01	Valve operation	3
A3.02	Pump start	3
A3.03	Pump discharge pressure	2
A3.04	System flow	3
A3.05	Suppression pool temperature	3
A3.06	Reactor building cooling water/ Reactor building service water start signal	3
A3.07	Control room alarms	3
A3.08	System initiation sequence	3

3.5 Safety Function 5: Containment Integrity

System: SF5RHRSPC Residual Heat Removal System: Suppression Pool Cooling Mode (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Residual Heat Removal System: Suppression Pool Cooling Mode in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Residual heat removal system pumps	4
A4.02	Valves pertaining to suppression pool cooling	4
A4.03	Keep fill	3
A4.04	Minimum flow valves	3
A4.05	The overrides for suppression pool cooling valve logic	4

3.5 Safety Function 5: Containment Integrity

System: **SF5RHRSPR Residual Heat Removal System: Drywell and Wetwell Spray Mode**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships Residual Heat Removal System: Drywell and Wetwell Spray-Mode and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical power distribution system	3
K1.02	Reactor pressure vessel instrumentation	3
K1.03	Reactor building cooling water systems	3
K1.04	Fire protection system (PRA)	3
K1.05	Engineered Safety Function logic and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Drywell and wetwell spray motor operated valves	2
K2.02	Residual heat removal pumps	3
K2.03	Valve control logic	2
K 3	**Knowledge of the effect that a loss or malfunction of the Residual Heat Removal System: Drywell and Wetwell Spray-Mode will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Drywell/ wetwell pressure	4
K3.02	Drywell/ wetwell temperature	4
K3.03	Drywell/ wetwell components, due to continued operation with elevated pressure and/or temperature and/or water level	3
K 4	**Knowledge of Residual Heat Removal System: Drywell and Wetwell Spray Mode design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	3
K4.02	Reduction in vessel injection flow during accident conditions	3
K4.03	Prevention of piping overpressurization	2
K4.04	Pump minimum flow protection	3
K4.05	Residual heat removal pump motor cooling	2
K4.06	Prevention of water hammer	3
K4.07	Adequate pump net positive suction head	2
K4.08	Spray flow cooling	3
K4.09	Prevention of leakage to the environment through system heat exchanger	3

3.5	**Safety Function 5: Containment Integrity**	
System:	**SF5RHRSPR Residual Heat Removal System: Drywell and Wetwell Spray Mode (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply Residual Heat Removal System: Drywell and Wetwell Spray Mode:** (CFR: 41.5 / 45.3)	
K5.01	Evaporative cooling	2
K5.02	Convective cooling	2
K5.03	Vacuum breaker operation	3
K5.04	Suppression pool	3
K5.05	Residual heat removal system piping	4
K5.06	Residual heat removal system pumps	4
K5.07	Keep fill	3
K5.08	Drywell spray penetration	3
K5.09	Containment instrumentation	3
K5.10	Wetwell spray penetration	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Residual Heat Removal System: Drywell and Wetwell Spray-Mode:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Keep fill	3
K6.03	Suppression pool (temperature level and pressure)	3
K6.04	ECCS room cooling	2
K6.05	Reactor pressure vessel instrumentation	3
K6.06	Wetwell to drywell vacuum breakers	3
K6.07	Reactor building cooling water system	3
K6.08	Containment integrity	3
K6.09	Suction flow path	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Residual Heat Removal System: Drywell and Wetwell Spray Mode controls including:** (CFR: 41.5 / 45.5)	
A1.01	Drywell pressure	4
A1.02	Drywell temperature	3
A1.03	Wetwell pressure	4
A1.04	Wetwell temperature	3
A1.05	Suppression pool temperature	3

3.5 Safety Function 5: Containment Integrity

System: SF5RHRSPR Residual Heat Removal System: Drywell and Wetwell Spray Mode (continued)

K/A NO.	ABILITY	IMPORTANCE
A1.06	System flow	3
A1.07	System pressure	3
A1.08	Suppression pool level	3
A1.09	RHR pump motor amps	2
A1.10	Emergency generator loading	3

A 2 Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Residual Heat Removal System: Drywell And Wetwell Spray Mode; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	Inadequate net positive suction head	2	3
A2.02	RHR pumps trips	3	3
A2.03	AC electrical power distribution system	3	3
A2.04	Pump seal failure	2	3
A2.05	Inadequate room cooling	3	3
A2.06	Reactor pressure vessel instrumentation failures	3	3
A2.07	Motor operated valve failures	3	3
A2.08	Pump runout	3	3
A2.09	Valve logic failure	3	3
A2.10	High suppression pool level	3	3
A2.11	High drywell/wetwell pressure	4	4
A2.12	Loss of, or inadequate heat exchanger cooling flow	3	3
A2.13	High drywell temperature	3	3
A2.14	Low (or negative) drywell pressure during system operation	4	4
A2.15	Low (or negative) wetwell pressure during system operation	4	4
A2.16	Loss of coolant accident	4	4
A2.17	Loss of drywell cooling system	3	3

A 3 Ability to monitor automatic operations of the Residual Heat Removal System: Drywell and Wetwell Spray Mode including:
(CFR: 41.7 / 45.7)

A3.01	Drywell and wetwell spray initiation sequence	3

3.5 Safety Function 5: Containment Integrity

System: **SF5RHRSPR Residual Heat Removal System: Drywell and Wetwell Spray Mode (continued)**

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Residual Heat Removal System: Drywell and Wetwell Spray Mode in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Residual heat removal system pumps	4
A4.02	Residual heat removal system suction valves	3
A4.03	Residual heat removal system spray valves (PRA)	4
A4.04	Keep fill	3
A4.05	Minimum flow valves	3
A4.06	Valve logic override	4

3.5 Safety Function 5: Containment Integrity

System: **SF5SEC Secondary Containment**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Secondary Containment and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor building heating, ventilation, and air conditioning system	3
K1.02	Primary containment system	4
K1.03	Standby gas treatment system	4
K1.04	Instrument air system	3
K1.05	Reactor building	3
K1.06	Radioactive drain transfer system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Secondary Containment will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Off-site radioactivity release	4
K3.02	Core alterations	3
K3.03	Movement of irradiated fuel in the secondary containment	3
K3.04	Operations with a potential for draining the reactor vessel (OPDRVs)	3
K 4	**Knowledge of Secondary Containment design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Personnel access without breaching secondary containment	4
K4.02	Protection against over pressurization	3
K4.03	Fluid leakage collection	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Secondary Containment:** (CFR: 41.5 / 45.3)	
	None	

3.5 Safety Function 5: Containment Integrity

System: SF5SEC Secondary Containment (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Secondary Containment:** (CFR: 41.7 / 45.7)		
K6.01	Reactor building heating, ventilation, and air conditioning system	4	
K6.02	Standby gas treatment system	4	
K6.03	Primary containment system	4	
K6.04	Instrument air system	3	
K6.05	Reactor building	3	
	ABILITY		
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Secondary Containment controls including:** (CFR: 41.5 / 45.5)		
A1.01	High area temperature	4	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Secondary Containment; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Access doors or equipment hatch failure	3	4
A2.02	Excessive outleakage	4	4
A2.03	High area radiation	3	4
A2.04	High airborne radiation	3	4
A2.05	High area temperature	3	3
A2.06	High area water levels	3	3
A2.07	Low secondary containment differential pressure	3	3
A 3	**Ability to monitor automatic operations of the Secondary Containment including:** (CFR: 41.7 / 45.7)		
A3.01	Secondary containment isolation	4	
A3.02	Secondary containment differential pressure	4	
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
	None		

3.6 Safety Function 6: Electrical

System: **SF6EPDS AC Electrical Distribution System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the AC Electrical Distribution System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Emergency diesel generators	4
K1.02	Direct current power supply system	3
K1.03	Offsite power system	3
K1.04	Vital AC power supply system	3
K1.05	Main turbine/generator	3
K1.06	Combustion turbine generator	4
K1.07	Engineered Safety Function logic and control system	3
K1.08	Remote shutdown system	3
K1.09	Plant information and control system	3
K1.10	Instrument and control power supply system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the AC Electrical Distribution System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Major system loads	4
K3.02	Emergency diesel generators	4
K3.03	Direct current power supply system	3
K3.04	Vital AC power supply system	3
K3.05	Offsite power system	3
K3.06	Combustion turbine generator	4
K3.07	Instrumentation and control power supply system	3
K 4	**Knowledge of AC Electrical Distribution System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Bus lockouts	3
K4.02	Circuit breaker automatic trips	3
K4.03	Interlocks between automatic bus transfer and breakers	3
K4.04	Protective relaying	3
K4.05	Paralleling of AC sources (syncroscope)	4
K4.06	Redundant power sources to vital buses	4

3.6 Safety Function 6: Electrical

System: SF6EPDS AC Electrical Distribution System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to the AC Electrical Distribution System:** (CFR: 41.5 / 45.3)	
K5.01	Principle involved with paralleling two AC sources	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or components malfunctions will have on the AC Electrical Distribution System:** (CFR: 41.7 / 45.7)	
K6.01	DC power	3
K6.02	Loss of off-site power	4
K6.03	Main generator trip	4

	ABILITY		
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the AC Electrical Distribution System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Effect on instrumentation and controls of switching power supplies	3	
A1.02	Effects of loads when energizing a bus	3	
A1.03	Bus voltage	3	
A1.04	Load currents	3	
A1.05	Breaker lineups	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the AC Electrical Distribution System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Turbine/generator trip	3	4
A2.02	Loss of coolant accident	4	4
A2.03	Loss of off-site power	4	4
A2.04	Types of loads that, if deenergized, would degrade or hinder plant operation	4	4
A2.05	Bus grounds	3	3
A2.06	Deenergizing a live bus	3	3
A2.07	Energizing a dead bus	3	3
A2.08	Exceeding voltage limitations	3	3

3.6 Safety Function 6: Electrical

System: SF6EPDS AC Electrical Distribution System (continued)

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A2.09	Exceeding current limitations	3	3
A2.10	Degraded system voltages	3	4
A2.11	Main generator load rejection	3	3
A2.12	Station blackout	4.4	

A 3 Ability to monitor automatic operations of the AC Electrical Distribution System including:
(CFR: 41.7 / 45.7)

K/A NO.	ABILITY	IMPORTANCE
A3.01	Breaker tripping	3
A3.02	Automatic bus transfer	3
A3.03	Load shedding	3
A3.04	Load sequencing	3
A3.05	Synchronizing and paralleling of different AC supplies	3

A 4 Ability to manually operate and/or monitor the AC Electrical Distribution System in the control room:
(CFR: 41.7 / 45.5 to 45.8)

K/A NO.	ABILITY	IMPORTANCE
A4.01	Available breakers and disconnects (including available switchyard)	3
A4.02	Synchroscope, including understanding of running and incoming voltages	3
A4.03	Local operation of breakers	3
A4.04	Synchronizing and paralleling of different AC supplies	4
A4.05	Voltage, current, power, and frequency on AC buses	3
A4.06	Perform ground isolation	2

3.6 Safety Function 6: Electrical

System: **SF6DC Direct Current Power Supply System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Direct Current Power Supply System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical power distribution system	3
K1.02	Control building heating, ventilation, and air conditioning system	3
K1.03	Control rod drive system	3
K1.04	Engineered Safety Function logic and control system	4
K1.05	Plant information and control system	4
K1.06	Reactor trip and isolation system	4
K1.07	Reactor core isolation cooling system	4
K1.08	Fuel pool cooling and cleanup system	3
K1.09	Turbine lube oil system	2
K1.10	Generator seal oil system	2
K1.11	Lighting and servicing power supply system	2
K1.12	Emergency diesel generator system	3
K1.13	Vital AC power supply system	3
K1.14	Suppression pool cleanup system	2
K1.15	Turbine control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Alternate rod insertion valves	3
K2.02	Backup scram relay contacts to CRD air header dump valves	3
K2.03	Reactor core isolation cooling system DC valves	3
K2.04	Emergency lighting system	2
K2.05	Engineered Safety Function logic and control system	3
K2.06	Plant information and control system	3
K 3	**Knowledge of the effect that a loss or malfunction of the Direct Current Power Supply System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Emergency diesel generators	3
K3.02	Engineered Safety Function logic and control system	3
K3.03	Reactor core isolation cooling system	3
K3.04	Reactor trip and isolation system	3
K3.05	Control rod drive system	3
K3.06	Suppression pool cleanup system	2
K3.07	Fuel pool cooling and cleanup system	2
K3.08	Turbine lube oil system	2
K3.09	Generator seal oil system	2

3.6 Safety Function 6: Electrical

System: SF6DC Direct Current Power Supply System (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K3.10	Lighting and servicing power supply system	2
K3.12	Vital AC power supply system	3
K3.13	Plant information and control system	3
K3.14	AC electrical power distribution system	3
K3.15	Automatic depressurization system	3
K 4	**Knowledge of Direct Current Power Supply System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Manual/ automatic transfers of control	3
K4.02	Breaker interlocks, permissives, bypasses and cross ties	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply Direct Current Power Supply System:** (CFR: 41.5 / 45.3)	
K5.01	Hydrogen generation during battery charging	3
K5.02	Battery charger and battery	3
K5.03	Ground detection	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Direct Current Power Supply System:** (CFR: 41.7 / 45.7)	
K6.01	Electrical power distribution system	3
K6.02	Battery ventilation	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Direct Current Power Supply System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Battery discharging rate	3

3.6 **Safety Function 6: Electrical**

System: **SF6DC Direct Current Power Supply System (continued)**

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Direct Current Power Supply System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Grounds	3	3
A2.02	Loss of ventilation during charging	3	3
A2.03	Station blackout	3	3
A 3	**Ability to monitor automatic operations of the Direct Current Power Supply System including:** (CFR: 41.7 / 45.7)		
A3.01	Control room indications and alarms	3	
A 4	**Ability to manually operate and/or monitor the Direct Current Power Supply System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Major breakers and control power fuses	3	

3.6 Safety Function 6: Electrical

System: SF6EDGCTG Emergency Generators (Diesel/Combustion Turbine Generator)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between Emergency Generators (Diesel/Combustion Turbine Generators) and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Electrical power distribution system	4
K1.02	Direct current power supply system	3
K1.03	Fire protection system	3
K1.04	Reactor building cooling water system	3
K1.05	Remote shutdown system	3
K1.06	Engineered Safety Function logic and control system	4
K1.07	Makeup water purified system	2
K1.08	Vital AC power supply system	3
K1.09	Reactor building heating, ventilation, and air conditioning system	3
K1.10	Plant information and control system	3
K1.11	Residual heat removal system	4
K1.12	High pressure core flooder system	4
K1.13	Grounding and lightning protection system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Air compressor	2
K2.02	Fuel oil pumps	2
K2.03	Lube oil pumps	2
K2.04	Emergency diesel generator field flash	2
K 3	**Knowledge of the effect that a loss or malfunction of the Emergency Generators (Diesel/Combustion Turbine Generators) will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Residual heat removal system	4
K3.02	High pressure core flooder system	4
K3.03	Electrical power distribution system	4
K 4	**Knowledge of Emergency Generators (Diesel/Combustion Turbine Generators) design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Generator trips (normal)	4
K4.02	Generator trips (emergency/Loss of coolant accident)	4
K4.03	Speed droop control	3

3.6 Safety Function 6: Electrical

System: **SF6EDGCTG Emergency Generators (Diesel/Combustion Turbine Generator) (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.04	Field flashing	3
K4.05	Load shedding and sequencing	3
K4.06	Governor control	3
K4.07	Local operation and control	3
K4.08	Automatic startup	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Emergency Generators (Diesel/Combustion Turbine Generators):** (CFR: 41.5 / 45.3)	
K5.01	Definition of frequency and synchronous frequency	2
K5.02	Reactive power control	2
K5.03	Real power control	2
K5.04	Fuel oil supply subsystem	3
K5.05	Starting air subsystem	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Emergency Generators (Diesel/Combustion Turbine Generators):** (CFR: 41.7 / 45.7)	
K6.01	Starting air	4
K6.02	Fuel oil pumps	4
K6.03	Lube oil pumps	4
K6.04	Ignition system (combustion turbine generator)	3
K6.05	Reactor building cooling water system	4
K6.06	Electrical power distribution system	4
K6.07	DC electrical power supply system	3
K6.08	Engineered Safety Function logic and control system	4
K6.09	Makeup water purified system	3
K6.10	Loss of offsite power	3
K6.11	Loss of coolant accident	3
K6.12	Jacket cooling water	3

3.6 Safety Function 6: Electrical

System: SF6EDGCTG Emergency Generators (Diesel/Combustion Turbine Generator) (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Emergency Generators (Diesel/Combustion Turbine Generators controls including:** (CFR: 41.5 / 45.5)	
A1.01	Lube oil temperature	3
A1.02	Fuel consumption rate	2
A1.03	Operating voltages, currents, and temperatures	3
A1.04	Crank case temperature and pressure	3
A1.05	Cylinder temperature differential	2
A1.06	Emergency generator room temperature	2
A1.07	Maintaining minimum load on generator (to prevent reverse power)	3
A1.08	Diesel generator load (MWe and frequency)	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Emergency Generators (Diesel/Combustion Turbine Generators); and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Parallel operation of generator	4	4
A2.02	Unloading prior to securing generator	3	3
A2.03	Operating unloaded, lightly loaded, and highly loaded.	3	3
A2.04	Consequences of operating under/over excited	3	3
A2.05	Synchronization of the generator with other electrical supplies	4	4
A2.06	Opening normal and/or alternate power to Class 1E AC bus	3	3
A2.07	Loss of off-site power during full-load testing	4	4
A2.08	Initiation of generator room fire protection system	3	4
A2.09	Loss of electrical power distribution system	4	4
A2.10	LOCA	4	4
A2.11	Station blackout	4	4

A 3 **Ability to monitor automatic operations of the Emergency Generators (Diesel/Combustion Turbine Generators) including:**
(CFR: 41.7 / 45.7)

A3.01	Automatic starting of emergency generator	3
A3.02	Minimum time for load pick up	3
A3.03	Control room indications and alarms	3

3.6 Safety Function 6: Electrical

System: SF6EDGCTG Emergency Generators (Diesel/Combustion Turbine Generator) (continued)

K/A NO.	ABILITY	IMPORTANCE
A3.04	Operation of the governor control system on frequency and voltage control	3
A3.05	Load shedding and sequencing	3
A3.06	Reactor building cooling water system operation	3

A 4 Ability to manually operate and/or monitor Emergency Generators (Diesel/Combustion Turbine Generator) in the control room:
(CFR: 41.7 / 45.5 to 45.8)

A4.01	Adjustment of exciter voltage	3
A4.02	Synchroscope	3
A4.03	Transfer of control between manual and automatic	3
A4.04	Manual start, loading, and stopping of generator	4
A4.05	Transfer of generator (with load) to grid	4

3.6 Safety Function 6: Electrical

System: SF6VAC Vital AC Power Supply System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Vital AC Power Supply System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Rod control and information system	3
K1.02	Reactor trip and isolation system	3
K1.03	Process radiation monitoring system	3
K1.04	Neutron monitoring system	3
K1.05	Standby liquid control system	3
K1.06	Plant data network	2
K1.07	Containment atmospheric monitoring system	2
K1.08	Electrical power distribution system	3
K1.09	DC power supply system	3
K1.10	Control building heating, ventilation, and air conditioning system	2
K1.11	Recirculation flow control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Vital AC Power Supply System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor trip and isolation system	3
K3.02	Reactor recirculation flow control system	3
K3.03	Neutron monitoring system	3
K3.04	Standby liquid control system	3
K3.05	Plant data network	2
K3.06	Containment atmospheric monitoring system	2
K3.07	Rod control and information system	3
K3.08	Control building heating, ventilation, and air conditioning system	2
K 4	**Knowledge of Vital AC Power Supply System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Transfer from preferred power to alternate power supplies	3

3.6 Safety Function 6: Electrical

System: SF6VAC Vital AC Power Supply System (continued)

K/A NO.	ABILITY	IMPORTANCE
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Vital AC Power Supply System:** (CFR: 41.5 / 45.3)	
K5.01	General principles of static inverter operation	2
K5.02	General principles of static switch operation	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Vital AC Power Supply System:** (CFR: 41.7 / 45.7)	
K6.01	Electrical power distribution system	3
K6.02	DC power supply system	3
K6.03	Static inverter	3

ABILITY

A 1 **Ability to predict and/or monitor changes in parameters associated with operating the Vital AC Power Supply System controls including:**
(CFR: 41.5 / 45.5)

None

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Vital AC Power Supply System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Under voltage	3	3
A2.02	Over voltage	3	3
A2.03	Frequency changes in the system	2	3

A 3 **Ability to monitor automatic operations of the Vital AC Power Supply System including:**
(CFR: 41.7 / 45.7)

A3.01	Transfer from preferred to alternate source	3

3.6 Safety Function 6: Electrical

System: SF6VAC Vital AC Power Supply System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Vital AC Power Supply System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Transfer from alternative source to preferred source	3

3.6 Safety Function 6: Electrical

System: **SF6I&C Instrumentation and Control Power Supply System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Instrumentation and Control Power Supply System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Engineered Safety Function logic and control system	4
K1.02	Plant information and control system	4
K1.03	Makeup water condensate system	2
K1.04	Residual heat removal system	2
K1.05	High pressure core flooder system	2
K1.06	Reactor building cooling water system	2
K1.07	Reactor service water system	2
K1.08	Service air system	2
K1.09	Instrument air system	2
K1.10	Drywell cooling system	3
K1.11	Electrical power distribution system	3
K1.12	AC electrical power distribution system	4
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Instrumentation and Control Power Supply System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Engineered Safety Function logic and control system	4
K3.02	Plant information and control system	4
K3.03	Makeup water condensate system	2
K3.04	Residual heat removal system	2
K3.05	High pressure core flooder system	2
K3.06	Reactor water cleanup system	2
K3.07	Reactor building cooling water system	2
K3.08	Reactor service water system	2
K3.09	Service air system	2
K3.10	Instrument air system	3
K 4	**Knowledge of Instrumentation and Control Power Supply System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
	None	

3.6 Safety Function 6: Electrical

System: SF6I&C Instrumentation and Control Power Supply System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Instrumentation and Control Power Supply System:** (CFR: 41.5 / 45.3)	
	None	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Instrumentation and Control Power Supply System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	4

ABILITY

A 1 **Ability to predict and/or monitor changes in parameters associated with operating the Instrumentation and Control Power Supply System controls including:**
(CFR: 41.5 / 45.5)

None

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Instrumentation and Control Power Supply System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	Under voltage	3	3
A2.02	Over voltage	3	3
A2.03	Distribution board feed breaker trip	3	3

A 3 **Ability to monitor automatic operations of the Instrumentation and Control Power Supply System including:**
(CFR: 41.7 / 45.7)

None

3.6 Safety Function 6: Electrical

System: SF6I&C Instrumentation and Control Power Supply System (continued)

K/A NO. ABILITY IMPORTANCE

A 4 Ability to manually operate and/or monitor the Instrumentation and Control Power Supply System in the control room:
(CFR: 41.7 / 45.5 to 45.8)

None

3.7 Safety Function 7: Instrumentation

System: SF7APR Automatic Power Regulator System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships and between the Automatic Power Regulator System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Rod control and information system	4
K1.02	Neutron monitoring system	3
K1.03	Recirculation flow control system	4
K1.04	Steam bypass and pressure control system	4
K1.05	Plant information and control system	3
K1.06	Turbine control system	4
K1.07	Reactor water cleanup system	3
K1.08	Main generator	3
K1.09	Automated thermal limit monitoring system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Automatic power regulator digital controllers	2
K 3	**Knowledge of the effect that a loss or malfunction of the Automatic Power Regulator System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Rod control and information system	4
K3.02	Recirculation flow control system	4
K3.03	Steam bypass and pressure control system	4
K3.04	Turbine control system	4
K3.05	Plant information and control system	4
K 4	**Knowledge of Automatic Power Regulator System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Determination of reactor criticality when Automatic Power Regulator is in automatic mode	3
K4.02	Trip of Automatic Power Regulator to manual when system or component conditions are abnormal during execution of prescribed sequences	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7APR Automatic Power Regulator System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Automatic Power Regulator System:** (CFR: 41.5 / 45.3)	
K5.01	Main generator output	3
K5.02	Reactor power	4
K5.03	Rod pattern control	3
K5.04	Reactivity control	3
K5.05	Reactor water temperature during startup and shutdown	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Automatic Power Regulator System:** (CFR: 41.7 / 45.7)	
K6.01	Plant information and control system	3
K6.02	Neutron monitoring system	3
K6.03	Reactor water cleanup system	3
K6.04	Steam bypass and pressure control system	4
K6.05	Turbine control system	3
K6.06	Main generator system	4
K6.07	Rod control and information system	4
K6.08	Recirculation flow control system	4
K6.09	Automated thermal limit monitoring system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Automatic Power Regulator System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor power	4
A1.02	Reactor pressure	3
A1.03	Main generator power output	3
A1.04	Reactor water temperature	3
A1.05	Power/flow operating map	3

3.7 Safety Function 7: Instrumentation

System: SF7APR Automatic Power Regulator System (continued)

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Automatic Power Regulator System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
A2.01	Fault detection while in automatic mode of operation	3	3
A 3	**Ability to monitor automatic operations of the Automatic Power Regulator System including:** (CFR: 41.7 / 45.7)		
A3.01	Dedicated operator interface indications	3	
A3.02	Verification of proper functioning/operability	3	
A3.03	Annunciator and alarm signals	3	
A3.04	Reactor power	4	
A3.05	Core flow	4	
A3.06	Control rod position	4	
A3.07	Reactor pressure	3	
A3.08	Reactor water temperature	3	
A3.09	Main generator output	3	
A 4	**Ability to manually operate and/or monitor the Automatic Power Regulator System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Console controls to set up various automatic power regulator modes of operation	4	

3.7 Safety Function 7: Instrumentation

System: **SF7ATLM Automated Thermal Limit Monitor**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Automated Thermal Limit Monitor and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Rod control and information system	4
K1.02	Automatic power regulator system	4
K1.03	Feedwater control system	2
K1.04	Recirculation flow control system	4
K1.05	Neutron monitoring system	3
K1.06	Plant information and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Automated thermal limit monitor system controllers	2
K 3	**Knowledge of the effect that a loss or malfunction of the Automated Thermal Limit Monitor will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Rod control and information system	4
K3.02	Recirculation flow control system	4
K3.03	Automatic power regulator system	4
K 4	**Knowledge of Automated Thermal Limit Monitor design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks/errors	4
K4.02	Bypassing an automated thermal limit monitor channel	3
K4.03	System testing	2
K4.04	Inhibiting an increase in recirculation flow	4
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Automated Thermal Limit Monitor:** (CFR: 41.5 / 45.3)	
	None	

3.7 Safety Function 7: Instrumentation

System: SF7ATLM Automated Thermal Limit Monitor (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunction or component malfunctions will have on the Automated Thermal Limit Monitor:** (CFR: 41.7 / 45.7)	
K6.01	Recirculation flow control system	3
K6.02	Feedwater control system input (cleanup water flow, feedwater temperature and total feedwater flow to RPV)	3
K6.03	Plant information and control system	3
K6.05	Neutron monitoring system	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Automated Thermal Limit Monitor controls including:** (CFR: 41.5 / 45.5)	
A1.01	Rod position	3
A1.02	Status of control rod withdrawal blocks	3
A1.03	Status of recirculation flow increase blocks	3
A1.03	Automated thermal limit monitor channel bypass status	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Automated Thermal Limit Monitor; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Power supply loss	2	2
A2.02	Loss of neutron monitoring input	3	3
A2.03	Automatic self-bypass of the ATLM protective features	2	2

A 3	**Ability to monitor automatic operations of the Automated Thermal Limit Monitor including:** (CFR: 41.7 / 45.7)	
A3.01	System indications and alarms on control room panels and backpanels	3
A3.02	Verification of proper functioning/operability	3
A3.03	Control rod withdrawal blocks	3
A3.04	Inhibit of recirculation flow increase	3
A3.05	Automatic bypass below low power setpoint	3

3.7 Safety Function 7: Instrumentation

System: SF7ATLM Automated Thermal Limit Monitor (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Automated Thermal Limit Monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Controls to bypass/unbypass an Automated Thermal Limit Monitor channel	3

3.7 Safety Function 7: Instrumentation

System: SF7APRM Average Power Range Monitor/Local Power Range Monitor System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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	Reactor trip and isolation system	4
K1.02	Multi-channel rod block monitor system	3
K1.03	Safety parameter display system	3
K1.04	Plant information and control system	3
K1.05	Rod control and information system	3
K1.06	Automated traversing incore probe system	3
K1.07	Reactor pressure vessel	3
K1.08	Automatic power regulator system	3
K1.09	Oscillation power range monitor sub-system	4
K1.10	Recirculation flow control system	3
K1.11	Engineered Safety Function logic and control system	3
K1.12	Vital AC power supply system	3
K1.13	Automated thermal limit monitor system	3
K1.14	Primary containment system	2
K1.15	Rod worth minimizer system	3
K1.16	Feedwater control system	3
K1.17	Automatic depressurization system	4
K 2	**Knowledge bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Local Power Range Monitor detector channels	2
K2.02	Average Power Range Monitor channels	3
K2.03	Oscillation power range monitor channels	2
K 3	**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:** (CFR: 41.7 / 45.4)	
K3.01	Reactor trip and isolation system	4
K3.02	Recirculation flow control system	3
K3.03	Rod control and information system	3
K3.04	Reactor power indication	4
K3.05	Multichannel rod block monitor	3
K3.06	Core thermal limit calculations	4
K3.07	Automatic power regulator system	3

3.7 Safety Function 7: Instrumentation

System: SF7APRM Average Power Range Monitor/Local Power Range Monitor System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.08	Oscillation power range monitor system	4
K3.09	Engineered Safety Function logic and control system	3
K3.10	Automated thermal limit monitor system	3
K3.11	Rod worth minimizer system	3
K 4	**Knowledge of Average Power Range Monitor/Local Power Range Monitor System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	4
K4.02	Reactor scram signals	4
K4.03	Individual Local Power Range Monitor detector replacement	2
K4.04	Alarm seal-in	2
K4.05	Effects of detector aging on Average Power Range Monitor/Local Power Range Monitor readings	3
K4.06	Average Power Range Monitor flow biased trip setpoints	4
K4.07	Multichannel rod block monitor setpoints	4
K4.08	Sampling of overall core power in each Average Power Range Monitor (accomplished through Local Power Range Monitor assignments and symmetrical rod patterns)	3
K4.09	Detection of power oscillations	4
K4.10	Inhibit of automatic initiation of Automatic Depressurization System	4
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Average Power Range Monitor/Local Power Range Monitor System:** (CFR: 41.5 / 45.3)	
K5.01	Local Power Range Monitor detector operation	3
K5.02	Effects of voids on Local Power Range Monitor indication	3
K5.03	Control rod symmetrical patterns	3
K5.04	Local Power Range Monitor detector location and core symmetry	3
K5.05	Core flow effects on Average Power Range Monitor trip setpoints	4
K5.06	Assignment of Local Power Range Monitor's to specific Average Power Range Monitor channels	2

3.7 Safety Function 7: Instrumentation

System: SF7APRM Average Power Range Monitor/Local Power Range Monitor System (continued)

K/A NO.	ABILITY	IMPORTANCE	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Average Power Range Monitor/Local Power Range Monitor System:** (CFR: 41.7 / 45.7)		
K6.01	Reactor trip and isolation system	4	
K6.02	Automated traversing incore probe system	2	
K6.03	Detectors	3	
K6.04	Rod control and information system	3	
K6.05	Vital AC power supply system	3	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Average Power Range Monitor/Local Power Range Monitor System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Reactor power indication	4	
A1.02	Reactor trip and isolation system status	4	
A1.03	Control rod block status	4	
A1.04	Scram and rod block trip setpoints	4	
A1.05	Indications and alarms	3	
A1.06	Average Power Range Monitor (gain adjustment factor)	4	
A1.07	Injection of cold water into the reactor pressure vessel	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Average Power Range Monitor/Local Power Range Monitor System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Power supply degraded	3	3
A2.02	Upscale or downscale trips	4	4
A2.03	Inoperative trip (all causes)	4	4
A2.04	Scram trip signals	4	4
A2.05	Rod block signals	4	4
A2.06	Loss of reactor recirculation flow signal	4	4
A2.07	Core flow channels upscale/downscale	3	4
A2.08	Faulty or erratic operation of detectors/systems	3	3

3.7 Safety Function 7: Instrumentation

System: SF7APRM Average Power Range Monitor/Local Power Range Monitor System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Average Power Range Monitor/Local Power Range Monitor System including:** (CFR: 41.7 / 45.7)	
A3.01	Panel indications	3
A3.02	Annunciator and alarm signals	3
A3.03	Reactor trip and Isolation System status	4
A3.04	Control rod block status	4
A3.05	Inhibit of automatic initiation of Automatic Depressurization System	4
A 4	**Ability to manually operate and/or monitor the Average Power Range Monitor/Local Power Range Monitor System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Average Power Range Monitor back panel switches	3
A4.02	Local Power Range Monitor back panel switches	3
A4.03	Oscillation Power Range Monitor back panel switches	3
A4.05	Trip bypasses	3
A4.06	Bypass an Average Power Range Monitor/Local Power Range Monitor channel	3

3.7 Safety Function 7: Instrumentation

System: **SF7NBI Nuclear Boiler Instrumentation**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Nuclear Boiler Instrumentation and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor trip and isolation system	4
K1.02	Neutron monitoring system	3
K1.03	Engineered Safety Function logic and control system	4
K1.04	Safety/relief valves	4
K1.05	Recirculation flow control system	3
K1.06	Feedwater control system	4
K1.07	Feedwater system	3
K1.08	Plant information and control system	3
K1.09	Reactor pressure vessel	4
K1.10	Steam bypass and pressure control system	4
K1.11	Remote shutdown system	3
K1.12	Alternate feedwater injection system	3
K1.13	Control rod drive system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Nuclear Boiler Instrumentation will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor trip and isolation system	4
K3.02	Leak detection and isolation system	4
K3.03	Reactor core isolation cooling system	4
K3.04	High pressure core flooder system	4
K3.05	Residual heat removal	4
K3.06	Automatic depressurization system	4
K3.07	Relief/safety valves	4
K3.08	Alternate rod insertion	4
K3.09	Recirculation flow control system	3
K3.10	Feedwater control system	4
K3.11	Feedwater system	3
K3.12	Main turbine	3
K3.13	Emergency diesel generators	4
K3.14	Anticipated transient without scram logic	4

3.7 Safety Function 7: Instrumentation

System: SF7NBI Nuclear Boiler Instrumentation (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.15	Plant information and control system	3
K3.16	Reactor pressure vessel	3
K3.17	Vessel temperature monitoring	3
K3.18	Vessel level monitoring	4
K3.19	Vessel pressure monitoring	4
K3.20	Core flow monitoring	4
K3.21	Core differential pressure monitoring	4
K3.22	Loose parts detection in the primary system	3
K3.23	Reactor internal pump flow monitoring	2
K3.24	Recirculation system	3
K3.25	Steam bypass and pressure control system	3
K 4	**Knowledge of Nuclear Boiler Instrumentation design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Reading of nuclear boiler parameters outside the control room	4
K4.02	Physical separation of sensors	3
K4.03	Redundancy of sensors	3
K4.04	Inputs to the reactor trip and isolation system	4
K4.05	Initiation of the emergency core cooling systems	4
K4.06	Initiation of the leak detection and isolation system	4
K4.07	Protection for the main turbine from high moisture carryover	3
K4.08	Protection against filling the main steam lines from the feed system	3
K4.09	Inputs to alternate reactor shutdown system	4
K4.10	Reactor vessel overpressure protection	4
K4.11	Overpressure protection for various low-pressure systems	3
K4.13	Temperature compensation for water level indication	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Nuclear Boiler Instrumentation:** (CFR: 41.5 / 45.3)	
K5.01	Vessel vibration measurement (loose parts monitor)	2
K5.02	Steam flow effect on reactor water level	3
K5.03	Anticipated transient without scram logic	4
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Nuclear Boiler Instrumentation:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution system	3
K6.02	DC electrical distribution system	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7NBI Nuclear Boiler Instrumentation (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Nuclear Boiler Instrumentation controls including:** (CFR: 41.5/45.5)	
A1.01	Control room indications	3
A1.02	Removing or returning a transmitter from/to service	3
A1.03	Surveillance testing	3
A1.04	System venting	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Nuclear Boiler Instrumentation; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of power supply	3	3
A2.02	Reactor coolant temperature	3	3

A 3	**Ability to monitor automatic operations of the Nuclear Boiler Instrumentation including:** (CFR: 41.7 / 45.7)	
A3.01	Relationship between display readings and actual parameter values	3
A 4	**Ability to manually operate and/or monitor the Nuclear Boiler Instrumentation in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Channel select controls	3
A4.02	Process computer	3

3.7 Safety Function 7: Instrumentation

System: **SF7RAD Radiation Monitoring System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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	2
K1.02	Offgas system	3
K1.03	Plant stack	3
K1.04	Reactor building cooling water system	3
K1.05	Radioactive waste treatment system	3
K1.06	Reactor building heating, ventilation, and air conditioning system	3
K1.07	Fuel building heating, ventilation, and air conditioning system	3
K1.08	Service building heating, ventilation, and air conditioning system	2
K1.09	Leak detection and isolation system	4
K1.10	Turbine building heating, ventilation, and air conditioning system	3
K1.11	Radwaste building heating, ventilation, and air conditioning system	3
K1.12	Plant information and control system	3
K1.13	Emergency response information system	2
K1.14	Vital AC power supply system	2
K1.15	Instrument air system	2
K1.16	Engineered Safety Function logic and control system	3
K1.17	Standby gas treatment system	3
K1.18	Makeup water purified system	2
K1.19	Control building heating, ventilation, and air conditioning system	3
K1.20	Extraction system	3
K 2	**Knowledge of bus or electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Main steamline radiation monitors	3
K2.02	Offgas radiation monitoring system	3
K2.03	Plant stack radiation monitoring	3
K2.04	Radwaste liquid radiation monitoring system	2
K2.05	Reactor building heating, ventilation, and air conditioning monitors	3
K2.06	Area radiation monitors	2
K2.07	Control room ventilation monitors	2
K 3	**Knowledge of the effect that a loss or malfunction of the Radiation Monitoring System will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	Station liquid effluent release monitoring	3
K3.02	Station gaseous effluent release monitoring	3
K3.03	Station area radiation monitoring	3
K3.04	Offgas system	4

3.7 Safety Function 7: Instrumentation

System: SF7RAD Radiation Monitoring System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.05	Reactor building heating, ventilation, and air conditioning	3
K3.06	Drywell sump liquid discharge	2
K3.07	Radwaste building ventilation	3
K3.08	Control building heating, ventilation, and air conditioning system	3
K 4	**Knowledge of Radiation Monitoring System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	3
K4.02	Automatic actions to contain the radioactive release in the event that the predetermined release rates are exceeded	4
K4.03	Fail safe tripping of process radiation monitoring logic during conditions of instrument failure	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Radiation Monitoring System:** (CFR: 41.7 / 45.4)	
K5.01	Hydrogen injection operation's effect on process radiation indications	3
K5.02	Drywell sump liquid discharge	2
K5.03	Turbine gland seal condenser exhaust	2
K5.04	Fuel handling area ventilation exhaust	3
K5.05	Drywell	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Radiation Monitoring System:** (CFR: 41.7 / 45.7)	
K6.01	Vital AC power	3
K6.02	Plant information and control system	2
K6.03	Leak detection and isolation system	2
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Radiation Monitoring System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Alarms and indications associated with normal operations	3
A1.02	Alarms and indications associated with surveillance testing	3

System: **SF7RAD Radiation Monitoring System (continued)**

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (d) 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 conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Fuel element failure	4	4
A2.02	AC electrical failure	3	3
A2.03	Downscale trips	3	3
A2.04	Offgas system failure	3	3
A2.05	Low fuel pool level	3	3
A2.06	Loss of coolant accident	4	4
A2.07	Leakage and/or breaks from contaminated systems to atmosphere or to other process systems	3	4
A2.08	Refuel floor handling accidents/operations	3	4
A2.09	Low reactor water level during refueling operations	3	4
A 3	**Ability to monitor automatic operations of the Radiation Monitoring System including:** (CFR: 41.7 / 45.7)		
A3.01	Offgas system isolation indications	4	
A3.02	Liquid radwaste isolation indications	3	
A3.03	Radwaste handing interlocks	2	
A3.04	Drywell LCW or HCW sump isolation indications	3	
A3.05	Ventilation system isolation indications	3	
A3.06	Display indications	3	
A3.07	Meter indications	3	
A3.08	Containment isolation indications	4	
A3.09	Lights and alarms	3	
A 4	**Ability to manually operate and/or monitor the Radiation Monitoring System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4. 01	Manually trip process radiation monitor logic	3	

3.7 Safety Function 7: Instrumentation

System: **SF7RTIS Reactor Trip and Isolation System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Trip and Isolation System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Neutron monitoring system	4
K1.02	Nuclear boiler system	4
K1.03	Vital AC power supply system	3
K1.04	Control rod drive system	3
K1.05	Plant information and control system	3
K1.06	Turbine main steam system	3
K1.07	Suppression pool temperature monitoring system	3
K1.08	Rod control and information system	3
K1.09	Recirculation flow control system	3
K1.10	Leak detection and isolation system	3
K1.11	Engineered Safety Function logic and control system	3
K1.12	Direct current power supply system	3
K1.13	Feedwater control system	3
K1.14	Instrumentation and control power supply system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor Trip and Isolation System logic channels	3
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Trip and Isolation System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Leak detection and isolation system	4
K3.02	Reactor Protection System logic channels	4
K3.03	Scram air header solenoid operated valves	4
K3.04	Reactor power	4
K3.05	Reactor coolant primary system integrity	4
K3.06	The magnitude of heat energy that must be absorbed by the containment during accident/transient conditions	3
K3.07	The ability of the core cooling systems to provide adequate core cooling during loss of coolant accidents	4
K3.08	Recirculation flow control system	3
K3.09	Secondary containment integrity	3
K3.10	Plant information and control	3
K3.11	Engineered Safety Function logic and control system	3
K3.12	Feedwater control system	3

3.7 Safety Function 7: Instrumentation

System: SF7RTIS Reactor Trip and Isolation System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Reactor Trip and Isolation System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	System redundancy and reliability	3
K4.02	The prevention of a reactor scram following a single component failure	4
K4.03	Functional testing of the system while maintaining power operation	4
K4.04	Manual system activation	4
K4.05	Complete control rod insertion following scram signal generation	4
K4.06	Control rod insertion following RPS system electrical failure	4
K4.07	Dual-rod scram testing	3
K4.08	Operation with the neutron monitoring system selection switch in non-coincident position	3
K4.09	Initiation of the “scram follow” function following a reactor scram signal	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Trip and Isolation System:** (CFR: 41.5 / 45.3)	
K5.01	Specific logic arrangements	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Trip and Isolation System:** (CFR: 41.7 / 45.7)	
K6.01	Vital AC power supply system	3
K6.02	Neutron monitoring system	3
K6.03	Main steam system	3
K6.04	Main condenser vacuum	3
K6.05	Turbine main steam system	3
K6.06	Leak detection and isolation system	3
K6.07	Control rod drive system	3
K6.08	Suppression pool temperature monitoring system	3
K6.09	Direct current power supply system	3
K6.10	Instrumentation and control power supply system	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7RTIS Reactor Trip and Isolation System (continued)**	
K/A NO	**ABILITY**	**IMPORTANCE**
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Trip and Isolation System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor power	4
A1.02	Reactor water level	3
A1.03	Reactor pressure	3
A1.04	Control rod position	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Trip and Isolation System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	**SRO**
A2.01	RTIS power supply failure	4	4
A2.02	Neutron monitoring system failure	4	4
A2.03	RTIS logic channel failure	3	4
A2.04	High reactor power	4	4
A2.05	High reactor pressure	4	4
A2.06	Low reactor level	4	4
A2.07	High main steam line flow	4	4
A2.08	Low main steam line pressure	4	4
A2.09	High drywell pressure	4	4
A2.10	Turbine stop valve closure signal	4	4
A2.11	Control valve fast closure signal	4	4
A2.12	Main steamline isolation valve closure	4	4
A2.13	Low condenser vacuum	4	4
A2.14	Low control rod drive charging header pressure	4	4
A2.15	Changing mode switch position	4	4
A2.16	Half-scram signal	2	2
A2.17	Complete scram signal	4	4
A2.18	Half-MSIV isolation signal	2	2
A2.18	Complete MSIV isolation signal	4	4
A2.20	High main steam line tunnel temperature	4	4
A2.21	High suppression pool temperature	4	4
A2.22	Short reactor period	4	4

3.7 Safety Function 7: Instrumentation

System: SF7RTIS Reactor Trip and Isolation System (continued)

K/A NO	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Reactor Trip and Isolation System including:** (CFR: 41.7 / 45.7)	
A3.01	Reactor power	4
A3.02	Control rod position	4
A3.03	Control room indications and alarms	4
A3.04	End-of-cycle recirculation pump trip	4
A 4	**Ability to manually operate and/or monitor the Reactor Trip and Isolation System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Reactor mode switch	4
A4.02	Manual scram pushbuttons	4
A4.03	Manual scram reset switch	4
A4.04	Divisional manual main steam line isolation switch	3
A4.05	CRD charging pressure trip bypass switch	4
A4.06	Divisional RPS/MSIV sensor bypass switch	3
A4.07	Divisional RPS/MSIV trip logic function trip bypass switch	3
A4.08	Divisional trip logic function auto trip test switch	3
A4.09	Main steam line isolation bypass switch	3

3.7 Safety Function 7: Instrumentation

System: SF7MRBM Multi-Channel Rod Block Monitor System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Multi-Channel Rod Block Monitor System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Average power range/local power range monitor sub-system	3
K1.02	Rod control and information system	3
K1.03	Plant information and control system	3
K1.04	Vital AC power supply system	3
K1.05	Automated thermal limit monitor system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Multi-channel rod block monitor channels	2
K 3	**Knowledge of the effect that a loss or malfunction of the Multi-Channel Rod Block Monitor System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Rod control and information system	3
K 4	**Knowledge of Multi-Channel Rod Block Monitor System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	3
K4.02	Allows manual or auto setup of rod block lines during power increase	3
K4.03	Automatic setdown of rod block lines during power reduction	3
K4.04	Initiation point	3
K4.05	Bypass an MRBM channel	**3**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Multi-Channel Rod Block Monitor System:** (CFR: 41.5 / 45.3)	
K5.01	Trip reference selection	3
K5.02	Local power range monitors	3
K5.03	Control rod selection	3

3.7 Safety Function 7: Instrumentation

System: SF7MRBM Multi-Channel Rod Block Monitor System (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Multi-Channel Rod Block Monitor System:** (CFR: 41.7 / 45.7)	
K6.01	Vital AC power supply system	2
K6.02	Local power range monitor detectors	3
K6.03	Automated thermal limit monitor system	3
K6.04	Core flow signal	2

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Multi-Channel Rod Block Monitor System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Trip reference	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Multi-Channel Rod Block Monitor System ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Withdrawal of control rod in high power region of core	3	4
A2.02	Loss or reduction in core flow (flow comparator)	3	3
A2.03	Loss of associated Average Power Range Monitor channel	3	3
A2.04	Power supply loss	3	3
A2.05	Multi-channel rod block monitor upscale or inoperable	3	3

A 3	**Ability to monitor automatic operations of the Multi-Channel Rod Block Monitor System including:** (CFR: 41.7 / 45.7)	
A3.01	Control room indications and alarms	3
A3.02	Verification or proper functioning/operability	4
A3.03	Back panel indications	4
A3.04	Automatic setup when in automatic rod withdrawal mode	3
A3.05	Automatic setdown of setpoint during power reduction	3

3.7 Safety Function 7: Instrumentation

System: SF7MRBM Multi-Channel Rod Block Monitor System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 4	**Ability to manually operate and/or monitor the Multi-Channel Rod Block Monitor System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	MRBM back panel switches, indications and indicating lights	3
A4.02	Trip bypasses	3
A4.03	"Setup" pushbutton	3

3.7 Safety Function 7: Instrumentation

System: SF7RWM Rod Worth Minimizer System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Rod Worth Minimizer System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Rod control and information system	3
K1.02	Neutron monitoring system	3
K1.03	Reactor trip and isolation system	3
K1.04	Vital AC power supply system	3
K1.05	Plant information and control system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Rod worth minimizer circuitry	2
K 3	**Knowledge of the effect that a loss or malfunction of the Rod Worth Minimizer System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Rod control and information system	3
K 4	**Knowledge of Rod Worth Minimizer System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Insert blocks	3
K4.02	Withdraw blocks	4
K4.03	Automatic bypass above low power setpoint	3
K4.04	System testing	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Rod Worth Minimizer System:** (CFR: 41.5 / 45.3)	
K5.01	Low power set point	3
K5.02	Low power alarm point	3
K5.02	Rod groups and steps	3
K5.03	Withdraw block	4
K5.04	Insert block	4
K5.05	Possible fuel damage due to rod withdrawal error	3

3.7 Safety Function 7: Instrumentation

System: **SF7RWM Rod Worth Minimizer System (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Rod Worth Minimizer System:** (CFR: 41.7 / 45.7)	
K6.01	Vital AC power supply system	3
K6.02	Rod control and information system	3
K6.03	Neutron monitoring system	3
K6.04	Reactor trip and isolation system	3
K6.05	Inoperable control rod	3
K6.06	Stuck control rod	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Rod Worth Minimizer System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Rod position	3
A1.02	Status of control rod movement blocks	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Rod Worth Minimizer System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Power supply loss	3	3
A2.02	Inoperable control rod	3	3
A2.03	Stuck control rod	3	3
A2.04	Out of sequence rod movement	3	4
A2.05	RWM hardware/software failure	3	3

A 3	**Ability to monitor automatic operations of the Rod Worth Minimizer System including:** (CFR: 41.7 / 45.7)	
A3.01	System indication	3
A3.02	Verification of proper functioning/operability	4
A3.03	Annunciator and alarm signals	3
A3.04	Control rod movement blocks	4
A3.05	Automatic bypass above the low power setpoint	3

3.7 Safety Function 7: Instrumentation

System: SF7RWM Rod Worth Minimizer System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Rod Worth Minimizer in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Bypass single channel of the rod worth minimizer circuitry	3
A4.02	Dual channel bypass for special operations	2

3.7 Safety Function 7: Instrumentation

System: SF7SRNM Startup Range Neutron Monitoring System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Startup Range Neutron Monitoring System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor trip and isolation system	4
K1.02	Rod control and information system	3
K1.03	Plant information and control system	3
K1.04	Reactor pressure vessel	3
K1.05	Primary containment system	3
K1.06	Engineered Safety Function logic and control system	3
K1.07	Automatic power regulator system	3
K1.08	Vital AC power supply system	3
K1.09	Alternate reactor shutdown system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Startup range neutron monitoring channels/detectors	3
K 3	**Knowledge of the effect that a loss or malfunction of the Startup Range Neutron Monitoring System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor trip and isolation system	3
K3.02	Rod control and information system	3
K3.03	Reactor power indications	4
K3.04	Automatic power regulator system	3
K3.05	Engineered Safety Function logic and control system	3
K3.06	Plant information and control system	3
K3.07	Alternate reactor shutdown system	3
K 4	**Knowledge of Startup Range Neutron Monitoring System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Rod withdrawal blocks	4
K4.02	Reactor scram signals	3
K4.03	Gamma compensation	2
K4.04	Different power determination methods (counting and Campbelling technique)	2
K4.05	Bypassing a startup range neutron monitoring channel	3
K4.06	SRNM indications when changing reactor mode switch position	2

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7SRNM Startup Range Neutron Monitoring System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K4.07	ATWS permissive for automatic SLC initiation	3
K4.08	Non-coincidence scram signals during initial fuel loading	2
K4.09	Alarm seal-in	2
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Startup Range Neutron Monitoring System:** (CFR: 41.5 / 45.3)	
K5.01	Gamma discrimination	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Startup Range Neutron Monitoring System:** (CFR: 41.7 / 45.7)	
K6.01	Reactor trip and isolation system	3
K6.02	Vital AC power supply system	3
K6.03	Startup range neutron monitoring detectors	3
K6.04	Reactor vessel	3
K6.05	Primary containment system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Startup Range Neutron Monitoring System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor power indication	4
A1.02	Reactor trip and isolation system status	3
A1.03	Control rod block status	4
A1.04	Scram, rod block, and period alarm trip setpoints	4
A1.05	Indications and alarms	3
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Startup Range Neutron Monitoring System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)	

		RO	SRO
A2.01	Vital AC power supply loss	3	3
A2.02	Startup range neutron monitoring inoperable condition	3	4

3.7 Safety Function 7: Instrumentation

System: **SF7SRNM Startup Range Neutron Monitoring System (continued)**

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A2.03	Up scale and downscale trips	4	4
A2.04	Faulty or erratic operation of detectors/system	3	4
A 3	**Ability to monitor automatic operations of the Startup Range Neutron Monitoring System including:** (CFR: 41.7 / 45.7)		
A3.01	Control room indications	3	
A3.02	Annunciator and alarm signals	3	
A3.03	Reactor trip and isolation system status	4	
A3.04	Control rod block status	4	
A3.05	ATWS permissive for SLC initiation	3	
A 4	**Ability to manually operate and/or monitor the Startup Range Neutron Monitoring in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Startup range neutron monitoring channel bypass switches	3	

3.7 Safety Function 7: Instrumentation

System: **SF7ATIP Automated Traversing In-Core Probe System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between Automated Traversing In-Core Probe System and the following:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Local power range monitors	3
K1.02	Plant information and control system	3
K1.03	Instrument air system	2
K1.04	Leak detection and isolation system	3
K1.05	DC power supply system	2
K1.06	Electrical power distribution system	2
K1.07	Instrumentation and control power supply system	2
K1.08	Reactor pressure vessel	3
K1.09	Primary containment system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Shear valves	2
K2.02	ATIP channels/detectors	2
K 3	**Knowledge of the effect that a loss or malfunction of the Automated Traversing In-Core Probe System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Local power range monitor's calibration	2
K 4	**Knowledge of Automated Traversing In-Core Probe System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Primary containment isolation	3
K4.02	Radiation shielding	2
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to Automated Traversing In-Core Probe System:** (CFR: 41.5 / 45.3)	
K5.01	Increasing area radiation monitor indications	

3.7 Safety Function 7: Instrumentation

System: SF7ATIP Automated Traversing In-Core Probe (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Automated Traversing In-Core Probe System:** (CFR: 41.7 / 45.7)	
K6.01	DC power supply system	2
K6.02	AC electrical power distribution system	2
K6.03	Instrumentation and control power supply system	2
K6.04	Plant information and control system	3
K6.05	Leak detection and isolation system	3
K6.06	Instrument air system	2
K6.07	Nuclear boiler system	2

	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Automated Traversing In-Core Probe System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Radiation levels	3
A1.02	Detector position	3
A1.03	Valve status	3
A1.04	Drive speed	2
A1.05	Detector output	2
A1.06	Radiation alarms	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Automated Traversing In-Core Probe System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5/45.6)

		RO	SRO
A2.01	Low reactor water level	3	3
A2.02	High drywell pressure	3	3
A2.03	Drive mechanism failure	2	2
A2.04	Electrical power distribution system	2	2
A2.05	DC power supply system	2	2
A2.06	Shear valve closures	2	3
A2.07	Failure to retract during accident conditions	3	4
A2.08	Failure to retract to shield	3	3

3.7 Safety Function 7: Instrumentation

System: SF7ATIP Automated Traversing In-Core Probe (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Automated Traversing In-Core Probe System including:** (CFR: 41.7 / 45.7)	
A3.01	Detector position	2
A3.02	Detector drive speed	2
A3.03	Valve operation	3
A3.04	Indicating lights	2
A3.05	Detector output	2
A 4	**Ability to manually operate and/or monitor the Automated Traversing In-Core Probe System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Isolation valves	3

3.7 Safety Function 7: Instrumentation

System: SF7ELCS Engineered Safety Function Logic and Control System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Engineered Safety Function Logic and Control System and the following systems:** (CFR: 41.2 to 41.9/45.7 to 45.8)	
K1.01	Reactor trip and isolation system	3
K1.02	Neutron monitoring system	3
K1.03	Standby liquid control system	4
K1.04	Process radiation monitoring system	3
K1.05	Plant information and control system	3
K1.06	DC power supply system	3
K1.07	Instrumentation and control power system	3
K1.08	Leak detection and isolation system	3
K1.09	Suppression pool temperature monitoring system	3
K1.10	High pressure core flooder system	4
K1.11	Reactor core isolation cooling system	4
K1.12	Residual heat removal system	4
K1.13	Automatic depressurization system	4
K1.14	Emergency diesel generators	3
K1.15	Standby gas treatments system	3
K1.16	Reactor building cooling water system	3
K1.17	Reactor service water system	3
K1.18	Heating, ventilation, and air conditioning system emergency cooling water system	3
K1.19	High-pressure nitrogen gas supply system	3
K1.20	Alternate reactor shutdown system	3
K1.21	Feedwater system (feedwater line break circuitry)	3
K1.22	Containment atmospheric monitoring system	3
K1.23	Reactor building heating, ventilation, and air conditioning system	3
K1.24	Control building heating, ventilation, and air conditioning system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Engineered Safety Function Logic and Control System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor trip and isolation system	3
K3.02	Neutron monitoring system	3
K3.03	Standby liquid control system	4
K3.04	Process radiation monitoring system	3

3.7 Safety Function 7: Instrumentation

System: SF7ELCS Engineered Safety Function Logic and Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.05	Plant information and control system	3
K3.06	Leak detection and isolation system	3
K3.07	Suppression pool temperature monitoring system	3
K3.08	High pressure core flooder system	4
K3.09	Reactor core isolation cooling system	4
K3.10	Residual heat removal system	4
K3.11	Automatic depressurization system	4
K3.12	Emergency diesel generators	3
K3.13	Standby gas treatment system	3
K3.14	Reactor building cooling water system	3
K3.15	Reactor service water system	3
K3.16	Heating, ventilation, and air conditioning system emergency cooling water system	3
K3.17	High-pressure nitrogen gas supply system	3
K3.18	Alternate reactor shutdown system	3
K3.19	Feedwater system (feedwater line break circuitry)	3
K3.20	Containment atmospheric monitoring system	3
K3.21	Reactor building heating, ventilation, and air conditioning system	3
K3.22	Control building heating, ventilation, and air conditioning system	3

K 4 Knowledge of Engineered Safety Function Logic and Control System design feature(s) and/or interlocks which provide for the following:
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.01	Redundancy of instrumentation	3
K4.02	On-line self diagnostic testing	3
K4.03	Initiation of the emergency core cooling systems	4
K4.04	Inputs to alternate rod insertion circuitry	4

K 5 Knowledge of the operational implications or cause and effect relationships as they apply to Engineered Safety Function Logic and Control System:
(CFR: 41.5 / 45.3)

None

K 6 Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Engineered Safety Function Logic and Control System:
(CFR: 41.7 / 45.7)

K/A NO.	KNOWLEDGE	IMPORTANCE
K6.01	Instrumentation and control power supply system	3
K6.02	DC power supply system	3

3.7 Safety Function 7: Instrumentation

System: SF7ELCS Engineered Safety Function Logic and Control System (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 1.	**Ability to predict and/or monitor changes in parameters associated with operating the Engineered Safety Function Logic and Control System controls including:** (CFR: 41.5/45.5)		
A1.01	Removing or returning a channel to service	3	
A1.02	Surveillance testing	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Nuclear Boiler Instrumentation; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of AC or DC power supply	3	3
A2.02	System initiation/isolation due to Engineered Safety Function logic and control actuation	3	3
A 3	**Ability to monitor automatic operations of the Engineered Safety Function Logic and Control System including:** (CFR: 41.7 / 45.7)		
A3.01	System initiation/isolation	3	
A 4	**Ability to manually operate and/or monitor the Engineered Safety Function Logic and Control System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Removing or returning a channel to service	3	

3.7 Safety Function 7: Instrumentation

System: **SF7PICS Plant Information and Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Plant Information and Control System and the following systems:** (CFR: 41.2 to 41.9/45.7 to 45.8)	
K1.01	Main steam system	3
K1.02	Reactor recirculation system	3
K1.03	Control rod drive system	3
K1.04	Leak detection and isolation system	3
K1.05	Reactor water cleanup system	3
K1.06	Fuel pool cooling and cleanup system	2
K1.07	Suppression pool cleanup system	2
K1.08	Turbine main steam system	3
K1.09	Condensate, feedwater and condensate air extraction system	2
K1.10	High vent and drain system	2
K1.11	Main turbine	2
K1.12	Steam bypass and pressure control system	3
K1.13	Turbine gland steam system	2
K1.14	Turbine lube oil system	2
K1.15	Moisture separator reheaters	2
K1.16	Hydrogen gas cooling system	2
K1.17	Generator cooling system	2
K1.18	Generator seal oil system	2
K1.19	Main condenser	2
K1.20	Offgas system	3
K1.21	Circulating water system	2
K1.22	Makeup water purified system	2
K1.23	Turbine building cooling water system	2
K1.24	Heating, ventilation, and air conditioning system normal cooling water system	2
K1.25	Turbine service water system	2
K1.26	Atmosphere control system	3
K1.27	Drywell cooling system	3
K1.28	Control building heating, ventilation, and air conditioning system	3
K1.29	Turbine building heating, ventilation, and air conditioning system	2
K1.30	Instrument air system	2
K1.31	AC electrical power distribution system	3
K1.32	Makeup water condensate system	2
K1.33	Neutron monitoring system	3
K1.34	Reactor trip and isolation system	3
K1.35	Engineered Safety Function logic and control system	3
K1.36	Rod control and information system	3
K1.37	Feedwater control system	3

3.7 Safety Function 7: Instrumentation

System: SF7PICS Plant Information and Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K1.38	Recirculation flow control system	3
K1.39	Standby liquid control system	3
K1.40	Process radiation monitoring system	3
K1.41	Area radiation monitoring system	2
K1.42	Alternate feedwater injection system	3
K1.43	Automated traversing incore probe system	2
K1.44	Automatic power regulator system	3
K1.45	Instrumentation and control power supply system	3
K1.46	Direct current power supply system	3
K1.47	Loose parts monitoring system	2
K1.48	Asset monitoring system	2
K1.49	Plant data network	2
K1.50	Containment atmospheric monitoring system	3
K1.51	Fuel servicing equipment	3
K1.52	Turbine supervisory system	3
K1.53	Combustion turbine system	3
K1.54	Emergency diesel generator system	3

K 2 Knowledge of bus or division power supplies to the following:
(CFR: 41.7)

None

K 3 Knowledge of the effect that a loss or malfunction of the Plant Information and Control System will have on the following:
(CFR: 41.7 / 45.4)

K3.01	Main steam system	3
K3.02	Reactor recirculation system	3
K3.03	Control rod drive system	3
K3.04	Leak detection and isolation system	3
K3.05	Reactor water cleanup system	3
K3.06	Fuel pool cooling and cleanup system	2
K3.07	Suppression pool cleanup system	2
K3.08	Turbine main steam system	3
K3.09	Condensate, feedwater and condensate air extraction system	2
K3.10	High vent and drain system	2
K3.11	Main turbine	2
K3.12	Steam bypass and pressure control system	3
K3.13	Turbine gland steam system	2
K3.14	Turbine lube oil system	2
K3.15	Moisture separator reheaters	2
K3.16	Hydrogen gas cooling system	2
K3.17	Generator cooling system	2

3.7 Safety Function 7: Instrumentation

System: SF7PICS Plant Information and Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.18	Generator seal oil system	2
K3.19	Main condenser	2
K3.20	Offgas system	3
K3.21	Circulating water system	2
K3.22	Makeup water purified system	2
K3.23	Turbine building cooling water system	2
K3.24	Heating, ventilation, and air conditioning system normal cooling water system	2
K3.25	Turbine service water system	2
K3.26	Atmosphere control system	3
K3.27	Drywell cooling system	3
K3.28	Control building heating, ventilation, and air conditioning system	3
K3.29	Turbine building heating, ventilation, and air conditioning system	2
K3.30	Instrument air system	2
K3.31	AC electrical power distribution system	3
K3.32	Makeup water condensate system	2
K3.33	Neutron monitoring system	3
K3.34	Reactor trip and isolation system	3
K3.35	Engineered Safety Function logic and control system	3
K3.36	Rod control and information system	3
K3.37	Automated thermal limit monitoring system	3
K3.38	Feedwater control system	3
K3.39	Recirculation flow control system	3
K3.40	Standby liquid control system	3
K3.41	Process radiation monitoring system	3
K3.42	Area radiation monitoring system	2
K3.43	Alternate feedwater injection system	3
K3.44	Automated traversing incore probe system	2
K3.45	Automatic power regulator system	3
K3.46	Instrumentation and control power supply system	3
K3.47	Direct current power supply system	3
K3.48	Loose parts monitoring system	2
K3.49	Asset monitoring system	2
K3.50	Plant data network	2
K3.51	Containment atmospheric monitoring system	3
K3.52	Fuel servicing equipment	2
K3.53	Turbine supervisory system	3
K3.54	Combustion turbine system	3
K3.55	Emergency diesel generator system	3

3.7 Safety Function 7: Instrumentation

System: SF7PICS Plant Information and Control System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Plant Information and Control System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy of instrumentation	2
K4.02	On-line self diagnostic testing	2
K 5	**Knowledge of the operational implications or cause-effects relationships as they apply to Plant Information and Control System:** (CFR: 41.5 / 45.3)	
K5.01	Power generation control system	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Plant Information and Control System:** (CFR: 41.7 / 45.7)	
K6.01	Instrumentation and control power supply system	3
K6.02	DC power supply system	3

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Plant Information and Control System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Control room indications associated with normal operations	2	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Plant Information and Control System ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	AC or DC power supply failure	3	3

3.7 Safety Function 7: Instrumentation

System: SF7PICS Plant Information and Control System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 3	**Ability to monitor automatic operations of Plant Information and Control System including:** (CFR: 41.7 / 45.7)	
A3.01	Reactor startup, power operation, and shutdown of the plant in Power Generation Control System “automatic or semi-automatic mode of operation	3
A 4	**Ability to manually operate and/or monitor the Plant Information and Control System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Activate appropriate breakpoint to allow continuation of Power Generation Control System automatic operation	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7SPTM Suppression Pool Temperature Monitoring System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Suppression Pool Temperature Monitoring System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Engineered Safety Function logic and control system	4
K1.02	Plant information and control system	3
K1.03	Reactor trip and isolation system	4
K1.04	Primary containment system (suppression pool temperature and level)	3
K1.05	Remote shutdown system	3
K1.06	Residual heat removal system	4
K1.07	Vital AC power supply system	3
K1.08	Reactor building cooling water system	4
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Suppression pool temperature monitoring logic channels	2
K 3	**Knowledge of the effect that a loss or malfunction of the Suppression Pool Temperature Monitoring System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Primary containment system (suppression pool temperature and level)	3
K3.02	Reactor trip and isolation system	4
K3.03	Residual heat removal system	4
K3.04	Remote shutdown system	3
K3.05	Plant information and control system	3
K3.06	Reactor building cooling water system	4
K 4	**Knowledge of Suppression Pool Temperature Monitoring System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	System redundancy and reliability	3
K4.02	Arrangement of temperature sensors in suppression pool	2
K4.03	Method of determining average temperature of suppression pool	3
K4.04	Suppression pool temperature monitoring logic arrangement	3

3.7 Safety Function 7: Instrumentation

System: SF7SPTM Suppression Pool Temperature Monitoring System (continued)

K/A NO	KNOWLEDGE	IMPORTANCE
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Suppression Pool Temperature Monitoring System:** (CFR: 41.5 / 45.3)	
K5.01	Low suppression pool level	3
K5.02	Safety/relief valve operation	3
K 6	**Knowledge of the effect of the following plant malfunctions, system malfunctions or component malfunctions will have on the Suppression Pool Temperature Monitoring System:** (CFR: 41.7 / 45.7)	
K6.01	Primary containment system (suppression pool temperature and level)	3
K6.02	Vital AC power supply system	3
K6.03	Engineered Safety Function logic and control system	3

ABILITY

K/A NO	ABILITY	RO	SRO
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Suppression Pool Temperature Monitoring System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Surveillance testing	2	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Suppression Pool Temperature Monitoring System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
A2.01	High suppression pool temperature	3	3
A2.02	Low suppression pool level	3	3
A2.03	Failure or erratic operation of suppression pool temperature/level detector	3	3

3.7 Safety Function 7: Instrumentation

System: SF7SPTM Suppression Pool Temperature Monitoring System (continued)

K/A NO	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Suppression Pool Temperature Monitoring System including:** (CFR: 41.7 / 45.7)	
A3.01	Control room indications and alarms	3
A3.02	Initiations and actuations due high suppression pool temperature	3
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	SPTM backpanel switches	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7RSS Remote Shutdown System**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Remote Shutdown System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3
K1.02	Nuclear Boiler Instrumentation system	3
K1.03	Residual heat removal system	4
K1.04	High pressure core flooder system	3
K1.05	Reactor building cooling water system	3
K1.06	AC electrical distribution system	3
K1.07	Reactor service water system	3
K1.08	Atmosphere control system	3
K1.09	Makeup water condensate system	2
K1.10	Emergency diesel generator system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Remote Shutdown System will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	Main steam system	3
K3.02	Nuclear Boiler Instrumentation system	3
K3.03	Residual heat removal system	4
K3.04	High pressure core flooder system	3
K3.05	Reactor building cooling water system	3
K3.06	AC electrical distribution system	3
K3.07	Reactor service water system	3
K3.08	Atmosphere control system	3
K3.09	Makeup water condensate system	2
K3.10	Emergency diesel generator system	3
K 4	**Knowledge of Remote Shutdown System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Ability to transfer control of interfacing system equipment from the main control room and override capability (manual and automatic) of operating the interfacing equipment from the main control room	3

3.7	**Safety Function 7: Instrumentation**	
System:	**SF7RSS Remote Shutdown System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Remote Shutdown System:** (CFR: 41.7 / 45.4)	
K5.01	Heat removal mechanisms	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Remote Shutdown System:** (CFR: 41.7 / 45.7)	
K6.01	Conditions which cause the main control room to become inaccessible	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Remote Shutdown System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Reactor pressure vessel water level	3
A1.02	Reactor pressure vessel pressure	3
A1.03	Residual heat removal pump discharge pressure	3
A1.04	Residual heat removal heat exchanger inlet temperature	3
A1.05	Residual heat removal heat exchanger outlet temperature	3
A1.06	Residual heat removal system flow	3
A1.07	High pressure core flooder system flow	3
A1.08	High pressure core flooder pump discharge pressure	3
A1.09	Reactor service water system ultimate heat sink water level	3
A1.10	Reactor service water system ultimate heat sink temperature	3
A1.11	Reactor building cooling water system flow	3
A1.12	Suppression pool level	3
A1.13	Drywell temperature	3
A1.14	Drywell pressure	3
A1.15	Condensate storage tank level	3
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Remote Shutdown System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)	

K/A NO.		RO	SRO
A2.01	Control room evacuation	3	4

3.7 Safety Function 7: Instrumentation

System: SF7RSS Remote Shutdown System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
A 3	**Ability to monitor automatic operations of the Remote Shutdown System including:** (CFR: 41.7 / 45.7) None	
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8) None	

3.8 Safety Function 8: Plant Service Systems

System **SF8SFS Fire Protection System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Fire Protection System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main generator hydrogen system	3
K1.02	Auxiliary steam system	2
K1.03	A.C electrical power distribution system	3
K1.04	Residual heat removal system	4
K1.05	Fire detection system	2
K1.06	Makeup water preparation system	2
K1.07	Instrument air system	2
K1.08	Turbine lube oil system	2
K1.09	Fuel oil transfer system	2
K1.10	Emergency diesel generators	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Fire protection supervisory circuits	2
K2.02	Motor driven pumps	3
K2.03	Fire detection system	2
K 3	**Knowledge of the effect that a loss or malfunction of the Fire Protection System will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	The ability to detect fires	3
K3.02	Personnel protection	3
K3.03	Plant protection	4
K3.04	Residual heat removal system	4
K 4	**Knowledge of Fire Protection System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.5 / 41.7 / 45.3 / 45.5 to 45.8)	
K4.01	Adequate supply of water for the fire protection system	3
K4.02	Automatic system initiation	3
K4.03	Maintenance of fire header pressure	3
K4.04	Personnel safety during halon and/or carbon dioxide system actuation	4
K4.05	Fire protection capability during loss of off-site power	4
K4.06	Fire suppression capability that does not rely on the displacement of oxygen (Halon)	3
K4.07	Diesel engine protection	3
K4.08	Ability to provide alternate source of water to the reactor pressure vessel or primary containment	4

3.8	**Safety Function 8: Plant Service Systems**	
System	**SF8SFS Fire Protection System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Fire Protection System:** (CFR: 41.5/45.3)	
K5.01	Effect of carbon dioxide on fires	3
K5.02	Effect of Halon on fires	3
K5.03	Effect of water spray on electrical components	3
K5.04	Diesel operations	3
K5.05	Heat detection	3
K5.06	Smoke detection	3
K5.07	Reactor water level	3
K5.08	Emergency generator rooms	3
K5.09	Main generator exciter	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Fire Protection System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Diesel fuel transfer system	3
K6.03	Fire detection system	2
K6.04	Makeup water preparation system	2
K6.05	Instrument air system	2
	ABILITY	
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Fire Protection System controls including:** (CFR: 41.5/45.5)	
A1.01	System pressure	3
A1.02	System flow	2
A1.03	Fire doors	3
A1.04	Fire dampers	3
A1.05	System lineups	3

3.8 Safety Function 8: Plant Service Systems

System SF8SFS Fire Protection System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Fire Protection System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	System logic failure	3	3
A2.02	AC electrical power distribution system failure	3	3
A2.03	Fire protection diesel trips	3	3
A2.04	Low fire header pressure	3	3
A2.05	Inadvertent system initiation	3	3
A2.06	Failure to actuate when required	3	3
A2.07	Pump trips	3	3
A2.08	Low diesel fuel supply	3	3
A 3	**Ability to monitor automatic operations of the Fire Protection System including:** (CFR: 41.7 / 45.7)		
A3.01	Fire water pump start	3	
A3.02	Fire main pressure	3	
A3.03	Actuation of fire detectors	3	
A3.04	System initiation	3	
A3.05	Fire doors	3	
A3.06	Fire dampers	3	
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Electric fire pump	3	
A4.02	Diesel fire pump	3	

3.8 Safety Function 8: Plant Service Systems

System SF8FHS Fuel Handling Equipment

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical or control/protection logic relationships between the Fuel Handling Equipment and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Rod control and information system	3	3
K1.02	Fuel pool ventilation	3	3
K1.03	Fuel pool cooling and cleanup system	2	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)		
	None		
K 3	**Knowledge of the effect that a loss or malfunction of the Fuel Handling Equipment will have on the following:** (CFR: 41.7 / 45.4)		
K3.01	Rod control and information system	3	3
K3.02	Fuel handling operations	3	4
K3.03	Core modifications/alterations	3	4
K 4	**Knowledge of Fuel Handling Equipment design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)		
K4.01	Prevention of core alterations during control rod movements	3	4
K4.02	Prevention of control rod movement during core alterations	3	4
K4.03	Protection against inadvertently lifting radioactive components out of the water	3	4
K4.04	Movement of the spent fuel cask only over designated areas	3	3
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Fuel Handling Equipment:** (CFR: 41.5 / 45.3)		
K5.01	Crane/hoist operation	3	3
K5.02	Fuel handling equipment interlocks	3	4
K5.03	Water as a shield against radiation	3	3
K5.04	Spent fuel pool design	3	4
K5.05	Fuel orientation	3	4
K5.06	Fuel	3	3
K5.07	Core components	3	3

3.8 Safety Function 8: Plant Service Systems

System SF8FHS Fuel Handling Equipment (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**	
		RO	**SRO**
K5.08	Spent fuel cask	3	3
K5.09	Reactor vessel components	3	3
K5.10	Fuel pool configuration	3	3
K5.11	Refuel floor ventilation	3	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Fuel Handling Equipment** (CFR: 41.7 / 45.7)		
K6.01	AC electrical power distribution system	3	3
K6.02	Rod control and information system	3	4
K6.03	Refueling platform air system	3	4
K6.04	Fuel pool water inventory	3	3
K6.05	Refuel floor ventilation	3	3
K6.06	Fuel pool cooling and cleanup system	2	2
	ABILITY		
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Fuel Handling Equipment controls including:** (CFR: 41.5 / 45.5)		
A1.01	Spent fuel pool level	3	3
A1.02	Refuel floor radiation levels/airborne levels	3	4
A1.03	Core reactivity level	3	4
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Fuel Handling Equipment; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
A2.01	Interlock failure	3	3
A2.02	Loss of refueling platform air system	3	4
A2.03	Loss of electrical power	3	3

3.8 Safety Function 8: Plant Service Systems

System SF8FHS Fuel Handling Equipment (continued)

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A 3	**Ability to monitor automatic operations of the Fuel Handling Equipment including:** (CFR: 41.7 / 45.7)		
A3.01	Crane/refuel bridge movement	3	4
A3.02	Interlock operation	3	4
A 4	**Ability to manually operate and/or monitor Fuel Handling Equipment at the equipment location:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Neutron monitoring system	4	4
A4.02	Control rod drive system	3	4

3.8 Safety Function 8: Plant Service Systems

System **SF8IAS Instrument Air System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Instrument Air System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Service air system	3
K1.02	High pressure nitrogen gas supply system	3
K1.03	Reactor building cooling water system	3
K1.04	Main steam system	3
K1.05	Engineered Safety Function logic and control system	2
K1.06	Control rod drive system	3
K1.07	Automated traversing in core probe system	2
K1.08	Offgas system	2
K1.09	AC electrical power distribution system	3
K1.10	Extraction system	2
K1.11	Fire protection system	2
K1.12	Neutron monitoring system	3
K1.13	Main turbine	2
K1.14	Leak detection and isolation system	2
K1.15	Instrument and control power supply system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Instrument air compressor	3
K 3	**Knowledge of the effect that a loss or malfunction of the Instrument Air System will have on the following:** (CFR: 41.7 / 45.6)	
K3.01	Service air system	3
K3.02	Main steam system	3
K3.03	Control rod drive system	3
K3.04	Automated traversing in core probe system	2
K3.05	Offgas system	2
K3.06	Extraction system	2
K3.07	Fire protection system	2
K3.08	Neutron monitoring system	3
K3.09	Main turbine	2

3.8 Safety Function 8: Plant Service Systems

System SF8IAS Instrument Air System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.	**Knowledge of Instrument Air System design feature(s) and or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Manual/automatic transfers of control	3
K4.02	Cross-over to other air systems	3
K4.03	Securing of IAS upon loss of cooling water	3
K5.	**Knowledge of the operational implications or cause and effect relationships as they apply to the Instrument Air System:** (CFR: 41.5 / 45.3)	
K5.01	Air compressors	3
K5.02	Service air cross-connect valve	2
K5.03	Pneumatic operated devices	2
K 6	**Knowledge of the effect of the following plant conditions, plant malfunctions or component malfunctions will have on the Instrument Air System:** (CFR: 41.7 / 45.7)	
K6.01	Air compressors	2
K6.02	Service air cross-connect valve	3
K6.03	Engineered Safety Function logic and control system	2
K6.04	Electrical power distribution system	3
K6.05	High pressure nitrogen gas supply system	3
K6.06	Reactor building cooling water system	2
K6.07	Instrument and control power supply system	2
	ABILITY	
A 1	**Ability to predict and / or monitor changes in parameters associated with operating the Instrument Air System controls including:** (CFR: 41.5 / 45.5)	
	None	

3.8	**Safety Function 8: Plant Service Systems**		
System	**SF8IAS Instrument Air System (continued)**		
K/A NO.	**ABILITY**	**IMPORTANCE**	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations 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	3
A 3	**Ability to monitor automatic operations of the Instrument Air System including:** (CFR: 41.7 / 45.7)		
A3.01	Air pressure	3	
A3.02	Air temperature	2	
A 4	**Ability to manually operate and/or monitor the Instrument Air System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Instrument air compressors	3	

3.8 Safety Function 8: Plant Service Systems

System **SF8RBCW Reactor Building Cooling Water System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Building Cooling Water System and the following systems:** (CFR: 41.2 to 41.9/45.7 to 45.8)	
K1.01	Reactor service water system	4
K1.02	Process radiation monitoring system	3
K1.03	Reactor recirculation system	3
K1.04	Remote shutdown system	3
K1.05	Heating, ventilation, and air conditioning system emergency cooling water system	2
K1.06	Engineered Safety Function logic and control system	3
K1.07	Makeup water purified system	2
K1.08	Suppression pool cleanup system	2
K1.09	Instrument air system	3
K1.10	Control rod drive system	3
K1.11	Leak detection and isolation system	3
K1.12	Recirculation flow control system	3
K1.13	Residual heat removal system	3
K1.14	High pressure core flooder system	3
K1.15	Reactor water cleanup system	3
K1.16	Fuel pool cooling and cleanup system	3
K1.17	Sampling system	2
K1.18	Radioactive drain transfer system	2
K1.19	Post accident monitoring system	2
K1.20	AC electrical power distribution system	3
K1.21	Emergency diesel generator system	3
K1.22	Suppression pool temperature monitoring system	3
K1.23	Drywell cooling system	3
K1.24	Heating, ventilation and air conditioning system	3
K1.25	Containment atmospheric monitoring system	3
K1.26	Service air system	2
K1.27	Turbine building cooling water system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	RBCW pumps	3
K2.02	RBCW containment isolation valves	3

3.8	**Safety Function 8: Plant Service Systems**	
System	**SF8RBCW Reactor Building Cooling Water System (continued)**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Building Cooling Water System will have on the following:** (CFR: 41.7 / 45.6)	
K3.01	Reactor service water system	3
K3.02	Reactor recirculation system	3
K3.03	Heating, ventilation, and air conditioning system emergency cooling water system	3
K3.04	Process radiation monitoring system	3
K3.05	Suppression pool cleanup system	2
K3.06	Instrument air system	3
K3.07	Control rod drive system	3
K3.08	Recirculation flow control system	3
K3.09	Residual heat removal system	3
K3.10	High pressure core flooder system	3
K3.11	Reactor water cleanup system	3
K3.12	Fuel pool cooling and cleanup system	2
K3.13	Sampling system	2
K3.14	Radioactive drain transfer system	2
K3.15	Emergency diesel generator system	3
K3.16	Drywell cooling system	3
K3.17	Heating, ventilation and air conditioning system	3
K3.18	Containment atmospheric monitoring system	2
K3.19	Service air system	2
K3.20	Turbine building cooling water system	2
K4.	**Knowledge of Reactor Building Cooling Water System design feature(s) and or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic start of standby pump	3
K4.02	Emergency diesel generator load sequencing	3
K4.03	RBCW response to LOCA signal	3
K4.04	RBCW response to high suppression pool temperature	3
K4.05	Operation from the remote shutdown panel	3
K4.06	RBCE response to a high RBCW supply temperature	3
K5.	**Knowledge of the operational implications or cause-effect relationships as they apply to the Reactor Building Cooling Water System:** (CFR: 41.5 / 45.3)	
K5.01	Chemistry control	2

3.8 Safety Function 8: Plant Service Systems

System SF8RBCW Reactor Building Cooling Water System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Building Cooling Water System:** (CFR: 41.7 / 45.7)		
K6.01	AC electrical power distribution system	3	
K6.02	Heating, ventilation, and air conditioning system emergency cooling water system	2	
K6.03	Makeup water purified system	2	
K6.04	Plant information and control system	3	
K6.05	Engineered Safety Function logic and control system	3	
K6.06	Suppression pool cleanup system	2	
K6.07	Instrument air system	2	
K6.11	Process radiation monitoring system	2	
	ABILITY		
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Building Cooling Water System controls including:** (CFR: 41.5 / 45.5)		
A1.01	RBCW flow rate	3	
A1.02	RBCW temperature	3	
A1.03	RBCW pressure	3	
A1.04	Surge tank level	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Building Cooling Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of RBCW pump	3	4
A2.02	High/low surge tank level	3	4
A2.03	High/low RBCW temperature	3	3
A2.04	Radiation monitoring system alarm	3	3
A2.05	Loss of AC electrical power distribution system	3	3

3.8 Safety Function 8: Plant Service Systems

System SF8RBCW Reactor Building Cooling Water System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Reactor Building Cooling Water System including:** (CFR: 41.7 / 45.7)	
A3.01	Setpoints on instrument signal levels for normal operations, warnings, and trips that are applicable to the RBCW	3
A3.02	System alignment due to high suppression pool temperature	4
A3.03	Emergency diesel generator load sequencing	3
A3.04	System alignment due to LOCA signal	4
A3.05	System alignment due to loss of offsite power	3
A 4	**Ability to manually operate and/or monitor the Reactor Building Cooling Water System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	RBCW indications and controls	3

3.8 Safety Function 8: Plant Service Systems

System **SF8RSW Reactor Service Water System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Service Water System and the following systems:** (CFR: 41.2 to 41.9/45.7 to 45.8)	
K1.01	Remote shutdown system	3
K1.02	Engineered Safety Function logic and control system	3
K1.03	Sampling system	2
K1.04	Radioactive drain transfer system	2
K1.05	Reactor building cooling water system	4
K1.06	Instrument air system	2
K1.07	AC electrical power distribution system	3
K1.08	Chemical storage and transfer system	2
K1.09	Turbine service water system	2
K1.10	Makeup water preparation system	2
K1.11	Plant information and control system	3
K1.12	Circulating water system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor service water pumps	3
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Service Water System will have on the following:** (CFR: 41.7 / 45.6)	
K3.01	Reactor building cooling water system	4
K4.	**Knowledge of Reactor Service Water System design feature(s) and or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic start of standby pump	3
K4.02	Emergency diesel generator load sequencing	3
K4.03	Response to loss of coolant accident signal	3
K4.04	Response to a loss of offsite power signal	3
K4.05	Response to a reactor building cooling/reactor building service water heat exchanger room high water level signal	3
K4.06	Response to high suppression pool temperature	3
K4.07	Operation from the remote shutdown panel	3

3.8 Safety Function 8: Plant Service Systems

System **SF8RSW Reactor Service Water System (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K5.	**Knowledge of the operational implications or cause-effect relationships as they apply to the Reactor Service Water System:** (CFR: 41.5 / 45.3)	
K5.01	Chemistry control	2
K5.02	Cold weather operations	2
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Service Water System:** (CFR: 41.7 / 45.7)	
K6.01	Remote shutdown system	3
K6.02	Engineered Safety Function logic and control system	3
K6.03	Sampling system	2
K6.04	Radioactive drain transfer system	2
K6.05	Instrument air system	2
K6.06	AC electrical power distribution system	3
K6.07	Chemical storage and transfer system	2
K6.08	Turbine service water system	2
K6.09	Makeup water preparation system	2
K6.10	Plant information and control system	3
K6.11	Circulating water system	2

ABILITY

A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Service Water System controls including:** (CFR: 41.5 / 45.5)	
A1.01	RSW flow rate	3
A1.02	RSW temperature	3
A1.03	RSW header supply pressure	3
A1.04	Ultimate heat sink basin level	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Service Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Loss of RSW pump	3	4
A2.02	Low ultimate heat sink water level	3	4

3.8 Safety Function 8: Plant Service Systems

System SF8RSW Reactor Service Water System

K/A NO.	**ABILITY**	**IMPORTANCE**	
		RO	**SRO**
A2.03	Loss of AC electrical power distribution system	3	3
A2.04	Loss of coolant accident	4	4
A2.05	Loss of offsite power	3	4
A2.06	High water level in the RBCW/RSW heat exchanger room	3	3
A 3	**Ability to monitor automatic operations of the Reactor Service Water System Including:** (CFR: 41.7 / 45.7)		
A3.01	System alignment due to high suppression pool temperature	4	
A3.02	System alignment due to LOCA signal	4	
A3.03	System alignment due to loss of offsite power	3	
A3.04	Emergency diesel generator load sequencing	3	
A3.05	Setpoints on instrument signal levels for normal operations, warnings, and trips that are applicable to the RSW	3	
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 /45.5 to 45.8)		
A4.01	RSW indications and controls	3	

3.9 Safety Function 9: Radioactivity Release

System: **SF9OG Offgas System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Offgas System and the following systems:** (CFR: 41.2 to 41.9/45.7 to 45.8)	
K1.01	Feedwater and condensate air extraction system	3
K1.02	Process radiation monitoring system	3
K1.03	Radioactive waste treatment system	2
K1.04	Instrument air system	3
K1.05	Turbine building cooling water system	3
K1.06	AC electrical distribution system	2
K1.07	Sampling system	3
K1.08	Turbine building heating, ventilation, and air conditioning system	2
K1.09	Heating steam and condensate water return system	2
K1.10	Heating, ventilation, and air conditioning system normal cooling water system	2
K1.11	Makeup water purified system	2
K1.12	Plant information and control system	3
K1.13	Hydrogen water chemistry system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Offgas system vacuum pump	2
K 3	**Knowledge of the effect that a loss or malfunction of the Offgas System will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	Condenser vacuum	4
K3.02	Off-site radioactivity release	3
K3.03	Hydrogen concentration	3
K 4	**Knowledge of Offgas System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Dilution of hydrogen gas concentration	3
K4.02	Prevention of water entering the recombiner catalyst	3
K4.03	Maintenance of sufficient oxygen gas inventory to allow for complete hydrogen recombination	2
K4.04	The prevention of hydrogen explosions and/or fires	3
K4.05	Redundancy	3

3.9 Safety Function 9: Radioactivity Release

System: SF9OG Offgas System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.06	Decay of fission product gases to particulate daughters	3
K4.07	Maximizing charcoal bed efficiency	3
K4.08	Automatic system isolation	3
K4.09	Filtration of radioactive particulate	3

K 5 **Knowledge of the operational implications or cause and effect relationships as they apply to Offgas System:**
(CFR: 41.7 / 45.4)

K/A NO.	KNOWLEDGE	IMPORTANCE
K5.01	Heat removal mechanisms	2
K5.02	Heat addition mechanisms	2
K5.03	Hydrogen concentration measurement	3
K5.04	Oxygen concentration measurement	3
K5.05	Catalytic recombination	3
K5.06	Radioactive decay	3
K5.07	Charcoal adsorption of fission product gases	3
K5.08	Hydrogen and oxygen recombination	3
K5.09	Decontamination factors	2
K5.10	Explain the necessity of reducing relative humidity for carbon bed filters.	3
K5.11	Elevated release point	3
K5.12	Condenser vacuum	3
K5.13	Off-site radioactivity release	3

K 6 **Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Offgas System:**
(CFR: 41.7 / 45.7)

K/A NO.	KNOWLEDGE	IMPORTANCE
K6.01	Instrument air system	3
K6.02	Process radiation monitoring system	3
K6.03	Turbine building cooling water system	2
K6.04	Hydrogen water chemistry system	3
K6.05	AC electrical distribution system	3
K6.06	Feedwater and condensate air extraction system	3
K6.07	Fuel cladding integrity	3
K6.08	Condenser vacuum	3
K6.09	Heating steam and condensate water return system	2
K6.10	Makeup water purified system	2
K6.11	Turbine building heating, ventilation, and air conditioning system	2
K6.12	Plant information and control system	3

3.9	**Safety Function 9: Radioactivity Release**	
System:	**SF9OG Offgas System (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Offgas System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Condenser vacuum	3
A1.02	Station radioactive release rate	3
A1.03	Preheater discharge temperature	2
A1.04	Recombiner catalyst temperature	2
A1.05	Cooler condenser discharge temperature	2
A1.06	Filter differential pressure	2
A1.07	Charcoal bed humidity	2
A1.08	System flow	3
A1.09	Charcoal bed temperature	2
A1.10	Charcoal vault temperature	2
A1.11	Offgas condenser temperatures	2
A1.12	Process radiation monitoring indications	3
A1.13	Hydrogen gas concentration	3
A1.14	Oxygen gas concentration	3
A1.15	Steam supply pressures	3

A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Offgas System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5/45.6)		
		RO	**SRO**
A2.01	Low condenser vacuum	3	3
A2.02	Low dilution steam flow	3	3
A2.03	Offgas system high radiation	4	4
A2.04	High charcoal bed humidity	3	3
A2.05	Offgas system holdup volume explosion/ fire	4	4
A2.06	Low oxygen injection flow	3	3
A2.07	AC electrical distribution system failures	3	3
A2.08	Offgas system high flow	3	3
A2.09	Offgas system low flow	3	3
A2.10	Recombiner high temperature	3	3
A2.11	Recombiner low temperature	2	3
A2.12	Offgas filter high differential pressure	3	3
A2.13	Air intrusion	3	3
A2.14	Loss of offgas system loop seals	3	3
A2.15	Reactor power changes	3	3

3.9 Safety Function 9: Radioactivity Release

System: SF9OG Offgas System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Offgas System including:** (CFR: 41.7 / 45.7)	
A3.01	System isolations	3
A3.02	System flows	3
A3.03	System temperatures	3
A3.04	Station radioactive release rate	3
A3.05	System indications and alarms	3
A3.06	System differential pressures	3
A3.07	Process radiation monitoring system indications	3
A3.08	Startup and shutdown of the offgas system	3
A 4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
A4.01	Reset system isolations	3
A4.02	Offgas system controls/components	3

3.9 Safety Function 9: Radioactivity Release

System: **SF9HVAC Plant Ventilation Systems**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Plant Ventilation Systems and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	AC electrical distribution system	3
K1.02	Secondary containment	3
K1.03	Standby gas treatment system	4
K1.04	Atmosphere control system	3
K1.05	Process radiation monitoring system	3
K1.06	Instrument air system	3
K1.07	Heating, ventilation, and air conditioning system normal cooling water system	2
K1.08	Heating, ventilation, and air conditioning system emergency cooling water system	3
K1.09	Reactor building cooling water system	3
K1.10	Turbine building cooling water system	2
K1.11	Engineered Safety Function logic and control system	3
K1.12	Leak detection and isolation system	3
K1.13	Radioactive drain transfer system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Reactor building supply and exhaust fans	2
K2.02	Turbine building supply and exhaust fans	2
K2.03	Radwaste building supply and exhaust fans	2
K 3	**Knowledge of the effect that a loss or malfunction of the Plant Ventilation Systems will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	Secondary containment temperature	3
K3.02	Reactor building temperature	3
K3.03	Reactor building pressure	3
K3.04	Secondary containment differential pressure	3
K3.05	Turbine building temperature	2
K3.06	Turbine building differential pressure	2

3.9 Safety Function 9: Radioactivity Release

System: SF9HVAC Plant Ventilation Systems (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Plant Ventilation Systems design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic initiation of standby gas treatment system	4
K4.02	Secondary containment isolation	4
K4.03	Automatic starting and stopping of fans	3
K4.04	Smoke removal	3
K 5	**Knowledge of the operational implications or cause-effect relationships as they apply to PLANT VENTILATION Systems:** (CFR: 41.7 / 45.4)	
K5.01	Airborne contamination control	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Plant Ventilation Systems:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical distribution system	3
K6.02	Instrument air system	3
K6.03	Heating, ventilation, and air conditioning normal cooling water system	3
K6.04	Heating, ventilation, and air conditioning emergency cooling water system	3
K6.05	Reactor building cooling water system	3
K6.06	Turbine building cooling water system	2
K6.07	Engineered Safety Function logic and control system	3
K6.08	Leak detection and isolation system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Plant Ventilation Systems controls including:** (CFR: 41.5 / 45.5)	
A1.01	Filter differential pressure	2
A1.02	Fan differential pressure	2
A1.03	Area temperatures	2
A1.04	Secondary containment differential pressure	3

3.9 Safety Function 9: Radioactivity Release

System: SF9HVAC Plant Ventilation Systems (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Plant Ventilation Systems; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	High drywell pressure	3	3
A2.02	Low reactor water level	3	4
A2.03	Loss of coolant accident	4	4
A2.04	High radiation	4	4
A2.05	Secondary containment differential pressure	3	4
A 3	**Ability to monitor automatic operations of the Plant Ventilation Systems including:** (CFR: 41.7 / 45.7)		
A3.01	Isolation/initiation signals	4	
A 4	**Ability to manually operate and/or monitor the Plant Ventilation Systems in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Start and stop fans	3	
A4.02	Open and close dampers	2	

3.9 Safety Function 9: Radioactivity Release

System: SF9RAD Radiation Monitoring System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic 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
K1.02	Offgas system	3
K1.03	Plant stack	3
K1.04	Reactor building cooling water system	3
K1.05	Radioactive waste treatment system	3
K1.06	Reactor building heating, ventilation, and air conditioning system	3
K1.07	Fuel building heating, ventilation, and air conditioning system	3
K1.08	Service building heating, ventilation, and air conditioning system	2
K1.09	Leak detection and isolation system	4
K1.10	Turbine building heating, ventilation, and air conditioning system	3
K1.11	Radwaste building heating, ventilation, and air conditioning system	3
K1.12	Plant information and control system	3
K1.13	Emergency response information system	2
K1.14	Vital AC power supply system	2
K1.15	Instrument air system	2
K1.16	Engineered Safety Function logic and control system	3
K1.17	Standby gas treatment system	3
K1.18	Makeup water purified system	2
K1.19	Control building heating, ventilation, and air conditioning system	3
K 2	**Knowledge of bus or electrical power supplies to the following:** (CFR: 41.7)	
K2.01	Main steamline radiation monitors	3
K2.02	Offgas radiation monitoring system	3
K2.03	Plant stack radiation monitoring	3
K2.04	Radwaste liquid radiation monitoring system	2
K2.05	Reactor building heating, ventilation, and air conditioning monitors	3
K2.06	Area radiation monitors	2
K2.07	Control room ventilation monitors	2
K 3	**Knowledge of the effect that a loss or malfunction of the Radiation Monitoring System will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	Station liquid effluent release monitoring	3
K3.02	Station gaseous effluent release monitoring	3
K3.03	Station area radiation monitoring	3
K3.04	Offgas system	4

3.9 Safety Function 9: Radioactivity Release

System: SF9RAD Radiation Monitoring System (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K3.05	Reactor building heating, ventilation, and air conditioning	3
K3.06	Drywell sump liquid discharge	2
K3.07	Radwaste building ventilation	3
K3.08	Control building heating, ventilation, and air conditioning system	3
K 4	**Knowledge of Radiation Monitoring System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	3
K4.02	Automatic actions to contain the radioactive release in the event that the predetermined release rates are exceeded	4
K4.03	Fail safe tripping of process radiation monitoring logic during conditions of instrument failure	4
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Radiation Monitoring System:** (CFR: 41.7 / 45.4)	
K5.01	Hydrogen injection operation's effect on process radiation indications	3
K5.02	Drywell sump liquid discharge	2
K5.03	Turbine gland seal condenser exhaust	2
K5.04	Fuel handling area ventilation exhaust	3
K5.05	Drywell	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Radiation Monitoring System:** (CFR: 41.7 / 45.7)	
K6.01	Vital AC power	3
K6.02	Plant information and control system	2
K6.03	Leak detection and isolation system	2
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Radiation Monitoring System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Alarms and indications associated with normal operations	3
A1.02	Alarms and indications associated with surveillance testing	3

3.9 Safety Function 9: Radioactivity Release

System: SF9RAD Radiation Monitoring System (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
A 2	**Ability to (d) 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 conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Fuel element failure	4	4
A2.02	AC electrical failure	3	3
A2.03	Downscale trips	3	3
A2.04	Offgas system failure	3	3
A2.05	Low fuel pool level	3	3
A2.06	Loss of coolant accident	4	4
A2.07	Leakage and/or breaks from contaminated systems to atmosphere or to other process systems	3	4
A2.08	Refuel floor handling accidents/operations	3	4
A2.09	Low reactor water level during refueling operations	3	4
A 3	**Ability to monitor automatic operations of the Radiation Monitoring System including:** (CFR: 41.7 / 45.7)		
A3.01	Offgas system isolation indications	4	
A3.02	Liquid radwaste isolation indications	3	
A3.03	Radwaste handing interlocks	2	
A3.04	Drywell LCW or HCW sump isolation indications	3	
A3.05	Ventilation system isolation indications	3	
A3.06	Display indications	3	
A3.07	Meter indications	3	
A3.08	Containment isolation indications	4	
A3.09	Lights and alarms	3	
A 4	**Ability to manually operate and/or monitor Radiation Monitoring System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4. 01	Manually trip process radiation monitor logic	3	

3.9 Safety Function 9: Radioactivity Release

System: SF9RW Radwaste System

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Radwaste System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Makeup water condensate system	2
K1.02	Instrument air system	2
K1.03	Service air system	2
K1.04	AC electrical power distribution system	3
K1.05	Instrument and control power supply system	2
K1.06	Reactor water cleanup system	3
K1.07	Fuel pool cooling and cleanup system	3
K1.08	Residual heat removal system	2
K1.09	Turbine building service water system	2
K1.10	Process radiation monitoring system	3
K1.11	Condensate storage and transfer system	2
K1.11	Makeup water purified system	2
K1.12	Radioactive drain transfer system	2
K1.13	Solid waste system	2
K1.14	Make-up water condensate system	2
K1.15	Reactor building cooling water system	2
K1.16	Radwaste building heating, ventilation, and air conditioning system	2
K1.17	Mobile liquid radwaste processing system	2
K1.18	Mobile solid radwaste processing system	2
K1.19	Low conductivity waste system	3
K1.20	High conductivity waste system	3
K1.21	Hot shower and storm drain system	2
K1.22	Spent sludge system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Radwaste System will have on the following:** (CFR: 41.5 / 45.3)	
K3.01	RWCU system	2
K3.02	Makeup water condensate system	2
K3.03	Low and high conductivity waste sumps	3
K3.04	Fuel pool cooling and cleanup system	2
K3.05	Residual heat removal system	2
K3.06	Radioactive drain transfer system	2

System: SF9RW Radwaste System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE

K 4 **Knowledge of the Radwaste System design feature(s) and/or interlocks which provide for the following:**
(CFR: 41.7)

None

K 5 **Knowledge of the operational implications or cause and effect relationships as they apply to the Radwaste System:**
(CFR: 41.5 / 45.3)

None

K 6 **Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Radwaste System:**
(CFR: 41.7)

K6.01	Instrument air system	2
K6.02	Service air system	2
K6.03	AC electrical power distribution system	3
K6.04	Instrument and control power supply system	2
K6.05	Radwaste building heating, ventilation, and air conditioning	2
K6.06	Process radiation monitoring system	3
K6.07	Makeup water purified system	2

ABILITY

A 1 **Ability to predict and/or monitor changes in parameters associated with operating the Radwaste System controls including:**
(CFR: 41.5 / 45.5)

A1.01	Radiation level	3
A1.02	Off-site radioactivity release	3

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Radwaste System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:**
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	System rupture	3	3
A2.02	High turbidity water	2	3

System: SF9RW Radwaste System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
A 3	**Ability to monitor automatic operations of the Radwaste System including:** (CFR: 41.7 / 45.7)	
	None	
A 4	**Ability to manually operate and/or monitor the Radwaste System in the control room:** (CFR: 41.7 / 45.5 to 45.8)	
	None	

3.9 Safety Function 9: Radioactivity Release

System: **SF9RPV Reactor Vessel Internals**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Reactor Vessel Internals and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Main steam system	3
K1.02	Reactor recirculation system	3
K1.03	Feedwater system	3
K1.04	Residual heat removal system	3
K1.05	High pressure core flooder system	3
K1.06	Reactor core isolation cooling system	3
K1.07	Control rod drive system	3
K1.08	Fine motion control rod drive mechanism	3
K1.09	Standby liquid control system	3
K1.10	Reactor water cleanup system	3
K1.11	Automatic depressurization system	3
K1.12	Loose parts monitoring system	2
K1.13	Automated Traversing In-core Probe system	3
K1.14	Neutron monitoring system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
	None	
K 3	**Knowledge of the effect that a loss or malfunction of the Reactor Vessel Internals will have on the following:** (CFR: 41.7 / 45.4)	
K3.01	Reactor water level	3
K3.02	Reactor pressure	3
K3.03	Reactor power	3
K3.04	Plant radiation levels	3
K3.05	Off-site radioactive release	3
K3.06	Leak detection and isolation system	3
K3.07	Nuclear Boiler Instrumentation	3
K 4	**Knowledge of Reactor Vessel Internals design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Separation of fluid flow paths within the vessel	3
K4.02	Core orificing	3
K4.03	Moisture removal from generated steam	3
K4.04	Natural circulation	3

3.9 Safety Function 9: Radioactivity Release

System: SF9RPV Reactor Vessel Internals (continued)

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Reactor Vessel Internals:** (CFR: 41.5 / 45.3)	
	None	
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Reactor Vessel Internals:** (CFR: 41.7 / 45.7)	
K6.01	Control rod drive system	3
K6.02	Fine motion control rod drive mechanism	3
K6.03	Reactor recirculation system	3
K6.04	Feedwater system	3
K6.05	Standby Liquid Control system	3
K6.06	Safety/relief valves	3
K6.07	Reactor water cleanup system	3
K6.08	Nuclear Boiler Instrumentation	3
K6.09	High pressure core flooder system	3
K6.10	Residual heat removal system	3
K6.11	Reactor core isolation cooling system	3
K6.12	Automatic depressurization system	3
K6.13	Loose parts monitoring	2
K6.14	Automated traversing in-core probe system	3
K6.15	Neutron monitoring system	3
K6.16	Main steam system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Reactor Vessel Internals controls including:** (CFR: 41.5 / 45.5)	
	None	

3.9 Safety Function 9: Radioactivity Release

System: SF9RPV Reactor Vessel Internals (continued)

K/A NO. ABILITY IMPORTANCE

A 2 Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Reactor Vessel Internals; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:
(CFR: 41.5 / 45.6)

		RO	SRO
A2.01	LOCA	4	4
A2.02	Overpressurization transient	4	4
A2.03	Control rod drop accident	4	4
A2.04	Excessive heatup/cooldown rate	4	4
A2.05	Exceeding thermal limits	4	4
A2.06	Exceeding safety limits	4	4

A 3 Ability to monitor automatic operations of the Reactor Vessel Internals including:
(CFR: 41.7 / 45.7)

None

A 4 Ability to manually operate and/or monitor the Reactor Vessel Internals in the control room:
(CFR: 41.7 / 45.5 to 45.8)

None

3.9 Safety Function 9: Radioactivity Release

System: SF9FPC Fuel Pool Cooling and Cleanup System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Fuel Pool Cooling and Cleanup System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Residual heat removal system	3
K1.02	Makeup water condensate system	2
K1.03	Sampling system	2
K1.04	Instrument air system	2
K1.05	AC electrical power distribution system	2
K1.06	Reactor building cooling water system	3
K1.07	Low conductivity waste system	2
K1.08	Radwaste drain transfer system	3
K1.09	Suppression pool cleanup system	2
K1.10	Reactor water cleanup system	2
K1.11	Direct current power supply system	2
K1.12	Reactor pressure vessel instrumentation system	2
K1.13	Plant information and control system	3
K1.14	Spent sludge system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Fuel pool cooling and cleanup pumps	2
K 3	**Knowledge of the effect that a loss or malfunction of the Fuel Pool Cooling and Cleanup System will have on the following:** (CFR: 41.7 /45.6)	
K3.01	Fuel pool temperature	3
K3.02	Fuel pool water level	3
K3.03	Fuel pool water clarity	3
K3.04	Fuel pool water chemistry	2
K3.05	Fuel pool water fission product concentration	3
K3.06	Area radiation levels	3
K3.07	Suppression pool chemistry	2
K3.08	Refueling operations	3

3.9 Safety Function 9: Radioactivity Release

System: SF9FPC Fuel Pool Cooling and Cleanup System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K 4	**Knowledge of Fuel Pool Cooling and Cleanup System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Redundancy	2
K4.02	Pool clarity	2
K4.03	Maintenance of adequate pool temperature	3
K4.04	Overpressure protection for fuel pool cooling system filter	2
K4.05	Net positive suction head requirements for fuel pool cooling pumps	2
K4.06	Maintenance of adequate pool level	3
K4.07	Supplemental heat removal capability	3
K4.08	Pool cooling during loss of coolant accident	3
K4.09	Maintenance of filter/demineralizer precoat during low flow conditions	2
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Fuel Pool Cooling and Cleanup System:** (CFR: 41.5 / 45.3)	
K5.01	Spent fuel decay heat generation	3
K5.02	Mechanical filtration operation	2
K5.03	Maximum normal heat load	3
K5.04	Maximum (abnormal) heat load	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Fuel Pool Cooling and Cleanup System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Residual heat removal system	2
K6.03	Makeup water condensate system	3
K6.04	Reactor building cooling water system	3
K6.05	Instrument air system	2
K6.06	Radwaste drain transfer system	2
K6.07	Reactor well seal failure	3
K6.08	Direct current power supply system	2
K6.09	Reactor pressure vessel instrumentation system	2
K6.10	Plant information and control system	3
K6.11	Reactor building heating, ventilation, and air conditioning system	2
K6.12	Low conductivity waste system	2
K6.13	Suppression pool cleanup system	2

3.9 Safety Function 9: Radioactivity Release

System: SF9FPC Fuel Pool Cooling and Cleanup System (continued)

K/A NO.	ABILITY	IMPORTANCE
AI.	**Ability to predict and/or monitor changes in parameters associated with operating the Fuel Pool Cooling and Cleanup System controls including:** (CFR: 41.5 / 45.5)	
A1.01	Surge tank level	3
A1.02	Pool level	3
A1.03	Pool temperature	3
A1.04	Pump discharge pressure	2
A1.05	Filter/demineralizer differential pressure	2
A1.06	System flow	3
A1.07	System temperature	3
A1.08	Pool chemistry	2
A1.09	Pool clarity	2
A1.10	Pool activity levels	2

A 2 **Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Fuel Pool Cooling and Cleanup System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)

		RO	SRO
A2.01	High pool level	3	3
A2.02	Low pool level	3	3
A2.03	Low surge tank level/high level	3	3
A2.04	Pump trip	3	3
A2.05	High fuel pool temperature	3	3
A2.06	Reactor building cooling water failure	3	3
A2.07	AC electrical power distribution system failures	3	3
A2.08	Refueling bellows seal high flow	3	3
A2.09	High spent fuel pool gate drain flow	3	3
A2.10	High filter/demineralizer differential pressure	2	2
A2.11	Low filter/demineralizer differential pressure	2	2
A2.12	Low system flow	2	2
A2.13	Low pump suction pressure	2	2
A2.14	Low pool clarity	3	3
A2.15	Inadequate system/pool chemistry	3	3

A 3 **Ability to monitor automatic operations of the Fuel Pool Cooling and Cleanup System including:** (CFR: 41.7 / 45.7)

A3.01	Valve operation	2
A3.02	Pump trip(s)	3
A3.03	System indications and alarms	3

3.9 Safety Function 9: Radioactivity Release

System: SF9FPC Fuel Pool Cooling and Cleanup System (continued)

K/A NO.	ABILITY	IMPORTANCE
A 4	**Ability to manually operate and/or monitor the Fuel Pool Cooling and Cleanup System in the control room:** CFR: 41.7 / 45.5 to 45.8)	
A4.01	Fuel pool cooling and cleanup system pumps	3
A4.02	Fuel pool cooling and cleanup system valves	3

3.9 Safety Function 9: Radioactivity Release

System: SF9SGTS Standby Gas Treatment System

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
K 1	**Knowledge of the physical or control/protection logic relationships between the Standby Gas Treatment System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Reactor building heating, ventilation, and air conditioning system	3
K1.02	Plant ventilation stack	3
K1.03	Process radiation monitoring system	3
K1.04	Atmosphere control system	3
K1.05	Leak detection and isolation system	3
K1.06	Fire protection system	2
K1.07	Makeup water purified system	2
K1.08	Radioactive drain transfer system	2
K1.09	Plumbing and drainage system	2
K1.10	Engineered Safety Function logic and control system	3
K1.11	AC electrical power distribution system	3
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Standby gas treatment process and cooling fans	2
K2.02	Standby gas treatment motor operated inlet/outlet flow damper	2
K2.03	Standby gas treatment initiation logic	2
K2.04	Standby gas treatment filter train heaters	2
K2.05	Standby gas treatment inlet and outlet space heaters	2
K 3	**Knowledge of the effect that a loss or malfunction of the Standby Gas Treatment System will have on the following:** (CFR: 41.7 /45.6)	
K3.01	Secondary containment differential pressure	3
K3.02	Off-site release rate	4
K3.03	Primary containment pressure	3
K3.04	Secondary containment pressure	3
K3.05	Secondary containment radiation/contamination levels	3
K3.06	Atmosphere control system	3
K 4	**Knowledge of Standby Gas Treatment System design feature(s) and/or interlocks which provide for the following:** (CFR: 41.7)	
K4.01	Automatic system initiation	4
K4.02	Charcoal bed decay heat removal	3
K4.03	Moisture removal	3
K4.04	Radioactive particulate filtration	3

3.9 Safety Function 9: Radioactivity Release

System: **SF9SGTS Standby Gas Treatment System (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE
K4.05	Fission product iodine removal	3
K4.06	Charcoal bed retention	2
K4.07	Control charcoal bed relative humidity	2
K 5	**Knowledge of the operational implications or cause and effect relationships as they apply to Standby Gas Treatment System:** (CFR: 41.5 / 45.3)	
K5.01	Heat removal mechanisms	2
K5.02	Primary containment	3
K5.03	Secondary containment	3
K5.04	Wetwell	3
K5.05	Primary containment pressure	3
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Standby Gas Treatment System:** (CFR: 41.7 / 45.7)	
K6.01	AC electrical power distribution system	3
K6.02	Process radiation monitoring	3
K6.03	Drywell high pressure	3
K6.04	Leak detection and isolation system	3
K6.05	Fire protection system	2
K6.06	Engineered Safety Function logic and control system	3
K6.07	Radioactive drain transfer system	2
K6.08	Makeup water purified system	2
K6.09	Plant ventilation stack	3
K6.10	Reactor building heating, ventilation, and air conditioning system	3
	ABILITY	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Standby Gas Treatment System controls including:** (CFR: 41.5 / 45.5)	
A1.01	System flow	3
A1.02	Drywell/wetwell pressure	3
A1.03	Off-site radioactive release	3
A1.04	Secondary containment differential pressure	3
A1.05	Standby gas treatment system filter train temperature	3

System: SF9SGTS Standby Gas Treatment System (continued)

K/A NO.	ABILITY	IMPORTANCE	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Standby Gas Treatment System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Low system flow	3	3
A2.02	High system flow	3	3
A2.03	High filter train temperature	3	3
A2.04	High filter train moisture content	3	3
A2.05	Standby gas treatment process fan trips	3	3
A2.06	Motor operated inlet/outlet flow damper closures	3	3
A2.07	AC electrical power distribution system failure	3	3
A2.08	Low reactor water level	3	3
A2.09	High drywell/wetwell pressure	3	3
A2.10	High refuel floor ventilation exhaust radiation	3	3
A2.11	High secondary containment ventilation exhaust radiation	3	4
A1.12	Refueling floor ventilation exhaust radiation	3	4
A2.13	High charcoal bed temperature	2	2
A2.14	Filter train heater trips	2	2
A 3	**Ability to monitor automatic operations of the Standby Gas Treatment System including:** (CFR: 41.7 / 45.7)		
A3.01	System flow	3	
A3.02	Standby gas treatment system process fan start	3	
A3.03	Standby gas treatment system motor operated damper operation	3	
A3.04	System temperature/humidity	3	
A3.05	Secondary containment differential pressure	3	
A3.06	Standby gas treatment cooling fans	3	
A 4	**Ability to manually operate and/or monitor the Standby Gas Treatment System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4. 01	Standby gas treatment system fans	3	
A4. 02	Standby gas treatment system-motor operated dampers	3	

3.9 Safety Function 9: Radioactivity Release

System: **SF9CRHVAC Control Room Habitability Area Heating, Ventilation, and Air Conditioning System**

K/A NO.	KNOWLEDGE	IMPORTANCE
K 1	**Knowledge of the physical or control/protection logic relationships between the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)	
K1.01	Process radiation monitoring system	3
K1.02	Heating, ventilation, and air conditioning emergency cooling water system	3
K1.03	Fire protection system	3
K1.04	Makeup water purified system	2
K1.05	Engineered Safety Function logic and control system	3
K1.06	Non-radioactive drain transfer system	2
K1.07	AC electrical power distribution system	3
K1.08	Vital AC power supply system	3
K1.09	Direct current power supply system	2
K 2	**Knowledge of bus or division power supplies to the following:** (CFR: 41.7)	
K2.01	Control room habitability area heating, ventilation, and air conditioning supply fans	2
K2.02	Control room habitability area heating, ventilation, and air conditioning exhaust fans	2
K2.03	Control room habitability area heating, ventilation, and air conditioning emergency filtration unit supply fans	2
K2.04	Control room habitability area heating, ventilation, and air conditioning motor operated normal supply dampers	2
K2.05	Control room habitability area heating, ventilation, and air conditioning emergency filtration unit air supply dampers	2
K 3	**Knowledge of the effect that a loss or malfunction of the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System will have on the following:** (CFR: 41.7 /45.6)	
K3.01	Control room habitability	4
K3.02	Control room temperature	3
K3.03	Control room pressure	3

3.9 Safety Function 9: Radioactivity Release

System: SF9CRHVAC Control Room Habitability Area Heating, Ventilation, and Air Conditioning System (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE
K3.04	Control room habitability area heating, ventilation, and air conditioning humidity	2
K3.05	Control room habitability area heating, ventilation, and air conditioning radioactivity	3

K 4 Knowledge of Control Room Habitability Area Heating, Ventilation, and Air Conditioning System design feature(s) and/or interlocks which provide for the following:
(CFR: 41.7)

K4.01	System initiations/reconfiguration	3
K4.02	Control room temperature	2
K4.03	Smoke removal mode	3

K 5 Knowledge of the operational implications or cause-effect relationships as they apply to Control Room Habitability Area Heating, Ventilation, and Air Conditioning System:
(CFR: 41.5 / 45.3)

K5.01	Airborne contamination (e.g., radiological, toxic gas, smoke) control	3

K 6 Knowledge of the effect of the following plant conditions, system malfunctions or component malfunctions will have on the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System:
(CFR: 41.7 / 45.7)

K6.01	AC electrical power distribution system	3
K6.02	Vital AC power supply system	2
K6.03	Direct current power supply system	2
K6.04	Heating, ventilation, and air conditioning emergency cooling water system	3
K6.05	Fire protection system	3
K6.06	Process radiation monitoring system	3
K6.07	Makeup water purified system	2
K6.08	Engineered Safety Function logic and control system	3
K6.09	Non-radioactive drain transfer system	2

3.9 Safety Function 9: Radioactivity Release

System: **SF9CRHVAC Control Room Habitability Area Heating, Ventilation, and Air Conditioning System (continued)**

K/A NO.	ABILITY	IMPORTANCE	
A 1	**Ability to predict and/or monitor changes in parameters associated with operating the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System controls including:** (CFR: 41.5 / 45.5)		
A1.01	Filter differential pressure	2	
A1.02	Fan differential pressure	2	
A1.03	Area temperatures	3	
A1.04	Control room pressure	3	
A1.05	Control room humidity	2	
A1.05	Airborne radioactivity levels	3	
A 2	**Ability to (a) predict the impacts of the following system/component malfunctions or operations on the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations:** (CFR: 41.5 / 45.6)		
		RO	**SRO**
A2.01	Initiation/reconfiguration	3	3
A2.02	Extreme environmental conditions	3	3
A2.03	Initiation/reconfiguration failure	3	4
A2.04	Initiation/failure of fire protection system	3	3
A 3	**Ability to monitor automatic operations of the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System including:** (CFR: 41.7 / 45.7)		
A3.01	Initiation/reconfiguration	3	
A3.02	Initiation/failure of fire protection system	3	
A 4	**Ability to manually operate and/or monitor the Control Room Habitability Area Heating, Ventilation, and Air Conditioning System in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Initiate/reset system	3	
A4.02	Control room habitability area heating, ventilation, and air conditioning supply and exhaust fans	3	
A4.03	Control room habitability area heating, ventilation, and air conditioning emergency filtration unit supply fans	3	
A4.04	Reposition dampers	3	

4.0	**EMERGENCY PLANT AND ABNORMAL PLANT EVOLUTIONS**	
4.1	**Emergency Plant Evolutions**	
EPE:	**EPE1001 High Drywell Pressure**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Drywell Pressure**: (CFR: 41.8 to 41.10)	
EK1.01	Primary containment integrity	4
EK2.	**Knowledge of the interrelations between High Drywell Pressure and the following:** (CFR: 41.7 / 45.8)	
EK2.01	High pressure core flooder system	4
EK2.02	Reactor core isolation cooling	4
EK2.03	Residual heat removal system/Low pressure flooder mode	4
EK2.04	Reactor trip and isolation system	4
EK2.05	Emergency diesel generators	4
EK2.06	Leak detection and isolation system	4
EK2.07	Automatic depressurization system	4
EK2.08	Drywell spray	4
EK2.09	Suppression pool cooling	4
EK2.10	Wetwell spray	4
EK2.11	Safety parameter display system	3
EK2.12	Drywell cooling system	3
EK2.13	Condensate system	4
EK2.14	Containment overpressure protection system	3
EK2.16	Atmosphere control system	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Drywell Pressure**: (CFR: 41.5 / 45.6)	
EK3.01	Drywell spray operation	4
EK3.02	Wetwell spray operation	4
EK3.03	Containment overpressure protection operation	4
EK3.04	Emergency depressurization	4
EK3.05	Reactor scram	4
EK3.06	Drywell venting	4

4.1 **Emergency Plant Evolutions**

EPE: **EPE1001 High Drywell Pressure (continued)**

K/A NO.	ABILITY	IMPORTANCE
EA1.	**Ability to operate and/or monitor the following as they apply to High Drywell Pressure:** (CFR: 41.7 / 45.6)	
EA1.01	High pressure core flooder system	4
EA1.02	Reactor core isolation cooling system	4
EA1.03	Residual heat removal system/Low pressure flooder mode	4
EA1.04	Reactor trip and isolation system	4
EA1.05	Emergency diesel generators	4
EA1.06	Leak detection and isolation system	4
EA1.07	Automatic depressurization system	4
EA1.08	Drywell spray	4
EA1.09	Wetwell spray	4
EA1.10	Suppression pool cooling	4
EA1.11	Drywell cooling system	3
EA1.12	Containment atmospheric monitoring	4
EA1.13	Wetwell to drywell vacuum relief breakers	3
EA1.14	Atmosphere control system	3
EA1.15	Containment overpressure protection system	3

EA2. **Ability to determine and/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
EA2.02	Drywell temperature	4	4
EA2.03	Suppression pool level	4	4
EA2.04	Wetwell pressure	4	4
EA2.05	Wetwell air-space temperature	4	4
EA2.04	Suppression pool temperature	4	4
EA2.05	Primary containment radiation levels	4	4

4.1	**Emergency Plant Evolutions**	
EPE:	**EPE1002 High Reactor Pressure**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Reactor Pressure:** (CFR: 41.8 to 41.10)	
EK1.01	Pressure effects on reactor power	4
EK1.02	Reactor pressure vessel integrity	4
EK1.03	Safety/relief valve tailpipe temperature/pressure relationships	4
EK1.04	Decay heat generation	4
EK1.05	Exceeding safety limits	4
EK1.06	Pressure effects on reactor pressure vessel water level	4
EK2.	**Knowledge of the interrelations between High Reactor Pressure and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor trip and isolation system	4
EK2.02	Alternate reactor shutdown system	4
EK2.03	Fine motion control rod motor drive insertion function (FM Control Rod Drive run-in)	4
EK2.04	Recirculation system	4
EK2.05	Safety/relief valves	4
EK2.06	Reactor core isolation cooling system	4
EK2.07	Steam bypass and pressure control system	4
EK2.08	Reactor power	4
EK2.09	Safety parameter display system	3
EK2.10	Reactor pressure vessel water level	4
EK2.11	ESF logic and control system	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Reactor Pressure**: (CFR: 41.5 / 45.6)	
EK3.01	Safety/relief valve opening	4
EK3.02	Reactor internal pump trip	4
EK3.03	Alternate rod insertion	4
EK3.04	Standby liquid control system initiation signal	3
EK3.05	Steam bypass and pressure control system	4
EK3.06	Feedwater control system operation (feedwater pump speed runback)	4
EK3.07	Fine motion control rod motor driven insertion function (FM Control Rod Drive run-in)	4
EK3.08	Automatic reactor scram	4

4.1 Emergency Plant Evolutions

EPE: EPE1002 High Reactor Pressure (continued)

K/A NO.	ABILITY	IMPORTANCE	
EA1.	**Ability to operate and/or monitor the following as they apply to High Reactor Pressure:** (CFR: 41.7 / 45.6)		
EA1.01	Main steam line drains	3	
EA1.02	Steam bypass and pressure control system	4	
EA1.03	Safety/relief valves	4	
EA1.04	Reactor core isolation cooling system	4	
EA1.05	Alternate rod insertion	4	
EA1.06	Standby liquid control system	3	
EA1.07	Reactor trip and isolation system	4	
EA1.08	Feedwater control system (feedwater pump speed runback)	4	
EA1.09	Fine motion control rod motor driven insertion function (FM Control Rod Drive run-in)	4	
EA1.10	Reactor internal pump trip	4	
EA1.11	Reactor water cleanup system	3	
EA2.	**Ability to determine and/or interpret the following as they apply to High Reactor Pressure:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
EA2.01	Reactor pressure vessel pressure	4	4
EA2.02	Reactor power	4	4
EA2.03	Suppression pool temperature	4	4
EA2.04	Suppression pool level	4	4
EA2.05	Reactor pressure vessel water level	4	4

4.1 Emergency Plant Evolutions

EPE: **EPE1003 Suppression Pool High Water Temperature**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Suppression Pool High Water Temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Pump net positive suction head	3
EK1.02	Steam condensation	4
EK1.03	Primary containment integrity	3
EK2.	**Knowledge of the interrelations between Suppression Pool High Water Temperature and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Suppression pool cooling	4
EK2.02	Wetwell spray	4
EK2.03	Wetwell pressure	3
EK2.04	Safety parameter display system	3
EK2.05	Suppression pool level	4
EK2.06	Suppression pool temperature monitoring system	4
EK3.	**Knowledge of the reasons for the following responses as they apply to Suppression Pool High Water Temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency/normal reactor pressure vessel depressurization	4
EK3.02	Suppression pool cooling	4
EK3.03	Wetwell spray	4
EK3.04	Standby liquid control system injection	4
EK3.05	Automatic reactor scram	4
EK3.06	Reactor building cooling water system automatic initiation	4
EK3.07	Reactor service water system automatic initiation	4

ABILITY

EA1.	**Ability to operate and/or monitor the following as they apply to Suppression Pool High Water Temperature:** (CFR: 41.7 / 45.6)	
EA1.01	Suppression pool cooling	4
EA1.03	Suppression pool temperature monitoring	4

EA2. **Ability to determine and/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	4
EA2.02	Suppression pool level	4	4
EA2.03	Reactor pressure vessel pressure	4	4

4.1 Emergency Plant Evolutions

EPE: EPE1004 High Drywell Temperature

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Drywell Temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Reactor pressure vessel water level measurement	4
EK1.02	Equipment environmental qualification	3
EK1.03	Primary containment integrity	3
EK2.	**Knowledge of the interrelations between High Drywell Temperature and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Drywell spray	4
EK2.02	Components internal to the drywell	3
EK2.03	Reactor pressure vessel water level indication	4
EK2.04	Drywell cooling system	4
EK2.05	Safety Parameter Display System	2
EK3.	**Knowledge of the reasons for the following responses as they apply to High Drywell Temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization.	4
EK3.02	Reactor pressure vessel flooding	4
EK3.03	Drywell spray operation	4
EK3.04	Increased drywell cooling	4
EK3.05	Reactor scram	4
EK3.06	Lower drywell flooder actuation	3

ABILITY

EA1.	**Ability to operate and/or monitor the following as they apply to High Drywell Temperature:** (CFR: 41.7 / 45.6)	
EA1.01	Drywell spray	4
EA1.02	Drywell cooling system	4
EA1.03	Drywell pressure	4

EA2. **Ability to determine and/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	4
EA2.02	Reactor pressure vessel pressure	4	4
EA2.03	Reactor pressure vessel water level	4	4
EA2.04	Drywell pressure	4	4
EA2.05	Wetwell pressure...	4	4
EA2.06	Wetwell air space temperature	3	4

4.1 Emergency Plant Evolutions

EPE: **EPE1005 High Suppression Pool Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications as they apply to High Suppression Pool Water Level**: (CFR: 41.8 to 41.10)	
EK1.01	Containment integrity	3
EK2.02	Termination of injection sources external to containment	3
EK2.	**Knowledge of the interrelations between High Suppression Pool Water Level and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Residual heat removal system	3
EK2.02	High pressure core flooder system	3
EK2.03	Wetwell to drywell vacuum breakers	3
EK2.04	Safety relief valves and respective discharge piping	3
EK2.05	Drywell water level	3
EK206	Reactor core isolation cooling system	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Suppression Pool Water Level:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	4
EK3.02	Lowering suppression pool water level	4
EK3.03	Reactor scram	3

ABILITY

K/A NO.	ABILITY	IMPORTANCE
EA1.	**Ability to operate and/or monitor the following as they apply to High Suppression Pool Water Level:** (CFR: 41.7 / 45.6)	
EK1.01	High pressure core flooder system	3
EA102	Residual heat removal system	3
EA1.03	Reactor core isolation cooling system	3

EA2. **Ability to determine and/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	4
EA2.02	Reactor pressure	4	4
EA2.03	Drywell water level	3	4

4.1 Emergency Plant Evolutions

EPE: **EPE1006 Low Suppression Pool Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Low Suppression Pool Water Level:** (CFR: 41.8 to 41.10)	
EK1.01	Steam condensation	4
EK1.02	Pump net positive suction head	4
EK1.03	Heat capacity	4
EK2.	**Knowledge of the interrelations between Low Suppression Pool Water Level and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor core isolation cooling system	4
EK2.02	Residual heat removal system/low pressure flooder mode	4
EK2.03	High pressure core flooder system	4
EK2.04	Horizontal vent submergence	4
EK2.05	SRV discharge submergence	4
EK2.06	Safety Parameter Display System	3
EK2.07	Suppression pool temperature detector submergence	3
EK3.	**Knowledge of the reasons for the following responses as they apply to Low Suppression Pool Water Level:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	4
EK3.02	Reactor core isolation cooling system	4
EK3.03	High pressure core flooder system	4
EK3.04	Reactor scram	4
EK3.05	net positive suction head considerations for Emergency Core Cooling System pumps	4
	ABILITY	
EA1.	**Ability to operate and/or monitor the following as they apply to Low Suppression Pool Water Level:** (CFR: 41.7 / 45.6)	
EA1.01	Emergency Core Cooling System systems (net positive suction head considerations)	4
EA1.02	Reactor core isolation cooling system	4
EA1.03	High pressure core flooder system	4
EA1.04	Suppression pool cleanup system	2
EA1.05	Residual heat removal system	4

4.1 **Emergency Plant Evolutions**

EPE: **EPE1006 Low Suppression Pool Water Level**

K/A NO.	**ABILITY**	**IMPORTANCE**	
EA2.	**Ability to determine and/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	4
EA2.02	Suppression pool temperature	4	4
EA2.03	Reactor pressure	4	4
EA2.04	Drywell/ suppression chamber differential pressure	4	4

4.1 Emergency Plant Evolutions

EPE: EPE1007 Reactor Low Water Level

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Reactor Low Water Level:** (CFR: 41.8 to 41.10)	
EK1.01	Adequate core cooling	4
EK1.02	Natural circulation	4
EK1.02	Water level effects on reactor power	4
EK2.	**Knowledge of the interrelations between Reactor Low Water Level and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor pressure vessel water level indication	4
EK2.02	Reactor pressure vessel pressure.	4
EK2.03	Reactor core isolation cooling system	4
EK2.04	Residual heat removal system: Low pressure flooder mode	4
EK2.05	High pressure core flooder system	4
EK2.06	Automatic depressurization system	4
EK2.07	Recirculation system	3
EK2.08	Reactor trip and isolation system	4
EK2.09	Leak detection and isolation system	4
EK2.10	Alternate rod insertion circuitry	4
EK2.11	AC electrical power distribution system	3
EK2.12	Feedwater control system	4
EK2.13	Residual heat removal system: shutdown cooling mode	4
EK2.14	Standby liquid control system	4
EK2.15	ESF logic and control system	3
EK2.16	Safety parameter display system	2
EK2.17	Fire protection system	4
EK3.	**Knowledge of the reasons for the following responses as they apply to Reactor Low Water Level**: (CFR: 41.5 / 45.6)	
EK3.01	Automatic depressurization system initiation	4
EK3.02	Core coverage	4
EK3.03	Steam cooling	4
EK3.04	Emergency depressurization	4
EK3.05	Reactor scram	4
EK3.06	Reactor core isolation cooling initiation	4
EK3.07	High pressure core flooder initiation	4
EK3.08	Residual heat removal system: Low pressure flooder mode initiation	4
EK3.09	Alternate rod insertion initiation	4

4.1 Emergency Plant Evolutions

EPE: EPE1007 Reactor Low Water Level (continued)

K/A NO.	ABILITY	IMPORTANCE
EA1.	**Ability to operate and/or monitor the following as they apply to Reactor Low Water Level:** (CFR: 41.7 / 45.6)	
EA1.01	Residual heat removal system: Low pressure flooder mode	4
EK2.02	High pressure core flooder systems	4
EA1.03	Reactor core isolation system	4
EA1.04	Automatic depressurization system	4
EA1.05	Safety/relief valves	4
EA1.06	Alternate injection subsystems	4
EA1.07	Control rod drive system	4
EA1.08	Condensate system	4
EA1.09	Feedwater system	4
EA1.10	Feedwater control system	4
EA1.11	Fire protection system	$

EA2. **Ability to determine and/or interpret the following as they apply to Reactor Low Water Level:**
(CFR: 41.10 / 43.5 / 45.13)

K/A NO.	ABILITY	RO	SRO
EA2.01	Reactor pressure vessel water level	4	4
EA2.02	Reactor power	4	4
EA2.03	Reactor pressure vessel pressure	4	4
EA2.04	Adequate core cooling	4	4

4.1 Emergency Plant Evolutions

EPE: **EPE1008 High Secondary Containment Area Temperature**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Secondary Containment Area Temperature:** (CFR: 41.8 to 41.10)	
EK1.01	Personnel protection	4
EK1.02	Radiation releases	4
EK1.03	Impact of operating environment on components	3
EK1.04	Maximum normal operating temperature	3
EK1.05	Maximum safe operating temperature	3
EK2.	**Knowledge of the interrelations between High Secondary Containment Area Temperature and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Area/room coolers	4
EK2.02	Reactor building HVAC system	4
EK2.03	Leak detection and isolation system	4
EK2.04	Temperature sensitive instrumentation	3
EK2.05	Systems required for safe shut-down	4
EK2.06	Systems required to suppress a fire	3
EK2.07	Systems required for adequate core cooling	3
EK2.08	Systems required to protect the containment	3
EK2.09	Primary system discharging in secondary containment	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Secondary Containment Area Temperature:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	4
EK3.02	Reactor scram	4
EK3.03	Isolating affected systems	4

ABILITY

K/A NO.	ABILITY	IMPORTANCE
EA1.	**Ability to operate and/or monitor the following as they apply to High Secondary Containment Area Temperature:** (CFR: 41.7 / 45.6)	
EA1.01	Reactor building HVAC system	4
EA1.02	Fire protection system	3
EA1.03	Affected systems so as to isolate damaged portions	4

EA2. **Ability to determine and/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	4	4
EA2.02	Equipment operability	3	4
EA2.03	Cause of high area temperature	4	4

4.1 Emergency Plant Evolutions

EPE: **EPE1009 High Secondary Containment Area Radiation Levels**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Secondary Containment Area Radiation Levels:** (CFR: 41.8 to 41.10)	
EK1.01	Component environmental qualifications	2
EK1.02	Personnel protection	4
EK1.03	Radiation releases.	4
EK1.04	Maximum normal operating radiation limit	3
EK1.05	Maximum safe operating radiation limit	3
EK2.	**Knowledge of the interrelations between High Secondary Containment Area Radiation Levels and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Area radiation monitoring system	4
EK2.02	Process radiation monitoring system	4
EK2.03	Reactor Building HVAC system	4
EK2.04	Standby gas treatment system	4
EK2.05	Primary system discharging in to secondary containment	3
EK2.06	Systems required to suppress a fire	3
EK2.07	Systems required for adequate core cooling	3
EK2.08	Systems required to shutdown the reactor	3
EK2.09	Systems required to protect the containment	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Secondary Containment Area Radiation Levels:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	3
EK3.02	Reactor scram	4
EK3.03	Isolating affected systems	4
EK3.04	Personnel evacuation	4
EK3.05	Emergency plan	4
	ABILITY	
EA1.	**Ability to operate and/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.	4
EA1.02	Process radiation monitoring system	4
EA1.03	Reactor Building HVAC system	4
EA1.04	Standby gas treatment system	4
EA1.05	Affected systems so as to isolate damaged portions	4

4.1 Emergency Plant Evolutions

EPE: EPE1009 High Secondary Containment Area Radiation Levels (continued)

K/A NO. ABILITY IMPORTANCE

EA2. Ability to determine and/or interpret the following as they apply to High Secondary Containment Area Radiation Levels:
(CFR: 41.10/43.5/45.13)

K/A NO.	ABILITY	RO	SRO
EA2.01	Area radiation levels	4	4
EA2.02	Equipment operability	3	3
EA2.03	Cause of high area radiation	4	4

4.1 Emergency Plant Evolutions

EPE: **EPE1010 Reactor Building Heating, Ventilation, and Air Conditioning Exhaust High Radiation**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Reactor Building HVAC Exhaust High Radiation:** (CFR: 41.8 to 41.10)	
EK1.01	Personnel protection	4
EK1.02	Radiation releases	4
EK2.	**Knowledge of the interrelations between Reactor Building HVAC Exhaust High Radiation and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Process radiation monitoring system	4
EK2.02	Standby gas treatment system	4
EK2.03	Reactor building HVAC system	4
EK2.04	Leak detection and isolation system	4
EK3.	**Knowledge of the reasons for the following responses as they apply to Reactor Building HVAC Exhaust High Radiation:** (CFR: 41.5 / 45.6)	
EK3.01	Isolating reactor building HVAC system	4
EK3.02	Starting standby gas treatment system	4
EK3.03	Personnel evacuation.	4

ABILITY

EA1.	**Ability to operate and/or monitor the following as they apply to Reactor Building HVAC Exhaust High Radiation:** (CFR: 41.7 / 45.6)	
EA1.01	Process radiation monitoring system	4
EA1.02	Reactor building HVAC system	4
EA1.03	Standby gas treatment system	4

EA2. **Ability to determine and/or interpret the following as they apply to Reactor Building HVAC Exhaust High Radiation:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
EA2.01	Ventilation radiation levels	4	4
EA2.02	Cause of high radiation levels	4	4

4.1	**Emergency Plant Evolutions**	
EPE:	**EPE1011 Secondary Containment High Differential Pressure**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Secondary Containment High Differential Pressure:** (CFR: 41.8 to 41.10)	
EK1.01	Secondary containment integrity	4
EK1.02	Radiation release	4
EK2.	**Knowledge of the interrelations between Secondary Containment High Differential Pressure and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor building HVAC system	4
EK2.02	Standby gas treatment system	4
EK2.03	Off-site release rate	3
EK3.	**Knowledge of the reasons for the following responses as they apply to Secondary Containment High Differential Pressure:** (CFR: 41.5 / 45.6)	
EK3.01	Reactor building HVAC system response	3
	ABILITY	
EA1.	**Ability to operate and/or monitor the following as they apply to Secondary Containment High Differential Pressure:** (CFR: 41.7 / 45.6)	
EA1.01	Reactor building HVAC system	4
EA1.02	Standby gas treatment system	4
EA2.	**Ability to determine and/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	4
EA2.02	Off-site release rate	3	4

4.1 Emergency Plant Evolutions

EPE: **EPE1012 Secondary Containment High Floor Drain Sump/Area Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Secondary Containment High Floor Drain Sump/Area Water Level:** (CFR: 41.8 to 41.10)	
EK1.01	Radiation releases	3
EK1.02	Electrical ground/ circuit malfunction	3
EK1.03	Maximum normal operating limit	3
EK1.04	Maximum safe operating limit	3
EK2.	**Knowledge of the interrelations between Secondary Containment High Floor Drain Sump/Area Water Level and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor building high conductivity and low conductivity waste drains	3
EK2.02	Radwaste system	3
EK2.03	Systems required to shutdown the reactor	3
EK2.04	Systems required to suppress a fire	3
EK2.05	Systems required for adequate core cooling	3
EK2.06	Primary system discharging to secondary containment	3
EK3.	**Knowledge of the reasons for the following responses as they apply to Secondary Containment High Floor Drain Sump/Area Water Level:** (CFR: 41.5 / 45.6)	
EK3.01	Emergency depressurization	3
EK3.02	Reactor scram	3
EK3.03	Isolating affected systems (PRA)	4
EK3.04	Pumping reactor building sumps	3
	ABILITY	
EA1.	**Ability to operate and/or monitor the following as they apply to Secondary Containment High Floor Drain Sump/Area Water Level:** (CFR: 41.7 / 45.6)	
EA1.01	Reactor building high conductivity and low conductivity waste drains	3
EA1.02	Affected systems so as to isolate damaged portions (PRA)	4
EA1.03	Radwaste systems	3

4.1	**Emergency Plant Evolutions**
EPE:	**EPE1012 Secondary Containment High Floor Drain Sump/Area Water Level (continued)**

K/A NO.	**ABILITY**	**IMPORTANCE**	
EA2.	**Ability to determine and/or interpret the following as they apply to Secondary Containment High Floor Drain Sump/Area Water Level:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
EA2.01	Operability of components within the affected area	3	3
EA2.02	Water level in the affected area	3	3
EA2.03	Cause of the high water level	3	4

4.1 Emergency Plant Evolutions

EPE: EPE1013 Scram Condition and Reactor Power >5% or Unknown

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to Scram Condition and Reactor Power >5% or Unknown:** (CFR: 41.8 to 41.10)	
EK1.01	Reactor pressure effects on reactor power	4
EK1.02	Reactor water level effects on reactor power	4
EK1.03	Boron effects on reactor power (Standby liquid control system)	4
EK1.04	Hot shutdown boron weight	3
EK1.05	Cold shutdown boron weight	3
EK1.06	Cooldown effects on reactor power	4
EK1.07	Shutdown margin	3
EK2.	**Knowledge of the interrelations between Scram Condition and Reactor Power >5% or Unknown and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Reactor trip and isolation system	4
EK2.02	Alternate reactor shutdown system	4
EK2.03	Control rod drive system	4
EK2.04	Neutron monitoring system	4
EK2.05	Safety parameter display system	3
EK2.06	Reactor pressure vessel water level	4
EK2.07	Reactor pressure vessel pressure	4
EK2.08	Rod control and information system	4
EK2.09	Alternate boron injection methods	3
EK2.10	Reactor internal pump runback and trips	4
EK2.11	Feedwater spargers	4
EK2.12	ESF logic and control system	3
EK2.13	Reactor recirculation flow control system	4
EK3.	**Knowledge of the reasons for the following responses as they apply to Scram Condition and Reactor Power >5% or Unknown:** (CFR: 41.5 / 45.6)	
EK3.01	Reactor internal pump runback	4
EK3.02	Trip of reactor internal pumps	4
EK3.03	Standby liquid control system injection	4
EK3.04	Lowering of reactor pressure vessel water level (PRA)	4
EK3.05	Feedwater pump runback	4
EK3.06	Hot shutdown boron weight	2
EK3.07	Cold shutdown boron weight	3
EK3.08	Maintaining heat sinks external to the containment	4
EK3.09	Various alternate methods of control rod insertion	4

4.1 Emergency Plant Evolutions

EPE: **EPE1013 Scram Condition and Reactor Power >5% or Unknown (continued)**

K/A NO.	ABILITY	IMPORTANCE
EA1.	**Ability to operate and/or monitor the following as they apply to Scram Condition and Reactor Power >5% or Unknown:** (CFR: 41.7 / 45.6)	
EA1.01	Reactor trip and isolation system	4
EA1.02	Initiation of alternate rod insertion function	4
EA1.03	Standby liquid control system	4
EA1.04	Control rod drive system	4
EA1.05	Neutron monitoring system	4
EA1.06	Rod control and information system	4
EA1.07	Safety parameter display system	3
EA1.08	Alternate boron injection methods	4
EA1.09	Leak detection and isolation system	4
EA1.10	Feedwater control system (PRA)	4
EA1.11	Reactor recirculation system	4
EA1.12	Reactor water cleanup system	4

EA2. **Ability to determine and/or interpret the following as they apply to Scram Condition and Reactor Power >5% or Unknown:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
EA2.01	Reactor power	4	4
EA2.02	Reactor power oscillations	4	4
EA2.03	Reactor pressure vessel water level	4	4
EA2.04	Standby liquid control system tank level	4	4
EA2.05	Suppression pool temperature	4	4
EA2.06	Control rod position	4	4
EA2.07	Reactor pressure vessel pressure	4	4
EA2.08	Containment conditions/isolations	4	4
EA2.09	Reactor recirculation flow	4	4

4.1 Emergency Plant Evolutions

EPE: **EPE1014 High Off-Site Release Rate**

K/A NO.	KNOWLEDGE	IMPORTANCE
EK1.	**Knowledge of the operational implications of the following concepts as they apply to High Off-Site Release Rate:** (CFR: 41.8 to 41.10)	
EK1.01	Biological effects of radioisotope ingestion	3
EK1.02	Protection of the general public	4
EK1.03	Meteorological effects on off-site release	3
EK2.	**Knowledge of the interrelations between High Off-Site Release Rate and the following:** (CFR: 41.7 / 45.8)	
EK2.01	Radwaste system	3
EK2.02	Offgas system	4
EK2.03	Plant ventilation systems	4
EK2.04	Stack-gas monitoring system	4
EK2.05	Site emergency plan	4
EK2.06	Process radiation monitoring system	3
EK2.07	Control room habitability area HVAC system	4
EK2.08	Safety parameter display system	3
EK2.09	Post accident sample system (PASS)	3
EK2.10	Condensate air extraction system	3
EK3.	**Knowledge of the reasons for the following responses as they apply to High Off-Site Release Rate** (CFR: 41.5 / 45.6)	
EK3.01	Implementation of site emergency plan	4
EK3.02	System isolations	4
EK3.03	Control room habitability area HVAC system isolation	4
EK3.04	Emergency depressurization	4
	ABILITY	
EA1.	**Ability to operate and/or monitor the following as they apply to High Off-Site Release Rate:** (CFR: 41.7 / 45.6)	
EA1.01	Stack-gas monitoring system	4
EA1.02	Meteorological instrumentation	3
EA1.03	Process radiation monitoring system	4
EA1.04	Safety parameter display system	3
EA1.05	Post accident sample system	3
EA1.06	Plant ventilation	4
EA1.07	Control room habitability area HVAC system	4

EPE: EPE1014 High Off-Site Release Rate (continued)

K/A NO.	ABILITY	IMPORTANCE	
EA2.	**Ability to determine and/or interpret the following as they apply to High Off-Site Release Rate:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
EA2.01	Off-site	3	4
EA2.02	Total number of curies released	2	3
EA2.03	Radiation levels	4	4
EA2.04	Source of offsite release	4	4

4.2 Abnormal Plant Evolutions

APE: APE2001 Partial or Complete Loss of Forced Core Flow Circulation

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Partial or Complete Loss of Forced Core Flow Circulation:** (CFR: 41.8 to 41.10)	
AK1.01	Natural circulation	4
AK1.02	Power/flow distribution	3
AK1.03	Thermal limits	4
AK1.04	Power oscillations	3
AK1.05	Selected control rod run-in initiation	4
AK2.	**Knowledge of the interrelations between Partial or Complete Loss of Forced Core Flow Circulation and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor recirculation system	4
AK2.02	Nuclear boiler instrumentation	3
AK2.03	Reactor pressure vessel water level	4
AK2.05	Reactor power	4
AK2.06	Core flow indication	4
AK2.07	Reactor trip and isolation system	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Partial or Complete Loss of Forced Core Flow Circulation:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor pressure vessel water level response.	3
AK3.02	Reactor power response	4
AK3.03	Reactor scram	3
AK3.04	Reduced reactor internal pump operating requirements	3
AK3.05	Core flow indication	3

4.2 Abnormal Plant Evolutions

APE: APE2001 Partial or Complete Loss of Forced Core Flow Circulation (continued)

K/A NO.	ABILITY	IMPORTANCE
AA1.	**Ability to operate and/or monitor the following as they apply to Partial or Complete Loss of Forced Core Flow Circulation:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor recirculation system	4
AA1.02	Reactor trip and isolation system	3
AA1.03	Rod control and information system	3
AA1.04	Recirculation flow control system	3
AA1.05	Neutron monitoring system	3
AA1.06	Nuclear boiler instrumentation	3
AA1.07	Selected control rod run-in	4

AA2. **Ability to determine and/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
AA2.02	Neutron monitoring	3	3
AA2.03	Actual core flow	3	3
AA2.04	Reactor internal pump operability	3	3
AA2.05	Nuclear boiler instrumentation	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2002 Loss of Main Condenser Vacuum**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Main Condenser Vacuum:** (CFR: 41.8 to 41.10)	
AK1.01	Plant efficiency	2
AK1.02	Turbine efficiency	2
AK1.03	Loss of heat sink	4
AK1.04	Offgas flow changes	3
AK2.	**Knowledge of the interrelations between Loss of Main Condenser Vacuum and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Main turbine	3
AK2.02	Leak detection and isolation system	4
AK2.03	Steam bypass and pressure control system	3
AK2.04	Feedwater system	3
AK2.05	Condensate system	3
AK2.06	Offgas system	3
AK2.07	Circulating water system	3
AK2.08	Seal steam	3
Ak2.09	Reactor trip and isolation system	3
AK2.10	Condensate air extraction system	2
AK3.	**Knowledge of the reasons for the following responses as they apply to Loss of Main Condenser Vacuum:** (CFR: 41.5 / 45.6)	
AK3.01	Turbine trip	3
AK3.02	Turbine bypass valve closure	3
AK3.03	Main steam isolation valve closure	3
AK3.04	Air ejector flow	3
AK3.05	Decreased main generator output	2
AK3.06	Reactor power reduction	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Loss of Main Condenser Vacuum:** (CFR: 41.7 / 45.6)	
AA1.01	Condensate system	3
AA1.02	Offgas system	3
AA1.03	Reactor trip and isolation system	3
AA1.04	Leak detection and isolation system	3
AA1.05	Main turbine	3
AA1.06	Steam bypass and pressure control system	3
AA1.07	Circulating water system	3
AA1.08	Recirculation flow control system	3
AA1.09	Rod control and information system	3

4.2 Abnormal Plant Evolutions

APE: APE2002 Loss of Main Condenser Vacuum (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
AA2.	**Ability to determine and/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/absolute pressure	3	3
AA2.02	Generator output.	2	2
AA2.03	Offgas system flow	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2003 Partial or Complete Loss of AC Power**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Partial or Complete Loss of AC Power:** (CFR: 41.8 to 41.10)	
AK1.01	Effect of battery discharge rate on capacity	3
AK1.02	Load shedding	3
AK1.03	Under voltage/degraded voltage effects on electrical loads	3
AK1.04	Electrical bus divisional separation	3
AK1.05	Failsafe component design	3
AK1.06	Station blackout	4
AK2.	**Knowledge of the interrelations between Partial or Complete Loss of AC Power and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Station batteries	3
AK2.02	Emergency diesel generators	4
AK2.03	Combustion turbine generators	4
AK2.04	AC electrical distribution system	4
AK2.05	AC electrical loads	3
AK2.06	DC electrical loads	3
AK2.07	Reactor core isolation cooling system	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Partial or Complete Loss of AC Power:** (CFR: 41.5 / 45.6)	
AK3.01	Manual and auto bus transfer	3
AK3.02	Load shedding and sequencing	4
AK3.03	Ground isolation	3
AK3.04	Reactor scram	4
AK3.05	Containment isolation	4
	ABILITY	
AA1.	**Ability to operate and/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
AA1.02	Emergency diesel generators	4
AA2.03	Combustion turbine generators	4
AA1.04	Systems necessary to assure safe plant shutdown	4
AA1.05	DC electrical distribution system	4

4.2 Abnormal Plant Evolutions

APE: APE2003 Partial or Complete Loss of AC Power (continued)

K/A NO.	ABILITY	IMPORTANCE	
AA2.	**Ability to determine and/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	Cause of partial or complete loss of AC power	3	4
AA2.02	Reactor power, pressure, and level	4	4
AA2.03	Battery status	3	4
AA2.04	System lineups	4	4
AA2.05	Whether a partial or complete loss of AC power has occurred	4	4

4.2 Abnormal Plant Evolutions

APE: **APE2004 Partial or Complete Loss of DC Power**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Partial or Complete Loss of DC Power:** (CFR: 41.8 to 41.10)	
AK1.01	Electrical bus divisional separation	3
AK1.02	Effect of battery discharge rate on capacity	3
AK1.03	Loss of breaker protection	3
AK1.04	Prevention of inadvertent system(s) actuation upon restoration of DC power	3
AK2.	**Knowledge of the interrelations between Partial or Complete Loss of DC Power and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Battery charger	3
AK2.02	Batteries	3
AK2.03	Reactor core isolation cooling system	4
AK2.04	AC electrical power distribution system	3
AK2.05	Emergency diesel generators	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Partial or Complete Loss of DC Power:** (CFR: 41.5 / 45.6)	
AK3.01	Manual load shedding	3
AK3.02	Ground isolation/fault determination	3
AK3.03	Reactor scram	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Partial or Complete Loss of DC Power:** (CFR: 41.7 / 45.6)	
AA1.01	DC electrical distribution systems	3
AA1.02	Systems necessary to assure safe plant shutdown	4
AA1.03	AC electrical power distribution system	3

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2004 Partial or Complete Loss of DC Power (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AA2.	**Ability to determine and/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	Cause of partial or complete loss of DC power	3	4
AA2.02	Extent of partial or complete loss of DC power	4	4
AA2.03	Battery voltage	3	3
AA2.04	System lineups	3	3

4.2 Abnormal Plant Evolutions

APE: APE2005 Main Turbine Generator Trip

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to MAIN TURBINE GENERATOR TRIP:** (CFR: 41.8 to 41.10)	
AK1.01	Pressure effects on reactor power	4
AK1.02	Core thermal limit considerations	3
AK1.03	Pressure effects on reactor pressure vessel water level	4
AK2.	**Knowledge of the interrelations between MAIN TURBINE GENERATOR TRIP and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor trip and isolation system	4
AK2.02	Feedwater temperature	3
AK2.03	Reactor recirculation system	3
AK2.04	Main generator protection	3
AK2.05	Extraction steam system	3
AK2.06	Seal steam evaporator	2
AK2.07	Steam bypass and pressure control system	4
AK2.08	AC electrical distribution system	3
AK2.09	Turbine protection	3
AK3.	**Knowledge of the reasons for the following responses as they apply to MAIN TURBINE GENERATOR TRIP:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor scram	4
AK3.02	Reactor internal pump trip and runback	3
AK3.03	Feedwater temperature decrease	3
AK3.04	Main generator trip	3
AK3.05	Extraction steam/moisture separator isolations	3
AK3.06	Main turbine bypass valve operation	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to MAIN TURBINE GENERATOR TRIP:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor recirculation system	3
AA1.02	Reactor trip and isolation system	4
AA1.03	Rod control and information system	3
AA1.04	Main generator controls	3
AA1.05	Steam bypass and pressure control system	4

4.2 Abnormal Plant Evolutions

APE: APE2005 Main Turbine Generator Trip (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
AA1.06	Condenser vacuum breaker	2
AA1.07	AC electrical distribution	3
AA1.08	Turbine control system	3

AA2. Ability to determine and/or interpret the following as they apply to Main Turbine Generator Trip:
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
AA2.01	Turbine speed	3	3
AA2.02	Turbine vibration	2	3
AA2.03	Turbine valve position	3	3
AA2.04	Reactor pressure vessel pressure	4	4
AA2.05	Reactor power	4	4
AA2.06	Feedwater temperature	3	3
AA2.07	Reactor pressure vessel water level	4	4
AA2.08	Electrical distribution status	3	3
AA2.09	Number of running reactor internal pumps and their speed	3	3

4.2 Abnormal Plant Evolutions

APE: APE2006 Reactor Scram

K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Reactor Scram:** (CFR: 41.8 to 41.10)	
AK1.01	Decay heat generation and removal	4
AK1.02	Shutdown margin	3
AK1.03	Reactivity control	4
AK2.	**Knowledge of the interrelations between Reactor Scram and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor trip and isolation system	4
AK2.02	Feedwater control system	4
AK2.03	Control rod drive system	4
AK2.04	Reactor power	4
AK2.05	Steam bypass and pressure control system	4
AK2.06	Recirculation flow control system	3
AK2.07	Main turbine trip	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Reactor Scram**: (CFR: 41.5 / 45.6)	
AK3.01	Reactor pressure vessel water level response	4
AK3.02	Reactor power response	4
AK3.03	Reactor pressure vessel pressure response	4
AK3.04	Reactor pressure vessel water level setpoint setdown	3
AK3.06	Reactor internal pump speed reduction	3
AK3.07	Scram follow function	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Reactor Scram:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor trip and isolation system	4
AA1.02	Feedwater control system (PRA)	4
AA1.03	Steam bypass and pressure control system	4
AA1.04	Reactor recirculation system	3
AA1.05	Neutron monitoring system	4
AA1.06	Control rod drive system	4
AA1.07	Rod control and information system	4
AA1.08	Recirculation flow control system	4

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2006 Reactor Scram (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**

AA2. **Ability to determine and/or interpret the following as they apply to Reactor Scram:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	**SRO**
AA2.01	Reactor power	4	4
AA2.02	Control rod position	4	4
AA2.03	Reactor pressure vessel water level	4	4
AA2.04	Reactor pressure vessel pressure	4	4
AA2.05	Whether a reactor scram has occurred	4	4
AA2.06	Cause of reactor scram	4	4

4.2 Abnormal Plant Evolutions

APE: **APE2007 High Reactor Pressure**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Reactor Pressure:** (CFR: 41.8 to 41.10)	
AK1.01	Pump shutoff head	3
AK1.02	Pressure effects on reactor power	4
AK1.03	Turbine load	3
AK2.	**Knowledge of the interrelations between High Reactor Pressure and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Steam bypass and pressure control system	4
AK2.02	Reactor power	4
AK2.03	Residual heat removal system/Low pressure flooder mode	3
AK2.04	Shutdown cooling	3
AK3.	**Knowledge of the reasons for the following responses as they apply to High Reactor Pressure**: (CFR: 41.5 / 45.6)	
AK3.01	RCIC operation	3
AK3.02	Safety/relief valve operation	4
AK3.03	Steam bypass and pressure control system operation	4
AK3.04	Reactor internal pump trip	4

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to High Reactor Pressure:** (CFR: 41.7 / 45.6)		
AA1.01	Reactor core isolation cooling system	3	
AA1.02	Safety/relief valve operation	4	
AA1.03	Steam bypass and pressure control system	4	
AA2.	**Ability to determine and/or interpret the following as they apply to High Reactor Pressure**: (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Reactor pressure vessel pressure	4	4
AA2.02	Reactor power	4	4
AA2.03	Reactor pressure vessel water level	4	4

4.2 Abnormal Plant Evolutions

APE: **APE2008 High Reactor Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Reactor Water Level:** (CFR: 41.8 to 41.10)	
AK1.01	Moisture carryover.	3
AK1.02	Component erosion/damage	3
AK1.03	Feed flow/steam flow mismatch	3
AK2.	**Knowledge of the interrelations between High Reactor Water Level and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Feedwater system	4
AK2.02	Feedwater control system	4
AK2.03	Reactor core isolation cooling system	3
AK2.04	High pressure core flooder system	3
AK2.05	Main turbine	3
AK2.06	Steam bypass and pressure control system	3
AK2.07	Reactor water cleanup system (ability to drain)	3
AK3.	**Knowledge of the reasons for the following responses as they apply to High Reactor Water Level:** (CFR: 41.5 / 45.6)	
AK3.01	Main turbine trip	3
AK3.02	Feedwater pump trip	3
AK3.03	Reactor core isolation cooling system steam supply valve closure	3
AK3.04	High pressure core flooder injection valve closure	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to High Reactor Water Level:** (CFR: 41.7 / 45.6)	
AA1.01	Feedwater control system	4
AA1.02	Reactor water cleanup (ability to drain)	3
AA1.03	Reactor core isolation cooling system	3
AA1.04	High pressure core flooder system	3
AA1.05	Main turbine	3
AA1.06	Feedwater system	4

4.2 Abnormal Plant Evolutions

APE: APE2008 High Reactor Water Level (continued)

K/A NO.	ABILITY	IMPORTANCE	
AA2.	**Ability to determine and/or interpret the following as they apply to High Reactor Water Level:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Reactor pressure vessel water level	4	4
AA2.02	Steam flow/feed flow mismatch	3	3
AA2.03	Reactor water cleanup blowdown flow	3	3
AA2.04	Reactor pressure vessel water swell	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2009 Low Reactor Water Level**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Low Reactor Water Level:** (CFR: 41.8 to 41.10)	
AK1.01	Steam carryunder	3
AK1.02	Natural circulation	3
AK2.	**Knowledge of the interrelations between Low Reactor Water Level and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor pressure vessel water level indication	4
AK2.02	Feedwater water level control system	4
AK2.03	Reactor recirculation system	3
AK2.04	Reactor water cleanup system	3
AK2.05	Reactor trip and isolation system	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Low Reactor Water Level:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor internal pump trip and runback	3

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to Low Reactor Water Level** (CFR: 41.7 / 45.6)	
AA1.01	Feedwater system	4
AA1.02	Feedwater control system	4
AA1.03	Recirculation system	3
AA1.04	Reactor water cleanup system	3
AA1.05	Condensate system (PRA)	4

AA2. **Ability to determine and/or interpret the following as they apply to Low Reactor Water Level:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
AA2.01	Reactor pressure vessel water level	4	4
AA2.02	Steam flow/feed flow mismatch	4	4
AA2.03	Reactor water cleanup blowdown flow rate	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2010 High Drywell Pressure**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Drywell Pressure:** (CFR: 41.8 to 41.10)	
AK1.01	Temperature increases	3
AK1.02	Dewpoint increases	2
AK2.	**Knowledge of the interrelations between High Drywell Pressure and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Suppression pool level	3
AK2.02	Drywell wetwell differential pressure	3
AK2.03	Atmosphere control system	3
AK2.04	Drywell cooling and ventilation	4
AK2.05	Instrument air system	3
AK2.06	High pressure nitrogen gas supply system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to High Drywell Pressure:** (CFR: 41.5/45.6)	
AK3.01	Drywell/wetwell venting	4
AK3.02	Increased drywell cooling	3
AK3.03	Radiation level monitoring	3
AK3.04	Leak investigation	4
AK3.05	Temperature monitoring	4
AK3.06	Termination of drywell inerting	2
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to High Drywell Pressure:** (CFR: 41.7 / 45.6)	
AA1.01	Drywell ventilation/cooling	3
AA1.02	High and low conductivity waste sumps	4
AA1.03	Nitrogen makeup	3
AA1.04	Sampling system	3
AA1.05	Drywell wetwell vent and purge	3
AA1.06	Leakage detection systems	3
AA1.07	Atmosphere control system	3
AA1.08	Process radiation monitoring system	3

4.2 Abnormal Plant Evolutions

APE: APE2010 High Drywell Pressure (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
AA2.	**Ability to determine and/or interpret the following as they apply to High Drywell Pressure:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Leak rates	3	4
AA2.02	Drywell pressure	4	4
AA2.03	Drywell radiation levels	3	4
AA2.04	Drywell temperature	4	4
AA2.05	Drywell dewpoint	2	2

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2011 High Drywell Temperature**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Drywell Temperature:** (CFR: 41.8 to 41.10)	
AK1.01	Pressure/temperature relationship	3
AK2.	**Knowledge of the interrelations between High Drywell Temperature and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Drywell cooling	4
AK3.	**Knowledge of the reasons for the following responses as they apply to High Drywell Temperature:** (CFR: 41.5 / 45.6)	
AK3.01	Increased drywell cooling	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to High Drywell Temperature:** (CFR: 41.7 / 45.6)	
AA1.01	Drywell cooling system	4
AA2.02	Sampling system	2
AA2.	**Ability to determine and/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
AA2.02	Drywell pressure	4	4
AA2.03	Dewpoint	2	2

4.2 Abnormal Plant Evolutions

APE: **APE2012 High Suppression Pool Temperature**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Suppression Pool Temperature:** (CFR: 41.8 to 41.10)	
AK1.01	Pool stratification	3
AK1.02	Ambient temperature effects	2
AK1.03	Localized heating	3
AK2.	**Knowledge of the interrelations between High Suppression Pool Temperature and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Suppression pool cooling	4
AK2.02	Safety relief valve actuation	4
Ak2.03	Reactor core isolation cooling system	4
AK2.04	Suppression pool temperature monitoring system	4
AK2.05	ESF logic and control system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to High Suppression Pool Temperature:** (CFR: 41.5 / 45.6)	
AK3.01	Suppression pool cooling operation	4
AK3.02	Limiting heat additions	4

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to High Suppression Pool Temperature:** (CFR: 41.7 / 45.6)	
AA1.01	Suppression pool cooling	4
AA1.02	Systems that add heat to the suppression pool	4

AA2.	**Ability to determine and/or interpret the following as they apply to High Suppression Pool Temperature:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Suppression pool temperature	4	4
AA2.02	Localized heating/stratification	3	4

4.2 Abnormal Plant Evolutions

APE: APE2013 Inadvertent Reactivity Addition

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Inadvertent Reactivity Addition:** (CFR: 41.8 to 41.10)	
AK1.01	Prompt critical	4
AK1.02	Reactivity anomaly	3
AK1.03	Shutdown margin	4
AK1.04	Fuel thermal limits	4
AK1.05	Abnormal reactivity additions	4
AK2.	**Knowledge of the interrelations between Inadvertent Reactivity Addition and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor trip and isolation system	4
AK2.02	Fuel thermal limits	4
AK2.03	Fuel temperature	3
AK2.04	Void concentration	3
AK2.05	Neutron monitoring system	4
AK2.06	Moderator temperature	3
AK2.07	Reactor power	4
AK2.08	Rod control and information system	3
AK2.09	Safety limits	4
AK2.10	Recirculation flow control system	4
AK2.11	Feedwater control system	3
AK2.12	Steam bypass and pressure control system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Inadvertent Reactivity Addition:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor scram	4
AK3.02	Control rod blocks	4
AK3.03	Selected control rod run-in	4
AK3.04	Core flow increase block	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Inadvertent Reactivity Addition:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor trip and isolation system	4
AA1.02	Recirculation flow control system	4
AA1.03	Rod control and information system	3

4.2 Abnormal Plant Evolutions

APE: APE2013 Inadvertent Reactivity Addition (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**
AA1.04	Neutron monitoring system	4
AA1.05	Steam bypass and pressure control system	3
AA1.06	Feedwater temperature	4

AA2. Ability to determine and/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	4
AA2.02	Reactor period	4	4
AA2.03	Cause of reactivity addition	4	4
AA2.04	Violation of fuel thermal limits	4	4
AA2.05	Violation of safety limits	4	4

4.2 Abnormal Plant Evolutions

APE: **APE2014 Incomplete Scram**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Incomplete Scram:** (CFR: 41.8 to 41.10)	
AK1.01	Shutdown margin	4
AK1.02	Cooldown effects on reactor power	4
AK1.03	Reactivity effects	4
AK1.04	Reactor pressure	4
AK2.	**Knowledge of the interrelations between Incomplete Scram and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Control rod drive system	4
AK2.02	Rod control and information system	3
AK2.03	Reactor trip and isolation system	4
AK2.04	Neutron monitoring system	4
AK2.05	Safety parameter display system	3
AK2.06	Instrument air	4
AK2.07	Alternate rod insertion	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Incomplete Scram:** (CFR: 41.5 / 45.6)	
AK3.01	Bypassing rod insertion blocks	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Incomplete Scram:** (CFR: 41.7 / 45.6)	
AA1.01	Control rod drive system	4
AA1.02	Reactor trip and isolation system	4
AA1.03	Rod control and information system	3
AA1.04	Neutron monitoring system	4
AA1.05	Safety parameter display system.	3
AA1.06	Alternate rod insertion	4

4.2 Abnormal Plant Evolutions

APE: **APE2014 Incomplete Scram (continued)**

K/A NO.	ABILITY	IMPORTANCE	
AA2.	**Ability to determine and/or interpret the following as they apply to Incomplete Scram:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Reactor power	4	4
AA2.02	Control rod position	4	4

4.2 Abnormal Plant Evolutions

APE: **APE2015 Control Room Evacuation**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Control Room Evacuation:** (CFR: 41.8 to 41.10)	
	None	
AK2.	**Knowledge of the interrelations between Control Room Evacuation and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Remote shutdown panel	4
AK2.02	Local control stations	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Control Room Evacuation:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor scram	4
AK3.02	Turbine trip	4
AK3.03	Disabling control room controls	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Control Room Evacuation:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor trip and isolation system	4
AA1.02	AC electrical power distribution system	3
AA1.03	Reactor pressure vessel water level	4
AA1.04	Control room/local control transfer mechanisms (PRA)	4
AA1.05	Reactor pressure vessel pressure	4
AA1.06	Safety/relief valves (PRA)	3
AA1.07	Residual heat removal system (PRA)	3
AA1.08	High pressure core flooder system	3
AA1.09	Reactor building cooling water system	3
AA1.10	Reactor service water system	3
AA1.11	Atmosphere control system	3
AA1.12	Makeup water condensate system	3
AA1.13	Suppression pool temperature monitoring system	3

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2015 Control Room Evacuation (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AA2.	**Ability to determine and/or interpret the following as they apply to Control Room Evacuation:** (CFR: 41.10 / 43.5 / 45.13)	

K/A NO.	ABILITY	RO	SRO
AA2.01	Reactor power	4	4
AA2.02	Reactor pressure vessel water level	4	4
AA2.03	Reactor pressure vessel pressure	4	4
AA2.04	Suppression pool temperature	4	4
AA2.05	Drywell pressure	4	4
AA2.06	Cooldown rate	3	4
AA2.07	Wetwell pressure	3	3
AA2.08	Reactor pressure vessel water temperature	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2016 High Off-Site Release Rate**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Off-Site Release Rate:** (CFR: 41.8 to 41.10)	
AK1.01	Biological effects of radioisotope ingestion	2
AK1.02	Protection of the general public	4
AK1.03	Meteorological effects on off-site release	3
AK2.	**Knowledge of the interrelations between High Off-Site Release Rate and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Fission product production versus reactor power	3
AK2.02	Radwaste system	3
AK2.03	Off-gas system	3
AK2.04	Plant ventilation systems	3
AK2.05	Site emergency plan	3
AK2.06	Control room habitability area ventilation system	3
AK2.07	Safety parameter display system	3
AK2.08	Condensate air extraction system	3
AK2.09	Process radiation monitoring system	3
AK2.10	Standby gas treatment system	3
AK2.11	Reactor trip and isolation system	3
AK2.12	Leak detection and isolation system	4
AK2.13	Fuel pool cooling and cleanup system	2
AK3.	**Knowledge of the reasons for the following responses they apply to High Off-Site Release Rate:** (CFR: 41.5 / 45.6)	
AK3.01	System isolations	4
AK3.02	Plant ventilation	3
AK3.03	Implementation of site emergency plan	4
AK3.04	Power reduction	4
AK3.05	Control room habitability area ventilation system	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to High Off-Site Release Rate:** (CFR: 41.7 / 45.6)	
AA1.01	Radwaste system	3
AA1.02	Off-gas system	4
AA1.03	Plant ventilation systems	3
AA1.04	Safety parameter display system	3
AA1.05	Condensate air extraction system	3
AA1.06	Process radiation monitoring system	3
AA1.07	Standby gas treatment system	4
AA1.10	Reactor trip and isolation system	4
AA1.08	Leak detection and isolation system	4
AA1.09	Meteorological data	3

4.2 Abnormal Plant Evolutions

APE: APE2016 High Off-Site Release Rate (continued)

K/A NO.	**ABILITY**	**IMPORTANCE**	
AA2.	**Ability to determine and/or interpret the following as they apply to High Off-Site Release Rate:** (CFR: 41.10 / 43.5 / 45.13)		
		RO	**SRO**
AA2.01	Off-site release rate	3	4
AA2.02	Total number of curies released	2	4
AA2.03	Radiation levels	3	4
AA2.04	Source of off-site release	4	4
AA2.05	Meteorological data	3	4

4.2 Abnormal Plant Evolutions

APE: **APE2017 Partial or Complete Loss of Reactor Building Cooling Water**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Partial or Complete Loss of Reactor Building Cooling Water:** (CFR: 41.8 to 41.10)	
AK1.01	Effects on component/system operations	4
AK2.	**Knowledge of the interrelations between Partial or Complete Loss of Reactor Building Cooling Water and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor water cleanup system	3
AK2.02	Reactor recirculation system	3
AK2.03	Residual heat removal system	4
AK2.04	Fuel pool cooling and cleanup system	3
AK2.05	Plant operations	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Partial or Complete Loss of Reactor Building Cooling Water:** (CFR: 41.5 / 45.6)	
AK3.01	Isolation of non-essential heat loads	3
AK3.02	Reactor power reduction	3
AK3.03	Securing individual components (prevent equipment damage)	3
AK3.04	Starting standby pump	3
AK3.05	Placing standby heat exchanger in service	3
AK3.06	Increasing cooling water flow to heat exchangers	3

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to Partial or Complete Loss of Reactor Building Cooling Water:** (CFR: 41.7 / 45.6)	
AA1.01	System loads	3
AA1.02	Affected systems so as to isolate damaged portions	3

AA2. **Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of Reactor Building Cooling Water:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
AA2.01	Component temperatures	3	3
AA2.02	Cooling water temperature	3	3
AA2.03	Cause for partial or complete loss	3	3
AA2.04	System flow	3	3
AA2.05	System pressure	3	3
AA2.06	Surge tank level	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2018 Partial or Complete Loss of Instrument Air**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Partial or Complete Loss of Instrument Air:** (CFR: 41.8 to 41.10)	
	None	
AK2.	**Knowledge of the interrelations between Partial or Complete Loss of Instrument Air and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Control rod drive system	4
AK2.02	Reactor building cooling water system	3
AK2.03	Feedwater system	3
AK2.04	Reactor water cleanup system	3
AK2.05	Main steam system	3
AK2.06	Offgas system	3
AK2.07	Fuel pool cooling and cleanup system	3
AK2.08	Radwaste system	3
AK2.09	Service air system	3
AK2.10	Reactor core isolation cooling	3
AK2.11	Atmosphere control system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Partial or Complete Loss of Instrument Air:** (CFR: 41.5 / 45.6)	
AK301	Standby air compressor operation	4
AK3.02	Auto cross-tie of service air system to instrument air system on lower instrument air header pressure	3
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Partial or Complete Loss of Instrument Air:** (CFR: 41.7 / 45.6)	
AA1.01	Backup air supply	4
AA1.02	Instrument air compressor power supplies	3

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2018 Partial or Complete Loss of Instrument Air (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AA2.	**Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of Instrument Air:** (CFR: 41.10 / 43.5 / 45.13)	

K/A NO.	ABILITY	RO	SRO
AA2.01	Instrument air system pressure	4	3
AA2.02	Status of instrument air system loads	3	3

4.2 Abnormal Plant Evolutions

APE: APE2019 Inadvertent Containment Isolation

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Inadvertent Containment Isolation:** (CFR: 41.8 to 41.10)	
AK1.01	Loss of normal heat sink	4
AK1.02	Power/reactivity control	4
AK1.03	Water chemistry	2
AK1.04	Bottom head thermal stratification	3
AK1.05	Loss of drywell/containment cooling	3
AK2.	**Knowledge of the interrelations between Inadvertent Containment Isolation and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Main steam system	4
AK2.02	Sampling system	3
AK2.03	Drywell cooling	3
AK2.04	Reactor water cleanup system	3
AK2.05	Reactor core isolation cooling system	3
AK2.06	Automated traversing in-core probe system	3
AK2.07	Residual heat removal system/shutdown cooling	3
AK2.08	Low/high conductivity waste system	3
AK2.09	Standby gas treatment system	3
AK2.10	Reactor building cooling water system	3
AK2.11	Atmosphere control system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Inadvertent Containment Isolation:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor scram	4
AK3.02	Drywell/containment pressure response	3
AK3.03	Drywell/containment temperature response	3
AK3.04	Reactor pressure vessel pressure response	4
AK3.05	Reactor pressure vessel water level response	4
AK3.06	Suppression pool water level response.	3
AK3.07	Suppression pool temperature response	3
AK3.08	Wetwell pressure response	3
AK3.09	Safety relief valve operation	3
AK3.10	Reactor core isolation cooling operation	3

4.2 Abnormal Plant Evolutions

APE: APE2019 Inadvertent Containment Isolation (continued)

K/A NO.	ABILITY	IMPORTANCE
AA1.	**Ability to operate and/or monitor the following as they apply to Inadvertent Containment Isolation:** (CFR: 41.7 / 45.6)	
AA1.01	Leak detection and isolation system	4
AA1.02	Drywell cooling system	3
AA1.03	Reactor building HVAC system	3

AA2. **Ability to determine and/or interpret the following as they apply to Inadvertent Containment Isolation:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
AA2.01	Drywell pressure	4	4
AA2.02	Drywell temperature	3	3
AA2.03	Reactor power	4	4
AA2.04	Reactor pressure vessel pressure	4	4
AA2.05	Reactor pressure vessel water level	4	4
AA2.06	Cause of isolation	3	4

4.2 Abnormal Plant Evolutions

APE: APE2020 Loss of Shutdown Cooling

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Shutdown Cooling:** (CFR: 41.8 to 41.10)	
AK1.01	Decay heat	4
AK1.02	Thermal stratification	3
AK1.03	Adequate core cooling	4
AK1.04	Natural circulation	4
AK2.	**Knowledge of the interrelations between Loss of Shutdown Cooling and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor pressure vessel water temperature	4
AK2.02	Reactor water cleanup system	3
AK2.03	Reactor building cooling water system	3
AK2.04	Fuel pool cooling and cleanup system	3
AK2.05	Reactor recirculation system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Loss of Shutdown Cooling:** (CFR: 41.5 / 45.6)	
AK3.01	Raising reactor pressure vessel water level	3
AK3.02	Feeding and bleeding reactor vessel	3
AK3.03	Increasing drywell cooling	3
AK3.04	Maximizing reactor water cleanup flow	3
AK3.05	Establishing alternate decay heat removal flow paths (PRA)	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Loss of Shutdown Cooling:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor water cleanup system	3
AA1.02	RHR/shutdown cooling (PRA)	4
AA1.03	Reactor building cooling water system~~s~~	3
AA1.04	Alternate decay heat removal methods	4
AA1.05	Reactor recirculation system	3
AA1.06	Containment/ drywell temperature	3

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2020 Loss of Shutdown Cooling (continued)**	
K/A NO.	**ABILITY**	**IMPORTANCE**
AA2.	**Ability to determine and/or interpret the following as they apply to Loss of Shutdown Cooling:** (CFR: 41.10 / 43.5 / 45.13)	

		RO	**SRO**
AA2.01	Reactor pressure vessel water heatup/cooldown rate	4	4
AA2.02	RHR/shutdown cooling system flow	3	3
AA2.03	Reactor pressure vessel water level	4	4
AA2.04	Reactor pressure vessel water temperature	3	4
AA2.05	Reactor pressure vessel metal temperature	3	4
AA2.06	Reactor pressure vessel pressure	3	3
AA2.07	Reactor recirculation flow	3	3

4.2 Abnormal Plant Evolutions

APE: APE2021 Loss of Control Rod Drive Pumps

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Control Rod Drive Pumps:** (CFR: 41.8 to 41.10)	
AK1.01	Reactivity control	4
AK2.	**Knowledge of the interrelations between Loss of Control Rod Drive Pumps and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Reactor recirculation system	3
AK2.02	Fine motion control rod mechanism	3
AK2.03	Hydraulic control unit accumulator pressures	3
AK2.04	Reactor pressure vessel water level	3
AK2.05	Reactor water cleanup system	3
AK3.	**Knowledge of the reasons for the following responses as they apply to Loss of Control Rod Drive Pumps:** (CFR: 41.5 / 45.6)	
AK3.01	Reactor scram	4

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to Loss of Control Rod Drive Pumps:** (CFR: 41.7 / 45.6)	
AA1.01	Control rod drive system	3
AA1.02	Reactor trip and isolation system	4
AA1.03	Reactor recirculation system	3
AA1.04	Reactor water cleanup system	3

AA2. **Ability to determine and/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	Hydraulic control unit accumulator pressure	4	4
AA2.02	Control rod drive system status	3	3

4.2 Abnormal Plant Evolutions

APE: **APE2022 Refueling Accidents**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Refueling Accidents:** (CFR: 41.8 to 41.10)	
AK1.01	Radiation exposure hazards	4
AK1.02	Shutdown margin	3
AK1.03	Inadvertent criticality	4
AK2.	**Knowledge of the interrelations between Refueling Accidents and the following:** (CFR: 41.7 / 45.8)	
AK2.01	Fuel handling equipment	3
AK2.02	Fuel pool cooling and cleanup system	3
AK2.03	Radiation monitoring equipment	3
AK2.04	Rod control and information system.	3
AK2.05	Reactor building HVAC system	4
AK2.06	Standby gas treatment system	4
AK3.	**Knowledge of the reasons for the following responses as they apply to Refueling Accidents:** (CFR: 41.5 / 45.6)	
AK3.01	Refueling floor evacuation	4
AK3.02	Interlocks associated with fuel handling equipment	3
AK3.03	Reactor building HVAC system isolation	3

ABILITY

AA1.	**Ability to operate and/or monitor the following as they apply to Refueling Accidents:** (CFR: 41.7 / 45.6)	
AA1.01	Reactor building HVAC system	3
AA1.02	Fuel pool cooling and cleanup system	3
AA1.03	Fuel handling equipment	3
AA1.04	Radiation monitoring equipment	3
AA1.05	Neutron monitoring system	3
AA1.06	Standby gas treatment system	4

AA2. **Ability to determine and/or interpret the following as they apply to Refueling Accidents:**
(CFR: 41.10 / 43.5 / 45.13)

		RO	SRO
AA2.01	Area radiation levels	4	4
AA2.02	Fuel pool level	3	4
AA2.03	Airborne contamination levels	3	4
AA2.04	Occurrence of fuel handling accident	3	4
AA2.05	Entry conditions of emergency plan	3	4

4.2 Abnormal Plant Evolutions

APE: **EPE2023 Plant Fire On-Site**

K/A NO.	KNOWLEDGE	IMPORTANCE
AK1	**Knowledge of the operation applications of the following concepts as they apply to Plant Fire On-Site:** (CFR: 41.10 / 43.5 / 45.11)	
AK1.01	Fire classifications by type	3
AK1.02	Fire fighting	3
AK2.	**Knowledge of the interrelations between Plant Fire On-Site and the following:** (CFR: 41.10 / 43.5 / 45.11)	
AK2.01	Sensors/detectors and dampers	3
AK2.02	Controllers and positioners	2
AK2.03	Motors	3
AK2.04	Breakers/relays/disconnects/transformers	3
AK3	**Knowledge of the reasons for the following responses as they apply to Plant Fire On-Site:** (CFR: 41.10 / 43.5 / 45.11)	
AK3.01	Installation of fire detectors	2
AK3.02	Steps called out in the site fire protection plant/fire protection system manual or fire zone manual	2
AK3.03	Fire detector surveillance test	2
AK3.04	Actions contained in the abnormal procedure for plant fire on site (CFR: 41.10 / 43.5 / 45.11)	3
	ABILITY	
AA1	**Ability to operate and/ or monitor the following as they apply to Plant Fire On-Site:** (CFR: 41.10 / 43.5 / 45.11)	
AA1.01	Respirator air pack	3
AA1.02	Re-installation of fire detector	2
AA1.03	Bypass of fire zone detector	2
AA1.04	Bypass of heat detector	2
AA1.05	Plant and control room habitability area ventilation systems	3
AA1.06	Fire alarm	3
AA1.07	Fire alarm reset panel	2
AA1.08	Fire fighting equipment used on each class of fire	3
AA1.09	Plant fire zone panel (including detector location)	3

4.2 Abnormal Plant Evolutions

APE: EPE2023 Plant Fire On-Site (continued)

K/A NO.	ABILITY	IMPORTANCE	
AA2	**Ability to determine and interpret the following as they apply to Plant Fire On-Site:** (CFR: 41.10 / 43.5 / 45.11)		
		RO	**SRO**
AA2.01	Damper position	3	3
AA2.02	Fire alarm	3	3
AA2.03	The fire's extent of potential operational damage to plant equipment	3	3
AA2.04	Ventilation alignment necessary to secure affected area	3	3
AA2.05	Need for pressurizing control room (recirculating mode)	3	3
AA2.06	Need for placing control room habitability area HVAC in smoke removal mode	4	4
AA2.07	Need for placing the reactor building HVAC system in smoke removal mode	4	4
AA2.08	Need for placing the turbine building HVAC system in smoke removal mode	4	4
AA2.09	Need for placing the control building safety-related equipment area HVAC system in smoke removal mode	4	4
AA2.10	Whether malfunction is due to common-mode electrical failures	3	3
AA2.11	Time limit of long-term-breathing air system for control room	3	3
AA2.12	Time limit for use of respirators	3	3
AA2.13	Location of vital equipment within fire zone	3	4
AA2.14	Need for emergency plant shutdown	3	4
AA2.15	Equipment that will be affected by fire suppression activities in each zone	3	4
AA2.16	Requirements for establishing a fire watch	2	4
AA2.17	Vital equipment and control systems to be maintained and operated during a fire	3	4
AA2.18	Systems that may be affected by the fire	3	4

4.2	**Abnormal Plant Evolutions**	
APE:	**APE2024 Generator Voltage and Electric Grid Disturbances**	
K/A NO.	**KNOWLEDGE**	**IMPORTANCE**
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.4, 41.5, 41.7, 41.10 / 45.8)	
AK1.01	Over-excitation	3
AK1.02	Under-excitation	3
AK2.	**Knowledge of the interrelations between Generator Voltage and Electric Grid Disturbances and the following:** (CFR: 41.4, 41.5, 41.7, 41.10 / 45.8)	
AK2.01	Motors	3
AK2.02	Breakers, relays	3
AK2.03	Sensors, detectors, indicators	3
AK2.04	Controllers, positioners	3
AK2.05	Pumps	3
AK2.06	Reactor power	4
AK2.07	Turbine/generator control	4
AK2.08	Bus frequency	3
AK3.	**Knowledge of the reasons for the following responses 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	4
AK3.02	Actions contained in abnormal operating procedure for voltage and grid disturbances	4
	ABILITY	
AA1.	**Ability to operate and/or monitor the following as they apply to Generator Voltage and Electric Grid Disturbances:** (CFR: 41.5 and 41.10 / 45.5, 45.7, and 45.8)	
AA1.01	Grid frequency and voltage	4
AA1.02	Turbine/generator controls	4
AA1.03	Voltage regulator controls	4
AA1.04	Reactor controls	4
AA1.05	Engineered safety features	4

4.2 Abnormal Plant Evolutions

APE: APE2024 Generator Voltage and Electric Grid Disturbances (continued)

K/A NO. ABILITY IMPORTANCE

AA2. Ability to determine and/or interpret the following as they apply to Generator Voltage and Electric Grid Disturbances:
(CFR: 41.5 and 43.5 / 45.5, 45.7, and 45.8)

K/A NO.	ABILITY	RO	SRO
AA2.01	Operating point on the generator capability curve	4	4
AA2.02	Voltage outside the generator capability curve	4	4
AA2.03	Generator current outside the capability curve	4	4
AA2.04	VARs outside capability curve	4	4
AA2.05	Operational status of offsite circuit	3	4
AA2.06	Generator frequency limitations	3	4
AA2.07	Operational status of engineered safety features	4	4
AA2.08	Criteria to trip the turbine or reactor	4	4
AA2.09	Operational status of emergency diesel generators	4	4
AA2.10	Generator overheating and the required actions	4	4

5.0 Components

COMPONENT: 291001 Valves
(CFR: 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	The operation of safety valves	3.4	3.5
K1.02	The operation of relief valves	3.4	3.6
K1.03	The relationship of valve position to flow rate and back pressure	2.7	2.8
K1.04	Valve design for a given failed valve position (open, closed, and, as-is positions); spring loaded valves; hydraulic, pneumatically controlled valves; electric motor driven valves)	2.7	2.8
K1.05	The significance of stem position (valve status) for gate valves	2.9	2.8
K1.06	Safety concerns in the use of gate valves (protect valves seals, open slowly)	2.7	2.7
K1.07	Cautions for placing a valve controller in manual mode	3.4	3.4
K1.08	Emergency operation of MOV with motor inoperable	3.4	3.5
K1.09	The stroke test for a valve, including the use of a stopwatch	2.7	2.7
K1.10	Principles of operation and purpose of check valves	3.1	3.1
K1.11	Operation of manual valves and verification of position with indicator lights	3.2	3.2
K1.12	Reason for using globe valves versus gates valves for throttling	2.6	2.8

COMPONENT: **291002 Sensors and Detectors**
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Flow		
K1.01	Operation of venturis and orifices	2.4	2.5
K1.02	Temperature compensation requirements	2.4	2.5
K1.03	Effects of gas or steam on liquid flow rate indications (erroneous reading)	2.5	2.6
K1.04	Modes of failure	2.9	3.1
K1.05	Operation of a flow D/P cell type flow detector	3.1	3.1
	Level		
K1.06	Temperature/pressure compensation requirements	2.8	2.9
K1.07	Operation of a differential pressure level detector	3.2	3.2
K1.08	Effects of operating environment (pressure, temperature, and radiation)	2.8	2.9
K1.09	Modes of failure	3.3	3.3
	Pressure		
K1.10	Theory of operation of bourdon tubes, diaphragms, bellows, and pressure detectors	2.4	2.5
K1.11	Effects of operating environment (pressure, temperature, radiation)	2.3	2.5
K1.12	Operation of a pressure D/P cell	2.8	2.9
K1.13	Modes of failure	2.9	3.1
	Temperature		
K1.14	Theory of operation of T/C, RTD, thermostats, thermometers (expanding fluid)	2.3	2.4
K1.15	Indications of failure modes of T/C, RTD, thermometers	2.6	2.8
	Position Detector		
K1.16	Failure modes of reed switches, LVDT, limit switches, and potentiometers	2.5	2.7
K1.17	Applications of reed switches, magnets, LVDT, potentiometers, and limit switches	2.3	2.4

COMPONENT: **291002 Sensors and Detectors (continued)**
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Electrical		
K1.18	Applications of voltmeters, ammeters, frequency, and ground detectors	2.2	2.4
	Nuclear Instrumentation		
K1.19	Operation of fission chambers, ion chambers	3.0	3.1
K1.20	Neutron monitoring indication units	3.2	3.2
K1.21	Effects of voltage changes on neutron detector performance	2.8	2.9
K1.22	Failure modes of fission chambers, ion chambers, and proportional counters	3.0	3.1
	Radiation Detection		
K1.23	Operation of ion chambers, G-M tubes and scintillation detectors	2.8	2.9
K1.24	Use of portable radiation monitoring instruments	3.1	3.2

COMPONENT: **291003 Controllers and Positioners**
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Function and operation of flow controller in manual and automatic modes	3.5	3.7
K1.02	Function and operation of a speed controller	3.5	3.6
K1.03	Operation of a valve controller, including seal-in features	3.3	3.4
K1.04	Function and operation of pressure and temperature controllers, including pressure and temperature control valves	3.3	3.3
K1.05	Function and characteristics of valve positioners	2.8	2.8
K1.06	Function and characteristics of governors and other mechanical controllers	2.5	2.6
K1.07	Safety precautions with respect to the operation of controllers and positioners	2.8	2.8
K1.08	Theory of operation of the following types of controllers: electronic, electrical, and pneumatic	2.2	2.2
K1.09	Effects on operation of controllers due to proportional, proportional and reset, and proportional and integral features	2.0	2.2

COMPONENT: **291004 Pumps**
(CFR: 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Centrifugal		
K1.01	Identification, symptoms, and consequences of cavitation	3.2	3.2
K1.02	Reasons for venting a centrifugal pump	2.8	2.8
K1.03	Consequences of air binding	2.8	2.9
K1.04	Consequences of operating a pump dead headed or for extended recirculation times	3.0	3.1
K1.05	Discuss relationships among head, flow, speed, and power	2.8	2.9
K1.06	Need for net positive suction head (NPSH); effects of loss of suction	3.3	3.3
K1.07	Starting current and operating current interpretation	2.8	2.8
K1.08	Purpose of starting a pump with discharge valve closed	2.8	2.8
K1.09	Pressure and flow relationship of pumps in parallel	2.3	2.4
K1.10	Pressure and flow relationship of pumps in series	2.3	2.4
K1.11	Definition of pump shutoff head	2.4	2.5
K1.12	"Runout" of a centrifugal pump (definition, indications, causes, effects, and corrective measures)	2.8	2.8
K1.13	Principles of operation of a centrifugal pump	2.6	2.7
K1.14	Relationship between flow from a pump and suction heads	2.5	2.5
K1.15	Purpose of pump minimum flow requirements	2.9	2.9
	Positive Displacement		
K1.16	Discuss relationship among head, flow, speed, and power	2.5	2.7
K1.17	Net positive suction head (NSPH) requirements for a positive displacement pump	2.5	2.6
K1.18	Consequences of operating a positive displacement pump against a closed flow path	3.3	3.3
K1.19	Functions and characteristics of positive displacement pumps	2.6	2.6
K1.20	Reason for starting a positive displacement pump with the discharge valve open; need to clear the flow path	3.1	3.1
K1.21	Safety procedures and precautions associated with positive displacement pumps	3.1	3.0

COMPONENT: 291005 Motors and Generators
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Locked motor rotor, recognition from motor parameters	2.6	2.6
K1.02	Potential consequences of overheating motor insulation or motor bearings	2.6	2.7
K1.03	Causes of excessive current in motors, such as low voltage, overloading, and mechanical binding	2.6	2.7
K1.04	Relationship between pump motor current (ammeter reading) and the following: pump fluid flow, head, speed, and stator temperature	2.7	2.7
K1.05	Explain the difference between starting current and operating (running) current in a motor	2.6	2.7
K1.06	Reason for limiting the number of motor starts in a given time period	2.9	3.1
K1.07	Electrical units: volts, amps, AC, DC, and hertz	2.6	2.6
K1.08	Consequences of overexcited/underexcited	2.5	2.6
K1.09	Interrelations of the following: VARs, Watts, Amps, Volts, Power factor	2.3	2.6

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	2.7	2.7
K1.02	Proper filling of a shell and tube heat exchanger	2.6	2.6
K1.03	Basic heat transfer in a heat exchanger	2.4	2.6
K1.04	Effects of heat exchanger flow rates that are too high or too low	2.8	2.8
K1.05	Flow paths for the heat exchanger (counterflow and U-types)	2.2	2.3
K1.06	Components of a heat exchanger (shells, tubes, plates, etc.)	2.3	2.3
K1.07	Control of heat exchanger temperatures	2.7	2.8
K1.08	Relationship between flow rates and temperatures	2.9	3.0
K1.09	Definition of thermal shock	2.7	2.8
K1.10	Principle of operation of condensers	2.8	2.8
K1.11	Relationship between condenser vacuum and backpressure	2.8	2.8
K1.12	Causes of natural circulation	2.9	3.0
K1.13	Use of steam tables to determine saturation pressure for a given temperature and vice versa	2.7	2.9
K1.14	Fluid hammer and methods of prevention	3.1	3.2
K1.15	Effects of heat exchanger tube fouling	2.6	2.8
K1.16	Effects of scaling on heat exchanger operation	2.5	2.6
K1.17	Consequences of heat exchanger tube failure	2.7	2.8
K1.18	Reasons for non-condensible gas removal	2.8	2.9

COMPONENT: **291007 Demineralizers and Ion Exchangers**
(CFR: 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Effect of excessive differential pressure on demineralizer performance	2.6	2.7
K1.02	Reason for sampling inlet and outlet of demineralizer	2.5	2.6
K1.03	Effects of channeling in a demineralizer	2.8	2.9
K1.04	Purpose of a demineralizer	2.8	2.9
K1.05	Purpose of demineralizer D/P gauge	2.4	2.5
K1.06	Reason for demineralizer temperature and flow limits	2.7	2.7
K1.07	Principles of demineralizer operation	2.3	2.5
K1.08	Demineralizer D/P to determine condition of demineralizer resin bed	2.6	2.6
K1.09	Effects of demineralizer operation on water conductivity	2.7	2.7

COMPONENT: **291008 Breakers, Relays and Disconnects**
(CFR: 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Purpose for racking out breakers (de-energize components and associated control and indication circuits)	3.6	3.6
K1.02	Local indication that breaker is open, closed or tripped	3.4	3.5
K1.03	Meaning of power supply circuit breaker indicator lights and capability to remotely open and close	3.3	3.4
K1.04	Operation of various push buttons, switches and handles and the resulting action on breakers	3.3	3.3
K1.05	Function of thermal overload protection device	3.0	3.1
K1.06	Interpreting one-line diagram of control circuitry	3.2	3.6
K1.07	Safety procedures and precautions associated with breakers, including MCC bus breakers, high, medium and low voltage breakers, relays and disconnects	3.5	3.7
K1.08	Effects of closing breakers with current out of phase, different frequencies, high voltage differential, low current, or too much load	3.4	3.5
K1.09	Effect of racking out breakers on control and indicating circuits and removal of control power on breaker operation	3.4	3.5
K1.10	Function, control, and precautions associated with disconnects	3.3	3.4

6.0 Theory

6.1 Reactor Theory

(CFR: 41.1)

Reactor Theory: 292001 Neutrons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define fast, intermediate, and slow neutrons.	2.0	2.1
K1.02	Define prompt and delayed neutrons.	3.0	3.1
K1.03	Define thermal neutrons.	2.7	2.7
K1.04	Describe neutron moderation.	3.2	3.2
K1.05	Identify characteristics of good moderators.	2.4	2.6
K1.06	Define neutron lifetime.	1.9	1.9
K1.07	Define neutron generation time.	1.9	1.9
K1.08	Describe fast flux, thermal flux, and flux distribution.	2.2	2.4

6.1 Reactor Theory
(CFR: 41.1)

Reactor Theory: 292002 Neutron Life Cycle

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Describe the neutron life cycle using the following terms:		
K1.01	fast fission factor	1.9	1.9
K1.02	fast non-leakage probability factor	1.9	1.9
K1.03	resonance escape probability factor	2.0	2.1
K1.04	thermal non-leakage probability factor	1.9	2.0
K1.05	thermal utilization factor	1.9	2.0
K1.06	reproduction factor	1.9	1.9
K1.07	Define critical, subcritical, and supercritical with respect to a reactor	3.5	3.5
K1.08	Define effective multiplication factor and discuss its relationship to the state of the reactor	2.7	2.8
K1.09	Define K-excess.	2.4	2.6
K1.10	Define shutdown margin.	3.2	3.5
K1.11	Define reactivity.	3.2	3.3
K1.12	State the relationship between reactivity and effective multiplication factor	2.4	2.5
K1.13	Calculate shutdown margin using procedures and given plant parameters	1.8	2.4
K1.14	Evaluate change in shutdown margin due to changes in plant parameters	2.6	2.9

6.1 Reactor Theory

(CFR: 41.1)

Reactor Theory: 292003 Reactor Kinetics and Neutron Sources

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Explain the concept of subcritical multiplication.	2.9	3.0
K1.02	Given the simplified formula for subcritical multiplication, perform calculations involving steady state count rate and source count rate.	2.1	2.3
K1.03	Describe the production of delayed neutrons.	2.4	2.4
K1.04	Define delayed neutron fraction and effective delayed neutron fraction; state the reasons for variation.	2.5	2.5
K1.05	Define reactor period.	3.7	3.7
K1.06	Explain the effect of delayed neutrons on reactor period.	3.7	3.7
K1.07	Explain prompt critical, prompt jump, and prompt drop.	3.3	3.3
K1.08	Given the power equation, solve problems for power changes and period.	2.7	2.8
K1.09	Define doubling time and calculate it using the power equation.	2.5	2.6
K1.10	Explain the necessity for installed neutron sources in a reactor core.	2.4	2.4
K1.11	Explain why installed sources are not needed after one cycle of core operation.	2.4	2.4

6.1 Reactor Theory

(CFR: 41.1)

Reactor Theory: 292004 Reactivity Coefficients

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define the temperature coefficient of reactivity.	3.2	3.2
K1.02	Describe the effect on the magnitude of the temperature coefficient of reactivity from changes in moderator temperature and core age.	2.5	2.6
K1.03	Explain resonance absorption.	2.6	2.7
K1.04	Explain doppler broadening and self-shielding.	2.6	2.7
K1.05	Define the doppler coefficient of reactivity.	2.9	2.9
	Describe the effect on the magnitude of the doppler coefficient of reactivity for changes in the following:		
K1.06	Moderator temperature	2.1	2.2
K1.07	Core void fraction	2.1	2.2
K1.08	Fuel temperature	2.2	2.4
K1.09	Core age	1.9	2.1
K1.10	Define the void coefficient of reactivity.	3.2	3.2
	Describe the effect on the magnitude of void coefficient from changes in the following:		
K1.11	Core void fraction	2.5	2.6
K1.12	Fuel temperature	2.2	2.3
K1.13	Core age	2.1	2.2
K1.14	Compare the relative magnitudes of the temperature, doppler, and void coefficients of reactivity.	3.3	3.3

6.1 Reactor Theory
(CFR: 41.1)

Reactor Theory: 292005 Control Rods

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Relate notch and rod position.	3.2	3.3
K1.02	Name the material used for thermal neutron absorption in control rods.	2.5	2.6
K1.03	Describe nuclear properties of active material in the rod.	1.9	1.9
K1.04	Predict direction of change in reactor power for a change in control rod position.	3.5	3.5
K1.05	Define rod density.	2.5	2.6
K1.06	Define reactor scram.	3.7	3.8
K1.07	Define control rod worth, differential control rod worth, and integral control rod worth.	2.4	2.6
K1.08	Explain the shape of curves for differential and integral CRW versus rod position.	2.1	2.3
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.	2.5	2.6
K1.10	State the purpose of flux shaping and rod sequencing.	2.8	3.3
K1.11	Define deep rods, and shallow rods.	2.4	2.5
K1.12	Describe effects of deep and shallow control rods on axial and radial flux distribution.	2.6	2.9

6.1 Reactor Theory

(CFR: 41.1)

Reactor Theory: 292006 Fission Product Poisons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Define fission product poison.	2.7	2.8
K1.02	State the characteristics of Xenon-135 as a fission product poison.	3.1	3.1
K1.03	Describe the production of Xenon-135.	2.9	2.9
K1.04	Describe the removal of Xenon-135.	2.9	2.9
	Describe the following processes and state their effect on reactor operations:		
K1.05	Equilibrium Xenon	2.9	2.9
K1.06	Maneuvering Xenon	2.7	2.7
K1.07	Xenon following a scram	3.2	3.2
K1.08	Describe the effects that Xenon concentration has on flux shape and control rod patterns.	2.8	3.2
	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	2.5	2.5
K1.10	Reactor startup with Xenon-135 already present in the core	2.9	2.9
K1.11	Power changes from steady-state power to another	2.6	2.7
K1.12	Reactor scram.	2.8	2.3
K1.13	Reactor shutdown.	2.6	2.6
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	3.1	3.2
K1.15	State the characteristics of Samarium-149 as a fission product poison.	2.1	2.1
K1.16	Describe the production of Samarium-149.	1.8	1.9
K1.17	Describe the removal of Samarium-149.	1.9	1.9
K1.18	Define equilibrium samarium.	1.8	1.8
	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	1.7	1.8
K1.20	Reactor shutdown.	1.6	1.7
K1.21	Describe effects of power changes on samarium concentration.	1.7	1.8
K1.22	Compare effects of Samarium-149 on reactor operation with those of Xenon-135.	2.4	2.4

6.1 Reactor Theory

(CFR: 41.1)

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	2.9	3.1
K1.02	Describe and explain distribution of burnable poisons in the core.	1.8	2.0
K1.03	Given a curve of K-effective versus core age, state the reasons for maximum, minimum, and inflection points.	2.4	2.7

6.1 Reactor Theory
(CFR: 41.1)

Reactor Theory: 292008 Reactor Operational Physics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Startup and Approach to Criticality		
K1.01	List parameters which should be monitored and controlled during the approach to criticality.	3.8	3.9
K1.02	List reactivity control mechanisms which exist for plant conditions during the approach to criticality.	3.8	3.8
K1.03	Describe count rate and period response which should be observed for rod withdrawal during the approach to criticality.	4.1	4.0
K1.04	Relate the concept of subcritical multiplication to predicted count rate and period response for control rod withdrawal during the approach to critical.	3.3	3.4
K1.05	Explain characteristics to be observed when the reactor is very close to criticality.	4.3	4.3
	Criticality		
K1.06	List parameters which should be monitored and controlled upon reaching initial criticality.	4.2	4.2
K1.07	Define criticality as related to a reactor startup.	3.9	3.9
K1.08	Describe reactor power and period response once criticality is reached.	4.1	4.1
	Intermediate Range Operation		
K1.09	List parameters which should be monitored and controlled during the intermediate phase of startup.	3.9	3.9
K1.10	Explain procedures for adjusting reactor period during the intermediate phase of startup.	3.6	3.6
K1.11	Discuss the concept of the point of adding heat (POAH) and its impact on reactor power	3.7	3.8
K1.12	Describe reactor power and period response prior to reaching the POAH.	3.6	3.7
K1.13	Explain characteristics to look for when the POAH is reached.	3.8	3.9
	Heatup Operation		
K1.14	Describe three parameters to be monitored and controlled during heatup.	3.5	3.5
K1.15	Describe reactor power and period response after reaching the point of adding heat.	3.7	3.7
K1.16	Explain procedures for establishing and controlling heatup rate.	3.6	3.7

6.1 Reactor Theory
(CFR: 41.1)

Reactor Theory: 292008 Reactor Operational Physics (Continued)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Power Operation		
K1.17	Describe three parameters to be monitored and controlled during power operation.	3.6	3.6
K1.18	Describe means by which reactor power will be increased to rated power	3.8	3.8
K1.19	Explain transient and steady-state effects of a control rod withdrawal on reactor power and void fraction content.	3.1	3.2
K1.20	Explain transient and steady-state effects of an increase in core flow on reactor power and void fraction.	3.3	3.4
K1.21	Explain the relationship between steam production rate and reactor power given specific conditions.	2.9	3.0
K1.22	Explain the effect that opening steam bypass valves, during power operation, will have on reactor power	3.5	3.6
K1.23	Explain the necessity for rod pattern exchanges.	2.6	3.1
K1.24	Describe the parameters to be monitored and controlled during rod pattern exchanges.	2.8	3.2
	Reactor Response on a Scram		
K1.25	Explain the shape of a curve of reactor power versus time after a scram.	2.8	2.9
	Normal Reactor Shutdown		
K1.26	Explain reactor power response to a decrease in core flow.	3.4	3.7
K1.27	Explain reactor power response to a control rod insertion.	3.4	3.5
K1.28	Explain the necessity for inserting control rods in a predetermined sequence during normal shutdown.	3.4	3.7
K1.29	Define decay heat.	3.4	3.6
K1.30	Explain the relationship between decay heat generation and: a) power level history, b) power production, and c) time since reaction shut down.	3.2	3.5

6.2 Thermodynamics Theory

(CFR: 41.14)

Thermodynamics: 293001 Thermodynamic Units and Properties

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Convert between absolute and relative pressure and vacuum scales.	2.2	2.3
K1.02	Recognize the difference between absolute and relative temperature scales.	2.1	2.1
K1.03	Describe how common pressure and level sensing instruments work.	2.5	2.7
K1.04	Explain relationships between work, power, and energy.	1.8	1.9

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: **293002 Basic Energy Concepts**

K/A NO.	**KNOWLEDGE**	**IMPORTANCE RO**	**IMPORTANCE SRO**
K1.01	Identify energy and work forms.	1.6	1.7
K1.02	Explain the law of conservation of energy.	1.9	1.9
K1.03	Explain the difference between state and phase of a working substance.	1.6	1.7
K1.04	Explain the application of enthalpy in the monitoring of plant processes.	2.1	2.4
K1.05	Identify the relationship between heat flow during a process and a T-S diagram representation of the process.	2.0	2.2
K1.06	Define specific heat.	1.8	2.1
K1.07	Apply specific heat in solving heat transfer problems.	1.5	1.6

6.2 Thermodynamics Theory

(CFR: 41.14)

Thermodynamics: 293003 Steam

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Describe effects of pressure on density or specific volume of a liquid.	2.3	2.4
K1.02	Distinguish between liquids, vapors, gases, and fluids.	2.2	2.3
K1.03	Define latent heat of vaporization	2.3	2.4
K1.04	Define vaporization line	2.0	2.1
K1.05	Define critical point	1.8	1.8
K1.06	Define vapor dome	1.8	2.0
K1.07	Define saturated liquid	2.7	2.8
K1.08	Define wet vapor	1.8	1.9
K1.09	Define saturated vapor	2.5	2.6
K1.10	Define vapor pressure	1.8	1.9
K1.11	Define moisture content	2.3	2.3
K1.12	Define quality	2.5	2.6
K1.13	Define superheated vapor	2.3	2.4
K1.14	Define supersaturated vapor	1.8	1.8
K1.15	Define subcooled and compressed liquids	2.4	2.4
K1.16	Define subcooling	2.8	2.8
K1.17	Define specific heat	1.9	2.1
	Identify the following terms on a T-s diagram:		
K1.18	Critical point	1.7	1.7
K1.19	Saturated liquid line	2.1	2.2
K1.20	Saturated vapor line	2.2	2.3
K1.21	Solid, liquid, gas, vapor, and fluid regions	2.1	2.2
K1.22	Explain the usefulness of steam tables to the Control Room Operator	2.9	3.2
K1.23	Use saturated and superheated steam tables.	2.8	3.1

6.2 Thermodynamics Theory
(CFR: 41.14)

Thermodynamics: 293004 Thermodynamic Process

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Explain the relationship between real and ideal processes.	1.6	1.7
K1.02	Explain the shape of the T-s diagram process line for a typical boiler	1.8	1.9
	<u>Nozzles</u>		
K1.03	Describe the functions of nozzles in flow restrictors.	2.2	2.2
K1.04	Describe the functions of nozzles in air ejectors.	2.5	2.6
K1.05	Describe the principles of operation of a jet pump	2.7	2.7
	<u>Turbines</u>		
K1.06	Explain the function of nozzles, fixed blading, and moving blading in the turbine.	1.9	2.1
K1.07	Explain the reason turbines are multistages.	2.1	2.2
K1.08	Define turbine efficiency.	2.0	2.1
K1.09	Explain the difference between actual turbine performance and ideal thermal efficiency.	1.7	1.8
	<u>Pumps</u>		
K1.10	Define pump efficiency.	1.8	1.9
K1.11	Explain the difference between ideal and real pumping processes.	1.7	1.8
	<u>Condensers</u>		
K1.12	Discuss subcooling.	2.9	3.1
K1.13	Explain vacuum formation in condenser processes.	2.5	2.6
K1.14	Explain the condensing process.	2.6	2.7
	<u>Throttling and the Throttling Process</u>		
K1.15	Define throttling.	2.2	2.3
K1.16	Explain the reduction of process pressure from throttling.	2.1	2.3

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: **293005 Thermodynamic Cycles**

K/A NO.	**KNOWLEDGE**	**IMPORTANCE** RO	SRO
K1.01	Define thermodynamic cycle.	1.7	1.8
K1.02	Define thermodynamic cycle efficiency in terms of net work produced and energy applied.	1.7	1.7
KI.03	Describe the moisture effects on turbine integrity and efficiency.	2.6	2.7
K1.04	Explain steam quality effects on nuclear turbine design.	2.3	2.4
K1.05	State the advantages of moisture separators/reheaters and feedwater heaters for a typical steam cycle.	2.7	2.8

6.2 Thermodynamics Theory

(CFR: 41.14)

Thermodynamics: 293006 Fluid Statics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Distinguish between fluids and other substances.	1.7	1.8
K1.02	Distinguish between static pressure, dynamic pressure, and total pressure.	2.0	2.2
K1.03	Define head loss.	2.4	2.5
K1.04	Discuss operational considerations of viscosity as related to head loss.	1.7	1.9
K1.05	Explain operational implications of fluid hammer	3.2	3.3
	<u>Pumps and Pump Characteristics</u>		
K1.06	State the purpose of a pump.	2.5	2.6
K1.07	Discuss pump head.	2.5	2.6
K1.08	Discuss relationship between pump speed, head, flow, and power without using formulas or calculations.	2.5	2.6
K1.09	Define cavitation.	2.8	2.9
K1.10	Define net positive suction head (NPSH).	2.7	2.8
K1.11	Define pump shut-off head, pump runout, and axial thrust.	2.4	2.5
K1.12	Explain the importance of proper system venting for pump operations.	2.9	2.9
K1.13	Explain the results of putting centrifugal pumps in parallel or series combinations.	2.6	2.7
K1.14	Given the characteristic curve for a typical centrifugal pump, explain the reason for its shape.	2.2	2.3
K1.15	Using a centrifugal pump characteristic curve and a system Characteristic curve, illustrate how the system operating point changes due to system changes.	2.3	2.4
K1.16	Describe how a centrifugal pump characteristic curve will change with pump speed.	2.1	2.3
K1.17	Explain how operating a centrifugal pump at shutoff head may cause overheating of the pump and describe methods used to avoid overheating.	2.6	2.7
K1.18	Discuss the characteristic curve for a typical positive displacement pump and explain the reason for its shape.	1.9	2.1
K1.19	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.	2.7	2.9
K1.20	Define or explain mass flow rate	2.4	2.4
K1.21	Define or explain two-phase flow	2.4	2.6
K1.22	Define or explain pressure spike	2.2	2.3
K1.23	Define or explain gas binding	2.2	2.3

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: 293006 Fluid Statics (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.24	Define or explain recirculation ratio	2.1	2.3
K1.25	Define or explain pipe whip	2.1	2.2
K1.26	Explain why flow measurements must be corrected for density changes.	2.3	2.4
K1.27	Explain the relationship between pressure head and velocity head in a fluid system.	1.8	2.0
K1.28	Describe the methods of controlling system flow rates.	2.6	2.7

6.2 Thermodynamics Theory
(CFR: 41.14)

Thermodynamics: 293007 Heat Transfer and Heat Exchangers

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Heat Transfer		
K1.01	Describe three mechanisms of heat transfer	3.2	3.2
K1.02	Describe thermal conductivity.	2.4	2.6
K1.03	Explain the manner in which fluid films affects heat transfer	2.7	2.8
	Heat Exchangers		
K1.04	Discuss parallel flow heat exchangers.	1.9	2.2
K1.05	Discuss counter-flow heat exchangers.	2.0	2.2
K1.06	Discuss the factors which affect heat transfer rate in a heat exchanger	2.7	2.8
K1.07	Describe how the presence of gases or steam can affect heat transfer and fluid flow in heat exchangers.	2.7	2.9
	Condenser Applications of Heat Transfer		
K1.08	List functions of the main condenser in a power plant.	3.0	3.1
K1.09	Discuss operational implications of condensate depression.	2.5	2.7
	Core Thermal Power		
K1.10	Define core thermal power	2.7	2.9
K1.11	Explain methods of calculating core thermal power	2.6	3.1
K1.12	Define percent reactor power	2.6	2.7
K1.13	Calculate core thermal power using a simplified heat balance.	2.3	2.9

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: 293008 Thermal Hydraulics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Boiling Heat Transfer		
K1.01	Distinguish between boiling processes and other heat transfer mechanisms.	2.6	2.8
K1.02	Describe surface or cavity nucleation.	2.2	2.3
K1.03	List factors affecting bubble formation in a cavity.	1.9	2.1
K1.04	Describe means by which boiling improves convection heat transfer	2.6	2.7
K1.05	Describe microconvection.	1.4	1.5
	Pool Boiling Curve (T vs. Q/A)		
K1.06	Define a natural convection heat transfer	2.5	2.6
K1.07	Define nucleate boiling, subcooled nucleate boiling, and bulk boiling.	2.8	3.0
K1.08	Describe departure from nucleate boiling	2.9	3.1
K1.09	Describe onset of transition boiling.	3.0	3.2
K1.10	Describe critical heat flux	2.9	3.0
K1.11	Describe transition (partial film) boiling.	2.7	2.8
K1.12	Describe stable film boiling.	2.7	2.8
K1.13	Describe burnout and burnout heat flux.	2.3	2.3
	Two Phase Flow		
K1.14	Classify slug flow region along a fuel channel, experiencing two phase flow.	2.0	2.1
K1.15	Describe annular flow region along a hypothetical fuel channel, experiencing two phase flow.	2.2	2.3
K1.16	Describe dryout region or mist flow region along a hypothetical fuel channel, experiencing two phase flow.	2.2	2.3
K1.17	Describe onset of transition boiling point along a hypothetical fuel channel, experiencing two phase flow.	2.5	2.8
K1.18	Describe effects of flowrate and phase change on the heat transfer coefficient.	2.2	2.4
	Core Inlet Subcooling		
K1.19	Define core inlet subcooling.	2.6	2.8
K1.20	Define carryunder	2.4	2.6

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: **293008 Thermal Hydraulics (continued)**

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Voids and Void Fraction		
K1.21	Define void fraction.	3.0	3.0
K1.22	Explain the term void as applied to core operations	2.9	3.0
K1.23	Define quality	2.5	2.7
K1.24	Draw the temperature profile from the centerline of a fuel pellet o the centerline of the channel.	2.4	2.5
	Recirculation System		
K1.25	Explain the reason for forced core recirculation.	3.2	3.2
K1.26	Explain the jet pump operating principle.	2.9	3.1
K1.27	Explain the necessity of determining core coolant flow.	2.9	3.0
K1.28	Describe the factors affecting single- and two-phase flow resistance.	2.3	2.5
	Core Orificing		
K1.29	Describe the effects of increasing bundle power on bundle flow resistance.	2.8	3.0
K1.30	Compare the flow resistance through high powered bundles to that of low powered bundles.	2.7	2.7
K1.31	Explain the necessity of core orificing.	2.9	3.0
K1.32	Describe core bypass flow.	2.5	2.6
K1.33	Explain the need for adequate core bypass flow.		
	Natural Circulation	2.4	2.6
K1.34	Explain the causes of natural circulation in BWR's.	2.9	3.1
K1.35	Describe problems that thermal stratification can cause.	3.1	3.3
K1.36	Describe means by which the operator can determine if natural circulation flow exists.	3.1	3.3
K1.37	Describe means by which the operator can enhance natural circulation.	3.2	3.4

6.2 Thermodynamics Theory
(CFR: 41.14)

Thermodynamics: 293008 Thermal Hydraulics (continued)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	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	1.8	2.1
K1.39	Axial core flux	1.8	1.9
K1.40	Inlet temperature	1.8	1.9
K1.41	Heat generation rate	1.8	2.0
K1.42	Flow rate in the channel	1.8	1.9
K1.43	Sketch the temperature profile in the axial and radial directions for a typical fuel rod and explain the reason for its shape.	2.0	2.2

6.2 Thermodynamics Theory
(CFR: 41.14)

Thermodynamics: 293009 Core Thermal Limits

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	Explain radial peaking factor (RPF)	2.1	2.5
K1.02	Explain axial peaking factor (APF)	2.2	2.6
K1.03	Explain local peaking factor (LPF)	2.1	2.5
K1.04	Explain total peaking factor (TPF)	2.2	2.6
K1.05	State the reason thermal limits are necessary.	3.3	3.5
	Linear Heat Generation Rate (LHGR)		
K1.06	Define LHGR	3.4	3.8
K1.07	Explain the basis of the limiting condition of LHGR	2.8	3.6
K1.08	Describe the mode of fuel failure for LHGR	3.0	3.4
K1.09	Define FLPD and MFLPD.	3.1	3.7
	Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)		
K1.10	Define average planar linear heat generation rate (APLHGR)	3.3	3.7
K1.11	Explain the basis of the limiting condition for APLGHR	2.8	3.6
K1.12	Describe the mode of fuel failure for APLHGR	2.9	3.5
K1.13	Define MAPLHGR	3.1	3.6
K1.14	Explain the mechanisms most limiting for each region of the MAPLHGR limit curves.	2.2	2.7
K1.15	Describe conditions under which radiative heat transfer becomes the significant method of heat transfer within a fuel bundle.	2.6	3.1
K1.16	Discuss how changes in the heat generation rate and thermal conductivity of the fuel rod affect fuel centerline temperature	2.4	2.8
	Minimum Critical Power Ratio (MCPR)		
K1.17	Define critical power	3.3	3.7
K1.18	Define critical power ratio	3.2	3.7
K1.19	Explain the basis of the limiting condition for CPR	2.8	3.6
K1.20	Describe the mode of fuel failure for CPR	3.1	3.6
K1.21	Define MCPR	3.1	3.6
K1.22	Describe the effects of subcooling on critical power	2.9	3.3
K1.23	Describe the effects of mass flow on critical power	2.8	3.2
K1.24	Describe the effects of pressure on critical power	2.7	3.2
K1.25	Describe the effects of local power distribution on critical power	2.7	3.2
K1.26	Describe the effects of axial power distribution on critical power	2.6	3.1

6.2 **Thermodynamics Theory**
(CFR: 41.14)

Thermodynamics: **293009 Core Thermal Limits (continued)**

K/A NO.	**KNOWLEDGE**	**IMPORTANCE RO**	**SRO**
K1.27	Explain the purpose of the flow biasing correlation factor, (K), as it relates to MCPR limits.	2.7	3.3
K1.28	Define FLCPR	3.0	3.5
	Thermal Time Constant		
K1.29	Define fuel thermal time constant.	2.4	2.7
K1.30	Relate thermal time constant to transient operating condition.	2.3	2.7
	Pellet Clad Interaction		
K1.31	Describe pellet clad interaction	3.0	3.4
K1.32	List the causes of PCI.	2.9	3.3
K1.33	Describe the purpose of the pellet to clad gap.	2.4	2.8
K1.34	Identify the possible effects of fuel densification.	2.3	2.6
K1.35	Describe the effects of iodine and cadmium on pellet clad interaction.	2.2	2.6
	PCIOMR		
K1.36	Explain the purpose for PCIOMR	2.8	3.4
K1.37	Identify how the PCIOMR rules minimize the adverse effects of pellet clad interaction.	2.6	3.3
K1.38	State the items measured for each of the three core thermal limits.	2.7	3.1
	For the following plant operating or accident conditions, identify which of the three core thermal limits are most limiting:		
K1.39	Full power operation	2.8	3.2
K1.40	Loss of reactor coolant	2.8	3.3
K1.41	Increase in core flow	2.8	3.3
K1.42	Increase in reactor pressure	2.8	3.3
K1.43	Cold water addition	2.9	3.4

6.2 Thermodynamics Theory

(CFR: 41.14)

Thermodynamics: 293010 Brittle Fracture and Vessel Thermal Stress

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	State the brittle fracture mode of failure.	2.4	2.8
K1.02	State the definition of Nil-Ductility Transition Temperature.	2.2	2.7
K1.03	Define reference temperature.	2.0	2.5
K1.04	State how the possibility of brittle fracture is minimized by operating limitations.	2.9	3.2
K1.05	State the effect of fast neutron irradiation on reactor vessel metals.	2.5	2.8

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This catalog provides the basis for the development of content-valid licensing examinations for reactor operators (ROs) and senior reactor operators (SROs). The examinations developed using this Catalog will sample the topics listed under Title 10, Code of Federal Regulations , Part 55 (10 CFR 55). This is a new Knowledge and Abilities catalog developed specifically to address the General Electric Advanced Boiling Water Reactor.

This catalog is organized into six major sections: Organization of the Catalog, Generic Knowledge and Ability Statements, Plant Systems grouped by Safety Functions, Emergency and Abnormal Plant Evolutions, Components and Theory.

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Advanced Boiling Water Reactors

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