BACKGROUND DOCUMENT FOR ABWR KNOWLEDGE AND ABILITIES CATALOG

Why a new K/A catalog?
Licensing of new reactor designs triggered an industry assessment of reactor operator licensing processes and basis documents. An NEI task force concluded the existing Boiling Water Reactor (BWR) Knowledge and Abilities (K/A) catalog should be modified to reflect the knowledge and abilities needed to operate the Advanced Boiling Water Reactor (ABWR) design.

Process and History
The NEI new plant operator licensing task force developed a "Knowledge's and Abilities Revision Plan" dated December 2008, which described two alternatives: amend the existing BWR K/A catalog, or develop a new, design-specific catalog.

In January 2009, an STPNOC specific project plan (attachment 1) was developed to describe the process for revising NUREG 1123 to reflect the ABWR plant design. The initial K/A project plan described a process in which the current NUREG 1123 would be revised with ABWR specific knowledges and abilities added and knowledge and abilities that were not applicable would be identified. After revising a representative system it was recommended to the NRC that an ABWR specific K/A catalog be developed vice revising NUREG 1123. An ABWR specific catalog would be "cleaner" in that knowledge and abilities that were not applicable to the ABWR design would be removed from the document and only K/As that were pertinent to the ABWR design would be in the document. The NRC agreed with the recommendation to create an ABWR specific knowledge and abilities catalog.

From February 2009 thru July 2010, the STPNOC Unit 3/4 training department developed the draft ABWR K/A catalog using the current NUREG 1123 as a guide in the development process. The draft catalog was approved by the ABWR expert panel in November, 2010 and submitted to the NRC in December, 2010.

Importance Rating Methodology
Between June and September 2010, a subcommittee of the expert panel determined the importance rating by consensus for the generics, systems, emergency and abnormal plant evolutions sections of the catalog. The generic fundamentals section of the catalog was not changed. The importance ratings are whole numbers from one thru five (not averages). These importance ratings were approved by the expert panel at a meeting in October 2010. Attachments 6 and 7 were used as guidance in determining the importance rating

NRC participation
NRC representatives from headquarters, Region II and IV, and the Technical Training Center in Chattanooga, TN, participated in selected expert panel meetings. In addition the NRC was continuously updated on the status of the ABWR K/A development project through NEI meetings and phone conversations.

Meetings with AP1000 K/A catalog team
The ABWR K/A catalog developer participated in meetings with the AP1000 K/A catalog revision team three times in 2010 to ensure consistency between the two K/A catalogs. The NRC participated in some of these meeting.

Summary of Significant Changes

1. **Knowledge and Ability Stem Statements**

   The KA stem is the bolded high level description of the knowledge (K1, K2 …) or ability (A1, A2, …). The K/A statement is the specific knowledge or ability the operator is expected to demonstrate. The statements are listed below the stems.

   Throughout this document the term, XXS, is an identifier for the subject system.

   During the development of the catalog, the expert panel intended to meet three goals; standardize the stems, clearly define the scope of the stems, and ensure the K/A statement supports the stem. In order to accomplish this goal some of the stem statements were changed.

Systems

K1

The stem for K1 was revised to delete the statement "or cause-effect relationships". Cause-effect relationships are addressed in K5.

K1 identifies the systems that have a direct interaction with system XXS. The systems have either a plant protection/control logic relationship or physical piping relationship to system XXS. The System Design Description (SDD), Section 3.5, "System Interfaces" contains the list of supporting and dependent systems. Knowledges that were tied to the "cause-effect relationship" were moved to K5.

K2

The stem for K2 was revised to specify bus or division power relationships. Also, to the extent possible, specific components were identified instead of generic items like "pumps and valves" for that system

K2 comes from the applicable system design description and electrical diagrams.

K3

The stem for K3 was not revised.

K3 lists the systems included in K1 that will be affected by a loss of XXS.

K4

The stem for K4 was not revised.

K4 contains the Safety-Related Functions, Licensing-Related Functions, Defense-in-Depth Functions, and Non-Safety-Related Functions. SDD sections 3.1, "Functions", section 3.4, "Operation", and 3.6, "Instrumentation and Control", are the source for these K/A.

K5

The stem for K5 was revised to include cause-and-effect relationships. It was moved from the previous K1.

Information for K5 came from section 3.3, "Detailed System Description" and Section 4, "Specific Requirements for Components" of the SDD and may include some application of generic fundamentals that could not be tied to the Generic Fundamentals section of the K/A catalog. Since the Generic Fundamentals portion of the original BWR K/A catalog was developed after the catalog was initially developed there were redundant items in K5 and the Generic Fundamentals section of the book. Those items identified as being redundant were removed from K5. See Attachment 2 for the items that were deleted from K5 because were tied to items in the Generic Fundamentals section.

K6

The stem for K6 was modified to address plant conditions, system malfunctions, and component malfunctions on system XXS.

K6 lists the systems included in K1 that will have an effect on XXS if the listed system is not operating according to design. It also may list the components of system XXS whose failure can affect the operation of the XXS.

A1

The stem for A1 was not revised.

A1 includes parameters associated with operation of the XXS.

A2

The stem for A2 was not revised.

A2 is the ability to mitigate the consequences of selected items from K6.

A3

The stem for A3 was not revised.

A3 includes the automatic features of the XXS identified in K4.

A4

The A4 stem was revised to read "and" instead of "and/or."

A4 includes those systems having manual control functions operated from the main control room (unless specified elsewhere).

Emergency and Abnormal Plant Evolutions Section

The knowledge and ability stem statements were not revised.

2. **Generic Knowledge and Abilities**

   Based on guidance contained within a document created by the NRC (SRO Clarification Guidance, Revision 1), the expert panel adjusted the importance rating of some K/A statements for ROs and provided clarifying guidance ("such as" statements) for selected knowledge or ability statements.

3. **Generic fundamentals knowledges in systems K5**

   A comparison of the K5 knowledge statements and the knowledges in the generic fundamentals section of the catalog was performed. If any knowledge in K5 could be tied to a knowledge in the generic fundamentals section, they were removed from K5. Attachment 2 identifies the knowledges that were removed.

4. **Importance Ratings**

   In the systems section of the catalog, with the exception of A2 and the Fuel Handling System, there is one importance rating for the knowledge and abilities for RO and SRO. A2 and the Fuel Handling System will have separate importance ratings for RO and SRO. In the emergency and abnormal evolutions section of the catalog, with the exception of EA2 and AA2, there will be one importance rating. EA2 and AA2 will have separate importance ratings for RO and SRO.

5. **Task Lists**

   The systems task lists were removed from the catalog. These task lists were very generic and had limited value for writing exams. The plant specific task is available to use if required for developing the NRC exam. See attachment 4 for the justification of removal of the task list.

6. **Systems that were in multiple safety functions**

   Some systems were located in two safety functions. A detailed review of System Design Descriptions and other documents was performed to determine if those systems should be in two safety functions. As a result some systems were removed from a safety function. See attachment 3 for the basis for removing some systems from a safety function.

7. **PRA and Operating Experience**

   The ABWR K/A catalog knowledge and abilities were reviewed to identify those K/As that could be linked to the ABWR operator tasks important to perform for PRA considerations and significant operating experience identified in SOERs. Any K/A that could linked to these were identified with a "PRA" or "OE" next to them. Two new systems were incorporated into the catalog based on their importance to the PRA. The SOERs were reviewed through SOER 10-2,"Engaged, Thinking Organizations".

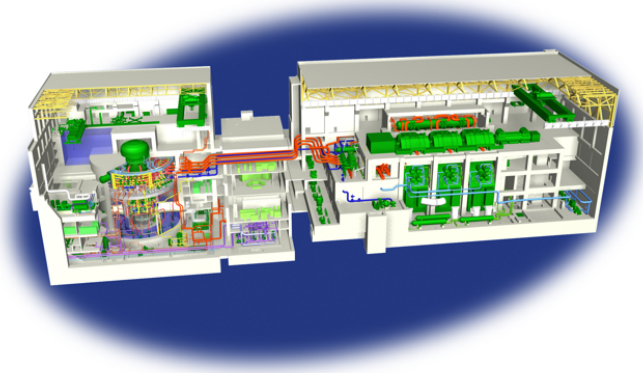
ATTACHMENTS

ATTACHMENT ONE

Document Number: N/A	
Revision: 8	Effective Date: 08/19/2009

Nuclear Operating Company

NUREG 1123 PLAN



	Authored: Mike Wagner	Date: 8/19/2009
	Reviewed: Steve Reeves	Date: 8/19/2009
	Approved: Glenn Macdonald	Date: 8/24/2009

Goal:

ATTACHMENT ONE

This plan describes the process for the revision of the existing Boiling Water Reactor (BWR) K/A Catalog (NUREG 1123). These potential changes are based on the Advanced Boiling Water Reactor (ABWR) plant design which will have new systems, tasks or knowledge and abilities.

Overview:

NUREG 1123 provides the content basis for development of licensing examinations for reactor operators (RO's) and senior reactor operators (SRO's). This catalog was established in 1985 and last updated in 2007.

The existing K/A catalogs may not comprehensively reflect the knowledge and abilities that operators will need to operate an ABWR. The purpose of this plan is to revise the BWR NRC K/A catalog to enable utilities and the NRC to develop valid operator licensing examinations for an ABWR. Revising the K/A catalogs for existing BWRs is not a purpose of this project.

Key stakeholders, including the utility, vendor, NRC, and INPO representatives will participate in the project. An analysis of the applicability of existing K/As for BWRs will be performed, and deletions, additions, or revisions identified.

Significant K/A revision project activities include the following:

- Develop project milestones
- Develop methodology for gap analysis
- Gain NRC concurrence of plan
- Perform gap analysis
- Determine importance ratings
- Update NRC on gap analysis and importance ratings
- Draft revised BWR catalogs
- Submit proposed catalog to the NRC
- Review and comment on proposed catalogs by NRC
- Incorporate NRC comments

ATTACHMENT ONE

Plan Details:

The dates for the project milestones are based on the following:

1. The NEI License Operator Focus Group (LOFG) Knowledge and Abilities Catalog Revision Plan that was developed in December, 2008. The dates in this ABWR plan are consistent with the overall due dates in the LOFG plan.
2. The current operator training schedule. The first license class is scheduled to have their audit and NRC exam in the May/June, 2013 timeframe. Based on this date, it is assumed that the ABWR revision to NUREG 1123 needs to be available in May, 2012 for exam development.
3. The current plant operating procedures development plan. Commencement of the development of the EOPs and SAGs is scheduled for June, 2010 with completion in May, 2011. Development of the Abnormal Operating Procedures is scheduled to start in May, 2009 with completion by November 2010. Enough information on the EOPs and SAGs should be available to meet milestone 4 due date.

Project Milestones	**Due Date / Status**
1. Develop methodology for gap analysis	December 2008 / Complete
2. Identify members of the Expert Panel that will determine importance ratings	May 28, 2009 / Complete
3. Perform gap analysis and revise NUREG 1123 for available systems IAW HFE plan (50%)	December 31, 2009 / Complete
4. Complete gap analysis (including determination of importance ratings) for remaining areas in NUREG 1123.	January 10, 2011
5. Update NRC on gap analysis and importance ratings (the NRC will be updated on a routine bases prior to this date)	January 10, 2011
6. NRC review and comment on revision to NUREG 1123 and send comments to STPNOC	March 7, 2011
7. STPNOC resolve NRC comments and submit final draft of ABWR K&A catalog to NRC	July 11, 2011
8. ABWR K&A catalog issued by NRC	January 9, 2012

ATTACHMENT ONE

Project Milestone Descriptions

1. **Gap Analysis Methodology:**
   a) Review the existing K/A's.
   b) Review new nuclear plant design and operating information (as available).
      i) System Design Descriptions
      ii) Piping and Instrument Diagrams
      iii) Interlock Block Diagrams
      iv) Operating Procedures
      v) Design Control Documents
      vi) Human Factors Engineering Inputs
      vii) Task List
      viii) Task Analysis Data
   c) Identify current K/A's that apply to new technology.
      i) Exactly the same
      ii) Some modification required
      iii) Not applicable
      iv) Identify areas of common scope
   d) Identify new K/A's associated with new technology.
      i) New system
      ii) New component
      iii) New procedure
      iv) Human system interface (HSI).

ATTACHMENT ONE

2. **Identify members of the expert panel that will determine importance ratings.**

   The Expert Panel will review the Knowledge and Abilities that have been determined to need their importance ratings reviewed or determined. This group should consist of the following personnel:

   a) Two members of STP Units 3 & 4 Operations Training Department (BWR and ABWR background). One of these individuals will act as the chairperson for this panel.

   b) One STP 3 & 4 line organization member with BWR and/or ABWR knowledge.

   c) One international ABWR subject matter expert.

   d) One individual that is an ABWR design subject matter expert.

   e) One member of the Nuclear Regulatory Commission (optional).

   With the exception of the NRC individual, the above personnel will meet the quorum requirements for the expert panel. Additional personnel may participate on the expert panel.

   As an aid for the expert panel, a flowchart has been developed to help determine if a system should be added or deleted from the revision to NUREG 1123.

3. **Perform gap analysis and revise NUREG 1123 for available systems IAW HFE plan (50%)**

   The gap analysis will be based on available information and in time to support operator licensing needs. The K/As will be assigned the 10 CFR 55 designators as appropriate (RO, SRO, and simulator). A common template developed by the LOTF will be used for the revision that will be submitted to the NRC. The plan to complete 50% of the systems is in attachment one.

4. **Complete gap analysis (including determination of importance ratings) for remaining areas in NUREG 1123.**

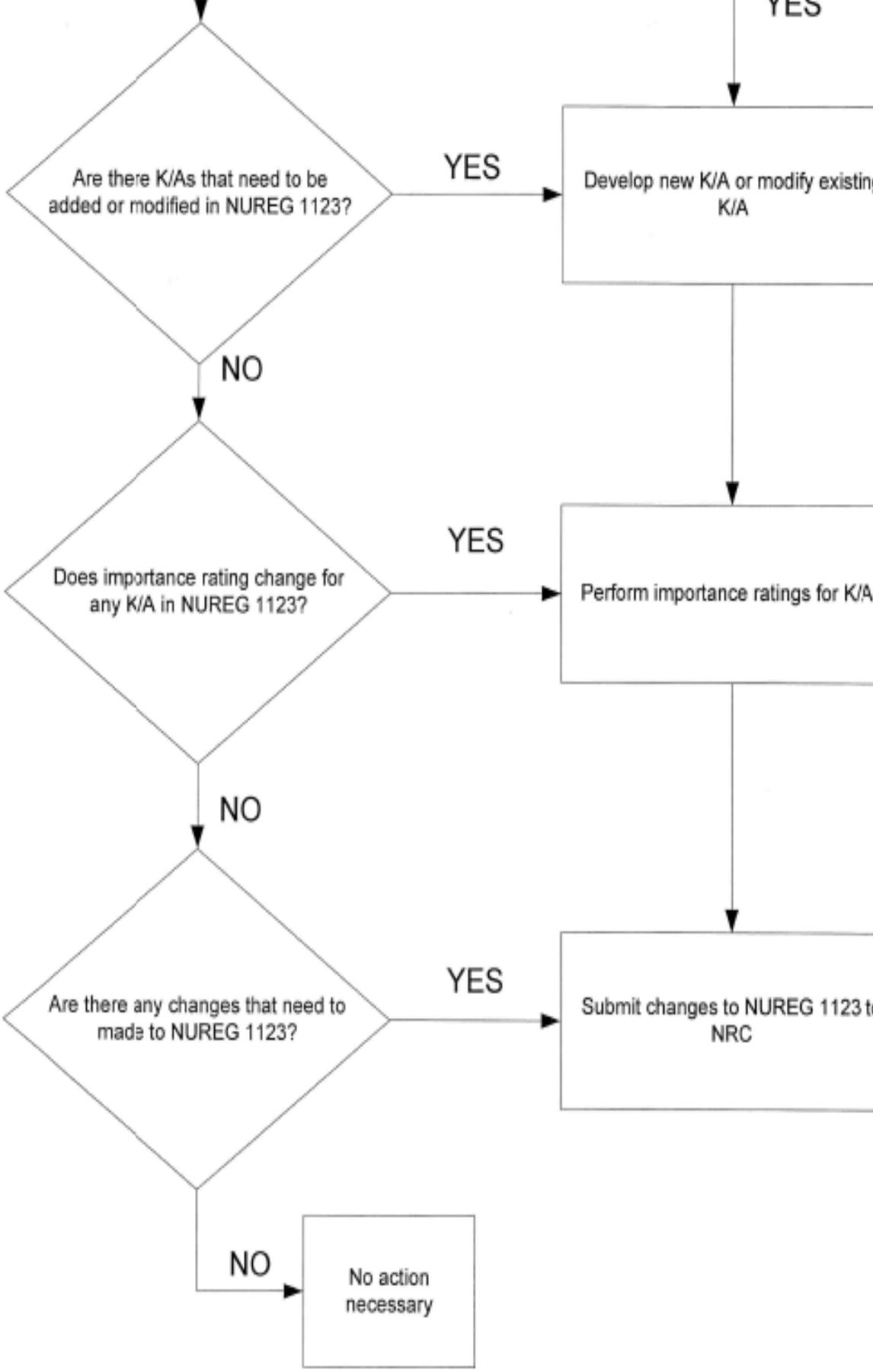
   The gap analysis will be based on available information and in time to support operator licensing needs. The expert panel will use the current importance to safety definitions to determine the importance rating for new or revised K/As. The K/As will be assigned the 10 CFR 55 designators as appropriate (RO, SRO, and simulator). A common template developed by the LOTF will be used for the revision that will be submitted to the NRC

ATTACHMENT ONE

5. **Update NRC on gap analysis and importance ratings.**
   The NRC will be involved in all aspects of this project thus this essentially will be an ongoing milestone.
6. **NRC review and comment on revision to NUREG 1123.**
   The NRC will review the draft NUREG 1123 and provide comments to STPNOC
7. **STPNOC resolve NRC comments and submit final draft of ABWR K&A catalog to NRC.**

   Comments will be addressed by the ABWR focus group subcommittee.
8. **ABWR K&A catalog issued by NRC**

   The approved ABWR NUREG K&A Catalog or approved draft version is issued by the NRC in time to support development of the first ABWR NRC exam. Development of the first ABWR exam is scheduled to start in May 2012.


YES
Are there K/As that need to be added or modified in NUREG 1123?
YES
Develop new K/A or modify existing K/A
NO
Does importance rating change for any K/A in NUREG 1123?
YES
Perform importance ratings for K/A
NO
Are there any changes that need to made to NUREG 1123?
YES
Submit changes to NUREG 1123 to NRC
NO
No action necessary

ATTACHMENT 2

Most knowledges in K5, "Knowledge of the operational implication of the following concepts as they apply to **XXXXX** system", can be tied to either the Generic Fundamentals section of the K/A catalog to another K/A for the applicable system.

This document shows the ties to other K/As which would justify the removal of the K/A from section K5.

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Control Rod Drive Hydraulic System	
K5.01 Pump operation (2.4, 2.4)	Components (Pumps) There were numerous examples K1.13, Principles of operation of a centrifugal pump
K5.02 Flow indication (2.6, 2.6)	Thermodynamics (Fluid Statics) K1.29, Describe the method of controlling system flow rates
K5.03 Pressure indication (2.7, 2.7)	Thermodynamics (Thermo Units & Properties) K1.03, Describe how common pressure and level sensing instruments work
K5.04 Indication of pump cavitation (2.4, 2.4)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding
K5.05 Indication of pump runout (2.7, 2.7)	Components (Pumps) K1.12, "Runout" of a centrifugal pump (definition, indications, causes, effects, and corrective measures
K5.06 Differential pressure indication (2.5, 2.6)	Components (Sensors/Detectors) K1.05, Operation of a flow D/P cell type flow detector K1.07, Operation of a differential pressure level detector K1.12, Operation of a pressure D/P cell
K5.07 Air operated control valves (2.3, 2.4)	Components (Valves) K1.04, Valve design for a given failed-valve(open closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves
K5.08 Solenoid operated valves (2.5, 2.6)	Components (Valves) K1.04, Valve design for a given failed-valve(open closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves
K5.09 System venting (2.2, 2.2)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
FMCRD	
K5.01 Hydraulics (2.6, 2.7)	Covered in FMCRD K4.05, The use of either accumulator or reactor water to scram the control rod
K5.02 Flux Shaping (2.8, 3.3)	Reactor Theory (Control rods) K1.10, State the purpose of flux shaping and rod sequencing
K5.03 Reactor power control (3.3, 3.4)	Reactor Theory (Control rods) K1.04, Predict direction of change in reactor power for a change in control rod position
K5.04 Rod sequence patterns (3.1, 3.4)	Reactor Theory (Control rods) K1.10, State the purpose of flux shaping and rod sequencing
K5.05 Reverse power effect (3.0, 3.4)	Reactor Theory (Fission product poisons) K1.10, Reactor startup with Xenon-135 already present in the core
K5.06 How control rod worth varies with moderator temp and void (2.7, 2.9)	Reactor Theory (Control rods) K1.09, Explain direction of change in the magnitude of CRW for a change in moderator temperature, void fraction
K5.07 How control rod movements affect core reactivity (3.3, 3.6)	Reactor Theory (Control rods) K1.04, Predict direction of change in reactor power for a change in control rod position
K5.08 How control rods affect shutdown margin (3.1, 3.5)	Reactor Theory (Neutron life cycle) K1.14, Evaluate change in shutdown margin due to change in plant parameters

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Recirculation Flow Control	
K5.01 Fluid coupling: BWR-3,4	N/A ABWR
K5. 02 Feedback signals (2.6, 2.6)	Components (Controllers and positioners) K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic
K5.03 Error signals (2.4, 2.4)	Components (Controllers and positioners) K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Recirculation System	
K5.01 Indications of pump cavitation (2.7, 2.8)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding
K5.02 Jet pump operation: BWR 3,4,5,6	N/A ABWR
K5.03 Pump/motor cooling (2.7, 2.7)	Covered in K4.02
K5.04 System venting (2.4, 2.6)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation
K5.05 End of cycle recirculation pump trip (3.5, 3.6)	Covered in K4.09
K5.065 ATWS (3.6, 3.7)	Covered in K4.10
K5.07 Natural circulation (3.3, 3.4)	Thermodynamics (Thermal hydraulics) K1.34 K1.34, Explain the causes of natural circulation K1.37, Describe the means by which an operator can enhance natural circulation
K5.08 E/P converters: Plant specific	N/A ABWR
K5.09 Hydraulically operated valves: Plant specific	N/A ABWR
K5.10 Recirculation system motor generator set operation (2.8, 2.8)	Covered in K4.05, K4.14

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Rod Control and Information System	
K5.01 Rod pattern and program development (2.3, 3.2)	Reactor Theory (Control Rods) K1.10, State the purpose of flux shaping and rod sequencing Reactor Theory(Reactor Operational Physics) K1.23, Explain the necessity for rod pattern exchanges K1.24, Describe the parameters to be monitored and controlled during rod pattern exchanges
K5.02 Rod pattern controller	N/A ABWR
K5.04 Rod sequences (2.7, 3.0)	Reactor Theory (Control Rods) K1.10, State the purpose of flux shaping and rod sequencing
K5.05 Rod density (2.7, 3.0)	Reactor Theory (Control Rods) K1.05, Define rod density
K5.08 Transition zone	N/A ABWR
K5.09 High power setpoint	N/A ABWR
K5.10 Rod withdrawal limiter	N/A ABWR
K5.11 Control rod motion (3.3, 3.3)	Covered in K1.03
K5.12 Command word generation and sequencing	N/A ABWR
K5.13 Position indication (2.5, 2.7)	Components (Sensor/Detectors) K1.16, Failure modes of reed switches, LVDT, limit switches, and potentiometers K1.17, Application of reed switches, magnets, LVDT, limit switches, and potentiometers

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Standby Liquid Control	
K5.04 Explosive valve operation	N/A ABWR
K5.05 Accumulator operation: Plant specific	N/A ABWR
K5.06 Tank level measurement (3.2, 3.2)	Components (Sensors/Detectors) K1.07, Operation of a differential pressure level detector

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
High Pressure Core Flooder	
K5.01 Indications of pump cavitation (2.5, 2.8)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding
K5.02 Heat removal (transfer) mechanism	Deleted since this is a holdover from spray cooling
K5.03 System venting (2.4, 2.4)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation
K5.04 Adequate core cooling (3.8, 4.0)	Deleted related to K1.10 and K3.03

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Condensate System	
K5.01 System venting (2.5, 2.5)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation
K5.02 Water conductivity measurement (2.4, 2.4)	Components (Demineralizer and ion exchangers) K1.09, Effects of demineralizer operation on water conductivity
K5.03 Heat exchange level operation (2.6, 2.7)	Components (Controllers) K1.03, Operation of a valve controller, including seal in features K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic
K5.04 Ion exchange process (2.1, 2.1)	Components (Demineralizers and Ion Exchangers) K1.07, Principle of demineralizer operation
K5.05 Deaeration of condensate (2.2, 2.2)	N/A ABWR
K5.06 Air operated valve operation (2.4, 2.4)	Components (Valves) K1.04, Valve design for a given failed-valve(open closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves
K5.07 Level controller operation (2.7, 2.7)	Components (Controllers) K1.03, Operation of a valve controller, including seal in features K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic
K5.08 Pump cavitation (2.5, 2.6)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding
K5.09 Air ejection operation (2.8, 2.8)	Thermodynamics (Thermodynamic process) K1.04, Describe the functions of nozzles in air ejectors Components (Heat Exchangers and Condensers) K1.18, Reasons for non-condensible gas removal

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Reactor Core Isolation System	
K5.01 Indications of pump cavitation (2.6, 2.6)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding
K5.02 Flow indication (3.1, 3.1)	Thermodynamics (Fluid Statics) K1.29, Describe the method of controlling system flow rates
K5.03 Differential pressure indication (2.6, 2.6)	Components (Sensors/Detectors) K1.05, Operation of a flow D/P cell type flow detector K1.12, Operation of a pressure D/P cell
K5.04 Testable check valve operation (2.6, 2.7)	Components (Valves) K1.10, Principles of operation and purpose of check valves
K5.05 Centrifugal pump operation (2.4, 2.4)	Components (Pumps) There were numerous examples K1.13, Principles of operation of a centrifugal pump
K5.06 Turbine operation (2.7, 2.7)	Thermodynamics (Thermodynamic processes) K1.06, Explain the function of nozzles, fixed blading, and moving blading in the turbine K1.07, Explain the reason turbines are multistage

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Feedwater System	
System venting (2.4, 2.4)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation
Water hammer (2.5, 2.5)	Components (Heat exchangers and condensers) K1.14, Fluid hammer and methods of prevention Thermodynamics (Fluid statics) K1.05, Explain operational implications of fluid hammer
K5.03 Turbine operation: TDRFP's-Only	N/A ABWR

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
RWCU	
K5.01 Electro/pneumatic converter operation (1.9, 2.1)	Components (Controllers and Positioners) K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic
K5.02 Control device operation (2.2, 2.2)	
K5.03 Demineralizer operation (2.4, 2.5)	Components (Demineralizers and Ion Exchangers) K1.07, Principle of demineralizer operation
K5.04 Heat exchanger operation (2.7, 2.7)	Components (Heat exchangers and condensers) K1.01 – K1.17
K5.05 Flow controllers (2.6, 2.6)	Components (Controllers) K1.03, Operation of a valve controller, including seal in features K1.08, Theory of operation of the following types of controllers: electronic, electrical, and pneumatic
K5.06 Pressure controllers	N/A ABWR
K5.07 Conductivity measurement (2.5, 2.6)	Components (Demineralizer and ion exchangers) K1.09, Effects of demineralizer operation on water conductivity
K5.08 Temperature measurement (2.6, 2.6)	Components (Sensors/Detectors) K1.14, Theory of operation of T/C, RTD, thermostats, thermometers(expanding fluid)

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Feedwater Control	
K5.01 GEMAC/Foxboro/Bailey controller operation: Plant-Specific	N/A ABWR
K5.02 Electro/Pneumatic converter operation	N/A ABWR
K5.03 Water level measurement – (3.1, 3.2)	Components (Sensors/Detectors) K1.07, Operation of a differential pressure level detector
K5.06 Pump runout – (2.4, 2.4)	Components (Pumps) K1.12, "Runout" of a centrifugal pump (definition, indications, causes, effects, and corrective measures
K5.07 Turbine speed control mechanisms: TDRFP	N/A ABWR
K5.08 Heat removal mechanisms: FWCI	N/A ABWR
K5.09 †Adequate core cooling: FWCI	N/A ABWR

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
RHR/LPFL: Injection mode	
Testable check valve operation (2.7, 2.9)	Components (Valves) K1.10, Principles of operation and purpose of check valves Could be moved to K4 or related to K3.04
Core cooling methods (3.5, 3.7)	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
ADS	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Main and Reheat Steam System	
K5.01, Constant enthalpy expansion through a valve (2.0,2.2)	Thermodynamics, Basic Energy Concepts K1.04, Explain the application of enthalpy in the monitoring of plant processes
K5.02, Definition and causes of steam/water hammer (2.9, 3.1)	Components (Heat exchangers and condensers) K1.14, Fluid hammer and methods of prevention Thermodynamics (Fluid statics) K1.05, Explain operational implications of fluid hammer
K5.03, Definition and causes of thermal stress (2.7 ,2.9)	Covered in Thermodynamics (Brittle Fracture and Vessel Thermal Stress
K5.05, Flow indication (2.8, 2.8)	Thermodynamics (Fluid Statics) K1.29 – Describe the method of controlling system flow rates
K5.07 Hydraulic operated MSIV's (2.6, 2.7)	N/A ABWR
K5.08, Solenoid operated valves (2.6, 2.7)	Components (Valves) K1.04, Valve design for a given failed-valve(open closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Reactor Turbine Pressure Regulating System	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Relief/Safety Valves	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Shutdown Cooling System (RHR Shutdown Cooling)	
K5.01, NPSH (2.2, 2.4)	Components, Pumps K1.05, Need for net positive suction head (NPSH); effects of loss of suction
K5.02, Valve operation (2.8, 2.9)	Components, Valves – Many examples K1.01 - 1.12
K5.03, Heat removal mechanisms (2.8, 3.1)	Component, Heat Exchangers and Condensers K1.03, Basic heat transfer in a heat exchanger
K5.04, System venting (2.4, 2.4)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Primary Containment and Auxiliaries	
K5.02, Guard pipe operation: Mark-III (2.3,2.4)	N/A ABWR
K5.03, Down comer operation (2.8, 2.9)	N/A ABWR
K5.04, Horizontal vent operation: Mark-III (2.4, 2.6)	Covered in K4.09
K5.05, Hydrogen recombiner operation: Plant-Specific (2.8, 3.0)	N/A ABWR
K5.06, Hydrogen igniter operation: Plant-Specific (2.8, 2.9)	N/A ABWR
K5.07, Suppression pool clean-up: Plant-Specific (2.3, 2.4)	Covered in K1.05
K5.08, Pressure measurement (2.7, 2.8)	Thermodynamics (Thermo Units & Properties) K1.03, Describe how common pressure and level sensing instruments work
K5.11, Temperature measurement (2.7, 2.7)	Components (Sensors/Detectors) K1.14, Theory of operation of T/C, RTD, thermostats, thermometers(expanding fluid)
K.15, Moisture content measurement: Plant-Specific (2.4, 2.6)	N/A ABWR
K5.14, Differential pressure measurement (2.6, 2.8)	Components (Sensors/Detectors) K1.05, Operation of a flow D/P cell type flow detector K1.07, Operation of a differential pressure level detector K1.12, Operation of a pressure D/P cell

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Leak Detection and Isolation System	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Reactor Vessel Internals	
Reactor Vessel Internals already done in SF 9	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE

RHR/ LPFL: Suppression Pool Cooling Mode

K5.01, System venting (2.6, 2.7)

K5.02, Pump cavitation (2.7, 2.8)

K5.03, Pressure measurement (2.7, 2.8)

K5.04, Heat exchanger operation (2.9 , 2.9)

BASIS FOR REMOVAL

Thermodynamics (Fluid Statics)
K1.12, Explain the importance of proper system venting for pump operation
Components (Pumps)
K1.01, Identification, symptoms, and consequences of cavitation
K1.03 Consequences of air binding
Thermodynamics (Thermo Units & Properties)
K1.03, Describe how common pressure and level sensing instruments work
Components (Heat exchangers and condensers) K1.01 – K1.17

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
RHR/LPFL: Containment Spray (Drywell and Wetwell) System Mode	
K5.01, System venting (2.2, 2.2)	Thermodynamics (Fluid Statics) K1.12, Explain the importance of proper system venting for pump operation
K5.02, Water hammer (2.6, 2.7)	Components (Heat exchangers and condensers) K1.14, Fluid hammer and methods of prevention Thermodynamics (Fluid statics) K1.05, Explain operational implications of fluid hammer
K5.03, Pump cavitation (2.3, 2.5)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03, Consequences of air binding

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
A.C. Electrical Distribution K5.02, Breaker control (2.6, 2.9)	Components (Breaker, Relays, and Disconnects) K1.01 – K1.09

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Emergency Generators	
K5.04, Governor control (2.4, 2.5)	Covered in K4.06
K5.05, Paralleling A.C. power sources (3.4, 3.4)	Components (Breakers, Relays, and Disconnects) K1.03. Effects of closing breakers with current out of phase, different frequencies, voltage differential, low current, or too much load
K5.06, Load sequencing (3.4, 3.5)	Covered in K4.05
K5.07, Speed droop (2.3, 2.4)	Covered in K4.05

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Automated Thermal Limit Monitor	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
APRM/LPRM	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Nuclear Boiler Instrumentation	
K5.01, Vessel level measurement (3.1, 3.2)	Thermodynamics (Thermo Units & Properties) K1.03, Describe how common pressure and level sensing instruments work
K5.02, Vessel pressure measurement (3.1, 3.2)	Components (Sensors/Detectors) K1.05, Operation of a flow D/P cell type flow detector K1.07, Operation of a differential pressure level detector K1.12, Operation of a pressure D/P cell
K5.03, Vessel temperature measurement (3.0, 3.2)	Components (Sensors/Detectors) K1.14, Theory of operation of T/C, RTD, thermostats, thermometers(expanding fluid)
K5.04, Vessel differential pressure measurement (2.8, 2.9)	Thermodynamics (Thermo Units & Properties) K1.03, Describe how common pressure and level sensing instruments work
K5.06, Rapid vessel depressurization effects on vessel level indications (3.4, 3.6)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K5.07, Elevated containment temperature effects on level indication (3.6, 3.8)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K.09, Recirculation flow effects on level indications: Design-Specific (2.9, 2.9)	N/A ABWR
K5.10, Indicated level versus actual vessel level during vessel heatups or cooldowns (3.1, 3.3)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K5.11, Indicated vessel temperature response during rapid heatups or cooldowns (3.2, 3.3)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K5.12, Effects on level indication due to rapid changes in void fraction (3.2, 3.3)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K5.13, Reference leg flashing: Design-Specific (3.5, 3.6)	Components (Sensors/Detectors) K1.08, Effects of operating environment (pressure, temperature, radiation)
K5.14, Density (2.6, 2.6)	Thermodynamics, Steam K1.01, Describe effects of pressure on density or specific volume of a liquid
K5.15, Static pressure (2.2, 2.2)	Thermodynamics, Steam K1.01, Describe effects of pressure on density or specific volume of a liquid

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Radiation Monitoring	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE

Rod control and information system

K5.04, Rod sequences: BWR-6, (2.7, 3.0)

K5.05, Rod density: BWR-6 , (2.7 , 3.0)

BASIS FOR REMOVAL

Reactor Theory (Control Rods)
K1.10, State the purpose of flux shaping and rod sequencing
Reactor Theory (Control Rods)
K1.05, Define rod density

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Rod Worth Minimizer	
K5.08, Operating sequence: P-Spec(Not-BWR6), (2.9, 2.9)	Reactor Theory (Control Rods) K1.10, State the purpose of flux shaping and rod sequencing

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Startup Neutron Monitoring System K5.01, Detector operation (2.6, 2.6)	Components (Sensors and Detectors) K1.19,Operation of fission chambers, ion chambers K1.22, Failure modes of fission chambers, ion chambers, and proportional counters

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Automatic Traversing Incore Probe System K5.01, Neutron flux detection: (Not-BWR1) (2.2, 2.5)	Components (Sensors and Detectors) K1.19,Operation of fission chambers, ion chambers K1.22, Failure modes of fission chambers, ion chambers, and proportional counters

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Fire Protection System	
K5.04 Valve operation	Components (Valves) Numerous K/As

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Fuel Handling System	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Instrument Air System	
K6.02, Pressure gauges (2.4, 2.4)	Components (Sensors/Detectors) K1.10, Theory of operation of bourdon tubes diaphragms bellows, and pressure detectors
K6.03, Temperature indicators (2.7, 2.7)	Components (Sensors/Detectors) K1.14, Theory of operation of T/C, RTD, thermostats, thermometers (expanding fluid
K6.07, Valves (2.5, 2.6)	Components (Valves) Numerous K/As
K6.08, Sensors and detectors (2.3, 2.3)	Components (Sensors/Detectors) Numerous K/As
K6.09, Controllers and positioners (2.3, 2.3)	Components (Controllers and Positioners) Numerous K/As
K6.10, Motors (2.3, 2.4)	Components (Motors and Generators) Numerous K/As
K6.11, Heat exchangers and condensers (2.3, 2.3)	Components (Heat Exchangers and Condensers) Numerous K/As
K6.12, Breakers, relays and disconnects (2.9, 2.9)	Components (Breakers, Relays and Disconnects) Numerous K/As

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE

Offgas

K5.01 Air operated valve operation (2.3, 2.3)

BASIS FOR REMOVAL

Components (Valves)

K1.04, Valve design for a given failed-valve(open closed, and as-is positions; spring loaded valves; hydraulic, pneumatically controlled valves; electric motor-driven valves

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Plant Ventilation	
K5.02, Differential pressure control (3.2, 3.4)	Component (Controller and Positioners) K1.04, Function and operation of pressure and temperature controllers, including pressure and temperature control valves
K5.03, Temperature control (2.5, 2.6)	Component (Controller and Positioners) K1.04, Function and operation of pressure and temperature controllers, including pressure and temperature control valves

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Radiation Monitoring System	
None	

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Radwaste	
K5.01, Units of radiation, dose and dose rate (2.7, 3.0)	Generic Knowledges and Abilities (Radiation Control) Would be covered in this section
K5.02, Radiation hazards and ALARA concept (3.1, 3.6)	Generic Knowledges and Abilities (Radiation Control) Would be covered in this section

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Reactor Vessel Internals	
K5.01, Thermal limits (3.5, 3.9)	Thermodynamic (Core Thermal Limits) Numerous examples in section.
K5.02, Fission product poisons (2.9, 3.1)	Reactor Theory (Fission Product Poisons) Numerous examples in section.
K5.03, Burnable poisons (2.7, 3.0)	Reactor Theory (Fuel Depletion and Burnable Poisons) K1.01, Define burnable poisons and state it use in the reactor.
K5.04, PCIOMR Plant-Specific (3.1, 3.7)	N/A ABWR
K5.05, Brittle fracture (3.1, 3.3)	Thermodynamics, Brittle Fracture and Vessel Thermal Stress K1.01, State the brittle fracture mode of failure. K.1.04, State how the possibility of brittle fracture is minimized by operating limitations.
K5.06, Heat transfer mechanisms (2.8, 3.2)	Thermodynamics, Thermal Hydraulics K1.01, Distinguish between boiling processes and other heat transfer mechanisms
K5.07, Safety limits (3.9, 4.4)	Generic Knowledge and Abilities (Equipment control) 2.2.22, Knowledge of limiting conditions for operations and safety limits

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Fuel Pool Cooling and Cleanup	
K5.01, Heat removal mechanisms (2.5, 2.7)	Covered in K4.03 and K4.07
K5.02, Pump cavitation (2.1, 2.2)	Components (Pumps) K1.01, Identification, symptoms, and consequences of cavitation K1.03 Consequences of air binding
K5.04, Demineralizer ion exchange (2.0, 2.2)	Components (Demineralizers and Ion Exchangers) K1.07, Principle of demineralizer operation

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Standby Gas Treatment System	
K5.02, Air operated valves: Plant-Specific (2.3, 2.5)	N/A ABWR

ATTACHMENT 2

SYSTEM AND K5 KNOWLEDGE	BASIS FOR REMOVAL
Control Room HVAC	
K5.02, Differential pressure control (2.8, 2.8)	Component (Controller and Positioners) K1.04, Function and operation of pressure and temperature controllers, including pressure and temperature control valves
K5.03, Temperature control (2.6, 2.7)	Component (Controller and Positioners) K1.04, Function and operation of pressure and temperature controllers, including pressure and temperature control valves

ATTACHMENT 3

K/A SYSTEM REALIGNMENT

1. **Rod Control and Information System (RCIS)**

   Recommendation
   Keep in Safety Function 1 "Reactivity Control" and remove from Safety Function 7,"Instrumentation" .
   Basis
   Per the System Design Description (SDD) for RCIS, the main objective of the system is to "provide the capability to control the fine motion control rod drive (FMCRD) motors of the Control Rod Drive System to permit changes in core **reactivity** so that reactor power level and power distribution can be **controlled**".

   Also, this would be consistent with Recirculation Flow Control System which is in SF1 and not in SF 7. In addition, Feedwater Control System is located only in Safety Function 2, "Reactor Water Inventory Control" and not in SF 7.

2. **High Pressure Core Flooder System (HPCF)**

   Recommendation
   Keep in Safety Function 2 "Reactor Water Inventory Control" and remove from Safety Function 4, "Heat Removal from Core".
   Basis
   Currently HPCS and HPCI (systems that are similar in purpose with HPCF) are in SF 2 and SF 4.

   Per the System Design Description (SDD) for HPCF, the following is the main function of HPCF:
   "The dual train HPCF system shall provide emergency makeup water to the reactor pressure vessel (RPV) for transient or Loss-of-Coolant Accident (LOCA) events. For reactor vessel water level transients, HPCF shall be designed to prevent **reactor vessel water level** from dropping below a level which would initiate RHR or ADS."

3. **Residual Heat Removal/ Low Pressure Flooder (RHR/LPFL)**

   Recommendation
   Keep in Safety Function 2 "Reactor Water Inventory Control" and remove from Safety Function 4, "Heat Removal from Core".
   Basis
   Per the System Design Description (SDD) for RHR/LPFL, the following is the main function of the system:

   "Shall **add water to the reactor pressure vessel (RPV)** in response to a loss-of-coolant accident (LOCA) or in response to transients if Reactor Core Isolation Cooling (RCIC) or High Pressure Core Flooder System (HPCF) do not satisfy reactor water level requirements."

ATTACHMENT 4

TASKS FOR ABWR K/A CATALOG

Problem Statement

Tasks are included in the section 3, Plant Systems, of NUREG 1123, Knowledge and Abilities (K/A) catalog. A large amount of time is being devoted to reviewing and revising these tasks during the revision of the K/A catalog. The currently listed tasks for each system are not used in the development of the NRC written and operating exam.

Discussion

An ABWR specific Knowledges and Abilities (K/A) catalog is being developed using NUREG 1123 as the baseline document. Currently tasks are identified for each system in Section 3, Plant Systems. A large amount of time has been spent on determining what tasks should be listed for each system in the K/A catalog. During discussions on the revision process, the value of having tasks listed in the K/A catalog has been raised.

It has been proposed that section 3, "Plant Systems", of ABWR K/A catalog either contain a list of generic tasks for the systems or delete the task lists entirely. The tasks that are currently listed in the K/A catalog are not used in the development of the NRC license exam (written and operating). The following sections of NUREG 1123 were also reviewed to determine if tasks were identified:

1. Section 2, Generic Knowledges and Abilities
2. Section 4, Emergency and Plant Evolutions
3. Section 5, Components
4. Section 6, Theory (Reactor Theory and Thermodynamics)

None of these sections had tasks associated with the knowledge and abilities contained within the various evolutions.

NUREG 1021, Operating Licensing Examination Standards for Power Reactors, was also reviewed to determine if the K/A catalog tasks are used in the development of the licensing exam. There was nothing in the document that tied the tasks to developing the exams.

The following are options to resolve the issue:

- Do not remove the tasks from the K/A catalog. Revise them as necessary to reflect ABWR technology.
- Develop a list of generic tasks that are common to all of the systems in the K/A catalog
- Remove the tasks from the K/A catalog

ATTACHMENT 4

TASKS FOR ABWR K/A CATALOG

Recommendation and Disposition

Tasks were removed from catalog. The NRC agreed with this decision. There is no benefit in having or maintaining the tasks in the catalog.

Attachment 5
PRA

1. **Backup manual initiation of HPCF**.

    a. Covered in HPCF system, A4.05 "Ability to manually operate and monitor in the control room: Manual initiation controls"

2. **Recover of feedwater following scram with and without isolation**.

    a. Covered in Abnormal Plant Evolution "Reactor Scram",
    AA1.02, "Ability to operate and/or monitor the following as they apply to Scram: Feedwater control system"

3. **Use of condensate injection following scram with reactor depressurized**.

    a. Added in Abnormal Plant Evolution, "Low Reactor Water Level"
    AA1.05, "Ability to operate and/or monitor the following as they apply to Low Reactor Water Level: Condensate system

4. **Control of reactor water level in an ATWS**.

    a. Covered in Emergency Plant Evolution, "Scram Condition Present and Reactor Power Above APRM Downscale or Unknown".
    EK3.04, Knowledge of the reasons for the following responses as they apply to scram condition present and reactor power above APRM downscale or unknown: Intentional lowering of reactor pressure vessel water level

    b. Added in Emergency Plant Evolution," Scram Condition Present and Reactor Power Above APRM Downscale or Unknown."
    EA1.10, Ability to operate and/or monitor the following as they apply to scram condition present and reactor power above APRM downscale or unknown: Feedwater control system

5. **Emergency depressurization of the reactor**.

    a. Covered in ADS system
    A4.02 Ability to manually operate and/or monitor in the control room: ADS logic initiation controls.

Attachment 5
PRA

6. **Alignment and initiation of firewater for RPV injection with ECCS failure in an earthquake, or in a severe accident following a core melt**.

    a. Added in Emergency Plant Evolution, "Low Reactor Water Level" EK2.17 Knowledge of the interrelations between REACTOR LOW WATER LEVEL and the following: Fire protection system.

    b. Added in Emergency Plant Evolution, "Low Reactor Water Level" EA1.11 Ability to operate and/or monitor the following as they apply to REACTOR LOW WATER LEVEL: Fire protection system.

    c. Covered in Residual Heat Removal System: Low Pressure Flooder Injection Mode:
    K1.09 Knowledge of the physical connections between the RESIDUAL HEAT REMOVAL SYSTEM: Low Pressure Flooder Injection Mode and the following systems: Fire Protection System.

7. **Alignment and initiation of firewater for drywell spray.**

    a. Covered in Residual Heat Removal System: Drywell/Wetwell Spray Mode: K1.04 Knowledge of the physical connections Residual Heat Removal System: Drywell and Wetwell Spray Mode and the following systems: Fire Protection Systems.

8. **Initiation of wetwell spray.**

    a. Covered in Residual Heat Removal System: Drywell/Wetwell Spray Mode: K1.04 Knowledge of the physical connections Residual Heat Removal System: Drywell and Wetwell Spray Mode and the following systems: Fire Protection Systems.

    b. Covered in Residual Heat Removal System: Drywell/Wetwell Spray Mode: A3.01 Ability to monitor automatic operations of the Residual Heat Removal System: Drywell and Wetwell Spray Mode including: Drywell and wetwell spray initiation sequence

    c. Covered in Residual Heat Removal System: Drywell/Wetwell Spray Mode: A4.03 Ability to manually operate and monitor in the control room: Residual heat removal system spray valves

Attachment 5
PRA

9. **Isolation of water sources in an internal flood**.

    a. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EK3.03 Knowledge of the reasons for the following responses as they apply to Secondary Containment High Sump/Area Water Level: Isolating affected systems.

    b. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EA1.02 Ability to operate and/or monitor the following as they apply to Secondary Containment High Sump/Area Water Level: Affected systems so as to isolate damaged portions.

10. **Reopening of HPCF injection valves following maintenance**

    a. Covered in Generic Knowledge and Abilities
    2.1.29 Knowledge of how to conduct system lineups, such as valves, breakers, switches, etc. and
    2.2.18 Ability to determine the expected plant configuration using design and configuration control documentation, such as drawings, line-ups, tag-outs, etc.

11. **Calibration of sensors**

    a. This is not an operator task. This would be an Instrumentation and Control Technician task.

12. **Closure of watertight doors in an internal flood**

    a. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EK3.03 Knowledge of the reasons for the following responses as they apply to Secondary Containment High Sump/Area Water Level: Isolating affected systems.

    b. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EA1.02 Ability to operate and/or monitor the following as they apply to Secondary Containment High Sump/Area Water Level: Affected systems so as to isolate damaged portions.

Attachment 5
PRA

13. **Opening of doors/hatches to divert water in an internal flood**

    a. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EK3.03 Knowledge of the reasons for the following responses as they apply to Secondary Containment High Sump/Area Water Level: Isolating affected systems.

    b. Covered in Emergency Plant Evolution, "Secondary Containment High Sump/Area Water Level"
    EA1.02 Ability to operate and/or monitor the following as they apply to Secondary Containment High Sump/Area Water Level: Affected systems so as to isolate damaged portions.

14. **Use of non-safety grade equipment for decay heat removal and inventory makeup during shutdown operations**

    a. Covered in Abnormal Plant Evolution, "Loss of Shutdown Cooling"
    AK3.05 Knowledge of the reasons for the following responses as they apply to Loss of Shutdown Cooling: Establishing alternate heat removal flow paths.

15. **Use of remote shutdown panel when main control room is uninhabitable**

    Covered in a number systems that have controls on the Remote Shutdown Panel (Residual Heat Removal, Reactor Building Cooling Water, Reactor Service Water, AC Electrical Distribution, High Pressure Core Flooder, Safety/Relief Valves, etc.)

16. **Outage planning to minimize risk during shutdown operations**

    a. Covered in Generic Knowledge and Abilities
    2.2.18 Knowledge of the process for managing maintenance activities during shutdown operations, such as risk assessments, work prioritization, etc.

17. **Initiation of standby RHR in event of failure of operating RHR during shutdown operations**

    Covered in Abnormal Plant Evolution, "Loss of Shutdown Cooling"
    AA1.02 Ability to operate and/or monitor the following as they apply to Loss of Shutdown Cooling: RHR/shutdown cooling.

Attachment 6
IMPORTANCE RATINGS

5

1. Would lack of understanding of the knowledge or ability lead to the following:
    A. Prevent this system from performing its intended function or,
    B. Core damage or radioactive release

and

2. This system is not backed by a redundant train, system, or design feature

and

3. This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

4

1. Would lack of understanding of the knowledge or ability lead to the following:
    A. Prevent this system from performing its intended function or,
    B. Potentially cause core damage or radioactive release

and

2. This system is backed up by a redundant system or design feature (but could be affected by a common cause failure)

and

3. This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

Attachment 6
IMPORTANCE RATINGS

3

1. Would lack of understanding of the knowledge or ability lead to the following:
    A. Cause this system to be inoperable (per Technical Specifications) and not available
    B. No core damage or radioactive release

and

2. This system is backed up by a redundant system or design feature.

and

3. This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

2

1. Would lack of understanding of the knowledge or ability lead to the following:
    A. Cause this system to be inoperable (per Technical Specifications) but available
    B. No core damage or radioactive release

NOTE:
If a knowledge or ability that has been rated a 2 meets the following criteria, that item may be rated a 2.5:

Would lack of understanding of the knowledge or ability impact an operator in performing critical tasks (as identified in the ABWR probability risk assessment (PRA)). Critical task are defined as: Human actions which are identified through PRA analyses to have significant impact on safety.

or

This system will not perform its intended function as described in the Abnormal Operating Procedures to mitigate the consequences of event.

1

1. Lack of understanding of the knowledge or ability will have no impact on the operability of the system thus would not impact the safe operation of the nuclear facility.

Attachment 6
IMPORTANCE RATINGS

Would lack of understanding of the knowledge or ability lead to the following:
Prevent this system from performing its intended function or,
Core damage or radioactive release
and
This system is not backed by a redundant train, system, or design feature
and
This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

Yes → Rate as 5

No

Would lack of understanding of the knowledge or ability lead to the following:
Prevent this system from performing its intended function or,
Potentially cause core damage or radioactive release
and
This system is backed up by a redundant system or design feature (but could be affected by a common cause failure)
and
This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

Yes → Rate as 4

No

Would lack of understanding of the knowledge or ability lead to the following:
Cause this system to be inoperable (per Technical Specifications) and not available and,
No core damage or radioactive release
and
This system is backed up by a redundant system or design feature.
and
This system will not perform its intended function as described in the Emergency Operating Procedures and/or the Severe Accident Guidelines.

Yes → Rate as 3

No

Would lack of understanding of the knowledge or ability lead to the following:
Cause this system to be inoperable (per Technical Specifications) but available and,
No core damage or radioactive release

Note:
If a knowledge or ability that has been rated a 2 meets the following criteria, that item may be rated a 2.5:

- Would lack of understanding of the knowledge or ability impact an operator in performing critical tasks (as identified in the ABWR probability risk assessment (PRA)). Critical task are defined as: Human actions which are identified through PRA analyses to have significant impact on safety.

or

- This system will not perform its intended function as described in the Abnormal Operating Procedures to mitigate the consequences of event

Yes → Rate as 2

No

Rate as 1