NUREG-1122
Revision 2

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

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ABSTRACT

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized-Water Reactors (PWRs) (NUREG-1122, Revision 2) provides the basis for the development of content-valid licensing examinations for reactor operators (ROs) and senior reactor operators (SROs). The examinations developed using the PWR Catalog along with the Operator Licensing Examination Standards for Power Reactors (NUREG-1021, Rev. 8) will sample the topics listed under Title 10, Code of Federal Regulations, Part 55 (10 CFR 55).

The PWR Catalog contains approximately 5,100 knowledge and ability (K/A) statements for ROs and SROs at PWRs. The catalog is organized into six major sections: Catalog Organization, Generic Knowledge and Ability Statements, Plant Systems, Emergency and Abnormal Plant Evolutions, Components and Theory.

Revision 1 to the PWR Catalog modified the form and content of the original catalog. The K/As were linked to their applicable 10 CFR 55 item numbers. SRO level K/As were identified by 10 CFR 55.43 item numbers. The plant-wide generic and system generic K/As were combined in one section. Systems were organized into nine safety functions and the emergency and abnormal evolutions were reorganized and expanded.

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

1. addition of K/As that had been omitted in Rev. 1 (approximately 70).
2. deletion of duplicate K/As (approximately 15).
3. correction of importance values of consolidated K/As to reflect highest previously assigned values (approximately 75).
4. correction of typographical errors.
5. addition of importance value modifiers that had been omitted in Rev. 1 (approximately 225).

Corrections and additions are identified by "redline" marking in the margins.

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SUMMARY OF SIGNIFICANT CHANGES

The changes described in paragraphs 1 through 6, below, were incorporated in Revision 1 of the catalog in August, 1995. Paragraph 7 describes changes that are incorporated with Revision 2 of the catalog.

1 ORGANIZATION OF THE CATALOG CHANGES

1.1 10 CFR 55 items listed

The content of the written examinations and operating licensing tests is dictated by Sections 55.41, 55.43, and 55.45 of Title 10 of the Code of Federal Regulations (10 CFR). The thirty four (34) items listed in 10 CFR 55 are listed in the catalog to reduce the need for cross referencing.

1.2 Stem statements linked to 10 CFR 55 items

The linkage of K/As to the 10 CFR 55.41, 43 and 45 requirements was done to help ensure that the examinations include a representative sample from among the applicable items. 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 Senior Reactor Operator (SRO) K/As identified

NUREG-1021, Rev. 8, "Operator Licensing Examination Standards for Power Reactors," Section ES-401, requires at least 25% of the site-specific written examination for SROs to evaluate K/As required for the higher license level. The original catalogs did not explicitly identify the K/As that represented the higher license level. Differences in RO and SRO importance ratings were sometimes used, but, the rating differences were not linked to the 10 CFR 55.43 SRO items. In this catalog revision, SRO license level K/As were linked to the items associated with the 10 CFR 55.43 SRO items. This is intended to remove subjectivity from selection of higher license level K/As.

1.4 Senior Reactor Operator Limited to Fuel Handling (LSRO) discussion added

NUREG-1021, Rev. 8, Section 701 refers to the K/A catalog. In an effort to assure consistency between the Examination Standards and the catalog, a brief discussion of the use of the catalog for LSRO examinations was included.

1.5 New catalog organization was implemented.

1 ORGANIZATION OF THE CATALOG

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Equipment Control K/As

Radiation Control K/As
Emergency Procedures / Plan K/As

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6 THEORY
Reactor Theory Knowledge Categories (8)
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1.6 Revised knowledge and ability stem statements for plant systems.

The knowledge and ability stem statements (categories) for plant systems were revised for consistency with the BWR catalog. This involved revising three knowledge stem statements as shown below. The changes are underlined.

K3. Knowledge of the effect that a loss <u>or malfunction</u> of the (SYSTEM) will have on the following:
(CFR 41.7 / 45.6)

K5. Knowledge of the <u>operational implications</u> of the following concepts as they apply to the (SYSTEM):
(CFR 41.5 / 45.7)

K6 Knowledge of the <u>effect of a loss or malfunction of the</u> following will have on the (SYSTEM):
(CFR 41.7 / 45.7)

1.7 Revised knowledge and ability stem statements for emergency plant evolutions.

The knowledge and ability stem statements (categories) for emergency plant evolutions were revised for consistency with the BWR catalog. This involved revising all five (5) knowledge stem statements as shown below. The changes are underlined.

EK1. Knowledge of the operational implications of the following concepts as they apply to the (EMERGENCY PLANT EVOLUTION):
(CFR 41.8 / 41.10 / 45.3)

EK2. Knowledge of the interrelations between (EMERGENCY PLANT EVOLUTION) and the following:
(CFR 41.7 / 45.7)

EK3. Knowledge of the reasons for the following responses as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 41.5 / 41.10 / 45.6 / 45.13)

EA1. Ability to operate and / or monitor the following as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 41.7 / 45.6)

EA2. Ability to determine and interpret the following as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 43.5 / 45.13)

2 GENERIC KNOWLEDGE AND ABILITIES CHANGES

2.1 The System Generic and Emergency Plant Evolution K/As were combined with the Plant-Wide Generic K/As.

Many of the old system generic K/As had plant-wide applicability as well as local applicability. In addition, the old plant-wide generic section had relatively few K/As to draw upon to make up 13% of the RO examination or 17% of the SRO examination, per NUREG-1021. As a result, all generic K/As were merged into one section.

OLD SYSTEM GENERIC K/A	NEW K/A
1	2.1.2
2	2.1.14
3	2.4.30
4	2.1.27
5	2.2.22
6	2.2.25
7	2.1.28
8	2.4.31
9	2.1.30
10	2.1.32
11	2.1.33
12	2.4.50
13	2.1.23
14	2.4.49
15	2.4.4

2.2 The new generic knowledge and abilities section was grouped into four (4) topic areas.

These are generally administrative knowledge and abilities with broad application across systems and operations. The four (4) topic areas listed below, were derived from, NUREG-1021, ES-301.

1. Conduct of Operations K/As
2. Equipment Control K/As

3. Radiation Control K/As
4. Emergency Procedures /Plan K/As

The generic K/As for "Conduct of Operations," are used to evaluate the applicant's knowledge of the daily operation of the facility. The types of information covered under this category may include for example, shift turnover or temporary modification procedures.

The generic K/As for "Equipment Control " are used to evaluate the administrative issues associated with the management and control of plant systems and equipment. Examples of the types of information evaluated under this topic include maintenance and temporary modifications of systems. Fuel handling and refueling K/As were also organized into this topic area because of the equipment control aspect of fuel handling.

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

The generic K/As for "Emergency Procedures / Plan" are used to evaluate the applicant's general knowledge of emergency operations. The K/As are designed to evaluate knowledge of the emergency procedures use. The emergency plan K/As 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.

2.3 Approximately one hundred (100) new generic K/As were added.

The new K/As were identified through license examiner surveys and an independent review of the catalog, NUREG-1021, licensee event reports and inspection reports. All new K/As were directly linked to the applicable 10 CFR 55 requirements.

3 SAFETY FUNCTIONS CHANGES

3.1 Consolidated Safety Functions to match BWR Catalog.

The eleven (11) original PWR safety functions were consolidated into nine (9) safety functions. There were several reasons for this change.

First, NUREG-0737, Supplement 1 treated core cooling and heat removal from the primary system as one safety function. It did not separate RCS heat removal from secondary system heat transport as in the original safety functions 4 and 5. Therefore, original safety functions 4 and 5 were combined into new 4, Heat Removal From Reactor Core.

Second, original Safety Function 8, Control Air System focused on two plant service systems rather than on a safety function. Safety functions have a broader context in the operation of a plant. Therefore, original Safety Function 8 was consolidated into new

Safety Function 8, Plant Service Systems.

Third, original Safety Function 10, Auxiliary Thermal Systems focused on two specific systems. Safety functions have a broader context in the operation of a nuclear power plant. Therefore, original Safety Function 10 was consolidated into new Safety Function 8, Plant Service Systems.

Fourth, a number of systems listed under original Safety Function 11: Indirect Radioactivity Release Control were more applicable to Plant Service Systems. Specifically fire protection and fuel handling systems did not fit neatly in Function 11. Therefore, they were moved to Safety Function 8, Plant Services Systems.

Fifth, original Safety Function 11, Indirect Radioactivity Release Control implies that there is a direct radioactivity release control function when there is not. NUREG-0737, Supplement 1 and the BWR catalog does not make the distinction between direct and indirect releases. Therefore, the title of originalold Safety Function 11 has been changed in new Safety Function 9 to Radioactivity Release.

3.2 Organized original Emergency Plant Evolutions to Section 4.

Many of the emergency plant evolutions affected more than one safety function. In addition, organizing the emergency plant evolutions by safety function did not provide an integrated picture of the overall emergency and abnormal procedures networks at PWRs. This change is discussed in more detail in Section 4 changes.

3.3 Moved System Generic K/As to new generic section 2.

The original system generic K/As were removed from the individual system sections, and relocated in the new Section 2, Generic Knowledge and Abilities section. This was done because a number of the original system generic K/As had plant wide applicability.

K3. Knowledge of the effect that a loss or malfunction of the (SYSTEM) will have on the following:
(CFR 41.7 /45.6)

K5. Knowledge of the operational implications of the following concepts as they apply to the (SYSTEM):
(CFR 41.5 / 45.7)

K6. Knowledge of the effect of a loss or malfunction on the following will have on the (SYSTEM):
(CFR 41.7 / 45.7)

The knowledge and ability stem statements (categories) for emergency plant evolutions were revised for consistency with the BWR catalog. This involved revising all five (5) knowledge and ability stem statements as shown below with the changes underlined:

EK1. Knowledge of the operational implications following concepts as they apply to the (EMERGENCY PLANT EVOLUTION)
(CFR 41.8 / 41.10 / 45.3)

EK2. Knowledge of the interrelations between (EMERGENCY PLANT EVOLUTION) and the following:
(CFR 41.7 / 45.7)

EK3. Knowledge of the reasons for the following responses as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 41.5 / 41.10 / 45.6 . 45.13)

EA1. Ability to operate and / or monitor the following as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 41.7 / 45.6)

EA2. Ability to determine and interpret the following as they apply to (EMERGENCY PLANT EVOLUTION):
(CFR 43.5 / 45.13)

3.4 Consolidated multi-mode plant system K/As.

This change was made for several reasons. First, only ten (10) of the forty five (45) plant systems were organized in more than one mode. This created inconsistency in the way the tasks and K/As associated with the plant system were presented within the catalog. This also resulted in K/A duplication (e.g. 28 duplicate K/As in ECCS).

As result of this change, duplicate K/As were eliminated and the remaining K/As were organized into one section per system. The systems affected by this change are listed below:

1. Control Rod Drive System
2. Chemical and Volume Control System
3. Reactor Coolant System
4. Emergency Core Cooling System
5. Main Turbine Generator System
6. Condensate System
7. Containment Spray System
8. Emergency Diesel Generator
9. Component Cooling Water System
10. Circulating Water System.

4 EMERGENCY (EPE) AND ABNORMAL PLANT EVOLUTIONS (APE) CHANGES

4.1 The original EPEs were organized into generic EPEs and APEs. |

The original EPEs represented a mix of EPEs and APEs. In the context of the K/A |

catalog an EPE is any condition, event or symptom which leads to entry into emergency operating procedures (EOPs). An APE is any degraded condition, event or symptom not leading directly to an EOP entry condition nor related to an operational condition as: power operation, hot shutdown, start-up, shutdown and refueling.

4.2 All EPEs and APEs were consolidated in new Section 4.

The original PWR catalog listed 7 EPEs and 31 APEs in the individual safety function sections. This method of organizing the EPEs and APEs did not accommodate integrative situations crossing several plant systems and or safety functions. The consolidated organization in Section 4 is designed to accommodated integrative evolutions.

4.3 Vendor specific EPEs and APEs were added to Section 4.

| The original EPEs did not address the EPE and APE differences imposed by vendor specific technologies and procedures. As a result, 40 new vendor specific APEs and APEs were added.

5 COMPONENTS CHANGES

| 5.1 Component K/As were linked to 10 CFR 55 item numbers.

6 THEORY CHANGES

| 6.1 Reactor Theory and Thermodynamics theory K/As were linked to 10 CFR 55 item numbers.

| 7 REVISION 2 CHANGES

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| **7.1** Approximately 70 K/As that had been ommited in Rev. 1 were added.
| **7.2** Approximately 15 duplicate K/As were deleted.
| **7.3** Approximately 75 corrections were made to the importance values of consolidated
| K/As to reflect highest previously assigned values.
| **7.4** Typographical errors were corrected.
| **7.5** Importance value modifiers that had been omitted in Rev. 1 were added.

|

| Corrections and additions are identified by “redline” marking.

1 ORGANIZATION OF THE CATALOG

1.1 INTRODUCTION

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors (PWR) NUREG-1122, Revision 2, 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, Revision 8 "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 Part 55 of Title 10 of the Code of Federal Regulations (10 CFR 55). All knowledge and abilities (K/As) in this catalog are directly linked by item number to 10 CFR 55.

1.3 RO WRITTEN EXAMINATION ITEMS

The items for RO written examinations are specified in 10 CFR 55.41(b). The RO written examination questions should be generated from a representative sample of K/As derived from among the 10 CFR 55.41(b) items listed below:

(1) Fundamentals of reactor theory, including fission process, neutron multiplication, source effects, control rod effects, criticality indications, reactivity coefficients, and poison effects.

(2) General design features of the core, including core structure, fuel elements, control rods, core instrumentation, and coolant flow.

(3) Mechanical components and design features of reactor primary system.

(4) Secondary coolant and auxiliary systems that affect the facility.

(5) Facility operating characteristics during steady state and transient conditions, including coolant chemistry, causes and effects of temperature, pressure and reactivity changes, effects of load changes, and operating limitations and reasons for these operating characteristics.

(6) Design, components, and function of reactivity control mechanisms and instrumentation.

(7) Design, components, and function of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.

(8) Components, capacity, and functions of emergency systems.

(9) Shielding, isolation, and containment design features, including access limitations.

(10) Administrative, normal, abnormal, and emergency operating procedures for the facility.

(11) Purpose and operation of radiation monitoring systems, including alarms and survey equipment.

(12) Radiological safety principles and procedures.

(13) Procedures and equipment available for handling and disposal of radioactive materials and effluents.

(14) Principals of heat transfer, thermodynamics and fluid mechanics.

The RO written examination is administered in two sections, a generic fundamentals examination (GFE) section and a site-specific examination. The GFE covers those knowledge items that do not vary significantly among reactors of the same type (refer to NUREG-1021, ES-205). The GFE covers components, reactor theory, and thermodynamics knowledge.

The component knowledge items are derived from 10 CFR 55.41(b) items 3 and 7. Reactor theory knowledge items are derived from 10 CFR 55.41(b)1. Thermodynamic knowledge items are derived from 10 CFR 55.41(b)14.

The site-specific RO written examination covers K/As that vary among reactors of the same type. The guidance for preparation of RO written examination is presented in NUREG-1021, ES-401. The RO examination includes a balanced mix of generic K/As, plant systems K/As, and emergency/abnormal evolution K/As. The K/As associated with the RO site-specific written examinations are derived from 10 CFR 55.41(b) items 2 through 13.

1.4 SRO WRITTEN EXAMINATION ITEMS

The items for SRO written examinations are presented in 10 CFR 55.43(b). The guidance for preparation of the SRO written examination is presented in NUREG-1021, ES-401. The examination for SRO should include at least 25 percent (25%) higher license level K/As from the 7 items listed under 10 CFR 55.43(b). No more than 75 percent (75%) of the SRO K/As may be derived from the 10 CFR 55.41(b) RO K/As. The 7 SRO items listed under 10 CFR 55.43(b) include:

(1) Conditions and limitations in the facility license.

(2) Facility operating limitations in the technical specifications and their bases.

(3) Facility licensee procedures required to obtain authority for design and operating changes in the facility.

(4) Radiation hazards that may arise during normal and abnormal situations, including maintenance activities and various contamination conditions.

(5) Assessment of facility conditions and selection of appropriate procedures during normal, abnormal, and emergency situations.

(6) Procedures and limitations involved in initial core loading, alterations in core configuration, control rod programming, and determination of various internal and external effects on core reactivity.

(7) Fuel handling facilities and procedures.

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, ES-301. The operating test should include a representative selection of K/As derived from 13 items listed in 10 CFR 55.45(a). The 13 items listed in 10 CFR 55.45(a) are:

(1) Perform pre-startup procedures for the facility, including operating of those controls associated with plant equipment that could affect reactivity.

(2) Manipulate the console controls as required to operate the facility between shutdown and designated power levels.

(3) Identify enunciators and condition-indicating signals and perform appropriate remedial actions where appropriate.

(4) Identify the instrumentation systems and the significance of facility instrument readings.

(5) Observe and safely control the operating behavior characteristics of the facility.

(6) Perform control manipulations required to obtain desired operating results during normal, abnormal, and emergency situations.

(7) Safely operate the facility's heat removal systems, including primary coolant, emergency coolant, and decay heat removal systems, and identify the relations of proper operation of these systems to the operation of the facility.

(8) Safety operate the facility's auxiliary and emergency systems, including operation of those controls associated with plant equipment that could affect reactivity or the release of radioactive materials to the environment

(9) Demonstrate or describe the use and function of the facility's radiation monitoring systems, including fixed radiation monitors and alarms, portable survey instruments, and personnel monitoring equipment.

(10) Demonstrate a knowledge of significant radiation hazards, including permissible levels in excess of those authorized, and ability to perform other procedures to reduce excessive levels of radiation and to guard against personnel exposure.

(11) Demonstrate knowledge of the emergency plan for the facility, including, as appropriate, the operator's or senior operator's responsibility to decide when the plan should be executed and the duties under the plan assigned.

(12) Demonstrate the knowledge and ability as appropriate to the assigned position to assume the responsibilities associated with the safe operation of the facility.

(13) Demonstrate the applicant's ability to function within the control room team as appropriate to the assigned position, in such a way that the facility licensee’s procedures are adhered to and that the limitations in its license and amendments are not violated.

1.6 SENIOR OPERATORS LIMITED TO FUEL HANDLING

The specifications for examinations for Senior Operators Limited to Fuel Handling (LSRO) are provided in Examination Standard, NUREG 1021, Section ES-701. 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 PWR CATALOG

The Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water Reactors is organized into 6 major sections. K/As are grouped according to the major section to which they pertain. This organization is shown schematically below.

1 ORGANIZATION OF THE CATALOG

2 GENERIC KNOWLEDGE AND ABILITIES (132)
Conduct of Operations K/As
Equipment Control K/As
Radiation Control K/As
Emergency Procedures / Plan K/As

3 PLANT SYSTEMS (45)
Knowledge Categories (K1 - K6)
Ability Categories (A1 - A4)

4 EMERGENCY AND ABNORMAL PLANT EVOLUTIONS

Generic EPEs and APEs(38)
Babcock and Wilcox EPEs and APEs (17)
Combustion Engineering EPEs and APEs (7)
Westinghouse EPEs and APEs (16)
Knowledge Categories (EK/AK 1 - EK/ AK3)
Ability Categories (EA/AA 1 - EA/AA 2)

5 COMPONENTS
Component Knowledge Categories (8)

6 THEORY
Reactor Theory Knowledge Categories (8)
Thermodynamics Knowledge Categories (10)

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 listed below:

1) Conduct of Operations K/As
2) Equipment Control K/As
3) Radiation Control K/As
4) Emergency Procedures /Plan K/As

The generic K/As for "Conduct of Operations" are used to evaluate the applicant's knowledge of the daily operation of the facility. The types of information covered under this category may include, for example, shift turnover or temporary modification procedures.

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

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

The generic K/As for "Emergency Procedures / Plan" are used to evaluate the applicant's general knowledge of emergency operations. The K/As are designed to evaluate knowledge of the emergency procedures network and its 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 PWR nuclear power plant operation. The safety function groups are:

1) Reactivity Control
2) Reactor Coolant System Inventory Control
3) Reactor Pressure Control
4) Heat Removal From Reactor Core
5) Containment Integrity
6) Electrical
7) Instrumentation
8) Plant Service Systems
9) Radioactivity Release.

Forty five (45) plant systems have been included in the PWR Catalog based on their relationship and importance to 9 safety functions. Table 1 contains a list of these plant systems, arranged within safety function. It should be noted that 3 plant systems (Reactor Coolant System, Chemical and Volume Control System, and Emergency Core Cooling System) each contribute to 2 safety functions. Also, because the emergency plant evolutions are linked to more than one system, they have been listed separately under the appropriate, related function. Each system has a 3-digit identifier. The identifiers are the same as those used by INPO. See Section 3 of the PWR catalog for the delineation of K/As for the plant systems.

Table 1
Plant Systems by Safety Functions

Safety Function 1: Reactivity Control

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

Safety Function 2: Reactor Coolant System Inventory Control

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

Safety Function 3: Reactor Pressure Control

006	Emergency Core Cooling System
010	Pressurizer Pressure Control System

Safety Function 4: Heat Removal From Reactor Core

Primary System

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

Secondary System

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

Safety Function 5: Containment Integrity

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

Safety Function 6: Electrical

062	A.C. Electrical Distribution
063	D.C. Electrical Distribution
064	Emergency Diesel Generators

Safety Function 7: Instrumentation

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

Safety Function 8: Plant Service Systems

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

Safety Function 9: Radioactivity Release

068	Liquid Radwaste System
071	Waste Gas Disposal System

1.9.2 Plant System K/A Stem Statements

The information delineated within each plant system is organized into 6 different types of knowledge and 4 different types of ability. If there are no knowledge or ability statements following a stem statement there is no applicable K/A.

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

Table 2
Knowledge and Ability Stem Statements for Plant Systems

Knowledge Stem Statements

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

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

K3. Knowledge of the effect that a loss or malfunction of the (SYSTEM) will have on the following:
(CFR: 41.7 / 45.6)

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

K5. Knowledge of the operational implications of the following concepts as they apply to the (SYSTEM):
(CFR: 41.5 / 45.7)

K6 Knowledge of the of the effect of a loss or malfunction on the following will have on the (SYSTEM):
(CFR: 41.7 / 45.7)

Ability Stem Statements

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

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

A3. Ability to monitor automatic operations of the (SYSTEM) including:
(CFR: 41.7 / 45.5)

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

1.10 EMERGENCY AND ABNORMAL PLANT EVOLUTIONS

1.10.1 Generic and Vendor Specific EPEs and APEs

Section 4 of the PWR catalog contains generic and vendor specific emergency plant evolutions (EPEs) and Abnormal Plant Evolutions (APEs). The listing of EPEs and APEs was developed to include those integrative situations crossing several plant systems and/or safety functions.

An emergency plant evolution is any condition, event or symptom which leads to entry into Emergency Operating Procedures (EOPs). An abnormal plant evolution is any degraded condition, event, or symptom not directly leading to an EOP entry condition.

It is recognized that for each condition, there are degrees of severity. The EOP entry conditions were used as the bases for classifying a condition either as an EPE or an APE. Any abnormal condition which degrades as to threaten the plant safety will result in entry into the EOPs is treated as an emergency condition.

Table 3 contains a list of emergency and abnormal plant evolutions included in the PWR catalog. Within PWRs, there are three nuclear steam system supply (NSSS) vendors, Babcock and Wilcox, Combustion Engineering, and Westinghouse. The NSSS vendors have EPEs and APEs that are common to all three vendors, and they have evolutions that are vendor specific. Therefore, this Section 4 is organized by generic and vendor specific EPEs and APEs.

The EPEs and APEs each have a unique three-digit evolution number.

Table 3
Emergency and Abnormal Plant Evolutions

Generic Emergency Plant Evolutions (EPEs)

007 Reactor Trip
009 Small Break LOCA

011 Large Break LOCA
029 Anticipated Transient Without Scram (ATWS)
038 Steam Generator Tube Rupture
055 Station Blackout
074 Inadequate Core Cooling

Generic Abnormal Plant Evolutions (APEs)

001 Continuous Rod Withdrawal
003 Dropped Control Rod
005 Inoperable/Stuck Control Rod
008 Pressurizer Vapor Space Accident
015 Reactor Coolant Pump Malfunctions
017 Reactor Coolant Pump Malfunctions (Loss of RC Flow)
022 Loss of Reactor Coolant Makeup
024 Emergency Boration
025 Loss of Residual Heat Removal System
026 Loss of Component Cooling Water
027 Pressurizer Pressure Control System Malfunction
028 Pressurizer Level Control Malfunction
032 Loss of Source Range Nuclear Instrumentation
033 Loss of Intermediate Range Nuclear Instrumentation
036 Fuel Handling Incidents
037 Steam Generator Tube Leak
040 Steam Line Rupture
051 Loss of Condenser Vacuum
054 Loss of Main Feedwater
056 Loss of Off-Site Power
057 Loss of Vital AC Electrical Instrument Bus
058 Loss of DC Power
059 Accidental Liquid Radwaste Release
060 Accidental Gaseous Radwaste Release
061 Area Radiation Monitoring (ARM) System Alarms
062 Loss of Nuclear Service Water
065 Loss of Instrument Air
067 Plant Fire on Site
068 Control Room Evacuation
069 Loss of Containment Integrity
076 High Reactor Coolant Activity

Babcock and Wilcox EPEs /APEs

E02 Vital System Status Verification
E03 Inadequate Subcooling Margin
E04 Inadequate Heat Transfer
E05 Excessive Heat Transfer

E08 LOCA Cooldown
E09 Natural Circulation Operations
E10 Post-Trip Stabilization
E13 EOP Rules
E14 EOP Enclosures
A01 Plant Runback
A02 Loss of NNI-X
A03 Loss of NNI-Y
A04 Turbine Trip
A05 Emergency Diesel Actuation
A06 Shutdown Outside Control Room
A07 Flooding
A08 Refueling Canal Level Decrease

Combustion Engineering Emergency and Abnormal Plant Evolutions
E02 Reactor Trip Recovery
E05 Excess Steam Demand
E06 Loss of Feedwater
E09 Functional Recovery
A11 RCS Overcooling
A13 Natural Circulation Operations
A16 Excess RCS Leakage

Westinghouse Emergency and Abnormal Plant Evolutions
E02 SI Termination
E03 LOCA Cooldown and Depressurization
E04 LOCA Outside Containment
E05 Loss of Secondary Heat Sink
E06 Degraded Core Cooling
E07 Saturated Core Cooling
E08 Pressurized Thermal Shock
E09 Natural Circulation Operations
E10 Natural Circulation with Steam Void in Vessel with/without RVLIS
E11 Loss of Emergency Coolant Recirculation
E12 Uncontrolled Depressurization of all Steam Generators
E13 Steam Generator Overpressure
E14 High Containment Pressure
E15 Containment Flooding
E16 High Containment Radiation

1.10.2 K/a Stem Statements for EPEs and APEs

The information delineated within each emergency plant evolution is organized into 3 different types of knowledge and 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 examination and the operating test. See Table 4 below:

Table 4
Knowledge and Ability Stem Statements for Emergency Plant Evolutions

Knowledge Stem Statements

EK1 Knowledge of the operational implications of the following concepts as they apply to the loss of (SYSTEM):
(CFR: 41.8 / 41.10 / 45.3)

EK2. Knowledge of the interrelations between the loss of (SYSTEM) and the following:
(CFR: 41.7 / 45.7)

EK3. Knowledge of the reasons for the following responses as they apply to the loss of (SYSTEM):
(CFR: 41.5 / 41.10 / 45.6 / 45.13)

Ability Stem Statements

EA1. Ability to operate and / or monitor the following as they apply to the loss of (SYSTEM):
(CFR: 41.7 / 45.5 / 45.6)

EA2. Ability to determine and interpret the following as they apply to the loss of (SYSTEM):
(CFR: 43.5 / 45.13)

1.11 COMPONENTS

Basic components such as valves and pumps are found in many systems. NUREG-1021, section ES-205, “General Fundamentals Examination,” lists 8 categories of components. The 8 categories of components, for which additional knowledge statements are necessary are listed below and delineated in Section 5 of the PWR 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 has a unique 6-digit code number identified in NUREG-1021, and 10 CFR 55.41(b) item number. See Table 5, below.

Table 5
Components

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

1.12 THEORY

NUREG-1021, Section ES-205, "General Fundamentals Examination," lists theory items. General fundamental knowledge which underlies safe performance on the job is delineated in Section 6 of the PWR Catalog. These theory topics represent general fundamental concepts related to plant operation. Each theory topic has the same 6-digit code number identified in NUREG-1021. The applicable 10 CFR 55 item number is provided for Reactor Theory and Thermodynamics Theory.

Reactor Theory (CFR: 41.1)

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

Thermodynamics Theory (CFR: 41.14)

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

1.13 IMPORTANCE RATINGS

Importance, in this context, considers 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 and Senior Reactor Operators next to each knowledge and ability in the catalog. These ratings reflect average ratings of individual NRC and utility panel members. The rating scale is presented in Table 6, below.

Table 6
RO and SRO Importance Ratings

Rating	Importance for safe operation
5	Essential
4	Very important
3	Fairly important
2	Of limited importance
1	Insignificant Importance
*	Indicates variability in the responses

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

1.13.1 Asterisk and Question Ratings

Some importance ratings are followed by an asterisk (*) or question mark (?). These marks indicate variability in the rating responses. An asterisk indicates that the rating spread was very broad. An asterisk can also signify that more than 15 percent of the raters indicated that the knowledge or ability is not required for the RO/SRO position at their plant, either because it refers to an inapplicable design feature or because it is the responsibility of someone else (e.g. SRO vs. RO). A question mark indicates that more than 15 percent of the raters felt that they were not familiar with the knowledge or ability as related to the particular system or design feature. These marks indicate a need for examination developers to review plant-specific materials to determine whether or not that knowledge or ability is indeed appropriate for inclusion in any given examination.

1.13.2 Difference Ratings

A dagger (†) to the left of an individual knowledge or ability statement indicates that more than 20 percent (20%) of the raters indicated that the level of knowledge or ability required by an SRO is different than the level of knowledge or ability required by an RO. In the PWR catalog, daggers may only appear next to plant-wide generic

K/A statements, system-wide generic K/A statements, and statements in Appendices A and B as this information was not collected for the statements in the other sections of the catalog.

1.14 ACRONYMS AND TERMS

APE	abnormal plant evolution
AFAS	auxiliary feed actuation signal
AFW	auxiliary feedwater system
ALARA	as low as reasonably achievable
AOV	air operated valve
ARM	area radiation monitoring system
ATWS	anticipated transient without scram
BIT	boron injection tank
BWST	borated water storage tank
CARS	condenser air removal system
CAT	chemical addition tank
CCS	containment cooling system
CCWS	component cooling water system
CEA	control element assembly (Combustion Engineering)
CIRS	containment iodine removal system
COLSS	core operating limit support system
CPS	containment purge system
CRDM	control rod drive motor
CRDS	control rod drive system
CRT	cathode ray tube
Crud	corrosion product material floating in system
CSAS	containment spray actuation signal
CSS	containment spray system
CVCS	chemical and volume control system
D/G	diesel generator
D/P	differential pressure
DNB	departure from nucleate boiling
ECCS	emergency core cooling system
ECP	estimated critical position
EDG	emergency diesel generator
EPE	emergency plant evolution
ESF	engineered safety feature
ESFAS	engineered safety features actuation system
FHES	fuel handling equipment system
FPS	fire protection system
HPI	high pressure injection
HRPS	hydrogen recombiner and purge control system

1.14 ACRONYMS AND TERMS (Continued)

HVAC	heating, ventilation and air conditioning
IAS	instrument air system
I&C	instrumentation and control
ICS	integrated control system (Babcock and Wilcox)
INPO	Institute of Nuclear Power Operation
ITMS	in-core temperature monitor system
JTA	job-task analysis
K/A	knowledge and ability
K-effective	subcritical multiplication factor
LOCA	loss of coolant accident
LPI	low pressure injection
LRS	liquid radwaste system
LVDT	linear variable differential transformer
MFW	main feedwater
M/G	motor generator
MOV	motor operated valve
MRSS	main and reheat steam system
MSIV	main steam isolation valve
MTC	moderator temperature coefficient
MT/G	main turbine generator
NIS	nuclear instrumentation system
NNI	non-nuclear instrumentation
NPSH	net positive suction head
NRC	Nuclear Regulatory Commission
P&ID	piping and instrumentation diagram
PDIL	power dependent insertion limit
PEO	plant equipment operator
PORV	power operated relief valves
PPDIL	pre-power dependent insertion limit
PRM	process radiation monitor
PRT	pressurizer relief tank
PTS	pressurized thermal shock
PWR	pressurized water reactor
PZR	pressurizer
PZR LCS	pressurizer level control system
PZR PCS	pressurizer pressure control system
RCP	reactor coolant pump
RCS	reactor coolant system
rem	roentgen equivalent man
RHR	residual heat removal
RMS	radiation monitoring system
RO	reactor operator
RPI	rod position indication

1.14 ACRONYMS AND TERMS (Continued)

RPS	reactor protection system
RWST	refueling water storage tank
SAS	station air system
SDS	steam dump system
SFPS	spent fuel pool cooling system
S/G	steam generator
S/GB	steam generator blowdown
SCR	silicon controlled rectifier
SDM	shutdown margin
SIS	safety injection system
SME	subject matter expert
SOP	standard operating procedure
SRO	senior reactor operator
SS	shift supervisor
SUR	startup rate
SWS	service water system
T-ave	average reactor coolant temperature
T-cold	measured temperature of inlet
T/G	turbine generator
T-ref	reference temperature for RCS
UHI	upper head injection
VARS	volt-amperes reactive
VCT	volume control tank
WGDS	waste gas disposal system

2.0 GENERIC KNOWLEDGES AND ABILITIES

2.1 Conduct of Operations

2.1.1 **Knowledge of conduct of operations requirements.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.7 SRO 3.8

2.1.2 **Knowledge of operator responsibilities during all modes of plant operation.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 4.0

2.1.3 **Knowledge of shift turnover practices.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.4

2.1.4 **Knowledge of shift staffing requirements.**
(CFR: 41.10 / 43.2)
IMPORTANCE RO 2.3 SRO 3.4

2.1.5 **Ability to locate and use procedures and directives related to shift staffing and activities.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 3.4

2.1.6 **Ability to supervise and assume a management role during plant transients and upset conditions.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 2.1 SRO 4.3

2.1.7 **Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation.**
(CFR: 43.5 / 45.12 / 45.13)
IMPORTANCE RO 3.7 SRO 4.4

2.1.8 **Ability to coordinate personnel activities outside the control room.**
(CFR: 45.5 / 45.12 / 45.13)
IMPORTANCE RO 3.8 SRO 3.6

2.1 Conduct of Operations (continued)

2.1.9 **Ability to direct personnel activities inside the control room.**
(CFR: 45.5 / 45.12 / 45.13)
IMPORTANCE RO 2.5 SRO 4.0

2.1.10 **Knowledge of conditions and limitations in the facility license.**
(CFR: 43.1 / 45.13)
IMPORTANCE RO 2.7 SRO 3.9

2.1.11 **Knowledge of less than one hour technical specification action statements for systems.**
(CFR: 43.2 / 45.13)
IMPORTANCE RO 3.0 SRO 3.8

2.1.12 **Ability to apply technical specifications for a system.**
(CFR: 43.2 / 43.5 / 45.3)
IMPORTANCE RO 2.9 SRO 4.0

2.1.13 **Knowledge of facility requirements for controlling vital / controlled access.**
(CFR: 41.10 / 43.5 / 45.9 / 45.10)
IMPORTANCE RO 2.0 SRO 2.9

2.1.14 **Knowledge of system status criteria which require the notification of plant personnel.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 2.5 SRO 3.3

2.1.15 **Ability to manage short-term information such as night and standing orders.**
(CFR: 45.12)
IMPORTANCE RO 2.3 SRO 3.0

2.1.16 **Ability to operate plant phone, paging system, and two-way radio.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 2.9 SRO 2.8

2.1.17 **Ability to make accurate, clear and concise verbal reports.**
(CFR: 45.12 / 45.13)
IMPORTANCE RO 3.5 SRO 3.6

2.1 Conduct of Operations (continued)

2.1.18 **Ability to make accurate, clear and concise logs, records, status boards, and reports.**
(CFR: 45.12 / 45.13)
IMPORTANCE RO 2.9 SRO 3.0

2.1.19 **Ability to use plant computer to obtain and evaluate parametric information on system or component status.**
(CFR: 45.12)
IMPORTANCE RO 3.0 SRO 3.0

2.1.20 **Ability to execute procedure steps.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 4.3 SRO 4.2

2.1.21 **Ability to obtain and verify controlled procedure copy.**
(CFR: 45.10 / 45.13)
IMPORTANCE RO 3.1 SRO 3.2

2.1.22 **Ability to determine Mode of Operation.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.8 SRO 3.3

2.1.23 **Ability to perform specific system and integrated plant procedures during all modes of plant operation.**
(CFR: 45.2 / 45.6)
IMPORTANCE RO 3.9 SRO 4.0

2.1.24 **Ability to obtain and interpret station electrical and mechanical drawings.**
(CFR: 45.12 / 45.13)
IMPORTANCE RO 2.8 SRO 3.1

2.1.25 **Ability to obtain and interpret station reference materials such as graphs, monographs, and tables which contain performance data.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.8 SRO 3.1

2.1.26 **Knowledge of non-nuclear safety procedures (e.g. rotating equipment, electrical, high temperature, high pressure, caustic, chlorine, oxygen and hydrogen).**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 2.2 SRO 2.6

2.1 Conduct of Operations (continued)

2.1.27 **Knowledge of system purpose and or function.**
(CFR: 41.7)
IMPORTANCE RO 2.8 SRO 2.9

2.1.28 **Knowledge of the purpose and function of major system components and controls.**
(CFR: 41.7)
IMPORTANCE RO 3.2 SRO 3.3

2.1.29 **Knowledge of how to conduct and verify valve lineups.**
(CFR: 41.10 / 45.1 / 45.12)
IMPORTANCE RO 3.4 SRO 3.3

2.1.30 **Ability to locate and operate components, including local controls.**
(CFR: 41.7 / 45.7)
IMPORTANCE RO 3.9 SRO 3.4

2.1.31 **Ability to locate control room switches, controls and indications and to determine that they are correctly reflecting the desired plant lineup.**
(CFR: 45.12)
IMPORTANCE RO 4.2 SRO 3.9

2.1.32 **Ability to explain and apply all system limits and precautions.**
(CFR: 41.10 / 43.2 / 45.12)
IMPORTANCE RO 3.4 SRO 3.8

2.1.33 **Ability to recognize indications for system operating parameters which are entry-level conditions for technical specifications.**
(CFR: 43.2 / 43.3 / 45.3)
IMPORTANCE RO 3.4 SRO 4.0

2.1.34 **Ability to maintain primary and secondary plant chemistry within allowable limits.**
(CFR: 41.10 / 43.5 / 45.12)
IMPORTANCE RO 2.3 SRO 2.9

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: 45.1)
IMPORTANCE RO 3.7 SRO 3.6

2.2.2 **Ability to manipulate the console controls as required to operate the facility between shutdown and designated power levels.**
(CFR: 45.2)
IMPORTANCE RO 4.0 SRO 3.5

2.2.3 (multi-unit) **Knowledge of the design, procedural, and operational differences between units.**
(CFR: 41 / 43 / 45)
IMPORTANCE RO 3.1 SRO 3.3

2.2.4 (multi-unit) **Ability to explain the variations in control board layouts, systems, instrumentation and procedural actions between units at a facility.**
(CFR: 45.1 / 45.13)
IMPORTANCE RO 2.8 SRO 3.0*

2.2.5 **Knowledge of the process for making changes in the facility as described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 1.6 SRO 2.7

2.2.6 **Knowledge of the process for making changes in procedures as described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.3 SRO 3.3

2.2.7 **Knowledge of the process for conducting tests or experiments not described in the safety analysis report.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.0 SRO 3.2

2.2.8 **Knowledge of the process for determining if the proposed change, test, or experiment involves an unreviewed safety question.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 1.8 SRO 3.3

2.2 Equipment Control (Continued)

2.2.9 **Knowledge of the process for determining if the proposed change, test or experiment increases the probability of occurrence or consequences of an accident during the change, test, or experiment.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.0 SRO 3.3

2.2.10 **Knowledge of the process for determining if the margin of safety, as defined in the basis of any technical specification is reduced by a proposed change, test or experiment.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 1.9 SRO 3.3

2.2.11 **Knowledge of the process for controlling temporary changes.**
(CFR: 41.10 / 43.3 / 45.13)
IMPORTANCE RO 2.5 SRO 3.4*

2.2.12 **Knowledge of surveillance procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.4

2.2.13 **Knowledge of tagging and clearance procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.6 SRO 3.8

2.2.14 **Knowledge of the process for making configuration changes.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.1 SRO 3.0

2.2.15 **Ability to identify and utilize as-built design and configuration change documentation to ascertain expected current plant configuration and operate the plant.**
(CFR: 43.3 / 45.13)
IMPORTANCE RO 2.2 SRO 2.9

2.2.16 **Knowledge of the process for making of field changes.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 1.9 SRO 2.6*

2.2.17 **Knowledge of the process for managing maintenance activities during power operations.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.5

2.2 Equipment Control (Continued)

2.2.18 **Knowledge of the process for managing maintenance activities during shutdown operations.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.6

2.2.19 **Knowledge of maintenance work order requirements.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.1 SRO 3.1

2.2.20 **Knowledge of the process for managing troubleshooting activities.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.2 SRO 3.3

2.2.21 **Knowledge of pre- and post-maintenance operability requirements.**
(CFR: 43.2)
IMPORTANCE RO 2.3 SRO 3.5

2.2.22 **Knowledge of limiting conditions for operations and safety limits.**
(CFR: 43.2 / 45.2)
IMPORTANCE RO 3.4 SRO 4.1

2.2.23 **Ability to track limiting conditions for operations.**
(CFR: 43.2 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.24 **Ability to analyze the affect of maintenance activities on LCO status.**
(CFR: 43.2 / 45.13)
IMPORTANCE RO 2.6 SRO 3.8

2.2.25 **Knowledge of bases in technical specifications for limiting conditions for operations and safety limits.**
(CFR: 43.2)
IMPORTANCE RO 2.5 SRO 3.7

2.2.26 **Knowledge of refueling administrative requirements.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 2.5 SRO 3.7

2.2.27 **Knowledge of the refueling process.**
(CFR: 43.6 / 45.13)
IMPORTANCE RO 2.6 SRO 3.5

2.2 Equipment Control (Continued)

| 2.2.28 **Knowledge of new and spent fuel movement procedures.**
(CFR: 43.7 / 45.13)
IMPORTANCE RO 2.6 SRO 3.5

| 2.2.29 **Knowledge of SRO fuel handling responsibilities.**
(CFR: 43.6 / 45.12)
IMPORTANCE RO 1.6 SRO 3.8

| 2.2.30 **Knowledge of RO duties in the control room during fuel handling such as alarms from fuel handling area, communication with fuel storage facility, systems operated from the control room in support of fueling operations, and supporting instrumentation.**
(CFR: 45.12)
IMPORTANCE RO 3.5 SRO 3.3

| 2.2.31 **Knowledge of procedures and limitations involved in initial core loading.**
(CFR: 43.6)
IMPORTANCE RO 2.2 SRO 2.9*

| 2.2.32 **Knowledge of the effects of alterations on core configuration.**
(CFR: 43.6)
IMPORTANCE RO 2.3 SRO 3.3

| 2.2.33 **Knowledge of control rod programming.**
(CFR: 43.6)
IMPORTANCE RO 2.5 SRO 2.9

| 2.2.34 **Knowledge of the process for determining the internal and external effects on core reactivity.**
(CFR: 43.6)
IMPORTANCE RO 2.8 SRO 3.2*

2.3 Radiation Control

2.3.1 **Knowledge of 10 CFR: 20 and related facility radiation control requirements.**
(CFR: 41.12 / 43.4. 45.9 / 45.10)
IMPORTANCE RO 2.6 SRO 3.0

2.3.2 **Knowledge of facility ALARA program.**
(CFR: 41.12 / 43.4 / 45.9 / 45.10)
IMPORTANCE RO 2.5 SRO 2.9

2.3.3 **Knowledge of SRO responsibilities for auxiliary systems that are outside the control room (e.g., waste disposal and handling systems).**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 1.8 SRO 2.9

2.3.4 **Knowledge of radiation exposure limits and contamination control, including permissible levels in excess of those authorized.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.5 SRO 3.1

2.3.5 **Knowledge of use and function of personnel monitoring equipment.**
(CFR: 41.11 / 45.9)
IMPORTANCE RO 2.3 SRO 2.5

2.3.6 **Knowledge of the requirements for reviewing and approving release permits.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.1 SRO 3.1

2.3.7 **Knowledge of the process for preparing a radiation work permit.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 2.0 SRO 3.3

2.3.8 **Knowledge of the process for performing a planned gaseous radioactive release.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.3 SRO 3.2

2.3.9 **Knowledge of the process for performing a containment purge.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.5 SRO 3.4

2.3 Radiation Control (Continued)

2.3.10 **Ability to perform procedures to reduce excessive levels of radiation and guard against personnel exposure.**
(CFR: 43.4 / 45.10)
IMPORTANCE RO 2.9 SRO 3.3

2.3.11 **Ability to control radiation releases.**
(CFR: 45.9 / 45.10)
IMPORTANCE RO 2.7 SRO 3.2

2.4 Emergency Procedures /Plan

2.4.1 **Knowledge of EOP entry conditions and immediate action steps.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 4.3 SRO 4.6

2.4.2 **Knowledge of system set points, interlocks and automatic actions associated with EOP entry conditions.**
(CFR: 41.7 / 45.7 / 45.8)
Note: The issue of setpoints and automatic safety features is not specifically covered in the systems sections).
IMPORTANCE RO 3.9 SRO 4.1

2.4.3 **Ability to identify post-accident instrumentation.**
(CFR: 41.6 / 45.4)
IMPORTANCE RO 3.5 SRO 3.8

2.4.4 **Ability to recognize abnormal indications for system operating parameters which are entry-level conditions for emergency and abnormal operating procedures.**
(CFR 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.0 SRO 4.3

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 2.9 SRO 3.6

2.4.6 **Knowledge symptom based EOP mitigation strategies.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.1 SRO 4.0

2.4.7 **Knowledge of event based EOP mitigation strategies.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.1 SRO 3.8

2.4.8 **Knowledge of how the event-based emergency/abnormal operating procedures are used in conjunction with the symptom-based EOPs.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 3.7

2.4 Emergency Procedures /Plan (Continued)

2.4.9 **Knowledge of low power / shutdown implications in accident (e.g. LOCA or loss of RHR) mitigation strategies.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.3 SRO 3.9

2.4.10 **Knowledge of annunciator response procedures.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 3.1

2.4.11 **Knowledge of abnormal condition procedures.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.4 SRO 3.6

2.4.12 **Knowledge of general operating crew responsibilities during emergency operations.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3.4 SRO 3.9

2.4.13 **Knowledge of crew roles and responsibilities during EOP flowchart use.**
(CFR: 41.10 / 45.12)
IMPORTANCE RO 3.3 SRO 3.9

2.4.14 **Knowledge of general guidelines for EOP flowchart use.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.9

2.4.15 **Knowledge of communications procedures associated with EOP implementation.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.0 SRO 3.5

2.4.16 **Knowledge of EOP implementation hierarchy and coordination with other support procedures.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 4.0

2.4.17 **Knowledge of EOP terms and definitions.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.1 SRO 3.8

2.4 Emergency Procedures /Plan (Continued)

2.4.18 **Knowledge of the specific bases for EOPs.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.6

2.4.19 **Knowledge of EOP layout, symbols, and icons.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.7 SRO 3.7

2.4.20 **Knowledge of operational implications of EOP warnings, cautions, and notes.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 4.0

2.4.21 **Knowledge of the parameters and logic used to assess the status of safety functions including:**
1. Reactivity control
2. Core cooling and heat removal
3. Reactor coolant system integrity
4. Containment conditions
5. Radioactivity release control.
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.7 SRO 4.3

2.4.22 **Knowledge of the bases for prioritizing safety functions during abnormal/emergency operations.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.0 SRO 4.0

2.4.23 **Knowledge of the bases for prioritizing emergency procedure implementation during emergency operations.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.8 SRO 3.8

2.4.24 **Knowledge of loss of cooling water procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 3.3 SRO 3.7

2.4.25 **Knowledge of fire protection procedures.**
(CFR: 41.10 / 45.13)
IMPORTANCE RO 2.9 SRO 3.4

2.4 Emergency Procedures /Plan (Continued)

2.4.26 **Knowledge of facility protection requirements including fire brigade and portable fire fighting equipment usage.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 2.9 SRO 3.3

2.4.27 **Knowledge of fire in the plant procedure.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.0 SRO 3.5

2.4.28 **Knowledge of procedures relating to emergency response to sabotage.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.3 SRO 3.3

2.4.29 **Knowledge of the emergency plan.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.6 SRO 4.0

2.4.30 **Knowledge of which events related to system operations/status should be reported to outside agencies.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.2 SRO 3.6

2.4.31 **Knowledge of annunciators alarms and indications, and use of the response instructions.**
(CFR: 41.10 / 45.3)
IMPORTANCE RO 3.3 SRO 3.4

2.4.32 **Knowledge of operator response to loss of all annunciators.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 3.3 SRO 3.5

2.4.33 **Knowledge of the process used track inoperable alarms.**
(CFR: 41.10 / 43.5 / 45.13)
IMPORTANCE RO 2.4 SRO 2.8

2.4.34 **Knowledge of RO tasks performed outside the main control room during emergency operations including system geography and system implications.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 3.8 SRO 3.6

2.4 Emergency Procedures /Plan (Continued)

2.4.35 **Knowledge of local auxiliary operator tasks during emergency operations including system geography and system implications.**
(CFR: 43.5 / 45.13)
IMPORTANCE RO 3.3 SRO 3.5

2.4.36 **Knowledge of chemistry / health physics tasks during emergency operations.**
(CFR: 43.5)
IMPORTANCE RO 2.0 SRO 2.8

2.4.37 **Knowledge of the lines of authority during an emergency.**
(CFR: 45.13)
IMPORTANCE RO 2.0 SRO 3.5

2.4.38 **Ability to take actions called for in the facility emergency plan, including (if required) supporting or acting as emergency coordinator.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.2 SRO 4.0

2.4.39 **Knowledge of the RO's responsibilities in emergency plan implementation.**
(CFR: 45.11)
IMPORTANCE RO 3.3 SRO 3.1

2.4.40 **Knowledge of the SRO's responsibilities in emergency plan implementation.**
(CFR: 45.11)
IMPORTANCE RO 2.3 SRO 4.0

2.4.41 **Knowledge of the emergency action level thresholds and classifications.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.3 SRO 4.1

2.4.42 **Knowledge of emergency response facilities.**
(CFR: 45.11)
IMPORTANCE RO 2.3 SRO 3.7

2.4.43 **Knowledge of emergency communications systems and techniques.**
(CFR: 45.13)
IMPORTANCE RO 2.8 SRO 3.5

2.4 Emergency Procedures /Plan (Continued)

2.4.44 **Knowledge of emergency plan protective action recommendations.**
(CFR: 43.5 / 45.11)
IMPORTANCE RO 2.1 SRO 4.0

2.4.45 **Ability to prioritize and interpret the significance of each annunciator or alarm.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.3 SRO 3.6

2.4.46 **Ability to verify that the alarms are consistent with the plant conditions.**
(CFR: 43.5 / 45.3 / 45.12)
IMPORTANCE RO 3.5 SRO 3.6

2.4.47 **Ability to diagnose and recognize trends in an accurate and timely manner utilizing the appropriate control room reference material.**
(CFR: 41.10,43.5 / 45.12)
IMPORTANCE RO 3.4 SRO 3.7

2.4.48 **Ability to interpret control room indications to verify the status and operation of system, and understand how operator actions and directives affect plant and system conditions.**
(CFR: 43.5 / 45.12)
IMPORTANCE RO 3.5 SRO 3.8

2.4.49 **Ability to perform without reference to procedures those actions that require immediate operation of system components and controls.**
(CFR: 41.10 / 43.2 / 45.6)
IMPORTANCE RO 4.0 SRO 4.0

2.4.50 **Ability to verify system alarm setpoints and operate controls identified in the alarm response manual.**
(CFR: 45.3)
IMPORTANCE RO 3.3 SRO 3.3

Safety Function 1:
Reactivity Control

001 Control Rod Drive System

TASK:

Perform full-length control rod assembly drop time test
Disconnect and connect control rod drive shaft from control rod
Perform safety group transfer operations between the dc hold and auxiliary power supplies
Operate control rods to shape axial power
Perform individual rod transfer operations between the normal and auxiliary power supplies
Perform regulating group transfer operations between the normal and auxiliary power supplies
De-energize a CRDM
operate control rods manually while the reactor is at power (Mode 1)

Establish initial conditions for reactor startup
Perform estimated critical position calculations
Perform control rod programming verification
Start up the CRDS
Perform rod group latching and position indication alignment
Manually trip the reactor
Adjust overlap between sequential rods
Perform a shutdown group withdrawal
Operate the CRDS to bring the reactor critical
Shift the control rod drive mode of control from manual sequential to automatic sequential
Shift the control rod drive mode between automatic and manual group or manual individual
Shift the control rod drive mode between manual group or manual individual and manual sequential
Operate the CRDS to shut down the reactor
Secure rod drive M/G sets
Shut down the CRDS
Start up rod drive M/G sets
Perform SDM calculations
Recover from a sequence inhibit situation
Level a control rod while in the automatic mode of control

SYSTEM: 001 Control Rod Drive System

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CRDS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CCW	3.0*	3.2*
K1.02	CVCS	3.6*	3.7*
K1.03	CRDM	3.4	3.6
K1.04	RCS	3.2*	3.4*
Kl.05	NIS and RPS	4.5	4.4
K1.06	WGDS	1.7*	2.0*
K1.07	Quench tank	1.7*	2.1*
K1.08	CCWS: must be shut down to prevent condensation on CRDM stators	2.2*	2.4*
K1.09	CCWS must be cut in before energizing CRDS	2.8*	3.1*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	One-line diagram of power supply to M/G sets.	3.5	3.6
K2.02	One-line diagram of power supply to trip breakers	3.6	3.7
K2.03	One-line diagram of power supplies to logic circuits	2.7*	3.1
K2.04	Control rod lift coil...	2.1*	2.7
K2.05	M/G sets	3.1*	3.5
K2.06	Circuit breakers	2.4	2.8
K2.07	Sensors and detectors...	2.1	2.4
K2.08	Motors	1.7	2.1
K3	**Knowledge of the effect that a loss or malfunction of the CRDS will have on the following:** (CFR: 41.7/45.6)		
K3.01	CVCS	2.9*	3.0*
K3.02	RCS	3.4*	3.5
K3.03	CCW	2.2*	2.4*
K4	**Knowledge of CRDS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Rod position indication	3.5	3.8
K4.02	Control rod mode select control (movement control)	3.8	3.8
K4.03	Rod control logic	3.5	3.8
K4.04	Circuitry and principle of operation for LVDT or reed switch	2.5	2.8

K4.05	Boration and dilution.	3.9*	3.9*
K4.06	Indication of what caused reactor trip (first-out panel)	3.7	4.2
K4.07	Rod stops	3.7	3.8
K4.08	Prevention of excessive rod movement	3.2*	3.4
K4.09	Recovery of dropped rod	3.9	4.1
K4.10	Trip signals that would prevent reset of reactor trip signals	3.6	3.8
K4.11	Resetting of CRDM circuit breakers	2.7	2.9
K4.12	Re-zeroing rod demand position counters.	2.5	2.6
K4.13	Operation of CRDS controls for withdrawing lingering rods and transferring rods and rod groups	3.4	3.4
K4.14	Operation parameters, including proper rod speed	2.6	2.8
K4.15	Operation of latching controls for groups and individual rods	2.7	3.0
K4.16	Synchronization of power supplies to CRDS	2.2	2.4
K4.17	Override (bypass) for rod bank motion when one rod is bottomed	2.9*	3.1*
K4.18	Configuration of control/shutdown rods in core	2.1	2.5
K4.19	How contactors absorb arcing where used in conjunction with circuit breakers	1.4	1.5
K4.20	The permissives and interlocks associated with increase from zero power	3.2	3.4
K4.21	Prevention of adverse chemical conditions	1.9	2.3
K4.22	Seismic considerations	1.4	1.8
K4.23	Rod motion inhibit	3.4	3.8

K5 **Knowledge of the following operational implications as they apply to the CRDS:**
(CFR: 41.5/45.7)

K5.01	Understanding and application of individual and over-lapped rod bank curves	3.3	3.7
K5.02	Definitions of differential rod worth and integral rod worth; their applications	2.9	3.4
K5.03	Principles of operation of rod drive motor (magnetic jack or roller nut)	2.1	2.4
K5.04	Rod insertion limits	4.3	4.7
K5.05	Interpretation of rod worth curves, including proper curve to use: all rods in (ARI), all rods out (ARO), hot zero power (HZP), hot full power (HFP)	3.5	3.9
K5.06	Effects of control rod motion on axial offset	3.8	4.1
K5.07	Effects of an asymmetric rod configuration on power distribution	3.3	4.0
K5.08	Reasons for rod insertion limits and their effect on shutdown margin	3.9	4.4

K5.09	Relationships between reactivity due to boron and reactivity due to control rod	3.5	3.7
K5.10	Effect of rod motion on core power distribution and RCS temperatures	3.9	4.1
K5.11	Relationship between reactivity worth of power-shaping control rod group and other control rod groups (power-shaping, or part-length, rods have much less reactivity than full-length control rods)	3.1	3.6*
K5.12	Effects on power of inserting axial shaping rods	3.4*	4.1*
K5.13	Effects of past power history on xenon concentration and samarium concentration	3.7	4.0
K5.14	Interpretation of isothermal temperature coefficient; ability to apply it with respect to isothermal temperature defect	2.3	2.8
K5.15	Relationship between RCS temperature and MTC	3.4	3.7
K5.16	Relationship between RCS temperature and NDT of vessel	3.4	4.0
K5.17	Sources for adding positive reactivity	4.2	4.2
K5.18	Anticipation of criticality at any time when adding positive reactivity during startup	4.2	4.3
K5.19	Reasons for using boron in the reactor	3.1	3.4
K5.20	Effects of RCS temperature on boron reactivity worth	2.8	3.2
K5.21	Unit of measure of RCS boron concentration	2.2	2.5
K5.22	Reason for use of peak samarium instead of equilibrium samarium in shutdown margin calculations	2.2	2.5
K5.23	Definition and effects of xenon absorption cross section	2.2	2.6
K5.24	Definition and effects of moderator absorption cross section	2.1	2.4
K5.25	Definition and effects of moderator scattering cross section	1.8	2.1
K5.26	Definition of moderator temperature coefficient; application to reactor control	3.3	3.6
K5.27	Interpretation of isothermal temperature coefficient; ability to apply it with respect to the isothermal temperature defect	2.4*	2.8*
K5.28	Boron reactivity worth vs. boron concentration, i.e., amount of boron needed (ppm) to change core reactivity to desired amount	3.5	3.8
K5.29	Effect on reactivity of changes in T-ave	3.7	3.9
K5.30	Effects of fuel burnout on reactivity in the core	2.9	3.1
K5.31	Concept of equilibrium with respect to isotope production and decay	2.6	3.0
K5.32	Fission process	2.5	2.8
K5.33	Xenon production and removal process	3.2	3.5
K5.34	Effects of power level on peak samarium	2.1	2.2
K5.35	Methods of samarium production and removal	2.1	2.3
K5.36	Significance of sign (always minus) of a calculated power defect	3.1	3.4
K5.37	Sources of decay heat and effects on RCS	3.6	4.1
K5.38	Definition of xenon transient; causes; effects on reactivity	3.5	4.1
K5.39	Definition and units of reactivity	2.7	2.9

K5.40	Definition of ppm	2.0	2.2
K5.41	Theory of radioactive decay of reactor poisons such as ^{131}I, ^{135}Xe	2.4	2.8
K5.42	Definitions of T-ave and no-load T-ave	2.9	3.0
K5.43	Definition of T-ref	3.2	3.4
K5.44	Definition of isothermal temperature defect	2.2	2.6
K5.45	Heat transfer formulas for primary and secondary coolant	2.4	2.9
K5.46	Hot channel factors	2.3	3.6
K5.47	Factors affecting SUR: b-eff, l, p	2.9	3.4
K5.48	Definition of fuel temperature (Doppler) effect	3.3	3.5
K5.49	Definitions and effects of factors affecting power defect: moderator temperature defect, fuel temperature defect, moderator void defect, redistribution, individual contribution effects (the summation of all defects) 3.7		3 . 4
K5.50	Definition of moderator void defect	2.2	2.5
K5.51	Definition of xenon oscillation	3.1	3.7
K5.52	Definition and purpose of axial offset	3.0	3.6
K5.53	Definition of delta flux and its relationship to axial offset	2.8	3.4
K5.54	Definition and units of reactivity	2.8	3.1
K5.55	Definition and function of moderator	3.0	3.2
K5.56	Determination of degrees of subcooling, using temperature and pressure indications for primary coolant	4.2	4.6
K5.57	Interpretation of rod drop test data	2.2	2.5
K5.58	Reason for overlap of control banks	2.7	3.2
K5.59	Reasons for overlap of control rod banks for withdrawal and insertion	2.7	3.4
K5.60	Reason for using M/G sets to power rod control system	1.9	2.4
K5.61	Operational theory for M/G sets	1.5	1.7
K5.62	Effects of RCS temperature on rod worth	2.2	2.8
K5.63	Meaning of zero SUR; reactor just critical or completely shut down	3.3*	3.4
K5.64	Reason for withdrawing shutdown group: to provide adequate shutdown margin	3.3	3.8
K5.65	CRDS circuitry, including effects of primary/secondary power mismatch on rod motion	3.2	3.6
K5.66	Not Used	N/A	N/A
K5.67	Nucleonics associated with startup	2.9	3.2
K5.68	Understanding of "cold-water" (startup) accidents	3.4	3.8
K5.69	Purpose of overlap between source and intermediate range instrumentation	2.9	3.6
K5.70	Method used to parallel the rod control M/G sets	2.1	2.6
K5.71	Reason for maintaining cross-tie breaker between rod drive M/G sets; reliability of control rod drive trip breakers during operation of one M/G set		2 . 4 2.9
K5.72	Reactivity balance (shutdown withdrawal precedes dilution)	3.1	3.6
K5.73	Need for maintenance of stable plant conditions during rod exercising	2.7	3.1
K5.74	Reactor may <u>not</u> go critical upon withdrawal of a shut-down group	3.7	4.0
K5 75	Definition, uses, and calculation of l/m plot	2.9	3.5
K5 76	Effects on power of inserting axial shaping rods	3.3*	3.7*

K5.77	Determination of the amount of boron needed to back out rods from the core, including effects of xenon	3.2	3.6
K5.78	Response effects on T-ave. of dilution without rod motion	3.3	3.5
K5.79	Effects of positioning of axial shape rods on SDM	3.0*	3.6*
K5.80	Prediction of changes in boron concentration due to power operation, dilution, or boration	3.4	3.9
K5.81	Determination (using plant curve book) of reactivity change associated with the difference in boron concentration	3.2	3.6
K5.82	Interpretation of differential and integral boron worth curves	2.7	3.1
K5.83	Approximation of change in reactivity due to change in boron concentration (using differential boron thumb rule)	3.4	3.5
K5.84	Significance of sign change (plus or minus) in reactivity due to change in boron concentration	3.3	3.5
K5.85	Estimation of xenon reactivity based on time to reach peak xenon after trip/shutdown, approximate peak xenon reactivities after shutdown from various power levels, approximate xenon worth during the decay process following peak worth	3.5	3.7
K5.86	Significance of sign change (plus or minus) in reactivity due to change in samarium level	2.3	2.7
K5.87	Magnitude of heat decay as a function of time after shutdown	3.2	3.5
K5.88	Effects of boron on temperature coefficient	2.9	3.4
K5.89	Relationships of axial offset to ECP: method of recovery from high power trip, allowing for xenon transient, with minimum boron movement	2.3	3.2
K5.90	Estimation of core life based on RCS boron concentration (correlation of estimated critical boron concentration with time in core life)	2.3*	3.1*
K5.91	Estimation of samarium reactivity based on time to reach peak samarium after trip/shutdown, and on approximate peak samarium reactivities after shutdown from various power levels	1.9	2.4
K5.92	Comparison of actual data with historical data to determine whether a trend exists	2.1	3.1
K5.93	Axial offset problems caused by xenon oscillations (and their application to Tech-Spec power limitations)	3.2	4.1
K5.94	Definition of shutdown margin	3.3	3.6
K5.95	Effect of reactor power changes on RCS temperature	3.4	3.7
K5.96	Sign changes (plus or minus) in reactivity, obtained when positive reactivities are added to negative reactivities	3.2	3.4
K5.97	Relationship of T-ave. to T-ref	3.3	3.6
K5.98	Effect of adding high or low boron concentration to maintain T-ave. equal to T-ref	3.4	3.8

SYSTEM: **001 Control Rod Drive System**

K6 **Knowledge of the effect of a loss or malfunction on the following CRDS components:**
(CFR: 41.7/45.7)

K6.01	Control rod configuration and construction material	2.2	2.5
K6.02	Purpose and operation of sensors feeding into the CRDS	2.8	3.3
K6.03	Reactor trip breakers, including controls	3.7	4.2
K6.04	Breakers, relays, and disconnects	2.4	2.8
K6.05	Sensors and detectors	2.4	2.7
K6.06	Motors	2.1	2.1
K6.07	Transformers and voltage regulators	1.8	2.0
K6.08	Purpose and position switch of alarm for high flux at shutdown	2.9*	3.2*
K6.09	Purpose and operation of neutron flux recorder at high speed concentration	2.9*	2.9*
K6.10	Location and operation of rod control M/G sets and control panel, including trips	3.1*	3.3
K6.11	Location and operation of CRDS fault detection (trouble alarms) and reset system, including rod control annunciator	2.9	3.2
K6.12	Location and interpretation of CRDS ac/dc status alarms	2.9*	3.2*
K6.13	Location and operation of RPIS	3.6	3.7
K6.14	Location and interpretation of reactor trip breaker	4.0	4.1

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CRDS controls including:**
(CFR: 41.5/45.5)

A1.01	T-ave. and no-load T-ave	3.8	4.2
A1.02	T-ref	3.1	3.4
A1.03	S/G level and pressure	3.6	3.7
A1.04	PZR level and pressures	3.7	3.9
A1.05	Effect on T-ave. of dilution without rod motion compensation	3.4	3.9
A1.06	Reactor power	4.1	4.4
A1.07	RCS average temperature indications (T-ave.)	3.7	4.0
A1.08	Verification that CRDS temperatures are within limits before starting	2.6	3.0
A1.09	Location and interpretation of RCS temperature and pressure indications	4.2	4.4
A1.10	Location and operation of controls and indications for CRDS component cooling water	2.9	2.7
A1.11	Required primary system subcooling during shutdown; location of indication	3.7	3.9
A1.12	Estimation of decay heat load, in order to control RCS temperature with proper amount of heat removal	2.9	3.4
A1.13	"Prepower dependent insertion limit" and power dependent insertion limit, determined with metroscope	4.0?	4.2?

SYSTEM: 001 Control Rod Drive System

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

A2.01	Loss of CCW or fan cooling	3.1	3.7
A2.02	Loss of power source to reactor trip breakers	3.8	4.3
A2.03	Effect of stuck rod or Misaligned rod	3.5	4.2
A2.04	Positioning of axial shaping rods and their effect on SDM	3.2*	3.8*
A2.05	Fractured split pins	1.9?	1.9?
A2.06	Effects of transient xenon on reactivity	3.4	3.7
A2.07	Effect of reactor trip on primary and secondary parameters and systems	4.1	4.4
A2.08	Loss of CCW to CRDS	2.9	3.3
A2.09	Station blackout	3.8*	4.0
A2.10	Loss of power to one or more M/G sets	3.4	3.9
A2.11	Situations requiring a reactor trip	4.4	4.7
A2.12	Erroneous ECP calculation	3.6	4.2
A2.13	ATWS	4.4	4.6
A2.14	Urgent failure alarm, including rod-out-of-sequence and motion-inhibit alarms	3.7	3.9
A2.15	Quadrant power tilt	3.6	4.2
A2.16	Possible causes of mismatched control rods	3.0	3.8
A2.17	Rod-misalignment alarm	3.3	3.8
A2.18	Incorrect rod stepping sequence	3.2	3.8
A2.19	Axial flux distribution	3.6	4.0
A2.20	Isolation of left coil on affected rod to prevent coil burnout	2.6*	3.6*

A3 **Ability to monitor automatic operation of the CRDS, including:**
(CFR: 41.7/45.13)

A3.01	Reactor power	4.1	4.0
A3.02	Rod height	3.7	3.6
A3.03	Axial imbalance	3.6	3.8
A3.04	Radial imbalance	3.5	3.8
A3.05	Individual vs. group rod position	3.5	3.5
A3.06	RCS temperature and pressure	3.9	3.9
A3.07	Boration/dilution	4.1	3.7
A3.08	Anticipation of criticality at any time when adding positive reactivity	3.9	4.0

SYSTEM: **001 Control Rod Drive System**

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

A4.01	Controls for CCWS	3.1	2.9
A4.02	Boration/dilution	4.1	3.9
A4.03	CRDS mode control	4.0	3.7
A4.04	Part-length rod position	3.9*	3.6*
A4.05	Determination of the amount of boron needed to back the rods out of the core, including xenon effects if equilibrium is not yet achieved	3.7	3.7
A4.06	Control rod drive disconnect/connect	2.9	3.2
A4.07	Power source transfer check	3.3?	3.3?
A4.08	Mode select for CRDS; operation of rod control M/G sets and control panel	3.7	3.4
A4.09	CCWS	2.8	3.1
A4.10	Determination of an ECP	3.5	3.9
A4.11	Determination of SDM	3.5	4.1
A4.12	Stopping T/G load changes; only make minor adjustments to prevent coil burnout	2.9*	2.9
A4.13	Stopping other changes in plant, e.g., turbine, S/G, SDBCS, boration, before adjusting rods	2.7*	2.9*
A4.14	Resetting rod control logic while recovering from mis-aligned rod, using instrument Tech-Specs	3.0	3.4
A4.15	Stopping boration/dilution or other means of reactivity change while adjusting either rod position or T-ave	3.1*	3.1*

004 Chemical and Volume Control System (CVCS)

TASK: Perform lineup of the CVCS
Perform boron concentration dilution (bleed) of the RCS
Perform boration (feed) for the RCS
Perform boration system flow path verification
Fill and vent the CVCS
Perform boration flow-path verification
Start up the CVCS
Perform borated water source operability verification
What if RCS temperature starts to increase after placing demineralizer in service?
Nitrogen purge the VCT
Perform boric acid pump functional test
What if estimated critical position is not calculated properly and reactor goes critical before it is expected?
Perform hydrogen purge and establish hydrogen overpressure
Shut down the CVCS
Operate the CVCS to increase the primary system pressure
Perform boron concentration change calculations
Shift to automatic feed and bleed of the RCS
Operate a mixed-bed demineralizer
Operate the cation bed demineralizer
Operate a deborating demineralizer
Perform RCS dilution using purification demineralizer in series with deborating demineralizer
Deborate to a critical condition during reactor startup
Monitor the CVCS operation
Perform excess letdown to either VCT or radwaste
Perform excess letdown to the reactor coolant drain/CVCS holdup tank
Operate the CVCS to form a steam bubble in the PZR
Operate the CVCS to collapse the steam bubble in the PZR
Switch the letdown filters (post-demineralizer filters)
Operate letdown coolers
Operate seal injection subsystem (auto-manual)
Vent a volume control/makeup tank (VCT)
Manual makeup to the VCT
Perform low-pressure purification using the RHRS
Degas the RCS through the VCT
Adjust the charging flow rate
Adjust the letdown flow rate
Change the seal injection filters
Operate the CVCS to make up to the RWST
Degas the RCS through the PZR

SYSTEM **004 Chemical and Volume Control System**

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CVCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	PZR LCS	3.6	4.0
K1.02	PZR and RCS temperature and pressure relationships	3.5	3.8
K1.03	Operation, function and control of T/G	2.2	2.6
K1.04	RCPS, including seal injection flows	3.4	3.8
K1.05	CRDS operation in automatic mode control	2.7*	3.2
K1.06	Makeup system to VCT	3.1	3.1
K1.07	NIS	2.6	2.9
K1.08	Interface of CVCS with PRT	2.2	2.4
K1.09	Relationship between CVCS and RPIS	2.2*	2.7
K1.10	Pneumatic valves and RHRS	2.7	2.9
K1.11	Expected PRT response when opening PORV during bubble formation in PZR	2.9	3.2
K1.12	Nitrogen systems	2.4	2.6
K1.13	Hydrogen systems	2.8	2.9
K1.14	IAS	2.6	2.8
K1.15	ECCS	3.8	4.0
K1.16	Boric acid storage tank	3.3	3.5
Kl.17	PZR	3.4	3.4
K1.18	CCWS	2.9	3.2
K1.19	Primary grade water supply	2.7	2.9
K1.20	Location of sample points for chemically sampled fluid systems	1.7	2.5
K1.21	WGDS	2.4	2.8
K1.22	BWST	3.4	3.7
K1.23	RWST	3.4	3.7
K1.24	RHRS	3.4	3.9
K1.25	Interface between HPI flow path and excess letdown flow path	2.7*	3.2*
K1.26	Flow path from CVCS to reactor coolant drain tank and holdup tank	2.7	2.8
K1.27	Relationship between seal filter and letdown filter	2.3*	2.3*
K1.28	Interface between high-activity waste tank and letdown filter drain	2.1*	2.4*
K1.29	Effect and detection of leaking PORV or relief on PZR level and pressure, including VCT makeup activity in automatic mode	3.4	4.0
K1.30	Relationship between letdown flow and RCS pressure	2.9	3.1
K1.31	Interface between CVCS and degassifier (WGDS)	2.3	2.5
K1.32	Minimum VCT pressure effect on RCP seals	2.8	3.1
K1.33	Interface between clean waste receiver tank and seal injection filters	2.3*	2.7*

K1.34	Interface between CVCS and reactor coolant drain tank; and PZR PCS	2.7	2.9
K1.35	Understanding of interface with LRS	2.5	2.8
K1.36	CCWS	2.6	2.8

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

K2.01	Boric acid makeup pumps	2.9	3.1
K2.02	Makeup pumps	2.9	3.1
K2.03	Charging pumps	3.3	3.5
K2.04	BWST tank heaters	2.6	2.7
K2.05	MOVs	2.7	2.9
K2.06	Control instrumentation	2.6*	2.7
K2.07	Heat tracing	2.7	3.2

K3 **Knowledge of the effect that a loss or malfunction of the CVCS will have on the following:**
(CFR: 41.7/45/6)

K3.01	CRDS (automatic)	2.5*	2.9
K3.02	DELETED		
K3.03	CCWS	2.2	2.4
K3.04	RCPS	3.7	3.9
K3.05	PZR LCS	3.8	4.2
K3.06	RCS temperature and pressure	3.4	3.6
K3.07	PZR level and pressure	3.8	4.1
K3.08	RCP seal injection	3.6	3.8

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

K4.01	Oxygen control in RCS	2.8	3.3
K4.02	Control of pH, and range of acceptability	2.1	2.6
K4.03	Protection of ion exchangers (high letdown temperature will isolate ion exchangers)	2.8	2.9
K4.04	Manual/automatic transfers of control	3.2	3.1
K4.05	Interrelationships and design basis, including fluid flow splits in branching networks (e.g., charging and seal injection flow)	3.3	3.2
K4.06	Isotopic control	2.3	2.7
K4.07	Water supplies	3.0	3.3
K4.08	Hydrogen control in RCS	2.8	3.2
K4.09	High temperature limit on CVCS to protect ion exchange resins	2.4	3.1

K4.10	Minimum temperature requirements on borated systems (prevent crystallization)	3.2	3.8
K4.11	Temperature/pressure control in letdown line: prevent boiling, lifting reliefs, hydraulic shock, piping damage, and burst	3.1	3.6
K4.12	Minimum level of VCT	3.1	3.4
K4.13	Interlock between letdown isolation valve and flow control valve	3.2*	3.5
K4.14	Control interlocks on letdown system (letdown tank bypass valve)	2.8*	3.2
K4.15	Interlocks associated with operation of orifice isolation valves	3.0*	3.4
K4.16	Temperature at which the temperature control valve automatically diverts flow from the demineralizer to the VCT; reason for this diversion	2.6	3.0

K5 **Knowledge of the operational implications of the following concepts as they apply to the CVCS:**
(CFR: 41.5/45.7)

K5.01	Importance of oxygen control in RCS	2.7	3.3
K5.02	Explosion hazard associated with hydrogen containing systems	3.5	3.9
K5.03	Definition of pH, reasons for importance, range of acceptability in RCS	2.2	2.9
K5.04	Reason for hydrogen cover gas in VCT (oxygen scavenge)	2.8	3.2
K5.05	Source of neutrons (leakage, effect of core life) and NIS indications	2.3*	2.8
K5.06	Concept of boron "worth" or inverse boron "worth" (reactivity, pcm/ppm)	3.0	3.3
K5.07	Relationship between SUR and reactivity	2.8	3.2
K5.08	Estimation of subcritical multiplication factor (K-eff) by means other than the 6-factor formula: relationship of count rate changes to reactivity changes	2.6	3.2
K5.09	Thermal shock: high component stress due to rapid temperature change	3.7	4.2
K5.10	Importance of nil-ductility transition temperature in plant operations	3.2	3.7
K5.11	Thermal stress, brittle fracture, pressurized thermal shock	3.6	3.9
K5.12	Effects of temperature on corrosion	2.3	2.7
K5.13	Galvanic and general corrosion	2.1	2.6
K5.14	Reduction process of gas concentration in RCS: vent-accumulated non-condensable gases from PZR bubble space, depressurized during cooldown or by alternately heating and cooling (spray) within allowed pressure band (drive more gas out of solution)	2.5	2.9

K5.15	Boron and control rod reactivity effects as they relate to MTC	3.3	3.5
K5.16	Source of T-ave. and T-ref. signals to control and RPS	3.2	3.4
K5.17	Types and effects of radiation, dosimetry, and shielding-time-distance	2.6	3.1
K5.18	Relationship between neutron flux and reactivity	2.8	3.3
K5.19	Concept of SDM	3.5	3.9
K5.20	Reactivity effects of xenon, boration, and dilution	3.6	3.7
K5.21	Ppm and weight % for boron	2.2	2.7
K5.22	Ion bead degradation by temperature	2.3	2.6
K5.23	Radioactive decay of crud	1.9	2.4
K5.24	Decontamination factors	1.9	2.5
K5.25	Channeling of ion exchanger	1.9	2.4
K5.26	Relationship between VCT pressure and NPSH for charging pumps	3.1	3.2
K5.27	Reason for nitrogen purge of CVCS	2.6	3.2
K5.28	Reason for "burping" non-condensable gases from VCT	2.4	3.0
K5.29	Reason for sampling for chloride, fluoride, sodium and solids in RCS	2.6	3.3
K5.30	Relationship between temperature and pressure in CVCS components during solid plant operation	3.8	4.2
K5.31	Purpose of flow path around boric acid storage tank	3.0*	3.4
K5.32	Purpose and control of heat tracing (prevent crystallization)	3.1	3.4
K5.33	Use of a boronometer	2.3*	2.6
K5.34	For ion exchangers: demineralization, boration/ deboration, thermal regeneration, lithium control	2.4	2.8
K5.35	Heat exchanger principles and the effects of flow, temperature and other parameters	2.5	2.9
K5.36	Solubility of boron in water; temperature effect	2.5	2.8
K5.37	Effects of boron saturation on ion exchanger behavior	2.6	3.1
K5.38	Use of thermal well for accessibility of resistance temperature detector	1.7	1.9
K5.39	Relationship between flow and pressure drop for fluids passing through valves and orifices	2.4	2.7
K5.40	Response of PRT during bubble formation in PZR: increase in quench tank pressure when cycling PORV shows that complete steam bubble does not exist, that significant noncondensable gas is still present	3.0*	3.4*
K5.41	Solubility of gases in solution: temperature and pressure effects	2.3	2.6
K5.42	Solubility of boron in water: temperature effect	2.4	2.7
K5.43	Saturation, subcooling, superheat in steam/water	3.6	3.9
K5.44	Pressure response in PZR during in-and-out surge	3.2	3.4
K5.45	Resistance heating: power/current relations	1.8	2.1
K5.46	Reason for going solid in PZR (collapsing steam bubble): make sure no steam is in PRT when PORV is opened to drain RCS	2.5*	2.9
K5.47	Reason for second CCW pump when second heat exchanger is lined up	2.4*	2.9

K5.48	Purpose of hydrogen purging and sampling processes	2.2	2.9
K5.49	Purpose and method of hydrogen removal from RCS before opening system: explosion hazard, nitrogen purge	2.7	3.3
K5.50	Design basis letdown system temperatures: resin integrity	2.6	2.7
K5.51	Operation principle of hydrogen catalytic recombiners	1.9*	2.3
K5.52	Reason for of reducing letdown rate when filling PZR; collapse steam bubble	2.4	2.7
K5.53	Reason for keeping VCT pressure as low as possible during degas	2.3	2.6
K5.54	Calculation of rate of boron change in RCS as function flow rate	2.2	2.6
K5.55	Factors which effect changes in letdown temperature	2.3	2.4
K5.56	Sources of radio iodine in RCS (hazard in filter changeout)	2.1	2.7

K6 Knowledge of the effect of a loss or malfunction on the following CVCS components: (CFR: 41.7 / 45.7)

K6.01	Spray/heater combination in PZR to assure uniform boron concentration	3.1	3.3
K6.02	Demineralizers and ion exchangers	2.5	2.6
K6.03	Valves	2.4	2.5
K6.04	Pumps	2.8	3.1
K6.05	Sensors and detectors	2.5	2.5
K6.06	Motors	2.1	2.3
K6.07	Heat exchangers and condensers	2.7	2.8
K6.08	Breakers, relays, and disconnects	2.0	2.2
K6.09	Purpose of VCT divert valve	2.8	3.1
K6.10	Boric acid storage tank/boron injection tank recirculation flow path	2.7	3.1
K6.11	Recirculation valve on boric acid storage tank (why it is closed during functional test)	2.4*	2.7
K6.12	Principle of recirculation valve: (permit emergency flow even if valve is blocked by crystallized boric acid)	2.6	2.9
K6.13	Purpose and function of the boration/dilution batch controller	3.1	3.3
K6.14	Recirculation path for charging pumps	2.7	3.0
K6.15	Reason for venting VCT and pump casings while filling: vents must connect to LRS	2.8	3.1
K6 16	Purpose of spray nozzle in VCT	2.3	2.6
K6.17	Flow paths for emergency boration	4.4	4.6
K6.18	Design characteristics of boric acid transfer pump	2.0	2.3
K6.19	Purpose of centrifugal pump miniflows (recirculation)	2.3	2.6
K6.20	Function of demineralizer, including boron loading and temperature limits	2.5	3.1
K6.21	Design and purpose of charging pump desurger	2.1*	2.4
K6.22	Design minimum and maximum flow rates for letdown system.	2.6	2.9

K6.23	Capacity of boron recovery tanks: plan not to exceed by inefficient boron movement; interface with boron recovery system	2.1*	2.7
K6.24	Controllers and positioners	2.5	2.6
K6.25	Tank capacity: RCS makeup, CVCS, and boron recovery system	2.2	2.6
K6.26	Methods of pressure control of solid plant (PZR relief and water inventory)		3 . 8
			4.1
K6.27	Purpose of RHR relief and isolation valves	3.4	3.6
K6.28	Interface between high-activity waste tank and letdown filter drain	2.2*	2.5
K6.29	Reason for excess letdown and its relationship to CCWS	2.7	3.1
K6.30	Purpose and control of degassifier inlet and divert valves	2.3*	2.5
K6.31	Seal injection system and limits on flow range	3.1	3.5
K6.32	Venting of VCT: reduce concentration of gases in solution, keep stress in tank down	2.1	2.5
K6.33	Principles of boronometer	1.9*	2.1
K6.34	Maximum allowable purge flow rate	1.9	2.2
K6.35	Relationship between VCT vent rate and vent header pressure	2.2	2.5
K6.36	Letdown pressure control to prevent RCS coolant from flashing to steam in letdown piping	2.9	3.1
K6.37	Boron loading of demineralizer resin	2.9	3.4
K6.38	Methods of minimizing the amount of RCS coolant water processed and reducing the amount of waste water generated	2.4	3.2

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CVCS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Activity levels in primary system	2.9	3.8
A1.02	T-ave. and T-ref	3.4*	3.6
A1.03	RCS pressure	3.8	3.8
A1.04	PZR pressure and level	3.9	4.1
A1.05	S/G pressure and level	2.9*	3.2
A1.06	VCT level	3.0	3.2
A1.07	Maximum specified letdown flow	2.7	3.1
A1.08	Normal operating band for letdown flow rate	2.7	2.9
A1.09	RCS pressure and temperature	3.6	3.8
A1.10	Reactor power	3.7	3.9
A1.11	Letdown and charging flows	3.0	3.0
A1.12	Rate of boron concentration reduction in RCS as a function of letdown flow while deborating demineralizer is in service	2.8	3.2

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the CVCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5/ 43/5 / 45/3 / 45/5)

A2.01	RCS pressure allowed to exceed limits	3.8	4.2
A2.02	Loss of PZR level (failure mode)	3.9	4.2
A2.03	Boundary isolation valve leak	3.6	4.2
A2.04	Unplanned gas release	3.7*	4.1
A2.05	RCP seal failures	4.0	4.3
A2.06	Inadvertent boration/dilution	4.2	4.3
A2.07	Isolation of letdown/makeup	3.4	3.7
A2.08	Loss of heat tracing	3.0	3.7
A2.09	High primary and/or secondary activity	3.0	3.9
A2.10	Inadvertent boration/dilution	3.9	4.2
A2.11	Loss of IAS	3.6	4.2
A2.12	CIAS, SIAS	4.1	4.3
A2.13	Low RWST	3.6	3.9
A2.14	Emergency boration	3.8*	3.9
A2.15	High or low PZR level	3.5	3.7
A2.16	T-ave. and T-ref. deviations	3.2	3.6
A2.17	Low PZR pressure	3.4	3.7
A2.18	High VCT level	3.1	3.1
A2.19	High secondary and primary concentrations of chloride, fluoride, sodium and solids	2.8	3.5
A2.20	Shifting demineralizer while divert valve is lined up to VCT	2.7	2.7
A2.21	Excessive letdown flow, pressure, and temperatures on ion exchange resins (also causes)	2.7	2.7
A2.22	Mismatch of letdown and changing flows	3.2	3.1
A2.23	High filter D/P	2.6	2.7
A2.24	Isolation of both letdown filters at one time: down-stream relief lifts	2.8	2.8
A2.25	Uncontrolled boration or dilution	3.8	4.3
A2.26	Low VCT pressure	2.8	3.0
A2.27	Improper RWST boron concentration	3.5	4.2
A2.28	Depressurizing of RCS while it is hot	3.7	4.3
A2.29	Indication by increased letdown flow that demineralizers are bypassed	2.3	2.4
A2.30	Reduction of boron concentration in the letdown flow; its effects on reactor operation	3.3	3.6
A2.31	Potential for RCS chemical contamination when placing CVCS demineralizer in service	2.3	2.7
A2.32	Expected reactivity changes after valving in a new mixed-bed demineralizer that has not been preborated	3.4	3.9

A2.33	Fact that isolating cation demineralizer stops boron dilution and enables restoration of normal boron concentration	2.7	3.3
A2.34	Fact that for very low RCS boron concentrations, deborating demineralizers may be more cost effective than using makeup water	2.2*	2.3
A2.35	Reactor trip	3.3	3.8
A3	**Ability to monitor automatic operation of the CVCS, including:** (CFR: 41.7 / 45.5)		
A3.01	Water and boron inventory	3.5	3.7
A3.02	Letdown isolation	3.6	3.6
A3.03	Ion exchange bypass	2.9	2.9
A3.04	VCT pressure control	2.8	2.9
A3.05	RCS pressure and temperature	3.9	3.9
A3.06	T-ave. and T-ref	3.9	3.8
A3.07	S/G level and pressure	3.3	3.3
A3.08	Reactor power	3.9	3.9
A3.09	VCT level	3.3	3.2
A3.10	PZR level and pressure	3.9	3.9
A3.11	Charging/letdown	3.6	3.4
A3.12	Interpretation of letdown demineralizer flow-divert valve position indicating lights	3.0	2.7
A3.13	DELETED		
A3.14	Letdown and charging flows	3.4	3.1
A3.15	PZR pressure and temperature	3.5	3.6
A3.16	Interpretation of emergency borate valve position indicating lights	3.8	4.2
A3.17	Interpretation of ion exchanger status light	2.3	2.4
A3.18	Interpretation of letdown orifice isolation valve position indicators	2.8	2.7
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41/7 / 45.5 to 45.8)		
A4.01	Boron and control rod reactivity effects	3.8	3.9
A4.02	Calculation of ECP and related boration/dilution/reactivity relationships	3.2	3.9
A4.03	Construction and use of 1/M plots (inverse multiplication, criticality prediction method)	2.7	3.2
A4.04	Calculation of boron concentration changes	3.2	3.6
A4.05	Letdown pressure and temperature control valves.	3.6	3.1
A4.06	Letdown isolation and flow control valves	3.6	3.1
A4.07	Boration/dilution	3.9	3.7
A4.08	Charging	3.8	3.4
A4.09	PZR spray and heater controls	3.5	3.3
A4.10	Boric acid pumps	3.6	3.2

A4.11	RCP seal injection.	3.4	3.3
A4.12	Boration/dilution batch control	3.8	3.3
A4.13	VCT level control and pressure control	3.3	2.9
A4.14	Ion exchangers and demineralizers	2.8	2.4
A4.15	Boron concentration	3.6	3.7
A4.16	Activity levels of RCS and letdown	2.7	3.5
A4.17	Deborating demineralizer	2.7	2.7
A4.18	Emergency borate valve	4.3	4.1
A4.19	CVCS letdown orifice isolation valve and valve control switches	3.1	2.8
A4.20	Deborating demineralizer selector valve and selector valve control switch	2.6	2.5
A4.21	Letdown demineralizer flow divert valve control switch	2.6	2.3
A4.22	Boronometer chart recorder	2.5*	2.5*
A4.23	Calculation of the required volume through the deborating demineralizer, using the appropriate equation	2.1	2.3

014 Rod Position Indication System (RPIS)

TASK: Start up the RPIS
Shut down the RPIS
Record the primary coil voltage to verify rod position

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the RPIS and the following systems:** (CFR: 41.3 to 41.9 / 45.7 to 45.8)		
K1.01	CRDS.	3.2*	3.6
K2.02	NIS	3.0	3.3
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Reed switches	1.8	2.0
K2.02	Metroscope	1.9*	2.2
K2.03	Pulse counters	1.7	2.1
K3	**Knowledge of the effect that a loss or malfunction of the RPIS will have on the following**: (CFR: 41.7 / 45.6)		
K3.01	CRDS	2.4	2.8*
K3.02	Plant computer	2.5	2.8*
K4	**Knowledge of RPIS design feature(s) and/or interlock(s) which provide for the following**: (CFR: 41.5 / 45.7)		
K4.01	Upper electrical limit	2.5*	2.7*
K4.02	Lower electrical limit	2.5*	2.7*
K4.03	Rod bottom lights	3.2	3.4*
K4.04	Zone reference lights	2.6*	2.9*
K4.05	Rod hold interlocks	3.1	3.3
K4.06	Individual and group misalignment	3.4	3.7

SYSTEM: 014 Rod Position Indication System (RPIS)

K5 Knowledge of the operational implications of the following concepts as they apply to the RPIS:
(CFR: 41.5 / 45.7)

K5.01	Reasons for differences between RPIS and step counter	2.7	3.0
K5.02	RPIS independent of demand position	2.8	3.3
K5.03	Differences in accuracy of reed switches and pulse counters	2.1	2.3
K5.04	Concepts of magnetic flux and permeability of stainless steel housing	1.5	1.7

K6 Knowledge of the affect if a loss or malfunction on the following will have on the RPIS:
(CFR: 41.5 / 45.7)

K6.01	Sensors and detectors	2.3	2.5
K6.02	Breakers, relays, and disconnects	1.7	1.8
K6.03	Metroscope	2.1*	2.6

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RPIS controls, including:
(CFR: 41.5 / 45.5)

A1.01	Metroscope reed switch display	2.9*	3.1
A1.02	Control rod position indication on control room panels	3.2	3.6
A1.03	PDIL, PPDIL	3.6?	3.8?
A1.04	Axial and radial power distribution	3.5	3.8

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

A2.01	Loss of offsite power	2.8	3.3
A2.02	Loss of power to the RPIS	3.1	3.6
A2.03	Dropped rod	3.6	4.1
A2.04	Misaligned rod	3.4	3.9
A2.05	Reactor trip	3.9	4.1
A2.06	Loss of LVDT	2.6*	3.0*
A2.07	Loss of reed switch	2.6	2.9

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

None

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

A4.01	Rod selection control	3.3	3.1
A4.02	Control rod mode-select switch	3.4	3.2
A4.03	Primary coil voltage measurement	2.6*	2.7*
A4.04	Re-zeroing of rod position prior to startup	2.7	2.7

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Safety Function 2:
Reactor Coolant System Inventory Control page

002 Reactor Coolant System (RCS)

TASK:

Perform lineups on the RCS
Vent the CRDM
Drain the RCS
Drain the S/G (primary side)
Drain the refueling cavity
Fill the refueling cavity
Perform RCS water inventory balance
Add nitrogen to the PZR
Monitor the RCS
Establish natural circulation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the RCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RWST	3.7	3.9
K1.02	CRDS	2.9*	3.0*
K1.03	Borated water storage tank	3.8	3.8
K1.04	RCS vent system	2.8	3.2
K1.05	PRT	3.2	3.4
K1 06	CVCS	3.7	4.0
K1 07	Reactor vessel level indication system	3.5*	3.7*
K1.08	ECCS	4.5	4.6
K1 09	PZR	4.1	4.1
K1 10	Reactor coolant drain tank	2.8	3.1
K1.11	S/GS, feedwater systems	4.1	4.2
K1 12	NIS	3.5*	3.6
K1.13	RCPS	4.1	4.2
K1.14	Spent-fuel pool purification	2.3	2.6
K1.15	Refueling canal	2.2	2.4
K1.16	Refueling water purification	1.9	2.2
K1.17	MT/G	3.5	3.8

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

None

SYSTEM 002 Reactor Coolant System (RCS)

K3 Knowledge of the effect that a loss or malfunction of the RCS will have on the following:
(CFR: 41.7)

K3.01	LRS	2.1	2.6
K3.02	Fuel	4.2	4.5
K3.03	Containment	4.2	4.6

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

K4.01	Filling and draining the RCS	2.7	3.0
K4 02	Monitoring reactor vessel level	3.5*	3.8*
K4.03	Venting the RCS	2.9	3.2
K4 04	Filling and draining the refueling canal	2.2	2.7
K4.05	Detection of RCS leakage	3.8	4.2
K4.06	Prevention of missile hazards	2.1	2.4
K4.07	Contraction and expansion during heatup and cooldown..	3.1	3.5
K4.08	Anchoring of components--ie, loops, vessel, S/Gs, and coolant pumps	1.9	2.1
K4.09	Operation of loop isolation valves.	3.2	3.2
K4.10	Overpressure protection	4.2	4.4

K5 Knowledge of the operational implications of the following concepts as they apply to the RCS:
(CFR: 41.5 / 45.7)

K5.01	Basic heat transfer concepts	3.2	3.6
K5.02	Purpose of vent flow path when draining	2.5	2.9
K5.03	Difference in pressure-temperature relationship between the water/steam system and the water/nitrogen system.	2.2	2.6
K5.04	Reason for requirement he plant to be in steady-state condition during RCS water inventory balance	3.1	3.4
K5.05	Reason for drain tank pressure rise during water inventory operations	2.9	3.3
K5.06	Pressure, temperature, and volume relationships of nitrogen gas in association with water	2.3	2.6
K5.07	Reactivity effects of RCS boron, pressure and temperature	3.6	3.9
K5.08	Why PZR level should be kept within the programmed band	3.4	3.9
K5.09	Relationship of pressure and temperature for water saturation and subcooling conditions	3.7	4.2
K5.10	Relationship between reactor power and RCS differential temperature.	3.6	4.1
K5.11	Relationship between effects of the primary coolant system and the secondary coolant system	4.0	4.2
K5.12	Relationship of temperature average and loop differential temperature to loop hot-let and cold-leg temperature indications	3.7	3.9

K5.13	Causes of circulation.	3.5	3.9
K5.14	Consequences of forced circulation loss.	3.8	4.2
K5.15	Reasons for maintaining subcooling margin during natural circulation	4.2	4.6
K5.16	Reason for automatic features of the Feedwater control system during total loss of reactor coolant flow	3.5	4.0
K5.17	Need for monitoring in-core thermocouples during natural circulation.	3.8	4.2
K5.18	Brittle fracture	3.3	3.6
K5.19	Neutron embrittlement	2.6	2.9
K5.20	Corrosion control principles	2.3	2.7

K6 **Knowledge of the effect or a loss or malfunction on the following RCS components:**
(CFR: 41.7 / 45.7)

K6.01	RCS valves that may pose and unusually high radiological Hazard because of trapped crud	2.2	2.9
K6.02	RCP	3.6	3.8
K6.03	Reactor vessel level indication	3.1	3.6
K6.04	RCS vent valves	2.5	2.9
K6.05	Valves	2.1	2.4
K6.06	Sensors and Detectors	2.5	2.8
K6.07	Pumps	2.5	2.8
K6.08	Controllers and Positioners	2.4	2.7
K6.09	Motors	2.1	2.5
K6.10	Breakers, relays, and disconnects	2.2	2.4
K6.11	Thermal sleeves	2.2	2.6
K6.12	Code Safety valves	3.0	3.5
K6.13	Reactor vessel and internals	2.3	2.8
K6.14	Core components	2.2	2.8
K6.15	Post-accident sampling	TBD	TBD

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RCS controls including**:
(CFR: 41.5 / 45.7)

A1.01	Primary and secondary pressure	3.8	4.1
A1.02	PZR and makeup tank level	3.6	3.9
A1.03	Temperature	3.7	3.8
A1.04	Subcooling Margin	3.9	4.1
A1.05	RCS flow	3.4	3.7
A1.06	Reactor power	4.0	4.0
A1.07	Reactor differential temperature	3.3	3.5
A1.08	RCS average temperature	3.7	3.8
A1.09	RCS T-ave	3.7	3.8
A1.10	RCS T-ref	3.7	3.8
A1.11	Relative level indications in the RWST, the refueling cavity, the PZR and the reactor vessel during preparation for refueling	2.7	3.2

A1.12	Radioactivity level when venting CRDS	2.9*	3.3
A1.13	Core exit thermocouples	3.4	4.0

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

A2.01	Loss of coolant inventory	4.3	4.4
A2.02	Loss of coolant pressure	4.2	4.4
A2.03	Loss of forced circulation	4.1	4.3
A2.04	Loss of heat sinks	4.3	4.6

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

A3.01	Reactor coolant leak detection system	3.7	3.9
A3.02	Containment sound-monitoring system	2.6*	2.8*
A3.03	Pressure, temperatures, and flows	4.4	4.6

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

A4.01	RCS leakage calculation program using the computer	3.5*	3.8*
A4.02	Indications necessary to verify natural circulation from appropriate level, flow, and temperature indications and valve positions upon loss of forced circulation	4.3	4.5
A4.03	Indications and controls necessary to recognize and correct saturation conditions	4.3	4.4
A4.04	The filling/draining of LPI pumps during refueling	2.8	2.6
A4.05	The HPI system when it is used to refill the refueling cavity	2.8*	2.7*
A4.06	Overflow level of the RWST	2.9	2.7
A4.07	Flow path linking the RWST through the RHR system to the RCS hot legs for gravity refilling of the refueling cavity	2.8	3.1
A4.08	Safety parameter display systems	3.4*	3.7*

004 Chemical and Volume Control System (CVCS)

TASK:

Perform lineup of the CVCS
Perform boron concentration dilution (bleed) of the RCS
Perform boration (feed) for the RCS
Perform boration system flow path verification
Fill and vent the CVCS
Perform boration flow-path verification
Start up the CVCS
Perform borated water source operability verification
What if RCS temperature starts to increase after placing demineralizer in service?
Nitrogen purge the VCT
Perform boric acid pump functional test
What if estimated critical position is not calculated properly and reactor goes critical before it is expected?
Perform hydrogen purge and establish hydrogen overpressure
Shut down the CVCS
Operate the CVCS to increase the primary system pressure
Perform boron concentration change calculations
Shift to automatic feed and bleed of the RCS
Operate a mixed-bed demineralizer
Operate the cation bed demineralizer
Operate a deborating demineralizer
Perform RCS dilution using purification demineralizer in series with deborating demineralizer
Deborate to a critical condition during reactor startup
Monitor the CVCS operation
Perform excess letdown to either VCT or radwaste
Perform excess letdown to the reactor coolant drain/CVCS holdup tank
Operate the CVCS to form a steam bubble in the PZR
Operate the CVCS to collapse the steam bubble in the PZR
Switch the letdown filters (post-demineralizer filters)
Operate letdown coolers
Operate seal injection subsystem (auto-manual)
Vent a volume control/makeup tank (VCT)
Manual makeup to the VCT
Perform low-pressure purification using the RHRS
Degas the RCS through the VCT
Adjust the charging flow rate
Adjust the letdown flow rate
Change the seal injection filters
Operate the CVCS to make up to the RWST
Degas the RCS through the PZR

SYSTEM 004 Chemical and Volume Control System

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CVCS and the following systems**: (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	PZR LCS	3.6	4.0
K1.02	PZR and RCS temperature and pressure relationships	3.5	3.8
K1.03	Operation, function and control of T/G	2.2	2.6
K1.04	RCPS, including seal injection flows	3.4	3.8
K1.05	CRDS operation in automatic mode control	2.7*	3.2
K1.06	Makeup system to VCT	3.1	3.1
K1.07	NIS	2.6	2.9
K1.08	Interface of CVCS with PRT	2.2	2.4
K1.09	Relationship between CVCS and RPIS	2.2*	2.7
K1.10	Pneumatic valves and RHRS	2.7	2.9
K1.11	Expected PRT response when opening PORV during bubble formation in PZR	2.9	3.2
K1.12	Nitrogen systems	2.4	2.6
Kl.13	Hydrogen systems	2.8	2.9
K1.14	IAS	2.6	2.8
K1.15	ECCS	3.8	4.0
K1.16	Boric acid storage tank	3.3	3.5
Kl.17	PZR	3.4	3.4
K1.18	CCWS	2.9	3.2
K1.19	Primary grade water supply	2.7	2.9
K1.20	Location of sample points for chemically sampled fluid systems	1.7	2.5
K1.21	WGDS	2.4	2.8
K1.22	BWST	3.4	3.7
K1.23	RWST	3.4	3.7
K1.24	RHRS	3.4	3.9
K1.25	Interface between HPI flow path and excess letdown flow path	2.7*	3.2*
K1.26	Flow path from CVCS to reactor coolant drain tank and holdup tank	2.7	2.8
K1.27	Relationship between seal filter and letdown filter	2.3*	2.3*
K1.28	Interface between high-activity waste tank and letdown filter drain	2.1*	2.4*
K1.29	Effect and detection of leaking PORV or relief on PZR level and pressure, including VCT makeup activity in automatic mode	3.4	4.0
K1.30	Relationship between letdown flow and RCS pressure	2.9	3.1
K1.31	Interface between CVCS and degassifier (WGDS)	2.3	2.5
K1.32	Minimum VCT pressure effect on RCP seals	2.8	3.1
K1.33	Interface between clean waste receiver tank and seal injection filters	2.3*	2.7*

K1.34	Interface between CVCS and reactor coolant drain tank; and PZR PCS	2.7	2.9
K1.35	Understanding of interface with LRS	2.5	2.8
K1.36	CCWS	2.6	2.8

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

K2.01	Boric acid makeup pumps	2.9	3.1
K2.02	Makeup pumps	2.9	3.1
K2.03	Charging pumps	3.3	3.5
K2.04	BWST tank heaters	2.6	2.7
K2.05	MOVs	2.7	2.9
K2.06	Control instrumentation	2.6*	2.7
K2.07	Heat tracing	2.7	3.2

K3 **Knowledge of the effect that a loss or malfunction of the CVCS will have on the following:**
(CFR: 41.7/ 45/6)

K3.01	CRDS (automatic)	2.5*	2.9
K3.02	PZR LCS	3.7	4.1
K3.03	CCWS	2.2	2.4
K3.04	RCPS	3.7	3.9
K3.05	PZR LCS	3.8	4.2
K3.06	RCS temperature and pressure	3.4	3.6
K3.07	PZR level and pressure	3.8	4.1
K3.08	RCP seal injection	3.6	3.8

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

K4.01	Oxygen control in RCS	2.8	3.3
K4.02	Control of pH, and range of acceptability	2.1	2.6
K4.03	Protection of ion exchangers (high letdown temperature will isolate ion exchangers)	2.8	2.9
K4.04	Manual/automatic transfers of control	3.2	3.1
K4.05	Interrelationships and design basis, including fluid flow splits in branching networks (e.g., charging and seal injection flow)	3.3	3.2
K4.06	Isotopic control	2.3	2.7
K4.07	Water supplies	3.0	3.3
K4.08	Hydrogen control in RCS	2.8	3.2
K4.09	High temperature limit on CVCS to protect ion exchange resins	2.4	3.1

K4.10	Minimum temperature requirements on borated systems (prevent crystallization)	3.2	3.8
K4.11	Temperature/pressure control in letdown line: prevent boiling, lifting reliefs, hydraulic shock, piping damage, and burst	3.1	3.6
K4.12	Minimum level of VCT	3.1	3.4
K4.13	Interlock between letdown isolation valve and flow control valve	3.2*	3.5
K4.14	Control interlocks on letdown system (letdown tank bypass valve)	2.8*	3.2
K4.15	Interlocks associated with operation of orifice isolation valves	3.0*	3.4
K4.16	Temperature at which the temperature control valve automatically diverts flow from the demineralizer to the VCT; reason for this diversion	2.6	3.0

K5 **Knowledge of the operational implications of the following concepts as they apply to the CVCS**:
(CFR: 41.5/ 45.7)

K5.01	Importance of oxygen control in RCS	2.7	3.3
K5.02	Explosion hazard associated with hydrogen containing systems	3.5	3.9
K5.03	Definition of pH, reasons for importance, range of acceptability in RCS	2.2	2.9
K5.04	Reason for hydrogen cover gas in VCT (oxygen scavenge)	2.8	3.2
K5.05	Source of neutrons (leakage, effect of core life) and NIS indications	2.3*	2.8
K5.06	Concept of boron "worth" or inverse boron "worth" (reactivity, pcm/ppm)	3.0	3.3
K5.07	Relationship between SUR and reactivity	2.8	3.2
K5.08	Estimation of subcritical multiplication factor (K-eff) by means <u>other</u> than the 6-factor formula: relationship of count rate changes to reactivity changes	2.6	3.2
K5.09	Thermal shock: high component stress due to rapid temperature change	3.7	4.2
K5.10	Importance of nil-ductility transition temperature in plant operations	3.2	3.7
K5.11	Thermal stress, brittle fracture, pressurized thermal shock	3.6	3.9
K5.12	Effects of temperature on corrosion	2.3	2.7
K5.13	Galvanic and general corrosion	2.1	2.6
K5.14	Reduction process of gas concentration in RCS: vent-accumulated non-condensable gases from PZR bubble space, depressurized during cooldown or by alternately heating and cooling (spray) within allowed pressure band (drive more gas out of solution)	2.5	2.9

K5.15	Boron and control rod reactivity effects as they relate to MTC	3.3	3.5
K5.16	Source of T-ave. and T-ref. signals to control and RPS	3.2	3.4
K5.17	Types and effects of radiation, dosimetry, and shielding-time-distance	2.6	3.1
K5.18	Relationship between neutron flux and reactivity	2.8	3.3
K5.19	Concept of SDM	3.5	3.9
K5.20	Reactivity effects of xenon, boration, and dilution	3.6	3.7
K5.21	Ppm and weight % for boron	2.2	2.7
K5.22	Ion bead degradation by temperature	2.3	2.6
K5.23	Radioactive decay of crud	1.9	2.4
K5.24	Decontamination factors	1.9	2.5
K5.25	Channeling of ion exchanger	1.9	2.4
K5.26	Relationship between VCT pressure and NPSH for charging pumps	3.1	3.2
K5.27	Reason for nitrogen purge of CVCS	2.6	3.2
K5.28	Reason for "burping" non-condensable gases from VCT	2.4	3.0
K5.29	Reason for sampling for chloride, fluoride, sodium and solids in RCS	2.6	3.3
K5.30	Relationship between temperature and pressure in CVCS components during solid plant operation	3.8	4.2
K5.31	Purpose of flow path around boric acid storage tank	3.0*	3.4
K5.32	Purpose and control of heat tracing (prevent crystallization)	3.1	3.4
K5.33	Use of a boronometer	2.3*	2.6
K5.34	For ion exchangers: demineralization, boration/ deboration, thermal regeneration, lithium control	2.4	2.8
K5.35	Heat exchanger principles and the effects of flow, temperature and other parameters	2.5	2.9
K5.36	Solubility of boron in water; temperature effect	2.5	2.8
K5.37	Effects of boron saturation on ion exchanger behavior	2.6	3.1
K5.38	Use of thermal well for accessibility of resistance temperature detector	1.7	1.9
K5.39	Relationship between flow and pressure drop for fluids passing through valves and orifices	2.4	2.7
K5.40	Response of PRT during bubble formation in PZR: increase in quench tank pressure when cycling PORV shows that complete steam bubble does not exist, that significant noncondensable gas is still present	3.0*	3.4*
K5.41	Solubility of gases in solution: temperature and pressure effects	2.3	2.6
K5.42	Solubility of boron in water: temperature effect	2.4	2.7
K5.43	Saturation, subcooling, superheat in steam/water	3.6	3.9
K5.44	Pressure response in PZR during in-and-out surge	3.2	3.4
K5.45	Resistance heating: power/current relations	1.8	2.1
K5.46	Reason for going solid in PZR (collapsing steam bubble): make sure no steam is in PRT when PORV is opened to drain RCS	2.5*	2.9
K5.47	Reason for second CCW pump when second heat exchanger is lined up	2.4*	2.9

K5.48	Purpose of hydrogen purging and sampling processes	2.2	2.9
K5.49	Purpose and method of hydrogen removal from RCS before opening system: explosion hazard, nitrogen purge	2.7	3.3
K5.50	Design basis letdown system temperatures: resin integrity	2.6	2.7
K5.51	Operation principle of hydrogen catalytic recombiners	1.9*	2.3
K5.52	Reason for of reducing letdown rate when filling PZR; collapse steam bubble	2.4	2.7
K5.53	Reason for keeping VCT pressure as low as possible during degas	2.3	2.6
K5.54	Calculation of rate of boron change in RCS as function flow rate	2.2	2.6
K5.55	Factors which effect changes in letdown temperature	2.3	2.4
K5.56	Sources of radio iodine in RCS (hazard in filter changeout)	2.1	2.7

K6 **Knowledge of the effect of a loss or malfunction on the following CVCS components:** (CFR: 41.7 / 45.7)

K6.01	Spray/heater combination in PZR to assure uniform boron concentration . .	3.1	3.3
K6.02	Demineralizers and ion exchangers	2.5	2.1
K6.03	Valves	2.4	2.5
K6.04	Pumps	2.8	3.1
K6.05	Sensors and detectors	2.5	2.5
K6.06	Motors	2.0	2.2
K6.07	Heat exchangers and condensers	2.7	2.8
K6.08	Breakers, relays, and disconnects	2.0	2.2
K6.09	Purpose of VCT divert valve	2.8	3.1
K6.10	Boric acid storage tank/boron injection tank recirculation flow path	2.7	3.1
K6.11	Recirculation valve on boric acid storage tank (why it is closed during functional test)	2.4*	2.7
K6.12	Principle of recirculation valve: (permit emergency flow even if valve is blocked by crystallized boric acid)	2.6?	2.9
K6.13	Purpose and function of the boration/dilution batch controller	3.1	3.3
K6.14	Recirculation path for charging pumps	2.7	3.0
K6.15	Reason for venting VCT and pump casings while filling: vents must connect to LRS	2.8	3.1
K6 16	Purpose of spray nozzle in VCT	2.3	2.6
K6.17	Flow paths for emergency boration	4.4	4.6
K6.18	Design characteristics of boric acid transfer pump	2.0	2.3
K6.19	Purpose of centrifugal pump miniflows (recirculation)	2.3	2.6
K6.20	Function of demineralizer, including boron loading and temperature limits	2.5	3.1
K6.21	Design and purpose of charging pump desurger	2.1*	2.4
K6.22	Design minimum and maximum flow rates for letdown system.	2.6	2.9

K6.23	Capacity of boron recovery tanks: plan not to exceed by inefficient boron movement; interface with boron recovery system	2.1*	2.7	
K6.24	Controllers and positioners	2.5	2.6	
K6.25	Tank capacity: RCS makeup, CVCS, and boron recovery system	2.2	2.6	
K6.26	Methods of pressure control of solid plant (PZR relief and water inventory)		3.8	4.1
K6.27	Purpose of RHR relief and isolation valves	3.4	3.6	
K6.28	Interface between high-activity waste tank and letdown filter drain	2.2*	2.5	
K6.29	Reason for excess letdown and its relationship to CCWS	2.7	3.1	
K6.30	Purpose and control of degassifier inlet and divert valves	2.3*	2.5	
K6.31	Seal injection system and limits on flow range	3.1	3.5	
K6.32	Venting of VCT: reduce concentration of gases in solution, keep stress in tank down	2.1	2.5	
K6.33	Principles of boronometer	1.9*	2.1	
K6.34	Maximum allowable purge flow rate	1.9	2.2	
K6.35	Relationship between VCT vent rate and vent header pressure	2.2	2.5	
K6.36	Letdown pressure control to prevent RCS coolant from flashing to steam in letdown piping	2.9	3.1	
K6.37	Boron loading of demineralizer resin	2.9	3.4	
K6.38	Methods of minimizing the amount of RCS coolant water processed and reducing the amount of waste water generated	2.4	3.2	

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CVCS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Activity levels in primary system	2.9	3.8
A1.02	T-ave. and T-ref	3.4*	3.6
A1.03	RCS pressure	3.8	3.8
A1.04	PZR pressure and level	3.9	4.1
A1.05	S/G pressure and level	2.9*	3.2
A1.06	VCT level	3.0	3.2
A1.07	Maximum specified letdown flow	2.7	3.1
A1.08	Normal operating band for letdown flow rate	2.7	2.9
A1.09	RCS pressure and temperature	3.6	3.8
A1.10	Reactor power	3.7	3.9
A1.11	Letdown and charging flows	3.0	3.0
A1.12	Rate of boron concentration reduction in RCS as a function of letdown flow while deborating demineralizer is in service	2.8	3.2

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the CVCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations**:
(CFR: 41.5 / 43/5 / 45/3 / 45/5)

A2.01	RCS pressure allowed to exceed limits	3.8	4.2
A2.02	Loss of PZR level (failure mode)	3.9	4.2
A2.03	Boundary isolation valve leak	3.6	4.2
A2.04	Unplanned gas release	3.7*	4.1
A2.05	RCP seal failures	4.0	4.3
A2.06	Inadvertent boration/dilution	4.2	4.3
A2.07	Isolation of letdown/makeup	3.4	3.7
A2.08	Loss of heat tracing	3.0	3.7
A2.09	High primary and/or secondary activity	3.0	3.9
A2.10	Inadvertent boration/dilution	3.9	4.2
A2.11	Loss of IAS	3.6	4.2
A2.12	CIAS, SIAS	4.1	4.3
A2.13	Low RWST	3.6	3.9
A2.14	Emergency boration	3.8*	3.9
A2.15	High or low PZR level	3.5	3.7
A2.16	T-ave. and T-ref. deviations	3.2	3.6
A2.17	Low PZR pressure	3.4	3.7
A2.18	High VCT level	3.1	3.1
A2.19	High secondary and primary concentrations of chloride, fluoride, sodium and solids	2.8	3.5
A2.20	Shifting demineralizer while divert valve is lined up to VCT	2.7	2.7
A2.21	Excessive letdown flow, pressure, and temperatures on ion exchange resins (also causes)	2.7	2.7
A2.22	Mismatch of letdown and changing flows	3.2	3.1
A2.23	High filter D/P	2.6	2.7
A2.24	Isolation of both letdown filters at one time: downstream relief lifts	2.8	2.8
A2.25	Uncontrolled boration or dilution	3.8	4.3
A2.26	Low VCT pressure	2.8	3.0
A2.27	Improper RWST boron concentration	3.5	4.2
A2.28	Depressurizing of RCS while it is hot	3.7	4.3
A2.29	Indication by increased letdown flow that demineralizers are bypassed	2.3	2.4
A2.30	Reduction of boron concentration in the letdown flow; its effects on reactor operation	3.3	3.6
A2.31	Potential for RCS chemical contamination when placing CVCS demineralizer in service	2.3	2.7
A2.32	Expected reactivity changes after valving in a new mixed-bed demineralizer that has not been preborated	3.4	3.9

A2.33	Fact that isolating cation demineralizer stops boron dilution and enables restoration of normal boron concentration	2.7	3.3
A2.34	Fact that for very low RCS boron concentrations, deborating demineralizers may be more cost effective than using makeup water	2.2*	2.3
A2.35	Reactor trip	3.3	3.8

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

A3.01	Water and boron inventory	3.5	3.7
A3.02	Letdown isolation	3.6	3.6
A3.03	Ion exchange bypass	2.9	2.9
A3.04	VCT pressure control	2.8	2.9
A3.05	RCS pressure and temperature	3.9	3.9
A3.06	T-ave. and T-ref	3.9	3.8
A3.07	S/G level and pressure	3.3	3.3
A3.08	Reactor power	3.9	3.9
A3.09	VCT level	3.3	3.2
A3.10	PZR level and pressure	3.9	3.9
A3.11	Charging/letdown	3.6	3.4
A3.12	Interpretation of letdown demineralizer flow-divert valve position indicating lights	3.0	2.7
A3.13	RCS temperature and pressure	3.4	3.6
A3.14	Letdown and charging flows	3.4	3.1
A3.15	PZR pressure and temperature	3.5	3.6
A3.16	Interpretation of emergency borate valve position indicating lights	3.8	4.2
A3.17	Interpretation of ion exchanger status light	2.3	2.4
A3.18	Interpretation of letdown orifice isolation valve position indicators	2.8	2.7

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

A4.01	Boron and control rod reactivity effects	3.8	3.9
A4.02	Calculation of ECP and related boration/dilution/reactivity relationships	3.2	3.9
A4.03	Construction and use of 1/M plots (inverse multiplication, criticality prediction method)	2.7	3.2
A4.04	Calculation of boron concentration changes	3.2	3.6
A4.05	Letdown pressure and temperature control valves	3.6	3.1
A4.06	Letdown isolation and flow control valves	3.6	3.1
A4.07	Boration/dilution	3.9	3.7
A4.08	Charging	3.8	3.4
A4.09	PZR spray and heater controls	3.5	3.3
A4.10	Boric acid pumps	3.6	3.2

A4.11	RCP seal injection	3.4	3.3
A4.12	Boration/dilution batch control	3.8	3.3
A4.13	VCT level control and pressure control	3.3	2.9
A4.14	Ion exchangers and demineralizers	2.8	2.4
A4.15	Boron concentration	3.6	3.7
A4.16	Activity levels of RCS and letdown	2.7	3.5
A4.17	Deborating demineralizer	2.7	2.7
A4.18	Emergency borate valve	4.3	4.1
A4.19	CVCS letdown orifice isolation valve and valve control switches	3.1	2.8
A4.20	Deborating demineralizer selector valve and selector valve control switch	2.6	2.5
A4.21	Letdown demineralizer flow divert valve control switch	2.6	2.3
A4.22	Boronometer chart recorder	2.5*	2.5*
A4.23	Calculation of the required volume through the deborating demineralizer, using the appropriate equation	2.1	2.3

006 Emergency Core Cooling System (ECCS)

TASK:
Perform ECCS pump operability checks
Fill the high-pressure SIS
Fill the accumulators/core flood tanks/safety injection tanks
Perform core flooding isolation valves alarms actuation test
Drain the accumulators/core flood tanks/safety injection tanks
Perform ECCS leak rate test
Fill the boron injection tank
Perform safety injection tank outlet isolation valve test
Prepare the SIS for a normal plant startup
Fill the refueling/borated water storage tank
Perform high-head safety injection test and flushing of stainless steel pipe
Recalculate and/or purify the refueling/borated water storage tank
Adjust HPI flow
Prepare the high-pressure SIS for shutdown
Secure the high-pressure SIS
Drain the high-pressure SIS
Adjust accumulator/core flood tank/safety injection tank pressure
Vent accumulation/core flood tank/safety injection tanks
Monitor the SIS
Operate the SIS in the recirculation mode
Manually initiate safety injection
What if HPI is overpressurizing the reactor?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ECCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Spent fuel cooling system	2.4*	2.8*
K1.02	ESFAS	4.3	4.6
K1.03	RCS	4.2	4.3
K1.04	Auxiliary spray system	2.7*	2.8*
K1.05	RCP seal injection and return	2.8*	2.9*
K1.06	Liquid waste tank/reactor drain tank	2.2	2.4
K1.07	MFW System	2.9*	3.3*
K1.08	CVCS	3.6	3.9
K1.09	Nitrogen	2.6	2.9
K1.10	Safety injection tank heating system	2.6*	2.8*
K1.11	CCWS	2.8	3.2
K1.12	Accumulator vent system	2.4	2.6
K1.13	CSS	3.3*	3.6*
K1.14	IAS	3.0	3.4*
K1.15	Accumulator drains	2.2*	2.2*

SYSTEM: **006 Emergency Core Cooling System (ECCS)**

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

K2.01	ECCS pumps	3.6	3.9
K2.02	Valve operators for accumulators	2.5*	2.9
K2.03	Heat tracing	2.3	2.5
K2.04	ESFAS-operated valves	3.6	3.8

K3 **Knowledge of the effect that a loss or malfunction of the ECCS will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	RCS	4.1*	4.2
K3.02	Fuel	4.3	4.4
K3.03	Containment	4.2	4.4

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

K4.01	Cooling of centrifugal pump bearings	2.6	2.9
K4.02	Relieving shutoff head (recirculation)	2.8	3.0
K4.03	Flushing of piping following transfer of highly concentrated boric acid	2.4	2.5
K4.04	System venting	2.3	2.5
K4.05	Autostart of HPI/LPI/SIP.	4.3	4.4
K4.06	Recirculation of minimum flow through pumps	2.7	3.1
K4.07	Normal water supply for SIS	3.4	3.8
K4 08	Recirculation flowpath of reactor building sump	3.4*	3.6*
K4.09	Valve positioning on safety injection signal	3.9	4.2
K4.10	Redundant pressure meters	3.3	3.6
K4.11	Reset of SIS	3.9	4.2
K4.12	HPI flow throttling	4.1*	4.3*
K4.13	Reset of containment isolation	3.8	4.1
K4.14	Cross-Connection of HPI/LPI/SIP	3.9	4.2
K4.15	RHR pump test flow path	2.4	2.6
K4.16	Interlocks between RHR valves and RCS	3.2	3.5
K4.17	Safety Injection valve interlocks	3.8	4.1
K4.18	Valves normally isolated from their control power	3.6*	3.7
K4.19	Interlocks to storage tank makeup valve	3.0	3.1
K4.20	Automatic closure of common drain line and fill valves to accumulator	3.2*	3.5*
K4.21	Bypassing/blocking ESF channels	4.1	4.3
K4.22	Interlocks between RCP seal flow rate and standby HPI pump	3.4*	3.7*
K4.23	Demineralized water supply to RWST	2.3*	2.5*
K4.24	Water inventory control	2.6	3.0
K4.25	Concentrated boric acid supply to RWST	2.8	3.2
K4.26	Parallel redundant systems	3.3	3.8
K4.27	Alarm for misalignment of the accumulator isolation valve	2.9	3.4
K4.28	RHR	3.2	3.5
K4.29	BIT recirculation	2.5*	2.9*
K4.30	Containment isolation	3.6	3.9

SYSTEM: **006 Emergency Core Cooling System (ECCS)**

K5 **Knowledge of the operational implications of the following concepts as they apply to ECCS:** (CFR: 41.5 / 45.7)

K5.01	Effects of temperatures on water level indications	2.8	3.3
K5.02	Relationship between accumulator volume and pressure	2.8	2.9
K5.03	Weight percent calculation boron concentration	1.9	2.2
K5.04	Brittle fracture, including causes and preventative actions	2.9	3.1
K5.05	Effects of pressure on a solid system	3.4	3.8
K5.06	Relationship between ECCS flow and RCS pressure	3.5	3.9
K5.07	Expected temperature levels in various locations of the RCS due to various plant conditions	2.7	3.0
K5.08	Operation of pumps in parallel	2.9*	3.1*
K5.09	Thermodynamics of water and steam, including subcooled margin, superheat,and saturation	3.3	3.6
K5.10	Theory of thermal stress	2.5	2.9*
K5.11	Basic heat transfer equation	2.5	2.4*
K5.12	Theory of fluid flow	2.4	2.6

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the ECCS:**
(CFR: 41.7 / 45.7)

K6.01	BIT/borated water sources	3.4	3.9
K6.02	Core flood tanks (accumulators)	3.4	3.9
K6.03	Safety Injection Pumps	3.6	3.9
K6.04	Breakers, relays and disconnects	2.1	2.5
K6.05	HPI/LPI cooling water	3.0	3.5
K6.06	Isolation valves	2.3	2.7
K6.07	Drain and fill valves	1.7	1.9
K6.08	Accumulator and sample system	1.7	1.9
K6.09	RWST purification system	1.8	1.9
K6.10	Valves	2.6	2.8
K6.11	Sensors and detectors	2.3	2.7
K6.12	Controllers and positioners	2.1	2.6
K6.13	Pumps	2.8	3.1
K6.14	Motors	2.4	2.5
K6.15	Filters	1.8	2.2
K6.16	Demineralizers	1.8	2.2
K6.17	Heat Exchangers and condensers	2.2	2.6
K6.18	Subcooling margin indicators	3.6	3.9
K6.19	HPI/LPI systems (mode change)	3.7	3.9

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ECCS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Avoidance of thermal and pressure stresses due to pump startup	3.1	3.4
A1.02	Boron concentration in accumulator, boron storage tanks.	3.0	3.6
A1.03	Flow rates in BWST/BW recirculation pumps	2.4	2.6

SYSTEM: 006 Emergency Core Cooling System (ECCS)

A1.04	D/P across accumulator isolation valve	2.2	2.5
A1.05	CCW flow (establish flow to RHR heat exchanger prior to placing in service	2.9	3.3
A1.06	Subcooling margin	3.6	3.9
A1.07	Pressure, high and low	3.3	3.6
A1.08	Temperature, high motor and bearing	2.8	3.1
A1.09	Pump amperage, including start, normal and locked	2.8	3.2
A1.10	CVCS Letdown flow	2.4	2.7*
A1.11	Boron Concentration	3.1	3.4
A1.12	RHR heatup limits	2.9	3.4
A1.13	Accumulator pressure (level, boron concentration)	3.5	3.7
A1.14	Reactor vessel level	3.6	3.9
A1.15	RWST Level and temperature	3.3	3.9
A1.16	RCS temperature, including superheat, saturation, and subcooled	4.1	4.2
A1.17	ECCS flow rate	4.2	4.3
A1.18	PZR level and pressure	4.0	4.3
A1.19	Subcooling	4.0	4.4

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the ECCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 45.5)

A2.01	High bearing temperature	2.9	3.1
A2.02	Loss of flow path	3.9	4.3
A2.03	System leakage	3.3	3.7
A2.04	Improper discharge pressure	3.4	3.8
A2.05	Improper amperage to the pump motor	3.4	3.5
A2.06	Water hammer	3.3	3.5
A2.07	Loss of heat tracing	2.8	3.1
A2.08	Effect of electric power loss on valve position	3.0	3.3
A2.09	Radioactive release from venting RWST to atmosphere	2.6	3.2*
A2.10	Low boron concentration in SIS	3.4	3.9
A2.11	Rupture of ECCS header	4.0	4.4
A2.12	Conditions requiring actuation of ECCS	4.5	4.8
A2.13	Inadvertent SIS actuation	3.9	4.2

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

A3.01	Accumulators	4.0*	3.9
A3.02	Pumps	4.1	4.1
A3.03	ESFAS-operated valves	4.1	4.1
A3.04	Cooling water systems	3.8	3.8
A3.05	Safety Injection Pumps	4.2	4.3
A3.06	Valve lineups	3.9	4.2
A3.07	RHR pumps	3.6*	3.7
A3.08	Automatic transfer of ECCS flowpaths	4.2	4.3

SYSTEM: **006 Emergency Core Cooling System (ECCS)**

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

A4.01	Pumps	4.1	3.9
A4.02	Valves	4.0*	3.8
A4.03	Transfer from boron storage tank to boron injection tank	3.5*	3.5*
A4.04	RHRS	3.7*	3.6
A4.05	Transfer of ECCS flowpaths prior to recirculation	3.9	3.8
A4.06	ESF control panel	4.4	4.4
A4.07	ECCS pumps and valves	4.4	4.4
A4.08	ESF system, including reset	4.2	4.3
A4.09	PZR LCS and PZR PCS	4.1	4.2
A4.10	Safety parameter display system	3.8*	4.2*
A4.11	Overpressure protection system	4.2	4.3

011 Pressurizer Level Control System (PZR LCS)

TASK: Operate PZR level control in manual
Transfer from manual to automatic PZR level control
Monitor the PZR LCS
Place the PZR level programmer in manual

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the PZR LCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CVCS	3.6	3.9
K1.02	RCS	3.7	3.8
K1.03	PZR PCS	3.7	4.0
K1.04	RPS	3.8	3.9
K1.05	Reactor regulating system	3.4?	3.5?
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Charging pumps	3.1	3.2
K2.02	PZR heaters	3.1	3.2
K2.03	Level channels and controllers	2.4*	2.4
K3	**Knowledge of the effect that a loss or malfunction of the PZR LCS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	CVCS	3.2*	3.4
K3.02	RCS	3.5	3.7
K3.03	PZR PCS	3.2	3.7
K4	**Knowledge of PZR LCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Operation of PZR heater cutout at low PZR level	3.3	3.7
K4.02	PZR level controller	3.3	3.4
K4.03	Density compensation of PZR level	2.6	2.9
K4.04	PZR level inputs	3.0	3.3
K4.05	PZR level inputs to RPS	3.7*	4.1*
K4.06	Letdown isolation	3.3	3.7
K4.07	Cold-calibrated channel	2.9	3.2

SYSTEM: **011 Pressurizer Level Control System (PZR LCS)**

K5	**Knowledge of the operational implications of the following concepts as they apply to the PZR LCS:** (CFR: 41.5 / 45.7)		
K5.01	Theory of operation of bellows-type level detector	1.9	2.2
K5.02	Principle of operation for the charging pump electric pneumatic flow control valve	2.0*	2.2*
K5.03	Principle of operation of the charging flow sensor	1.7	1.9
K5.04	Reasons for not allowing coolant to flash into steam in the letdown piping	2.5	2.9
K5.05	Interrelation of indicated charging flow rate with volume of water required to bring PZR level back to programmed level hot/cold	2.8	3.1
K5.06	Indicated charging flow: seal flow plus actual charging flow	2.9	3.2
K5.07	Definition of flow rate	1.9	2.1
K5.08	Relative flow rate through letdown subsystem as a function of flow control	2.3	2.5*
K5.09	Reason for manually controlling PZR level	2.6	2.7*
K5.10	Indications of reactor vessel bubble	3.7	4.0
K5.11	Reasons for selecting "manual" on letdown control valve controller	2.5*	2.8*
K5.12	Criteria and purpose of PZR level program	2.7	3.3
K5.13	Impact of high/low PZR level on interrelated system	3.2*	3.4
K5.14	Sizing of the PZR for maximum insurge/outsurge	1.9	2.2
K5.15	PZR level indication when RCS is saturated	3.6	4.0
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the PZR LCS:** (CFR: 41.7 / 45.7)		
K6.01	Reasons for starting charging pump while increasing letdown flow rate . . .	2.8*	3.2*
K6.02	Relationship of makeup flow rate to throttle valve position	2.2	2.5*
K6.03	Relationship between PZR level and PZR heater control circuit	2.9	3.3
K6.04	Operation of PZR level controllers	3.1	3.1
K6.05	Function of PZR level gauges as postaccident monitors	3.1	3.7
K6.06	Correlation of demand signal indication on charging pump flow valve controller to the valve position	2.5*	2.8*
K6.07	Correlation of demand signal indication with letdown PVC position	2.4	2.6
K6.08	Valves	2.1	2.4
K6.09	Sensor and detectors	2.4	2.6
K6.10	Controllers and positioners	2.3	2.6
K6.11	Pumps	1.9	2.1
K6.12	Motors	1.8	1.9
K6.13	Breakers, relays, and disconnects	1.9	2.0

SYSTEM **011 Pressurizer Level Control System (PZR LCS)**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PZR LCS controls including:**
(CFR: 41.5 / 45.5)

A1.01	PZR level and pressure	3.5	3.6
A1.02	Charging and letdown flows	3.3	3.5
A1.03	VCT level	2.8	3.2
A1.04	T-ave	3.1	3.3

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

A2.01	Excessive letdown	3.2	3.1
A2.02	Excessive charging	3.2	3.2
A2.03	Loss of PZR level	3.8	3.9
A2.04	Loss of one, two or three charging pumps	3.5	3.7
A2.05	Loss of PZR heaters	3.3	3.7
A2.06	Inadvertent PZR spray actuation	3.7	3.9
A2.07	Isolation of letdown	3.0	3.3
A2.08	Loss of level compensation	2.6	2.8
A2.09	High ambient reflux boiling temperature effect or indicated PZR level	2.9?	3.5?
A2.10	Failure of PZR level instrument - high	3.4	3.6
A2.11	Failure of PZR level instrument - low	3.4	3.6
A2.12	Operation of auxiliary spray	3.3	3.3

A3 **Ability to monitor automatic operation of the PZR LCS, including**:
(CFR: 41.7 / 45.5)

A3.01	Boration/dilution	2.8*	2.8
A3.02	Reactor power	2.6*	2.8*
A3.03	Charging and letdown	3.2*	3.3

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

A4.01	Charging pump and flow controls	3.5	3.2
A4.02	Movement of the pressure control valve, using manual controller	3.4	3.1
A4.03	PZR heaters	3.3	3.1
A4.04	Transfer of PZR LCS from automatic to manual control	3.2	2.9
A4.05	Letdown flow controller	3.2	2.9

013 Engineered Safety Features Actuation System (ESFAS)

TASK:
Monitor the ESFAS
What if safety injection (cold-leg injection) flow is not sufficient?
Manually initiate ESF
Perform the design basis accident sequence test
Reset the ESF
Bypass the ESF
Perform the integrated ESF test
Perform the ESF equipment response time test
Perform the ESF equipment performance test

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause effect relationships between the ESFAS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Initiation signals for ESF circuit logic	4.2	4.4
K1.02	RCP	3.2	3.6
K1.03	CCS	3.8	4.1
K1.04	RPS injection	3.9?	4.3?
K1.05	CSS	4.1	4.4
K1.06	ECCS	4.2	4.4
K1.07	AFW System	4.1	4.4
K1.08	CCWS	3.6	3.8
K1.09	CIRS	3.3*	3.7*
K1.10	CPS	2.8*	3.1*
K1.11	CVCS	3.3	3.8
K1.12	ED/G	4.1	4.4
K1.13	HVAC	2.8	3.1
K1.14	IAS	3.1*	3.4*
K1.15	MFW System	3.4	3.8
K1.16	MRSS	2.9*	3.4*
K1.17	LRS	2.6	3.0
K1.18	Premature reset of ESF actuation	3.7	4.1
K1.19	WGDS	2.6	3.0
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	ESFAS/safeguards equipment control	3.6*	3.8

SYSTEM 013 Engineered Safety Features Actuation System (ESFAS)

K3 Knowledge of the effect that a loss or malfunction of the ESFAS will have on the following:
(CFR: 41.7 / 45.6)

K3.01	Fuel	4.4	4.7
K3.02	RCS	4.3	4.5
K3.03	Containment	4.3	4.7

K4 Knowledge of ESFAS design feature(s) and/or inter-lock(s) which provide for the following:
(CFR: 41.7)

K4.01	SIS reset	3.9	4.3
K4.02	Containment integrity system reset	3.9	4.2
K4.03	Main Steam Isolation System	3.9	4.4
K4.04	Auxiliary feed actuation signal	4.3*	4.5*
K4.05	Core spray actuation signal reset	4.0*	4.2*
K4.06	Recirculation actuation system reset	4.0*	4.3*
K4.07	Power supply loss	3.7	4.1
K4.08	Redundancy	3.1	3.4
K4.09	Spurious trip protection	2.7	3.1*
K4.10	Safeguards equipment control reset	3.3	3.7
K4.11	Vital power load control	3.2	3.8
K4.12	Safety injection block	3.7	3.9
K4.13	MFW isolation/reset	3.7	3.9
K4.14	Upper head injection accumulator isolation	3.7*	4.0*
K4.15	Continuous testing	2.6	3.2
K4.16	Avoidance of PTS	3.8	4.2
K4.17	Reason for stopping air coolers on train being tested	2.9*	2.9*
K4.18	Reason for jumping containment high-high-pressure signal to containment spray pump on train being tested	3.3*	3.5*
K4.19	Reason for opening breaker on high-head injection pump	3.0*	3.4*
K4.20	Reason for stopping CCW pump on train being tested	3.1*	3.3*
K4.21	Reason for starting an additional service water booster pump for train not being tested and stopping the pump on train under test	3.1*	3.3*
K4.22	Reason for shut safety injection pump discharge valve of train to be tested	2.9*	3.1*
K4.23	Reason for disabling of ED/G during ESF sequencer test	2.6*	2.9*
K4.24	Reason for disabling of BIT so it will not function during ESF sequencer test	3.0*	3.1*

K5 Knowledge of the operational implications of the following concepts as they apply to the ESFAS:
(CFR: 41.5 / 45.7)

K5.01	Definitions of safety train and ESF channel	2.8	3.2
K5.02	Safety system logic and reliability	2.9	3.3

SYSTEM: 013 Engineered Safety Features Actuation System (ESFAS)

K6 Knowledge of the effect of a loss or malfunction on the following will have on the ESFAS:
(CFR: 41.7 / 45.5 to 45.8)

K6.01	Sensors and detectors	2.7*	3.1*
K6.02	Controllers and positioners	2.2	2.6
K6.03	Breakers, relays, and disconnects	2.4	2.9
K6.04	Trip setpoint calculators	2.4*	2.7*

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to Prevent exceeding design limits) associated with operating the ESFAS controls including:
(CFR: 41.5 / 45.5)

A1.01	RCS pressure and temperature	4.0	4.2
A1.02	Containment pressure, temperature, and humidity	3.9	4.2
A1.03	Feedwater header differential	2.6*	2.6*
A1.04	S/G level	3.4	3.6
A1.05	Main steam pressure	3.4	3.6
A1.06	RWST level	3.6	3.9
A1.07	Containment radiation	3.6	3.9
A1.08	Containment sump level	3.7	3.8
A1.09	T-hot	3.4	3.7
A1.10	T-cold	3.4	3.7

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

A2.01	LOCA	4.6	4.8
A2.02	Excess steam demand	4.3	4.5
A2.03	Rapid depressurization	4.4	4.7
A2.04	Loss of instrument bus	3.6	4.2
A2.05	Loss of dc control power	3.7	4.2
A2.06	Inadvertent ESFAS actuation	3.7*	4.0

A3 Ability to monitor automatic operation of the ESFAS including:
(CFR: 41.7 / 45.5)

A3.01	Input channels and logic	3.7*	3.9
A3.02	Operation of actuated equipment	4.1	4.2
A3.03	Continuous testing feature	2.4*	2.7*

SYSTEM: 013 Engineered Safety Features Actuation System (ESFAS)

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

A4.01	ESFAS-initiated equipment which fails to actuate	4.5	4.8
A4.02	Reset of ESFAS channels	4.3	4.4
A4.03	ESFAS initiation	4.5	4.7

Safety Function 3: Reactor Pressure Control

006 Emergency Core Cooling System (ECCS)

TASK:
Perform ECCS pump operability checks
Fill the high-pressure SIS
Fill the accumulators/core flood tanks/safety injection tanks
Perform core flooding isolation valves alarms actuation test
Drain the accumulators/core flood tanks/safety injection tanks
Perform ECCS leak rate test
Fill the boron injection tank
Perform safety injection tank outlet isolation valve test
Prepare the SIS for a normal plant startup
Fill the refueling/borated water storage tank
Perform high-head safety injection test and flushing of stainless steel pipe
Recirculate and/or purify the refueling/borated water storage tank
Adjust HPI flow
Prepare the high-pressure SIS for shutdown
Secure the high-pressure SIS
Drain the high-pressure SIS
Adjust accumulator/core flood tank/safety injection tank pressure
Vent accumulation/core flood tank/safety injection tanks
Monitor the SIS
Operate the SIS in the recirculation mode
Manually initiate safety injection
What if HPI is overpressurizing the reactor?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ECCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Spent fuel cooling system	2.4*	2.8*
K1.02	ESFAS	4.3	4.6
K1.03	RCS	4.2	4.3
K1.04	Auxiliary spray system	2.7*	2.8*
K1.05	RCP seal injection and return	2.8*	2.9
K1.06	Liquid waste tank/reactor drain tank	2.2	2.4
K1.07	MFW System	2.9*	3.3*
K1.08	CVCS	3.6	3.9
K1.09	Nitrogen	2.6	2.7
K1.10	Safety injection tank heating system	2.6*	2.8*
K1.11	CCWS	2.8	3.2
K1.12	Accumulator vent system	2.4	2 6
K1.13	CSS	3.3*	3.6*
K1.14	IAS	3.0	3.4*
K1.15	Accumulator drains	2.2*	2.2*

SYSTEM: **006 Emergency Core Cooling System (ECCS)**

K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	ECCS pumps	3.6	3.9
K2.02	Valve operators for accumulators	2.5*	2.9
K2.03	Heat tracing	2.3	2.5
K2.04	ESFAS-operated valves	3.6	3.8
K3	**Knowledge of the effect that a loss or malfunction of the ECCS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	4.1	4.2
K3.02	Fuel	4.3	4.4
K3.03	Containment	4.2	4.4
K4	**Knowledge of ECCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Cooling of centrifugal pump bearings	2.6	2.9
K4.02	Relieving shutoff head (recirculation)	2.8	3.0
K4.03	Flushing of piping following transfer of highly concentrated boric acid	2.4	2.5
K4.04	System venting	2.3	2.5
K4.05	Autostart of HPI/LPI/SIP...	4.3	4.4
K4.06	Recirculation of minimum flow through pumps	2.7	3.0
K4.07	Normal water supply for SIS	3.3	3.6
K4 08	Recirculation flowpath of reactor building sump	3.2*	3.6*
K4.09	Valve positioning on safety injection signal	3.8	4.2
K4.10	Redundant pressure meters	2.9	3.2
K4.11	Reset of SIS	3.9	4.2
K4.12	HPI flow throttling	4.1*	4.3*
K4.13	Reset of containment isolation	3.8	4.1
K5	**Knowledge of the operational implications of the following concepts as they apply to ECCS:** (CFR: 41.5 / 45.7)		
K5.01	Effects of temperatures on water level indications	2.8	3.3
K5.02	Relationship between accumulator volume and pressure	2.8	2.9
K5.03	Weight percent calculation boron concentration	1.9	2.2
K5.04	Brittle fracture, including causes and preventative actions	2.9	3.1
K5.05	Effects of pressure on a solid system	3.4	3.8
K5.06	Relationship between ECCS flow and RCS pressure	3.5	3.9
K5.07	Expected temperature levels in various locations of the RCS due to various plant conditions	2.7	3.0
K5.08	Operation of pumps in parallel	2.9*	3.1*

SYSTEM: 006 Emergency Core Cooling System (ECCS)

K6 Knowledge of the effect of a loss or malfunction on the following will have on the ECCS:
(CFR: 41.7 / 45.7)

K6.01	BIT/borated water sources.	3.4	3.9
K6.02	Core flood tanks (accumulators)	3.4	3.9
K6.03	Safety Injection Pumps	3.6	3.9
K6.04	Breakers, relays and disconnects	2.1	2.5
K6.05	HPI/LPI cooling water	3.0	3.5
K6.06	Isolation valves	2.3	2.7
K6.07	Drain and fill valves	1.7	1.9
K6.08	Accumulator and sample system	1.7	1.9
K6.09	RWST purification system	1.8	1.9
K6.10	Valves	2.2	2.4
K6.11	Sensors and detectors	2.1	2.6
K6.12	Controllers and positioners	2.1	2.6
K6.13	Pumps	2.6	2.9
K6.14	Motors	2.1	2.4
K6.15	Filters	1.8	2.2
K6.16	Demineralizers	1.8	2.2
K6.17	Heat Exchangers and condensers	2.1	2.4
K6.18	Subcooling margin indicators	3.5	3.9

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ECCS controls including:
(CFR: 41.5 / 45.5)

A1.01	Avoidance of thermal and pressure stresses due to pump startup	3.1	3.4
A1.02	Boron concentration in accumulator, boron storage tanks	3.0	3.6
A1.03	Flow rates in BWST/BW recirculation pumps	2.4	2.6
A1.04	D/P across accumulator isolation valve	2.2	2.5
A1.05	CCW flow (establish flow to RHR heat exchanger prior to placing in service)	2.9	3.3
A1.06	Subcooling margin	3.6	3.9
A1.07	Pressure, high and low	3.3	3.6
A1.08	Temperature, high motor and bearing	2.8	3.1
A1.09	Pump amperage, including start, normal and locked	2.8	3.2
A1.10	CVCS Letdown flow	2.4	2.7
A1.11	Boron Concentration	3.1	3.4
A1.12	RHR heatup limits	2.9	3.4
A1.13	Accumulator pressure (level, boron concentration)	3.5	3.7
A1.14	Reactor vessel level	3.5	3.8
A1.15	RWST Level and temperature	3.3	3.9
A1.16	RCS temperature, including superheat, saturation, and subcooled	4.1	4.2
A1.17	ECCS flow rate	4.2	4.3
A1.18	PZR level and pressure	4.0	4.3
A1.19	Subcooling	4.0	4.4

SYSTEM: 006 Emergency Core Cooling System (ECCS)

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the ECCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations**:
(CFR: 41.5 / 45.5)

A2.01	High bearing temperature	2.9	3.1
A2.02	Loss of flow path	3.9	4.3
A2.03	System leakage	3.3	3.7
A2.04	Improper discharge pressure	3.4	3.8
A2.05	Improper amperage to the pump motor	3.4	3.5
A2.06	Water hammer	3.3	3.5
A2.07	Loss of heat tracing	2.8	3.1
A2.08	Effect of electric power loss on valve position	3.0	3.3
A2.09	Radioactive release from venting RWST to atmosphere	2.6	3.2*
A2.10	Low boron concentration in SIS.	3.4	3.9
A2.11	Rupture of ECCS header	4.0	4.4
A2.12	Conditions requiring actuation of ECCS	4.5	4.8
A2.13	Inadvertent SIS actuation	3.9	4.2

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

A3.01	Accumulators	4.0*	3.9
A3.02	Pumps	4.1	4.1
A3.03	ESFAS-operated valves	4.1	4.1
A3.04	Cooling water systems	3.8	3.8
A3.05	Safety Injection Pumps	3.4	3.9
A3.06	Valve lineups	3.9	4.2
A3.07	RHR pumps	3.6	3.7
A3.08	Automatic transfer of ECCS flowpaths	4.2	4.3

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

A4.01	Pumps	4.1	3.9
A4.02	Valves	4.0*	3.8
A4.03	Transfer from boron storage tank to boron injection tank	3.5*	3.5*
A4.04	RHRS	3.7	3.6
A4.05	Transfer of ECCS flowpaths prior to recirculation.	3.9	3.8
A4.06	ESF control panel	4.4	4.4
A4.07	ECCS pumps and valves	4.4	4.4
A4.08	ESF system, including reset	4.2	4.3
A4.09	PZR LCS and PZR PCS	4.1	4.2
A4.10	Safety parameter display system	3.8*	4.2*
A4.11	Overpressure protection system	4.2	4.3

010 Pressurizer Pressure Control System (PZR PCS)

TASK:
Control PZR pressure in individual manual mode (using heaters or spray manually)
Test PORV operability
Control PZR pressure in master manual model
Heat up the PZR with the PZR heaters
Perform lineup on the PZR pressure relief system
Transfer from manual to automatic pressure control
Monitor PZR pressure
Monitor the PZR pressure relief system

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the PZR PCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RPS	3.9	4.1
K1.02	ESFAS	3.9	4.1
K1.03	RCS	3.6	3.7
K1.04	AFW	2.4	2.7
K1.05	PRTS	3.4	3.6
K1.06	CVCS	2.9	3.1
K1.07	Containment	2.9	3.1
K1.08	PZR LCS	3.2	3.5
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	PZR heaters	3.0	3.4
K2.02	Controller for PZR spray valve	2.5	2.7
K2.03	Indicator for PORV position	2.8*	3.0*
K2.04	Indicator for code safety position	2.7*	2.9*
K3	**Knowledge of the effect that a loss or malfunction of the PZR PCS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	3.8	3.9
K3.02	RPS	4.0	4.1
K3.03	ESFAS	4.0	4.2

SYSTEM: 010 Pressurizer Pressure Control System (PZR PCS)

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

K4.01	Spray valve warm-up	2.7	2.9
K4.02	Prevention of uncovering PZR heaters	3.0	3.4
K4.03	Over pressure control	3.8	4.1

K5 Knowledge of the operational implications of the following concepts as the apply to the PZR PCS:
(CFR: 41.5 / 45.7)

K5.01	Determination of condition of fluid in PZR, using steam tables	3.5	4.0
K5.02	Constant enthalpy expansion through a valve	2.6	3.0*

K6 Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS:
(CFR: 41.7 / 45.7)

K6.01	Pressure detection systems	2.7	3.1
K6.02	PZR	3.2	3.5
K6.03	PZR sprays and heaters	3.2	3.6
K6.04	PRT	2.9	3.2
K6.05	Valves	2.3	2.4
K6.06	Sensors and detectors	2.3	2.4
K6.07	Controllers and positioners	2.3	2.5

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PZR PCS controls including:
(CFR: 41.5 / 45.5)

A1.01	PZR and RCS boron concentrations	2.8	2.9*
A1.02	Spray and surge line flow rates	2.4	2.6*
A1.03	PRT pressure and temperature	2.9	3.2
A1.04	Effects of temperature change during solid operation	3.6	3.8
A1.05	Pressure effect on level	2.8	2.9
A1.06	RCS heatup and cooldown effect on pressure	3.1	3.2
A1.07	RCS pressure	3.7	3.7
A1.08	Spray nozzle DT	3.2	3.3
A1.09	Tail pipe temperature and acoustic monitors	3.4	3.7

SYSTEM: **010 Pressurizer Pressure Control System (PZR PCS)**

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

A2.01	Heater failures	3.3	3.6
A2.02	Spray valve failures	3.9	3.9
A2.03	PORV failures	4.1	4.2

A3 **Ability to monitor automatic operation of the PZR PCS, including:**
(CFR: 41.7 / 45.5)

A3.01	PRT temperature and pressure during PORV testing	3.0	3.2
A3.02	PZR pressure	3.6	3.5

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

A4.01	PZR spray valve	3.7	3.5
A4.02	PZR heaters	3.6	3.4
A4.03	PORV and block valves	4.0	3.8

Safety Function 4:
Heat Removal From Reactor Core page

PRIMARY SYSTEM

SECONDARY SYSTEM

002 Reactor Coolant System (RCS)

TASK:

Perform lineups on the RCS
Vent the CRDM
Drain the RCS
Drain the S/G (primary side)
Drain the refueling cavity
Fill the refueling cavity
Perform RCS water inventory balance
Add nitrogen to the PZR
Monitor the RCS
Establish natural circulation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the RCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RWST	3.7	3.9
K1.02	CRDS	2.9*	3.0*
K1.03	Borated water storage tank	3.8	3.8
K1.04	RCS vent system	2.8	3.2
K1.05	PRT	3.2	3.4
K1 06	CVCS	3.7	4.0
K1 07	Reactor vessel level indication system	3.5*	3.7*
K1.08	ECCS	4.5	4.6
K1 09	PZR	4.1	4.1
K1 10	Reactor coolant drain tank	2.8	3.1
K1.11	S/GS, feedwater systems	4.1	4.2
K1 12	NIS	3.5*	3.6
K1.13	RCPS	4.1	4.2
K1.14	Spent-fuel pool purification	2.3	2.6
K1.15	Refueling canal	2.2	2.4
K1.16	Refueling water purification	1.9	2.2
K1.17	MT/G	3.5	3.8
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
	None		

K3	**Knowledge of the effect that a loss or malfunction of the RCS will have on the following:** (CFR: 41.7)		
K3.01	LRS	2.1	2.6
K3.02	Fuel	4.2	4.5
K3.03	Containment	4.2	4.6
K4	**Knowledge of RCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Filling and draining the RCS	2.7	3.0
K4 02	Monitoring reactor vessel level	3.5*	3.8*
K4.03	Venting the RCS	2.9	3.2
K4 04	Filling and draining the refueling canal	2.2	2.7
K4.05	Detection of RCS leakage	3.8	4.2
K4.06	Prevention of missile hazards	1.9	2.2
K4.07	Contraction and expansion during heatup and cooldown	3.1	3.5
K4.08	Anchoring of components--ie, loops, vessel, S/Gs, and coolant pumps	1.5	1.8
K4.09	Operation of loop isolation valves	3.2	3.2
K4.10	Overpressure protection	4.2	4.4
K5	**Knowledge of the operational implications of the following concepts as they apply to the RCS:** (CFR: 41.5 / 45.7)		
K5.01	Basic heat transfer concepts	3.1	3.4
K5.02	Purpose of vent flow path when draining	2.5	2.9
K5.03	Difference in pressure-temperature relationship between the water/steam system and the water/nitrogen system	2.2	2.6
K5.04	Reason for requirement he plant to be in steady-state condition during RCS water inventory balance	2.9	3.4
K5.05	Reason for drain tank pressure rise during water inventory operations	2.7	3.0
K5.06	Pressure, temperature, and volume relationships of nitrogen gas in association with water	2.3	2.6
K5.07	Reactivity effects of RCS boron, pressure and temperature	3.3	3.6
K5.08	Why PZR level should be kept within the programmed band	3.4	3.9
K5.09	Relationship of pressure and temperature for water at saturation and subcooling conditions	3.7	4.2
K5.10	Relationship between reactor power and RCS differential temperature	3.6	4.1
K5.11	Relationship between effects of the primary coolant system and the secondary coolant system	4.0	4.2
K5.12	Relationship of temperature average and loop differential temperature to loop hot-let and cold-leg temperature indications	3.7	3.9

K5.13	Causes of circulation	3.3	3.6
K5.14	Consequences of forced circulation loss	3.7	4.2
K5.15	Reasons for maintaining subcooling margin during natural circulation	4.2	4.6
K5.16	Reason for automatic features of the Feedwater control system during total loss of reactor coolant flow	3.5	4.0
K5.17	Need for monitoring in-core thermocouples during natural circulation	3.8	4.1
K5.18	Brittle fracture	3.3	3.6
K5.19	Neutron embrittlement	2.6	2.9
K5.20	Corrosion control principles	2.3	2.7

K6 **Knowledge of the effect or a loss or malfunction on the following RCS components:**
(CFR: 41.7 / 45.7)

K6.01	RCS valves that may pose and unusually high radiological Hazard because of trapped crud	2.2	2.9
K6.02	RCP	3.6	3.8
K6.03	Reactor vessel level indication	3.1	3.6
K6.04	CS vent valves	2.5	2.9
K6.05	Valves	2.1	2.4
K6.06	Sensors and Detectors	2.5	2.8
K6.07	Pumps	2.5	2.8
K6.08	Controller and positioner	2.4	2.7
K6.09	Motors	2.1	2.5
K6.10	Breakers, relays, and disconnects	2.2	2.4
K6.11	Thermal sleeves	2.2	2.6
K6.12	Mode Safety valves	3.0	3.5
K6.13	Reactor vessel and internals	2.3	2.8
K6.14	Core components	2.2	2.8

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RCS controls including:**
(CFR: 41.5 / 45.7)

A1.01	Primary and secondary pressure	3.8	4.1
A1.02	PZR and makeup tank level	3.6	3.9
A1.03	Temperature	3.7	3.8
A1.04	Subcooling Margin	3.9	4.1
A1.05	RCS flow	3.4	3.7
A1.06	Reactor power	4.0	4.0
A1.07	Reactor differential temperature	3.3	3.5
A1.08	RCS average temperature	3.7	3.8
A1.09	RCS T-ave	3.7	3.8
A1.10	RCS T-ref	3.7	3.8
A1.11	Relative level indications in the RWST, the refueling cavity, the PZR and the reactor vessel during preparation for refueling	2.7	3.2

A1.12	Radioactivity level when vending CRDS	2.9	3.3
A1.13	Core exit thermocouples	3.4	4.0

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

A2.01	Loss of coolant inventory	4.3	4.4
A2.02	Loss of coolant pressure	4.2	4.4
A2.03	Loss of forced circulation	4.1	4.3
A2.04	Loss of heat sinks	4.3	4.6

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

A3.01	Reactor coolant leak detection system	3.7	3.9
A3.02	Containment sound-monitoring system	2.6*	2.8
A3.03	Pressure, temperatures, and flows	4.4	4.6

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

A4.01	RCS leakage calculation program using the computer	3.5*	3.8*
A4.02	Indications necessary to verify natural circulation from appropriate level, flow, and temperature indications and valve positions upon loss of forced circulation	4.3	4.5
A4.03	Indications and controls necessary to recognize and correct saturation conditions	4.3	4.4
A4.04	The filling/draining of LPI pumps during refueling	2.8	2.6
A4.05	The HPI system when it is used to refill the refueling cavity	2.8*	2.7*
A4.06	Overflow level of the RWST	2.9	2.7
A4.07	Flow path linking the RWST through the RHR system to the RCS hot legs for gravity refilling of the refueling cavity	2.8	3.1
A4.08	Safety parameter display systems	3.4*	3.7*

003 Reactor Coolant Pump System (RCPS)

TASK: Start an RCP
Monitor the operation of the RCPS
Perform a normal RCP shutdown
Vent RCP seals
Adjust flushing flow to RCP seals

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the RCPS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RCP lube oil	2.6	2.8
K1.02	RCP motor cooling and ventilation	2.6	2.8
K1.03	RCP seal system	3.3	3.6
K1.04	CVCS	2.6*	2.9*
K1.05	CCS	2.2	2.4*
K1.06	SWS	1.9	2.1
K1.07	RCP vibration monitoring	2.4	2.9
K1.08	Containment isolation	2.7*	3.0*
K1.09	RCS drain tank	2.0	2.2
K1.10	RCS	3.0	3.2
K1.11	Sound monitoring	2.3	2.5
K1.12	CCWS	3.0	3.3
K1.13	RCP bearing lift oil pump	2.5	2.5
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	RCPS	3.1	3.1
K2.02	CCW pumps	2.5*	2.6*
K2.03	RCP lube oil pumps	2.2	2.2
K2.04	Containment isolation valves for RCP cooling water	2.3	2.4
K2.05	RCP bearing lift oil pump	2.1	1.9
K3	**Knowledge of the effect that a loss or malfunction of the RCPS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	3.7	4.0
K3.02	S/G	3.5	3.8
K3.03	Feedwater and emergency feedwater	2.8	3.1
K3.04	RPS	3.9	4.2
K3.05	ICS	3.6*	3.7*
K3.06	MRSS	2.2	2.4

SYSTEM: 003 Reactor Coolant Pump System (RCPS)

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

K4.01	Minimizing power peaking	2.1	2.3
K4.02	Prevention of cold water accidents or transients	2.5	2.7*
K4.03	Adequate lubrication of the RCP	2.5	2.8
K4.04	Adequate cooling of RCP motor and seals	2.8	3.1
K4.05	Prevention of reverse rotation	2.3	2.7*
K4.06	Handling axial thrust (thrust bearing)	2.1	2.4
K4.07	Minimizing RCS leakage (mechanical seals)	3.2	3.4
K4.08	Anchoring the RCP and its associated piping	1.6	1.9
K4.09	Seal and pump venting	2.2	2.4
K4.10	Increasing pump inertia (flywheel)	2.3	2.5
K4.11	Isolation valve interlocks	3.0*	3.0*

K5 Knowledge of the operational implications of the following concepts as they apply to the RCPS:
(CFR: 41.5 / 45.7)

K5.01	The relationship between the RCPS flow rate and the nuclear reactor core operating parameters (quadrant power tilt, imbalance, DNB rate, local power density, difference in loop T-hot pressure)	3.3	3.9
K5.02	Effects of RCP coastdown on RCS parameters	2.8	3.2
K5.03	Effects of RCP shutdown on T-ave., including the reason for the unreliability of T-ave. in the shutdown loop	3.1	3.5
K5.04	Effects of RCP shutdown on secondary parameters, such as steam pressure, steam flow, and feed flow	3.2	3.5
K5.05	The dependency of RCS flow rates upon the number of operating RCPs	2.8*	3.0*
K5.06	Enthalpy increase associated with RCPs, and its effect upon calorimetric calculation of power	2.2	2.6
K5.07	The reason for "jogging" RCPs during venting or when starting under unusual conditions	2.4	2.6
K5.08	RCP current or supply voltage changes and cold versus hot operation	2.2	2.4*
K5.09	Effects of RCP operation on ? P, especially at lower temperatures	2.3	2.6*

K6 Knowledge of the effect of a loss or malfunction on the following will have on the RCPS:
(CFR: 41.7 / 45/5)

K6.01	RCP performance characteristics	1.9	2.4
K6.02	RCP seals and seal water supply	2.7	3.1
K6.03	RCP lift oil pump, lube oil pumps	2.4	2.6
K6.04	Containment isolation valves affecting RCP operation	2.8	3.1
K6.05	Impeller	1.6	1.9

K6.06	Thermal barrier	2.3	2.4
K6.07	Thrust and radial bearing	1.8	2.1
K6.08	Anti-reverse rotation device	2.1	2.4
K6.09	RCP electric motor	1.9	2.1
K6.10	Pumps	1.8	2.1
K6.11	Motors	1.6	1.9
K6.12	Sensors and detectors	1.7	2.1
K6.13	Breakers, relays, and disconnects	1.6	1.8
K6.14	Starting requirements	2.6	2.9

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RCPS controls including:**
(CFR: 41.5 / 45.5)

A1.01	RCP vibration	2.9	2.9
A1.02	RCP pump and motor bearing temperatures	2.9	2.9
A1.03	RCP motor stator winding temperatures	2.6	2.6
A1.04	RCP oil reservoir levels	2.6	2.5
A1.05	RCS flow	3.4	3.5
A1.06	PZR spray flow	2.9	3.1
A1.07	RCS temperature and pressure	3.4*	3.4
A1.08	Seal water temperature	2.5	2.6
A1.09	Seal flow and D/P	2.8	2.8
A1.10	RCP standpipe levels	2.5	2.7

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the RCPS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5/ 45.3 / 45/13)

A2.01	Problems with RCP seals, especially rates of seal leak-off	3.5	3.9
A2.02	Conditions which exist for an abnormal shutdown of an RCP in comparison to a normal shutdown of an RCP	3.7	3.9
A2.03	Problems associated with RCP motors, including faulty motors and current, and winding and bearing temperature problems	2.7	3.1
A2.04	Effects of fluctuation of VCT pressure on RCP seal injection flow	2.4	2.8
A2.05	Effects of VCT pressure on RCP seal leakoff flows	2.5	2.8

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

A3.01	Seal injection flow	3.3	3.2
A3.02	Motor current	2.6	2.5
A3.03	Seal D/P	3.2	3.1
A3.04	RCS flow	3.6	3.6
A3.05	RCP lube oil and bearing lift pumps	2.7*	2.6

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

A4.01	Seal injection	3.3	3.2
A4.02	RCP motor parameters	2.9	2.9
A4.03	RCP lube oil and lift pump motor controls	2.8	2.5
A4.04	RCP seal differential pressure instrumentation	3.1	3.0
A4.05	RCP seal leakage detection instrumentation	3.1	3.0
A4.06	RCP parameters	2.9*	2.9
A4.07	RCP seal bypass	2.6*	2.6
A4.08	RCP cooling water supplies	3.2	2.9

005 Residual Heat Removal System (RHRS)

TASK:

Perform lineups of the RHRS (shutdown cooling system)
Perform decay heat removal system valves automatic closure and interlock verification
Fill and vent the RHRS
Perform shutdown cooling return header valve test
What if the RHR pump is not operating properly?
Start up the RHRS
Perform the RHRS MOV cycling test
Operate an RHRS heat exchanger
Perform operability check of core cooling system
What if the RHR cooldown rate is exceeded?
Perform purification of the RHRS during shutdown cooling
Operator RHRS with the fuel pool cooling system
Monitor the RHRS
Shut down the RHRS
Drain the RHRS
Fill the refueling cavity/transfer canal using the RHRS
Drain the refueling cavity and/or dryer-separator using the RHRS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the RHRS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CCWS	3.2	3.4
K1.02	PZR	2.2	2.4
K1.03	Spent fuel pool cooling	2.2	2.3
K1.04	CVCS	2.9	3.1
K1.05	RCPS	2.1	2.2
K1.06	ECCS	3.5	3.6
K1.07	Borated water storage tank	2.9	2.9
K1.08	SWS	2.7	2.8
K1.09	RCSO	3.6	3.9
K1.10	CSS	3.2	3.4*
K1.11	RWST	3.5	3.6
K1.12	Safeguard pumps	3.1	3.4
K1.13	SIS	3.3	3.5

SYSTEM: 005 Residual Heat Removal System (RHRS)

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

K2.01	RHR pumps	3.0	3.2
K2.02	Containment isolation valves	2.4	2.6
K2.03	RCS pressure boundary motor-operated valves	2.7*	2.8*

K3 Knowledge of the effect that a loss or malfunction of the RHRS will have on the following:
(CFR: 41.7 / 45.6)

K3.01	RCS	3.9	4.0
K3.02	RCPS	2.1	2.1
K3.03	CVCS	2.2	2.4
K3.04	PZR	2.1*	2.2*
K3.05	ECCS	3.7*	3.8*
K3.06	CSS	3.1*	3.2*
K3.07	Refueling operations	3.2*	3.6*
K3.08	CCWS	2.1	2.2

K4 Knowledge of RHRS design feature(s) and/or interlock(s) which provide or the following:
(CFR: 41.7)

K4.01	Overpressure mitigation system	3.0	3.2
K4.02	Modes of operation	3.2	3.5*
K4.03	RHR heat exchanger bypass flow control	2.9	3.2
K4.04	Need for contents of liquid waste holdup tanks to be low enough before draining RHR system	2.0	2.3
K4.05	Relation between RHR flowpath and refueling cavity	2.5	2.9
K4.06	Function of RHR pump miniflow recirculation	2.7	3.0
K4.07	System protection logics, including high-pressure interlock, reset controls, and valve interlocks	3.2	3.5
K4.08	Lineup for "piggy-back" mode with high-pressure injection	3.1*	3.5*
K4.09	Vortexing while draining	2.2	2.5
K4.10	Control of RHR heat exchanger outlet flow	3.1	3.1
K4.11	Lineup for low head recirculation mode (external and internal)	3.5*	3.9*
K4.12	Lineup for piggyback mode with CSS	3.1*	3.7*

K5 **Knowledge of the operational implications of the following concepts as they apply the RHRS:**
(CFR: 41.5 / 45.7)

K5.01	Nil ductility transition temperature (brittle fracture)	2.6	2.9
K5.02	Need for adequate subcooling	3.4	3.5
K5.03	Reactivity effects of RHR fill water	2.9*	3.1*
K5 04	Calculation of heat load on the RHR heat exchanger	2.1	2.3*
K5 05	Plant response during "solid plant": pressure change due to the relative incompressibility of water	2.7*	3.1*
K5.06	Special concerns regarding the use of water chemistry	1.9*	2.6*
K5.07	Relationship between PZR level, VCT level, and charging flow	2.2	2.4*
K5.08	PTS	2.4*	2.5*
K5.09	Dilution and boration considerations	3.2	3.4

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the RHRS:**
(CFR: 41.7 / 45.7)

K6.01	RHR pump performance characteristics	2.4	2.6
K6.02	"Packless" valves	1.8*	1.9*
K6.03	RHR heat exchanger	2.5	2.6
K6.04	Valves	1.9	2.1
K6.05	Pumps	1.9	2.1
K6.06	Motors	1.8	1.8
K6.07	Sensors and detectors	2.1	2.3
K6.08	Controllers and positioners	2.2	2.4
K6.09	Demineralizers and ion exchangers	1.6	1.9
K6.10	Breakers, relays, and disconnects	1.7	1.8
K6.11	RHR heat exchanger and outlet flow control	2.3	2.7*

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RHRS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Heatup/cooldown rates	3.5	3.6
A1.02	RHR flow rate	3.3	3.4
A1.03	Closed cooling water flow rate and temperature	2.5	2.6
A1.04	Relationship between RWST level and level in the spent fuel pool	2.1*	2.3
A1.05	Detection of and response to presence of water in RHR emergency sump	3.3*	3.3*
A1.06	Relationship (dependence) of time available to perform system isolation surveillance test to time for decay heat to reach high limit	2.7	3.1*
A1.07	Determination of test acceptability by comparison of recorded valve response times with Tech-Spec requirements	2.5	3.1*

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

A2.01	Failure modes for pressure, flow, pump motor amps, motor temperature, and tank level instrumentation	2.7	2.9*
A2.02	Pressure transient protection during cold shutdown	3.5	3.7
A2.03	RHR pump/motor malfunction	2.9	3.1
A2.04	RHR valve malfunction	2.9	2.9

A3 Ability to monitor automatic operation of the RHRS, including:
(CFR: 41.7 / 45.5)

None

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

A4.01	Controls and indication for RHR pumps	3.6*	3.4
A4.02	Heat exchanger bypass flow control	3.4*	3.1
A4.03	RHR temperature, PZR heaters and flow, and nitrogen	2.8*	2.7*
A4.04	Controls and indication for closed cooling water pumps	3.1*	2.9
A4.05	Position of RWST recirculation valve (locked when not in use, continuously monitored when in use).	2.8*	2.8*

035 Steam Generator System (S/GS)

TASK:
Perform lineups on the S/GS
Perform S/G hydrostatic test for leaking tubes
Fill the S/G
Recirculate the S/G during wet lay-up
Remove S/G from wet lay-up recirculation
Add chemicals to the S/G
Monitor S/G operation
Drain the S/G

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the S/GS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	MFW/AFW systems	4.2	4.5
K1.02	MRSS	3.2	3.4
K1.03	Blowdown	2.4	2.6
K1.04	Condenser hotwell	2.2*	2.3
K1.05	Nitrogen	1.7	1.7
K1.06	Sampling	1.7	1.8
K1.07	S/G recirculation	1.9	1.9
K1.08	Chemical addition	1.8	2.2
K1.09	RCS	3.8	4.0
K1.10	ARM system	2.4	2.5
K1.11	PRM system	3.1	3.1
K1.12	RPS	3.7	3.9
K1.13	Condensate system	2.7	2.8
K1.14	ESF	3.9	4.1
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	S/G level control system	2.2*	2.3
K3	**Knowledge of the effect that a loss or malfunction of the S/GS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	4.4	4.6
K3.02	ECCS	4.0	4.3
K3.03	Secondary systems	3.0*	3.1*

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

K4.01	S/G level control	3.6	3.8
K4.02	S/G level indication	3.2	3.5
K4.03	Automatic blowdown and sample line isolation and reset	2.6*	2.8*
K4.04	Radiation high-level isolation while draining S/G secondary to main condenser	2.8*	3.1*
K4.05	Amount of reserve water in S/G	2.9	3.2
K4.06	S/G pressure	3.1	3.4
K4.07	Pre/post-blowdown system	2.3*	2.3*
K4.08	AFW pump operation as it relates to hydrotest	1.9*	2.1*
K4.09	Maintenance of hydrostatic pressure by throttling AFW control valve	1.7*	1.9*

K5 **Knowledge of operational implications of the following concepts as the apply to the S/GS:**
(CFR: 41.5 / 45.7)

K5.01	Effect of secondary parameters, pressure, and temperature on reactivity	3.4	3.9
K5.02	Chemistry control	2.2	2.9*
K5.03	Shrink and swell concept	2.8	3.1
K5.04	Purpose of using nitrogen blanket in S/G	2.0	2.3
K5.05	Relationship between AFW pump speed and discharge pres-- sure during hydrotest	1.7*	2.0*

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the S/GS:**
(CFR: 41.7 / 45.7)

K6.01	MSIVs	3.2	3.6
K6.02	Secondary PORV	3.1	3.5
K6.03	S/G level detector	2.6	3.0
K6.04	Pumps	1.6	1.9
K6.05	Motors	1.4	1.6
K6.06	Valves	1.9*	2.1*
K6.07	Sensors and detectors	2.2	2.2
K6.08	Controllers and positioners	1.9	2.1
K6.09	Heat exchangers and condensers	2.2*	2.3*

SYSTEM **035 Steam Generator System (S/GS)**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the S/GS controls including:**
(CFR: 41.5 / 45.5)

A1.01	S/G wide and narrow range level during startup, shut-down, and normal operations	3.6	3.8
A1.02	S/G pressure	3.5	3.8
A1.03	Feed flow/steam flow while going into wet lay-up	2.2	2.3

A2 **Ability to (a) predict the impacts of the following mal-functions or operations on the GS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.5)

A2.01	Faulted or ruptured S/Gs	4.5	4.6
A2.02	Reactor trip/turbine trip	4.2	4.4
A2.03	Pressure/level transmitter failure	3.4	3.6
A2.04	Steam flow/feed mismatch	3.6	3.8
A2.05	Unbalanced flows to the 5/Gs	3.2	3.4
A2.06	Small break LOCA	4.5	4.6

A3 **Ability to monitor automatic operation of the S/G including:**
(CFR: 41.7 / 45.5)

A3.01	S/G water level control	4.0	3.9
A3.02	MAD valves	3.7?	3.5?
A3.03	Components used to conduct a secondary side hydrostatic test (e.g., AFW pump)	1.9*	1.8*
A3.04	Components used to conduct S/G tube hydrostatic test	1.9	1.9

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

A4.01	Shift of S/G controls between manual and automatic control, by bumpless transfer	3.7	3.6
A4.02	Fill of dry S/G	2.7	2.8
A4.03	Lay-up to operating conditions	2.2	2.3
A4.04	Operating to lay-up conditions	2.2	2.4
A4.05	Level Control to enhance natural circulation	3.8	4.0
A4.06	S/G isolation on steam leak or tube rupture/leak	4.5	4.6
A4.07	Adjustment of cooling water flow rate from blowdown heat exchanger	2.0	2.0

A4.08	Recognition that increasing radiation levels in secondary systems may mean leaking and possibly ruptured S/G tubes	4.1	4.4
A4.09	Reason for using timed flow in filling top of S/G while going into wet lay-up	2.1*	2.0
A4.10	Need for frequent S/G level verification during wet lay-up	2.0*	2.0

Secondary System

039 Main and Reheat Steam System (MRSS)

TASK:
Perform a lineup of the MRSS
Perform MSIV partial-stroke test
Warm up and pressurize main steam leads
Perform MSIV full-stroke test
Perform a moisture separator/reheater cold start
Perform a moisture separator/reheater hot start
Perform an MSIV trip test
Operate high-pressure drains
Perform hydrostatic test of reheaters
Operate low-pressure drains
Monitor reheater operation
Dump steam through the atmospheric relief/dump valves
Monitor the MRSS
Shut down the MRSS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the MRSS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	S/G	3.1	3.2
K1.02	Atmospheric relief dump valves	3.3	3.3
K1.03	Instrument air	2.3	2.5
K1.04	RCS temperature monitoring and control	3.1	3.1
K1.05	T/G	2.5*	2.6*
K1.06	Condenser steam dump	3.1	3.0
K1.07	AFW	3.4*	3.4*
K1.08	MFW	2.7*	2.9*
K1.09	RMS	2.7	2.7
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	MRSS	1.5	1.8
K2.02	Moisture separator reheater valves	1.4	1.6
K3	**Knowledge of the effect that a loss or malfunction of the MRSS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	T/G	2.3	2.6*
K3.02	Condenser	1.8	1.9
K3.03	AFW pumps	3.2*	3.5*
K3.04	MFW pumps	2.5*	2.6*
K3.05	RCS	3.6	3.7
K3.06	SDS	2.8*	3.1

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

K4.01	Expected values of main steam temperature downstream of MSIVs during warm-up	1.8	1.8
K4.02	Utilization of T-ave. program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits	3.1	3.2
K4.03	Main condenser, including steam dump valves, operating limits, controls, indications	2.3	2.5
K4.04	Utilization of steam pressure program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits	2.9	3.1
K4.05	Automatic isolation of steam line	3.7	3.7
K4.06	Prevent reverse steam flow on steam line break	3.3	3.6
K4.07	Reactor building isolation	3.4	3.7
K4.08	Interlocks on MSIV and bypass valves	3.3	3.4

K5 **Knowledge of the operational implications of the following concepts as the apply to the MRSS:**
(CFR: 441.5 / 45.7)

K5.01	Definition and causes of steam/water hammer	2.9	3.1
K5.02	Definition and causes of thermal stress	2.4	2.7
K5.03	Definition of, and reason for, steam blanketing on moisture separator reheater	1.9	2.2
K5.04	Effect of condenser vacuum on plant efficiency	2.1	2.1
K5.05	Bases for RCS cooldown limits	2.7	3.1*
K5.06	Purpose of density compensation of main steam flow	2.2	2.4
K5.07	Latent heat of condensation applied to moisture separators	1.8	2.0
K5.08	Effect of steam removal on reactivity	3.6	3.6

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the MRSS:**
(CFR: 41.7 / 45.7)

K6.01	Valves	2.1*	2.4*
K6.02	Sensors and detectors	2.0	2.1
K6.03	Controllers and positioners	1.9	2.2
K6.04	Pumps	1.4	1.7
K6.05	Motors	1.3	1.5

SYSTEM: 039 Main and Reheat Steam System (MRSS)

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the MRSS controls including:
(CFR: 41.5 / 45.5)

A1.01	Moisture separator reheater, from its temperature and pressure	1.7	1.7
A1.02	Temperature heatup rate limit for main steam piping	2.2	2.3
A1.03	Primary system temperature indications, and required values, during main steam system warm-up	2.6	2.7
A1.04	Low pressure turbine metal inlet temperature indications relative to the opening and shutting of steam vents for moisture separator reheater	1.8	1.9
A1.05	RCS T-ave	3.2*	3.3
A1.06	Main steam pressure	3.0	3.1
A1.07	Main steam temperature	2.4	2.6
A1.08	Reheater steam pressure	1.8	1.9
A1.09	Main steam line radiation monitors	2.5*	2.7*
A1.10	Air ejector PRM	2.9*	3.0*

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

A2.01	Flow paths of steam during a LOCA	3.1	3.2
A2.02	Decrease in turbine load as it relates to steam escaping from relief valves	2.4	2.7*
A2.03	Indications and alarms for main steam and area radiation monitors (during SGTR)	3.4	3.7
A2.04	Malfunctioning steam dump	3.4	3.7
A2.05	Increasing steam demand, its relationship to increases in reactor power	3.3	3.6

A3 Ability to monitor automatic operation of the MRSS, including:
(CFR: 41.5 / 45.5)

A3.01	Moisture separator reheater steam supply	1.9*	1.7
A3.02	Isolation of the MRSS	3.1	3.5*

SYSTEM: **039 Main and Reheat Steam System (MRSS)**

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

A4.01	Main steam supply. valves	2.9*	2.8*
A4.02	Remote operators to auxiliary steam	2.1	1.9
A4.03	MFW pump turbines	2.8*	2.8*
A4.04	Emergency feedwater pump turbines	3.8	3.9
A4.05	Moisture separator reheater, checking its temperatures and steam pressures relative to heatup limits and operating limits	1.8	1.6
A4.06	Main steam drains	1.9	1.8
A4.07	Steam dump valves.	2.8*	2.9

041 Steam Dump System (SDS) and Turbine Bypass Control

TASK:
Energize the SDS
Shift to alternate channel (power supply) of ICS
Monitor the reactor regulating control system
Shift to and from various modes of SDS
Operate the SDS in various modes
De-energize the SDS
Perform feedwater block valve junction testing
Perform lineups of the SDS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the Physical connections and/or cause-effect relationships between the SDS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Circulating water to the condenser	2.2	2.5
K1.02	S/G level	2.7	2.9
K1.03	Feed pumps	2.1	2.1
K1.04	Feedwater block valves	2.0	2.0
K1.05	RCS	3.5	3.6
K1.06	Condenser	2.6	2.9
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	ICS, normal and alternate power supply	2.8*	2.9*
K2.02	ICS inverter breakers	2.8*	2.8*
K3	**Knowledge of the effect that a loss or malfunction of the SDS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	S/G	3.2*	3.3
K3.02	RCS	3.8	3.9
K3.03	T/G	2.2*	2.4*
K3.04	Reactor power	3.5	3 4

SYSTEM: **041 Steam Dump System (SDS)/Turbine Bypass Control**

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

K4.01	RRG/ICS system	2.9*	3.3*
K4.02	Condenser	2.3	2.6
K4.03	Load change	2.3	2.6
K4.04	Operation at power	2.1	2.3
K4.05	Plant startup	2.4	2.7
K4.06	MFW and AFW systems	2.1	2.4
K4.07	Relationship of vacuum level to condenser availability	2.4	2.7
K4.08	Control rod index	2.3*	2.6*
K4.09	Relationship of low/low T-ave. setpoint in SDS to primary cooldown	3.0	3.3*
K4.10	PZR LCS	2.3	2.5*
K4.11	T-ave./T-ref. program	2.8	3.1
K4.12	Reason for maintaining S/G in saturated condition during cooldown	2.3	2.4
K4.13	Relationship of S/G pressure to steam flow	2.2	2.4
K4.14	Operation of loss-of-load bistable taps upon turbine load loss	2.5*	2.8
K4.15	"Measured variable" readings on ICS hand-automatic stations and required action if reading is out of the acceptable band	2.9*	2.9*
K4.16	Low main steam pressure	2.6*	2.7*
K4.17	Reactor trip	3.7	3.9
K4.18	Turbine trip	3.4	3.6

K5 **Knowledge of the operational implications of the following concepts as the apply to the SDS**:
(CFR: 41.5 / 45.7)

K5.01	Relationship of no-load T-ave. to saturation pressure relief setting on valves	2.9	3.2
K5.02	Use of steam tables for saturation temperature and pressure	2.5	2.8
K5.03	Flow ? P relation for valves	1.9	2.1
K5.04	Basis for plant cooldown rates	2.4	3.1
K5.05	Basis for RCS design pressure limits	2.6	3.2*
K5.06	Effect of power change on fuel cladding	2.5	2.8*
K5.07	Reactivity feedback effects	3.1*	3.6

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the SDS:**
(CFR: 41.7 / 45.7)

K6.01	Condenser	2.1	2.4
K6.02	Valves, including main and bypass feedwater valves	2.2	2.6*
K6.03	Controller and positioners, including ICS, S/G, CRDS	2.7	2.9
K6.04	Main feed pumps, including effect on capacity of internal wear	1.8	1.9
K6.05	Sensors and detectors	1.6	1.7
K6.06	Breakers, relays, and disconnects	1.4	1.7

SYSTEM: **041 Steam Dump System (SDS)/Turbine Bypass Control**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the SDS controls including:**
(CFR: 41.5 / 45.5)

A1.01	T-ave., verification above low/low setpoint	2.9*	2.9
A1.02	Steam pressure	3.1	3.2

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the SDS; and (b) based on those predictions or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Unbalanced feedwater flow between two MFW pumps	2.1*	2.1
A2.02	Steam valve stuck open	3.6	3.9
A2.03	Loss of IAS	2.8	3.1

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

A3.01	RCS T-ave. meter (cooldown rate)	3.2*	3.2
A3.02	RCS pressure, RCS temperature, and reactor power	3.3	3.4
A3.03	Steam flow	2.7	2.8
A3.04	Condenser vacuum	2.2	2.3
A3.05	Main steam pressure	2.9*	2.9

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

A4.01	ICS voltage inverter	2.9*	3.1*
A4.02	Cooldown valves	2.7*	2.9*
A4.03	T-ave. mode	2.4*	2.5*
A4.04	Pressure mode	2.7*	2.7
A4.05	Main steam header pressure	3.1	3.3
A4.06	Atmospheric relief valve controllers	2.9*	3.1
A4.07	Remote gagging of stuck open-relief valves	2.9*	3.0*
A4.08	Steam dump valves	3.0*	3.1*

045 Main Turbine Generator (MT/G) System

TASK:

Perform overspeed trip and backup overspeed trip test of the T/G
Perform turbine auto stop functional test
Perform turbine valve freedom test
Start up the T/G to rated speed
Perform generator excitation
Operate generator voltage regulator
Synchronize the T/G with output grid at minimum load
Increase load on the T/G
Monitor the T/G
Unload the T/G electrically to minimum load
Secure generator output and excitation
Shut down the T/G
Operate the turbine turning gear
Operate the turbine bearing lift oil pumps
What if turbine fails to trip (during startup)?
What if turbine does not trip when required (during operation)?
What if auto-synchronous system out of service?
What if computer fails while performing calorimetric test?
Steam dump valves fail to shut
Delta flux exceeds operating band
What if control rods are below insertion limits?
Exciter breaker fails to open using control switch on main control board?
T/G voltage regulator failure to respond to control switch

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the MT/G system and the following systems**: (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	MRSS	2.1	2.2
Kl.02	Condenser	2.1	2.2
K1.03	AC distribution system	2.3	2.5
K1.04	Extraction steam system	1.8	1.9
K1.05	Generator cooling	1.9	2.1
K1.06	RCS, during steam valve test	2.6	2.6

K1.07	Secondary systems, when testing throttle and other valves	2.1*	2.1
K1.08	Moisture separator reheater (interface with low-pressure turbine)	1.8	1.8
K1.09	MRSS and MFW system, as T/G load is varied	2.1*	2.1
K1.10	Condenser operation (vacuum, temperature flow) heater drains, CCW and CW operations	1.9	1.8
K1.11	Electrical system, including unit auxiliary transformer and service transformer	2.3	2.4
K1.12	Load control system in "following mode"	2.1	2.1
K1.13	Load control circuit	2.0	2.1
K1.14	Bearing lift oil pump	1.7	1.7
K1.15	Turning gear operation	1.7	1.7
K1.16	Vibration and eccentricity monitoring system	1.6	1.7
K1.17	Turbine latching (reset) controls	1.9	2.0
K1.18	RPS	3.6	3.7
K1.19	ESFAS	3.4*	3.6
K1.20	Protection system	3.4	3.6

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

K2.01	T/G turning gear	1.7	1.7
K2.02	T/G lube oil pumps	1.9*	2.1

K3 **Knowledge of the effect that a loss or malfunction of the MT/G system will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	Remainder of the plant	2.9	3.2

K4 **Knowledge of MT/G system design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Programmed controller for relationship between steam pressure at T/G inlet (impulse, first stage) and plant power level	2.7	2.9
K4.02	Automatic shut of reheat stop valves as well as main control valves when tripping turbine	2.5*	2.9*
K4.03	Voltage regulation mode	1.8	2.2
K4.04	Turbine load-following mode of operation	2.1	2.5*
K4.05	Acceptable loading rate for T/G	1.7	2.2*
K4.06	Prevention of tie-in if phase difference (generator and system) is beyond set limit	2.0	2.3*
K4.07	Electrohydraulic control for response to load changes	2.4*	2.5
K4.08	The reactor bailey station and reactor diamond station in integrated control circuitry	2.6*	3.0*

SYSTEM 045 Main Turbine Generator (MT/G) System

K4.09	Generator capability, including power factor, VARs and hydrogen pressure	1.8	2.2*
K4.10	Programmed controller for T-ref. signal generation from first stage (impulse) pressure in turbine	2.4	2.7*
K4.11	T/G reactor trip	3.6	3.9
K4.12	Automatic turbine runback	3.3	3.6
K4.13	Overspeed protection	2.6*	2.8*
K4.14	Measurement of valve stroke times	1.5	1.7
K4.15	Steam blanketing (atmospheric pressure) moisture separator reheater to drive out air and non-condensables prior to starting up	1.6	1.7
K4.16	Recognition of unusual sounds during startup of turbine (vibration monitoring)	1.9	2.1
K4.17	Relationship between governor and throttle valves	1.8	2.1
K4.18	Use of T/G balance voltmeter prior to placing voltage regulator in service	1.6	1.8
K4.19	Low-speed rotation by turbine turning gear to prevent “set" in shaft	1.7	1.9
K4.20	Quenching of steam at entrance to exhaust hood by sprays	1.6	1.6
K4.21	Changeover from bearing oil pump to shaft pump as turbine speed increases	1.7	1.7
K4.22	Field excitation breakers in generator	1.6	1.7
K4.23	Shift from manual to automatic voltage regulation when within limits (bumpless transfer)	1.6	1.7
K4.24	Closure of motor-operated disconnects before closure of main generator breakers	1.9*	2.1
K4.25	Adjustment of electrohydraulic control to maintain minimum load on T/G when paralleled with system	2.1*	2.2
K4.26	Shifting of auxiliary buses between unit auxiliary transformer and service transformer during loading of main T/G (function of reactor power)	2.1*	2.3
K4.27	Calibrations of the nuclear instrumentation as flux shifts during T/G load increase (permissives and administrative holds)	2.6	2.9
K4.28	Chemical and health physics sampling as power is reduced	1.7*	2.3
K4.29	Load sharing between high-pressure and low-pressure turbine (shifts to low-pressure turbine as T/G load increases also affects interface with moisture separator reheater)	1.7	1.9
K4.30	Time required to effect load changes	1.9	2.1
K4.31	Operation of auto-synchronous system	1.8	2.0
K4.32	Paralleling of generator to grid when one team of generator breakers is closed	1.7	1.9
K4.33	Preventing of breaker closure unless generator frequency is within required amount of grid frequency	1.8	1.9
K4.34	Operation of CRDS in manual mode at T/G power below 15%	2.7	2.9

SYSTEM **045 Main Turbine Generator (MT/G) System**

K4.35	Operation of reactor in the load-following mode above 15% power	3.1	3.2
K4.36	T/G coastdown and connection to the turning gear at zero T/G speed	1.6	1.8
K4.37	Automatic functions associated with turbine trip: reactor trip, station power switched to offsite source, air to extraction steam non-return valves removed	3.4*	3.6
K4.38	Lube oil pump being on before engagement of turning-gear	1.7	1.8
K4.39	Load limiters/runback	2.8	3.0
K4.40	Avoidance of T/G critical speeds	1.9	2.1*
K4.41	Lockout of command relay to generator breaker	1.6	1.6
K4.42	Operation of SDS (turbine bypass) in event of load loss or plant trip	2.8*	3.0*
K4.43	T-ave. program, in relation to SDS controller	2.8	3.2*
K4.44	Impulse pressure mode control of steam dumps	2.5*	2.8*
K4.45	Operation of low-pressure steam dump to prevent T/G overspeed	2.3*	2.5*
K4.46	Defeat of reactor trip by overspeed trip test lever	2.5	2.8*
K4.47	Turbine trip upon reactor trip	4.0	4.3
K4.48	Trip of T/G and lube oil pumps by FPS	2.1*	2.3*

K5 **Knowledge of the operational implications of the following concepts as the apply to the MT/B System:**
(CFR: 41.5 / 45.7)

K5.01	Possible presence of explosive mixture in generator if hydrogen purity deteriorates	2.8*	3.2*
K5.02	Effects of moisture in steam on the turbine	2.1	2.4
K5.03	Purpose of extraction steam system	1.8	1.9*
K5.04	Basic design of turbine blades	1.3	1.5
K5.05	Effect of steam reheating, feedwater heating, and condenser vacuum on plant efficiency	1.9	2.1
K5.06	Understanding of the principle of operation of voltage regulator null meter	1.7	1.8
K5.07	Reasons why rotation of synchroscope must be slowing in fast direction prior to connection to the grid	1.8	2.1*
K5.08	Even heatup/cooldown of turbine	1.8	2.1*
K5.09	Maneuvering limits for T/G	1.9	2.2
K5.10	Reasons for different procedures in hot and cold starts (temperature differential limits)	1.7	1.9
K5.11	Purpose of turning gear	1.7	1.8
K5.12	Role of field excitation in generator	1.6	1.7
K5.13	Reason for having generator voltage slightly higher than system voltage when paralleling	1.6	1.7
K5.14	Reason for reactive load adjustment after paralleling	1.6	1.7
K5.15	Reason for paralleling both generator breaker circuits	1.6	1.7
K5.16	Need for heat balance as T/G load increases	2.0*	2.2*
K5.17	Relationship between moderator temperature coefficient and boron concentration in RCS as T/G load increases	2.5*	2.7*
K5.18	Purpose of low-power reactor trips (limited to 25% power)	2.7	3.2
K5.19	Reason for minimum T/G load (to cool low-pressure turbine blade tips)	1.7	1.9*
K5.20	Effect of temperature on lube oil viscosity	1.6	1.7

K5.21	Purpose of turbine lube oil lift pump (to hold T/G off main bearing at low rotation speeds)	1.6	1.6
K5.22	Operation of synchroscope	1.7	1.8
K5.23	Relationship between rod control and RCS boron concentration during T/G load increases	2.7	2.8

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the MT/G system components:**
(CFR: 41.7 / 45.7)

K6.01	Generator stator cooling (turbine building CCW)	2.0	2.1
K6.02	Breakers, relays, and disconnects	1.7	1.9
K6.03	Valves	1.6	1.7
K6.04	Main ac electrical system mimic bus	2.0	2.3
K6.05	Hydrogen purity analyzer	1.7	1.9
K6.06	Generator amplidyne balance system	1.6*	1.8*
K6.07	Hydrogen oil seal system on generator	1.7	1.8
K6.08	Turbine lube oil system	1.7	1.8
K6.09	Steam gland seal system on turbine	1.6	1.7
K6.10	Sensors and detectors	1.6	1.7
K6.11	Controllers and positioners	1.8	1.9
K6.12	Lube oil pump	1.6	1.6
K6.13	MFW, cooling water, heater drains, and demineralizers (unless automatic controls are provided, flows must be adjusted manually during power decrease)	1.7	1.7
K6.14	DELETED		

SYSTEM **045 Main Turbine Generator (MT/G) System**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the MT/G system controls including:**
(CFR: 41.5 / 45.5)

K/A NO.	ABILITY	IMPORTANCE RO	IMPORTANCE SRO
A1.01	Normal speed, sound, vibration, temperature, pressure, and flow characteristics of T/G	2.1*	2.2
A1.02	Electrical parameters for the T/G	1.9	2.1
A1.03	Use of sounding rod to monitor bearings for high vibration	1.7	1.7
A1.04	Turbine vibration and expansion during rise to full load	1.8	1.9
A1.05	Expected response of primary plant parameters (temperature and pressure) following T/G trip	3.8	4.1
A1.06	Expected response of secondary plant parameters following T/G trip	3.3	3.7

A2 **Ability to (a) predict the impacts of the following malfunctions or operation on the MT/G system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations**:
(CFR: 41.5 / 43.5 / 45.3 / 45.5)

K/A NO.	ABILITY	RO	SRO
A2.01	Condensate backing up in drains and reheaters	1.8	1.9
A2.02	Generator stator cooling water screen becoming clogged	1.9	1.9
A2.03	Mismatch between generator output and unit demand	2.1	2.1
A2.04	Improperly operating steam and turbine drains	1.7	1.8
A2.05	Changing extraction steaming rates	1.6	1.6
A2.06	Cold and hot starts	1.7	1.8
A2.07	Unsuccessful turbine latching	1.7	1.7
A2.08	Steam dumps are not cycling properly at low load, or stick open at higher load (isolate and use atmospheric reliefs when necessary)	2.8	3.1*
A2.09	If exciter fails, trip the T/G	2.2*	2.4*
A2.10	Voltage regulator malfunction	1.8	2.1*
A2.11	Control problems in primary, e.g., axial flux imbalance; need to reduce load on secondary	2.4	2.9*
A2.12	Control rod insertion limits exceeded (stabilize secondary)	2.5	2.8*
A2.13	Opening of the steam dumps at low pressure	2.1	2.5*
A2.14	Loss of condenser vacuum	2.1	2.4*
A2.15	Turbine overspeed	2.2*	2.6*
A2.16	Turbine blade failure	2.3*	2.4*
A2.17	Malfunction of electrohydraulic control	2.7*	2.9*

SYSTEM **045 Main Turbine Generator (MT/G) System**

A3 **Ability to monitor automatic operation of the MT/G system, including:**
(CFR: 41/7 / 45.5)

A3.01	Recognition of trends on main T/G output meter	2.1*	1.9
A3.02	Interpretation of T/G output breaker indicating lights	2.2*	2.1
A3.03	Interpretation of T/G voltage regulation indication	1.9	1.9
A3.04	T/G trip	3.4	3.6
A3.05	Electrohydraulic control	2.6	2.9
A3.06	Turbine supervisory instrumentation	2.1	2.2
A3.07	Turbine stop/governor valve closure on turbine trip	3.5	3.6
A3.08	Determination from throttle and governor indicators of turbine trip: several indications, including CRDS trip alarm	3 3*	3.5*
A3.09	Comparison of incoming and running voltmeters	1.9	2.0
A3.10	Voltage regulator	1.9	2.0
A3.11	Generator trip	2.6*	2.9*

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

A4.01	Turbine valve indicators (throttle, governor, control, stop, intercept), alarms, and annunciators	3.1	2.9
A4.02	T/G controls, including breakers	2.7	2.6*
A4.03	T/G speed indication for on-line and off-line operation	1.9	1.9
A4.04	Exhaust hood spray system for temperature control	1.9	1.6
A4 05	Electrical (T/G) and steam system adjustments	2.2	1.9
A4 06	Turbine stop valves	2.8	2.7*
A4.07	Voltage regulator	1.9	1.9
A4.08	RCS parameters (temperature and pressure), while conducting valve freedom test	2.7*	2.6*
A4.09	Turbine supervisory instruments during startup	1.8	1.9
A4.10	Startup T/G on load limits	1.9*	2.2
A4.11	T/G output breaker controls; understanding of indications and alarms	2.4*	2.3*
A4.12	Interpretation of electrohydraulic control indications	2.2	2.4*
A4.13	Governor and load limits	2.1	2.2

055 Condenser Air Removal System (CARS)

TASK: Perform lineups of the CARS
Conduct condenser air leakage check
Monitor the CARS operation
Operate the mechanical vacuum pump
Operate steam jet air ejectors

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CARS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Main turbine generator	1.6	1.7
K1.02	Main condenser	2.0	2.1
K1.03	Condensate	1.9	2.1
K1.04	S/G	1.9	2.0
K1.05	Polishing demineralizers	1.5	1.5
K1.06	PRM system	2.6	2.6
K1.07	WGDS	1.9	1.9
K1.08	Containment	1.7	1.6
K1.09	Auxiliary steam	1.6	1.6
K2	**Knowledge of bus power supplies to the following**: (CFR: 41.7)		
K2.01	Vacuum pump(s)	1.6	1.7
K2.02	Exhaust fan(s)	1.5	1.5
K3	**Knowledge of the effect that a loss or malfunction of the CARS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Main condenser	2.5	2.7
K3.02	T/G	1.7	1.9
K3.03	MT/G	1.6	1.9
K3.04	MFW pumps (steam driven)	1.7	2.0*
K3.05	SDS	2.3	2.6

SYSTEM: **055 Condenser Air Removal System (CARS)**

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

K4.01	Turbine startup	1.9	2.3*
K4.02	Effluent control and monitoring	2.4	2.6*

K5 **Knowledge of the operational implications of the following concepts as the apply to the CARS:**
(CFR: 41.5 / 45.7)

K5.01	Measures of pressure and vacuum	1.6	1.7
K5.02	Venturi effects	1.4	1.5
K5.03	Relationship between pressure and temperature	1.6	1.6
K5.04	S/G chemistry	1.6	1.9

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the CARS components:**
(CFR: 41.7 / 45.7)

K6.01	Air ejectors	1.7	1.7
K6.02	Vacuum pumps	1.6	1.8
K6.03	Heat exchangers	1.3	1.4
K6.04	Flow sensors	1.3	1.4

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CARS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Condenser vacuum gauge	1.7	2.0*
A1.02	Pressure and temperature sensors	1.6	1.7

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

A2.01	Loss of circulating cooling water system	2.1	2.2
A2.02	Loss of gland seal/gland exhaust	2.1	2.1
A2.03	Loss of air ejector cooling water	1.8*	2.0*
A2.04	Air in leakage	2.1	2.2

SYSTEM: **055 Condenser Air Removal System (CARS)**

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

A3.01	Air removal pump	1.8	1.9
A3.02	Steam to CARS	1.9	1.9
A3.03	Automatic diversion of CARS exhaust	2.5*	2.7*

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

A4.01	Sealing steam	1.8	1.9
A4.02	Vacuum pumps	1.8	1.9
A4.03	Steam to CARS	1.8	1.8

056 Condensate System

TASK:
Perform lineups of the condensate system
Operate condensate pumps in different combinations
De-aerate the condensate system prior to startup
Fill the condenser hotwell
Fill the condensate system
Place the condensate system in high pressure cleanup operation
start up the condensate system
shut down the condensate system
operate the low pressure heaters
operate the high pressure heaters
Operate the condensate booster pumps in different combinations
Operate the hotwell pumps
Manually operate the condensate hotwell makeup and dump system
monitor condensate system operate
Operate the condensate pump and air ejector recirc subsystem
What if high water level exists in low-pressure feedwater
heater during turbine operations?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Condensate System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	feedwater cleanup system	1.8	1.8
K1.02	Main vacuum and gland seal system	1.6	1.6
K1.03	MFW	2.6*	2.6
K1.04	Condenser	1.7	1.6
K1.05	Secondary sealing water	1.5	1.5
K1.06	Heater drains	1.4	1.5
K1.07	Gland seals	1.5	1.5
K1.08	CARs	1.6	1.6
K1.09	Extraction steam	1.6	1.6
K1.10	Chemical treating	1.7	1.7
K1.11	Stator cooling	1.5	1.5
K1.12	Secondary plant component cooling	1.6	1.6
K1.13	AFW	2.4*	2.4*
K1.14	Demineralizer water makeup system	1.7	1.9
K1.15	Hotwell pumps, booster pumps, and main feed pumps	2.1	2.1
K1.16	Demineralizer bypass valve (prevent water impact on resin beds during pump startup)	1.9	2.1*
K1.17	Feed system, the polishing demineralizer system, and the condensate strainer operation	1.9	2.1*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Condensate pumps and booster pumps	1.6	1.7*

SYSTEM: **056 Condensate System**

K3 **Knowledge of the effect that a loss or malfunction of the Condensate System will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	MFW	2.4*	2.4
K3.02	CARS	1.6	1.7
K3.03	MFW pumps	2.2*	2.3
K3.04	Heater drain pumps	1.6	1.6
K3.05	Extraction steam	1.6	1.6
K3.06	Gland steam system	1.5	1.6
K3.07	Stator coolant	1.7	1.6
K3.08	Hydrogen coolers	1.6	1.6

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

K4.01	Feedwater heating at low, intermediate, and high pressure	1.6	1.9
K4.02	Condensate demineralizer resin regenerative process	1.7	1.9
K4.03	Restricting hotwell level range	1.7	1.7
K4.04	Moving condensate to and from storage tank and hotwell	1.7	1.8
K4.05	Securing steam seals on main turbine during shutdown	1.5	1.6
K4.06	Proper sequencing of hotwell pumps and condensate polishing demineralzer bypass valves	1.5	1.6
K4.07	Cooling condensate pumps seals, using makeup water	1.5	1.7
K4.08	Venting condensate pump seals	1.4	1.5
K4.09	Feedwater pump turbine windmill protection	1.8	1.9
K4.10	Flow control valve for the gland exhaust condenser	1.5	1.6
K4.11	Byass of heater stream	1.7	2.0
K4.12	Condensate minimum flow recirculation valve	1.6	1.6
K4.13	Condensate pump runout capacity	1.7	1.7
K4.14	MFW pump NPSH	2.2	2.6*
K4.15	Booster pump starting interlock	1.9	2.1*
K4.16	Low-level and High-level heater	1.6	1.7
K4.17	Adjustment of automatic setpoint and polish demineralizer bypass valves	1.6	1.7
K4.18	Interlocks between booster pumps and auxiliary oil pumps.	1.5*	1.7
K4.19	Setpoints and trip levels for condensate pump and booster pump operations	1.9	1.9
K4.20	Flow rate limits of condensate piping system	1.6	1.7
K4.21	Operation of hotwell pump and air ejector recirculation line isolation valve to maintain header pressure	1.5*	1.7*
K4.22	Feed pump and booster pump NPSH protection	2.1	2.4*

SYSTEM: 056 Condensate System

K5 Knowledge of the operational implications of the following concepts as the apply to the Condensate system:
(CFR: 41.5 / 45.7)

K5.01	Principle of vacuum drag	1.5	1.5
K5.02	Energies associated with fluid flow (Kinetic, Potential pressure)	1.4	1.6
K5.03	Water hammer and methods of prevention	2.2	2.6*
K5.04	Function of lubricating oil and its application to pump and motor bearings	1.7	1.8
K5.05	Understanding of the working properties of water (Enthalpy, entropy, pressure, temperature, specific volume	1.7	2.0*
K5.06	Purpose of condensate demineralizer	1.7	1.9
K5.07	Purpose and principle of de-aeration, of oxygen removal from condensate	1.7	1.9
K5.08	Chemistry specs for secondary system dissolved oxygen (corrosion control	1.9	2.4
K5.09	Water quality requirements for demineralizer water	1.7	2.0
K5.10	Effects of leaks (on plant efficiency and personnel)	1.8	2.0
K5.11	Reasons for venting all high points in condensate system	1.5	1.7
K5.12	Reason and methods for breaking main condenser vacuum before removing turbine seals	1.6	1.7
K5.13	Purpose of low-pressure cleanup valve	1.5	1.6
K5.14	Purpose of valve between upper surge tank and hotwell	1.7*	1.7*
K5.15	Stabilization of piping system parameters after changes in chemistry	1.6	1.8
K5.16	Limits of condensate pump ability to feed S/G	2.0*	2.3*
K5.17	Principles and mechanisms of S/G water level control	2.3*	2.3*

K6 Knowledge of the effect of a loss or malfunction of the following will have on the Condensate System components:
(CFR: 41.7 / 45.7)

K6.01	Condensate pumps	1.7	1.9
K6.02	Booster pumps	1.7	1.9
K6.03	Main feed pumps	2.1	2.4*
K6.04	Valves	1.6	1.6
K6.05	Sensors and detectors	1.4	1.5
K6.06	Controllers and positioners	1.5	1.6
K6.07	Heat exchangers and condensers	1.6	1.7
K6.08	Breakers, relays, and disconnects	1.3	1.5
K6.09	Demineralizers	1.7	1.9
K6.10	Pumps	1.6	1.7
K6.11	Motors	1.4	1.6

SYSTEM: **056 Condensate System**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the Condensate System controls including:**
(CFR: 41.5 / 45.5)

A1.01	Pressure, flow and amps for condensate, booster, and main feed pumps	2.1*	2.4*
A1.02	Deleted		
A1.03	Normal sequence of alarms on startup of condensate pumps, including low suction pressure alarm	1.6	1.6
A1.04	Hotwell level alarms and flow indicators	1.6	1.7
A1.05	Differential pressure indicators (Across pumps, demineralizers	1.6	1.7
A1.06	Heater parameters (temperature, pressure, flow level) and their effect on condensate flow	1.7	1.8
A1.07	S/G level under transient induced by feed rate change (pumps on and off)	2.1	2.3*
A1.08	MFW pump suction pressure	2.3	2.6*

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

A2.01	Loss of condenser pressure	1.8	2.0
A2.02	Bad chemistry	1.8	2.3*
A2.03	Demineralizer D/P	1.8	2.0*
A2.04	Loss of condensate pumps	2.6	2.8*
A2.05	Condenser tube leakage	2.1	2.5*
A2.06	Abnormal hotwell pump discharge pressure	1.6	1.7
A2.07	Removal of condensate demineralizer from service	1.7	1.9
A2.08	Feedwater heater tube leak	1.6	1.8
A2.09	Feedwater level high or low	1.6	1.7
A2.10	Decreased effectiveness of condensate demineralizer due to increased flow through it	1.5	1.7
A2.11	Approximate time necessary to regenerate one condensate demineralizer resin bed	1.6	1.8*
A2.12	Opening of the heater string bypass valve	1.8	2.1*
A2.13	Opening of the condensate recirculation valve	1.7	1.8
A2.14	Opening of the condensate spill valve	2.0	2.2

SYSTEM: **056 Condensate System**

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

A3.01	Automatic hotwell level control	1.8	1.8
A3.02	Hotwell and condensate storage tank level indicators	1.9	2.1
A3.03	Condensate flow, header pressure, pump amperage and running indicators / related alarms and annunciators	1.8	1.7
A3.04	Verification (from multiple sources) that condensate pumps are operating	2.1	2.1
A3.05	Monitoring of steam jet air ejector air flow	1.7	1.8*
A3.06	Remote and local feedwater heater level indicators	1.7	1.6
A3.07	Determination that the differential pressure of the condensate demineralizer is within limits	1.6	1.7
A3.08	Flow through stator coolant and hydrogen coolers	1.6	1.5
A3.09	Automatic protection of MFW pump low suction pressure	2.1	2.4*
A3.10	Upper surge tank flowmeter	1.7*	1.6*

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

A4.01	Condensate pump controls	1.9	1.8
A4.02	Condensate demineralizer bypass valve and precoat by pass valve	2.0	1.9
A4.03	Hotwell high level dump	2.1*	2.1
A4.04	Cleanup Valve	1.8	1.7
A4.05	Valve between upper surge tank and hotwell	1.8*	1.7*
A4.06	Condensate demineralizer bypass valve controller	1.8	1.8*
A4.07	Hotwell pumps	1.7	1.7
A4.08	Condensate automatic makeup valve controller	1.7	1.5
A4.09	Demineralizer flow control valve	1.9*	1.7*
A4.10	Low-pressure and high-pressure cleanup valves	1.7*	1.6*
A4.11	Setpoints on polish demineralizer bypass valve controllers	1.6	1.6
A4.12	Condensate pump, including verification of proper startup from parameter readings	1.7	1.7
A4.13	Alarms associated with booster pump operation	1.7	1.7
A4.14	Auxiliary oil pumps for booster pumps	1.6	1.6
A4.15	Turbine and feedwater pump turbine exhaust temperature during shutdown	1.6	1.5
A4.16	Heater unit controls and control valves during heater startup/shutdown	1.5	1.5
A4.17	Deleted		
A4.18	Hotwell level alarms and flow indicators	1.9	1.7

059 Main Feedwater (MFW) System

Task: Perform initial lineup of the MFW system
Perform feedwater isolation valve functional test
Fill the MFW system
Perform MFW pump turbine tachometer overspeed trip test
Start up the MFW system
Operate the MFW pumps in different combinations
Operate the feedwater regulating system in manual and automatic modes
Operate / test MFW pump lube oil pump monitor MFW system operations
Shut down the MFW system
What if the automatic S/G water level control does not respond properly?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the MFW and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Condensate	2.3*	2.3
K1.02	AFW system	3.4*	3 . 4
K1.03	S/GS	3.1	3.3
K1.04	S/GS water level control system	3.4	3.4
K1.05	RCS	3.1*	3.2
K1.06	Chemical treatment	1.9	2.1
K1.07	ICS	3.2*	3.2*
K1.08	Heater drains	1.6	1.6
K1.09	Secondary cooling water	1.7	1.8
K1.10	Extraction steam	1.7	1.7
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	MFW system pumps	2.2*	2.3*
K2.02	MOVs	2.0*	2.1
K3	**Knowledge of the effect that a loss or malfunction of the MFW will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Condensate system	1.8	1.8
K3.02	AFW system	3.6	3.7
K3.03	S/GS	3.5	3.7.
K3.04	RCS	3.6	3.8

SYSTEM: 059 Main Feedwater (MFW) System

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

K4.01	MFW and startup feedwater valve combination.	2.4	2.6*
K4.02	Automatic turbine/reactor trip runback	3.3	3.5
K4.03	Adequate condensate flow	2.1	2.3*
K4.04	Heating of feedwater	1.9	2.2
K4.05	Control of speed of MFW pump turbine	2.5*	2.8*
K4.06	Comparison of actual D/P, between main steam and MFW pump discharge pressure, to programmed D/P when placing MFW pump in automatic mode	2.2*	2.4*
K4.07	Closing MFW pump drains	1.6*	1.7*
K4.08	Feedwater regulatory valve operation (on basis of steam flow, feed flow mismatch)	2.5	2.7
K4.09	Controlling MFW pump lube oil system	1.7	1.8
K4.10	Bearing oil signal to the turning gear start sequence	1.7	1.8
K4.11	Porting oil	1.8?	1.9?
K4.12	Sources of cooling water for MFW pump lube oil cooler	1.8	1.9
K4.13	Feedwater fill for S/G upon loss of RCPs	2.9	2.9
K4.14	Start permissives for MFW pumps	2.1	2.3 *
K4.15	Automatic starts for MFW pumps	2.2*	2.4*
K4.16	Automatic trips for MFW pumps	3.1*	3.2*
K4.17	Increased feedwater flow following a reactor trip	2.5*	2.8*
K4.18	Automatic feedwater reduction on plant trip	2.8*	3.0*
K4.19	Automatic feedwater isolation of MFW	3.2	3.4
K4.20	Automatic feed pump recirculation flow	1.9	2.2*

K5 Knowledge of the operational implications of the following concepts as the apply to the MFW:
(CFR: 41.5 / 45.7)

K5.01	Variation of flow discharge pressure	2.1	2.1
K5.02	Shrink and swell	2.4	2.6*
K5.03	Reason for maintenance of minimum D/P between main steam and MFW pump discharge pressure	2.1	2.2
K5.04	Definition of water hammer	2.3*	2.6*
K5.05	Reason for balancing MFW pump loads	2.0	2.2*
K5.06	Characteristics of level, flow, and pressure indications	1.8	2.1*
K5.07	Relationship between feedwater pump speed and feedwater regulating valve position	1.8	2.1*
K5.08	Reason for matching steam flow and feedwater flow	2.4	2.6*
K5.09	Effects of low temperature and high viscosity on oil system operations	1.6	1.7
K5.10	Theory of film-riding oil in journal bearing	1.4	1.6
K5.11	Definition of turbine windmilling	1.6	1.7
K5.12	Increased MFW pump discharge with increased turbine speed	2.2*	2.5*
K5.13	Reasons for monitoring feedwater pump suction flow/pressure	2.3	2.6*
K5.14	Quadrant power tilt	1.9	2.4*

SYSTEM: **059 Main Feedwater (MFW) System**

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the MFW components:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.1*
K6.02	Sensors and detectors	1.9	1.9
K6.03	Controllers and positioners	1.9	2.1*
K6.04	Pumps	1.9	2.1*
K6.05	Motors	1.7	1.9*
K6.06	Heat exchangers and condensers	1.6	1.8
K6.07	Breakers, relays, and disconnects	1.4	1.7
K6.08	Breakers, relays, and disconnects	1.6	1.8
K6.09	MFW pump speed and flow regulating valves (reason for adjusting position of both)	2.4*	2.6*
K6.10	Feedwater isolation valve travel time	1.9	2.1*
K6.11	High and low feedwater discharge header pressure	1.9	2.1*
K6.12	S/G controller logic for MFW regulating valve	2.3*	2.5

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the MFW controls including:**
(CFR: 41.5 / 45.5)

A1.01	Location, limits, and normal ranges for level, pressure flow, temperature, and RPM measurements associated with the MFW system	2.4*	2.5*
A1.02	MFW pump oil temperatures and MFW pump vibrations	1.8	1.9
A1.03	Power level restrictions for operation of MFW pumps and valves.	2.7*	2.9*
A1.04	Main steam pressure	2.2*	2.2*
A1.05	S/G level, comparison with normal values	2.4*	2.6
A1.06	Abnormal noises or vibrations of MFW pump	1.8	2.0
A1.07	Feed Pump speed, including normal control speed for ICS	2.5*	2.6*
A1.08	Oil Pressure indications for MFW pumps	1.7	1.8
A1.09	Feedwater pump bearing temperatures	1.7	1.8
A1.10	Feedwater pump seal leakoff temperature	1.6	1.6
A1.11	Feedwater regulating valve D/P	2.2*	2.2

SYSTEM: **Main Feedwater (MFW) System**

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

A2.01	Feedwater actuation of AFW system	3.4*	3.6*
A2.02	Loss of feedwater heater	2.2*	2.5*
A2.03	Overfeeding event	2.7	3.1*
A2.04	Feeding a dry S/G	2.9*	3.4*
A2.05	Rupture in MFW suction or discharge line	3.1*	3.4*
A2.06	Loss of steam flow to MFW system	2.7*	2.9*
A2.07	Tripping of MFW pump turbine	3.0*	3.3*
A2.08	Extremely low MFW pump control lube oil or bearing oil pressure	1.9	2.2*
A2.09	Overspeed on turning gear	1.6	1.8
A2.10	Secondary cooling water	1.7	1.8
A2.11	Failure of feedwater control system	3.0*	3.3*
A2.12	Failure of feedwater regulating valves	3.1*	3.4*
A2.13	Loss of condensate/heater draining flow	2.1*	2.1*

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

A3.01	Valve timer display	2.0*	2.1*
A3.02	Programmed levels of the S/G	2.9	3.1
A3.03	Feedwater pump suction flow pressure	2.5	2.6*
A3.04	Turbine driven feed pump	2.5*	2.6*
A3.05	Starts and stops on the main feed pumps	2.4*	2.7*
A3.06	Feedwater isolation	3.2*	3.3
A3.07	ICS	3.4*	3.5*

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

A4.01	MFW turbine trip indication	3.1*	3.1*
A4.02	Null out MFW pump D/P differences	2.3*	2.4*
A4.03	Feedwater control during power increase and decrease	2.9*	2.9
A4.04	Reset MFW overspeed trip	2.2*	2.3*
A4.05	MFW pump oil cooler, cooling water outlet valve controller	1.7	1.8
A4.06	MFW pump turbine reset switch	2.4*	2.3*
A4.07	Valve timer reset pushbutton	2.0*	1.9*
A4.08	Feed regulating valve controller	3.0*	2.9*
A4.09	Remote determination of operating feedwater pump turning gear	2.1*	2.0*
A4.10	ICS	3.9*	3.8*
A4.11	Recovery from automatic feedwater isolation	3.1	3.3
A4.12	Initiation of automatic feedwater isolation	3.4	3.5

061 Auxiliary / Emergency Feedwater (AFW) System

TASK:
Perform lineups of the AFW system
Perform AFW system operability demonstration
What if the AFW system did not operate properly automatically?
Fill and vent the AFW system
Auxiliary feed pump failure due to improper valve lineup
Start the AFW system
Perform AFW automatic actuation test
Feed steam generators with AFW system
Perform S/G auxiliary feed pump test
Operate motor driven AFW pumps
Perform S/G auxiliary feed pump flow capacity test
Operate turbine driven AFW pumps
Perform testing of AFW check valves
Shift auxiliary feed pump suction
Perform exercise of AFW MOVs test
Overspeed test the auxiliary feed pump turbine
shut down the AFW system
Drain the AFW pump turbine and steam supply header

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the AFW and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	S/G system	4.1	4.1
K1.02	MFW System	3.4	3.7
K1.03	Main steam system	3.5	3.9
K1.04	RCS	3.9	4.1
K1.05	Condensate system	2.6*	2.8*
K1.06	Cooling water	2.4*	2.6*
K1.07	Emergency water source	3.6	3.8
K1.08	Chemical treatment	2.1	2.3*
K1.09	PRMS	2.6*	2.8*
K1.10	Diesel fuel oil	2.6*	2.7*
K1.11	AFW turbine exhaust drains	2.7	2.8*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	AFW system MOVs	3.2*	3.3
K2.02	AFW electric drive pumps	3.7*	3.7
K2.03	AFW diesel driven pump	4.0*	3.8*

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SYSTEM: 061 Auxiliary / Emergency Feedwater (AFW) System

K3 Knowledge of the effect that a loss or malfunction of the AFW will have on the following:
(CFR: 41.7 / 45.6)

K3.01	RCS	4.4	4.6
K3.02	S/G	4.2	4.4

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

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K4.01	Water sources and priority of use	4.1	4.2
K4.02	AFW automatic start upon loss of MFW pump, S/G level, blackout, or safety injection	4.5	4.6
K4.03	Automatic blowdown/sample isolation	2.7	2.9*
K4.04	Prevention of AFW runout by limiting AFW flow	3.1	3.4
K4.05	Prevention of MFW swapover to AFW suction pressure is low	3.5*	3.7*
K4.06	AFW startup permissives	4.0*	4.2*
K4.07	Turbine trip, including overspeed	3.1*	3.3*
K4.08	AFW recirculation	2.7	2.9
K4.09	Crossties between multi-unit station	3.7	3.3
K4.10	Reset of MFW reactor trip logic	2.6	2.9*
K4.11	Automatic level control	2.7*	2.9*
K4.12	Natural circulation flow	3.5*	3.7
K4.13	Initiation of cooling water and lube oil	2.7	2.9
K4.14	AFW automatic isolation	3.5*	3.7*

K5 Knowledge of the operational implications of the following concepts as the apply to the AFW:
(CFR: 41.5 / 45.7)

K5.01	Relationship between AFW flow and RCS heat transfer	3.6	3.9
K5.02	Decay heat sources and magnitude	3.2	3.6
K5.03	Pump head effects when control valve is shut	2.6	2.9*
K5.04	Reason for warming up turbine prior to turbine startup	2.3	2.5*
K5.05	Feed line voiding and water hammer	2.7	3.2

K6 Knowledge of the effect of a loss or malfunction of the following will have on the AFW components:
(CFR: 41.7 / 45.7)

K6.01	Controllers and positioners	2.5	2.8*
K6.02	Pumps	2.6	2.7
K6.03	Motors	2.0	1.9
K6.04	Breakers, relays, and disconnects	1.7	1.9
K6.05	Valves	2.3*	2.5*
K6.06	Sensors and detectors	2.1	2.4*
K6.07	Pump lube oil system and cooling	2.0	2.2
K6.08	Bearing oil supply for turbine drive pumps	2.1	2.3

SYSTEM: 061 Auxiliary / Emergency Feedwater (AFW) System

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the AFW controls including:
(CFR: 41.5 / 45.5)

A1.01	S/G level	3.9	4.2
A1.02	S/G pressure	3.3*	3.6*
A1.03	Interactions when multi unit systems are cross tied	3.1*	3.6*
A1.04	AFW source tank level	3.9	3.9
A1.05	AFW flow/motor amps	3.6	3.7
A1.06	S/G hydrotest parameters	1.7	1.7

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

A2.01	Startup of MFW pump during AFW operation	2.5	2.6*
A2.02	Loss of air to steam supply valve	3.2*	3.6*
A2.03	Loss of dc power	3.1	3.4
A2.04	pump failure or improper operation	3.4	3.8
A2.05	Automatic control malfunction	3.1*	3.4*
A2.06	Back leakage of MFW	2.7	3.0
A2.07	Air or MOV failure	3.4	3.5
A2.08	Flow rates expected from various combinations of AFW pump discharge valves	2.7*	2.9*
A2.09	Total loss of feedwater.	TBD	TBD

A3 Ability to monitor automatic operation of the AFW, including:
(CFR: 41.7 / 45.5)

A3.01	AFW startup and flows	4.2	4.2
A3.02	RCS cooldown during AFW operations	4.0	4.0
A3.03	AFW S/G level control on automatic start	3.9	3.9
A3.04	Automatic AFW isolation	4.1	4.2
A3.05	Recognition of leakage, using sump level changes	2.5	2.5*
A3.06	S/G blowdown/sampling isolation	2.2*	2.3

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

None

076 Service Water System (SWS)

TASK:
Perform lineups of the SWS
Perform the SWS valve test
Fill and vent the SWS
Perform a service water pump test
Start up the SWS
Monitor the SWS
Operate service water pumps in various combinations
Operate heat exchangers in different combinations (two-train SWS)
Isolate service water from individual components
Shut down the SWS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause- effect relationships between the SWS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CCW system	3.4	3.3
K1.02	Turbine lube oil system	1.8	1.8
K1.03	Relationship of SWS to raw water filtration (RWF) system and location of SWS supply pump to RWF system	1.9*	1.9*
K1.04	Relationship of domestic water to lube water for SWS pumps	1.8*	1.9*
K1.05	D/G	3.8*	4.0*
K1.06	Switch gear room coolers	2.1*	2.0*
K1.07	Secondary closed cooling water	2.5*	2.3
K1.08	RHR system	3.5*	3.5*
K1.09	Reactor building closed cooling water	3.0*	3.1*
K1.10	Turbine building closed cooling water	2.1*	2.1
K1.11	Domestic water and raw water	1.7	1.6
K1.12	Intake screen system	1.9	2.1
K1.13	LRS	2.3*	2.3*
K1.14	Condenser circulating water	2.1	2.1
K1.15	FPS	2.5	2.6
K1.16	ESF	3.6	3.8
K1.17	PRMS	3.6*	2.7
K1.18	SWS normal heat loads	2.1	2.2
K1.19	SWS emergency heat loads	3.6*	3.7
K1.20	AFW	3.4*	3.4*
K1.21	Auxiliary backup SWS	2.7*	2.9*
K1.22	Water treatment	1.8	1.8

K1.23	Spent fuel pool makeup	2.1*	2.2
K1.24	Chemical addition	1.8	1.9
K1.25	Heat sink pond makeup	2.4*	2.3*
K1.26	Flood alarm system	2.2*	2.2*

K2 **Knowledge of bus power supplies to the following:**
(CFR: 41.7)

K2.01	Service water	2.7*	2.7
K2.02	Closed cooling water	2.2*	2.2*
K2.03	Secondary closed cooling water	2.1*	2.0*
K2.04	Reactor building closed cooling water	2.5*	2.6*
K2.05	Turbine building closed cooling water	2.0*	2.0*
K2.06	RHR components, controls, sensors, indications and alarms, including radiation monitors	2.2*	2.4*
K2.07	Cooling tower fans	2.2*	2.1*
K2.08	ESF-actuated MOVs	3.1*	3.3*
K2.09	Traveling screens	1.8	2.2*

K3 **Knowledge of the effect that a loss or malfunction of the SWS will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	Closed cooling water	3.4*	3.6
K3.02	Secondary closed cooling water	2.5*	2.8*
K3.03	Reactor building closed cooling water	3.5*	3.9*
K3.04	Turbine building closed cooling water	2.2*	2.4*
K3.05	RHR components, controls, sensors, indicators, and alarms, including rad monitors	3.0*	3.2*
K3.06	Turbine lube oil system	1.7	1.8
K3.07	ESF loads	3.7	3.9
K3.08	Radioactive liquid waste discharges	2.3	2.9*
K3.09	Normal process heat loads	1.9	2.1

K4 **Knowledge of SWS design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41/7)

K4.01	Conditions initiating automatic closure of closed cooling water auxiliary building header supply and return valves	2.5*	2.9*
K4.02	Automatic start features associated with SWS pump controls	2.9	3.2
K4.03	Automatic opening features associated with SWS isolation valves to CCW heat exchanges	2.9*	3.4*
K4.04	River intake water level recorders	2.2*	2.5*
K4.05	Service water train flow and discharge pressure when service water flow to heat exchanger for closed cooling water is throttled	2.3*	2.6*
K4.06	Service water train separation	2.8	3.2

SYSTEM: **076 Service Water System (SWS)**

K5 **Knowledge of the operational implications of the following concepts as the apply to the SWS:**
(CFR: 41.7 / 45.5)

K6 **Knowledge of the effects of a loss or malfunction of the following will have on the SWS components:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.0
K6.02	Sensors and detectors	1.7	1.9
K6.03	Controllers and positioners	1.9	2.0
K6.04	Pumps	2.1	2.2*
K6.05	Motors	1.7	1.8
K6.06	Heat exchangers and condensers	2.2	2.4*
K6.07	Breakers, relays, and disconnects	1.7	1.9
K6.08	Cooling towers	1.7*	1.8*
K6.09	Traveling screens	1.6	1.7
K6.10	Strainers	1.5	1.6

<u>ABILITY</u>

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the SWS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Line losses in SWS, by comparing SWS pump discharge and turbine building gauge	1.9	1.9
A1.02	Reactor and turbine building closed cooling water temperatures	2.6*	2.6*

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the SWS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45/3 / 45/13)

A2.01	Loss of SWS	3.5*	3.7*
A2.02	Service water header pressure	2.7	3.1

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

A3.01	Normal-process heat loads	2.4	2.5
A3.02	Emergency heat loads	3.7	3.7

SYSTEM: **076 Service Water System (SWS)**

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

A4.01	SWS pumps	2.9	2.9
A4.02	SWS valves	2.6	2.6
A4.03	Normal-process heat loads	2.3	2.4
A4.04	Emergency heat loads	3.5*	3.5
A4.05	Traveling water screens system	2.0	2.1

Safety Function 5: Containment Integrity — page

007 Pressurizer Relief Tank/Quench Tank System (PRTS)

TASK:
Perform lineups of the PRT (quench tank)
Fill the PRT
Monitor the PRT
Transfer the PRT (quench tank) contents
Add nitrogen to the PRT
Vent nitrogen from the PRT
Recirculate the PRT (quench tank) with cooling pumps
Operate the PRTS to form a steam bubble in the PZR

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the PRTS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Containment system	2.9	3.1
K1.02	WGDS	2.3	2.4
K1.03	RCS	3.0	3.2
K1.04	Nitrogen	2.1	2.3
K1.05	Makeup/fill water	2.1	2.2
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
	None		
K3	**Knowledge of the effect that a loss or malfunction of the PRTS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment	3.3	3.6
K4	**Knowledge of PRTS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Quench tank cooling	2.6	2.9
K4.02	Source of makeup/fill water	2.2	2.3
K4.03	Nitrogen cover gas	2.0	2.2

SYSTEM: **007 Pressurizer Relief Tank/Quench Tank System (PRTS)**

K5 **Knowledge of the operational implications of the following concepts as the apply to PRTS:**
(CFR: 41.5 / 45.7)

K5.01	Principles of steam quenching	2.2	2.6
K5.02	Method of forming a steam bubble in the PZR	3.1	3.4
K5.03	Characteristics of convection heat transfer	1.8	2.1
K5.04	Properties of noncondensable gases in contact with water	1.9	2.2
K5.05	Characteristics of conduction heat transfer	1.8	2.1
K5.06	Properties of condensable gases in contact with water	1.9	2.2

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the PRTS:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.0
K6.02	Sensors and detectors	1.8	1.9
K6.03	Pumps	1.4*	1.7*
K6.04	Motors	1.3*	1.6*
K6.05	Breakers, relays, and disconnects	1.6	1.8

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PRTS controls including:**
(CFR: 41.5 / 45.5)

A1.01	Maintaining quench tank water level within limits	2.9	3.1
A1.02	Maintaining quench tank pressure	2.7	2.9
A1.03	Monitoring quench tank temperature	2.6	2.7

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

A2.01	Stuck-open PORV or code safety	3.9	4.2
A2.02	Abnormal pressure in the PRT	2.6	3.2
A2.03	Overpressurization of the PZR	3.6	3.9
A2.04	Overpressurization of the waste gas vent header	2.5	2.9
A2.05	Exceeding PRT high-pressure limits	3.2	3.6
A2.06	Bubble formation in PZR	2.6	2.8
A2.07	Recirculating quench tank	2.3*	2.6*

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

A3.01	Components which discharge to the PRT	2.7*	2.9

SYSTEM: **007 Pressurizer Relief Tank/Quench Tank System (PRTS)**

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

A4.01	PRT spray supply valve	2.7*	2.7*
A4.02	PRT drain valve	2.2	2.2
A4.03	Nitrogen block valve	2.1	1.9
A4.04	PZR vent valve	2.6*	2.6
A4.05	PZR heaters	2.4*	2.2*
A4.06	Throttle valve	2.4*	2.2*
A4.07	Converting inches (or feet) of tank level to gallons (or percent)	1.6	1.8
A4.08	Location and interpretation of radioactive gas recorder	2.2*	2.3
A4.09	Relationships between PZR level and changing levels of the PRT and bleed holdup tank	2.5	2.7
A4.10	Recognition of leaking PORV/code safety	3.6	3.8

022 Containment Cooling System (CCS)

TASK:
Perform lineups of the CCS
Fill and vent the CCS
Start the CCS
Monitor the CCS (air and water sides)
What if lower containment temperature cannot be controlled within specified limits?
Shut down the CCS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	SWS/cooling system	3.5	3.7
K1.02	SEC/remote monitoring systems	3.7?	3.5?
K1.03	Auxiliary steam	2.4*	2.3*
K1.04	Chilled water	2.9*	2.9*
K2	**Knowledge of power supplies to the following:** (CFR: 41.7)		
K2.01	Containment cooling fans	3.0*	3.1
K2.02	Chillers	2.5*	2.4*
K2.03	MOVs	2.3*	2.3
K3	**Knowledge of the effect that a loss or malfunction of the CCS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment equipment subject to damage by high or low temperature, humidity, and pressure	2.9*	3.2*
K3.02	Containment instrumentation readings	3.0	3.3
K3.03	Electrical insulation	1.7	2.1
K4	**Knowledge of CCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Cooling of containment penetrations	2.5*	3.0*
K4.02	Correlation of fan speed and flowpath changes with containment pressure	3.1*	3.4*
K4.03	Automatic containment isolation	3.6*	4.0
K4.04	Cooling of control rod drive motors	2.8	3.1
K4.05	Containment cooling after LOCA destroys ventilation ducts	2.6*	2.7
K4.06	Containment pipe chase cooling	2.1*	2.4*

SYSTEM: 022 Containment Cooling System (CCS)

K5 Knowledge of the operational implications of the following concepts as the apply to the CCS:
(CFR: 41.5 / 45.7)

K5.01	Gas laws (Boyles, Charles), to appreciate environmental conditions	1.6	2.0

K6 Knowledge of the effect of a loss or malfunction of the following will have on the CCS components:
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.1
K6.02	Sensors and detectors	2.1	2.1
K6.03	Controllers and positioners	1.8	2.0
K6.04	Pumps	1.6	1.8
K6.05	Motors	1.7	1.9
K6.06	Breakers, relays, and disconnects	1.7	1.9
K6.07	Computers and calculators	1.8	1.9
K6.08	Heat exchangers and condensers	1.9	2.0

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CCS controls including:
(CFR: 41.5 / 45.5)

A1.01	Containment temperature	3.6	3.7
A1.02	Containment pressure	3.6	3.8
A1.03	Containment humidity	3.1	3.4
A1.04	Cooling water flow	3.2	3.3

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

A2.01	Fan motor over-current	2.5	2.7
A2.02	Fan motor vibration	2.3	2.6
A2.03	Fan motor thermal overload/high-speed operation	2.6	3.0
A2.04	Loss of service water	2.9*	3.2
A2.05	Major leak in CCS	3.1	3.5
A2.06	Loss of CCS pump	2.8*	3.2*

A3 Ability to monitor automatic operation of the CCS, including:
(CFR: 41.7 / 45.5)

A3.01	Initiation of safeguards mode of operation	4.1	4.3

SYSTEM: 022 Containment Cooling System (CCS)

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

A4.01	CCS fans	3.6	3.6
A4.02	CCS pumps	3.2*	3.1*
A4.03	Dampers in the CCS	3.2*	3.2*
A4.04	Valves in the CCS	3.1*	3.2
A4.05	Containment readings of temperature, pressure, and humidity system	3.8	3.8

SYSTEM: 025 Ice Condenser System

TASK: Monitor the ice condenser system

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ice condenser system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Containment ventilation	2.7*	2.7*
K1.02	Refrigerant systems	2.7*	2.7*
K1.03	Containment sump system	3.2*	3.0*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Containment ventilation fans and dampers	2.2*	2.7*
K2.02	Refrigerant systems	2.0*	2.5*
K2.03	Isolation valves	2.0*	2.2*
K3	**Knowledge of the effect that a loss or malfunction of the ice condenser system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment	3.8*	3.8*
K4	**Knowledge of ice condenser system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Glycol expansion tank levels and ice condenser system containment isolation valves	2.2*	2.5*
K4.02	System control	2.8*	3.0*
K5	**Knowledge of operational implications of the following concepts as they apply to the ice condenser system:** (CFR: 41.5 / 45.7)		
K5 01	Relationships between pressure and temperature	3.0*	3.4*
K5 02	Heat transfer	2.6*	2.8*
K5.03	Gas laws	2.4*	2.8*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ice condenser system:** (CFR: 41.7 / 45.7)		
K6.01	Upper and lower doors of the ice condenser	3.4*	3.6*

SYSTEM: **025 Ice Condenser System**

ABILITY

A1 **Ability to predict and/or monitor changes in parameters associated with operating the ice condenser system controls including:**
(CFR: 41.5 / 45.5)

A1.01	Temperature chart recorders	3.0*	3.0*
A1.02	Glycol expansion tank level	2.5*	2.2*
A1.03	Glycol flow to ice condenser air handling units	2.5*	2.5*

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the ice condenser system; correct, control, or mitigate the consequences of those malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Trip of glycol circulation pumps	2.2*	2.7*
A2.02	High/low floor cooling temperature	2.7*	2.5*
A2.03	Opening of ice condenser doors	3.0*	3.2*
A2.04	Containment isolation	3.0*	3.2*
A2.05	Abnormal glycol expansion tank level	2.5*	2.7*
A2.06	Decreasing ice condenser temperature	2.5*	2.7*

A3 **Ability to monitor automatic operation of the ice condenser system, including:**
(CFR: 41.7 / 45.5)

A3.01	Refrigerant system	3.0*	3.0*
A3.02	Isolation valves	3.4*	3.4*

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

A4.01	Ice condenser isolation valves	3.0*	2.7*
A4.02	Containment vent fans	2.7*	2.5*
A4.03	Glycol circulation pumps	2.2*	2.2*

026 Containment Spray System (CSS)

TASK:
Perform lineup of the CSS
Monitor CSS
Fill the CSS
Perform the recirculation spray systems valve test
Fill the containment spray chemical additive tank
Perform the recirculation spray subsystem pumps test
Recirculate a spray tank
Manually initiate containment spray
Perform the containment spray pump test
Perform postaccident recirculation
Secure containment spray
Isolate the CSS
Drain the CSS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CSS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	ECCS	4.2	4.2
K1.02	Cooling water	4.1	4.1
K1.03	Waste water holdup tank (vent)	2.1*	2.0*
K1.04	Fill/makeup water	2.2*	2.2*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Containment spray pumps	3.4*	3.6
K2.02	MOVs	2.7*	2.9
K3	**Knowledge of the effect that a loss or malfunction of the CSS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	CCS	3.9	4.1
K3.02	Recirculation spray system	4.2*	4.3

SYSTEM: **026 Containment Spray System (CSS)**

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

K4.01	Source of water for CSS, including recirculation phase after LOCA	4.2	4.3
K4.02	Neutralized boric acid to reduce corrosion and remove inorganic fission product iodine from steam (NAOH) in containment spray	3.1	3.6
K4.03	Not Used	N/A	N/A
K4.04	Reduction of temperature and pressure in containment after a LOCA by condensing steam, to reduce radiological hazard, and protect equipment from corrosion damage (spray)	3.7	4.1
K4.05	Prevention of material from clogging nozzles during recirculation	2.8	3.3
K4.06	Iodine scavenging via the CSS	2.8	3.2*
K4.07	Adequate level in containment sump for suction (interlock)	3.8*	4.1*
K4.08	Automatic swapover to containment sump suction for recirculation phase after LOCA (RWST low-low level alarm)	4.1*	4.3*
K4.09	Prevention of path for escape of radioactivity from containment to the outside (interlock on RWST isolation after swapover) .	3.7*	4.1*

K5 **Knowledge of operational implications of the following concepts as they apply to the CSS**:
(CFR: 41.5 / 45.7)

K5.01	Water chemistry relationship to corrosion control	2.2	2.9*
K5.02	Principle of eductor flow	1.9*	2.2*
K5.03	Stratification of liquids: concentrated NaOH solution has a higher specific gravity than weak boric acid solution, so they must be vigorously mixed to make an effective spray	2.0	2.5*
K5.04	Chemistry control	2.0	2.7

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the CSS:**
(CFR: 41.7 / 45.7)

K6.01	Valves	2.0	2.1
K6.02	Pumps	2.4*	2.4*
K6.03	Sensors and detectors	2.2*	2.3
K6.04	Controllers and positioners	2.0	2.1
K6.05	Heat exchangers	2.1	2.2*

SYSTEM: 026 Containment Spray System (CSS)

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CSS controls including:
(CFR: 41.5 / 45.5)

A1.01	Containment pressure	3.9	4.2
A1.02	Containment temperature	3.6*	3.9
A1.03	Containment sump level	3.5	3.5
A1.04	Containment humidity	3.1	3.3
A1.05	Chemical additive tank level and concentration	3.1	3.4
A1.06	Containment spray pump cooling	2.7	3.0

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

A2.01	Reflux boiling pressure spike when first going on re-circulation	2.7	3.0
A2.02	Failure of automatic recirculation transfer	4.2*	4.4*
A2.03	Failure of ESF	4.1	4.4
A2.04	Failure of spray pump	3.9	4.2
A2.05	Failure of chemical addition tanks to inject	3.7	4.1
A2.06	Increase in spray flow following swapover, because of higher pump suction pressure	2.2	2.6
A2.07	Loss of containment spray pump suction when in recirculation mode, possibly caused by clogged sump screen, pump inlet high temperature exceeded cavitation, voiding), or sump level below cutoff (interlock) limit	3.6	3.9
A2.08	Safe securing of containment spray when it can be done)	3.2	3.7
A2.09	Radiation hazard potential of BWST	2.5*	2.9*

A3 Ability to monitor automatic operation of the CSS, including:
(CFR: 41.7 / 45.5)

A3.01	Pump starts and correct MOV positioning	4.3	4.5
A3.02	Verification that cooling water is supplied to the containment spray heat exchanger	3.9*	4.2*

SYSTEM: **026 Containment Spray System (CSS)**

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

A4.01	CSS controls	4.5	4.3
A4.02	The remote location and use of spool pieces and other equipment to set up portable recirculation pump for additive tank, including power supply	2.3*	2.6*
A4.03	The remote location and use of the special tank needed for draining CSS	2.2*	2.5*
A4.04	The remote sampling of the NaOH tank and RWST/BWST for chemical analysis	2.2*	2.6*
A4.05	Containment spray reset switches	3.5	3.5

027 Containment Iodine Removal System (CIRS)

TASK: Operate the containment iodine removal units
Monitor the containment iodine removal units

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CIRS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CSS	3.4*	3.7*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Fans	3.1*	3.4*
K3	**Knowledge of the effect that a loss or malfunction of the CIRS will have on the following:** (CFR: 41.7 / 45.6)		
	None		
K4	**Knowledge of CIRS design feature(s) and/or interlock(s) which provide for the following**: (CFR: 41.7)		
	None		
K5	**Knowledge of the operational implications of the following concepts as they apply to the CIRS**: (CFR: 41.7 / 45.7)		
K5.01	Purpose of charcoal filters	3.1*	3.4*
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the CIRS:** (CFR: 41.7 / 45.7)		
	None		
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CIRS controls including:** (CFR: 41.5 / 45.5)		
	None		

SYSTEM: **027 Containment Iodine Removal System (CIRS)**

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

A2.01	High temperature in the filter system	3.0*	3.3*

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

None

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

A4.01	CIRS controls	3.3*	3.3*
A4.02	Remote operation and handling of iodine filters	2.8*	3.0*
A4.03	CIRS fans	3.3*	3.2*
A4.04	Filter temperature	2.8*	2.9*

028 Hydrogen Recombiner and Purge Control System (HRPS)

TASK:
- Perform lineups of the HRPS
- Perform hydrogen recombiner test
- Start up the hydrogen recombiners
- Start up the hydrogen purge system
- Monitor the HRPS
- Shut down the hydrogen purge system
- Operate the hydrogen analyzer

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the HRPS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Containment annulus ventilation system (including pressure limits)	2.5*	2.5
K1.02	Air supply system	2.0*	2.2*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Hydrogen recombiners	2.5*	2.8*
K3	**Knowledge of the effect that a loss or malfunction of the HRPS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Hydrogen concentration in containment	3.3	4.0
K4	**Knowledge of HRPS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
	None		
K5	**Knowledge of the operational implications of the following concepts as they apply to the HRPS:** (CFR: 41.5 / 45.7)		
K5.01	Explosive hydrogen concentration	3.4	3.9
K5.02	Flammable hydrogen concentration	3.4	3.9
K5.03	Sources of hydrogen within containment	2.9	3.6*
K5.04	The selective removal of hydrogen	2.6?	3.2?
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the HRPS:** (CFR: 41.7 / 45.7)		
K6.01	Hydrogen recombiners	2.6	3.1

SYSTEM: 028 Hydrogen Recombiner and Purge Control System (HRPS)

K/A NO.	ABILITY	IMPORTANCE RO	SRO
A1	**Ability to predict and/or monitor changes in parameter (to prevent exceeding design limits) associated with operating the HRPS controls including:** (CFR: 41.5 / 45.5)		
A1.01	Hydrogen concentration	3.4	3.8
A1.02	Containment pressure	3.4*	3.7*
A2	**Malfunctions or operations on the HRPS; and (b) based on those predictions, use procedures to correct, control or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)		
A2.01	Hydrogen recombiner power setting, determined by using plant data book	3.4*	3.6*
A2.02	LOCA condition and related concern over hydrogen	3.5	3.9
A2.03	The hydrogen air concentration in excess of limit flame propagation or detonation with resulting equipment damage in containment	3.4	4.0
A3	**Ability to monitor automatic operation of the HRPS, including:**		
	None		
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	HRPS controls	4.0*	4.0*
A4.02	Location and interpretation of containment pressure indications	3.7*	3.9
A4.03	Location and operation of hydrogen sampling and analysis of containment atmosphere, including alarms and indications	3.1	3.3

103 Containment System

TASK: Perform cycling of manual containment isolation value surveillance
Perform containment integrity verification
Perform containment isolation valve test
Perform containment leak test
Perform trip valve timing checks and leak detection to verify
Isolation valve integrity

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the containment system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	CCS	3.6	3.9
K1.02	Containment isolation/containment integrity	3.9	4.1*
K1.03	Shield building vent system	3.1*	3.5*
K1.04	Electrical penetrations	2.3	2.7
K1.05	Personnel access hatch and emergency access hatch	2.8*	3.0*
K1.06	Subsurface drain system	2.4*	2.7*
K1.07	Containment vacuum system	3.5*	3.7*
K1.08	SIS, including action of safety injection reset	3.6	3.8
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K3	**Knowledge of the effect that a loss or malfunction of the containment system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Loss of containment integrity under shutdown conditions	3.3*	3.7*
K3.02	Loss of containment integrity under normal operations	3.8	4.2
K3.03	Loss of containment integrity under refueling operations.	3.7	4.1
K4	**Knowledge of containment system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Vacuum breaker protection	3.0*	3.7*
K4.02	Containment penetration cooling	2.1	2.6
K4.03	Prevention of radiation streaming	2.1	2.6*
K4.04	Personnel access hatch and emergency access hatch	2.5	3.2
K4.05	Containment construction	1.9	2.2
K4.06	Containment isolation system	3.1	3.7
K5	**Knowledge of operational implications of the following concepts as they apply to the Containment System:** (CFR: 41.5 / 45.7)		
	None		

SYSTEM: **103 Containment System**

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the containment system:**
(CFR: 41.7 / 45.7)

K6.01	Valves	2.1*	2.3
K6.02	Controllers and positioners	1.9	2.1*
K6.03	Pumps	1.5	1.6
K6.04	Heat exchangers and condensers	1.5	1.7
K6.05	Breakers, relays, and disconnects	1.5	1.7
K6.06	Sensors and detectors	1.9	2.1

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the containment system controls including:**
(CFR: 41.5 / 45.5)

A1.01	Containment pressure, temperature, and humidity	3.7	4.1

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

A2.01	Integrated leak rate test	2.0*	2.6*
A2.02	Necessary plant conditions for work in containment	2.2	3.2*
A2 03	Phase A and B isolation	3.5*	3.8*
A2 04	Containment evacuation (including recognition of the alarm)	3.5*	3.6*
A2.05	Emergency containment entry	2.9	3.9

A3 **Ability to monitor automatic operation of the containment system, including:**
(CFR: 41.7 / 45.5)

A3.01	Containment isolation	3.9	4.2

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

A4.01	Flow control, pressure control, and temperature control valves, including pneumatic valve controller	3.2*	3.3
A4.02	Excess letdown divert valves to reactor coolant drain tank	2.1*	2.2*
A4.03	ESF slave relays	2.7*	2.7*
A4 04	Phase A and phase B resets	3.5*	3.5*

SYSTEM: 103 Containment System

A4 05	PDP speed controller	2.4*	2.2*
A4.06	Operation of the containment personnel airlock door	2.7*	2.9*
A4.07	Use of the air lock rate test panel	2.4*	2.5*
A4.08	Operation of refueling drain valves (for draining re-fueling canal to lower containment sump)	1.9	2.2
A4.09	Containment vacuum system	3.1*	3.7*

Safety Function 6:
Electrical **page**

062 A.C. Electrical Distribution

TASK:

Line up the ac electrical distribution system
Circuit breaker tests
Operate a static inverter
Equipment/bus testing for faults
Monitor the ac electrical distribution system
De-energize a motor control center (MCC) bus
Perform transfer of power supply to 4kV unit service buses
Restore a motor control center (MCC) bus to service
Perform ac breaker lineup
De-energize an engineering safeguards (4160V vital) bus
Station blackout
Restore an engineering safeguards bus to service
Perform operation of circuit breakers and generator motor-operated disconnects
Backfeed unit auxiliary transformer from main transmission switchboard (main T/G links removed)
Rack out a 480V/600V bus load breaker
Rack in a 480V/600V bus load breaker
Rack out an auxiliary bus breaker
Rack in an auxiliary bus breaker (4160V/6900V)
Transfer a vital (120V) instrument power supply
What if normal supply breaker failed to open?
Perform ground isolation
What if normal feedbreaker to the unit board does not close?
Isolate the power control breakers (PCBs)
What if the D/G does not start satisfactorily?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ac distribution system and the following systems**: (CFR: 41.2 to 41.9)		
K1.01	CO2 deluge	2.4	2.1*
K1.02	ED/G	4.1	4.4
K1.03	DC distribution	3.5	4.0
K1.04	Off-site power sources	3.7	4.2
K2	**Knowledge of bus power supplies to the following**: (CFR: 41.7)		
K2.01	Major system loads	3.3	3.4
K3	**Knowledge of the effect that a loss or malfunction of the ac distribution system will have on the following:** (CFR: 41.7 / 45.6)		

K3.01	Major system loads	3.5	3.9
K3.02	ED/G	4.1	4.4
K3.03	DC system	3.7	3.9

K4 **Knowledge of ac distribution system design feature(s) and/or interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Bus lockouts	2.6	3.2
K4.02	Circuit breaker automatic trips	2.5	2.7
K4.03	Interlocks between automatic bus transfer and breakers	2.8*	3.1
K4.04	Protective relaying	2.2	2.9
K4.05	Paralleling of ac sources (synchroscope)	2.7*	3.2
K4.06	One-line diagram of 6.9kV distribution, including sources of normal and alternative power	2.9*	3.3*
K4.07	One-line diagram of 4kV to 480V distribution, including sources of normal and alternative power	2.7	3.1
K4.08	One-line diagram of 230kV system, including sources of normal and alternative power	2.3*	2.9*
K4.09	One-line diagram of 120V distribution, including sources of normal and alternative power	2.4*	2.9*
K4.10	Uninterruptable ac power sources	3.1	3.5

K5 **Knowledge of the operational implications of the following concepts as they apply to the ac distribution system:**
(CFR: 41.5 / 45.7)

K5.01	Basic transformer theory (tap setting)	1.6	1.9
K5 02	Definition of open circuit	1.6	2.0
K5 03	Principles involved with paralleling between two ac sources	2.4	2.6
K5.04	General principles of operation of a static inverter	1.9	2.5

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the ac distribution system:**
(CFR: 41.7 / 45.7)

K6.01	Motors	1.7	1.8
K6.02	Breakers, relays, and disconnects	1.9	2.2

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ac distribution system controls including:**
(CFR: 41.5 / 45.5)

A1.01	Significance of D/G load limits	3.4	3.8
A1.02	Relationship between load and generator voltage	2.2	2.6

SYSTEM: 062 AC Electrical Distribution System

A1.03	Effect on instrumentation and controls of switching power supplies	2.5	2.8
A1.04	Effects on loads of energizing a bus	2.4	2.7
A1.05	Bus voltages	2.3	2.4
A1.06	Load currents	2.2	2.3
A1.07	Inverter outputs	2.4	2.6

A2 Ability to (a) predict the impacts of the following malfunctions or operations on the ac distribution system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Types of loads that, if de-energized, would degrade or hinder plant operation	3.4	3.9
A2.02	Causes and significance of grounds	2.2	2.6
A2.03	Consequences of improper sequencing when transferring to or from an inverter	2.9	3.4
A2.04	Effect on plant of de-energizing a bus	3.1	3.4*
A2.05	Methods for energizing a dead bus	2.9	3.3*
A2.06	Keeping the safeguards buses electrically separate	3.4*	3.9
A2.07	Consequences of opening a disconnect under load	3.0*	3.4*
A2.08	Consequences of exceeding voltage limitations	2.7	3.0*
A2.09	Consequences of exceeding current limitations	2.7	3.0*
A2.10	Effects of switching power supplies on instruments and controls	3.0	3.3
A2.11	Aligning standby equipment with correct emergency power source (D/G)	3.7	4.1
A2.12	Restoration of power to a system with a fault on it	3.2	3.6
A2.13	Identification and ranking of the most probable cause of grounds, referring to electrical distribution diagrams	2.2*	2.6*
A2.14	Performance of ground isolation procedures: determination of their effect on interface systems	2.3*	2.9*
A2.15	Consequence of paralleling out-of-phase/mismatch in volts	2.8	3.2
A2.16	Degraded system voltages	2.5	2.9

A3 Ability to monitor automatic operation of the ac distribution system, including:
(CFR: 41.7 / 45.5)

A3.01	Vital ac bus amperage	3.0	3.1
A3.02	Main T/G exciter current indicator	2.4*	2.2*
A3.03	Adequate transformer/inverter operation	2.3*	2.3
A3.04	Operation of inverter (e.g., precharging synchronizing light, static transfer)	2.7	2.9
A3.05	Safety-related indicators and controls	3.5	3.6

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

A4.01	All breakers (including available switchyard)	3.3	3.1
A4.02	Remote racking in and out of breakers	2.5	2.8
A4.03	Synchroscope, including an understanding of running and incoming voltages	2.8	2.9
A4.04	Local operation of breakers	2.6	2.7
A4.05	Remote preparation of breakers for testing	2.1	2.2
A4.06	Remote removal and re-installation of control power fuses	2.3	2.5
A4.07	Synchronizing and paralleling of different ac supplies	3.1*	3.1*

063 D.C. Electrical Distribution

TASK:

Start up and shift a vital battery charger
Monitor the dc electrical distribution system
Monitor the dc electrical system for grounds
Energize dc switchboards
De-energize dc switchboards
Energize dc equipment
De-energize dc equipment
Secure a battery charger

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the DC electrical system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Ground detection system	2.4	2.9
K1.02	AC electrical system	2.7	3.2
K1.03	Battery charger and battery	2.9	3.5
K1.04	Battery ventilation system	2.2	2.7
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Major DC loads	2.9*	3.1*
K2.02	Battery room ventilation	2.0	2.2
K3	**Knowledge of the effect that a loss or malfunction of the DC electrical system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	ED/G	3.7*	4.1
K3.02	Components using DC control power	3.5	3.7
K4	**Knowledge of DC electrical system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Manual/automatic transfers of control	2.7	3.0*
K4.02	Breaker interlocks, permissives, bypasses and cross-ties.	2.9*	3.2*
K4.03	Effect of jumpering out cells	2.1	2.4
K4.04	Trips	2.6?	2.9?
K5	**Knowledge of the operational implications of the following concepts as the apply to the DC electrical system:** (CFR: 41.5 / 45.7)		
K5.01	Knowledge of basic DC electrical theory	1.9	2.1
K5.02	Hydrogen generation during battery charging	2.2	2.6*

SYSTEM: **063 DC Electrical Distribution System**

K6	**Knowledge of the effect of a loss or malfunction on the following will have on the DC electrical system:** (CFR: 41.7 / 45.7)		
K6.01	Motors	1.8	1.7
K6.02	Breakers, relays and disconnects	1.9	2.1
K6.03	Test instruments	1.5	1.5
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters associated with operating the DC electrical system controls including:** (CFR: 41.5 / 45.5)		
A1.01	Battery capacity as it is affected by discharge rate	2.5	3.3
A1.02	Battery capacity, given ICV values	2.2	2.7*
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the DC electrical systems; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)		
A2.01	Grounds	2.5	3.2*
A2.02	Loss of ventilation during battery charging	2.3	3.1
A3	**Ability to monitor automatic operation of the DC electrical system, including:** (CFR: 41.7 / 45.5)		
A3.01	Meters, annunciators, dials, recorders, and indicating lights	2.7	3.1
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Major breakers and control power fuses	2.8*	3.1
A4.02	Battery voltage indicator	2.8*	2.9
A4.03	Battery discharge rate	3.0*	3.1

064 Emergency Diesel Generators (ED/G)

TASK: Perform a lineup of the ED/G system
Start an ED/G
Load the ED/G
Perform ED/G load tests
Monitor the ED/G
Perform ED/G inoperative test (loss of reserve power)
Unload the ED/G
Shut down the ED/G
Operate the diesel-starting air compressor
Restart an ED/G with an automatic start signal present
What if emergency loads are not shed when time sequence starts during emergency diesel inoperative test?
What if ED/G breaker closed at other than 12:00 position on synchroscope?
What if ED/G load is not reduced?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ED/G system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	AC distribution system	4.1	4.4
K1.02	D/G cooling water system	3.1	3.6*
K1.03	Diesel fuel oil supply system	3.6	4.0
K1.04	DC distribution system	3.6	3.9
K1.05	Starting air system	3.4	3.9
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Air compressor	2.7*	3.1
K2.02	Fuel oil pumps	2.8*	3.1
K2.03	Control power	3.2*	3.6
K3	**Knowledge of the effect that a loss or malfunction of the ED/G system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Systems controlled by automatic loader	3.8*	4.1
K3.02	ESFAS controlled or actuated systems	4.2	4.4
K3.03	ED/G (manual loads)	3.6	3.9*

SYSTEM: **064 Emergency Diesel Generator (ED/G) System**

K4	**Knowledge of ED/G system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Trips while loading the ED/G (frequency, voltage, speed)	3.8	4.1
K4.02	Trips for ED/G while operating (normal or emergency)	3.9	4.2
K4.03	Governor valve operation	2.5	3.0
K4.04	Overload ratings	3.1	3.7
K4.05	Incomplete-start relay	2.8	3.2
K4.06	Speed droop control	2.2	2.7
K4.07	Field flashing	2.2	2.8
K4.08	ED/G fuel isolation valves	2.9*	3.5
K4.09	Field on ED/G	2.4	3.0
K4.10	Automatic load sequencer: blackout	3.5	4.0
K4.11	Automatic load sequencer: safeguards	3.5	4.0
K5	**Knowledge of the operational implications of the following concepts as applied to the ED/G system:** (CFR: 41.5 / 45.7)		
K5.01	Definition of frequency and synchronous frequency	2.0	2.2
K5.02	Reactive power control (using set voltage)	1.9	2.4*
K5.03	Real power control (using set frequency)	1.9	2.4*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ED/G system:** (CFR: 41.7 / 45.7)		
K6.01	Valves	2.4	2.4*
K6.02	Sensors and detectors	2.4*	2.4*
K6.03	Controllers and positioners	2.4*	2.4*
K6.04	Pumps	2.2	2.3
K6.05	Motors	2.1	2.1
K6.06	Breakers, relays, and disconnects	2.3*	2.5*
K6.07	Air receivers	2.7	2.9
K6.08	Fuel oil storage tanks	3.2	3.3
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ED/G system controls including:** (CFR: 41.5 / 45.5)		
A1.01	ED/G lube oil temperature and pressure	3.0	3.1
A1.02	Fuel consumption rate with load	2.5	2.8
A1.03	Operating voltages, currents, and temperatures	3.2	3.3
A1.04	Crankcase temperature and pressure	2.8	2.9
A1.05	ED/G room temperature	2.5	2.5
A1.06	Cylinder temperature differential	2.3	2.5
A1.07	Deleted		
A1.08	Maintaining minimum load on ED/G (to prevent reverse power)	3.1	3.4

SYSTEM: 064 Emergency Diesel Generator (ED/G) System

A2 Ability to (a) predict the impacts of the following malfunctions or operations on the ED/G system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Failure modes of water, oil, and air valves	3.1*	3.3
A2.02	Load, VARS, pressure on air compressor, speed droop, frequency, voltage, fuel oil level, temperatures	2.7	2.9
A2.03	Parallel operation of ED/Gs	3.1	3.1
A2.04	Unloading prior to securing an ED/G	2.7	3.0
A2.05	Loading the ED/G	3.1	3.2*
A2.06	Operating unloaded, lightly loaded, and highly loaded time limit	2.9	3.3
A2.07	Consequences of operating under/over-excited	2.5	2.7
A2.08	Consequences of opening/closing breaker between buses (VARS, out-of-phase, voltage)	2.7	3.1
A2.09	Synchronization of the ED/G with other electric power supplies	3.1	3.3
A2.10	Unloading (reduction of generated power) in steps over a period of time	2.4	2.9
A2.11	Conditions (minimum load) required for unloading an ED/G	2.6	2.9
A2.12	Loss of air-cooling fans	2.8*	3.1*
A2.13	Consequences of opening auxiliary feeder bus (ED/G sub supply)	2.6*	2.8*
A2.14	Effects (verification) of stopping ED/G under load on isolated bus	2.7	2.9
A2.15	Water buildup in cylinders	2.6	3.1
A2.16	Loss of offsite power during full-load testing of ED/G	3.3	3.7
A2.17	Consequences of not shedding loads during nonoperability test	2.3*	2.6*
A2.18	Consequences of premature opening of breaker under load	2.6*	2.7
A2.19	Consequences of high VARS on ED/G integrity	2.5	2.7
A2.20	Identification and analysis of loads not shed during test	2.4*	2.7*
A2.21	Significance and interpretation of opening of ring bus during test	2.6*	2.9*
A2.22	Potential automatic safety sequences (water/CO2)and electrical damage (loose wires)	2.4	2.8*

A3 Ability to monitor automatic operation of the ED/G system, including:
(CFR: 41.7 / 45.5)

A3.01	Automatic start of compressor and ED/G	4.1	4.0
A3.02	Minimum time for load pickup	3.4	3.7
A3.03	Indicating lights, meters, and recorders	3.4	3.3
A3.04	Number of starts available with an air compressor	3.1	3.5
A3.05	Operation of the governor control of frequency and voltage control in parallel operation	2.8	2.9

A3.06	Start and stop	3.3	3.4
A3.07	Load sequencing	3.6*	3.7*
A3.08	Consequences of automatic transfer to automatic position after the ED/G is stopped	3.7?	4.0
A3.09	Functions (modes) of automatic transfer switch (to a startup bank)	4.0*	4.0
A3.10	Function of ED/G megawatt load controller	2.8	2.8*
A3.11	Need for setting offsite power breaker to automatic	3.1*	2.9*
A3.12	Purpose of automatic load sequencer	3.3*	3.5
A3.13	Rpm controller/megawatt load control (breaker-open/ breaker-closed effects)	3.0*	2.9

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

A4 01	Local and remote operation of the ED/G	4.0	4.3
A4 02	Adjustment of exciter voltage (using voltage control switch)	3.3	3.4
A4.03	Synchroscope	3.2	3.3
A4.04	Remote operation of the air compressor switch (different modes)	3.2*	3.2
A4.05	Transfer of ED/G control between manual and automatic	3.1	3.2
A4.06	Manual start, loading, and stopping of the ED/G	3.9	3.9
A4.07	Transfer ED/G (with load) to grid	3.4	3.4
A4.08	Opening of the ring bus	3.2*	3.2*
A4.09	Establishing power from the ring bus (to relieve ED/G)	3.2*	3.3*
A4.10	Need for, and consequences of, manually shedding (loads) safeguards bus	3.3	3.4
A4.11	The setting of droop voltage to zero	2.2	2.4
A4.12	Synchroscope	2.7*	2.6

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Safety Function 7: Instrumentation page

012 Reactor Protection System

TASK: Place an RPS channel in the tripped condition
Bypass a trip condition on a reactor protection panel
Monitor the RPS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause effect relationships between the RPS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	120V vital/instrument power system	3.4	3.7
K1.02	125V dc system	3.4	3.7
K1.03	CRDS	3.7	3.8
K1.04	RPIS	3.2*	3.3*
K1.05	ESFAS	3.8*	3.9
K1.06	T/G	3.1*	3.1
K1.07	SDS	3.2*	3.2*
K1.08	MFW	2.9*	3.1
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	RPS channels, components, and interconnections	3.3	3.7
K3	**Knowledge of the effect that a loss or malfunction of the RPS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	CRDS	3.9	4.0
K3.02	T/G	3.2*	3.3
K3.03	SDS	3.1*	3.3
K3.04	ESFAS	3.8*	4.1*
K4	**Knowledge of RPS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Trip logic when one channel OOC or in test	3.7	4.0
K4.02	Automatic reactor trip when RPS setpoints are exceeded for each RPS function; basis for each	3.9	4.3
K4.03	Function generator processing and combining of detector signals in RPS channels	2.3	2.7*
K4.04	Redundancy	3.1	3.3
K4 05	Spurious trip protection	2.7	2.9
K4 06	Automatic or manual enable/disable of RPS trips	3.2	3.5
K4.07	First-out indication	3.0	3.2*
K4.08	Logic matrix testing	2.8*	3.3*
K4.09	Separation of control and protection circuits	2.8	3.1

SYSTEM: **012 Reactor Protection System (RPS)**

K5	**Knowledge of the operational implications of the following concepts as the apply to the RPS:** (CFR: 41.5 / 45.7)		
K5.01	DNB	3.3*	3.8
K5.02	Power density	3.1*	3.3*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the RPS:** (CFR: 41.7 / 45/7)		
K6.01	Bistables and bistable test equipment	2.8	3.3
K6.02	Redundant channels	2.9	3.1
K6.03	Trip logic circuits	3.1	3.5
K6.04	Bypass-block circuits	3.3	3.6
K6.05	Test circuits	2.4	2.8
K6.06	Sensors and detectors	2.7*	2.8
K6.07	Core protection calculator	2.9*	3.2*
K6.08	COLSS	3.6*	3.7*
K6.09	CEAC	3.6*	3.7*
K6.10	Permissive circuits	3.3	3.5
K6.11	Trip setpoint calculators	2.9*	2.9

<u>ABILITY</u>

A1	**Ability to predict and/or monitor Changes in parameters (to prevent exceeding design limits) associated with operating the RPS controls including:** (CFR: 41.5 / 45.5)		
A1.01	Trip setpoint adjustment	2.9*	3.4*
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the RPS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.5)		
A2.01	Faulty bistable operation	3.1	3.6
A2.02	Loss of instrument power	3.6	3.9
A2.03	Incorrect channel bypassing	3.4	3.7
A2.04	Erratic power supply operation	3.1	3.2
A2.05	Faulty or erratic operation of detectors and function generators	3.1*	3.2*
A2.06	Failure of RPS signal to trip the reactor	4.4	4.7
A2.07	Loss of dc control power	3.2*	3.7

SYSTEM: **012 Reactor Protection System (RPS)**

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

A3.01	Individual channel	3.8	3.9
A3.02	Bistables	3.6	3.6
A3.03	Power supply	3.4	3.5
A3.04	Circuit breaker	2.8*	2.9
A3.05	Single and multiple channel trip indicators	3.6	3.7
A3.06	Trip logic	3.7	3.7
A3.07	Trip breakers	4.0	4.0

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

A4.01	Manual trip button	4.5	4.5
A4.02	Components for individual channels	3.3	3.4
A4.03	Channel blocks and bypasses	3.6	3.6
A4.04	Bistable, trips, reset and test switches	3.3*	3.3
A4.05	Channel defeat controls	3.6	3.6
A4.06	Reactor trip breakers	4.3	4.3
A4.07	M/G set breakers	3.9*	3.9*

015 Nuclear Instrumentation System

TASK:
Perform reactor power-range instrumentation calibration test
Perform axial power distribution monitoring test (alarm)
Perform calorimetric heat balance calculation
Perform hot-functional and low-power physics tests (meter refueling)
Perform source-range tests
Perform intermediate-range test
Perform power range permissives and trip test
Operate the scaler-timer
Operate the audio count-rate drawer
Perform a power imbalance calculation
Perform a quadrant-power-tilt calculation
Monitor the NIS
What if quadrant-power-tilt ratio exceeds tech-spec limits?
Perform full-core flux mapping

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the NIS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RPS	4.1	4.2
K1.02	Vital ac systems	3.4	3.6
K1.03	CRDS	3.1*	3.1
K1.04	ESF	3.5*	3.5*
K1.05	ICS	3.9*	3.9*
K1.06	Reactor regulating system	3.1*	3.4*
K1.07	Plant computer	2.4*	2.4
K1.08	RCS (pump start)	2.6*	2.9*
K2	**Knowledge of bus power supplies to the following**: (CFR: 41.7)		
K2.01	NIS channels, components, and interconnections	3.3	3.7
K3	**Knowledge of the effect that a loss or malfunction of the NIS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RPS	3.9	4.3
K3.02	CRDS	3.3*	3.5*
K3.03	Fuel handling system	2.7	3.4*
K3.04	ICS.	3.4*	4.0*
K3.05	Plant computer	2.3*	2.4
K3.06	Reactor regulating system	2.9*	3.2*

SYSTEM: **015 Nuclear Instrumentation System (NIS)**

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

K4.01	Source-range detector power shutoff at high powers	3.1	3.3
K4.02	Rod motion inhibits	3.7	3.9
K4.03	Reading of source range/intermediate range/power range outside control room	3.9*	4.0*
K4.04	Slow response time of SPNDs	3.4?	3.6?
K4.05	Reactor trip	4.3	4.5
K4.06	Reactor trip bypasses	3.9	4.2
K4.07	Permissives	3.7	3.8
K4.08	Automatic rod motion on demand signals	3.4	3.7
K4.09	Redundant sources of information on axial flux density distribution	2.8	3.3
K4.10	Redundant sources of information on power level	3.2	3.5

K5 **Knowledge of the operational implications of the following concepts as they apply to the NIS:**
(CFR: 41.5 / 45.7)

K5.01	Deleted		
K5.02	Discriminator/compensation operation	2.7	2.9
K5.03	Calibration adjustments	2.3*	2.6
K5.04	Factors affecting accuracy and reliability of calorimetric calibrations	2.6	3.1
K5.05	Criticality and its indications	4.1	4.4
K5.06	Subcritical multiplications and NIS indications	3.4	3.7
K5.07	Effects of burning on axial flux density	2.7?	2.9?
K5.08	Enthalpy	2.0	2.3*
K5.09	In-core detector operation	2.5	2.9
K5.10	Ex-core detector operation	2.8	3.0
K5.11	Axial flux imbalance, including long-range effects	3.3	3.7
K5.12	Quadrant power tilt, including long-range effects	3.2	3.6
K5.13	Peaking and hot-channel factor	3.1	3.5
K5.14	Neutron flux density, definition and relation to reactor power	2.8	3.1
K5.15	Effects of xenon on local flux, and factors affecting xenon concentrations	3.3	3.7
K5.16	Definition and calculation of quadrant tilt ratio	2.9	3.4
K5.17	DNB and DNBR definition and effects	3.5	3.7
K5.18	Definition of reactor poison	2.9	3.2
K5.19	Heat balance	2.9	3.2

SYSTEM: **015 Nuclear Instrumentation System (NIS)**

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the NIS:**
(CFR: 41.7 / 45.7)

K6.01	Sensors, detectors, and indicators	2.9	3.2
K6.02	Discriminator/compensation circuits	2.6	2.9
K6.03	Component interconnections	2.6	3.0
K6.04	Bistables and logic circuits	3.1	3.2
K6.05	Audio indication, including deaf spots in control room and containment	2.2	2.6
K6.06	Scaler-timers	2.1	2.6
K6.07	Imbalance indication	2.4	2.9*
K6.08	In-core detector locations, radially and axially	2.1	2.4

ABILITY

A1 **Ability to predict and/or monitor changes in parameters to prevent exceeding design limits) associated with operating the NIS controls including:**
(CFR: 41.5 . 45.5)

A1.01	NIS calibration by heat balance	3.5	3.8
A1.02	SUR	3.5	3.6
A1.03	NIS power indication	3.7	3.7
A1.04	Quadrant power tilt ratio	3.5	3.7
A1.05	Imbalance (axial shape)	3.7	3.9
A1.06	Fuel burnup	2.5*	2.9*
A1.07	Changes in boron concentration	3.3*	3.4*
A1.08	Changes in RCS temperature	3.3*	3.4

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

A2.01	Power supply loss or erratic operation	3.5	3.9
A2.02	Faulty or erratic operation of detectors or compensating components	3.1	3.5*
A2.03	Xenon oscillations	3.2	3.5*
A2.04	Effects on axial flux density of control rod alignment and sequencing, xenon production and decay, and boron vs. control rod reactivity changes	3.3	3.8
A2.05	Core void formation	3.3	3.8

SYSTEM: **015 Nuclear Instrumentation System (NIS)**

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

A3.01	Console and cabinet indications	3.8	3.8
A3.02	Annunciator and alarm signals	3.7	3.9
A3.03	Verification of proper functioning/operability	3.9	3.9
A3.04	Maximum disagreement allowed between channels	3.3	3.5
A3.05	Recognition of audio output expected for a given plant condition	2.6	2.7*
A3.06	Interpretation of in-core flux density maps from in-core detectors	2.4*	3.2*

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

A4.01	Selection of controlling NIS channel	3.6*	3.6*
A4.02	NIS indicators	3.9	3.9
A4.03	Trip bypasses	3.8	3.9

016 Non-Nuclear Instrumentation System (NNIS)

TASK: Line up the NNIS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the NNIS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RCS	3.4*	3.4*
K1.02	PZR LCS	3.4*	3.3*
K1.03	SDS	3.2*	3.2*
K1.04	MFW system	2.7*	2.7*
K1.05	Condensate	2.1*	2.2*
K1.06	AFW system	3.6*	3.5*
K1.07	ECCS	3.7*	3.7*
K1.08	PZR PCS	3.4*	3.4*
K1.09	ESFAS	3.7*	3.7*
K1.10	CCS	3.1*	3.1*
K1.11	MT/G	2.3*	2.2*
K1.12	S/G	3.5*	3.5*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	NNIS channels	2.4*	2.5*
K3	**Knowledge of the effect that a loss or malfunction of the NNIS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	3.4*	3.6*
K3.02	PZR LCS	3.4*	3.5*
K3.03	SDS	3.0*	3.1*
K3.04	MFW system	2.6*	2.7*
K3.05	Condensate	1.8*	2.0*
K3.06	AFW system	3.5*	3.7*
K3.07	ECCS	3.6*	3.7*
K3.08	PZR PCS	3.5*	3.7*
K3.09	ESFAS	3.5*	3.7*
K3.10	CCS	3.0*	3.2*
K3.11	MT/G	2.2*	2.2*
K3.12	S/G	3.4*	3.6*
K4	**Knowledge of NNIS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Reading of NNIS channel values outside control room	2.8*	2.9*

SYSTEM: **016 Non-Nuclear Instrumentation System (NNIS)**

K4.02	Sensing, signal processing, display, recording, and alarms	2.3*	2.7*
K4.03	Input to control systems	2.8*	2.9*

K5 **Knowledge of the operational implication of the following concepts as they apply to the NNIS:**
(CFR: 41.5 / 45.7)

K5.01	Separation of control and protection circuits	2.7*	2.8*

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the NNIS:**
(CFR: 41.7 / 45.7)

K6.01	Sensors and detectors	2.3*	2.5*

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the NNIS controls including:**
(CFR: 41.5 / 45.5)

None

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

A2.01	Detector failure	3.0*	3.1*
A2.02	Loss of power supply	2.9*	3.2*
A2.03	Interruption of transmitted signal	3.0	3.3*
A2.04	Voltage to instruments, both too high and too low	2.5*	2.6*

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

A3.01	Automatic selection of NNIS inputs to control systems	2.9*	2.9*
A3.02	Relationship between meter readings and actual parameter value	2.9*	2.9*

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

A4.01	NNI channel select controls	2.9*	2.8*
A4.02	Recorders	2.7	2.6*

017 In-Core Temperature Monitor System (ITM)

TASK: Operate the ITM
Monitor the ITM

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ITM system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Plant computer	3.2*	3.2*
K1.02	RCS	3.3	3.5
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.5)		
K2.01	ITM system	2.0	2.2
K3	**Knowledge of the effect that a loss or malfunction of the ITM system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Natural circulation indications	3.5*	3.7*
K4	**Knowledge of ITM system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Input to subcooling monitors	3.4	3.7
K4.02	Sensing and determination of location core hot spots	3.1	3.6
K4.03	Range of temperature indication	3.1	3.3
K5	**Knowledge of the operational implications of the following concepts as they apply to the ITM system:** (CFR: 41.5 / 45.7)		
K5.01	Temperature at which cladding and fuel melt	3.1	3.9
K5.02	Saturation and subcooling of water	3.7	4.0
K5.03	Indication of superheating	3.7	4.1
K6	**Knowledge of the effect of a loss or malfunction of the following ITM system components:** (CFR: 41.7 / 45.7)		
K6.01	Sensors and detectors	2.7	3.0

SYSTEM: 017 In-Core Temperature Monitor (ITM) System

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ITM system controls including:
(CFR: 41.5 / 45.7)

A1.01	Core exit temperature	3.7	3.9

A2 Ability to (a) predict the impacts of the following malfunctions or operations on the ITM system; and (b) based on those predictions, use procedures to correct, control or mitigate the consequences of those malfunctions or operations:
(CFR: 41.5 / 43.5 / 45.3 / 45.5)

A2.01	Thermocouple open and short circuits	3.1	3.5
A2.02	Core damage	3.6	4.1

A3 Ability to monitor automatic operation of the ITM system including:
(CFR: 41.7 / 45.5)

A3.01	Indications of normal, natural, and interrupted circulation of RCS	3.6*	3.8*
A3.02	Measurement of in-core thermocouple temperatures at panel outside control room	3.4*	3.1*

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

A4.01	Actual in-core temperatures	3.8	4.1
A4.02	Temperature values used to determine RCS/RCP operation during inadequate core cooling (i.e., if applicable, average of five highest values)	3.8	4.1

072 Area Radiation Monitoring (ARM) System

TASK:
Perform lineups of the ARM system
Perform the ARM instrumentation functional test
Operate ARM monitors
Monitor ARM operation
Perform the ARM equipment check

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ARM system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Plant ventilation systems	3.1*	3.5*
K1.02	Containment isolation	3.5	3.9
K1.03	Fuel building isolation	3.6*	3.7*
K1.04	Control room ventilation	3.3*	3.5*
K1.05	MRSS	2.8*	2.9*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Radiation monitoring systems	2.3*	2.5
K3	**Knowledge of the effect that a loss or malfunction of the ARM system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment ventilation isolation	3.2*	3.4*
K3.02	Fuel handling operations	3.1	3.5
K4	**Knowledge of ARM system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Containment ventilation isolation	3.3*	3.6*
K4.02	Fuel building isolation	3.2*	3.4*
K4.03	Plant ventilation systems	3.2*	3.6*
K5	**Knowledge of the operational implications of the following concepts as they apply to the ARM system:** (CFR: 41.5 / 45.7)		
K5.01	Radiation theory, including sources, types, units, and effects	2.7	3.0
K5.02	Radiation intensity changes with source distance	2.5	3.2

K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ARM system:** (CFR: 41.7 / 45.5 to 45.8)		
K6.01	Sensors and detectors	2.1	2.6
K6.02	Valves	1.6	1.9

K/A NO.	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ARM system controls including:** (CFR: 41.5 / 45.5)		
A1.01	Radiation levels	3.4	3.6
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the ARM system- and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 43.3 / 45.13)		
A2.01	Erratic or failed power supply	2.7	2.9
A2.02	Detector failure	2.8	2.9
A2.03	Blown power-supply fuses	2.7	2.9
A3	**Ability to monitor automatic operation of the ARM system, including:** (CFR: 41.7 / 45.5)		
A3.01	Changes in ventilation alignment	2.9*	3.1
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Alarm and interlock setpoint checks and adjustments	3.0*	3.3
A4.02	Major components	2.5*	2.5
A4.03	Check source for operability demonstration	3.1	3.1

073 Process Radiation Monitoring (PRM) System

TASK:
Perform lineups of air PRM system
Perform PRM instrumentation functional check
Operate the PRMs
Perform PRM equipment check
Monitor the PRM system

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the PRM system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Those systems served by PRMs	3.6	3.9
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Radiation monitoring systems	2.3*	2.7*
K3	**Knowledge of the effect that a loss or malfunction of the PRM system will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Radioactive effluent releases	3.6	4.2
K4	**Knowledge of PRM system design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Release termination when radiation exceeds setpoint	4.0	4.3
K4.02	Letdown isolation on high-RCS activity	3.3*	3.9*
K5	**Knowledge of the operational implications as they apply to concepts as they apply to the PRM system:** (CFR: 41.5 / 45.7)		
K5.01	Radiation theory, including sources, types, units, and effects	2.5	3.0
K5.02	Radiation intensity changes with source distance	2.5	3.1
K5.03	Relationship between radiation intensity and exposure limits	2.9*	3.4

SYSTEM: **073 Process Radiation Monitoring (PRM) System**

K6	**Knowledge of the effect of a loss or malfunction of the following will have on the PRM system:** (CFR: 41.7 / 45.7)		
K6.01	Sensors and detectors	2.2	2.4
K6.02	Moving filters	2.0	2.1
K6.03	Sample blowers	1.9	2.0
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PRM system controls including:** (CFR: 41.5 / 45.7)		
A1.01	Radiation levels	3.2	3.5
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the PRM system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)		
A2.01	Erratic or failed power supply	2.5	2.9*
A2.02	Detector failure	2.7	3.2
A2.03	Calibration drift	2.4	2.9*
A3	**Ability to monitor automatic operation of the PRM system, including:** (CFR: 41.7 / 45.5)		
	None		
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
A4.01	Effluent release	3.9	3.9
A4.02	Radiation monitoring system control panel	3.7	3.7
A4.03	Check source for operability demonstration	3.1	3.2

Safety Function 8: Plant Service Systems page

008 Component Cooling Water System (CCWS)

TASK:
Perform CCWS component operability test
Perform CCWS flow path verification
Perform CCWS pump test
Perform CCW flow balance
Determine CCWS leak rate from RCS
Perform lineups of the CCWS
Fill the CCWS
Fill the OCWS components
Start up the CCWS
Shut down the CCWS
Drain the CCWS (one loop)
Add chemical to the CCWS
Coordinate bleed and feed of component cooling system for chemistry control
Operate CCWS pumps in different combinations
Operate CCW heat exchangers in different combinations
Monitor component cooling system operation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the CCWS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.9)		
K1.01	SWS	3.1	3.1
K1.02	Loads cooled by CCWS	3.3	3.4
K1.03	PRMS	2.8*	3.0
K1.04	RCS, in order to determine source(s) of RCS leakage into the CCWS	3.3	3.3
K1.05	Sources of makeup water	3.0	3.1
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	CCW valves	2.1	2.2
K2.02	CCW pump, including emergency backup	3.0*	3.2*

SYSTEM: 008 Component Cooling Water System (CCWS)

K3 Knowledge of the effect that a loss or malfunction of the CCWS will have on the following:

K3.01	Loads cooled by CCWS	3.4	3.5
K3.02	CRDS	2.9	3.1
K3.03	RCP	4.1	4.2

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

K4.01	Automatic start of standby pump	3.1	3.3
K4.02	Operation of the surge tank, including the associated valves and controls . .	2.9	2.7
K4.03	Sensing elements for the measurement of flow rates for the total CCW flow rate and for the flow rates to the components	2.4*	2.4*
K4.04	Weir design aspect of the surge tank	2.1*	2.7*
K4.05	CCW pump pressure head and water inventory (capacity of CCWS surge tank	2.4	2.5
K4.06	Auxiliary building CCWS isolation	2.3*	2.6*
K4.07	Operation of the CCW swing-bus power supply and its associated breakers and controls	2.6*	2.7*
K4.08	Protection of ion exchange resins from high letdown temperature	2.3	2.3
K4.09	The "standby" feature for the CCW pumps	2.7	2.9

K5 Knowledge of the operational implications of the following concepts as they apply to the CCWS:
(CFR: 41.5 / 45.7)

K5.01	Chemistry control	1.8	2.3
K5.02	"Water hammer" and how such might be produced in the CCWS`	2.2*	2.3*
K5.03	Flow rate and velocity of a liquid and of a gas, including temperature effects and their various units of measure	1.7	2.1
K5.04	Purpose of venting components when filling or draining the CCWS	2.3	2.4
K5.05	Theory of the measurement of flow rate	1.6	1.8
K5.06	The concentration level of a chemical solution; how to change the concentration level	1.6	2.0*
K5.07	Causes and effects of corrosion on carbon steel and stainless steel; the effects on heat transfer through such materials	1.6	2.1
K5.08	Effects on corrosion rate of steels due to corrosion inhibiting chemicals .	1.5	2.1*
K5.09	Knowledge of which chemicals are used for corrosion inhibitors in the CCWS	1.6	2.1

SYSTEM: **008 Component Cooling Water System (CCWS)**

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the CCW:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.1
K6.02	Sensors and detectors	1.9	2.0
K6.03	Controllers and positioners	1.8	2.0
K6.04	Pumps	2.1	2.3*
K6.05	Motors	1.7	1.8
K6.06	Heat exchangers and condensers	2.1*	2.4*
K6.07	Breakers, relays, and disconnects	1.8	2.1

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the CCWS controls including**:
(CFR: 41.5 / 45.5)

A1.01	CCW flow rate	2.8	2.9
A1.02	CCW temperature	2.9	3.1
A1.03	CCW pressure	2.7	2.9
A1.04	Surge tank level	3.1	3.2

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

A2.01	Loss of CCW pump	3.3	3.6
A2.02	High/low surge tank level	3.2	3.5
A2.03	High/low CCW temperature	3.0	3.2
A2.04	PRMS alarm	3.3	3.5*
A2.05	Effect of loss of instrument and control air on the position of the CCW valves that are air operated	3.3*	3.5
A2.06	Calculation of required recirculation time for chemical addition	1.7*	2.0*
A2.07	Consequences of high or low CCW flow rate and temperature; the flow rate at which the CCW standby pump will start	2.5*	2.8*
A2.08	Effects of shutting (automatically or otherwise) the isolation valves of the letdown cooler	2.5	2.7*
A2.09	Results of excessive exit temperature from the letdown cooler, including the temperature effects on ion-exchange resins	2.3	2.8

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

A3.01	Setpoints on instrument signal levels for normal opera-tions, warnings, and trips that are applicable to the CCWS	3.2*	3.0
A3.02	Operation of the CCW pumps, including interlocks and the CCW booster pump	3.2	3.2
A3.03	All flow rate indications and the ability to evaluate the performance of this closed-cycle cooling system..	3.0	3.1
A3.04	Requirements on and for the CCWS for different condi-tions of the power plant	2.9	3.2
A3.05	Control of the electrically operated, automatic isolation valves in the CCWS	3.0	3.1
A3.06	Typical CCW pump operating conditions, including vibra-tion and sound levels and motor current	2.5	2.5
A3.07	Effects of recirculation within the CCWS	2.3*	2.2*
A3.08	Automatic actions associated with the CCWS that occur as a result of a safety injection signal	3.6*	3.7*
A3.09	Normal CRDM temperatures	2.4*	2.3
A3.10	CCW pump instruments and their respective sensors, including flow, pressure, oil level, and discharge temperature	2.9*	3.0

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

A4.01	CCW indications and controls	3.3	3.1
A4.02	Filling and draining operations of the CCWS including the proper venting of the components	2.5*	2.5
A4.03	Throttling of the CCW pump discharge valve	2.7*	2.5*
A4.04	Startup of a CCW pump when the system is shut down.	2.6*	2.6
A4.05	Normal CCW-header total flow rate and the flow rates to the components cooled by the CCWS	2.7*	2.5*
A4.06	Remote operation of hand-operated throttle valves to regulate CCW flow rate	2.5*	2.5
A4.07	Control of minimum level in the CCWS surge tank	2.9*	2.9
A4.08	CCW pump control switch	3.1*	2.8
A4.09	CCW temperature control valve	3.0*	2.9*
A4.10	Conditions that require the operation of two CCW coolers	3.1*	3.1
A4.11	CCW pump recirculation valve and its three-way control switch	3.0*	2.9*

029 Containment Purge System (CPS)

TASK: Perform lineups of the CPS
Start up the CPS
Shut down the CPS
Vent the containment building
Initiate a containment radiation signal

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Containment Purge System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Gaseous radiation release monitors	3.4	3.7
K1.02	Containment radiation monitor	3.3	3.6
K1.03	Engineered safeguards	3.6	3.8
K1.04	Purge system	3.0?	3.1?
K1.05	Containment air cleanup and recirculation system	2.9*	3.1*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Purge fans	2.1	2.3*
K2.02	Recirculation fans	2.0	2.4*
K2.03	Purge exhaust radiation monitors	2.3*	2.7*
K2.04	Purge valves	2.1	2.3
K2.05	Supply air heaters	1.7	1.9
K3	**Knowledge of the effect that a loss or malfunction of the Containment Purge System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment parameters	2.9	3.1
K3.02	Containment entry	2.9*	3.5*
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Use of filters for purging to the atmosphere	2.4	2.9
K4.02	Negative pressure in containment	2.9	3.1
K4.03	Automatic purge isolation	3.2*	3.5
K4 04	Prevention of damage to fans from lack of flow rate	2.4	2.6
K4.05	Temperature limits on dampers	2.0*	2.1*

K5 Knowledge of the operational implication of the following concepts as they apply to the Containment Purge System:
(CFR: 41.5 / 45.7)

K5.01	Maximum concentration permissible	2.4	2.9*
K5.02	Dilution	2.3	2.8

K6 Knowledge of the effect of a loss or malfunction on the following will have on the Containment Purge System:
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.0
K6.02	Sensors and detectors	2.1*	2.3*
K6.03	Controllers and positioners	1.9	2.1
K6.04	Pumps	1.6	1.9
K6.05	Motors	1.6	1.9
K6.06	Heat exchangers and condensers	1.8	1.9
K6.07	Breakers, relays, and disconnects	1.8	1.9

ABILITY

A1 Ability to predict and/or monitor changes in parameters to prevent exceeding design limits) associated with operating the Containment Purge System controls including:
(CFR: 41.5 / 45.5)

A1.01	Supply air temperature	1.9	2.1
A1.02	Radiation levels	3.4	3.4
A1.03	Containment pressure, temperature, and humidity	3.0*	3.3*

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

A2.01	Maintenance or other activity taking place inside containment	2.9	3.6
A2.02	Continuance of outdoor temperature inversion	2.2	2.9
A2.03	Startup operations and the associated required valve lineups	2.7	3.1
A2.04	Health physics sampling of containment atmosphere	2.5*	3.2*

A3 Ability to monitor automatic operation of the Containment Purge System including:
(CFR: 41.7 / 45.5)

A3.01	CPS isolation	3.8	4.0

SYSTEM: 029 Containment Purge System (CPS)

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

A4.01	Containment purge flow rate	2.5	2.5
A4.02	Outside atmospheric conditions (prior to purge)	2.2	2.5
A4.03	Inlet filtration and heating system	1.7	1.8
A4.04	Containment evacuation signal	3.5	3.6

033 Spent Fuel Pool Cooling System (SFPCS)

TASK: Fill the spent fuel pools
Operate the SFPCS between refueling pool and spent fuel pool
Perform BWST purification using filter/demineralizer
Lower refueling pool level (fuel transfer canal)
Perform decay heat removal using the SFPCS

K/A NO.	KNOWLEDGE.	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Spent Fuel Pool Cooling System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RCS	2.4	2.5
K1.02	RHRS	2.5	2.7
K1.03	SIS	2.4	2.5
K1.04	BWST	2.4	2.4
K1.05	RWST	2.7*	2.8*
K1.06	Boric acid storage tank	2.2	2.3
K1.07	Emergency makeup water systems	2.4	2.5
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	SFPCS components	1.9	2.1
K3	**Knowledge of the effect that a loss or malfunction of the Spent Fuel Pool Cooling System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Area ventilation systems	2.6	3.1
K3.02	Area and ventilation radiation monitoring systems	2.8	3.2
K3.03	Spent fuel temperature	3.0	3.3
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Maintenance of spent fuel level	2.9	3.2
K4.02	Maintenance of spent fuel cleanliness	2.5	2.7
K4.03	Anti-siphon devices	2.6	2.9
K4.04	Maintenance of spent fuel pool radiation	2.7?	2.9?
K4.05	Adequate SDM (boron concentration)	3.1	3.3

SYSTEM: 033 Spent Fuel Pool Cooling System (SFPCS)

K5	**Knowledge of the operational implication of the following concepts as they apply to the Spent Fuel Pool Cooling System:** (CFR: 41.5 / 45.7)			
K5.01	Pump theory	....	1.6	1.9
K5.02	Heat transfer	....	1.7	1.9
K5.03	D/P detector theory of OPS	....	1.5	1.6
K5.04	K-eff	....	2.1	2.3*
K5.05	Decay heat	....	2.1	2.3
K5.06	Shielding	....	2.1	2.5
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the Spent Fuel Pool Cooling System:** (CFR: 41.7 / 45.7)			
K6.01	Pumps	....	1.7	1.9
K6.02	Heat exchangers	....	1.8	1.9
K6.03	Valves	....	1.7	1.7
K6.04	Motors	....	1.7	1.7
K6.05	Pressure and pressure detectors	....	1.7	1.7
K6.06	Temperature sensors	....	1.8	1.8
K6.07	Filters and demineralizers	....	1.7	1.8
	<u>ABILITY</u>			
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with Spent Fuel Pool Cooling System operating the controls including:** (CFR: 41.5 / 45.5)			
A1.01	Spent fuel pool water level	....	2.7	3.3
A1.02	Radiation monitoring systems	....	2.8	3.3
A1.03	SFPCS controls and sensors	....	2.4	2.7
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the Spent Fuel Pool Cooling System ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:** (CFR: 41.5 / 43.5 / 45.3 / 45.13)			
A2.01	Inadequate SDM	....	3.0	3.5
A2.02	Loss of SFPCS	....	2.7	3.0
A2.03	Abnormal spent fuel pool water level or loss of water level	....	3.1	3.5
A3	**Ability to monitor automatic operation of the Spent Fuel Pool Cooling System including:** (CFR: 41.7 / 45.5)			
A3.01	Temperature control valves	....	2.5*	2.7*
A3.02	Spent fuel leak or rupture	....	2.9	3.1

SYSTEM: **033 Spent Fuel Pool Cooling System (SFPCS)**

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

A4.01	SFPCS pumps	2.4	2.9
A4.02	SFPCS valves	2.4	2.8
A4.03	Support systems for fill and transfer of SFPCS water	2.4	2.9
A4.04	Deleted		
A4.05	Deleted		
A4.06	Deleted		

034 Fuel Handling Equipment System (FHES)

TASK:

Operate the spent fuel handling machine/bridge/platform crane
Operate the new fuel elevator
Operate the refueling machine/main fuel handling bridge (fuel element change)
Operate the control rod change machine/fuel handling bridge/reactor building crane (control rod change)
Operate the fuel transfer system/fuel transfer carriages and upenders
Operate the auxiliary fuel handling bridge manipulator crane
Operate the auxiliary building overhead crane (general load handling)
What if a spent fuel assembly is dropped in containment?

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Fuel Handling System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RCS	2.5	3.2
K1.02	RHRS	2.5	3.2
K1.03	CVCS	2.1	2.7*
K1.04	NIS	2.6	3.5
K1 05	Shutdown monitor	2.5*	3.4*
K1 06	SFPCS	2.4	3.0*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	All fuel handling equipment (e.g., cranes, fuel elevators, handling bridge)	1.5	2.0
K2.02	Air supply	1.6	1.9
K2.03	Area monitors	1.9	2.2
K3	**Knowledge of the effect that a loss or malfunction of the Fuel Handling System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment ventilation	2.4*	2.9*
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Fuel protection from binding and dropping	2.6	3.4
K4.02	Fuel movement	2.5	3.3
K4.03	Overload protection	2.6	3.3

SYSTEM: 034 Fuel Handling Equipment System (FHES)

K5 Knowledge of the operational implication of the following concepts as they apply to the Fuel Handling System:
(CFR: 41.5 / 45.7)

K5.01	General principles of mechanical lifting	1.7?	2.1?
K5.02	Limiting of load	2.0	2.6
K5.03	Residual heat removal; decay	2.2	2.7

K6 Knowledge of the effect of a loss or malfunction on the following will have on the Fuel Handling System :
(CFR: 41.7 / 45.7)

K6.01	Fuel handling equipment	2.1	3.0
K6.02	Radiation monitoring systems	2.6	3.3

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the Fuel Handling System controls including:
(CFR: 41.5 / 45.5)

A1.01	Load limits	2.4	3.2
A1.02	Water level in the refueling canal	2.9	3.7

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

A2.01	Dropped fuel element	3.6	4.4
A2.02	Dropped cask	3.4	3.9
A2.03	Mispositioned fuel element	3.3	4.0

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

A3.01	Travel limits	2.5*	3.1
A3.02	Load limits	2.5*	3.1
A3.03	High flux at shutdown	2.9	3.3

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

A4.01	Radiation levels	3.3	3.7
A4.02	Neutron levels	3.5	3.9

075 Circulating Water System

TASK:
Perform circulating water/service water systems test
Remove marine growth from main condenser circulating water passages
Perform lineups of the circulating water system
Start up the circulating water system
Monitor circulating water system operations
Shut down the circulating water system
Operate the water box priming subsystem
Monitor water box priming subsystem operation
Monitor condenser cleaning subsystem operation
Start up and shut down the de-icing subsystem
Operate circulating water pumps in different combinations
Isolate a water box (salt water operations)
Restore flow to a water box
Operate the vacuum priming system on the circulating water system vacuum loop
Operate the cooling towers
Isolate a water box (fresh water)
Operate the cooling tower blowdown subsystem
Operate cooling tower makeup subsystem

K/A NO.	KNOWLEDGE`	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the circulating water system and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	SWS	2.5	2.5
K1.02	Liquid radwaste discharge	2.9	3.1
K1.03	Condenser	1.9	1.9
K1.04	S/GB	1.7	1.8
K1.05	MRSS and SDS	2.0	1.9
K1.06	Cooling towers	1.9*	1.7*
K1.07	Recirculation spray system	2.2*	2.1*
K1.08	Emergency/essential SWS	3.2*	3.2*
K1.09	Vacuum priming	1.5	1.4
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Circulating water pumps	1.6	1.7
K2.02	MOVs	1.7	1.7
K2.03	Emergency/essential SWS pumps	2.6*	2.7*
K2.04	Lube oil pumps	1.4*	1.4*

SYSTEM: **075 Circulating Water System**

K3 **Knowledge of the effect that a loss or malfunctions of the circulating water system will have on the following:**
(CFR: 41.7 / 45.6)

K3.01	SWS	2.3	2.6
K3.02	Main condenser	2.1	2.4
K3.03	SDS	2.3	2.4
K3.04	MT/G	1.9	2.1
K3.05	Recirculation spray system	2.1*	2.3*
K3.06	Plant efficiency	1.5	1.7
K3.07	ESFAS	3.4*	3.5*

K4 **Knowledge of circulating water system design feature(s) and interlock(s) which provide for the following:**
(CFR: 41.7)

K4.01	Heat sink	2.5	2.8
K4.02	Interlocks between circulating water system pumps and discharge valve	2.0*	2.1*
K4.03	Interlocks between circulating water system pumps and cooling tower pumps	1.7*	2.1*
K4.04	Automatic pickup of backup lube oil pumps (AC and DC)	1.7*	1.9
K4.05	Operation of condenser tube cleaning system	1.5*	1.5*
K4.06	Traveling screen operation	1.6	1.8
K4.07	Relationship between water box inlet valve position and circulating pump logic (including switching time required to close water box inlet valve switch)	1.7*	1.7*

K5 **Knowledge of the operational implications of the following concepts as they apply to the circulating water system:**
(CFR: 41.5 / 45.7)

K5.01	Definition and units of measure of a vacuum	1.4	1.5
K5.02	Purpose of a vacuum on the main condenser	1.5	1.5
K5.03	Factors that affect main condenser vacuum	1.5	1.6
K5.04	Principle of operation of the main condenser	1.4	1.6
K5.05	Principle of operation of the cooling towers	1.6*	1.9*
K5.06	Principle of cooling by evaporation	1.4	1.6
K5.07	Relationship of seawater temperature to marine growth	1.4*	1.6*
K5.08	Purpose of the vacuum priming system	1.6	1.6
K5.09	Relationship between circulating water conductivity and corrosion	1.5	1.7
K5.10	Damage to piping and components from hydraulic shock	1.7	1.8

SYSTEM: **075 Circulating Water System**

K6 **Knowledge of the effect of a loss or malfunction of the following will have on the circulating water system:**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.5	1.6
K6.02	Sensors and detectors	1.5	1.5
K6.03	Controllers and positioners	1.5	1.5
K6.04	Pumps	1.5	1.6
K6.05	Motors	1.5	1.5
K6.06	Breakers, relays, and disconnects	1.5	1.5

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the circulating water system controls including:**
(CFR: 41.5 / 45.5)

A1.01	Cooling water temperature	1.8	2.0
A1.02	Intake levels	2.2*	2.5
A1.03	Pump amperage (normal range and limitations)	1.7	1.7
A1.04	Pump oil levels and seal flows (normal range and limitations)	1.7	1.6
A1.05	Lube oil temperature and pressure	1.5	1.6
A1.06	Circulating water temperature (inlet and outlet)	1.7	1.7
A1.07	Circulating water pump motor current and pump discharge pressure	1.5	1.5
A1.08	Circulating water makeup pump motor current (within limits)	1.6*	1.6*
A1.09	Normal conditions for pump oil levels and seal water pressure	1.4	1.5

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

A2.01	Loss of intake structure	3.0*	3.2
A2.02	Loss of circulating water pumps	2.5	2.7
A2.03	Safety features and relationship between condenser vacuum, turbine trip, and steam dump	2.5	2.7*
A2.04	Effects of extremes in ambient temperature on cooling tower operation	1.8*	2.1*
A2.05	Potential damage to condenser from high discharge pressures of circulating water pump	1.6	1.6

A2.06	Operating two circulating water pumps when power level exceeds 50% of plant rating	1.7*	1.8*
A2.07	Potential effects of improper cooling water system flow	1.7	1.7
A2.08	Ice buildup on intake structure	2.0*	2.0*
A2.09	Operation of amertap ball collector flaps and screens in normal, backwash, and emergency backwash modes	1.7*	1.7*
A2.10	Automatic startup mode of water box priming pumps relative to specified minimum vacuum	1.5*	1.6*
A2.11	Time required for fill of piping by induction of water into circulating system using vacuum system	1.5*	1.6*

A3 Ability to monitor automatic operation of the circulating water system, including:
(CFR: 41.7 / 45.5)

A3.01	Automatic isolation of circulating water valves	2.1*	2.1*
A3.02	Alternate flow paths for circulating water	2.3*	2.3*
A3.03	Pump amperage (normal range and limitations).	1.7	1.7
A3.04	Pump oil levels and seal flows (normal range and limitations)	1.7	1.6
A3.05	Verification that pump discharge valve closes when circulating water pump stops	1.7	1.6
A3.06	Normal and abnormal collector flap differential pressures and setpoints	1.6*	1.5*
A3.07	Makeup flow control valve controller and indicator..	1.7*	1.6*

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

A4.01	Emergency/essential SWS pumps	3.2*	3.2*
A4.02	Circulating water pump	2.2*	2.3
A4.03	The circulating water system, such that the correct number of pumps are operating for all plant power levels	2.3*	2.2
A4.04	Air eductor system	1.8*	1.8*
A4.05	The circulating water system, to maintain a vacuum in the main condenser during shutdown as long as is necessary	2.3*	2.3
A4.06	Water box vacuum priming isolation valves, control switches, and indicators	1.8*	1.7*
A4.07	Vacuum priming tank/priming compressor controller	1.7*	1.6*
A4.08	Gland seal water supply system	1.6	1.6
A4.09	Circulating water box inlet and outlet valves	1.9*	1.8*
A4.10	Circulating water pump and circulating pump discharge valve	1.9	1.8

SYSTEM: 075 Circulating Water System

A4.11	Startup and shutdown of the circulating water pump	1.9	1.9
A4.12	Discharge valve interlock system	1.8*	1.7*
A4.13	Cooling tower operations	1.8*	1.7*
A4.14	Lube oil pumps for circulating water pump	1.5*	1.7*
A4.15	Operation of the vacuum priming system	1.4	1.5
A4.16	Traveling screens in manual operation	1.6	1.6
A4.17	Isolation of a water box	1.5	1.5
A4.18	Operation of the circulating water bay sluice gate	1.6*	1.7*
A4.19	De-icing valve	1.6*	1.7*
A4.20	Blowout preventers	1.7*	1.8*

078 Instrument Air System (IAS)

TASK: Perform lineups of the IAS
Start up the IAS
Monitor IAS
Shift instrument air compressors
Operate system air dryers
Perform testing of automatic operation of IAS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the IAS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Sensor air	2.8*	2.7*
K1.02	Service air	2.7*	2.8
K1.03	Containment air	3.3*	3.4*
K1.04	Cooling water to compressor	2.6	2.9
K1.05	MSIV air	3.4*	3.5*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Instrument air compressor	2.7	2.9
K2.02	Emergency air compressor	3.3*	3.5*
K3	**Knowledge of the effect that a loss or malfunction of the IAS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Containment air system	3.1*	3.4*
K3.02	Systems having pneumatic valves and controls	3.4	3.6
K3.03	Cross-tied units	3.0	3.4
K4	**Knowledge of IAS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Manual/automatic transfers of control	2.7	2.9
K4.02	Cross-over to other air systems	3.2	3.5
K4.03	Securing of SAS upon loss of cooling water	3.1*	3.3*
K5	**Knowledge of the operational implications of following concepts as they apply to the IAS:** (CFR: 41.5 / 45.7)		
K5.01	Gas laws	1.5	1.7
K5.02	Diesel effect	1.7	1.8

K6 **Knowledge of the effect of a loss or malfunction on the following will have on the IAS:**
(CFR: 41.7 / 45.7)

K6.01	Air compressors	2.4	2.6
K6.02	Pressure gauges	1.9	2.1
K6.03	Temperature indicators	1.8	2.1
K6.04	Service air refusal valve	2.2*	2.4*
K6.05	Air dryers	2.1	2.2
K6.06	Cross-tie valve	2.1	2.4
K6.07	Valves	1.7	1.9
K6.08	Sensors and detectors	1.7	1.9
K6.09	Controllers and positioners	1.7	2.1
K6.10	Motors	1.5	1.7
K6.11	Heat exchangers and condensers	1.6	1.7
K6.12	Breakers, relays, and disconnects	1.5	1.8
K6.13	Filters	1.6	1.9

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the IAS controls including:**
(CFR: 41.5 / 45.5)

None

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

A2.01	Air dryer and filter malfunctions	2.4	2.9

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

A3.01	Air pressure	3.1	3.2
A3.02	Air temperature	2.3	2.3

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

A4.01	Pressure gauges	3.1	3.1

079 Station Air System (SAS)

TASK: Perform lineups of SAS
Start up a station air compressor
Monitor SAS operation
Shut down the SAS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the SAS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	IAS	3.0	3.1
K1.02	Cooling water to compressor	2.2	2.2
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Station air compressors	2.3	2.3
K3	**Knowledge of the effect that a loss or malfunction of the SAS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Ventilation system	1.7	1.9
K4	**Knowledge of SAS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Cross-connect with IAS	2.9	3.2
K4.02	Automatic control of station air pressure	2.2	2.4
K5	**Knowledge of the operational implication of the following concepts as they apply to the SAS:** (CFR: 41.5 / 45.7)		
K5.01	Gas laws	1.4	1.6
K5.02	Diesel effect: safety implications	1.5	1.7
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the SAS:** (CFR: 41.7 / 45.7)		
K6.01	Valves	1.6	1.7
K6.02	Sensors and detectors	1.4	1.5
K6.03	Controllers and positioners	1.7	1.8
K6.04	Motors	1.3	1.4
K6.05	Heat exchangers and condensers	1.3	1.4
K6.06	Breakers, relays, and disconnects	1.4	1.4
K6.07	Filters	1.5	1.6

SYSTEM: **079 Station Air System (SAS)**

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the SAS controls including:**
(CFR: 41.5 / 45.5)

None

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

A2.01	Cross-connection with IAS	2.9	3.2

A3 **Ability to monitor automatic operation of the SAS including:**
(CFR: 41.7 / 45.5)

A3.01	Normal operating pressure	2.0*	2.1*
A3.02	Normal operating temperature	1.8	1.9
A3.03	Automatic start of the compressor	1.9	2.0

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

A4.01	Cross-tie valves with IAS	2.7	2.7
A4.02	Reduction of loads off SAS	2.1	2.1

086 Fire Protection System (FPS)

TASK: Perform lineup of the FPS
Place the FPS in standby
Shut down the FPS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Fire Protection System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	High-pressure service water	3.0*	3.4*
K1.02	Raw service water	2.7*	3.2*
K1.03	AFW system	3.4*	3.5*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
	None		
K3	**Knowledge of the effect that a loss or malfunction of the Fire Protection System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	Shutdown capability with redundant equipment	2.7	3.2
K4	**Knowledge of design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
K4.01	Adequate supply of water for FPS	3.1	3.7
K4.02	Maintenance of fire header pressure	3.0	3.4
K4.03	Detection and location of fires	3.1	3.7
K4.04	Personnel safety	3.1*	3.4
K4.05	Halon	3.0*	3.4*
K4.06	CO_2	3.0	3.3
K4.07	MT/G and T/G protection	2.5	2.8
K5	**Knowledge of the operational implication of the following concepts as they apply to the Fire Protection System:** (CFR: 41.5 / 45.7)		
K5.01	Effect of CO_2 on fire	2.2	2.6
K5.02	Effect of halon on fire	2.2	2.6
K5.03	Effect of water spray on electrical components	3.1	3.4
K5.04	Hazards to personnel as a result of fire type and methods of protection	2.9	3.5*

SYSTEM: **086 Fire Protection System (FPS)**

K6 **Knowledge of the effect of a loss or malfunction on the Fire Protection System following will have on the :**
(CFR: 41.7 / 45.7)

K6.01	Pumps	2.1	2.3
K6.02	Valves	1.9	1.9
K6.03	Motors	1.7	1.9
K6.04	Fire, smoke, and heat detectors	2.6	2.9

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with Fire Protection System operating the controls including:**
(CFR: 41.5 / 45.5)

A1.01	Fire header pressure	2.9	3.3
A1.02	Fire water storage tank level	3.0*	3.2*
A1.03	Fire doors	2.7	3.2*
A1.04	Fire dampers	2.7	3.3
A1.05	FPS lineups	2.9	3.1

A2 **Ability to (a) predict the impacts of the following 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 malfunctions or operations:**
(CFR: 41.5 / 43.5 / 45.3 / 45.13)

A2.01	Manual shutdown of the FPS	2.9	3.1
A2.02	Low FPS header pressure	3.0	3.3
A2.03	Inadvertent actuation of the FPS due to circuit failure or welding	2.7	2.9
A2.04	Failure to actuate the FPS when required, resulting in fire damage	3.3	3.9

A3 **Ability to monitor automatic operation of the Fire Protection System including:**
(CFR: 41.7 / 45.5)

A3.01	Starting mechanisms of fire water pumps	2.9	3.3
A3.02	Actuation of the FPS	2.9	3.3
A3.03	Actuation of fire detectors	2.9	3.3

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

A4.01	Fire water pumps	3.3	3.3
A4.02	Fire detection panels	3.5	3.5
A4.03	Fire alarm switch	3.5	3.4
A4.04	Fire water storage tank makeup pumps	3.4*	3.3*
A4.05	Deluge valves	3.0	3.5
A4.06	Halon system	3.2	3.2*

Safety Function 9:
Radioactivity Release — page

068 Liquid Radwaste System (LRS)

TASK:

Perform lineups of the reactor coolant waste (RCW) system (clean radwaste system)
Perform transfer operations from an RCW holdup/receiver tank
Perform transfer operations from a reactor coolant monitor tank
Perform transfer operations from reactor coolant drain/pressurizer relief tank
Monitor the RCW/boron recovery system
Start up the RCW/boron evaporator
Transfer waste/boron recovery evaporator concentrates
Shut down the RCW/boron recovery evaporator
Recirculate distillate through the polishing demineralizer
Perform transfer of distillate to primary water storage tank

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause effect relationships between the Liquid Radwaste System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	RCS and CVCS	2.4	2.6
K1.02	Waste gas vent header	2.5	2.6
K1.03	PRT	2.2	2.3
K1.04	Reactor drain tank	2.4*	2.5*
K1.05	CWS/CCWS	2.3	2.6
K1.06	Boron recovery equipment	2.1*	2.3*
K1.07	Sources of liquid wastes for LRS	2.7	2.9
K1.08	Auxiliary steam	1.9*	2.2*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Transfer pump	1.7*	1.9
K2.02	Automatic isolation valves	1.9	2.1
K2.03	Radiation monitors	2.1	2.2
K3	**Knowledge of the effect that a loss or malfunction of the Liquid Radwaste System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	CVCS	2.2	2.4
K3.02	WGDS	2.1	2.4

SYSTEM: 068 Liquid Radwaste System (LRS)

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

K4.01	Safety and environmental precautions for handling hot, acidic, and radioactive liquids	3.4	4.1

K5 Knowledge of the operational implication of the following concepts as they apply to the Liquid Radwaste System:
(CFR: 41.5 / 45.7)

K5.01	Thermal stress on equipment	1.7	2.2*
K5.02	Relationships between temperature and pressure of a water-based fluid	1.5	1.9
K5.03	Units of radiation, dose, and dose rate	2.6	2.6
K5.04	Biological hazards of radiation and the resulting goal of ALARA	3.2	3.5
K5.05	Relationship between evaporator reboiler steam pressure and the heatup rate	1.7	1.9
K5.06	Evaporation-condensation cycle of distilling units	1.6*	1.8*

K6 Knowledge of the effect of a loss or malfunction on the following will have on the Liquid Radwaste System :
(CFR: 41.7 / 45.7)

K6.01	Filters	1.7	1.9
K6.02	Demineralizers and ion exchangers	1.9	2.0
K6.03	Boron recovery evaporator	1.9	1.9
K6.04	Valves	1.8	1.9
K6.05	Pumps	1.7	1.8
K6.06	Controllers and positioners	1.7	1.7
K6.07	Sensors and detectors	1.9	1.9
K6.08	Breakers, relays, and disconnects	1.6	1.7
K6.09	Miscellaneous liquid radiation waste drain tanks and waste holdup tanks	1.9	2.1
K6.10	Radiation monitors	2.5	2.9
K6.11	Waste evaporators	1.8	2.1

ABILITY

A1 Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with Liquid Radwaste System operating the controls including:
(CFR: 41.5 / 45.5)

A1.01	Waste coolant monitor tank	2.2*	2.5*
A1.02	Evaporator pressure control	2.2*	2.3*

SYSTEM: **068 Liquid Radwaste System (LRS)**

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

A2.01	A boric-acid "freeze"	2.3?	2.2?
A2.02	Lack of tank recirculation prior to release	2.7*	2.8*
A2.03	Insufficient sampling frequency of the boric acid in the evaporator bottoms	2.5*	2.6*
A2.04	Failure of automatic isolation	3.3	3.3

A3 **Ability to monitor automatic operation of the Liquid Radwaste System including:**
(CFR: 41.7 / 45.5)

A3.01	Evaporator pressure control	2.5*	2.4*
A3.02	Automatic isolation	3.6	3.6

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

A4.01	Control board for boron recovery	2.7*	2.4*
A4.02	Remote radwaste release	3.2*	3.1*
A4.03	Stoppage of release if limits exceeded	3.9	3.8
A4.04	Automatic isolation	3.8	3.7

071 Waste Gas Disposal System (WGDS)

TASK:
Perform lineups of the WGDS
Start up the WGDS
Shift WGDS compressors
Shift waste gas decay tanks
Return gas to the CYCS holdup tank
Conduct authorized waste gas release
Monitor WGDS operation
Purge the waste gas surge tank and compressors
Sample the waste gas decay tanks
Recover from automatic termination of gas release due to PRMS system alarm
Shut down the WGDS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the Waste Gas Disposal System and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Nitrogen gas	2.1	2.1
K1.02	Sealing water	2.2	2.2
K1.03	LRS	2.1	2.1
K1.04	Station ventilation	2.7	2.8
K1.05	Meteorological tower	2.7	2.8
K1.06	ARM and PRM systems	3.1*	3.1
K1.07	RCS	2.1	2.1
K1.08	CVCS	2.2	2.2
K1.09	Plant sampling system	2.1	2.2
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	WGDS	1.9	2.1
K2.02	Isolation valve	2.0*	2.0
K2.03	ARM and PRM systems	2.1*	2.3
K3	**Knowledge of the effect that a loss or malfunction of the Waste Gas Disposal System will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	LRS	2.0	2.3
K3.02	CVCS	2.1	2.1
K3.03	RCS	2.2	2.1
K3.04	Ventilation system	2.7	2.9
K3.05	ARM and PRM systems	3.2	3.2

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

K4.01	Pressure capability of the waste gas decay tank	2.6	3.0
K4.02	Sealing water around the shaft of the gas compressor	2.5*	2.5*
K4.03	Tank loop seals	2.5*	2.6*
K4.04	Isolation of waste gas release tanks	2.9	3.4
K4.05	Point of release	2.7	3.0
K4.06	Sampling and monitoring of waste gas release tanks	2.7*	3.5*

K5 **Knowledge of the operational implication of the following concepts as they apply to the Waste Gas Disposal System:**
(CFR: 41.5 / 45.7)

K5.01	Relative pressure measurements	1.7	2.1
K5.02	Relationships and measurements of gas temperature, pressure, and flow rate	1.7	1.9
K5.03	Sources of hydrogen that could accumulate in the decay tank	2.3	2.9
K5.04	Relationship of hydrogen/oxygen concentrations to flammability	2.5	3.1
K5.05	Methods of measuring hydrogen gas concentration	2.1	2.7
K5.06	Radioactive decay	2.3	2.4

K6 **Knowledge of the effect of a loss or malfunction on the Waste Gas Disposal System following will have on the :**
(CFR: 41.7 / 45.7)

K6.01	Valves	1.9	2.1
K6.02	Sensors and detectors	1.9	1.9
K6.03	Controllers and positioners	1.8	1.9
K6.04	Pumps	1.6	1.7
K6.05	Motors	1.6	1.7
K6.06	Breakers, relays, and disconnects	1.7	1.8
K6.07	Compressors	1.9	2.1
K6.08	Rupture disks	2.2	2.5
K6.09	Waste gas header	2.3	2.5
K6.10	Surge and decay tanks	2.3	2.5

SYSTEM: **071 Waste Gas Disposal System (WGDS)**

A1 **Ability to predict and/or monitor changes in parameters(to prevent exceeding design limits) associated with Waste Gas Disposal System operating the controls including:**
(CFR: 41.5 / 45.5)

A1.01	Time response of radiation levels to release of waste gas	2.2	2.9
A1.02	Nitrogen addition to the decay tank	2.0	2.3
A1.03	Holdup tank pressure and level	2.3	2.4
A1.04	Waste gas header pressure vs. compressor operation	2.3	2.5
A1.05	Decay tank pressure vs. liquid levels	2.0	2.1
A1.06	Ventilation system	2.5	2.8
A1.07	Surge tank pressure and level	2.0	2.2

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

A2.01	Use of WGDS to prevent entry of oxygen into holdup tanks during liquid transfers	2.3?	2.8?
A2.02	Use of waste gas release monitors, radiation, gas flow rate, and totalizer	3.3	3.6
A2.03	Rupture disk failures	2.7*	3.3*
A2.04	Loss of cover gas	2.3*	2.7*
A2.05	Power failure to the ARM and PRM Systems	2.5*	2.6
A2.06	Supply failure to the isolation valve	2.4	2.5
A2.07	Loss of meteorological tower	2.5	2.9
A2.08	Meteorological changes	2.5	2.8*
A2.09	Stuck-open relief valve	3.0*	3.5*

A3 **Ability to monitor automatic operation of the Waste Gas Disposal System including:**
(CFR: 41.7 / 45.5)

A3.01	HRPS	2.6*	2.7*
A3.02	Pressure-regulating system for waste gas vent header	2.8	2.8
A3.03	Radiation monitoring system alarm and actuating signals	3.6	3.8

SYSTEM: **071 Waste Gas Disposal System (WGDS)**

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

A4.01	Valve to put the holdup tank into service; indications of valve positions and tank pressure	2.7*	2.2*
A4.02	Waste-gas compressor, including control switch, unloading valve, and drain valve	2.5*	2.3*
A4.03	Valves and indications for sealing water to the gas-compressor shaft	2.6*	2.2*
A4.04	Radwaste liquid transfer pumps	2.4	2.1*
A4.05	Gas decay tanks, including valves, indicators, and sample line	2.6*	2.6*
A4.06	Meteorological charts and recorders, along with the stop-time and waste-gas release number	2.8	3.3
A4.07	Waste gas release flow meter	3.0*	3.0*
A4.08	Nitrogen gas addition	2.3*	2.0*
A4.09	Waste gas release rad monitors	3.3	3.5
A4.10	WGDS sampling	2.5*	2.4*
A4.11	WGDS startup and shutdown	2.5*	2.3*
A4.12	Air purge of WGDS release radiation monitors	2.3*	2.4*
A4.13	Recovery from automatic termination of gas release due to PRM system alarm	3.0	3.1
A4.14	WDGS status alarms	2.8	3.0
A4.15	Procedure for putting the waste gas compressor in service and for removing it from service	2.4*	2.3*
A4.16	Waste gas decay tank shifts	2.5*	2.2*
A4.17	Stopping transfer of radioactive liquids to WGDS decay tank	2.6*	2.5*
A4.18	Operation of radwaste liquid transfer pumps	2.2*	2.0*
A4.19	Bringing an empty WDGS decay tank on line and shutting down a full tank	2.5*	2.2*
A4.20	Placing WGDS gas compressors in automatic operation	2.5*	2.2*
A4.21	Valve lineup for returning gas to the CVCS holdup tank from a waste gas decay tank	2.4*	2.1*
A4.22	Use of recycle gas header	2.3*	2.2*
A4.23	Procedure for regulating pressure in CVCS holdup tanks	2.3*	2.1*
A4.24	The double verification required before waste gas release	2.9*	3.4*
A4.25	Setting of process radiation monitor alarms, automatic functions, and adjustment of setpoints	3.2*	3.2
A4.26	Authorized waste gas release, conducted in compliance with radioactive gas discharge permit	3.1	3.9
A4.27	Opening and closing of the decay tank discharge control valve	3.0*	2.7*
A4.28	Nitrogen additions to the decay tank, and knowledge of limits	2.4*	2.4
A4.29	Sampling oxygen, hydrogen and nitrogen concentrations in WDGS decay tank; knowledge of limits	3.0*	3.6*
A4.30	Water drainage from the WGOS decay tanks	2.9*	2.6*

Generic Emergency Plant Evolutions page

EPE: 007 Reactor Trip

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the reactor trip:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Principles of neutron detection	2.4	2.9
EK1.02	Shutdown margin	3.4	3.8
EK1.03	Reasons for closing the main turbine governor valve and the main turbine stop valve after a reactor trip	3.7	4.0
EK1.04	Decrease in reactor power following reactor trip (prompt drop and subsequent decay)	3.6	3.9
EK1.05	Decay power as a function of time	3.3	3.8
EK1.06	Relationship of emergency feedwater flow to S/G and decay heat removal following reactor trip	3.7	4.1
EK2	**Knowledge of the interrelations between a reactor trip and the following:** (CFR 41.7 / 45.7)		
EK2.01	Sensors and detectors	2.3	2.3
EK2.02	Breakers, relays and disconnects	2.6	2.8
EK2.03	Reactor trip status panel	3.5	3.6
EK2.04	Controllers and positioners	2.3	2.4
EK3	**Knowledge of the reasons for the following as the apply to a reactor trip:** (CFR 41.5 /41.10 / 45.6 / 45.13)		
EK3.01	Actions contained in EOP for reactor trip	4.0	4.6
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a reactor trip:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	T/G controls	3.7	3.4
EA1.02	MFW System	3.8	3.7
EA1.03	RCS pressure and temperature	4.2	4.1
EA1.04	RCP operation and flow rates	3.6	3.7
EA1.05	Nuclear instrumentation	4.0	4.1
EA1.06	Reactor trip (scram): verification that the control and safety rods are in after the trip	4.4	4.5
EA1.07	MT/G trip; verification that the MT/G has been tripped	4.3	4.3
EA1.08	AFW System	4.4	4.3
EA1.09	CVCS	3.2	3.3
EA1.10	S/G pressure	3.7	3.7
EA2	**Ability to determine or interpret the following as they apply to a reactor trip:** (CFR 41.7 / 45.5 / 45.6)		
EA2.01	Decreasing power level, from available indications	4.1	4.3
EA2.02	Proper actions to be taken if the automatic safety functions have not taken place	4.3	4.6
EA2.03	Reactor trip breaker position	4.2	4.4

EPE: 007 Reactor Trip

EA2.04	If reactor should have tripped but has not done so, manually trip the reactor and carry out actions in ATWS EOP	4.4	4.6
EA2.05	Reactor trip first-out indication	3.4	3.9
EA2.06	Occurrence of a reactor trip	4.3	4.5

EPE: 009 Small Break LOCA

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the small break LOCA:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Natural circulation and cooling, including reflux boiling	4.2	4.7
EK1.02	Use of steam tables	3.5	4.2
EK2	**Knowledge of the interrelations between the small break LOCA and the following:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.2	2.3
EK2.02	Pumps	2.3	2.6*
EK2.03	S/Gs	3.0	3.3*
EK2.04	Sensors and detectors	2.3	2.6
EK3	**Knowledge of the reasons for the following responses as the apply to the small break LOCA:** (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	CCW System automatic isolation on high delta flow/ temperature to RCP thermal barrier	3.1*	3.6*
EK3.02	Opening excess letdown isolation valve	2.8*	3.2*
EK3.03	Reactor trip and safety initiation	4.1	4.4
EK3.04	Starting additional charging pumps	4.1	4.3
EK3.05	CCWS radiation alarm	3.4	3.8
EK3.06	RCS inventory balance	3.9	4.0
EK3.07	Increasing indication on CCWS process monitor: indicates in-leakage of radioactive liquids	3.3	3.6
EK3.08	PTS limits on RCS pressure and temperature - NC and FC	3.6	4.1
EK3.09	Closing CCW surge tank vent	3.1*	3.4*
EK3.10	Observation of PZR level	3.4	3.6
EK3.11	Dangers associated with inadequate core cooling	4.4	4.5
EK3.12	Letdown isolation	3.4	3.7
EK3.13	Stopping the affected RCP	3.4	3.7
EK3.14	Monitoring RCP lower bearings	3.1	3.2
EK3.15	Closing of RCP thermal barrier outlet valves	3.2	3.2
EK3.16	Containment temperature, pressure, humidity and level limits	3.8	4.1
EK3.17	Automatic isolation of containment	4.0	4.3
EK3.18	Monitoring containment radiation levels	3.9	4.3
EK3.19	Operator initiation of containment vent isolation/indication	3.6?	3.9?
EK3.20	Tech-Spec leakage limits	3.5	4.3
EK3.21	Actions contained in EOP for small break LOCA/leak	4.2	4.5
EK3.22	Maintenance of heat sink	4.4	4.5
EK3.23	RCP tripping requirements	4.2	4.3
EK3.24	ECCS throttling or termination criteria	4.1	4.6
EK3.25	Monitoring of in-core T-cold	3.6	3.9
EK3.26	Maintenance of RCS subcooling	4.4	4.5
EK3.27	Manual depressurization or HPI recirculation for sustained high pressure	3.6	3.8
EK3.28	Manual ESFAS initiation requirements	4.5	4.5

EPE: **009 Small Break LOCA**

ABILITY

EA1 **Ability to operate and monitor the following as they apply to a small break LOCA:**
(CFR 41.7 / 45.5 / 45.6)

EA1.01	RCS pressure and temperature	4.4	4.3
EA1.02	RB sump level	3.8	3.8
EA1.03	Low-pressure SWS activity monitor	3.2*	3.2*
EA1.04	CVCS	3.7*	3.5
EA1.05	CCWS	3.4*	3.4
EA1.06	Plant computer	3.0*	3.3
EA1.07	CCS	3.7	3.9
EA1.08	Containment isolation system	4.0	4.1
EA1.09	RCP	3.6	3.6
EA1.10	Safety parameter display system	3.8*	3.9*
EA1.11	AFW/MFW	4.1	4.1
EA1.12	RPS	4.2	4.2
EA1.13	ESFAS	4.4	4.4
EA1.14	Secondary pressure control	3.4	3.4
EA1.15	PORV and PORV block valve	3.9	4.1
EA1.16	Subcooling margin monitors	4.2	4.2
EA1.17	PRT	3.4	3.4
EA1.18	Balancing of HPI loop flows	3.4*	3.2*
EA1.19	LRS	2.3	2.4

EA2 **Ability to determine or interpret the following as they apply to a small break LOCA**:
(CFR 43.5 / 45.13)

EA2.01	Actions to be taken, based on RCS temperature and pressure, saturated and superheated	4.2	4.8
EA2.02	Possible leak paths	3.5	3.8
EA2.03	CCWS high-radiation alarm	3.4	3.8
EA2.04	PZR level	3.8	4.0
EA2.05	The time available for action before PZR is empty, given the rate of decrease of PZR level	3.4*	3.9
EA2.06	Whether PZR water inventory loss is imminent	3.8	4.3
EA2.07	CCWS surge tank vent isolation valve indication	2.7*	3.1*
EA2.08	Letdown isolation valve position indication	2.9*	2.9*
EA2.09	Low-pressure SWS activity monitor	2.8*	3.3*
EA2.10	Airborne activity	3.1	3.7
EA2.11	Containment temperature, pressure, and humidity	3.8	4.1
EA2.12	Charging pump ammeter	2.8	2.7
EA2.13	Charging pump flow indication	3.4	3.6
EA2.14	Actions to be taken if PTS limits are violated	3.8	4.4
EA2.15	RCS parameters	3.3	3.4
EA2.16	CCW suction pressure guage	2.3*	2.4
EA2.17	Total flow meter	3.3?	3.9?
EA2.18	CCW temperature indication for RCP oil coolers	2.3	2.6*
EA2.19	Containment air cooler run indication	2.7	3.1
EA2.20	Containment vent damper position indicator	2.6	2.9
EA2.21	Containment radiation trend recorder	3.4	3.9
EA2.22	Charging flow trend recorder	3.0*	3.3*
EA2.23	RCP operating parameters and limits	2.8	3.3

EPE: 009 Small Break LOCA

EA2.24	RCP temperature setpoints	2.6	2.9
EA2.25	Reactor trip setpoints	3.9	4.1
EA2.26	Activity waste tank level gauges	2.1*	2.5*
EA2.27	Activity waste tank trend recorder	2.1*	2.4*
EA2.28	Leak rate, from change in reactor coolant drain tank level	2.8	3.1*
EA2.29	CVCS pump indicating lights for determining pump status	3.2	3.4
EA2.30	Tech-Spec limits for plant operation with less than four loops	2.5*	3.5*
EA2.31	Tech-Spec limits for plant operation with an idle loop	2.5*	3.5*
EA2.32	SDM	3.2*	3.6*
EA2.33	RCS water inventory balance and Tech-Spec limits	3.3	3.8
EA2.34	Conditions for throttling or stopping HPI	3.6	4.2
EA2.35	Conditions for throttling or stopping reflux boiling spray	3.4*	4.1*
EA2.36	Difference between overcooling and LOCA indications	4.2	4.6
EA2.37	Existence of adequate natural circulation	4.2	4.5
EA2.38	Existence of head bubble	3.9	4.3
EA2.39	Adequate core cooling	4.3	4.7

EPE: 011 Large Break LOCA

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the Large Break LOCA :** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Natural circulation and cooling, including reflux boiling.	4.1	4.4
EK2	**Knowledge of the interrelations between the and the following Large Break LOCA:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.4	2.4
EK2.02	Pumps	2.6*	2.7*
EK3	**Knowledge of the reasons for the following responses as the apply to the Large Break LOCA**: (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Verifying main steam isolation valve position	3.4*	3.5*
EK3.02	Feedwater isolation	3.5*	3.7*
EK3.03	Starting auxiliary feed pumps and flow, ED/G, and service water pumps	4.1	4.3
EK3.04	Placing containment fan cooler damper in accident position	4.0*	4.3
EK3.05	Injection into cold leg	4.0*	4.1
EK3.06	Actuation of Phase A and B during LOCA initiation	4.3*	4.3*
EK3.07	Stopping charging pump bypass flow	3.5*	3.6*
EK3.08	Flowpath for sump recirculation	3.9	4.1
EK3.09	Maintaining D/Gs available to provide standby power	4.2	4.5
EK3.10	PTS limits on RCS pressure and temperature	3.7	3.9
EK3.11	NC and PC	3.3?	3.4?
EK3.12	Actions contained in EOP for emergency LOCA (large break)	4.4	4.6
EK3.13	Hot-leg injection/recirculation	3.8	4.2
EK3.14	RCP tripping requirement	4.1	4.2
EK3.15	Criteria for shifting to recirculation mode	4.3	4.4
EA1	**Ability to operate and monitor the following as they apply to a Large Break LOCA:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	Control of RCS pressure and temperature to avoid violating PTS limits	3.7*	3.8*
EA1.02	Reflux boiling sump level indicators	3.8	4.1
EA1.03	Securing of RCPs	4.0	4.0
EA1.04	ESF actuation system in manual	4.4	4.4
EA1.05	Manual and/or automatic transfer of suction of charging pumps to borated source	4.3	3.9
EA1 06	D/Gs	4.2	4.2
EA1.07	Containment isolation system	4.4	4.4
EA1.08	Valves to prevent water hammer	2.7*	2.6*
EA1.09	Core flood tank initiation	4.3	4.3
EA1.10	AFW and SWS pumps	4.1	3.8
EA1.11	Long-term cooling of core	4.2	4.2
EA1.12	Long-term containment of radioactivity	4.1	4.4

EPE: 011 Large Break LOCA

EA1.13	Safety injection components	4.1*	4.2
EA1.14	Subcooling margin monitors	3.9	4.1
EA1.15	RCS temperature and pressure	4.2	4.2
EA1.16	Balancing of HPI loop flows	3.5*	3.5*
EA1.17	Safety parameter display system	3.5*	4.1*

EA2 Ability to determine or interpret the following as they apply to a Large Break LOCA:
(CFR 43.5 / 45.13)

EA2.01	Actions to be taken, based on RCS temperature and pressure - saturated and superheated	4.2	4.7
EA2.02	Consequences to RHR of not resetting safety injection	3.3*	3.7*
EA2.03	Consequences of managing LOCA with loss of CCW	3.7	4.2
EA2.04	Significance of PZR readings	3.7	3.9
EA2.05	Significance of charging pump operation	3.3	3.7*
EA2.06	That fan is in slow speed and dampers are in accident mode during LOCA	3.7*	4.0*
EA2.07	That equipment necessary for functioning of critical pump water seals is operable	3.2?	3.4*
EA2.08	Conditions necessary for recovery when accident reaches stable phase	3.4*	3.9*
EA2.09	Existence of adequate natural circulation	4.2	4.3
EA2.10	Verification of adequate core cooling	4.5	4.7
EA2.11	Conditions for throttling or stopping HPI	3.9	4.3
EA2.12	Conditions for throttling or stopping reflux boiling spray	3.6*	3.8*
EA2.13	Difference between overcooling and LOCA indications	3.7*	3.7*
EA2.14	Actions to be taken if limits for PTS are violated	3.6*	4.0

EPE : 029 Anticipated Transient Without Scram (ATWS)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the ATWS:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Reactor nucleonics and thermo-hydraulics behavior	2.8	3.1
EK1.02	Definition of reactivity	2.6	2.8
EK1.03	Effects of boron on reactivity	3.6	3.8
EK1.04	Interpretation of terms: milliamps, logs, mils, percent, and reactivity units	2.2	2.5*
EK1.05	definition of negative temperature coefficient as applied to large PWR coolant systems	2.8	3.2
EK2	**Knowledge of the interrelations between the and the following an ATWS:** (CFR 41.7 / 45.7)		
EK2.01	Valves	1.9	2.1
EK2.02	Sensors and detectors	2.2	2.5
EK2.03	Controllers and positions	2.1	2.3
EK2.04	Pumps	2.1	2.1
EK2.05	Motors	1.9	1.9
EK2.06	Breakers, relays, and disconnects	2.9*	3.1*
EK3	**Knowledge of the reasons for the following responses as the apply to the ATWS**: (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Verifying a reactor trip; methods	4.2	4.5
EK3.02	Starting a specific charging pump	3.1	3.1
EK3.03	Opening BIT inlet and outlet valves	3.7*	3.6*
EK3.04	Closing the normal charging header isolation valves	3.1*	3.1*
EK3.05	Closing the centrifugal charging pump recirculation valve	3.4*	3.5*
EK3.06	Verifying a main turbine trip; methods	4.2	4.3
EK3.07	Using local turbine trip lever	3.1*	3.4*
EK3.08	Closing the main steam isolation valve	3.6*	3.8
EK3.09	Opening centrifugal charging pump suction valves from RWST	3.7*	4.0*
EK3.10	Manual rod insertion	4.1	4.1
EK3.11	Initiating emergency boration	4.2	4.3
EK3.12	Actions contained in EOP for ATWS	4.4	4.7
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a ATWS:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	Charging pumps	3.4*	3.1
EA1.02	Charging pump suction valves from RWST operating switch	3.6*	3.3
EA1.03	Charging pump suction valves from VCT operating switch	3.5*	3.2
EA1.04	BIT inlet valve switches	3.9*	3.8*
EA1.05	BIT outlet valve switches	3.7*	3.6*
EA1.06	Operating switches for normal charging header isolation valves	3.2*	3.1
EA1.07	Operating switch for charging pump recirculation valve	3.4*	3.1*
EA1.08	Reactor trip switch pushbutton	4.5	4.5

EPE: 029 Anticipated Transient Without Scram (ATWS)

EA1.09	Manual rod control	4.0	3.6
EA1.10	Rod control function switch	3.6	3.2
EA1.11	Manual opening of the CRDS breakers	3.9*	4.1
EA1.12	M/G set power supply and reactor trip breakers	4.1	4.0
EA1.13	Manual trip of main turbine	4.1	3.9
EA1.14	Driving of control rods into the core	4.2	3.9
EA1.15	AFW system	4.1	3.9

EA2 Ability to determine or interpret the following as they apply to a ATWS:
(CFR 43.5 / 45.13)

EA2.01	Reactor nuclear instrumentation	4.4	4.7
EA2.02	Reactor trip alarm	4.2	4.4
EA2.03	Centrifugal charging pump ammeter	2.9*	3.1*
EA2.04	CVCS centrifugal charging pump operating indication	3.2*	3.3*
EA2.05	System component valve position indications	3.4*	3.4*
EA2.06	Main turbine trip switch position indication	3.8	3.9
EA2.07	Reactor trip breaker indicating lights	4.2	4.3
EA2.08	Rod bank step counters and RPI	3.4	3.5
EA2.09	Occurrence of a main turbine/reactor trip	4.4	4.5
EA2.10	Positive displacement charging pumps	3.1*	3.4*

EPE: 038 Steam Generator Tube Rupture (SGTR)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the SGTR:** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Use of steam tables	3.1	3.4
EK1.02	Leak rate vs. pressure drop	3.2	3.5
EK1.03	Natural circulation	3.9	4.2
EK1.04	Reflux boiling	3.1*	3.3
EK2	**Knowledge of the interrelations between the and the following a SGTR:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.2*	2.2
EK2.02	Sensors and detectors	2.4	2.5
EK2.03	Controllers and positioners	2.1	2.2
EK2.04	Pumps	2.3*	2.4
EK2.05	Motors	2.1	2.2
EK2.06	Heat exchangers and condensers	2.1	2.4
EK2.07	Breakers, relays, and disconnects	2.1*	2.3
EK3	**Knowledge of the reasons for the following responses as the apply to the SGTR**: (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Equalizing pressure on primary and secondary sides of ruptured S/G	4.1	4.3
EK3.02	Prevention of secondary PORV cycling	4.4	4.5
EK3.03	Automatic actions associated with high radioactivity in S/G sample lines	3.6*	4.0*
EK3.04	Automatic actions provided by each PRM	3.9	4.1
EK3.05	Normal operating precautions to preclude or minimize SGTR	4.0	4.3
EK3.06	Actions contained in EOP for RCS water inventory balance, S/G tube rupture, and plant shutdown procedures	4.2	4.5
EK3.07	RCS loop isolation values	3.4*	3.8
EK3.08	Criteria for securing RCP	4.1	4.2
EK3.09	Criteria for securing/throttling ECCS	4.1	4.5
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a SGTR:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	S/G levels, for abnormal increase in any S/G	4.5	4.4
EA1.02	Steam and feedwater flow, for mismatched condition	4.2	4.1
EA1.03	SWS to the turbine building	1.9*	2.0
EA1.04	PZR spray, to reduce coolant system pressure	4.3	4.1
EA1.05	Maximum controlled depressurization rate for affected S/G	4.1	4.3
EA1.06	Cleanup of a contaminated S/G	2.1*	2.5*
EA1.07	PRT tank temperature, pressure, and setpoints	2.5*	2.6*
EA1.08	Core cooling monitor	3.7*	3.8*
EA1.09	PZR tank level/pressure indicators, gauges, and recorder.	3.2	3.3
EA1.10	Control room radiation monitoring indicators and alarms	3.7*	3.7
EA1.11	S/G level indicators	3.8	3.9
EA1.12	S/G blowdown line radiation monitors	4.3	4.3
EA1.13	Steam flow indicators	3.7*	3.6

EPE:	038 Steam Generator Tube Rupture (SGTR)		
EA1.14	AFW pump control and flow indicators	4.1	3.9
EA1.15	AFW source level and capacity (chart)	3.9	3.9
EA1.16	S/G atmospheric relief valve and secondary PORV controllers and indicators	4.4	4.3
EA1.17	S/G sample isolation valve indicators	3.2*	3.2
EA1.18	S/G blowdown valve indicators	4.0	3.9
EA1.19	MFW System status indicator	3.4	3.4
EA1.20	AFW flow control valve reset switches and indicators	3.8*	3.6*
EA1.21	Charging pump ammeter and running indicator	3.4*	3.1*
EA1.22	RHR operating pump ammeter and indicators	2.7*	2.6
EA1.23	Boric acid pumps	2.6*	2.5*
EA1.24	Safety injection pump ammeter and indicators	3.6*	3.4
EA1.25	CCW pump ammeter and indicators	2.6*	2.4
EA1.26	High-head safety injection mini-flow valves and position indicators	3.6	3.4
EA1.27	Steam dump valve status lights and indicators	3.9	3.9
EA1.28	Interlock between MSIV and bypass valve	3.6*	3.5
EA1.29	CVCS tank indicators and water charging sources	3.5*	3.3
EA1.30	Safety injection and containment isolation systems	4.0	3.8
EA1.31	Reactor trip breaker and safety injection interlock	4.1	4.0
EA1.32	Isolation of a ruptured S/G	4.6	4.7
EA1.33	Use of S/G for natural circulation cooldown	4.4	4.3
EA1.34	Obtaining shutdown with natural circulation	4.2	4.3
EA1.35	Steam dump condenser	3.5	3.6
EA1.36	Cooldown of RCS to specified temperature	4.3	4.5
EA1.37	Controlling of thermal shock during PZR spray operation	3.5*	3.4
EA1.38	PZR heaters	3.3*	3.3
EA1.39	Drawing S/G into the RCS, using the "feed and bleed" method	3.6*	3.7
EA1.40	Adding boron, to raise its ppm to the required shutdown concentration	4.0	4.0
EA1.41	Venting of the S/G to the atmosphere	3.4*	3.4*
EA1.42	Shutting of high-head safety injection mini-flow valves	3.3*	3.3*
EA1.43	Manual isolation of steam dump valves	3.6*	3.5*
EA1.44	Level operating limits for S/Gs	3.4*	3.4
EA1.45	Safely parameter display system	3.9*	4.0*

EA2 **Ability to determine or interpret the following as they apply to a SGTR**:
(CFR 43.5 / 45.13)

EA2.01	When to isolate one or more S/Gs	4.1	4.7
EA2.02	Existence of an S/G tube rupture and its potential consequences	4.5	4.8
EA2.03	Which S/G is ruptured	4.4	4.6
EA2.04	Radiation levels (MREM/hr)	3.9	4.2*
EA2.05	Causes and consequences of shrink and swell in S/Gs	2.8*	2.9
EA2.06	Shutdown margins and required boron concentrations	3.8	4.4
EA2.07	Plant conditions, from survey of control room indications	4.4	4.8
EA2.08	Viable alternatives for placing plant in safe condition when condenser is not available	3.8	4.4
EA2.09	Existence of natural circulation, using plant parameters.	4.2	4.2
EA2.10	Flowpath for charging and letdown flows	3.1	3.3
EA2.11	Local radiation reading on main steam lines	3.7*	3.9*
EA2.12	Status of MSIV activating system	3.9*	4.2
EA2.13	Magnitude of rupture	3.1*	3.7

EPE: 038 Steam Generator Tube Rupture (SGTR)

EA2.14	Magnitude of atmospheric radioactive release if cooldown must be completed using steam dumps or if atmospheric reliefs lift	3.3*	4.6
EA2.15	Pressure at which to maintain RCS during S/G cooldown	4.2	4.4
EA2.16	Actions to be taken if S/G goes solid and water enters steam line	4.2	4.6
EA2.17	RCP restart criteria	3.8	4.4

EPE: 055 Loss of Offsite and Onsite Power (Station Blackout)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the Station Blackout :** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Effect of battery discharge rates on capacity	3.3	3.7
EK1.02	Natural circulation cooling	4.1	4.4
EK2	**Knowledge of the interrelations between the and the following Station Blackout:** (CFR 41.7 / 45.7)		
EK2.01	Valves	2.0	2.2
EK2.02	Sensors, detectors and indicators	2.1*	2.2*
EK2.03	Controllers and positioners	1.9	2.1
EK2.04	Pumps		
EK2.05	Motors	2.0	2.2
EK2.06	Heat exchangers and condensers	1.7	2.1
EK2.07	Breakers, relays, and disconnects	2.2*	2.4*
EK3	**Knowledge of the reasons for the following responses as the apply to the Station Blackout**: (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Length of time for which battery capacity is designed	2.7	3.4
EK3.02	Actions contained in EOP for loss of offsite and onsite power	4.3	4.6
	ABILITY		
EA1	**Ability to operate and monitor the following as they apply to a Station Blackout:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	In-core thermocouple temperatures	3.7	3.9
EA1.02	Manual ED/G start	4.3	4.4
EA1.03	Manual MT jacking	1.9*	1.9*
EA1.04	Reduction of loads on the battery	3.5	3.9
EA1.05	Battery, when approaching fully discharged	3.3	3.6
EA1.06	Restoration of power with one ED/G	4.1	4.5
EA1.07	Restoration of power from offsite	4.3	4.5

EPE: **055 Loss of Offsite and Onsite Power (Station Blackout)**

EA2 **Ability to determine or interpret the following as they apply to a Station Blackout**:
(CFR 43.5 / 45.13)

EA2.01	Existing valve positioning on a loss of instrument air system	3.4	3.7
EA2.02	RCS core cooling through natural circulation cooling to S/G cooling	4.4	4.6
EA2.03	Actions necessary to restore power	3.9	4.7
EA2.04	Instruments and controls operable with only dc battery power available . . .	3.7	4.1
EA2.05	When battery is approaching fully discharged	3.4	3.7
EA2.06	Faults and lockouts that must be cleared prior to re- energizing buses	3.7	4.1

EPE: 074 Inadequate Core Cooling

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
EK1	**Knowledge of the operational implications of the following concepts as they apply to the Inadequate Core Cooling :** (CFR 41.8 / 41.10 / 45.3)		
EK1.01	Methods of calculating subcooling margin	4.3	4.7
EK1.02	Potential consequences of uncovering the core	4.6	4.8
EK1.03	Processes for removing decay heat from the core	4.5	4.9
EK1.04	Use of steam tables, including subcooled, saturated, and superheated regions	3.7	4.1
EK1.05	Definition of saturated liquid	2.8	3.2
EK1.06	Definition of superheated steam	3.0	3.3
EK1.07	Definition of saturated steam	2.8	3.2
EK1.08	Definition of subcooled liquid	2.8	3.1
EK1.09	Calculation of volume of water added to the RCS, using tank level indicators	3.1	3.6
EK2	**Knowledge of the interrelations between the and the following Inadequate Core Cooling:** (CFR 41.7 / 45.7)		
EK2.01	RCP	3.6	3.8
EK2.02	PORV	3.9	4.0
EK2.03	AFW pump	4.0	4.0
EK2.04	HPI pumps	3.9	4.1
EK2.05	LPI pumps	3.9	4.1
EK2.06	Turbine bypass and atmospheric dump valves	3.5*	3.6
EK2.07	Valves	2.4*	2.5
EK2.08	Sensors and detectors	2.5*	2.5
EK2.09	Controllers and positioners	2.6*	2.6*
EK2.10	Pumps	2.2	2.3
EK2.11	Motors	1.9	2.1
EK2.12	Heat exchangers and condensers	2.2	2.4
EK2.13	Breakers, relays, and disconnects	2.0	2.1
EK3	**Knowledge of the reasons for the following responses as the apply to the Inadequate Core Cooling**: (CFR 41.5 / 41.10 / 45.6 / 45.13)		
EK3.01	Maintaining cooldown rates within specified limits	3.4	4.2
EK3.02	Maintaining S/G level and pressure within specified limits	3.7	4.2
EK3.03	Placing the plant in hot standby status	3.4	3.8
EK3.04	Tripping RCPs	3.9	4.2
EK3.05	Activating the HPI system	4.2	4.5
EK3.06	Confirming that the PORV cycles open at the specified setpoint	3.9	4.2
EK3.07	Starting up emergency feedwater and RCPs	4.0	4.4
EK3 08	Securing RCPs	4.1	4.2
EK3 09	Opening the cross-connect valve from the LPI to the HPI suction	4.4*	4.6*
EK3.10	Isolating core flood tanks to prevent inadvertent discharge	3.5	3.8*
EK3.11	Guidance contained in EOP for Inadequate Core Cooling	4.0	4.4

EA1	**Ability to operate and monitor the following as they apply to a Inadequate Core Cooling:** (CFR 41.7 / 45.5 / 45.6)		
EA1.01	RCS water inventory	4.2	4.4
EA1.02	RCS cooldown rate	3.9	4.2
EA1.03	The alternate control station for turbine bypass valve operation	3.9*	3.9*
EA1.04	Turbine bypass or atmospheric dump valves, to obtain and maintain the desired pressure	3.9	4.1
EA1.05	PORV	3.9	4.1
EA1.06	RCPs	3.6	3.9
EA1.07	AFW System	4.2	4.3
EA1.08	HPI System	4.2	4.2
EA1.09	CVCS	3.7	3.8
EA1.10	Core flood system	4.0*	4.1*
EA1.11	Reactor building sump and its interlocks	3.6	3.7
EA1.12	RCS temperature and pressure indicators	4.1	4.4
EA1.13	Subcooling margin indicators	4.3	4.6
EA1.14	Alarm for loss of subcooling margin	4.1	4.2
EA1.15	Hot-leg and cold-leg temperature recorders	3.9	4.1
EA1.16	RCS in-core thermocouple indicators	4.4	4.6
EA1.17	S/G pressure and level indicators	4.0	4.1
EA1.18	AFW pump flow indicators and ammeter	3.9	3.9
EA1.19	AFW supply tank level indicators	3.7	3.8
EA1.20	ECCS pump flow meters, ammeters, and running lights	4.2	4.2
EA1.21	Condensate storage tank level gauge	3.7	3.7
EA1.22	AFW discharge control valve controllers, indicators, and lights	3.9	3.9
EA1.23	PORV block valve indicators, switches, controls (for both RCS and S/G)	3.9	4.0
EA1.24	Turbine bypass valve hand/automatic controls, indicators, and setpoints	3.6	3.8
EA1.25	Atmospheric dump valve controllers and indicators	3.8	3.8
EA1.26	Reactor building emergency sump isolation valve control switches and indicators	3.8*	3.8*
EA1.27	ECCS valve control switches and indicators	4.2	4.2
EA1.28	Core flood tank isolation valve controls and indicators	3.7*	3.9*
EA1.29	Quench tank temperature, pressure, and level instrumentation	3.4	3.7
EA2	**Ability to determine or interpret the following as they apply to a Inadequate Core Cooling**: (CFR 43.5 / 45.13)		
EA2.01	Subcooling margin	4.6	4.9
EA2.02	Availability of main or auxiliary feedwater	4.3	4.6
EA2.03	Availability of turbine bypass valves for cooldown	3.8	4.1
EA2.04	Relationship between RCS temperature and main steam pressure	3.7	4.2
EA2.05	Trends in water levels of PZR and makeup storage tank caused by various sized leaks in the RCS	3.4	4.2
EA2.06	Changes in PZR level due to PZR steam bubble transfer to the RCS during inadequate core cooling	4.0	4.6
EA2.07	The difference between a LOCA and inadequate core cooling, from trends and indicators	4.1	4.7
EA2.08	The effect of turbine bypass valve operation on RCS temperature and pressure	3.8	4.6*

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APE: 001 Continuous Rod Withdrawal

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Continuous Rod Withdrawal:** (CFR 41.8 / 41.10 / 45.3)		
AK1.01	Prompt criticality	3.4*	3.7
AK1.02	SUR	3.6	3.9
AK1.03	Relationship of reactivity and reactor power to rod movement	3.9	4.0
AK1.04	Effect of continuous rod withdrawal on insertion limits and SDM	3.7	3.9
AK1.05	Effects of turbine-reactor power mismatch on rod control	3.5	3.8
AK1.06	Relationship of reactivity and reactor power to rod movement	4.0	4.2
AK1.07	Effects of power level and control position on flux	3.5	3.8
AK1.08	Control rod motion on S/G pressure	2.9	3.2
AK1.09	Reason for use of pulse/analog converter (determination of actual rod positions)	2.1*	2.6
AK1.10	Definition of T-ave., T-ref., °F, linear scale, % megawatts, reactor power, Kg/fe, pcm, ? k/k, rate, % of level	2.4	2.6
AK1.11	Definitions of core quadrant power tilt	2.8	3.3
AK1.12	Long-range effects of core quadrant power tilt	2.8	3.8
AK1.13	Units of measure for power range indication	2.4	2.9
AK1.14	Interaction of ICS control stations as well as purpose, function, and modes of operation of ICS	3.4*	3.7
AK1.15	Theory of operation of rod drive motors	1.7	2.0
AK1.16	Definition and application of power defect	3.0	3.4
AK1.17	MTC	3.4	3.7
AK1.18	Fuel temperature coefficient	3.4	3.8
AK1.19	Voids coefficient	2.6	2.8
AK1.20	Differential rod worth	3.1	3.3
AK1.21	Integral rod worth	2.9	3.2
AK1.22	Delta flux (? I)	3.2	3.6
AK1.23	Calculation of power defect: algebraic sum of moderator temperature and fuel temperature defects	2.6	2.9
AK2.	**Knowledge of the interrelations between the Continuous Rod Withdrawal and the following:** (CFR 41.7 / 45.7)		
AK2.01	Rod bank step counters	2.9	3.2
AK2.02	Controllers and positioners	2.4	2.5
AK2.03	Sensors and detectors	2.3	2.6
AK2.04	Breakers, relays, disconnects, and control room switches	2.4	2.6
AK2.05	Rod motion lights	2.9*	3.1

APE: **001 Continuous Rod Withdrawal**

AK2.06	T-ave./ref. deviation meter	3.0*	3.1
AK2.07	Boric acid pump running lights	2.8	2.9
AK2.08	Individual rod display lights and indications	3.1	3.0

AK3. **Knowledge of the reasons for the following responses as they apply to the Continuous Rod Withdrawal:**
(CFR 41.5,41.10 / 45.6 / 45.13)

AK3.01	Manually driving rods into position that existed before start of casualty	3.2	3.6
AK3.02	Tech-Spec limits on rod operability	3.2	4.3

ABILITY

AA1. **Ability to operate and / or monitor the following as they apply to the Continuous Rod Withdrawal:**
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Bank select switch	3.5	3.2
AA1.02	Rod in-out-hold switch	3.6	3.4
AA1.03	Boric acid pump control switch	3.4	3.2
AA1.04	Operating switch for emergency boration motor-operated valve operating switch	3.8	3.6
AA1.05	Reactor trip switches	4.3	4.2
AA1.06	Rod transfer switches	3.0*	2.9*
AA1.07	RPI	3.3	3.1

AA2. **Ability to determine and interpret the following as they apply to the Continuous Rod Withdrawal:**
(CFR: 43.5 / 45.13)

AA2.01	Reactor tripped breaker indicator	4.2	4.2
AA2.02	Position of emergency boration valve	4.2	4.2
AA2.03	Proper actions to be taken if automatic safety functions have not taken place	4.5	4.8
AA2.04	Reactor power and its trend	4.2	4.3
AA2.05	Uncontrolled rod withdrawal, from available indications	4.4	4.6

APE: 003 Dropped Control Rod

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Dropped Control Rod: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Reason for turbine following reactor on dropped rod event	3.2	3.7
AK1.02	Effects of turbine-reactor power mismatch on rod control	3.1	3.4
AK1.03	Relationship of reactivity and reactor power to rod movement	3.5	3.8
AK1.04	Effects of power level and control position on flux	3.1	3.7
AK1.05	CVCS response to dropped rod	2.3*	2.6*
AK1.06	Control rod motion on S/G pressure	2.3	2.7
AK1.07	Effect of dropped rod on insertion limits and SDM	3.1	3.9
AK1.08	Reason for use of pulse/analog converter (determination of actual rod positions)	2.1*	2.5*
AK1.09	Definition of T-ave., T-ref., °F, linear scale, % megawatts, reactor power, Kw/ft, pcm, ? k/k, rate, % of level	2.3	2.6
AK1.10	Definitions of core quadrant power tilt	2.6	2.9
AK1.11	Long-range effects of core quadrant power tilt	2.5	3.5
AK1.12	Units of measure for power range indication	2.3*	2.5*
AK1.13	Interaction of ICS control stations as well as purpose, function, and modes of operation of ICS	3.2*	3.6
AK1.14	Theory of operation of rod drive motors	1.5	1.8
AK1.15	Definition and application of power defect	2.8	3.0
AK1.16	MTC	2.9	3.2
AK1.17	Fuel temperature coefficient	2.9	3.1
AK1.18	Voids coefficient	2.1	2.2
AK1.19	Differential rod worth	2.8	2.9
AK1.20	Integral rod worth	2.6	2.7
AK1.21	Delta flux (? I)	2.7	3.2
AK1.22	Calculation of power defect: algebraic sum of moderator temperature and fuel temperature defects	2.5	2.6
AK2.	**Knowledge of the interrelations between the Dropped Control Rod and the following: (CFR 41.7 / 45.7)**		
AK2.01	Controllers and positioners	2.1	2.1
AK2.02	Breakers, relays, and disconnects	2.1	2.2
AK2.03	Metroscope	3.1*	3.2*
AK2.04	Sensors and detectors	2.4	2.4
AK2.05	Control rod drive power supplies and logic circuits	2.5	2.8

APE: 003 Dropped Control Rod

AK3. Knowledge of the reasons for the following responses as they apply to the Dropped Control Rod:
(CFR 41.5,41.10 / 45.6 / 45.13)

AK3.01	When ICS logic has failed on a dropped rod, the load must be reduced until flux is within specified target bank	3.5*	3.9*
AK3.02	Reactor runback with a dropped control rod	3.3*	3.7
AK3.03	Turbine automatic runback with reactor in order to balance power output	3.4*	3.7*
AK3.04	Actions contained in EOP for dropped control rod	3.8*	4.1
AK3.05	Tech-Spec limits for reduction of load to 50% power if flux cannot be brought back within specified target band	3.4*	4.1*
AK3.06	Reset of demand position counter to zero	2.7*	3.0*
AK3.07	Tech-Spec limits for T-ave	3.8*	3.9*
AK3.08	Criteria for inoperable control rods	3.1	4.2
AK3.09	Recording of group bank position for dropped rod (reference point used to withdraw dropped rod to equal height with other rods in the bank)	3.0*	3.5*
AK3.10	RIL and PDIL	3.2?	4.2?

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the Dropped Control Rod:
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Demand position counter and pulse/analog converter	2.9*	2.9
AA1.02	Controls and components necessary to recover rod	3.6	3.4
AA1.03	Rod control switches	3.6	3.3
AA1.04	Control rod drive safety rod out limit bypass switch or key	3.4*	3.3
AA1.05	Reactor power - turbine power	4.1	4.1
AA1.06	RCS pressure and temperature	4.0	4.1
AA1.07	In-core and ex-core instrumentation	3.8	3.8

AA2. Ability to determine and interpret the following as they apply to the Dropped Control Rod:
(CFR: 43.5 / 45.13)

AA2.01	Rod position indication to actual rod position	3.7	3.9
AA2.02	Signal inputs to rod control system	2.7	2.8
AA2.03	Dropped rod, using in-core/ex-core instrumentation, in-core or loop temperature measurements	3.6	3.8
AA2.04	Rod motion stops due to dropped rod	3.4*	3.6*
AA2.05	Interpretation of computer in-core TC map for dropped rod location	2.5*	3.2*

APE: 005 Inoperable/Stuck Control Rod

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Inoperable / Stuck Control Rod: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Axial power imbalance	3.1	3.8
AK1.02	Flux tilt	3.1	3.9
AK1.03	Xenon transient	3.2	3 6
AK1.04	Definitions of axial imbalance, neutron error, power demand, actual power tracking mode, ICS tracking	3.0*	3.4*
AK1.05	Calculation of minimum shutdown margin	3.3	4.1
AK1.06	Bases for power limit, for rod misalignment	2.9	3.8
AK2.	**Knowledge of the interrelations between the Inoperable / Stuck Control Rod and the following: (CFR 41.7 / 45.7)**		
AK2.01	Controllers and positioners	2.5	2.5
AK2.02	Breakers, relays, disconnects, and control room switches	2.5	2.6
AK2.03	Metroscope	3.1*	3.3*
AK2.04	Sensors and detectors	2.4	2.6
AK3.	**Knowledge of the reasons for the following responses as they apply to the Inoperable / Stuck Control Rod: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Boration and emergency boration in the event of a stuck rod during trip or normal evolutions	4.0	4.3
AK3.02	Rod insertion limits	3.6	4.2
AK3.03	Tech-Spec limits for rod mismatch	3.6	4.1
AK3.04	Tech-Spec limits for inoperable rods	3.4	4.1
AK3.05	Power limits on rod misalignment	3.4	4.2
AK3.06	Actions contained in EOP for inoperable/stuck control rod	3.9	4.2
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Inoperable / Stuck Control Rod: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	CRDS	3.6	3.4
AA1.02	Rod selection switches	3.7	3.5
AA1.03	Metroscope	3.4*	3.4*
AA1.04	Reactor and turbine power	3.9	3.9
AA1.05	RPI	3.4	3.4
AA2.	**Ability to determine and interpret the following as they apply to the Inoperable / Stuck Control Rod: (CFR: 43.5 / 45.13)**		

APE: 005 Inoperable/Stuck Control Rod

AA2.01	Stuck or inoperable rod from in-core and ex-core NIS, in-core or loop temperature measurements	3.3	4.1
AA2.02	Difference between jog and run rod speeds, effect on CRDM of stuck rod	2.5*	3.0*
AA2.03	Required actions if more than one rod is stuck or inoperable	3.5	4.4
AA2.04	Interpretation of computer in-core TC map for dropped rod location	2.3*	3.4

APE: 008 Pressurizer (PZR) Vapor Space Accident (Relief Valve Stuck Open)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to a Pressurizer Vapor Space Accident: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Thermodynamics and flow characteristics of open or leaking valves	3.2	3.7
AK1.02	Change in leak rate with change in pressure	3.1	3.7
AK2.	**Knowledge of the interrelations between the Pressurizer Vapor Space Accident and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.7*	2.7
AK2.02	Sensors and detectors	2.7*	2.7
AK2.03	Controllers and positioners	2.5	2.4
AK2.04	Pumps	1.9	2.0
AK3.	**Knowledge of the reasons for the following responses as they apply to the Pressurizer Vapor Space Accident: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Why PZR level may come back on scale if RCS is saturated.	3.7	4.4
AK3.02	Why PORV or code safety exit temperature is below RCS or PZR temperature	3.6	4.1
AK3.03	Actions contained in EOP for PZR vapor space accident/ LOCA	4.1	4.6
AK3.04	RCP tripping requirements	4.2	4.6
AK3.05	ECCS termination or throttling criteria	4.0	4.5
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Pressurizer Vapor Space Accident: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	PZR spray block valve and PORV block valve	4.2	4.0
AA1.02	HPI pump to control PZR level/pressure	4.1	3.9
AA1.03	Turbine bypass in manual control to maintain header pressure	2.8	2.6
AA1.04	Feedwater pumps	2.8*	2.5
AA1.05	LPI System	3.4	3.3
AA1.06	Control of PZR level	3.6	3.6
AA1 07	Reseating of code safety and PORV	4.0	4.2
AA1 08	PRT level pressure and temperature	3.8	3.8

APE : 008 Pressurizer (PZR) Vapor Space Accident (Relief Valve Stuck Open)

AA2. Ability to determine and interpret the following as they apply to the Pressurizer Vapor Space Accident: (CFR: 43.5 / 45.13)

AA2.01	RCS pressure and temperature indicators and alarms	3.9	4.2
AA2.02	PZR spray valve position indicators and acoustic monitors	3.9	4.1
AA2.03	PORV position indicators and acoustic monitors	3.9	3.9
AA2.04	High-temperature computer alarm and alarm type	3.2	3.4
AA2.05	PORV isolation (block) valve switches and indicators	3.9	3.9
AA2.06	PORV logic control under low-pressure conditions	3.3	3.6
AA2.07	Feedwater flow indicators and pump controllers	2.4	2.4
AA2.08	Rod position indicators	2.1	2.2
AA2.09	PZR spray block valve controls and indicators	3.6	3.7
AA2.10	High-pressure injection valves and controllers	3.6	3.6
AA2.11	Turbine bypass header pressure indicators	2.3	2.4
AA2.12	PZR level indicators	3.4	3.7
AA2.13	High-pressure safety injection pump flow indicator, ammeter, and controller	3.8	3.9
AA2.14	Saturation temperature monitor	4.2	4.4
AA2.15	ESF control board, valve controls, and indicators	3.9	4.2
AA2.16	RCS in-core thermocouple indicators; use of plant computer for interpretation	3.8	4.1
AA2.17	Steam dump valve controller (position)	2.5	2.7*
AA2.18	Computer indications for RCS temperature and pressure	3.0	3.0*
AA2.19	PZR spray valve failure, using plant parameters	3.4	3.6
AA2.20	The effect of an open PORV on code safety, based on observation of plant parameters	3.4	3.6
AA2.21	The feed flow of different channels, using the feed regulator valve controller and indicators	2.1	2.2*
AA2.22	Consequences of loss of pressure in RCS; methods for evaluating pressure loss	3.8	4.2
AA2.23	Criteria for throttling high-pressure injection after a small LOCA	3.6	4.3
AA2.24	Value at which turbine bypass valve maintains header pressure after a reactor trip	2.6	2.6*
AA2.25	Expected leak rate from open PORV or code safety	2.8	3.4
AA2.26	Probable PZR steam space leakage paths other than PORV or code safety	3.1	3.4
AA2.27	Effects on indicated PZR pressure and/or level of sensing line leakage	2.9	3.2
AA2.28	Safety parameter display system indications	3.3*	3.9
AA2.29	The effects of bubble in reactor vessel	3.9	4.2
AA2.30	Inadequate core cooling	4.3	4.7

APE : 015/017 Reactor Coolant Pump (RCP) Malfunctions

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Reactor Coolant Pump Malfunctions (Loss of RC Flow): (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Natural circulation in a nuclear reactor power plant	4.4	4.6
AK1.02	Consequences of an RCPS failure	3.7	4.1
AK1.03	The basis for operating at a reduced power level when one RCP is out of service	3.0 *	4.0*
AK1.04	Basic steady state thermodynamic relationship between RCS loops and S/Gs resulting from unbalanced RCS flow	2.9	3.1*
AK1.05	Effects of unbalanced RCS flow on in-core average temperature, core imbalance, and quadrant power tilt	2.7	3.3
AK2.	**Knowledge of the interrelations between the Reactor Coolant Pump Malfunctions (Loss of RC Flow) and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.5	1.6
AK2.02	Sensors and detectors	2.0	2.1
AK2.03	Controllers and positioners	1.7	1.7
AK2.04	Pumps	2.0	2.1
AK2.05	Motors	1.9	2.0
AK2.06	Breaker, relays, and disconnects	1.6	1.7
AK2.07	RCP seals	2.9	2.9
AK2.08	CCWS	2.6	2.6
AK2.09	RCP flywheel	2.2	2.2
AK2.10	RCP indicators and controls	2.8*	2.8
AK3.	**Knowledge of the reasons for the following responses as they apply to the Reactor Coolant Pump Malfunctions (Loss of RC Flow) : (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Potential damage from high winding and/or bearing temperatures	2.5	3.1
AK3.02	CCW lineup and flow paths to RCP oil coolers	3.0	3.1
AK3.03	Sequence of events for manually tripping reactor and RCP as a result of an RCP malfunction	3.7	4.0
AK3.04	Reduction of power to below the steady state power- to-flow limit	3.1*	3.2*
AK3.05	Shift of T-ave. sensors to the loop with the highest flow	2.8*	3.0*
AK3.06	Performance of a core power map, calculations of quad-rant power tilt, monitoring of core imbalance	2.4	3.1*
AK3.07	Ensuring that S/G levels are controlled properly for natural circulation enhancement	4.1	4.2
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Reactor Coolant Pump Malfunctions (Loss of RC Flow): (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	RCP lube oil system	2.4*	2.4

APE : 015/017 Reactor Coolant Pump (RCP) Malfunctions

AA1.02	RCP oil reservoir level and alarm indicators	2.8	2.7
AA1.03	Reactor trip alarms, switches, and indicators	3.7*	3.8
AA1.04	RCP ventilation cooling fan run indicators	2.5	2.5
AA1.05	RCS flow	3.8	3.8
AA1.06	CCWS	3.1	2.9
AA1.07	RCP seal water injection subsystem	3.5	3.4
AA1.08	S/G LCS	3.0*	2.9
AA1.09	RCS temperature detection subsystem	3.1	3.2
AA1.10	RCP ammeter and trip alarm	2.7	2.6
AA1.11	RCP on/off and run indicators	2.5	2.4
AA1.12	Reactor coolant loop flow meters	2.8*	3.1
AA1.13	Reactor power level indicators	3.4*	3.4*
AA1.14	Power range remote flux meter	2.9*	3.0*
AA1.15	High-power/low-flow reactor trip block status lights	3.5*	3.6*
AA1.16	Low-power reactor trip block status lights	3.2*	3.5*
AA1.17	Station auxiliary transformer volt-amp meters	2.2*	2.2
AA1.18	Station auxiliary power supply breakers and indicators	2.3*	2.4
AA1.19	Power transfer confirm lamp	2.9*	3.0*
AA1.20	RCP bearing temperature indicators	2.7	2.7
AA1.21	Development of natural circulation flow	4.4	4.5
AA1.22	RCP seal failure/malfunction	4.0	4.2
AA1.23	RCP vibration	3.1	3.2

AA2. Ability to determine and interpret the following as they apply to the Reactor Coolant Pump Malfunctions (Loss of RC Flow): (CFR: 43.5 / 45.13)

AA2.01	Cause of RCP failure	3.0	3.5*
AA2.02	Abnormalities in RCP air vent flow paths and/or oil cooling system	2.8	3.0
AA2.03	Temperature differential across the RCP oil cooler	2.2	2.2
AA2.04	Temperature differential across the RCP air cooler	1.9	2.1
AA2.05	Relationship between RCP ammeter readings and RCS average temperature	1.9	2.2
AA2.06	Relationship between cooling air flow and oil reservoir temperature/level for RCP	1.8	2.3
AA2.07	Calculation of expected values of flow in the loop with RCP secured	2.1	2.9
AA2.08	When to secure RCPs on high bearing temperature	3.4	3.5
AA2.09	When to secure RCPs on high stator temperatures	3.4	3.5
AA2.10	When to secure RCPs on loss of cooling or seal injection	3.7	3.7
AA2.11	When to jog RCPs during ICC	3.4*	3.8*

APE: 022 Loss of Reactor Coolant Makeup

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Reactor Coolant Pump Makeup: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Consequences of thermal shock to RCP seals	2.8	3.2*
AK1.02	Relationship of charging flow to pressure differential between charging and RCS	2.7	3.1
AK1.03	Relationship between charging flow and PZR level	3.0	3.4
AK1.04	Reason for changing from manual to automatic control of charging flow valve controller	2.9	3.0
AK2.	**Knowledge of the interrelations between the Loss of Reactor Coolant Pump Makeup and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.4	2.4
AK2.02	Sensors and detectors	1.9	2.1
AK2.03	Controllers and positioners	2.2	2.3
AK2.04	Pumps	2.3	2.3
AK2.05	Motors	2.1	2.1
AK2.06	Heat exchangers and condensers	1.9	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Reactor Coolant Pump Makeup: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Adjustment of RCP seal backpressure regulator valve to obtain normal flow	2.7	3.1
AK3.02	Actions contained in SOPs and EOPs for RCPs, loss of makeup, loss of charging, and abnormal charging	3.5	3.8
AK3.03	Performance of lineup to establish excess letdown after determining need	3.1*	3.3*
AK3.04	Isolating letdown	3.2	3.4
AK3.05	Need to avoid plant transients	3.2	3.4
AK3.06	RCP thermal barrier cooling	3.2	3.3
AK3.07	Isolating charging	3.0*	3.2

APE: 022 Loss of Reactor Coolant Makeup

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the Loss of Reactor Coolant Pump Makeup: (CFR 41.7 / 45.5 / 45.6)

AA1.01	CVCS letdown and charging	3.4	3.3
AA1.02	CVCS charging low flow alarm, sensor, and indicator	3.0	2.9
AA1.03	PZR level trend	3.2	3.2
AA1.04	Speed demand controller and running indicators (positive displacement pump)	3.3	3.2*
AA1.05	RCP seal back pressure regulator valves and flow indicators	2.9*	2.8*
AA1.06	CVCS charging pump ammeters and running indicators	2.9	2.7
AA1.07	Excess letdown containment isolation valve switches and indicators	2.8*	2.7*
AA1.08	VCT level	3.4	3.3
AA1.09	RCP seal flows, temperatures, pressures, and vibrations	3.2	3.3

AA2. Ability to determine and interpret the following as they apply to the Loss of Reactor Coolant Pump Makeup: (CFR: 43.5 / 45.13)

AA2.01	Whether charging line leak exists	3.2	3.8
AA2.02	Charging pump problems	3.2	3.7
AA2.03	Failures of flow control valve or controller	3.1	3.6
AA2.04	How long PZR level can be maintained within limits	2.9	3.8

APE: 024 Emergency Boration

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Emergency Boration: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Relationship between boron addition and change in T-ave	3.4	3.8
AK1.02	Relationship between boron addition and reactor power	3.6	3.9
AK1.03	Calculation of boration time from volumetric boron addition and addition rate	2.4	2.9
AK1.04	Low temperature limits for boron concentration	2.8	3.6
AK2.	**Knowledge of the interrelations between the Emergency Boration and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.7	2.7
AK2.02	Sensors and detectors	2.1	2.2
AK2.03	Controllers and positioners	2.6	2.5
AK2.04	Pumps	2.6	2.5
AK2.05	Motors	2.1	2.1
AK2.06	Breakers, relays, and disconnects	2.0	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Emergency Boration: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	When emergency boration is required	4.1	4.4
AK3.02	Actions contained in EOP for emergency boration	4.2	4.4
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Emergency Boration: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Use of spent fuel pool as backup to BWST	2.7*	3.4*
AA1.02	Boric acid pump	3.7	3.5
AA1.03	Boric acid controller	3.5	3.3
AA1.04	Manual boration valve	3.6*	3.7
AA1.05	Performance of letdown system during emergency boration	3.1	3.2

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AA1.06	BWST temperature	3.2	3.1
AA1.07	BWST level	3.3	3.4
AA1.08	Pump speed controlled to protect pump seals	2.7*	3.0*
AA1.09	Safety injection	3.5*	3.5*
AA1.10	CVCS centrifugal charging pumps	3.5*	3.4*
AA1.11	BIT suction and recirculation valves	2.9*	2.7*
AA1.12	Normal boron flow meter	2.4	2.3
AA1.13	Boric acid flow controller	3.2	3.0
AA1.14	RCS makeup isolation valve indicators	2.6*	2.4
AA1.15	Boric acid transfer pump speed selector switch and running lights	3.1*	2.9*
AA1.16	T-ave. meters	3.3	3.2
AA1.17	Emergency borate control valve and indicators	3.9	3.9
AA1.18	Emergency boron flow meter	3.7*	3.6*
AA1.19	Makeup control system selector switch for CVCS isolation valve	3.2*	3.1*
AA1.20	Manual boration valve and indicators	3.2*	3.3
AA1.21	CVCS charging pump miniflow isolation valves and indicators	2.8*	2.7*
AA1.22	Safety injection valves, switches, flow meters, and indicators	3.2*	3.2
AA1.23	CVCS centrifugal charging pump switches and indicators	3.3*	3.3*
AA1.24	BIT inlet and outlet valve switches and indicators	3.2*	3.1*
AA1.25	Boration valve indicators	3.4*	3.3
AA1.26	Boric acid storage tank	3.3	3.3

AA2. Ability to determine and interpret the following as they apply to the Emergency Boration:
(CFR: 43.5 / 45.13)

AA2.01	Whether boron flow and/or MOVs are malfunctioning, from plant conditions	3.8*	4.1
AA2.02	When use of manual boration valve is needed	3.9	4.4
AA2.03	Correlation between boric acid controller setpoint and boric acid flow	2.9*	3.0
AA2.04	Availability of BWST	3.4	4.2
AA2.05	Amount of boron to add to achieve required SDM	3.3	3.9
AA2.06	When boron dilution is taking place	3.6	3.7

APE: 025 Loss of Residual Heat Removal System (RHRS)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Residual Heat Removal System: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Loss of RHRS during all modes of operation	3.9	4.3
AK2.	**Knowledge of the interrelations between the Loss of Residual Heat Removal System and the following: (CFR 41.7 / 45.7)**		
AK2.01	RHR heat exchangers	2.9	2.9
AK2.02	LPI or Decay Heat Removal/RHR pumps	3.2*	3.2
AK2.03	Service water or closed cooling water pumps	2.7	2.7
AK2.04	Raw water or sea water pumps	2.4	2.4
AK2.05	Reactor building sump	2.6	2.6
AK2.06	Valves	2.2	2.1
AK2.07	Sensors and detectors	2.1	2.2
AK2.08	Controllers and positioners	2.2	2.2
AK2.09	Pumps	2.2	2.2
AK2.10	Motors	1.8	1.7
AK2.11	Heat exchangers and condensers	2.1*	2.1
AK2.12	Breakers, relays, and disconnects	1.7	1.8
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Residual Heat Removal System: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Shift to alternate flowpath	3.1	3.4
AK3.02	Isolation of RHR low-pressure piping prior to pressure increase above specified level	3.3	3.7
AK3.03	Immediate actions contained in EOP for Loss of RHRS	3.9	4.1

APE: **025 Loss of Residual Heat Removal System (RHRS)**

ABILITY

AA1. **Ability to operate and / or monitor the following as they apply to the Loss of Residual Heat Removal System:**
(CFR 41.7 / 45.5 / 45.6)

AA1.01	RCS/RHRS cooldown rate	3.6	3.7
AA1.02	RCS inventory	3.8	3.9
AA1.03	LPI pumps	3.4	3.3
AA1.04	Closed cooling water pumps	2.8*	2.6
AA1.05	Raw water or sea water pumps	2.7	2.6
AA1.06	Not Used	N/A	N/A
AA1.07	Not Used	N/A	N/A
AA1.08	RHR cooler inlet and outlet temperature indicators	2.9*	2.9
AA1.09	LPI pump switches, ammeter, discharge pressure gauge, flow meter, and indicators	3.2	3.1
AA1.10	LPI pump suction valve and discharge valve indicators	3.1*	2.9
AA1.11	Reactor building sump level indicators	2.9	3.0
AA1.12	RCS temperature indicators	3.6	3.5
AA1.13	SWS radiation monitors	2.5	2.6
AA1 14	Waste tank radiation monitors	2.1*	2.1
AA1.15	Waste tank level gauges and recorders	2.1	2.1
AA1.16	Service water pump manual switch, flow gauge, running lights, and ammeters	2.2	2.2
AA1.17	Service water block valve indicators and flow valve controllers	2.1	2.0*
AA1.18	LPI header cross-connect valve controller and indicators	2.6*	2.8*
AA1.19	Block orifice bypass valve controller and indicators	2.6*	2.4*
AA1.20	HPI pump control switch, indicators, ammeter running lights, and flow meter	2.6*	2.5*
AA1.21	Letdown flow indicator	2.3	2.5
AA1.22	Obtaining of water from BWST for LPI system	2.9*	2.8
AA1.23	RHR heat exchangers	2.8	2.9

AA2. **Ability to determine and interpret the following as they apply to the Loss of Residual Heat Removal System:**
(CFR: 43.5 / 45.13)

AA2.01	Proper amperage of running LPI/decay heat removal/RHR pump(s)	2.7	2.9
AA2.02	Leakage of reactor coolant from RHR into closed cooling water system or into reactor building atmosphere	3.4	3.8
AA2.03	Increasing reactor building sump level	3.6	3.8
AA2.04	Location and isolability of leaks	3.3*	3.6
AA2.05	Limitations on LPI flow and temperature rates of change	3.1*	3.5*
AA2.06	Existence of proper RHR overpressure protection	3.2*	3.4*
AA2.07	Pump cavitation	3.4	3.7

APE: 026 Loss of Component Cooling Water (CCW)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Component Cooling Water: (CFR 41.8 / 41.10 / 45.3)**		
	None		
AK2.	**Knowledge of the interrelations between the Loss of Component Cooling Water and the following: (CFR 41.7 / 45.7)**		
	None		
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Component Cooling Water: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	The conditions that will initiate the automatic opening and closing of the SWS isolation valves to the CCWS coolers	3.2*	3.5*
AK3.02	The automatic actions (alignments) within the CCWS resulting from the actuation of the ESFAS	3.6	3.9
AK3.03	Guidance actions contained in EOP for Loss of CCW	4.0	4.2
AK3.04	Effect on the CCW flow header of a loss of CCW	3.5	3.7
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Component Cooling Water: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	CCW temperature indications	3.1	3.1
AA1.02	Loads on the CCWS in the control room	3.2	3.3
AA1.03	SWS as a backup to the CCWS	3.6*	3.6*
AA1.04	CRDM high-temperature alarm system	2.7*	2.8
AA1.05	The CCWS surge tank, including level control and level alarms, and radiation alarm	3.1	3.1
AA1.06	Control of flow rates to components cooled by the CCWS	2.9	2.9
AA1. 07	Flow rates to the components and systems that are serviced by the CCWS; interactions among the components	2.9	3.0

APE: **026 Loss of Component Cooling Water (CCW)**

AA2. **Ability to determine and interpret the following as they apply to the Loss of Component Cooling Water:**
(CFR: 43.5 / 45.13)

AA2.01	Location of a leak in the CCWS	2.9	3.5
AA2.02	The cause of possible CCW loss	2.9	3.6
AA2.03	The valve lineups necessary to restart the CCWS while bypassing the portion of the system causing the abnormal condition	2.6	2.9
AA2.04	The normal values and upper limits for the temperatures of the components cooled by CCW	2.5	2.9*
AA2.05	The normal values for CCW-header flow rate and the flow rates to the components cooled by the CCWS	2.4*	2.5*
AA2.06	The length of time after the loss of CCW flow to a component before that component may be damaged	2.8*	3.1*

APE: 027 Pressurizer Pressure Control System (PZR PCS) Malfunction

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Pressurizer Pressure Control Malfunctions: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Definition of saturation temperature	3.1	3.4
AK1.02	Expansion of liquids as temperature increases	2.8	3.1
AK1.03	Latent heat of vaporization/condensation	2.6	2.9
AK2.	**Knowledge of the interrelations between the Pressurizer Pressure Control Malfunctions and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.1	2.2
AK2.02	Sensors and detectors	2.4	2.6
AK2.03	Controllers and positioners	2.6	2.8
AK2.04	Pumps	1.9	2.1
AK2.05	Motors	1.8	2.0
AK3.	**Knowledge of the reasons for the following responses as they apply to the Pressurizer Pressure Control Malfunctions: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Isolation of PZR spray following loss of PZR heaters	3.5*	3.8
AK3.02	Verification of alternate transmitter and/or plant computer prior to shifting flow chart transmitters	2.9*	3.0
AK3.03	Actions contained in EOP for PZR PCS malfunction	3.7	4.1
AK3.04	Why, if PZR level is lost and then restored, that pressure recovers much more slowly	2.8	3.3
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Pressurizer Pressure Control Malfunctions: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	PZR heaters, sprays, and PORVs	4.0	3.9
AA1.02	SCR-controlled heaters in manual mode	3.1*	3.0
AA1.03	Pressure control when on a steam bubble	3.6	3.5
AA1.04	Pressure recovery, using emergency-only heaters	3.9*	3.6*
AA1.05	Transfer of heaters to backup power supply	3.3*	3.2*

APE: 027 Pressurizer Pressure Control System (PZR PCS) Malfunction

**AA2. Ability to determine and interpret the following as they apply to the Pressurizer Pressure Control Malfunctions:
(CFR: 43.5 / 45.13)**

AA2.01	Conditions which will cause an increase in PZR level	3.4	3.8
AA2.02	Normal values for RCS pressure	3.8	3.9
AA2.03	Effects of RCS pressure changes on key components in plant	3.3	3.4
AA2.04	Tech-Spec limits for RCS pressure	3.7	4.3
AA2.05	PZR heater setpoints	3.2	3.3
AA2.06	Conditions requiring plant shutdown	3.5	3.9
AA2.07	Makeup flow indication	3.1	3.1
AA2.08	Letdown flow indication	3.2	3.2
AA2.09	Reactor power	3.5	3.6
AA2.10	PZR heater energized/de-energized condition	3.3	3.6
AA2.11	RCS pressure	4.0	4.1
AA2.12	PZR level	3.7	3.8
AA2.13	Seal return flow	2.8	2.9
AA2.14	RCP injection flow	2.8	2.9
AA2.15	Actions to be taken if PZR pressure instrument fails high	3.7	4.0
AA2.16	Actions to be taken if PZR pressure instrument fails low	3.6	3.9
AA2.17	Allowable RCS temperature difference vs. reactor power	3.1	3.3
AA2.18	Operable control channel	3.4	3.5

APE: 028 Pressurizer (PZR) Level Control Malfunction

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Pressurizer Level Control Malfunctions: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	PZR reference leak abnormalities	2.8*	3.1*
AK2.	**Knowledge of the interrelations between the Pressurizer Level Control Malfunctions and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.2	2.2
AK2.02	Sensors and detectors	2.6	2.7
AK2.03	Controllers and positioners	2.6	2.9
AK2.04	Pumps	2.3	2.4
AK2.05	Heat exchangers and condensers	1.9	2.1
AK2.06	Motors	1.8	2.1
AK2.07	Breakers, relays, and disconnects	1.8	2.2
AK3.	**Knowledge of the reasons for the following responses as they apply to the Pressurizer Level Control Malfunctions: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Relationship between the letdown flow rate and capacity rating of orifices	2.4	2.8
AK3.02	Relationships between PZR pressure increase and reactor makeup/letdown imbalance	2.9	3.2
AK3.03	False indication of PZR level when PORV or spray valve is open and RCS saturated	3.5	4.1
AK3.04	Change in PZR level with power change, even though RCS T-ave. constant, due to loop size difference	2.9*	3.0*
AK3.05	Actions contained in EOP for PZR level malfunction	3.7	4.1

APE: 028 Pressurizer (PZR) Level Control Malfunction

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the Pressurizer Level Control Malfunctions: (CFR 41.7 / 45.5 / 45.6)

AA1.01	PZR level reactor protection bistables	3.8*	3.9
AA1.02	CVCS	3.4	3.4
AA1.03	RCP and seal water system	2.9	2.9
AA1.04	Regenerative heat exchanger and temperature limits	2.7	2.8
AA1.05	Initiation of excess letdown per the CVCS	2.8	2.9
AA1.06	Checking of RCS leaks	3.3	3.6
AA1.07	Charging pumps maintenance of PZR level (including manual backup)	3.3	3.3
AA1.08	Selection of an alternate PZR level channel if one has failed	3.7	3.6

AA2. Ability to determine and interpret the following as they apply to the Pressurizer Level Control Malfunctions: (CFR: 43.5 / 45.13)

AA2.01	PZR level indicators and alarms	3.4	3.6
AA2.02	PZR level as a function of power level or T-ave. including interpretation of malfunction	3.4	3.8
AA2.03	Charging subsystem flow indicator and controller	2.8	3.3
AA2.04	Ammeters and running indicators for CVCS charging pumps	2.6	3.1
AA2.05	Flow control valve isolation valve indicator	2.6	2.7
AA2.06	Letdown flow indicator	2.7	2.8
AA2.07	Seal water flow indicator for RCP	2.6	2.9
AA2.08	PZR level as a function of power level	3.1	3.5
AA2.09	Charging and letdown flow capacities	2.9	3.2
AA2.10	Whether the automatic mode for PZR level control is functioning improperly, necessity of shift to manual modes	3.3	3.4
AA2.11	Leak in PZR	3.2	3.6
AA2.12	Cause for PZR level deviation alarm: controller malfunction or other instrumentation malfunction	3.1	3.5
AA2.13	The actual PZR level, given uncompensated level with an appropriate graph	2.9	3.2
AA2.14	The effect on indicated PZR levels, given a change in ambient pressure and temperature of reflux boiling	2.6	2.8

APE: 032 Loss of Source Range Nuclear Instrumentation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Source Range Nuclear Instrumentation: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Effects of voltage changes on performance	2.5	3.1
AK2.	**Knowledge of the interrelations between the Loss of Source Range Nuclear Instrumentation and the following: (CFR 41.7 / 45.7)**		
AK2.01	Power supplies, including proper switch positions	2.7*	3.1
AK2.02	Sensors and detectors	2.4	2.7
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Source Range Nuclear Instrumentation: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Startup termination on source-range loss	3.2	3.6
AK3.02	Guidance contained in EOP for loss of source-range nuclear instrumentation	3.7*	4.1
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Source Range Nuclear Instrumentation: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Manual restoration of power	3.1*	3.4*

APE: **032 Loss of Source Range Nuclear Instrumentation**

AA2. **Ability to determine and interpret the following as they apply to the Loss of Source Range Nuclear Instrumentation: (CFR: 43.5 / 45.13)**

AA2.01	Normal/abnormal power supply operation	2.6	2.9*
AA2.02	Expected change in source range count rate when rods are moved	3.6	3.9
AA2.03	Expected values of source range indication when high voltage is automatically removed	2.8	3.1*
AA2.04	Satisfactory source-range/intermediate-range overlap	3.1	3.5
AA2.05	Nature of abnormality, from rapid survey of control room data	2.9*	3.2*
AA2.06	Confirmation of reactor trip	3.9*	4.1*
AA2.07	Maximum allowable channel disagreement	2.8	3.4*
AA2.08	Testing required if power lost, then restored	2.2	3.1
AA2.09	Effect of improper HV setting	2.5	2.9

APE: 033 Loss of Intermediate Range Nuclear Instrumentation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Intermediate Range Nuclear Instrumentation: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Effects of voltage changes on performance	2.7	3.0
AK2.	**Knowledge of the interrelations between the Loss of Intermediate Range Nuclear Instrumentation and the following: (CFR 41.7 / 45.7)**		
AK2.01	Power supplies, including proper switch position	2.4	2.9
AK2.02	Sensors and detectors	2.3	2.6
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Intermediate Range Nuclear Instrumentation: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Termination of startup following loss of intermediate-range instrumentation	3.2	3.6
AK3.02	Guidance contained in EOP for loss of intermediate-range instrumentation	3.6	3.9
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Intermediate Range Nuclear Instrumentation: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Power-available indicators in cabinets or equipment drawers	2.9	3.1
AA1.02	Level trip bypass	3.0	3.1
AA1.03	Manual restoration of power	3.0*	3.2*

APE: 033 Loss of Intermediate Range Nuclear Instrumentation

AA2. Ability to determine and interpret the following as they apply to the Loss of Intermediate Range Nuclear Instrumentation: (CFR: 43.5 / 45.13)

AA2.01	Equivalency between source-range, intermediate-range, and power-range channel readings	3.0	3.5
AA2.02	Indications of unreliable intermediate-range channel operation	3.3	3.6
AA2.03	Indication of blown fuse	2.8	3.1
AA2.04	Satisfactory overlap between source-range, intermediate-range and power-range instrumentation	3.2	3.6
AA2.05	Nature of abnormality, from rapid survey of control room data	3.0*	3.1?
AA2.06	Cause of failure of an intermediate-range channel	2.3	2.8*
AA2.07	Confirmation of reactor trip	3.9	4.2
AA2.08	Intermediate range channel operability	3.3	3.4
AA2.09	Conditions which allow bypass of an intermediate-range level trip switch	3.4*	3.7*
AA2.10	Tech-Spec limits if both intermediate-range channels have failed	3.1	3.8
AA2.11	Loss of compensating voltage	3.1	3.4
AA2.12	Maximum allowable channel disagreement	2.5*	3.1*
AA2.13	Testing required if power lost, then restored	2.2*	2.8*

APE 036 Fuel Handling Incidents

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Fuel Handling Incidents : CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Radiation exposure hazards	3.5	4.1
AK1.02	SDM	3.4	3.8
AK1.03	Indications of approaching criticality	4.0	4.3
AK2.	**Knowledge of the interrelations between the Fuel Handling Incidents and the following: (CFR 41.7 / 45.7)**		
AK2.01	Fuel handling equipment	2.9	3.5
AK2.02	Radiation monitoring equipment (portable and installed)	3.4	3.9
AK3.	**Knowledge of the reasons for the following responses as they apply to the Fuel Handling Incidents: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Different inputs that will cause a reactor building evacuation	3.1	3.7
AK3.02	Interlocks associated with fuel handling equipment	2.9	3.6
AK3.03	Guidance contained in EOP for fuel handling incident	3.7	4.1
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Fuel Handling Incidents: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Reactor building containment purge ventilation system	3.3	3.8
AA1.02	ARM system	3.1	3.5
AA1.03	Reactor building containment evacuation alarm enable switch	3.5	3.9
AA1.04	Fuel handling equipment during an incident	3.1	3.7
AA2.	**Ability to determine and interpret the following as they apply to the Fuel Handling Incidents: (CFR: 43.5 / 45.13)**		
AA2.01	ARM system indications	3.2	3.9
AA2.02	Occurrence of a fuel handling incident	3.4	4.1
AA2.03	Magnitude of potential radioactive release	3.1*	4.2*

APE: 037 Steam Generator (S/G) Tube Leak

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Steam Generator Tube Leak: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Use of steam tables	2.9*	3.3
AK1.02	Leak rate vs. pressure drop	3.5	3.9
AK2.	**Knowledge of the interrelations between the Steam Generator Tube Leak and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.1	2.0
AK2.02	Sensors and detectors	2.4	2.4
AK2.03	Controllers and positioners	2.3	2.2
AK2.04	Pumps	2.1	2.1
AK2.05	Motors	1.9	1.9
AK2.06	Heat exchangers and condensers	2.4	2.5
AK2.07	Breakers, relays, and disconnects	1.9	2.0
AK3.	**Knowledge of the reasons for the following responses as they apply to the Steam Generator Tube Leak: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Collection of Condensate in air ejector monitor due to its failure	2.3	2.6
AK3.02	Reset and check of Condensate air ejector exhaust monitor	3.2	3.5
AK3.03	Comparison of makeup flow and letdown flow for various modes of operation	3.1	3.3
AK3.04	Use of "feed and bleed" process	2.5	2.9
AK3.05	Actions contained in procedures for radiation monitoring, RCS water inventory balance, S/G tube failure, and plant shutdown	3.7	4.0
AK3.06	Normal operating precautions to preclude or minimize SGTR	3.6	4.1
AK3.07	Actions contained in EOP for S/G tube leak	4.2	4.4
AK3.08	Criteria for securing RCP	4.1	4.3
AK3.09	Maximum load change capability of facility	2.7*	3.1*
AK3.10	Automatic actions associated with high radioactivity in S/G sample lines	3.3*	3.7*

APE: 037 Steam Generator (S/G) Tube Leak

AA1. Ability to operate and / or monitor the following as they apply to the Steam Generator Tube Leak:
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Maximum controlled depressurization rate for affected S/G	3.7	3.6
AA1.02	Condensate exhaust system	3.1*	2.9
AA1.03	Loop isolation valves	3.0*	2.9
AA1.04	Condensate air ejector exhaust radiation monitor and failure indicator	3.6	3.9
AA1.05	Radiation monitor for auxiliary building exhaust processes	3.3	3.5
AA1.06	Main steam line rad monitor meters	3.8*	3.9*
AA1.07	CVCS letdown flow indicator	3.1	3.2
AA1.08	Charging flow indicator	3.3	3.1
AA1.09	RCS loop pressure indicators	3.3	3.2
AA1.10	CVCS makeup tank level indicator	2.9	3.1
AA1.11	PZR level indicator	3.4	3.3
AA1.12	Control panel power range channel recorders	2.3*	2.5*
AA1.13	S/G blowdown radiation monitors	3.9	4.0

AA2. Ability to determine and interpret the following as they apply to the Steam Generator Tube Leak:
(CFR: 43.5 / 45.13)

AA2.01	Unusual readings of the monitors; steps needed to verify readings	3.0	3.4
AA2.02	Agreement/disagreement among redundant radiation monitors	3.4	3.9
AA2.03	That the expected indication on main steam lines from the S/Gs should show increasing radiation levels	3.4	3.9
AA2.04	Comparison of RCS fluid inputs and outputs, to detect leaks	3.4	3.7
AA2.05	Past history of leakage with current problem	2.8	3.3
AA2.06	S/G tube failure	4.3	4.5
AA2.07	Flowpath for dilution of ejector exhaust air	3.1	3.6
AA2.08	Failure of Condensate air ejector exhaust monitor	2.8	3.3
AA2.09	System status, using independent readings from redundant Condensate air ejector exhaust monitor	2.8*	3.4*
AA2.10	Tech-Spec limits for RCS leakage	3.2	4.1
AA2.11	When to isolate one or more S/Gs	3.8	3.8*
AA2.12	Flow rate of leak	3.3	4.1
AA2.13	Which S/G is leaking	4.1	4.3
AA2.14	Actions to be taken if S/G goes solid and water enters steam lines	4.0	4.4
AA2.15	Magnitude of atmospheric radioactive release if cool-down must be completed using steam dump or atmospheric reliefs	3.4*	4.2
AA2.16	Pressure at which to maintain RCS during S/G cooldown	4.1	4.3

APE: 040 Steam Line Rupture

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Steam Line Rupture: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Consequences of PTS	4.1	4.4
AK1.02	Leak rate versus pressure change	3.2	3.6
AK1.03	RCS shrink and consequent depressurization	3.8	4.2
AK1.04	Nil ductility temperature	3.2	3.6
AK1.05	Reactivity effects of cooldown	4.1	4.4
AK1.06	High-energy steam line break considerations	3.7	3.8
AK1.07	Effects of feedwater introduction on dry S/G	3.4	4.2
AK2.	**Knowledge of the interrelations between the Steam Line Rupture and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.6*	2.5
AK2.02	Sensors and detectors	2.6*	2.6
AK2.03	Controllers and positioners	2.4*	2.4
AK2.04	Pumps	2.0	2.1
AK2.05	Breakers, relays, and disconnects	1.9	2.1
AK2.06	Motors	2.0	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Steam Line Rupture: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Operation of steam line isolation valves	4.2	4.5
AK3.02	ESFAS initiation	4.4	4.4
AK3.03	Steam line non-return valves	3.2*	3.5*
AK3.04	Actions contained in EOPs for steam line rupture	4.5	4.7
AK3.05	Airlock leak tests	2.1*	2.3
AK3.06	Containment temperature and pressure considerations	3.4	3.9

APE: 040 Steam Line Rupture

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the Steam Line Rupture: (CFR 41.7 / 45.5 / 45.6)

AA1.01	Manual and automatic ESFAS initiation	4.6	4.6
AA1.02	Feedwater isolation	4.5	4.5
AA1.03	Isolation of one steam line from header	4.3	4.3
AA1.04	Isolation of all steam lines from header	4.3	4.3
AA1.05	Manual and automatic RPS trip initiation	4.5	4.5
AA1.06	S/G and steam line pressures and flows	4.0	4.1
AA1.07	Steam pressures and flow rates via computer, safety parameter display system, and other indications	3.4*	3.7
AA1.08	Normal operating steam parameters, as a function of power	3.6	3.7
AA1.09	Setpoints of main steam safety and PORVs	3.4*	3.4
AA1.10	AFW system	4.1	4.1
AA1.11	MFW system	3.2*	3.1*
AA1.12	RCS pressure and temperature	4.2	4.2
AA1.13	Steam line isolation valve indications	4.2	4.2
AA1.14	Nuclear instrumentation	4.2	4.2
AA1.15	T-ave. protection indicators	3.9*	3.8*
AA1.16	Reactor coolant loop delta temperature gauges	3.4	3.4*
AA1.17	Reactor trip breaker indicators	4.3	4.3
AA1.18	Control rod position indicators	4.2	4.2
AA1.19	Postaccident monitoring panel indicators	3.8*	3.9
AA1.20	Containment pressure and temperature trends	4.1	4.2
AA1.21	Vibration alarm	2.3*	2.5
AA1.22	Load sequencer status lights	3.0*	3.0*
AA1.23	All pressure gauges per steam generator (for pressure drop)	3.6	3.5
AA1.24	Main steam header pressure gauges	3.8	3.8

AA2. Ability to determine and interpret the following as they apply to the Steam Line Rupture: (CFR: 43.5 / 45.13)

AA2.01	Occurrence and location of a steam line rupture from pressure and flow indications	4.2	4.7
AA2.02	Conditions requiring a reactor trip	4.6	4.7
AA2.03	Difference between steam line rupture and LOCA	4.6	4.7
AA2.04	Conditions requiring ESFAS initiation	4.5	4.7
AA2.05	When ESFAS systems may be secured	4.1	4.5

APE: 051 Loss of Condenser Vacuum

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Condenser Vacuum: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Relationship of condenser vacuum to circulating water, flow rate, and temperature	2.4*	2.4*
AK2.	**Knowledge of the interrelations between the Loss of Condenser Vacuum and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.6	1.6
AK2.02	Controllers and positioners	1.6	1.6
AK2.03	Pumps	1.6	1.5
AK2.04	Motors	1.6	1.5
AK2.05	Heat exchangers and condensers	1.7*	1.6
AK2.06	Sensors and detectors	1.6	1.5
AK2.07	Steam jet air ejectors and vacuum pumps	1.9*	1.7
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Condenser Vacuum: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Loss of steam dump capability upon loss of condenser vacuum	2.8*	3.1*
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Condenser Vacuum: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Condenser vacuum pump	1.9*	1.9
AA1.02	Condenser vacuum	2.3*	2.2*
AA1.03	Gland steam header pressure	2.0*	1.9
AA1.04	Rod position	2.5*	2.5*
AA1.05	Turbine header pressure	1.8*	1.7
AA1.06	Turbine throttle and governor valves position	2.0*	2.0
AA1.07	Feedwater flow	2.2*	2.2*
AA1.08	Air ejector steam supply	2.3*	2.1
AA1.09	Circulating water system	2.1*	2.0

APE: **051 Loss of Condenser Vacuum**

AA2. **Ability to determine and interpret the following as they apply to the Loss of Condenser Vacuum:**
(CFR: 43.5 / 45.13)

AA2.01	Cause for low vacuum condition	2.4*	2.7*
AA2.02	Conditions requiring reactor and/or turbine trip	3.9	4.1

APE: 054 Loss of Main Feedwater (MFW)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Main Feedwater (MFW): (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	MFW line break depressurizes the S/G (similar to a steam line break)	4.1	4.3
AK1.02	Effects of feedwater introduction on dry S/G	3.6	4.2
AK2.	**Knowledge of the interrelations between the Loss of Main Feedwater (MFW) and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.4*	2.3
AK2.02	Controller and positioners	2.2*	2.2
AK2.03	Pumps	2.1	2.2
AK2.04	Motors	1.9	2.0
AK2.05	Heat exchangers and condensers	1.9	2.1
AK2.06	Breakers, relays, and disconnects	1.8	1.9
AK2.07	Sensors and detectors	2.1	2.2
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Main Feedwater (MFW): (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Reactor and/or turbine trip, manual and automatic	4.1	4.4
AK3.02	Matching of feedwater and steam flows	3.4*	3.7*
AK3.03	Manual control of AFW flow control valves	3.8	4.1
AK3.04	Actions contained in EOPs for loss of MFW	4.4	4.6
AK3.05	HPI/PORV cycling upon total feedwater loss	4.6	4.7
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Main Feedwater (MFW): (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	AFW controls, including the use of alternate AFW sources	4.5	4.4
AA1.02	Manual startup of electric and steam-driven AFW pumps	4.4	4.4
AA1.03	AFW auxiliaries, including oil cooling water supply	3.5	3.7
AA1.04	HPI, under total feedwater loss conditions	4.4	4.5

APE: 054 Loss of Main Feedwater (MFW)

AA2. Ability to determine and interpret the following as they apply to the Loss of Main Feedwater (MFW):
(CFR: 43.5 / 45.13)

AA2.01	Occurrence of reactor and/or turbine trip	4.3	4.4
AA2.02	Differentiation between loss of all MFW and trip of one MFW pump	4.1	4.4
AA2.03	Conditions and reasons for AFW pump startup	4.1	4.2
AA2.04	Proper operation of AFW pumps and regulating valves	4.2	4.3
AA2.05	Status of MFW pumps, regulating and stop valves	3.5	3.7
AA2.06	AFW adjustments needed to maintain proper T-ave. and S/G level	4.0	4.3
AA2.07	Reactor trip first-out panel indicator	3.4*	3.9
AA2.08	Steam flow-feed trend recorder	2.9	3.3*

APE: 056 Loss of Offsite Power

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Offsite Power: CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Principle of cooling by natural convection	3.7	4.2
AK1.02	Definition of terms: volts, watts, amp, degrees F, %, psig, inches of mercury, gpm	1.9	2.1
AK1.03	Definition of subcooling: use of steam tables to determine it	3.1*	3.4*
AK1.04	Definition of saturation conditions, implication for the systems	3.1*	3.2*
AK2.	**Knowledge of the interrelations between the Loss of Offsite Power and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.8	1.8
AK2.02	Sensors, detectors, and indicators	2.0*	1.9
AK2.03	Controllers and positioners	1.9	1.9
AK2.04	Pumps	1.7	1.7
AK2.05	Motors	1.7	1.7
AK2.06	Heat exchangers and condensers	1.6	1.7
AK2.07	Demineralizers and ion exchangers	1.6	1.6
AK2.08	Breakers, relays, and disconnects	2.1*	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Offsite Power: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Order and time to initiation of power for the load sequencer	3.5	3.9
AK3.02	Actions contained in EOP for loss of offsite power	4.4	4.7
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Offsite Power: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Power relief controllers to maintain no-load T-ave	4.0*	3.8*
AA1.02	ESF bus synchronization select switch to close bus tie breakers	4.0*	3.9
AA1.03	Adjustment of ED/G load by selectively energizing PZR backup heaters	3.2*	3.3*
AA1.04	Adjustment of speed of ED/G to maintain frequency and voltage levels	3.2	3.1
AA1.05	Initiation (manual) of safety injection process	3.8	3.9
AA1.06	Safety injection pump	3.6*	3.6*
AA1.07	Service water pump	3.2*	3.2*
AA1.08	HVAC chill water pump and unit	2.5*	2.5
AA1.09	CCW pump	3.3	3.3
AA1.10	Auxiliary/emergency feedwater pump (motor driven)	4.3	4.3
AA1.11	HPI system	3.7*	3.7
AA1.12	Reactor building cooling unit	3.2	3.3
AA1.13	Fuel handling building exhaust fan	2.2	2.2
AA1.14	Relay room cooling unit	2.3*	2.3*
AA1.15	Service water booster pump	2.7*	2.9*
AA1.16	ESF switch gear room cooling unit	2.5	2.5
AA1.17	Service water building normal ventilation supply fan	2.3*	2.4*

AA1.18	Control room normal ventilation supply fan	3.2	3.2
AA1.19	Battery room ventilation exhaust fan	2.4*	2.4*
AA1.20	Speed switch room ventilation fan	3.0*	3.0*
AA1.21	Reset of the ESF load sequencers	3.3*	3.3*
AA1.22	Main turbine lube oil system	1.8	1.9
AA1.23	Turbine turning gear (manually)	1.9*	1.9
AA1.24	Plant computer, to call up in-core temperature monitoring group	2.9*	3.0*
AA1.25	Main steam supply valve control switch	2.9*	2.9*
AA1.26	Circuit breakers	2.5*	2.6
AA1.27	Normal letdown isolation valve	2.3*	2.3
AA1.28	SWS flow control valve for the CCW cooler to control CCW outlet temperature	3.1*	3.1
AA1.29	CCW heat exchanger temperature control valves	2.7	2.7
AA1.30	AFW flow control valve operating switches	3.5	3.6
AA1.31	PZR heater group control switches	3.3	3.3
AA1.32	PZR PORV hand switch	3.4*	3.4
AA1.33	PORV block valve control switch	3.3	3.5
AA1.34	Normal makeup flow controller	2.7	2.8
AA1.35	Control switches for the reactor makeup water pump	2.3*	2.3*
AA1.36	Gland seal and condenser air removal systems	1.8	1.8
AA1.37	Instrument air	3.4	3.5

AA2. **Ability to determine and interpret the following as they apply to the Loss of Offsite Power:**
(CFR: 43.5 / 45.13)

AA2.01	PORV controller indicator and setpoint	3.3*	3.4
AA2.02	ESF load sequencer status lights	3.5*	3.6*
AA2.03	Operational status of safety injection pump	3.8	3.9
AA2.04	Operational status of service water pump	3.5	3.7
AA2.05	Operational status of HVAC chill water pump	2.6*	2.8*
AA2.06	Operational status of CCW pump	3.5	3.6
AA2.07	Operational status of emergency feedwater pump (motor driven)	4.2	4.3
AA2.08	Operational status of fuel-handling building exhaust fan	2.2	2.3*
AA2.09	Operational status of reactor building cooling unit	2.7	2.9
AA2.10	Operational status of relay room cooling unit	2.0*	2.2*
AA2.11	Operational status of service water booster pump	2.9*	2.9*
AA2.12	Operational status of ESF switch gear room cooling unit	2.4*	2.6*
AA2.13	Operational status of ventilation supply fans for the service water building, control room and battery room	2.5	2.6
AA2.14	Operational status of ED/Gs (A and B)	4.4	4.6
AA2.15	Operational status of main generator emergency bearing oil pumps	1.9	2.1
AA2.16	Operational status of feedwater pump turbine emergency oil pumps	1.9*	2.1*
AA2.17	Operational status of PZR backup heaters	3.4	3.6
AA2.18	Reactor coolant temperature, pressure, and PZR level recorders	3.8	4.0
AA2.19	T-cold and T-hot indicators (wide range)	4.0	4.2
AA2.20	AFW flow indicator	3.9	4.1
AA2.21	ED/G frequency and voltage indicators	3.6	3.8
AA2.22	Emergency lube oil pump indicators and low-pressure alarms on ED/G	3.4	3.6
AA2.23	Turbine trip-reactor button and indicator	3.7	3.9
AA2.24	CCW pump ammeter, flowmeter and run indicator	3.0	3.1
AA2 25	Emergency feedwater ammeter and flowmeter	3.9	4.0
AA2 26	Reactor building cooling unit ammeter and run indicator	2.2*	2.4*
AA2.27	Fuel-handling building exhaust fan indicator	1.8*	1.9*
AA2.28	Auxiliary building gas treatment indicator	2.2*	2.6*
AA2.29	Service water booster pump ammeter and flowmeter	3.0*	3.2*

AA2.30	Switch gear room cooling unit run indicator	2.0	2.2
AA2.31	Ventilation supply fan and run indicators for the service water building, control room and battery room	2.1	2.2
AA2.32	Transient trend of coolant temperature toward no-load T-ave	4.3	4.3
AA2.33	ESF channels, A and B breaker-trip alarms, indicators and bus voltage indicators	3.6?	3.7?
AA2.34	Rod bottom lights	4.1	4.2
AA2.35	Reactor trip alarm	4.1	4.1
AA2.36	Turbine stop valve indicator	3.9	4.1
AA2.37	ED/G indicators for the following: voltage, frequency, load, load-status, and closure of bus tie breakers	3.7*	3.8
AA2.38	Load sequencer status lights	3.7*	3.8
AA2.39	Safety injection pump ammeter and flowmeter	3.5*	3.6
AA2.40	Service water pump ammeter and flowmeter	3.3	3.4
AA2.41	HVAC chill water pump run and alarm indicators	2.3*	2.3*
AA2.42	Occurrence of a reactor trip	4.1	4.1
AA2.43	Occurrence of a turbine trip	3.9	4.1
AA2.44	Indications of loss of offsite power	4.3	4.5
AA2.45	Indicators to assess status of ESF breakers (tripped/not-tripped) and validity of alarms (false/not-false)	3.6*	3.9
AA2.46	That the ED/Gs have started automatically and that the bus tie breakers are closed	4.2	4.4
AA2.47	Proper operation of the ED/G load sequencer	3.8	3.9
AA2.48	Reactor coolant temperature, pressure, and PZR level following a power outage transient	4.3	4.4
AA2.49	Nonessential equipment to be secured to avoid overload of ED/Gs	3.0	3.4
AA2.50	That load and VAR limits, alarm setpoints, frequency and voltage limits for ED/Gs are not being exceeded	2.8*	3.1
AA2.51	_T, (core, heat exchanger, etc.)	3.3*	3.4*
AA2.52	PZR level required for a given power level	2.6*	2.8*
AA2.53	Status of emergency bus under voltage relays	2.9	3.2
AA2.54	Breaker position (remote and local)	2.9	3.0
AA2.55	Subcooled margin monitors	3.8	3.9
AA2.56	RCS T-ave	3.6*	3.7
AA2.57	RCS hot-leg and cold-leg temperatures	3.9	4.1
AA2.58	Air compressors (indicating lights)	2.3	2.6*
AA2.59	Gland seal pressure gauge	1.5	1.6
AA2.60	MSIV open	2.7*	2.9*
AA2.61	Condensate pump	1.6	1.7
AA2.62	Breaker for feedwater pumps	1.7	1.9*
AA2.63	Feedwater heater drain pump breaker trip	1.5	1.5
AA2.64	Circulating water pump switch	1.6	1.7
AA2.65	Screen wash pump	1.5	1.7
AA2.66	CVCS charging flow	3.2	3.4
AA2.67	Seal injection flow (for the RCPs)	2.9	3.1
AA2.68	CVCS letdown flow	2.7	2.9
AA2.69	Valve position	2.3*	2.5*
AA2.70	Reactor building CCW temperature	2.1	2.2
AA2.71	Turbine service water heat exchange	1.7	1.7
AA2.72	Auxiliary feed flow	4.1	4.3
AA2.73	PZR heater on/off	3.5	3.6
AA2.74	PORV position	3.6	3.7
AA2.75	CVCS makeup	3.0	3.2
AA2.76	Reactor makeup water pump (running)	2.6	2.6
AA2.77	Auxiliary feed pump (running)	4.1	4.4
AA2.78	Bus voltmeters	2.7	3.0

APE: 056 Loss of Offsite Power

AA2.79	Turbine turning gear status light	1.7	1.7

AA2.80	Input/output voltage alarm	2.1*	2.2*
AA2.81	S/G level meter scale and pressure gauge	3.7	3.8
AA2.82	Temperatures displayed on plant computer CRT monitor	2.6	2.7
AA2.83	Instrument air pressure gauge	2.7	3.0
AA2.84	Turbine bearing pressure meter	1.6	1.8
AA2.85	Condenser vacuum gauge readings	1.8*	1.9*
AA2.86	Main steam pressure meter scale	2.7*	2.7*
AA2.87	Circulation water pump ammeter readings	1.6	1.6
AA2.88	Necessary S/G water level for natural circulation	4.1	4.2

APE: 057 Loss of Vital AC Electrical Instrument Bus

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Vital AC Instrument Bus: (CFR 41.8 / 41.10 / 45.3)**		
	None		
AK2.	**Knowledge of the interrelations between the Loss of Vital AC Instrument Bus and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	1.9	2.1
AK2.02	Sensors, detectors, and indicators	2.2*	2.3*
AK2.03	Controllers and positioners	2.2*	2.4
AK2.04	Pumps	2.0	1.9
AK2.05	Breakers, relays and disconnects	2.2*	2.3
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Vital AC Instrument Bus: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Actions contained in EOP for loss of vital ac electrical instrument bus	4.1	4.4
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Vital AC Instrument Bus: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Manual inverter swapping	3.7*	3.7
AA1.02	Manual control of PZR level	3.8	3.7
AA1.03	Feedwater pump speed to control pressure and level in S/G	3.6*	3.6
AA1.04	RWST and VCT valves	3.5	3.6
AA1.05	Backup instrument indications	3.2	3.4
AA1.06	Manual control of components for which automatic control is lost	3.5	3 5

APE: 057 Loss of Vital AC Electrical Instrument Bus

**AA2. Ability to determine and interpret the following as they apply to the Loss of Vital AC Instrument Bus:
(CFR: 43.5 / 45.13)**

AA2.01	Safety injection tank pressure and level indicators	3.7	3.8
AA2.02	Core flood tank pressure and level indicators	3.7*	3.8*
AA2.03	RPS panel alarm annunciators and trip indicators	3.7	3.9
AA2.04	ESF system panel alarm annunciators and channel status indicators	3.7	4.0
AA2.05	S/G pressure and level meters	3.5	3.8
AA2.06	AC instrument bus alarms for the inverter and alternate power source	3.2	3.7
AA2.07	Valve indicator of charging pump suction valve from RWST	3.3	3.5
AA2.08	Reactor power digital display and remote flux meter	3.4*	3.5*
AA2.09	T-ave. and T-ref. chart recorder	3.1*	3.4*
AA2.10	Turbine load limiter control	2.3	2.5
AA2.11	Main feed pump running indicator and controller	2.9*	3.0*
AA2.12	PZR level controller, instrumentation, and heater indications	3.5	3.7
AA2.13	VCT level and pressure indicators and recorders	3.0	3.4
AA2.14	That substitute power sources have come on line on a loss of initial ac	3.2	3.6
AA2.15	That a loss of ac has occurred	3.8	4.1
AA2.16	Normal and abnormal PZR level for various modes of plant operation	3.0	3.1
AA2.17	System and component status, using local or remote controls	3.1	3.4
AA2.18	The indicator, valve, breaker, or damper position which will occur on a loss of power	3.1	3.1
AA2.19	The plant automatic actions that will occur on the loss of a vital ac electrical instrument bus	4.0	4.3
AA2.20	Interlocks in effect on loss of ac vital electrical instrument bus that must be bypassed to restore normal equipment operation	3.6	3.9

APE: 058 Loss of DC Power

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of DC Power: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Battery charger equipment and instrumentation	2.8	3.1*
AK1.02	Electrical units: volts, amps, and dc	2.0	2.3
AK2.	**Knowledge of the interrelations between the Loss of DC Power and the following: (CFR 41.7 / 45.7)**		
AK2.01	Motors	1.9	2.2
AK2.02	Breakers, relays, and disconnects	2.2*	2.4*
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of DC Power: (CFR 41.5,41.10 / 45.6 / 45.1)**		
AK3.01	Use of dc control power by D/Gs	3.4*	3.7
AK3.02	Actions contained in EOP for loss of dc power	4.0	4.2
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of DC Power: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Cross-tie of the affected dc bus with the alternate supply	3.4*	3.5
AA1.02	Static inverter dc input breaker, frequency meter, ac output breaker, and ground fault detector	3.1*	3.1
AA1.03	Vital and battery bus components	3.1	3.3
AA2.	**Ability to determine and interpret the following as they apply to the Loss of DC Power: (CFR: 43.5 / 45.13)**		
AA2.01	That a loss of dc power has occurred; verification that substitute power sources have come on line	3.7	4.1
AA2.02	125V dc bus voltage, low/critical low, alarm	3.3*	3.6
AA2.03	DC loads lost; impact on ability to operate and monitor plant systems	3.5	3.9

APE: 059 Accidental Liquid Radwaste Release

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Accidental Liquid Radwaste Release: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Types of radiation, their units of intensity and the location of the sources of radiation in a nuclear power plant	2.7	3.1
AK1.02	Biological effects on humans of various types of radiation, exposure levels that are acceptable for nuclear power plant personnel, and the units used for radiation-intensity measurements and for radiation exposure levels	2.6	3.2*
AK1.03	Effects of placing a radioactive source near a radiation monitor; in particular, near a radioactive-liquid radiation monitor	2.3	2.9*
AK1.04	The relationship between background radiation intensity and the alarm setpoints on a radioactive liquid monitor	2.3	2.9*
AK1.05	The calculation of offsite doses due to a release from the power plant	2.6*	3.6*
AK2.	**Knowledge of the interrelations between the Accidental Liquid Radwaste Release and the following: (CFR 41.7 / 45.7)**		
AK2.01	Radioactive-liquid monitors	2.7	2.8
AK2.02	Radioactive-gas monitors	2.7	2.7
AK2.03	Valves	2.0	2.0
AK2.04	Sensors, detectors, and indicators	1.9	1.9
AK3.	**Knowledge of the reasons for the following responses as they apply to the Accidental Liquid Radwaste Release: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Termination of a release of radioactive liquid	3.5	3.9
AK3.02	Implementation of E-plan	3.2*	4.5
AK3.03	Declaration that a radioactive-liquid monitor is inoperable	3.0	3.7
AK3.04	Actions contained in EOP for accidental liquid radioactive-waste release .	3.8	4.3

APE: **059 Accidental Liquid Radioactive-Waste Release**

ABILITY

AA1. **Ability to operate and / or monitor the following as they apply to the Accidental Liquid Radwaste Release:**
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Radioactive-liquid monitor	3.5	3.5
AA1.02	ARM system	3.3	3.4
AA1.03	Flow rate controller	3.0*	2.9

AA2. **Ability to determine and interpret the following as they apply to the Accidental Liquid Radwaste Release:**
(CFR: 43.5 / 45.13)

AA2.01	The failure-indication light arrangement for a radioactive-liquid monitor	3.2	3.5
AA2.02	The permit for liquid radioactive-waste release	2.9	3.9
AA2.03	Failure modes, their symptoms, and the causes of misleading indications on a radioactive-liquid monitor	3.1	3.6
AA2.04	The valve lineup for a release of radioactive liquid	3.2*	3.5*
AA2.05	The occurrence of automatic safety actions as a result of a high PRM system signal	3.6	3.9
AA2.06	That the flow rate of the liquid being released is less than or equal to that specified on the release permit	3.5*	3.8

APE: 060 Accidental Gaseous Radwaste Release

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Accidental Gaseous Radwaste Release: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Types of radiation, their units of intensity and the location of sources of radiation in a nuclear reactor power plant	2.5	3.1*
AK1.02	Biological effects on humans of the various types of radiation, exposure levels that are acceptable for personnel in a nuclear reactor power plant; the units used for radiation intensity measurements and for radiation exposure levels	2.5	3.1*
AK1.03	Theory of radiation detection and intensity measurement by the use of ionization chambers and scintillation type radiation detectors	2.1	2.5*
AK1.04	Calculation of offsite doses due to a release from the power plant	2.5*	3.7*
AK2.	**Knowledge of the interrelations between the Accidental Gaseous Radwaste Release and the following: (CFR 41.7 / 45.7)**		
AK2.01	ARM system, including the normal radiation-level indications and the operability status	2.6	2.9*
AK2.02	Auxiliary building ventilation system	2.7	3.1
AK2.03	Valves	2.1	2.1
AK2.04	Sensors, detectors, and indicators	1.9	1.9
AK3.	**Knowledge of the reasons for the following responses as they apply to the Accidental Gaseous Radwaste: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Implementation of E-plan	2.9	4.2
AK3.02	Isolation of the auxiliary building ventilation	3.3*	3.5*
AK3.03	Actions contained in EOP for accidental gaseous-waste release	3.8	4.2
AK3.04	Startup of the gas treatment system	2.2*	2.7*

APE: **060 Accidental Gaseous-Waste Release**

ABILITY

AA1. **Ability to operate and / or monitor the following as they apply to the Accidental Gaseous Radwaste:**
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Area radiation monitors	2.8	3.0
AA1.02	Ventilation system	2.9	3.1

AA2. **Ability to determine and interpret the following as they apply to the Accidental Gaseous Radwaste:**
(CFR: 43.5 / 45.13)

AA2.01	A radiation-level alarm, as to whether the cause was due to a gradual (in time) signal increase or due to a sudden increase (a "spike"), including the use of strip-chart recorders, meter and alarm observations	3.1	3.7
AA2.02	The possible location of a radioactive-gas leak, with the assistance of PEO, health physics and chemistry personnel	3.1	4.0
AA2.03	The steps necessary to isolate a given radioactive-gas leak, using P&IDs	3.2	3.9
AA2.04	The effects on the power plant of isolating a given radioactive-gas leak	2.6	3.4*
AA2.05	That the automatic safety actions have occurred as a result of a high ARM system signal	3.7	4.2
AA2.06	Valve lineup for release of radioactive gases	3.6*	3.8

APE: 061 Area Radiation Monitoring (ARM) System Alarms

AK1. **Knowledge of the operational implications of the following concepts as they apply to Area Radiation Monitoring (ARM) System Alarms: CFR 41.8 / 41.10 / 45.3)**

AK1.01	Detector limitations	2.5*	2.9?

AK2. **Knowledge of the interrelations between the Area Radiation Monitoring (ARM) System Alarms and the following: (CFR 41.7 / 45.7)**

AK2.01	Detectors at each ARM system location	2.5*	2.6*

AK3. **Knowledge of the reasons for the following responses as they apply to the Area Radiation Monitoring (ARM) System Alarms: (CFR 41.5,41.10 / 45.6 / 45.13)**

AK3.01	Effect of temperature inversion on ARM system channel indications	2.3	2.6
AK3.02	Guidance contained in alarm response for ARM system	3.4	3.6

<u>ABILITY</u>

AA1. **Ability to operate and / or monitor the following as they apply to the Area Radiation Monitoring (ARM)System Alarms: (CFR 41.7 / 45.5 / 45.6)**

AA1.01	Automatic actuation	3.6	3.6

AA2. **Ability to determine and interpret the following as they apply to the Area Radiation Monitoring (ARM) System Alarms: (CFR: 43.5 / 45.13)**

AA2.01	ARM panel displays	3.5	3.7
AA2.02	Normal radiation intensity for each ARM system channel	2.9	3.2
AA2.03	Setpoints for alert and high alarms	3.0	3.3
AA2.04	Whether an alarm channel is functioning properly	3.1	3.5
AA2.05	Need for area evacuation; check against existing limits	3.5	4.2
AA2.06	Required actions if alarm channel is out of service	3.2	4.1

APE: 062 Loss of Nuclear Service Water

AK1. **Knowledge of the operational implications of the following concepts as they apply to Loss of Nuclear Service Water:**
(CFR 41.8 / 41.10 / 45.3)

None

AK2. **Knowledge of the interrelations between the Loss of Nuclear Service Water and the following:**
(CFR 41.7 / 45.7)

None

AK3. **Knowledge of the reasons for the following responses as they apply to the Loss of Nuclear Service Water:**
(CFR 41.4, 41.8 / 45.7)

AK3.01	The conditions that will initiate the automatic opening and closing of the SWS isolation valves to the nuclear service water coolers .	3.2*	3.5*
AK3.02	The automatic actions (alignments) within the nuclear service water resulting from the actuation of the ESFAS	3.6	3.9
AK3.03	Guidance actions contained in EOP for Loss of nuclear service water	4.0	4.2
AK3.04	Effect on the nuclear service water discharge flow header of a loss of CCW	3.5	3.7

AA1. **Ability to operate and / or monitor the following as they apply to the Loss of Nuclear Service Water (SWS):**
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Nuclear service water temperature indications	3.1	3.1
AA1.02	Loads on the SWS in the control room	3.2	3.3
AA1.03	SWS as a backup to the CCWS	3.6*	3.6
AA1.04	CRDM high-temperature alarm system	2.7*	2.8
AA1.05	The CCWS surge tank, including level control and level alarms, and radiation alarm	3.1	3.1
AA1.06	Control of flow rates to components cooled by the SWS	2.9	2.9
AA1.07	Flow rates to the components and systems that are serviced by the SWS; interactions among the components	2.9	3.0

AA2. **Ability to determine and interpret the following as they apply to the Loss of Nuclear Service Water:**
(CFR: 43.5 / 45.13)

AA2.01	Location of a leak in the SWS	2.9	3.5
AA2.02	The cause of possible SWS loss	2.9	3.6
AA2.03	The valve lineups necessary to restart the SWS while bypassing the portion of the system causing the abnormal condition	2.6	2.9
AA2.04	The normal values and upper limits for the temperatures of the components cooled by SWS	2.5	2.9*
AA2.05	The normal values for SWS-header flow rate and the flow rates to the components cooled by the SWS	2.4*	2.5*
AA2.06	The length of time after the loss of SWS flow to a component before that component may be damaged	2.8*	3.1*

APE: 065 Loss of Instrument Air

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Instrument Air: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Understanding units of flow and pressure SCFM, linear, meter, psig	1.9	2.2
AK2.	**Knowledge of the interrelations between the Loss of Instrument Air and the following: (CFR 41.7 / 45.7)**		
AK2.01	Compressors	2.2	2.4
AK2.02	Valves	1.9	2.1
AK2.03	Pumps	1.7	1.8
AK2.04	Motors	1.6	1.7
AK2.05	Air dryers, filters, and heat exchangers	2.0	2.2
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Instrument Air: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Placing previously running compressor switch "off"	2.2*	2.3
AK3.02	Checking previously running compressor electrical breaker	2.2	2.4
AK3.03	Knowing effects on plant operation of isolating certain equipment from instrument air	2.9	3.4
AK3.04	Cross-over to backup air supplies	3.0	3.2
AK3.05	Checking electric loads on a running compressor	2.2?	2.7?
AK3.06	Blocking open certain valves during recovery	2.3*	2.7*
AK3.07	Backup of compressor cooling water	2.3*	2.5*
AK3.08	Actions contained in EOP for loss of instrument air	3.7	3.9

APE: 065 Loss of Instrument Air

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the Loss of Instrument Air:
(CFR 41.7 / 45.5 / 45.6)

AA1.01	Remote manual loaders	2.7*	2.5
AA1.02	Components served by instrument air to minimize drain on system	2.6	2.8
AA1.03	Restoration of systems served by instrument air when pressure is regained	2.9	3.1
AA1.04	Emergency air compressor	3.5*	3.4*
AA1.05	RPS	3.3*	3.3*

AA2. Ability to determine and interpret the following as they apply to the Loss of Instrument Air:
(CFR: 43.5 / 45.13)

AA2.01	Cause and effect of low-pressure instrument air alarm	2.9	3.2
AA2.02	Relationship of flow readings to system operation	2.4*	2.6*
AA2.03	Location and isolation of leaks	2.6	2.9
AA2.04	Typical conditions which could cause a compressor trip (e.g., high temperature)	2.2	2.7
AA2.05	When to commence plant shutdown if instrument air pressure is decreasing	3.4*	4.1
AA2.06	When to trip reactor if instrument air pressure is de-creasing	3.6*	4.2
AA2.07	Whether backup nitrogen supply is controlling valve position	2.8*	3.2*
AA2.08	Failure modes of air-operated equipment	2.9*	3.3

APE 067: Plant fire on site

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Plant Fire on Site: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Fire classifications, by type	2.9	3.9
AK1.02	Fire fighting	3.1	3.9
AK2.	**Knowledge of the interrelations between the Plant Fire on Site and the following: (CFR 41.7 / 45.7)**		
AK2.01	Sensors, detectors and valves	2.3	2.5*
AK2.02	Controllers and positioners	2.0	2.3
AK2.03	Motors	1.9	2.1
AK2.04	Breakers, relays, and disconnects	1.9	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the Plant Fire on Site: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Installation of fire detectors	2.3	2.8
AK3.02	Steps called out in the site fire protection plan, FPS manual, and fire zone manual	2.5	3.3
AK3.03	Fire detector surveillance test	2.0*	2.5*
AK3.04	Actions contained in EOP for plant fire on site	3.3	4.1
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Plant Fire on Site: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Respirator air pack	3.6	3.6
AA1.02	Re-installation of a fire detector	2.4*	2.5*
AA1.03	Bypass of a fire zone detector	2.5*	2.8*
AA1.04	Bypass of a heat detector	2.5*	2.7*
AA1.05	Plant and control room ventilation systems	3.0	3.1
AA1.06	Fire alarm	3.5	3.7
AA1.07	Fire alarm reset panel	2.9	3.0
AA1.08	Fire fighting equipment used on each class of fire	3.4	3.7
AA1.09	Plant fire zone panel (including detector location)	3.0	3.3

APE: **067 Plant Fire On Site**

AA2. **Ability to determine and interpret the following as they apply to the Plant Fire on Site:**
(CFR: 43.5 / 45.13)

AA2.01	Auxiliary building gas treatment system	2.5*	2.8*
AA2.02	Damper position	2.5	2.9
AA2.03	Fire alarm	3.3	3.5
AA2.04	The fire's extent of potential operational damage to plant equipment	3.1	4.3
AA2.05	Ventilation alignment necessary to secure affected area	3.2	3.6
AA2.06	Need for pressurizing control room (recirculation mode)	3.3	3.6
AA2.07	Whether malfunction is due to common-mode electrical failures	2.6	3.1*
AA2.08	Limits of affected area	2.9	3.6
AA2.09	That a failed fire alarm detector exists	2.4	2.7
AA2.10	Time limit of long-term-breathing air system for control room	2.9*	3.6*
AA2.11	Time limit for use of respirators	3.3*	3.5
AA2.12	Location of vital equipment within fire zone	2.9	3.9
AA2.13	Need for emergency plant shutdown	3.3	4.4
AA2.14	Equipment that will be affected by fire suppression activities in each zone	3.2	4.3
AA2.15	Requirements for establishing a fire watch	2.9	3.9
AA2.16	Vital equipment and control systems to be maintained and operated during a fire	3.3	4.0
AA2.17	Systems that may be affected by the fire	3.5	4.3

APE: 068 Control Room Evacuation

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Control Room Evacuation: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Use of steam tables	2.4*	2.7*
AK2.	**Knowledge of the interrelations between the Control Room Evacuation and the following: (CFR 41.7 / 45.7)**		
AK2.01	Auxiliary shutdown panel layout	3.9	4.0
AK2.02	Reactor trip system	3.7	3.9
AK2.03	Controllers and positioners	2.9	3.1
AK2.04	Pumps	2.2	2.4*
AK2.05	Motors	2.1	2.1
AK2.06	Breakers, relays, and disconnects	2.4*	2.7
AK2.07	ED/G	3.3	3.4
AK3.	**Knowledge of the reasons for the following responses as they apply to the Control Room Evacuation: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	System response to reactor trip	3.9	4.2
AK3.02	System response to turbine trip	3.7	4.1
AK3.03	Transfer of AFW flow control valves and pumps to local control	3.7	4.3
AK3.04	Filling the feedwater system and closing the AFW pump discharge valve	3.0*	3.2*
AK3.05	Repositioning valves to isolate and drain the AFW pump turbine and steam supply header	2.5*	3.0*
AK3.06	Transfer of S/G atmospheric relief valves to local control; operation to maintain specified T-ave	3.9	4.3
AK3.07	Maintenance of S/G level, using AFW flow control valves	4.0	4.3
AK3.08	Trip of the MFW and necessary Condensate pumps	3.4	3.9
AK3.09	Transfer of the following to local control: charging pumps, charging header flow control valve, PZR heaters, and boric acid transfer pumps	3.9	4.4
AK3.10	Maintenance of PZR level, using pumps and heaters	3.9	4.2
AK3.11	Tech-Spec limits and tables for quantity of boric acid	3.2	3.6
AK3.12	Required sequence of actions for emergency evacuation of control room	4.1	4.5

AK3.13	Performing a shutdown margin calculation, including boron needed and boration time	3.3	3.9
AK3.14	Safety injection setpoint of main steam line pressure	3.2*	3.4*
AK3.15	Turbine trip setpoint for automatic-stop because of low oil pressure	2.2*	2.4*
AK3.16	Fail-open of the control room doors for personnel evacuation	2.8*	3.3*
AK3.17	Injection of boric acid into the RCS	3.7	4.0
AK3.18	Actions contained in EOP for control room evacuation emergency task	4.2	4.5

K/A NO.	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Control Room Evacuation: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	S/G atmospheric relief valve	4.3	4.5
AA1.02	AFW emergency pump	4.3	4.5
AA1.03	S/G level	4.1	4.3
AA1.04	MFW pump trip	3.3*	3.6
AA1.05	Condensate pump trip	2.7*	2.9*
AA1.06	Charging pump	4.1	4.2
AA1.07	PZR heaters	4.1	4.2
AA1.08	Local boric acid flow	4.2*	4.2*
AA1.09	Synchroscope key	3.1*	2.7*
AA1.10	Power distribution: ac and dc	3.7*	3.9
AA1.11	Emergency borate valve controls and indicators	3.9	4.1
AA1.12	Auxiliary shutdown panel controls and indicators	4.4	4.4
AA1.13	Charging pump controllers (to maintain PZR level)	4.1	4.2
AA1.14	Reactor trip breakers and switches	4.2	4.4
AA1.15	Turbine trip lights and indicators	3.7	3.7
AA1.16	Turbine throttle valve indicating lights and position indicators	3.2*	3.3
AA1.17	Turbine stop valve bistable lights	3.2*	3.3*
AA1.18	Turbine automatic-stop oil pressure indicators and lights	2.8*	2.8*
AA1.19	Boric acid transfer pump	3.7	3.9
AA1.20	Indicators for operation of startup transformer	3.2*	3.2*
AA1.21	Transfer of controls from control room to shutdown panel or local control	3.9	4.1
AA1.22	Flow control valve for RCS charging header	4.0	4.3
AA1.23	Manual trip of reactor and turbine	4.3	4.4
AA1.24	Control room re-accessibility	3.0*	3.6
AA1.25	Plant emergency alarm	3.2*	3.7

AA1.26	Unlocking of switches and operation of AFW valves	3.6*	3.8*
AA1.27	Local trip of main feed pumps and Condensate pumps	3.2*	3.4*
AA1.28	PZR level control and pressure control	3.8	4.0
AA1.29	Calculation of boron needed for xenon-free shutdown	3.1	3.6
AA1.30	Operation of the letdown system	3.4	3.6
AA1.31	ED/G	3.9	4.0
AA1.32	Natural circulation flow	3.9	4.1

AA2. Ability to determine and interpret the following as they apply to the Control Room Evacuation:
(CFR: 43.5 / 45.13)

AA2.01	S/G level	4.0	4.3
AA2.02	Local boric acid flow	3.7*	4.2*
AA2.03	T-hot, T-cold, and in-core temperatures	4.0	4.2
AA2.04	S/G pressure	3.7	4.0
AA2.05	Availability of heat sink	4.2	4.3
AA2.06	RCS pressure	4.1	4.3
AA2.07	PZR level	4.1	4.3
AA2.08	S/G pressure	3.9	4.1
AA2.09	Saturation margin	4.1	4.3
AA2.10	Source range count rate	4.2*	4.4*
AA2.11	Indications of natural circulation	4.3	4.4

APE: 069 Loss of Containment Integrity

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to Loss of Containment Integrity: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Effect of pressure on leak rate	2.6	3.1
AK2.	**Knowledge of the interrelations between the Loss of Containment Integrity and the following: (CFR 41.7 / 45.7)**		
AK2.01	Valves	2.4*	2.4
AK2.02	Sensors and detectors	2.4*	2.4
AK2.03	Personnel access hatch and emergency access hatch	2.8*	2.9
AK3.	**Knowledge of the reasons for the following responses as they apply to the Loss of Containment Integrity: (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	Guidance contained in EOP for loss of containment integrity	3.8*	4.2
	ABILITY		
AA1.	**Ability to operate and / or monitor the following as they apply to the Loss of Containment Integrity: (CFR 41.7 / 45.5 / 45.6)**		
AA1.01	Isolation valves, dampers, and electropneumatic devices.	3.5	3.7
AA1.02	Blind flanges, as part of containment isolation	2.2	2.5
AA1.03	Fluid systems penetrating containment	2.8	3.0
AA2.	**Ability to determine and interpret the following as they apply to the Loss of Containment Integrity: (CFR: 43.5 / 45.13)**		
AA2.01	Loss of containment integrity	3.7	4.3
AA2.02	Verification of automatic and manual means of restoring integrity	3.9	4.4

APE 076: High Reactor Coolant Activity

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
AK1.	**Knowledge of the operational implications of the following concepts as they apply to High Reactor Coolant Activity: (CFR 41.8 / 41.10 / 45.3)**		
AK1.01	Radioactivity units	2.1	2.5
AK1.02	Radiation source term and transport pathway	2.0	2.5
AK1.03	Channeling in a demineralizer	1.9	2.0
AK1.04	Effects of excessive temperature on a demineralizer resin	2.1	2.3
AK1.05	Definition and use of the following terms: °F, log scale, CPM, multipoint, setpoint, gpm, pH, D/F, conductivity	1.9	2.3
AK1.06	Chemical shock and crud burst	2.1	2.6
AK1.07	Thermal shock	2.2	2.4
AK1.08	Hydraulic shock	2.1	2.3
AK1.09	Relationship between letdown flow rate and letdown temperature	2.2	2.3
AK2.	**Knowledge of the interrelations between the High Reactor Coolant Activity and the following: (CFR 41.7 / 45.7)**		
AK2.01	Process radiation monitors	2.6	3.0
AK2.02	CCW pump and heat exchangers	2.1	2.3
AK2.03	Sensors and detectors	1.9	1.9
AK2.04	Valves	1.8	1.9
AK2.05	Controllers and positioners	1.9	1.9
AK2.06	Demineralizers and ion exchangers	2.0	2.1
AK3.	**Knowledge of the reasons for the following responses as they apply to the High Reactor Coolant Activity : (CFR 41.5,41.10 / 45.6 / 45.13)**		
AK3.01	RCS differentiating activity due to fission products and due to corrosion products, from chemistry report	2.4	3.1
AK3.02	Increased CCW flow	2.4	2.6
AK3.03	Orifice controls for minimum letdown flow rates	2.1*	2.1
AK3.04	Setpoint controls for maximum demineralizer flow rates	2.3	2.5
AK3.05	Corrective actions as a result of high fission-product radioactivity level in the RCS	2.9	3.6
AK3.06	Actions contained in EOP for high reactor coolant activity	3.2	3.8

APE: 076 High Reactor Coolant Activity

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the High Reactor Coolant Activity: (CFR 41.7 / 45.5 / 45.6)

AA1.01	Interlocks associated with orifice isolation valve	2.4	2.2
AA1.02	CCWS standby pump and outlet valves	2.1	2.0
AA1.03	CVCS letdown flow rate and temperature	2.3*	2.1
AA1.04	Failed fuel-monitoring equipment	3.2	3.4

AA2. Ability to determine and interpret the following as they apply to the High Reactor Coolant Activity: (CFR: 43.5 / 45.13)

AA2.01	Location or process point that is causing an alarm	2.7	3.2
AA2.02	Corrective actions required for high fission product activity in RCS	2.8	3.4
AA2.03	RCS radioactivity level meter	2.5	3.0
AA2.04	Process effluent radiation chart recorder	2.6	3.0
AA2.05	CVCS letdown flow rate indication	2.2	2.5
AA2.06	Response of PZR LCS to changes in the letdown flow rate	2.2	2.5
AA2.07	When demineralizer resin needs to be replaced	2.4	2.7*

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4.3 <u>Babcock and Wilcox</u> EPEs / APEs

<u>Babcock and Wilcox</u>
E02 Vital System Status Verification

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Vital System Status Verification);
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.6 SRO 3.6

EK1.2 Normal, abnormal and emergency operating procedures associated with (Vital System Status Verification).
IMPORTANCE RO 3.8 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Vital System Status Verification).
IMPORTANCE RO 3.8 SRO 3.8

EK2. Knowledge of the interrelations between the (Vital System Status Verification) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 4.0

EK2.2 Facility’s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.2 SRO 4.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Vital System Status Verification) :
(CFR: 41.5 / 41.10, 45.6, 45.13)

K/A NO. KNOWLEDGE

EK3.1 Facility operating characteristics during transient conditions, including c coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.8

EK3.2 Normal, abnormal and emergency operating procedures associated with (Vital System Status Verification).
IMPORTANCE RO 3.0 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.6 SRO 3.4

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Vital System Status Verification):
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.6

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.6

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.0 SRO 3.2

EPE: Vital System Status Verification (Continued)

K/A NO. KNOWLEDGE

EA2. Ability to determine and interpret the following as they apply to the (Vital System Status Verification): (CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.5 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.2 SRO 3.8

Babcock and Wilcox
E03 Inadequate Subcooling Margin

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Inadequate Subcooling Margin): (CFR: 41.8 / 41.10, (CFR: 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.1 SRO 3.5

EK1.2 Normal, abnormal and emergency operating procedures associated with (Inadequate Subcooling Margin).
IMPORTANCE RO 3.8 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Inadequate Subcooling Margin).
IMPORTANCE RO 4.0 SRO 4.0

EK2. Knowledge of the interrelations between the (Inadequate Subcooling Margin) and the following: (CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.8

EK2.2 Facility’s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.3 SRO 4.3

K/A NO. KNOWLEDGE

EK3. Knowledge of the reasons for the following responses as they apply to the (Inadequate Subcooling Margin)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.8

EK3.2 Normal, abnormal and emergency operating procedures associated with (Inadequate Subcooling Margin).
IMPORTANCE RO 3.6 SRO 3.8

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.4 SRO 3.8

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.2 SRO 3.5

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Inadequate Subcooling Margin)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.1 SRO 3.8

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.8 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.6 SRO 3.8

EPE: Inadequate Subcooling Margin (Continued)

K/A NO. KNOWLEDGE

EA2. Ability to determine and interpret the following as they apply to the (Inadequate Subcooling Margin)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.0 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.0

Babcock and Wilcox
E04 Inadequate Heat Transfer

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Inadequate Heat Transfer):
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Inadequate Heat Transfer).
IMPORTANCE RO 4.0 SRO 4.2

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Inadequate Heat Transfer).
IMPORTANCE RO 4.0 SRO 4.0

EK2. Knowledge of the interrelations between the (Inadequate Heat Transfer) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 4.0

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.2 SRO 4.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Inadequate Heat Transfer)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.5 SRO 3.7

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Inadequate Heat Transfer).
IMPORTANCE RO 3.5 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.2 SRO 3.8

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.5

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Inadequate Heat Transfer)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.4 SRO 4.2

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.4 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.6 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (Inadequate Heat Transfer)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 4.4

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.6 SRO 4.4

E05 Excessive Heat Transfer

K/A NO. KNOWLEDGE

K1. Knowledge of the operational implications of the following concepts as they apply to the (Excessive Heat Transfer)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.8 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Excessive Heat Transfer).
IMPORTANCE RO 4.0 SRO 4.2

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Excessive Heat Transfer).
IMPORTANCE RO 3.8 SRO 3.8

EK2. Knowledge of the interrelations between the (Excessive Heat Transfer) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 4.0

EK2.2 Facility’s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.2 SRO 4.4

EK3. Knowledge of the reasons for the following responses as they apply to the (Excessive Heat Transfer)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.5 SRO 3.7

EPE: Excessive Heat Transfer (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Excessive Heat Transfer).
IMPORTANCE RO 3.5 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.2 SRO 3.8

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.8 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Excessive Heat Transfer)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.2 SRO 4.2

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.6

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.2

EA2. Ability to determine and interpret the following as they apply to the (Excessive Heat Transfer)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.0 SRO 4.2

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.6 SRO 4.0

E08 LOCA Cooldown

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (LOCA Cooldown)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (LOCA Cooldown).
IMPORTANCE RO 3.5 SRO 3.8

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (LOCA Cooldown).
IMPORTANCE RO 3.3 SRO 3.5

EK2. Knowledge of the interrelations between the (LOCA Cooldown) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.0 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (LOCA Cooldown)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.0 SRO 3.4

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (LOCA Cooldown).
IMPORTANCE RO 3.0 SRO 3.6

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.0 SRO 3.6

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.8 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (LOCA Cooldown)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.7

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.1 SRO 3.1

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (LOCA Cooldown)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.8 SRO 4.2

K/A NO. **KNOWLEDGE**

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.3 SRO 4.0

Babcock and Wilcox
E09 Natural Circulation Cooldown

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Natural Circulation Cooldown)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.7

EK1.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Cooldown).
IMPORTANCE RO 3.7 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Natural Circulation Cooldown).
IMPORTANCE RO 3.5 SRO 3.5

EK2. Knowledge of the interrelations between the (Natural Circulation Cooldown) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 4.0

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.0 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (Natural Circulation Cooldown)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.4

EPE: Natural Circulation Cooldown (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Cooldown).
IMPORTANCE RO 3.0 SRO 3.8

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 3.4

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.8 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Natural Circulation Cooldown)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.5

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.5

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.7

EA2. Ability to determine and interpret the following as they apply to the (Natural Circulation Cooldown)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.8 SRO 4.2

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.0

Babcock and Wilcox
E10 Post-Trip Stabilization

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Post-Trip Stabilization)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 4.0 SRO 4.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (Post-Trip Stabilization).
IMPORTANCE RO 3.5 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Post -Trip Stabilization).
IMPORTANCE RO 4.0 SRO 4.0

EK2. Knowledge of the interrelations between the (Post-Trip Stabilization) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 4.0

EK2.2 Facility’s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (Post-Trip Stabilization)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.0 SRO 4.0

EPE: Post-Trip Stabilization (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Post-Trip Stabilization).
IMPORTANCE RO 3.0 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.0 SRO 3.0

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 4.0 SRO 4.0

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Post-Trip Stabilization)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.5

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.5 SRO 4.0

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.5 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (Post-Trip Stabilization)
(CFR: 43.5, 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.5 SRO 4.0

K/A NO. **KNOWLEDGE**

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.0

<u>**Babcock and Wilcox**</u>
E13 EOP Rules

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (EOP Rules)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 2.4 SRO 2.6

EK1.2 Normal, abnormal and emergency operating procedures associated with (EOP Rules).
IMPORTANCE RO 3.0 SRO 3.6

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (EOP Rules).
IMPORTANCE RO 3.0 SRO 3.2

EK2. Knowledge of the interrelations between the (EOP Rules) and the following
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.4

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.2 SRO 3.4

EK3. Knowledge of the reasons for the following responses as they apply to the (EOP Rules)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.0 SRO 3.7

EPE: EOP Rules (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (EOP Rules).
IMPORTANCE RO 3.2 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.2 SRO 2.7

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (EOP Rules)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.2

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.8 SRO 3.0

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (EOP Rules)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency
IMPORTANCE RO 3.4 SRO 4.0

EPE: **EOP Rules (Continued)**

K/A NO. **KNOWLEDGE**

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.8 SRO 4.0

<u>Babcock and Wilcox</u>

E14 EOP Enclosures

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (EOP Enclosures)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 3.4

EK1.2 Normal, abnormal and emergency operating procedures associated with (EOP Enclosures).
IMPORTANCE RO 3.6 SRO 3.8

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (EOP Enclosures).
IMPORTANCE RO 3.2 SRO 3.2

EK2. Knowledge of the interrelations between the (EOP enclosures) and the following
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.4

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 3.8

EK3. Knowledge of the reasons for the following responses as they apply to the (EOP Enclosures)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.0 SRO 3.2

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (EOP Enclosures).
IMPORTANCE RO 3.0 SRO 3.7

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.5

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.5

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (EOP Enclosures)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.6

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.8 SRO 3.2

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.6 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (EOP Enclosures)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriated procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 4.0 SRO 4.0

A01 Plant Runback

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Plant Runback)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.0

AK1.2 Normal, abnormal and emergency operating procedures associated with (Plant Runback).
IMPORTANCE RO 3.5 SRO 3.8

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Plant Runback).
IMPORTANCE RO 3.7 SRO 3.7

AK2. Knowledge of the interrelations between the (Plant Runback) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.5

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.5

AK3. Knowledge of the reasons for the following responses as they apply to the (Plant Runback)
(CFR: 41.5 / 41.10, 45.6, 45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.4

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Plant Runback).
IMPORTANCE RO 3.2 SRO 3.6

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.6 SRO 3.2

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.2 SRO 3.4

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Plant Runback)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.7

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.5

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 3.7

AA2. Ability to determine and interpret the following as they apply to the (Plant Runback)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.0 SRO 3.7

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 3.8

Babcock and Wilcox
A02 Loss of NNI-X

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Loss of NNI-X)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.2

AK1.2 Normal, abnormal and emergency operating procedures associated with (Loss of NNI-X).
IMPORTANCE RO 3.4 SRO 4.0

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Loss of NNI-X).
IMPORTANCE RO 3.8 SRO 3.8

AK2. Knowledge of the interrelations between the (Loss of NNI-X) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 4.0

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 3.8

AK3. Knowledge of the reasons for the following responses as they apply to the (Loss of NNI-X)
(CFR: 41.5 / 41.10, 45.6, 45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.7 SRO 3.0

APE: Loss of NNI-X (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Loss of NNI-X).
IMPORTANCE RO 3.7 SRO 4.0

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.2

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.7 SRO 3.7

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Loss of NNI-X)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.8

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.4 SRO 3.2

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.6

AA2. Ability to determine and interpret the following as they apply to the (NNI-X)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.6 SRO 4.0

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 4.0 SRO 4.0

Babcock and Wilcox
A03 Loss of NNI-Y

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Loss of NNI-Y)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 2.5 SRO 3.0

AK1.2 Normal, abnormal and emergency operating procedures associated with (Loss of NNI-Y).
IMPORTANCE RO 3.0 SRO 3.7

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (NNI-Y).
IMPORTANCE RO 3.0 SRO 3.3

AK2. Knowledge of the interrelations between the (Loss of NNI-Y) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.7

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.3 SRO 3.3

AK3. Knowledge of the reasons for the following responses as they apply to the (Loss of NNI-Y)
(CFR: 41.5 / 41.10, 45.6, 45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 2.5 SRO 3.0

APE: Loss of NNI-Y (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Loss of NNI-Y).
IMPORTANCE RO 3.0 SRO 3.5

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 2.5 SRO 3.0

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.5

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Loss of NNI-Y)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 4.0

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.0 SRO 3.3

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.3

AA2. Ability to determine and interpret the following as they apply to the (Loss of NNI-Y)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.7 SRO 4.0

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility’s license and amendments.
IMPORTANCE RO 4.0 SRO 4.0

A04 Turbine Trip

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Turbine Trip)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.3

AK1.2 Normal, abnormal and emergency operating procedures associated with (Turbine Trip).
IMPORTANCE RO 3.2 SRO 3.8

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Turbine Trip).
IMPORTANCE RO 3.2 SRO 3.3

AK2. Knowledge of the interrelations between the (Turbine Trip) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 3.3

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.3 SRO 3.5

AK3. Knowledge of the reasons for the following responses as they apply to the (Turbine Trip)
(CFR: 41.5 / 41.10, 45.6, 45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.2

APE: Turbine Trip (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Turbine Trip).
IMPORTANCE RO 3.4 SRO 3.6

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.4 SRO 3.4

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.4 SRO 3.2

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Turbine Trip)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 3.3

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.0

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.5 SRO 3.7

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

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.3 SRO 3.7

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.7 SRO 3.7

A05 Emergency Diesel Actuation

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Emergency Diesel Actuation)
(CFR: 41.8 / 41.10, 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.7 SRO 3.7

AK1.2 Normal, abnormal and emergency operating procedures associated with (Emergency Diesel Actuation).
IMPORTANCE RO 3.3 SRO 4.0

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Emergency Diesel Actuation).
IMPORTANCE RO 3.8 SRO 3.7

AK2. Knowledge of the interrelations between the (Emergency Diesel Actuation) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.8

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.7

AK3. Knowledge of the reasons for the following responses as they apply to the (Emergency Diesel Actuation)
(CFR: 41.5 / 41.10, 45.6, 45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.4

APE: Emergency Diesel Actuation (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Emergency Diesel Actuation).
IMPORTANCE RO 3.4 SRO 3.8

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.2 SRO 3.8

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.6

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Emergency Diesel Actuation)
(CFR: 41.7 / 45.5,45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.3 SRO 4.2

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.0 SRO 3.3

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 3.7

AA2. Ability to determine and interpret the following as they apply to the (Emergency Diesel Actuation)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.5 SRO 4.2

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 3.8

A06 Shutdown Outside Control Room

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Shutdown Outside Control Room):
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 4.0 SRO 4.0

AK1.2 Normal, abnormal and emergency operating procedures associated with (Shutdown Outside Control Room).
IMPORTANCE RO 4.3 SRO 4.3

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Shutdown Outside Control Room).
IMPORTANCE RO 3.4 SRO 3.4

AK2. Knowledge of the interrelations between the (Shutdown Outside Control Room) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.8

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 4.2 SRO 4.2

AK3. Knowledge of the reasons for the following responses as they apply to the (Shutdown Outside Control Room) :
(CFR: 41.5 / 41.10, 45.6, 45.13

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.6

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Shutdown Outside Control Room).
IMPORTANCE RO 3.8 SRO 3.8

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.2 SRO 4.2

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.8 SRO 3.8

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Shutdown Outside Control Room)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.3 SRO 4.2

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.5

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.0

AA2. Ability to determine and interpret the following as they apply to the (Shutdown Outside Control room)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.6 SRO 4.2

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.7 SRO 4.2

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A07 Flooding

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Flooding)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.5

AK1.2 Normal, abnormal and emergency operating procedures associated with (Flooding).
IMPORTANCE RO 3.3 SRO 3.7

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Flooding).
IMPORTANCE RO 3.3 SRO 3.5

AK2. Knowledge of the interrelations between the (Flooding) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.5

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.3 SRO 3.3

AK3. Knowledge of the reasons for the following responses as they apply to the (Flooding)
(CFR: 41.5 / 41.10, 45.6, 45.13

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 2.6 SRO 3.0

APE: Flooding (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Flooding).
IMPORTANCE RO 3.2 SRO 3.4

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.6 SRO 3.2

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.6

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Flooding): (CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.5

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.8 SRO 3.0

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.5

AA2. Ability to determine and interpret the following as they apply to the (Flooding) (CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.0 SRO 3.6

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.3 SRO 3.7

<u>**Babcock and Wilcox**</u>

A08 Refueling Canal Level Decrease

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Refueling Canal Level Decrease)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.7 SRO 3.8

AK1.2 Normal, abnormal and emergency operating procedures associated with (Refueling Canal Level Decrease).
IMPORTANCE RO 3.7 SRO 4.0

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Refueling Canal Level Decrease).
IMPORTANCE RO 3.8 SRO 4.0

AK2. Knowledge of the interrelations between the (Refueling Canal Level Decrease) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.8

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 4.0

AK3. Knowledge of the reasons for the following responses as they apply to the (Refueling Canal Level Decrease)
(CFR: 41.5 / 41.10 / 45.6,45.13)

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.6

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Refueling Canal Level Decrease).
IMPORTANCE RO 3.2 SRO 3.4

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.0 SRO 3.8

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.6

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Refueling Canal Level Decrease)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.2 SRO 3.8

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.8 SRO 3.0

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 3.7

AA2. Ability to determine and interpret the following as they apply to the (Refueling Canal Level Decrease)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.8 SRO 4.0

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.8 SRO 4.0

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4.4 Combustion Engineering EPEs / APEs

Combustion Engineering
E02 Reactor Trip Recovery

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Reactor Trip Recovery)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 2.9 SRO 3.2

EK1.2 Normal, abnormal and emergency operating procedures associated with (Reactor Trip Recovery).
IMPORTANCE RO 3.0 SRO 3.4

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Reactor Trip Recovery).
IMPORTANCE RO 3.0 SRO 3.4

EK2. Knowledge of the interrelations between the (Reactor Trip Recovery) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.7

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (Reactor Trip Recovery)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EPE: Reactor Trip Recovery (Continued)

K/A NO. KNOWLEDGE

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.7

EK3.2 Normal, abnormal and emergency operating procedures associated with (Reactor Trip Recovery).
IMPORTANCE RO 2.8 SRO 3.5

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.7

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.2 SRO 3.7

ABILITY

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

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.7

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.3 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.8

EPE: Reactor Trip Recovery (Continued)

K/A NO. KNOWLEDGE

EA2. Ability to determine and interpret the following as they apply to the (Reactor Trip Recovery)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.7 SRO 3.7

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.0 SRO 4.0

<u>Combustion Engineering</u>

E05 Excess Steam Demand

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Excess Steam Demand)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.3

EK1.2 Normal, abnormal and emergency operating procedures associated with (Excess Steam Demand).
IMPORTANCE RO 3.2 SRO 3.8

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Excess Steam Demand).
IMPORTANCE RO 3.4 SRO 3.7

EK2. Knowledge of the interrelations between the (Excess Steam Demand) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.6

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.7 SRO 4.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Excess Steam Demand)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.6 SRO 3.8

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Excess Steam Demand).
IMPORTANCE RO 3.3 SRO 3.8

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 4.0

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.2 SRO 3.6

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Excess Steam Demand)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.9 SRO 4.2

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.5 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (Excess Steam Demand)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.7 SRO 4.0

EPE: Excess Steam Demand (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.4 SRO 4.2

Combustion Engineering
E06 Loss of Feedwater

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Loss of Feedwater)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Loss of Feedwater).
IMPORTANCE RO 3.2 SRO 3.7

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Loss of Feedwater).
IMPORTANCE RO 3.2 SRO 3.7

EK2. Knowledge of the interrelations between the (Loss of Feedwater) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.7

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (Loss of Feedwater)
(CFR: 41.5 / 41.10, 45.6 / 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.9

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Loss of Feedwater).
IMPORTANCE RO 3.2 SRO 3.7

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.8

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.2 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Loss of Feedwater)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.9

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.4 SRO 4.0

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.2 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (Loss of Feedwater)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.8 SRO 3.9

EPE: Loss of Feedwater (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.0 SRO 4.2

Combustion Engineering
E09 Functional Recovery

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Functional Recovery)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 3.7

EK1.2 Normal, abnormal and emergency operating procedures associated with (Functional Recovery).
IMPORTANCE RO 3.2 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Functional Recovery).
IMPORTANCE RO 3.2 SRO 3.7

EK2. Knowledge of the interrelations between the (Functional Recovery) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.7 SRO 4.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Functional Recovery)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.5 SRO 3.9

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Functional Recovery).
IMPORTANCE RO 3.0 SRO 3.5

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.9

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.3 SRO 3.9

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Functional Recovery)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.2 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.6 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (Functional Recovery)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 4.4

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.0

Combustion Engineering
A11 RCS Overcooling

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (RCS Overcooling)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.1 SRO 3.3

AK1.2 Normal, abnormal and emergency operating procedures associated with (RCS Overcooling).
IMPORTANCE RO 3.0 SRO 3.3

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (RCS Overcooling).
IMPORTANCE RO 3.0 SRO 3.2

AK2. Knowledge of the interrelations between the (RCS Overcooling) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.2 SRO 3.4

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.2 SRO 3.4

AK3. Knowledge of the reasons for the following responses as they apply to the (RCS Overcooling)
(CFR: 41.5 / 41.10, 45.6, 45.13

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.5

APE: **RCS Overcooling (Continued)**

K/A NO. **KNOWLEDGE**

AK3.2 Normal, abnormal and emergency operating procedures associated with (RCS Overcooling).
IMPORTANCE RO 2.9 SRO 3.4

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.1 SRO 3.5

| AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.1 SRO 3.3

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (RCS Overcooling)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.5

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.4

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.0 SRO 3.5

AA2. Ability to determine and interpret the following as they apply to the (RCS Overcooling)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.9 SRO 3.3

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility’s license and amendments.
IMPORTANCE RO 3.0 SRO 3.4

A13 Natural Circulation Operations

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Natural Circulation Operations)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.5

AK1.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Operations).
IMPORTANCE RO 3.2 SRO 3.5

AK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Natural Circulation Operations).
IMPORTANCE RO 3.1 SRO 3.4

AK2. Knowledge of the interrelations between the (Natural Circulation Operations) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.0 SRO 3.4

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.4 SRO 3.6

AK3. Knowledge of the reasons for the following responses as they apply to the (Natural Circulation Operations)
(CFR: 41.5 / 41.10, 45.6, 45.13

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.7

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Operations).
IMPORTANCE RO 2.9 SRO 3.4

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.4 SRO 3.8

| AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.1 SRO 3.4

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Natural Circulation Operations)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.6

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.1 SRO 3.6

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.2 SRO 3.8

AA2. Ability to determine and interpret the following as they apply to the (Natural Circulation Operations)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.7 SRO 3.7

K/A NO. **KNOWLEDGE**

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 2.9 SRO 3.8

<u>**Combustion Engineering**</u>

A16 Excess RCS Leakage

K/A NO. KNOWLEDGE

AK1. Knowledge of the operational implications of the following concepts as they apply to the (Excess RCS Leakage)
(CFR: 41.8 / 41.10 / 45.3)

AK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.5

AK1.2 Normal, abnormal and emergency operating procedures associated with (Excess RCS Leakage).
IMPORTANCE RO 3.0 SRO 3.4

AK1.3 Annunciators and conditions indicating signals, and remedial action associated with the (Excess RCS Leakage).
IMPORTANCE RO 3.2 SRO 3.5

AK2. Knowledge of the interrelations between the (Excess RCS Leakage) and the following:
(CFR: 41.7 / 45.7)

AK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.2 SRO 3.5

AK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.0 SRO 3.3

AK3. Knowledge of the reasons for the following responses as they apply to the (Excess RCS Leakage)
(CFR: 41.5 / 41.10, 45.6, 45.13

AK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.7

APE: Excess RCS Leakage (Continued)

K/A NO. KNOWLEDGE

AK3.2 Normal, abnormal and emergency operating procedures associated with (Excess RCS Leakage).
IMPORTANCE RO 2.8 SRO 3.3

AK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.3 SRO 3.7

AK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 2.9 SRO 3.4

ABILITY

AA1. Ability to operate and / or monitor the following as they apply to the (Excess RCS Leakage)
(CFR: 41.7 / 45.5 / 45.6)

AA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.6

AA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.0 SRO 3.5

AA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.0 SRO 3.6

AA2. Ability to determine and interpret the following as they apply to the (Excess RCS Leakage)
(CFR: 43.5 / 45.13)

AA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.7 SRO 3.5

APE: Excess RCS Leakage (Continued)

K/A NO. KNOWLEDGE

AA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 2.9 SRO 3.7

4.5 Westinghouse EPEs / APEs

<u>Westinghouse</u>
E01 Rediagnosis

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Reactor Trip or Safety Injection/Rediagnosis)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.1 SRO 3.5

EK1.2 Normal, abnormal and emergency operating procedures associated with (Reactor Trip or Safety Injection / Rediagnosis).
IMPORTANCE RO 3.4 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Reactor Trip or Safety Injection/Rediagnosis).
IMPORTANCE RO 3.1 SRO 3.5

EK2. Knowledge of the interrelations between the (Reactor Trip or Safety Injection/Rediagnosis) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.5

EK2.2 Facility’s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.8

EK3. Knowledge of the reasons for the following responses as they apply to the (Reactor Trip or Safety Injection/Rediagnosis)
(CFR: 41.5, 41.10, 45.6, 45.13)

EPE: **Rediagnosis(Continued)**

K/A NO. **KNOWLEDGE**

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.0 SRO 3.3

EK3.2 Normal, abnormal and emergency operating procedures associated with (Reactor Trip or Safety Injection/Rediagnosis).
IMPORTANCE RO 3.0 SRO 3.9

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.5 SRO 3.3

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.3 SRO 3.6

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Reactor Trip or Safety Injection/Rediagnosis)
(CFR: 41.7 / 45.5, 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.7

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.3 SRO 3.6

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (Reactor Trip or Safety Injection Rediagnosis)
(CFR: 43.5 / 45.13)

EPE: Rediagnosis(Continued)

K/A NO. KNOWLEDGE

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.3 SRO 3.9

Westinghouse
E02 SI Termination

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (SI Termination)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (SI Termination).
IMPORTANCE RO 3.4 SRO 3.9

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (SI Termination).
IMPORTANCE RO 3.5 SRO 3.8

EK2. Knowledge of the interrelations between the (SI Termination) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (SI Termination)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.6

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (SI Termination).
IMPORTANCE RO 3.3 SRO 3.8

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.9 SRO 3.9

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (SI Termination)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 3.9

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (SI Termination)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.3 SRO 4.2

EPE: SI Termination (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.0

E03 LOCA Cooldown and Depressurization

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (LOCA Cooldown and Depressurization)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 4.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (LOCA Cooldown and Depressurization).
IMPORTANCE RO 3.6 SRO 4.1

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (LOCA Cooldown and Depressurization).
IMPORTANCE RO 3.5 SRO 3.8

EK2. Knowledge of the interrelations between the (LOCA Cooldown and Depressurization) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 4.0

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.7 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (LOCA Cooldown and Depressurization)
(CFR: 41.5 / 41.10, 45.6 / 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.7

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (LOCA Cooldown and Depressurization).
IMPORTANCE RO 3.4 SRO 3.9

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.9 SRO 3.9

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.9

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (LOCA Cooldown and Depressurization)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.7 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 4.1

EA2. Ability to determine and interpret the following as they apply to the (LOCA Cooldown and Depressurization)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.2

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.1

E04 LOCA Outside Containment

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (LOCA Outside Containment)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.9

EK1.2 Normal, abnormal and emergency operating procedures associated with (LOCA Outside Containment).
IMPORTANCE RO 3.5 SRO 4.2

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (LOCA Outside Containment).
IMPORTANCE RO 3.5 SRO 3.9

EK2. Knowledge of the interrelations between the (LOCA Outside Containment) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (LOCA Outside Containment)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.5

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (LOCA Outside Containment).
IMPORTANCE RO 3.4 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 3.8

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (LOCA Outside Containment)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.0 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (LOCA Outside Containment)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.3

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.6 SRO 4.2

E05 Loss of Secondary Heat Sink

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Loss of Secondary Heat Sink)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.8 SRO 4.1

EK1.2 Normal, abnormal and emergency operating procedures associated with (Loss of Secondary Heat Sink).
IMPORTANCE RO 3.9 SRO 4.5

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Loss of Secondary Heat Sink).
IMPORTANCE RO 3.9 SRO 4.1

EK2. Knowledge of the interrelations between the (Loss of Secondary Heat Sink) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.9 SRO 4.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Loss of Secondary Heat Sink)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.8

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Loss of Secondary Heat Sink).
IMPORTANCE RO 3.7 SRO 4.1

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.0 SRO 4.1

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.7 SRO 3.9

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Loss of Secondary Heat Sink)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 4.1 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.7 SRO 4.0

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.8 SRO 4.2

EA2. Ability to determine and interpret the following as they apply to the (Loss of Secondary Heat Sink)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.4

EPE: Loss of Secondary Heat Sink (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.7 SRO 4.3

E06 Degraded Core Cooling

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Degraded Core Cooling)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.6 SRO 4.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (Degraded Core Cooling).
IMPORTANCE RO 3.5 SRO 4.1

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Degraded Core Cooling).
IMPORTANCE RO 3.7 SRO 3.9

EK2. Knowledge of the interrelations between the (Degraded Core Cooling) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.8

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.8 SRO 4.1

EK3. Knowledge of the reasons for the following responses as they apply to the (Degraded Core Cooling)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.8

EPE: Degraded Core Cooling (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Degraded Core Cooling).
IMPORTANCE RO 3.5 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 4.0 SRO 3.9

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Degraded Core Cooling)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.8

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.5 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (Degraded Core Cooling)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.2

EPE: Degraded Core Cooling (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.1

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E07 Saturated Core Cooling

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Saturated Core Cooling)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Saturated Core Cooling).
IMPORTANCE RO 3.1 SRO 3.6

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Saturated Core Cooling).
IMPORTANCE RO 3.2 SRO 3.6

EK2. Knowledge of the interrelations between the (Saturated Core Cooling) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.2 SRO 3.5

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.5 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Saturated Core Cooling)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.1 SRO 3.7

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Saturated Core Cooling).
IMPORTANCE RO 3.2 SRO 3.7

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 3.6

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated. |
IMPORTANCE RO 3.3 SRO 3.6

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Saturated Core Cooling)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.6

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.2 SRO 3.7

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.5 SRO 3.9

EA2. Ability to determine and interpret the following as they apply to the (Saturated Core Cooling)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.3 SRO 3.9

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E08 Pressurized Thermal Shock

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Pressurized Thermal Shock)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.5 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Pressurized Thermal Shock).
IMPORTANCE RO 3.4 SRO 4.0

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Pressurized Thermal Shock).
IMPORTANCE RO 3.5 SRO 4.0

EK2. Knowledge of the interrelations between the (Pressurized Thermal Shock) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.7

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.6 SRO 4.0

EK3. Knowledge of the reasons for the following responses as they apply to the (Pressurized Thermal Shock)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.9

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Pressurized Thermal Shock).
IMPORTANCE RO 3.6 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.7 SRO 3.8

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.4 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Pressurized Thermal Shock)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.8

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.6 SRO 4.0

EA2. Ability to determine and interpret the following as they apply to the (Pressurized Thermal Shock)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.2

EPE: Pressurized Thermal Shock (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.5 SRO 4.1

E09 Natural Circulation Operations

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Natural Circulation Operations)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.0 SRO 3.4

EK1.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Operations).
IMPORTANCE RO 3.3 SRO 3.7

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Natural Circulation Operations).
IMPORTANCE RO 3.3 SRO 3.6

EK2. Knowledge of the interrelations between the (Natural Circulation Operations) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.2 SRO 3.4

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Natural Circulation Operations)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.6

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation Operations).
IMPORTANCE RO 3.2 SRO 3.6

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.5 SRO 3.6

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.4 SRO 3.6

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Natural Circulation Operations)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.5 SRO 3.5

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.5 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (Natural Circulation Operations)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.1 SRO 3.8

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility’s license and amendments.
IMPORTANCE RO 3.4 SRO 3.8

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E10 Natural Circulation with Steam Void in Vessel with/without RVLIS

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Natural Circulation with Steam Void in Vessel with/without RVLIS)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.3 SRO 3.6

EK1.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation with Steam Void in Vessel with/without RVLIS).
IMPORTANCE RO 3.4 SRO 3.6

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Natural Circulation with Steam Void in Vessel with/without RVLIS).
IMPORTANCE RO 3.3 SRO 3.6

EK2. Knowledge of the interrelations between the (Natural Circulation with Steam Void in Vessel with/without RVLIS) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.3 SRO 3.5

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Natural Circulation with Steam Void in Vessel with/without RVLIS)
(CFR: 41.5 / 41.10, 45.6 / 45.13)

EPE: **Natural Circulation with Steam Void in Vessel with/without RVLIS Continued)**

K/A NO. **KNOWLEDGE**

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.4 SRO 3.7

EK3.2 Normal, abnormal and emergency operating procedures associated with (Natural Circulation with Steam Void in Vessel with/without RVLIS).
IMPORTANCE RO 3.2 SRO 3.7

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.4 SRO 3.6

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.4 SRO 3.7

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Natural Circulation with Steam Void in Vessel with/without RVLIS)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.6

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.7

EPE: Natural Circulation with Steam Void in Vessel with/without RVLIS Continued)

K/A NO. KNOWLEDGE

EA2. Ability to determine and interpret the following as they apply to the (Natural Circulation with Steam Void in Vessel with/without RVLIS)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 3.9

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.4 SRO 3.9

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E11 Loss of Emergency Coolant Recirculation

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Loss of Emergency Coolant Recirculation)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.7 SRO 4.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (Loss of Emergency Coolant Recirculation).
IMPORTANCE RO 3.6 SRO 4.1

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Loss of Emergency Coolant Recirculation).
IMPORTANCE RO 3.6 SRO 4.0

EK2. Knowledge of the interrelations between the (Loss of Emergency Coolant Recirculation) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.6 SRO 3.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.9 SRO 4.3

EK3. Knowledge of the reasons for the following responses as they apply to the (Loss of Emergency Coolant Recirculation)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.3 SRO 3.9

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Loss of Emergency Coolant Recirculation).
IMPORTANCE RO 3.5 SRO 4.0

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.8 SRO 3.8

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.6 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Loss of Emergency Coolant Recirculation)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.9 SRO 4.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.5 SRO 3.8

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.7 SRO 4.2

EA2. Ability to determine and interpret the following as they apply to the (Loss of Emergency Coolant Recirculation)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.4 SRO 4.2

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.4 SRO 4.2

E12 Uncontrolled Depressurization of all Steam Generators

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Uncontrolled Depressurization of all Steam Generators)
(CFR: 41.8 / 41.10 / 45.3)

EK1.1 Components:, capacity, and function of emergency systems.
IMPORTANCE RO 3.4 SRO 3.8

EK1.2 Normal, abnormal and emergency operating procedures associated with (Uncontrolled Depressurization of all Steam Generators).
IMPORTANCE RO 3.5 SRO 3.8

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Uncontrolled Depressurization of all Steam Generators).
IMPORTANCE RO 3.4 SRO 3.7

EK2. Knowledge of the interrelations between the (Uncontrolled Depressurization of all Steam Generators) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.7

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.6 SRO 3.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Uncontrolled Depressurization of all Steam Generators)
(CFR: 41.5 / 41.10, 45.6, 45.13)

K/A NO. KNOWLEDGE

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.5 SRO 3.9

EK3.2 Normal, abnormal and emergency operating procedures associated with (Uncontrolled Depressurization of all Steam Generators).
IMPORTANCE RO 3.3 SRO 3.9

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.5 SRO 3.7

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.5 SRO 3.8

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Uncontrolled Depressurization of all Steam Generators)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.8 SRO 3.8

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.6 SRO 3.7

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.4 SRO 3.9

EPE: **Uncontrolled Depressurization of all Steam Generators (Continued)**

K/A NO. **KNOWLEDGE**

EA2. Ability to determine and interpret the following as they apply to the (Uncontrolled Depressurization of all Steam Generators)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.2 SRO 4.0

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.4 SRO 3.9

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E13 Steam Generator Overpressure

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Steam Generator Overpressure)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.2 SRO 3.4

EK1.2 Normal, abnormal and emergency operating procedures associated with (Steam Generator Overpressure).
IMPORTANCE RO 3.0 SRO 3.3

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Steam Generator Overpressure).
IMPORTANCE RO 3.0 SRO 3.2

EK2. Knowledge of the interrelations between the (Steam Generator Overpressure) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.0 SRO 3.1

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.0 SRO 3.2

EK3. Knowledge of the reasons for the following responses as they apply to the (Steam Generator Overpressure)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 2.9 SRO 3.2

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Steam Generator Overpressure).
IMPORTANCE RO 2.9 SRO 3.3

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.2 SRO 3.4

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.1 SRO 3.3

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Steam Generator Overpressure)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.1 SRO 3.3

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.0 SRO 3.2

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.1 SRO 3.4

EA2. Ability to determine and interpret the following as they apply to the (Steam Generator Overpressure)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.9 SRO 3.4

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.0 SRO 3.4

E14 High Containment Pressure

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (High Containment Pressure)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 3.3 SRO 3.6

EK1.2 Normal, abnormal and emergency operating procedures associated with (High Containment Pressure).
IMPORTANCE RO 3.2 SRO 3.7

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (High Containment Pressure).
IMPORTANCE RO 3.3 SRO 3.6

EK2. Knowledge of the interrelations between the (High Containment Pressure) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.4 SRO 3.7

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 3.4 SRO 3.8

EK3. Knowledge of the reasons for the following responses as they apply to the (High Containment Pressure)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 3.2 SRO 3.6

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (High Containment Pressure).
IMPORTANCE RO 3.1 SRO 3.7

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.5 SRO 3.5

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.3 SRO 3.6

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (High Containment Pressure)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.7 SRO 3.7

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 3.3 SRO 3.4

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 3.3 SRO 3.8

EA2. Ability to determine and interpret the following as they apply to the (High Containment Pressure)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 3.3 SRO 3.8

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.3 SRO 3.8

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E15 Containment Flooding

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (Containment Flooding)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 2.8 SRO 3.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (Containment Flooding).
IMPORTANCE RO 2.7 SRO 2.9

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (Containment Flooding).
IMPORTANCE RO 2.8 SRO 3.0

EK2. Knowledge of the interrelations between the (Containment Flooding) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 2.8 SRO 2.9

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 2.7 SRO 2.9

EK3. Knowledge of the reasons for the following responses as they apply to the (Containment Flooding)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 2.7 SRO 2.9

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (Containment Flooding).
IMPORTANCE RO 2.8 SRO 3.1

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 2.9 SRO 29

EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 2.9 SRO 3.0

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (Containment Flooding)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 2.9 SRO 3.0

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.7 SRO 2.9

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 2.8 SRO 3.0

EA2. Ability to determine and interpret the following as they apply to the (Containment Flooding)
(CFR: 43.5 / 45.13)

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.7 SRO 3.2

EPE: Containment flooding (Continued)

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 2.9 SRO 3.3

E16 High Containment Radiation

K/A NO. KNOWLEDGE

EK1. Knowledge of the operational implications of the following concepts as they apply to the (High Containment Radiation)
(CFR: 41.8 / 41.10, 45.3)

EK1.1 Components, capacity, and function of emergency systems.
IMPORTANCE RO 2.7 SRO 3.0

EK1.2 Normal, abnormal and emergency operating procedures associated with (High Containment Radiation).
IMPORTANCE RO 2.7 SRO 3.2

EK1.3 Annunciators and conditions indicating signals, and remedial actions associated with the (High Containment Radiation).
IMPORTANCE RO 3.0 SRO 3.3

EK2. Knowledge of the interrelations between the (High Containment Radiation) and the following:
(CFR: 41.7 / 45.7)

EK2.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.0 SRO 3.3

EK2.2 Facility's heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.
IMPORTANCE RO 2.6 SRO 3.0

EK3. Knowledge of the reasons for the following responses as they apply to the (High Containment Radiation)
(CFR: 41.5 / 41.10, 45.6, 45.13)

EK3.1 Facility operating characteristics during transient conditions, including coolant chemistry and the effects of temperature, pressure, and reactivity changes and operating limitations and reasons for these operating characteristics.
IMPORTANCE RO 2.9 SRO 3.1

EPE: High Containment Radiation (Continued)

K/A NO. KNOWLEDGE

EK3.2 Normal, abnormal and emergency operating procedures associated with (High Containment Radiation).
IMPORTANCE RO 2.9 SRO 3.3

EK3.3 Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations.
IMPORTANCE RO 3.0 SRO 3.0

| EK3.4 RO or SRO function within the control room team as appropriate to the assigned position, in such a way that procedures are adhered to and the limitations in the facilities license and amendments are not violated.
IMPORTANCE RO 3.0 SRO 3.2

ABILITY

EA1. Ability to operate and / or monitor the following as they apply to the (High Containment Radiation)
(CFR: 41.7 / 45.5 / 45.6)

EA1.1 Components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
IMPORTANCE RO 3.1 SRO 3.2

EA1.2 Operating behavior characteristics of the facility.
IMPORTANCE RO 2.9 SRO 3.0

EA1.3 Desired operating results during abnormal and emergency situations.
IMPORTANCE RO 2.9 SRO 3.3

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

EA2.1 Facility conditions and selection of appropriate procedures during abnormal and emergency operations.
IMPORTANCE RO 2.9 SRO 3.3

K/A NO. KNOWLEDGE

EA2.2 Adherence to appropriate procedures and operation within the limitations in the facility's license and amendments.
IMPORTANCE RO 3.0 SRO 3.3

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SECTION 5
COMPONENTS page

COMPONENT: 191001 Valves (CFR 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.01	The function and operation of safety valves	3.3	3.4
K1.02	The function and operation of relief valves	3.0	3.3
K1.03	The relationship of valve position to flow rate and back pressure	2.7	2.9
K1.04	The failed-valve positions for different operators (open, closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-drive valves)	2.8	3.2
K1.05	Equipment protection concerns in the use of valves (protect valve seals, open slowly)	2.6	2.8
K1.06	†Manual operation of MOV with motor inoperable	3.3	3.7
K1.07	Principles of operation and purpose of check valves	2.5	2.8
K1.08	Operation of valves and verification of position	3.4	3.4
K1.09	Reason for using globe valves versus gates valves for throttling	2.2*	2.4

COMPONENT: 191002 Sensors and Detectors (CFR 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Flow		
K1.01	Characteristics of venturis and orifices	2.2*	2.4
K1.02	Temperature/density compensation requirements	2.7	2.9
K1.03	Effects of gas or steam on liquid flow rate indications (erroneous reading)	2.7	2.9
K1.04	Modes of failure	2.7	2.7
K1.05	Explain the operation of a flow D/P cell type flow detector	2.6	2.8
	Level		
K1.06	Temperature/pressure compensation requirements	2.5	2.6
K1.07	Theory and operation of level detectors	2.5	2.6
K1.08	†Effects of operating environment (pressure and temperature)	2.8	3.1
K1.09	Modes of failure	2.9	3.0
	Pressure		
K1.10	Theory and operation of pressure detectors (bourdon tubes, diaphragms, bellows, forced balance, and variable capacitance)	2.3	2.5
K1.11	Effects of operating environment (pressure, temperature)	2.7	3.0
K1.12	Modes of failure	2.8	2.9
	Temperature		
K1.13	Theory and operation of T/C, RTD, thermostats	2.6	2.8
K1.14	Failure modes of T/C and RTD	2.8	2.9
	Position Detectors		
K1.15	Failure lodes of reed switches, LVDT, limit switches, and potentiometers	2.3	2.4

COMPONENT: 191002 Sensors and Detectors

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.16	Applications of reed switches, magnets, LVDT, potentiometers, and limit switches	2.3	2.7
	<u>Nuclear Instrumentation</u>		
K1.17	Effects of core voiding on neutron detection	3.3	3.5
	<u>Portable and Personal Radiation Detection</u>		
K1.18	Theory and operation of ion chambers, G-M tubes and scintillation detectors	2.6	2.8
K1.19	Use of portable and personal radiation monitoring instruments.	3.1	3.3
K1.20	Theory and operation of failed-fuel detectors	2.5	2.7

COMPONENT: 191003 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	3.1	3.2
K1.02	†Function and operation of a speed controller	2.6	2.7
K1.03	Operation of valves controllers in manual and automatic mode	3.1	3.1
K1.04	Function and operation of pressure and temperature controllers, including pressure and temperature control valves	2.8	3.0
K1.05	Function and characteristics of valve positioners	2.5	2.8
K1.06	Function and characteristics of governors and other mechanical controllers	2.3	2.6
K1.07	Safety precautions with respect to the operation of controllers and positioners	2.3	2.6
K1.08	Theory of operation of the following types of controllers: electronic, electrical, and pneumatic	2.1	2.6
K1.09	Effects on operation of controllers due to proportional, integral (reset), derivative (rate), as well as their combinations	2.4	2.5
K1.10	Function and characteristics of air-operated valves, including failure modes	2.4	2.8
K1.11	†Cautions for placing a valve controller in manual mode	2.8	2.9

COMPONENT: 191004 Pumps (CFR 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Centrifugal		
K1.01	Identification, symptoms, and consequences of cavitation	3.3	3.5
K1.02	Reasons for venting a centrifugal pump	3.1	3.4
K1.03	Consequences of air steam binding	3.1	3.3
K1.04	Consequences of operating a pump dead headed or for extended times without adequate recirculation	3.3	3.4
K1.05	Discuss relationships among head, flow, and power as related to pump speed	2.3	2.4
K1.06	Need for net positive suction head (NPSH); effects of loss of suction	3.2	3.3
K1.07	Starting current and operating current interpretation	2.9	2.9
K1.08	Purpose of starting a pump with discharge valve closed	2.4	2.6
K1.09	Pressure and flow relationship of pumps in parallel	2.4	2.Z
K1.10	Pressure and flow relationship of pumps in series	2.4	2.4
K1.11	Definition of pump shutoff head	2.3	2.4
K1.12	"Runout" of a centrifugal pump (definition, indications, causes, effects, and corrective measures)	2.5	2.7
K1.13	Theory of operation of a centrifugal pump	2.1	2.1
K1.14	Using a centrifugal pump characteristic curve and a system characteristic curve, illustrate how the system operating point changes due to system changes	2.4	2.5
K1.15	Relationship between flow from a pump and suction heads	2.5	2.8
K1.16	Safety procedures and precautions associated with centrifugal pumps	2.8	2.9
K1.17	Define pump efficiency	1.8*	1.9*
K1.18	Explain the difference between ideal and real pumping process	1.4*	1.7*

COMPONENT: 191004 Pumps

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	Positive Displacement		
K1.19	Discuss the relationship among head, flow, speed, and power	2.4	2.4
K1.20	Net positive suction head (NPSH) requirements for a positive displacement pump	2.8	2.8
K1.21	Consequences of operating a positive displacement pump against a closed flow path	3.0	3.1
K1.22	Applications and characteristics of positive displacement pumps	2.3	2.5
K1.23	Reason for starting a positive displacement pump with the discharge valve open	2.8	2.9
K1.24	Safety procedures and precautions associated with positive displacement pumps	3.0	3.1
K1.25	Basic operation of positive displacement pumps	2.3	2.4
K1.26	Theory of operation of positive displacement pumps	1.9	2.0
K1.27	Discuss the characteristic curve for a typical positive displacement pump and explain the reason for its shape	2.1*	2.1
	Jet Pumps		
K1.28	Describe the principles of operation of a jet pump	1.8*	1.8*

COMPONENT: 191005 Motor and Generators (CFR 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Indication of a locked rotor	2.8	3.1
K1.02	Potential consequences of overheating insulation or bearings	2.8	2.9
K1.03	Causes of excessive current in motors and generators, such as low voltage, overloading, and mechanical binding	2.7	2.8
K1.04	Relationship between pump motor current (ammeter reading) and the following: pump fluid flow, head, speed, and stator temperature	2.7	2.8
K1.05	Explain the difference between starting current and operating (running) current in a motor	2.8	2.7
K1.06	Reason for limiting the number of motor starts in a given time period	3.0	3.1
K1.07	Electrical units: Volts, Amps, VARs, Watts, and Hertz	2.1*	2.3
K1.08	Consequences of overexcited/under excited	2.1	2.3
K1.09	Interrelations of the following: VARs, Watts, Amps, Volts, Power factor	1.9*	2.1
K1.10	Load sharing with parallel generators	2.3*	2.4
K1.11	†Motor and generator protective devices	2.3*	2.4

COMPONENT: 191006 Heat Exchangers and Condensers (CFR 41.4)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Startup/shutdown of a heat exchanger	2.1	2.3
K1.02	Proper filling of a shell-and-tube heat exchanger	2.1	2.3
K1.03	Basic heat transfer in a heat exchanger	2.2	2.3
K1.04	Effects of heat exchanger flow rates that are too high or too low and methods of proper flow adjustment	2.5	2.7
K1.05	Flow paths for the heat exchanger (counterflow and U-types)	1.8*	1.9*
K1.06	Components of a heat exchanger (shells, tubes, plates, etc.)	1.7*	1.9*
K1.07	Control of heat exchanger temperatures	2.4	2.6
K1.08	Relationship between flow rates and temperatures	2.4	2.4
K1.09	Definition of thermal shock	2.8	2.8
K1.10	Principle of operation of condensers	2.3	2.4
K1.11	Relationship between condenser vacuum and backpressure	2.1*	2.1*
K1.12	Effects of tube fouling and tube failure scaling on heat exchanger operation	2.5	2.7
K1.13	Consequences of heat exchanger tube failure	2.8	2.9
K1.14	Reasons for non-condensable gas removal	2.4	2.6

COMPONENT: 191007 Demineralizers and Ion Exchangers (CFR 41.3)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Effect of excessive differential pressure on demineralizer performance	2.3	2.5
K1.02	Effects of channeling in a demineralizer	2.1	2.3
K1.03	Reason for sampling inlet and outlet of demineralizer	2.2	2.5
K1.04	Reason for demineralizer temperature and flow limits	2.4	2.4
K1.05	Principles of demineralizer operation	2.0	2.2
K1.06	Demineralizer D/P to determine condition of demineralizer resin bed	2.1	2.5
K1.07	Effects of demineralizer operation on water conductivity	2.1	2.2
K1.08	Demineralizer characteristics that can cause a change in boron concentration	3.Z	3.1
K1.09	Reasons for bypassing demineralizers	2.5	2.7
K1.10	Reasons for using mixed-bed demineralizers to process primary water	2.1	2.3
K1.11	Plant evolutions which can cause crud bursts and the effect on demineralizers	2.5	2.8
K1.12	Definition of "boron saturated" as it relates to a demineralizer	2.7	2.9
K1.13	Definition of "lithium saturated" as it relates to a demineralizer	2.1	2.1
K1.14	Effect of temperature on saturated ion exchangers	2.4	2.6

COMPONENT: 191008 Breakers, Relays, and Disconnects (CFR 41.7)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	†Purpose of racking out breakers (de-energize components and associated control and indication circuits)	2.6	2.8
K1.02	Local indication that breaker is open, closed or tripped	2.8	2.9
K1.03	Loss of power supply circuit breaker indicator lights and capability in remotely open and close	2.9	3.1
K1.04	Operation of various push buttons, switches and handles and the resulting action on breakers	2.9	3.0
K1.05	Function of thermal overload protection device	2.3	2.4
K1.06	†Interpretation of symbols for breakers, relays and disconnects in a one-line diagram	2.3	2.6
K1.07	Safety procedures and precautions associated with breakers, including MCC bus breakers, high, medium and low voltage breakers, relays and disconnects	3.0	3.3
K1.08	Effects of closing breakers with current out of phase, different frequencies, high voltage differential, low current, or too much load	3.3	3.5
K1.09	Effect of racking out breakers on control and indicating circuits and removal of control power on breaker operation	2.8	3.1
K1.10	†Function, control, and precautions associated with disconnects	2.7*	3.1
K1.11	Control room indication of a breaker status	3.1	3.3
K1.12	Trip indicators for circuit breakers and protective relays	2.9	2.9

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Section 6: THEORY

REACTOR THEORY (CFR 41.1)

REACTOR THEORY: 192001 Neutrons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define fast, intermediate, and slow neutrons.	1.9*	2.0
K1.02	Define prompt and delayed neutrons.	2.4	2.5
K1.03	Define thermal neutrons.	2.2	2.3
K1.04	Describe neutron moderation.	2.4	2.4
K1.05	Identify characteristics of good moderators.	2.0*	2.1*
K1.06	Define neutron lifetime.	1.6*	1.6*
K1.07	Define neutron generation time.	1.6*	1.6*
K1.08	Describe fast flux, thermal flux, and flux distribution.	1.9*	2.0
K1.09	Describe sources of neutrons.	2.3	2.4

REACTOR THEORY: 192002 Neutron Life Cycle

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Describe the neutron life cycle using the following terms:		
K1.01	--fast fission factor.	1.4*	1.4*
K1.02	--fast non-leakage probability factor.	1.4*	1.6*
Kl.03	--resonance escape probability factor.	1.9*	1.9*
K1.04	--thermal non-leakage probability factor.	1.5*	1.6*
K1.05	--thermal utilization factor.	1.9*	1.9*
K1.06	--reproduction factor.	1.5*	1.6*
K1.07	Define critical, subcritical, and supercritical with respect to a reactor and in terms of the effective multiplication factor.	3.1	3.1
K1.08	Define effective multiplication factor and discuss its relationship to the state of a reactor.	2.6	2.6
K1.09	Define K-excess (excess reactivity).	2.5	2.7
K1.10	Define shutdown margin.	3.2	3.6
K1.11	Define reactivity.	2.9	3.0
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.	3.5*	3.7*
K1.14	†Evaluate change in shutdown margin due to changes in plant parameters.	3.8	3.9

REACTOR THEORY: 192003 Reactor Kinetics and Neutron Sources

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Explain the concept of subcritical multiplication.	2.7	2.8
K1.02	Given the simplified formula for subcritical multiplication, perform calculations involving steady state count rate and source count rate.	2.2	2.3
K1.03	Describe the production of delayed neutrons.	2.3	2.4
K1.04	Define delayed neutron fraction and effective delayed neutron fraction: state the reasons for variation.	2.4	2.4
K1.05	Define start-up rate.	2.7	2.8
K1.06	Describe the factors affecting start-up rate.	3.2	3.3
K1.07	Explain the effect of delayed neutrons on reactor control.	3.0	3.0
K1.08	Explain the prompt critical, prompt jump, and prompt drop.	2.8	2.9
K1.09	Given the power equation, solve problems for power changes.	2.3	2.3
K1.10	Define doubling time and calculate it using the power equation.	1.6*	1.6*
K1.11	Explain the necessity for installed neutron sources in a reactor core.	2.7	2.8

REACTOR THEORY: 192004 Reactivity Coefficients

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define moderator temperature coefficient of reactivity.	3.1	3.2
K1.02	Define fuel temperature coefficient of reactivity.	3.0	3.2
K1.03	Describe the effect on the magnitude of the temperature coefficient of reactivity from changes in moderator temperature and core age.	2.9	3.1
K1.04	Explain resonance absorption.	2.4	2.4
K1.05	Explain doppler broadening and self-shielding.	2.3*	2.4*
K1.06	Describe time effects of core age, moderator temperature, and boron concentration on moderator temperature coefficients.	3.1	3.1
K1.07	Describe the effects of core age, fuel temperature, and moderator temperature on fuel temperature (doppler) coefficient.	2.9	2.9
K1.08	Describe the components of power coefficient.	3.1	3.1
K1.09	Compare boron reactivity worth vs. boron concentration.	2.8	2.9
K1.10	Compare boron reactivity worth vs. moderator temperature.	2.9	2.9
K1.11	Explain the change in reactivity addition rate due to boration/dilution over core life.	2.9	3.1
K1.12	Explain differences between reactivity coefficients and reactivity defects.	2.7	2.7
K1.13	Explain and describe the effect of power defect and doppler defect on reactivity.	2.9	2.9

REACTOR THEORY: 192005 Control Rods (Full and/or Part Length)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Name the material used for thermal neutron absorption in control rods.	1.8*	1.9*
K1.02	Describe nuclear properties of active neutron absorber material in the control rod.	1.9	2.0*
K1.03	Predict direction of change in reactor power for a chance in control rod position.	3.5	3.6
K1.04	Define reactor scram/trip.	3.2*	3.2*
K1.05	Define control rod worth, differential control rod worth, and integral control rod worth.	2.8	3.1
K1.06	Explain the shape of curves for differential and integral new versus rod position.	2.6	2.9
K1.07	Explain direction of change in magnitude of CRW far a change in moderator temperature, boron concentration, and fission product poisons.	2.5	2.8
K1.08	State the purpose of flux shaping.	2.7	2.9
K1.09	State the purpose of rod sequencing and overlap.	2.8	3.0
K1.10	†Describe axial flux imbalance, including long-range effects.	3.0	3.3
K1.11	†Describe the effects of quadrant power tilt (symmetric offset), including long-range effects.	2.8	3.2
K1.12	†Describe power peaking or hot-channel factors.	2.9	3.1
K1.13	†Define and calculate quadrant tilt (symmetric offset) ratio	2.9	3.3
K1.14	Explain the effects of full and/or part length rods on Delta I (flux distribution).	3.2	3.5
K1.15	†Discuss rod insertion limits.	3.4	3.9
K1.16	†Describe the effects of control rods on power peaking or hot-channel factors.	2.8	3.1

REACTOR THEORY: 192006 Fission Product Poisons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define fission product poison.	2.5	2.6
K1.02	State the characteristics of Xenon-135 as a fission product poison.	3.0	1.1
K1.03	Describe the production of Xenon-135.	2.7	2.8
K1.04	Describe the removal of Xenon-135.	2.8	2.8
	Describe the following processes and state their effect on reactor operations:		
K1.05	--Equilibrium Xenon	3.1	3.1
K1.06	--Transient Xenon	3.2	3.4
K1.07	--Xenon following a scram	3.4	3.4
K1.08	Describe the effects that Xenon concentration has on flux shape and control rod patterns.	3.3	3.4
	Plot the curve and explain the reasoning for the reactivity insertion by Xenon-124 versus time for the following:		
K1.09	--Initial reactor startup and ascension to rated power.	3.0	3.1
K1.10	--Reactor startup with Xenon-135 already present in the core.	3.1	3.2
K1.11	--Power changes from steady-state power to another.	3.1	3.1
K1.12	--Reactor scram.	3.1	3.1
K1.13	--Reactor shutdown.	2.9	3.0
K1.14	Explain the methods and reasons for the operator to compensate for the time dependent behavior of Xenon 135 concentration in the reactor.	3.2	3.3
K1.15	State the characteristics of Samarium-149 as a fission product poison.	1.9*	1.9*
K1.16	Describe the production of Samarium-149.	1.8*	1.8*
K1.17	Describe the removal of Samarium-14?.	1.8*	1.8*

REACTOR THEORY: 192006 Fission Product Poisons

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
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.	1.8*	1.9*
K1.20	--Reactor shutdown.	1.7*	1.8*
K1.21	Describe the 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.	1.8*	1.8*

REACTOR THEORY: 192007 Fuel Depletion and Burnable Poisons

		IMPORTANCE	
K/A NO.	**KNOWLEDGE**	**RO**	**SRO**
K1.01	**Define burnable poison and state its use in the reactor.**	**2.1**	**2.5**
K1.02	**Describe and explain distribution of burnable poisons in the core.**	**2.0***	**2.2**
K1.03	**Given a curve of K-effective versus core age, state the reasons for maximum, minimum, and inflection points.**	**1.7***	**2.1**
K1.04	**Describe how and why boron concentration changes over core life.**	**3.1**	**3.4**
K1.05	**Describe the effects of boration/dilution on reactivity during forced-flow and natural circulation conditions.**	**3.0**	**3.2**

REACTOR THEORY: 192008 Reactor Operational Physics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	List parameters which should be monitored and controlled during the approach to criticality.	3.4	3.5
K1.02	†List reactivity control mechanisms which exist for plant conditions during the approach to criticality.	2.8	3.1
K1.03	Describe count rate and instrument response which should be observed for rod withdrawal during the approach to criticality.	3.9	4.0
K1.04	Relate the concept of subcritical multiplication to predicted count rate response for control rod withdrawal during the approach to critical.	3.8	3.8
K1.05	Explain characteristics to be observed when the reactor is very close to criticality.	3.8	3.9
K1.06	Calculate ECP using a 1/M plot.	2.9	3.1
K1.07	Calculate ECP using procedures and given plant procedures.	3.5	3.6
K1.08	List parameters which should be monitored and controlled upon reaching criticality.	3.5	3.7
K1.09	Define criticality as related to a reactor startup.	3.2	3.3
K1.10	Describe reactor power response once criticality is reached.	3.3	3.4
K1.11	Describe how to determine if a reactor is critical.	3.8	3.8
K1.12	List parameters which should be monitored and controlled during the intermediate phase of startup (from criticality to PCAH).	3.5	3.6
K1.13	Discuss the concept of the point of adding heat (POAH) and its impact on reactor power.	3.4	3.6
K1.14	Describe reactor power response prior to reaching the POAH.	3.1	3.1
K1.15	Explain characteristics to look for when the POAH is reached.	3.4	3.4
K1.16	Describe monitoring and control of reactor power and primary temperature during 0% to 15% (B & W).	3.2	3.3

REACTOR THEORY: 192008 Reactor Operational Physics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1.17	Describe reactor power response after reaching the point of adding heat.	3.3	3.4
K1.18	Describe the monitoring and control of T-ave, T-ref, and power during power operation.	3.6	3.5
K1.19	Describe means by which reactor power will be increased to rated power.	3.5	3.6
K1.20	Explain the effects of control rod motion or boration/dilution on reactor power.	3.8	3.9
K1.21	Explain the relationship between steam flow and reactor power given specific conditions.	3.6	3.8
K1.22	Explain how boron concentration affects core life.	2.6 ?	3.8?
K1.23	Explain the shape of a curve of reactor power versus time after a scram.	2.9	3.1
K1.24	Explain reactor power response to a control rod insertion.	3.5	3.6
K1.25	Explain the necessity for inserting control rods in a predetermined sequence during normal shutdown.	2.9	3.1
K1.26	Define decay heat.	3.1	3.2
K1.27	Explain the relationship between decay heat generation and: a) power level history, b) power production, and c) time since reactor shutdown.	3.1	3.4

THERMODYNAMICS THEORY
(CFR 41.14)

THERMODYNAMICS: 193001 Thermodynamic Units and Properties

		IMPORTANCE	
K/A NO.	**KNOWLEDGE**	**RO**	**SRO**
K1.01	**Convert between absolute and gauge pressure and vacuum scales.**	**2.5**	**2.7**
K1.02	**Recognize the difference between absolute and relative (Kelvin) temperature scales.**	**1.9***	**2.0***
K1.03	**Describe how pressure and level sensing instruments work.**	**2.6**	**2.6**
K1.04	**Explain relationships between work, power, and energy.**	**2.2**	**2.3**
K1.05	**Explain the law of conservation of energy.**	**2.1***	**2.1**

THERMODYNAMICS: 193003 Steam

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define energy and work.	1.9*	2.0*
K1.02	Describe effects of pressure and temperature on density or specific volume of a liquid.	2.4	2.5
K1.03	Describe the effects of pressure and temperature on density or specific volume of a gas.	2.3	2.4
	Define the following terms:		
K1.04	--Latent heat of vaporization	2.3	2.3
K1.05	--Vaporization line	1.9*	1.9*
K1.06	--Critical point	1.9*	1.9*
K1.07	--Vapor dome	1.8*	1.8*?
K1.08	--Saturated liquid	2.8	2.8
K1.09	--Wet vapor	2.1*	2.1
K1.10	--Saturated vapor	2.3	2.3
K1. 11	--Vapor pressure	1.7*	1.8*
K1.12	--Moisture content	2.8	2.3
K1.13	--Quality	2.3	2.3
K1.14	--Superheated vapor	2.4	2.5
K1.15	--Supersaturated vapor	1.8*	1.9*
K1.16	--Subcooled and compressed liquids	2.6	2.7
K1.17	--Subcooling	3.0	3.2
K1.18	--Specific heat	2.3*	2.3
K1.19	- -Enthalpy	2.3	2.4
	Identify the following terms on a T-s diagram:		
K1.20	--Critical point	1.9*	2.0*
K1.21	--Saturated liquid line	2.1*	2.1

THERMODYNAMICS: 193003 Steam

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.22	--Saturated vapor line	2.0	2.1
K1.23	--Solid, liquid, gas, vapor, and fluid regions	1.9*	1.9*
K1.24	Explain the usefulness of steam tables to the Control Room operator.	2.8	3.1
K1.25	Explain and use saturated and superheated steam tables.	3.3	3.4
K1.26	Apply specific heat in solving heat transfer problems.	1.9*	2.0*

THERMODYNAMICS: 193004 Thermodynamic Processes

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Explain the relationship between real and ideal processes.	1.8*	1.9*
K1.02	Explain the shape of the T-s diagram process line for a typical secondary system.	1.7*	1.9*
	Nozzles:		
K1.03	Describe the functions of nozzles in flow restrictors.	1.9*	1.9*
K1.04	Describe the functions of nozzles in air ejectors.	2.0	2.0
	Turbines		
K1.05	Explain the function of nozzles fixed blading and moving blading in the turbine.	1.6*	1.7*
K1.06	Explain the reason turbines are multistages.	1.5*	1.7*
K1.07	Define turbine efficiency.	1.6*	1.6*
K1.08	Explain the difference between real and ideal turbine efficiency.	1.6*	1.7*
	Pumps:		
K1.09	Define pump efficiency.	1.3*	1.3*
K1.10	Explain the difference between ideal and real pumping processes.	1.3	1.3*
	Condensers		
K1.11	Describe the process of condensate depression and its effect on plant operation.	2.4	2.5
K1.12	Explain vacuum formation in condenser processes.	2.2	2.3
K1.13	Explain, the condensing process.	2.2	2.3
	Throttling and the throttling Process		
K1.14	Explain the reduction of process pressure from throttling.	2.1	2.3
K1.15	Determine the exit conditions for a throttling process based on the use of steam and/or water	2.8	2.8

THERMODYNAMICS: 193005 Thermodynamic Cycles

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Define thermodynamic cycle.	1.6*	1.7*
K1.02	Define thermodynamic cycle efficiency in terms of net work produced and energy applied.	1.6*	1.8*
K1.03	Describe how changes in secondary system parameter affect thermodynamic efficiency.	2.5	2.6
K1.04	Describe the moisture effects on turbine integrity and efficiency.	2.1	2.3
K1.05	State the advantages of moisture separators/repeaters and feedwater heaters for a typical steam cycle.	1.9	1.9

THERMODYNAMICS: 193006 Fluid Statics and Dynamics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	Distinguish between static pressure, dynamic pressure, and total pressure.	2.2	2.3
K1.02	Define head loss.	2.3	1.4
K1.03	Discuss operational considerations of viscosity as related to head loss.	1.7*	1.8*
K1.04	Explain operational implications of water hammer.	3.4	3.6
	Define or explain the following terms and concepts:		
K1.05	--Mass flow rate	2.9	3.0
K1.06	--Two-phase flow	2.8	2.9
K1.07	--Pressure spike	2.7	2.7
K1.08	--Gas binding	2.8	1.8
K1.09	--Recirculation ratio	1.9*	1.9*
K1.10	--Water hammer	3.3	3.4
K1.11	--Cavitation	3.1	3.3
K1.12	Explain why flow measurements must be corrected for density changes.	2.5	2.6
K1.13	Explain the relationship between pressure head and velocity head in a fluid system.	2.2	2.3
K1.14	Discuss the velocity profiles for laminar flow and turbulent flow.	1.8*	1.9*
K1.15	Describe the methods of controlling system flow rates.	3.1	3.3

THERMODYNAMICS: 193007 Heat Transfer

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
	Heat Transfer		
K1.01	Describe three mechanisms of heat transfer.	2.5	2.5
K1.02	Define thermal conductivity.	2.0	2.2
K1.03	Explain the manner in which fluid films affect heat transfer.	2.2	2.4
K1.04	Describe how the presence of gases or steam can affect heat transfer and fluid flow in heat exchangers.	2.8	3.0
	Core Thermal Power		
K1.05	Define core thermal power.	2.7	2.9
K1.06	Explain methods of calculating core thermal power.	3.1	3.3
K1.07	Define percent reactor power.	2.7	2.8
K1.08	Calculate core thermal power using a simplified heat balance.	3.1	3.4

THERMODYNAMICS: 193008 Thermal Hydraulics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
	<u>Departure from Nucleate Boiling</u>		
K1.01	Distinguish between boiling processes and other heat transfer mechanisms.	2.8	3.0
K1.02	Describe means by which boiling affects convection heat transfer.	2.8	3.0
K1.03	Describe the processes of nucleate boiling, subcooled nucleate boiling, and bulk boiling.	2.8	3.1
K1.04	Describe DNB (departure from nucleate boiling).	3.1	3.3
K1.05	List the parameters that affect DNR and DNBR and describe their effect(s).	3.4	3.6
K1.06	Describe CHF (critical heat flux).	2.8	2.9
K1.07	Describe transition (partial film) boiling.	2.6	2.6
K1.08	Describe film boiling.	2.6	2.6
K1.09	Describe burnout and burnout heat flux.	2.3	2.4
K1.10	Define DNBR.	2.9	3.1
	<u>Two Phase Flow</u>		
K1.11	Classify slug flow region along a fuel pin, experiencing two phase flow.	1.9*	2.1*
K1.12	Describe annular flow region along a hypothetical fuel pin, experiencing two phase flow.	1.8*	1.9*
K1.13	Describe dryout region or mist flow region along a hypothetical fuel pin, experiencing two phase flow.	1.9*	2.1*
K1.14	Describe effects of flowrate and phase change on the heat transfer coefficient.	2.6	2.7
K1.15	Define and describe subcooling margin (SCM).	3.6	3.8
K1.16	Draw the temperature profile from the centerline of a fuel pellet to the centerline of the flow channel.	2.4	2.6
K1.17	Explain the necessity of determining core coolant flow.	2.9	3.2

THERMODYNAMICS: 193008 Thermal Hydraulics

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.18	Describe the factors affecting single- and two-phase flow resistance.	2.3	2.5
K1.19	Describe core bypass flow.	2.5	2.8
K1.20	Explain the need for adequate core bypass flow.	2.9	2.9
	<u>Natural Circulation</u>		
K1.21	Explain the conditions which Must exist to establish natural circulation.	3.9	4.2*
K1.22	Describe means to determine if natural circulation flow exists.	4.2*	4.2*
K1.23	Describe means by which natural circulation can be enhanced.	3.9	4.1
K1.24	†Describe the process of reflux boiling (boiler condenser process).	2.7	3.1
K1.25	†Describe how gas binding affects natural circulation.	3.3	3.4
	<u>Sketch the axial temperature and enthalpy profiles for a typical-reactor coolant channel and describe how they are affected by the following</u>:		
K1.26	--Onset of nucleate boiling	2.2*	2.4
K1.27	--Axial core flux	2.2*	2.4
K1.28	--Inlet temperature	2.2*	2.4*
K1.29	--Heat generation rate	2.2*	2.4
K1.30	--Flow rate in the channel	2.3*	2.4

THERMODYNAMICS: 193009 Core Thermal Limits

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	†--Radial peaking factor (RPF)	2.3	2.8
K1.02	†--Axial peaking factor (APF)	2.3	2.8
K1.03	†--Local peaking factor (LPF)	2.2	2.7
K1.04	†--Total peaking factor (TPF)	2.3	2.7
K1.05	†State the reason thermal limits are necessary.	3.1	3.5
K1.06	†Describe the function of the core protection calculator (thermal margin calculator).	2.8	3.7
K1.07	Describe factors that affect peaking and hot channel factors.	2.9	3.3

THERMODYNAMICS: 193010 Brittle Fracture and Vessel Thermal Stress

K/A NO.	KNOWLEDGE	IMPORTANCE RO	SRO
K1.01	State the brittle fracture made of failure.	2.8	3.2
K1.02	State the definition of Nil-Ductility Transition Temperature.	2.4	2.5
K1.03	Define reference temperature.	2.0	2.4
K1.04	State how the possibility of brittle fracture is minimized by operating limitations.	3.3	3.7
K1.05	State the effect of fast neutron irradiation on reactor vessel metals.	2.9	3.0
K1.06	Define pressurized thermal shock (PTS)	3.6	3.8
K1.07	State the operational concerns of uncontrolled cooldown.	3.8	4.1*