Form 4.1-BWR Boiling-Water Reactor Examination Outline

Facility: Columbia Generating Station														Date of Exam: March 2, 2023								
Tier	Group	RO K/A Category Points												SRO-Only Points								
		K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	Total	A2		G		Total				
1. Emergency and Abnormal Plant Evolutions	1	4	4	3	N/A			3	3	N/A		3	20									
	2	1	1	1				1	1			1	6									
	Tier Totals	5	5	4				4	4			4	26									
2. Plant Systems	1	2	2	2	2	2	2	3	3	3	3	2	26									
	2	1	1	1	1	1	1	0	1	2	1	1	11									
	Tier Totals	3	3	3	3	3	3	3	4	5	4	3	37									
3. Generic Knowledge and Abilities Categories	CO		EC				RC		EM				6	CO		EC		RC		EM		
	2		2				1		1													
4. Theory	Reactor Theory				Thermodynamics								6									
	3				3																	

Notes: CO = Conduct of Operations; EC = Equipment Control; RC = Radiation Control;
EM = Emergency Procedures/Plan

* These systems/evolutions may be eliminated from the sample when Revision 2 of the K/A catalog is used to develop the sample plan

** These systems/evolutions are only included as part of the sample (as applicable to the facility) when Revision 2 of the K/A catalog is used to develop the sample plan

Form 4.1-BWR	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 1 (RO/SRO)								
E/APE # / Name	K1	K2	K3	A1	A2	G	K/A Topic(s)	IR	#
295001 (APE 1) Partial or Complete Loss of Forced Core Flow Circulation			X				Knowledge of the reasons for the following responses or actions as they apply to Partial or Complete Loss of Forced Core Flow Circulation: (CFR: 41.5 / 45.6) AK3.07 Recirculation pump discharge/suction valve manipulation	3.3	1
295003 (APE 3) Partial or Complete Loss of AC Power					X		Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of AC Power: (CFR: 41.10 / 43.5 / 45.13) AA2.04 System lineups	3.6	2
295004 (APE 4) Partial or Total Loss of DC Power	X						Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Partial or Complete Loss of DC Power: (CFR: 41.8 to 41.10) AK1.04 Battery capacity	3.9	3
295005 (APE 5) Main Turbine Generator Trip					X		Ability to determine and/or interpret the following as they apply to Main Turbine Generator Trip: (CFR: 41.10 / 43.5 / 45.13) AA2.09 Turbine limitations	2.9	4
295006 (APE 6) Scram	X						Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to SCRAM: (CFR: 41.8 to 41.10) AK1.02 Shutdown margin	3.6	5
295016 (APE 16) Control Room Abandonment / 7				X			Ability to operate and/or monitor the following as they apply to Control Room Abandonment: (CFR: 41.7 / 45.6) AA1.16 Cooling water systems	3.3	6
295018 (APE 18) Partial or Complete Loss of CCW		X					Knowledge of the relationship between Partial or Complete Loss of Component Cooling Water and the following systems or components: (CFR: 41.7 / 45.8) AK2.03 Reactor water cleanup system	3.5	7
295019 (APE 19) Partial or Complete Loss of Instrument Air				X			Ability to operate and/or monitor the following as they apply to Partial or Complete Loss of Instrument Air: (CFR: 41.7 / 45.6) AA1.01 Backup air supply	3.4	8
295021 (APE 21) Loss of Shutdown Cooling						X	2.4.14 Knowledge of general guidelines for emergency and abnormal operating procedures usage (CFR: 41.10 / 43.1 / 45.13)	3.8	9
295023 (APE 23) Refueling Accidents	X						Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Refueling Accidents: (CFR: 41.8 to 41.10) AK1.03 Inadvertent criticality	3.8	10
295024 (EPE 1) High Drywell Pressure			X				Knowledge of the reasons for the following responses or actions as they apply to High Drywell Pressure: (CFR: 41.5 / 45.6) EK3.01 Drywell spray (Mark I, II)	4.4	11
295025 (EPE 2) High Reactor Pressure					X		Ability to determine and/or interpret the following as they apply to High Reactor Pressure: (CFR: 41.10 / 43.5 / 45.13) EA2.04 Suppression pool level	4.4	12
295026 (EPE 3) Suppression Pool High Water Temperature		X					Knowledge of the relationship between Suppression Pool High Water Temperature and the following systems or components: (CFR: 41.7 / 45.8) EK2.10 LPCS	3.7	13

295027 (EPE 4) High Containment Temperature (Mark III Containment Only)									
295028 (EPE 5) High Drywell Temperature (Mark I and Mark II only)						X	2.4.12 Knowledge of operating crew responsibilities during emergency and abnormal operations (CFR: 41.10 / 45.12)	4.0	14
295030 (EPE 7) Low Suppression Pool Water Level						X	2.4.46 Ability to verify that the alarms are consistent with the plant conditions (CFR: 41.10 / 43.5 / 45.3 / 45.12)	4.2	15
295031 (EPE 8) Reactor Low Water Level		X					Knowledge of the relationship between Reactor Low Water Level and the following systems or components: (CFR: 41.7 / 45.8) EK2.11 Reactor protection system	4.3	16
295037 (EPE 14) Scram Condition Present and Reactor Power Above APRM Downscale or Unknown			X				Knowledge of the reasons for the following responses or actions as they apply to SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown: (CFR: 41.5 / 41.7 / 45.6) EK3.07 Alternate control rod insertion methods	4.2	17
295038 (EPE 15) High Offsite Radioactivity Release Rate				X			Ability to operate and/or monitor the following as they apply to High Offsite Radioactivity Release Rate: (CFR: 41.7 / 45.6) EA1.07 Control room heating, ventilation, and air conditioning	3.7	18
600000 (APE 24) Plant Fire on Site		X					Knowledge of the relationship between Plant Fire on Site and the following systems or components: (CFR 41.7 / 45.7) AK2.06 Fire pumps	3.8	19
700000 (APE 25) Generator Voltage and Electric Grid Disturbances	X						Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Generator Voltage and Electric Grid Disturbances: (CFR: 41.4, 41.5, 41.7, 41.10 / 45.8) AK1.02 Over-excitation	3.1	20
K/A Category Totals:	4	4	3	3	3	3	Group Point Total:		20

Form 4.1-BWR	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO/SRO)								
E/APE # / Name	K1	K2	K3	A1	A2	G	K/A Topic(s)	IR	#
295002 (APE 2) Loss of Main Condenser Vacuum									
295007 (APE 7) High Reactor Pressure									
295008 (APE 8) High Reactor Water Level									
295009 (APE 9) Low Reactor Water Level	X						Knowledge of the operational implications and/or cause and effect relationships of the following as they apply to Low Reactor Water Level: (CFR: 41.8 to 41.10) AK1.05 Natural circulation	3.5	21
295010 (APE 10) High Drywell Pressure		X					Knowledge of the relationship between High Drywell Pressure and the following systems or components: (CFR: 41.7 / 45.8) AK2.08 Plant ventilation systems	3.2	22
295011 (APE 11) High Containment Temperature (Mark III Containment only)									
295012 (APE 12) High Drywell Temperature			X				Knowledge of the reasons for the following responses or actions as they apply to High Drywell Temperature: (CFR: 41.5 / 45.6) AK3.01 Increased drywell cooling	3.8	23
295013 (APE 13) High Suppression Pool Water Temperature/ 5						X	2.1.7 Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation (CFR: 41.5 / 43.5 / 45.12 / 45.13)	4.4	24
295014 (APE 14) Inadvertent Reactivity Addition				X			Ability to operate and/or monitor the following as they apply to Inadvertent Reactivity Addition: (CFR: 41.7 / 45.6) AA 1.11 Feedwater system	3.9	25
295017 (APE 17) High Offsite Release Rate									
295020 (APE 20) Inadvertent Containment Isolation									
295022 (APE 22) Loss of Control Rod Drive Pumps					X		Ability to determine and/or interpret the following as they apply to Loss of Control Rod Drive Pumps: (CFR: 41.10 / 43.5 / 45.13) AA2.01 Accumulator pressure	4.0	26
295029 (EPE 6) High Suppression Pool Water Level									
295032 (EPE 9) High Secondary Containment Area Temperature									
295033 (EPE 10) High Secondary Containment Area Radiation Levels									
295034 (EPE 11) Secondary Containment Ventilation High Radiation / 9									
295035 (EPE 12) Secondary Containment High Differential Pressure									

295036 (EPE 13) Secondary Containment High Sump/Area Water Level									
500000 (EPE 16) High Containment Hydrogen Concentration									
K/A Category Point Totals:	1	1	1	1	1	1	Group Point Total:		6

Form 4.1-BWR	BWR Examination Outline Plant Systems—Tier 2/Group 1 (RO/SRO)													
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	K/A Topic(s)	IR	#
203000 (SF2, SF4 RHR/LPCI) RHR/LPCI: Injection Mode					X							Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the RHR/LPCI: Injection Mode: (CFR: 41.5 / 45.3) K5.02 Core cooling methods	4.2	27
205000 (SF4 SCS) Shutdown Cooling								X				Ability to (a) predict the impacts of the following on the Shutdown Cooling System (RHR Shutdown Cooling Mode) and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 45.6) A2.08 Loss of heat exchanger cooling	4.0	28
206000 (SF2, SF4 HPCI) High-Pressure Coolant Injection														
207000 (SF4 IC) Isolation (Emergency) Condenser														
209001 (SF2, SF4 LPCS) Low-Pressure Core Spray			X									Knowledge of the effect that a loss or malfunction of the Low-Pressure Core Spray System will have on the following systems or system parameters: (CFR: 41.7 / 45.4) K3.02 ADS logic	4.1	29
209002 (SF2, SF4 HPCS) High-Pressure Core Spray		X										Knowledge of electrical power supplies to the following: (CFR: 41.7) K2.02 Valves	3.9	30
211000 (SF1 SLCS) Standby Liquid Control	X											Knowledge of the physical connections and/or cause and effect relationships between the Standby Liquid Control System and the following systems: (CFR: 41.2 to 41.9 / 45.7 to 45.8) K1.06 Reactor vessel internals	3.3	31
212000 (SF7 RPS) Reactor Protection				X								Knowledge of Reactor Protection System design features and/or interlocks that provide for the following: (CFR: 41.7) K4.07 Manual SCRAM	4.2	32
215003 (SF7 IRM) Intermediate-Range Monitor				X								Knowledge of Intermediate Range Monitor System design features and/or interlocks that provide for the following: (CFR: 41.7) K4.10 Automatically bypassing IRM rod block signals	3.6	33
215004 (SF7 SRMS) Source-Range Monitor											X	2.1.45 Ability to identify and interpret diverse indications to validate the response of another indication (CFR: 41.7 / 43.5 / 45.4)	4.3	34
215005 (SF7 PRMS) Average Power Range Monitor/Local Power Range Monitor							X					Ability to predict and/or monitor changes in parameters associated with operation of the Average Power Range Monitor/Local Power Range Monitor System, including: (CFR: 41.5 / 45.5) A1.03 Control rod block status	3.9	35
217000 (SF2, SF4 RCIC) Reactor Core Isolation Cooling			X									Knowledge of the effect that a loss or malfunction of the Reactor Core Isolation Cooling System will have on the following systems or system parameters: (CFR: 41.7 / 45.4) K3.05 Suppression pool level	3.3	36

218000 (SF3 ADS) Automatic Depressurization									X		Ability to manually operate and/or monitor in the control room: (CFR: 41.7 / 45.5 to 45.8) A4.03 ADS logic reset	3.9	37
223002 (SF5 PCIS) Primary Containment Isolation/Nuclear Steam Supply Shutoff									X		Ability to manually operate and/or monitor in the control room: (CFR: 41.7 / 45.5 to 45.8) A4.03 Reset of system isolations	4.0	38
239002 (SF3 SRV) Safety Relief Valves		X									Knowledge of electrical power supplies to the following: (CFR: 41.7) K2.01 SRV solenoids	3.7	39
259002 (SF2 RWLCS) Reactor Water Level Control								X			Ability to (a) predict the impacts of the following on the Reactor Water Level Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.07 Loss of comparator bias signal	3.0	40
261000 (SF9 SGTS) Standby Gas Treatment						X					Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Standby Gas Treatment System: (CFR: 41.7 / 45.7) K6.01 AC electrical distribution	3.5	41
262001 (SF6 AC) AC Electrical Distribution					X						Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the AC Electrical Distribution: (CFR: 41.5 / 45.3) K5.01 Paralleling AC sources	3.9	42
262002 (SF6 UPS) Uninterruptable Power Supply (AC/DC)						X					Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Uninterruptable Power Supply (AC/DC): (CFR: 41.7 / 45.7) K6.01 AC electrical distribution	3.4	43
263000 (SF6 DC) DC Electrical Distribution								X			Ability to monitor automatic operation of the DC Electrical Distribution, including: (CFR: 41.7 / 45.7) A3.02 Breaker trips	3.5	44
264000 (SF6 EGE) Emergency Generators (Diesel/Jet)								X			Ability to monitor automatic operation of the Emergency Generators, including: (CFR: 41.7 / 45.7) A3.04 Frequency and voltage control	4.0	45
300000 (SF8 IA) Instrument Air										X	2.1.27 Knowledge of system purpose and/or function (CFR: 41.7)	3.9	46
400000 (SF8 CCW) Component Cooling Water	X										Knowledge of the physical connections and/or cause and effect relationships between the Component Cooling Water System and the following systems: (CFR: 41.4 to 41.5 / 41.7 to 41.9 / 45.6 to 45.8) K1.02 Loads cooled by CCW	3.8	47
510000 (SF4 SWS*) Service Water							X				Ability to predict and/or monitor changes in parameters associated with operation of the Service Water System, including: (CFR: 41.5 / 45.5) A1.05 Service water flow	3.3	48
203000 (SF2, SF4 RHR/LPCI) RHR/LPCI: Injection Mode								X			Ability to monitor automatic operation of the RHR/LPCI: Injection Mode, including: (CFR: 41.7 / 45.7) A3.08 System initiation sequence.	4.0	49
215003 (SF7 IRM) Intermediate-Range Monitor									X		Ability to manually operate and/or monitor in the control room: (CFR: 41.7 / 45.5 to 45.8) A4.03 IRM range switches	3.9	50

215005 (SF7 PRMS) Average Power Range Monitor/Local Power Range Monitor								X				Ability to (a) predict the impacts of the following on the Average Power Range Monitor/Local Power Range Monitor System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.10 Changes in void concentration	3.3	51
262002 (SF6 UPS) Uninterruptable Power Supply (AC/DC)							X					Ability to predict and/or monitor changes in parameters associated with operation of the Uninterruptable Power Supply (AC/DC), including: (CFR: 41.5 / 45.5) A1.03 Lights and alarms	3.1	52
K/A Category Point Totals:	2	2	2	2	2	2	3	3	3	3	2	Group Point Total:		26

Form 4.1-BWR	BWR Examination Outline Plant Systems—Tier 2/Group 2 (RO/SRO)													
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	K/A Topic(s)	IR	#
201001 (SF1 CRDH) CRD Hydraulic														
201002 (SF1 RMCS) Reactor Manual Control														
201003 (SF1 CRDM) Control Rod and Drive Mechanism										X		Ability to manually operate and/or monitor in the control room: (CFR: 41.1-7 / 45.1-8) A4.01 CRD mechanism temperature	3.0	53
201004 (SF7 RSCS) Rod Sequence Control	X											Knowledge of the physical connections and/or cause and effect relationships between the Rod Sequence Control System and the following systems: (CFR: 41.2 to 41.9 / 45.7 to 45.8) K1.01 Reactor manual control system	3.5	54
201005 (SF1, SF7 RCIS) Rod Control and Information														
201006 (SF7 RWMS) Rod Worth Minimizer														
202001 (SF1, SF4 RS) Recirculation														
202002 (SF1 RSCTL) Recirculation Flow Control											X	291003 Controllers and Positioners K1.01 Function and operation of flow controller in manual and automatic modes	3.7	55
204000 (SF2 RWCU) Reactor Water Cleanup														
214000 (SF7 RPIS) Rod Position Information								X				Ability to (a) predict the impacts of the following on the Rod Position Information System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.04 Power supply loss	3.3	56
215001 (SF7 TIP) Traversing In-Core Probe														
215002 (SF7 RBMS) Rod Block Monitor														
216000 (SF7 NBI) Nuclear Boiler Instrumentation		X										Knowledge of electrical power supplies to the following: (CFR: 41.7) K2.01 Analog trip system	3.6	57
219000 (SF5 RHR SPC) RHR/LPCI: Torus/Suppression Pool Cooling Mode									X			Ability to monitor automatic operation of the RHR/LPCI: Torus/Suppression Pool Cooling Mode, including: (CFR: 41.7 / 45.7) A3.01 Valve operation	3.9	58
223001 (SF5 PCS) Primary Containment and Auxiliaries														
226001 (SF5 RHR CSS) RHR/LPCI: Containment Spray Mode														
230000 (SF5 RHR SPS) RHR/LPCI: Torus/Suppression Pool Cooling Mode					X							Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the	3.3	59

												RHR/LPCI: Torus/Suppression Pool Spray Mode: (CFR: 41.5 / 45.3) K5.02 Pump cavitation/vortex		
233000 (SF9 FPCCU) Fuel Pool Cooling/Cleanup														
234000 (SF8 FH) Fuel Handling Equipment														
239001 (SF3, SF4 MRSS) Main and Reheat Steam								X				Ability to monitor automatic operation of the Main and Reheat Steam System, including: (CFR: 41.7 / 45.7) A3.01 Isolation of main steam system	4.2	60
239003 (SF9 MSIVLC) Main Steam Isolation Valve Leakage Control														
241000 (SF3 RTPRS) Reactor/Turbine Pressure Regulating														
245000 (SF4 MTGEN) Main Turbine Generator/Auxiliary														
256000 (SF2 CDS) Condensate														
259001 (SF2 FWS) Feedwater														
268000 (SF9 RW) Radwaste			X									Knowledge of the effect that a loss or malfunction of the Radwaste System will have on the following systems or system parameters: (CFR: 41.5 / 45.3) K3.04 Primary containment drain sumps	3.0	61
271000 (SF9 OG) Offgas				X								Knowledge of Offgas System design features and/or interlocks that provide for the following: (CFR: 41.7) K4.11 Elevated release point	3.3	62
272000 (SF7, SF9 RMS) Radiation Monitoring														
286000 (SF8 FPS) Fire Protection														
288000 (SF9 PVS) Plant Ventilation														
290001 (SF5 SC) Secondary Containment														
290003 (SF9 CRV) Control Room Ventilation						X						Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Control Room Ventilation: (CFR: 41.7 / 45.7) K6.02 Component cooling water system	2.9	63
290002 (SF4 RVI) Reactor Vessel Internals														
510001 (SF8 CWS*) Circulating Water														
K/A Category Point Totals:	1	1	1	1	1	1	1	1	1	1	1	Group Point Total:		11

Form 4.1-COMMON Common Examination Outline

Facility: Columbia Generating Station		Date of Exam: March 2, 2023				
Generic Knowledge and Abilities—Tier 3 (RO/SRO)						
Category	K/A #	Topic	RO		SRO-Only	
			IR	#	IR	#
1. Conduct of Operations	2.1.4	Knowledge of individual licensed operator responsibilities related to shift staffing, such as medical requirements, “no-solo” operation, maintenance of active license status, 10 CFR Part 55 (CFR: 41.10 / 43.2)	3.3	64		
	2.1.20	Ability to interpret and execute procedure steps (CFR: 41.10 / 43.5 / 45.12)	4.6	65		
	Subtotal		N/A		N/A	
2. Equipment Control	2.2.22	Knowledge of limiting conditions for operation and safety limits (CFR: 41.5 / 43.2 / 45.2)	4.0	66		
	2.2.43	Knowledge of the process used to track inoperable alarms (CFR: 41.10 / 43.5 / 45.13)	3.0	67		
	Subtotal		N/A		N/A	
3. Radiation Control	2.3.12	Knowledge of radiological safety principles and procedures pertaining to licensed operator duties, such as response to radiation monitor alarms, containment entry requirements, fuel handling responsibilities, access to locked high-radiation areas, or alignment of filters (CFR: 41.12 / 43.4 / 45.9 / 45.10)	3.2	68		
	Subtotal		N/A		N/A	
4. Emergency Procedures/ Plan	2.4.12	Knowledge of operating crew responsibilities during emergency and abnormal operations (CFR: 41.10 / 45.12)	4.0	69		
	Subtotal		N/A		N/A	
Tier 3 Point Total				**6**		**7**

Theory—Tier 4 (RO)				
Category	K/A #	Topic	RO	
			IR	#
Reactor Theory	6	292005 Control Rods K1.04 Predict direction of change in reactor power for a change in control rod position	3.5	70
	6	292006 Fission Product Poisons K1.01 Define fission product poison	2.8	71
	6	292008 Reactor Operational Physics K1.02 List reactivity control mechanisms that exist for plant conditions during the approach to criticality	3.8	72
	Subtotal		N/A	
Thermodynamics	6	293007 Heat Transfer K1.03 Explain the manner in which fluid films affects heat transfer	2.8	73
	6	293008 Thermal-Hydraulics K1.28 Describe the factors affecting single- and two-phase flow resistance	2.5	74
	6	293009 Core Thermal Limits K1.24 Describe the effects of pressure on critical power	3.2	75
	Subtotal		N/A	
Tier 4 Point Total				**6**

Form 4.1-BWR Boiling-Water Reactor Examination Outline

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Tier	Group	RO K/A Category Points												SRO-Only Points									
		K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	Total	A2		G		Total					
1. Emergency and Abnormal Plant Evolutions	1				N/A					N/A				4		3		7					
	2													2		1		3					
	Tier Totals													6		4		10					
2. Plant Systems	1													3		2		5					
	2													1	1	1		3					
	Tier Totals													5		3		8					
3. Generic Knowledge and Abilities Categories	CO			EC				RC		EM				CO	EC	RC	EM	7					
														2	2	1	2						
4. Theory	Reactor Theory							Thermodynamics															

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E/APE # / Name	K1	K2	K3	A1	A2	G	K/A Topic(s)	IR	#
295001 (APE 1) Partial or Complete Loss of Forced Core Flow Circulation						X	2.4.45 Ability to prioritize and interpret the significance of each annunciator or alarm (CFR: 41.10 / 43.5 / 45.3 / 45.12)	4.3	76
295003 (APE 3) Partial or Complete Loss of AC Power									
295004 (APE 4) Partial or Total Loss of DC Power									
295005 (APE 5) Main Turbine Generator Trip						X	2.4.21 Knowledge of the parameters and logic used to assess the status of emergency operating procedures critical safety functions or shutdown critical safety functions (CFR: 41.7 / 43.5 / 45.12)	4.6	77
295006 (APE 6) Scram									
295016 (APE 16) Control Room Abandonment / 7									
295018 (APE 18) Partial or Complete Loss of CCW									
295019 (APE 19) Partial or Complete Loss of Instrument Air					X		Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of Instrument Air: (CFR: 41.10 / 43.5 / 45.13) AA2.01 Instrument air pressure	3.9	78
295021 (APE 21) Loss of Shutdown Cooling					X		Ability to determine and/or interpret the following as they apply to Loss of Shutdown Cooling: (CFR: 41.10 / 43.5 / 45.13) AA2.03 Reactor water level	4.0	79
295023 (APE 23) Refueling Accidents									
295024 (EPE 1) High Drywell Pressure									
295025 (EPE 2) High Reactor Pressure									
295026 (EPE 3) Suppression Pool High Water Temperature									
295027 (EPE 4) High Containment Temperature (Mark III Containment Only)									
295028 (EPE 5) High Drywell Temperature (Mark I and Mark II only)									
295030 (EPE 7) Low Suppression Pool Water Level					X		Ability to determine and/or interpret the following as they apply to Low Suppression Pool Water Level: (CFR: 41.10 / 43.5 / 45.13) EA2.03 Reactor Pressure	3.7	80
295031 (EPE 8) Reactor Low Water Level					X		Ability to determine and/or interpret the following as they apply to Reactor Low Water Level: (CFR: 41.10 / 43.5 / 45.13) EA2.01 Reactor water level	4.6	81
295037 (EPE 14) Scram Condition Present and Reactor Power Above APRM Downscale or Unknown									

295038 (EPE 15) High Offsite Radioactivity Release Rate									
600000 (APE 24) Plant Fire on Site									
700000 (APE 25) Generator Voltage and Electric Grid Disturbances						X	2.2.36 Ability to analyze the effect of maintenance activities, such as degraded power sourced, on the status of limiting conditions for operation. (CFR: 41.10 / 43.2 / 45.13)	4.2	82
K/A Category Totals:					4	3	Group Point Total:		7

Form 4.1-BWR	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO/SRO)								
E/APE # / Name	K1	K2	K3	A1	A2	G	K/A Topic(s)	IR	#
295002 (APE 2) Loss of Main Condenser Vacuum					X		Ability to determine and/or interpret the following as they apply to Loss of Main Condenser Vacuum: (CFR: 41.10 / 43.5 / 45.13) AA2.04 Offgas system flow	3.6	83
295007 (APE 7) High Reactor Pressure									
295008 (APE 8) High Reactor Water Level					X		Ability to determine and/or interpret the following as they apply to High Reactor Water Level: (CFR: 41.10 / 43.5 / 45.13) AA2.01 Reactor water level	4.4	84
295009 (APE 9) Low Reactor Water Level									
295010 (APE 10) High Drywell Pressure									
295011 (APE 11) High Containment Temperature (Mark III Containment only)									
295012 (APE 12) High Drywell Temperature									
295013 (APE 13) High Suppression Pool Water Temperature/ 5									
295014 (APE 14) Inadvertent Reactivity Addition									
295017 (APE 17) High Offsite Release Rate									
295020 (APE 20) Inadvertent Containment Isolation									
295022 (APE 22) Loss of Control Rod Drive Pumps									
295029 (EPE 6) High Suppression Pool Water Level									
295032 (EPE 9) High Secondary Containment Area Temperature									
295033 (EPE 10) High Secondary Containment Area Radiation Levels									
295034 (EPE 11) Secondary Containment Ventilation High Radiation / 9									
295035 (EPE 12) Secondary Containment High Differential Pressure									
295036 (EPE 13) Secondary Containment High Sump/Area Water Level						X	2.4.41 Knowledge of the emergency action level thresholds and classifications (SRO Only) (CFR: 43.5 / 45.11)	4.6	85
500000 (EPE 16) High Containment Hydrogen Concentration									
K/A Category Point Totals:					2	1	Group Point Total:		3

Form 4.1-BWR	BWR Examination Outline Plant Systems—Tier 2/Group 1 (RO/SRO)													
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	K/A Topic(s)	IR	#
203000 (SF2, SF4 RHR/LPCI) RHR/LPCI: Injection Mode														
205000 (SF4 SCS) Shutdown Cooling														
206000 (SF2, SF4 HPCI) High-Pressure Coolant Injection														
207000 (SF4 IC) Isolation (Emergency) Condenser														
209001 (SF2, SF4 LPCS) Low-Pressure Core Spray														
209002 (SF2, SF4 HPCS) High-Pressure Core Spray														
211000 (SF1 SLCS) Standby Liquid Control														
212000 (SF7 RPS) Reactor Protection														
215003 (SF7 IRM) Intermediate-Range Monitor														
215004 (SF7 SRMS) Source-Range Monitor								X				Ability to (a) predict the impacts of the following on the Source Range Monitor System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.03 Stuck detector	3.2	86
215005 (SF7 PRMS) Average Power Range Monitor/Local Power Range Monitor														
217000 (SF2, SF4 RCIC) Reactor Core Isolation Cooling														
218000 (SF3 ADS) Automatic Depressurization														
223002 (SF5 PCIS) Primary Containment Isolation/Nuclear Steam Supply Shutoff											X	2.1.32 Ability to explain and apply system precautions, limitations, notes, or cautions (CFR: 41.10 / 43.2 / 45.12)	4.0	87
239002 (SF3 SRV) Safety Relief Valves														
259002 (SF2 RWLCS) Reactor Water Level Control											X	2.2.12 Knowledge of surveillance procedures (CFR: 41.10 / 43.2 / 45.13)	4.1	88
261000 (SF9 SGTS) Standby Gas Treatment														
262001 (SF6 AC) AC Electrical Distribution														
262002 (SF6 UPS) Uninterruptable Power Supply (AC/DC)														

263000 (SF6 DC) DC Electrical Distribution								X				Ability to (a) predict the impacts of the following on the DC Electrical Distribution and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.04 Station blackout	4.2	89
264000 (SF6 EGE) Emergency Generators (Diesel/Jet)														
300000 (SF8 IA) Instrument Air														
400000 (SF8 CCW) Component Cooling Water								X				Ability to (a) predict the impacts of the following on the Component Cooling Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.01 Loss of CCW pump	3.9	90
510000 (SF4 SWS*) Service Water														
K/A Category Point Totals:								3			2	Group Point Total:		5

Form 4.1-BWR	BWR Examination Outline Plant Systems—Tier 2/Group 2 (RO/SRO)													
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G	K/A Topic(s)	IR	#
201001 (SF1 CRDH) CRD Hydraulic														
201002 (SF1 RMCS) Reactor Manual Control								X				Ability to (a) predict the impacts of the following on the Reactor Manual Control System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.02 Rod drift	4.0	91
201003 (SF1 CRDM) Control Rod and Drive Mechanism														
201004 (SF7 RSCS) Rod Sequence Control														
201005 (SF1, SF7 RCIS) Rod Control and Information														
201006 (SF7 RWMS) Rod Worth Minimizer											X	2.2.22 Knowledge of limiting conditions for operation and safety limits (CFR: 41.5 / 43.2 / 45.2)	4.7	92
202001 (SF1, SF4 RS) Recirculation														
202002 (SF1 RSCTL) Recirculation Flow Control														
204000 (SF2 RWCU) Reactor Water Cleanup														
214000 (SF7 RPIS) Rod Position Information														
215001 (SF7 TIP) Traversing In-Core Probe														
215002 (SF7 RBMS) Rod Block Monitor														
216000 (SF7 NBI) Nuclear Boiler Instrumentation														
219000 (SF5 RHR SPC) RHR/LPCI: Torus/Suppression Pool Cooling Mode														
223001 (SF5 PCS) Primary Containment and Auxiliaries														
226001 (SF5 RHR CSS) RHR/LPCI: Containment Spray Mode														
230000 (SF5 RHR SPS) RHR/LPCI: Torus/Suppression Pool Cooling Mode														
233000 (SF9 FPCCU) Fuel Pool Cooling/Cleanup														
234000 (SF8 FH) Fuel Handling Equipment						X						Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Fuel Handling System: (CFR: 41.7 / 45.7) K6.02 Reactor manual control system	3.4	93
239001 (SF3, SF4 MRSS) Main and Reheat Steam														
239003 (SF9 MSIVLC) Main Steam Isolation Valve Leakage Control														
241000 (SF3 RTPRS) Reactor/Turbine Pressure Regulating														
245000 (SF4 MTGEN) Main Turbine Generator/Auxiliary														

256000 (SF2 CDS) Condensate														
259001 (SF2 FWS) Feedwater														
268000 (SF9 RW) Radwaste														
271000 (SF9 OG) Offgas														
272000 (SF7, SF9 RMS) Radiation Monitoring														
286000 (SF8 FPS) Fire Protection														
288000 (SF9 PVS) Plant Ventilation														
290001 (SF5 SC) Secondary Containment														
290003 (SF9 CRV) Control Room Ventilation														
290002 (SF4 RVI) Reactor Vessel Internals														
510001 (SF8 CWS*) Circulating Water														
K/A Category Point Totals:						1		1			1	Group Point Total:		3

Form 4.1-COMMON Common Examination Outline

Facility: Columbia Generating Station		Date of Exam: March 2, 2023				
Generic Knowledge and Abilities—Tier 3 (RO/SRO)						
Category	K/A #	Topic	RO		SRO-Only	
			IR	#	IR	#
1. Conduct of Operations	2.1.35	Knowledge of the fuel handling responsibilities of SROs (SRO Only) (CFR: 43.7)			3.9	94
	2.1.37	Knowledge of procedures, guidelines, or limitations associated with reactivity management (CFR: 41.1 / 41.5 / 41.10 / 43.6 / 45.6)			4.6	95
	Subtotal		N/A		N/A	
2. Equipment Control	2.2.5	Knowledge of the process for making design or operating changes to the facility, such as 10 CFR 50.59, “Changes, Tests and Experiments,” screening and evaluation processes, administrative processes for temporary modifications, disabling annunciators, or installation of temporary equipment (CFR: 41.10 / 43.3 / 45.13)			3.2	96
	2.2.19	Knowledge of maintenance work order requirements (CFR: 41.10 / 43.5 / 45.13)			3.4	97
	Subtotal		N/A		N/A	
3. Radiation Control	2.3.14	Knowledge of radiation or contamination hazards that may arise during normal, abnormal, or emergency conditions or activities, such as analysis and interpretation of radiation and activity readings as they pertain to administrative, normal, abnormal, and emergency procedures, or analysis and interpretation of coolant activity, including comparison to emergency plan or regulatory limits (SRO Only) (CFR: 43.4 / 45.10)			3.8	98
	Subtotal		N/A		N/A	
4. Emergency Procedures/ Plan	2.4.16	Knowledge of emergency and abnormal operating procedures implementation hierarchy and coordination with other support procedures or guidelines such as, operating procedures, abnormal operating procedures, or severe accident management guidelines (CFR: 41.10 / 43.5 / 45.13)			4.4	99
	2.4.52	Knowledge of the lines of authority during implementation of the emergency plan, emergency plan implementing procedures, emergency operating procedures, or severe accident guidelines (CFR: 41.10 / 45.13)			4.0	100
	Subtotal		N/A		N/A	
Tier 3 Point Total				**6**		**7**

Form 4.1-1 Record of Rejected Knowledge and Abilities

Refer to Examination Standard (ES)-4.2, “Developing Written Examinations,” Section B.3, for deviations from the approved written examination outline.

Tier/Group	Randomly Selected K/A	Reason for Rejection
1/1	295003.AA2.03 (RO-2)	Original K/A: Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of AC Power: (CFR: 41.10 / 43.5 / 45.13) AA2.03 Battery status. IR: 3.9. Reason for Rejection: Similar to K/A for question RO-3. Unable to write an independent question. Recommended Replacement K/A: Ability to determine and/or interpret the following as they apply to Partial or Complete Loss of AC Power: (CFR: 41.10 / 43.5 / 45.13) AA2.04 System lineups. IR: 3.6 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
1/1	295025.EA2.02 (RO-12)	Original K/A: Ability to determine and/or interpret the following as they apply to High Reactor Pressure: (CFR: 41.10 / 43.5 / 45.13) EA2.02 Reactor power. IR: 4.4. Reason for Rejection: Unable to write a satisfactory question due to insufficient plausible distractors. Recommended Replacement K/A: Ability to determine and/or interpret the following as they apply to High Reactor Pressure: (CFR: 41.10 / 43.5 / 45.13) EA2.04 Suppression pool level. IR: 4.0. Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
1/1	295028.2.4.31 (RO-14)	Original K/A: High Drywell Temperature - Knowledge of annunciator alarms, indications, or response procedures (CFR: 41.10 / 45.3). IR: 4.2. Reason for Rejection: Similar to K/A for question RO-13. Unable to write an independent question. Recommended Replacement K/A: 295028.2.4.12 High Drywell Temperature - Knowledge of operating crew responsibilities during emergency and abnormal operations (CFR: 41.10 / 45.12). IR: 4.0 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
1/2	295014.AA1.10 (RO-25)	Original K/A: Ability to operate and/or monitor the following as they apply to Inadvertent Reactivity Addition: (CFR: 41.7 / 45.6) AA1.10 HPCS. IR 3.5 Reason for Rejection: Unable to write a Tier 1 question. CGS has implemented BWROG EPG/SAG Revision 4 which has removed any references to HPCS as a concern for inadvertent reactivity addition in all EOPs, AOPs, and ARPs. Recommended Replacement K/A: Ability to operate and/or monitor the following as they apply to Inadvertent Reactivity Addition: (CFR: 41.7 / 45.6): AA1.11 Feedwater system. IR: 3.9 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/1	203000.K5.04 (RO-27)	Original K/A: Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the RHR/LPCI: Injection Mode: (CFR: 41.5 / 45.3) K5.04 NPSH limits IR 3.4 Reason for Rejection: K/A almost identical to question 59. Recommended Replacement K/A: 203000.K5.02 - Knowledge of the operational implications or cause and effect relationships of the following concepts as they apply to the RHR/LPCI: Injection Mode: (CFR: 41.5 / 45.3) Core cooling methods IR: 4.2 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/1	209001 K3.05 (RO-29)	Original K/A: Knowledge of the effect that a loss or malfunction of the Low-Pressure Core Spray System will have on the following systems or system parameters: (CFR: 41.7 / 45.4) K3.05 Drywell cooling. IR: 2.8. Reason for Rejection: CGS is a BWR 5 and does not have LPCS drywell cooling feature. Recommended Replacement K/A: 209001.K3.02 - Knowledge of the effect that a loss or malfunction of the Low-Pressure Core Spray System will have on the following systems or system parameters: (CFR: 41.7 / 45.4) ADS logic. IR: 4.1 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
2/1	261000 K6.02 (RO-41)	Original K/A: Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Standby Gas Treatment System: (CFR: 41.7 / 45.7) K6.02 DC electrical distribution IR: 3.2. Reason for Rejection: CGS does not use DC power in any SGT system including control power, initiation logic, and component power. Recommended Replacement K/A: 261000.K6.01 - Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Standby Gas Treatment System: (CFR: 41.7 / 45.7) AC electrical distribution. IR: 3.5 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/1	262002 K6.04 (RO-43)	Original K/A: Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Uninterruptable Power Supply (AC/DC): (CFR: 41.7 / 45.7) K6.04 Motor generator IR: 3.2. Reason for Rejection: CGS does not use motor generators in conjunction with Uninterruptable Power Supplies Recommended Replacement K/A: 262002.K6.01 - Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Uninterruptable Power Supply (AC/DC): (CFR: 41.7 / 45.7) AC electrical distribution. IR: 3.4 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/1	400000 K1.09 (RO-47)	Original K/A: Knowledge of the physical connections and/or cause and effect relationships between the Component Cooling Water System and the following systems: (CFR: 41.4 to 41.5 / 41.7 to 41.9 / 45.6 to 45.8) Recirculation flow control system. IR: 2.8. Reason for Rejection: Unable to write an operationally valid question with plausible distractors. Recommended Replacement K/A: 400000.K1.02 - Knowledge of the physical connections and/or cause and effect relationships between the Component Cooling Water System and the following systems: (CFR: 41.4 to 41.5 / 41.7 to 41.9 / 45.6 to 45.8) Loads cooled by CCW. IR: 3.8 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
2/1	510000.A1.02 (RO-48)	Original K/A: Ability to predict and/or monitor changes in parameters associated with operation of the Service Water System, including: (CFR: 41.5 / 45.5) A1.02 Temperature control valve position. IR: 3.3 Reason for Rejection: At CGS, there are no temperature control valves associated with the Service Water System. Recommended Replacement K/A: 510000.A1.05 - Ability to predict and/or monitor changes in parameters associated with operation of the Service Water System, including: (CFR: 41.5 / 45.5) Service water flow. IR: 3.3 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/1	203000 A3.07 (RO-49)	Original K/A: Ability to monitor automatic operation of the RHR/LPCI: Injection Mode, including: (CFR: 41.7 / 45.7) A3.07 Loop selection. IR: 4.1. Reason for Rejection: CGS does not have automatic loop selection of LPCI. Recommended Replacement K/A: 203000.A3.08 - Ability to monitor automatic operation of the RHR/LPCI: Injection Mode, including: (CFR: 41.7 / 45.7) System initiation sequence. IR: 4.0 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/2	293001 A1.10 (RO-60)	Original K/A: Ability to predict and/or monitor changes in parameters associated with operation of the Main and Reheat Steam System, including: (CFR: 41.5 / 45.5) Reactor power IR: 4.1. Reason for Rejection: Unable to write a question that does not overlap with question 25. Unable to write a satisfactory question using other topics in the same K/A group. Recommended Replacement K/A: 293001.A3.01 - Ability to monitor automatic operation of the Main and Reheat Steam System, including: (CFR: 41.7 / 45.7) Isolation of main steam system IR: 4.2. Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
2/2	271000 K4.11 (RO-62)	Original K/A: Knowledge of Offgas System design features and/or interlocks that provide for the following: (CFR: 41.7) K4.03 Sufficient oxygen providing for complete hydrogen recombination IR: 2.9. Reason for Rejection: Cannot write an operationally valid question based on system design. Recommended Replacement K/A: 271000.K4.11 - Knowledge of Offgas System design features and/or interlocks that provide for the following: (CFR: 41.7) K4.11 Elevated release point IR: 3.3. Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/2	290003 K6.03 (RO-63)	Original K/A: Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Control Room Ventilation: (CFR: 41.7 / 45.7) K6.03 Plant pneumatic system IR: 2.7. Reason for Rejection: Plant pneumatic systems do not interface with Control Room Ventilation at CGS. Recommended Replacement K/A: 290003.K6.02 - Knowledge of the effect of the following plant conditions, system malfunctions, or component malfunctions on the Control Room Ventilation: (CFR: 41.7 / 45.7) Component cooling water system IR: 2.9. Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
3	2.4.39 (RO-69)	Original K/A: Knowledge of RO responsibilities in emergency plan implementing procedures (CFR: 41.10 / 45.11). IR: 3.9. Reason for Rejection: ROs do not have emergency plan implementation responsibilities at CGS. Recommended Replacement K/A: 2.4.12 - Knowledge of operating crew responsibilities during emergency and abnormal operations (CFR: 41.10 / 45.12). IR: 4.0 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
1/1	295030 EA2.04 (SRO-80)	Original K/A: Ability to determine and/or interpret the following as they apply to Low Suppression Pool Water Level: (CFR: 41.10 / 43.5 / 45.13) EA2.04 Drywell/suppression chamber differential pressure (Mark I, II). IR: 3.5. Reason for Rejection: No actions are taken in the EOPs based on drywell/suppression chamber differential pressure. Recommended Replacement K/A: 209030.EA2.03 - Ability to determine and/or interpret the following as they apply to Low Suppression Pool Water Level: (CFR: 41.10 / 43.5 / 45.13) Reactor Pressure. IR: 3.7 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
1/1	700000 2.1.23 (SRO-82)	Original K/A: Generator Voltage and Electric Grid Disturbances - Ability to perform general or normal operating procedures during any plant condition (CFR: 41.10 / 43.5 / 45.2 / 45.6). IR: 4.2. Reason for Rejection: Not able to write an operationally valid SRO question. Recommended Replacement K/A: 700000.2.2.36 – Generator Voltage and Grid Disturbances – Ability to analyze the effect of maintenance activities, such as degraded power sourced, on the status of limiting conditions for operation. (CFR: 41.10 / 43.2 / 45.13) IR: 4.2 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
1/2	295008 AA2.03 (SRO-84)	Original K/A: Ability to determine and/or interpret the following as they apply to High Reactor Water Level: (CFR: 41.10 / 43.5 / 45.13) Reactor water cleanup blowdown flow. IR: 3.2. Reason for Rejection: Not able to write an operationally valid SRO question. Recommended Replacement K/A: 295008.AA2.01 – Ability to determine and/or interpret the following as they apply to High Reactor Water Level: (CFR: 41.10 / 43.5 / 45.13) AA2.01 Reactor water level IR: 4.4 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Form 4.1-1 Record of Rejected Knowledge and Abilities

Tier/Group	Randomly Selected K/A	Reason for Rejection
2/1	400000 A2.07 (SRO-90)	Original K/A: Ability to (a) predict the impacts of the following on the Component Cooling Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.07 Loss of cooling to residual heat removal system heat exchangers. IR: 3.8. Reason for Rejection: Component Cooling Water (Reactor Close Cooling Water) does not provide any cooling to RHR heat exchangers at CGS (cooling is provided by service water). Recommended Replacement K/A: Ability to (a) predict the impacts of the following on the Component Cooling Water System and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal operations: (CFR: 41.5 / 43.5 / 45.6) A2.01 Loss of CCW pump. IR: 3.9 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
2/2	201006.2.4.3 (SRO-92)	Original K/A: Rod Worth Minimizer - Ability to identify post-accident instrumentation (CFR: 41.6 / 45.4). IR: 4.0. Reason for Rejection: There is no post-accident instrumentation associated with the Rod Worth Minimizer Recommended Replacement K/A: 2.2.22 Knowledge of limiting conditions for operation and safety limits (CFR: 41.5 / 43.2 / 45.2). IR: 4.7 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.
3	201006.2.3.6 (SRO-98)	Original K/A: Ability to approve liquid or gaseous release permits (CFR: 41.13 / 43.4 / 45.10) IR: 3.8. Reason for Rejection: Overlap with JPM. Recommended Replacement K/A: 2.3.14 Knowledge of radiation or contamination hazards that may arise during normal, abnormal, or emergency conditions or activities, such as analysis and interpretation of radiation and activity readings as they pertain to administrative, normal, abnormal, and emergency procedures, or analysis and interpretation of coolant activity, including comparison to emergency plan or regulatory limits (SRO Only) (CFR: 43.4 / 45.10) IR: 3.8 Replacement K/A randomly selected in accordance with NUREG-1021 and guidance provided by the Chief Examiner.

Facility: Columbia Generating Station Date of Examination: 02/20/23

Examination Level RO ☒ SRO ☐ Operating Test Number: 1

Administrative Topic (Step 1)	Activity and Associated K/A (Step 2)	Type Code (Step 3)
Conduct of Operations	RO – Perform alternate power calculation per PPM 9.3.1 Description: Perform attachment 7.4 of PPM 9.3.1 (Alternate power calculation worksheet) in order to validate the Manual Core Heat Balance. K/A 2.1.7 (4.4 / 4.7)	(R)(D)
Conduct of Operations	RO – MT Load Rate determination Description: Determine MT Load Rate change per SOP-MT-START assuming a fatigue index of 20,000 cycles. K/A 2.1.20 (4.6 / 4.6)	(R)(M)
Equipment Control	RO – Determine correct hose for performance of LLRT. Description: Candidate must determine the correct hose for performance of high pressure op test during LLRT. Based on test information provided candidate must determine the correct hose to use for the hydro from the 4 hoses provided. K/A 2.2.12 (3.7 / 4.1)	(R)(N)
Radiation Control	RO – Identify LHRA entry requirements. Description: Candidate is provided with the requirement to hang a tag on RHR-V-211 located in a LHRA. Determine the correct RWP and the correct ALARA task for the evolution. K/A 2.3.12 (3.2 / 3.7)	(R)(N)
Emergency Plan	N/A	

Facility: Columbia Generating Station Date of Examination: 02/20/23

Examination Level: RO ☐ SRO ☒ Operating Test Number: 1

Administrative Topic (Step 1)	Activity and Associated K/A (Step 2)	Type Code (Step 3)
Conduct of Operations	SRO – Determine operating point and required actions following a FW Heater trip. Description: Using ABN-POWER Attachment 7.1, determine the operating point (Final Feedwater Temperature Reduction) and actions required for Feedwater Heater 6A trip. K/A 2.1.7 (4.4 / 4.7)	(R)(M)
Conduct of Operations	SRO – Operability determination Description: Based on conditions, determine operability of Fire Hose Station and complete a fire protection impairment. K/A 2.1.23 (4.3 / 4.4)	(R)(N)
Equipment Control	SRO – Determine SLC Operability Description: Using OSP-INST-H101 and completed copy of CSP-SLC-M101 determine the operability of SLC. K/A 2.2.45 (N/A / 4.7)	(R)(M)
Radiation Control	SRO – Approve CW Blowdown per PPM 12.2.9 Description: Using PPM 12.2.9, SOP-CW-OPS and initial conditions provided, determine if CW blowdown can be approved based on available instrumentation. K/A 2.3.6 (2.0 / 3.8)	(D)(P) (R)
Emergency Plan	SRO – Evaluate dose assessment projection (from URI, Provided) and determine EAL. Description: based on plant conditions and provided dose assessment, determine EAL action level classification. K/A 2.4.41 (N/A / 4.6)	(R)(N)

Instructions for completing Form 3.2-1, "Administrative Topics Outline"

1. For each license level, determine the number of administrative job performance measures (JPMs) and topic areas as follows:

Topic	Number of JPMs	
	RO*	SRO and RO Retakes
Conduct of Operations	1 (or 2)	2
Equipment Control	1 (or 0)	1
Radiation Control	1 (or 0)	1
Emergency Plan	1 (or 0)	1
Total	**4**	**5**

* Reactor operator (RO) applicants do not need to be evaluated on every topic (i.e., "Equipment Control," "Radiation Control," or "Emergency Plan" can be omitted by doubling up on "Conduct of Operations"), unless the applicant is taking only the administrative topics portion of the operating test (with a waiver or excusal of the other portions).

2. Enter the associated knowledge and abilities (K/A) statement and summarize the administrative activities for each JPM.

3. For each JPM, specify the type codes for location and source as follows:

Location:

(C)ontrol room: **0**

(S)imulator: **0**

Class**(R)**oom: **9**

Source and Source Criteria:

(P)revious two NRC exams: **1**
(no more than one JPM that is **randomly selected** from last two NRC exams)

(D)irect from bank: **2**
(no more than three for ROs, no more than four for SROs and RO retakes)

(N)ew: **4** Significantly **(M)**odified from bank: **3**
(no fewer than one)

Facility: Columbia Generating Station Date of Examination: 02/20/23
Operating Test Number: 1

Exam Level: ☒ RO ☐ SRO-I ☐ SRO-U

System/JPM Title	Type Code	Safety Func.
Control Room Systems (8 for RO)		
S-1 Inject SLC per SOP-SLC-INJECTION-QC Description: Due to high-power ATWS conditions, the candidate will initiate SLC per SOP-SLC-INJECTION-QC. When SLC is initiated, SLC-P-1A will inject at reduced flow and RWCU-V-4 will not automatically close. K/A: 211000 A2.09 (4.4 / 4.1)	(EN)(M)(S)	**1**
S-2 Restore RPV water level -50" to +54" using LPCS. (ALT) Description: ED has been performed on low reactor water level, LPCS failed to auto start, and other pressure injection sources are not available. PPM 5.5.1 was performed to override ECCS valve logic to allow throttling RPV injection. Manually start LPCS and inject to the core using SOP-LPCS-INJECTION-QC. LPCS-V-5 Fails to auto open due to logic failure. Restore RPV level to -50 to +54" using LPCS K/A: 209001 A4.05 (4.2 / 4.2)	(A)(EN)(L)(N)(S)	2
S-3 Perform TSP-APRM-C301 to GAF APRM's Description: Reactor power is at 11% during a startup. You have been directed to perform TSP-APRM-C301 per PPM 3.1.2 Startup flow chart. K/A 215005 A1.07 (3.7 / 3.7)	(N)(EN)(S)	7
S-4 Lower Reactor Pressure using DEH in BPV manual (ALT) Description: The CRS directs you to lower RPV pressure to 550 psig at the rate of 50 psig per minute per SOP-DEH-QC. DEH pressure change will fail in automatic requiring pressure control using Bypass Valve Manual operation from the DEH control panel. K/A: 241000 A4.06 (4.2 / 4.2)	(A)(D)(L)(S)	3
S-5 Vent the drywell per SOP-CN-CONT-VENT (ALT) Description: When the candidate lines up Standby Gas treatment for venting the Drywell SGT-V-5B2 fails to auto open. Manual operator action will result in SGT-V-5B2 opening K/A: 223001 A2.07 (4.4 / 4.3)	(S)(A)(P)(EN)	5

S-6 Restore RCC to service following NS4 Isolation per ABN-FAZ Description: Perform steps 4.3.1 through 4.3.4 (F or A Signal Restoration) per ABN-FAZ to restore RCC to service following NS4 group 4 isolation. K/A: 400000 A2.11 (4.2 / 3.7)	(S)(N) (EN)	8
S-7 Transfer SM-1 to TR-N1 from TR-S Description: Transfer 4160 VAC bus SM-1 from the start up transformer to the normal transformer per SOP-ELEC-4160-OPS K/A: 262001 A4.04 (3.9 / 3.9)	(M)(S)	6
S-8 Initiate CR HVAC in manual pressurization mode Description: Place both trains of Control Room Ventilation in the Manual Pressurization Mode of operation per SOP-HVAC/CR-OPS K/A:290003 A4.01 (3.8 / 3.8)	(M)(EN) (S)	9
In-Plant Systems (3 for RO)		
P-1: Perform section 5.2 of SOP-CIA-OPS Description: Candidate will perform SOP-CIA-OPS section 5.2. Requires manual adjustment of CIA-PCV-1 spring adjusting screw. Requires candidate determination of how adjustment will be made based on plant conditions. K/A: 300000 A2.03 (3.9 / 3.8)	(A)(L) (N)(R)	**8**
P-2 Start 125 VDC Battery Charger C1-1A. Description: Candidate places C1-1A in service to restore Div 1 125VDC. During restoration Voltage will be out of tolerance requiring performance of responsibilities as Duty Electrician to adjust the potentiometer prior to closing the DC output breaker. K/A 263000 A2.01 (3.5 / 3.2)	(A)(N) (R)(E)	**6**
P-3 Remote shutdown panel activation during a control room evacuation (TIME CRITICAL)** Description: Based on a Main Control Room evacuation due to fire, and from a designated starting point, transit to the Remote Shutdown Panel and activate panel within required time using ABN-CR-EVAC Attachment 7.2. K/A: 295016 AA1.07 (4.2 / 4.3) (** Ref: OI-69, TCOA-3/TCOA-4)	(D)(E) (R)	7

Facility: Columbia Generating Station Date of Examination: 02/20/23
Operating Test Number: 1

Exam Level: ☐ RO ☒ SRO-I ☐ SRO-U

System/JPM Title	Type Code	Safety Func.
Control Room Systems (8 for RO)		
S-1 Inject SLC per SOP-SLC-INJECTION-QC Description: Due to high-power ATWS conditions, the candidate will initiate SLC per SOP-SLC-INJECTION-QC. When SLC is initiated, SLC-P-1A will inject at reduced flow and RWCU-V-4 will not automatically close. K/A: 211000 A2.09 (4.4 / 4.1)	(EN)(M)(S)	**1**
S-2 Restore RPV water level -50" to +54" using LPCS. (ALT) Description: ED has been performed on low reactor water level, LPCS failed to auto start, and other pressure injection sources are not available. PPM 5.5.1 was performed to override ECCS valve logic to allow throttling RPV injection. Manually start LPCS and inject to the core using SOP-LPCS-INJECTION-QC. LPCS-V-5 Fails to auto open due to logic failure. Restore RPV level to -50 to +54" using LPCS K/A: 209001 A4.05 (4.2 / 4.2)	(A)(EN)(L)(N)(S)	2
S-4 Lower Reactor Pressure using DEH in BPV manual.(ALT) Description: The CRS directs you to lower RPV pressure to 550 psig at the rate of 50 psig per minute per SOP-DEH-QC. DEH pressure change will fail in automatic requiring pressure control using Bypass Valve Manual operation from the DEH control panel. K/A: 241000 A4.06 (4.2 / 4.2)	(A)(D)(L)(S)	3
S-5 Vent the drywell per SOP-CN-CONT-VENT (ALT) Description: When the candidate lines up Standby Gas treatment for venting the Drywell SGT-V-5B2 fails to auto open. Manual operator action will result in SGT-V-5B2 opening K/A: 223001 A2.07 (4.2 / 4.3)	(S)(A)(P)(EN)	5
S-6 Restore RCC to service following NS4 Isolation per ABN-FAZ Description: Perform steps 4.3.1 through 4.3.4 (F or A Signal Restoration) per ABN-FAZ to restore RCC to service following NS4 group 4 isolation. K/A: 400000 A2.11 (4.2 / 3.7)	(S)(N)(EN)	8

S-7 Transfer SM-1 to TR-N1 from TR-S Description: Transfer 4160 VAC bus SM-1 from the start up transformer to the normal transformer per SOP-ELEC-4160-OPS K/A: 262001 A4.04 (3.9 / 3.9)	(M)(S)	6
S-8 Initiate CR HVAC in manual pressurization mode Description: Place both trains of Control Room Ventilation in the Manual Pressurization Mode of operation per SOP-HVAC/CR-OPS K/A:290003 A4.01 (3.8 / 3.8)	(M)(EN)(S)	9
In-Plant Systems (3 for RO)		
P-1: Perform section 5.2 of SOP-CIA-OPS Description: Candidate will perform SOP-CIA-OPS section 5.2. Requires manual adjustment of CIA-PCV-1 spring adjusting screw. Requires candidate determination of how adjustment will be made based on plant conditions. K/A: 300000 A2.03 (3.9 / 3.8)	(A)(L)(N)(R)	**8**
P-2 Start 125 VDC Battery Charger C1-1A. Description: Candidate places C1-1A in service to restore Div 1 125VDC. During restoration Voltage will be out of tolerance requiring performance of responsibilities as Duty Electrician to adjust the potentiometer prior to closing the DC output breaker. K/A 263000 A2.01 (3.5 / 3.2)	(A)(N)(R)(E)	**6**
P-3 Remote shutdown panel activation during a control room evacuation (TIME CRITICAL)** Description: Based on a Main Control Room evacuation due to fire, and from a designated starting point, transit to the Remote Shutdown Panel and activate panel within required time using ABN-CR-EVAC Attachment 7.2. K/A: 295016 AA1.07 (4.2 / 4.3) (** Ref: OI-69, TCOA-3/TCOA-4)	(D)(E)(R)	7

Facility: Columbia Generating Station Date of Examination: 02/20/23
Operating Test Number: 1

Exam Level: ☐ RO ☐ SRO-I ☒ SRO-U

System/JPM Title	Type Code	Safety Func.
Control Room Systems (8 for RO)		
S-4 Lower Reactor Pressure using DEH in BPV manual.(ALT) Description: The CRS directs you to lower RPV pressure to 550 psig at the rate of 50 psig per minute per SOP-DEH-QC. DEH pressure change will fail in automatic requiring pressure control using Bypass Valve Manual operation from the DEH control panel. K/A: 241000 A4.06 (4.2 / 4.2)	(A)(D) (L)(S)	3
S-8 Initiate CR HVAC in manual pressurization mode Description: Place both trains of Control Room Ventilation in the Manual Pressurization Mode of operation per SOP-HVAC/CR-OPS K/A:290003 A4.01 (3.8 / 3.8)	(M)(EN) (S)	9
In-Plant Systems (3 for RO)		
P-1: Perform section 5.2 of SOP-CIA-OPS Description: Candidate will perform SOP-CIA-OPS section 5.2. Requires manual adjustment of CIA-PCV-1 spring adjusting screw. Requires candidate determination of how adjustment will be made based on plant conditions. K/A: 300000 A2.03 (3.9 / 3.8)	(A)(L) (N)(R)	**8**
P-2 Start 125 VDC Battery Charger C1-1A. Description: Candidate places C1-1A in service to restore Div 1 125VDC. During restoration Voltage will be out of tolerance requiring performance of responsibilities as Duty Electrician to adjust the potentiometer prior to closing the DC output breaker. K/A 263000 A2.01 (3.5 / 3.2)	(A)(N) (R)(E)	**6**
P-3 Remote shutdown panel activation during a control room evacuation (TIME CRITICAL)** Description: Based on a Main Control Room evacuation due to fire, and from a designated starting point, transit to the Remote Shutdown Panel and activate panel within required time using ABN-CR-EVAC Attachment 7.2. K/A: 295016 AA1.07 (4.2 / 4.3) (** Ref: OI-69, TCOA-3/TCOA-4)	(D)(E) (R)	7

1. Determine the number of control room system and in-plant system job performance measures (JPMs) to develop using the following table:

License Level	Control Room	In-Plant	Total
Reactor Operator (RO)	8	3	11
Senior Reactor Operator-Instant (SRO-I)	7	3	10
Senior Reactor Operator-Upgrade (SRO-U)	2 or 3	3 or 2	5

2. Select safety functions and systems for each JPM as follows:

   Refer to Section 1.9 of the applicable knowledge and abilities (K/A) catalog for the plant systems organized by safety function. For pressurized-water reactor operating tests, the primary and secondary systems listed under Safety Function 4, "Heat Removal from Reactor Core," in Section 1.9 of the applicable K/A catalog, may be treated as separate safety functions (i.e., two systems, one primary and one secondary, may be selected from Safety Function 4). From the safety function groupings identified in the K/A catalog, select the appropriate number of plant systems by safety functions to be evaluated based on the applicant's license level (see the table in step 1).

   For RO/SRO-I applicants: Each of the control room system JPMs and, separately, each of the in-plant system JPMs must evaluate a different safety function, and the same system or evolution cannot be used to evaluate more than one safety function in each location. One of the control room system JPMs must be an engineered safety feature.

   For SRO-U applicants: Evaluate SRO-U applicants on five different safety functions. One of the control room system JPMs must be an engineered safety feature, and the same system or evolution cannot be used to evaluate more than one safety function.

3. Select a task for each JPM that supports, either directly or indirectly and in a meaningful way, the successful fulfillment of the associated safety function. Select the task from the applicable K/A catalog (K/As for plant systems or emergency and abnormal plant evolutions) or the facility licensee's site-specific task list. If this task has an associated K/A, the K/A should have an importance rating of at least 2.5 in the RO column. K/As that have importance ratings of less than 2.5 may be used if justified based on plant priorities; inform the NRC chief examiner if selecting K/As with an importance rating less than 2.5. The selected tasks must be different from the events and evolutions conducted during the simulator operating test and tasks tested on the written examination. A task that is similar to a simulator scenario event may be acceptable if the actions required to complete the task are significantly different from those required in response to the scenario event.

   Apply the following specific task selection criteria:

   - At least one of the tasks shall be related to a shutdown or low-power condition.

- Four to six of the tasks for RO and SRO-I applicants shall require execution of alternative paths within the facility licensee's operating procedures. Two to three of the tasks for SRO-U applicants shall require execution of alternative paths within the facility licensee's operating procedures.
- At least one alternate path JPM must be new or modified from the bank.
- At least one of the tasks conducted in the plant shall evaluate the applicant's ability to implement actions required during an emergency or abnormal condition.
- At least one of the tasks conducted in the plant shall require the applicant to enter the radiologically controlled area. This provides an excellent opportunity for the applicant to discuss or demonstrate radiation control administrative subjects.

If it is not possible to develop or locate a suitable task for a selected system, return to step 2 and select a different system.

4. For each JPM, specify the codes for type, source, and location:

Code	License Level Criteria		
	RO	SRO-I	SRO-U
(A)lternate path	4–6 **(5)**	4–6 **(5)**	2–3 **(3)**
(C)ontrol room			
(D)irect from bank	≤ 9 **(2)**	≤ 8 **(4)**	≤ 4 **(2)**
(E)mergency or abnormal in-plant	≥ 1 **(5)**	≥ 1 **(5)**	≥ 1 **(2)**
(EN)gineered safety feature (for control room system)	≥ 1 **(4)**	≥ 1 **(3)**	≥ 1 **(2)**
(L)ow power/shutdown	≥ 1 **(3)**	≥ 1 **(3)**	≥ 1 **(2)**
(N)ew or (M)odified from bank (must apply to at least one alternate path JPM)	≥ 2 **(8)**	≥ 2 **(7)**	≥ 1 **(3)**
(P)revious two exams (randomly selected)	≤ 3 **(1)**	≤ 3 **(1)**	≤ 2 **(0)**
(R)adiologically controlled area	≥ 1 **(3)**	≥ 1 **(3)**	≥ 1 **(3)**
(S)imulator	**(8)**	**(7)**	**(2)**

Facility:	Columbia Generating Station	Scenario No.: 1	Op Test No.:
Examiners:		Operators:	

Initial Conditions:	Columbia is operating at 95% power. Power ascension was in progress previous shift following a Reactor Feedwater Heater recovery. Bus Duct Cooling Fan B is tagged OOS for motor bearing inspection.
Turnover:	Following turnover, you have been directed to and place DEH into GV optimization per SOP-MT-GV/OPTIMIZATION section 5.1 and raise reactor power to 100% at 1% per minute per PPM 3.2.6 power maneuvering section 5.4. Sufficient margin to fuel-preconditioning limits per PPM 9.3.18 has been verified.

Critical Tasks:

CT-1	Initiate WW sprays using RHR-B prior to wetwell pressure exceeding 12# per PPM 5.2.1 Primary Containment Control.
CT-2	Manually restore power to SM-8 by closing DG-2 output breaker with 10 minutes of loss of power to SM-8. (Restores SW flow to DG-2 and allows for operation of RHR-SYS-B for containment sprays)

NOTE: (per NUREG-1021 Appendix D) IF an operator or the crew significantly deviates from or fails to follow procedures that affect the maintenance of basic safety functions, those actions may form the basis of a CT identified in the post scenario review.

Event No.	Trigger	Event Type*	Event Description
1	-	N (CRS, BOP) R (ATC)	BOP Operator places the MT is GV optimization mode per SOP-MT-GV/OPTIMIZATION (section 5.1). ATC raises reactor power with flow using Reactor Recirculation flow to 100%.
2	2	TS (CRS)	RHR-V-17A will experience loss of power. The CRS will declare LCO 3.6.1.5 Condition A (RHR Drywell Spray). 7-day completion time to restore RHR to operable status. RHR-SYS-A loses drywell spray function capability.
3	3	TS (CRS) C (BOP)	An electrical fault result's in 115Kv (TR-B) line open phase. E-CB-TRB fails to auto close. The CRS will enter ABN-ELEC-GRID and take actions per section 4.4. CRS will evaluate and declare LCO 3.8.1 Condition A.
4	4	C (CRS / BOP)	A Minimum Seismic Earthquake occurs. AR-EX-1A trips. The CRS enters ABN-EXHAUSTER to manually start AR-EX-1B (BOP). 2 Minutes after AR-EX-1B is started it also trips, the crew will monitor for turbine vibrations per ABN-EXHAUSTER.
5	5	C (CRS / ATC)	The crew monitors turbine vibrations increasing. The CRS takes actions per the annunciator response to reduce turbine loading to reduce turbine vibrations. ATC will reduce power as directed by the CRS. Turbine vibrations will continue to increase following the down power.
6	-	M (ALL) MC (BOP)	As Main turbine vibrations continue to increase, the CRS will direct a manual reactor scram and trip of the turbine. (Pre-inserted malfunction) The Main Generator will fail to automatically trip following the reactor scram. BOP will manually trip the Main Generator and monitor vibrations decreasing.

7	-	I (ATC)	Following the Reactor Scram, ATC will line up on the startup flow control valves per SOP-RFW-FCV-QC. The startup flow control valves will not respond to the startup flow controller; ATC will have to control RFP speed and throttle RFW-V-109 as necessary to control Reactor Water level. ATC can also optionally use RCIC for additional level control.
8	8	C (ALL)	OBE / LOCA. A recirculation line leak develops. The CRS will take actions per PPM 5.2.1 and spray the Wetwell when containment pressure reaches 2 psig. **(CT-1)** ATC will adjust level control strategy based on level decreasing due to the recirculation line leak. RHR-P-2A will experience a broken shaft making it unavailable for sprays.
9	9	I (CRS / BOP) MC (BOP)	Shortly after the earthquake a ground will develop and cause a lock out on SM-3. The B-8 Breaker is unavailable. DG-2 Output breaker fails to automatically close resulting in SM-8 losing power. **(CT-2)**. The CRS and BOP will take actions to restore power to SM-8 by manually closing the DG-2 output breaker. This action will be required to restore RHR-P-2B which will allow for Drywell sprays. (RHR Sys A malfunctions preclude its ability to perform this function) After SM-8 is restored, the Crew will spray the Drywell using RHR-B and stabilize level in the normal operating band of +13 to +54 inches.
* (N)ormal (R)eactivity (I)nstrument (C)omponent (M)ajor (MC)Manual Control (TS)Technical Specifications			

Target Quantitative Attributes	Actual	Description
Events after EOP entry (1-2)	**3**	Start up flow control valve failure / LOCA / SM-3 Lockout – DG2 output breaker FAC
Abnormal events (2-4)	**3**	ABN-ELEC-GRID / ABN-EARTHQUAKE / ABN-EXHAUSTER
Major transients (1-2)	**1**	MT Vibration Scram
EOPs entered/requiring substantive actions (1-2)	**2**	PPM 5.1.1 RPV Control / PPM 5.2.1 Primary Containment Control
Entry into a contingency EOP with substantive actions (≥ 1 per scenario set)	**0**	
Pre-identified Critical tasks (≥ 2)	**3**	See Critical Task Sheets

Facility:	Columbia Generating Station	Scenario No.: 2	Op Test No.:
Examiners:		Operators:	

Initial Conditions:	Columbia is operating at 97% power.
Turnover:	Following shift turnover, lower reactor power to 95% at 1% per minute using Reactor Recirculation flow per PPM 3.2.6 (Power Maneuvering) to support OSP-MS-Q702 (Bypass Valves Test). Perform OSP-MS-Q702 following the power reduction.

Critical Tasks:

CT-1	Stop and prevent injection into the RPV, with the exception of SLC, RCIC, and CRD, to establish an LL of -65 inches in an ATWS with GT 5% power within 10 minutes of receipt of the scram signal.
CT-2	With a reactor scram required and the reactor not shutdown, take actions (initiates SLC from MCR) to inject SLC per PPM 3.3.1 QC prior to commencing performance of PPM 5.5.11 Alternate Rod Insertions.

NOTE: (per NUREG-1021 Appendix D) IF an operator or the crew significantly deviates from or fails to follow procedures that affect the maintenance of basic safety functions, those actions may form the basis of a CT identified in the post scenario review.

Event No.	Trigger	Event Type*	Event Description
1	-	C (BOP) R (ATC) TS (CRS)	Upon taking the shift, the BOP performs OSP-MS-Q702 (Bypass Valves Test). The ATC lowers power with RRC flow to facilitate performance of the test. During the test, BPV2 fails to open. The CRS evaluates TS and enters LCO 3.7.6 TSAS A.1 which requires satisfying the requirements of the LCO within 2 hours.
2	2	C (ATC, CRS) TS (CRS)	Control rod 22-23 (initially at position 10) starts drifting out and continues to drift out until either the FULL OUT (position 48) is reached, or until manual action is initiated to fully insert the control rod. ATC (per ABN-ROD Immediate Action) will press and hold the INSERT or CONTINUOUS INSERT pushbutton to manually insert the affected rod until fully inserted. Control rod 22-23 will remain inserted after releasing the pushbutton. CRS evaluates TS and enters LCO 3.1.3 TSAS C.1 which requires fully inserting the inoperable control rod within 3 hours (which will be met) and TSAS C.2 which requires disarming the associated CRD within 4 hours.
3	3	C (ALL) MC (BOP)	A leak develops in the CAS (Control and Service Air) system resulting in lowering CAS pressure. The CRS enters ABN-CAS. The standby CAS compressors fail to auto start and must be started manually (BOP). CAS header pressure initially rises following the manual start of the standby CAS compressors. The CAS leak will then grow in size causing CAS header pressure to again lower. The CRS directs manually opening the feedwater startup flow control valves (ATC) in anticipation of losing all air. The CRS will set a key parameter for CAS pressure which will result in manual scram actions.

4	-	M (ALL)	Without any means to restore CAS header pressure, the CRS will direct a manual reactor scram. An electric ATWS occurs after the Reactor Mode Switch is placed in shutdown. Alternate Rod Insertion (ARI) will not be successful. The crew will respond IAW PPM 5.1.1 (RPV Control) and PPM 5.1.2 (RPV Control – ATWS). PPM 5.1.1 (Table A1) directs the following: Stop and prevent of injection into the RPV with the exception of CRD, SLC and RCIC (CT-1); Inject boron with SLC (CT-2); and Inhibit ADS. SLC-P-1A trips on overcurrent after running for 1 minute. Removing the applicable RPS fuses per PPM 5.5.11 (Alternate Control Rod Insertions) inserts all control rods.
5	-	C, MC (BOP)	When reactor water level lowers below -50" while intentionally lowering level under ATWS conditions, FDR-V-4 (Drywell Floor Drain Outboard Discharge PCIV) fails to auto close. BOP manually closes FDR-V-4.
6	6	M (ALL)	After all rods are in (upon pulling RPS fuses) and the crew has transitioned to PPM 5.1.1 RPV Control, TR-S (Startup Transformer) experiences a lockout. DG-3 output breaker fails to auto close following the lockout and cannot be manually closed making HPCS unavailable. The loss of condensate and feedwater requires that RPV level control be shifted to RCIC.
7	7	C (CRS, BOP) MC (BOP)	MS-RV-1C (Main Steam Relief Valve 1C) inadvertently opens causing an uncontrolled RPV pressure reduction. The CRS enters ABN-SRV and directs placing the control switch for MS-RV-1C to OFF (BOP).
8	-	C, MC (ATC)	Due to the loss of feed and condensate, and with HPCS unavailable, ATC will use RCIC for RPV level control. When ATC restarts RCIC for level control, RCIC-V-13 fails to auto open. ATC manually opens RCIC-V-13 to restore RPV level to the directed band.
* (N)ormal (R)eactivity (I)nstrument (C)omponent (M)ajor (MC)Manual Control (TS)Technical Specifications			

Target Quantitative Attributes	Actual	Description
Events after EOP entry (1-2)	**3**	TR-S Lockout / MS-RV-1C Inadvertently Opens / RCIC-V-13 Fails to Auto Open
Abnormal events (2-4)	**3**	ABN-ROD / ABN-CAS / ABN-SRV
Major transients (1-2)	**2**	Manual Scram with Electric ATWS / Startup Transformer (TR-S) Lockout
EOPs entered/requiring substantive actions (1-2)	**1**	PPM 5.1.1 (RPV Control)
Entry into a contingency EOP with substantive actions (≥ 1 per scenario set)	**1**	PPM 5.1.2 (RPV Control – ATWS)
Pre-identified Critical tasks (≥ 2)	**2**	See Critical Task Sheets.

Facility:	Columbia Generating Station	Scenario No.: 3	Op Test No.:
Examiners:		Operators:	

Initial Conditions:	Columbia is operating at 100% power. CRD-P-1B is tagged out for coupling repairs and is expected back in service next shift.
Turnover:	No evolutions scheduled for this shift.

Critical Tasks:

CT-1	With CRD pressure LT 940 psig and two or more control rod accumulator trouble alarms in, initiate a manual scram within 20 minutes of CRD pressure LT 940 psig. (With a loss of both CRD pumps it would be acceptable for the crew to determine that the accumulator trouble alarms are due to low accumulator pressure, therefore it is not required for the crew to wait on a report from a field operator to perform a manual reactor scram.
CT-2	With a loss of all Reactor Water Level Indication from the main control room: Per PPM 5.1.6 Reactor pressure is lowered using SRV's (or Bypass Valves) and there is an injection source lined up and flow is established to the RPV (PPM 5.1.6 Table L1).

NOTE: (Per NUREG-1021, Appendix D) If an operator or the Crew significantly deviates from or fails to follow procedures that affect the maintenance of basic safety functions, those actions may form the basis of a CT identified in the post-scenario review."

Event No.	Trigger	Event Type*	Event Description
1	1	C (BOP, CRS) TS (CRS)	DG-1 will spuriously start and will have severe voltage oscillations. 2 Minutes after spurious start the alarm will come in for DG-1 high vibrations. The crew will take actions to trip DG-1 (per OI-9 Transient Acts). The CRS will evaluate TS and declare 3.8.1B AC sources Operating, perform SR 3.8.1.1 for operable offsite circuits with in 1 hour and restore DG to operable status in 72 hours.
2	2	TS (CRS)	RCIC Turbine experiences a spurious Mechanical over speed trip. The CRS will enter ABN-RCIC-ISOL/TRIP and perform actions to attempt to restore. The CRS will evaluate TS and declare LCO 3.5.3 condition A to verify HPCS operable immediately and restore RCIC to an operable status in 14 Days.
3	3	I, MC (ATC)	CRD-FC-600 slowly fails upscale in automatic. ATC will take manual control of CRD-FC-600 to restore CRD parameters to normal.
4	4	C (CRS, ATC)	MSE with Excess flow check valve closures. CRS enters ABN-INSTRUMENTATION and ABN-EARTHQUAKE to evaluate the loss of level and pressure instrumentation. ATC will verify available level instruments; BOP will perform actions for ABN-EARTHQUAKE. RBM Critical NUMAC failure results in selecting an edge rod and bypassing RBM-B.
5	5	M (ALL)	CRD-P-1A will experience a slow failure resulting in lowering CRD pressure (with multiple accumulator alarms) the CRS will enter ABN-CRD and take action to manually scram the reactor (**CT-1**). (Charging header pressure cannot be restored to GE 940 psig within 20 minutes with steam dome pressure GE 900 psig). On scram 6 Rods will fail to insert, reactor power will be LT 1%. CRS will enter PPM 5.1.1 RPV Control and transition to PPM 5.1.2 RPV Control ATWS.

6	-	C, MC (BOP)	On Turbine trip and electric plant transfer Breaker S-1 Fails to auto close, BOP will manually close breaker S-1 and re-power SL-11 per SOP-ELEC-480V-OPS-QC.
7	7	I (ALL)	OBE Earthquake results in further excess flow check valve closures. The CRS and ATC will evaluate ABN-INSTRUMENTATION and declare that all level instrumentation has been lost. ATC will perform SOP-RXSD-DETERMINATION-QC to determine that the reactor is shut down under existing control rod pattern, the CRS will transition to PPM 5.1.6 RPV Flooding. Crew will open 7 SRVs and inject to the RPV per PPM 5.1.6 RPV Flooding ATWS. (**CT-2**). Crew will align an injection source and ensure flooded to the main steam lines.

* (N)ormal (R)eactivity (I)nstrument (C)omponent (M)ajor (MC)Manual Control (TS)Technical Specifications

Target Quantitative Attributes	Actual	Description
Events after EOP entry (1-2)	**2**	S-1 Breaker fails to auto close / OBE loss of instrumentation.
Abnormal events (2-4)	**3**	ABN-INSTRUMENTATION / ABN-EARTHQUAKE / ABN-CRD
Major transients (1-2)	**1**	Scram on loss of CRD pressure
EOPs entered/requiring substantive actions (1-2)	**2**	PPM 5.1.1 RPV Control / PPM 5.1.2 RPV Control ATWS
Entry into a contingency EOP with substantive actions (≥ 1 per scenario set)	**1**	PPM 5.1.6 RPV Flooding ATWS
Pre-identified Critical tasks (≥ 2)	**2**	See Critical Task Sheets

Facility:	Columbia Generating Station	Scenario No.: 4 **Spare Scenario**	Op Test No.:
Examiners:		Operators:	

Initial Conditions:	Columbia is operating at 100% power. RWCU-DM-1B is removed from service for planned backwash/precoat.
Turnover:	Following shift turnover, you have been directed to swap operating WMA fans for run time equalization. Start WMA-FN-51A and secure WMA-FN51B. Pre-requisites 3.1, 3.2, 3.3, 3.4, 3.5 and 3.6 of SOP-HVAC/CR-OPS have been previously completed by the off-going crew.

Critical Tasks:

CT-1	With both ASD inverters on battery power and normal power cannot be restored Scram the reactor within 20 minutes of loss of normal power to ASD Inverters.
CT-2	With suppression pool water level lowering, take actions to make up to the wetwell to prevent emergency depressurization. (Emergency depressurization would be required when WW level cannot be restored and maintained GT 19'2")

NOTE: An unintentional or unnecessary RPS or ESF actuation may result in the creation of a post-scenario Critical Task, if that actuation results in a significant plant degradation or significantly alters a mitigation strategy.

Event No.	Trigger	Event Type*	Event Description
1	1	C (CRS / BOP) TS (CRS)	During the performance of this evolution WMA-AD-51A1 control power fuse blows charring the fuse block resulting in inability to swap the fans. The operator backs out from the procedure and does not secure WMA-FN-51B SRO Evaluates Tech Specs and enters LCO 3.7.3 Condition A (restore CREF in 7 days) and LCO 3.7.4 condition A (restore CR AC subsystem in 30 days)
2	2	C (CRS) C, MC (ATC)	Crew receives a call from the Radwaste tool crib attendant who reports a large puddle of water in the service air compressor area. The Crew will enter ABN-FLOODING. The flooding causes a ground in MC-6B resulting in an overcurrent trip of SL-63. After the bus loss RRC-P-1A fails to automatically run back to 51HZ. The RWCR operator reports that during the performance of RWCU backwash and precoat, RWCU-TK-2 overflowed, and the flooding has been stopped.
3	3	R (ATC) R, TS (CRS)	RRC-P-1A trips - CRS enters ABN-RRC-LOSS, ABN-CORE and ABN-POWER and directs ATC actions to reduce rodline below 80% per ABN-RRC-LOSS. The CRS will evaluate TS and declare LCO 3.4.1B1 and declare Loop A not in operation in 2 hours.
4	4	M (ALL)	Continued ASD electrical problems result in a loss of E-PP-ASD 1/3. With both inverters on battery power the crew will manually Scram the reactor per ABN-ASD-INV. **(CT-1)**
5		C (CRS / BOP)	Following the scram and automatic turbine trip. After BPV fast opening occurs, Bypass valve 1 will stick in the open position (Will not be controlled by servo valve). Operators will be unsuccessful is manually closing the bypass valve from DEH control panel. Crew will be required to take actions to fast close the MSIV's prior to 500# per ABN-PRESSURE and use SRV's for pressure control.

6		C (ATC)	Following scram when aligning to the startup flow control valves. RFW-LIC-620 auto function is failed (cannot place RFC-LIC-620 in automatic mode of operation). ATC will be forced to manually control reactor water level using the start up flow control valves both before and after MSIV closure.
7	7	C (CRS / BOP)	Following plant stabilization after the scram, the air line for REA-V-1 will break, this resulting in REA-V-1 closure. Secondary containment DP alarm will come in and the crew will take action to start SGT to restore secondary containment per ABN-HVAC and annunciator response procedures.
8	8	M (ALL)	The plant will experience an OBE earthquake with a suppression pool wall break. Level in the suppression pool will lower and the crew will take actions to make up to the wetwell per PPM 5.5.23 using HPCS to prevent a required emergency depressurization per PPM 5.2.1 Primary Containment Control.

* (N)ormal (R)eactivity (I)nstrument (C)omponent (M)ajor (MC)Manual Control (TS)Technical Specifications

Target Quantitative Attributes	Actual	Description
Events after EOP entry (1-2)	**4**	RFW-LIC-620 Auto Failure / BPV 1 Fails open / REA-V-1 Closure / WW Leak
Abnormal events (2-4)	**5**	ABN-FLOODING / ABN-RRC-LOSS / ABN-POWER / ABN-ASD-INV / ABN-PRESSURE
Major transients (1-2)	**2**	ABN-ASD-INV Scram / WW Leak into CRD pump room
EOPs entered/requiring substantive actions (1-2)	**2**	PPM 5.1.1 RPV Control / PPM 5.2.1 Primary Containment Control
Entry into a contingency EOP with substantive actions (≥ 1 per scenario set)	**0**	
Pre-identified Critical tasks (≥ 2)	**2**	See Critical Task Sheets