Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37379

August 24, 2000

Mr. Luis A. Reyes
U.S. Nuclear Regulatory Commission
Region II
61 Forsyth St., SW, Suite 23T85
Atlanta Federal Center
Atlanta, Georgia 30323-3415

Attention: Mr. H.O. Christensen

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - SENIOR REACTOR OPERATOR (SRO) REACTOR OPRATOR (RO) LICENSING EXAMINATIONS

This letter provides our comments concerning questions on the written licensing examinations administered on August 21, 2000. Specifically, we are requesting your consideration to accept two possible answers on four questions. Enclosure 1 includes the examination questions and the basis for this request. Also, additional information concerning two of the job performance measures is being provided in Enclosure 2. These comments were discussed with the chief examiner, Charles Payne, on August 24, 2000.

If you have any questions, please call me at (423) 843-7001 or Pedro Salas at (423) 843-7170.

Sincerely,

Richard T. Purcell

Enclosures
cc: See page 2

Enclosures

cc: Mr. R. W. Hernan, Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

NRC Resident Inspector
Sequoyah Nuclear Plant
2600 Igou Ferry Road
Soddy-Daisy, Tennessee 37379-3624

JDS:JWP:PMB
Enclosures
cc: Mr. R. W. Hernan, Project Manager
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Soddy-Daisy, Tennessee 37379-3624

R. F. Driscoll, STC 2H-SQN (Enclosure)
EDMS, WTC A-K (Enclosure)

I\operator license\examquestions082000

LICENSING TRANSMITTAL TO NRC
SUMMARY AND CONCURRENCE SHEET

THE PURPOSE OF THIS CONCURRENCE SHEET IS TO ASSURE THE ACCURACY AND COMPLETENESS OF TVA SUBMITTALS TO THE NRC.

DATE ____________ DATE DUE NRC 08/28/2000

SUBMITTAL PREPARED BY J. W. Proffitt

SUBJECT: Sequoyah Nuclear Plant (SQN) - Senior Reactor Operator (SRO) And Reactor Operator (RO) Licensing Examinations

PURPOSE/SUMMARY Transmit to NRC comments on the RO and SRO licensing examinations administered on August 21, 2000.

RESPONDS TO ____________ (RIMS NO.)

NEW COMMITMENTS ___ YES X NO

INDEPENDENT REVIEW ____________ DATE: ____________

LICENSING BASIS CHANGE - If this submittal requires a change to the licensing basis, a change has been initiated in accordance with NADP-7. ____________ DATE ____________

A concurrence signature reflects that the signatory has assured that the submittal is appropriate and consistent with TVA Policy, applicable commitments are approved for implementation and supporting documentation for submittal completeness and accuracy has been prepared.

CONCURRENCE (3)

NAME	ORGANIZATION	SIGNATURE	DATE
D. L. Koehl	SQN Plant Manager	for [signature]	8/24/00
M. J. Lorek	SQN Asst. PM	[signature]	8/24/00
H. H. Butterworth	SQN Operations Mgr.	H Butterworth	8/24/2000

10CFR 50.54(f) oath or affirmation required [ ] Yes [ ] No [X] N/A

NAME	ORGANIZATION	SIGNATURE	DATE
J. W. Proffitt	SQN IA Spec.	James W Proffitt	8/24/2000
J. D. Smith	SQN Licensing Supv.	[signature]	8/24/2000
P. Salas	SQN LIC & IA Mgr.	[signature]	8/24/00

I:license/operator license/ examquestions082000
JWP:DJS

Comments on JPM # 58AP, "Faulted S/G Isolation with MSIV Stuck Open"

NUREG-1021, Revision 8, Appendix C Section B. 1 requires those system and plant conditions be established that would permit the task to be performed realistically. In addition, sufficient information regarding the status of the plant should be provided to the candidates as part of the initial conditions.

The initial conditions established for this JPM may not have permitted the task to be performed realistically.

- The simulator was setup with a MSLB outside of containment, all four MSIVs were open, all AFW pumps running with maximum indicated flow, and T_{ave} at 531°F. The candidates were told that the crew had transitioned to E-2 from E-0 and were directed to implement E-2. Given the simulator setup and the initial conditions provided to the candidates, the crew would have met the criteria of E-0, step 15 to implement EA-3-8 to minimize plant cooldown by reducing AFW flow to ~ 440 gpm. Subsequently, the crew would have transitioned to E-2 at E-0, step 19. The failure to establish the appropriate initial conditions potentially masked the indications needed for the candidates to positively conclude that an intact SG existed at step 2 of E-2.

SEQUOYAH NUCLEAR PLANT
JOB PERFORMANCE MEASURE

JPM # 58AP

FAULTED STEAM GENERATOR ISOLATION WITH MSIV STUCK OPEN

Original Signatures on File

PREPARED/ REVISED BY:	H J Birch	Date/	9-15-95
VALIDATED BY:	* R Russell	Date/	10/25/95
APPROVED BY:	Walter S. Hunt (Operations Training Manager)	Date/	10/28/95
CONCURRED:	** N/A (Operations Representative)	Date/	

* Validation not required for minor enhancements, procedure Rev changes that do not affect the JPM, or individual step changes that do not affect the flow of the JPM.
** Operations Concurrence required for new JPMs and changes that affect the flow of the JPM (if not driven by a procedure revision).

NUCLEAR TRAINING

REVISION/USAGE LOG

REVISION NUMBER	DESCRIPTION OF REVISION	V	DATE	PAGES AFFECTED	PREPARED/ REVISED BY:
5	Transfer from WP. Minor enhancements.	N	8/19/94	All	HJ Birch
6	Incorporated U2 TDAFW HS use	N	10/27/94	6	HJ Birch
7	Incorporate Rev B changes.	Y	9/45/95	All	HJ Birch
pen/ink	E-2 revision had no impact. Revised K/A ratings. Reformatted critical steps.	N	8/13/98	All	JP Kearney
pen/ink	E-2 Rev update only	N	9/23/99	4	SR Taylor
pen/ink	Clarify step 4 standard based on 1999 annual exam performance results.	N	3/13/00	5	SR Taylor

V - Specify if the JPM change will require another Validation (Y or N).
See cover sheet for criteria.

SEQUOYAH NUCLEAR PLANT
RO/SRO
JOB PERFORMANCE MEASURE

Task:

Faulted Steam Generator Isolation With MSIV Stuck OPEN

Note: This JPM satisfies Simulator Manipulation "Z".

JA/TA task # : 0001060501 **(RO)**

K/A Ratings:
035A2.01 (4.5/4.6)

Task Standard:

Faulted S/G (#1) is isolated from all other steam sources as directed by E-2.

Evaluation Method : Simulator __X__ In-Plant ________

==

Performer: ______________________________
NAME

Start Time ________

Performance Rating : SAT _____ UNSAT _____ Performance Time _____

Finish Time _______

Evaluator: ______________________________/__________
SIGNATURE DATE

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COMMENTS

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SPECIAL INSTRUCTIONS TO EVALUATOR:

1. Sequenced steps identified by an "s"
2. Any UNSAT requires comments
3. Initialize the simulator to IC-42 for complete setup **OR** initialize the simulator to IC # 10 **THEN** activate **MF # MS04A** (to fail #1 MSIV OPEN) and malfunction **# MS02A** (steam leak outside containment on loop #1 S/G) **at 3%** severity.
4. Manually trip Rx and initiate SI. Run simulator until all automatic actions are completed and then FREEZE simulator until the operator has been briefed.
5. Insure operator performs the following required actions for **SELF-CHECKING;**
   a. Identifies the correct unit, train, component, etc.
   b. Reviews the intended action and expected response.
   c. Compares the actual response to the expected response.

Validation Time: CR. 8 mins **Local** ____________

Tools/Equipment/Procedures Needed:

E-2 "Faulted Steam Generator Isolation".
EA-1-1 "Closing MSIVs Locally"

References:

	Reference	Title	Rev No.
1.	E-2	Faulted Steam Generator Isolation	10

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READ TO OPERATOR

Directions to Trainee:

I will explain the initial conditions, and state the task to be performed. All control room steps shall be performed for this JPM. I will provide initiating cues and reports on other actions when directed by you. When you complete the task successfully, the objective for this job performance measure will be satisfied. Ensure you indicate to me when you understand your assigned task. To indicate that you have completed your assigned task return the handout sheet I provided you and to indicate completion of your answer to a knowledge question return the written copy of the question to me.

INITIAL CONDITIONS:

Unit 1 was at 100 % RTP when a Reactor Trip and Safety injection was actuated.
The crew has determined that all S/G pressures are decreasing.
E-0 has directed the crew to implement E-2 "Faulted Steam Generator Isolation".

INITIATING CUES:

The US/SRO directs you, the Unit 1 CRO, to implement E-2 and identify and Isolate the faulted S/G.
Inform the US/SRO when all actions to isolate the faulted S/G have been initiated.

Job Performance Checklist:

STEP/STANDARD	SAT/UNSAT
STEP 1.: Obtain a copy of the required procedure. STANDARD: Operator obtains a copy of E-2.	___ SAT ___ UNSAT Start Time____
STEP 2.: CHECK MSIV's and MSIV bypass valves CLOSED. RNO: CLOSE valves. **NOTE: MSIV 1-FCV-1-4 will NOT close.** STANDARD: Operator places HSs-1-4, 11, 22, 29 in the closed position and verifies green (& blue) lights ON, verifies HSs-1- 147, 148, 149, 150 are in the closed position with green lights ON. Recognizes FCV-1-4 will **NOT** close as indicated by RED light on handswitch ON. **NOTE: Operator must perform RNO for step 1.**	___ SAT ___ UNSAT **Critical Step**
STEP 3.: IF any MSIV can NOT be closed, THEN CLOSE MSIV USING EA-1-1, Closing MSIVs Locally. ***CUE*: *The OATC will implement EA-1-1.*** STANDARD: Operator dispatched to close loop 1 MSIV using EA-1-1.	___ SAT ___ UNSAT **Critical Step**
STEP 4.: CHECK S/G secondary pressure boundary integrity: Any S/G press controlled or rising. **NOTE: The other steam generators are NOT faulted.** STANDARD: Operator checks all S/G pressures using PI-1-2A & B, 9A & B , 20 A & B, 27 A & B OR PR-1-2 and determines that only #1 S/Gs pressure is decreasing uncontrolled and continues with E-2. Note: Other S/Gs may also be decreasing due to the cooldown, however, operator should realize this and not transition to ECA-2.1.	___ SAT ___ UNSAT

Job Performance Checklist:

STEP/STANDARD		SAT/UNSAT
STEP 5.:	Identify Faulted S/G: a. Any S/G pressure DROPPING in an uncontrolled manner. b. Any S/G pressure less than 140 psig.	___ SAT ___ UNSAT
NOTE:	**Critical ONLY IF another S/G is identified as faulted.**	**Critical Step**
STANDARD:	Operator correctly identifies #1 S/G as faulted S/G.	
STEP 6.:	ISOLATE Faulted S/G	
STANDARD:	The following steps isolate the faulted S/G.	
STEP 7.:	ISOLATE MFW.	___ SAT ___ UNSAT
STANDARD:	Operator verifies FCV-3-35, 35A, and 33 closed by green light "ON" for respective valves.	
STEP 8.:	ISOLATE AFW	___ SAT ___ UNSAT
STANDARD:	Operator depresses pushbutton controls for LCV-3-164/164A to accident reset THEN places each in the manual position, verifies amber light on XX-3-148 ON and closes each valve by turning switch to the closed position and verifies the green lights on for each valve. Places 1-HS-3-174 to the CLOSE position [HS may be placed in the PTL position] and verifies valve closed by green light on XX-3-148.	**Critical Step**
STEP 9.:	CLOSE steam supply valve to TD AFW pump FCV-1-15 or 16 CLOSED.	___ SAT ___ UNSAT
STANDARD:	Operator places HS for FCV-1-15 in the CLOSED position and verifies green light "ON". [THEN places HS for FCV-1-16 in the OPEN position and verifies red light "ON".] [ ] not critical.	**Critical Step**

Job Performance Checklist:

STEP/STANDARD		SAT/UNSAT
STEP 10.:	VERIFY S/G blowdown valves CLOSED.	___ SAT ___ UNSAT
STANDARD:	Operator ensures FCV-1-7 and 181 closed as indicated by green light "ON" for respective valves.	
STEP 11.:	VERIFY atmospheric relief CLOSED.	___ SAT ___ UNSAT
STANDARD:	Operator ensure PCV-1-6 closed by green light "ON" HS.	
STEP 12.:	Inform the US that the #1 S/G has been identified and isolated per E-2.	___ SAT ___ UNSAT Stop Time____
NOTE:	**If operator continues to the end of the procedure, cue the remaining steps as appropriate.**	
STANDARD:	Operator informs the US that the #1 S/G has been identified and isolated per E-2.	

Comments on JPM # NRC 2000-1, "Uncontrolled depressurization of all S/Gs"

NUREG-1021, Revision 8, Appendix C Section B. 1 requires those system and plant conditions be established that would permit the task to be performed realistically. In addition, sufficient information regarding the status of the plant should be provided to the candidates as part of the initial conditions.

The initiating cues provided to the candidates may not have been sufficient to facilitate task performance.

- The alarm for RM-119 was acknowledged as part of the simulator setup. The initiating cues given the candidates stated that the unit had experienced a secondary side transient that required the crew to manually initiate a safety injection and each steam generator had a safety valve fail to reseat. The procedural flowpath was E-0, E-2, and ECA-2.1. For the conditions given, the crew would have acknowledged the RM-119 alarm either before manual initiating safety injection or during the performance of E-0 when the CRO checks the back panels. Per OPDP-1, "Conduct of Operations" and EPM-4, "Users Guide," the operator that acknowledges the alarm would announce the alarm to the crew and implement the Alarm Response Procedure (ARP). Therefore, since the simulator setup had the alarm in the acknowledged state, the initiating cues should have informed the candidates of this fact and the status of ARP implementation.

- The 15 gallon per day (GPD) and 128 GPD limits for 1-RM-90-119 would have been known to the crew during shift turnover. This information was not provided to the candidates.

NUREG-1021, Revision 8, Appendix C Section B. 4 requires that the Examiner provide appropriate cues.

Appropriate cues may not have been given to the candidates at step 7 of ECA-2.1.

- The cue given to the candidates at Step 3.a. of ECA -2.1 was that the event had been in progress for 45 minutes. Normally, RadCon can complete their surveys within 20 minutes. In this JPM, notification of RadCon would have occurred when the ARP was implemented approximately 45 minutes earlier. Therefore, the cue given at Step 7.b should have been that radiation levels on the main steam lines were abnormal.

SEQUOYAH NUCLEAR PLANT
JOB PERFORMANCE MEASURE

JPM # NRC-2000-1

ECA-2.1, UNCONTROLLED DEPRESSURIZATION OF ALL STEAM GENERATORS

PREPARED/ REVISED BY:	Lacy Pauley	Date: 7/19/2000
	Phil Gass	
VALIDATED BY:	*	Date: 7/19/2000
	Scott Poteet for OTM	
APPROVED BY:		Date: 7/19/2000
	(Operations Training Manager)	
CONCURRED:	**	Date/
	(Operations Representative)	

* Validation not required for minor enhancements, procedure Rev changes that do not affect the JPM, or individual step changes that do not affect the flow of the JPM.
** Operations Concurrence required for new JPMs and changes that affect the flow of the JPM (if not driven by a procedure revision).

NUCLEAR TRAINING

REVISION/USAGE LOG

REVISION NUMBER	DESCRIPTION OF REVISION	V	DATE	PAGES AFFECTED	PREPARED/ REVISED BY:
0	New JPM for NRC exam	Y	7/19/2000	All	L. Pauley

V - Specify if the JPM change will require another Validation (Y or N).
See cover sheet for criteria.

SEQUOYAH NUCLEAR PLANT
RO/SRO
JOB PERFORMANCE MEASURE

Task: Complete first 7 steps of ECA-2.1 and transition to E-3. **JA/TA task # :** 3310110602

K/A Ratings:
006A1.06 {3.6/3.9}
038EA2.04 {3.9/4.2}

Task Standard: Complete first 7 steps of ECA-2.1 which include, starting MD AFW pumps, Re-establish MD AFW flow, Reducing feed flow to 25 gpm to each SG and isolating steam to TD AFW pump. Then transition to E-3, "Steam Generator Tube Rupture" due to high condenser exhaust rad levels.
NOTE: This task is not time critical, the operator must proceed promptly to prevent overfilling PZR and lifting a PZR PORV due to SI and Charging pump flow with no LOCA in progress.

Evaluation Method : Simulator __X__ In-Plant ________

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Performer: ________________________________
NAME
Start time ________

Performance Rating : SAT _____ UNSAT _____ Performance Time _____ Finish time ________

Evaluator: ________________________/______________
SIGNATURE DATE

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COMMENTS

SPECIAL INSTRUCTIONS TO EVALUATOR:

1. Critical steps identified by an asterisk (*)
2. Sequenced steps identified by an "s"
3. Initialize the simulator in **IC-78**. **If IC 78** is not available, then initialize to **IC 10** and continue the with the following steps for setup.
4. Insert **MF FW09A and FW09B** to prevent auto start of both MD AFW Pumps
5. Insert **MF TH05A 3%,** SGTR on # 1 S/G.
6. Insert **MF MS03A, MS03B, MS03C, and MS03D at 100%** (one SV failed open on each S/G).
7. Place the simulator in RUN and manually trip the reactor and manually initiate SI. Allow the simulator to run until TC indicate ~450°F (> 100°F RCS cooldown). Turn the MSIV switches to close and Freeze the simulator
8. Any UNSAT requires comments
9. Insure operator performs the following required actions for **SELF-CHECKING**;
   a. Identifies the correct unit, train, component, etc.
   b. Reviews the intended action and expected response.
   c. Compares the actual response to the expected response.

Validation Time: CR _______ Local ___________

Tools/Equipment/Procedures Needed:
ECA-2.1, "Uncontrolled Depressurization of all Steam Generators"

REFERENCES:

	Reference	Title	Rev No.
A.	ECA-2.1	Uncontrolled Depressurization of All Steam Generators	8
B.	EA-3-8	Manual Control of AFW Flow	4
C.	EA-3-9	Establishing Turbine Driven AFW Flow	3

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READ TO OPERATOR

Directions to Trainee:

I will explain the initial conditions, and state the task to be performed. I will provide initiating cues and reports on other actions when directed by you. All steps shall be simulated for this task When you complete the task successfully, the objective for this job performance measure will be satisfied. Ensure you indicate to me when you understand your assigned task. To indicate that you have completed your assigned task return the handout sheet I provided you.

INITIAL CONDITIONS:

Unit 1 experienced a secondary side pressure transient, that resulted in lifting code safety valves on all Steam generators. One code safety valve failed to reseat on each steam generator. A Safety Injection was manually initiated. At step 19 of E-0, the crew transitioned to E-2. The crew completed the first two steps of E-2 and transitioned to ECA-2.1.

INITIATING CUES:

The US/SRO directs you, the Unit 1 CRO, to perform the actions of ECA-2.1.

Job Performance Checklist:

STEP/STANDARD		SAT/UNSAT
STEP 1.:	Obtain a copy of the required procedure.	___ SAT ___ UNSAT
STANDARD:	Operator obtains a copy of ECA-2.1.	
STEP 2.:	CHECK secondary pressure boundary	___ SAT ___ UNSAT
STANDARD:	Operator checks the following valves for all four S/Gs closed. If they are open he should close or take action to close the valves. MSIVs and MSIV bypass valves MFW Regulating valve and regulating bypass valves MFW Isolation valves Atmospheric relief valves SG Blowdown valves Checks MFW flow indication at ZERO	
STEP3.:	CHECK MD AFW pumps running.	___ SAT ___ UNSAT
STANDARD:	Operator identifies that both MD AFW pumps are not running and goes to the RNO.	
STEP4.:	START MD AFW pumps.	___ SAT ___ UNSAT **Critical Step**
STANDARD:	Operator starts both pumps	
STEP *5.:	CLOSE TD AFW pump steam supply valves FCV-1-17 or FCV-1-18.	___ SAT ___ UNSAT **Critical Step**
STANDARD:	Ensures FCV-1-17 or FCV-1-18 are closed. Closing both valves is acceptable but not required.	

Job Performance Checklist:

STEP/STANDARD		SAT/UNSAT
STEP6.:	MONITOR S/G narrow range levels greater than 10%[25% ADV]	___ SAT ___ UNSAT
STANDARD:	Operator checks all S/G narrow range levels and determines that all near zero NR, THEN goes to the RNO.	
STEP 7.:	MAINTAIN feed flow to affected S/Gs greater than or equal to 25 gpm UNTIL level greater than 10% (25%ADV).	___ SAT ___ UNSAT
STANDARD:	Operator determines that feed flow to the affected S/G is $\geq$ 25 gpm (~ 260 gpm per S/G) and proceeds with the procedure.	
*STEP 8.:	CONTROL feed flow to minimize RCS cooldown. CHECK T-cold cooldown rate less than 100°F/hr.	___ SAT ___ UNSAT **Critical Step**
STANDARD:	Operator correctly identifies cooldown rate greater than 100 °F and goes to the RNO.	
*STEP 9.:	REDUCE feed flow to 25 gpm to each S/G.	___ SAT ___ UNSAT **Critical Step**
STANDARD:	Operator reduces feed flow to all four S/G to 25 gpm. Operator should reset the MDAFW LCVs, place each in manual bypass and manually reduce AFW flow to 25 gpm per S/G. Operator proceeds with substep 3.c. • Reducing flow is done by pressing each MDAFW LCV control selector switch to reset the accident signal and selecting manual bypass position. • THEN holding each MDAFW LCV control switch in the close position until flow is reduced to 25 gpm per S/G as indicated on FI-3-163A, 155A, 147A, and 170A.	
*STEP 10.:	MONITOR T-hots stable or dropping.	___ SAT ___ UNSAT **Critical Step**
STANDARD:	Operator Monitors all loops T-hots stable or dropping.	

Job Performance Checklist:

STEP/STANDARD	SAT/UNSAT
STEP11.: DETERMINE if RCP operation is permissible. NOTE: Operator should use steam tables or the operator aid on M-4 panel. STANDARD: Operator determines that RCS subcooling (based on core exit T/C) greater than 40°F and monitors CST level greater than 10%.	___ SAT ___ UNSAT
STEP 12.: MONITOR CST level greater than 10% STANDARD: Operator determines CST level approximately 80% and proceeds to the next step.	___ SAT ___ UNSAT
STEP 13.: MONITOR Pressurizer PORVs and block valves STANDARD: Operator ensures power to block valves AVAILABLE. Checks the PORVs CLOSED or closes a block valves if a PORV is open and checks at least one block valve OPEN.	___ SAT ___ UNSAT
STEP14.: VERIFY secondary radiation NORMAL. STANDARD: Operator notifies Chem Lab to sample S/G activity every 60 minutes and notifies RADCON to survey main steam lines.	___ SAT ___ UNSAT

Job Performance Checklist:

STEP/STANDARD	SAT/UNSAT
*STEP 15.: CHECK the following radiation monitors including available trends prior to isolation. NOTE: Condenser exhaust hi radiation alarm will be LIT and red light will be LIT on the radiation monitor. Based on this indication the recommendation to transition to E-3. STANDARD: Checks the following radiation monitors: Main Steam line RM NORMAL Condenser exhaust RM **ABNORMAL [AR-M12A window D-3 alarm is lit and red light lit on RM-90-99 panel]** S/G blowdown recorder RR-90-120 pen # 1 and pen # 2 normal. Post-Accident Radiation Monitor RR-90-268B, points 3, 4, 5, and 6 NORMAL	___ SAT ___ UNSAT **Critical step**
STEP16.: Operator informs the US/SRO that the first seven steps of ECA-2.1 are complete and the crew should transition to E-3 based on high radiation in the condenser exhaust and S/G blowdown. ***Cue:*** ***Acknowledge that the first seven steps of ECA-2.1 are complete and that there will be a crew brief prior to transition to E-3.***	___ SAT ___ UNSAT

Sequoyah Nuclear Plant
August 2000 NRC Written Exam

Changes to exam questions based on SQN post-exam review

027 2.3.10
SRO Question # 67 attached

Change:

Accept either C or D as correct answer.

Justification:

D is the correct answer on the answer key and is a true statement. Supporting documentation is included in the master exam answers and justification submitted prior to the exam.

C is also correct. Supporting documentation is listed below and attached.

Tech Spec ¾.5.5 bases for Refueling Water Storage Tanks boron concentration

Memo from Gordon Rich, Plant Chemistry Superintendent to Lacy Pauley dated August 23, 2000.

Applicable pages from Chemistry Training materials

Summary: Iodine is removed from the containment atmosphere by containment spray from the RWST and the removal is enhanced after containment sump swapover by the addition of sodium as the ice melts and the PH increased in the containment sump.

67. Given the following plant conditions:

- Unit 1 is responding to a LOCA using E-1 procedure
- RCS dose equivalent Iodine-131 activity is 290 micro curies per gram

Which ONE (1) of the following describes a method or design feature used to reduce the iodine-131 concentration in the containment atmosphere AND reduce the potential for inadvertent release of Iodine from the containment?

A. When containment iodine exceeds Tech Spec limits, E-1 directs the venting of the containment to reduce the concentration to within limits

B. When containment iodine exceeds Tech Spec limits, E-1 directs the purging of the containment to reduce the concentration to within limits.

C. Containment spray water from the RWST will remove elemental iodine from the containment atmosphere.

D. A sodium tetraborate additive in the ice will remove elemental iodine from the containment atmosphere.

Pauley, Lacy

From: Rich, Gordon L.
Sent: Wednesday, August 23, 2000 2:41 PM
To: Pauley, Lacy
Cc: Richie, Robert E. Jr.
Subject: Effect of Containment Spray on Iodine in Containment Atmosphere

The question was asked if the containment spray would scrub the iodines out of the environment of the containment following a LOCA. The simple answer is yes, but it also depends on several factors. The RWST water contains at least 2000 ppm boron as boric acid. This is mainly a water solution that has an acidic pH, which will mix with the tetraborate from the melting ice to control the pH in the containment sump to near neutral

From the chemistry of the RCS, the iodine is mainly in the iodide form (combined with Cs as CsI) in solution. If a LOCA occurs, the iodide will be airborne in small droplets or dissolved in the steam. Some of it will eventually convert to iodine which is more volatile, or could become methyl iodide if there are organics present. The reason that the pH in the sump is controlled basic is to control the long term volatility of these two species. In acidic solutions the volatility is greater. Most accident analysis assumes the volatile form of iodine so that if the volatile species can be controlled, it will be conservative. Real accidents (i.e.Three Mile Island) have had very little release of iodine as long as water is present. The major iodine releases in accident conditions occurred at Chernobyl and Windscale (English Gas Cooled Reactor) where there was no water present. This is because all forms of iodine are soluble in water to some extent (Handbook of Chemistry and Physics lists iodine as slightly soluble in water), but especially the iodide which is the most common form on the initial release.

The bottom line is that iodine is physically scrubbed from the containment atmosphere by spraying water on the steam/droplets following a LOCA, since the solubility is much higher in the water phase. The basic pH effect is more efficient than acidic, but the scrubbing is still effective due to the mass of water present, and the relatively small amount of iodine present.

Rob is faxing you some documentation taken from previous training on the subject. If you have any questions after reading, let me know.

Gordon

3/4.5.5 REFUELING WATER STORAGE TANK

The OPERABILITY of the RWST as part of the ECCS ensures that a sufficient supply of borated water is available for injection by the ECCS in the event of a LOCA. The limits on RWST minimum volume and boron concentration ensure that 1) sufficient water is available within containment to permit recirculation cooling flow to the core, and 2) the reactor will remain subcritical in the cold condition following mixing of the RWST and the RCS water volumes with all control rods inserted except for the most reactive control assembly. These assumptions are consistent with the LOCA analyses.

Additionally, the OPERABILITY of the RWST as part of the ECCS ensures that sufficient negative reactivity is injected into the core to counteract any positive increase in reactivity caused by RCS cooldown. R144

The contained water volume limit includes an allowance for water not usable because of tank discharge line location or other physical characteristics.

The limits on contained water volume and boron concentration of the RWST also ensure a pH value of between 7.5 and 9.5 for the solution recirculated within containment after a LOCA. This pH band minimizes the evolution of iodine and minimizes the effect of chloride and caustic stress corrosion on mechanical systems and components.

MAY 11 1990

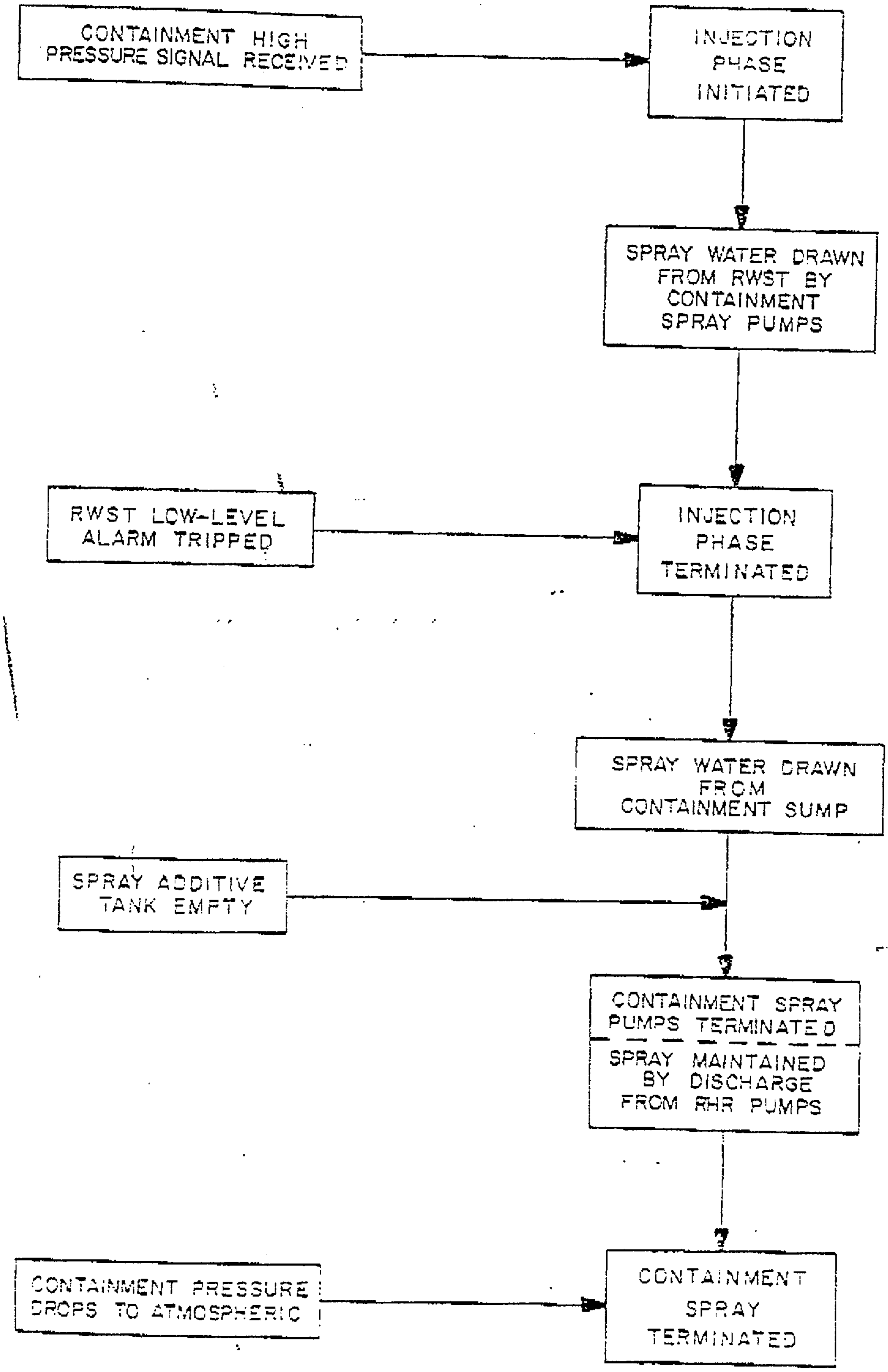
2.2 Containment Isolation

Upon release from the coolant system, radionuclides will enter the containment and will be transported and deposited throughout. Radioactive material may then be transported to the environment through leak paths or a failed containment. The containment isolation system is designed to ensure that radioactivity released from the reactor coolant system is retained within the containment. In the event of a loss-of-coolant accident, containment isolation signals are received by valves which close to isolate all potential leakage pathways that penetrate the containment but are not required to limit the accident consequences. This minimizes the leakage of radioactive materials through lines penetrating the containment structure, such that the site boundary dose guidelines specified in 10CFR100 are not exceeded. Those penetrations which serve components of engineered safety features do not close automatically as part of containment isolation. However, there are provisions for manually isolating these lines from the control room if it should be necessary.

2.3 Iodine Removal

In the event of a break in either the reactor coolant or the main steam system, the containment spray system may be activated to maintain the containment pressure below the design pressure and to remove elemental iodine from the containment atmosphere in order to limit potential off-site and site boundary doses to values below those set by 10CFR100. The spray system provides sufficient cooling to condense any steam released during the accident, thereby reducing the containment pressure.

The containment spray system operates in two sequential phases, as illustrated in the flow chart of Figure 2. The first phase, known as the injection phase, is an immediate automatic response to a break, and is initiated by a containment high pressure signal. In this phase, borated water is drawn from the refueling water storage tank (RWST) by



Two Phase Operation of Containment Spray System
Core Damage Figure 2

the containment spray pumps and forced through spray nozzles within the containment. The 30 percent sodium hydroxide (NaOH) solution contained in the spray additive tank is mixed with the spray stream. The sodium hydroxide addition enhances the overall removal of the iodine.

Once the RWST water level drops low enough to trip the low-level alarm, the injection mode is terminated and the recirculation phase is initiated, with water being drawn from the containment sump. During this phase, at least one containment spray pump is operated until all of the sodium hydroxide has been removed from the spray additive tank. Thereafter, the containment spray pumps are shut off and the spraying is maintained by the recirculation of water from the sump by diversion of part of the discharge from the residual heat removal pumps. Once the containment pressure has dropped to atmospheric pressure (or below for subatmospheric containments), the containment spray may be terminated.

Most of the iodine that is released from failed fuel is assumed to be released in the form of free iodine, I_2. This assumption is made, in part, for conservativism since any other chemical forms are less volatile over aqueous solutions and therefore are less likely to be released to containment than elemental iodine. The containment spray solution is introduced into the containment in the form of a fine mist. This maximizes the surface area of the spray solution, thereby increasing the net absorption of the iodine vapor by the droplets. Iodine is highly reactive and reacts rapidly with the water in the steam or containment spray according to the reaction

$$I_2 + H_2O \rightleftharpoons H^+ + I^- + HOI$$

The hypoiodous acid (HOI) is unstable and reacts rapidly to form the iodate ion IO_3^- by the reaction

$$3HOI \rightleftharpoons 2I^- + 3H^+ + IO_3^-$$

Both the I^- and the IO_3^- are very soluble in water and tend to form stable salts. The net reaction for the hydrolysis of iodine is

$$3I_2 + 3H_2O \rightleftharpoons 5I^- + IO_3^- + 6H^+$$

There is some retention of water in the vapor

The equilibrium constant for the hydrolysis reaction is quite small. In a high acid solution, the amount of free iodine which reacts is small. This results from the sixth power relationship of the H^+ ion on the magnitude of the equilibrium constant. However, in a solution which has a low concentration of H^+ (i.e., a high pH), the fraction of available iodine which reacts is much greater. The addition of sodium hydroxide to the containment spray raises its pH to about 9. At this pH, the extremely low hydrogen ion concentration results in the reaction of free iodine with water to proceed very nearly to completion.

The iodine partition coefficient for the aqueous system is a measure of the fraction of iodine in the aqueous phase with respect to that in the gaseous phase. The magnitude of the coefficient is a function of the chemical form of the iodine. That is, when the predominate chemical species are water soluble, little iodine exists in the vapor phase and the partition coefficient is large. As the products of the iodine hydrolysis reaction are highly water soluble, forcing the reaction to near completion by maintaining a high pH (>9) results in a large aqueous partition coefficient and a highly effective scavenging of the iodine from the gaseous phase. Once the iodine has been absorbed into the spray droplets, the high pH has the effect of producing water soluble species. In order to retain the iodine in solution, the solution pH must be maintained greater than about 9.

Typically, the quantity and concentration of the sodium hydroxide solution in the spray additive tank is such that the pH of the water in the containment sump is maintained between 8.5 and 11.0. The lower limit is set to ensure that the iodine which has been absorbed into the spray droplets will remain in solution once the water collects in the containment sump. The upper limit of 11.0 to set to avoid the caustic attack on metals and concrete that would occur if the pH were allowed to rise to near 14.

The scavenging of the iodine by the spray complements the removal of the iodine by deposition on the containment surfaces. The net removal mechanisms lower the estimated off-site thyroid dose resulting from a release of fission products to the containment. The final stage for the removal of iodine is a filtration system employing activated charcoal which absorbs iodine. This limits the iodine released through the containment ventilation systems.

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Changes to exam questions based on SQN post-exam review

062 2.2.13
RO Question # 73 attached
SRO Question # 73 attached

Change:

Accept either C or D as correct answer.

Justification:

D is the correct answer on the answer key and is a true statement. Supporting documentation is included in the master exam answers and justification submitted prior to the exam.

C is also correct. Supporting documentation is listed below and attached.

SPP-10.2 page 19 (Appendix A page 1 item 10) states "When placing or removing clearances inside electrical boards, the operator should ensure that no loose materials remain in the breaker compartment".

SPP-10.2 page 37 (Appendix L page 6 item 7.2.B) states "Before energy is restored to equipment and/or systems that have been tagged out, a visual inspection of the work area is made by an authorized person to ensure that all nonessential items have been removed and all components are operationally intact".

Summary: While neither of the above references REQUIRE operations personnel to open the compartment doors to specifically verify removal of grounds, it is reasonable to expect that they would observe inadvertently left ground cables during the inspections described above.

73. Which ONE (1) of the following statements correctly describe the requirement(s) for safety grounds when used on plant equipment, in conjunction with a clearance?

A. Prior to being issued a clearance, the person responsible for the work MUST ensure all safety grounds have been placed and numbered ground discs attached as required.

B. After a clearance released, the person responsible for the work MUST ensure all safety grounds have been removed and numbered ground discs returned to their storage cabinet.

C. Operations personnel picking up a clearance on the 6.9 KV Unit Board are REQUIRED to open the compartment doors and verify removal of three phase ground wires.

D. Following the issue of a clearance requiring three-phase grounds, a ground disc on the ground side of each phase is required except where a single device provides a 3-phase ground.

73. Which ONE (1) of the following statements correctly describe the requirement(s) for safety grounds when used on plant equipment, in conjunction with a clearance?

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D. Following the issue of a clearance requiring three-phase grounds, a ground disc on the ground side of each phase is required except where a single device provides a 3-phase ground.

APPENDIX L
Page 6 of 10

1. Verify the equipment and/or system operating controls are shutdown by performing a visual inspection of the operating controls (pushbuttons, switches, etc.).

2. Test the equipment and/or system by use of appropriate test equipment and/or visual inspection to confirm that energy isolation has been effective.

7.2 <u>Sequence of Restoring Equipment to Service</u>

A. Before energy is restored to equipment and/or systems, an authorized person verifies that all personnel are in the clear.

B. Before energy is restored to equipment and/or systems that have been tagged out, a visual inspection of the work area is made by an authorized person to ensure that all nonessential items have been removed and all components are operationally intact.

C. Each tagout device shall be removed from each point of control only by the authorized supervisor who attached it.

<u>EXCEPTION</u> In the event that the authorized person, because of illness, injury, or some other reason is not available at the worksite to remove his/her lockout/tagout device(s) and it is essential that this be done in his/her absence, management may appoint another authorized person to do this function. When this is done, the appointed authorized person assumes full responsibility for the function and performs the following activities:

1. Reviews the overall work activity and walks down the boundaries of the lockout/tagout and verifies all locked and/or tagged points of control.

2. Informs each involved employee of the planned release of the lockout/tagout and re-energization of the equipment.

3. Performs Steps A, B and C of Section 7.2.

4. Notifies the authorized person for whom he was appointed by management to release and restore the equipment of the release and activities immediately or upon the return of the original authorized person to the worksite.

D. The authorized person closes the Lockout/Tagout Log entries and dispositions the Lockout/Tagout sheets initiated in accordance with Section 5.0, Steps G and H.

APPENDIX A
Page 1 of 2

SPECIAL REQUIREMENTS FOR ELECTRICAL CLEARANCES

1. Component handswitches shall not be used as the sole isolation point for establishing a clearance boundary unless the handswitch is a disconnect device which serves to deenergize the circuit requiring isolation. The handswitches should be tagged as indication/information that associated equipment is under clearance.

2. If potential or station service transformers are outside of the clearance zone, they may be cleared from the primary side. If they are inside the clearance zone, they must be also cleared from the secondary side.

3. Coupling capacitors within a clearance zone must have their secondary circuits shorted if work is to be performed on or near them.

4. Static capacitors within a clearance zone must be grounded. The person receiving the clearance is responsible for discharging and grounding the static capacitors.

5. Any changes in current transformer secondary circuits that are in service must be approved by the operator who is responsible for maintaining protection to equipment.

6. Blocks shall be removed in current transformer secondaries when connected in parallel with current transformers that are energized, before work is performed on them. If blocks are not available, it will be necessary to short circuit the current transformer, ground, and open the secondary circuits.

7. When two or more transformers are connected to ground through a common reactor, the transformer's neutral ground switch for the transformer to be cleared shall be opened and tagged with a hold notice or Danger tag.

8. All disconnecting devices or breakers that establish a clearance boundary must be opened, made inoperable, and tagged to ensure that they will not be closed.

9. Gang or motor-operated disconnects/air-break switches must be mechanically locked in the open position and visually checked to verify that all blades are open.

10. When placing or removing clearances inside electrical boards, the operator should ensure that no loose materials remain in the breaker compartment.

11. A clearance hung for electrical equipment will ensure that other sources of hazards to personnel or equipment are evaluated before issuance of that clearance, such as control power, motor heaters, and alternate power supplies.

12. When removing clearances from an electrical board's potential transformer compartments, ensure the door is securely latched after closing.

13. When opening rotary-operated molded case breakers, positive indication in the form of a snap or click is required to ensure that the breaker is open. If positive indication is not verified, evaluate the situation with the SM.

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Changes to exam questions based on SQN post-exam review

W/EK02 EK2.2
RO Question # 25 attached
SRO Question # 6 attached

Change:

Accept either B or D as correct answer.

Justification:

B is the correct answer on the answer key and is a true statement. Supporting documentation is included in the master exam answers and justification submitted prior to the exam.

E-0 step 15 is a continuous action step. Since T-avg is not stable or trending to between 547 and 552, action of the RNO is applicable. The RNO requires ENSURING steam dumps and atmospheric relief valves are closed and IF cooldown continues THEN close MSIVs and MSIV bypass valves.

EPM-4 page 16 item 3.5.A.7 states "The operator may close the MSIVs after the reactor is tripped on a steam or feed line break. Also, AFW may be isolated to a faulted S/G provided that the requirements for secondary heat sink are satisfied".

Summary: D is also correct based on the continuous action step of E-0 and the prudent operator action described in EPM -4.

25. Given the following plant conditions:

- Unit #1 has experienced a Reactor Trip and SI.
- The crew has transitioned to and performed the proper procedures and are currently performing ES-1.1 "SI Termination."
- The CRO notices that the pressure in #2 Steam Generator is decreasing rapidly out of control and notifies the SRO.

Which ONE (1) of the following describes the direction the SRO should give the crew?

A. Close all MSIVs, SG PORVs and isolate Main Feedwater, Auxiliary Feedwater, and S/G blowdown lines.

B. Transition to E-2, "Faulted Steam Generator Isolation" from the Fold Out Page.

C. Transition to E-1, "Loss of Reactor or Secondary Coolant" from the Fold Out Page.

D. Verify all Steam Dumps and Steam Generator PORVs are closed, then close all MSIVs.

6. Given the following plant conditions:

- Unit #1 has experienced a Reactor Trip and SI.
- The crew has transitioned to and performed the proper procedures and are currently performing ES-1.1 "SI Termination."
- The CRO notices that the pressure in #2 Steam Generator is decreasing rapidly out of control and notifies the SRO.

Which ONE (1) of the following describes the direction the SRO should give the crew?

A. Close all MSIVs, SG PORVs and isolate Main Feedwater, Auxiliary Feedwater, and S/G blowdown lines.

B. Transition to E-2, "Faulted Steam Generator Isolation" from the Fold Out Page.

C. Transition to E-1, "Loss of Reactor or Secondary Coolant" from the Fold Out Page.

D. Verify all Steam Dumps and Steam Generator PORVs are closed, then close all MSIVs.

3.5 Prudent Operator Actions

A. The following are examples of prudent operator actions[1]:

1. When an automatic action has failed to occur, the operator may take actions to compensate for the failed automatic action.
2. When a failure causes a spurious automatic actuation, the operator may take actions to restore from the automatic actuation as appropriate.
3. The operator may take actions to shut down secondary or nonessential equipment, provided all the following conditions are met:
   - The actions are not mitigating in nature.
   - The actions do not interfere with mitigating actions.
   - Operating configuration of ESF equipment is not changed.
4. The operator may take actions to isolate the Turbine Driven Auxiliary Feedwater Level Control Valves to preclude a SG overfill condition provided that the requirements for secondary heat sink are satisfied.
5. The operator may stop the RCPs when Phase B is actuated. (Note that this action is NOT appropriate if the reactor is not tripped).
6. The operator may realign the TDAFWP steam supply to prevent a radioactive release on a S/G tube leak or rupture.
7. The operator may close the MSIVs after the reactor is tripped on a steam or feed line break. Also, AFW may be isolated to a faulted S/G provided that the requirements for secondary heat sink are satisfied.

B. In deciding if taking prudent action is appropriate, the following elements should be considered as a whole:

1. Plant safety status should be maintained or enhanced. Prudent mitigative or preemptive action should not degrade plant status or put the plant in a less safe state or challenge it more than the initiating event. It should not cause a RED or ORANGE path critical safety function condition. For example, closing the MSIVs to isolate the condenser steam dumps at 100% power would challenge the plant more than the original problem by lifting pressurizer and S/G safeties and causing an overheat and load rejection event. However, in Modes 3, 4, 5, or 6, closing the MSIVs to stop an uncontrolled cooldown and positive reactivity addition event would have minimal impact on plant status, while enhancing reactor safety.

(1) Defined in Section 5.0, Definitions.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
15.	**MONITOR** RCS temperatures: • **IF** any RCP running, **THEN** **CHECK** T-avg stable at or trending to between 547°F and 552°F. OR • **IF** RCPs stopped, **THEN** **CHECK** T-cold stable at or trending to between 547°F and 552°F.	**IF** temperature less than 547°F and dropping, **THEN** **PERFORM** the following: a. **ENSURE** steam dumps and atmospheric reliefs CLOSED. b. **IF** cooldown continues, **THEN** **PERFORM** the following: 1) **CONTROL** total feed flow **USING** EA-3-8, Manual Control of AFW Flow. 2) **MAINTAIN** total feed flow greater than 440 gpm UNTIL narrow range level greater than 10% [25% ADV] in at least one S/G. c. **IF** cooldown still continues, **THEN** **CLOSE** MSIVs and MSIV bypass valves. **IF** temperature greater than 552°F and rising, **THEN** • **DUMP** steam to condenser. OR • **DUMP** steam **USING** atmospheric reliefs
16.	**DISPATCH** personnel to perform EA-0-1, Equipment Checks Following ESF Actuation.	

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Changes to exam questions based on SQN post-exam review

078 K2.01
RO Question # 86 attached
SRO Question # 83 attached

Change:

Accept either C or D as correct answer.

Justification:

C is the correct answer on the answer key and is a true statement. Following a loss of offsite power, A and B compressors can be reset and started locally at any time.

D also correct because of language structure. Since the A and B compressors can be reset and started locally at any time, then they can be reset and locally started **before or after** the Blackout Relays are reset. Distractor D should have been written as follows: "Air compressors A and B can be reset and started locally **ONLY** after the Blackout Relays are reset". The word "ONLY" would have precluded D as a correct answer.

86. Given the following plant conditions:

- Both units were operating at 100% power.
- A loss of offsite power occurred.
- Both units automatically shutdown.
- All four DG started and energized their respective shutdown boards.

Which ONE (1) of the following describes the required actions to restore the air system service prior to restoration of offsite power?

A. No action is necessary, air compressors A, B, C, and D will be sequenced back on by the Blackout Sequencer.

B. Air compressors A, B, C, and D can be reset and started locally at any time.

C. Air compressors A and B can be reset and started locally at any time.

D. Air compressors A and B can be reset and started locally after the Blackout Relays are reset.

83. Given the following plant conditions:

- Both units were operating at 100% power.
- A loss of offsite power occurred.
- Both units automatically shutdown.
- All four DG started and energized their respective shutdown boards.

Which ONE (1) of the following describes the required actions to restore the air system service prior to restoration of offsite power?

A. No action is necessary, air compressors A, B, C, and D will be sequenced back on by the Blackout Sequencer.

B. Air compressors A, B, C, and D can be reset and started locally at any time.

C. Air compressors A and B can be reset and started locally at any time.

D. Air compressors A and B can be reset and started locally after the Blackout Relays are reset.