Facility: Columbia Generating Station Date of Exam: April 2015

| 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 & Abnormal Plant Evolutions | 1 | 3 | 4 | 4 | N/A | | | 3 | 3 | N/A | | 3 | 20 | | | 7 |
| | 2 | 2 | 1 | 1 | | | | 1 | 1 | | | 1 | 7 | | | 3 |
| | Tier Totals | 5 | 5 | 5 | | | | 4 | 4 | | | 4 | 27 | | | 10 |
| 2. Plant Systems | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 26 | | | 5 |
| | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 | | | 3 |
| | Tier Totals | 5 | 4 | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 38 | | | 8 |
| 3. Generic Knowledge and Abilities Categories | | 1 | | | 2 | | | 3 | | | 4 | | 10 | 1 | 2 | 3 | 4 | 7 |
| | | 3 | | | 3 | | | 2 | | | 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 outlines (i.e., except for one category in Tier 3 of the SRO-only outline, the "Tier Totals" in each K/A category shall not be less than two).
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 associated outline; systems or evolutions that do not apply at the facility should be deleted and justified; 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' importance ratings (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 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.

| ES-401 | BWR Examination Outline<br>Emergency and Abnormal Plant Evolutions - Tier 1/Group 1 (RO) | | | | | | Form ES-401-1 | | |
|---|---|---|---|---|---|---|---|---|---|
| E/APE # / Name / Safety Function | K 1 | K 2 | K 3 | A 1 | A 2 | G | K/A Topic(s) | IR | Q# |
| 295001 Partial or Complete Loss of Forced Core Flow Circulation / 1 & 4 | | | | | | X | G2.1.19 Partial or Complete Loss of Forced Core Flow Circulation - Ability to use plant computers to evaluate system or component status | 3.9 | 39 |
| 295003 Partial or Complete Loss of AC / 6 | | | | | X | | AA2.04 Ability to determine and/or interpret the following as they apply to PARTIAL OR COMPLETE LOSS OF A.C. POWER: System lineups | 3.5 | 40 |
| 295004 Partial or Total Loss of DC Pwr / 6 | | | | X | | | AA1.02 Ability to operate and/or monitor the following as they apply to PARTIAL OR COMPLETE LOSS OF D.C. POWER: Systems necessary to assure safe plant shutdown | 3.8 | 41 |
| 295005 Main Turbine Generator Trip / 3 | | | X | | | | AK3.02 Knowledge of the reasons for the following responses as they apply to MAIN TURBINE GENERATOR TRIP: Recirculation pump downshift/trip | 3.4 | 42 |
| 295006 SCRAM / 1 | | X | | | | | AK2.01 Knowledge of the interrelations between SCRAM and the following: RPS | 4.3 | 43 |
| 295016 Control Room Abandonment / 7 | | | | | X | | AA2.06 Ability to determine and/or interpret the following as they apply to CONTROL ROOM ABANDONMENT: Cooldown rate | 3.3 | 44 |
| 295018 Partial or Total 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 | 3.5 | 45 |
| 295019 Partial or Total Loss of Inst. Air / 8 | | X | | | | | AK2.16 Knowledge of the interrelations between PARTIAL OR COMPLETE LOSS OF INSTRUMENT AIR and the following: Reactor core isolation cooling | 2.8 | 46 |
| 295021 Loss of Shutdown Cooling / 4 | | | X | | | | AK3.04 Knowledge of the reasons for the following responses as they apply to LOSS OF SHUTDOWN COOLING: Maximizing reactor water cleanup flow | 3.3 | 47 |
| 295023 Refueling Acc / 8 | | | | | | X | G2.4.18 Knowledge of the specific bases for EOPs | 3.3 | 51 |
| 295024 High Drywell Pressure / 5 | | | | | X | | EA2.04 Ability to determine and/or interpret the following as they apply to HIGH DRYWELL PRESSURE: Suppression chamber pressure | 3.9 | 48 |
| 295025 High Reactor Pressure / 3 | | | | | | X | G2.1.45 High Reactor Pressure - Ability to identify and interpret diverse indications to validate the response of another indication | 4.3 | 49 |
| 295026 Suppression Pool High Water Temp. / 5 | | | | X | | | EA1.03 Ability to operate and/or monitor the following as they apply to SUPPRESSION POOL HIGH WATER TEMPERATURE: Temperature monitoring | 3.9 | 50 |
| 295027 High Containment Temperature / 5 | | | | | | | Not Selected | | |
| 295028 High Drywell Temperature / 5 | X | | | | | | EK1.02 Knowledge of the operational implications of the following concepts as they apply to HIGH DRYWELL TEMPERATURE: Equipment environmental qualification | 2.9 | 52 |
| 295030 Low Suppression Pool Wtr Lvl / 5 | | | | X | | | EA1.03 Ability to operate and/or monitor the following as they apply to LOW SUPPRESSION POOL WATER LEVEL: HPCS | 3.4 | 53 |
| 295031 Reactor Low Water Level / 2 | | | X | | | | EK3.02 Knowledge of the reasons for the following responses as they apply to REACTOR LOW WATER LEVEL: Core coverage | 4.4 | 54 |
| 295037 SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown / 1 | | X | | | | | EK2.14 Knowledge of the interrelationship between SCRAM CONDITION PRESENT AND REACTOR ABOVE APRM DOWNSCALE OR UNKNOWN and the following: RPIS: Plant Specific | 3.6 | 55 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 295038 High Off-site Release Rate / 9 | X | | | | | | EK1.02 Knowledge of the operational implications of the following concepts as they apply to HIGH OFF-SITE RELEASE RATE : Protection of the general public | 4.2 | 56 |
| 600000 Plant Fire On Site / 8 | | X | | | | | AK2.01 Knowledge of the interrelations between PLANT FIRE ON SITE and the following: Sensors / detectors and valves | 2.6 | 57 |
| 700000 Generator Voltage and Electric Grid Disturbances / 6 | | | X | | | | AK3.02 Knowledge of the reasons for the following responses as they apply to GENERATOR VOLTAGE AND ELECTRICAL GRID DISTURBANCES: Actions contained in abnormal operating procedure for voltage and grid disturbances | 3.6 | 58 |
| K/A Category Totals: | 3 | 4 | 4 | 3 | 3 | 3 | Group Point Total: | | 20 |

| ES-401 | BWR Examination Outline<br>Emergency and Abnormal Plant Evolutions - Tier 1/Group 2 (RO) | | | | | | | Form ES-401-1 | |
|---|---|---|---|---|---|---|---|---|---|
| E/APE # / Name / Safety Function | K 1 | K 2 | K 3 | A 1 | A 2 | G | K/A Topic(s) | IR | # |
| 295002 Loss of Main Condenser Vac / 3 | | | | | X | | AA2.02 Ability to determine and/or interpret the following as they apply to LOSS OF MAIN CONDENSER VACUUM: Reactor power | 3.2 | 59 |
| 295007 High Reactor Pressure / 3 | | | X | | | | AK3.06 Knowledge of the reasons for the following responses as they apply to HIGH REACTOR PRESSURE: Reactor/turbine pressure regulating system operation | 3.7 | 63 |
| 295008 High Reactor Water Level / 2 | | X | | | | | AK2.09 Knowledge of the interrelationships between HIGH REACTOR WATER LEVEL and the following: Reactor Water Cleanup System (ability to drain) | 3.1 | 60 |
| 295009 Low Reactor Water Level / 2 | | | | | | | | | |
| 295010 High Drywell Pressure / 5 | | | | | | | | | |
| 295011 High Containment Temp / 5 | | | | | | | | | |
| 295012 High Drywell Temperature / 5 | | | | | | | | | |
| 295013 High Suppression Pool Temp. / 5 | | | | | | | | | |
| 295014 Inadvertent Reactivity Addition / 1 | | | | | | X | G2.4.20 Inadvertent Reactivity Addition - Knowledge of the operational implications of EOP warnings, cautions, and notes. 295014 G2.4.20 (3.8) (CFR 41.10) Tier1 / Group 2 | 3.8 | 61 |
| 295015 Incomplete SCRAM / 1 | | | | X | | | AA1.07 Ability to operate and/or monitor the following as they apply to INCOMPLETE SCRAM: Neutron monitoring system | 3.6 | 62 |
| 295017 High Off-site Release Rate / 9 | | | | | | | | | |
| 295020 Inadvertent Cont Isolation / 5 & 7 | | | | | | | | | |
| 295022 Loss of CRD Pumps / 1 | | | | | | | | | |
| 295029 High Suppression Pool Wtr Lvl / 5 | | | | | | | | | |
| 295032 High Secondary Containment Area Temperature / 5 | X | | | | | | EK1.04 Knowledge of the operational implications of the following concepts as they apply to HIGH SECONDARY CONTAINMENT AREA TEMPERATURE: Impact of operating environment on components | 3.1 | 64 |
| 295033 High Secondary Containment Area Radiation Levels / 9 | | | | | | | | | |
| 295034 Secondary Containment Ventilation High Radiation / 9 | | | | | | | | | |
| 295035 Secondary Containment High Differential Pressure / 5 | | | | | | | | | |
| 295036 Secondary Containment High Sump/Area Water Level / 5 | X | | | | | | EK1.02 Knowledge of the operational implications of the following concepts as they apply to SECONDARY CONTAINMENT HIGH SUMP/AREA WATER LEVEL: Electrical ground/ circuit malfunction | 2.6 | 65 |
| 500000 High CTMT Hydrogen Conc. / 5 | | | | | | | | | |
| K/A Category Point Totals: | 2 | 1 | 1 | 1 | 1 | 1 | Group Point Total: | | 7 |

| ES-401 | BWR Examination Outline<br>Plant Systems - Tier 2/Group 1 (RO) | | | | | | | | | | | Form ES-401-1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System # / Name | K 1 | K 2 | K 3 | K 4 | K 5 | K 6 | A 1 | A 2 | A 3 | A 4 | G | K/A Topic(s) | IR | # |
| 203000 RHR/LPCI: Injection Mode | | | | | | | | X | | | | A2.03 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: Valve closures | 3.2 | 1 |
| 205000 Shutdown Cooling | | | | | | | X | | | | | A1.06 Ability to predict and/or monitor changes in parameters associated with operating the SHUTDOWN COOLING SYSTEM (RHR SHUTDOWN COOLING MORE) controls including: Reactor temperatures (moderator, vessel, flange) | 2.7 | 2 |
| 206000 HPCI | | | | | | | | | | | | NA CGS | | |
| 207000 Isolation Condenser | | | | | | | | | | | | NA CGS | | |
| 209001 LPCS | | | | X | | | | | | | | K4.06 Knowledge of LOW PRESSURE CORE SPRAY SYSTEM design feature(s) and/or interlocks which provide for the following: Adequate pump net positive suction head | 2.6 | 3 |
| 209002 HPCS | | | X | | | | | | | | | K3.03 Knowledge of the effect that a loss or malfunction of the HIGH PRESSURE CORE SPRAY SYSTEM (HPCS) will have on following: Adequate Core Cooling | 3.9 | 4 |
| | | | | | | X | | | | | | K6.01 Knowledge of the effect that a loss or malfunction of the following will have on the HIGH PRESSURE CORE SPRAY SYSTEM (HPCS): Electrical power. | 3.6 | 5 |
| 211000 SLC | | X | | | | | | | | | | K2.02 Knowledge of electrical power supplies to the following: Explosive valves | 3.1 | 6 |
| 212000 RPS | X | | | | | | | | | | | K1.06 Knowledge of the physical connections and/or cause effect relationships between REACTOR PROTECTION SYSTEM and the following: Control rod drive hydraulic system | 3.5 | 7 |
| 215003 IRM | | | | | | | | | | | X | G2.1.28 Intermediate Range Monitor System: Knowledge of the purpose and function of major system components and controls. | 4.1 | 8 |
| 215004 Source Range Monitor | | | | | | | | | | X | | A4.01 Ability to manually operate and/or monitor in the control room: SRM count rate and period | 2.9 | 9 |
| 215005 APRM / LPRM | | | | | | | | | X | | | A3.06 Ability to monitor automatic operations of the AVERAGE POWER RANGE MONITOR/LOCAL POWER RANGE MONITOR SYSTEM including: Maximum disagreement between flow comparator channels | 3.0 | 10 |
| 217000 RCIC | X | | | | | | | | | | | K1.01 Knowledge of the physical connections and/or cause – effect relationships between REACTOR CORE ISOLATION COOLING SYSTEM (RCIC) and the following: Condensate storage and transfer system | 3.5 | 11 |
| 218000 ADS | | X | | | | | | | | | | K2.01 Knowledge of electrical power supplies to the following: ADS logic | 3.1 | 12 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 223002 PCIS/Nuclear Steam Supply Shutoff | | | X | | | | | | | | | K3.11 Knowledge of the effect that a loss or malfunction of the PRIMARY CONTAINMENT ISOLATION SYSTEM/NUCLEAR STEAM SUPPLY SHUT-OFF will have on following: Plant ventilation | 2.8 | 13 |
| 239002 SRVs | | | | X | | | | | | | | K4.03 Knowledge of RELIEF/SAFETY VALVES design feature(s) and/or interlocks which provide for the following: Prevents siphoning of water into SRV discharge piping and limits loads on subsequent actuation of SRV's | 3.1 | 14 |
| 259002 Reactor Water Level Control | | | | | X | | | | | | | K5.01 Knowledge of the operational implications of the following concepts as they apply to REACTOR WATER LEVEL CONTROL SYSTEM: GEMAC/Foxboro/ Bailey controller operation | 3.1 | 15 |
| 261000 SGTS | | | | | | X | | | | | | K6.01 Knowledge of the effect that a loss or malfunction of the following will have on the STANDBY GAS TREATMENT SYSTEM : A.C. electrical distribution | | 16 |
| | | | | | | | | | | | X | G2.1.30 Standby Gas Treatment System: Ability to locate and operate components, including local controls | 4.4 | 17 |
| 262001 AC Electrical Distribution | | | | | X | | | | | | | K5.02 Knowledge of the operational implications of the following concepts as they apply to A.C. ELECTRICAL DISTRIBUTION: Breaker control | 2.6 | 18 |
| | | | | | | | X | | | | | A1.03 Ability to predict and/or monitor changes in parameters associated with operating the A.C. ELECTRICAL DISTRIBUTION controls including: Bus voltage | 2.9 | 19 |
| 262002 UPS (AC/DC) | | | | | | | | X | | | | A2.01 Ability to (a) predict the impacts of the following on the UNINTERRUPTABLE POWER SUPPLY (A.C./D.C.); and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Under voltage | 2.6 | 20 |
| 263000 DC Electrical Distribution | | | | | | | | | X | | | A3.01 Ability to monitor automatic operations of the D.C. ELECTRICAL DISTRIBUTION including: Meters, dials, recorders, alarms, and indicating lights. | 3.2 | 21 |
| 264000 EDGs | | | | | | | X | | | | | A1.03 Ability to predict and/or monitor changes in parameters associated with operating the EMERGENCY GENERATORS (DIESEL/JET) controls including: Operating voltages, currents, and temperatures | 2.8 | 22 |
| | | | | | | | | | | X | | A4.03 Ability to manually operate and/or monitor in the control room: Transfer of emergency control between manual and automatic | 3.2 | 23 |
| 300000 Instrument Air | X | | | | | | | | | | | K1.03 Knowledge of the connections and / or cause effect relationships between INSTRUMENT AIR SYSTEM and the following: Containment air | 2.8 | 24 |
| | | X | | | | | | | | | | K2.01 Knowledge of electrical power supplies to the following: Instrument air compressor | 3.0 | 25 |
| 400000 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 | 3.0 | 26 |
| K/A Category Point Totals: | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | Group Point Total: | | 26 |

| ES-401 | BWR Examination Outline<br>Plant Systems - Tier 2/Group 2 (RO) | | | | | | | | | | | Form ES-401-1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System # / Name | K 1 | K 2 | K 3 | K 4 | K 5 | K 6 | A 1 | A 2 | A 3 | A 4 | G | K/A Topic(s) | IR | # |
| 201001 CRD Hydraulic | | | | | | | | | | | | | | |
| 201002 RMCS | | | X | | | | | | | | | K3.01 Knowledge of the effect that a loss or malfunction of the REACTOR MANUAL CONTROL SYSTEM will have on following: Ability to move control rods | 3.4 | 27 |
| 201003 Control Rod and Drive Mechanism | | | | | X | | | | | | | K5.04 Knowledge of the operational implications of the following concepts as they apply to CONTROL ROD AND DRIVE MECHANISM: Rod sequence patterns | 3.1 | 28 |
| 201004 RSCS | | | | | | | | | | | | | | |
| 201005 RCIS | | | | | | | | | | | | N/A at CGS | | |
| 201006 RWM | | | | | | | | | | | | | | |
| 202001 Recirculation | | | | | | | | | | | | | | |
| 202002 Recirculation Flow Control | | | | | | | | | | | | | | |
| 204000 RWCU | X | | | | | | | | | | | K1.10 Knowledge of the physical connections and/or cause/effect relationships between REACTOR WATER CLEANUP SYSTEM and the following: Reactor water quality | 3.3 | 29 |
| 214000 RPIS | | | | | | | | | | | | | | |
| 215001 Traversing In-core Probe | | | | X | | | | | | | | K4.01 Knowledge of TRAVERSING IN-CORE PROBE design feature(s) and/or interlocks which provide for the following: Primary containment isolation | 3.4 | 30 |
| 215002 RBM | | | | | | | | | | | | | | |
| 216000 Nuclear Boiler Inst | | | | | | | | | | | | | | |
| 219000 RHR/LPCI: Torus/Pool Cooling Mode | | | | | | | | | | | X | G2.1.7 RHR/LPCI: Torus/Suppression Pool Cooling Mode: Ability to evaluate plant performance and make operational judgments based on operating characteristics, reactor behavior, and instrument interpretation | 4.4 | 31 |
| 223001 Primary CTMT and Aux. | | | | | | X | | | | | | K6.01 Knowledge of the effect that a loss or malfunction of the following will have on the PRIMARY CONTAINMENT SYSTEM AND AUXILIARIES: Drywell cooling | 3.6 | 32 |
| 226001 RHR/LPCI: CTMT Spray Mode | | | | | | | | | | | | | | |
| 230000 RHR/LPCI: Torus/Pool Spray Mode | | | | | | | | | | | | | | |
| 233000 Fuel Pool Cooling/Cleanup | | X | | | | | | | | | | K2.02 Knowledge of electrical power supplies to the following: RHR pumps | 2.8 | 33 |
| 234000 Fuel Handling Equipment | | | | | | | | | | | | | | |
| 239001 Main and Reheat Steam | | | | | | | | | X | | | A3.02 Ability to monitor automatic operations of the MAIN AND REHEAT STEAM SYSTEM including: Opening and closing of drain valves as turbine load changes | 2.9 | 34 |
| 239003 MSIV Leakage Control | | | | | | | | | | | | | | |
| 241000 Reactor/Turbine Pressure Regulator | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 245000 Main Turbine Gen. / Aux. | | | | | | | | | | | | | | |
| 256000 Reactor Condensate | | | | | | | | | | | | | | |
| 259001 Reactor Feedwater | X | | | | | | | | | | | K1.09 Knowledge of the physical connections and/or cause - effect relationships between REACTOR FEEDWATER SYSTEM and the following: Reactor water level | 3.3 | 35 |
| 268000 Radwaste | | | | | | | X | | | | | A1.01 Ability to predict and/or monitor changes in parameters associated with operating the RADWASTE controls including: Radiation level | 2.7 | 36 |
| 271000 Offgas | | | | | | | | | | | | | | |
| 272000 Radiation Monitoring | | | | | | | | | | | | | | |
| 286000 Fire Protection | | | | | | | | | | X | | A4.04 Ability to predict and/or monitor changes in parameters associated with operating the RADWASTE controls including: Radiation level | 2.8 | 37 |
| 288000 Plant Ventilation | | | | | | | | | | | | | | |
| 290001 Secondary CTMT | | | | | | | | | | | | | | |
| 290003 Control Room HVAC | | | | | | | | X | | | | A2.02 Ability to (a) predict the impacts of the following on the CONTROL ROOM HVAC; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Extreme environmental conditions | 3.1 | 38 |
| 290002 Reactor Vessel Internals | | | | | | | | | | | | | | |
| K/A Category Point Totals: | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Group Point Total: | | 12 |

| Facility: Columbia Generating Station | | | Date of Exam: April, 2015 | | | |
|---|---|---|---|---|---|---|
| Category | K/A # | Topic | RO | | SRO-Only | |
| | | | IR | Q# | IR | # |
| 1. Conduct of Operations | 2.1.4 | | | | 3.8 | 94 |
| | 2.1.26 | | | | 3.6 | 95 |
| | 2.1.29 | Knowledge of how to conduct system lineups, such as valves, breakers, switches, etc | 4.1 | 67 | | |
| | 2.1.37 | Knowledge of procedures, guidelines, or limitations associated with reactivity management. | 4.3 | 66 | | |
| | 2.1.44 | Knowledge of RO duties in the control room during fuel handling such as responding to alarms from the fuel handling area, communication with the fuel storage facility, systems operated from the control room in support of fueling operations, and supporting instrumentation | 3.9 | 68 | | |
| | | | | | | |
| | **Sub-total** | | | **3** | | **2** |
| 2. Equipment Control | 2.2.5 | | | | 3.2 | 96 |
| | 2.2.19 | | | | 3.4 | 97 |
| | 2.2.1 | Ability to perform pre-startup procedures for the facility, including operating those controls associated with plant equipment that could affect reactivity | 4.5 | 69 | | |
| | 2.2.21 | Knowledge of pre- and post-maintenance operability requirements | 4.0 | 70 | | |
| | 2.2.42 | Ability to recognize system parameters that are entry-level conditions for Technical Specifications | 3.9 | 71 | | |
| | | | | | | |
| | **Sub-total** | | | **3** | | **2** |
| 3. Radiation Control | 2.3.6 | | | | 3.8 | 98 |
| | 2.3.12 | | | | 3.7 | 99 |
| | 2.3.14 | Knowledge of radiation or contamination hazards that may arise during normal, abnormal, or emergency conditions or activities | 3.4 | 72 | | |
| | 2.3.15 | Knowledge of radiation monitoring systems, such as fixed radiation monitors and alarms, portable survey instruments, personnel monitoring equipment, etc | 2.9 | 73 | | |
| | | | | | | |
| | **Sub-total** | | | **2** | | **2** |
| 4. Emergency Procedures / Plan | 2.4.30 | | | | 4.1 | 100 |
| | 2.4.6 | Knowledge of EOP mitigation strategies | 3.7 | 75 | | |
| | 2.4.12 | Knowledge of general operating crew responsibilities during emergency operations | 4.6 | 74 | | |
| | **Sub-total** | | | **2** | | **1** |
| Tier 3 Point Total | | | | 10 | | 7 |

Facility: Columbia Gen Station Date of Exam: April, 2015

| Tier | Group | RO K/A Category Points | | | | | | | | | | | | SRO-Only Points | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | K 1 | K 2 | K 3 | K 4 | K 5 | K 6 | A 1 | A 2 | A 3 | A 4 | G * | Total | A2 | G* | Total |
| 1. Emergency & Abnormal Plant Evolutions | 1 | | | | N/A | | | | | N/A | | | 20 | 3 | 4 | 7 |
| | 2 | | | | | | | | | | | | 7 | 2 | 1 | 3 |
| | Tier Totals | | | | | | | | | | | | 27 | 5 | 5 | 10 |
| 2. Plant Systems | 1 | | | | | | | | | | | | 26 | 3 | 2 | 5 |
| | 2 | | | | | | | | | | | | 12 | 1 1 | 1 | 3 |
| | Tier Totals | | | | | | | | | | | | 38 | 5 | 3 | 8 |
| 3. Generic Knowledge and Abilities Categories | | 1 | | 2 | | 3 | | 4 | | | | | 10 | 1 | 2 | 3 | 4 | 7 |
| | | | | | | | | | | | | | | 2 | 2 | 2 | 1 | |

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 outlines (i.e., except for one category in Tier 3 of the SRO-only outline, the "Tier Totals" in each K/A category shall not be less than two).
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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' importance ratings (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 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.

| ES-401 | BWR Examination Outline<br>Emergency and Abnormal Plant Evolutions - Tier 1/Group 1 (SRO) | | | | | | | Form ES-401-1 | |
|---|---|---|---|---|---|---|---|---|---|
| E/APE # / Name / Safety Function | K 1 | K 2 | K 3 | A 1 | A 2 | G | K/A Topic(s) | IR | # |
| 295001 Partial or Complete Loss of Forced Core Flow Circulation / 1 & 4 | | | | | | | | | |
| 295003 Partial or Complete Loss of AC / 6 | | | | | | | | | |
| 295004 Partial or Total Loss of DC Pwr / 6 | | | | | X | | AA2.04 Ability to determine and/or interpret the following as they apply to PARTIAL OR COMPLETE LOSS OF D.C. POWER: System lineups | 3.3 | 76 |
| 295005 Main Turbine Generator Trip / 3 | | | | | | | | | |
| 295006 SCRAM / 1 | | | | | | | | | |
| 295016 Control Room Abandonment / 7 | | | | | X | | AA2.02 Ability to determine and/or interpret the following as they apply to CONTROL ROOM ABANDONMENT: Reactor Water Level | 3.9 | 77 |
| 295018 Partial or Total Loss of CCW / 8 | | | | | | | EA2 | | |
| 295019 Partial or Total Loss of Inst. Air / 8 | | | | | X | | AA2.02 Ability to determine and/or interpret the following as they apply to PARTIAL OR COMPLETE LOSS OF INSTRUMENT AIR: Status of safety-related instrument air system loads | 3.7 | 78 |
| 295021 Loss of Shutdown Cooling / 4 | | | | | | | | | |
| 295023 Refueling Acc / 8 | | | | | | X | G2.2.40 Refueling Accidents - Ability to apply Technical Specifications for a system | 4.5 | 79 |
| 295024 High Drywell Pressure / 5 | | | | | | | | | |
| 295025 High Reactor Pressure / 3 | | | | | | | | | |
| 295026 Suppression Pool High Water Temp. / 5 | | | | | | X | G2.2.38 Suppression Pool High Water Temperature - Knowledge of conditions and limitations in the facility license. | 4.5 | 80 |
| 295027 High Containment Temperature / 5 | | | | | | | | | |
| 295028 High Drywell Temperature / 5 | | | | | | | | | |
| 295030 Low Suppression Pool Wtr Lvl / 5 | | | | | | | | | |
| 295031 Reactor Low Water Level / 2 | | | | | | | | | |
| 295037 SCRAM Condition Present and Reactor Power Above APRM Downscale or Unknown / 1 | | | | | | | | | |
| 295038 High Off-site Release Rate / 9 | | | | | | X | G2.4.44 High Off-Site Release Rate - Knowledge of emergency plan protective action recommendations | 4.4 | 81 |
| 600000 Plant Fire On Site / 8 | | | | | | | | | |
| 700000 Generator Voltage and Electric Grid Disturbances / 6 | | | | | | X | G2.2.37 Generator Voltage and Electric Grid Disturbances - Ability to determine operability and/or availability of safety related equipment. | 4.6 | 82 |
| K/A Category Totals: | | | | | 3 | 4 | Group Point Total: | | 7 |

| ES-401 | BWR Examination Outline<br>Emergency and Abnormal Plant Evolutions - Tier 1/Group 2 (SRO) | | | | | | Form ES-401-1 | | |
|---|---|---|---|---|---|---|---|---|---|
| E/APE # / Name / Safety Function | K 1 | K 2 | K 3 | A 1 | A 2 | G | K/A Topic(s) | IR | # |
| 295002 Loss of Main Condenser Vac / 3 | | | | | | | | | |
| 295007 High Reactor Pressure / 3 | | | | | | | | | |
| 295008 High Reactor Water Level / 2 | | | | | | | | | |
| 295009 Low Reactor Water Level / 2 | | | | | | | | | |
| 295010 High Drywell Pressure / 5 | | | | | | | | | |
| 295011 High Containment Temp / 5 | | | | | | | | | |
| 295012 High Drywell Temperature / 5 | | | | | | | | | |
| 295013 High Suppression Pool Temp. / 5 | | | | | | | | | |
| 295014 Inadvertent Reactivity Addition / 1 | | | | | | | | | |
| 295015 Incomplete SCRAM / 1 | | | | | | X | G2.1.45 Ability to identify and interpret diverse indications to validate the response of another indication | 4.3 | 83 |
| 295017 High Off-site Release Rate / 9 | | | | | | | | | |
| 295020 Inadvertent Cont. Isolation / 5 & 7 | | | | | | | | | |
| 295022 Loss of CRD Pumps / 1 | | | | | | | | | |
| 295029 High Suppression Pool Wtr Lvl / 5 | | | | | | | | | |
| 295032 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 | 3.5 | 84 |
| 295033 High Secondary Containment Area Radiation Levels / 9 | | | | | | | | | |
| 295034 Secondary Containment Ventilation High Radiation / 9 | | | | | | | | | |
| 295035 Secondary Containment High Differential Pressure / 5 | | | | | | | | | |
| 295036 Secondary Containment High Sump/Area Water Level / 5 | | | | | X | | EA2.01 Ability to determine and/or interpret the following as they apply to SECONDARY CONTAINMENT HIGH SUMP/AREA WATER LEVEL: Operability of components within the affected area | 3.2 | 85 |
| 500000 High CTMT Hydrogen Conc. / 5 | | | | | | | | | |
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| | | | | | | | | | |
| K/A Category Point Totals: | | | | | 2 | 1 | Group Point Total: | | 3 |

| ES-401 | BWR Examination Outline Plant Systems - Tier 2/Group 1 (SRO) | | | | | | | | | | | | Form ES-401-1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System # / Name | K 1 | K 2 | K 3 | K 4 | K 5 | K 6 | A 1 | A 2 | A 3 | A 4 | G | K/A Topic(s) | IR | # |
| 203000 RHR/LPCI: Injection Mode | | | | | | | | | | | | | | |
| 205000 Shutdown Cooling | | | | | | | | | | | | | | |
| ~~206000 HPCI~~ | | | | | | | | | | | | | | |
| ~~207000 Isolation (Emergency) Condenser~~ | | | | | | | | | | | | | | |
| 209001 LPCS | | | | | | | | X | | | | A2.07 Ability to (a) predict the impacts of the following on the LOW PRESSURE CORE SPRAY SYSTEM ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Loss of room cooling | 2.8 | 86 |
| 209002 HPCS | | | | | | | | | | | X | G2.2.12 Knowledge of surveillance procedures | 4.1 | 87 |
| 211000 SLC | | | | | | | | | | | | | | |
| 212000 RPS | | | | | | | | | | | | | | |
| 215003 IRM | | | | | | | | | | | | | | |
| 215004 Source Range Monitor | | | | | | | | | | | | | | |
| 215005 APRM / LPRM | | | | | | | | | | | | | | |
| 217000 RCIC | | | | | | | | X | | | | A2.15 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: Steam line break. | 3.8 | 88 |
| 218000 ADS | | | | | | | | | | | | | | |
| 223002 PCIS/Nuclear Steam Supply Shutoff | | | | | | | | | | | | | | |
| 239002 SRVs | | | | | | | | | | | | | | |
| 259002 Reactor Water Level Control | | | | | | | | | | | | | | |
| 261000 SGTS | | | | | | | | | | | | | | |
| 262001 AC Electrical Distribution | | | | | | | | | | | | | | |
| 262002 UPS (AC/DC) | | | | | | | | | | | | | | |
| 263000 DC Electrical Distribution | | | | | | | | | | | | | | |
| 264000 EDGs | | | | | | | | | | | X | G2.2.17 EDG's - Knowledge of the process for managing maintenance activities during power operations, such as risk assessments, work prioritization, and coordination with the transmission system operator. | 3.8 | 89 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300000 Instrument Air | | | | | | | | | | | | | | |
| 400000 Component Cooling Water | | | | | | | | X | | | | A2.02 Ability to (a) predict the impacts of the following on the UNINTERRUPTABLE POWER SUPPLY (A.C./D.C.) ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Over voltage. | 3.0 | 90 |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| K/A Category Point Totals: | | | | | | | | 3 | | | 2 | Group Point Total: | | 5 |

| ES-401<br>401-1 | BWR Examination Outline<br>Plant Systems - Tier 2/Group 2 (SRO) | | | | | | | | | | | Form ES- | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System # / Name | K 1 | K 2 | K 3 | K 4 | K 5 | K 6 | A 1 | A 2 | A 3 | A 4 | G | K/A Topic(s) | IR | # |
| 201001 CRD Hydraulic | | | | | | | | | | | | | | |
| ~~201002 RMCS~~ | | | | | | | | | | | | | | |
| 201003 Control Rod and Drive Mechanism | | | | | | | | | | | | | | |
| ~~201004 RSCS~~ | | | | | | | | | | | | | | |
| 201005 RCIS | | | | | | | | | | | | | | |
| ~~201006 RWM~~ | | | | | | | | | | | | | | |
| 202001 Recirculation | | | | | | | | X | | | | A2.05 Ability to (a) predict the impacts of the following on the RECIRCULATION SYSTEM ; and (b) based on those predictions, use procedures to correct, control, or mitigate the consequences of those abnormal conditions or operations: Inadvertent recirculation flow increase | 4.0 | 91 |
| 202002 Recirculation Flow Control | | | | | | | | | | | | | | |
| 204000 RWCU | | | | | | | | | | | | | | |
| ~~214000 RPIS~~ | | | | | | | | | | | | | | |
| 215001 Traversing In-core Probe | | | | | | | | | | | | | | |
| ~~215002 RBM~~ | | | | | | | | | | | | | | |
| 216000 Nuclear Boiler Inst. | | | | | | | | | | | | | | |
| 219000 RHR/LPCI: Torus/Pool Cooling Mode | | | | | | | | | | | | | | |
| 223001 Primary CTMT and Aux. | | | | | | | | | | | | | | |
| 226001 RHR/LPCI: CTMT Spray Mode | | | | | | | | | | | X | G2.2.40 RHR/LPCI: Containment Spray System Mode - Ability to apply Technical Specifications for a system | 4.7 | 92 |
| ~~230000 RHR/LPCI: Torus/Pool Spray Mode~~ | | | | | | | | | | | | | | |
| 233000 Fuel Pool Cooling/Cleanup | | | | | | | | | | | | | | |
| 234000 Fuel Handling Equipment | | | | | X | | | | | | | K5.02 Knowledge of the operational implications of the following concepts as they apply to FUEL HANDLING EQUIPMENT: Fuel handling equipment interlocks | 3.7 | 93 |
| 239001 Main and Reheat Steam | | | | | | | | | | | | | | |
| 239003 MSIV Leakage Control | | | | | | | | | | | | | | |
| 241000 Reactor/Turbine Pressure Regulator | | | | | | | | | | | | | | |
| 245000 Main Turbine Gen. / Aux. | | | | | | | | | | | | | | |
| 256000 Reactor Condensate | | | | | | | | | | | | | | |
| 259001 Reactor Feedwater | | | | | | | | | | | | | | |
| 268000 Radwaste | | | | | | | | | | | | | | |
| 271000 Offgas | | | | | | | | | | | | | | |
| 272000 Radiation Monitoring | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 286000 Fire Protection | | | | | | | | | | | | | | |
| 288000 Plant Ventilation | | | | | | | | | | | | | | |
| 290001 Secondary CTMT | | | | | | | | | | | | | | |
| 290003 Control Room HVAC | | | | | | | | | | | | | | |
| 290002 Reactor Vessel Internals | | | | | | | | | | | | | | |
| K/A Category Point Totals: | | | | | 1 | | | 1 | | | 1 | Group Point Total: | | 3 |

| Facility: Columbia Generating Station | | | Date of Exam: April, 2015 | | | |
|---|---|---|---|---|---|---|
| Category | K/A # | Topic | RO | | SRO-Only | |
| | | | IR | Q# | IR | # |
| 1. Conduct of Operations | 2.1.29 | Knowledge of how to conduct system lineups, such as valves, breakers, switches, etc. | | | 3.8 | 94 |
| | 2.1.35 | Knowledge of fuel handling responsibilities of SROs. | | | 3.6 | 95 |
| | 2.1.14 | | | | | |
| | 2.1.29 | | | | | |
| | 2.1.44 | | | | | |
| | | | | | | |
| | **Sub-total** | | | | | **2** |
| 2. Equipment Control | 2.2.5 | Knowledge of the process for making design or operating changes to the facility. | | | 3.2 | 96 |
| | 2.2.25 | Knowledge of the bases in Technical Specifications for limiting conditions for operations and safety limits. | | | 3.4 | 97 |
| | 2.2.1 | | | | | |
| | 2.2.21 | | | | | |
| | 2.2.42 | | | | | |
| | | | | | | |
| | **Sub-total** | | | | | **2** |
| 3. Radiation Control | 2.3.4 | Knowledge of the radiation exposure limits under normal and emergency conditions. | | | 3.7 | 98 |
| | 2.3.12 | Knowledge of radiological safety principles pertaining to licensed operator duties, such as containment entry requirements, fuel handling responsibilities, access to locked high-radiation areas, aligning filters, etc. | | | 3.7 | 99 |
| | 2.3.14 | | | | | |
| | 2.3.15 | | | | | |
| | | | | | | |
| | **Sub-total** | | | | | **2** |
| 4. Emergency Procedures / Plan | 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. | | | 4.1 | 100 |
| | 2.4.1 | | | | | |
| | 2.4.6 | | | | | |
| | **Sub-total** | | | | | **1** |
| Tier 3 Point Total | | | | | | **7** |

| Tier / Group | Randomly Selected K/A | Reason for Rejection |
|---|---|---|
| 2 / 1 | 205000 A1.04 | RO Exam #2 – This K/A's topic is SDC/RHR pump suction pressure. RO exam question # 1 topic is RHR and suction valve; question #3 topic is NPSH for LPCS; question #11topic is RCIC and suction flowpath. Felt this K/A would over sample the topic of suction valving/NPSH – K/A A1.06 was randomly chosen as replacement. |
| 2 / 1 | 215004 A4.03 | RO Exam #9 – Could not write a discernible question to this K/A as Columbia does not have CRT display for SRMs. K/A A4.01 was randomly chosen as replacement. |
| 2 / 1 | 261000 K6.04 | RO Exam #16 – This K/A is very similar to question written for 223002 K3.11 which is Question #13 on the RO Exam. K/A K6.01 randomly chosen as replacement. |
| 2 / 1 | 264000 A1.04 | RO Exam #22 –Question written was associated with DG3 and was not in the spirit of the KA – question was rejected. Could not write a question associated with DG1/2 and crank case temperature/ pressure that was not a GFES type question. 264000 A1.03 randomly chosen as replacement. |
| 2 / 1 | 300000 K2.02 | RO Exam #25 – This K/A is not applicable to Columbia. 300000 K2.01 randomly chosen as replacement. |
| 2 / 1 | 201002 K3.02 | RO Exam #27 – Could not generate three credible distractors for questions written. 201001 K3.01 randomly chosen as replacement. |
| 2 / 2 | 259001 K2.01 | RO Exam #35 – This K/A is not applicable to Columbia. No other K2 K/A was available. 259001 K1.09 randomly chosen as replacement. |
| 1 / 1 | 295024 EA2.08 | RO Exam #48 – Could not write a discernible question to this K/A topic as no correlation between Drywell pressure and radiation levels. K/A EA2.04 randomly chosen as replacement. |
| 1 / 1 | 295027 | RO Exam #51 – 295027 High Containment Temperature is not applicable to Columbia. 295023 – Refueling Accidents chosen as replacement as this topic was only topic in Tier 1 Group 1 not originally chosen. |
| 1 / 2 | 295008 AK2.01 | RO Exam #60 – Could not write a discernible question to this K/A as there is no interrelationship between RPV High Level and our RPS system. K/A AK2.09 was randomly chosen as replacement. |

| Tier / Group | Randomly Selected K/A | Reason for Rejection |
|---|---|---|
| 1 / 2 | 295020 AK3.08 | RO Exam #63 – Could not write a question that had three credible distractors. K/A 295007 AK3.06 was randomly chosen as replacement. |
| 3 | 2.1.14 | RO Exam #66 – Could not write a question that was appropriate for the RO exam associated with making plant wide announcements. During exam review I was instructed to reject this K/A and select a different one. K/A 2.1.37 was randomly chosen as replacement. |
| 3 | 2.4.1 | RO Exam #74 – Question written was borderline SRO and was not 'generic' in nature. During exam review it was suggested I reject this K/A and select a different one. K/A 2.4.12 was randomly selected as replacement. |
| Other items noted concerning the RO Exam outline – Question #7 - 212000 K1.06 has a 3.5 IR not a 3.3 IR; Question #42 - 295005 K/A should be AK3.02 not AA3.02; Question #48 - 295024 K/A should be EA2.08 not AA2.08; Question #53 - 295030 K/A should be EA1.03 not AA1.03; Question #57 - 600000 K/A should be AK2.01 not EK2.01; Question #58 - 700000 K/A should be AK3.02 not EK3.02; Question #60 - 295008 - K2 was checked but K/A indicated was AK3.1; Question #64 - 295032 K/A should be EK1.04 not AK1.04 | | |

| Tier / Group | Randomly Selected K/A | Reason for Rejection |
|---|---|---|
| 1 / 1 | 295016 AA2.05 | SRO Exam #77 – Could not write a discernible SRO Only question for determining/ interpreting Drywell pressure as it applies to Control Room Abandonment. K/A AA2.02 was randomly chosen as replacement. |
| 3 | 2.1.4 | SRO Exam #94 – Could not write an SRO Only question for this K/A as it applies to ROs and SROs alike. K/A 2.1.29 was randomly chosen as replacement. |
| 3 | 2.1.26 | SRO Exam #95 – Could not write a discernible SRO Only question. K/A 2.1.35 was randomly chosen as replacement. |
| 3 | 2.2.19 | SRO Exam #97 – Could not write a discernible SRO Only question. K/A 2.2.25 was randomly chosen as replacement. |
| 3 | 2.3.6 | SRO Exam #98 – Original question written was for a non-radioactive release was rejected. Could not write a question for radioactive releases that had three credible distractors. CGS has not made a radioactive release in over ten years.<br>K/A 2.3.4 was randomly chosen as replacement. |
| | | |

ES-301 **RO NRC ADMIN Topic Outline** Form ES-301-1

| Facility: **Columbia Generating Station** | | Date of Examination: **April 2015** |
|---|---|---|
| Examination Level: RO **X** SRO | | Operating Test Number: **1** |
| Administrative Topic (see Note) | Type Code* | Describe activity to be performed |
| Conduct of Operations | M, R | Main Turbine change of load rate determination |
| Conduct of Operations | P, R | Alternate determination of drywell identified leak rate |
| Equipment Control | D, R | Determine FPC-P-1A clearance order requirements |
| Radiation Control | N, R | Determine Radiological posting requirements |
| Emergency Procedures/Plan | | |

NOTE: All items (5 total) are required for SROs. RO applicants require only 4 items unless they are retaking only the administrative topics, when all 5 are required.

* Type Codes & Criteria: (C)ontrol room, (S)imulator, or Class(R)oom
(D)irect from bank (≤ 3 for ROs; ≤ 4 for SROs & RO retakes)
(N)ew or (M)odified from bank (≥ 1)
(P)revious 2 exams (≤ 1; randomly selected)

ES-301 **SRO NRC ADMIN Topic Outline** Form ES-301-1

| Facility: **Columbia Generating Station** | | Date of Examination: **April 2015** |
|---|---|---|
| Examination Level: RO SRO **X** | | Operating Test Number: **1** |
| Administrative Topic (see Note) | Type Code* | Describe activity to be performed |
| Conduct of Operations | P, D, R | Based on plant conditions and pull sheets supplied, determine early criticality will occur and then determine required procedural actions. |
| Conduct of Operations | M, R | Based on plant conditions, determine if 'Voluntary Entry into AIA' is allowable. |
| Equipment Control | M, R | Determination of Operating Point and required action following feedwater heater trip. |
| Radiation Control | D, R | Estimate Main Condenser air ejector gross gamma activity and determine required actions. |
| Emergency Procedures/Plan | M, R | Given a QEDPS, determine that a General Emergency should be declared and complete a Classification Notification Form for the declaration. |

NOTE: All items (5 total) are required for SROs. RO applicants require only 4 items unless they are retaking only the administrative topics, when all 5 are required.

* Type Codes & Criteria: (C)ontrol room, (S)imulator, or Class(R)oom
(D)irect from bank (≤ 3 for ROs; ≤ 4 for SROs & RO retakes)
(N)ew or (M)odified from bank (≥ 1)
(P)revious 2 exams (≤ 1; randomly selected)

Facility: Columbia Date of Examination: April, 2015

Exam Level: RO ☐ SRO-I ☐ SRO-U ☐ Operating Test No.: 1

Control Room Systems@ (8 for RO); (7 for SRO-I); (2 or 3 for SRO-U, including 1 ESF)

| System / JPM Title | Type Code* | Safety Function |
|---|---|---|
| S1. Reduce RPV pressure with DEH; BPV fail in Auto – take manual control. (241000A4.02) The task is to lower RPV pressure to 550 psig at 50 psig per minute with DEH in automatic. DEH does not open the bypass valves in auto. The operator then takes manual control of bypass valves to lower RPV pressure.<br>(LO001780) – Performed by the RO, SRO-I and SRO-U | N, A, L, S | 3 |
| S2. Restore power to RPS-B. (212000A4.14) The task is to restore power and reset RPS-B. The B MG set is found not to be operable and power is then supplied from alternate power source.<br>(LO001779) Performed by the RO, SRO-I and SRO-U | M, A, L, S | 7 |
| S3. Given a LOCA and reactor scram have occurred. HPCS is currently injecting. RPV level is -130" and slowly trending down. The task is to use RHR-A and return RPV level to given band. When injection with RHR-A begins, the pump will start to cavitate. The operator will take action and secure RHR-P-2A. Injection with a different ECCS system will then be attempted but that systems injection valve will not open. Injection with a third ECCS system will then be attempted and RPV level will be returned to desired level band.<br>(LO001815) Performed by the RO, SRO-I and SRO-U | N, L, EN, S | 4 |
| S4. Transfer SL-31 to SL-21 from SM-3 (262001A4.01) Perform procedure and when the transfer is made the supply breaker does not auto trip but can be tripped manually.<br>(LO001781) Performed by the RO and SRO-I | M, S | 6 |

| | | |
|---|---|---|
| S5. Start RRC-P-1B at power (202001A4.01) Performs procedure and when RRC-P-1B is started, its speed does not stop increasing. The operator will trip RRC-P-1B per the immediate operator action of ABN-POWER.<br>(LO001642) Performed by the RO and SRO-I | D, A, S | 1 |
| S6. Align SSW to the FPC HX (233000A2.08) The task is to align service water to both Fuel Pool Cooling heat exchangers following a complete loss of RCC.<br>(LO001756) Performed by the RO and SRO-I | D, P, S | 9 |
| S7. Swap RCC pumps (Partial loss of RCC) (400000A2.01) The task is start RCC-P-1B and stop RCC-P-1C. RCC-P-1B starts normally but when RCC-P-1C is stopped, RCC-P-1B trips leaving only one operating RCC pump. Actions per ABN-RCC are then performed to secure and isolate RWCU.<br>(LO001806) Performed by the RO | N, A, S | 8 |
| C1. Emergency Drywell Venting per PPM 5.5.15. (223001A4.07) The task is to vent the Drywell with Standby Gas Treatment train B.<br>(LR000161) Performed by RO and SRO-I | D, C, R, E, EN | 5 |

| In-Plant Systems[@] (3 for RO); (3 for SRO-I); (3 or 2 for SRO-U) | | |
|---|---|---|
| P1. Prevent a RCIC High Exhaust Pressure trip. (217000 A2.02) During a station blackout, performs the actions of PPM 5.6.2 required to prevent a high exhaust pressure trip and a high area temperature isolation of the RCIC system.<br>(LR000218) Performed by the RO, SRO-I and SRO-U | D, E, EN, L, P, R | 2 |
| P2. Reset the HPCS DG mechanical overspeed trip. (264000A4.04) The task is to reset the mechanical overspeed trip on the HPCS diesel generator.<br>(LR001563) Performed by the RO and SRO-I | D, R | 6 |
| P3. Respond to CR HVAC High Radiation. (288000A2.02) During isolation of the Northwest Remote Air Intake, one of the valves cannot be closed which then requires removal of a fuse to complete isolation the intake path.<br>(LO001595) Performed by the RO, SRO-I and SRO-U | D, E, A, R | 9 |

All RO and SRO-I control room (and in-plant) systems must be different and serve different safety functions; all 5 SRO-U systems must serve different safety functions; in-plant systems and functions may overlap those tested in the control room.

| * Type Codes | Criteria for RO / SRO-I / SRO-U | |
|---|---|---|
| (A)lternate path | 4-6 / 4-6 / 2-3 | Actual - 5 / 4 / 3 |
| (C)ontrol room | | Actual - 1 / 1 / 0 |
| (D)irect from bank | ≤ 9 / ≤ 8 / ≤ 4 | Actual - 6 / 6 / 2 |
| (E)mergency or abnormal in-plant | ≥ 1 / ≥ 1 / ≥ 1 | Actual - 2 / 2 / 2 |
| (EN)gineered safety feature | - / - / ≥1 (control room system) | Actual - 3 /3 /2 |
| (L)ow-Power / Shutdown | ≥ 1 / ≥ 1 / ≥ 1 | Actual – 4 / 4 / 4 |
| (N)ew or (M)odified from bank including 1(A) | ≥ 2 / ≥ 2 / ≥ 1 | Actual – 5 / 4 / 3 |
| (P)revious 2 exams | ≤ 3 / ≤ 3 / ≤ 2 (randomly selected) | Actual – 2 / 2 / 1 |
| (R)CA | ≥ 1 / ≥ 1 / ≥ 1 | Actual – 3 / 3 / 3 |
| (S)imulator | | Actual – 7 / 6 / 3 |

Facility: Columbia NRC Scenario No: 1
Examiners: _____ Operators: _____
_____ _____
_____ _____

Initial conditions: Reactor Power is 90%. Power was reduced due to economic dispatch. OSP-ELEC-M701, DG-1 monthly surveillance is in progress and completed up to step 7.3.69. SM-1 has been transferred to TR-S. There are twenty minutes left in the run. OPS2 is in DG-1 room.

Turnover: ATC – Raise Reactor power with flow to 95% power. The reactivity brief has been performed.
BOP – After the power increase continue with OSP-ELEC-M701, DG-1 Monthly Operability Test starting at step 7.3.70. DG-1 phone # is 8563.
ATC – When step 7.3.78 has been performed, perform OSP-CRD-M701, Control Rod Exercise, starting with rod 18-59 and working across from left to right and then from top to bottom until all fully withdrawn control rods have been exercised. The reactivity brief has been performed.

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 1. | T = 0 | R (ATC) | Raise power with Flow. |
| 2. | T = 0 | N (BOP) | Complete OSP-ELEC-M701, DG-1 Monthly Operability Test. |
| 3. | T = 10 | C (ATC)<br>C (SRO)<br>TS (SRO) | Perform Control Rod Exercise surveillance - OSP-CRD-M701.<br>Second rod is uncoupled. |
| 4. | T = 25 | I (BOP)<br>I (SRO)<br>TS (SRO) | HPCS Spurious Injection |
| 5. | T = 35 | | Minimum Seismic Earthquake.<br>RHR-V-16A loses power. |
| 6. | T = 40 | C (SRO) | Another Seismic Tremor.<br>CW Pipe Rupture outside Protected Area.<br>MT Back Pressure rise requiring a Reactor scram and MT Trip. |
| 7. | T = 50 | M (All) | Operating Basis Earthquake.<br>Loss of Startup Power. |

**Critical Task is to initiate systems required to restore RPV level back to +13" to +54" level band prior to RPV level reaching -161".**

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 8. | T = 55 | M (All) | LOCA.<br>Drywell Floor Rupture. |
| | | C (BOP) | RHR-P-2B breaker fails to auto close. |
| 9. | T = 60 | C (SRO) | RHR-B-16B Fails to open results in the inability to spray the Drywell. |
| 10. | T = 70 | | Emergency Depressurize due to High Drywell Temperature GT 330°F. |
| **Critical Task is to initiate an Emergency Depressurization when Drywell Temperature cannot be restored and maintained LT 330°F within 10 minutes after 330°F is reached.** | | | |

* (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

# SCENARIO DESCRIPTION

EVENT 1 – Power is raised to 95% with Recirc Flow.

EVENT 2 – Complete OSP-ELEC-M701 (DG-1 Monthly Operability Surveillance). This is a normal evolution that is performed at the same time OSP-CRD-M701 is being performed.

EVENT 3 – Perform OSP-CRD-M701 (Control Rod Exercise Surveillance). The second rod tested, control rod 22-59, will be uncoupled when checked. Tech Specs 3.1.3 Control Rod Operability will be referenced and Condition C will apply – Fully insert the control rod within 3 hours and disarm the rod within 4 hours. The control rod will be driven full in and isolated with cooling flow maintained.

EVENT 4 – Spurious HPCS injection. The HPCS pump will start and begin injecting into the reactor. The crew will take actions per ABN-LEVEL and verify if the initiation signal is valid or not. Two RPV levels and two containment pressure readings will be observed. The crew will determine the initiation is NOT valid and secure the HPCS pump and close the injection valve. Tech Specs will be referenced and determine TS 3.5.1 ECCS – Operating and determines Condition B applies: B.1 – Verify by administrative means RCIC System is operable when RCIC is required to be operable immediately AND B.2 - Restore HPCS System to operable status within 14 days.

EVENT 5 – Minimum Seismic Earthquake occurs which causes scaffold to fall into RHR-V-16A cubicle. This valve is one of the two spray valves that is opened to initiate Drywell sprays on RHR-A system. There are Tech Spec implications due to this valve not being operable but the scenario progresses before Tech Specs can be referenced.

EVENT 6 – Another Minimum Seismic Earthquake occurs and results in a Circ Water line rupture outside the protected area. As a result, Main Turbine back pressure will start to rise. The crew should recognize that the event is not recoverable and insert a manual scram to remove the Main Turbine from service.

EVENT 7 – After the immediate scram actions have been performed, an Operating Basis Earthquake will occur causing a loss of Startup Power and the Drywell Floor Ruptures and a LOCA (starts on time delay).

EVENT 8 – LOCA, Drywell Floor Rupture and RHR-P-2B Breaker Fails to Auto Close – is closed manually and the pump starts. The LOCA requires Wetwell and Drywell spray initiations. EOPs are entered: PPM 5.1.1, RPV Control, is entered on low RPV water level of +13" on the Reactor scram. PPM 5.2.1, Primary Containment Control, is entered at 1.68 psig Drywell pressure and other containment parameters as they occur.

EVENT 9 – When Drywell sprays are attempted on RHR-B, one spray valve, RHR-V-16B does not open, which results in an inability to spray the Drywell.

EVENT 10 – When Drywell Temperature reached 330°F, the crew will exit the pressure leg of PPM 5.1.1, RPV Control, and enter PPM 5.3.1, Emergency RPV Depressurization as Drywell temperature cannot be restored and maintained LT 330°F.

The scenario will be terminated when RPV level is being returned to normal or as directed by the scenario coordinator.

Facility: Columbia NRC Scenario No: 2
Examiners: _____ Operators: _____
_____ _____
_____ _____

Initial conditions: Columbia is operating 100% power. OSP-SGT-M702 is scheduled to be performed. APRM 'A' has a failed power supply and is bypassed.

Turnover: Perform the Standby Gas Treatment B System Monthly Operability surveillance, OSP-SGT-M702.

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 1. | T = 0 | N (BOP) | Perform SGT B System Operability surveillance – OSP-SGT-M702. |
| 2. | T = 05 | I (ATC)<br>TS (SRO) | APRM Flow Unit "A" fails upscale. |
| 3. | T=15 | I (BOP)<br>I (SRO)<br>TS (SRO) | LD-TE-4A fails high causing a RCIC isolation and RCIC turbine trip.<br>RCIC-V-8 does not auto close – is closed manually. |
| 4. | T=25 | R (ATC) | RRC-P-1A high vibration.<br>Reduce reactor power with RRC flow. |
| 5. | T = 45 | C (ATC)<br>C (SRO)<br>M (All) | RRC-P-1A upper and lower seals fail requiring entry into single loop operations. When seals fail a LOCA begins and a manual reactor scram is inserted. |
| 6. | T = 55 | C (ATC) | Hydraulic ATWS.<br>Reduced SLC Flow.<br>RWCU-V-4 does not close – close RWCU-V-1 to isolate RWCU.<br>Lower RPV Level -80" to -140". |
| **Critical Task is to terminate and prevent injection into the RPV with the exception of SLC, RCIC, and CRD, prior to lowering level. (SRO/ATC)** | | | |
| 7. | T = 50 | M (All) | Hydraulic ATWS; Scram/Reset/Scram not effective in inserting control rods; Control rods cannot be manually driven in. |

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 8. | T = 70 | C (ATC)<br>C (SRO) | Both RFW Pumps trip and cannot be restarted. |
| | | M (All) | RPV level cannot be maintained due to loss of the Reactor Feed Pumps and at -183" ATWS - Emergency Depressurization is required. |
| **Critical Task is to initiate an Emergency Depressurization when RPV water level cannot be maintained above -183" and within five minutes of RPV level reaching -183". (SRO/ATC/BOP)** | | | |
| **Critical Task is during an ATWS with an Emergency Depressurization required, stop and prevent injection except from RCIC, SLC and CRD prior to any injection occurring from that system into the RPV before reaching the MSCP value for injection. (SRO/BOP/ATC)** | | | |
| **Critical Task is when RPV pressure is below MSCP, slowly inject into the RPV with Table 5 systems to return RPV level to -183" to LL prior to exiting Leg 'Y' of the level leg of PPM 5.1.2, RPV Control – ATWS. (SRO/ATC)** | | | |

* (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

# SCENARIO DESCRIPTION

The scenario begins with Columbia operating at full power. APRM 'A' is INOP.

**EVENT 1** – Perform OSP-SGT-M702, SGT B Monthly Operability surveillance. This is a normal evolution for the BOP operator that has the candidate start SGT Train B.

**EVENT 2** – APRM Flow Unit "A" fails upscale due to failed instrument. The ATC operator will respond to alarms and recognize the flow unit has failed upscale. SRO will refer to Tech Spec 3.3.1.1 RPS Instrumentation and determine Condition A applies – Place channel in trip within 12 hours OR place associated trip system in trip within 12 hours.

**EVENT 3** – RCIC isolation on failed temperature instrument. RCIC-V-8 does not auto close but does close when manually attempted. Tech Specs will be referenced: References Tech Spec 3.5.3 RCIC System and determines condition A applies - Verify by administrative means High Pressure Core Spray System is operable immediately AND Restore RCIC to operable status within 14 days. Refers to Tech Spec 3.3.6.1 Primary Containment Isolation Instrumentation and determines Function 3e for LD-TE-4A's failure applies which references Condition F – Isolate the affected penetration flow path(s) within 1 hour.

**EVENT 4** – A high vibration alarm will be received for RRC-P-1A. Vibration level reports from the field will be received which require RRC-P-1A speed to be lowered and the pump will eventually be stopped (see Event 5).

**EVENT 5** – When reactor power is lowered to 97%, the lower seal for RRC-P-1A will begin to fail. When reactor power reaches 92% the upper seal for RRC-P-1A will begin to fail. This will result in a LOCA and rising Drywell pressure. A manual scram will be inserted prior to Drywell pressure reaching the automatic scram setpoint of 1.68 psig.

**EVENT 6** – When the reactor is scrammed a Hydraulic ATWS occurs. SLC will be initiated but develop only 13 gpm injection flow. Additionally, RWCU-V-4 will not close automatically or manually. RWCU-V-1 can be closed to isolate RWCU system. RPV level will be lowered to -80" to -140".

**EVENT 7** – Control rods will be attempted to be inserted per PPM 5.5.11, Alternate Control Rod Insertion. Scram – Reset – Scram is not effective in inserting control rods and control rods cannot be inserted by individually driving them.

**EVENT 8** – When the scram is reset, both Reactor Feedwater pumps trip due to failed high RPV water level instrumentation. The high RPV water level signals cannot be reset which results in RFPs not being able to be restarted and causes RPV level to drop. When RPV level cannot be restored and maintained GT -183", an ATWS Emergency Depressurization will be performed. Injection will be stopped and prevented, and seven ADS SRVs will be opened. When RPV pressure reaches Main Steam Cooling Pressure of 188 psig, RPV injection will recommence.

The scenario will be terminated when RPV level is being maintained in the given band or as directed by the scenario coordinator.

Facility: Columbia NRC Scenario No: 3

Examiners: _____ Operators: _____

_____ _____

_____ _____

Initial Conditions: This is a Division 3 work week. OSP-ELEC-M703, DG-3 Monthly Surveillance, is in progress. OPS 2 is standing by in the HPCS DG room and can be contacted at ext. 8563. DG-3 is running and SM-2 is being powered from TR-S per OPS-ELEC-M703. PDIS signal X108 (DG3 voltage) is not available.

Turnover Information: Continue with DG-3 monthly surveillance which has been completed through step 7.3.31.

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 1. | T = 0 | N (BOP) | Synchronize and load DG-3 per monthly surveillance OSP-ELEC-M703. |
| 2. | T = 05 | C (ATC)<br>C (SRO)<br>TS (SRO) | Control Rod 06-43 Drifts In.<br>SRO – Tech Spec. |
| 3. | T = 15 | TS (SRO) | Failure of HPCS-P-2 requiring manual trip of DG-3.<br>SRO - Tech Spec. |
| 4. | T = 25 | C (ATC)<br>C (SRO)<br>R (ATC) | High Level Trip of FWH-6B requiring reducing core flow to LE 92 Mlbm/hr.<br>Rod Line GT 100% requiring using Fast Shutdown Sequence to insert control rods to lower rod line. |
| 5. | T = 45 | M (All) | DEH Leak - eventually requires a manual scram be inserted. |
| **Critical Task is to initiate a Manual Reactor Scram when the DEH Low Low Reservoir Level alarm annunciates within 15 minutes of the Low Reservoir level annunciator and prior to the MT tripping (This is a procedural requirement of ABN-DEH).** | | | |
| 6. | T = 55 | C (ATC)<br>C (BOP)<br>C (SRO) | TR-S Lockout; MSIVs close; Initiate RCIC/CRD for level control. |

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 7. | T = 60 | I (BOP) | DG-1 and DG-2 Fail to Auto Start. |
| 8. | T = 65 | M (All) | LOCA - Spray Wetwell and Drywell. |
| **Critical Task is to initiate Drywell Sprays when Wetwell Pressure exceeds 12 psig, prior to exceeding PSP and after verifying DSIL and RHR not required for adequate core cooling.** | | | |
| 9. | T = 75 | | RPV level drops to TAF. Initiate Emergency Depressurization on low RPV Level and return level to normal with low pressure ECCS pumps. |
| **Critical Task is to initiate an Emergency Depressurization after RPV water level reaches TAF and within 5 minutes of level dropping below -161 inches.** | | | |

- (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

# SCENARIO DESCRIPTION

The scenario begins with power at 100%. DG-3 is running and SM-2 is powered from Startup to support surveillance testing of DG-3.

Turnover information is that OSP-ELEC-M703, DG-3 Monthly Surveillance, is in progress and DG-3 is running and is ready to be synchronized. The BOP operator will continue with this surveillance and sync DG-3.

**EVENT 1** - The BOP operator will continue with this surveillance and sync DG-3.

**EVENT 2** - Control rod 06-43 drifts into the core. The ATC operator will identify the drifting control rod, select it, determine which direction it is drifting, and drive it to the full in position. Tech Specs 3.1.3, Control Rod Operability will be referenced and it will be determine that Condition C applies (One or more control rods inoperable for reasons other than Condition A or B) and take actions: Fully insert the inoperable control rod within 3 hours and Disarm the associated CRD within 4 hours.

**EVENT 3** - A short time after the DG-3 is synchronized, HPCS-P-2, the HPCS Service Water pump, will trip and Service Water to DG-3 will be lost. The crew will enter ABN-SW and per the immediate actions, DG-3 will be immediately tripped locally. The SRO will review Tech Specs for HPCS DG being INOP. The SRO will enter TS 3.7.2, High Pressure Core Spray (HPCS) Service Water System and determines Condition A applies: HPCS SW System inoperable which requires declaring HPCS System Inoperable immediately. He will then refer to Tech Specs 3.5.1, ECCS Operating, and determines Condition B applies: HPCS System inoperable which requires to verify by administrative means RCIC System is operable when RCIC is required to be operable immediately and Restore HPCS System to operable status within 14 days.

**EVENT 4** - The next event is a high level trip of High Pressure Feedwater Heater 6B. Feedwater temperature will drop by GT 6°F requiring entry into ABN-POWER. Reactor Power to rise requiring the ATC Operator to lower power with flow and to drive control rods to maintain LT the 100% rod line. When the fast shutdown sequence is used to insert control rods it requires core flow to be lowered to 92 Mlbm/hr and then to 75Mlbm/hr (depending on rod line).

**EVENT 5** – When plant systems have stabilized and control rods have been inserted, the next event is a leak in the DEH system. ABN-DEH will be entered. The crew will determine, based on the alarms received in the control room that the leak rate requires insertion of a manual reactor scram and trip of the Main Turbine and Main Generator.

**EVENT 6** - When the Startup transformer, TR-S, closes in after the MT/MG trip, it will lockout. The Backup Transformer, TR-B, will close in and power SM-7 and SM-8.

When TR-S is lost the MSIVs will close causing a LOCA to develop. Manual pressure control on SRV will be required. RCIC will be initiated and CRD restarted to feed the RPV but RPV level will continue to drop.

**EVENT 7** - On the High Drywell Pressure initiation signal (1.68 psig), DG-1 and DG-2 will fail to auto start. When initiations are checked the BOP Operator will take actions and manually start both Diesel Generators.

Facility: Columbia NRC Scenario No: 4
Examiners: _____ Operators: _____
_____ _____
_____ _____

Initial conditions: Reactor Power is 90%. Power was reduced due to CW-P-1B not being available. The work on CW-P-1B has been completed. OPS4 is standing by in the CWPH for a start of CW-P-1B

Turnover: Start CW-P-1B. After the pump start, raise reactor power with flow to 100%. The reactivity brief has been performed.

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 1. | T = 0 | N (BOP) | Start CW-P-1B. |
| 2. | T = 5 | R (ATC) | Raise power with Flow. |
| 3. | T = 10 | I (BOP)<br>I (SRO)<br>TS (SRO) | RHR-RLY-K112C Fails and RHR-V-42C opens. |
| 4. | T = 20 | I (ATC)<br>I (SRO)<br>TS (SRO) | Scram Discharge Volume level instrument fails – Half Scram.<br>2 Control Rods Scram but one does not go full in. |
| 5. | T = 35 | M (All) | Main Steam Tunnel steam leak – Insert a manual reactor scram.<br>One Main steam line does not isolate. |
| 6. | T = 40 | C (ATC)<br>I (BOP) | Electric ATWS – B RPS side – Pull fuses to insert control rods.<br>SLC fails to initiate. |
| **Critical Task is to insert control rods prior to exiting PPM 5.1.2 RPV Control - ATWS.** | | | |
| 7. | T = 60 | C (BOP) | CB-S1 Fails to auto close – closed manually – repower SL-11. |
| 8. | T = 70 | C (SRO) | Main Steam Tunnel steam leak gets larger and spreads to another area. |
| 9. | T = 70 | | Emergency Depressurize when 2 Areas GT Max Safe Temperatures. |
| **Critical task is to initiate an EMERGENCY DEPRESSURIZATION when 2 Areas have exceeded their Max Safe Operating Temperatures and within 5 minutes of establishing that the second areas temperature has exceeded its MSOT and complete actions before 15 minutes (time associated with when Emergency Director could direct evacuation of personnel at SAE).** | | | |

* (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

## SCENARIO DESCRIPTION

**EVENT 1** – The BOP operator will start CW-P-1B as a normal evolution.

**EVENT 2** – Reactor power will be raised to 100% with RRC flow at the rate of 1% power per minute or 1 Hz per minute.

**EVENT 3** – The next event is a failure of RHR-RLY-K112C which is the RHR-V-42B/C Open Permissive relay. The crew will respond and find RHR-V-42C stroking open. The crew will manually close RHR-V-42C. The CRS will declare RHR-C Inoperable and enters Tech Spec 3.5.1, ECCS – Operating, and determines condition A (one low pressure ECCS injection/spray subsystem inoperable) applies which requires to restore low pressure injection/spray subsystem to operable status within 7 days. The CRS will declare RHR-RLY-K112C inop and enter Tech Spec 3.3.5.1, Emergency Core Cooling System (ECCS) Instrumentation and uses table 3.3.5.1-1 to determine the function is 2f and that condition C applies which requires to declare supported features inop when redundant feature ECCS initiation capability is inoperable within 1 hour (is not applicable) and restore channel to operable status within 24 hours.

**EVENT 4** – The next event is a failure of a Scram Discharge Volume level switch (fails high) which causes a half scram on A RPS. Due to failed fuses on the B RPS side, two control rods will scram but only one goes full in. Control rod 30-03 stops at position 10. The crew will enter ABN-ROD and reduce reactor power with flow to LE 80 Mlbm/hr. Control rod 30-03 will be manually driven full in. For the control rods - Refers to Tech Spec 3.1.3, Control Rod Operability, and determines Condition C (One or more control rods inoperable for reasons other than A or B) applies which requires to fully insert inoperable control rod within 3 hours and disarm the associated CRD within 4 hours. For the SDV Level switch – Refers to Tech Spec 3.3.1.1, Reactor Protection System (RPS) Instrumentation and determines Condition A (one or more required channels inoperable) which requires place channel in trip within 12 hours OR place associated trip system in trip within 12 hours. Recognizes that the system already in a tripped condition.

**EVENT 5** – The next event is a steam leak in the Main Steam Tunnel. As temperatures rise the crew will determine the MSIVs will eventually close and a manual reactor scram will be inserted. When the isolation for high Main Steam Tunnel temperature occurs, both the inboard and outboard MSIVs on the A Main Steam line do not close.

**EVENT 6** – When the scram is inserted, only about one quarter of the control rods will insert due to a partial Electric ATWS on the B RPS side (A RPS is tripped due to the SDV instrument failure). When SLC is started the systems will not initiate. The crew will pull RPS fuses and all control rods will insert.

**EVENT 7** – When the Main Turbine trips the startup breaker for SM-1 will not auto close. Actions will be taken to manually close the S1 breaker and then to repower SL-11.

**EVENT 8** –The Main Steam line steam leak gets bigger and spreads to a second area. The first area is the Main Steam Tunnel and Max Safe temperature is 320°F.

**EVENT 9** – The crew will Emergency Depressurize the RPV when two areas are greater than their Max Safe Operating temperatures. The second area is the RWCU Pipe Area temperature and Max Safe temperature is 340°F.

The scenario will be terminated after the Emergency Depressurization has been performed.

Facility: Columbia NRC Scenario No: 5 (Spare)
Examiners: _____ Operators: _____
_____ _____
_____ _____

Initial conditions: Reactor Power is 58%. RFW-P-1A was removed from service for required maintenance and has just been placed back into Automatic operation. Dittmer has requested that CB-4888 be opened to facilitate switchyard maintenance.

Turnover: Raise reactor power to 65% with flow. The reactivity brief has been completed. When power is at 65%, open CB-4888.

| Event No. | Timeline | Event Type* | Event Description |
|---|---|---|---|
| 1. | T = 0 | R (ATC) | Raise power with flow to 65% reactor power |
| 2. | T = 10 | N (BOP) | Open CB-4888 |
| 3. | T = 15 | C (ATC) | CRD flow controller fails |
| 4. | T = 20 | I (BOP)<br>TS (SRO) | HPCS-LS-2A Spurious Trip; HPCS-V-1 does not auto close |
| 5. | T = 35 | TS (SRO) | MS-LS-200A fails downscale |
| 6. | T = 50 | C (ATC)<br>C (SRO) | MSR Drain Tank Controller Fails – Requires manual scram. MT trip. |
| 7. | T = 60 | C (BOP) | MG Fail to trip – requires manual action to trip the Main Generator. |
| 8. | T = 65 | M (ALL) | LOCA |
| 9. | T = 70 | C (BOP) | Initiate containment sprays - Wetwell Spray Valve RHR-V27A or RHR-V-27B fails to open. (First loop selected for wetwell spray.) |

**Critical Task is to spray the Drywell when Wetwell pressure reaches 12 psig, prior to exceeding PSP and after verifying DSIL and RHR not required for adequate core cooling.**

**Critical Task is to secure Drywell sprays after Drywell pressure has dropped LT 12 psig and prior to Drywell pressure reaching zero psig.**

* (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

## SCENARIO DESCRIPTION

**EVENT 1** –Reactor power is raised from 58% to 65% with flow by the ATC operator.

**EVENT 2** –BPA requested PCB 4888 be opened to allow BPA to perform switchyard maintenance. The BOP operator will open PCB 4888.

**EVENT 3** – When CB-4888 is opened, the CRD Drive Header Flow Control Valve controller, CRD-FCV-600, fails to 100% output signal fully opening CRD-FCV-2A (2B). The ATC operator will take manual control of CRD-FCV-600 and adjust output to achieve CRD Cooling Header flow to ~ 62 GPM and Drive Header dP to ~265 psid.

**EVENT 4** – When the actions for the failed CRD controller are completed, there will be a spurious trip of HPCS-LS-2A which causes a HPCS Suction switchover and HPCS-V-15 to open. The crew will investigate and observe that HPCS-V-1 did not auto close. The crew will take action to close HPCS-V-1. Tech Specs will be reviewed - refers to Tech Spec 3.3.5.1 and Table 3.3.5.1-1 and determines 3.e is applicable which indicates condition D applies – place channel in trip in 24 hours or align HPCS to the SP within 24 hours.

**EVENT 5** – After Tech Specs for HPCS have been addressed a downscale failure of MS-LIS-200A occurs. The crew will investigate and determine MS-LIS-200A has failed downscale. Tech Specs 3.3.6.1 Condition A will be referenced which requires placing channel in trip within 24 hours.

**EVENT 6** – A failure of the valves for a MSR Drain Tank will occur. The BOP operator will attempt to take manual control and reduce drain tank level but will not be successful. Eventually a MSR High Level alarm annunciates. The crew should take action and insert a manual scram and trip the Main Turbine which will trip on High MSR Level in 30 seconds from receipt of the MSR High Level alarm.

**EVENT 7** – When a scram is inserted, the Main Turbine will trip but the Main Generator will not trip. The crew will take actions to trip the Main Generator and will be successful when the Unit and Overall Unit pushbuttons are depressed. The Critical Task will be to trip the Main Generator.

**EVENT 8** – When the Main Generator is tripped a LOCA will occur. Containment pressure will rise to require Wetwell spray and Drywell spray initiations.

**EVENT 9** – When Wetwell Sprays are directed, the first RHR loop selected for Wetwell Sprays will have the Wetwell Spray valve fail to open. The crew will swap loops and spray initiation will be effective. Drywell sprays will be initiated at 12 psig and be effective in reducing containment pressure. Before Wetwell and Drywell pressures reach zero psig the crew will secure Wetwell and Drywell sprays.

The scenario will be terminated when Drywell sprays have been secured.