

Facility: Byron Station, Units 1 and 2														Date of Exam: December 2017					
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	3	3	3	N/A			3	3	N/A			3	18	3	3	6		
	2	1	1	2	N/A			2	2	N/A			1	9	2	2	4		
	Tier Totals	4	4	5	N/A			5	5	N/A			4	27	5	5	10		
2. Plant Systems	1	3	2	3	3	2	2	3	3	3	2	2	28	2	3	5			
	2	1	0	1	1	1	1	1	1	1	1	1	10	N/A	2	1	3		
	Tier Totals	4	2	4	4	3	3	4	4	4	3	3	38	4	4	8			
3. Generic Knowledge and Abilities Categories					1		2		3		4		10		1	2	3	4	7
					3		2		2		3				2	2	1	2	

- Note: 1. Ensure that at least two topics from every applicable K/A category are sampled within each tier of the RO and SRO-only outline sections (i.e., except for one category in Tier 3 of the SRO-only section, the "Tier Totals" in each K/A category shall not be less than two). (One Tier 3 radiation control K/A is allowed if it is replaced by a K/A from another Tier 3 category.)
2. The point total for each group and tier in the proposed outline must match that specified in the table. The final point total for each group and tier may deviate by ±1 from that specified in the table based on NRC revisions. The final RO exam must total 75 points, and the SRO-only exam must total 25 points.
3. Systems/evolutions within each group are identified on the outline. Systems or evolutions that do not apply at the facility should be deleted with justification. Operationally important, site-specific systems/evolutions that are not included on the outline should be added. Refer to Section D.1.b of ES-401 for guidance regarding the elimination of inappropriate K/A statements.
4. Select topics from as many systems and evolutions as possible. Sample every system or evolution in the group before selecting a second topic for any system or evolution.
5. Absent a plant-specific priority, only those K/As having an importance rating (IR) of 2.5 or higher shall be selected. Use the RO and SRO ratings for the RO and SRO-only portions, respectively.
6. Select SRO topics for Tiers 1 and 2 from the shaded systems and K/A categories.
7. The generic (G) K/As in Tiers 1 and 2 shall be selected from Section 2 of the K/A catalog, but the topics must be relevant to the applicable evolution or system. Refer to Section D.1.b of ES-401 for the applicable K/As.
8. On the following pages, enter the K/A numbers, a brief description of each topic, the topics' IRs for the applicable license level, and the point totals (#) for each system and category. Enter the group and tier totals for each category in the table above. If fuel-handling equipment is sampled in a category other than Category A2 or G* on the SRO-only exam, enter it on the left side of Column A2 for Tier 2, Group 2. (Note 1 does not apply). Use duplicate pages for RO and SRO-only exams.
9. For Tier 3, select topics from Section 2 of the K/A catalog and enter the K/A numbers, descriptions, IRs, and point totals (#) on Form ES-401-3. Limit SRO selections to K/As that are linked to 10 CFR 55.43.

G* Generic K/As

* These systems/evolutions must be included as part of the sample (as applicable to the facility) when Revision 3 of the K/A catalog is used to develop the sample plan. They are not required to be included when using earlier revisions of the K/A catalog.

** These systems/evolutions may be eliminated from the sample (as applicable to the facility) when Revision 3 of the K/A catalog is used to develop the sample plan.

ES-401		PWR Examination Outline						Form ES-401-2	
Emergency and Abnormal Plant Evolutions—Tier 1/Group 1 (RO/SRO)									
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
000007 (EPE 7; BW E02&E10; CE E02) Reactor Trip, Stabilization, Recovery / 1	.03						Knowledge of the operational implications of the following concepts as they apply to the reactor trip: Reasons for closing the main turbine governor valve and the main turbine stop valve after a reactor trip	3.7	1
					.03		Ability to determine or interpret the following as they apply to a reactor trip: Reactor trip breaker position	4.2	76
000008 (APE 8) Pressurizer Vapor Space Accident / 3									
000009 (EPE 9) Small Break LOCA / 3						2.2.4	Ability to explain the variations in control board/control room layouts, systems, instrumentation, and procedural actions between units at a facility.	3.6	77
000011 (EPE 11) Large Break LOCA / 3		.02					Knowledge of the interrelations between the Large Break LOCA and the following: Pumps	2.6	2
000015 (APE 15) Reactor Coolant Pump Malfunctions / 4						2.1.23	Ability to perform specific system and integrated plant procedures during all modes of plant operation.	4.3	3
000022 (APE 22) Loss of Reactor Coolant Makeup / 2			.01				Knowledge of the reasons for the following responses as they apply to the Loss of Reactor Coolant Makeup: Adjustment of RCP seal backpressure regulator valve to obtain normal flow	2.7	4
000025 (APE 25) Loss of Residual Heat Removal System / 4					.04		Ability to determine and interpret the following as they apply to the Loss of Residual Heat Removal System: Location and isolability of leaks	3.3	5
000026 (APE 26) Loss of Component Cooling Water / 8			.01				Knowledge of the reasons for the following responses as they apply to the Loss of Component Cooling Water: The conditions that will initiate the automatic opening and closing of the SWS isolation valves to the CCWS coolers	3.2	6
000027 (APE 27) Pressurizer Pressure Control System Malfunction / 3	.02						Knowledge of the operational implications of the following concepts as they apply to Pressurizer Pressure Control Malfunctions: Expansion of liquids as temperature increases	2.8	7

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E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
						2.2.39	Knowledge of less than or equal to one hour Technical Specification action statements for systems.	4.5	78
000029 (EPE 29) Anticipated Transient Without Scram / 1					.04		Ability to determine or interpret the following as they apply to a ATWS: CVCS centrifugal charging pump operating indication	3.2	8
					.05		Ability to determine or interpret the following as they apply to a ATWS: System component valve position indications	3.4	79
000038 (EPE 38) Steam Generator Tube Rupture / 3	.04						Knowledge of the operational implications of the following concepts as they apply to the SGTR: Reflux boiling	3.1	9
000040 (APE 40; BW E05; CE E05; W E12) Steam Line Rupture—Excessive Heat Transfer / 4									
000054 (APE 54; CE E06) Loss of Main Feedwater / 4				.01			Ability to operate and / or monitor the following as they apply to the Loss of Main Feedwater (MFW): AFW controls, including the use of alternate AFW sources	4.5	10
000055 (EPE 55) Station Blackout / 6			.02				Knowledge of the reasons for the following responses as they apply to the Station Blackout: Actions contained in EOP for loss of offsite and onsite power	4.3	11
000056 (APE 56) Loss of Offsite Power / 6									
000057 (APE 57) Loss of Vital AC Instrument Bus / 6						2.2.36	Ability to analyze the effect of maintenance activities, such as degraded power sources, on the status of limiting conditions for operations.	3.1	12
000058 (APE 58) Loss of DC Power / 6				.01			Ability to operate and / or monitor the following as they apply to the Loss of DC Power: Cross-tie of the affected dc bus with the alternate supply	3.4	13

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E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
000062 (APE 62) Loss of Nuclear Service Water / 4				.07			Ability to operate and / or monitor the following as they apply to the Loss of Nuclear Service Water (SWS): Flow rates to the components and systems that are serviced by the SWS; interactions among the components	2.9	14
000065 (APE 65) Loss of Instrument Air / 8						2.2, 3.7	Ability to determine operability and/or availability of safety related equipment.	3.6	15
					.07		Ability to determine and interpret the following as they apply to the Loss of Instrument Air: Whether backup nitrogen supply is controlling valve position	3.2	80
000077 (APE 77) Generator Voltage and Electric Grid Disturbances / 6		.02					Knowledge of the interrelations between Generator Voltage and Electric Grid Disturbances and the following: Breakers, relays	3.1	16
						2.240	Ability to apply Technical Specifications for a system.	4.7	81
(W E04) LOCA Outside Containment / 3									
(W E11) Loss of Emergency Coolant Recirculation / 4					2.1		Ability to determine and interpret the following as they apply to the (Loss of Emergency Coolant Recirculation): Facility conditions and selection of appropriate procedures during abnormal and emergency operations.	3.4	17
(BW E04; W E05) Inadequate Heat Transfer—Loss of Secondary Heat Sink / 4		2.2					Knowledge of the interrelations between the (Loss of Secondary Heat Sink) and the following: Facility*s heat removal systems, including primary coolant, emergency coolant, the decay heat removal systems, and relations between the proper operation of these systems to the operation of the facility.	3.9	18
K/A Category Totals:	3	3	3	3	3	3	Group Point Total:		18
					3	3			6

ES-401		PWR Examination Outline						Form ES-401-2	
Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO/SRO)									
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
000001 (APE 1) Continuous Rod Withdrawal / 1									
000003 (APE 3) Dropped Control Rod / 1	.21						Knowledge of the operational implications of the following concepts as they apply to Dropped Control Rod: Delta flux (ΔI).	2.7	19
000005 (APE 5) Inoperable/Stuck Control Rod / 1			.05				Knowledge of the reasons for the following responses as they apply to the Inoperable/Stuck Control Rod: Power limits on rod misalignment	3.4	20
000024 (APE 24) Emergency Boration / 1						2.125	Ability to interpret reference materials, such as graphs, curves, tables, etc.	3.9	21
000028 (APE 28) Pressurizer (PZR) Level Control Malfunction / 2									
000032 (APE 32) Loss of Source Range Nuclear Instrumentation / 7		.01					Knowledge of the interrelations between the Loss of Source Range Nuclear Instrumentation and the following: Power supplies, including proper switch positions	2.7	22
000033 (APE 33) Loss of Intermediate Range Nuclear Instrumentation / 7					.08		Ability to determine and interpret the following as they apply to the Loss of Intermediate Range Nuclear Instrumentation: Intermediate range channel operability	3.3	23
000036 (APE 36; BW/A08) Fuel-Handling Incidents / 8									
000037 (APE 37) Steam Generator Tube Leak / 3					.09		Ability to determine and interpret the following as they apply to the Steam Generator Tube Leak: System status, using independent readings from redundant Condensate air ejector exhaust monitor	3.4	82
000051 (APE 51) Loss of Condenser Vacuum / 4			.01				Knowledge of the reasons for the following responses as they apply to the Loss of Condenser Vacuum: Loss of steam dump capability upon loss of condenser vacuum	2.8	24

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Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO/SRO)									
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
(W E13) Steam Generator Overpressure / 4									
(W E15) Containment Flooding / 5									
(W E16) High Containment Radiation / 9									
(BW A01) Plant Runback / 1									
(BW A02 & A03) Loss of NNI-X/Y/7									
(BW A04) Turbine Trip / 4									
(BW A05) Emergency Diesel Actuation / 6									
(BW A07) Flooding / 8									
(BW E03) Inadequate Subcooling Margin / 4									
(BW E08; W E03) LOCA Cooldown—Depressurization / 4					2.1		Ability to determine and interpret the following as they apply to the (LOCA Cooldown and Depressurization): Facility conditions and selection of appropriate procedures during abnormal and emergency operations.	3.4	27

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Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO/SRO)									
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
(BW E09; CE A13**; W E09 & E10) Natural Circulation/4									
(BW E13 & E14) EOP Rules and Enclosures									
(CE A11**; W E08) RCS Overcooling—Pressurized Thermal Shock / 4									
(CE A16) Excess RCS Leakage / 2									
(CE E09) Functional Recovery									
(CE E13*) Loss of Forced Circulation/LOOP/Blackout / 4									
K/A Category Point Totals:	1	1	2	2	2	1	Group Point Total:		9
					2	2			4

ES-401	PWR Examination Outline Plant Systems—Tier 2/Group 1 (RO/SRO)											Form ES-401-2		
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
003 (SF4P RCP) Reactor Coolant Pump			.03									Knowledge of the effect that a loss or malfunction of the RCPS will have on the following: Feedwater and emergency feedwater	2.8	28
									.01			Ability to monitor automatic operation of the RCPS, including: Seal injection flow	3.3	29
004 (SF1; SF2 CVCS) Chemical and Volume Control									.18			Ability to monitor automatic operation of the CVCS, including: Interpretation of letdown orifice isolation valve position indicators	2.8	30
005 (SF4P RHR) Residual Heat Removal							.07					Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the RHRs controls including: Determination of test acceptability by comparison of recorded valve response times with Tech-Spec requirements	2.5	31
											2.1.30	Ability to locate and operate components, including local controls.	4.4	32
006 (SF2; SF3 ECCS) Emergency Core Cooling					.10							Knowledge of the operational implications of the following concepts as they apply to ECCS: Theory of thermal stress		33
								.10				Ability to (a) predict the impacts of the following malfunctions or operations on the ECCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Low boron concentration in SIS		86
007 (SF5 PRTS) Pressurizer Relief/Quench Tank			.01									Knowledge of the effect that a loss or malfunction of the PRTS will have on the following: Containment	3.3	34
									.01			Ability to monitor automatic operation of the PRTS, including: Components which discharge to the PRT	2.7	35

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System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
008 (SF8 CCW) Component Cooling Water	.02											Knowledge of the physical connections and/or cause-effect relationships between the CCWS and the following systems: Loads cooled by CCWS	3.3	36
010 (SF3 PZR PCS) Pressurizer Pressure Control						.02						Knowledge of the effect of a loss or malfunction of the following will have on the PZR PCS: PZR	3.2	37
012 (SF7 RPS) Reactor Protection								.06				Ability to (a) predict the impacts of the following malfunctions or operations on the RPS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Failure of RPS signal to trip the reactor	4.4	38
013 (SF2 ESFAS) Engineered Safety Features Actuation		.01										Knowledge of bus power supplies to the following: ESFAS/safeguards equipment control	3.6	39
								.06				Ability to (a) predict the impacts of the following malfunctions or operations on the ESFAS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Inadvertent ESFAS actuation	3.7	40
022 (SF5 CCS) Containment Cooling			.01									Knowledge of the effect that a loss or malfunction of the CCS will have on the following: Containment equipment subject to damage by high or low temperature, humidity, and pressure	2.9	41
											2.2.22	Knowledge of limiting conditions for operations and safety limits.	4.7	87
025 (SF5 ICE) Ice Condenser														
026 (SF5 CSS) Containment Spray	.01											Knowledge of the physical connections and/or cause effect relationships between the CSS and the following systems: ECCS	4.2	42
											2.4.2	Knowledge of system set points, interlocks and automatic actions associated with EOP entry conditions.	4.5	43

ES-401	PWR Examination Outline Plant Systems—Tier 2/Group 1 (RO/SRO)											Form ES-401-2		
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
039 (SF4S MSS) Main and Reheat Steam					.01							Knowledge of the operational implications of the following concepts as the apply to the MRSS: Definition and causes of steam/water hammer	2.9	44
				.02								Knowledge of MRSS design feature(s) and/or interlock(s) which provide for the following: Utilization of T-ave. program control when steam dumping through atmospheric relief/dump valves, including T-ave. limits	3.1	45
059 (SF4S MFW) Main Feedwater										.08		Ability to manually operate and monitor in the control room: Feed regulating valve controller	3.0	46
061 (SF4S AFW) Auxiliary/Emergency Feedwater							.01					Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the AFW controls including: S/G level	3.9	47
062 (SF6 ED AC) AC Electrical Distribution				.02								Knowledge of ac distribution system design feature(s) and/or interlock(s) which provide for the following: Circuit breaker automatic trips	2.5	48
								.03				Ability to (a) predict the impacts of the following malfunctions or operations on the AC distribution system; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Consequences of improper sequencing when transferring to or from an inverter	2.9	49
063 (SF6 ED DC) DC Electrical Distribution							.01					Ability to predict and/or monitor changes in parameters associated with operating the DC electrical system controls including: Battery capacity as it is affected by discharge rate	2.5	50
064 (SF6 EDG) Emergency Diesel Generator						.07						Knowledge of the effect of a loss or malfunction of the following will have on the ED/G system: Air receivers	2.7	51
073 (SF7 PRM) Process Radiation Monitoring										.01		Ability to manually operate and/or monitor in the control room: Effluent release	3.9	52

ES-401	PWR Examination Outline Plant Systems—Tier 2/Group 1 (RO/SRO)											Form ES-401-2		
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
											2.4.35	Knowledge of local auxiliary operator tasks during an emergency and the resultant operational effects.	4.0	88
076 (SF4S SW) Service Water	.16											Knowledge of the physical connections and/or cause- effect relationships between the SWS and the following systems: ESF	3.6	53
								.02				Ability to (a) predict the impacts of the following malfunctions or operations on the SWS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Service water header pressure	2.7	89
078 (SF8 IAS) Instrument Air			.02									Knowledge of IAS design feature(s) and/or interlock(s) which provide for the following: Cross-over to other air systems	3.2	54
		.01										Knowledge of bus power supplies to the following: Instrument air compressor		55
103 (SF5 CNT) Containment											2.4.34	Knowledge of RO tasks performed outside the main control room during an emergency and the resultant operational effects.	4.1	90
053 (SF1; SF4P ICS*) Integrated Control														
K/A Category Point Totals:	3	2	3	3	2	2	3	3	3	2	2	Group Point Total:		28
								2			3			5

ES-401	PWR Examination Outline											Form ES-401-2		
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	#
075 (SF8 CW) Circulating Water											2.1.32	Ability to explain and apply system limits and precautions.	4.0	93
079 (SF8 SAS**) Station Air														
086 Fire Protection									.01			Ability to monitor automatic operation of the Fire Protection System including: Starting mechanisms of fire water pumps	2.9	65
050 (SF 9 CRV*) Control Room Ventilation														
K/A Category Point Totals:	1	0	1	1	1	1	1	1	1	1	1	Group Point Total:		10
								2			1			3

Facility: Byron Station, Units 1 and 2		Date of Exam: December 2017				
Category	K/A #	Topic	RO		SRO-only	
			IR	#	IR	#
1. Conduct of Operations	2.1.5	Ability to use procedures related to shift staffing, such as minimum crew complement, overtime limitations, etc.	2.9	66		
	2.1.17	Ability to make accurate, clear, and concise verbal reports.	3.9	67		
	2.1.27	Knowledge of system purpose and/or function.	3.9	68		
	2.1.26	Knowledge of industrial safety procedures (such as rotating equipment, electrical, high temperature, high pressure, caustic, chlorine, oxygen and hydrogen).			3.6	94
	2.1.36	Knowledge of procedures and limitations involved in core alterations.			4.1	95
	Subtotal				3	2
2. Equipment Control	2.2.15	Ability to determine the expected plant configuration using design and configuration control documentation, such as drawings, line-ups, tag-outs, etc.	3.9	69		
	2.2.17	Knowledge of the process for managing maintenance activities during power operations, such as risk assessments, work prioritization, and coordination with the transmission system operator.	2.6	70		
	2.2.19	Knowledge of maintenance work order requirements.			3.4	96
	2.2.20	Knowledge of the process for managing troubleshooting activities.			3.8	97
	Subtotal				2	2
3. Radiation Control	2.3.4	Knowledge of radiation exposure limits under normal or emergency conditions.	3.2	71		
	2.3.5	Ability to use radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc.	2.9	72		
	2.3.15	Knowledge of radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc.			3.1	98
	Subtotal				2	1
4. Emergency Procedures/Plan	2.4.9	Knowledge of EOP mitigation strategies.	3.7	73		
	2.4.30	Knowledge of events related to system operation/status that must be reported to internal organizations or external agencies, such as the State, the NRC, or the transmission system operator.	2.7	74		
	2.4.50	Ability to verify system alarm setpoints and operate controls identified in the alarm response manual.	4.2	75		
	2.4.25	Knowledge of fire protection procedures.			3.7	99
	2.4.41	Knowledge of the emergency action level thresholds and classifications.			4.6	100
	Subtotal				3	2
Tier 3 Point Total				10		7