Facility: **Duane Arnold Energy Center** Date of Exam: **April 8 – 19, 2019**

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	3	3	N/A			3	3	N/A		4	20	3		4		7		
	2	1	1	1				1	2			1	7	2		1		3		
	Tier Totals	5	4	4				4	5			5	27	5		5		10		
2. Plant Systems	1	2	2	2	3	3	3	3	2	2	2	2	26	2		3		5		
	2	1	1	2	1	1	1	1	1	1	1	1	12	1	1	1		3		
	Tier Totals	3	3	4	4	4	4	4	3	3	3	3	38	4		4		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. 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.

ES-401	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 1 (RO)							Form ES-401-1	
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
295001 (APE 1) Partial or Complete Loss of Forced Core Flow Circulation / 1 & 4	X						AK1.02 - Knowledge of the operational implications of the following concepts as they apply to PARTIAL OR COMPLETE LOSS OF FORCED CORE FLOW CIRCULATION: Power/flow distribution. (CFR: 41.8 to 41.10)	3.3	1
295003 (APE 3) Partial or Complete Loss of AC Power / 6						X	Generic K/A 2.4.3 - Ability to identify post-accident instrumentation. (CFR: 41.6 / 45.4)	3.7	2
295004 (APE 4) Partial or Total Loss of DC Power / 6					X		AA2.03 - Ability to determine and/or interpret the following as they apply to PARTIAL OR COMPLETE LOSS OF D.C. POWER: Battery voltage. (CFR: 41.10 / 43.5 / 45.13)	2.8	3
295005 (APE 5) Main Turbine Generator Trip / 3				X			AA1.01 - Ability to operate and/or monitor the following as they apply to MAIN TURBINE GENERATOR TRIP: Recirculation system: Plant-Specific. (CFR: 41.7 / 45.6)	3.1	4
295006 (APE 6) Scram / 1			X				AK3.01 - Knowledge of the reasons for the following responses as they apply to SCRAM: Reactor water level response. (CFR: 41.5 / 45.6)	3.8	5
295016 (APE 16) Control Room Abandonment / 7		X					AK2.02 - Knowledge of the interrelations between CONTROL ROOM ABANDONMENT and the following: Local control stations: Plant-Specific. (CFR: 41.7 / 45.8)	4.0	6
295018 (APE 18) Partial or Complete Loss of CCW / 8	X						AK1.01 - Knowledge of the operational implications of the following concepts as they apply to PARTIAL OR COMPLETE LOSS OF COMPONENT COOLING WATER: Effects on component/system operations. (CFR: 41.8 to 41.10)	3.5	7
295019 (APE 19) Partial or Complete Loss of Instrument Air / 8						X	Generic K/A 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	8
295021 (APE 21) Loss of Shutdown Cooling / 4					X		AA2.01 - Ability to determine and/or interpret the following as they apply to LOSS OF SHUTDOWN COOLING: Reactor water heatup/cooldown rate. (CFR: 41.10 / 43.5 / 45.13)	3.5	9
295023 (APE 23) Refueling Accidents / 8				X			AA1.06 - Ability to operate and/or monitor the following as they apply to REFUELING ACCIDENTS: Neutron monitoring. (CFR: 41.7 / 45.6)	3.3	10
295024 High Drywell Pressure / 5			X				EK3.07 - Knowledge of the reasons for the following responses as they apply to HIGH DRYWELL PRESSURE: Drywell venting. (CFR: 41.5 / 45.6)	3.5	11
295025 (EPE 2) High Reactor Pressure / 3		X					EK2.08 - Knowledge of the interrelations between HIGH REACTOR PRESSURE and the following: Reactor/turbine pressure regulating system: Plant-Specific. (CFR: 41.7 / 45.8)	3.7	12

295026 (EPE 3) Suppression Pool High Water Temperature / 5	X						EK1.02 - Knowledge of the operational implications of the following concepts as they apply to SUPPRESSION POOL HIGH WATER TEMPERATURE: Steam condensation. (CFR: 41.8 to 41.10)	3.5	13
295027 (EPE 4) High Containment Temperature (Mark III Containment Only) / 5									
295028 (EPE 5) High Drywell Temperature (Mark I and Mark II only) / 5						X	Generic K/A 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	14
295030 (EPE 7) Low Suppression Pool Water Level / 5					X		EA2.01 - Ability to determine and/or interpret the following as they apply to LOW SUPPRESSION POOL WATER LEVEL: Suppression pool level. (CFR: 41.10 / 43.5 / 45.13)	4.1	15
295031 (EPE 8) Reactor Low Water Level / 2				X			EA1.05 - Ability to operate and/or monitor the following as they apply to REACTOR LOW WATER LEVEL: Reactor core isolation system. (CFR: 41.7 / 45.6)	4.3	16
295037 (EPE 14) Scram Condition Present and Reactor Power Above APRM Downscale or Unknown / 1			X				EK3.02 - Knowledge of the reasons for the following responses as they apply to SCRAM CONDITION PRESENT AND REACTOR POWER ABOVE APRM DOWNSCALE OR UNKNOWN: SBLC injection. (CFR: 41.5 / 45.6)	4.3	17
295038 (EPE 15) High Offsite Radioactivity Release Rate / 9		X					EK2.07 - Knowledge of the interrelations between HIGH OFF-SITE RELEASE RATE and the following: Control room ventilation. (CFR: 41.7 / 45.8)	3.5	18
600000 (APE 24) Plant Fire On Site / 8	X						AK1.02 - Knowledge of the operation applications of the following concepts as they apply to Plant Fire On Site: Fire Fighting.	2.9	19
700000 (APE 25) Generator Voltage and Electric Grid Disturbances / 6						X	Generic K/A 2.4.31 - Knowledge of annunciator alarms, indications, or response procedures. (CFR: 41.10 / 45.3)	4.2	20
K/A Category Totals:	4	3	3	3	3	4	Group Point Total:		20

ES-401	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (RO)							Form ES-401-1	
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
295002 (APE 2) Loss of Main Condenser Vacuum / 3									
295007 (APE 7) High Reactor Pressure / 3									
295008 (APE 8) High Reactor Water Level / 2					X		AA2.05 - Ability to determine and/or interpret the following as they apply to HIGH REACTOR WATER LEVEL: Swell. (CFR: 41.10 / 43.5 / 45.13)	2.9	21
295009 (APE 9) Low Reactor Water Level / 2									
295010 (APE 10) High Drywell Pressure / 5									
295011 (APE 11) High Containment Temperature (Mark III Containment only) / 5									
295012 (APE 12) High Drywell Temperature / 5				X			AA1.01 - Ability to operate and/or monitor the following as they apply to HIGH DRYWELL TEMPERATURE: Drywell ventilation system. (CFR: 41.7 / 45.6)	3.5	22
295013 (APE 13) High Suppression Pool Temperature. / 5									
295014 (APE 14) Inadvertent Reactivity Addition / 1			X				AK3.02 - Knowledge of the reasons for the following responses as they apply to INADVERTENT REACTIVITY ADDITION: Control rod blocks. (CFR: 41.5 / 45.6)	3.7	23
295015 (APE 15) Incomplete Scram / 1									
295017 (APE 17) Abnormal Offsite Release Rate / 9									
295020 (APE 20) Inadvertent Containment Isolation / 5 & 7		X					AK2.11 - Knowledge of the interrelations between INADVERTENT CONTAINMENT ISOLATION and the following: Standby gas treatment system/FRVS: Plant-Specific. (CFR: 41.7 / 45.8)	3.2	24
295022 (APE 22) Loss of Control Rod Drive Pumps / 1									
295029 (EPE 6) High Suppression Pool Water Level / 5	X						EK1.01 - Knowledge of the operational implications of the following concepts as they apply to HIGH SUPPRESSION POOL WATER LEVEL: Containment integrity. (CFR: 41.8 to 41.10)	3.4	25
295032 (EPE 9) High Secondary Containment Area Temperature / 5									
295033 (EPE 10) High Secondary Containment Area Radiation Levels / 9									
295034 (EPE 11) Secondary Containment Ventilation High Radiation / 9						X	Generic K/A 2.4.47 - Ability to diagnose and recognize trends in an accurate and timely manner utilizing the appropriate control room reference material. (CFR: 41.10 / 43.5 / 45.12)	4.2	26
295035 (EPE 12) Secondary Containment High Differential Pressure / 5									

295036 (EPE 13) Secondary Containment High Sump/Area Water Level / 5					X		EA2.03 - Ability to determine and/or interpret the following as they apply to SECONDARY CONTAINMENT HIGH SUMP/AREA WATER LEVEL: Cause of the high water level (CFR: 41.10 / 43.5 / 45.13)	3.4	27
500000 (EPE 16) High Containment Hydrogen Concentration / 5									
K/A Category Point Totals:	1	1	1	1	2	1	Group Point Total:		7

ES-401	BWR Examination Outline Plant Systems—Tier 2/Group 1 (RO)											Form ES-401-1	
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	X				A1.01 - Ability to predict and/or monitor changes in parameters associated with operating the RHR/LPCI: INJECTION MODE (PLANT SPECIFIC) controls including: Reactor water level. (CFR: 41.5 / 45.5) A2.06 - Ability to (a) predict the impacts of the following on the RHR/LPCI: INJECTION MODE (PLANT SPECIFIC); and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Emergency generator failure. (CFR: 41.5 / 45.6)	4.2 3.8	28 29
205000 (SF4 SCS) Shutdown Cooling						X						K6.04 - Knowledge of the effect that a loss or malfunction of the following will have on the SHUTDOWN COOLING SYSTEM (RHR SHUTDOWN COOLING MODE): Reactor water level. (CFR: 41.7 / 45.7)	3.6	30
206000 (SF2, SF4 HPCIS) High-Pressure Coolant Injection				X								K4.02 - Knowledge of HIGH PRESSURE COOLANT INJECTION SYSTEM (HPCIS) design feature(s) and/or interlocks which provide for the following: System Isolation: Plant-Specific. (CFR: 41.7)	3.9	31
207000 (SF4 IC) Isolation (Emergency) Condenser														
209001 (SF2, SF4 LPCS) Low-Pressure Core Spray					X		X					K5.01 - Knowledge of the operational implications of the following concepts as they apply to LOW PRESSURE CORE SPRAY SYSTEM: Indications of pump cavitation. (CFR: 41.5 / 45.3) A1.08 - Ability to predict and/or monitor changes in parameters associated with operating the LOW PRESSURE CORE SPRAY SYSTEM controls including: System lineup. (CFR: 41.5 / 45.5)	2.6 3.3	32 33
209002 (SF2, SF4 HPCS) High-Pressure Core Spray														
211000 (SF1 SLCS) Standby Liquid Control			X									K3.01 - Knowledge of the effect that a loss or malfunction of the STANDBY LIQUID CONTROL SYSTEM will have on following: Ability to shut down the reactor in certain conditions. (CFR: 41.7 / 45.4)	4.3	34
212000 (SF7 RPS) Reactor Protection		X				X						K2.01 - Knowledge of electrical power supplies to the following: RPS motor-generator sets. (CFR: 41.7) K6.01 - Knowledge of the effect that a loss or malfunction of the following will have on the REACTOR PROTECTION SYSTEM: A.C. electrical distribution. (CFR: 41.7 / 45.7)	3.2 3.6	35 36

215003 (SF7 IRM) Intermediate-Range Monitor	X										K1.01 - Knowledge of the physical connections and/or cause effect relationships between INTERMEDIATE RANGE MONITOR (IRM) SYSTEM and the following: RPS. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.9	37
215004 (SF7 SRMS) Source-Range Monitor										X	Generic K/A 2.4.45 - Ability to prioritize and interpret the significance of each annunciator or alarm. (CFR: 41.10 / 43.5 / 45.12)	4.1	38
215005 (SF7 PRMS) Average Power Range Monitor/Local Power Range Monitor					X				X		K5.06 - Knowledge of the operational implications of the following concepts as they apply to AVERAGE POWER RANGE MONITOR/LOCAL POWER RANGE MONITOR SYSTEM: Assignment of LPRM's to specific APRM channels. (CFR: 41.5 / 45.3) A4.05 - Ability to manually operate and/or monitor in the control room: Trip bypasses. (CFR: 41.7 / 45.5 to 45.8)	2.5 3.4	39 40
217000 (SF2, SF4 RCIC) Reactor Core Isolation Cooling								X			A3.02 - Ability to monitor automatic operations of the REACTOR CORE ISOLATION COOLING SYSTEM (RCIC) including: Turbine startup. (CFR: 41.7 / 45.7)	3.6	41
218000 (SF3 ADS) Automatic Depressurization							X				A2.02 - Ability to (a) predict the impacts of the following on the AUTOMATIC DEPRESSURIZATION SYSTEM; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Large break LOCA. (CFR: 41.5 / 45.6)	3.5	42
223002 (SF5 PCIS) Primary Containment Isolation/Nuclear Steam Supply Shutoff						X					A1.02 - Ability to predict and/or monitor changes in parameters associated with operating the PRIMARY CONTAINMENT ISOLATION SYSTEM/NUCLEAR STEAM SUPPLY SHUT-OFF controls including: Valve closures. (CFR: 41.5 / 45.5)	3.7	43
239002 (SF3 SRV) Safety Relief Valves						X					K6.04 - Knowledge of the effect that a loss or malfunction of the following will have on the RELIEF/SAFETY VALVES: D.C. power: Plant-Specific. (CFR: 41.7 / 45.7)	3.0	44
259002 (SF2 RWLCS) Reactor Water Level Control					X						K5.03 - Knowledge of the operational implications of the following concepts as they apply to REACTOR WATER LEVEL CONTROL SYSTEM: Water level measurement. (CFR: 41.5 / 45.3)	3.1	45
261000 (SF9 SGTS) Standby Gas Treatment				X							K4.05 - Knowledge of STANDBY GAS TREATMENT SYSTEM design feature(s) and/or interlocks which provide for the following: Fission product gas removal. (CFR: 41.7)	2.6	46

262001 (SF6 AC) AC Electrical Distribution			X								K3.03 - Knowledge of the effect that a loss or malfunction of the A.C. ELECTRICAL DISTRIBUTION will have on following: D.C. electrical distribution. (CFR: 41.7 / 45.4)	2.9	47
262002 (SF6 UPS) Uninterruptable Power Supply (AC/DC)	X										K1.19 - Knowledge of the physical connections and/or cause-effect relationships between UNINTERRUPTABLE POWER SUPPLY (A.C./D.C.) and the following: Power range neutron monitoring system: Plant-Specific. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	2.9	48
263000 (SF6 DC) DC Electrical Distribution		X									K2.01 - Knowledge of electrical power supplies to the following: Major D.C. loads. (CFR: 41.7)	3.1	49
264000 (SF6 EGE) Emergency Generators (Diesel/Jet) EDG									X		A4.05 - Ability to manually operate and / or monitor in the control room: Transfer of emergency generator (with load) to grid. (CFR: 41.7 / 45.5 to 45.8)	3.6	50
300000 (SF8 IA) Instrument Air				X						X	K4.03 - Knowledge of (INSTRUMENT AIR SYSTEM) design feature(s) and or interlocks which provide for the following: Securing of IAS upon loss of cooling water. (CFR: 41.7) G2.1.28 - Knowledge of the purpose and function of major system components and controls. (CFR: 41.7)	2.8 4.1	51 52
400000 (SF8 CCS) Component Cooling Water								X			A3.01 - Ability to monitor automatic operations of the CCWS including: Setpoints on instrument signal levels for normal operations, warnings, and trips that are applicable to the CCWS (CFR: 41.7 / 45.7)	3.0	53
510000 (SF4 SWS*) Service Water (Normal and Emergency)													
K/A Category Point Totals:	2	2	2	3	3	3	2	2	2	2	Group Point Total:		26

ES-401	BWR Examination Outline Plant Systems—Tier 2/Group 2 (RO)											Form ES-401-1		
System # / Name	K1	K2	K3	K4	K5	K6	A1	A2	A3	A4	G*	K/A Topic(s)	IR	#
201001 (SF1 CRDH) CRD Hydraulic			X									K3.03 - Knowledge of the effect that a loss or malfunction of the CONTROL ROD DRIVE HYDRAULIC SYSTEM will have on following: Control rod drive mechanisms. (CFR: 41.7 / 45.4)	3.1	54
201002 (SF1 RMCS) Reactor Manual Control														
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														
202001 (SF1, SF4 RS) Recirculation														
202002 (SF1 RSCTL) Recirculation Flow Control														
204000 (SF2 RWCU) Reactor Water Cleanup	X											K1.11 - Knowledge of the physical connections and/or cause-effect relationships between REACTOR WATER CLEANUP SYSTEM and the following: PCIS/NSSSS. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.5	55
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		X										K2.02 - Knowledge of electrical power supplies to the following: Pumps. (CFR: 41.7)	3.1*	56
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 Spray Mode														
233000 (SF9 FPCCU) Fuel Pool Cooling/Cleanup											X	Generic K/A 2.4.18 - Knowledge of the specific bases for EOPs. (CFR: 41.10 / 43.1 / 45.13)	3.3	57
234000 (SF8 FH) Fuel-Handling Equipment														
239001 (SF3, SF4 MRSS) Main and Reheat Steam										X		A4.11 - Ability to manually operate and/or monitor in the control room: Alternate methods of verifying valve positions. (CFR: 41.7 / 45.5 to 45.8)	3.1	58
239003 (SF9 MSVLCS) Main Steam Isolation Valve Leakage Control														
241000 (SF3 RTPRS) Reactor/Turbine Pressure Regulating					X							K5.04 – Knowledge of the operational implications of the following concepts as they apply to REACTOR/TURBINE PRESSURE REGULATING SYSTEM: Turbine inlet pressure vs. reactor pressure. (CFR: 41.5 / 45.3)	3.3	59

245000 (SF4 MTGEN) Main Turbine Generator/Auxiliary								X			A3.05 - Ability to monitor automatic operations of the MAIN TURBINE GENERATOR AND AUXILIARY SYSTEMS including: Control valve operation. (CFR: 41.7 / 45.7)	3.0	60
256000 (SF2 CDS) Condensate								X			A2.06 - Ability to (a) predict the impacts of the following on the REACTOR CONDENSATE SYSTEM; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Low hotwell level (CFR: 41.5 / 45.6)	3.2	61
259001 (SF2 FWS) Feedwater							X				A1.06 - Ability to predict and/or monitor changes in parameters associated with operating the REACTOR FEEDWATER SYSTEM controls including: Feedwater heater level. (CFR: 41.5 / 45.5)	2.7	62
268000 (SF9 RW) Radwaste													
271000 (SF9 OG) Offgas						X					K6.11 - Knowledge of the effect that a loss or malfunction of the following will have on the OFFGAS SYSTEM: Condenser vacuum. (CFR: 41.7 / 45.7)	3.2	63
272000 (SF7, SF9 RMS) Radiation Monitoring													
286000 (SF8 FPS) Fire Protection				X							K4.06 - Knowledge of FIRE PROTECTION SYSTEM design feature(s) and/or interlocks which provide for the following: Fire suppression capability that does not rely on the displacement of oxygen (Halon): Plant-Specific. (CFR: 41.7 / 45.7)	3.4	64
288000 (SF9 PVS) Plant Ventilation			X								K3.04 - Knowledge of the effect that a loss or malfunction of the PLANT VENTILATION SYSTEMS will have on following: Secondary containment pressure: Plant-Specific. (CFR: 41.5 / 45.3)	3.2	65
290001 (SF5 SC) Secondary Containment													
290003 (SF9 CRV) Control Room Ventilation													
290002 (SF4 RVI) Reactor Vessel Internals													
51001 (SF8 CWS*) Circulating Water													
K/A Category Point Totals:	1	1	2	1	1	1	1	1	1	1	Group Point Total:		12

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E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
295001 (APE 1) Partial or Complete Loss of Forced Core Flow Circulation / 1 & 4									
295003 (APE 3) Partial or Complete Loss of AC Power / 6									
295004 (APE 4) Partial or Total Loss of DC Power / 6						X	Generic K/A 2.4.41 - Knowledge of the emergency action level thresholds and classifications. (CFR: 41.10 / 43.5 / 45.11)	4.6	76
295005 (APE 5) Main Turbine Generator Trip / 3					X		AA2.03 - Ability to determine and/or interpret the following as they apply to MAIN TURBINE GENERATOR TRIP: Turbine valve position. (CFR: 41.10 / 43.5 / 45.13)	3.1	77
295006 (APE 6) Scram / 1									
295016 (APE 16) Control Room Abandonment / 7									
295018 (APE 18) Partial or Complete Loss of CCW / 8						X	Generic K/A 2.2.44 - Ability to interpret control room indications to verify the status and operation of a system, and understand how operator actions and directives affect plant and system conditions. (CFR: 41.5 / 43.5 / 45.12)	4.4	78
295019 (APE 19) Partial or Complete Loss of Instrument Air / 8									
295021 (APE 21) Loss of Shutdown Cooling / 4									
295023 (APE 23) Refueling Accidents / 8									
295024 High Drywell Pressure / 5					X		EA2.02 - Ability to determine and/or interpret the following as they apply to HIGH DRYWELL PRESSURE: Drywell temperature. (CFR: 41.10 / 43.5 / 45.13)	4.0	79
295025 (EPE 2) High Reactor Pressure / 3						X	Generic K/A 2.2.40 - Ability to apply Technical Specifications for a system. (CFR: 41.10 / 43.2 / 43.5 / 45.3)	4.7	80
295026 (EPE 3) Suppression Pool High Water Temperature / 5					X		EA2.01 - Ability to determine and/or interpret the following as they apply to SUPPRESSION POOL HIGH WATER TEMPERATURE: Suppression pool water temperature. (CFR: 41.10 / 43.5 / 45.13)	4.2	81
295027 (EPE 4) High Containment Temperature (Mark III Containment Only) / 5									
295028 (EPE 5) High Drywell Temperature (Mark I and Mark II only) / 5									
295030 (EPE 7) Low Suppression Pool Water Level / 5									
295031 (EPE 8) Reactor Low Water Level / 2									
295037 (EPE 14) Scram Condition Present and Reactor Power Above APRM Downscale or Unknown / 1									
295038 (EPE 15) High Offsite Radioactivity Release Rate / 9									

600000 (APE 24) Plant Fire On Site / 8									
700000 (APE 25) Generator Voltage and Electric Grid Disturbances / 6						X	Generic K/A 2.1.20 - Ability to interpret and execute procedure steps. (CFR: 41.10 / 43.5 / 45.12)	4.6	82
K/A Category Totals:	0	0	0	0	3	4	Group Point Total:		7

ES-401	BWR Examination Outline Emergency and Abnormal Plant Evolutions—Tier 1/Group 2 (SRO)							Form ES-401-1	
E/APE # / Name / Safety Function	K1	K2	K3	A1	A2	G*	K/A Topic(s)	IR	#
295002 (APE 2) Loss of Main Condenser Vacuum / 3					X		AA2.02 - Ability to determine and/or interpret the following as they apply to LOSS OF MAIN CONDENSER VACUUM: Reactor power: Plant-Specific. (CFR: 41.10 / 43.5 / 45.13)	3.3	83
295007 (APE 7) High Reactor Pressure / 3									
295008 (APE 8) High Reactor Water Level / 2									
295009 (APE 9) Low Reactor Water Level / 2									
295010 (APE 10) High Drywell Pressure / 5									
295011 (APE 11) High Containment Temperature (Mark III Containment only) / 5									
295012 (APE 12) High Drywell Temperature / 5									
295013 (APE 13) High Suppression Pool Temperature. / 5									
295014 (APE 14) Inadvertent Reactivity Addition / 1									
295015 (APE 15) Incomplete Scram / 1									
295017 (APE 17) Abnormal Offsite Release Rate / 9									
295020 (APE 20) Inadvertent Containment Isolation / 5 & 7									
295022 (APE 22) Loss of Control Rod Drive Pumps / 1						X	Generic K/A 2.1.27 - Knowledge of system purpose and/or function. (CFR: 41.7)	4.0	84
295029 (EPE 6) High Suppression Pool Water Level / 5									
295032 (EPE 9) High Secondary Containment Area Temperature / 5					X		EA2.02 - Ability to determine and/or interpret the following as they apply to HIGH SECONDARY CONTAINMENT AREA TEMPERATURE: Equipment operability. (CFR: 41.10 / 43.5 / 45.13)	3.5	85
295033 (EPE 10) High Secondary Containment Area Radiation Levels / 9									
295034 (EPE 11) Secondary Containment Ventilation High Radiation / 9									
295035 (EPE 12) Secondary Containment High Differential Pressure / 5									
295036 (EPE 13) Secondary Containment High Sump/Area Water Level / 5									
500000 (EPE 16) High Containment Hydrogen Concentration / 5									
K/A Category Point Totals:	0	0	0	0	2	1	Group Point Total:		3

ES-401	BWR Examination Outline Plant Systems—Tier 2/Group 1 (SRO)											Form ES-401-1	
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	Generic K/A 2.4.20 - Knowledge of the operational implications of EOP warnings, cautions, and notes. (CFR: 41.10 / 43.5 / 45.13)	4.3	86
205000 (SF4 SCS) Shutdown Cooling														
206000 (SF2, SF4 HPCIS) High-Pressure Coolant Injection								X				A2.05 - Ability to (a) predict the impacts of the following on the HIGH PRESSURE COOLANT INJECTION SYSTEM (HPCIS); and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: D.C. electrical failure (CFR: 41.5 / 45.6)	3.8*	87
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											X	Generic K/A 2.4.6 - Knowledge of EOP mitigation strategies. (CFR: 41.10 / 43.5 / 45.13)	4.7	88
212000 (SF7 RPS) Reactor Protection														
215003 (SF7 IRM) Intermediate-Range Monitor														
215004 (SF7 SRMS) Source-Range Monitor														
215005 (SF7 PRMS) Average Power Range Monitor/Local Power Range Monitor														
217000 (SF2, SF4 RCIC) Reactor Core Isolation Cooling								X				A2.12 - Ability to (a) predict the impacts of the following on the REACTOR CORE ISOLATION COOLING SYSTEM (RCIC); and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Valve openings. (CFR: 41.5 / 45.6)	3.0	89
218000 (SF3 ADS) Automatic Depressurization														
223002 (SF5 PCIS) Primary Containment Isolation/Nuclear Steam Supply Shutoff														
239002 (SF3 SRV) Safety Relief Valves														
259002 (SF2 RWLCS) Reactor Water Level Control														
261000 (SF9 SGTS) Standby Gas Treatment														
262001 (SF6 AC) AC Electrical Distribution											X	Generic K/A 2.2.42 - Ability to recognize system parameters that are entry-level conditions for Technical Specifications. (CFR: 41.7 / 41.10 / 43.2 / 43.3 / 45.3)	4.6	90

262002 (SF6 UPS) Uninterruptable Power Supply (AC/DC)													
263000 (SF6 DC) DC Electrical Distribution													
264000 (SF6 EGE) Emergency Generators (Diesel/Jet) EDG													
300000 (SF8 IA) Instrument Air													
400000 (SF8 CCS) Component Cooling Water													
510000 (SF4 SWS*) Service Water (Normal and Emergency)													
K/A Category Point Totals:	0	0	0	0	0	0	0	2	0	0	3	Group Point Total:	5

ES-401 BWR Examination Outline Plant Systems—Tier 2/Group 2 (SRO) Form ES-401-1

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				A2.06 - Ability to (a) predict the impacts of the following on the CONTROL ROD AND DRIVE MECHANISM; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Loss of CRD cooling water flow. (CFR: 41.5 / 45.6)	3.1	91
201004 (SF7 RSCS) Rod Sequence Control														
201005 (SF1, SF7 RCIS) Rod Control and Information														
201006 (SF7 RWMS) Rod Worth Minimizer														
202001 (SF1, SF4 RS) Recirculation											X	Generic K/A 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. (CFR: 41.10 / 43.5 / 45.11)	4.1	92
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 Spray Mode														
233000 (SF9 FPCCU) Fuel Pool Cooling/Cleanup														
234000 (SF8 FH) Fuel-Handling Equipment	X											K1.04 - Knowledge of the physical connections and/or cause-effect relationships between FUEL HANDLING EQUIPMENT and the following: Reactor manual control system. (CFR: 41.2 to 41.9 / 45.7 to 45.8)	3.6	93
239001 (SF3, SF4 MRSS) Main and Reheat Steam														
239003 (SF9 MSVLCS) 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													
51001 (SF8 CWS*) Circulating Water													
K/A Category Point Totals:	1	0	0	0	0	0	1	0	0	0	1	Group Point Total:	3

Facility: **Duane Arnold Energy Center** Date of Exam: **April 8 – 19, 2019**

Category	K/A #	Topic	RO		SRO-only	
			IR	#	IR	#
1. Conduct of Operations	2.1.34	Knowledge of primary and secondary plant chemistry limits. (CFR: 41.10 / 43.5 / 45.12)	2.7	66		
	2.1.3	Knowledge of shift or short-term relief turnover practices. (CFR: 41.10 / 45.13)	3.7	67		
	2.1.39	Knowledge of conservative decision making practices. (CFR: 41.10 / 43.5 / 45.12)	3.6	68		
	2.1.23	Ability to perform specific system and integrated plant procedures during all modes of plant operation. (CFR: 41.10 / 43.5 / 45.2 / 45.6)			4.4	94
	2.1.43	Ability to use procedures to determine the effects on reactivity of plant changes, such as reactor coolant system temperature, secondary plant, fuel depletion, etc. (CFR: 41.10 / 43.6 / 45.6)			4.3	95
	Subtotal			3		2
2. Equipment Control	2.2.14	Knowledge of the process for controlling equipment configuration or status. (CFR: 41.10 / 43.3 / 45.13)	3.9	69		
	2.2.36	Ability to analyze the effect of maintenance activities, such as degraded power sources, on the status of limiting conditions for operations. (CFR: 41.10 / 43.2 / 45.13)	3.1	70		
	2.2.38	Knowledge of conditions and limitations in the facility license. (CFR: 41.7 / 41.10 / 43.1 / 45.13)	3.6	71		
	2.2.25	Knowledge of the bases in Technical Specifications for limiting conditions for operations and safety limits. (CFR: 41.5 / 41.7 / 43.2)			4.2	96
	2.2.43	Knowledge of the process used to track inoperable alarms. (CFR: 41.10 / 43.5 / 45.13)			3.3	97
	Subtotal			3		2
3. Radiation Control	2.3.7	Ability to comply with radiation work permit requirements during normal or abnormal conditions. (CFR: 41.12 / 45.10)	3.5	72		
	2.3.15	Knowledge of radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc. (CFR: 41.12 / 43.4 / 45.9)	2.9	73		
	2.3.11	Ability to control radiation releases. (CFR: 41.11 / 43.4 / 45.10)			4.3	98
	Subtotal			2		1
4. Emergency Procedures/Plan	2.4.12	Knowledge of general operating crew responsibilities during emergency operations. (CFR: 41.10 / 45.12)	4.0	74		
	2.4.26	Knowledge of facility protection requirements, including fire brigade and portable fire fighting equipment usage. (CFR: 41.10 / 43.5 / 45.12)	3.1	75		
	2.4.32	Knowledge of operator response to loss of all annunciators. (CFR: 41.10 / 43.5 / 45.13)			4.0	99
	2.4.50	Ability to verify system alarm setpoints and operate controls identified in the alarm response manual. (CFR: 41.10 / 43.5 / 45.3)			4.0	100
	Subtotal			2		2
Tier 3 Point Total				10		7