NRC Resolution of facility comments.

Q77: Facility Comment: Accept a second correct answer as a subset of the original correct answer.

NRC Resolution: The facility submittal provides a clear walkthrough on graphs as to why their proposed second correct answer is a subset of the original answer.

Accept two correct answers as proposed.

Q78: Facility Comment: This question was modified to make it SRO level and a stem focus issue resulted. The original correct answer depends on whether or not "extremely high vibration" exists at ON-192-002 step 3.4. This term is not actually defined anyplace. This makes the choice between the original answer and the proposed second answer a matter of CRS judgement. The facility comment is more involved, concerning operator expected response to actions

NRC Resolution: The NRC identified the definition issue during review of the facility comment and considered this to be adequate justification for accepting the facility resolution

Accept two correct answers as proposed.

Q80: Facility comment: The question stem presents a combined electric, then hydraulic ATWS. All physically available (given the stem conditions) methods of rod insertion are available with no preferred method. Accept two correct answers.

NRC Resolution: Review of EO-100-113 sh 2 indicates that there are preferred methods for an uncomplicated electric or hydraulic ATWS, but all methods are “on the table” for the situation presented in the stem. Review by 6 NRC examiners did not result in one clear correct answer.

Accept two correct answers as proposed.

Following the administration of the LOC–26 written examination on August 21, 2014, SSES conducted an examination analysis in accordance with NUREG–1021 ES–403 D.3.a and reviewed the results of the preliminary grading and examination analysis with the applicants.

No changes were made during the administration of the exam.

From the exam analysis and post–exam review with the applicants SSES has identified three written exam questions (SRO 77, SRO 78, and SRO 80) where a change in the answer key is requested. During the exam there were no questions asked by the applicants regarding these three questions. The requested changes to the questions are founded in procedure requirements and the bases are described in detail below. The complete examination analysis is included as part of the submittal package.

SRO QUESTION 77

Refer to the figure on the following page when answering this question.

Unit 1 is operating at rated power with main generator operation as shown.

Transient grid conditions result in oscillations in generator reactive load.

Main generator reactive load begins to oscillate between 200 and 300 MVAR.

Annunciator GEN VOLT REG AUTO TO MAN SETPOINT UNBALANCED (AR-106-C09) is in alarm.

Annunciator GENERATOR FIELD OVERVOLTAGE (AR-106-A06) remains clear.

Which one of the following describes the appropriate actions to direct in response to the conditions represented by the process computer display?

A. Verify the Auto Voltage Regulator automatically maintains Generator Field current < 6000 amps
Adjust HC-10002, MAN VOLT REG ADJUST, as necessary to clear AR-106-C09

B. Immediately transfer to the Manual Voltage Regulator
Lower HC-10002, MAN VOLT REG ADJUST, until generator reactive load is < 150 MVAR

C. Reduce core power per the CRC instructions to lower generator load to restore positive margin to the capability curve
Perform GO-100-012, Power Operations for an unplanned power reduction

D. Immediately reduce core power per the CRC instructions to lower power by 5 percent
Perform GO-100-012, Power Operations for an unplanned power reduction

Answer Explanation associated with the question as submitted

ON-198-001 is the governing procedure for operation outside the generator capability curve with the main generator voltage regulator in AUTO. The initial conditions presented show operation just inside the limits of the capability curve. The transient results in sustained operation outside of the capability curve.

A is incorrect. While the AUTO voltage regulator has automatic circuitry to lower field current < 5876 amps, this is only activated on a generator field overvoltage condition, which has not occurred. Adjusting the manual voltage regulator to match the AUTO regulator can be performed, but will not mitigate operation outside of the capability curve.

B is incorrect. Placing the manual voltage regulator in MANUAL is not authorized by the procedure. There is no basis for assuming misoperation of the voltage regulator in AUTO as the stem clearly indicates the excessive reactive loading is due to grid conditions.

C is correct. A power reduction is authorized by ON-198-001. Performing the power reduction per the CRC instructions is the preferred method. GO-100-012 will have to be performed due to the unplanned power reduction.

D is incorrect. While a power reduction is authorized by ON-198-001, 5 percent is more than required to obtain a positive margin on the capability curve. Note 2 to Step 3.5.3 of ON-198-001 allows up to 2 minutes for the AUTO voltage regulator to attempt to restore margin, so immediate action is not required. The 5 percent requirement is taken from ON-193-001 for a EHC control valve oscillation.

Examination Analysis

7 of 11 applicants selected response C as the correct answer. 1 applicant selected D as the correct answer. 2 applicants selected A and 1 selected B.

Recommended Change

Accept response D as a second correct answer to the question, in addition to the original keyed answer C.

Justification For Change – refer to reference diagrams below

ON-198-001, Unit 1 Main Generator MVAR Control for AUTO Voltage Regulator Operation when Synched to the Grid, requires the operator to maintain the Main Generator parameters within those established by the Generator Capability Curve. Section 3.5 is directed to be performed if MVAR output is approaching or exceeding the curve limits. The information provided in the stem of the question establishes conditions outside the curve limits. Oscillations between 200 to 300 MVAR places the generator operation above the 75 psig curve limit as indicated on the plant computer reference given to the applicants.

Correctly applying the procedure requirements of ON-198-001 step 3.5.3 and GO-100-001, step 5.3.11.b, results in reducing reactor power which reduces generator power to restore operation within the limits of the curve. These procedural steps however do not indicate the amount of adjustment necessary. On-198-001 does direct restoring operation to the allowable region as described in step 3.5 NOTE (2) d.

Selecting response C, Reduce core power per the CRC instructions to lower generator load to restore positive margin to the capability curve and Perform GO-100-012, Power Operations for an unplanned power reduction as the correct answer results in a reduction of generator MW to restore "positive margin." The magnitude of positive margin is not described by the procedure requirements. Interpolation of the numbers on the curve given results in a reduction to approximately 1300 MW to reenter the allowable region.

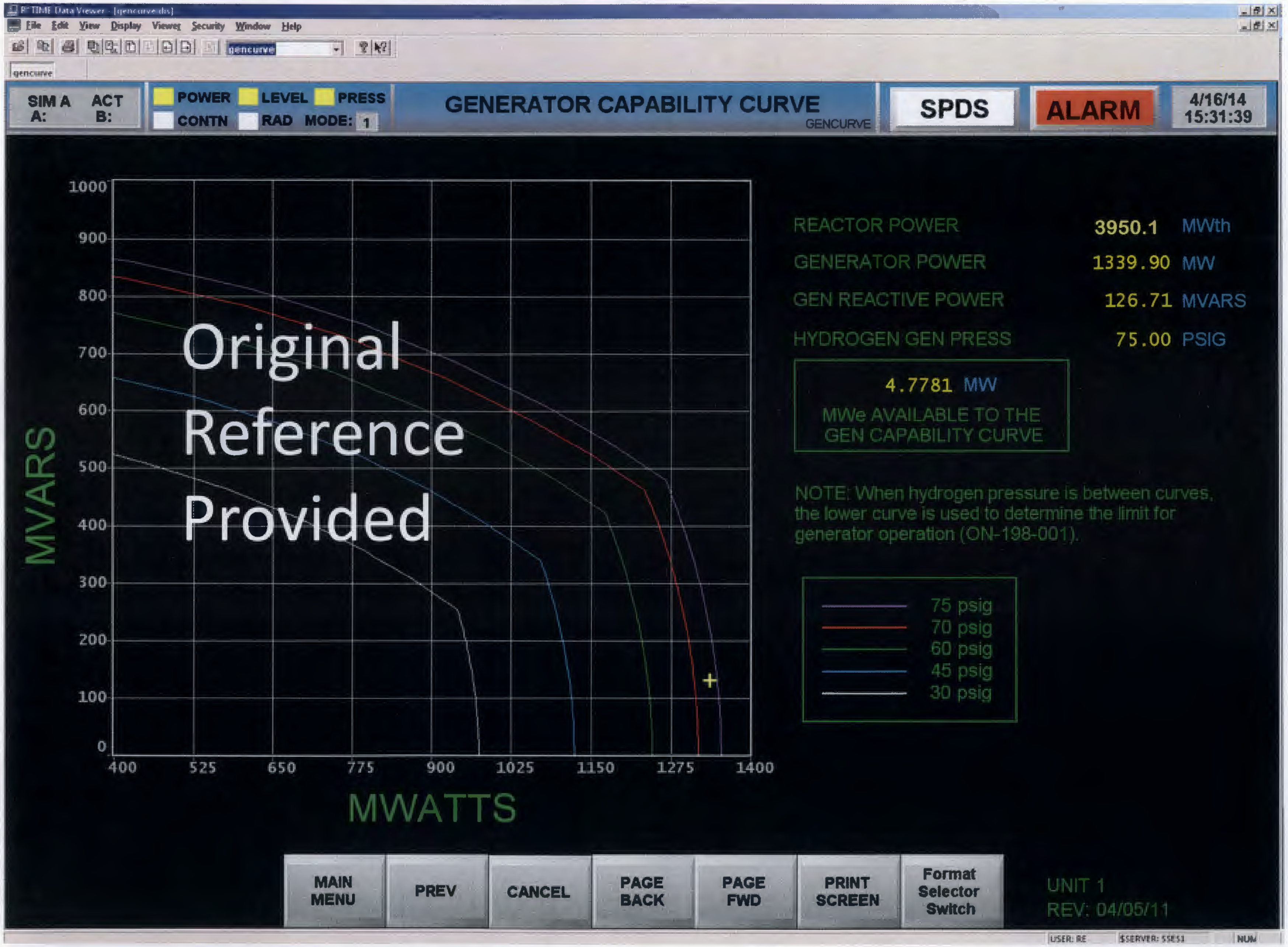
Selecting response D, Immediately reduce core power per the CRC instructions to lower power by 5 percent Perform GO-100-012, Power Operations for an unplanned power reduction as the correct answer results in a reduction of generator MW to restore "positive margin" also. Lowering core power by 5 percent gives a corresponding decrease of generator power by 5 percent resulting in a final output power of 1272 MW. The magnitude of positive margin is not described by the procedure requirements. Interpolation of the numbers on the curve provided to the applicants results in a reduction to approximately 1272 MW providing acceptable margin which would be reasonable for the conditions given. Directing a power reduction of 5 percent would be an acceptable operating practice as the SRO would be expected to establish a target power level when ordering a reactivity change. Note: SSES does not agree with the original question explanation of choice D which stated that ON-198-001 allows up to 2 minutes to restore margin, so immediate action is not required. ON-198-001, Note (2), step 3.5.3 states, "Allow the Automatic Voltage Regulator no greater than two (2) minutes to reduce MVAR output if MVAR output exceeds Generator Capability Curve." Therefore, immediate action to reduce reactor core power is required and would be expected.

Response D is a subset of response C as a 5 percent reduction provides an operating point within the allowable range. An evaluation of the bases for selecting either C or D as an acceptable response reveals that in both cases the generator is operating within the established limits of the capability curve and all procedure requirements are followed.

Note: Distractors A and B remain incorrect for the reasons provided previously in Explanation section of the original question.

Given an evaluation of the above criteria SSES recommends accepting both responses C and D as correct answers.

References:
ON-198-001, Unit 1 Main Generator MVAR Control for AUTO Voltage Regulator Operation when Synched to Grid
Generator Capability Curve and GO-100-012, Power Maneuvers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gencurve
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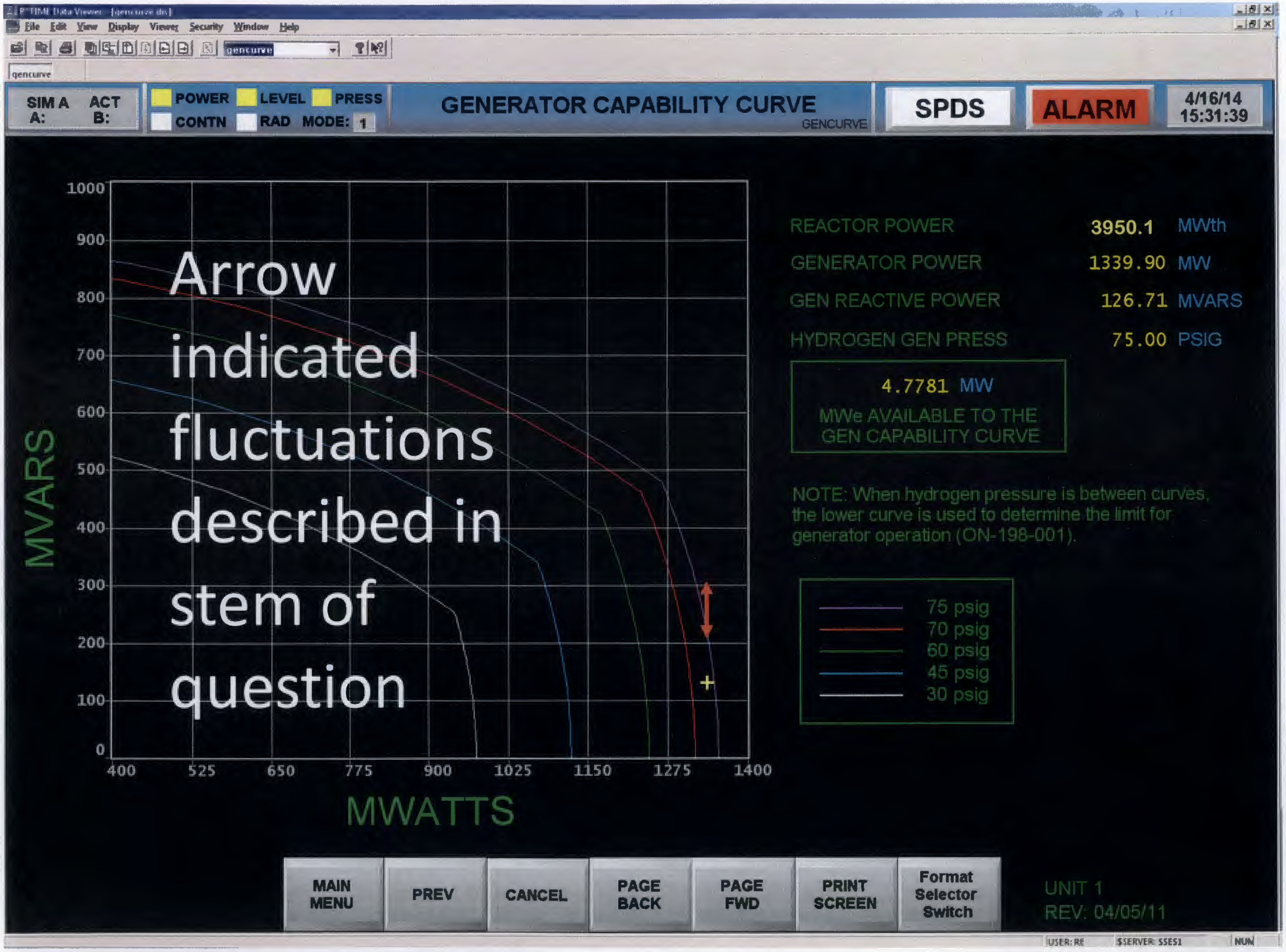
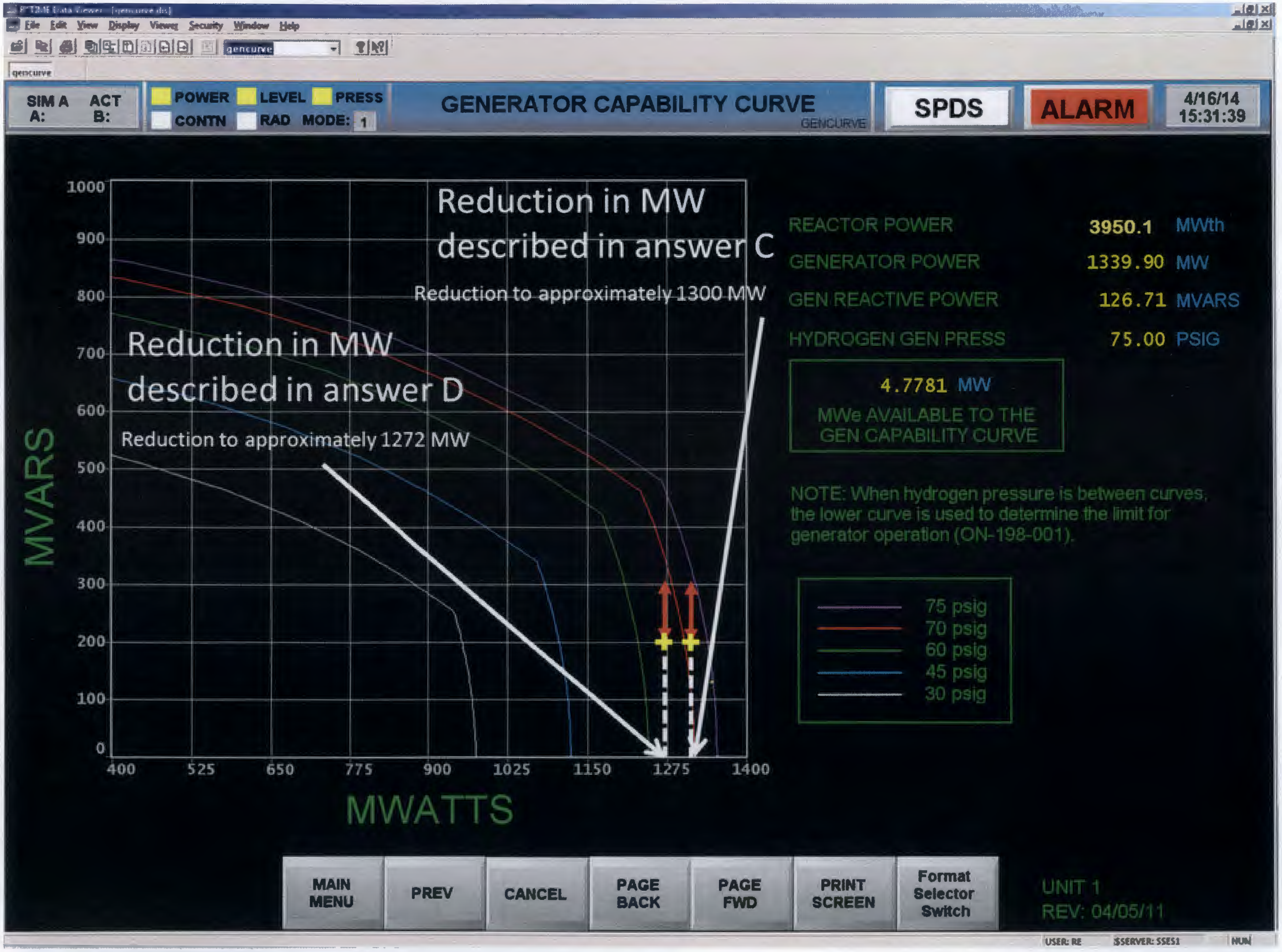
ACT B:
POWER
LEVEL
PRESS
CONTN
RAD
MODE: 1
GENERATOR CAPABILITY CURVE
GENCURVE
SPDS
ALARM
4/16/14
15:31:39
Original Reference Provided
MVARS
1000
900
800
700
600
500
400
300
200
100
0
400
525
650
775
900
1025
1150
1275
1400
MWATTS
REACTOR POWER 3950.1 MWth
GENERATOR POWER 1339.90 MW
GEN REACTIVE POWER 126.71 MVARS
HYDROGEN GEN PRESS 75.00 PSIG
4.7781 MW
MWe AVAILABLE TO THE GEN CAPABILITY CURVE
NOTE: When hydrogen pressure is between curves, the lower curve is used to determine the limit for generator operation (ON-198-001).
75 psig
70 psig
60 psig
45 psig
30 psig
MAIN MENU
PREV
CANCEL
PAGE BACK
PAGE FWD
PRINT SCREEN
Format Selector Switch
UNIT 1
REV: 04/05/11


File Edit View Display Viewer Security Window Help
gencurve
SIM A A:
ACT B:
POWER
LEVEL
PRESS
CONTN
RAD
MODE: 1
GENERATOR CAPABILITY CURVE
GENCURVE
SPDS
ALARM
4/16/14 15:31:39
Arrow indicated fluctuations described in stem of question
MVARS
MWATTS
1000
900
800
700
600
500
400
300
200
100
0
400
525
650
775
900
1025
1150
1275
1400
REACTOR POWER 3950.1 MWth
GENERATOR POWER 1339.90 MW
GEN REACTIVE POWER 126.71 MVARS
HYDROGEN GEN PRESS 75.00 PSIG
4.7781 MW
MWe AVAILABLE TO THE GEN CAPABILITY CURVE
NOTE: When hydrogen pressure is between curves, the lower curve is used to determine the limit for generator operation (ON-198-001).
75 psig
70 psig
60 psig
45 psig
30 psig
MAIN MENU
PREV
CANCEL
PAGE BACK
PAGE FWD
PRINT SCREEN
Format Selector Switch
UNIT 1
REV: 04/05/11


SIM A: ACT B:
POWER LEVEL PRESS
CONTN RAD MODE: 1
GENERATOR CAPABILITY CURVE
GENCURVE
SPDS
ALARM
4/16/14 15:31:39
Reduction in MW described in answer C
Reduction to approximately 1300 MW
Reduction in MW described in answer D
Reduction to approximately 1272 MW
MVARS
MWATTS
REACTOR POWER 3950.1 MWth
GENERATOR POWER 1339.90 MW
GEN REACTIVE POWER 126.71 MVARS
HYDROGEN GEN PRESS 75.00 PSIG
4.7781 MW
MWe AVAILABLE TO THE GEN CAPABILITY CURVE
NOTE: When hydrogen pressure is between curves, the lower curve is used to determine the limit for generator operation (ON-198-001).
75 psig
70 psig
60 psig
45 psig
30 psig
MAIN MENU
PREV
CANCEL
PAGE BACK
PAGE FWD
PRINT SCREEN
Format Selector Switch
UNIT 1
REV: 04/05/11

SRO QUESTION 78

Unit 1 is shutting down for a forced outage. Reactor Power is 20 percent.

Annunciator TURB GEN BRG HI VIBRATION (AR-105-E05) alarms due to bearing #5 rotor and casing high vibration.

Operators trip the Main Turbine. The generator output breaker opens, but turbine speed does not lower.

Turbine bearing #5 vibration continues to rise. Vibration is currently 15 mils, up 5 mils every minute.

Which one of the following identifies the appropriate actions to direct to lower turbine vibration?

A. Close the MSIVs and MSL drains immediately
Verify turbine speed begins to lower

B. Place the Mode switch to SHUTDOWN immediately
Close the MSIVs and MSL drains
Verify turbine speed begins to lower

C. Place the Mode switch to SHUTDOWN immediately
Close the MSIVs and MSL drains
Open the Main Condenser vacuum breakers if vibration does not lower

D. Place the Mode switch to SHUTDOWN immediately
Close the MSIVs and MSL drains
Open the Main Condenser vacuum breakers <u>after</u> turbine speed lowers below 1200 rpm

<u>Answer Explanation associated with the question as submitted</u>

The Main Turbine has been tripped due to a high vibration condition. On the turbine trip leak by on the main turbine stop and control valves has resulted in the turbine remaining at speed. Turbine vibration remains high and is rising slowly.

A is incorrect. Action to isolate steam flow to the main turbine is required by ON-193-002 Step 3.2. Although reactor power is below the bypass for reactor scram on turbine trip, directing an action, closing MSIVs that will result in a reactor scram without first initiating a reactor scram is not allowed.

B is incorrect. Per ON-193-002 Step 3.2 the steam supply to the main turbine should be isolated if turbine speed does not lower after a turbine trip. Additional action to break vacuum is warranted at this time due to the rapid rise in vibration.

C is correct. Breaking vacuum is required because vibration is rising rapidly. Vibration is above the trip limit, so the "extremely high" threshold has been met. This is the procedural method for breaking vacuum per ON-193-002.

D is incorrect. While the actions specified are correct and in the correct sequence, the trend on turbine vibration will result in extremely high values before the turbine coasts down to 1200 rpm.

Examination Analysis

9 of 11 applicants selected response D as the correct answer.

Recommended Change

Accept distractor D as a second correct answer to the question, in addition to the original keyed answer C.

Justification For Change

ON-193-002, Main Turbine Trip, is entered as a result of the conditions given in the stem of the question. The stem indicates that turbine speed is not lowering after the operators have tripped the turbine. Also turbine vibration continues to rise.

The question asks the applicant to identify the appropriate actions to direct to lower turbine vibration.

Correctly applying the procedure requirements of ON-193-002 step 3.4 results in scramming the reactor and closing the MSIVs and Main Steam Line Drains to lower turbine speed by isolating all steam flow to the turbine. The step also reduces the coast down time by increasing condenser pressure as a result of opening the main condenser vacuum breakers. A Caution precedes step 3.4 indicating that "breaking vacuum when turbine speed is greater than 1200 rpm will cause severe stress on last stage turbine buckets."

Selecting response C as a correct choice accomplishes the following:

Place the Mode switch to SHUTDOWN immediately

Close the MSIVs and MSL drains

Open the Main Condenser vacuum breakers if vibration does not lower

Based on information given in the stem of the question - Annunciator TURB GEN BRG HI VIBRATION (AR-105-E05) alarms due to bearing #5 rotor and casing high vibration, the applicant could correctly conclude from the alarm response procedure that an automatic turbine trip should have occurred at 11.5 mils but based on the stem conditions the turbine is still operating at normal speed. Breaking vacuum is required because vibration is rising rapidly as indicated in the stem of the question (currently 15 mils, up 5 mils every minute). Vibration is above the trip limit, so the "extremely high" threshold as stated in ON-193-002, step 3.4 has been met. Therefore, selecting step 3.4 of ON-193-002 is a correct response to the information given in the stem of the question. It is reasonable for the applicant to correctly conclude that isolating steam to the turbine will reduce turbine speed and vibration. The last element of response C qualifies the action to be taken to "Open the Main Condenser vacuum breakers only if vibration does not lower". This qualifying statement about the effect of the two previous actions (i.e., if vibration does not lower) could lead the applicant to direct opening the main condenser vacuum breakers without applying the caution statement (i.e., to delay until turbine speed lowers to 1200 rpm) since reduced coast down time is required if vibration does not lower. This qualifying statement (i.e., if vibration does not lower) makes response C correct by supplying the applicant with the conditions of the turbine after the first two actions are taken.

Selecting response D as a correct choice accomplishes the following:

Place the Mode switch to SHUTDOWN immediately

Close the MSIVs and MSL drains

Open the Main Condenser vacuum breakers after turbine speed lowers below 1200 rpm.

The first two actions in answer choices C and D are correct actions from ON-193-002 step 3.4. The decision to apply the caution is based on whether turbine vibrations will lower after closing the MSIVs. It is operationally valid for the applicants to conclude that vibrations will lower following closure of the MSIVs. The applicant could correctly conclude that isolating steam to the turbine will reduce turbine speed with a resultant reduction in vibration. Unlike answer choice C, no qualifying information is given in answer choice D regarding the status of turbine vibration following closure of the MSIVs. Therefore, the operator would be correct in applying the procedural caution statement to delay opening the vacuum breakers until turbine speed lowers to 1200 rpm. Since no qualifying information is given regarding turbine vibration following MSIV closure in response D, response D is also a correct response.

Note: Answer choices A & B are incorrect. A is incorrect because if the mode switch was not taken to shutdown prior to closing the MSIVs an automatic high pressure scram would occur.

B is incorrect because the stem of the question asks which of the following identifies the appropriate actions to direct to lower turbine vibration. Answer choice B states "Verify turbine speed begins to lower". In selecting response B the applicant must disregard the information given in the stem which indicates turbine vibration is extremely high and rising (i.e., so high that the turbine should have tripped). ON-193-002, step 3.4, requires reduced coastdown time since a condition of extremely high vibrations exits requiring breaking vacuum. Additional action is required which would result in breaking condenser vacuum either immediately or when turbine speed lowers to 1200 rpm. It's incumbent upon the operator in this situation to reduce the speed of the turbine in a timely fashion thus reducing turbine vibration as quickly as possible. Selecting choice B does not reduce speed in a timely manner which is directed by ON-193-002.

Given an evaluation of the above criteria SSES recommends accepting responses C and D both as correct answers.

<u>References:</u>

ON-193-002, Main Turbine Trip

AR-105-001,E05

SRO QUESTION 80

Question

Unit 1 has experienced a failure of RPS to trip.

When ARI was initiated, a large number of control rods on the right side of the full core display continued to show not fully inserted

All actions in the power leg of EO-100-113 were completed to the point of attempting control rod insertion.

ES-158-002, ARI and RPS Trip Bypass, was directed to be performed. The in-field portion of the ES was completed.

Annunciators RPS CHAN A1/A2(B1/B2) SCRAM DSCH VOL HI WTR LEVEL TRIP (AR-103(104)-F02), have subsequently cleared.

Which one of the following should be directed next in an attempt to insert the withdrawn rods?

A. Reset the scram, then insert a manual scram using the RPS manual scram pushbuttons in accordance with ES-158-002, RPS and ARI Trip Bypass

B. Individually scram control rods in accordance with Attachment A of EO-100-113 Sheet 2

C. Vent the scram air header in accordance with the posted instructions

D. Insert control rods in accordance with ES-155-001, Venting CRD to Insert Control Rods

Answer Explanation associated with the question as submitted

The conditions presented in the stem are consistent with an electrical ATWS, as indicated by the failure of the full core display to enter full-in/full-out mode, where ARI initiation or maximizing CRD flow were successful in inserting most of the control rods. ES-158-002 was directed for installation to defeat ARI to re-pressurize the scram air header for subsequent scram attempts. The RPS trip bypass portion of the ES were installed, but for no effect.

A is incorrect. The actions described are the next steps to perform to complete ES-158-002 to attempt a re-scram. However, as RPS has failed to trip this action will not have any effect and will not insert control rods.

B is incorrect. Individually attempting to scram control rods may have some success, but re-venting the scram air header to attempt to re-scram all withdrawn control rods is the preferred response.

C is correct. With RPS untripped and ARI defeated to re-pressurize the scram air header (indicated by the SDV now being drained), this action will vent the scram air header for an attempt to re-scram the control rods.

D is incorrect. This action would be effective in attempting to insert the control rods, but is not allowed to be used until all other methods have been attempted.

Examination Analysis

10 of 11 applicants missed the question overall. 6 applicants selected response B, 4 applicants selected response A.

Recommended Change

Accept distractor B as a second correct answer to the question, in addition to the original keyed answer C.

Justification For Change

In order to select the correct response, the applicant must determine the malfunctions in the automatic scram system and align the remaining available methods of control rod insertion with those not affected by the malfunctions described in the stem of the question.

The applicant could correctly conclude the following from the information given in the stem:

- RPS has completely failed (stated in stem)
- ARI was partially effective (stated in stem that a large number of control rods did not show fully inserted) – based on this information the ARI valves actuated, the scram air header depressurized, and some control rod movement occurred but was hindered by some unstated hydraulic interference.
- Emergency Operating Procedures were entered (EO-100-113 SH2, Control Rod Insertion) and steps completed up to the point of attempting control rod insertion (stated in the stem)
- ES-158-002, ARI and RPS Trip Bypass in field portion completed. Based on the action accomplished by ES-158-002, ARI is bypassed and will no longer actuate from the control room switches. Note the procedure would also bypass RPS except for manual scram however; this information is not relevant since the information in the stem establishes a failure of RPS to trip under any circumstance.
- The scram condition originally inserted by ARI (which was partially effective) has been reset and the scram discharge volume is drained based on *RPS CHAN A1/A2 (B1/B2) SCRAM DSCH VOL HI WTR LEVEL TRIP* being clear which is stated in the stem.

Selecting response C (*Vent the scram air header in accordance with the posted instructions*), as a correct choice is based on correct conclusions made by the applicant as follows:

This method of control rod insertion is an approved method directed by procedure (EO-100-113 SH2, Control Rod Insertion). Note that the procedural paths in EO-100-113 SH2 are not prioritized. Methods are valid if operationally possible based on the system malfunction present.

- The method of venting the scram air header is an operationally valid choice since ARI and RPS cannot be used from the control room to initiate a scram, and since the scram air header is re-pressurized as concluded from the scram discharge volume vent and drain valves being open and the scram discharge volume being drained, therefore this method to vent the scram air header locally to insert control rods could be effective.
- This method of venting the scram air header to insert control rods was partially effective before since ARI had previously been initiated and some control rod movement occurred as indicated by information provided in the stem.
- The physical plant locations to vent the scram air header (choice C) or individually scram the control rods (choice B) are the same (locally near the hydraulic control unit banks in the reactor building) therefore both of these actions could be completed in parallel if sufficient manpower was available.

Based on this evaluation, the applicant could conclude that response C is a correct choice.

Selecting response B (*Individually scram control rods in accordance with Attachment A of EO-100-113 Sheet 2),* is also a correct choice based on correct conclusions made by the applicant as follows:

- The method of control rod insertion is an approved method directed by procedure (EO-100-113 SH2, Control Rod Insertion) and all conditions given in step CR-16 are met to proceed as described below and indicated by the information given in the stem.

  IF ALL

  - ARI DISABLED
  - SCRAM RESET
  - SCRAM AIR HEADER NOT VENTED
  - RPS FUSES NOT REMOVED

  Note that the procedural paths in EO-100-113 SH2 are not prioritized. Methods are valid if operationally possible based on the system malfunction present.

  The method of individually scramming control rods is an operationally valid choice since ARI and RPS cannot be used from the control room to initiate a scram, therefore another method to individually scram control rods is appropriate.

- The applicant concludes that the method of venting the scram air header to insert control rods was only partially effective before since ARI had previously been initiated and a large number of control rods did not indicate fully inserted.
- The physical locations to individually scram the control rods (choice B) or vent the scram air header (choice C) are the same (locally near the hydraulic control unit banks in the reactor building) therefore personnel travel time to complete the actions or personnel safety would not be a factor in selecting an alternate method.
- The bases for EO-100-113 SH2, Control Rod Insertion, document EO-000-113 step CR 16 for individually scramming control rods states "Even with an incompletely drained or non-vented scram discharge volume, sufficient capacity may remain in the scram discharge volume to accommodate discharge flow from control rod scrams taken one at a time as opposed to all at once." The applicant could correctly conclude that this method would be effective based on the information provided in the stem of the question.
- The bases for EO-100-113 SH2, Control Rod Insertion, document EO-000-113 step CR 16 for individually scramming control rods also states Control rods are individually scrammed until control rods will not insert and it is determined that other methods of inserting control rods would be more effective. Based on the information given in the stem, there is no remaining information for the applicant to determine if another method would be more effective until this method is applied since the initial indication given was that the first method of scramming was only partially effective.

Based on this evaluation, the applicant could conclude that response B is a correct choice.

Responses A & D remain incorrect. Response A cannot be a correct response because the stem states RPS failed and therefore cannot be tripped to initiate control rod insertion. Response D cannot be a correct response because other methods are available (choices B & C), and the bases for EO-100-113 SH2, Control Rod Insertion, document EO-000-113 step CR 28 states that this method for venting CRD over piston volumes is only applicable when "ALL OTHER METHODS HAVE FAILED" and further explains that this step is entered when all other means of inserting control rods have been unsuccessful.

Given an evaluation of the above criteria SSES recommends accepting responses B and C both as correct answers.

References
EO-100-113 SH2, Control Rod Insertion and EOP Bases for steps CR-16 and CR-28
ES-158-002, ARI and RPS Trip Bypass

PROCEDURE COVER SHEET

PPL SUSQUEHANNA, LLC PROCEDURE	
MAIN TURBINE TRIP ADHERENCE LEVEL: CONTINUOUS USE	6/13/2014 ON-193-002 Revision 24 Page 1 of 14~~14~~

QUALITY CLASSIFICATION:	APPROVAL CLASSIFICATION:
(X) QA Program ( ) Non-QA Program	(X) Plant ( ) Non-Plant ( ) Instruction

EFFECTIVE DATE: ______________

PERIODIC REVIEW FREQUENCY: 2 Year

PERIODIC REVIEW DUE DATE: ______________

RECOMMENDED REVIEWS:

Procedure Owner: F Shift

Responsible Supervisor: Shift Manager-F Shift

Responsible FUM: Manager-Nuclear Operations

Responsible Approver: Manager-Nuclear Operations

1. SYMPTOMS AND OBSERVATIONS

1.1 Any of following alarms at Unit Operating Benchboard 1C651:

1.1.1 MAIN TURB MASTER TRIP

1.1.2 GEN LOCKOUT RELAYS TRIP

1.1.3 EXCITER FIELD BKR TRIP

1.2 One or more annunciators associated with condition causing Main Turbine/Main Generator trip at Unit Operating Benchboard 1C651.

1.3 Reactor Scram if Main Turbine trip occurred with Reactor power > 26%.

2. AUTOMATIC ACTIONS

2.1 Main Turbine Stop Valves SV-1,2,3 and 4 close.

2.2 Main Turbine Control Valves CV-1,2,3 and 4 close.

2.3 Main Turbine Combined Intermediate Valves CIV-1,2,3,4,5 and 6 close.

2.4 Bypass Valves BPV-1, 2, 3, 4 and 5 open to maintain set pressure.

2.5 Auxiliary Busses 11A (1A101) and 11B (1A102) transfer to Startup Bus 10 (0A103).

2.6 As Main Turbine coasts down, following pumps start:

2.6.1 Motor Suction Pump 1P108.

2.6.2 Turning Gear Oil Pump 1P111.

2.6.3 Turbine Lift Pumps 1P109A,B,C,D,E,F,G,H & J

2.7 Reactor Recirc Pumps 1P401A and B trip caused by EOC-RPT if thermal power > 26%.

2.8 Stator Cooling Pumps 1P116A and B trip if Main Turbine Tripped on Main Generator Lockout due to Generator Differential or Generator Neutral Overvoltage conditions (86GE Lockout Relay).

3. OPERATOR ACTIONS

☐

NOTE:	Subsections within section 3 may be performed in any order as determined by Shift Supervision based on the nature of the event and the priority of required operator actions. Steps within each subsection must be performed in the order written.

3.1 **Ensure**:

☐ 3.1.1 Main Generator Output Breaker TRIPS.

☐ 3.1.2 IF Main Generator is unable to disconnect from Grid after a Turbine trip, **Perform** ON-198-004.

☐ 3.1.3 Main Generator Exciter Field Breaker TRIPS.

☐ 3.1.4 Auxiliary Bus "11A" 1A101 TRANSFERS to Startup Bus 0A103.

☐ 3.1.5 Auxiliary Bus "11B" 1A102 TRANSFERS to Startup Bus 0A103.

☐ 3.1.6 Motor Suction Pump 1P108 STARTS.

☐ 3.1.7 Turning Gear Oil Pump 1P111 STARTS.

☐ 3.1.8 Turbine Lift Pumps 1P109A,B,C,D,E,F,G, H & J START.

☐ 3.1.9 IF Rx Power > 26% when Main Turbine Tripped, Reactor Recirc Pumps 1P401A and B TRIP caused by EOC-RPT.

3.2 **IF** Main Turbine speed not lowering, **Perform** the following:

3.2.1 IF Rx Power < 26% when Main Turbine tripped,

☐ **Scram** the Reactor **PER** ON-100-101, Scram Scram Imminent.

3.2.2 **Close** the MSIV's and Main Stm Drains

☐ • MN STM LINE A OB ISO HV-141-F028A

☐ • MN STM LINE B OB ISO HV-141-F028B

☐ • MN STM LINE C OB ISO HV-141-F028C

☐ • MN STM LINE D OB ISO HV-141-F028D

☐ • MN STM LINE A IB ISO HV-141-F022A

- ☐ • MN STM LINE B IB ISO HV-141-F022B
- ☐ • MN STM LINE C IB ISO HV-141-F022C
- ☐ • MN STM LINE D IB ISO HV-141F022D
- ☐ • MN STM LINE IB DRAIN HV-141-F016
- ☐ • MN STM LINE OB DRAIN HV-141-F019

☐ 3.3 **Monitor** Main Turbine coastdown.

☐

CAUTION

Breaking vacuum when turbine speed is greater than 1200 rpm will cause severe stress on last stage turbine buckets.

3.4 **IF** reduced coastdown time is required due to extremely high bearing vibration, **Break** vacuum as follows:

☐ NOTE: MSIV's will close at 19.0 inches Hg Absolute (10.2 inches Hg Vacuum) unless Low Vacuum Trip bypassed. Turbine Bypass Valves will close at 22.2 inches Absolute (7 inches Hg Vacuum).

3.4.1 **IF** Rx Power < 26% when Main Turbine tripped,

☐ **Scram** the Reactor **PER** ON-100-101, Scram Scram Imminent.

3.4.2 **Close** the MSIV's and Main Stm Drains

- ☐ • MN STM LINE A OB ISO HV-141-F028A
- ☐ • MN STM LINE B OB ISO HV-141-F028B
- ☐ • MN STM LINE C OB ISO HV-141-F028C
- ☐ • MN STM LINE D OB ISO HV-141-F028D
- ☐ • MN STM LINE A IB ISO HV-141-F022A
- ☐ • MN STM LINE B IB ISO HV-141-F022B
- ☐ • MN STM LINE C IB ISO HV-141-F022C

☐ • MN STM LINE D IB ISO HV-141F022D

☐ • MN STM LINE IB DRAIN HV-141-F016

☐ • MN STM LINE OB DRAIN HV-141-F019

☐ 3.4.3 At 1C668, **Open** CDSR VAC BKR HV-10742A, B, C by depressing common **OPEN** push button.

☐ 3.4.4 **Observe** Main Condenser Vacuum decays to atmospheric pressure.

☐ 3.4.5 **Remove** Sealing Steam from turbine Seals in accordance with OP-192-001.

3.5 **Evaluate** need to enter following ON's:

☐ 3.5.1 ON-100-101, Scram, Scram Imminent

☐ 3.5.2 ON-164-002, Loss of Reactor Recirculation Flow

☐ 3.5.3 ON-197-001, Loss of Stator Cooling

3.6 At Generator and Transformers Protection Relays Vertical Board 1C654, **Circle** as found position **AND** as applicable **Reset** the following Primary and Backup Lockout Relays if tripped:

☐

NOTE:	Actuation of Aux Transformer 11 Ground Overvoltage Lockout Relay (86GE) indicates a possible ground fault condition on either the 11A or 11B Aux Buses. 86GE Relay actuation blocks the Fast and Slow transfer of Aux Buses to Tie Bus.

☐

CAUTION

Resetting the Aux Transformer 11 Neutral Overvoltage Relay (86GE) could re-energize the Fault condition.

3.6.1 **IF** Aux Transformer 11 Neutral Overvoltage Relay 86GE Tripped:

☐ a. **Contact** Electrical Maintenance for investigation.

☐ b. **DO NOT Reset** Auxiliary Transformer 11 Neutral Overvoltage Lockout Relay 86GE.

☐ c. **DO NOT Reset** any Generator Lockout Relays, until after the cause of the 86GE Lockout Relay trip is understood.

☐

NOTE:	Primary Lockout Relays 86GA and 86GC cannot be reset until Gen Sync BKR Low Gas Pressure Lockout condition is cleared at 1R101. (AR-106-E10)

3.6.2 **IF** Aux Transformer 11 Neutral Overvoltage Relay 86GE Reset:

a. **Reset** Generator Primary Lockout Relays:

☐ (1) 86GA TRIPPED/RESET (circle as found position)

☐ (2) 86GC TRIPPED/RESET (circle as found position)

3.6.3 **IF** Backup Lockout Relays 86GB and 86GD Tripped,

☐ a. **Reset/Ensure Reset** Breaker Failure Lockout Relay 86BF–190B1 at Panel 0C190B (A13, El 714).

☐

NOTE:	Backup Lockout Relays 86GB and 86GD cannot reset until Breaker Failure Lockout Relay 86BF-190B1 at Panel 0C190B is reset.

b. **Reset** Generator Backup Lockout Relays:

☐ (1) 86GB TRIPPED/RESET (circle as found position)

☐ (2) 86GD TRIPPED/RESET (circle as found position)

3.7 At Generator and Transformer Protection Relays Vertical Board 1C654, **Perform** the following for Stator Coolant Pumps 1P116A(B).

3.7.1 **Circle** as found position for following Primary and Backup Stator Cooling Lockout Relays.

☐ a. 86GI TRIPPED/RESET

☐ b. 86GJ TRIPPED/RESET

3.8 **Perform** one of the following:

☐ 3.8.1 **IF** turbine tripped due to a rub during turbine startup, **WHEN** directed by Shift Supervision, **Return** turbine to 100 RPM IAW OP-193-001, MAIN TURBINE STARTUP **AND** **Continue** with this procedure.

OR

☐ 3.8.2 At ZERO RPM, **Ensure** Turning Gear 1S103 AUTOMATICALLY STARTS and ENGAGES at TURNING GEAR HS-10168.

☐ 3.9 **IF** Main Turbine will be out of service for > 96 hours, **Remove** Turbine from Turning Gear IAW OP-193-001.

☐ 3.10 **WHEN** Plant conditions stabilize, **Refer** to General Operating Procedure for Plant cooldown or startup to place Plant in desired conditions.

3.11 At Turbine EHC Panel 1C663 (Bay E)

☐ 3.11.1 **PRIOR** to Reset, **Record** First Hit: ________

☐ 3.11.2 **Reset** First Hit by **Depressing** the two reset pushbuttons simultaneously.

☐ 3.12 **Circle** relay target numbers operated on Attachment A, Relay Target Status Sheet.

☐

NOTE:	Section 5.2 describes relay functions.

☐ 3.13 **Reset** tripped relay targets.

☐ 3.14 **Ensure** Main Generator shutdown in accordance with OP-198-001, Main Generator System.

☐ 3.15 **IF** Tripped, **Reset** following Primary and Backup Stator Cooling Lockout Relays **AFTER** determination made that Stator Cooling System operation will not adversely impact Main Generator performance.

☐ 3.15.1 **Ensure** selector switch HSS-10186 at Generator Hydrogen and Stator Cooling Water Control Panel 1C125 to 1A-1B/STOP (1B-1A/STOP) position.

☐	NOTE: Stator Coolant Pumps 1P116A and 1P116B will auto start in the next step unless selector switch HSS-10186 is positioned for Stator Cooling Pump Shutdown.

3.15.2 **Reset** Primary and Backup Stator Cooling Lockout Relays:

☐ a. 86GI RESET

☐ b. 86GJ RESET

☐ 3.15.3 **IF** required, **Return** Stator Cooling System to service in accordance with OP-197-001.

3.16 **Forward** completed copy of this procedure to following for review:

3.16.1 Unit Supervisor ____________________ / __________
Signature Date

3.16.2 Shift Manager ____________________ / __________
Signature Date

3.16.3 System Engineering - Switchyards ____________________ / __________
Signature Date

3.16.4 Assistant Operations Manager

3.17 **Forward** reviewed copy of this procedure to: None

4. REFERENCES

4.1 Electrical Schematic E-14 Sh 1 Logic Diagram Unit 1 Protection

4.2 Electrical Schematic E-21 Sh 1 Schematic Meter Relay Diagram Generator Main Unit Aux Trans Unit 1

4.3 Electrical Schematic E-111 Sh 1-4 Schematic Diagram Unit Protection Unit 1

4.4 FSAR Section 15.2.3 Turbine Trip

4.5 EWR 1549711

5. DISCUSSION

This procedure addresses actions for any cause of Main Turbine Trip. For a Main Turbine trip above 26% Reactor power, based on Turbine First Stage Pressure, Stop Valve Closure or Control Valve fast closure causes Reactor Scram. Below this value, Scram is bypassed. Main Turbine Trip can be caused by Main Generator Trip on Load Reject or other electrical fault. These trips protect Main Generator from damage. For Main Turbine Trip accompanied by Reactor Scram, actions of this procedure must be performed in conjunction with ON-100-101, Scram, Scram Imminent.

5.1 The following abnormal conditions or malfunctions produce a Main Turbine trip:

5.1.1 Unit Primary Lockout Relay Trip

5.1.2 Unit Backup Lockout Relay Trip

5.1.3 Low Electro-Hydraulic-Control (EHC) pressure

5.1.4 Thrust Bearing Wear Detector

5.1.5 Low Bearing Oil Pressure

5.1.6 Moisture Separator Drain Tank High Level

5.1.7 Turbine High Vibration

5.1.8 Loss of Stator Cooling

5.1.9 Shaft Lube Oil Pump Low Discharge Pressure

5.1.10 Loss of Primary and Backup Speed Signal

5.1.11 Low Condenser Vacuum

5.1.12 Overspeed

5.1.13 Backup Overspeed

5.1.14 High Reactor Vessel Level

5.1.15 Manual

5.2 Following abnormal conditions or malfunctions produce Main Generator Primary and Backup Lockout causing Main Turbine trip.

PANEL 1C654 TARGET NOs	DESCRIPTION	TRIPS 86G LOCKOUTS
1 & 2/2	MAIN TRF 1A ØA DIFF	A,C
2 & 2/2	MAIN TRF 1A ØA INSTANT	A,C
3 & 2/2	MAIN TRF 1A ØB DIFF	A,C
4 & 2/2	MAIN TRF 1A ØB INSTANT	A,C
5 & 2/2	MAIN TRF 1A ØC DIFF	A,C
6 & 2/2	MAIN TRF 1A ØC INSTANT	A,C
7 & 2/3	MAIN TRF 1B ØA DIFF	A,C
8 & 2/3	MAIN TRF 1B ØA INSTANT	A,C
9 & 2/3	MAIN TRF 1B ØB DIFF	A,C
10 & 2/3	MAIN TRF 1B ØB INSTANT	A,C
11 & 2/3	MAIN TRF 1B ØC DIFF	A,C
12 & 2/3	MAIN TRF 1B ØC INSTANT	A,C
13 & 3/3	AUX TRF 11 ØA DIFF	A,C
14 & 3/3	AUX TRF 11 ØA INSTANT	A,C
15 & 3/3	AUX TRF 11 ØB DIFF	A,C
16 & 3/3	AUX TRF 11 ØB INSTANT	A,C
17 & 3/3	AUX TRF 11 ØC DIFF	A,C
18 & 3/3	AUX TRF 11 ØC INSTANT	A,C
19 & 1/4	ALTERNATOR EXCITER AØ DIFF	A,C
20 & 1/4	ALTERNATOR EXCITER BØ DIFF	A,C
21 & 1/4	ALTERNATOR EXCITER CØ DIFF	A,C
22 & 1/1	GENERATOR ØA DIFF	A,C,I
23 & 1/1	GENERATOR ØB DIFF	A,C,I
24 & 1/1	GENERATOR ØC DIFF	A,C,I
25 & 3/5	GEN NEGATIVE PHASE SEQUENCE	A,C
26 and alarm	GEN VOLTAGE UNBALANCE RELAY & GEN REGULATOR POTENTIAL FUSE BLOWN	NONE
AR106 H06	VOLT/REG/PRIMARY RELAY POTENTIAL FUSE BLOWN	
27 and alarm	GEN VOLTAGE UNBALANCE RELAY & GEN METERING FUSE BLOWN	NONE
AR106 G06	METER/BACKUP RELAY POTENTIAL FUSE BLOWN	
28 & 3/4	TRF 11 GROUND DIFF	A,C
29 & 2/4	GEN PRIMARY ANTIMOTORING	A,C

PANEL 1C654 TARGET NOs	DESCRIPTION	TRIPS 86G LOCKOUTS
30 & 1/3	GEN LOSS OF FIELD	A,C
31, 32, 33, & 1/5	GEN UNDER FREQUENCY	A,C
34 & 1/2	GEN NEUTRAL OVERVOLTAGE	A,C,I
35 & 2/1	230 KV SPAN ØA DIFF	A,C
36 & 2/1	230 KV SPAN ØB DIFF	A,C
37 & 2/1	230 KV SPAN ØC DIFF	A,C
38 & 5/1	UNIT ØA DIFF	B,D
39 & 5/1	UNIT ØA INSTANT	B,D
40 & 5/1	UNIT ØB DIFF	B,D
41 & 5/1	UNIT ØB INSTANT	B,D
42 & 5/1	UNIT ØC DIFF	B,D
43 & 5/1	UNIT ØC INSTANT	B,D
44 & 4/1	GEN OUT OF STEP	B,D
45 & 5/3	AUX TRF 11 ØA OVERCURRENT	B,D
46 & 5/3	AUX TRF 11 ØA INSTANT	B,D
47 & 5/3	AUX TRF 11 ØB OVERCURRENT	B,D
48 & 5/3	AUX TRF 11 ØB INSTANT	B,D
49 & 5/3	AUX TRF 11 ØC OVERCURRENT	B,D
50 & 5/3	AUX TRF 11 ØC INSTANT	B,D
51 & 4/2	GEN GROUND OVERVOLTAGE	B,D,J
52 & 4/3	GEN NEUT OVERVOLTAGE (STARTUP)	B,D,J
53 & 5/2	AUX TRF 11 NEUT OVERVOLTAGE	B,D,E
54 and alarm	GEN VOLTAGE UNBALANCE RELAY & GEN METERING POTENTIAL FUSE BLOWN	NONE
AR106 G06	METER/BACKUP RELAY POTENTIAL FUSE BLOWN	
55 and alarm	GEN VOLTAGE UNBALANCE RELAY & GEN REGULATOR POTENTIAL FUSE BLOWN	NONE
AR106 H06	VOLT/REG/PRIMARY RELAY POTENTIAL FUSE BLOWN	
56 & 5/4	GEN LOSS OF FIELD	B,D
57 & 6/1	GEN BACKUP ANTI-MONITORING	B,D
2/5	GEN OVEREXCITATION (110%)	A,C
3/1	MAIN TRF 1A SUDDEN PRESSURE	A,C
3/2	MAIN TRF 1B SUDDEN PRESSURE	A,C
4/4	GEN OVEREXCITATION (118%)	B,D

PANEL 1C654 TARGET NOs	DESCRIPTION	TRIPS 86G LOCKOUTS
4/5	230 KV SPAN PROTECTION (SEE TARGETS ON 0C190A, 0C190B, 0C192)	B,D
5/5	SPARE	- - - - -
6/2	230 KV SPAN PROTECTION (SEE TARGETS ON 0C190A, 0C190B, 0C192)	A,C
6/3	GENERATOR OVERSPEED	A,C
6/4	BREAKER FAILURE OR OPEN BREAKER FLASHOVER (SEE TARGETS ON 0C190B)	B,D
6/5	GEN SYNC BKR LOSS GAS LOCKOUT	- - - - -

	TARGET NOs		DESCRIPTION	TRIP 86G LOCKOUTS
Panel 0C190A	1 Line Diff 87-190A01			A, B, C, D
	2 Prim Trip Timer 62P-190A01			A, B, C, D
	3 POTT 21B/67NB-190B01			A, B, C, D
Panel 0C190B	4 B.U. Trip Timer 62B-190B01			A, B, C, D
	5 Breaker Failure 50-190B01			A, B, C, D
	6 Breaker Failure 86BF-190B01			A, B, C, D
Panel 0C192	8 DTT1 Trip Receive	21	CARRIER 2 START	A, B, C, D
	9 TCO Trip Receive	67N	CARRIER 2 GROUND TRIP & START	A, B, C, D

5.3 Backup Lockout Relay

5.3.1 Generator Out of Step

5.3.2 Power Directional Relay for Anti-motoring

5.3.3 Loss of Field Relay Backup

5.3.4 Unit Auxiliary Transformer Overcurrent

5.3.5 Unit Auxiliary Transformer Neutral Overvoltage

5.3.6 Generator Neutral Overvoltage

5.3.7 Unit Differential

5.3.8 Generator Ground Overvoltage

5.3.9 Generator Overexcitation

5.3.10 Generator 230KV Circuit Breaker Failure

UNIT 1 RELAY TARGET STATUS SHEET

PANEL 1C654

1	11	21	31	41	51	1/1	2/1	3/1	4/1	5/1	6/1
2	12	22	32	42	52	1/2	2/2	3/2	4/2	5/2	6/2
3	13	23	33	43	53	1/3	2/3	3/3	4/3	5/3	6/3
4	14	24	34	44	54	1/4	2/4	3/4	4/4	5/4	6/4
5	15	25	35	45	55	1/5	2/5	3/5	4/5	5/5	6/5
6	16	26	36	46	56						
7	17	27	37	47	57	86GA	86GB				
8	18	28	38	48		86GC	86GD				
9	19	29	39	49		86GI	86GE				
10	20	30	40	50			86GJ				

______________________ / ____________ / ____________
PCO / Time / Date

Panel 0C190A

1
2

Panel 0C190B

3 4 5 6

Panel 0C192

8 9

______________________ / ____________ / ____________
NPO / Time / Date

PROCEDURE COVER SHEET

PPL SUSQUEHANNA, LLC PROCEDURE	
LEVEL/POWER CONTROL ADHERENCE LEVEL: CONTINUOUS USE	3/13/2014 EO-000-113 Revision 13 Page 1 of 67

QUALITY CLASSIFICATION:	APPROVAL CLASSIFICATION:
(X) QA Program ( ) Non-QA Program	(X) Plant ( ) Non-Plant ( ) Instruction

EFFECTIVE DATE: ____________

PERIODIC REVIEW FREQUENCY: 2 Year

PERIODIC REVIEW DUE DATE: ____________

RECOMMENDED REVIEWS:

Procedure Owner:	EOP Coordinator
Responsible Supervisor:	Supervisor-Operations Engineering
Responsible FUM:	Manager-Nuclear Operations
Responsible Approver:	Manager-Nuclear Operations

1. GENERAL

Provides instructions to control reactor power, RPV water level, and RPV pressure during ATWS events. These three parameters are controlled in a manner which minimize the threat to both core and primary containment integrity. Core integrity is threatened by operation with low RPV water level (near or below TAF), low RPV pressure, and high core inlet subcooling. Primary containment integrity is threatened by excessive thermal loading.

Operation with water level near or below TAF is avoided because in this region level is expected to be difficult to control, there is potential for fuel uncovery and heat-up of the cladding, and only Fuel Zone level indication, which is not calibrated for reactor operation at rated pressure, is available.

At low RPV pressure the reactor is expected to be highly unstable, and power oscillations may lead to fuel damage. Unstable operation with potential for fuel damage can also occur at high levels of core-inlet subcooling even with the reactor at rated pressure.

In the non-isolation ATWS (MSIVs open), containment integrity is threatened by fission power in excess of the turbine bypass system capacity. For the isolation ATWS, fission power in excess of the RHR system capacity presents a threat to containment.

Actions which are designed to limit threat to core and containment include:

- Optional methods of inserting control rods and injection of boron.
- Reducing reactor power and core-inlet subcooling by deliberately lowering RPV water level.
- Assigning a priority to the use of injection systems.
- Delaying RPV cooldown until reactor shutdown has been assured by control rod insertion or injection of Cold Shutdown Boron Weight.
- Avoiding reactor depressurization on PSL and HCTL if initial ATWS power was greater than 5%.
- Raising RPV water level to remix boron.

Generic tracking tables for ES procedures and parameters are on the board to assist the operating crew in tracking parameter trends and ES procedure implementation. These were added to the board as aids, and do not trigger or direct activities.

2. ENTRY CONDITIONS

The entry condition to this flowchart is:

Any entry condition to EO-000-102

AND

More than 1 control rod is > 00

If the scram is unsuccessful upon entry to EO-000-102, a failure-to-scram event (ATWS) has occurred and EO-000-102 step RC-2 directs entry to this flowchart.

TABLE 2
RPV CONTROL ENTRY CONDITIONS

- RPV WATER LVL **< +13"**
- RPV PRESSURE **> 1087 PSIG**
- DW PRESSURE **> 1.72 PSIG**
- EXISTING SCRAM CONDITION AND PWR **> 5%** OR CANNOT BE DETERMINED

EO-000-102 may have been entered due to any one of the four plant parameter entry conditions listed in Table 2, or any one of the procedural entry conditions from Primary Containment Control, Secondary Containment Control, or Radioactivity Release Control.

If while performing EO-000-113 actions, another RPV Control entry condition occurs, it is only necessary to re-enter EO-000-113 at Step LQ-1. During an ATWS event, re-entry to EO-000-102 is not required. If direction to purposely lower level is in progress, re-entry on low RPV water level is not required. Since lowering level is procedurally controlled, this does not represent a change in conditions that needs to be evaluated.

EO-000-113 effects control of RPV water level under conditions when it cannot be determined that control rod insertion alone will assure that the reactor will remain shutdown under all conditions. Actions to control RPV water level in this flowchart differ from those in EO-000-102 in order to address four basic concerns:

1. When boron is injected into the RPV, the systems used for control of RPV water level must be operated to minimize boron dilution and cold water injection, and to promote boron mixing.

2. If the reactor cannot be shut down and suppression pool temperature continues to rise, RPV water level must be controlled not only to cool the core, but also to minimize suppression pool heatup.

3. In the non-isolation ATWS where the feedwater system is available for makeup to the RPV, water level must be controlled to prevent the buildup of high levels of core-inlet subcooling which can drive the reactor into unstable operation.

4. Even if boron has not been injected into the RPV and the reactor is subcritical on control rods under hot conditions, injection of cold water could cause criticality without negative reactivity feedback occurring until reactor power reaches the heating range.

(Reference: PSTG RPV Control Guideline Purpose and Entry Conditions)

3. PROCEDURE

☐

NOTE:	Subsections within Section 3 may be performed in any order as determined by Shift Supervision based on the nature of the event and priority of the operator actions. Steps within each subsection must be completed in the order written.

LQ-1 EXIT RPV CONTROL

When directed to control RPV parameters during ATWS conditions, guidance given in EO-000-113 supersedes instructions given in EO-000-102. It is therefore necessary to exit this procedure.

(Reference: PSTG 1st Override before RC/L-2)

LQ-2 IS MORE THAN 1 CONTROL ROD **> 00**

This step is applicable to all subsequent steps within this flowpath. It is applicable whether the step was entered from above, or transfer resulted in entry below this step. It remains applicable to those steps until flowchart is exited.

The intent of this step is to define the condition that allows EO-000-113 to be exited. EO-000-113 may only be exited if it can be determined the reactor will remain shutdown under all conditions without boron. If reactor shutdown margin can be assured for all conditions by control rod insertion alone, reactor power, RPV level and RPV pressure control actions are continued in EO-000-102.

The most effective way for an Operator to make this determination whether the reactor will remain shutdown under all conditions without boron is by observing that no more than one control rod is greater than position 00. If more than one control rod fails to fully insert, the operator can determine that the reactor will remain shutdown by confirming all control rods are inserted to the MSBWP (Maximum Subcritical Banked Withdrawal Position). MSBWP is the maximum banked control rod position to which all control rods can be withdrawn in addition to the highest worth control rod being fully withdrawn and the reactor remain shut down under all conditions. MSBWP is 00 for Unit 1 and 00 for Unit 2. It is calculated assuming:

1. Most reactive time in core life.
2. No xenon is present in the core.
3. No voids are present in the core.
4. Moderator temperature is 68°F.
5. Highest worth control rod is fully withdrawn.

If all control rods are inserted to the MSBWP, (in addition to the highest worth control rod being fully withdrawn), the reactor will remain shutdown and the intent of this step is met. All other EO steps that also confirm the reactor is shutdown can be answered “NO.”

For control rod configurations where more than one control rod is at a position greater than MSBWP, Reactor Engineering may, through a shutdown margin calculation, determine that the reactor will remain shutdown under all conditions without boron. If Reactor Engineering makes that determination, the condition to exit EO-000-113 is satisfied; the step may be answered “NO” and step LQ-3 may be performed.

(Reference: PSTG override before C5-1; first override before RC/Q-1)

LQ-3 STOP BORON INJECTION
AND
GO TO RPV CONTROL

If it can be determined the reactor will remain shutdown under all conditions without boron, it is appropriate to return to the RPV Control procedure in order to restore and maintain RPV water level in its normal range. Boron injection is terminated and the procedure is exited.

(Reference: PSTG override before C5-1; first override before RC/Q-1)

LQ-4 ENSURE RX MODE SWITCH IN S/D

When the reactor mode switch is placed in the SHUTDOWN position, a diverse and redundant reactor scram signal is generated by the RPS logic. Sets of contacts momentarily open which trip the RPS logic in the same manner as the automatic RPS logic trips.

(Reference: PSTG RC/Q-1)

LQ-5 ENSURE ARI INITIATED

Initiation of ARI provides an independent and redundant means of depressurizing the reactor scram air header and operating the scram discharge volume vent and drain valves.

(Reference: PSTG RC/Q-2)

LQ-6 RECORD INITIAL ATWS PWR:

______________________%

The purpose of this step is to declare and record the "initial ATWS power level" for use in future decisions regarding RPV depressurization.

The 5% determination is based on <u>initial</u> ATWS power, or reactor power before any other steps to reduce reactor power are performed, that is, before boron is injected, reactor recirculation is tripped or RPV water level is lowered. There is no guarantee that RPV water level will remain low or boron will remain in the core following rapid depressurization; therefore, "initial ATWS power level" is recorded. This value will be referenced by steps that direct actions to control power and perform rapid depressurization.

Loss of APRM indication, by itself, does not mean that reactor power cannot be determined. The values of reactor period, steam flow, RPV pressure and pressure trend, number of open SRVs or main turbine BPVs, etc. are valid indications of reactor power level relative to this decision. If reactor power cannot be determined by these methods for any reason, reactor power must be assumed to be above the APRM downscale trip and tripping reactor recirculation pumps is appropriate.

Fuel damaging, large amplitude power excursions may occur at low RPV pressures if reactor power is > 5%. Also, development of the HCTL assumes that the reactor is shutdown. Therefore, depressurization due to HCTL or PSL during an ATWS is restricted to conditions where initial ATWS power level is ≤ 5%. If power level cannot be determined or is oscillating around 5%, it is conservative to declare power > 5%.

Initial ATWS power does not change on re-entry to this procedure.

(Reference: PSTG first override before RC/P-2, SP/T-3, PC/P-3)

LQ-7 MONITOR AND CONTROL LQ/Q LQ/L AND LQ/P CONCURRENTLY

The symptomatic approach to emergency response, upon which the EOPs are based, precludes being able to establish in advance a priority for executing any of the parallel action paths of Level/Power control. Rather, current values and trends of parameters and the status of plant systems and equipment dictate the relative importance of individual Level/Power Control steps and the relative priority with which they should be accomplished.

(Reference: PSTG RC-1 Monitor and Control Concurrently)

LQ/Q - Reactor Power Control

LQ/Q-1 IS INITIAL ATWS PWR **> 5%**
OR CANNOT BE DETERMINED

An affirmative answer to this question results in immediate boron injection.

When scram and ARI have failed, initial ATWS power must be assessed to determine if immediate boron injection is required. If initial ATWS power was greater than 5%, then a relatively large number of control rods have failed to insert. The seriousness of this condition requires immediate injection of boron to positively terminate the ATWS event.

If power is oscillating around 5%, it is conservative to declare power is > 5%.

Early boron injection has the following benefits:

- Stop or prevent large-magnitude Limit Cycle Oscillations which can lead to core damage.
- Limit fuel damage from uneven flux patterns that could result from partial rod inserts.
- Protect the primary containment from excessive heat input.

(Reference: PSTG step RC/Q-2)

LQ/Q-2 **BEFORE** SUPP POOL TEMP REACHES **150°F**

GO TO LQ/Q-3

The intent of this step is to ensure, for a low power ATWS, that boron is injected early enough to minimize the challenge to primary containment integrity.

If boron injection was not required due to initial power level and conditions have since changed, this step ensures boron initiation takes place early enough to minimize the challenge to primary containment integrity. If boron injection is initiated before suppression pool temperature reaches 150°F, emergency RPV depressurization due to HCTL may be precluded for initial ATWS power levels ≤ 5% for an isolated RPV with suppression pool cooling in service. At higher power levels, the HCTL will be exceeded.

This step will only be required if initial ATWS power was ≤ 5%. If initial ATWS power was > 5%, boron injection would have been required per steps LQ/Q-3 or LQ/Q-4.

The logic term "BEFORE" permits injection of boron at any temperature up to the suppression pool temperature of 150°F. If suppression pool temperature exceeds 150°F, the action of this step is still required.

Level/Power Control is entered from RPV Control if more than one control rod is > 00. If, however, a scram condition exists, reactor power is ≤ 5%, and no other RPV control entry condition exists, there is no permission to enter Level/Power Control from the EOPs. To authorize use of alternate methods of control rod insertion in this situation, entry to Level/Power Control at this step is directed from ON-100-101 (ON-200-101) Scram, Scram Imminent. However, if any entry condition occurs while inserting control rods, EO-000-113 must be entered at LQ-1.

(Reference: PSTG step RC/Q-6)

LQ/Q-3 INJECT SBLC
AND
INHIBIT ADS, IF NOT INITIATED

ADS initiation may result in the injection of large amounts of relatively cold, unborated water from low pressure injection systems. With the reactor either critical or shutdown on boron, the positive reactivity addition due to boron dilution and temperature reduction through the injection of cold water may result in a reactor power excursion large enough to cause substantial core damage. Preventing ADS is therefore appropriate whenever boron injection is required.

However, if ADS has already initiated prior to performing this step, it is not inhibited. Actions to limit injection flow rates to maintain RPV level or flooded conditions will already be in progress, and the loss of boron will be minimized. Additionally, inhibiting ADS if already initiated will conflict with direction provided by other Emergency Procedures.

Instructions for inhibiting ADS are located in OP-183-001 (OP-283-001), Automatic Depressurization System & Safety/Relief Valves.

(Reference: PSTG step RC/Q-2 and second override before RC/Q-1)

LQ/Q-4 **IF** BORON CANNOT BE INJECTED WITH SBLC

INJECT BORON WITH RCIC
IAW ES-150-002 (ES-250-002)

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until the flowchart is exited.

If, at any time, it is determined that boron is not entering RPV, this step permits the use of the alternate injection method. ES-150-002 (ES-250-002), Boron Injection Using RCIC System, provides instructions for this alternate injection method.

(Reference: PSTG second override before RC/Q-1)

LQ/Q-5 ENSURE:

RWCU ISOLATED
<u>OR</u>
FILTER/DEMINS BYPASSED AND ISOLATED

Isolation of RWCU is desirable when boron is injected into the RPV because the demineralizers remove boron from the reactor coolant. However, RWCU may be restored and used to augment RPV pressure control IAW ES-161-002 (ES-261-002), RWCU Recirculation Mode Bypassing Interlocks.

For this condition, and when RWCU has failed to automatically isolate, operator action is to isolate the system.

(Reference: PSTG second override before RC/Q-1)

LQ/Q-6 ENSURE SRM'S AND IRM'S INSERTED

If all but a few control rods are inserted, reactor power will soon be downscale on APRMs and other means must be used to observe decreasing reactor power. Source range and intermediate range detectors are inserted to fulfill need for low power indication.

Inserting SRMs and IRMs is required regardless of reactor power, since they will function long enough to achieve reactor shutdown.

(Reference: PSTG step RC/Q-2)

LQ/Q-7 **IF** ANY STEAM TURBINE ON-LINE

ENSURE RECIRC RUN BACK TO MIN

An immediate and rapid reactor power reduction may be achieved by reducing reactor coolant recirculation flow. The most rapid flow rate reduction and, consequently, the most rapid power reduction, is achieved by tripping the recirculation pumps. However, if the recirculation pump trip is initiated from a high power level, the resulting rapid changes in steam flow, RPV pressure, and RPV water level may cause a trip of one or more of the following steam-driven turbines: main turbine-generator, HPCI, RCIC and feedwater. If the main turbine-generator trips and reactor power exceeds the turbine bypass valve capacity, RPV pressure will increase until one or more SRVs open. Heatup of the suppression pool then begins and boron injection may ultimately be required. If HPCI, RCIC, or feedwater trip, the resultant RPV water level transient may require emergency depressurization of the RPV and operation of less desirable RPV injection sources.

To effect a more controlled reduction in reactor power and thereby avoid main turbine-generator and RPV injection system trips and their associated complications, a recirculation flow runback to minimum (≤ 30% speed) is performed prior to tripping the recirculation pumps. The word "ensure" recognizes that an automatic runback may have already occurred. If it has, no other action is required. If an automatic runback to the #1 limiter has not occurred, runback to minimum is accomplished by lowering the demand on the individual controllers to minimum.

(Reference: PSTG step RC/Q-3)

LQ/Q-8 **IF** INITIAL ATWS PWR **> 5%**
OR CANNOT BE DETERMINED

TRIP BOTH RECIRC PUMPS

A recirculation pump trip from high power provides a rapid reduction in power. If initial ATWS power was below the APRM downscale trip setpoint (5%), tripping the recirculation pumps results in little reduction in reactor power since power is already near the decay heat level. Diverse indications should be used to evaluate reactor power level.

3-D model tests have demonstrated that forced recirculation need not be maintained if boron injection is later required. Natural circulation flow provides adequate boron mixing.

(Reference: PSTG step RC/Q-4)

LQ/Q-9 MAXIMIZE CRD

This step is provided to increase cooling water differential pressure to maximum which may cause the control rods to drift inward and shutdown the reactor. Maximizing the unit's CRD system is a relatively fast method for inserting negative reactivity. If the CRD system is not in service additional operator actions to restore the system is provided in step CR-4.

(Reference: PSTG step RC/Q-7.2)

LQ/Q-10 GO TO CONTROL ROD INSERTION

This step divides reactor power control into two flowpaths. Control rod insertion methods are given on sheet 2 of EO-000-113, and boron injection instructions are given in the Level/Power Control steps. Both flowpaths are performed concurrently as indicated by the exit-and-perform-concurrently arrow associated with this step.

The symptom based approach to emergency response prevents assignment of priorities to either of these flowpaths since the time at which boron must be injected into the RPV is dependent on the magnitude of the ATWS event.

This is a critical step if SLCS fails and the MSIVs are closed because primary containment venting can still be avoided if manual control rod insertion is initiated promptly. For an MSIV-closure ATWS with complete failure to scram and complete failure of SLCS, reactor power can be reduced to within the capacity of the RHR system by individually driving control rods with the CRD system.

(Reference: PSTG Execute Steps RC/Q-6 and RC/Q-7 Concurrently)

LQ/Q-11 **IF** SBLC TANK LVL DROPS TO **0 GAL**

STOP BORON INJECTION

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until the flowchart is exited.

Intent of this step is to preserve availability of the SBLC System should it be required for subsequent injection.

A tank level of 0 gallons ensures SBLC suction piping remains covered, so pump functionally is preserved. OP-153-001, (OP-253-001) and (ES-150-002, ES-250-002) direct opening of heater supply breaker. The words "stop boron injection" are intentionally used rather than "trip SBLC pumps" to recognize that either SBLC pumps or RCIC, if aligned for alternate boron injection, may be accomplishing boron injection.

An indicated tank level of 0 gallons means that a volume of boron greater than the Cold Shutdown Boron Weight (CSBW) 1350 gallons of 10% concentration, has been injected. CSBW is defined to the least amount of soluble boron which , if injected into the RPV and mixed uniformly, will maintain the reactor shutdown under all conditions.

If the SBLC system functions are designed and SBLC tank level starts at greater than or equal to the minimum required by Technical Specifications, a volume greater than CSBW will be injected when tank level decreases to 0 gallons.

CSBW is determined assuming:

1. All rods are full out.
2. Core is at most reactive exposure.
3. No Xe in core.
4. No voids in core.
5. Water temperature 68°F.
6. Shutdown cooling and RWCU is in service.
7. Reactor level is at +54".

(Reference: PSTG second override before RC/Q-1)

LQ/L - RPV Level Control

LQ/L-1 ENSURE ALL:

- ISOLATIONS
- ECCS INITIATIONS
- DG'S START

Intent of this step is to quickly assess plant status and to determine proper automatic operation of plant equipment occurred.

SPDS may be used to determine Containment Isolations.

"Ensure" means take manual action for any automatic operation that should have occurred but did not.

Diesel generator initiation assures that there is redundant source of electrical power available for RPV water level control. A loaded diesel generator must be supplied with adequate ESW flow within 4½ minutes. This limit is extended to 8 minutes if diesel generator is running unloaded. Adequate ESW flow is described in OP-054-001, Emergency Service Water System. Instructions on how to manually shut-down a running diesel generator are located in OP-024-001.

Instructions to bypass interlocks IAW ES procedures always supersede this step's requirements.

(Reference: PSTG RC/L-1)

LQ/L-2 **IF** WATER LVL CANNOT BE DETERMINED

GO TO RPV FLOODING

CAUTION

1 RPV WATER LVL INSTR MAY BE USED WHEN DETERMINED USABLE IAW ON-145-004 (ON-245-004)
OR
IT READS WITHIN BAND (INCHES):

SHUTDOWN	50	500
UPSET	45	180
EXTENDED	-85	180
NARROW	2	60
WIDE		
NO FIRE ON 749	-145	60
X218_Z7 (X232_Z5) ALARM	-125	60
FUEL ZONE	-290	-110

This step is applicable to all subsequent steps within this flowpath. It is applicable whether the step was entered from above, or transfer resulted in entry below this step. It remains applicable to those steps until flowchart is exited.

As documented in RC/L-2, off-scale RPV water level indication alone is not an indication that "RPV water level cannot be determined". The decision is made based on knowing whether or not level can be determined. If level indication is believed to be erroneous or unbelievable, entry to EO-000-114, RPV FLOODING, is warranted.

If at any time during the performance of this procedure, RPV water level cannot be determined, RPV Flooding is required.

Caution 1 is applicable throughout this flowpath.

Factors inherent in the design of the RPV water level measurement systems make the validity of information supplied by these instruments dependent on the value of RPV pressure, drywell temperature, and reactor building temperature. The above caution provides the minimum usable water levels when drywell and reactor building temperatures near these instrument reference leg vertical runs are at their bounding values. ON-145-004 (ON-245-004), RPV Water Level Anomaly, identifies the specific conditions in which the instruments are usable. (See EO-000-100 for discussion of CAUTION 1.)

(Reference: PSTG override before C5-1)

LQ/L-3 RESET MAIN GEN LOCKOUTS

The intent of this step is to prevent an inappropriate auxiliary bus load shed.

Since spurious operation of the load shed scheme will cause an undesirable loss of loads such as condensate pumps, service water pumps, circulating water pumps, auxiliary boilers and turbine building heating load centers, main generator lockouts are reset if RPV level can be maintained above -129".

(Reference: PSTG C5-2)

LQ/L-4 IS INITIAL ATWS PWR **> 5%** OR CANNOT BE DETERMINED

Answer to this question will determine whether RPV water level should be lowered, or whether it should be maintained in the normal operating band.

(Reference: PSTG step C5-3)

LQ/L-5 INHIBIT ADS, IF NOT INITIATED

Actions in this flowpath lower RPV water level near the automatic initiation setpoint of ADS. Rapid and uncontrolled injection of relatively cold, unborated water from low pressure injection systems may occur as RPV pressure decreases below the shutoff heads of these pumps. This would quickly dilute boron concentration in the core and reduce reactor coolant temperature. When the reactor is not shutdown, or when the shutdown margin is small, sufficient positive reactivity might be added in this way to cause a reactor power excursion. Therefore, ADS initiation is purposely prevented as one of the first actions. When required to initiate ADS, explicit direction to depressurize the RPV is provided in the EOPs.

However, if ADS has already initiated prior to performing this step, it is not inhibited. Actions to limit injection flow rates to maintain RPV level or flooded conditions will already be in progress, and the loss of boron will be minimized. Additionally, inhibiting ADS if already initiated will conflict with direction provided by other Emergency Procedures. (Reference: PSTG C5-3)

LQ/L-6 USING TABLE **15** SYSTEMS
IRRESPECTIVE OF LVL AND PWR OSCILLATIONS

THROTTLE INJECTION
AND
PREVENT INJECTION

UNTIL LVL BETWEEN **-60"** AND **-110"**

The purpose of this step is to uncover the feedwater spargers sufficiently to reduce core inlet subcooling.

A General Electric Company study (NEDO-32047) indicates that the major threat to fuel integrity from ATWS is caused by large-amplitude power/flow instabilities. These density-wave instabilities will most likely develop in the non-isolation ATWS where the feedwater system is still available for makeup to the RPV. In this event, the feedwater system maintains normal water level, but feedwater heating is lost due to tripping of the turbine. Without preheating of the feedwater, high levels of core-inlet subcooling develop which can drive the reactor into a highly unstable mode of operation. General Electric calculations indicate that power oscillations become large enough to cause melting of fuel in high-power bundles.

In the non-isolation ATWS event, clad damage due to unstable operation can be prevented or at least mitigated by promptly reducing feedwater flow so that level is lowered below the feedwater spargers. Once level drops below the sparger nozzles, which are located at -24", the feedwater is sprayed into a region occupied by saturated steam. Steam will then condense on the injected feedwater, and the coolant will be heated as it falls to the liquid surface within the downcomer. Heating of the feedwater by steam condensation limits the buildup of core inlet subcooling and can prevent the onset of severe power/flow instabilities.

Although the purpose of this step is to uncover the feedwater spargers sufficiently to reduce inlet subcooling, water level will eventually be maintained between -161" and -60" per step LQ/L-13 to effect a reduction in reactor power, thereby reducing heat rate to the containment.

TABLE 15
SYSTEMS

- SLC
- FW
- COND
- CRD MAXIMIZED AS NECESSARY
- RCIC
  WITH SUCTION FROM CST IF AVAILABLE
- HPCI
  WITH SUCTION FROM CST IF AVAILABLE
- LPCI WITH INJECTION THRU HX ASAP

<u>CAUTIONS</u>

140 OPERATION OF HPCI OR RCIC
WITH SUCTION FROM SUPP POOL
AND SUPP POOL TEMP **> 140°F**
MAY RESULT IN EQUIPMENT DAMAGE.

50 ELEVATED SUPP CHMBR PRESS
MAY TRIP RCIC ON HIGH EXHAUST PRESS.

11 HPCI INJECTIONS CAUSE THERMAL SHOCK TO RPV
AT FEEDWATER PENETRATIONS.

VL OPERATION OF RHR
OR CORE SPRAY WITH SUCTION FROM SUPP POOL
AND PUMP FLOW BELOW VL
MAY RESULT IN EQUIPMENT DAMAGE.

The preferred systems for use in controlling RPV water level are those Table 15 Systems which inject into the feedwater sparger or outside the core shroud. These are used because cold water is preheated by steam and the flow path outside the core shroud mixes the relatively cold injected water with the warmer water in the lower plenum prior to reaching the core. Injection from SLC and CRD are always permitted during ATWS events. The operator throttles existing injection except CRD and SLC and prevents unwanted injection as necessary to decrease level.

Preventing injection such as RCIC and HPCI as level drops below -30" and -38" respectively may be required when feedwater is available.

LPCI is aligned with injection through the heat exchanger as soon as possible. The benefit of injecting through the heat exchanger is that it results in containment heat removal. There is very little increase in core inlet subcooling with the heat exchangers aligned, so the risk of unstable operation is not increased appreciably.

(Reference: PSTG C5-3)

LQ/L-7 BYPASS RCIC LOW PRESS ISO AS NECESSARY IAW ES-150-001 (ES-250-001)

OPERATE RCIC AS NECESSARY IAW ES-150-003 (ES-250-003)

SUPPLYING 125VDC LOADS AS NECESSARY IAW ES-002-001

When necessary, low RPV pressure isolation interlocks are defeated for RCIC because some injection into the RPV can still be sustained above the turbine stall pressure. However, the higher steam demand required for HPCI operation prevents sustained operation at low pressure.

During a loss of AC power to 125VDC battery chargers 1D613, 2D613, 1D623 and/or 2D623, long term availability of HPCI, RCIC and/or ADS beyond 4 hours requires use of the portable generator (0G503) to maintain 125VDC control power.

(Reference: PSTG C5-3)

LQ/L-8 **IF** ANY MSL IS NOT ISOLATED

BYPASS MSIV AND CIG INTERLOCKS

RPV water level is lowered to near the MSIV isolation set point, so it is appropriate to prevent MSIV isolation to preserve the Main condenser as a heat sink as long as possible.

CIG isolation interlocks are bypassed to ensure an uninterrupted pneumatic supply pressure to hold open the MSIVs. OP-184-001 (OP-284-001), Main Steam System, provides instructions for bypassing the MSIV and CIG interlocks.

(Reference: PSTG C5-3)

CAUTION

LOSS OF I-A
CAUSES LOSS OF NORMAL FW INJECTION

Purpose of this caution is to advise the operator of the undesirable results from failure to promptly recover from the loss of instrument air. It is recognized that instrument air can be lost for many reasons, but in Level/Power Control, the probability of losing instrument air is increased since level is intentionally lowered close to -129" and containment pressure is likely increasing close to 1.72 psig.

(Reference: PSTG Caution 9)

LQ/L-9 **IF** PC PRESS CANNOT BE MAINTAINED **< 65 PSIG**

STOP RPV INJECTION
FROM SOURCES EXTERNAL TO PC
EXCEPT FROM:

- SYSTEMS NEEDED FOR ADEQUATE CORE COOLING
- SBLC
- CRD
- RCIC

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

If an unisolable break exists inside the drywell, continued RPV injection from sources external to the primary containment will increase primary containment water level after RPV water level reaches the elevation of the break. The increasing primary containment water level will, in turn, increase the hydrostatic pressure over submerged components and compress the primary containment airspace, thereby increasing the atmospheric pressure.

Above 65 psig, primary containment vent valve operability is not assured. Vent valves are located in both the drywell and suppression chamber, therefore, primary containment pressure must be monitored in both compartments. If primary containment pressure, either drywell or suppression chamber, cannot be maintained below 65 psig, injection into the RPV from sources external to primary containment is terminated unless injection is needed for adequate core cooling. If adequate core cooling cannot be assured, injection from sources external to the primary containment is continued.

This override terminates only injection "from sources external to the primary containment." Injection from the suppression pool may continue. Injection from boron injection systems and CRD is not terminated because operation of these systems may be needed to establish and maintain the reactor shutdown.

(Reference: PSTG override before C5-1)

LQ/L-10 **IF** RAPID DEPRESS REQ'D

GO TO LQ/L-18

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

The steps which follow specify the use of various systems to control RPV water level. If rapid depressurization of the RPV is required, these systems must be operated to minimize the potential for rapid injection of cold, unborated water into the core region as RPV pressure decreases below pump shutoff head. Steps following LQ/L-18 provide appropriate instructions for controlling injection systems in this manner.

(Reference: PSTG 1st override before C5-5)

LQ/L-11 IS INITIAL ATWS PWR **> 5%** OR CANNOT BE DETERMINED

Answer to this question determines which water level control band will be prescribed.

(Reference: PSTG step C5-5)

CAUTION

A RAPID INCREASE IN INJECTION
MAY INDUCE LARGE PWR EXCURSION
AND SUBSTANTIAL CORE DAMAGE.

This caution is applicable throughout this flowpath.

This Caution highlights the potential for large reactor power excursions and subsequent core damage from rapid injection of cold, unborated water when injection is continued, per the next step, to maintain RPV water level within the prescribed band.

(Reference: PSTG Caution 6)

LQ/L-12 MAINTAIN LVL BETWEEN **-129" AND +54"**
USING TABLE **15** SYSTEMS
BYPASSING RCIC LOW PRESS ISO AS NECESSARY IAW ES-150-001 (ES-250-001)

OPERATE RCIC AS NECESSARY IAW ES-150-003 (ES-250-003).

SUPPLYING 125VDC LOADS AS NECESSARY IAW ES-002-001.

A wide water level control band is given to afford maximum flexibility in controlling water level.

If water level had been controlled in the normal operating range and initial ATWS power level was ≤ 5%, the wide band allows level to be maintained in the normal band of +13" to +54".

If the initiating event was a low RPV water level condition, it cannot be known if the low water level had been the reason that initial power level was ≤ 5%. The wide water level control band allows level to be controlled at the level it bottomed out at, but above -129". This lower limit is intended to remove any incentive to recover level to the normal operating band if it is possible that low water level had suppressed the initial ATWS power level.

Table 15 systems prescribed here are the same systems prescribed in LQ/L-6. Refer to that step for a complete explanation of the systems and cautions applicable to their use.

The basis for defeating the RCIC system interlocks and supplying 125VDC loads is given in step LQ/L-7.

(Reference: PSTG C5-5)

<u>CAUTION</u>

A RAPID INCREASE IN INJECTION
MAY INDUCE LARGE PWR EXCURSION
AND SUBSTANTIAL CORE DAMAGE.

This caution is applicable throughout this flowpath.

This Caution highlights the potential for large reactor power excursions and subsequent core damage from rapid injection of cold, unborated water when injection is continued, per the next step, to maintain RPV water level within the prescribed band.

(Reference: PSTG Caution 6)

LQ/L-13 MAINTAIN LVL BETWEEN **-60" AND -161"**
USING TABLE **15** SYSTEMS
BYPASSING RCIC LOW PRESS ISO AS NECESSARY IAW ES-150-001 (ES-250-001)

OPERATE RCIC AS NECESSARY IAW ES-150-003 (ES-250-003).

SUPPLYING 125VDC LOADS AS NECESSARY IAW ES-002-001.

This step identifies the widest, acceptable water level control band. Although level fluctuations within this band are safe, it is very desirable to maintain level within the more restrictive target area of -110" to -60". The target area and expanded band are shown in Figure 8, Water Level Operation Guidance. The intent of this step is to remain within the target band at all times unless prohibited by system perturbations, and remain within the expanded band at all times.

Operation outside the target area has the following disadvantages:

The basis for an upper level of -60" is given in LQ/L-6.

A lower level of -110" is specified for the following reasons:

1. Provides a margin for core coverage.

2. Avoids operation near TAF where core power is more responsive to RPV pressure fluctuations.

3. Makes level control easier by maintaining level above the narrow region of the downcomer.

   Below -110" the downcomer free area reduces from 300 ft^2 to 88 ft^2 resulting in increased magnitude of indicated level oscillations.

4. Maintains sufficient core flow to carry liquid boron from lower plenum upward into the core.

   As level is decreased below -110", boron mixing efficiency is reduced because the natural circulation flow rate through the jet pumps is reduced and not as efficient at carrying the injected boron from the lower plenum upward into the core.

   At very low downcomer water levels near or below top of active fuel, there is little water available in the region above the jet pump throat for mixing with boron injected via RCIC. In this situation, there is concern that boron may accumulate in the stagnant region of the downcomer which is below the jet pump throat.

5. Water level can be determined from wide range level instrumentation.

6. Avoids MSIV isolation setpoint of -129".

CAUTION

12 PROLONGED OPERATION IN YELLOW AREA OF FIG **8** MAY RESULT IN ADDITIONAL CONTAINMENT LOADING AND PWR INSTABILITIES.

This caution is added to alert the operator of the undesirable affects of operating outside the target band of -110" to -60". Operation outside the target band can result in increased power level, increased containment loading, and the potential for power oscillations.

Table 15 systems prescribed here are the same systems prescribed in LQ/L-6. Refer to that step for a complete explanation of the systems and cautions applicable to their use.

If this step is entered following Rapid Depressurization and systems listed in LQ/L-21 are being used, their continued use is allowed.

The basis for defeating the RCIC system interlocks and supplying 125VDC loads is given in Step LQ/L-7.

(Reference: PSTG C5-5)

LQ/L-14 **IF** LVL CANNOT BE RESTORED AND MAINTAINED **> -161"**

1 GO TO LQ/L-18
2 GO TO RAPID DEPRESS

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

The intent of this step is to specify the limit when rapid depressurization of the RPV is appropriate despite the possibility of creating power/flow instabilities at low pressure.

Depressurizing a critical core results in destabilizing effects and has a potential to cause core damage. The initial influence of reactor depressurization is stabilizing since the additional flashing of liquid phase required for depressurization introduces excess voids in the reactor core which can essentially terminate the fission process if the rate of depressurization is high enough. Once the depressurization is complete, however, the result is the immediate initiation of power excursions. Core damage is expected to occur from high clad stresses induced by: temperature excursions above the rewet temperature, PCI, cyclic fatigue, burnout or having the fuel enthalpy exceed the cladding failure threshold.

Core destabilizing effects are mitigated by boron injection. Therefore, the decision to perform rapid depressurization must not be made too early since an earlier RD results in less boron being present in the RPV when the RD is taken. While the goal is to perform the RD as close to -161" as possible, the wording of the step gives flexibility to perform the action after reaching -161".

The determination that level cannot be restored and maintained > -161" must be based upon:

- availability of high pressure injection systems, and
- present level trend

For example, level may have dropped below -161", but the level trend shows that it will be able to be recovered above the limit. In this case, rapid depressurization should be deferred.

Controlling reactor pressure, power and level with condensate and SRVs at 500 psig is difficult because all 3 parameters affect each other. Therefore, rapid depressurization is recommended when high-pressure injection cannot be obtained.

(Reference: PSTG C5-5 and C5-6)

LQ/L-15 **IF** PWR COMMENCES AND CONTINUES TO RAISE

GO TO LQ/L-5

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

If reactor power commences and continues to increase as RPV water level is raised, the amount of boron required to shut down the reactor (HSBW) has not reached the core. The return to step LQ/L-5 will again require that RPV water level be lowered to suppress reactor power while additional actions to shut down the reactor proceed.

As injection into the RPV is initially increased to raise RPV water level, a small transient increase in reactor power is expected as natural circulation core flow is re-established. This power increase will be reversed as boron is mixed and carried from the lower plenum up into the core region. The wording in the above step, "...commences and continues to increase...," denotes only a sustained increase in reactor power indicative of insufficient boron in the core.

(Reference: PSTG override preceding C5-6)

LQ/L-16 **WHEN** HOT S/D BORON WEIGHT IS INJECTED
TANK LVL **Table 19**.

RESTORE AND MAINTAIN LVL BETWEEN
+13" AND **+54"**

Hot Shutdown Boron Weight (HSBW) is defined to be the weight of soluble boron which, if injected into the RPV and uniformly mixed, will maintain the reactor shutdown under hot standby conditions. It assures the reactor will be shutdown irrespective of control rod position when RPV water level is raised to uniformly mix the injected boron.

When HSBW has been injected, RPV water level is restored to and maintained within the normal operating range. If SLC system functions as designed and SLC tank level starts at or greater than the minimum required by Technical Specifications, then HSBW will be injected when tank level decreases to Table 19 gallons. The tank concentration is assumed to be at the Technical Specification minimum concentration. This takes about 25 minutes. As RPV water level is increased, natural circulation flow is increased and the boron which may have accumulated in the lower plenum is quickly mixed and distributed throughout the core region. Delays in raising RPV water level increases the time the core may be at power, and may result in a greater challenge to containment.

The HSBW is determined assuming:

1. Control rods withdrawn to maximum rod block limit.
2. Core is at most reactive exposure.
3. Hot full power Xe.
4. No voids in core.
5. RPV water temperature is the saturation temperature for the lowest lifting SRV setpoint pressure.
6. Water level is at the high level trip setpoint (+54 in.).
7. No shutdown cooling is in service.
8. RWCU is in service.

The intent of this step is to wait until HSBW is injected before raising RPV level. In those circumstances when boron does not reach the RPV and is lost for this purpose, this step requires that HSBW be injected even if this requires refilling SLC tank with new boron.

RPV water level is restored and maintained with the systems which were effectively providing RPV injection in the previous steps of this flowchart. For example: if RPV water level could not be restored until Core Spray was placed in service in step LQ/L-21, the continued use of Core Spray is appropriate in this step.

TABLE 19
HSBW INJECTED

INITIAL TANK VOLUME	FINAL TANK VOLUME
2000	1150
1900	1060
1800	975
1700	891
1600	806
1500	722
1400	637

(Reference: PSTG C5-6)

LQ/L-17 **WHEN** LVL CANNOT BE RESTORED AND MAINTAINED **> +13"**

MAINTAIN LVL **> -161"**

If RPV water level cannot be maintained in the normal range, an alternate control band with a lower limit is defined. The widened RPV water level control band provides added operational flexibility while still assuring adequate core cooling through core submergence. It makes available additional time to place in service those injection systems not yet operating. The widened band also accommodates controlling RPV water level, without employing additional contingency actions, for a condition where a break exists between the low RPV water level scram setpoint and TAF where injection flow cannot overcome break flow.

(Reference: PSTG C5-6)

LQ/L-18 STOP INJECTION
AND
PREVENT INJECTION

FROM:

- FW
- COND
- LPCI
- CORE SPRAY
- HPCI

Intent of this step is to prevent uncontrolled injection of large amounts of cold water as RPV pressure decreases below the shutoff head of operating system pumps.

For feedwater, this would mean tripping feedwater pumps or closing their discharge valves.

For condensate, this would mean preventing injection below RPV pressure of 700 psig using values or if needed, tripping condensate pumps.

For LPCI and Core Spray, this would require preventing injection in accordance with overriding section of their respective operating procedures.

For HPCI, this would require preventing injection in accordance with TERMINATE HPCI DURING AN ATWS section of HPCI operating procedures.

Injection from boron injection systems and CRD is not terminated because operation of these systems may be needed to establish and maintain reactor shutdown. Further, the injection flowrates from these systems are small compared to those of the other Table 15 systems. Injection from RCIC is not stopped because the injection flowrate from this system is small.

(Reference: PSTG C5-5.1)

CAUTION

A RAPID INCREASE IN INJECTION
MAY INDUCE LARGE PWR EXCURSION
AND SUBSTANTIAL CORE DAMAGE.

This caution is applicable throughout this flowpath.

The applicability of this Caution highlights the potential for large reactor power excursions and subsequent core damage from rapid injection of cold, unborated water when injection is commenced after depressurization is initiated.

(Reference: PSTG Caution 6)

LQ/L-19 **WHEN** RAPID DEPRESS HAS BEEN INITIATED

COMMENCE AND IRRESPECTIVE
OF VORTEX LIMITS
SLOWLY RAISE INJECTION
TO RESTORE AND MAINTAIN
LVL BETWEEN **-60"** AND **-161"**

USING TABLE **15** SYSTEMS

Intent of this step is to re-establish injection in a controlled manner after rapid depressurization has been initiated.

"Initiated" is defined as ADS valves have been opened, either automatically or manually. It is not intended that the depressurization process be completed, only initiated. As long as any number of ADS valves have been opened in response to an automatic signal or manual action, this condition is met and injection may be slowly re-established.

Steps LQ/L-6, LQ/L-12 and LQ/L-13 permit use of these same Table 15 systems. Refer to RC/L-6 for a complete explanation of the systems and cautions applicable to their use. Here, however, an explicit direction is given to commence injection "irrespective of vortex limits," since restoration of adequate core cooling takes precedence over adherence to normal operating limits. The undesirable consequences of uncovering the reactor core outweigh the risk of equipment damage which could result if vortex limits are exceeded. Immediate and catastrophic pump failure is not expected to occur should operation beyond these limits be required.

A specific order governing the priority over use of these systems cannot be predetermined as it will depend greatly on plant conditions. Consider the following factors to determine order:

- Injection through FW spargers (preferred)
- System availability
- Time and manpower required to operate system
- System throttling capability/control
- Water quality

Re-establishing injection into the RPV is required in order to adequately cool the core and to make up the mass of steam being rejected through open SRVs. Since the reactor may become critical during this evolution, injection into the RPV is increased slowly to preclude the possibility of large power excursions caused by rapid injection of cold unborated water.

The level control band of -60" to -161" is the widest, acceptable water level control band. Although level fluctuations within this band are safe, it is very desirable to maintain level within the more restrictive target area of -110" to -60". The target area and expanded band are shown in Figure 8, Water Level Operation Guidance. Operation outside of the target area has numerous disadvantages which are described in LQ/L-13. The intent of this step is to restore and maintain level within the target band at all times unless prohibited by system perturbations or inadequate vessel injection, and remain within the expanded band at all times.

CAUTION

12 PROLONGED OPERATION IN YELLOW AREA OF FIG **8**
MAY RESULT IN ADDITIONAL CONTAINMENT
LOADING AND PWR INSTABILITIES.

This caution is added to alert the operator of the undesirable affects of operating outside the target band of -110" to -60". Operation outside the target band can result in increased power level, increased containment loading, and the potential for power oscillations.

(Reference: PSTG C5-5.2)

LQ/L-20 CAN LVL BE RESTORED AND
MAINTAINED **> -161"**

This decision tests the success of the previous actions to maintain the core submerged.

(Reference: PSTG C5-5.2)

CAUTION

A RAPID INCREASE IN INJECTION
MAY INDUCE LARGE PWR EXCURSION
AND SUBSTANTIAL CORE DAMAGE.

This caution is applicable throughout this flowpath.

The applicability of this Caution highlights the potential for large reactor power excursions and subsequent core damage from rapid injection of cold, unborated water when injection is commenced.

(Reference: PSTG Caution 6)

LQ/L-21 COMMENCE AND IRRESPECTIVE OF VORTEX LIMITS
SLOWLY RAISE INJECTION TO
RESTORE AND MAINTAIN LVL **> -161"**
USING ANY:

- CORE SPRAY
- RHRSW X-TIE FROM EITHER UNIT
- FIRE SYSTEM IAW ES-013-001
- FIRE SYSTEM THROUGH RHR A KEEPFILL
- CRD X-TIE TO OTHER UNIT
- ECCS KEEP-FILL
- RHR SDC SUCTION FILL
- PORTABLE PUMP TRUCK IAW DC-B5B-102 (DC-B5B-202)

Same as LQ/L-19, vortex limits do not apply.

If RPV level cannot be maintained above -161" using the preferred systems, other systems are required. Core Spray injects inside the shroud. RHRSW injects low quality water. ECCS Keep-Fill and RHR SDC Suction Fill are a relatively low capacity source of injection.

SLC is not included in this list. The ATWS event requires that SLC should remain available for the injection of boron by the reactor power control flowpath.

A specific order governing the priority over use of these systems cannot be predetermined as it will depend greatly on plant conditions. Consider the following factors to determine order:

- System availability
- Time and manpower required to operate system
- System throttling capability/control
- Water quality

Alternate injection sources under failure-to-scram conditions include those that inject inside the core shroud and alternate injection subsystems which are those that inject water of a lower quality, those that require unusual or complex lineups, and those that would be used only if a preferred system were unavailable.

Per BWROG guidance, some injection methods may be appropriate for consideration under severe accident conditions when additional support personnel are available but impractical for use under emergency conditions by the normal shift complement. Use of the Portable Pump Truck for injection per the Damage Control procedure is not considered practical for the on-shift Operations crew without additional support during EOP implementation.

The Fire System has the capability of being lined-up by two flow paths. The injection path using the RHR A Loop Keep-fill system is less complex if access to the Reactor Building exists, but has a lower injection capability (approx. 300 gpm at 0 psig RPV). The line-up through the RHRSW system is more complex, but has the greater injection capability (approx. 1100 gpm at 0 psig RPV). Both paths can be aligned simultaneously. It is expected that injection through the RHR A Loop Keep-fill path would be established first. Fire pump injection to the vessel should then be maximized by follow-up actions to align the RHRSW path and inject through both paths simultaneously.

Instructions for aligning these systems are given in the following procedures:

- Core Spray
  OP-151-001 (OP-251-001) Core Spray System

- RHRSW Cross-Tie From Either Unit
  OP-116-001 (OP-216-001) RHR Service Water System

- Fire System
  ES-013-001 Fire Protection System Cross-Tie to RHRSW and
  OP-149-001 (OP-249-001) RHR System

- CRD Cross-Tie to Other Unit
  OP-155-001 (OP-255-001) Control Rod Drive Hydraulics System

- ECCS Keep-Fill
  OP-149-001 (OP-249-001) RHR System

- RHR Suction Fill
  OP-149-002 (OP-249-002) RHR Shutdown Cooling

- Portable Pump Truck
  DC-B5B-102 (DC-B5B-202) Connection Of Portable Pump Truck To The RHRSW System To Provide Alternate Means Of Low Pressure RPV Injection, Containment Sprays Or Suppression Pool Makeup To Unit One (Two)

(Reference: PSTG C5-5.2)

LQ/L-22 CAN LVL BE RESTORED AND MAINTAINED **> -161"**

If level can be restored and maintained above -161", control is transferred back to LQ/L-13 where a new level band is given.

LQ/L-23 CONTINUE RPV INJECTION
AND
CONTACT TSC TO ENTER
EP-DS-002 RPV AND PC FLOODING

When injection with all available sources fails to provide sufficient injection to establish and maintain adequate core cooling, as a last resort, Level/Power Control water level actions are abandoned and submergence of the core is attempted through flooding the primary containment. Control of RPV pressure remains in EO-000-112 and control of RPV water level is transferred to EP-DS-002, RPV and Primary Containment Flooding.

RPV and Primary Containment Flooding continues injection with those systems authorized in Level/Power Control. The only difference of injection sources is RPV and Primary Containment Flooding authorizes alignment of core spray suction to the CST, thereby increasing the contribution from outside containment sources.

The additional contribution from the CSTs (and RWST if cross-tied) is insignificant compared to the volume required to fill primary containment to TAF. While flooding primary containment, RPV and primary containment venting are required when water level reaches 85 ft. Therefore, there is no minimum time limit specified for making the decision to enter RPV and Primary Containment Flooding.

Alternate injection subsystems specified in LQ/L-21 may have become available if rapid depressurization took place at TAF. Depending on power level and which systems are presently injecting or expected to become available, the time to recover level to TAF will vary. Unlike RPV Control where the reactor is shutdown, a general guideline for determining when transfer to RPV and Primary Containment Flooding is appropriate cannot be given.

(Reference: PSTG override preceding C5-5.3; step C5-5.3)

LQ/P - RPV Pressure Control

LQ/P-1 **BEFORE** DEPRESSURIZING **< 700 PSIG**
PREVENT UNCONTROLLED COND INJECTION

This step requires that action be taken prior to depressurizing the RPV to less than 700 psig which is the shutoff head of the condensate pumps.

If the RPV is depressurized to less than 700 psig without the RFP discharge valves closed and the condensate system is in service, then an uncontrolled flood of the RPV will take place as condensate water injects through the feed pumps into the reactor.

(Reference: PSTG RC/P)

LQ/P-2 **IF** ECCS INITIATION IMMINENT

BEFORE DEPRESSURIZING **< 400 PSIG**

PREVENT INJECTION FROM LPCI AND CS PUMPS NOT REQ'D TO ASSURE ADEQUATE CORE COOLING

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

The intent of this step is to prevent injection that would complicate efforts to control RPV water level. The ECCS initiation signals for Susquehanna include either 1) low RPV level, or 2) a combination of high drywell pressure and low RPV pressure. The word "imminent" is used to compensate for the combined initiation signal, since the existence of high drywell pressure and low RPV pressure would result in an ECCS injection, the very thing this step is trying to prevent. By requiring injection to be overridden when ECCS initiation is imminent, injection can be overridden when either signal exists (high drywell pressure or low RPV pressure), thereby, preventing ECCS injection before it occurs.

The term "prevent" permits securing pumps to preclude injection. The subsequent use of these systems is not prohibited by this override statement when plant conditions change such that system operation is required to assure adequate core cooling. Discussion of "prevent injection" is located in LQ/L-18.

(Reference: PSTG override before RC/P-1)

LQ/P-3 **IF** ANY SRV IS CYCLING

MANUALLY OPEN SRV'S
UNTIL PRESS DROPS TO **945 PSIG**

"SRV cycling" is defined as multiple, closely sequenced valve actuations with valve opening being initiated in response to RPV pressure increasing to/above the lifting setpoint, valve closure being governed by RPV pressure decreasing to/below the reset setpoint. The consequences associated with SRV cycling require prompt manual action to reduce RPV pressure below the SRV lifting setpoint. Actions to prevent SRV cycling will minimize:

- Significant dynamic loads/stresses imposed on the RPV, on the SRV tail pipes and supporting structures, and on the primary containment structures.
- Fluctuating RPV water level (shrink occurring when the valves close as RPV pressure starts once again to increase, and swell occurring when the valves open as RPV pressure rapidly decreases).
- Repeated challenges to SRV operability (the potential failure of a valve to open on demand or to close once it has opened).

SRV cycling is terminated by manual action to reduce RPV pressure to substantially below 1106 psig (the lowest SRV lifting setpoint).

Manual operation of the SRVs to effect the desired prompt reduction in RPV pressure has the following advantages:

- Level swells will be minimized because the SRVs cycle in groups in automatic but in manual control one SRV at a time may be used.
- Operable irrespective of MSIV status.
- Magnitude of RPV depressurization can be directly controlled.

RPV pressure reduction with SRVs is continued until RPV pressure reaches the pressure at which steam flow through the main turbine bypass valves is at 100% of bypass valve capacity. If the MSIVs are open, reducing RPV pressure to below this value results in partial closure of the bypass valves and a corresponding increase in the amount of steam discharged to the suppression pool through the SRVs. If the MSIVs are not open, reducing RPV pressure to the lowest pressure at which all turbine bypass valves would be fully open if controlling pressure provides an adequate operating margin below the setpoint pressure of the lowest lifting SRV.

Since a prompt reduction in RPV pressure is desired as soon as possible to discontinue SRV cycling, adherence to a specific SRV opening sequence is unwarranted in this step.

(Reference: PSTG step RC/P-1)

LQ/P-4 **IF** INITIAL ATWS PWR ≤ **5%**
AND
SUPP POOL TEMP AND LVL CANNOT BE MAINTAINED BELOW FIG **2** HCTL

MAINTAIN RPV PRESS BELOW LIMIT
EXCEEDING COOLDOWN RATE IF NECESSARY

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

If suppression pool temperature and level cannot be maintained below HCTL (Heat Capacity Temperature Limit) the primary containment vent valve opening pressure may be exceeded following RPV depressurization. Refer to step SP/T-4 in EO-000-103 for discussion of HCTL.

The figure is not provided on this flowchart because the condition requires that containment parameters be controlled first. The containment control procedure will provide the required figure and is performed concurrently with this procedure. Therefore, the action of this step is only applicable when the figure is already being referenced.

Fuel damaging, large amplitude power excursions may occur at low RPV pressures if reactor power is > 5%. Also, development of the HCTL assumes that the reactor is shutdown. Therefore, depressurization due to HCTL or PSL during an ATWS is restricted to conditions where initial ATWS power level is ≤ 5%. The 5% determination is based on "initial ATWS power," or reactor power before water level is lowered or boron is injected because there is no guarantee level will remain low or boron will remain in the core following depressurization. Therefore, if initial ATWS power level is > 5%, depressurization is not required for this step.

Control of suppression pool temperature is directed in the SP/T flowpath of EO-000-103. If the actions currently being taken in EO-000-103 to limit suppression pool temperature increase are inadequate and initial ATWS power is ≤ 5%, RPV pressure is reduced in order to remain below the HCTL.

If SRVs are used to maintain RPV pressure below the HCTL, the margin to the limit will not improve; that is, the delta between containment parameters and the HCTL will not increase. This is because SRV use adds heat to the suppression pool, and suppression pool temperature is one of the three factors that is included in the HCTL. Other methods of RPV depressurization that discharge outside primary containment, such as BPV's, and HPCI in CST to CST mode, reduce RPV pressure without adding heat to the suppression pool, thereby, increasing margin to the limit.

The normal cooldown rate LCO may be exceeded to the extent necessary to maintain RPV pressure below the HCTL. If RPV pressure cannot be maintained below the HCTL, emergency RPV depressurization will be required, possibly resulting in an even more rapid cooldown.

(Reference: PSTG 1st override before step RC/P-2)

LQ/P-5 **IF** ALL:

- BORON INJECTION REQ'D
- MAIN CONDENSER AVAILABLE
- NO GROSS FUEL FAILURE
- NO MSL BREAK

BYPASS MSIV AND CIG INTERLOCKS
AND
OPEN MSIV'S IAW ES-184-002 (ES-284-002)

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

To stabilize and control RPV pressure, the reactor steam generation rate must remain within the capacity of systems designed to remove the steam from the RPV. With the reactor not subcritical, the amount of steam that may have to be released could be substantial. If this heat energy is discharged to the suppression pool, the HCTL could be reached in a very short time. Therefore, utilization of the main condenser as a heat sink for this energy is of sufficient importance to warrant opening the MSIVs even if the valves automatically closed.

This step permits bypassing the low RPV water level portion of the MSIV isolation logic, and CIG isolation interlocks. OP-184-001 (OP-284-001), Main Steam System, provides instructions for bypassing the following interlocks from the control room at 1C644 (2C644) and 1C645 (2C645):

- MSIV low water level isolations
- CIG high drywell pressure and low water level isolations.

ES-184-002 (ES-284-002), Reopening MSIVs Bypassing Isolations, provides instructions for restoring CIG (including a LOCA/LOOP compressor trip), and reopening the MSIVs.

Other MSIV isolation interlocks are not bypassed because they provide automatic protection for conditions where reopening the MSIVs is not appropriate.

The determination of "NO GROSS FUEL FAILURE" or "NO MSL BREAK" can be made without long, detailed investigation. Conservative implementation of this step would be to perform the procedure which bypasses interlocks in those cases that are not clearly determined, because re-opening MSIV's is very important during ATWS.

MSIVs may be reopened if all the following conditions exist:

- Boron Injection is Required.
- Main condenser is available, since the only reason for opening the MSIVs is to utilize the main condenser as the heat sink.
- No indication of gross fuel failure, since opening the MSIVs with grossly failed fuel could result in a significant release of fission products to the environment. "Gross" fuel failure is specified to distinguish from small cladding leaks. <u>The judgment is subjective based on operator assessment of all available indications</u>. If it is concluded that no gross fuel failure exists but in actuality core damage has occurred, high radiation should be detected when the MSIVs are opened and MSIV isolation can be directed to reclose the valves.

- No indication of steam line break, since opening MSIVs with a break in the downstream piping could result in an uncontrolled loss of reactor coolant inventory, release of fission products to the environment and cause personal injury or significant damage to plant equipment. It is difficult, however, to determine whether a steam line break exists with the MSIVs closed, other than by visual inspection of system piping. If there is reasonable assurance that no break existed before MSIV closure, an operator may conclude that no break developed subsequent to valve closure. Still, the judgment is subjective, based on assessment of all available indications. If it is concluded that no steam line break exists but, in actuality, one does exist, high steam line flow and high steam tunnel temperature should be detected when MSIVs are opened and the MSIV isolation logic should automatically reclose the valves.

(Reference: PSTG 2nd override before step RC/P-2)

LQ/P-6 STABILIZE PRESS **< 1087 PSIG** USING BPV'S
AUGMENTING PRESS CONTROL WITH ANY:

- SRV'S

  IF SUPP POOL LVL **> 5'**

  OPEN SRV'S USING OPENING SEQUENCE A B C

  IF **≤ 200 PSIG** INDICATED ON EITHER ADS N2 BOTTLE HEADER

  PLACE ALL SRV SWITCHES TO OFF

- HPCI CST TO CST MODE
- RCIC CST TO CST MODE
- SJAE
- RFPT
- STEAM SEAL EVAP
- MSL DRAINS
- RWCU RECIRC MODE
  BYPASSING INTERLOCKS AS NECESSARY
  IAW ES-161-002 (ES-261-002)
- RWCU BLOWDOWN MODE ONLY WITH NO BORON INJECTED
  IAW ES-161-001 (ES-261-001)

CAUTIONS

50 ELEVATED SUPP CHMBR PRESS
MAY TRIP RCIC ON HIGH EXHAUST PRESS.

The intent of this step is to hold pressure as constant as practicable.

RPV pressure is stabilized to facilitate control of RPV water level. If pressure is allowed to oscillate, RPV water level may fluctuate due to the effects of shrink and swell.

Pressure is stabilized at a value below the high RPV pressure scram setpoint to avoid SRV actuation and to permit the scram logic to be reset (if no other scram signal exists). No minimum value is specified since the pressure at which RPV Control is entered cannot be predetermined and the procedure must provide appropriate guidance for all events. A target pressure should be selected close to the initial value and below the RPV pressure scram setpoint that permits use of available injection systems. An initial adjustment to establish an appropriate target pressure is permitted, provided the target can be reached expeditiously and the Technical Specification cooldown rate LCO is not exceeded.

A pressure reduction from an intermediate pressure to a pressure as low as the shutdown cooling RPV pressure interlock (98 psig) is <u>not</u> considered a permissible initial pressure adjustment even if the depressurization is within the LCO cooldown rate. To maintain RPV water level at intermediate or low RPV pressures, the typical complement of RPV injection systems should not require such a pressure reduction.

“Stabilize” means to hold RPV pressure as constant as practicable within due constraints imposed by the nature of the event, the degree of control afforded by the systems used, and the availability of personnel to perform manual control functions. The specific actions required and the degree to which the ideal of a constant pressure can be approached will vary according to these constraints.

Both the rate and the magnitude of RPV pressure changes must be considered. A pressure that is slowly decreasing over a relatively wide control band may be more “stable” than short-period oscillations within a narrower control band. In general, the adequacy of steps taken to stabilize RPV pressure must be judged by the effect of any continuing pressure variations on RPV water level and by whether additional actions are possible or likely to afford better control capability. If pressure variations are not interfering with RPV water level or cannot be stopped, pressure may be considered stabilized. If continuing pressure oscillations are complicating efforts to control RPV water level or if the existing pressure prevents use of available injection systems, additional effort is warranted.

The main turbine bypass valves are the preferred means of controlling RPV pressure, since they provide good control capability, are of relatively large capacity, and do not add heat to the suppression pool. The direction to use the bypass valves implicitly permits opening the MSIVs and placing the main condenser in service if such actions are necessary and conditions permit. It does not, however, constitute authorization to defeat any MSIV isolation interlocks.

If the main turbine bypass valves cannot be used to control RPV pressure, or when the available capacity of the main turbine bypass valves (and main condenser) is less than that required to control RPV pressure below the high RPV pressure scram setpoint, additional systems must be employed to augment RPV pressure control.

Since symptom-oriented procedures must accommodate a full spectrum of initial plant conditions and event scenarios, no prioritization regarding the use of the listed RPV pressure control systems is specified in this step.

If suppression pool water level is not above the top of the SRV discharge device (5'), steam discharged through the SRVs passes directly into the suppression chamber airspace. The magnitude of the resultant primary containment pressure increase could potentially exceed primary containment pressure limits.

When manual SRV actuation is required for RPV pressure control, an opening sequence is preferred which distributes heat uniformly throughout the suppression pool to avoid high local pool temperatures which may result in inefficient pool cooling. The opening sequence also uniformly distributes the total number of SRV actuations among the total number of SRVs.

Purpose of placing SRV switches to "OFF" when ADS nitrogen bottle supply drops to 200 psig is to preserve the remaining pneumatic supply in the 90 psig header so that the non-ADS SRVs will be available if RPV rapid depressurization is later required and ADS valves do not work. The ADS nitrogen bottle supply is the safety-related backup to the 150-psig header. The bottles have a 3-day storage capacity based on the system design leakage rate. A drop in bottle pressure to 200 psig is indicative of a loss of system integrity and the potential loss of the bottles' ability to supply the ADS function. Manual and relief mode operation of SRVs uses pneumatic supply; safety mode does not. By placing SRV control switches to "OFF," the SRVs will open at safety setpoints without expending pneumatic supply, thereby, preserving their availability to rapidly depressurize the RPV if later required. If CIG compressors or IA system (if system crosstied) are in service and maintaining the 90 psig header, continued use of SRV's to stabilize pressure is allowed since the pneumatic supply for valve operation is maintained. The SRV switch is returned to "OFF" when closed. This maintains depressurization function if header pressure is subsequently lost.

After the 90 psig CIG header is exhausted, use of the 150 psig ADS header is generally not authorized for pressure control. Instead, the 150 psig header is reserved for rapid depressurization. The only exception to this is when shutting down from the remote shutdown panels. If pneumatic supply to non-ADS SRVs is lost, ON-100/200-009 directs operation of the ADS valves from the upper and lower relay rooms as a redundant path to achieve hot and cold shutdown for that event. No other procedure permits operating ADS SRVs from the relay rooms.

For pressure control, HPCI and RCIC are operated in CST to CST mode.

Operation of RWCU in the recirculation mode may require by-passing isolation interlocks. In order to make this mode more effective cooling may need to be maximized. Instructions for bypassing interlocks and maximizing cooling are contained in ES-161-002 (ES-261-002), RWCU Recirc Mode for Pressure Control.

Since operation of RWCU in the recirculation mode does not remove coolant inventory from the RPV, overriding interlocks and operation of the system during boron injection (if the filter/demineralizers are bypassed) is authorized.

Operation of RWCU in the blowdown mode when boron has been injected into the RPV is not permitted in order to maintain the required concentration of boron in the RPV.

Prior to RWCU blowdown, reactor coolant is sampled and analyzed for activity as prescribed by ES-161-001 (ES-261-001), RWCU Blowdown Mode Bypassing Interlocks. Failure to determine coolant activity might result in discharge of radioactivity to the environment beyond allowable limits.

This step does not require RPV cooldown nor does it provide all the necessary precautions that should be met prior to cooldown. For guidance on RPV cooldown continue in this flowpath.

Instructions for operating the required systems are contained in the following procedures:

- BPVs
  OP-193-001 (OP-293-001) Main Turbine Operation
- SRVs
  OP-183-001 (OP-283-001) Automatic Depressurization System and Safety Relief Valves
- HPCI
  OP-152-001 (OP-252-001) HPCI System
- RCIC
  OP-150-001 (OP-250-001) RCIC System
- SJAE
  OP-172-001 (OP-272-001) SJAE and Off Gas System
- Reactor Feed Pump Turbine
  OP-145-001 (OP-245-001) RFP and RFP Lube Oil System
- Steam Seal Evaporator
  OP-192-001 (OP-292-001) Seal Steam System
- Main Steam Line Drains
  OP-184-001 (OP-284-001) Main Steam System

(Reference: PSTG step RC/P-2)

LQ/P-7 **IF** RX IS CRITICAL

GO TO LQ/P-6

This step is applicable to all subsequent steps within this flowpath. It remains applicable to those steps until flowchart is exited.

The remaining steps of this flowpath depressurize and cool the RPV to cold shutdown conditions. The positive reactivity added during cooldown may return the reactor to criticality. Stopping depressurization stabilizes RPV pressure until the reactor is again subcritical.

(Reference: PSTG override preceding RC/P-3)

LQ/P-8 **WHEN** RX SUBCRITICAL DUE TO CONTROL RODS
OR
COLD S/D BORON WEIGHT INJECTED

DEPRESSURIZE AT **< 100°F/HR**

RPV depressurization and cooldown may not proceed until reactor is subcritical by control rod position or amount of boron injected into the RPV.

If any amount of boron less than Cold Shutdown Boron Weight (CSBW) has been injected into the RPV, cooldown is not permitted. CSBW is defined in LQ/Q-11 The core reactivity response from cooldown in a partially borated core is unpredictable and subsequent steps may not prescribe the correct actions for such conditions if criticality were to occur.

If no boron has been injected into the RPV, depressurization and cooldown may proceed as long as the reactor is subcritical. Such action is permitted even though the existing margin to criticality is small. A return to criticality under these conditions is acceptable because termination of the cooldown will stop the reactor power increase.

If SRV handswitches had been placed to "OFF" position per LQ/P-6, the requirement to maintain switches in "OFF" no longer applies. Handswitches are placed to "OFF" per LQ/P-6 to preserve the remaining pneumatic supply during the stabilization step so SRVs would be available if later required for rapid depressurization. (See LQ/P-6 basis.) When RPV parameters have been stabilized and it has been decided to initiate a depressurization, the use of SRVs to depressurize would be consistent with the purpose they were preserved to perform, i.e., depressurize the RPV.

The pressure reduction performed in this step may be carried out using any of the systems listed in step LQ/P-6. The technical specification cooldown rate is observed to maintain RPV metal ductility limits.

(Reference: PSTG RC/P-3)

LQ/P-9 **IF** SRV'S ARE BEING USED TO DEPRESSURIZE

USE SUSTAINED SRV OPENING

Purpose of maintaining an SRV open when using SRVs to depressurize during the established cooldown is to conserve the remaining pneumatic supply. This prolongs the period of time that the Operator can control pressure from the control room while attempts are made to recover CIG. Maintaining an SRV open also completes the depressurization, or a major portion of it, while pneumatic supply is available rather than delaying depressurization and risking the ability to do so. Sustained SRV opening also minimizes the number of challenges to SRV operability.

This step recognizes that SRVs might be in use as directed by other steps in this procedure. It does not give authorization to exceed the 100°F/hr cooldown limit. Steps that authorize SRV use specify whether the 100°F/hr cooldown rate may be exceeded or not.

(Reference: PSTG step RC/P-3)

LQ/P-10 **WHEN** S/D COOLING INTERLOCK CLEARS

CONTINUE TO COOL DOWN TO **< 200°F**
WITH S/D COOLING
USING ONLY THOSE RHR PUMPS
NOT REQ'D TO MAINTAIN LVL **> +13"**
IN LPCI MODE

Operation of shutdown cooling is the normal method of conducting a controlled cooldown of the RPV to cold shutdown conditions. Shutdown cooling is placed in service when the low RPV water level and high RPV pressure shutdown cooling interlocks clear.

Maintaining RPV water level in the preferred band takes priority over forced cooldown of the RPV. If operation of an RHR pump in the LPCI Mode is required to maintain water level, it may not be used for shutdown cooling.

Loss of Shutdown Cooling at +13" is a re-entry condition to EO-100-113.

Instructions for placing shutdown cooling in service are found in OP-149-002 (OP-249-002), RHR Shutdown Cooling.

(Reference: PSTG step RC/P-4)

LQ/P-11 **IF** S/D COOLING CANNOT BE PLACED IN SERVICE

MAINTAIN PRESS < S/D COOLING INTERLOCK
WITH SYSTEMS USED FOR DEPRESS

If shutdown cooling cannot be established, continued RPV depressurization and cooldown may be accomplished using any combination of the systems listed in Step LQ/P-6. The wording of this step permits, but does not require, continued cooldown below the shutdown cooling RPV pressure interlock. If no requirement for rapid depressurization has been established, continued pressure reduction is expected to be of little benefit.

As RPV pressure and temperature decrease, it may be necessary to re-evaluate the most appropriate method for continuing to achieve further pressure and temperature reduction. Under certain conditions RPV pressure may be reduced to zero and temperature to below 212°F without employing shutdown cooling.

(Reference: PSTG step RC/P-4)

CONTROL ROD INSERTION

113 SH 2

CR-1 IS MORE THAN 1 CONTROL ROD **> 00**

This step becomes effective when read and remains effective until flowchart is exited.

The intent of this step is to define the condition that allows EO-000-113 sheet 2 to be exited. Refer to step LQ-2.

(Reference: PSTG first override before step RC/Q-1)

CR-2 STOP BORON INJECTION
AND
GO TO SCRAM PROCEDURE

This procedure may be used concurrently with boron injection steps. When this procedure is successful in inserting rods then it is appropriate to terminate boron injection. This step directs entry to the scram procedure where guidance will be given for balance of plant systems. The scram procedure was exited when it was determined that the reactor would not remain shut down under all conditions without boron and can now be returned to and performed concurrently with other emergency procedures.

(Reference: PSTG first override before step RC/Q-1)

CR-3 USE ONE OR MORE OF FOLLOWING

The options available for control rod insertion are listed and conditions must be evaluated to determine which method or methods will be most effective.

(Reference: PSTG step RC/Q-7)

DRIFTING RODS WITH COOLING WATER PRESS

CR-4 MAXIMIZE CRD USING EITHER UNIT

This step is provided to increase cooling water differential pressure to maximum which may cause the control rods to drift inward and shutdown the reactor.

Instructions for maximizing CRD flow are given in the operating procedure OP-155-001 (OP-255-001), Control Rod Drive Hydraulic System.

(Reference: PSTG step RC/Q-7.2)

DRIVING RODS

CR-5 **IF** CRD RUNNING IN EITHER UNIT
DRIVE RODS AS FOLLOWS

This step tests the availability of CRD. CRD pumps must be running to provide the drive water differential pressure necessary to insert control rods. If CRD is not running, the remaining steps need not be performed. Instructions for cross-tying Unit 1 and Unit 2 CRD Systems are given in OP-155/255-001.

(Reference: PSTG step RC/Q-7.2)

CR-6 BYPASS RWM **(HC)**

Rod Worth Minimizer must be bypassed to remove control rod blocks that are generated from the abnormal rod pattern. RWM is bypassed using the installed bypass key switch IAW OP-131-001 (OP-231-001), Rod Worth Minimizer.

(Reference: PSTG step RC/Q-7.2)

CR-7 ESTABLISH APPROXIMATELY (IF OBTAINABLE): **(HC)**

63 GPM COOLING WATER FLOW
AND
350 PSID DRIVE WATER PRESS

CLOSING CHARGING WATER ISO 146F034 (246F034) AS NECESSARY

Intent of this step is to ensure CRD system flow and differential pressure is sufficient to manually drive rods. System Operating Parameters are listed preceded by "approximately" to recognize that the system may not be operating within these limits when this step is reached. Such is the case if CRD flow was maximized to drift rods. If rods can be manually inserted, CRD parameters are within acceptable limits.

Drive water pressure of 350 psid is directed due to the potential for channel bow/bulge. There may be difficulty inserting rods manually at 250 psid due to this phenomenon. Increasing drive water pressure is already directed in ON-155-001 (ON-255-001) if difficulty is encountered inserting rods. The higher drive water pressure potentially reduces plant risk by minimizing the time to drive rods.

In order to manually drive control rods, charging water flow must be isolated from the HCUs so cooling water flow and drive water pressure can be restored. If ATWS is electrical or scram has been reset, scram valves will not be open. If a scram signal is in, scram valves will be open with charging water flowing through the CRDs into the RPV. Even if scram valves to only one CRD are open, it may not be possible to establish normal drive water pressure. For this reason it may be necessary to close the charging water isolation, 146F034 (246F034) valve. Status of scram valves can be determined selecting DISPLAY SCRAM VALVES OPEN.

(Reference: PSTG step RC/Q-7.2)

CR-8 SELECT RODS IN ROTATING QUADRANTS **(HC)**
AND
DEPRESS CONTINUOUS INSERT
FOR EACH OF FOLLOWING
UNTIL FULL-IN OR ROD WILL NOT MOVE:

1 INTERMEDIATE POSITION RODS

2 FULL-OUT RODS

A sequence for control rod insertion is specified that minimizes flux imbalance while control rods are being inserted.

Regardless of intermediate position, all rods with intermediate indication on the full-core display (not red or green) are inserted first followed by control rods that have (red) full out indication, in a symmetrical pattern. This is because intermediate rods typically have a higher rod worth than full-out rods.

(Reference: PSTG step RC/Q-7.2)

CR-9 IS ADEQUATE CRD PUMP SUCTION AVAILABLE

Normal CRD suction will be lost when CST level drops below 45% (135,000 gallons). CRD suction is preserved by making up to the hotwell with demin water transfer and jockey pumps.

(Reference: PSTG step RC/Q-7.2)

CR-10 ENSURE AT LEAST ONE COND PUMP RUNNING

The intent of this step and the next two steps is to maintain CRD suction for driving rods.

Condensate Pump provides reject flow to the reject line.

(Reference: PSTG step RC/Q-7.2)

CR-11 OPEN HV10517 (HV20517)
HP CDSR DEMIN WATER MAKEUP

Opening this valve opens a flow path from the demineralized water storage tank to the hotwell.

(Reference: PSTG step RC/Q-7.2)

CR-12 START ALL:

- 0P507A DEMIN WTR TRANSFER PP
- 0P507B DEMIN WTR TRANSFER PP
- 0P508 DEMIN WTR JOCKEY PP

Operation of the demin water transfer and jockey pumps provides makeup water to the hotwell.

(Reference: PSTG step RC/Q-7.2)

CR-13 **WHEN** RODS WILL NOT INSERT **(HC)**

ENSURE CHARGING WATER
ISO 146F034 (246F034) OPEN

When this method of control rod insertion is not needed or is not effective, restore the charging water header flow by opening charging water header isolation valve 146F034 (246F034).

(Reference: PSTG step RC/Q-7.2)

INDIVIDUALLY SCRAMMING RODS

CAUTION

SDV VENT AND DRAIN VALVES
FAIL CLOSED ON LOSS OF I-A.

Auxiliary bus load shed causes loss of instrument air. Scram discharge vent and drain valves fail closed upon loss of instrument air, thereby preventing the volume from draining. Inability to drain the scram discharge volume will prevent two Control Rod Insertion options: Individually Scramming Rods; Resetting and Scramming Again.

Purpose of this caution is to advise the operator of the negative impact on control rod insertion from failure to promptly recover from the loss of instrument air. It is recognized that instrument air can be lost for many reasons, but in Level/Power Control, the probability of losing instrument air is increased since level is intentionally lowered close to -129" and containment pressure is likely increasing close to 1.72 psig.

(Reference: PSTG Caution 10)

CR-14 DISABLE ARI
AND
BYPASS RPS LOGIC TRIPS AS NECESSARY
IAW ES-158-002 (ES-258-002)

If a scram signal exists, it must be reset before individually scramming rods. The presence of ARI and RPS logic trips will prevent a SCRAM signal from being reset. ES-158-002 (ES-258-002), RPS and ARI Trip Bypass, provides instructions to disable ARI and bypass RPS logic trips.

(Reference: PSTG step RC/Q-7.2)

CR-15 RESET SCRAM

After ARI is disabled and RPS logic trips are bypassed, the scram is reset. Instructions for resetting the scram are given in OP-158-001 (OP-258-001), RPS System.

(Reference: PSTG step RC/Q-7.2)

CR-16 **IF** ALL:

- ARI DISABLED
- SCRAM RESET
- SCRAM AIR HEADER NOT VENTED
- RPS FUSES NOT REMOVED

INDIVIDUALLY SCRAM RODS
IAW ATTACHMENT A

The advantage of individually scramming control rods is that resulting exhaust water occupies a smaller volume than required for a full scram. While it may not be possible to scram all control rods in a full scram, it may be possible to scram some rods individually. Individual control rod scrams using the scram test switches will generally insert control rods faster than manual control rod insertion. Even with an incompletely drained or non-vented scram discharge volume, sufficient capacity may remain in the scram discharge volume to accommodate discharge flow from control rod scrams taken one at a time as opposed to all at once.

Attachment A describes one sequence for manually scramming control rods. This sequence insures that control rods are inserted in a symmetrical pattern that balances the flux in each quadrant of the core.

It is important to attempt to scram each control rod in a particular group designation (A,B,C, or D) prior to attempting to scram control rods for a different group designation even if some control rods will not insert.

Control rods are individually scrammed until control rods will not insert and it is determined that other methods of inserting control rods would be more effective.

(Reference: PSTG step RC/Q-7.2)

RESETTING AND SCRAMMING AGAIN

CAUTION

SDV VENT AND DRAIN VALVES
FAIL CLOSED ON LOSS OF I-A.

Auxiliary bus load shed causes loss of instrument air. Scram discharge vent and drain valves fail closed upon loss of instrument air, thereby preventing the volume from draining. Inability to drain the scram discharge volume will prevent two Control Rod Insertion options: Individually Scramming Rods; Resetting and Scramming Again.

Purpose of this caution is to advise the operator of the negative impact on control rod insertion from failure to promptly recover from the loss of instrument air. It is recognized that instrument air can be lost for many reasons, but in Level/Power Control, the probability of losing instrument air is increased since level is intentionally lowered close to -129" and containment pressure is likely increasing close to 1.72 psig.

(Reference: PSTG Caution 10)

CR-17 **WHEN** SCRAM FAILURE IS HYDRAULIC

CONTINUE

The following steps attempt to repeat a manual scram. They are only applicable for a hydraulic scram failure.

Table 20 is provided to help determine if the ATWS is electrical or hydraulic. Check the answer to each line according to plant conditions and the column that has the most checks is the most likely ATWS type.

TABLE 20
SYMPTOMS OF ELECTRICAL OR HYDRAULIC ATWS

CONDITION	HYD	ELEC
• FULL CORE DISPLAY FULL-IN/FULL-OUT MODE	YES	NO
• SCRAM AIR HEADER LOW PRESS ALARM	YES	NO
• SDV VENT AND DRAIN VLV'S CLOSED	YES	NO
• ALL ARI VLV'S REPOSITIONED	YES	NO

(Reference: PSTG step RC/Q-7.2)

CR-18 DISABLE ARI
AND
BYPASS RPS LOGIC TRIPS
AS NECESSARY IAW ES-158-002 (ES-258-002)

If a scram signal exists, it must be reset before attempting to scram again. The presence of ARI and RPS logic trips will prevent a SCRAM signal from being reset. ES-158-002 (ES-258-002), RPS and ARI Trip Bypass, provides instructions to disable ARI and bypass RPS logic trips.

(Reference: PSTG step RC/Q-7.2)

CR-19 RESET SCRAM

After ARI is disabled and RPS logic trips are bypassed, the scram is reset. Instructions for resetting the scram are given in OP-158-001 (OP-258-001), RPS System.

(Reference: PSTG step RC/Q-7.2)

CR-20 ENSURE CHARGING WATER ISO 146F034 (246F034) OPEN

If the charging water isolation valve was closed for driving rods, the valve will need to be opened to charge the HCU accumulators.

CR-21 **WHEN** SDV PARTIALLY DRAINS

INSERT MANUAL SCRAM

Since it is possible that a potential hydraulic problem exists, the scram discharge volume is allowed to drain and then a manual scram is inserted again to attempt to insert the control rods.

How long to wait for SDV to partially drain after the scram is reset can be estimated based on the following:

- Approximately 45 seconds are required for the scram air header to fully repressurize.
- Approximately 5 minutes are required for HCU accumulators to fully recharge.
- When the control room alarm "RPS CHAN A1/A2 (B1/B2) SCRAM DSCH VOL HI WTR LEVEL TRIP" is clear then less than 66 gallons remain in the SDV. This normally takes 7 minutes to occur.

(Reference: PSTG step RC/Q-7.2)

VENTING
SCRAM AIR HEADER

Steps to vent and restore Scram Air Header are placed in upper left corner of flowchart, upside down, for use by the PCO, as necessary, without having to turn board around.

CR-22 **WHEN** SCRAM FAILURE IS ELECTRICAL

CONTINUE

The following steps attempt to vent the scram air header. They are only applicable when the scram air header is not already vented by automatic systems as would be the case when the ATWS is due to electrical systems failure.

Table 20 is provided to help determine if the ATWS is electrical or hydraulic. Check the answer to each line according to plant conditions and the column that has the most checks is the most likely ATWS type.

TABLE 20
SYMPTOMS OF ELECTRICAL OR HYDRAULIC ATWS

CONDITION	HYD	ELEC
• FULL CORE DISPLAY FULL-IN/FULL-OUT MODE	YES	NO
• SCRAM AIR HEADER LOW PRESS ALARM	YES	NO
• SDV VENT AND DRAIN VLV'S CLOSED	YES	NO
• ALL ARI VLV'S REPOSITIONED	YES	NO

(Reference: PSTG RC/Q-7.2)

([1]) CR-23 OPEN ARI SYS SOLENOID VALVES BYPASS 147021 (247021) **(HC)**

Initiation of ARI opens both SCRAM Air Hdr Vent valves SV-147099/SV-147100 (SV-247099/SV-247100) and closes both SCRAM Hdr Block Valves SV-147101/SV-147102 (SV-247101/SV-247102). Although unlikely, ARI failure could be due to one or both vent valves failing to open while both block valves properly close. If both ARI block valves are closed, a flowpath does not exist for venting the SCRAM air header. Due to this case, the block valves' bypass is opened before proceeding.

(Reference: PSTG/SAG RC/Q-7.2)

([1]) CR-24 CLOSE SCRAM AIR SUPPLY **(HC)**
147002A (247002A) AND 147002B (247002B)
AND
UNCAP AND OPEN
SCRAM AIR HEADER VENT 147007 (247007)

This step attempts to open scram valves by removing air from the scram air header using manual valves.

(Reference: PSTG RC/Q-7.2)

([1]) CR-25 **WHEN** RODS STOP MOVING INWARD **(HC)**

1. CLOSE AND CAP
SCRAM AIR HEADER VENT 147007 (247007)
2. OPEN SCRAM AIR SUPPLY
147002A (247002A) OR 147002B (247002B)
3. CLOSE ARI SYS SOLENOID VALVES BYPASS
147021 (247021)

This step is simply to restore from actions taken in previous step, when these actions are no longer warranted as indicated by control rods not moving inward whether they did move or not.

(Reference: PSTG RC/Q-7.2)

DE-ENERGIZING SCRAM SOLENOIDS

CR-26 **WHEN** SCRAM FAILURE IS ELECTRICAL

REMOVE RPS FUSES
IAW ES-158-001 (ES-258-001)

This step attempts to open scram valves by de-energizing the scram pilot solenoids. It is only applicable when the scram air header is not already vented by automatic systems as would be the case when the ATWS was due to electrical systems failure.

Direction for removing the fuses to de-energize the scram pilot solenoids is given in ES-158-001 (ES-258-001), De-energizing Scram Pilot Solenoids.

Table 20 is provided to help determine if the ATWS is electrical or hydraulic. Check the answer to each line according to plant conditions and the column that has the most checks is the most likely ATWS type.

TABLE 20
SYMPTOMS OF ELECTRICAL OR HYDRAULIC ATWS

CONDITION	HYD	ELEC
• FULL CORE DISPLAY FULL-IN/FULL-OUT MODE	YES	NO
• SCRAM AIR HEADER LOW PRESS ALARM	YES	NO
• SDV VENT AND DRAIN VALVES CLOSED	YES	NO
• ALL ARI VALVES REPOSITIONED	YES	NO

(Reference: PSTG step RC/Q-7.2)

CR-27 **WHEN** RODS STOP MOVING INWARD

RESTORE RPS FUSES
IAW ES-158-001 (ES-258-001)

This step is simply to restore from actions taken in previous step, when these actions are no longer warranted as indicated by control rods not moving inward whether they did move or not.

(Reference: PSTG step RC/Q-7.2)

VENTING
CRD OVERPISTON VOLUME

CR-28 **WHEN** ALL OTHER METHODS HAVE FAILED

INSERT CONTROL RODS
IAW ES-155-001 (ES-255-001)

This step is entered when other means of inserting control rods have been unsuccessful.

This procedure provides a method of inserting the control rods using the differential pressure available between the reactor and the reactor building atmosphere.

By connecting a hose to the withdrawal line vent and directing the effluent to a contained radwaste drain, the reactor pressure is used to insert the control rod.

This method is used only when all other methods for inserting control rods are unsuccessful because it is difficult, time consuming, dangerous or could cause the spread of contamination.

Instructions for venting CRD overpiston volume are found in ES-155-001 (ES-255-001), Venting CRD to Insert Control Rods.

(Reference: PSTG step RC/Q-7.2)

4. REFERENCES

4.1 EC-EOPC-0519, SABRE Calculations to Support Technical Basis of IPE and ATWS EOP

4.2 EC-RISK-1063, Evaluation of Operator Actions for Application in the Susquehanna Individual Plant Examination

([1]) 4.3 LRF 99-055-034: This LRF generated two placards that include instructions to vent the Unit 1 and Unit 2 SCRAM air headers, respectively. Placards are posted at the Unit 1 and Unit 2 CRD skids.

4.4 Memo PLI-50399, C. Kukielka to B.R. Stitt, "Operation of Diesel Generators Without ESW Flow," May 13, 1987

INDIVIDUALLY SCRAM RODS

☐

CAUTION

Attempt to scram all control rods for any group designation (A, B, C, or D) before attempting to scram any control rods from a different group.

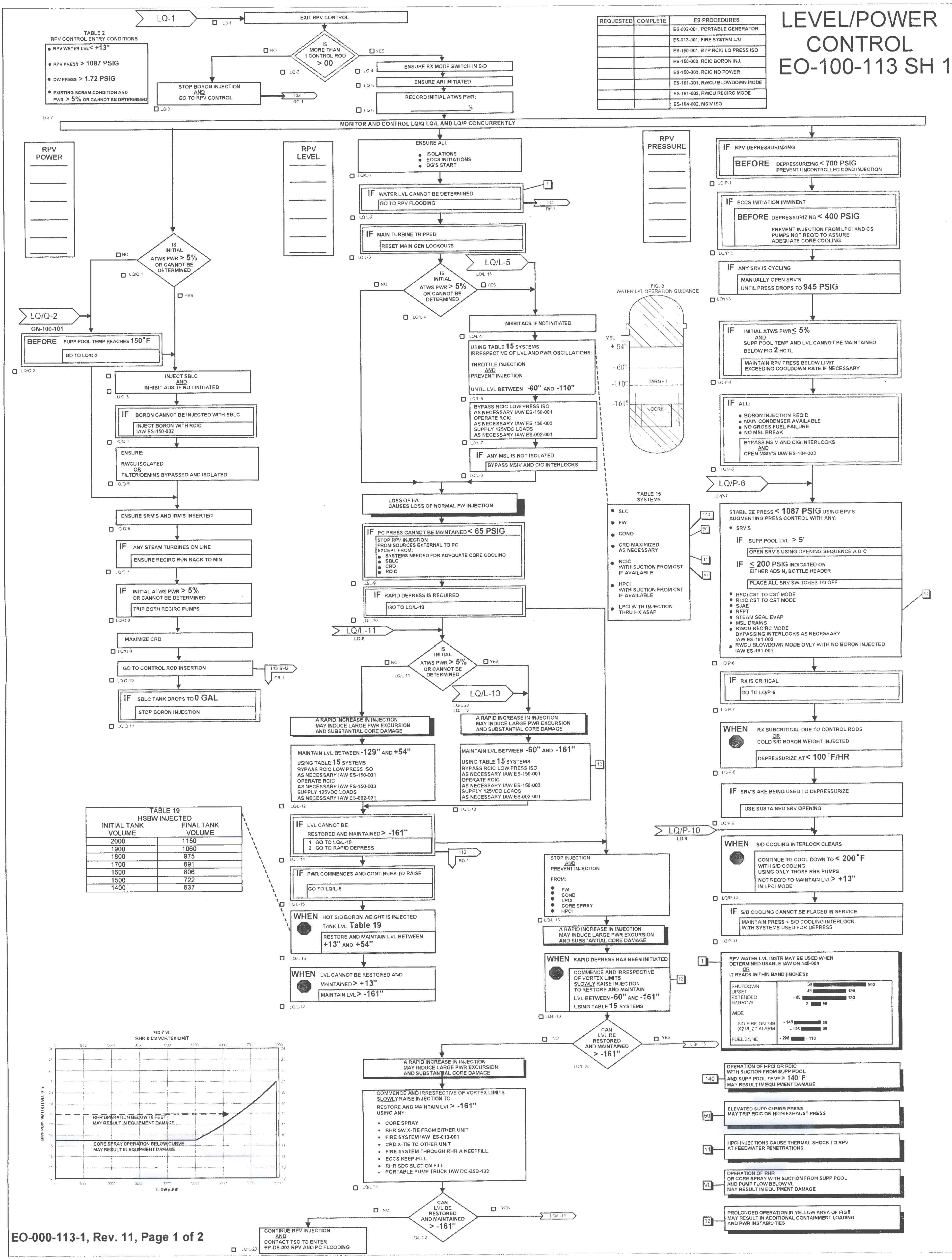
CRD MAP
UNIT 1 AND UNIT 2

NORTH ⇒

	26-51 D	22-47 B	18-51 A	10-51 B	14-55 A		30-59 D	46-55 A	38-55 B			
30-47 A	30-55 C	18-43 C	22-55 D	14-47 C	26-59 B		34-59 A	42-51 B	38-51 A	34-51 C	34-55 D	30-51 B
26-55 A	22-39 D	14-51 D	18-55 B	10-47 A	18-59 C		38-59 C	50-51 A	42-55 C	42-47 A	38-47 D	34-47 B
22-51 C	26-39 A	18-47 D	10-43 D	06-43 C	22-59 A		54-43 A	54-47 B	46-51 D	46-47 C	38-43 C	34-43 A
26-47 C	22-43 A	14-43 B	14-39 A	06-47 D	02-43 A		42-59 D	50-43 C	46-43 B	42-43 D	42-39 C	38-39 B
26-43 B	30-31 A	18-35 A	14-35 D	10-39 C	02-39 D		54-31 B	50-39 B	50-47 D	46-39 A	38-31 D	30-43 D
30-39 C	26-35 D	22-35 C	18-39 B	06-35 A	02-35 C		50-35 A	46-35 D	46-31 C	38-35 A	34-35 C	34-39 D
30-23 C	26-23 A	26-31 C	22-31 B	10-35 B	06-39 B	REACTOR VESSEL	54-39 D	50-31 D	42-35 B	42-31 A	34-31 B	30-35 B
26-27 B	22-27 A	18-27 C	14-27 B	18-31 D	06-31 D		58-43 B	54-35 C	58-39 A	38-27 C	38-23 B	30-27 D
22-19 C	18-19 A	22-23 D	14-23 A	14-31 C	02-31 B		58-35 D	58-31 C	54-23 D	42-23 C	34-27 A	34-23 D
26-15 C	14-19 D	18-23 B	10-27 D	02-27 A	10-31 A		54-27 A	58-23 B	50-27 C	38-19 A	42-15 A	30-19 B
22-11 A	22-15 B	10-19 B	10-23 C	06-23 B	02-23 D		58-27 B	54-19 C	50-19 A	46-27 B	46-23 A	34-19 C
26-07 A	30-07 C	18-15 D	06-27 C	02-19 C	18-03 A		58-19 D	38-03 A	50-15 D	50-23 B	42-27 D	38-15 D
26-19 D	26-11 B	14-11 B	10-11 D	06-19 A	22-03 C		42-03 B	54-15 B	46-19 D	42-19 B	38-11 C	34-15 B
30-15 A		18-11 C	14-15 C	10-15 A	06-15 D		34-03 C	46-11 B	46-07 A	46-15 C	38-07 B	30-11 D
		22-07 D	18-07 B	14-07 A	26-03 D		50-11 C	30-03 B	42-11 D	42-07 C	34-11 A	34-07 D

FOR EACH HCU:

☐ 1. PLACE BOTH SCRAM TEST SWITCHES TO TEST.
☐ 2. WAIT 10 SECONDS.
☐ 3. RETURN BOTH SCRAM TEST SWITCHES TO NORMAL.


LEVEL/POWER CONTROL
EO-100-113 SH 1
REQUESTED | COMPLETE | ES PROCEDURES
ES-002-001, PORTABLE GENERATOR
ES-013-001, FIRE SYSTEM L/U
ES-150-001, BYP RCIC LO PRESS ISO
ES-150-002, RCIC BORON INJ.
ES-150-003, RCIC NO POWER
ES-161-001, RWCU BLOWDOWN MODE
ES-161-002, RWCU RECIRC MODE
ES-184-002, MSIV ISO
LQ-1
EXIT RPV CONTROL
TABLE 2
RPV CONTROL ENTRY CONDITIONS
RPV WATER LVL < +13"
RPV PRESS > 1087 PSIG
DW PRESS > 1.72 PSIG
EXISTING SCRAM CONDITION AND PWR > 5% OR CANNOT BE DETERMINED
IS MORE THAN 1 CONTROL ROD > 00
NO
YES
STOP BORON INJECTION AND GO TO RPV CONTROL
ENSURE RX MODE SWITCH IN S/D
ENSURE ARI INITIATED
RECORD INITIAL ATWS PWR: %
MONITOR AND CONTROL LQ/Q LQ/L AND LQ/P CONCURRENTLY
RPV POWER
RPV LEVEL
RPV PRESSURE
ENSURE ALL:
ISOLATIONS
ECCS INITIATIONS
DG'S START
IF WATER LVL CANNOT BE DETERMINED
GO TO RPV FLOODING
IF MAIN TURBINE TRIPPED
RESET MAIN GEN LOCKOUTS
IS INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
LQ/L-5
INHIBIT ADS, IF NOT INITIATED
USING TABLE 15 SYSTEMS IRRESPECTIVE OF LVL AND PWR OSCILLATIONS:
THROTTLE INJECTION AND PREVENT INJECTION
UNTIL LVL BETWEEN -60" AND -110"
BYPASS RCIC LOW PRESS ISO AS NECESSARY IAW ES-150-001
OPERATE RCIC AS NECESSARY IAW ES-150-003
SUPPLY 125VDC LOADS AS NECESSARY IAW ES-002-001
IF ANY MSL IS NOT ISOLATED
BYPASS MSIV AND CIG INTERLOCKS
LQ/Q-2
ON-100-101
BEFORE SUPP POOL TEMP REACHES 150°F
GO TO LQ/Q-3
INJECT SBLC AND INHIBIT ADS, IF NOT INITIATED
IF BORON CANNOT BE INJECTED WITH SBLC
INJECT BORON WITH RCIC IAW ES-150-002
ENSURE:
RWCU ISOLATED OR FILTER/DEMINS BYPASSED AND ISOLATED
ENSURE SRM'S AND IRM'S INSERTED
IF ANY STEAM TURBINES ON LINE
ENSURE RECIRC RUN BACK TO MIN
IF INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
TRIP BOTH RECIRC PUMPS
MAXIMIZE CRD
GO TO CONTROL ROD INSERTION
IF SBLC TANK DROPS TO 0 GAL
STOP BORON INJECTION
LOSS OF I-A CAUSES LOSS OF NORMAL FW INJECTION
IF PC PRESS CANNOT BE MAINTAINED < 65 PSIG
STOP RPV INJECTION FROM SOURCES EXTERNAL TO PC EXCEPT FROM:
SYSTEMS NEEDED FOR ADEQUATE CORE COOLING
SBLC
CRD
RCIC
IF RAPID DEPRESS IS REQUIRED
GO TO LQ/L-18
LQ/L-11
LQ/L-13
A RAPID INCREASE IN INJECTION MAY INDUCE LARGE PWR EXCURSION AND SUBSTANTIAL CORE DAMAGE
MAINTAIN LVL BETWEEN -129" AND +54"
MAINTAIN LVL BETWEEN -60" AND -161"
USING TABLE 15 SYSTEMS
IF LVL CANNOT BE RESTORED AND MAINTAINED > -161"
1 GO TO LQ/L-18
2 GO TO RAPID DEPRESS
IF PWR COMMENCES AND CONTINUES TO RAISE
GO TO LQ/L-5
WHEN HOT S/D BORON WEIGHT IS INJECTED TANK LVL Table 19
RESTORE AND MAINTAIN LVL BETWEEN +13" AND +54"
WHEN LVL CANNOT BE RESTORED AND MAINTAINED > +13"
MAINTAIN LVL > -161"
TABLE 19
HSBW INJECTED
INITIAL TANK VOLUME | FINAL TANK VOLUME
2000 | 1150
1900 | 1060
1800 | 975
1700 | 891
1600 | 806
1500 | 722
1400 | 637
FIG 8
WATER LVL OPERATION GUIDANCE
MSL
+54"
-60"
-110"
-161"
TARGET
CORE
TABLE 15 SYSTEMS
SLC
FW
COND
CRD MAXIMIZED AS NECESSARY
RCIC WITH SUCTION FROM CST IF AVAILABLE
HPCI WITH SUCTION FROM CST IF AVAILABLE
LPCI WITH INJECTION THRU HX ASAP
STOP INJECTION AND PREVENT INJECTION FROM:
FW
COND
LPCI
CORE SPRAY
HPCI
WHEN RAPID DEPRESS HAS BEEN INITIATED
COMMENCE AND IRRESPECTIVE OF VORTEX LIMITS SLOWLY RAISE INJECTION TO RESTORE AND MAINTAIN LVL BETWEEN -60" AND -161" USING TABLE 15 SYSTEMS
CAN LVL BE RESTORED AND MAINTAINED > -161"
COMMENCE AND IRRESPECTIVE OF VORTEX LIMITS SLOWLY RAISE INJECTION TO RESTORE AND MAINTAIN LVL > -161" USING ANY:
CORE SPRAY
RHR SW X-TIE FROM EITHER UNIT
FIRE SYSTEM IAW ES-013-001
CRD X-TIE TO OTHER UNIT
FIRE SYSTEM THROUGH RHR A KEEPFILL
ECCS KEEP-FILL
RHR SDC SUCTION FILL
PORTABLE PUMP TRUCK IAW DC-B5B-102
CONTINUE RPV INJECTION AND CONTACT TSC TO ENTER EP-DS-002 RPV AND PC FLOODING
IF RPV DEPRESSURIZING
BEFORE DEPRESSURIZING < 700 PSIG PREVENT UNCONTROLLED COND INJECTION
IF ECCS INITIATION IMMINENT
BEFORE DEPRESSURIZING < 400 PSIG
PREVENT INJECTION FROM LPCI AND CS PUMPS NOT REQ'D TO ASSURE ADEQUATE CORE COOLING
IF ANY SRV IS CYCLING
MANUALLY OPEN SRV'S UNTIL PRESS DROPS TO 945 PSIG
IF INITIAL ATWS PWR ≤ 5% AND SUPP POOL TEMP AND LVL CANNOT BE MAINTAINED BELOW FIG 2 HCTL
MAINTAIN RPV PRESS BELOW LIMIT EXCEEDING COOLDOWN RATE IF NECESSARY
IF ALL:
BORON INJECTION REQ'D
MAIN CONDENSER AVAILABLE
NO GROSS FUEL FAILURE
NO MSL BREAK
BYPASS MSIV AND CIG INTERLOCKS AND OPEN MSIV'S IAW ES-184-002
LQ/P-6
STABILIZE PRESS < 1087 PSIG USING BPV'S AUGMENTING PRESS CONTROL WITH ANY:
SRV'S
IF SUPP POOL LVL > 5'
OPEN SRV'S USING OPENING SEQUENCE A B C
IF ≤ 200 PSIG INDICATED ON EITHER ADS N2 BOTTLE HEADER
PLACE ALL SRV SWITCHES TO OFF
HPCI CST TO CST MODE
RCIC CST TO CST MODE
SJAE
RFPT
STEAM SEAL EVAP
MSL DRAINS
RWCU RECIRC MODE BYPASSING INTERLOCKS AS NECESSARY IAW ES-161-002
RWCU BLOWDOWN MODE ONLY WITH NO BORON INJECTED IAW ES-161-001
IF RX IS CRITICAL
GO TO LQ/P-6
WHEN RX SUBCRITICAL DUE TO CONTROL RODS OR COLD S/D BORON WEIGHT INJECTED
DEPRESSURIZE AT < 100°F/HR
IF SRV'S ARE BEING USED TO DEPRESSURIZE
USE SUSTAINED SRV OPENING
LQ/P-10
WHEN S/D COOLING INTERLOCK CLEARS
CONTINUE TO COOL DOWN TO < 200°F WITH S/D COOLING USING ONLY THOSE RHR PUMPS NOT REQ'D TO MAINTAIN LVL > +13" IN LPCI MODE
IF S/D COOLING CANNOT BE PLACED IN SERVICE
MAINTAIN PRESS < S/D COOLING INTERLOCK WITH SYSTEMS USED FOR DEPRESS
RPV WATER LVL INSTR MAY BE USED WHEN DETERMINED USABLE IAW ON-145-004 OR IT READS WITHIN BAND (INCHES):
SHUTDOWN
UPSET
EXTENDED
NARROW
WIDE
FUEL ZONE
OPERATION OF HPCI OR RCIC WITH SUCTION FROM SUPP POOL AND SUPP POOL TEMP > 140°F MAY RESULT IN EQUIPMENT DAMAGE
ELEVATED SUPP CHMBR PRESS MAY TRIP RCIC ON HIGH EXHAUST PRESS
HPCI INJECTIONS CAUSE THERMAL SHOCK TO RPV AT FEEDWATER PENETRATIONS
OPERATION OF RHR OR CORE SPRAY WITH SUCTION FROM SUPP POOL AND PUMP FLOW BELOW VL MAY RESULT IN EQUIPMENT DAMAGE
PROLONGED OPERATION IN YELLOW AREA OF FIG 8 MAY RESULT IN ADDITIONAL CONTAINMENT LOADING AND PWR INSTABILITIES
FIG 7 VL
RHR & CS VORTEX LIMIT
RHR OPERATION BELOW 19 FEET MAY RESULT IN EQUIPMENT DAMAGE
CORE SPRAY OPERATION BELOW CURVE MAY RESULT IN EQUIPMENT DAMAGE
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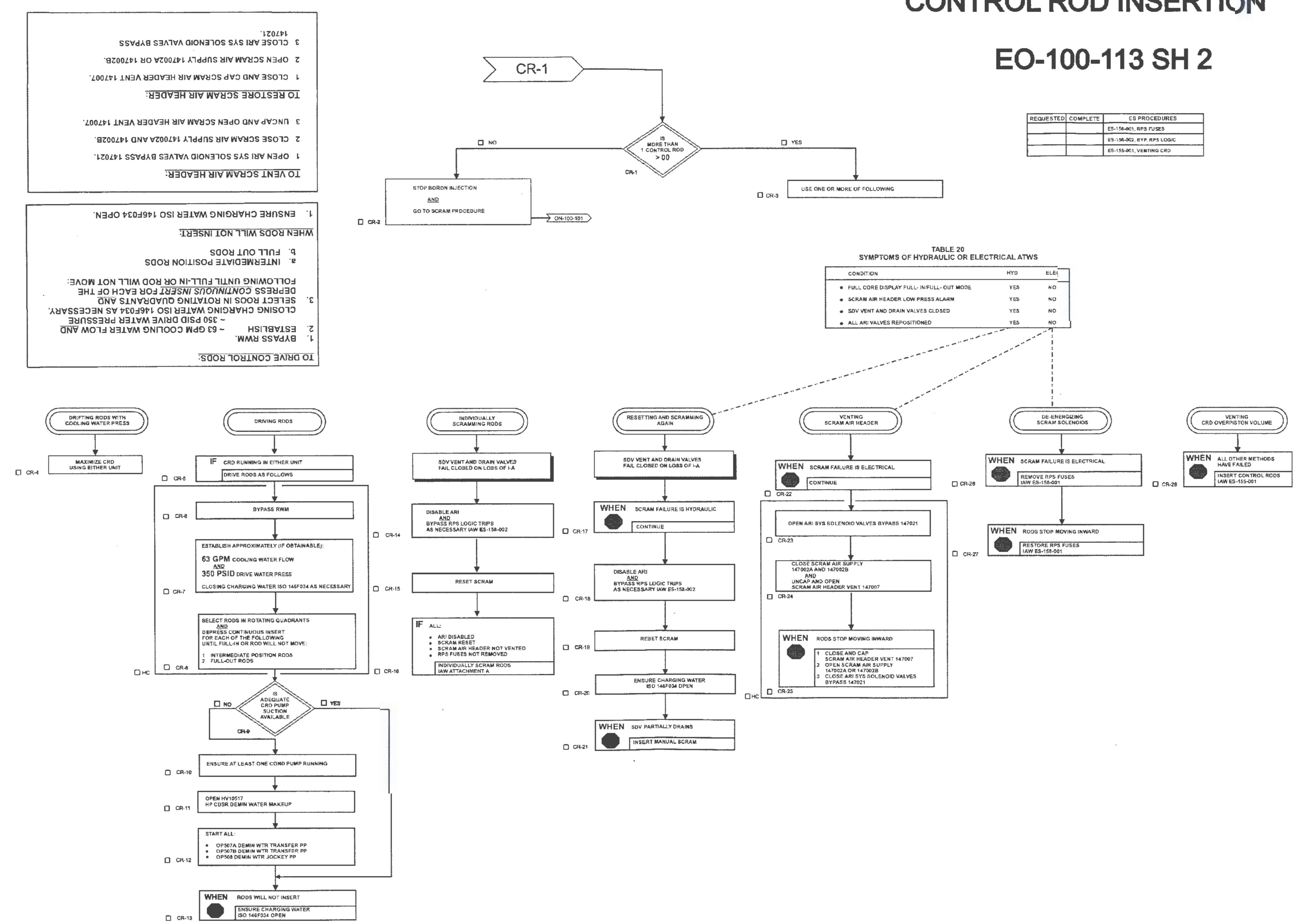
CONTROL ROD INSERTION

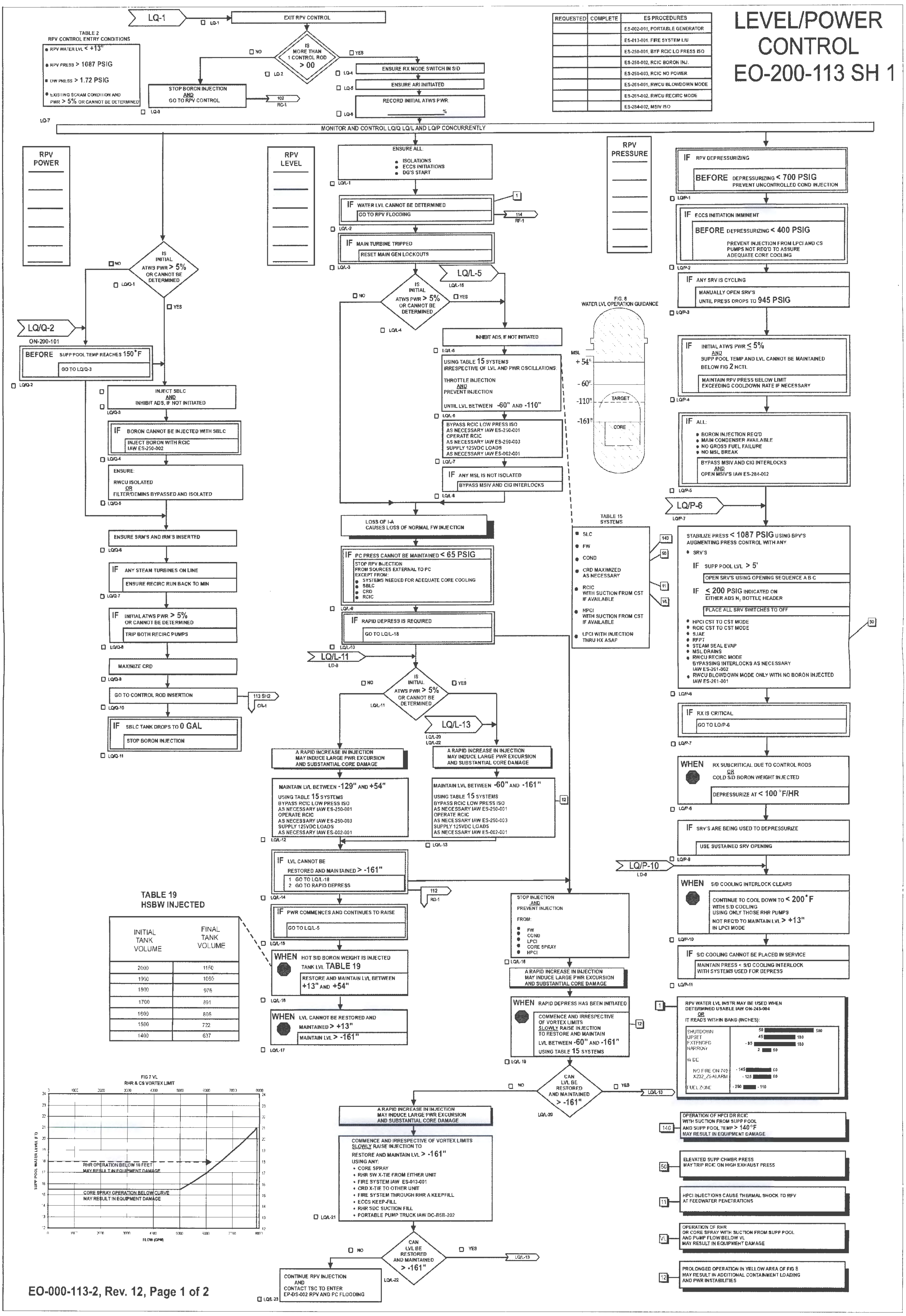
EO-100-113 SH 2



REQUESTED	COMPLETE	ES PROCEDURES
		ES-158-001, RPS FUSES
		ES-158-002, BYP. RPS LOGIC
		ES-155-001, VENTING CRD

TABLE 20
SYMPTOMS OF HYDRAULIC OR ELECTRICAL ATWS

CONDITION	HYD	ELEC
• FULL CORE DISPLAY FULL- IN/FULL- OUT MODE	YES	NO
• SCRAM AIR HEADER LOW PRESS ALARM	YES	NO
• SDV VENT AND DRAIN VALVES CLOSED	YES	NO
• ALL ARI VALVES REPOSITIONED	YES	NO


LEVEL/POWER CONTROL
EO-200-113 SH 1
LQ-1
EXIT RPV CONTROL
TABLE 2
RPV CONTROL ENTRY CONDITIONS
RPV WATER LVL < +13"
RPV PRESS > 1087 PSIG
DW PRESS > 1.72 PSIG
EXISTING SCRAM CONDITION AND PWR > 5% OR CANNOT BE DETERMINED
IS MORE THAN 1 CONTROL ROD > 00
STOP BORON INJECTION AND GO TO RPV CONTROL
ENSURE RX MODE SWITCH IN S/D
ENSURE ARI INITIATED
RECORD INITIAL ATWS PWR ______ %
REQUESTED
COMPLETE
ES PROCEDURES
ES-002-001, PORTABLE GENERATOR
ES-013-001, FIRE SYSTEM L/U
ES-250-001, BYP RCIC LO PRESS ISO
ES-250-002, RCIC BORON INJ.
ES-250-003, RCIC NO POWER
ES-261-001, RWCU BLOWDOWN MODE
ES-261-002, RWCU RECIRC MODE
ES-284-002, MSIV ISO
MONITOR AND CONTROL LQ/Q LQ/L AND LQ/P CONCURRENTLY
RPV POWER
RPV LEVEL
RPV PRESSURE
ENSURE ALL
ISOLATIONS
ECCS INITIATIONS
DG'S START
IF WATER LVL CANNOT BE DETERMINED
GO TO RPV FLOODING
IF MAIN TURBINE TRIPPED
RESET MAIN GEN LOCKOUTS
IF RPV DEPRESSURIZING
BEFORE DEPRESSURIZING < 700 PSIG
PREVENT UNCONTROLLED COND INJECTION
IF ECCS INITIATION IMMINENT
BEFORE DEPRESSURIZING < 400 PSIG
PREVENT INJECTION FROM LPCI AND CS PUMPS NOT REQ'D TO ASSURE ADEQUATE CORE COOLING
IF ANY SRV IS CYCLING
MANUALLY OPEN SRV'S UNTIL PRESS DROPS TO 945 PSIG
IS INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
LQ/Q-2
BEFORE SUPP POOL TEMP REACHES 150°F
GO TO LQ/Q-3
INJECT SBLC AND INHIBIT ADS, IF NOT INITIATED
IF BORON CANNOT BE INJECTED WITH SBLC
INJECT BORON WITH RCIC IAW ES-250-002
ENSURE: RWCU ISOLATED OR FILTER/DEMINS BYPASSED AND ISOLATED
ENSURE SRM'S AND IRM'S INSERTED
IF ANY STEAM TURBINES ON LINE
ENSURE RECIRC RUN BACK TO MIN
IF INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
TRIP BOTH RECIRC PUMPS
MAXIMIZE CRD
GO TO CONTROL ROD INSERTION
IF SBLC TANK DROPS TO 0 GAL
STOP BORON INJECTION
LQ/L-5
IS INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
INHIBIT ADS, IF NOT INITIATED
USING TABLE 15 SYSTEMS IRRESPECTIVE OF LVL AND PWR OSCILLATIONS
THROTTLE INJECTION AND PREVENT INJECTION
UNTIL LVL BETWEEN -60" AND -110"
BYPASS RCIC LOW PRESS ISO AS NECESSARY IAW ES-250-001
OPERATE RCIC AS NECESSARY IAW ES-250-003
SUPPLY 125VDC LOADS AS NECESSARY IAW ES-002-001
IF ANY MSL IS NOT ISOLATED
BYPASS MSIV AND CIG INTERLOCKS
FIG. 8 WATER LVL OPERATION GUIDANCE
MSL +54" -60" -110" -161" TARGET CORE
IF RPV PWR ≤ 5%
AND SUPP POOL TEMP AND LVL CANNOT BE MAINTAINED BELOW FIG 2 HCTL
MAINTAIN RPV PRESS BELOW LIMIT EXCEEDING COOLDOWN RATE IF NECESSARY
IF ALL:
BORON INJECTION REQ'D
MAIN CONDENSER AVAILABLE
NO GROSS FUEL FAILURE
NO MSL BREAK
BYPASS MSIV AND CIG INTERLOCKS AND OPEN MSIV'S IAW ES-284-002
LQ/P-6
LOSS OF I-A CAUSES LOSS OF NORMAL FW INJECTION
TABLE 15 SYSTEMS
SLC
FW
COND
CRD MAXIMIZED AS NECESSARY
RCIC WITH SUCTION FROM CST IF AVAILABLE
HPCI WITH SUCTION FROM CST IF AVAILABLE
LPCI WITH INJECTION THRU HX ASAP
STABILIZE PRESS < 1087 PSIG USING BPV'S AUGMENTING PRESS CONTROL WITH ANY SRV'S
IF SUPP POOL LVL > 5'
OPEN SRV'S USING OPENING SEQUENCE A B C
IF ≤ 200 PSIG INDICATED ON EITHER ADS N2 BOTTLE HEADER
PLACE ALL SRV SWITCHES TO OFF
HPCI CST TO CST MODE
RCIC CST TO CST MODE
SJAE
RFPT
STEAM SEAL EVAP
MSL DRAINS
RWCU RECIRC MODE BYPASSING INTERLOCKS AS NECESSARY IAW ES-261-002
RWCU BLOWDOWN MODE ONLY WITH NO BORON INJECTED IAW ES-261-001
IF PC PRESS CANNOT BE MAINTAINED < 65 PSIG
STOP RPV INJECTION FROM SOURCES EXTERNAL TO PC EXCEPT FROM: SYSTEMS NEEDED FOR ADEQUATE CORE COOLING, SBLC, CRD, RCIC
IF RAPID DEPRESS IS REQUIRED
GO TO LQ/L-18
LQ/L-11
IS INITIAL ATWS PWR > 5% OR CANNOT BE DETERMINED
LQ/L-13
IF RX IS CRITICAL
GO TO LQ/P-6
A RAPID INCREASE IN INJECTION MAY INDUCE LARGE PWR EXCURSION AND SUBSTANTIAL CORE DAMAGE
MAINTAIN LVL BETWEEN -129" AND +54"
MAINTAIN LVL BETWEEN -60" AND -161"
USING TABLE 15 SYSTEMS
WHEN RX SUBCRITICAL DUE TO CONTROL RODS OR COLD S/D BORON WEIGHT INJECTED
DEPRESSURIZE AT < 100 °F/HR
IF SRV'S ARE BEING USED TO DEPRESSURIZE
USE SUSTAINED SRV OPENING
LQ/P-10
IF LVL CANNOT BE RESTORED AND MAINTAINED > -161"
1 GO TO LQ/L-18
2 GO TO RAPID DEPRESS
WHEN S/D COOLING INTERLOCK CLEARS
CONTINUE TO COOL DOWN TO < 200°F WITH S/D COOLING USING ONLY THOSE RHR PUMPS NOT REQ'D TO MAINTAIN LVL > +13" IN LPCI MODE
TABLE 19
HSBW INJECTED
INITIAL TANK VOLUME | FINAL TANK VOLUME
2000 | 1150
1900 | 1060
1800 | 976
1700 | 891
1600 | 806
1500 | 722
1400 | 637
IF PWR COMMENCES AND CONTINUES TO RAISE
GO TO LQ/L-5
WHEN HOT S/D BORON WEIGHT IS INJECTED TANK LVL TABLE 19
RESTORE AND MAINTAIN LVL BETWEEN +13" AND +54"
WHEN LVL CANNOT BE RESTORED AND MAINTAINED > +13"
MAINTAIN LVL > -161"
STOP INJECTION AND PREVENT INJECTION FROM: FW, COND, LPCI, CORE SPRAY, HPCI
IF S/D COOLING CANNOT BE PLACED IN SERVICE
MAINTAIN PRESS < S/D COOLING INTERLOCK WITH SYSTEMS USED FOR DEPRESS
WHEN RAPID DEPRESS HAS BEEN INITIATED
COMMENCE AND IRRESPECTIVE OF VORTEX LIMITS SLOWLY RAISE INJECTION TO RESTORE AND MAINTAIN LVL BETWEEN -60" AND -161" USING TABLE 15 SYSTEMS
CAN LVL BE RESTORED AND MAINTAINED > -161"
FIG 7 VL RHR & CS VORTEX LIMIT
RHR OPERATION BELOW 18 FEET MAY RESULT IN EQUIPMENT DAMAGE
CORE SPRAY OPERATION BELOW CURVE MAY RESULT IN EQUIPMENT DAMAGE
FLOW (GPM)
SUPP POOL WATER LEVEL (FT)
COMMENCE AND IRRESPECTIVE OF VORTEX LIMITS SLOWLY RAISE INJECTION TO RESTORE AND MAINTAIN LVL > -161" USING ANY:
CORE SPRAY
RHR SW X-TIE FROM EITHER UNIT
FIRE SYSTEM IAW ES-013-001
CRD X-TIE TO OTHER UNIT
FIRE SYSTEM THROUGH RHR A KEEPFILL
ECCS KEEP-FILL
RHR SDC SUCTION FILL
PORTABLE PUMP TRUCK IAW DC-BSB-202
CAN LVL BE RESTORED AND MAINTAINED > -161"
CONTINUE RPV INJECTION AND CONTACT TSC TO ENTER EP-DS-002 RPV AND PC FLOODING
RPV WATER LVL INSTR MAY BE USED WHEN DETERMINED USABLE IAW ON-245-004 OR IT READS WITHIN BAND (INCHES):
SHUTDOWN, UPSET, EXTENDED, NARROW, WIDE, FUEL ZONE
140 OPERATION OF HPCI OR RCIC WITH SUCTION FROM SUPP POOL AND SUPP POOL TEMP > 140°F MAY RESULT IN EQUIPMENT DAMAGE
50 ELEVATED SUPP CHMBR PRESS MAY TRIP RCIC ON HIGH EXHAUST PRESS
11 HPCI INJECTIONS CAUSE THERMAL SHOCK TO RFW AT FEEDWATER PENETRATIONS
VL OPERATION OF RHR OR CORE SPRAY WITH SUCTION FROM SUPP POOL AND PUMP FLOW BELOW VL MAY RESULT IN EQUIPMENT DAMAGE
12 PROLONGED OPERATION IN YELLOW AREA OF FIG 8 MAY RESULT IN ADDITIONAL CONTAINMENT LOADING AND PWR INSTABILITIES
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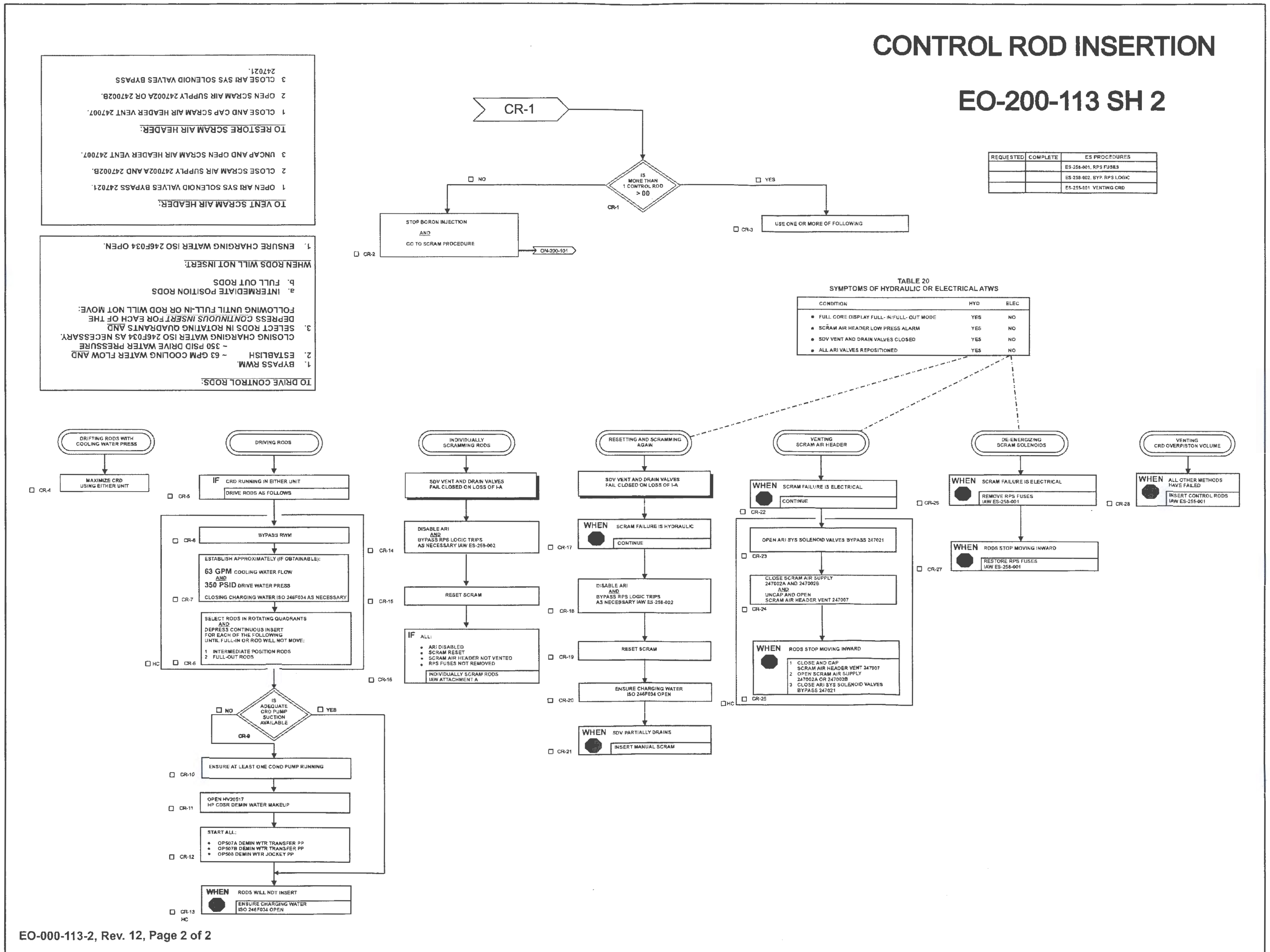
CONTROL ROD INSERTION
EO-200-113 SH 2
TO VENT SCRAM AIR HEADER:
1 OPEN AIR SYS SOLENOID VALVES BYPASS 247021.
2 CLOSE SCRAM AIR SUPPLY 247002A AND 247002B.
3 UNCAP AND OPEN SCRAM AIR HEADER VENT 247007.
TO RESTORE SCRAM AIR HEADER:
1 CLOSE AND CAP SCRAM AIR HEADER VENT 247007.
2 OPEN SCRAM AIR SUPPLY 247002A OR 247002B.
3 CLOSE AIR SYS SOLENOID VALVES BYPASS 247021.
TO DRIVE CONTROL RODS:
1. BYPASS RWM.
2. ESTABLISH ~63 GPM COOLING WATER FLOW AND ~350 PSID DRIVE WATER PRESSURE CLOSING CHARGING WATER ISO 246F034 AS NECESSARY.
3. SELECT RODS IN ROTATING QUADRANTS AND DEPRESS CONTINUOUS INSERT FOR EACH OF THE FOLLOWING UNTIL FULL-IN OR ROD WILL NOT MOVE:
a. INTERMEDIATE POSITION RODS
b. FULL OUT RODS
WHEN RODS WILL NOT INSERT:
1. ENSURE CHARGING WATER ISO 246F034 OPEN.
CR-1
IS MORE THAN 1 CONTROL ROD > 00
NO
YES
STOP BORON INJECTION AND GO TO SCRAM PROCEDURE
ON-200-101
USE ONE OR MORE OF FOLLOWING
REQUESTED
COMPLETE
ES PROCEDURES
ES-258-001, RPS FUSES
ES-258-002, BYP RPS LOGIC
ES-255-001, VENTING CRD
TABLE 20
SYMPTOMS OF HYDRAULIC OR ELECTRICAL ATWS
CONDITION
HYD
ELEC
FULL CORE DISPLAY FULL-IN/FULL-OUT MODE
SCRAM AIR HEADER LOW PRESS ALARM
SDV VENT AND DRAIN VALVES CLOSED
ALL ARI VALVES REPOSITIONED
DRIFTING RODS WITH COOLING WATER PRESS
MAXIMIZE CRD USING EITHER UNIT
DRIVING RODS
IF CRD RUNNING IN EITHER UNIT
DRIVE RODS AS FOLLOWS
BYPASS RWM
ESTABLISH APPROXIMATELY (IF OBTAINABLE):
63 GPM COOLING WATER FLOW
AND
350 PSID DRIVE WATER PRESS
CLOSING CHARGING WATER ISO 246F034 AS NECESSARY
SELECT RODS IN ROTATING QUADRANTS AND DEPRESS CONTINUOUS INSERT FOR EACH OF THE FOLLOWING UNTIL FULL-IN OR ROD WILL NOT MOVE:
1 INTERMEDIATE POSITION RODS
2 FULL-OUT RODS
IS ADEQUATE CRD PUMP SUCTION AVAILABLE
ENSURE AT LEAST ONE COND PUMP RUNNING
OPEN HV20517 HP CDSR DEMIN WATER MAKEUP
START ALL:
OP507A DEMIN WTR TRANSFER PP
OP507B DEMIN WTR TRANSFER PP
OP508 DEMIN WTR JOCKEY PP
WHEN RODS WILL NOT INSERT
ENSURE CHARGING WATER ISO 246F034 OPEN
INDIVIDUALLY SCRAMMING RODS
SDV VENT AND DRAIN VALVES FAIL CLOSED ON LOSS OF I-A
DISABLE ARI AND BYPASS RPS LOGIC TRIPS AS NECESSARY IAW ES-258-002
RESET SCRAM
IF ALL:
ARI DISABLED
SCRAM RESET
SCRAM AIR HEADER NOT VENTED
RPS FUSES NOT REMOVED
INDIVIDUALLY SCRAM RODS IAW ATTACHMENT A
RESETTING AND SCRAMMING AGAIN
WHEN SCRAM FAILURE IS HYDRAULIC
CONTINUE
ENSURE CHARGING WATER ISO 246F034 OPEN
WHEN SDV PARTIALLY DRAINS
INSERT MANUAL SCRAM
VENTING SCRAM AIR HEADER
WHEN SCRAM FAILURE IS ELECTRICAL
OPEN ARI SYS SOLENOID VALVES BYPASS 247021
CLOSE SCRAM AIR SUPPLY 247002A AND 247002B
UNCAP AND OPEN SCRAM AIR HEADER VENT 247007
WHEN RODS STOP MOVING INWARD
1 CLOSE AND CAP SCRAM AIR HEADER VENT 247007
2 OPEN SCRAM AIR SUPPLY 247002A OR 247002B
3 CLOSE ARI SYS SOLENOID VALVES BYPASS 247021
DE-ENERGIZING SCRAM SOLENOIDS
REMOVE RPS FUSES IAW ES-258-001
RESTORE RPS FUSES IAW ES-258-001
VENTING CRD OVERPISTON VOLUME
WHEN ALL OTHER METHODS HAVE FAILED
INSERT CONTROL RODS IAW ES-255-001
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