October 12, 2009

Purpose

This document describes the method used for identifying specific KAs to be included in the proposed AP1000 specific KA Catalog.

It should be noted that the AP1000 system design is somewhat different than legacy plants. As a result, functions in the new KA catalog may or may not be in the same system as in the current KA catalog.

Process

The APOG training committee consisting of former plant SROs with training experience met with WEC training instructors during the months of March to August. At each meeting the WEC training instructor responsible for the specific system advised the training team on how to status the KAs in the current KA catalog.

Each KA was reviewed and a decision was made to either leave the KA as is, delete the KA, modify the KA or add a new KA relative to that system.

During the month of September a decision was made to completely revise the manner in which the KAs were being addressed and closely couple the AP1000 SSDs to the new AP1000 KA catalog. That process is described below.

During the week of October 5 the training team met and compared the current revised KA catalog and new KA catalog.

The following systems are submitted for NRC review:
022 Containment Recirculation Cooling System
029 Containment Air Filtration System
035 Steam Generator System
039 Main and Reheat Steam System
056 Condensate System
059 Main and Startup Feedwater System
078 Compressed Air System (IAS and SAS)

A decision was made to delete the Ice Condenser and NNIS systems from the new KA catalog due to the AP1000 design. The only remaining function from the Containment Iodine Removal System has been moved to PXS and as a result, the Containment Iodine Removal System has also been removed from the KA catalog.

A new system for the AP1000, called DAS, has been added to the KA catalog.

Strategy

In order to be consistent, a systematic treatment of the KA catalog using a strict methodology was adopted when considering the KA statements to be included.

That methodology for the systems part of the KA catalog is described as follows:

K1 contains the systems that have a connection to system XXS. The selected systems listed have either a plant protection/control logic relationship or physical piping relationship to system XXS. The list of supporting and dependent systems can be found in the System Specification Document (SSD) Section 8.0, Interfacing Systems Requirements, and Appendix A, Interface Lists. The electrical systems were not included in K1 because they are addressed in K2. PLS was not included in K1. All systems are controlled through the PLS and the specific controls and interlocks are covered in K4. The relationship to PMS is found in K1 as either RTS (LCO 3.3.1), ESFAS (LCO 3.3.2), or PAMS (LCO 3.3.3). For example, the SGS has no piping connection to PXS but does have a plant protection/control logic relationship in that SGS has instrumentation that provides a reactor trip so RTS is included in K1. SGS instrumentation also provides for several ESFAS actuation signals so ESFAS is included in K1.

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

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

K6 lists the systems included in K1 that will have an affect on XXS if the listed system is lost. It also lists the components of system XXS whose failure can affect the operation of the XXS. The events and malfunctions listed in sections 4.0, System Operation and Performance and components from section 5.4, Component Requirements of the SSD were evaluated for inclusion in K6.

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

K4 contains selected Safety Related Functions, Licensing Related Functions, Defense in Depth Functions, and Non-Safety Related Functions. They are listed in section 1.0, System Functions and section 4.0, System Operation and Performance, of the SSD.

A3 contains the automatic features of the XXS identified in K4. A3 also includes related functions listed in LCO 3.3.1, Reactor Trip Instrumentation and 3.3.2, ESFAS Instrumentation.

A4 contains the features of the XXS listed in A3 that can also be manually performed as well as the features of the XXS system can only be manually performed. Items listed in A4 are limited to equipment that can be operated from and monitored in the control room relative to that specific system.

K2 comes from Appendix B-3 of the SSD. Equipment requiring 480Vac power and above was evaluated for inclusion. Equipment requiring less than 480Vac was evaluated for its importance to safety and included when required.

K5 comes from section 5.0, Equipment Requirements of the SSD and cause-effect relationships.

A1 includes the parameters associated with operation of the XXS.

Critical human actions and risk important tasks identified by the PRA are being included where appropriate.

Revised KA Stem Statements

K1
~~Knowledge of the physical connections and/or cause -effect relationships between the XXS and the following systems:~~

Knowledge of the physical connections between the XXS and the following systems:

K2
~~Knowledge of bus power supplies to the following:~~

Knowledge of bus or division power supplies to the following:

K3
Knowledge of the effect that a loss or malfunction of the XXS will have on the following:

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

K5
~~Knowledge of the operational implications of the following concepts as they apply to the XXS:~~

Knowledge of the operational implications or cause and effect relationships of the following as they apply to the XXS:

K6
~~Knowledge of the effect of a loss or malfunction of the following on XXS components:~~

Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the XXS:

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

Ability to predict and/or monitor changes in parameters associated with operation of the XXS including:

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

A3
Ability to monitor automatic operation of the XXS, including:

A4
~~Ability to manually operate and/or monitor in the control room:~~

Ability to manually operate and monitor in the control room:

022 Containment Recirculation Cooling System (~~CCS~~) (VCS)

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
Shut down the CCS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause effect relationships between the ~~CCS~~ VCS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
D-K1.01	~~SWS/cooling system~~	3.5	3.7
	Comment N/A AP1000 system design		
M-K1.02	~~SEC/remote monitoring systems~~ DAS.	3.7?	3.5?
	Comment AP1000 system design		
M-K1.03	~~Auxiliary steam~~ Hot water.	2.4*	2.3*
	Comment AP1000 terminology		
K1.04	Chilled water	2.9*	2.9*
K2	**Knowledge of power supplies to the following:** (CFR: 41.7)		
M-K2.01	Containment recirculation cooling fans	3.0*	3.1
	Comment AP1000 terminology		
D-K2.02	~~Chillers~~	2.5*	2.4*
	Comment N/A AP1000 system design		
D-K2.03	~~MOVs~~	2.3*	2.3
	Comment N/A AP1000 system design		

K3	**Knowledge of the effect that a loss or malfunction of the ~~CCS~~ VCS will have on the following:** (CFR: 41.7 / 45.6)		
M-K3.01	~~Containment equipment subject to damage by high or low temperature, humidity, and pressure~~ . . . . . . Impact on containment equipment by high or low temperature, humidity, and pressure. **Comment** Moved to new K5	2.9*	3.2*
M-K3.02	~~Containment instrumentation readings~~ . . . . . . Impact on containment instrumentation readings by high or low temperature, humidity, and pressure. **Comment** Moved to new K5	3.0	3.3
D-K3.03	~~Electrical insulation~~ . . . . . . **Comment** N/A AP1000 design	1.7	2.1
K4	**Knowledge of ~~CCS~~ VCS design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
D-K4.01	~~Cooling of containment penetrations~~ . . . . . . **Comment** N/A AP1000 design	2.5*	3.0*
D-K4.02	~~Correlation of fan speed and flowpath changes with containment pressure~~ . **Comment** Not a direct correlation - system design	3.1*	3.4*
D-K4.03	~~Automatic containment isolation~~ . . . . . . **Comment** Not a direct correlation -system design	3.6*	4.0
D-K4.04	~~Cooling of control rod drive motors~~ . . . . . . **Comment** N/A AP1000 design	2.8	3.1
D-K4.05	~~Containment cooling after LOCA destroys ventilation ducts~~ . . . . . . **Comment** N/A AP1000 design	2.6*	2.7
D-K4.06	~~Containment pipe chase cooling~~ . . . . . . **Comment** N/A AP1000 design	2.1*	2.4*

K5	**Knowledge of the operational implications of the following concepts as the apply to the ~~CCS~~ VCS:** (CFR: 41.5 / 45.7)		
~~**M**~~-K5.01	Gas laws (Boyles, Charles), as they relate to containment ~~appreciate~~ environmental conditions . . . . . . **Comment** Clarification	1.6	2.0
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the ~~CCS~~ VCS components:** (CFR: 41.7 / 45.7)		
M-K6.01	~~Valves~~ Dampers.	1.9	2.1
	Comment AP1000 terminology		
K6.02	Sensors and detectors	2.1	2.1
M-K6.03	Controllers and positioners chill water system.	1.8	2.0
	Comment AP1000 terminology		
K6.04	Pumps	1.6	1.8
M-K6.05	~~Motors~~ Fans.	1.7	1.9
	Comment AP1000 terminology		
M-K6.06	Breakers, relays~~, and disconnects~~	1.7	1.9
	Comment AP1000 design		
D-K6.07	~~Computers and calculators~~	1.8	1.9
	Comment N/A AP1000 system design		
M-K6.08	~~Heat exchangers and condensers~~ Cooling coils.	1.9	2.0
	Comment AP1000 terminology		
	ABILITY		
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ~~CCS~~ VCS 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
M-A1.04	~~Cooling water flow~~ Chilled/Hot water flow	3.2	3.3
	Comment		

Effect is seen in A1.01, A1.02 and A1.03

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the ~~CCS~~ VCS; 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
D-A2.04	~~Loss of service water~~	2.9*	3.2
	Comment N/A AP1000 system design		
M-A2.05	Major leak in ~~CCS~~ VCS	3.1	3.5
	Comment AP1000 terminology		
M-A2.06	Loss of ~~CCS~~ VCS pump	2.8*	3.2*
	Comment AP1000 terminology		

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

M-A3.01	~~Initiation of safeguards mode of operation~~	4.1	4.3
	Start and speed change signals		
	Comment AP1000 system design		

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

M-A4.01	~~CCS~~ VCS fans	3.6	3.6
	Comment AP1000 terminology		
D-A4.02	~~CCS pumps~~	3.2*	3.1*
	Comment N/A AP1000 system design		
D-A4.03	~~Dampers in the CCS~~	3.2*	3.2*
	Comment N/A AP1000 system design		
D-A4.04	~~Valves in the CCS~~	3.1*	3.2
	Comment N/A AP1000 system design		
A4.05	Containment readings of temperature, pressure, and humidity system	3.8	3.8

TASK:

8273 Startup the VCS
8274 • Align VWS to VCS fan coil unit section to be placed in service
8275 • Start up a VCS fan in each coil unit

8276 Operate the VCS
8277 • Monitor the VCS parameters
8278 • Shift operating VCS fans and cooling coils
8279 • Respond to auto transfer to standby VCS supply fan

8281 Shutdown the VCS
8282 • Shutdown a VCS fan and cooling coil

8283 Respond to VCS malfunctions
8284 • Respond to VCS alarms

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the VCS and the following systems:**		
K 1.01	DAS		
K 1.02	ESFAS		
K 1.03	PAMS		
K 1.04	PCS		
K 1.05	RCS		
K 1.06	VFS		
K 1.07	VWS		
K 1.08	VYS		
K 1.09	WLS		
K 2	**Knowledge of bus or division power supplies to the following:**		
K 2.01	Reactor Containment Recirculation Fans		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 3	**Knowledge of the effect that a loss or malfunction of the VCS will have on the following:**		
K 3.01	PCS		
K 3.02	RCS		
K 3.03	VFS		
K 3.04	VWS		
K 3.05	VYS		
K 3.06	WLS		
K 4	**Knowledge of VCS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Controls the ambient temperature in all areas of the Containment Building		
K 4.02	Supports Integrated Leak Rate Testing		
K 4.03	Control the spread of airborne contamination		
K 4.04	Mixes the containment atmosphere		
K 4.05	Monitoring of unidentified steam leakage inside containment		
K 4.06	Reactor Containment Recirculation Fan Auto Start		
K 4.07	Reactor Containment Recirculation Fan speed change		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the VCS:**		
K 5.01	Temperature and humidity effects on equipment located in containment		
K 5.02	Effect of rapid temperature changes on containment pressure		
K 5.03	Using Reactor Containment Recirculation Fan in post accident conditions		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the VCS:**		
K 6.01	DAS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.02	ESFAS		
K 6.03	PCS		
K 6.04	RCS		
K 6.05	VFS		
K 6.06	VWS		
K 6.07	VYS		
K 6.08	WLS		
K 6.09	Reactor Containment Recirculation Fan failure		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the VCS including:**		
A 1.01	RCS leakage		
A 1.02	MSS leakage into containment		
A 1.03	Containment Volumetric Temperature		
A 1.04	Containment pressure		
A 1.05	Containment humidity		
A 1.06	Reactor Cavity Temperature		
A 1.07	Containment Recirculation Fan Discharge Flow		
A 1.08	Ring Header Temperature		
A 1.09	Reactor Cavity Supply Duct Flow		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the VCS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	DAS		
A 2.02	ESFAS		
A 2.03	PCS		
A 2.04	RCS		
A 2.05	VFS		
A 2.06	VWS		
A 2.07	VYS		
A 2.08	WLS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.09	Reactor Containment Recirculation Fan failure		
A 3	**Ability to monitor automatic operation of the VCS, including:**		
A 3.01	Reactor Containment Recirculation Fan auto start		
A 3.02	Reactor Containment Recirculation Fans speed change		
A 3.03	Containment Isolation		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	Reactor Containment Recirculation Fan Start		
A 4.02	Reactor Containment Recirculation Fans speed change		
A 4.03	Containment Isolation		
A 4.04	Align for Post Accident Cooling		

Notes:

In the legacy Westinghouse plant; there is one containment cooling system. In NUREG 1122, it is cataloged in Safety Function 5 as 022, Containment Cooling System (CCS).

In AP1000 there is one containment cooling system. It is cataloged as 022, Containment Recirculation Cooling System (VCS).

029 ~~**Containment Purge System (CPS)**~~
Containment Air Filtration System (VFS)
AP1000 Terminology

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	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause- effect relationships between the VFS ~~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
M-K1.02	RMS ~~Containment radiation monitor~~ . . . . . **Comment** AP1000 Terminology	3.3	3.6
M-K1.03	PMS ~~Engineered safeguards~~ . . . . . **Comment** AP1000 Terminology	3.6	3.8
D-K1.04	~~Purge system~~ . . . . . **Comment** N/A AP1000 system design	3.0?	3.1?
D-K1.05	~~Containment air cleanup and recirculation system~~ . . . . . **Comment** VFS performs these function	2.9*	3.1*
N-K1.06	VAS **Comment** AP1000 system design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
K2.01	Purge fans	2.1	2.3*
D-K2.02	~~Recirculation fans~~ . . . . . **Comment** N/A AP1000 system design	2.0	2.4*
M- K2.03	~~Purge exhaust~~ Plant vent radiation monitors . . . . . **Comment** AP1000 Terminology	2.3*	2.7*

M-K2.04	~~Purge valves~~ HVAC dampers and isolation valves	2.1	2.3
	Comment AP1000 Terminology		
K2.05	Supply air heaters	1.7	1.9
K3	**Knowledge of the effect that a loss or malfunction of the ~~Containment Purge~~ Air Filtration 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*
N-K3.03	VAS **Comment** AP1000 system design new function		
K4	**Knowledge of VFS 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
M-K4.02	Negative pressure VAS ~~in containment~~ **Comment** AP1000 Terminology	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 VFS ~~Containment Purge System~~:** (CFR: 41.5 / 45.7)		
M-K5.01	Allowed containment airborne radioactivity ~~Maximum concentration permissible~~ **Comment** Clarification	2.4	2.9*
M-K5.02	Allowed containment pressure ~~Dilution~~ **Comment** Clarification	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
M-K6.02	RMS Sensors and detectors **Comment** AP1000 Terminology	2.1*	2.3*

M-K6.03	Controllers, ~~and~~ positioners and dampers	1.9	2.1
	Comment AP1000 Design		
M-K6.04	Fans ~~Pumps~~	1.6	1.9
	Comment AP1000 Design no pumps in system		
D-K6.05	~~Motors~~	1.6	1.9
	Comment N/A AP1000 Design		
K6.06	Heat exchangers and condensers	1.8	1.9
M-K6.07	Breakers, relays, ~~and disconnects~~	1.8	1.9
	Comment AP1000 design no disconnects		
N-K6.08	Filters **Comment** AP1000 Design		
ABILITY			
A1	**Ability to predict and/or monitor changes in parameters to prevent exceeding design limits) associated with operating the VFS ~~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 VFS ~~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
D-A2.02	~~Continuance of outdoor temperature inversion~~	2.2	2.9
	Comment Has no effect on VFS		
M-A2.03	Startup operations and the associated required damper ~~valve~~ lineups	2.7	3.1
	Comment AP1000 Terminology		
M-A2.04	~~Health physics~~ Sampling of containment atmosphere	2.5*	3.2*
	Comment Sampling could be done by HP or chemistry		

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A3	**Ability to monitor automatic operation of the VFS ~~Containment Purge System~~ including:** (CFR: 41.7 / 45.5)		
M-A3.01	VFS ~~CPS~~ isolation . . . . . **Comment** AP1000 Terminology	3.8	4.0
N-A3.02	PMS isolation **Comment** AP1000 Design		
N-A3.03	RMS isolation **Comment** AP1000 Design		
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
M-A4.02	MES parameters ~~Outside atmospheric conditions (prior to purge)~~ . . . . . **Comment** AP1000 Terminology	2.2	2.5
M-A4.03	Inlet filtration and heating (VYS) and cooling (VWS) systems . . . . . **Comment** AP1000 system design	1.7	1.8
A4.04	Containment evacuation signal	3.5	3.6

TASK:

8297 Align the VFS for standby operation

8298 Operate VFS
8299 • Monitor VFS parameters
8300 • Start a containment air filtration exhaust fan
8301 • Start a containment air filtration supply fan
8302 • Operate VFS to purge containment
8303 • Operate VFS components for containment pressure control

8304 Shutdown VFS
8305 • Shutdown a containment air filtration supply fan
8306 • Shutdown a containment air filtration exhaust fan

8307 Respond to VFS - related abnormalities
8308 • Respond to containment air filtration alarms
8309 • Respond to containment air filtration system malfunctions
8310 • Respond to containment air filtration exhaust fan high radiation auto start and alignment to fuel handling area subsystem exhaust
8311 • Recover from containment air filtration exhaust fan alignment to the fuel handling area subsystem exhaust
8312 • Respond to containment air filtration exhaust fan high radiation auto start and alignment to auxiliary/annex building subsystem exhaust
8313 • Recover from containment air filtration exhaust fan alignment to the auxiliary/annex building subsystem exhaust

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the VFS and the following systems:**		
K 1.01	CAS		
K 1.02	DAS		
K 1.03	ESFAS		
K 1.04	FPS		
K 1.05	PAMS		
K 1.06	RMS		
K 1.07	VAS		
K 1.08	VCS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.09	VWS		
K 1.10	VYS		
K 1.11	WGS		
K 2	**Knowledge of bus or division power supplies to the following:**		
K 2.01	Containment Supply Fans		
K 2.02	Containment Exhaust Fans		
K 3	**Knowledge of the effect that a loss or malfunction of the VFS will have on the following:**		
K 3.01	FPS		
K 3.02	RMS		
K 3.03	VAS		
K 3.04	WGS		
K 3.05	Containment Exhaust Fan Flow		
K 3.06	Containment Supply Fan Flow		
K 3.07	Containment Isolation		
K 3.08	Radiological Control		
K 3.09	Monitor plant vent effluent		
K 3.10	Containment pressure		
K 3.11	Containment humidity		
K 3.12	Containment temperature		
K 3.13	Pressure in the fuel handling area, and the radiologically controlled areas of the auxiliary and annex building		
K 4	**Knowledge of VFS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Containment Isolation		
K 4.02	Radiological Control		
K 4.03	Monitor plant vent effluent		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 4.04	Maintain the fuel handling area, and the radiologically controlled areas of the auxiliary and annex building at a slight negative pressure		
K 4.05	Containment pressure control during normal operation		
K 4.06	Containment humidity control during normal operation		
K 4.07	Containment temperature control during normal operation		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the VFS:**		
K 5.01			
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the VFS**		
K 6.01	CAS		
K 6.02	ESFAS		
K 6.03	FPS		
K 6.04	RMS		
K 6.05	VAS		
K 6.06	VCS		
K 6.07	VWS		
K 6.08	VYS		
K 6.09	ZBS		
K 6.10	LOCA		
K 6.11	Fuel Handling Area Exhaust Air High Radiation		
K 6.12	Auxiliary Building Area Exhaust Air High Radiation		
K 6.13	Annex/Auxiliary Building Exhaust Air High Radiation		
K 6.14	Containment Purge Exhaust Air High Radiation		
K 6.15	Plant Vent Exhaust Air High Radiation		
K 6.16	High Ambient Air Pressure Differentials		
K 6.17	VFS Charcoal Adsorber Fire		
K 6.18	Abnormal RCS Leakage Inside Containment		
K 6.19	Air Filter High Pressure Differential		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.20	Fan Low Airflow		
K 6.21	Supply Air Low Temperature		
K 6.22	Exhaust Air Temperature		
K 6.23	Charcoal Adsorber Humidity		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the VFS including:**		
A 1.01	Secondary Building Ambient Pressure Differential		
A 1.02	Containment Supply Air Temperature		
A 1.03	Charcoal Absorber Temperature		
A 1.04	Containment Exhaust Fan Flow		
A 1.05	Containment Supply Fan Flow		
A 1.06	Exhaust Air Relative Humidity		
A 1.07	Containment Supply Air Smoke		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the VFS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	CAS		
A 2.02	ESFAS		
A 2.03	FPS		
A 2.04	RMS		
A 2.05	VAS		
A 2.06	VCS		
A 2.07	VWS		
A 2.08	VYS		
A 2.09	ZBS		
A 2.10	LOCA		
A 2.11	Fuel Handling Area Exhaust Air High Radiation		
A 2.12	Auxiliary Building Area Exhaust Air High Radiation		
A 2.13	Annex/Auxiliary Building Exhaust Air High Radiation		
A 2.14	Containment Purge Exhaust Air High Radiation		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.15	Plant Vent Exhaust Air High Radiation		
A 2.16	High Ambient Air Pressure Differentials		
A 2.17	VFS Charcoal Adsorber Fire		
A 2.18	Abnormal RCS Leakage Inside Containment		
A 2.19	Air Filter High Pressure Differential		
A 2.20	Fan Low Airflow		
A 2.21	Supply Air Low Temperature		
A 2.22	Exhaust Air Temperature		
A 2.23	Charcoal Adsorber Humidity		
A 3	**Ability to monitor automatic operation of the VFS, including:**		
A 3.01	Auto fan operation		
A 3.02	Containment Air Filtration Isolation		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	Containment isolation		
A 4.02	Auto fan operation		
A 4.03	Secondary Building Ambient Pressure Differential		
A 4.04	Containment Supply Air Temperature		
A 4.05	Charcoal Absorber Temperature		
A 4.06	Containment Exhaust Fan Flow		
A 4.07	Containment Supply Fan Flow		
A 4.08	Exhaust Air Relative Humidity		
A 4.09	Containment Supply Air Smoke		

Notes:

In the legacy Westinghouse plant; there is one containment purge system. In NUREG 1122, it is cataloged in Safety Function 8 as 029, Containment Purge System (CPS).

In AP1000 there is one containment purge system. It is cataloged as 029, Containment Air Filtration System (VFS).

035 Steam Generator System (S/GS) (SGS)

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	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ~~S/GS~~ SGS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
M-K1.01	~~MFW/AFW systems~~ FWS. . . . . **Comment** AP1000 Terminology	4.2	4.5
M-K1.02	~~MRSS~~ MSS. . . . . **Comment** AP1000 Terminology	3.2	3.4
M-K1.03	~~Blowdown~~ BDS. . . . . **Comment** AP1000 Terminology	2.4	2.6
M-K1.04	~~Condenser hotwell~~ TDS. . . . . **Comment** AP1000 Terminology	2.2*	2.3
M-K1.05	~~Nitrogen~~ Plant Gas System (PGS). . . . . **Comment** AP1000 Terminology	1.7	1.7
M-K1.06	~~Sampling~~ SSS. . . . . **Comment** AP1000 Terminology	1.7	1.8
D-K1.07	~~S/G recirculation~~ . . . . . **Comment** Included in FWS and BDS above	1.9	1.9
K1.08	Chemical addition	1.8	2.2
K1.09	RCS	3.8	4.0
M-K1.10	~~ARM system~~ RMS . . . . . **Comment** AP1000 Terminology	2.4	2.5

D-K1.11	~~PRM system~~	3.1	3.1
	Comment Included in K1.10 above		
M-K1.12	~~RPS~~ PMS/PXS.	3.7	3.9
	Comment AP1000 Terminology		
D-K1.13	~~Condensate system~~	2.7	2.8
	Comment N/A AP1000 Design		
D-K1.14	~~ESF~~	3.9	4.1
	Comment Included in K1.12 above		
N-K1.15	CAS **Comment** AP1000 Design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
M-K2.01	~~S/G level control system~~ PLS.	2.2*	2.3
	Comment AP1000 Design and Terminology		
K3	**Knowledge of the effect that a loss or malfunction of the ~~S/GS~~ SGS will have on the following:** (CFR: 41.7 / 45.6)		
K3.01	RCS	4.4	4.6
D-K3.02	~~ECCS~~	4.0	4.3
	Comment N/A AP1000 Design		
M-K3.03	~~Secondary systems~~ FWS.	3.0*	3.1*
	Comment AP1000 Terminology		
N-K3.04	MSS		
	Comment AP1000 Terminology		
N-K3.05	BDS		
	Comment AP1000 Terminology		
N-K3.06	TDS		
	Comment AP1000 Terminology		

K4	**Knowledge of ~~S/GS~~ SGS 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*
D-K4.04	~~Radiation high-level isolation while draining S/G secondary to main condenser~~ . . . . . . **Comment** N/A AP1000 Design	2.8*	3.1*
M-K4.05	~~Amount of reserve water in S/G~~	2.9	3.2
	Amount of time available for SG decay heat removal prior to actuating PRHR heat exchanger **Comment** Clarification		
K4.06	S/G pressure	3.1	3.4
D-K4.07	~~Pre/post-blowdown system~~ . . . . . . **Comment** N/A AP1000 Design	2.3*	2.3*
D-K4.08	~~AFW pump operation as it relates to hydrotest~~ . . . . . . **Comment** N/A AP1000 Design - no AFW system	1.9*	2.1*
D-K4.09	~~Maintenance of hydrostatic pressure by throttling AFW control valve~~ . . . . . **Comment** N/A AP1000 Design	1.7*	1.9*
N-K4.10	FWS **Comment** AP1000 Design		
N-K4.11	SFW **Comment** AP1000 Design		
N-K4.12	Steam line isolation **Comment** AP1000 Design		
N-K4.13	Automatic Feedwater control mode (FWS/SFW) **Comment** AP1000 Design		

K5	**Knowledge of operational implications of the following concepts as the apply to the ~~S/GS~~ SGS:** (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
D-K5.05	~~Relationship between AFW pump speed and discharge pressure during hydrotest~~	1.7*	2.0*
	Comment N/A AP1000 Design		
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the ~~S/GS~~ SGS:** (CFR: 41.7 / 45.7)		
K6.01	MSIVs	3.2	3.6
M-K6.02	~~Secondary PORV~~ Steam Generator PORV	3.1	3.5
	Comment Clarification		
K6.03	S/G level detector	2.6	3.0
K6.04	Pumps	1.6	1.9
K6.05	Motors	1.4	1.6
D-K6.06	~~Valves~~	1.9*	2.1*
	Comment Significant valves are listed in this section		
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*
N-6.10	S/G Safety Valves		
	Comment AP1000 Terminology		
N-K6.11	Feed Control and Isolation valves		
	Comment AP1000 Terminology		
N-K6.12	Startup Feed Control and Isolation valves		
	Comment AP1000 Terminology		

ABILITY

A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ~~S/GS~~ SGS controls including:** (CFR: 41.5 / 45.5)		
A1.01	S/G wide and narrow range level during startup, shutdown, 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 malfunctions or operations on the SGS; 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
M-A2.05	Unbalanced flows to the ~~5~~S/Gs . . . . . **Comment** Correct existing error	3.2	3.4
A2.06	Small break LOCA	4.5	4.6
A3	**Ability to monitor automatic operation of the ~~S/G~~ SGS including:** (CFR: 41.7 / 45.5)		
A3.01	S/G water level control	4.0	3.9
M-A3.02	~~MAD valves~~ S/G PORVs. . . . . **Comment** What is a MAD valve?	3.7?	3.5?
D-A3.03	~~Components used to conduct a secondary side hydrostatic test (e.g., AFW pump)~~ . . . . . **Comment** N/A AP1000 Design	1.9*	1.8*
D-A3.04	~~Components used to conduct S/G tube hydrostatic test~~ . . . . . **Comment** N/A AP1000 Design	1.9	1.9
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
M-A4.01	Shift of S/G controls between manual and automatic control, ~~by bumpless transfer~~ . . . . . **Comment** AP1000 Design no hard controls	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
M-A4.06	S/G isolation on faulted or ruptured steam generator ~~steam leak or tube rupture/leak~~	4.5	4.6
	Comment Clarification and incorporate potential feedwater problems		
D-A4.07	~~Adjustment of cooling water flow rate from blowdown heat exchanger~~	2.0	2.0
	Comment Moved to condensate section of KA catalog		
A4.08	Recognition that increasing radiation levels in secondary systems may mean leaking and possibly ruptured S/G tubes	4.1	4.4
D-A4.09	~~Reason for using timed flow in filling top of S/G while going into wet lay-up~~	2.1*	2.0
	Comment N/A AP1000 no auto fill capability		
M-A4.10	~~Need for frequent~~ S/G level ~~verification~~ during wet lay-up	2.0*	2.0
	Comment Clarification and make consistent with stem		

TASK:

7969 Fill SG to wet layup

7970 Operate SG water level control in manual

7971 Transfer SG water level control between automatic and manual mode

7972 Use SG PORVs to maintain no-load temperature or to perform plant cooldown

7974 Monitor SG system and component parameters

7975 Place a SG in wet layup recirculation

7976 Drain a SG to WWS or WLS

7977 Respond to SGS alarms

7978 Respond to failed open SG PORV

7980 Manually operate the MSIV's from the MCR

7982 Respond to inadvertent closure of MSIV(s)

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the SGS and the following systems:**		
K 1.01	BDS		
K 1.02	CAS		
K 1.03	CVS		
K 1.04	DAS		
K 1.05	ESFAS		
K 1.06	FWS		
K 1.07	MSS		
K 1.08	MTS		
K 1.09	PAMS		
K 1.10	PGS		
K 1.11	PXS		
K 1.12	RCS		
K 1.13	RMS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.14	RTS		
K 1.15	SSS		
K 1.16	SDCS		
K 1.16	SMS		
K 1.17	TDS		
K 1.18	VXS		
K 1.19	WWS		
K 1.20	ZBS		
K 2	**Knowledge of bus or division power supplies to the following:**		
K 2.01	SG PORV Control Power		
K 2.02	SG PORV Block Valves		
K 2.03	MSIV Control power		
K 2.04	MSIV Hydraulic Pump		
K 2.05	MSIV Bypass Valve control power		
K 2.06	MFIV Control power		
K 2.07	MFIV Hydraulic Pump		
K 2.08	MFCV Control Power		
K 2.09	Startup Feedwater Isolation Valves		
K 2.10	SFCV Control Power		
K 2.11	Steam Generator Blowdown Isolation Valves		
K 3	**Knowledge of the effect that a loss or malfunction of the SGS will have on the following:**		
K 3.01	BDS		
K 3.02	FWS		
K 3.03	MSS		
K 3.04	MTS		
K 3.05	PXS		
K 3.06	RCS		
K 3.07	RMS		
K 3.08	TDS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 3.09	VXS		
K 3.10	WWS		
K 4	**Knowledge of SGS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Containment Isolation		
K 4.02	Steam line Isolation		
K 4.03	Feedwater isolation		
K 4.04	Secondary Side Overpressure Protection		
K 4.05	Steam flow measurement		
K 4.06	Steam pressure measurement		
K 4.07	SG level measurement		
K 4.08	Provide signals to DAS		
K 4.09	Decay Heat Removal		
K 4.10	Blowdown to the BDS		
K 4.11	Main Steam Line Warming		
K 4.12	Main Steam Line Drainage		
K 4.13	Steam Line Sampling		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the SGS:**		
K 5.01	SG tube leak detection		
K 5.02	SG level shrink and swell		
K 5.03	Plant response to a steam line break		
K 5.04	Plant response to a feedwater line break		
K 5.05	SGS response to a RCS LOCA		
K 5.06	Natural circulation		
K 5.07	Feedwater flow changes on RCS natural circulation flowrate		
K 5.08	Feedwater flow changes on Reactor power		
K 5.09	Feedwater flow changes on RCS pressure		
K 5.10	Feedwater flow changes on RCS temperature		
K 5.11	Feedwater flow changes on PZR level		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 5.12	Feedwater flow changes on SG level		
K 5.13	Feedwater flow changes on SG pressure		
K 5.14	Chemistry and corrosion control		
K 5.15	Failure to diagnose a FAULTED SG		
K 5.16	Failure to diagnose a SGTR event (PRA)		
K 5.17	Failure to close the MSIV to isolate the FAULTED SG, given a SGTR event (PRA)		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the SGS:**		
K 6.01	BDS		
K 6.02	CAS		
K 6.03	DAS		
K 6.04	ESFAS		
K 6.05	FWS		
K 6.06	MSS		
K 6.07	MTS		
K 6.08	PGS		
K 6.09	RCS		
K 3.10	RTS		
K 6.11	SDCS		
K 6.12	VXS		
K 6.13	ZBS		
K 6.14	Containment isolation		
K 6.15	Step load changes		
K 6.16	FWS line break		
K 6.17	MSS line break		
K 6.18	SGTR		
K 6.19	Faulted/Ruptured SG		
K 6.20	Inadvertent Opening/Failure to Close of a SG PORV or Main Steam Safety Valve		
K 6.21	Loss of forced RCS flow		
K 6.22	RCP trip		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.23	Inadvertent PRHR operation		
K 6.24	Loss of One Feedwater Pump		
K 6.25	Feedwater Heater Out of Service		
K 6.26	Excessive Feedwater Flow		
K 6.27	Loss of Normal Feedwater Flow		
K 6.28	Startup Feedwater Control Valve Failure		
K 6.29	Turbine Trip		
K 6.30	SG response to RCS LOCA		
K 6.31	SG PORV failure		
K 6.32	MSSV failure		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the SGS including:**		
A 1.01	RCS natural circulation flowrate		
A 1.02	PZR level		
A 1.03	Reactor power		
A 1.04	RCS pressure		
A 1.05	RCS temperature		
A 1.06	SG level		
A 1.07	SG pressure		
A 1.08	Feedwater flow		
A 1.09	Steam flow		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the SGS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	BDS		
A 2.02	CAS		
A 2.03	DAS		
A 2.04	ESFAS		
A 2.05	FWS		
A 2.06	MSS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.07	MTS		
A 2.08	PGS		
A 2.09	RCS		
A 2.10	RTS		
A 2.11	SDCS		
A 2.12	VXS		
A 2.13	ZBS		
A 2.14	Containment isolation		
A 2.15	Step load changes		
A 2.16	FWS line break		
A 2.17	MSS line break		
A 2.18	SGTR		
A 2.19	Faulted/Ruptured SG		
A 2.20	Inadvertent Opening/Failure to Close of a SG PORV or Main Steam Safety Valve		
A 2.21	Loss of forced RCS flow		
A 2.22	RCP trip		
A 2.23	inadvertent PRHR operation		
A 2.24	Loss of One Feedwater Pump		
A 2.25	Feedwater Heater Out of Service		
A 2.26	Excessive Feedwater Flow		
A 2.27	Loss of Normal Feedwater Flow		
A 2.28	Startup Feedwater Control Valve Failure		
A 2.29	Turbine Trip		
A 2.30	SGS response to a RCS LOCA		
A 2.31	SG PORV failure		
A 2.32	MSSV failure		
A 3	**Ability to monitor automatic operation of the SGS, including:**		
A 3.01	S signal		
A 3.02	SLI		
A 3.03	Turbine trip		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 3.04	MFCV Isolation		
A 3.05	MFW Pump Trip and Valve Isolation		
A 3.06	SFW Isolation		
A 3.07	PRHR HX Actuation		
A 3.08	SG Blowdown Isolation		
A 3.09	CVS Makeup Isolation		
A 3.10	SG PORV and Block Valve Isolation		
A 3.11	SG PORV operation and control		
A 3.12	SG NR Water Level Low Reactor trip		
A 3.13	SG NR Water Level High Reactor trip		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	SLI		
A 4.02	MFCV Isolation		
A 4.03	MFW Pump Trip and Valve Isolation		
A 4.04	SFW Isolation		
A 4.05	SG Blowdown Isolation		
A 4.06	SG PORV and Block Valve Isolation		
A 4.07	SG PORV operation and control		
A 4.08	Main steam line warming and pressurization		

Notes:

In the legacy Westinghouse plant; there is one steam generator system. In NUREG 1122, it is cataloged in Safety Function 4 as 035, Steam Generator System (S/G).

In AP1000 there is one steam generator system. It is cataloged as system 035, Steam Generator System (SGS). It covers the steam generator and all attached piping out to the isolation valves. This includes the SG PORV's, SG PORV Block Valves, and the Main Steam Safety Valves (MSSV's). The SG PORV and Block Valve Control and Isolation, Steam Line Isolation, Feedwater Isolation, and SG Blowdown Isolation functions are covered in SGS.

The SG water level control function is covered in 059, Feedwater System (FWS). The steam flow control function (except through the SG PORV) is covered in 041, Steam Dump Control System (SDCS).

039 Main and Reheat Steam System (MRSS) (MSS)

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	IMPORTANCE SRO
K1	**Knowledge of the physical connections and/or cause-effect relationships between the ~~MRSS~~ MSS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
M-K1.01	~~S/G~~ SGS. . . . . **Comment** AP1000 Terminology	3.1	3.2
K1.02	Atmospheric relief dump valves	3.3	3.3
M-K1.03	~~Instrument air~~ CAS. . . . . **Comment** AP1000 Terminology	2.3	2.5
K1.04	RCS temperature monitoring and control	3.1	3.1
M-K1.05	~~T/G~~ Main Turbine System . . . . . **Comment** AP1000 Terminology	2.5*	2.6*
M-K1.06	~~Condenser steam dump~~ SDS. . . . . **Comment** AP1000 Terminology	3.1	3.0
D-K1.07	~~AFW~~ . . . . . **Comment** N/A AP1000 Design	3.4*	3.4*
D-K1.08	~~MFW~~ . . . . . **Comment** AP1000 Design	2.7*	2.9*

D_K1.09	~~RMS~~	2.7	2.7
	Comment N/A AP1000 Design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
D-K2.01	~~MRSS~~	1.5	1.8
	Comment N/A AP1000 Design		
M-K2.02	~~Moisture separator reheater valves~~ 2nd stage reheating isolation valves.	1.4	1.6
	Comment AP1000 Design		
K3	**Knowledge of the effect that a loss or malfunction of the ~~MRSS~~ MSS will have on the following:** (CFR: 41.7 / 45.6)		
M-K3.01	~~T/G~~ MTS	2.3	2.6*
	Comment AP1000 Terminology		
K3.02	Condenser	1.8	1.9
D-K3.03	~~AFW pumps~~	3.2*	3.5*
	Comment N/A AP1000 Design		
D-K3.04	~~MFW pumps~~	2.5*	2.6*
	Comment N/A AP1000 Design		
D-K3.05	~~RCS~~	3.6	3.7
	Comment Covered in new K5		
D-K3.06	~~SDS~~	2.8*	3.1
	Comment N/A AP1000 Design part of MSS		
N-K3.07	DST		
	Comment AP1000 Design		
K4	**Knowledge of ~~MRSS~~ MSS 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

D-K4.02	~~Utilization of T-ave. program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits~~	3.1	3.2
	Utilization of the Tave mode control when dumping steam through the dump valves including Tave limits		
	Comment		
	Covered in SGS		
K4.03	Main condenser, including steam dump valves, operating limits, controls, indications	2.3	2.5
D-K4.04	~~Utilization of steam pressure program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits~~ . .	2.9	3.1
	Utilization of the steam pressure mode control when dumping steam through the dump valves including Tave limits		
	Comment		
	Covered in SGS		
D-K4.05	~~Automatic isolation of steam line~~	3.7	3.7
	Comment		
	Covered in SGS		
D-K4.06	~~Prevent reverse steam flow on steam line break~~	3.3	3.6
	Comment		
	Covered in SGS		
D-K4.07	~~Reactor building isolation~~	3.4	3.7
	Comment		
	N/A AP1000 Design MSIVs are part of SGS		
D-K4.08	~~Interlocks on MSIV and bypass valves~~	3.3	3.4
	Comment		
	N/A AP1000 Design MSIVs are part of the SGS		
D-K4.09	Utilization of the atmospheric relief valve pressure controller when dumping steam through the S/G PORVs including Tave limits		
	Comment		
	Covered in SGS		
D-K4.10	Operation of the remote operated PORV isolation valve on low flow steamline pressure		
	Comment		
	Covered in SGS		
N-K4.11	MSR continuous venting		
	Comment		
	AP1000 Design to prevent damage		
N-K4.12	MSR second stage low power control valve		
	Comment		
	AP1000 Design		
N-K4.13	Auto MSR Reheater isolation		
	Comment		
	AP1000 Design		

N-K4.14	Auto Aux Steam isolation **Comment** AP1000 Design		
N-K4.15	Auto Turbine Bypass Valve isolation **Comment** AP1000 Design		
N-K4.16	Auto Extraction Steam Valve isolation **Comment** AP1000 Design		
N-K4.17	S/G Safety Valves **Comment** AP1000 Design cause and effect relationship		
N-K4.11	Steamline low point and extraction low point drains **Comment** AP1000 Design cause and effect relationship		
K5	**Knowledge of the operational implications of the following concepts as the apply to the ~~MRSS~~ MSS:** (CFR: 441.5 / 45.7)		
M-K5.01	~~Definition and~~ Causes of steam/water hammer . . . . . . **Comment** KA match stem	2.9	3.1
M-K5.02	~~Definition and~~ Causes of thermal stress . . . . . . **Comment** KA match stem	2.4	2.7
M-K5.03	~~Definition of, and~~ Reason for, steam blanketing on moisture separator reheater . . . . . . **Comment** KA match stem	1.9	2.2
D-K5.04	~~Effect of condenser vacuum on plant efficiency~~ . . . . . . **Comment** KA moved to CARS	2.1	2.1
K5.05	Bases for RCS cooldown limits	2.7	3.1*
D-K5.06	~~Purpose of density compensation of main steam flow~~ . . . . . . **Comment** KA moved to SGS	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
D-K6.04	~~Pumps~~	1.4	1.7
	Comment N/A AP1000 Design - no pumps in system		
D-K6.05	~~Motors~~	1.3	1.5
	Comment N/A AP1000 Design - no motors in system		

ABILITY

A1 **Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ~~MRSS~~ MSS 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
D-A1.09	~~Main steam line radiation monitors~~	2.5*	2.7*
	Comment Moved to SGS		
D-A1.10	~~Air ejector PRM~~	2.9*	3.0*
	Comment Moved to CARS		

A2 **Ability to (a) predict the impacts of the following malfunctions or operations on the ~~MRSS~~ MSS; 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)

D-A2.01	~~Flow paths of steam with a faulted S/G~~ ~~during a LOCA~~	3.1	3.2
	Comment Covered in SGS		
D-A2.02	~~Decrease in turbine load as it relates to steam escaping from relief valves~~ .	2.4	2.7*
	Comment Covered in SGS		
D-A2.03	~~Indications and alarms for main steam and area radiation monitors (during SGTR)~~	3.4	3.7
	Comment		

Moved to SGS

M-A2.04	Malfunctioning Turbine Bypass Valve ~~steam dump~~	3.4	3.7
	Comment AP1000 Terminology		
M-A2.05	~~Increasing steam demand, its relationship to increases in reactor power~~ . . . How changes in steam demand affect reactor power	3.3	3.6
	Comment Covered in new K5		
A3	**Ability to monitor automatic operation of the ~~MRSS~~ MSS, including**: (CFR: 41.5 / 45.5)		
A3.01	Moisture separator reheater steam supply	1.9*	1.7
M-A3.02	Automatic isolation of the MRSS	3.1	3.5*
	Comment AP1000 Design		
A4	**Ability to manually operate and/or monitor in the control room:** (CFR: 41.7 / 45.5 to 45.8)		
M-A4.01	Main steam supply valves to the second stage heating	2.9*	2.8*
	Comment Clarification		
M-A4.02	~~Remote operators to~~ Main Steam supply to auxiliary steam	2.1	1.9
	Comment Clarification		
D-A4.03	~~MFW pump turbines~~	2.8*	2.8*
	Comment N/A AP1000 Design		
D-A4.04	~~Emergency feedwater pump turbines~~	3.8	3.9
	Comment N/A AP1000 Design		
M-A4.05	Moisture separator reheater, ~~checking its temperatures and steam pressures relative to~~ heatup ~~limits~~ and operating limits	1.8	1.6
	Comment Clarification		
A4.06	Main steam drains	1.9	1.8
M-A4.07	~~Steam dump valves~~ Turbine Bypass Valves	2.8*	2.9
	Comment AP1000 Terminology		
N-A4.08	Extraction Steam supply valves to the feed water heaters		
	Comment		

TASK:

7929 Perform MCR actions associated with MSS valve line-up

7930 Startup the MSS
7931 • Establish and verify initial conditions for starting up the MSS
7932 • Warm up and pressurize the main steam lines
7933 • Start up the moisture separator re-heaters (MSRs)

7934 Operate the MSS
7935 • Monitor MSS system and component parameters
7936 • Operate the main and re-heat steam system
7937 • Operate the MSS drains
7942 • Manually operate the MSRs

7945 Shutdown the MSS
7946 • Shutdown the main and reheat steam system

7948 Respond to MSS-related abnormalities
7949 • Respond to MSS alarms
7950 • Respond to failed open steam line automatic drain valve
7952 • Respond to failed closed re-heat supply valve to MSR
7953 • Respond to failure of extraction steam shutoff or non-return check valve to close

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the MSS and the following systems:**		
K 1.01	ASS		
K 1.02	CAS		
K 1.03	CDS		
K 1.04	ESFAS		
K 1.05	GSS		
K 1.06	HDS		
K 1.07	MTS		
K 1.08	PAMS		
K 1.09	PGS		
K 1.10	SDCS		
K 1.11	SGS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.12	SSS		
K 1.13	TDS		
K 1.14	VTS		
K 1.15	VYS		
K 2	**Knowledge of bus or division power supplies to the following:**		
K 2.01	MSR 2nd Stage Reheating Steam Main Isolation Valve control power		
K 2.02	Extraction Steam Power Operated Shutoff Valves		
K 2.03	Main Turbine Stop Valve control power		
K 2.04	MSS to Auxiliary Steam Supply Header Isolation Valve		
K 3	**Knowledge of the effect that a loss or malfunction of the MSS will have on the following:**		
K 3.01	ASS		
K 3.02	CDS		
K 3.03	GSS		
K 3.04	HDS		
K 3.05	MTS		
K 3.06	SDCS		
K 3.07	SGS		
K 3.08	SSS		
K 3.09	TDS		
K 3.10	VTS		
K 3.11	VYS		
K 4	**Knowledge of MSS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	SLI		
K 4.02	Moisture Separation and Reheat		
K 4.03	Extraction Steam		
K 4.04	Turbine Protection		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 4.05	Main steam line drains		
K 4.06	Aux and GSS steam		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the MSS:**		
K 5.01	Changing steam flow effect on RCS natural circulation flowrate		
K 5.02	Changing steam flow effect on PZR level		
K 5.03	Changing steam flow effect on Reactor power		
K 5.04	Changing steam flow effect on RCS pressure		
K 5.05	Changing steam flow effect on RCS temperature		
K 5.06	Changing steam flow effect on SG level		
K 5.07	Changing steam flow effect on SG pressure		
K 5.08	Changing 2nd Stage Reheating steam flow effect on MTS		
K 5.09	Water hammer		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the MSS:**		
K 6.01	ASS		
K 6.02	CAS		
K 6.03	CDS		
K 6.04	ESFAS		
K 6.05	HDS		
K 6.06	MTS		
K 6.07	SDCS		
K 6.08	SGS		
K 6.09	TDS		
K 6.10	VTS		
K 6.11	100% load rejection		
K 6.12	Turbine trip		
K 6.13	Reactor trip from 100% power		
K 6.14	Power transients involving less than 100% load reduction		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.15	High and Low ASS/GSS Supply Pressure		
K 6.16	Feedwater Heater High-2 Level		
K 6.17	MSR 2nd Stage Reheat Steam Valve Failure		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the MSS including:**		
A 1.01	Hot reheat steam temperatures		
A 1.02	LP Turbine Temperatures		
A 1.03	Reheating steam temperatures		
A 1.04	Reheating steam pressure		
A 1.05	MSS temperature		
A 1.06	MSS pressure		
A 1.07	RCS temperature		
A 1.08	ASS pressure		
A 1.09	GSS pressure		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the MSS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	ASS		
A 2.02	CAS		
A 2.03	CDS		
A 2.04	ESFAS		
A 2.05	HDS		
A 2.06	MTS		
A 2.07	SDCS		
A 2.08	SGS		
A 2.09	TDS		
A 2.10	VTS		
A 2.11	100% load rejection		
A 2.12	Turbine trip		
A 2.13	Reactor trip from 100% power		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.14	Power transients involving less than 100% load reduction		
A 2.15	High and Low ASS/GSS Supply Pressure		
A 2.16	Feedwater Heater High-2 Level		
A 2.17	MSR 2nd Stage Reheat Steam Valve Failure		
A 2.18	MSR Shell Relief Valve failure		
A 3	**Ability to monitor automatic operation of the MSS, including:**		
A 3.01	MSR 2nd Stage Reheat Steam flow		
A 3.02	Pressure Control Valves for ASS/GSS Supply		
A 3.03	Extraction Steam Power Operated Shutoff Valves		
A 3.04	Automatic Low Point Drain Valves		
A 3.05	SLI		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	Warming and pressurizing MSS		
A 4.02	MSR 2nd Stage Reheat Supply Steam flow		
A 4.03	MSR 2nd Stage Reheat Steam Air-Operated Isolation Valves		
A 4.04	Pressure Control Valves for ASS/GSS Supply		
A 4.05	Extraction Steam Power Operated Shutoff Valves		
A 4.06	Automatic Low Point Drain Valves		
A 4.07	SLI		

Notices:

In the legacy Westinghouse plant; there is one main and reheat steam system. In NUREG 1122, it is cataloged in Safety Function 4 as 039, Main and Reheat Steam System (MRSS).

In AP1000 there is one Main and Reheat Steam System. It is cataloged as 039, Main Steam System (MSS). It covers from the MSIV's to the condenser and to the 2nd Stage Reheat Isolation and Control Valves.

The SG PORV's, SG PORV Block Valves, Main Steam Safety Valves (MSSV's), SG PORV and Block Valve Control and Isolation, Steam Line Isolation, Feedwater Isolation, and SG Blowdown Isolation functions are covered in 035, Steam Generator System (SGS). The steam flow control function (except

056 Condensate System (CDS)

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)		
M-K1.01	~~feedwater cleanup system~~ CPS. . . . . **Comment** AP1000 terminology	1.8	1.8
D-K1.02	~~Main vacuum and gland seal system~~ . . . . . **Comment** AP1000 included in K1.07 and K1.08 below	1.6	1.6
M-K1.03	~~MFW~~ FWS. . . . . **Comment** AP1000 terminology	2.6*	2.6
K1.04	Condenser	1.7	1.6
M-K1.05	~~Secondary sealing water~~ Condensate seal water . . . . . ` **Comment** AP1000 terminology	1.5	1.5
M-K1.06	~~Heater drains~~ HDS. . . . . **Comment** AP1000 terminology	1.4	1.5
M-K1.07	~~Gland seals~~ GSS. . . . . **Comment** AP1000 terminology	1.5	1.5

M-K1.08	~~CARs~~ CMS **Comment** AP1000 terminology	1.6	1.6
K1.09	Extraction steam	1.6	1.6
M-K1.10	~~Chemical treating~~ CFS **Comment** AP1000 terminology	1.7	1.7
D-K1.11	~~Stator cooling~~ **Comment** N/A AP1000 Design	1.5	1.5
M-K1.12	~~Secondary plant component cooling~~ CCS **Comment** AP1000 terminology	1.6	1.6
D-K1.13	~~AFW~~ **Comment** N/A AP1000 system design no AFW	2.4*	2.4*
K1.14	Demineralizer water makeup system	1.7	1.9
M-1.15	~~Hotwell pumps, booster pumps, and main feed pumps~~ Condensate pumps **Comment** AP1000 terminology	2.1	2.1
D-K1.16	~~Demineralizer bypass valve (prevent water impact on resin beds during pump startup)~~ **Comment** AP1000 included in K1.01 and K1.03 above	1.9	2.1*
D-K1.17	~~Feed system, the polishing demineralizer system, and the condensate strainer operation~~ **Comment** AP1000 included in K1.01 and K1.03 above	1.9	2.1*
N-K1.18	BDS **Comment** AP1000 design		
N-K1.19	CES **Comment** AP1000 design		
N-K1.20	MTS **Comment** AP1000 design		
N-K1.21	MSS **Comment** AP1000 design		

N-K1.22	ASS **Comment** AP1000 design		
N-K1.23	CAS **Comment** AP1000 design		
N-K1.24	CWS **Comment** AP1000 design		
N-K1.25	SSS **Comment** AP1000 design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
M-K2.01	Condensate pumps ~~and booster pumps~~	1.6	1.7*
	Comment AP1000 design		
K3	**Knowledge of the effect that a loss or malfunction of the Condensate System will have on the following:** (CFR: 41.7 / 45.6)		
M-K3.01	~~MFW~~ FWS.	2.4*	2.4
	Comment AP1000 terminology		
D-K3.02	~~CARS~~	1.6	1.7
	Comment N/A AP1000 Design		
D-K3.03	~~MFW pumps~~	2.2*	2.3
	Comment Included in K3.01 above		
D-3.04	~~Heater drain pumps~~	1.6	1.6
	Comment AP1000 design - no heater drain pumps		
K3.05	Extraction steam	1.6	1.6
K3.06	Gland steam system	1.5	1.6
D-K3.07	~~Stator coolant~~	1.7	1.6
	Comment AP1000 design - not a condensate load		

D-K3.08	~~Hydrogen coolers~~	1.6	1.6
	Comment AP1000 design - not a condensate load		
K4	**Knowledge of Condensate System design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
M-K4.01	Feedwater heating at low, ~~intermediate,~~ and high pressure	1.6	1.9
	Comment Not a term used in AP1000 design		
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
M-K4.06	Proper sequencing of ~~hotwell~~ condenser pumps and condensate polishing demineralzer bypass valves	1.5	1.6
	Comment AP1000 terminology		
K4.07	Cooling condensate pumps seals, using makeup water	1.5	1.7
K4.08	Venting condensate pump seals	1.4	1.5
M-K4.09	~~Feedwater pump turbine windmill protection~~ Feedwater pump NPSH provided by DST	1.8	1.9
	Comment AP1000 design - intra system interlock		
M-K4.10	Flow ~~control valve~~ for the gland exhaust condenser	1.5	1.6
	Comment AP1000 design		
M-K4.11	Bypass of heater string ~~stream~~	1.7	2.0
	Comment Correct typo and use better terminology		
K4.12	Condensate minimum flow recirculation valve	1.6	1.6
K4.13	Condensate pump runout capacity	1.7	1.7
D-K4.14	~~MFW pump NPSH~~	2.2	2.6*
	Comment Included in K4.09 above		
M-K4.15	~~Booster~~ Condensate pump starting interlock	1.9	2.1*
	Comment AP1000 design		
M-K4.16	Low-level and High-level heater control	1.6	1.7
	Comment		

Clarification

M-K4.17 Adjustment of automatic flow setpoint and polish demineralizer bypass valves 1.6 1.7

Comment
Clarification

D-K4.18 ~~Interlocks between booster pumps and auxiliary oil pumps~~. 1.5* 1.7

Comment
AP1000 design no booster or auxiliary oil pumps

M-K4.19 Setpoints and trip levels for condensate pump ~~and booster pump~~ operations 1.9 1.9

Comment
AP1000 design

K4.20 Flow rate limits of condensate piping system 1.6 1.7

D-K4.21 ~~Operation of hotwell pump and air ejector recirculation line isolation valve to maintain header pressure~~ 1.5* 1.7*

Comment
AP1000 design - no air ejectors

D-K4.22 ~~Feed pump and booster pump NPSH protection~~ 2.1 2.4*

Comment
Included in FWS

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

M-K5.01 Principles and mechanisms of hotwell level control ~~of vacuum drag~~ 1.5 1.5

Comment
Includes vacuum drag as well of other principle of control and reject

D-K5.02 ~~Energies associated with fluid flow (Kinetic, Potential pressure) .~~ 1.4 1.6

Comment
GFE Topic

K5.03 Water hammer and methods of prevention 2.2 2.6*

D-K5.04 ~~Function of lubricating oil and its application to pump and motor bearings~~ 1.7 1.8

Comment
GFE Topic

D-K5.05 ~~Understanding of the working properties of water (Enthalpy, entropy, pressure, temperature, specific volume)~~ 1.7 2.0*

Comment
GFE Topic

D-K5.06 ~~Purpose of condensate demineralizer~~ 1.7 1.9

Comment
GFE Topic

D-K5.07	~~Purpose and principle of de-aeration, of oxygen removal from condensate~~	1.7	1.9
	Comment GFE Topic		
K5.08	Chemistry specs for secondary system dissolved oxygen (corrosion control)	1.9	2.4
D-K5.09	~~Water quality requirements for demineralizer water~~	1.7	2.0
	Comment GFE Topic		
K5.10	Effects of leaks (on plant efficiency and personnel)	1.8	2.0
D-K5.11	~~Reasons for venting all high points in condensate system~~	1.5	1.7
	Comment GFE Topic		
D-K5.12	~~Reason and methods for breaking main condenser vacuum before removing turbine seals~~	1.6	1.7
	Comment GFE Topic		
M-K5.13	~~Purpose of low-pressure cleanup valve~~ Condensate clean up.	1.5	1.6
	Comment Generic term to cover all clean up processes		
D-K5.14	~~Purpose of valve between upper surge tank and hotwell~~	1.7*	1.7*
	Comment Included in K5.01 above		
K5.15	Stabilization of piping system parameters after changes in chemistry	1.6	1.8
D-K5.16	~~Limits of condensate pump ability to feed S/G~~	2.0*	2.3*
	Comment N/A AP1000 design		
D-K5.17	Principles and mechanisms of ~~S/G water~~ DST level control	2.3*	2.3*
	Comment Covered in K4		
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
	Comment AP1000 design - part of Main Feed pumps		
D-K6.02	~~Booster pumps~~	1.7	1.9
	Comment AP1000 design - part of Main Feed pumps		
M-K6.03	Main Feed/Booster pumps	2.1	2.4*

	Comment AP1000 design		
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
M-K6.08	Breakers, relays, ~~and disconnects~~	1.3	1.5
	Comment AP1000 design - no disconnects		
K6.09	Demineralizers	1.7	1.9
K6.10	Pumps	1.6	1.7
K6.11	Motors	1.4	1.6
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)		
M-A1.01	Pressure, flow and amps for condensate, booster/, ~~and~~ main feed pumps . . .	2.1*	2.4*
	Comment AP1000 design and terminology		
A1.02	Deleted		
M-A1.03	Condensate Pump Startup ~~Normal sequence of alarms on startup of condensate pumps, including low suction pressure alarm~~	1.6	1.6
	Comment Simplify statement		
M-A1.04	Hotwell level ~~alarms and flow indicators~~	1.6	1.7
	Comment Consistent with A1.03 above		
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
M-A1.07	~~S/G level under transient induced by feed rate change (pumps on and off)~~ . Effects of starting and stopping pumps on DST level	2.1	2.3*
	Comment AP1000 design		
D-A1.08	~~MFW pump suction pressure~~	2.3	2.6*
	Comment Included in A1.01 above		
N-A1.09	DST parameters (level, pressure, temperature)		
	Comment AP1000 Design		

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)		
M-A2.01	Loss of condenser vacuum ~~pressure~~	1.8	2.0
	Comment Clarify intent of KA		
M-A2.02	~~Bad chemistry~~ Out of spec chemistry.	1.8	2.3*
	Comment Improve the wording of KA		
M-A2.03	High demineralizer D/P	1.8	2.0*
	Comment Identify malfuntion		
A2.04	Loss of condensate pumps	2.6	2.8*
A2.05	Condenser tube leakage	2.1	2.5*
M-A2.06	Abnormal ~~hotwell~~ condensate pump discharge pressure	1.6	1.7
	Comment AP1000 design and terminology		
A2.07	Removal of condensate demineralizer from service	1.7	1.9
A2.08	Feedwater heater tube leak	1.6	1.8
M-A2.09	Feedwater heater level ~~high or low~~	1.6	1.7
	Comment Clarify intent of KA		
M-A2.10	~~Decreased effectiveness of condensate demineralizer due to increased flow through it~~ Condensate demineralizer channeling	1.5	1.7
	Comment Clarify intent of KA		
M-A2.11	~~Approximate time necessary to regenerate one condensate demineralizer resin bed~~ Condensate demineralizer resin bed regeneration . .	1.6	1.8*
	Comment Clarify intent of KA and include all potential facets of operation		
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
M-A2.14	~~Opening of the condensate spill valve~~ Opening the hotwell level control valves. . .	2.0	2.21
	Comment AP1000 design		
N-A2.15	DST level high or low		
	Comment New system component		

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
D-A3.05	~~Monitoring of steam jet air ejector air flow~~ . . . . . . **Comment** N/A AP1000 design	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
D-A3.08	~~Flow through stator coolant and hydrogen coolers~~ . . . . . . **Comment** N/A AP1000 design	1.6	1.5
M-A3.09	~~Automatic protection of MFW pump low suction pressure~~ . . . . . . Automatic DST level control **Comment** AP1000 design - new component	2.1	2.4*
D-A3.10	~~Upper surge tank flowmeter~~ . . . . . . **Comment** Included in A3.01 above	1.7*	1.6*
N-A3.11	Condenser Vacuum **Comment** Gap in KAs		
A4	**Ability to manually operate and monitor in the control room:** CFR: (CFR: 41.7 / 45.5 to 45.8)		
M-A4.01	Condensate pump controls and parameters . . . . . . **Comment** More thorough description of component operation	1.9	1.8
M-A4.02	Condensate demineralizer bypass valve ~~and precoat by pass valve~~ and controller. **Comment** N/A AP1000 design	2.0	1.9
M-A4.03	Hotwell ~~high~~ level ~~dump~~ control valves and controllers . . . . . . **Comment** KA will now cover more than just make up valve and controllers	2.1*	2.1
M-A4.04	~~Cleanup Valve~~ Condensate recirc valve . . . . . . **Comment**	1.8	1.7

AP1000 terminology

D-A4.05	~~Valve between upper surge tank and hotwell~~ . . . . . **Comment** Covered in A4.03 above	1.8*	1.7*
D-A4.06	~~Condensate demineralizer bypass valve controller~~ . . . . . **Comment** Covered in A4.02 above	1.8	1.8*
D-A4.07	~~Hotwell pumps~~ . . . . . **Comment** Covered in A4.01 above	1.7	1.7
D-A4.08	~~Condensate automatic makeup valve controller~~ . . . . . **Comment** Covered in A4.03 above	1.7	1.5
M-A4.09	Demineralizer flow control valves . . . . . **Comment** Reflects AP1000 design	1.9*	1.7*
D-A4.10	Low-pressure and high-pressure cleanup valves . . . . . **Comment** Included in A4.04 above	1.7*	1.6*
D-A4.11	~~Setpoints on polish demineralizer bypass valve controllers~~ . . . . . **Comment** Included in A4.02 above - no setpoint adjustment in AP1000 design	1.6	1.6
D-A4.12	~~Condensate pump, including verification of proper startup from parameter readings~~ . . . . . **Comment** Covered in A4.01 above	1.7	1.7
D-A4.13	~~Alarms associated with booster pump operation~~ . . . . . **Comment** Covered in FWS system	1.7	1.7
D-A4.14	Auxiliary oil pumps for booster pumps . . . . . **Comment** Covered in FWS system	1.6	1.6
M-A4.15	~~Turbine and feedwater pump~~ Main turbine exhaust temperature ~~during shutdown~~ . **Comment** Clarification	1.6	1.5
M-A4.16	~~Heater unit controls and control valves during heater startup/shutdown~~ . . . Feedwater heater indication and controls **Comment** Clarification covers all controls	1.5	1.5
A4.17	Deleted		
D-A4.18	~~Hotwell level alarms and flow indicators~~	1.9	1.7
	Comment		

Included in A4.03 above

N-A4.19 DST indication and control

Comment

AP1000 design

N-A4.20 Main turbine exhaust hood spray indication and control

Comment

AP1000 design

N-A4.21 Water curtain spray indication and controls

Comment

AP1000 design

N-A4.22 Adjustment of cooling water flow rate from the B/D heat exchanger

Comment

AP1000 design

TASK:

7831 Perform MCR actions associated with CDS valve and component line-up

7832 Startup the CDS
7833 • Verify/establish initial conditions for starting up the CDS
7834 • Fill the condenser hotwell following outage
7835 • Place deaerator in service
7836 • Start initial condensate pump and monitor operation

7837 Operate CDS during plant heatup/startup and shutdown/cooldown
7838 • Initiate/ terminate hotwell recirculation
7839 • Establish condensate flow to BDS heat exchangers
7840 • Start/stop an additional condensate pump
7841 • Place third condensate pump in standby
7842 • Shift condensate pump status between standby and operating
7843 • Remove/restore feedwater heater from/to service
7844 • Monitor CDS system and component parameters

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the CDS and the following systems:**		
K 1.01	ASS		
K 1.02	BDS		
K 1.03	CAS		
K 1.04	CCS		
K 1.05	CES		
K 1.06	CFS		
K 1.07	CMS		
K 1.08	CPS		
K 1.09	CWS		
K 1.10	DWS		
K 1.11	FWS		
K 1.12	GSS		
K 1.13	HDS		
K 1.14	MSS		
K 1.15	MTS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.16	SDCS		
K 1.17	SSS		
K 2	**Knowledge of bus or division power supplies to the following:**		
K 2.01	Condensate Pumps		
K 2.02	Condensate Pump Discharge Valves		
K 2.03	1st and 2nd stage Feedwater Heater inlet and outlet isolation valves		
K 2.04	1st and 2nd stage Feedwater Heater bypass valve		
K 3	**Knowledge of the effect that a loss or malfunction of the CDS will have on the following:**		
K 3.01	BDS		
K 3.02	CFS		
K 3.03	CPS		
K 3.04	FWS		
K 3.05	GSS		
K 3.06	HDS		
K 3.07	MSS		
K 3.08	MTS		
K 4	**Knowledge of CDS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Condenser Hotwell level control		
K 4.02	DST level control		
K 4.03	Hotwell Recirculation		
K 4.04	DST Recirculation		
K 4.05	Long Cycle Recirculation		
K 4.06	Low Pressure Feedwater heating		
K 4.07	Feedwater heater automatic isolation and bypass		
K 4.08	Condensate polisher automatic isolation and bypass		
K 4.09	Removing heat from the GSS condenser		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 4.10	Removing heat from the BDS Heat Exchanger		
K 4.11	Condensate Pump Auto Start		
K 4.12	Condensate Pump Manual Start		
K 4.13	Condenser available signal (C-9)		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the CDS:**		
K 5.01	Reactor response to loss of feedwater heating		
K 5.02	Reactor response to returning feedwater heating to service		
K 5.03	Plant response to a loss of feedwater flow		
K 5.04	Water hammer prevention		
K 5.05	Condenser tube leaks		
K 5.06	SGTL		
K 5.07	Chemistry control		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the CDS.**		
K 6.01	ASS		
K 6.02	BDS		
K 6.03	CAS		
K 6.04	CES		
K 6.05	CFS		
K 6.06	CMS		
K 6.07	CPS		
K 6.08	CWS		
K 6.09	DWS		
K 6.10	FWS		
K 6.11	GSS		
K 6.12	HDS		
K 6.13	MSS		
K 6.14	MTS		
K 6.15	SDCS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.16	Condensate pump failure		
K 6.17	Feedwater heater isolation and bypass		
K 6.18	Diversion of heater drains to the condenser		
K 6.19	Abnormal hotwell level		
K 6.20	Abnormal DST Level		
K 6.21	High condenser pressure		
K 6.22	Abnormal condensate pump discharge header pressure		
K 6.23	High Condensate Outlet Temperature from BDS Heat Exchanger		
K 6.24	Low Condensate Flow		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the CDS including:**		
A 1.01	DST Level		
A 1.02	Hotwell level		
A 1.03	GSS Steam Condenser pressure		
A 1.04	Feedwater temperatures		
A 1.05	DST Recirculation		
A 1.06	Long cycle recirculation		
A 1.07	Condensate Pump amps		
A 1.08	Condensate Pump Discharge Pressure		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the CDS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	BDS		
A 2.02	CAS		
A 2.03	CFS		
A 2.04	CMS		
A 2.05	CPS		
A 2.06	CWS		
A 2.07	DWS		
A 2.08	FWS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.09	GSS		
A 2.10	HDS		
A 2.11	MSS		
A 2.12	MTS		
A 2.13	SDCS		
A 2.14	Condensate pump failure		
A 2.15	Feedwater heater isolation and bypass		
A 2.16	Diversion of heater drains to the condenser		
A 2.17	Abnormal hotwell level		
A 2.18	Abnormal DST Level		
A 2.19	High condenser pressure		
A 2.20	Abnormal condensate pump discharge header pressure		
A 2.21	High Condensate Outlet Temperature from BDS Heat Exchanger		
A 2.22	Low Condensate Flow		
A 3	**Ability to monitor automatic operation of the CDS, including:**		
A 3.01	Condensate pump start		
A 3.02	Hotwell recirculation control		
A 3.03	Hotwell level control		
A 3.04	DST level control		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	Hotwell recirculation		
A 4.02	DST Recirculation		
A 4.03	Long cycle recirculation		
A 4.04	Condensate pumps		
A 4.05	DST level control		
A 4.06	Hotwell level control		
A 4.07	Feedwater heater isolation and bypass		
A 4.07	Condensate polisher flow control and bypass valves		

Notes:

In the legacy Westinghouse plant; there is one condensate system. In NUREG 1122, the Condensate System is cataloged in Safety Function 4 as 056, Condensate System.

In AP1000 there is one condensate system. It is cataloged as system 056, Condensate System (CDS). It covers the condenser and hotwell through the condensate pumps through FW Heaters 1, 2, 3, and 4 and the Deaerator Storage Tank (DST). The FWS begins at the outlet of the DST.

059 ~~Main Feedwater (MFW) System~~
Main and Startup Feedwater System (FWS)

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~~ FWS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
K1.01	Condensate	2.3*	2.3
D-K1.02	~~AFW system~~ **Comments** AP1000 Design now part of FWS system	3.4*	3 . 4
M-K1.03	~~S/GS~~ SGS **Comments** AP1000 Terminology	3.1	3.3
D-K1.04	~~S/GS water level control system~~ **Comments** Covered in SGS system	3.4	3.4
K1.05	RCS	3.1*	3.2
D-K1.06	~~Chemical treatment~~ **Comments** Covered in BDS systems	1.9	2.1
M-K1.07	~~ICS~~ PLS **Comments** AP1000 Design and Terminology	3.2*	3.2*
M-K1.08	~~Heater drains~~ HDS **Comments** AP1000 Design and Terminology	1.6	1.6
M-K1.09	~~Secondary cooling water~~ Turbine building closed cooling water system (TCS) **Comments** AP1000 Design and Terminology	1.7	1.8

M-K1.10	~~Extraction steam~~ MTS.	1.7	1.7
	Comments AP1000 Design and Terminology		
N-K1.11	BDS **Comments** AP1000 Design		
N-K1.12	SSS **Comments** AP1000 Design		
N-K1.13	PMS **Comments** AP1000 Design		
N-K1.14	CAS **Comments** AP1000 Design		
N-K1.15	DWS **Comments** AP1000 Design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
M-K2.01	FWS Booster/MFW system pumps	2.2*	2.3*
	Comments AP1000 Design		
K2.02	MOVs	2.0*	2.1
N-K2.03	FWS Startup Feed Pumps		
K3	**Knowledge of the effect that a loss or malfunction of the FWS ~~MFW~~ will have on the following:** (CFR: 41.7 / 45.6)		
M-K3.01	Condensate system (CDS).	1.8	1.8
	Comments AP1000 Terminology		
D-K3.02	~~AFW system~~	3.6	3.7
	Comments N/A AP1000 Design		
M-K3.03	~~S/GS~~ SGS.	3.5	3.7
	Comments AP1000 Terminology		
K3.04	RCS	3.6	3.8

K4	**Knowledge of FWS ~~MFW~~ design feature(s) and/or interlock(s) which provide for the following:** (CFR: 41.7)		
M-K4.01	~~MFW and startup feedwater valve combination~~ . . . . . . Main Feedwater and Startup Feedwater cross connect valve operation **Comments** AP1000 Design and Terminology	2.4	2.6*
M-K4.02	~~Automatic turbine/reactor trip runback~~ . . . . . . Loss of Main Feed Pump auto turbine runback **Comments** AP1000 Design	3.3	3.5
D-K4.03	~~Adequate condensate flow~~ . . . . . . **Comments** N/A AP1000 Design	2.1	2.3*
K4.04	Heating of feedwater	1.9	2.2
D-K4.05	~~Control of speed of MFW pump turbine~~ . . . . . . **Comments** N/A AP1000 Design	2.5*	2.8*
M-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~~ . . . . . . Control of programmed feed regulating valve D/P **Comments** AP1000 Design	2.2*	2.4*
D-K4.07	~~Closing MFW pump drains~~ . . . . . . **Comments** N/A AP1000 Design	1.6*	1.7*
D-K4.08	~~Feedwater regulatory valve operation (on basis of steam flow, feed flow mismatch) .~~ . . . . . . **Comments** AP1000 Design covered in SGS	2.5	2.7
K4.09	Controlling MFW pump lube oil system	1.7	1.8
D-K4.10	~~Bearing oil signal to the turning gear start sequence~~ . . . . . . **Comments** N/A AP1000 Design	1.7	1.8
D-K4.11	~~Porting oil~~ . . . . . . **Comments** N/A AP1000 Design	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 *

D-K4.15	~~Automatic starts for MFW pumps~~ . . . . . **Comments** N/A AP1000 Design	2.2*	2.4*
K4.16	Automatic trips for MFW pumps	3.1*	3.2*
D-K4.17	~~Increased feedwater flow following a reactor trip~~ . . . . . **Comments** N/A AP1000 Design covered in level control of SGS	2.5*	2.8*
D-K4.18	~~Automatic feedwater reduction on plant trip~~ . . . . . **Comments** N/A AP1000 Design covered in level control of SGS	2.8*	3.0*
D-K4.19	~~Automatic feedwater isolation of MFW~~ . . . . . **Comments** N/A AP1000 Design covered in level control of SGS	3.2	3.4
K4.20	Automatic feed pump recirculation flow	1.9	2.2*
N-K4.21	Booster/Main Feedwater pump trip on a Feedwater isolation		
K5	**Knowledge of the operational implications of the following concepts as the apply to the FWS ~~MFW~~:** (CFR: 41.5 / 45.7)		
D-K5.01	~~Variation of flow discharge pressure~~ . . . . . **Comments** Covered in K5.03 below	2.1	2.1
D-K5.02	~~Shrink and swell~~ . . . . . **Comments** Covered in SGS	2.4	2.6*
M-K5.03	~~Reason for maintenance of minimum D/P between main steam and MFW pump discharge pressure~~ . . . . . Reason for maintaining programmed D/P between main steam and pump discharge header pressure **Comments** Clarify wording of KA	2.1	2.2
M-K5.04	~~Definition o~~f Water hammer . . . . . **Comments** KA Stem agreement	2.3*	2.6*
D-K5.05	~~Reason for balancing MFW pump loads~~ . . . . . **Comments** N/A AP1000 Design	2.0	2.2*
M-K5.06	~~Characteristics~~ Deviations in ~~of~~ level, flow, and pressure indications . . . . . **Comments** KA stem agreement	1.8	2.1*

D-K5.07	~~Relationship between feedwater pump speed and feedwater regulating valve position~~	1.8	2.1*
	Comments Included in 5.03 above		
M-K5.08	~~Reason for~~ Mismatch of steam flow and feedwater flow	2.4	2.6*
	Comments KA stem agreement		
K5.09	Effects of low temperature and high viscosity on oil system operations	1.6	1.7
D-K5.10	~~Theory of film riding oil in journal bearing~~	1.4	1.6
	Comments N/A AP1000 Design		
D-K5.11	~~Definition of turbine windmilling~~	1.6	1.7
	Comments N/A AP1000 Design		
D-K5.12	~~Increased MFW pump discharge with increased turbine speed~~	2.2*	2.5*
	Comments N/A AP1000 Design		
K5.13	Reasons for monitoring feedwater pump suction flow/pressure	2.3	2.6*
K5.14	Quadrant power tilt	1.9	2.4*
K6	**Knowledge of the effect of a loss or malfunction of the following will have on the FWS ~~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*
M-K6.06	Heat exchangers ~~and condensers~~	1.6	1.8
	Comments N/A AP1000 Design		
M-K6.07	Breakers, relays, ~~and disconnects~~	1.4	1.7
	Comments N/A AP1000 Design		
D-K6.08	~~Breakers, relays, and disconnects~~	1.6	1.8
	Comments Redundant to K6.07 above		
M-K6.09	~~MFW pump speed and~~ Mini flow and regulating valve~~s~~ position (reason for adjusting position of both)	2.4*	2.6*
	Comments Clarification		
D-K6.10	~~Feedwater isolation valve travel time~~	1.9	2.1*

	Comments Covered in SGS		
M-K6.11	~~High and low feedwater~~ Discharge header pressure	1.9	2.1*
	Comments Clarification		
D-K6.12	S/G controller logic for MFW regulating valve	2.3*	2.5
	Comments Covered in SGS		
ABILITY			
A1	**Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the FWS ~~MFW~~ controls including:** (CFR: 41.5 / 45.5)		
M-A1.01	~~Location, limits, and normal ranges for level, pressure flow, temperature, and RPM measurements associated with the MFW system~~	2.4*	2.5*
	Suction pressure, discharge pressure, DST level, feed flow, S/G level, mini flow valve and FRV position when starting or stopping a Booster/Main feed pump		
M-A1.02	FWS Booster/MFW pump oil temperatures ~~and MFW pump vibrations~~	1.8	1.9
	Comments AP1000 Design and terminology		
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
D-A1.07	~~Feed Pump speed, including normal control speed for ICS~~	2.5*	2.6*
	Comments N/A AP1000 Design		
A1.08	Oil Pressure indications for MFW pumps	1.7	1.8
A1.09	Feedwater pump bearing temperatures	1.7	1.8
D-A1.10	~~Feedwater pump seal leakoff temperature~~	1.6	1.6
	Comments N/A AP1000 Design		
A1.11	Feedwater regulating valve D/P	2.2*	2.2
N-A1.12	Starting or stopping a Startup Feedwater Pump (such as suction pressure, discharge Pressure, mini flow valve position, startup feed control valve, CST level and motor Amps)		
N-A1.13	Bypassing a high pressure feedwater heater string (such as feed water flow, feedwater temperature, and reactor power)		

A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the FWS ~~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)		
M-A2.01	~~Feedwater~~ Auto actuation of Startup feedwater ~~AFW system~~ . . . . . **Comments** AP1000 Design	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*
D-A2.06	~~Loss of steam flow to MFW system~~ . . . . . **Comments** N/A AP1000 Design	2.7*	2.9*
D-A2.07	~~Tripping of MFW pump turbine~~ . . . . . **Comments** N/A AP1000 Design	3.0*	3.3*
M-A2.08	~~Extremely low MFW pump control lube oil or~~ Bearing oil pressure . . . . . **Comments** Clarification of what should be known	1.9	2.2*
D-A2.09	~~Overspeed on turning gear~~ . . . . . **Comments** N/A AP1000 Design	1.6	1.8
M-A2.10	~~Secondary cooling water~~ TCS. . . . . **Comments** AP1000 Design and terminology	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*
D-A2.13	~~Loss of condensate/heater draining flow~~ . . . . . **Comments** Covered in A2.02 above	2.1*	2.1*
A3	**Ability to monitor automatic operation of the FWS ~~MFW~~, including:** (CFR: 41.7 / 45.5)		
D-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*
D-A3.04	~~Turbine driven feed pump~~	2.5*	2.6*
M-A3.05	~~Starts and stops on the~~ Booster/main feed pump~~s~~ operation.	2.4*	2.7*
A3.06	Feedwater isolation	3.2*	3.3
M-A3.07	~~ICS~~ PLS.	3.4*	3.5*
A4	**Ability to manually operate and monitor in the control room:**		

(CFR: 41.7 / 45.5 to 45.8)

M-A4.01	~~MFW turbine trip~~ Main Feedwater Pump indication	3.1*	3.1*
	Comments N/A AP1000 Design		
D-A4.02	~~Null out MFW pump D/P differences~~	2.3*	2.4*
	Comments N/A AP1000 Design		
A4.03	Feedwater control during power increase and decrease	2.9*	2.9
D-A4.04	~~Reset MFW overspeed trip~~	2.2*	2.3*
	Comments N/A AP1000 Design		
M-A4.05	MFW pump oil coolers, cooling water outlet valve position ~~controller~~ and oil pumps	1.7	1.8
	Comments Clarification better reflection of AP1000 Design		
D-A4.06	~~MFW pump turbine reset switch~~	2.4*	2.3*
	Comments N/A AP1000 Design		
D-A4.07	~~Valve timer reset pushbutton~~	2.0*	1.9*
	Comments N/A AP1000 Design		
M-A4.08	Main Feed ~~regulating~~ control valve ~~controller~~	3.0*	2.9*
	Comments AP1000 Terminology		
D-A4.09	~~Remote determination of operating feedwater pump turning gear~~	2.1*	2.0*
	Comments N/A AP1000 Design		
D-A4.10	~~ICS~~.	3.9*	3.8*
	Comments N/A AP1000 Design		
D-A4.11	~~Recovery from automatic main feedwater isolation~~	3.1	3.3
	Comments AP1000 Design and system operation		
M-A4.12	~~Initiation of automatic~~ Initiate ~~feedwater isolation~~	3.4	3.5
	Comments AP1000 Design and system operation		
N-A4.15	Main Feedwater pump indication		
	Comments AP1000 Design and system operation		

N-A4.16 Deareator Recirculation valve position

Comments
AP1000 Design and system operation

N-A4.17 Long cycle valve recirculation .

Comments
AP1000 Design and system operation

TASK:

7872 Lineup FWS

7873 • Perform MCR actions associated with startup feedwater valve line-up

7874 • Perform MCR actions associated with main feedwater valve line-up

7875 Operate the FWS

7876 • Monitor SFWS system and component parameters

7877 • Monitor MFWS system and component parameters

7878 • Establish level in the DST

7879 • Start up the SFWS

7880 • Start up the MFWS

7881 • Start/ stop startup feed pump

7882 • Start/ stop main feed pump

7883 • Shift from main feed pump to startup feed pump

7884 • Shift from startup feed pump to main feed pump

7885 • Verify feedwater transfer from MFCVs to the SFCVs during plant shutdown

7886 • Feed SGs during plant startup/ shutdown using startup feed pump and SFCVs

7887 • Feed SGs during plant startup/ shutdown using main feed pump and SFCVs

7888 • Unload and stop a booster/main feedwater pump during plant shutdown

7889 • Operate SFWS during plant heatup/startup and during shutdown/cooldown

7890 • Operate MFWS during plant heatup/startup and during shutdown/cooldown

7891 • Verify feedwater transfer from SFCVs to MFCVs during plant startup

7892 • Initiate/ terminate deaerator recirculation

7893 • Initiate/ terminate long-cycle recirculation

7894 • Remove/restore feedwater heater to/from service

7895 Shut down the FWS

7896 • Shut down the SFWS

7897 • Shut down the MFWS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO

K 1 Knowledge of the physical connections between the FWS and the following systems:

K 1.01 ASS
K 1.02 BDS
K 1.03 CAS
K 1.04 CDS
K 1.05 DWS
K 1.06 ESFAS
K 1.07 FPS
K 1.08 HDS
K 1.09 MSS
K 1.10 MTS
K 1.11 PAMS
K 1.12 SGS
K 1.13 SSS
K 1.14 TCS
K 1.15 ZBS

K 2 Knowledge of bus or division power supplies to the following:

K 2.01 Booster/Main Feedwater Pumps
K 2.02 Booster/Main Feedwater Pump discharge isolation valves
K 2.03 Startup Feedwater Pumps
K 2.04 Startup Feedwater Isolation Valves
K 2.05 SFCV Control Power
K 2.06 MFIV Control power
K 2.07 MFIV Hydraulic Pump
K 2.08 MFCV Control Power

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 3	**Knowledge of the effect that a loss or malfunction of the FWS will have on the following:**		
K 3.01	ASS		
K 3.02	CDS		
K 3.03	ESFAS		
K 3.04	HDS		
K 3.05	MSS		
K 3.06	MTS		
K 3.07	RCS		
K 3.08	SGS		
K 4	**Knowledge of FWS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Trip of the Booster/Main Feedwater Pumps		
K 4.02	Trip of the Startup Feedwater Pumps		
K 4.03	Decay Heat Removal		
K 4.04	Feedwater Heating		
K 4.05	Long Cycle Recirculation		
K 4.06	Feedwater flow measurement		
K 4.07	SG water level control in the Low Power Mode		
K 4.08	SG water level control in the High Power Mode		
K 4.09	Feedwater flowpath selection		
K 4.10	Reactor Trip Over ride		
K 4.11	SFW Pump auto start		
K 4.12	Trip of Booster/Main Feedwater Pumps Runback		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the FWS:**		
K 5.01	Feedwater flow changes on RCS natural circulation flowrate		
K 5.02	Feedwater flow changes on Reactor power		
K 5.03	Feedwater flow changes on RCS pressure		
K 5.04	Feedwater flow changes on RCS temperature		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 5.05	Feedwater flow changes on PZR level		
K 5.06	Feedwater flow changes on SG level		
K 5.07	Feedwater flow changes on SG pressure		
K 5.08	Water hammer		
K 5.09	Effect opening Booster/Main Feedwater Pump miniflow has on feedwater flow to the SG		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the FWS:**		
K 6.01	ASS		
K 6.02	CAS		
K 6.03	CDS		
K 6.04	ESFAS		
K 6.05	HDS		
K 6.06	MSS		
K 6.07	MTS		
K 6.08	SGS		
K 6.09	TCS		
K 6.10	ZBS		
K 6.11	Turbine Impulse Pressure Instrument		
K 6.12	Main Feedwater Flow Instrument		
K 6.15	Steam Flow Instrument		
K 6.17	Main Feedwater Temperature Instrument		
K 6.19	WR SG Level Instrument		
K 6.21	NR SG Level Instrument		
K 6.23	Steam Pressure Instrument		
K 6.24	Main Feedwater Flow Instrument		
K 6.25	Startup Feedwater Flow Instrument		
K 6.26	Trip of One Booster/Main FW Pump Train at Full Power		
K 6.27	Loss of Offsite Power Concurrent with Main Generator Trip		
K 6.28	Reactor Trip at Full Power		
K 6.29	Turbine Trip at Full Power Without Reactor Trip		
K 6.30	Main Feedwater Pump Low Lube Oil Supply Pressure		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 6.31	Startup Feedwater Pump High Discharge Temperature		
K 6.32	Feedwater Heaters Out of Service		
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the FWS including:**		
A 1.01	RCS natural circulation flowrate		
A 1.02	Reactor power		
A 1.03	RCS pressure		
A 1.04	RCS temperature		
A 1.05	PZR level		
A 1.06	SG level		
A 1.07	SG pressure		
A 1.08	Booster/Main Feedwater Pump suction pressure		
A 1.09	Main Feedwater Pump Discharge Pressure		
A 1.10	Main Feedwater Header Pressure		
A 1.11	Main Steam Pressure		
A 1.12	Main Feedwater flow		
A 1.13	Startup Feedwater Pump High Discharge Temperature		
A 1.14	Startup Feedwater Pump High Discharge Pressure		
A 1.15	Startup Feedwater Flow		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the FWS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	ASS		
A 2.02	CAS		
A 2.03	CDS		
A 2.04	ESFAS		
A 2.05	HDS		
A 2.06	MSS		
A 2.07	MTS		
A 2.08	SGS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 2.09	TCS		
A 2.10	ZBS		
A 2.11	Turbine Impulse Pressure		
A 2.12	Main Feedwater Flow		
A 2.13	Steam Flow		
A 2.14	Main Feedwater Temperature		
A 2.15	WR SG Level		
A 2.16	NR SG Level		
A 2.17	Steam Pressure		
A 2.18	Main Feedwater Flow		
A 2.19	Startup Feedwater Flow		
A 2.20	Startup Feedwater Temperature		
A 2.21	Trip of One Booster/Main FW Pump Train at Full Power		
A 2.22	Trip of All Booster/Main FW Pump Trains at Full Power		
A 2.23	Loss of Offsite Power Concurrent with Main Generator Trip		
A 2.24	Reactor Trip at Full Power		
A 2.25	Turbine Trip at Full Power Without Reactor Trip		
A 2.26	Main Feedwater Pump Low Lube Oil Supply Pressure		
A 2.27	Startup Feedwater Pump High Discharge Temperature		
A 2.28	Main Feedwater Pump High Lube Oil Supply Temperature		
A 2.29	Booster and Main Feedwater Pump High Bearing Oil Temperature		
A 2.30	Booster/Main Feedwater Pump Motor or Gear High Bearing Temperature		
A 2.31	Booster/Main Feedwater Pump Motor High Stator Temperature		
A 2.32	Main Feedwater Pump Low Flow		
A 2.33	Startup Feedwater Pump Low and High Flow		
A 2.34	Booster/Main Feedwater Pump/Motor/Gear High Radial Vibration		
A 2.35	Booster/Main Feedwater Pump or gear High Axial Vibration		
A 2.36	Feedwater Heaters Out of Service		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 3	**Ability to monitor automatic operation of the FWS, including:**		
A 3.01	MFCV		
A 3.02	Booster/Main Feedwater Pump trip		
A 3.03	SFCV		
A 3.04	Startup Feedwater from SFW Pumps		
A 3.05	Main FW Pump MinImum Flow Control Valves		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	Booster/Main Feedwater Pump operation		
A 4.02	SFW Pumps		
A 4.03	Long Cycle Recirculation Valve		
A 4.04	Main FW Pump MinImum Flow Control Valves		
A 4.05	MFCV		
A 4.06	SFCV		

Notes:

In the legacy Westinghouse plant, there are two feedwater systems; the Main Feedwater System and the Auxiliary/Emergency Feedwater System. In NUREG 1122, they are cataloged in Safety Function 4 as two separate systems. They are 059, Main Feedwater System (MFW) and 061, Auxiliary/Emergency Feedwater System (AFW).

In AP1000 there is one feedwater system that is comprised of two subsystems, Main Feedwater (MFW) and Startup Feedwater (SFW). Both subsystems are cataloged as system 059, Feedwater System (FWS).

Main Feedwater (MFW) covers from the outlet of the Deaerator Storage Tank (DST) though the HP Feedwater heaters, Main Feedwater Control Valves (MFCV's) and Startup Feedwater Control Valves (SFCV's) to the Main Feedwater Isolation Valves (MFIV's) and Startup Feedwater Isolation Valves (SFIV's).

Startup Feedwater (SFW) covers from the Condensate Storage Tank through the SFW Pumps into the Startup Feedwater lines.

The Steam Generator Level Control function is covered in FWS. The Feedwater Isolation function is covered with the Steam Generator System (SGS).

078 ~~**Instrument Air System (IAS)**~~
Compressed Air System (CAS)
New terminology for AP1000 design

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~~ CAS and the following systems:** (CFR: 41.2 to 41.9 / 45.7 to 45.8)		
D-K1.01	~~Sensor air~~ . . . . . **Comments** N/A AP1000 design	2.8*	2.7*
K1.02	Service air	2.7*	2.8
M-K1.03	~~Containment air~~ Containment components (such as CMT, PRHR and spray). . . . . **Comments** AP1000 system operation and clarification	3.3*	3.4*
M-K1.04	~~Cooling water to compressor~~ Component Cooling Water System (CCS) . . . . . **Comments** AP1000 design and terminology	2.6	2.9
D-K1.05	~~MSIV air~~ . . . . . **Comments** N/A AP1000 design	3.4*	3.5*
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
M-K2.01	Instrument air compressor(s) . . . . . **Comments** Clarification	2.7	2.9
D-K2.02	~~Emergency air compressor~~ . . . . . **Comments** N/A AP1000 design	3.3*	3.5*
K3	**Knowledge of the effect that a loss or malfunction of the ~~IAS~~ CAS will have on the following:** (CFR: 41.7 / 45.6)		
M-K3.01	Containment air ~~system~~ components (such as CMT, PRHR and spray). . . . . **Comments** AP1000 system operation and clarification	3.1*	3.4*

K3.02	Systems having pneumatic valves and controls	3.4	3.6
D-K3.03	~~Cross-tied units~~	3.0	3.4
	Comments N/A AP1000 design		
K4	**Knowledge of ~~IAS~~ CAS 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
M-K4.02	Cross-over ~~to~~ from other air systems (such as SAS or the temporary air compressor) .	3.2	3.5
	Comments AP1000 design		
M-K4.03	Securing of ~~SAS~~ IAS upon loss of ~~cooling water~~ CCS.	3.1*	3.3*
	Comments Clarification and agreement with question stem		
K5	**Knowledge of the operational implications of following concepts as they apply to the IAS:** (CFR: 41.5 / 45.7)		
D-K5.01	~~Gas laws~~	1.5	1.7
	Comments GFE		
D-K5.02	~~Diesel effect~~	1.7	1.8
	Comments GFE		
K6	**Knowledge of the effect of a loss or malfunction on the following will have on the ~~IAS~~ CAS:** (CFR: 41.7 / 45.7)		
K6.01	Air compressors	2.4	2.6
D-K6.02	~~Pressure gauges~~	1.9	2.1
	Comments N/A AP1000 design		
D-K6.03	~~Temperature indicators~~	1.8	2.1
	Comments N/A AP1000 design		
D-K6.04	~~Service air refusal valve~~	2.2*	2.4*
	Comments N/A AP1000 design		
K6.05	Air dryers	2.1	2.2

M-K6.06	~~Cross-tie valve~~ Containment isolation valve	2.1	2.4
	Comments AP1000 design		
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
M-K6.11	Heat exchangers and ~~condensers~~ coolers.	1.6	1.7
	Comments N/A AP1000 design		
M-K6.12	Breakers, relays, ~~and disconnects~~	1.5	1.8
	Comments N/A AP1000 design		
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~~ CAS controls including:** (CFR: 41.5 / 45.5) None		
A2	**Ability to (a) predict the impacts of the following malfunctions or operations on the ~~IAS~~ CAS; 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
N-A2.02	Air Compressors **Comment** AP1000 Design		
N-A2.03	Containment isolation valve **Comment** AP1000 Design		
A3	**Ability to monitor automatic operation of the ~~IAS~~ CAS, including:** (CFR: 41.7 / 45.5)		
A3.01	Air pressure	3.1	3.2
M-A3.02	~~Air temperature~~ Compressor package operating parameters (such as air or lube oil temperature, pressure).	2.3	2.3
	Comments AP1000 design more specific list of parameters		

N-A3.03 Dew Point

Comments

AP1000 design new system parameter

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

M-A4.01 Pressure ~~gauges~~ indication. 3.1 3.1

Comments

Reflect new control room design

N-A4.02 Air flow

Comments

Parameter than now be monitored in the control room

TASK:

7988 Lineup the CAS
7989 • Perform MCR actions associated with CAS valve and component line-up
7990 • Establish initial conditions for starting up the CAS

7991 Start up the CAS

7992 Operate the CAS
7993 • Stop an instrument or service air compressor
7994 • Enable/stop the high-pressure air compressor
7995 • Start a standby air compressor
7996 • Shift air compressor status between standby and operating
7997 • Place an instrument or service air compressor in standby
7998 • Operate instrument and service air subsystems in cross-connected modes
7999 • Monitor CAS system and component parameters

8000 Shut down the CAS

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1	**Knowledge of the physical connections between the CAS and the following systems:**		
K 1.01	BDS		
K 1.02	CCS		
K 1.03	CDS		
K 1.04	CMS		
K 1.05	CPS		
K 1.06	CVS		
K 1.07	CWS		
K 1.08	ESFAS		
K 1.09	FHS		
K 1.10	FPS		
K 1.11	FWS		
K 1.12	HCS		
K 1.13	HDS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.14	LOS		
K 1.15	MSS		
K 1.16	PAMS		
K 1.17	PCS		
K 1.18	PGS		
K 1.19	PXS		
K 1.20	RCS		
K 1.21	SGS		
K 1.22	SWS		
K 1.23	VAS		
K 1.24	VES		
K 1.25	VFS		
K 1.26	VHS		
K 1.27	VRS		
K 1.28	VTS		
K 1.29	VWS		
K 1.30	VXS		
K 1.31	VYS		
K 1.32	WGS		
K 1.33	WLS		
K 1.34	WRS		
K 1.35	ZAS		
K 1.36	ZBS		

K 2 Knowledge of bus or division power supplies to the following:

K 2.01 IA Compressor Package

K 2.02 IA Dryer Package

K 2.03 SA Compressor Package

K 2.04 SA Dryer Package

K 2.05 HPA Compressor and Filter Package

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 3	**Knowledge of the effect that a loss or malfunction of the CAS will have on the following:**		
K 3.01	BDS		
K 3.02	CCS		
K 3.03	CDS		
K 3.04	CMS		
K 3.05	CPS		
K 3.06	CVS		
K 3.07	CWS		
K 3.08	FHS		
K 3.09	FPS		
K 3.10	FWS		
K 3.11	HCS		
K 3.12	HDS		
K 3.13	LOS		
K 3.14	MSS		
K 3.15	PCS		
K 3.16	PGS		
K 3.17	PXS		
K 3.18	RCS		
K 3.19	SGS		
K 3.20	SWS		
K 3.21	VAS		
K 3.22	VES		
K 3.23	VFS		
K 3.24	VHS		
K 3.25	VRS		
K 3.26	VTS		
K 3.27	VWS		
K 3.28	VXS		
K 3.29	VYS		
K 3.30	WGS		
K 3.31	WLS		
K 3.32	WRS		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
K 1.33	ZAS		
K 4	**Knowledge of CAS design feature(s) and/or interlock(s) which provide for the following:**		
K 4.01	Containment Isolation		
K 4.02	Supplying IA from SA		
K 4.03	IA compressor auto start		
K 4.04	SA compressor auto start		
K 5	**Knowledge of the operational implications or cause and effect relationships of the following as they apply to the CAS:**		
K 5.01	Loss of IA		
K 5.02	Loss of SA		
K 6	**Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the CAS:**		
K 6.01	CCS		
K 6.02	ZBS		
K 6.03	IA Compressor Package		
K 6.04	IA Dryer Package		
K 6.05	IA High Dew Point		
K 6.06	Loss of IA Supply Pressure		
K 6.07	IA Total Flow high		
K 6.08	IA to Containment Flow high		
K 6.09	SA Compressor Package		
K 6.10	SA Dryer Package		
K 6.11	SA High Dew Point		
K 6.12	Loss SA Supply Pressure		
K 6.13	HPA Compressor and Filter Package		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 1	**Ability to predict and/or monitor changes in parameters associated with operation of the CAS including:**		
A 1.01	IA Compressor Package parameters		
A 1.02	IA Dryer Package parameters		
A 1.03	IA Supply Pressure		
A 1.04	SA Supply Pressure		
A 1.05	IA Total Flow		
A 1.06	IA to Containment Flow		
A 1.07	IA Dew Point		
A 2	**Ability to (a) predict the impacts of the following malfunctions or operations on the CAS and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations:**		
A 2.01	CCS		
A 2.02	ZBS		
A 2.03	IA Compressor Package		
A 2.04	IA Dryer Package		
A 2.05	IA High Dew Point		
A 2.06	Loss of IA Supply Pressure		
A 2.07	IA Total Flow high		
A 2.08	IA to Containment Flow high		
A 2.09	SA Compressor Package		
A 2.10	SA Dryer Package		
A 2.11	SA High Dew Point		
A 2.12	Loss SA Supply Pressure		
A 2.13	HPA Compressor and Filter Package		
A 2.14	Containment Isolation		
A 3	**Ability to monitor automatic operation of the CAS, including:**		
A 3.01	IA System		
A 3.02	SA System		

K/A NO.	KNOWLEDGE	IMPORTANCE RO	IMPORTANCE SRO
A 3.03	Containment isolation		
A 4	**Ability to manually operate and monitor in the control room:**		
A 4.01	IA System		
A 4.02	SA System		
A 4.03	Containment isolation		

Notes:

In the legacy Westinghouse plant, there are two compressed air systems, the Instrument Air System and the Service Air System. In NUREG 1122, the Instrument Air System and the Service Air System are cataloged in Safety Function 8 as two separate systems. They are 078, Instrument Air System (IAS) and 079, Service Air System (SAS).

In AP1000 there is one compressed air system that is comprised of three subsystems, the Instrument Air System (IA), Service Air System, (SA) and the High Pressure Air System (HPA). All three subsystems are cataloged as system 078, Compressed Air System (CAS).

079 Station Air System (SAS)

This system is actually a part of CAS

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
M-K1.02	~~Cooling water to compressor~~ CCS. . . . . **Comments** AP1000 terminology	2.2	2.2
N-K1.03	WLS **Comments** AP1000 design		
K2	**Knowledge of bus power supplies to the following:** (CFR: 41.7)		
M-K2.01	~~Station~~ Service air compressors . . . . . **Comments** AP1000 terminology	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)		
D-K3.01	~~Ventilation system~~ . . . . . **Comments** N/A AP1000 design	1.7	1.9
N-K3.02	WLS **Comments** AP1000 design		
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
N-K4.03	Securing of SAS upon loss off CCS **Comments** Clarification and agreement with question stem		

N-K4.04	Manual/automatic transfers of control **Comments** Make consistent with CAS		
K5	**Knowledge of the operational implication of the following concepts as they apply to the SAS:** (CFR: 41.5 / 45.7)		
D-K5.01	Gas laws	1.4	1.6
	Comments GFE		
D-K5.02	Diesel effect: safety implications	1.5	1.7
	Comment GFE Topic		
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
M-K6.05	Heat exchangers and ~~condensers~~ coolers.	1.3	1.4
	Comments AP1000 terminology		
M-K6.06	Breakers, relays, ~~and disconnects~~	1.4	1.4
	Comments N/A AP1000 design		
K6.07	Filters	1.5	1.6
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
N-A2.02	Air Compressors **Comments** Significant component in the system		
N-A2.03	Containment isolation valve **Comments** AP1000 design		

A3	**Ability to monitor automatic operation of the SAS including:** (CFR: 41.7 / 45.5)		
A3.01	Normal operating pressure	2.0*	2.1*
M-A3.02	Compressor package ~~Normal~~ operating parameters (such as air or lube oil temperature, Pressure). . . . . . **Comments** Better description of what to monitor	1.8	1.9
M-A3.03	~~Automatic start of the compressor~~ Dew Point. . . . . . **Comments** New system parameter to monitor	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
N-A4.03	Dew Point **Comments** New system parameter to monitor		
N-A4.04	Pressure indication **Comments** Clarification		