

AP600

Emergency Response Guidelines

AP600 Document Number GW-GJR-100

Revision 4

July 1, 1997

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Number SDG-1	Title RESPONSE TO LOSS OF RCS INVENTORY DURING SHUTDOWN	Rev./Date Rev. 4 7/1/97
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A. PURPOSE

The purpose of this guideline is to provide the actions necessary for maintaining core cooling and protecting the reactor core in the event that PRZR level is lost during shutdown operations when the RCS is intact or RCS level is too low to support operation of the RNS pumps during operation in reduced inventory conditions in the RCS.

B. SYMPTOMS OR ENTRY CONDITIONS

This guideline is entered from SDF-0.1, SHUTDOWN SAFETY Critical Safety Function Status Tree on an ORANGE condition.

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
1	Check If RNS Pumps Should Be Stopped:	
a.	RNS pumps - ANY RUNNING	a. Go to Step 2.
b.	RCS hot leg level - LESS THAN (SLO2)	b. Continue with Step 2. <u>IF</u> RCS level decreases to less than (SLO2) and RNS pumps start to cavitate, <u>THEN</u> stop RNS pumps.
c.	RNS pumps - CAVITATING	c. Continue with Step 2. <u>IF</u> RNS pumps start to cavitate, <u>THEN</u> stop RNS pumps.
d.	Stop RNS pumps	
2	Verify RCS Drain Path Isolation	Manually close valves as necessary.
	• RNS IRWST return valve	
	• Letdown	
	<p><i>NOTE The RCS is considered open when an opening exists that cannot be closed from the control room such as a SG manway.</i></p>	
3	Check RCS Status - OPEN	<u>IF</u> reduced inventory operations were in progress, <u>THEN</u> go to Step 4. <u>IF NOT</u> , <u>THEN</u> go to Step 15.
4	Verify Stage 1, 2 and 3 ADS Valves - OPEN	Manually open valves as necessary.

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
	<p><i>CAUTION</i></p> <ul style="list-style-type: none"> • Personnel working in containment should be warned before refilling the RCS to avoid inadvertent contamination of personnel working near RCS openings. • Only borated water should be added to the RCS to maintain adequate shutdown margin. • If RCS hot leg level remains less than (SL02) for greater than 30 minutes, automatic alignment for IRWST injection should be verified. 	
5	Refill RCS	
	<p>a. Refill RCS using CVS makeup pumps as necessary</p> <ul style="list-style-type: none"> • [Include additional AP600 details in EOPs] 	<p>a. IF CVS makeup can <u>NOT</u> be established, <u>THEN</u> refill the RCS using any of the following:</p> <ul style="list-style-type: none"> • CMTs. <p>-OR-</p> <ul style="list-style-type: none"> • Gravity feed using the IRWST to RNS suction line. <p>-OR-</p> <ul style="list-style-type: none"> • Gravity feed using the IRWST injection line.
	<p>b. Refill RCS until RCS hot leg level greater than (SL02)</p>	
6	Identify And Isolate Any RCS Leakage	
7	Check RCS Hot Leg Level - GREATER THAN (SL02)	Continue with Step 9. <u>WHEN</u> RCS hot leg level greater than (SL02), <u>THEN</u> do Step 8.

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
<p><i>CAUTION Starting an RNS pump may result in an RCS level decrease due to shrink or void collapse.</i></p>		
8	Try To Restore RNS Flow:	
	<ul style="list-style-type: none"> a. Start one RNS pump <ul style="list-style-type: none"> • [Include additional AP600 details in EOPs] b. Maintain RCS hot leg level - GREATER THAN (SL02) c. RNS flow - RESTORED d. Establish desired RCS cooldown rate e. Go to appropriate plant procedure 	c. Go to Step 9.
9	Check If Fourth Stage ADS Should Be Actuated:	
	<ul style="list-style-type: none"> a. CMT level - LESS THAN (SL05) b. Verify fourth stage ADS isolation valves - OPEN c. Verify IRWST injection isolation valves - OPEN 	<ul style="list-style-type: none"> a. Perform the following: <ul style="list-style-type: none"> 1) IF CMT level decreases to less than (SL05), THEN do Steps 9b and c. 2) IF RCS hot leg level indication decreases to less than (SL04), THEN manually actuate fourth stage ADS and do Steps 9b and c. 3) Continue with Step 10. b. Manually open valves as necessary. c. Manually open valves as necessary.

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
10	Check IRWST Level:	
	a. IRWST level - LESS THAN (SL06)	a. Perform the following: 1) <u>WHEN</u> IRWST level less than (SL06), <u>THEN</u> do Step 10b. 2) Go to Step 11.
	b. Verify containment sump recirculation valves - OPEN	b. Manually align valves as necessary.
11	Initiate Actions To Protect Personnel Working In Containment:	
	a. Evacuate non-essential personnel in containment	
	b. Periodically monitor containment radiation conditions	
12	Initiate Actions To Establish Containment Closure:	
	• Equipment hatch	
	• Personnel hatch	
	• Containment purge and exhaust system	
	• [Include additional AP600 details in EOPs]	
13	Start Available Containment Fan Coolers	
14	Return To Step 3	

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
15	Check If CMIs Should Be Actuated:	
a.	PRZR level - LESS THAN (SL01)	a. Go to Step 22.
b.	CMT injection valves - OPEN	b. Manually open valves as necessary.
16	Verify PRHR Actuated:	Actuate PRHR Initiation. IF valves will <u>NOT</u> open, <u>THEN</u> manually open valves as necessary.
	• Verify PRHR isolation valves - OPEN	
17	Check If ADS Should Be Actuated:	
a.	CMT level - LESS THAN (SL03)	a. IF RCS hot leg level indication greater than (SL04), <u>THEN</u> go to Step 22. IF <u>NOT</u> , <u>THEN</u> manually actuate ADS.
b.	Verify first stage ADS isolation valves - OPEN	b. Manually open valves as necessary.
c.	Check second stage ADS valves - OPEN	c. <u>WHEN</u> (ST01) seconds have elapsed from first stage ADS signal, <u>THEN</u> verify second stage ADS valves open. IF <u>NOT</u> , <u>THEN</u> manually open second stage ADS valves as necessary.
d.	Check third stage ADS valves - OPEN	d. <u>WHEN</u> (ST02) seconds have elapsed from second stage ADS signal, <u>THEN</u> verify third stage ADS valves open. IF <u>NOT</u> , <u>THEN</u> manually open third stage ADS valves as necessary.
	e. Align RNS to inject into RCS	

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
18	Check If Fourth Stage ADS Should Be Actuated:	
a.	CMT level - LESS THAN (SL05)	a. Perform the following: <ol style="list-style-type: none"> 1) IF CMT level decreases to less than (SL05), THEN do Steps 18b and c. 2) IF RCS hot leg level indication decreases to less than (SL04), THEN manually actuate fourth stage ADS and do Steps 18b and c. 3) Continue with Step 19.
b.	Verify fourth stage ADS isolation valves - OPEN	b. Manually open valves as necessary.
c.	Verify IRWST injection isolation valves - OPEN	c. Manually open valves as necessary.
19	Check IRWST Level:	
a.	IRWST level - LESS THAN (SL06)	a. Perform the following: <ol style="list-style-type: none"> 1) WHEN IRWST level less than (SL06), THEN do Step 19b. 2) Go to Step 27.
b.	Verify containment sump recirculation valves - OPEN	b. Manually align valves as necessary.
20	Evaluate Long Term Plant Status	
21	Go To Appropriate Plant Procedure	

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
	<p><i>CAUTION</i></p> <ul style="list-style-type: none"> • Personnel working in containment should be warned before refilling the RCS to avoid inadvertent contamination of personnel working near RCS openings. • Only borated water should be added to the RCS to maintain adequate shutdown margin. 	
22	Maintain PRZR Level - GREATER THAN (SL01)	
	<p>a. Maintain PRZR level using CVS makeup pumps as necessary</p> <ul style="list-style-type: none"> • [Include additional AP600 details in EOPs] 	<p>a. IF CVS makeup can <u>NOT</u> be established, <u>THEN</u> maintain PRZR level using any of the following:</p> <ul style="list-style-type: none"> • CMTs. <p>-OR-</p> <ul style="list-style-type: none"> • Gravity feed using the IRWST to RNS suction line. <p>-OR-</p> <ul style="list-style-type: none"> • Gravity feed using the IRWST injection line.
23	Check If CMT Injection Should Be Isolated	
	<p>a. PRZR level - GREATER THAN (SL01)</p> <p>b. Close CMT injection valves</p>	<p>a. Continue with Step 24. <u>WHEN</u> PRZR level greater than (SL01), <u>THEN</u> do Step 23b.</p>

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
<p><i>CAUTION Starting an RNS pump may result in an RCS level decrease due to shrink or void collapse.</i></p>		
24	Try To Restore RNS Flow:	
	a. RCS hot leg level - GREATER THAN (SLO2)	a. Go to Step 25.
	b. Start one RNS pump	
	• [Include additional AP600 details in EOPs]	
	c. Try to maintain PRZR level - GREATER THAN (SLO1)	
	d. RNS flow - RESTORED	d. Go to Step 25.
	e. CMTs - ISOLATED	e. Return to Step 22.
	f. PRHR - ISOLATED	f. Close PRHR isolation valves.
	g. Establish desired RCS cooldown rate	
	h. Go to appropriate plant procedure	
25	Establish RCS Heat Sink Using SGs:	
	a. SGs - ANY AVAILABLE	a. Perform the following:
		1) Try to restore SGs to service.
		2) Go to Step 26.
	b. Feed SGs as necessary to establish and maintain SG level	
	c. Open respective SG PORVs	

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
26	Establish RCS Heat Sink Using PRHR:	
a.	PRHR - AVAILABLE	a. Continue with Step 27. Try to restore PRHR. <u>WHEN</u> PRHR available, <u>THEN</u> do Steps 26b and c.
b.	Align PRHR to Cool RCS <ul style="list-style-type: none"> • [Include additional AP600 details in EOPs] 	
c.	PRHR cooling - IN SERVICE	c. <u>IF</u> RCS temperature increases to greater than (ST03) °F before a heat sink is established, <u>THEN</u> open all ADS valves.
27	Initiate Actions To Protect Personnel Working In Containment:	
a.	Evacuate non-essential personnel in containment	
b.	Periodically monitor containment radiation conditions	
28	Initiate Actions To Establish Containment Closure:	
	<ul style="list-style-type: none"> • Equipment hatch • Personnel hatch • Containment purge and exhaust system • [Include additional AP600 details in EOPs] 	
29	Start Available Containment Fan Coolers	

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STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
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30 Return To Step 15

- END -

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FOOTNOTES

Refer to SD GUIDELINE FOOTNOTE DEFINITION Document for a description of all footnoted parameters used in this guideline.

AP600

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Background Information

Book 1

Revision 4

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AP600 Document Number GW-CJR-100

Background Information

Book 2

Revision 4

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BACKGROUND INFORMATION
FOR
AP600
SHUTDOWN
EMERGENCY RESPONSE GUIDELINE

SDG-1
AP600 RESPONSE TO LOSS OF RCS INVENTORY
DURING SHUTDOWN

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3.2 Key Utility Decision Points

There is one key utility decision point in this guideline when the operator must initiate actions to protect personnel inside containment. In Steps 11 and 27, the operator is instructed to evacuate non-essential personnel inside containment. The operator will have to determine which personnel must be evacuated from containment at this time in the guideline.