

Facility: Byron Nuclear Generating Station														Date of Exam: September 2021					
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	1	N/A			2	2	N/A			2	9	2	2	4		
	Tier Totals	4	4	4	N/A			5	5	N/A			5	27	5	5	10		
2. Plant Systems	1	2	2	3	2	2	3	3	3	3	3	3	2	28	3	2	5		
	2	1	0	1	1	1	1	1	1	1	1	1	1	10	0	2	3		
	Tier Totals	3	2	4	3	3	4	4	4	4	4	4	3	38	5	3	8		
3. Generic Knowledge and Abilities Categories					1		2		3		4		10		1	2	3	4	7
					3		3		2		2				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)									
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					EK2.03 – Knowledge of the interrelations between a reactor trip and the following: Reactor trip status panel. (CFR: 41.7 / 45.7)	3.5	1
000008 (APE 8) Pressurizer Vapor Space Accident / 3			05				AK3.05 – Knowledge of the reasons for the following responses as they apply to the Pressurizer Vapor Space Accident: ECCS termination or throttling criteria. (CFR: 41.5, 10 / 45.6, 13)	4.0	2
000009 (EPE 9) Small Break LOCA / 3									
000011 (EPE 11) Large Break LOCA / 3				03			EA1.03 – Ability to operate and monitor the following as they apply to a Large Break LOCA: Securing of RCPs. (CFR: 41.7 / 45.5, 6)	4.0	3
000015 (APE 15) Reactor Coolant Pump Malfunctions / 4									
000022 (APE 22) Loss of Reactor Coolant Makeup / 2									
000025 (APE 25) Loss of Residual Heat Removal System / 4					03		AA2.03 – Ability to determine and interpret the following as they apply to the Loss of Residual Heat Removal System: Increasing reactor building sump level. (CFR: 43.5 / 45.13)	3.6	4
000026 (APE 26) Loss of Component Cooling Water / 8						04.04	G2.4.4 – Ability to recognize abnormal indications for system operating parameters that are entry-level conditions for emergency and abnormal operating procedures. (CFR: 41.10 / 43.2 / 45.6)	4.5	5
000027 (APE 27) Pressurizer Pressure Control System Malfunction / 3	03						AK1.03 – Knowledge of the operational implications of the following concepts as they apply to Pressurizer Pressure Control Malfunctions: Latent heat of vaporization/condensation. (CFR: 41.8, 10 / 45.3)	2.6	6
000029 (EPE 29) Anticipated Transient Without Scram / 1		06					EK2.06 – Knowledge of the interrelations between the and the following an ATWS: Breakers, relays, and disconnects. (CFR: 41.7 / 45.7)	2.9	7
000038 (EPE 38) Steam Generator Tube Rupture / 3			06				EK3.06 - Knowledge of the reasons for the following responses as they apply to the SGTR: Actions contained in EOP for RCS water inventory balance, S/G tube rupture, and plant shutdown procedures. (CFR: 41.5, 10 / 45.6, 13)	4.2	8
000040 (APE 40; BW E05; CE E05; W E12) Steam Line Rupture—Excessive Heat Transfer / 4				02			WE12 EA1.2 – Ability to operate and/or monitor the following as they apply to the (Uncontrolled Depressurization of all Steam Generators): Operating behavior characteristics of the facility. (CFR: 41.7 / 45.5, 6)	3.6	9
000054 (APE 54; CE E06) Loss of Main Feedwater / 4					02		AA2.02 – Ability to determine and interpret the following as they apply to the Loss of Main Feedwater (MFW): Differentiation between loss of all MFW and trip of one MFW pump. (CFR: 43.5 / 45.13)	4.1	10
000055 (EPE 55) Station Blackout / 6						04.35	G2.4.35 – Knowledge of local auxiliary operator tasks during an emergency and the resultant operational effects (CFR: 41.10 / 43.5 / 45.13)	3.8	11
000056 (APE 56) Loss of Offsite Power / 6	04						AK1.04 – Knowledge of the operational implications of the following concepts as they apply to Loss of Offsite Power: Definition of saturation conditions, implication for the systems. (CFR: 41.8, 10 / 45.3)	3.1	12
000057 (APE 57) Loss of Vital AC Instrument Bus / 6			01				AK3.01 – Knowledge of the reasons for the following responses as they apply to the Loss of Vital AC Instrument Bus: Actions contained in EOP for loss of vital AC electrical instrument bus. (CFR: 41.5, 10 / 45.6, 13)	4.1	13
000058 (APE 58) Loss of DC Power / 6									
000062 (APE 62) Loss of Nuclear Service Water / 4				06			AA1.06 – Ability to operate and/or monitor the following as they apply to the Loss of Nuclear Service Water (SWS): Control of flow rates to components cooled by the SWS (CFR: 41.7 / 45.5, 6)	2.9	14
000065 (APE 65) Loss of Instrument Air / 8					08		AA2.08 – Ability to determine and interpret the following as they apply to the Loss of Instrument Air: Failure modes of air-operated equipment (CFR: 43.5 / 45.13)	2.9	15

000077 (APE 77) Generator Voltage and Electric Grid Disturbances / 6	03						AK2.03 – Knowledge of the interrelations between Generator Voltage and Electric Grid Disturbances and the following: Sensors, detectors, indicators. (CFR: 41.4, 5, 7, 10 / 45.8)	3.0	16
(W E04) LOCA Outside Containment / 3									
(W E11) Loss of Emergency Coolant Recirculation / 4						04.31	G2.4.31 – Knowledge of annunciator alarms, indications, or response procedures. (CFR: 41.10 / 45.3)	4.2	17
(BW E04; W E05) Inadequate Heat Transfer—Loss of Secondary Heat Sink / 4	03						WE05 EK1.3 – Knowledge of the operational implications of the following concepts as they apply to the (Loss of Secondary Heat Sink): Annunciators and conditions indicating signals, and remedial actions associated with the (Loss of Secondary Heat Sink) (CFR: 41.8, 10 / 45.3)	3.9	18
K/A Category Totals:	3	3	3	3	3	3	Group Point Total:		18

(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										
(BW E09; CE A13**; W E09 & E10) Natural Circulation/4										
(BW E13 & E14) EOP Rules and Enclosures										
(CE A14**; W E08) RCS Overcooling— Pressurized Thermal Shock / 4						01. 25	G2.1.25 – Ability to interpret reference materials, such as graphs, curves, tables, etc. (CFR: 41.10 / 43.5 / 45.12)	3.9	27	
(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	1	2	2	2	Group Point Total:			9

ES-401		PWR Examination Outline Plant Systems—Tier 2/Group 1 (RO)											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			01									K3.01 – Knowledge of the effect that a loss or malfunction of the RCPS will have on the following: RCS (CFR: 41.7 / 45.6)	3.7	28
004 (SF1; SF2 CVCS) Chemical and Volume Control				14								K4.14 – Knowledge of CVCS design feature(s) and/or interlock(s) which provide for the following: Control interlocks on letdown system (letdown tank bypass valve). (CFR: 41.7)	2.8	29
						20						K6.20 – Knowledge of the effect of a loss or malfunction on the following CVCS components: Function of demineralizer, including boron loading and temperature limits. (CFR: 41.7 / 45.7)	2.5	30
005 (SF4P RHR) Residual Heat Removal					09							K5.09 – Knowledge of the operational implications of the following concepts as they apply to RHRs: Dilution and boration considerations. (CFR: 41.5 / 45.7)	3.2	31
006 (SF2; SF3 ECCS) Emergency Core Cooling						01						K6.01 – Knowledge of the effect of a loss or malfunction on the following will have on the ECCS: BIT/borated water sources. (CFR: 41.7 / 45.7)	3.4	32
							12					A1.12 – Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the ECCS controls including: RHR heatup limits. (CFR: 41.5 / 45.5)	2.9	33
007 (SF5 PRTS) Pressurizer Relief/Quench Tank							02					A1.02 – Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the PRTS controls including: Maintaining quench tank pressure. (CFR: 41.5 / 45.5)	2.7	34
008 (SF8 CCW) Component Cooling Water								05				A2.05 – Ability to (a) predict the impacts of the following malfunctions or operations on the CCWS, and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Effect of loss of instrument and control air on the position of the CCW valves that are air operated. (CFR: 41.5 / 43.5 / 45.3, 13)	3.3	35
010 (SF3 PZR PCS) Pressurizer Pressure Control									02			A3.02 – Ability to monitor automatic operation of the PZR PCS, including PZR pressure. (CFR: 41.7 / 45.5)	3.6	36
012 (SF7 RPS) Reactor Protection										04		A4.04 – Ability to manually operate and/or monitor in the control room: Bistable, trips, reset and test switches. (CFR: 41.7 / 45.5 to 45.8)	3.3	37
013 (SF2 ESFAS) Engineered Safety Features Actuation											01.31	G2.1.31 – Ability to locate control room switches, controls, and indications, and to determine that they correctly reflect the desired plant lineup. (CFR: 41.10 / 45.12)	4.6	38
022 (SF5 CCS) Containment Cooling	01											K1.01 – Knowledge of the physical connections and/or cause-effect relationships between the CCS and the following systems: SWS/cooling systems (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.5	39
			02									K3.02 – Knowledge of the effect that a loss or malfunction of the CCS will have on the following: Containment instrumentation readings. (CFR: 41.7 / 45.6)	3.0	40
025 (SF5 ICE) Ice Condenser														
026 (SF5 CSS) Containment Spray		02										K2.02 – Knowledge of bus power supplies to the following: MOVs. (CFR: 41.7)	2.7	41
039 (SF4S MSS) Main and Reheat Steam			04									K3.04 – Knowledge of the effect that a loss or malfunction of the MRSS will have on the following: MFW pumps. (CFR: 41.7 / 45.6)	2.5	42

059 (SF4S MFW) Main Feedwater				16						03				K4.16 – Knowledge of MFW design feature(s) and/or interlock(s) which provide for the following: Automatic trips for MFW pumps. (CFR: 41.7)	3.1	43
														A3.03 – Ability to monitor automatic operation of the MFW, including: Feedwater pump suction flow pressure. (CFR: 41.7 / 45.5)	2.5	44
061 (SF4S AFW) Auxiliary/Emergency Feedwater				05										K5.05 – Knowledge of the operational implications of the following concepts as they apply to the AFW: Feed line voiding and water hammer (CFR: 41.5 / 45.7)	2.7	45
062 (SF6 ED AC) AC Electrical Distribution								01						A1.01 – Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating AC distribution system control including: Significance of D/G load limits (CFR: 41.5 / 45.5)	3.4	46
									15					A2.15 – 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: Consequence of paralleling out-of-phase/mismatch in volts (CFR: 41.5 / 43.5 / 45.3, 13)	2.8	47
063 (SF6 ED DC) DC Electrical Distribution		01												K2.01 – Knowledge of bus power supplies to the following: Major DC loads (CFR: 41.7)	2.9	48
										01				A2.01 – Ability to (a) predict the impacts of the following malfunctions or operations on the DC electrical systems, and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Grounds. (CFR: 41.5 / 43.5 / 45.3, 13)	2.5	49
064 (SF6 EDG) Emergency Diesel Generator								07						K6.07 – Knowledge of the effect of a loss or malfunction of the following will have on the ED/G system: Air receivers. (CFR: 41.7 / 45.7)	2.7	50
073 (SF7 PRM) Process Radiation Monitoring													02	A4.02 – Ability to manually operate and/or monitor in the control room: Radiation monitoring system control panel (CFR: 41.7 / 45.5 to 45.8)	3.7	51
076 (SF4S SW) Service Water													02	A3.02 – Ability to monitor automatic operation of the SWS, including: Emergency heat loads. (CFR: 41.7 / 45.5)	3.7	52
078 (SF8 IAS) Instrument Air														G2.1.30 – Ability to locate and operate components, including local controls. (CFR: 41.7 / 45.7)	4.4	53
103 (SF5 CNT) Containment		08												K1.08 – Knowledge of the physical connections and/or cause-effect relationships between the containment system and the following systems: SIS, including actions of safety injection reset. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.6	54
													03	A4.03 – Ability to manually operate and/or monitor in the control room: ESF slave relays. (CFR: 41.7 / 45.5 to 45.8)	2.7	55
053 (SF1; SF4P ICS*) Integrated Control																
K/A Category Point Totals:	2	2	3	2	2	3	3	3	3	3	3	3	2	Group Point Total:		28

ES-401	PWR Examination Outline											Form ES-401-2		
Plant Systems—Tier 2/Group 2 (RO)														
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
001 (SF1 CRDS) Control Rod Drive					47							K5.47 – Knowledge of the following operational implications as they apply to the CRDS: Factors affecting SUR: b-eff, l, p (CFR: 41.5 / 45.7)	2.9	56
002 (SF2; SF4P RCS) Reactor Coolant														
011 (SF2 PZR LCS) Pressurizer Level Control						03						K6.03 – Knowledge of the effect of a loss or malfunction on the following will have on the PZR LCS: Relationship between PZR level and PZR heater control circuit. (CFR: 41.7 / 45.7)	2.9	57
014 (SF1 RPI) Rod Position Indication														
015 (SF7 NI) Nuclear Instrumentation							04					A1.04 – Ability to predict and/or monitor changes in parameters (to prevent exceeding design limits) associated with operating the NIS controls including: Quadrant Power Tilt Ratio. (CFR: 41.5 / 45.5)	3.5	58
016 (SF7 NNI) Nonnuclear Instrumentation														
017 (SF7 ITM) In-Core Temperature Monitor														
027 (SF5 CIRS) Containment Iodine Removal														
028 (SF5 HRPS) Hydrogen Recombiner and Purge Control														
029 (SF8 CPS) Containment Purge														
033 (SF8 SFPCS) Spent Fuel Pool Cooling								03				A2.03 – Ability to (a) predict the impacts of the following malfunctions or operations on the Spent Fuel Pool Cooling System; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Abnormal spent fuel pool water level or loss of water level (CFR: 41.5 / 43.5 / 45.3, 13)	3.1	59
034 (SF8 FHS) Fuel-Handling Equipment									02			A3.02 – Ability to monitor automatic operation of the Fuel Handling System, including: Load limits (CFR: 41.7 / 45.5)	2.5	60
035 (SF 4P SG) Steam Generator														
041 (SF4S SDS) Steam Dump/Turbine Bypass Control														
045 (SF 4S MTG) Main Turbine Generator										06		A4.06 – Ability to manually operate and/or monitor in the control room: Turbine stop valves. (CFR: 41.7 / 45.5 to 45.8)	2.8	61
055 (SF4S CARS) Condenser Air Removal														
056 (SF4S CDS) Condensate											01.27	G2.1.27 – Knowledge of system purpose and/or function. (CFR: 41.7)	3.9	62
068 (SF9 LRS) Liquid Radwaste														
071 (SF9 WGS) Waste Gas Disposal				04								K4.04 – Knowledge of design feature(s) and/or interlock(s) which provide for the following: Isolation of waste gas release tanks (CFR: 41.7)	2.9	63
072 (SF7 ARM) Area Radiation Monitoring														
075 (SF8 CW) Circulating Water			07									K3.07 – Knowledge of the effect that a loss or malfunction of the circulating water system will have on the following: ESFAS. (CFR: 41.7 / 45.6)	3.4	64
079 (SF8 SAS**) Station Air	01											K1.01 – Knowledge of the physical connections and/or cause-effect relationships between the SAS and the following systems: IAS. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.0	65

086 Fire Protection																
050 (SF 9 CRV*) Control Room Ventilation																
K/A Category Point Totals:	1	0	1	1	1	1	1	1	1	1	1	1	1	Group Point Total:		10

K/A Category Totals:					3	3	Group Point Total:			6

(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:					2	2	Group Point Total:		4

076 (SF4S SW) Service Water											02.12	G2.2.12 – Knowledge of surveillance procedures. (CFR: 41.10 / 45.13)	4.1	90
078 (SF8 IAS) Instrument Air														
103 (SF5 CNT) Containment														
053 (SF1; SF4P ICS*) Integrated Control														
K/A Category Point Totals:									3		2	Group Point Total:		5

ES-401	PWR Examination Outline											Form ES-401-2		
Plant Systems—Tier 2/Group 2 (SRO)														
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
001 (SF1 CRDS) Control Rod Drive														
002 (SF2; SF4P RCS) Reactor Coolant								03				A2.03 – Ability to (a) predict the impacts of the following malfunctions or operations on the RCS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Loss of forced circulation (CFR: 41.5 / 43.5 / 45.3, 5)	4.3	91
011 (SF2 PZR LCS) Pressurizer Level Control														
014 (SF1 RPI) Rod Position Indication														
015 (SF7 NI) Nuclear Instrumentation														
016 (SF7 NNI) Nonnuclear Instrumentation											02.40	G2.2.40 – Ability to apply Technical Specifications for a system. (CFR: 41.10 / 43.2, 5 / 45.3)	4.7	92
017 (SF7 ITM) In-Core Temperature Monitor														
027 (SF5 CIRS) Containment Iodine Removal														
028 (SF5 HRPS) Hydrogen Recombiner and Purge Control														
029 (SF8 CPS) Containment Purge														
033 (SF8 SFPCS) Spent Fuel Pool Cooling														
034 (SF8 FHS) Fuel-Handling Equipment														
035 (SF 4P SG) Steam Generator														
041 (SF4S SDS) Steam Dump/Turbine Bypass Control								02				A2.02 – Ability to (a) predict the impacts of the following malfunctions or operations on the SDS; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those malfunctions or operations: Steam valve stuck open (CFR: 41.5 / 43.5 /45.3, 13)	3.9	93
045 (SF 4S MTG) Main Turbine Generator														
055 (SF4S CARS) Condenser Air Removal														
056 (SF4S CDS) Condensate														
068 (SF9 LRS) Liquid Radwaste														
071 (SF9 WGS) Waste Gas Disposal														
072 (SF7 ARM) Area Radiation Monitoring														
075 (SF8 CW) Circulating Water														
079 (SF8 SAS**) Station Air														
086 Fire Protection														
050 (SF 9 CRV*) Control Room Ventilation														
K/A Category Point Totals:								2			1	Group Point Total:		3