Attachment 1

NRC Resolution of Facility Comments

Question No. 001 RO

Facility Comment: EP 1202-8, CRD Equipment Failure, Section C, Stuck Rod, allows 2 hours for correcting the problem before action is required to reduce power to less than 60% of the power allowed for the Reactor Coolant Pump (RC-P) combination. EP 1202-8, Section A, Asymmetric, Rod, states that power must be reduced to less than 60% of the power allowed for the RC-P combination within one hour. However, Technical Specification 3.3.2.2 allows two hours to reduce power to less than 60% of the power allowed for the RC- P combination for a rod declared inoperable per TS 4.7.1.2, which is an asymmetric rod, which conflicts with Section A of EP 1202-8, CRD Equipment Failure. Coincidently, two procedure change requests were previously submitted to correct EP 1202-8, Section A, Asymmetric Rod, to correspond with the TS requirement.

Facility Recommendation: Accept either "A" or "D" as correct answers. Question will be modified following the procedure change, and answer "A" will be the only correct answer.

NRC Resolution: Agree with facility's comment. Answers "A" or "D" will be accepted as being correct.

Question No. 007 RO

Facility Comment: The correct answer identified for the question was the main reason for preventing RCS heatup and repressurization, however, the training materials were revised (6/14/00) to reflect other potentially dangerous effects as additional bases. Therefore, the question now contains two correct answers.

Facility Recommendation: Accept either "C" or "D" as correct answers. Question will be revised to remove side effects as distractors or deleted.

NRC Resolution: Agree with facility's comment. Answers "C" or "D" will be accepted as being correct.

Question No. 038

Facility Comment: Due to an error on Enclosure 1 of OP-1103-15B, Estimated Critical Conditions, the examinee would arrive at answer "C" if step 12a is followed exactly as written. This step fails to include the negative sign for comparison with the Xenon value. This leads to choosing the critical rod position tolerance band as listed in answer "C".

Facility Recommendation: Accept either "B" or "C" as correct answers. A Procedure Problem Identification Report has been submitted to correct the procedure problem.

NRC Resolution: Agree with facility's comment. Answers "B" or"C" will be accepted as being correct.

Attachment 1 (Cont'd)

NRC Resolution of Facility Comments

Question No. 084 RO

Facility Comment: The question stem states that "A complete loss of the normal Secondary side Instrument Air header occurs." The candidate assumed that since the backup instrument air compressor is NORMALLY lined up to supply the TBV, it was part of the COMPLETE loss of secondary side Instrument Air header. This is a reasonable assumption based on the wording in the question and demonstrates the candidate's knowledge of how the system would respond. On a complete loss of air, the TBVs fail closed and can only be controlled locally using the handwheel. If this assumption is made, then response "B" would be a correct answer.

Facility Recommendation: Accept either "B" or "C" as correct answers. Question will be modified prior to future use to clarify the stem.

NRC Resolution: Agree with facility comment and recommendation. Answers "B" or "C" will be accepted as being correct.

Answer

Key

Corrections

Answer Key Corrections

Question # 001

Allow both A and D

Justification:

If the question is attacked from the standpoint of a stuck rod EP 1202-8, CRD Equipment Failure, allows two hours to reduce power to less than 60% of the power allowed for the Reactor Coolant Pump combination. This would support answer A. See EP 1202-8, CRD Equipment Failure, page 20, Rev. 53

If the question is attacked from the standpoint of an asymmetric rod EP 1202-8, CRD Equipment Failure, allows only one hour to reduce power to less than 60% of the power allowed for the Reactor Coolant Pump combination. This would support answer D. See EP 1202-8, CRD Equipment Failure, page 4, Rev. 53

However, Technical Specifications allows two hours to reduce power to less than 60% of the power allowed for the Reactor Coolant Pump combination for a rod declared inoperable per 4.7.1.2, which is an asymmetric rod. This conflicts with the Emergency Procedure above and would support answer A. See Technical Specifications pages 3-33, 3-34 and 4-48.

Procedure Change Requests 0606 and 0701, written 5/22/00 and 6/23/00 respectively, are in routing to correct EP 1202-8. The candidate was aware of these change requests due to researching the above discrepancies a few days before the examination.

Question will be modified after the new revision of 1202-8 is implemented to show A as the only correct answer.

Form ES-401-6 **Written Exam Question Worksheet** Q # 001

Examination Outline Cross-Reference RO SRO

KA # APE 005 AK3.04 Page 4.2-6 Tier # 1

RO/SRO Importance Rating 3.4 4.1 Group # 1

Measurement Knowledge of the reasons for the following responses as they apply to the Inoperable/Stuck Control Rod: Tech-Spec limits for inoperable rods

Proposed Question ☑ RO ☑ SRO ☐ PRA Related **Correct Answer** D

Sequence of events:
- Plant STARTUP in progress (4 RCPs operating).
- Power escalation stopped at 69% reactor power.
  - Group 7 Rod #1 mechanically stuck, 10 inches below the rest of Group 7.
  - Group 7 Absolute Group Average position indication = 55% withdrawn.
- 90 minutes later:
  - Rod #1 is unstuck, withdrawn and re-aligned with remaining Group 7 rods.
  - Power escalation to 100% is resumed at 30% per hour.

Identify the ONE (1) statement below that describes IF and WHY the above actions are procedurally ACCEPTABLE or UNACCEPTABLE in accordance with EP 1202-8, CRD Equipment Failure.

A. Actions are ACCEPTABLE; adverse power peaking will not occur - the stuck rod was re-aligned with its group within two (2) hours.

B. Actions are ACCEPTABLE; adverse power peaking will not occur - the stuck rod was re-aligned with its group while the group was less than 60% withdrawn.

C. Actions are UNACCEPTABLE; adverse power peaking could occur - the rate of power escalation was too rapid after the stuck rod was re-aligned with its group.

D. Actions are UNACCEPTABLE; adverse power peaking could occur - the stuck rod was (withdrawn) re-aligned with Group 7 with reactor power greater than 60%.

Technical Reference EP 1202-8, CRD Equipment Failure, Rev. 53, Pages 3 through 8.

Open Exam Reference

Learning Objective V.D.03.04 Given a misaligned control rod and time since misalignment determine the steps to be taken to re-align the rod and explain the bases for those actions per EP 1202-8.

Question Source ☐ New ☑ TMI Bank TMI Question #
☐ Modified TMI Bank Parent Question # 1

Question History ☑ Used in Last Two TMI NRC Exams Exam Date FEB 2000 CRO
☐ Used in Audit Exam ☐ Used in Training Program Quiz Date

Question Cognitive Level ☐ Memory or Fundamental Knowledge
☑ Comprehension or Analysis

10 CFR Part 55 Content ☑ 55.41 .5, .10 ☐ 55.43 ☑ 55.45 .6, .13

Discriminant Validity Statements

A Plausible since EP 1202-8 actions for stuck rod allow two (2) hours to reduce reactor power below 60%.

B Plausible since EP 1202-8 allows asymmetric rod recovery if greater than one (1) hour - only if reactor power is less than 60%.

C Plausible since EP 1202-8 limits power escalation to 3% per hour following recovery from an asymmetric rod condition for greater than 24 hours.

D Correct answer.

Comments None.

FOR INFORMATION ONLY

GPU NUCLEAR	TMI Emergency Procedure	Number 1202-8
Title: **CRD Equipment Failure**		Revision No. 53
Applicability/Scope: TMI Division	Responsible Office: Plant Operations Director	Effective Date: 10/12/99

This document is within QA plan scope	X	Yes		No
Safety Reviews Required	X	Yes		No

List of Effective Pages

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	Signature	Date
Originator		10/7/99
Procedure Owner	Stuart Brantley	10-8-99
PRG		10/9/99
Approver	James N Bullis	10/8/99

TABLE OF CONTENTS

A. **ASYMMETRIC ROD FAULT**

1A. Symptoms

1. Asymmetric rod fault light on the Diamond Rod Control Panel.

2. One or more fault lights lit on the rod position indication panel.

3. CRD pattern asymmetrical alarm on the main annunciator (G-2-1).

4. Rod mis-alignment indicated by position indication meters and the PPC.

5. Power Distribution Limits Exceeded alarm on the main Annunciator (G-2-6.)

6. PPC alarm L3039 "7 INCH ASYMMETRIC ROD".

NOTE

For a **DROPPED ROD**, follow Section B.

2A. Immediate Action

1. Automatic Action

a. A CRD OUT-INHIBIT occurs if ICS selected reactor power is greater than 60% with the Diamond Panel in AUTO.

2. Manual Actions

NOTE

The steps marked with an asterisk (*) shall be reverified as the first step in the follow-up action.

CAUTION

If a rod remains misaligned for greater than one (1) hour, adverse power peaking may occur during the re-alignment which could lead to fuel damage when reactor power is greater than 60% of the power allowed for the RC-P combination.

*a. Immediately evaluate for a PI problem or misaligned rod.

NOTE

Evaluation of possible PI Problems should include the following:

1. Check the imbalance meters on the console for flux imbalance.
2. Check NAS display #1 for evidence of tilt.
3. CRD groups 1 through 4 - verify the "Out-Limit" lamp on the PI panel for the affected rod is ON.
4. CRD Groups 5, 6, 7 or 8 - insert the affected group or rod a short distance to see if the individual PI jumps back to the group average position.
5. Have I & C check the operation of the API amplifier per the "Position Indicator Amplifier Check" section of 1430-CRD-19.

CAUTION

Realignment of the misaligned rod per the following step must occur within 1 hour of its discovery per Tech. Spec. 3.5.2.2.f. Go to Immediate Manual Action a.2 if realignment cannot be accomplished within 1 hour.

1. If it is determined that there is no PI problem with the rod, and the rod has been misaligned for less than 60 minutes, then attempt to realign the rod with the rest of the group using the follow-up actions of this procedure.

2. If the rod position cannot be determined, or if the immediate attempt to realign the rod is unsuccessful, then reduce reactor power to less than 60% of the allowable power for the RC-P combination within 60 minutes of discovery of the misaligned rod. And the overpower trip setpoint shall be reduced to ≤ 70% of the thermal power allowable within 10 hrs.

CAUTION

On an asymmetric rod without an IN-LIMIT, manual action is required to assure compliance with Tech. Specs Section 3.5.2

*b. If a runback is required, and feedwater, the reactor or the turbine is in MANUAL, then run the station in manual back to 60% of the allowable power for the RC-P combination.

NOTE

Compatible values of the neutron power, MWe and feedwater flow are found on the nomogram located on console CC.

3A. Follow Up Action

OBJECTIVE: Confirm rod position of the affected rod, and realign the rod with the group average. In case rod position cannot be confirmed, reduce reactor power to below 60% of the limit for the RC-P combination. Watch for quadrant power tilt and reduce power per Tech. Specs. to ensure core power distribution is acceptable. Applicable Tech Spec sections are 3.5.2 and the Core Operating Limits report.

_____ 1. Reverify the steps in the Immediate Manual Actions that are marked with an asterisk (*). Use redundant indications where available.

2. Verify quadrant power tilt is within allowable limits per Tech. Specs.

_____ a. If quadrant power tilt exceeds Tech. Spec. limits, or power/imbalance/tilt alarm MAP G-2-6 annunciates, obtain printouts for NAS displays 1, 4, 5, 18 and 20. The power reduction, if required due to tilt, should be accomplished per OP-1102-4, *Power Operations*.

NOTE

RPS trip setpoint adjustments that may need to be made in accordance with the following step are to be performed in accordance with 1430-RPS-3, *RPS Flux/Flow/Imbalance Setpoint Reduction*.

_____ b. Within 10 hours tilt shall be reduced to less than the tilt limit (except for physics tests) or comply with the requirements of Tech. Specs. 3.5.2.4.e.1 through 3.5.2.4.e.4.

_____ c. Verify compliance with Tech. Specs. 3.5.2.4.f and 3.5.2.4.g.

_____ 3. Following the power reduction, verify rod overlap between rod groups 6 and 7 is 25 +/-5%.

NOTE

Rod group overlap is determined by the formula [100-(Grp 6 - Grp 7)] = overlap. G-2-6, L3057 and/or G-2-2 (Sequence Fault) will alarm if overlap is abnormal.

_____ a. If the rod group overlap is NOT correct, select SEQUENCE OVERRIDE and INSERT group 6 or 7 to obtain the proper overlap.

_____ 4. If in AUTO, obtain a steady state plant operating condition and select MAN at the Diamond Rod Control panel.

_____ 5. If in MAN on the Diamond Rod Control Panel, cease rod motion unless continued insertion is required by plant conditions.

NOTE

If the ABSOLUTE and RELATIVE positions agree, but differ from the group average position, then the CRDM is NOT responding to commands. Review previous transfer operations and check for faulty transfer switch or faulty transfer logic equipment. If the RELATIVE position agrees with the group average, but the ABSOLUTE position indication is different from the group average, then suspect a faulty mechanism, blown motor output fuses or a faulty absolute position indication amplifier.

_____ 6. Compare the absolute to the relative position by alternately selecting ABSOLUTE and RELATIVE with the POSITION SELECT switch.

_____ 7. Reset the relative rod position indication for the affected rod as necessary using Section 3.4.1 of OP-1105-9, *Control Rod Drive System.*

_____ 8. If the affected Group is on the Aux Supply, check the CONTROL ON lamp on the PI Panel. If the CONTROL ON lamp is not illuminated, the mechanism did NOT transfer with the rest of the group.

NOTE

If the affected group is at its OUT-LIMIT, the GROUP OUT-LIMIT must be cleared prior to re-aligning the rod.

_____ 9. Attempt to exercise the asymmetric rod by transferring it to the Aux Supply and moving it toward the remaining rods in the group in RUN speed. Refer to Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

_____ 10. Observe the phase rotation lights in the affected rod's power supply cabinet when first attempting to move the rod.

_____ 11. If the rod responds normally, attempt to move the rod in the opposite direction in RUN speed.

_____ 12. If the rod does not respond, refer to the **STUCK ROD** section of this procedure.

_____ 13. If the rod responds normally, move the affected rod to the group average position by comparing the rod absolute position at the PI Panel to the Group average position on the console.

_____ 14. Transfer the rod back to its normal power supply. Refer to Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ 15. Return the rod groups to their correct sequence and overlap if necessary, and resume normal operation.

16. If the rod responds to commands, but lags the remainder of the rods in the group, keep the rod within 7" of the group by stopping rod motion, and re-aligning the rod with rest of the group by placing it on the Auxiliary Power Supply and positioning it at the group average. Refer to OP-1105-9, *Control Rod Drive System*, for transfers to and from the Auxiliary Power Supply.

17. Obtain the following computer printouts at the specified intervals pending further direction from the nuclear engineers.

a.	NAS display #1	Repeat every half-hour
b.	NAS display #5	Repeat every half hour
c.	NAS display #17	Repeat every hour
d.	NAS display #18	Repeat every 2 hours

18. If the rod cannot be exercised, and it is outside the allowable average position or, if both the absolute and relative position indications are inoperable, then perform the following within one (1) hour of declaring the rod inoperable:

a. Maintain reactor power at or below 60% of the allowable power for the RC-P combination.

b. Exercise the remaining rods to verify operability using SP-1303-3.1, *Control Rod Movement*.

c. Tech. Spec. 3.5.2 requires that an evaluation be initiated immediately to verify the existence of a 1% delta k/k hot shutdown margin.

NOTE

A shutdown margin of at least 1% must be present when the worth of an inoperable rod is combined with the highest worth operable rod.

d. If within one hour of determination of an inoperable rod as defined in Tech. Spec. 4.7.1 and once per 12 hours thereafter, it is not determined that a 1% delta k/k hot shutdown margin exists combining the worth of the inoperable rod with each of the other rods, the reactor shall be brought to the HOT SHUTDOWN condition within 6 hours until this margin is established.

e. If a shutdown margin of 1% or greater is verified within one hour of the determination that a rod is inoperable, then trim the remaining rods in the group to the position of the inoperable rod and continue normal operation. Maintain the inoperable rod within the limits of the allowable group average position.

19 Continue to evaluate shutdown margin at twelve hour intervals in accordance with Tech. Spec. 3.5.2.2.c.

20. If the computer is unavailable, calculate tilt and imbalance every half hour per AP-1203-7, *Hand Calculations for Quadrant Power Tilt and Core Power Imbalance.*

21. If the asymmetric condition exists for more than 24 hours, then power escalation following realignment shall be limited to 3% power/hour.

B. **DROPPED ROD**

1B. Symptoms

1. Unexpected In-limit indication.
2. CRD pattern asymmetrical alarm (G-2-1).
3. Absolute position shows one or more rods at 0% on both individual position indication meters and the PPC.
4. Flux tilt as indicated by incore and out-of-core detectors and NAS display #1.
5. Reduction in reactor power level with accompanying fluctuations in reactor coolant temperature and pressure, and pressurizer level.
6. ICS RUNBACK alarm (H-1-1) if Rx power is greater than 60% and the Diamond Panel is in AUTO.
7. Power Distribution Limits Exceeded alarm (G-2-6).
8. PPC alarm L3039 "7 INCH ASYMMETRIC ROD".
9. Asymmetric Rod Alarm on the Diamond Rod Control Panel.
10. Out-Inhibit Alarm on the Diamond Rod Control Panel if the Asymmetric Rod Alarm is received and reactor power is greater than 60%.

2B. Immediate Action

1. Automatic Action
   a. If ICS is in full auto, the plant will run back to 482 MWe.
   b. Possible reactor trip on low RCS pressure.
   c. Low pressurizer level may result from reduced reactor power and T_{ave}.
2. Manual Actions

NOTE

If the Diamond Rod Control Panel is in manual and a runback is required due to a dropped rod, the in-limit bypass pushbutton must be pressed to insert the group which contains the dropped rod.

NOTE

The location of the dropped rod in the core may cause Neutron Error to call for rod withdrawal until the signal from the Integrated Master causes Reactor Demand to drop below the NI Power signal input.

2.1 Prior to attempting to withdraw the dropped rod, verify the runback or manually reduce reactor power at a controlled rate to less than 60% of the allowable power for the RC-P combination.

2.2 If an entire rod group drops, then commence a plant shutdown from the present power level in accordance with OP-1102-10, *Plant Shutdown*.

3B. Follow-up Actions

Objective: Verify that, following a dropped rod, reactor power is reduced to less than 60% of the allowable power for the RC-P combination. Monitor quadrant power tilt and reduce power as necessary per Tech. Specs Section 3.5.2.4 and the Core Operating Limits Report to ensure that core power distribution is acceptable.

NOTE

A dropped rod is inoperable per T.S. 4.7.1.2

_____ 1. If reactor is less than 2% full power, then insert the remaining rods to achieve at least 1% dk/k shutdown. Do not add any positive reactivity until the requirements of OP-1103-8, *Approach to Criticality*, have been met.

2. Following the power reduction, perform the following when plant conditions are stable:

NOTE

Rod group overlap is determined by the formula [100-(Grp 6 - Grp 7)] = overlap. G-2-6, L3057 and/or G-2-2 (Sequence Fault) will alarm if overlap is abnormal.

_____ a. Verify rod group overlap between groups 6 & 7 is 25% +/- 5%.

_____ b. Obtain a computer printout of NAS displays 1, 4, 5, 18 and 20.

_____ c. Notify Plant Operations Management, Plant Nuclear Engineers and the dispatcher.

_____ d. Ensure compliance with core power distribution limits, axial imbalance, quadrant power tilt and rod index.

3. Approximately 15 minutes after the plant is stable, obtain the following printouts.

a.	NAS display #1	Repeat every half-hour
b.	NAS display #5	Repeat every half hour
c.	NAS display #17	Repeat every hour
d.	NAS display #18	Repeat every 2 hours

4. If the computer is unavailable, calculate tilt and imbalance every half hour per AP-1203-7, *Hand Calculations for Quadrant Power Tilt and Core Power Imbalance.*

5. If there is more than one inoperable rod, or if any Safety Group Rod is dropped and cannot be recovered, then commence a plant shutdown per OP-1102-10 within one (1) hour, and be in HOT SHUTDOWN within six (6) hours.

6. a. For a dropped SAFETY ROD, go to subsection "A" of this section.

   b. For a dropped REGULATING ROD, go to subsection "B" of this section.

NOTE

RPS trip setpoint adjustments that may need to be made in accordance with the following step are to be performed in accordance with 1430-RPS-3, *RPS Flux/Flow/Imbalance Setpoint Reduction.*

7. Within 10 hours tilt shall be reduced to less than the tilt limit (except for physics tests) or comply with the Tech. Spec. requirements of 3.5.2.4.e.1 through 3.5.2.4.e.4.

NOTE

During this time, Rod recovery attempts may continue. If an entire group is dropped, shutdown conditions should be attained prior to attempting to withdraw the rods.

8. Verify compliance with Tech. Specs. 3.5.2.4.f and 3.5.2.4.g.

9. Exercise the remaining rods to verify operability within 24 hours per SP-1303-3.1, *Control Rod Movement.*

10. Review the Transient Cycle Logbook requirements and make all required entries.

11. If the dropped rod condition exists for greater than 24 hours, then the power escalation after realignment shall be limited to 3% power/hour.

12. If the rod cannot be exercised, and it is outside the allowable group average position limit, or, if both the absolute and relative position indications are inoperable, then perform the following steps:

    a. Maintain reactor power at or below 60% of the allowable power for the RC-P combination.

b. Initiate an evaluation to verify a 1% delta k/k shutdown margin per OP 1103-15A, *Shutdown Margin and Reactivity Balance*, within one (1) hour of declaring the rod inoperable, and reverify every 12 hours thereafter.

c. If within one hour of determination of an inoperable rod as defined in Tech. Spec. 4.7.1 and once per 12 hours thereafter, it is not determined that a 1% delta k/k hot shutdown margin exists combining the worth of the inoperable rod with each of the other rods, the reactor shall be brought to the HOT SHUTDOWN condition within 6 hours until this margin is established.

d. Exercise the remaining rods to verify operability per SP-1303-3.1, *Control Rod Movement*, within 24 hours, and weekly thereafter.

SUBSECTION "A" DROPPED SAFETY ROD

CAUTION

With the SAFETY RODS OUT BYPASS switch in the BYPASS position, DO NOT attempt to move the regulating rods in SEQ with the safety rods on the Auxiliary Power Supply because of the possibility of moving both a safety group and a regulating group at the same time.

_____ a. Obtain controlled key #10 and place the SAFETY RODS OUT BYPASS switch in Cabinet SL3 in the bypass position.

_____ b. Determine the mechanism number for the dropped rod from NAS display 5 or enclosure 6 of OP-1105-9, *Control Rod Drive System.*

_____ c. Locate the motor output fuses for the affected rod at the motor output fuse panel in the Control Rod Drive Transfer Cabinets.

_____ d. Transfer the affected rod to the Auxiliary Power Supply. Refer to Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

NOTE

The lamp is ON only if the fuse is blown and the phase is energized.

_____ e. Observe the blown fuse indicating lamps while attempting to latch the rod. Refer to OP-1105-9, *Control Rod Drive System*, Section 3.2.4, Steps b through g. Record the phase which has the blown fuse, if applicable.

CAUTION

Prior to withdrawing the rod, evaluate for tilt problems and reduce power as necessary.

_____ f. If no fuses are blown, then attempt to withdraw the rod. Continue from step "j" of this section.

_____ g. If one or more fuses are blown, then replace them using the following method:

CAUTION

Do not pull fuses on energized phases. Severe flashing may occur resulting in equipment damage or personal injury. If necessary, check with a voltmeter that each phase is de-energized.

____ 1. Ensure that the rod is at its IN-LIMIT.

_____ 2. De-energize the mechanism by removing fuses F1 and F3 on the Programmer Control Assembly for the Auxiliary Power Supply.

_____ 3. In the transfer cabinets, replace the motor output fuses for the affected mechanism with KAW-25 fuses.

_____ 4. Re-install fuses F1 and F3 on the Programmer Control Assembly for the Auxiliary Power Supply.

_____ 5. Press FAULT RESET to reset the programmer lamp fault associated with the Auxiliary Power Supply.

_____ 6. Observe the blown fuse indicating lamps while attempting to latch the rod. Refer to OP-1105-9, *Control Rod Drive System*, Section 3.2.4, Steps b through g.

_____ h. If the fuses blow again, then initiate a job ticket to implement generic procedure 1420-CRD-1, *CRD Motor Output Fuse Troubleshooting,* and 1420-CRD-2, *CRD Stator/Power Cable Troubleshooting.*

CAUTION

Prior to withdrawing the rod, evaluate for tilt problems and reduce power as necessary.

_____ i. If the fuses do not blow, transfer the rod back to the DC Hold Bus. Refer to OP-1105-9, *Control Rod Drive System*, Section 3.2.3.

_____ j. Reset the Relative Position Indication for the rod in accordance with Section 3.4.1 of OP-1105-9, *Control Rod Drive System.*

_____ k. Transfer the affected safety group to the Auxiliary Power Supply in accordance with Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

_____ l. Press LATCH on the Diamond Rod Control Panel and INSERT the group in JOG speed until the GROUP OUT-LIMIT lamp on the Diamond Rod Control panel is OUT.

_____ m. Verify that the GROUP OUT-LIMIT lamp on the Diamond Rod Control panel for the selected group is OUT.

_____ n. Transfer the group back to the DC Hold Bus in accordance with Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ o. Select the dropped rod on the GROUP SELECT and SINGLE SELECT switch on the Diamond Rod Control panel.

_____ p. Transfer the rod to the Auxiliary Power Supply in accordance with Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

CAUTION

Rod withdrawal should be performed at a rate specified by the Nuclear Engineers. Do not exceed 60% Power.

_____ q. Withdraw the dropped rod by placing MANUAL COMMAND switch on the Diamond Rod Control panel in the WITHDRAW position.

r. As the rod is withdrawn, reactivity compensation may be necessary. Use the following steps to make the necessary adjustments to Reactor Power using the regulating rods.

_____ 1. Transfer the dropped rod back to the DC Hold Bus in accordance with Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ 2. On the Diamond Rod Control Panel, select GROUP.

_____ 3. On the Diamond Rod Control Panel, select SEQ.

_____ 4. Verify that the regulating group CONTROL ON lamp comes ON.

_____ 5. On the Diamond Rod Control Panel, press TRANS RESET.

_____ 6. Insert or withdraw the regulating rods as necessary using the MANUAL COMMAND switch on the Diamond Rod Control panel.

_____ 7. On the Diamond Rod Control Panel, select AUXIL.

_____ 8. On the Diamond Rod Control Panel, select SEQ-or.

_____ 9. On the Diamond Rod Control Panel, Select JOG.

_____ 10. On the Diamond Rod Control Panel, when the SY(NCH) lamp comes ON, press CLAMP.

_____ 11. On the Diamond Rod Control Panel, press MAN TRANS. Verify that the TR CF light comes ON.

_____ 12. On the Diamond Rod Control Panel, press CLAMP REL.

_____ 13. On the Diamond Rod Control Panel, press GROUP.

_____ 14. On the Diamond Rod Control Panel, select RUN.

_____ s. Continue withdrawing the dropped rod until the individual rod OUT-LIMIT lamp on the PI panel for the dropped rod comes ON.

_____ t. Transfer the dropped rod back to the DC Hold Bus in accordance with Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ u. Transfer the entire group to the Auxiliary Power Supply in accordance with Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

_____ v. Withdraw the entire group until the GROUP OUT-LIMIT lamp on the Diamond Rod Control panel comes ON.

_____ w. Transfer the group back to the DC Hold Bus in accordance with Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ x. Place the SAFETY RODS OUT BYPASS switch in the OFF position and return key #10 to the Control Room.

_____ y. Return to step 7 of the follow-up actions of this section.

SUB SECTION "B" DROPPED REGULATING ROD

_____ a. If the affected group is NOT at its group out-limit, then proceed to step "c."

b. If the affected group is at the Group Out-limit as indicated by the GROUP OUT-LIMIT lamp on the Diamond Rod Control Panel, then perform the following steps:

_____ 1. On the Diamond Rod Control Panel, select MAN.

_____ 2. On the Diamond Rod Control Panel, select SEQ-OR.

_____ 3. On the Diamond Rod Control Panel, place the GROUP SELECT switch to the affected rod group.

_____ 4. On the Diamond Rod Control Panel, select JOG.

_____ 5. On the Diamond Rod Control Panel, press and hold the LATCH pushbutton.

_____ 6. Using the MANUAL COMMAND switch INSERT the affected group until the GROUP OUTLIMIT LIGHT on the Diamond Rod Control panel goes OUT.

____ 7. Release the LATCH pushbutton.

_____ 8. On the Diamond Rod Control Panel, select RUN speed.

CAUTION

The controlling group cannot be moved while the dropped rod is on the Auxiliary Power Supply. To compensate for reactivity changes, transfer the dropped rod back to its normal power supply and select the controlling group.

_____ c. Determine the mechanism number for the dropped rod from NAS display 5 or enclosure 6 of OP-1105-9, *Control Rod Drive System.*

_____ d. Locate the motor output fuses for the affected rod at the motor output fuse panel in the Control Rod Drive Transfer Cabinets.

_____ e. Transfer the affected rod to the Auxiliary Power Supply. Refer to Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

NOTE

The lamp is ON only if the fuse is blown and the phase is energized.

_____ f. Observe the blown fuse indicating lamps while attempting to latch the rod. Refer to OP-1105-9, *Control Rod Drive System*, Section 3.2.4, Steps b through g. Record the phase which has the blown fuse, if applicable.

CAUTION

Prior to withdrawing the rod, evaluate for tilt problems and reduce power as necessary.

_____ g. If no fuses are blown, then attempt to withdraw the rod. Continue from step "j" of this section.

_____ h. If one or more fuses are blown, then replace them using the following method:

CAUTION

Do not pull fuses on energized phases. Severe flashing may occur resulting in equipment damage or personal injury. If necessary, check with a voltmeter that each phase is de-energized.

_____ 1. Ensure that the rod is at its IN-LIMIT.

_____ 2. De-energize the mechanism by removing fuses F1 and F3 on the programmer on the Programmer Control Assembly for the Auxiliary Power Supply.

_____ 3. In the transfer cabinets, replace the motor output fuses for the affected mechanism with KAW-25 fuses.

_____ 4. Re-install fuses F1 and F3 on the Programmer Console Assembly for the Auxiliary Power Supply.

_____ 5. Press FAULT RESET to reset the programmer lamp fault associated with the Auxiliary Power Supply.

_____ 6. Observe the blown fuse indicating lamps while attempting to latch the rod. Refer to OP-1105-9, *Control Rod Drive System*, Section 3.2.4, Steps b through g.

_____ i. If the fuses blow again, then initiate a job ticket to implement generic procedure 1420-CRD-1, *CRD Motor Output Fuse Troubleshooting,* and 1420-CRD-2, *CRD Stator/Power Cable Troubleshooting.*

_____ j. Prior to withdrawing the rod, evaluate for tilt problems and reduce power as necessary.

NOTE

Resetting the Relative Position Indication at this time will result in a SEQUENCE FAULT.

_____ k. Reset the Relative Position Indication for the rod in accordance with Section 3.4.1 of OP-1105-9, *Control Rod Drive System.*

CAUTION

Rod withdrawal should be performed at a rate specified by the Nuclear Engineers. Do not exceed 60% Power.

_____ l. Withdraw the dropped rod by placing MANUAL COMMAND switch on Diamond Rod Control switch in the WITHDRAW position.

m. As the rod is withdrawn, reactivity compensation may be necessary. Use the following steps to make the necessary adjustments to Reactor Power using the regulating rods.

_____ 1. Transfer the dropped rod back to its normal power supply in accordance with Section 3.2.3 of OP-1105-9, *Control Rod Drive System.*

_____ 2. On the Diamond Rod Control Panel, select GROUP.

_____ 3. On the Diamond Rod Control Panel, select SEQ.

_____ 4. On the Diamond Rod Control Panel, press TRANS RESET.

_____ 5. Verify that the regulating group CONTROL ON lamp comes ON.

_____ 6. Insert or withdraw the regulating rods as necessary using the MANUAL COMMAND switch on the Diamond Rod Control panel.

_____ 7. Transfer the affected rod back to the Auxiliary Power Supply using Section 3.2.2 of OP-1105-9, *Control Rod Drive System.*

_____ n. Repeat Steps "l" and "m" until the dropped rod reaches the group average as indicated by the individual Rod Position indicators on the PI panel.

_____ o. Select REL on the POSIT SELECT switch on the PI panel. Realign the indication(s) as necessary using Section 3.4.2 of OP-1105-9, *Control Rod Drive System.*

_____ p. On the Diamond Rod Control Panel, select SEQ-OR.

_____ q. Return the POSIT SELECT switch on the PI panel to ABSOL.

_____ r. On the Diamond Rod Control Panel, select JOG speed.

_____ s. On the Diamond Rod Control Panel, press AUX.

_____ t. On the Diamond Rod Control Panel, when the SY(NCH) light comes ON, press CLAMP.

_____ u. On the Diamond Rod Control Panel, press MAN TRANS. Verify that the TR CF light goes OUT.

_____ v. On the Diamond Rod Control Panel, press CLAMP REL.

_____ w. On the Diamond Rod Control Panel, press GROUP.

_____ x. On the Diamond Rod Control Panel, select OFF on Single Select Switch.

_____ y. On the Diamond Rod Control Panel, press TRANS RESET.

_____ z. On the Diamond Rod Control Panel, select RUN speed.

_____ aa. Using the Manual Command switch, withdraw the rods to the required position for plant operations.

_____ bb. On the Diamond Rod Control Panel, select OFF on Group Select Switch.

_____ cc. On the Diamond Rod Control Panel, select SEQ.

_____ dd. Return to step 7 of the follow-up actions of this section.

C. **STUCK ROD**

1C. Symptoms

1. Failure of a rod to respond to commands.
2. CRDM de-energized with no in-limit indication and no zero position indication.
3. Asymmetric rod fault alarm as indicated on the PI panel (7") or Diamond Panel (9").
4. Power Distribution Limits Exceeded alarm on main annunciator (G-2-6).
5. PPC alarm L3039 "7 INCH ASYMMETRIC ROD".

2C. Immediate Action

1. Automatic Action

a. None

2. Manual Action

NOTE

The steps with an asterisk (*) will be re-verified as the first step of the follow-up actions.

*a. Reduce reactor power to less than 60% of the thermal power allowed for the RC-P combination within 2 hours per Tech. Spec. 3.5.2.2.e if appropriate (9" asymmetric rod).

CAUTION

Only RUN speed should be used when attempting to move a stuck rod. This will minimize the possibility of overstressing the control rod assembly.

b. With the Diamond Rod Control Panel in manual, attempt to first insert the rod a short distance and then attempt to withdraw it a short distance.

3C. Follow-up Action

Objective: The reactor power shall be reduced to 60% of the allowable RC-P Combination within two hours of discovery of the inoperable rod. Additional actions shall be taken in accordance with Tech. Spec. 3.5.2.2.e if the condition exists for greater than 10 and 72 hours respectively.

_____ 1. Reverify the steps in the Immediate Manual Actions that are marked with an asterisk (*). Use redundant indications where available.

2. Verify quadrant power tilt is within allowable Tech. Spec. Limits.

_____ a. If quadrant power tilt exceeds Tech. Spec. limits, or, power/tilt/imbalance alarm MAP-G-2-6 annunciates, then obtain computer printouts for NAS groups 1, 4, 5, 18 and 20. The power reduction, if required due to tilt, should be accomplished per OP-1102-4, *Power Operations*.

_____ 3. Maintain power at or below 60% of the allowable thermal power for the RC-P combination.

_____ 4. Tech. Spec. 3.5.2 requires that an evaluation be initiated immediately to verify the existence of a 1% delta k/k hot shutdown margin.

NOTE

A shutdown margin of at least 1% must be present when the worth of an inoperable rod is combined with the highest worth operable rod.

_____ a. If within one hour of determination of an inoperable rod as defined in Tech. Spec. 4.7.1 and once per 12 hours thereafter, it is not determined that a 1% delta k/k hot shutdown margin exists combining the worth of the inoperable rod with each of the other rods, the reactor shall be brought to HOT SHUTDOWN condition within 6 hours until this margin is established.

_____ b. If a shutdown margin of 1% or greater is verified within one (1) hour of the determination that a rod is inoperable, then trim the remaining rods in the group to the position of the inoperable rod and continue normal operation. Maintain the inoperable rod within the limits of allowable group average position.

_____ c. If the control rod cannot be aligned per Tech. Spec. 3.5.2.2.f, then take additional actions within 10 hours in accordance with Tech. Spec. 3.5.2.2.e.

_____ d. If the control rod cannot be aligned per Tech. Spec. 3.5.2.2.f, then take additional actions within 72 hours in accordance with Tech. Spec. 3.5.2.2.e.

NOTE

RPS trip setpoint adjustments that may need to be made in accordance with the following step are to be performed in accordance with 1430-RPS-3, *RPS Flux/Flow/Imbalance Setpoint Reduction*.

5. Within 10 hours tilt shall be reduced to less than the tilt limit (except for physics tests) or comply with the requirements of 3.5.2.4.e.1 through 3.5.2.4.e.4.

6. Operation with more than one inoperable rod as defined in Tech. Spec. 4.7.1 and 4.7.2.3 in the safety or regulating rod banks shall not be permitted. Verify SDM $\geq$ 1% delta k/k or initiate boration to restore within limits within 1 hour. The reactor shall be brought to HOT SHUTDOWN within 6 hours.

7. If the control rod malfunction results in a complete loss of control rods (i.e., cannot move the control rods), then shut down the reactor per OP 1102-10, *Plant Shutdown*.

8. Exercise the remaining rods to verify operability using SP-1303-3.1, *Control Rod Movement*. Upper management should be contacted to discuss using Section 3.4.9 of OP-1105-9, *Control Rod Drive System*.

D. **MOTOR FAULT**

1D. Symptoms

1. Motor Fault lamp on the Diamond Rod Control Panel.
2. Direction Error lamp on affected Programmer Control Assembly.
3. Position indication shows one of the following:
   a. One or more groups of rods being driven in either direction with no command for motion present.
   b. Control rods being driven in the out direction with an in-motion command.
4. Unexpected increase or decrease in reactor power, temperature and pressure.
5. Possible sequence fault indication on Diamond Rod Control Panel and alarm G-2-2.
6. Possible reactor/turbine trip.

2D. Immediate Action

1. Automatic Action.
   a. The Diamond Rod Control Panel will revert to MANUAL.
2. Manual Action

NOTE

The steps with an asterisk (*) will be re-verified as the first step of the follow-up actions.

*a. Verify that the Diamond Rod Control Panel is in MANUAL.

b. Determine if in or out motion exists, if so, then:

❶ Select JOG speed on the Diamond Rod Control Panel.

*❷ Verify the GROUP and SINGLE SELECT switches are in OFF.

❸ Select SEQ OR (sequence override) on the Diamond Rod Control Panel.

c. If out motion continues, select that group with the group select switch and place the Manual Command switch in the INSERT position.

d. If uncontrolled out motion continues, then trip the reactor and go to ATP 1210-1, *Reactor Trip*.

3D. Follow-up Actions

Objective: Stop any uncontrolled rod motion. Determine which programmer is affected and determine the cause of the motor fault. Correct the cause of the motor fault and return the CRD panel to normal/desired operation.

____ 1. Reverify the steps in the Immediate Manual Actions that are marked with an asterisk (*). Use redundant indications where available.

2. If placing the MANUAL COMMAND SWITCH in the INSERT position stops rod withdrawal, or, if uncontrolled rod in-motion exists, then de-energize the programmer motor as follows:

CAUTION

Removing these fuses de-energizes the main programmer lamps as well as the programmer drive motors. The secondary programmer lamps must be operational to avoid tripping that group of rods.

____ a. Pull the fuses associated with affected group's programmer motor in the SECONDARY DC HOLD POWER SUPPLY CABINET.

GROUP	FUSE
5	F7
6	F8
7	F9
8	F10
AUX	F11

____ b. Verify that rod motion has stopped for uncontrolled in-motion.

____ 3. If a sequence fault has occurred, then refer to OP-1105-9, *Control Rod Drive System.*

____ 4. If the MOTOR FAULT has occurred without excessive rod motion, then check the DC brake supply fuse (F2) on the affected programmer control assembly. Replace as necessary.

____ 5. If the group power supply is faulty, then transfer the group to Auxiliary Power Supply and continue to operate using the Auxiliary Power Supply as the group supply.

NOTE

The DIRECTION ERROR light and DIRECTION ERROR RESET pushbutton are located inside the left side of each Power Supply Cabinet. If applicable, ensure that the power supply which has the direction error is noted.

____ 6. Correct the cause of the direction error.

7. Reset the motor fault by one of the following methods:

_____ a. At Diamond Rod Control Panel by pressing fault reset or

b. Performance of next 2 steps:

_____ ❶ At affected programmer control assembly, press the direction error reset push button located inside the left side of the affected power supply cabinet.

_____ ❷ Depress fault reset on the Diamond Rod Control Panel.

_____ 8. Return the Diamond Rod Control Panel to the desired mode of operation.

E. **STATOR HIGH TEMPERATURE**

1E. Symptoms

1. Computer alarms and printouts of the affected mechanism(s) giving the stator temperature.

2. Possible low ICCW CRD cooling flow as indicated on IC10-FI or MAP alarm C-1-2.

3. Possible ICCW CRD filter dP High alarm on MAP C-1-4.

4. Possible ICCW cooler outlet temperature high on IC6-TI or MAP alarm C-2-3.

5. Possible CRD cooling water outlet temperature high on IC9-TI.

6. Possible IC system CRD cooling water outlet temperature high alarm on MAP C-1-3.

2E. Immediate Actions

1. Automatic Actions

a. MU-V-1A/B close when CRD cooling water outlet temperature reaches 160°F.

2. Manual Actions

NOTE

The steps with an asterisk (*) will be re-verified as the first step of the follow-up actions.

*a. Verify MU-V-1A/B close if CRD outlet temperature reaches 160°F.

*b. Check the ICCW system for proper operation by verifying

1. The following parameters for the CRD system:

i. Flow to CRD stators > 100 gpm.
ii. CRD return temperature < 160°F
iii. dP across IC-F-1A/B.

c. If required to provide continued cooling to the CRDMs, then start the standby IC-P-1 and/or valve in the standby IC-F-1.

3E. Follow-up Actions

Objective: The objective of this procedure is to prevent stator failure due to a loss of cooling water flow or high temperature in the ICCW system.

____ 1. Reverify the steps in the Immediate Manual Actions that are marked with an asterisk (*). Use redundant indications where available.

2. Check all stator temperatures for high temperature indication.

3. Check CRD cooling water outlet temperature on IC9-TI. If temperature is high, then check river water flow path through the coolers. Start an additional river water pump as necessary.

4. Place the temperature input of the affected mechanism on analog trend on the PPC and reset the alarm setpoint for that point to 170°F.

5. If the temperature is between 160°F and 170°F, then continue normal operation.

6. If the mechanism is above 170°F, then de-energize the mechanism as follows:

   a. Reduce reactor power to 60% of the thermal power allowed for the RC-P combination.

   b. Obtain O&M Director's approval, or Plant Operations Director if O&M Director is not available and bypass the asymmetric rod alarm for the mechanism by placing toggle switch S2 on the individual PI amplifier in the down position.

   c. Determine the mechanism number for the rod from Enclosure 6 of 1105-9, Control Rod Drive System or from NAS display 5.

   d. Transfer the affected rod to the Auxiliary Power Supply

   e. Drive the rod fully into the core.

   f. De-energize the mechanism by removing the Auxiliary Power Supply programmer lamp fuses F1 and F3 on the programmer control assembly.

CAUTION

Use extreme care because of the energized components in the vicinity of the fuses removed in the next step.

WARNING

Do not pull the motor output fuses on energized phases. Severe flashing may occur resulting in equipment damage or personal injury. If necessary, check each phase de-energized with a voltmeter.

   g. Pull the six (6) motor output fuses located in the transfer cabinets for the mechanism.

   h. Replace the programmer lamp fuses F1 and F3.

   i. Press FAULT RESET on the Diamond Rod Control Panel.

7. If the stator temperature reaches 180°F, then de-energize the mechanism immediately. See Steps 6.d and 6.f above.

8. If more than one stator reaches 180°F, then trip the reactor and go to ATP-1210-1.

3.5.2 CONTROL ROD GROUP AND POWER DISTRIBUTION LIMITS

Applicability

This specification applies to power distribution and operation of control rods during power operation.

Objective

To assure an acceptable core power distribution during power operation, to set a limit on potential reactivity insertion from a hypothetical control rod ejection, and to assure core subcriticality after a reactor trip.

Specification

3.5.2.1 The available shutdown margin shall not be less than one percent $\Delta K/K$ with the highest worth control rod fully withdrawn.

3.5.2.2 Operation with inoperable rods:

a. Operation with more than one inoperable rod as defined in Specification 4.7.1 and 4.7.2.3 in the safety or regulating rod banks shall not be permitted. Verify SDM $\geq$ 1% $\Delta k/k$ or initiate boration to restore within limits within 1 hour. The reactor shall be brought to HOT SHUTDOWN within 6 hours.

b. If a control rod in the regulating and/or safety rod banks is declared inoperable in the withdrawn position as defined in Specification Paragraph 4.7.1.1 and 4.7.1.3, an evaluation shall be initiated immediately to verify the existence of one percent $\Delta k/k$ hot shutdown margin. Boration may be initiated to increase the available rod worth either to compensate for the worth of the inoperable rod or until the regulating banks are fully withdrawn, whichever occurs first. Simultaneously a program of exercising the remaining regulating and safety rods shall be initiated to verify operability.

c. If within one hour of determination of an inoperable rod as defined in Specification 4.7.1, and once per 12 hours thereafter, it is not determined that a one percent $\Delta k/k$ hot shutdown margin exists combining the worth of the inoperable rod with each of the other rods, the reactor shall be brought to the HOT SHUTDOWN condition within 6 hours until this margin is established.

d. Following the determination of an inoperable rod as defined in Specification 4.7.1, all rods shall be exercised within 24 hours and exercised weekly until the rod problem is solved.

e. If a control rod in the regulating or safety rod groups is declared inoperable per 4.7.1.2, and cannot be aligned per 3.5.2.2.f, power shall be reduced to $\leq$ 60% of the thermal power allowable for the reactor coolant pump combination within 2 hours, and the overpower trip setpoint shall be reduced to $\leq$ 70% of the thermal power allowable within 10 hours. Verify the potential ejected rod worth (ERW) is within the assumptions of the ERW analysis and verify peaking factor ($F_Q(Z)$ and $F^N_{\Delta H}$) limits per the COLR have not been exceeded within 72 hours.

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f. If a control rod in the regulating or axial power shaping groups is declared inoperable per Specification 4.7.1.2, operation may continue provided that within 1 hour the rods in the group are positioned such that the rod that was declared inoperable is maintained within allowable group average position limits of Specification 4.7.1.2.

g. If the inoperable rod in Paragraph "e" above is in groups 5, 6, 7, or 8, the other rods in the group may be trimmed to the same position. Normal operation of 100 percent of the thermal power allowable for the reactor coolant pump combination may then continue provided that within 1 hour the rod that was declared inoperable is maintained within allowable group average position limits in 3.5.2.5.

3.5.2.3 The worth of single inserted control rods during criticality is limited by the restriction of Specification 3.1.3.5 and the Control Rod Position Limits defined in Specification 3.5.2.5.

3.5.2.4 Quadrant Tilt:

a. Except for physics tests, the quadrant tilt, as determined using the full incore system (FIS), shall not exceed the values in the CORE OPERATING LIMITS REPORT.

The FIS is OPERABLE for monitoring quadrant tilt provided the number of valid symmetric string individual SPND signals in any one quadrant is not less than the limit in the CORE OPERATING LIMITS REPORT.

b. When the full incore system is not OPERABLE and except for physics tests quadrant tilt as determined using the power range channels for each quadrant (out of core detector system)(OCD), shall not exceed the values in CORE OPERATING LIMITS REPORT.

c. When neither detector system above is OPERABLE and, except for physics tests, quadrant tilt as determined using the minimum incore system (MIS), shall not exceed the values in the CORE OPERATING LIMITS REPORT.

d. Except for physics tests if quadrant tilt exceeds the tilt limit, allowable power shall be reduced 2 percent for each 1 percent tilt in excess of the tilt limit. For less than four pump operation, thermal power shall be reduced 2 percent below the thermal power allowable for the reactor coolant pump combination for each 1 percent tilt in excess of the tilt limit.

e. If quadrant power tilt exceeds the tilt limit then within a period of 10 hours, the quadrant power tilt shall be reduced to less than the tilt limit except for physics tests, or the following verifications and/or adjustments in setpoints and limits shall be made:

1. Verify $F_Q(Z)$ and $F^N_{\Delta H}$ are within limits of the COLR once per 2 hours and restore QPT to $\leq$ steady state limit within 24 hours, or perform steps 2, 3, & 4 below.

4.7 REACTOR CONTROL ROD SYSTEM TESTS

4.7.1 CONTROL ROD DRIVE SYSTEM FUNCTIONAL TESTS

Applicability

Applies to the surveillance of the control rod system.

Objective

To assure operability of the control rod system.

Specification

4.7.1.1 The control rod trip insertion time shall be measured for each control rod at either full flow or no flow conditions following each refueling outage prior to return to power. The maximum control rod trip insertion time for an operable control rod drive mechanism, except for the axial power shaping rods (APSRs), from the fully withdrawn position to ¾ insertion (104 inches travel) shall not exceed 1.66 seconds at hot reactor coolant full flow conditions or 1.40 seconds for the hot no flow conditions (Reference 1). For the APSRs it shall be demonstrated that loss of power will not cause rod movement. If the trip insertion time above is not met, the rod shall be declared inoperable.

4.7.1.2 If a control rod is misaligned with its group average by more than an indicated nine inches, the rod shall be declared inoperable and the limits of Specification 3.5.2.2 shall apply. The rod with the greatest misalignment shall be evaluated first. The position of a rod declared inoperable due to misalignment shall not be included in computing the average position of the group for determining the operability of rods with lesser misalignments.

4.7.1.3 If a control rod cannot be exercised, or if it cannot be located with absolute or relative position indications or in or out limit lights, the rod shall be declared to be inoperable.

Bases

The control rod trip insertion time is the total elapsed time from power interruption at the control rod drive breakers until the control rod has actuated the 25% withdrawn reference switch during insertion from the fully withdrawn position. The specified trip time is based upon the safety analysis in UFSAR, Chapter 14 and the Accident Parameters as specified therein.

Each control rod drive mechanism shall be exercised by a movement of a minimum of 3% of travel every 92 days.This requirement shall apply to either a partial or fully withdrawn control rod at reactor operating conditions. Exercising the drive mechanisms in this manner provides assurance of reliability of the mechanisms.

Answer Key Corrections

Question # 007

Allow both C and D

Justification:

The correct answer identified for the question was the main reason for preventing RCS heatup and repressurization. However, the training materials were revised on 6/14/00 to reflect other potentially dangerous effects as additional bases. Therefore, the question now contains two correct answers; C and D. See training handout excerpts.

The candidate attended the training on this subject using the revised materials as part of his upgrade program.

Question will be revised to remove side effects as distracters or deleted.

Form ES-401-6 **Written Exam Question Worksheet** Q # 007

Examination Outline Cross-Reference RO SRO

KA # BW E05 EK3.3 Page 4.3-10 Tier # 1

RO/SRO Importance Rating 4.2 3.8 Group # 1

Measurement Knowledge of the reasons for the following responses as they apply to the Excessive Heat Transfer: Manipulation of controls required to obtain desired operating results during abnormal, and emergency situations

Proposed Question ☑ RO ☑ SRO ☐ PRA Related **Correct Answer** C

The Control Room Supervisor directs stabilizing RCS pressure and T-cold on the "B" OTSG following a steam rupture on the "A" OTSG.

These actions are taken to prevent RCS heatup and repressurization in order to:

A. prevent possible loss of subcooling margin due to insurge and cooling of the Pressurizer.

B. minimize the formation of a reactor vessel head bubble due to the rapid cooldown

C. prevent placing additional stresses on the Reactor Coolant System.

D. minimize additional compressive stresses to the "A" OTSG tubes.

Technical Reference TDR No. 1199, Comparison of ATP 1210-3 and BWOG GEOG, Rev. 2 page 21

Open Exam Reference Steam Tables

Learning Objective V.E.03.02 Explain why it is desirable to minimize heatup and repressurization following an excessive primary to secondary heat transfer event.

Question Source ☑ New ☐ TMI Bank TMI Question #
☐ Modified TMI Bank Parent Question #

Question History ☐ Used in Last Two TMI NRC Exams Exam Date
☐ Used in Audit Exam ☐ Used in Training Program Quiz Date

Question Cognitive Level ☑ Memory or Fundamental Knowledge
☐ Comprehension or Analysis

10 CFR Part 55 Content ☑ 55.41 .5, .10 ☐ 55.43 ☑ 55.45 .6, .13

Discriminant Validity Statements

A Plausible effect on pressurizer, but not the basis.

B Plausible for natural circulation.

C Correct answer.

D Plausible effect on OTSG tubes, but not the basis.

Comments None.

Minimize RCS Repressurization

- Excessive cooldown produces higher stresses in the RV.
  - Vertical beltline welds below cold leg nozzles are the areas of concern - especially with RCPs off.
  - System re-pressurization increases these stresses.
- Raising RCS pressure increases DRY OTSG tube stresses.

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Minimize RCS Reheat

- Produces system re-pressurization, increasing stresses.
- Causes in-surge of cold water into the Pressurizer, resulting in difficult pressure control.
- Increases Tube-to-Shell ΔT for an isolated, dry OTSG

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Answer Key Corrections

Question # 038

Allow both B and C

Justification:

Due to an error on Enclosure 1 of OP 1103-15B, Estimated Critical Conditions, the examinee would arrive at answer C if step 12a is followed exactly as written. This step fails to include the negative sign for comparison with the Xenon value. This leads to choosing the incorrect critical rod position tolerance band.

A Procedure Problem Identification Report has been submitted to correct the procedure problem.

Form ES-401-6 **Written Exam Question Worksheet** Q # 038

Examination Outline Cross-Reference RO SRO

KA # SYSTEM 001 A4.10 Page 3.1-10 Tier # 2

RO/SRO Importance Rating 3.5 3.9 Group # 1

Measurement Ability to manually operate and/or monitor in the control room: Determination of an ECP

Proposed Question ☑ RO ☑ SRO ☐ PRA Related **Correct Answer** B

Calculate an Estimated Critical Rod Position (ECP) for the following plant conditions:
- 20 hours post trip
- Plant has been running at 100% power since initial cycle startup
- 400 EFPD
- 890 ppm Boron from RCS sample
- Boron correction factor of 0.98
- CRD Group 8 at 30%
- T-ave 532°F

Which ONE (1) of the following rod tolerance bands is the most correct for this ECP?

	Minimum	Maximum
A.	72% on Group 5	55% on Group 7
B.	11% on Group 6	73% on Group 7
C.	29% on Group 6	47% on Group 7
D.	30% on Group 7	100% on Group 7

Technical Reference OP 1103-15B, Estimated Critical Conditions, Rev 29 entire procedure

Open Exam Reference 1103-15B, Estimated Critical Conditions, Rev 29 entire procedure
Calculator
Ruler

Learning Objective V.B.11.05 Prior to startup, perform independent estimated critical rod position and estimated critical boron concentration calculations in accordance with OP 1103-15B.

Question Source ☑ New ☐ TMI Bank TMI Question #
☐ Modified TMI Bank Parent Question #

Question History ☐ Used in Last Two TMI NRC Exams Exam Date
☐ Used in Audit Exam ☐ Used in Training Program Quiz Date

Question Cognitive Level ☐ Memory or Fundamental Knowledge
☑ Comprehension or Analysis

10 CFR Part 55 Content ☑ 55.41 .7 ☐ 55.43 ☑ 55.45 .5, .8

Discriminant Validity Statements

A Plausible, but uses incorrect rod worth curve.

B Correct answer.

C Plausible, but uses incorrect Xenon tolerance value.

D Plausible, but uses peak Xenon value.

Comments None.

ENCLOSURE 1

Estimated Critical Rod Position

I. CALCULATION IS FOR AN ECP AT 532 ± 2°F ON: DATE _____ TIME _____

1. CYCLE BURNUP _____EFPD

2.a. FINAL MEASURED BORON CONCENTRATION _____ppmB

2.b. BORON DEPLETION CORRECTION FACTOR _____
(NAS Display 10, Control Room Log, Nuclear Engineering)

2.c. FINAL CORRECTED BORON CONCENTRATION (2a)X(2b) = _____ppmB

3. CRG 8 POSITION AT CRITICALITY _____% WD

4. FUEL EXCESS REACTIVITY (FIG 1) _____% Δk/k

5. CRG 8 REACTIVITY WORTH (FIG 2) _____% Δk/k

6. INVERSE BORON WORTH (FIG 3) _____ppmB/% Δk/k

7. BORON REACTIVITY WORTH

$$\left[\frac{\text{ppmB (\#2c)}}{\text{Inverse Boron (\#6)}}\right] \times (-1) = \text{_____\% Δk/k}$$

8. XENON REACTIVITY WORTH (PPC, NUCLEAR ENGR., FIG 4) _____% Δk/k

9. SAMARIUM AND PLUTONIUM BUILDUP (FIG 5)

9a. TIME SINCE LAST SHUTDOWN _____HRS

9b. REACTIVITY DUE TO BUILDUP _____% Δk/k

10. INSERTED CRG 5-7 WORTH REQUIRED FOR CRITICALITY

$$\left[\frac{(\text{FUEL})}{\text{\#4}} + \frac{(\text{CRG 8})}{\text{\#5}} + \frac{(\text{BORON})}{\text{\#7}} + \frac{(\text{XENON})}{\text{\#8}} + \frac{(\text{SM})}{\text{\#9b}}\right] \times (-1) = \text{_____\% Δk/k}$$

11. ESTIMATED CRITICAL ROD POSITION (FIG 6) _____% WD on CRG _____

12. CRITICAL ROD POSITION TOLERANCE BAND (FIG 6)

12a. CHECK ONE

_____0.5% Δk/k If |Xenon (#8)| is ≤ 0.5%Δk/k)

_____0.8% Δk/k If |Xenon (#8)| is > 0.5%Δk/k)

12b. MINIMUM ROD WITHDRAWAL LIMIT (#10 - #12a)_____ % WD on CRG _____

12c. MAXIMUM ROD WITHDRAWAL LIMIT (#10 + #12a)_____% WD on CRG _____

CALCULATED BY: _____ DATE/TIME _____

APPROVED BY (SRO): _____ DATE/TIME _____

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Send original to Operations for filing

ENCLOSURE 1

Estimated Critical Rod Position

I. CALCULATION IS FOR AN ECP AT 532 ± 2°F ON: DATE 6-29-00 TIME 0935

1. CYCLE BURNUP 400 EFPD
2.a. FINAL MEASURED BORON CONCENTRATION 890 ppmB
2.b. BORON DEPLETION CORRECTION FACTOR .98
(NAS Display 10, Control Room Log, Nuclear Engineering)
2.c. FINAL CORRECTED BORON CONCENTRATION (2a)X(2b) = 872.2 ppmB
3. CRG 8 POSITION AT CRITICALITY 30 % WD
4. FUEL EXCESS REACTIVITY (FIG 1) 10.45 % Δk/k
5. CRG 8 REACTIVITY WORTH (FIG 2) -.125 % Δk/k
6. INVERSE BORON WORTH (FIG 3) 135.75 ppmB/% Δk/k
7. BORON REACTIVITY WORTH

$$\left[\frac{\text{ppmB (\#2c)}}{\text{Inverse Boron (\#6)}}\right] \times (-1) =$$

-6.425 % Δk/k

8. XENON REACTIVITY WORTH (PPC, NUCLEAR ENGR., FIG 4) -2.65 % Δk/k
9. SAMARIUM AND PLUTONIUM BUILDUP (FIG 5)
   9a. TIME SINCE LAST SHUTDOWN 20 HRS
   9b. REACTIVITY DUE TO BUILDUP -.01 % Δk/k
10. INSERTED CRG 5-7 WORTH REQUIRED FOR CRITICALITY

$$\left[\frac{(\text{FUEL})}{\#4} + \frac{(\text{CRG 8})}{\#5} + \frac{(\text{BORON})}{\#7} + \frac{(\text{XENON})}{\#8} + \frac{(\text{SM})}{\#9b}\right] \times (-1) =$$

-1.24 % Δk/k

11. ESTIMATED CRITICAL ROD POSITION (FIG 6) 75 % WD on CRG 6
12. CRITICAL ROD POSITION TOLERANCE BAND (FIG 6)
   12a. CHECK ONE
   X 0.5% Δk/k If |Xenon (#8)| is ≤ 0.5%Δk/k)
   _____ 0.8% Δk/k If |Xenon (#8)| is > 0.5%Δk/k)
   12b. MINIMUM ROD WITHDRAWAL LIMIT (#10 - #12a) 97 (22') % WD on CRG 5 (6) -1.74
   12c. MAXIMUM ROD WITHDRAWAL LIMIT (#10 + #12a) 45 % WD on CRG 7

CALCULATED BY: _____ DATE/TIME 6-29-00 0935

APPROVED BY (SRO): _____ DATE/TIME _____

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Candidate's calculation

Answer Key Corrections

Question # 084

Allow both B and C

Justification:

The question stem states that "A complete loss of the normal Secondary side Instrument Air Header occurs." The candidate assumed that since the backup instrument air compressor is NORMALLY lined up to supply the TBV, it was part of the COMPLETE loss of secondary side Instrument Air header. This is a reasonable assumption based on the wording in the question and demonstrates the candidate's knowledge of how the system would respond. On a complete loss of air, the TBVs fail closed and can only be controlled locally using the handwheel. If this assumption is made, then response B would be a correct answer.

Question will be modified prior to future use to clarify the stem.

Form ES-401-6 **Written Exam Question Worksheet** Q # 084

Examination Outline Cross-Reference RO SRO

KA # SYSTEM 041 A2.03 Page 3.4-25 Tier # 2

RO/SRO Importance Rating 2.8 3.1 Group # 3

Measurement Ability to predict the impacts of the following malfunctions or operations on the SDS; and based on those predictions, use procedures to correct, control or mitigate the consequences of those malfunctions or operations: Loss of IAS

Proposed Question ☑ RO ☑ SRO ☑ PRA Related **Correct Answer** C

Turbine Bypass Valve (TBV) H/A stations are in hand with demand set at approximately 20% open. A complete loss of the normal Secondary side Instrument Air header occurs.

Which ONE (1) of the following describes the response of the TBVs and the method to control the valves?

The valves will:

A. Open. Controlled locally using the handwheel.

B. Close. Controlled locally using the handwheel.

C. Remain 20% open. Controlled from the H/A station in the CR.

D. Go to 50% open. Controlled by adjusting local air pressure to the controller.

Technical Reference EP 1202-36, Loss of Instrument Air, page 9, Rev. 29.

Open Exam Reference

Learning Objective IV.C.01.04 Explain the operation of the turbine bypass valves (MS-V-3 A-F), including controls, setpoints and relief capacity.

Question Source ☑ New ☐ TMI Bank TMI Question #
☐ Modified TMI Bank Parent Question #

Question History ☐ Used in Last Two TMI NRC Exams Exam Date
☐ Used in Audit Exam ☐ Used in Training Program Quiz Date

Question Cognitive Level ☐ Memory or Fundamental Knowledge
☑ Comprehension or Analysis

10 CFR Part 55 Content ☑ 55.41 .5 ☑ 55.43 .5 ☑ 55.45 .3, .13

Discriminant Validity Statements

A Plausible if fail position is misunderstood.

B Plausible if fail position is misunderstood.

C Correct answer. Backup air system will continue to supply motive air to the controller.

D Plausible if fail position is misunderstood.

Comments None.