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THE B&W **OWNERS GROUP**

Operator Support Committee

EMERGENCY OPERATING PROCEDURES TECHNICAL BASES DOCUMENT

Volume 2
GEOG Bases

AmerGen Energy Company, LLC
Duke Energy Corporation
Entergy Operations, Inc.
FirstEnergy Nuclear Operating Company
Florida Power Corporation

74-1152414

FRAMATOME TECHNOLOGIES

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TECHNICAL DOCUMENT

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VOLUME 2

GEOG BASES

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Part I

Introduction

The Generic Emergency Operating Guideline (GEOG) Bases is an annotated version of the GEOG in Volume 1. The GEOG Bases is intended to provide concise, readily accessible bases for each step or group of related steps in Volume 1. The Bases provides a brief summary of the more extensive bases in Volume 3. It also provides a link between Volume 1 and 3 in two ways: first, by referencing the appropriate Volume 3 material, and second, by providing some insight to the structure of Volume 1, since Volume 1 represents only one of many possible ways to proceduralize the guidance of Volume 3. Where applicable, the bases also cover cautions and notes related to the step(s).

The specific information provided in the GEOG Bases is grouped as follows:

Strategy	A summary of the basic mitigation strategy is stated at the front of each section no sequence is expressed or implied; any sequence requirements are provided with respective steps.
Indicators and Controls	A list of typical indicators and controls necessary to accomplish the step or group of steps is provided. This is not intended to be an all-inclusive list nor does it reflect plant-specific parameter designations. For example, "pump status" used in Volume 2 may, depending on the plant, be an indicator light, motor ammeter, discharge pressure, governor pressure, etc.
Purpose of Step	A brief purpose of the step is given, stating the objective to be accomplished.
Bases	A concise bases is provided for the actions taken in the step(s) and setpoints or values used in the step(s). This summary of the more extensive bases in Volume 3 should be sufficient to understand the purpose of the step(s).
Sequence	A brief statement of any sequence requirements imposed by the TBD.

TBD Volume 3 References — A list of Volume 3 references is provided to link the actions in the GEOG to the generic bases. This allows ready access to the full bases information and provides insight into the derivation of the GEOG from the bases since most steps have several Volume 3 references.

Volume 2 is intended to be used as a quick reference guide for readers of Volume 1. If questions regarding a specific step of Volume 1 are not answered in Volume 2, then the associated Volume 3 references should complete the picture.

Step sequencing in plant EOPs relative to the steps in the GEOG is affected by many aspects, including plant design differences, command and control policies, addition of items beyond the GEOG scope, etc. For example, the addition of a single plant-specific step would place the remaining steps out of sequence, and repeated justification for each 'displaced' step is not necessary. Therefore, the sequencing bases provided in Volume 2 is limited to those sequencing requirements imposed by FTI. Much of the GEOG does not have specific sequence requirements; steps could be re-ordered in many instances and still accomplish the goal. Some points regarding sequence bases:

1. FTI identifies specific sequence requirements imposed by analyses and engineering development of the guidelines. There will be other steps where a relative sequence is obvious, but not imposed as a requirement. For example, a step to bypass automatic low-pressure protection when conditions permit should logically come before a step to intentionally depressurize.

2. Logical sequencing like the bypass-depressurization example in 1 above should be borne out in the V&V of the plant EOPs. The intent of sequence basis information in Volume 2 is to provide vendor-sequencing criteria, which may not be obvious in V&V.

3. It is logical for steps structured as IF AT ANY TIME to be placed early in the section to ensure the broadest possible coverage within the section. Such reasoning is not specified as a sequence requirement imposed by the vendor.

4. A Utility should consider their command and control of EOPs in determining step sequencing. If the policy is to read and acknowledge details of steps even if they do not yet apply, then a different step sequence may be in order. For example, if the policy would require detailed three-point communication on a step or block of steps that do not yet apply then placement of these steps should consider whether more urgent steps may be unduly delayed.

5. Similarly, a Utility should also consider the operating philosophy for preparations and sequencing. For example, a step using SG drains to aid mitigation of a tube rupture may require 30 minutes to allow lineup. If the policy does not allow having the lineup started without first reaching an explicit EOP step, even though it is obvious the drains will be needed, then this should be factored into the EOP sequencing. The GEOG does not assume that there will be significant delays in performing its prescribed actions due to operating philosophy.

6. The overall intent in providing sequence bases information in this volume is to ensure the user is aware of any specific vendor requirements, without unduly imposing restrictions in EOP structure. For example, during a cooldown, steps to cool and depressurize the RCS will work in either order; there is no basis to require that a cooldown rate be established before any depressurization occurs or vice versa. There are many instances in the GEOG where the basic steps could be placed in a different order and still accomplish the objectives without violating any limits. This is acceptable, and there is no benefit to be gained from imposing arbitrary restrictions.

Values used in the GEOG, whether specific numbers or referenced plant-specific parameters, may or may not require error correction by the user. Many control parameters in the GEOG are target values, but some parameters must be assured even accounting for instrument and process errors. The bases in this volume identifies whether error correction is required. Users may have a graduated error correction process depending on the use and significance of a parameter. The bases does not attempt to identify a degree of error correction. Whether error correction is required or not as stated herein is with respect to use of the GEOG. If the user has an existing error correction requirement on a parameter used in GEOG, the fact that the GEOG does not require error correction does not negate existing requirements. For example, the GEOG does not require error correction to allowable ranges for safety system bypass, but the user's range for bypass may already have a error correction requirement.

Part II

List of Acronyms/Abbreviations

AAC	Alternate AC
ADV	Atmospheric Dump Valve
AFW	Auxiliary or Emergency Feedwater
ANO-1	Arkansas Nuclear One Unit 1
ATOG	Abnormal Transient Operating Guidelines
ATWS	Anticipated Transient Without Scram
BCC	Boiler-Condenser Cooling
BWST	Borated Water Storage Tank
CBP	Condensate Booster Pump
C/D	Cooldown
CF	Core Flood
CFT	Core Flood Tank
CR-3	Crystal River Unit 3
CRDM	Control Rod Drive Motor
DB	Davis-Besse
DH	Decay Heat
DHR	Decay Heat Removal
DHRS	Decay Heat Removal System
DSS	Diverse Scram System
ECC	Emergency Core Cooling
ECCS	Emergency Core Cooling System
EFPT	Emergency Feedwater Pump Turbine
EFW	Emergency Feedwater
EFWP	Emergency Feedwater Pump
EOP	Emergency Operating Procedures
ERV	Electromatic Relief Valve

List of Acronyms/Abbreviations (Cont'd)

ES	Engineered Safeguards
FA	Fuel Assemblies
FW	Feedwater (any source)
GPM	Gallons Per Minute
HLL	Hot Leg Level
HPI	High Pressure Injection
HPV	High Point Vent
IA	Instrument Air
I/C	Incore
ICC	Inadequate Core Cooling
ICS	Integrated Control System
IST	Integrated Systems Tests
LCO	Limiting Condition for Operation
L/D	Letdown
LOCA	Loss of Coolant Accident
LOFW	Loss of Feedwater
LOOP	Loss of Offsite Power
LPI	Low Pressure Injection
LSCM	Loss of Subcooling Margin
MFPT	Main Feed Pump Turbine
MFW	Main Feedwater
MS	Main Steam
MSIV	Main Steam Isolation Valve
MSSV	Main Steam Safety Valve
MU	Make Up System
NC	Natural Circulation

List of Acronyms/Abbreviations (Cont'd)

NDT	Nil-Ductility Transition
NNI	Non-Nuclear Instrumentation
NPSH	Net Positive Suction Head
NSS	Nuclear Steam Supply
NSSS	Nuclear Steam Supply System
ONS 1	Oconee Nuclear Station Unit 1
ONS 2	Oconee Nuclear Station Unit 2
ONS 3	Oconee Nuclear Station Unit 3
PCT	Peak Clad Temperature
PORV	Pressurizer Power or Pilot Operated Relief Valve
PSI	Pounds Per Square Inch Gauge
PSIG	Pounds Per Square Inch Gauge
PSV	Pressurizer Safety Valve
P-T	Pressure versus Temperature
PTS	Pressurized Thermal Shock
PZR	Pressurizer
RB	Reactor Building or Containment
RBS	Reactor Building Spray
RC	Reactor Coolant
RCITS	Reactor Coolant Inventory Trending Systems
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RPS	Reactor Protection System
RTD	Resistance Temperature Detector
RV	Reactor Vessel

List of Acronyms/Abbreviations (Cont'd)

SAG	Severe Accident Guidelines
SBLOCA	Small Break Loss of Coolant Accident
SBO	Station Blackout
SCM	Subcooling Margin
S/D	Shut Down
SER	Safety Evaluation Report
SFAS	Safety Features Actuation System
SFRCS	Steam/Feed Rupture Control System
SG	Steam Generator
SGTR	Steam Generator Tube Rupture
SPDS	Safety Parameter Display System
SPPS	Secondary Plant Protection System
SPND	Self-Powered Neutron Detector
T_{ave}	Reactor Coolant Average Temperature
TBD	Emergency Operating Procedures Technical Bases Document
TBS	Turbine Bypass System
TBV	Turbine Bypass Valve
T/C	Thermocouple
T_{cold}	Reactor Coolant System Cold Leg Temperature
T_{hot}	Reactor Coolant System Hot Leg Temperature
TMI-1	Three Mile Island Unit 1
TR	Tube Rupture
T_{sat}	Saturation Temperature
VLV	Valve
VSSV	Vital System Status Verification

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION III.A – EOP ENTRY

Strategy:

- Ensure the reactor is shutdown. All subsequent actions are based on a subcritical reactor.
- Ensure the turbine is correctly placed off-line.
- Verify appropriately controlled core cooling.
- Ensure proper operation of key systems and equipment.
- Verify stable plant conditions or route appropriately.

1.0 TRIP THE REACTOR.

1.1 IF AT ANY TIME during the performance of steps 1.1-1.6 the reactor is shutdown, THEN go to step 2.0.

1.2 Deenergize CRDMs [prioritized list of available breakers].

1.3 Maintain adequate primary to secondary heat transfer.

1.4 Begin maximum boric acid addition to RCS.

1.5 IF main feedwater is not available, THEN ensure main turbine tripped and EFW actuated.

1.6 Do not continue until the reactor is shutdown.

Indicators and Controls

Indicators:
- Power Range Nuclear Instruments
- Intermediate Range Nuclear Instruments
- BWST to HPI pump suction valves position indication
- HPI valves position indication
- HPI flow rate
- HPI pump supervisory indicators
- Control rod individual position indication panel
- Control rod group average indicators
- MFW/EFW flow rate
- SGs levels and pressures
- RCS Temperature (T_{cold}, T_{sat}) and RCS pressure
- Main turbine stop and control valve position indication
- ADV and TBV position indication
- CRDM power supply breaker(s) position indication
- CRDM power supply bus voltage indication
- CRD system power supply alarms
- RCS boron concentration
- Reactivity balance calculation curves

Controls:
- Reactor trip manual push button
- Main turbine trip manual push button
- BWST to HPI pump suction valves controls
- HPI valves controls
- HPI pump controls
- Control Rod Drive control panel
- MFW pump and valve controls

- EFW pump and valve controls
- ADV and TBV controls
- CRDM power supply breaker(s) controls

Purpose of Step
The purpose of this step is to ensure the reactor has been shutdown. If reactor shutdown is not verified, then guidance is provided that addresses ATWS concerns, such as maintaining a primary to secondary heat balance if possible (e.g., maintain main turbine and feedwater operation until reactor is successfully shutdown).

Bases
This step provides actions to mitigate a large-scale failure to trip (i.e., ATWS). Step 3.0 provides actions for stuck rods that can result in decreased shutdown margin. Verification of reactor power commensurate with successful reactor shutdown is necessary to ensure shutdown of the reactor has occurred or is occurring. If the reactor power indication shows reactor is not shutdown, there has been a failure of normal systems to shutdown the reactor. If control rods did not fully insert into the core, manual deenergization of control rods should be attempted, i.e., opening breakers to deenergize CRDMs.

Balancing primary to secondary heat transfer will help prevent excessive RCS pressure and temperature excursions while the reactor is still critical. Excessive RCS cooling can increase reactivity due to positive reactivity addition associated with moderator temperature coefficient. Attempts should be made to maintain MFW flow due to its higher capacity than EFW. The higher capacity may be needed until reactor is shutdown. If MFW is lost, then EFW actuation and turbine trip should be ensured to limit the heat balance mismatch and thus peak RCS pressure.

Maximum addition of boric acid to the RCS provides negative reactivity insertion to the reactor. Boric acid addition can be initiated quickly from the main control room. One method is to use the HPI pumps taking suction from the BWST and injecting borated water directly into the RCS via the HPI injection lines. Another method is to use the chemical addition system to add concentrated boric acid to the MU tank for injection into the RCS. For the specific plant conditions that exist, the method (e.g., boric acid source and flow path) which provides the maximum addition rate of boric acid into the RCS should be used, if possible. Negative reactivity addition using boron can be a relatively slow process and therefore should only be used while continuing to pursue other methods of reactor shutdown, e.g., accessing additional breakers outside the MCR.

Sequence
Step 1.0 must be completed before progressing any farther. With the exception of entry into III.E at power, the guidelines are based on a subcritical reactor and therefore must not be implemented until the reactor is shutdown. This includes not performing any actions specified in the rules until the reactor is shutdown, e.g., do not trip RCPs if SCM is lost while the reactor is not shutdown. The substeps of step 1.0 can be sequenced as best fits the plant-specific needs.

TBD Volume 3 References
III.A.2.2.1, III.A.3.1.A

2.0 TRIP THE TURBINE.

2.1 Ensure steam flow is secured to the turbine.

Indicators and Controls

Indicators: - Main turbine stop and control valve position indication
- Plant specific steam isolation valve position indication

Controls: - Main turbine trip pushbutton
- Plant specific steam isolation valve controls

Purpose of Step

The purpose of this step is to ensure the turbine is taken off-line as soon as the reactor is verified shutdown.

Bases

The main turbine is the largest steam load and can cause rapid overcooling of the RCS if not tripped following reactor shutdown. The turbine should trip automatically but the manual trip pushbutton is used to ensure prompt trip. In the unlikely event the turbine is still not tripped, then alternate plant-specific means of securing steam flow to the turbine should be used.

Sequence

This step must be performed after successful completion of step 1.0 (reactor verified shutdown) and prior to the VSSV checks beginning at step 3.0.

TBD Volume 3 References

III.A.2.2.2, III.A.3.2.A

SECTION III.A VITAL SYSTEM STATUS VERIFICATION

NOTE

If during the performance of the VSSV section, an upset in heat transfer symptom or SGTR symptom occurs, then treat the symptom immediately.

Indicators and Controls
N/A

Purpose of Step
This note provides a reminder that mitigation of a symptom takes priority over completion of these status checks.

Bases
The main thrust of the TBD is to provide the basis for operator actions for mitigating abnormal transients by means of predefined plant symptoms. By design (rigorous analyses and appropriate implementation of the TBD guidance) plant symptoms are given a higher priority over other conditions, such that their expeditious successful treatment will maintain core cooling and thus avert damage to the core. Mitigation of abnormal transients (symptoms) does not depend upon the operator's knowledge of what failed. Therefore, symptom treatment has priority over the stability checks of the VSSV (possible determination of what has failed).

Sequence
The note is placed prior to the VSSV steps.

TBD Volume 3 References
II.D.2.1.1 and II.D.2.2.1

VERIFICATION COLUMN | **REMEDIAL ACTION COLUMN**

3.0 ALL RODS EXCEPT GROUP 8 FULLY INSERTED

Begin boration as necessary to achieve [acceptable shutdown margin].

Indicators and Controls

Indicators:
- Control rod individual position indication panel
- Control rod group average indicators
- Plant-specific shutdown margin determination method
- Chemical addition system indications

Controls:
- MU/HPI pumps, valves controls
- Chemical addition system controls

Purpose of Step

The purpose of this step is to check for any stuck rods and, if any exist, to add negative reactivity to the RCS as necessary to counteract the effect of a stuck rod(s) and achieve [acceptable shutdown margin].

Bases

Completion of step 1.0 ensures reactor is sub-critical. This step ensures that minimum shutdown margin is achieved or will be achieved due to boric acid addition to the RCS. Stuck rod(s) may result in higher required boric acid concentration than would be required normally to achieve [plant specific acceptable shutdown margin]. [Plant specific acceptable shutdown margin] must be reached to ensure reactivity excursions do not result in recriticality.

Starting with this step, the remainder of this section is in a two-column format. This the format selected for the GEOG. There is no expressed format criteria being imposed on utility EOPs.

Sequence

There is no specific sequence requirement relative to the remainder of this section. However, if one or more stuck rods exist, it is prudent to take steps to ensure adequate shutdown margin as soon as reasonably achievable and prior to any activity, such as a cooldown, that could add positive reactivity.

TBD Volume 3 References

III.A.2.2.1 and III.A.3.1.B

VERIFICATION COLUMN		REMEDIAL ACTION COLUMN
4.0 PROPER SECONDARY INVENTORY CONTROL.	**a.**	**<u>IF</u> either SG level > [SG high level], <u>THEN</u> secure feed flow to affected SG(s).**
	b.	**Control FW.**

Indicators and Controls

Indicators:
- MFW flow rate
- MFW control and block valve position indication
- MFW pump speed indication
- SG levels
- RCS T_{avg}
- EFW pump status indications
- EFW flow rate
- EFW control valve position indication
- Other plant-specific FW source indications

Controls:
- MFW pump controls
- EFW pump controls
- Main and/or emergency feedwater control and block valve controls
- Other plant-specific FW source controls

Purpose of Step

This step checks for proper main feedwater system response and directs actions to mitigate a feedwater transient if it occurs. Proper control of primary to secondary heat transfer requires that feedwater be adequately controlled.

Bases

Following shutdown of the reactor and main turbine, feedwater flow and SG levels should be checked because if the feedwater system is still operating at full capacity (not normal situation following a reactor trip), possible carryover and main steam line flooding can occur within one minute of reactor trip. It is also necessary to ensure proper feedwater flow exists for conditions other than immediate post-trip.

If high flow exists with high SG levels, leading to possible feedwater carryover, then feedwater flow should be rapidly terminated; one possible way of accomplishing this is to trip the running main feedwater pumps. If feedwater carryover is not imminent, then time exists to attempt to regain control with control valves. It is also possible that underfeeding of SGs will require manipulation of the FW control and/or block valves and/or starting other feedwater sources to ensure proper primary to secondary heat transfer is maintained.

The plant specific value for [SG high level] is a limiting value and should be error-corrected.

Sequence

There is no specific sequence requirement. MFW transients can occur relatively quickly and thus it is prudent to have this check performed relatively early.

TBD Volume 3 References

III.A.2.2.2 and III.A.3.2.B

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
5.0 PROPER SECONDARY PRESSURE CONTROL.	**Control TBVs or ADVs manually to maintain desired header pressure. Reduce header pressure if necessary to reseat MSSVs.**

Indicators and Controls

Indicators:
- Turbine header pressure
- TBV and ADV position indication
- Turbine header pressure setpoint

Controls:
- TBV and ADV controls.

Purpose of Step

This step checks for proper turbine header pressure control and directs the manual use of TBVs/ADVs if proper pressure is not being maintained.

Bases

Turbine header pressure must be controlled properly in order to minimize RCS cooldown and depressurization (due to RC density increase leading to pressurizer level decrease) and maintain the appropriate primary to secondary heat balance. If normal automatic turbine header pressure controls have failed, manual turbine header pressure control should be attempted. This includes reducing header pressure to reseat MSSVs if necessary.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.A.2.2.2, and III.A.3.2.A

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
6.0 MU FLOW RESPONDING PROPERLY TO CONTROL PZR LEVEL TO [post-trip level setpoint].	**Control makeup and letdown manually as required.**

Indicators and Controls

Indicators:
- MU flow rate
- MU valve position indication
- Pressurizer level
- MU pump indications
- Letdown system indications
- MU tank level

Controls:
- MU valve controls
- MU pump controls
- Letdown valve and cooler controls

Purpose of Step

This step checks for proper response of the MU system and pressurizer level response and directs action to control pressurizer level if response is abnormal.

Bases

For a normal reactor trip as well as other plant conditions, appropriate control of pressurizer level contributes to proper RCS pressure/inventory control.

If the normal automatic MU controls have failed to respond properly to pressurizer level, manual control is necessary.

If a symptom is not present, then HPI is not used to control pressurizer level. That is, unless a transient (symptom) is in progress, pressurizer level is adjusted with MU; HPI is not needed and can complicate achieving stability and cause unnecessary HPI nozzle thermal cycles.

The plant-specific value for [post-trip level setpoint] is intended as a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.A.2.2.3 and III.A.3.3.

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
7.0 GENERATOR OUTPUT AND EXCITER BREAKERS OPEN.	**Ensure the output breakers are open; then open the exciter breaker.**

Indicators and Controls

Indicators:
- Main generator output breaker(s) position indication
- Plant specific main generator output electrical indications
- Main generator exciter breakers(s) position indication

Controls:
- Output breaker controls
- Exciter breaker controls

Purpose of Step

The purpose of this step is to ensure the main turbine-generator is properly disconnected from the grid.

Bases

When the prime mover for the main generator (i.e., the main turbine) is shutdown, then the main generator must be disconnected from the grid to prevent motoring. If there has been a successful automatic or manual trip of the main turbine, then this step provides a check to ascertain if the main generator has been disconnected from the grid. The main generator breakers may remain closed for a few seconds after the trip due to design time delays. The exciter breaker should not be opened until the output breaker is verified open for protection of the generator.

Sequence

There is no sequence requirement for the placement of this step. However, if the generator must be manually disconnected, the output breakers must be opened and verified open prior to opening the exciter breaker.

TBD Volume 3 References

III.A.2.2.4 and III.A.3.4

VERIFICATION COLUMN | **REMEDIAL ACTION COLUMN**

8.0 INSTRUMENT AIR SYSTEM PRESSURE PROPER.

Refer to [procedure number].

Indicators and Controls:

Indicators:
- Instrument air pressure
- Instrument air compressor indications
- Instrument air system sectionalizing valves position indication
- Additional plant specific indications

Controls:
- Plant specific controls

Purpose of Step

The purpose of this step is to check for proper instrument air pressure and to direct actions to control the plant with a degraded instrument air system while attempts are made to restore the instrument air system to proper operation.

Bases

Certain plant control functions (e.g., feedwater flow) and indications may depend upon proper instrument air system operation. If normal automatic instrument air controls have failed to maintain proper operation, corrective steps should be taken in accordance with [plant specific procedure].

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.A.2.2.5.

VERIFICATION COLUMN | **REMEDIAL ACTION COLUMN**

9.0 NNI/ICS POWER ON.

Refer to [procedure number].

Indicators and Control:
Indicators: - Plant specific indicators

Controls: - Plant specific controls

Purpose of Step
The purpose of this step is to check status of NNI/ICS power and refer to plant specific guidance on controlling the plant without NNI/ICS systems while attempting to restore NNI/ICS power. In addition, acknowledging which instruments and controls are still functional following an NNI/ICS power loss is useful in controlling the plant.

Bases
If NNI/ICS power is lost, it is desirable to restore it as soon as possible (this is a secondary concern and should not be necessary for transient mitigation). Even though restoration of NNI/ICS power is not required for successful transient mitigation, expeditious restoration may enhance transient management. If NNI/ICS power is lost, corrective steps should be taken in accordance with [plant specific procedure].

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.A.2.2.4.

VERIFICATION COLUMN

10.0 ES BUSSES ENERGIZED FROM [normal source].

REMEDIAL ACTION COLUMN

a. Ensure proper operation of emergency AC supply.

b. IF no [emergency power source (or alternate AC source)] starts and loads, THEN refer to [SBO procedure] as appropriate.

c. Start a MU pump and reestablish seal injection per [plant specific guidance].

Indicators and Controls:

Indicators:
- Plant specific emergency power system indications
- Plant specific diesel indications
- Seal injection flow rate
- Seal injection valve indication
- MU pump indications

Controls:
- Plant specific emergency power system controls
- Plant specific diesel controls
- Seal injection valve controls
- MU pump controls

Purpose of Step

The purpose of this step is to check if auxiliary power is available. If auxiliary power is not available, then emergency AC power is ensured. In the event emergency power is not available, then an appropriate SBO procedure is addressed. Once a source of power is available, a MU Pump is started.

Bases

Maintaining AC power to plant equipment will ensure successful transient mitigation. If normal auxiliary power is lost, then emergency power must be provided and a MU pump restarted to ensure appropriate seal flow and cooling. If all AC power is lost (emergency power not available), then adequate core cooling can be maintained by providing plant-specific guidance relative to plant control on DC power alone.

RCPs and any running MU pump will stop and seal injection flow will be lost upon loss of AC power. Actions should be taken to restore a MU pump and seal injection flow as soon as possible to prevent possible RCP seal damage and to enable restart of RCPs when offsite power is restored.

When RCPs stop, NC flow should develop and provide core cooling. This is ensured by the actions associated with Rule 4.0 and verified by operator checks that core cooling is being appropriately controlled. If this is not the case, LHT symptoms will develop and appropriate actions will be taken to establish adequate core cooling.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.A.2.2.4, III.A.3.3, III.A.3.4 and IV.H

VERIFICATION COLUMN | **REMEDIAL ACTION COLUMN**

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
11.0 NO ES ACTUATION SETPOINT REACHED.	**Ensure actuation of appropriate channels.**

Indicators and Controls

Indicators: - Alarm Panels
- ES equipment status

Controls: - Plant Specific ES Controls

Purpose of Step

The purpose of this step is to determine if an ES actuation has occurred or should have occurred and to ensure proper actuation if applicable.

Bases

Verification of the status of ES systems is required to ensure safe shutdown and core cooling capability along with RB integrity. If any ES system has actuated, plant specific guidance will be needed to verify proper actuation and operation of ES systems. In addition, if plant conditions indicate that an ES system should have initiated and failed to do so automatically, then actions must be taken to initiate the system manually.

Sequence

There is no specific sequence requirement.

TBD Volume III References

III.A.3.3

VERIFICATION COLUMN | REMEDIAL ACTION COLUMN

12.0 NO [secondary plant protection system] ACTUATION SETPOINT REACHED.

Ensure actuation as appropriate.

Indicators and Controls

Indicators:
- Alarm panels
- [secondary plant protection system] status
- Plant specific pump and valve status

Controls:
- [secondary plant protection system] controls
- Plant specific pump and valve controls

Purpose of Step

The purpose of this step is to ensure proper operation of secondary plant protection systems. This includes verifying or manually controlling secondary side equipment or systems.

Bases

Normally, it is expected that the [secondary plant protection system] will not be actuated, however, if this system is actuated the operator should ensure proper actuation and control of the [plant-specific systems].

EFW

Automatic actuation of the EFW system may indicate insufficient MFW flow or a loss of MFW flow. Primary to secondary heat transfer balance is dependent on proper operation of the EFW system under these conditions. Plants should verify the proper automatic actuation and control of the EFW system or manually initiate and/or control when required. Verify proper operation of the EFW control/isolation valves upon EFW system start.

MFW

Continued MFW system operation following successful start of EFW may lead to a primary to secondary heat trnasfer upset. This check should also ensure MFW is properly isolated to minimize plant cooldown and SG control problems. It is not desireable to have both MFW and EFW feeding the SGs at the same time.

Main Steam

Steam pressure control is required to balance primary to secondary heat transfer. This check is to ensure proper operation of the steam isolation portion of the [secondary plant protection system], if so equipped.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References
III.A.2.2.2, III.A.3.2.C

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
13.0 SUBCOOLING MARGIN ≥ [subcooling margin limit].	**Go to Loss of SCM, Section III.B Step 1.0.**

Indicators and Controls

Indicators:
- P-T display
- RCS pressure
- RCS temperature (T_{hot} or incore thermocouples)
- SCM monitor
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is to determine if subcooling margin exists. It is a routing step, which provides direction to the appropriate guidance in Section III.B if a lack of subcooling margin is identified.

Bases

VSSV is the entry point into the emergency operating guidelines. The main purpose of this section is to quickly identify any plant upsets or symptoms of upsets in heat transfer. Symptoms of upsets are continuously monitored and should be addressed as soon as they are identified. However, this step is the first of several checks for upsets in heat transfer in VSSV to ensure the plant is still in a stable heat transfer configuration. Adequate core cooling is assured as long as the core remains covered with reactor coolant. The core will remain covered as long as subcooling margin exists. Therefore, as long as subcooling margin exists, the core will be adequately cooled.

Of the three symptoms of upsets in heat transfer, i.e. loss of SCM, lack of primary to secondary heat transfer, and excessive primary to secondary heat transfer, loss of SCM receives the highest priority since its existence directly jeopardizes core cooling. Treatment of lack of primary to secondary heat transfer and excessive primary to secondary heat transfer should occur after actions to restore SCM have been taken.

The plant-specific value for [subcooling margin limit] is a limiting value and should be error corrected.

Sequence

Subcooling margin is the highest priority symptom, and therefore it is logical to check it prior to the other symptoms. However, there is no specific sequence requirement, and monitoring for all symptoms is a continuous requirement.

TBD Volume 3 References

II.A.3.1, II.B.3.2.1, III.A.2.3

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
14.0 CONTROLLED PRIMARY TO SECONDARY HEAT TRANSFER EXISTS.	**FOR LACK OF HEAT TRANSFER go to Section III.C step 1.0.** **FOR EXCESSIVE HEAT TRANSFER go to Section III.D STEP 1.0**

Indicators and Controls

Indicators:
- P-T display
- RCS temperature (T_{hot}, T_{cold}, incore thermocouples)
- RCS pressure
- SG pressure/levels
- FW flows
- SPDS
- SCM monitor

Controls: - N/A

Purpose of Step

The purpose of this step is to determine if primary to secondary heat transfer is being controlled properly. This is a routing step, which provides direction to the appropriate guidance in Section III.C or III.D if an upset in primary to secondary heat transfer is identified.

Bases

This is the second check for upsets in primary to secondary heat transfer. An upset in primary to secondary heat transfer will cause the primary system to either increase or decrease in temperature. Excessive heat transfer will cause the primary temperature to decrease while too little heat transfer will cause primary temperature to increase.

Achieving controlled primary to secondary heat transfer is one main goal of transient mitigation. If an upset in the balance of primary to secondary heat transfer is identified, actions must be taken to restore the balance in accordance with sections III.C or III.D.

Sequence

Lack of heat transfer and excessive heat transfer are lower priority symptoms than loss of SCM, and therefore it is logical to check them after SCM. However, there is no specific sequence requirement and monitoring for all symptoms is a continuous requirement.

TBD Volume 3 References

II.B.3.2.2, II.B.3.2.3, II.B.3.3, III.A.2.1.3, III.A.2.3.

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
15.0 [plant specific indications] DO NOT INDICATE A SGTR IS OCCURRING.	**Go to SGTR Section III.E, Step 1.0.**

Indicators and Controls

Indicators:
- Steam Line Radiation Monitors
- Condenser Air Ejector Monitors or Vacuum Pump Exhaust
- SG Levels
- FW Flow
- SG Chemistry Samples
- Any other plant specific indicators

Controls:
- N/A

Purpose of Step

This is a separate check for a SGTR aside from direct Section III.E entry routing for controlling a reactor shutdown with a tube rupture while minimizing radiation releases. The main purpose of this step is a check for a SGTR and a routing step, which provides direction to the appropriate Section III.E if a SGTR is identified.

Bases

A SGTR is an indication of a plant upset and should be addressed accordingly through guidance provided in III.E.

Sequence

There is no specific sequence requirement.

TBD Volume III References

II.A.4.0, III.A.2.4

VERIFICATION COLUMN	REMEDIAL ACTION COLUMN
16.0 RCS LEAKAGE < NORMAL MAKEUP CAPACITY.	**Go to Section IV.A, step 1.0.**

Indicators and Controls

Indicators:
- MU/HPI flow
- Pressurizer level
- MU tank level

Controls:
- None

Purpose of Step

This is a routing step to ensure the appropriate guidance is implemented.

Bases

The structure of GEOG is such that the routing can return to III.A or never leave III.A with some RCS leakage. RCS leakage within the capacity of normal makeup is addressed in step 17.0. Leakage greater than normal makeup capacity requires plant cooldown per Section IV.A

Sequence

There is no specific sequence requirement.

TBD Volume III References

III.A.3.3

VERIFICATION COLUMN | REMEDIAL ACTION COLUMN

17.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

STATUS

THE PLANT IS IN A SAFE SHUTDOWN SUBCOOLED CONDITION WITH CONTROLLED PRIMARY TO SECONDARY HEAT TRANSFER. RCS LEAKAGE WITHIN THE CAPACITY OF NORMAL MAKEUP MAY EXIST. PLANT OPERATORS WILL CONTINUE TO MAINTAIN SURVEILLANCE OF KEY PLANT PARAMETERS FOR INDICATION OF UPSETS IN HEAT TRANSFER. FURTHER ACTION AT THIS POINT WILL BE AT THE DISCRETION OF MANAGEMENT.

Indicators and Controls
Indicators: - N/A

Controls: - N/A

Purpose of Step
This step denotes the end of GEOG guidance.

Bases
The plant is stable with no upsets requiring mitigation and no compelling requirements to force a plant cooldown.

Utilities may elect to add additional status checks to this section. Given the stated plant conditions, further guidance is outside the scope of GEOG.

Sequence
There is no specific sequence requirement.

TBD Volume III References
None

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION III.B – LOSS OF SCM

Strategy:

- Ensure adequate core cooling by:
  - Immediate trip of RCPs
  - Ensuring proper operation of ES systems
  - Ensuring SGs available as heat sinks
  - Rapid cooldown if no HPI

- Monitor for possible ICC conditions

- Restore SCM if possible

- Restore relatively stable conditions with controlled core cooling and route appropriately

1.0 TRIP RCPs (Rule 1.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{hot} or incore thermocouple)
- RCP status
- SCM monitor
- SPDS
- P-T display

Controls:
- RCP motor controls

Purpose of Step

The purpose of this step is to immediately trip RCPs upon loss of SCM.

Bases

The RCPs are tripped immediately upon loss of SCM to prevent possible core damage if a subsequent trip of the RCPs occurred during certain size small break LOCAs. If the RCS void fraction is greater than about 70% when RCPs are tripped, the peak clad temperature can exceed the maximum temperature allowed by 10CFR50.46. A manual trip of the RCPs before the RCS void fraction reaches 70% prevents this possibility.

Analyses were performed which used both conservative Appendix K assumptions and realistic assumptions with the objective of meeting the requirements of 10CFR50.46. Using conservative Appendix K assumptions, it was shown that RCPs must be tripped within two minutes after losing SCM to prevent the RCS from evolving to a high enough void fraction such that the core would be uncovered if the RCPs were tripped at a later time. Using more realistic assumptions, the maximum allowed time for tripping the RCPs was determined to be 10 minutes.

These analyses showed that continued RCP operation could allow the RCS to evolve to a void fraction of 70% or greater if a certain range of break sizes were present. If the RCPs were tripped when the void fraction was 70% or greater, core uncovery would occur. Since RCP trip later in time cannot be absolutely prevented, it is necessary to trip RCPs before the RCS void fraction could increase to 70%. Once RCPs are tripped, the rate of loss of RCS inventory is reduced to the point where HPI (along with heat removal by the SGs in some cases) can keep the core covered.

These guidelines have been written to require that the RCPs be tripped immediately upon indication of loss of SCM. The primary reason for this is to make the action event dependent rather than time dependent.

The two-minute criterion is used in these guidelines rather than ten minutes for three reasons. First, the realistic analysis assumed full flow from two HPI pumps. For the scenario where both HPI pumps start but for some reason full HPI flow does not exist, the process of achieving and verifying full HPI flow may well take more than two minutes. If, in fact, full HPI flow cannot be obtained, then the risk of core uncovery exists if the RCPs are tripped later than two minutes (i.e., two minutes bounds all scenarios, ten minutes does not). The second reason is the complexity and likelihood for confusion if the RCP criteria had both a 2-minute and a 10-minute criterion. Finally, the RCP trip on loss of SCM is expected to be an immediate action due to the potential consequences of not performing the trip when required and to eliminate/reduce time-based decisions. Use of a 10-minute criterion would detract from this intent.

Based on the analyses performed, core cooling with saturated RC is assured regardless of the high RCS void fraction as long as the RCPs remain operative. Therefore, if the RCPs are not tripped within two minutes of loss of SCM, they must be operated until SCM is restored or LPI flow is established. To prevent mechanical damage to all the RCPs and to extend the operability time for the RCPs, only one RCP in each loop should be operated. If they fail, the two pumps, which were idle, should be started even if mechanical damage is again likely. Thus, if the RCPs are not tripped within two minutes of the loss of SCM, then they must be operated even though RCP damage may occur.

<u>Sequence</u>

RCP trip must be performed immediately on loss of SCM and therefore must be the first step. There are no other actions with a shorter time performance basis than the RCP trip.

<u>TBD Volume 3 References</u>
IV.A.2.1, IV.A.2.2 and V.1.0

2.0 INITIATE HPI/LPI (Rules 1.0, 2.0 and 3.0).

Indicators and Controls

Indicators:
- HPI pump status
- HPI flow rate
- LPI pump status
- LPI flow rate
- RCS pressure
- RCS temperature (incore thermocouple)

Controls:
- HPI pump motor controls
- HPI valve controls
- LPI pump motor controls
- LPI valve controls

Purpose of Step

The purpose of this step is to ensure that full HPI/LPI flow is provided to the RCS whenever SCM is lost.

Bases

ECCS injection flow is required whenever SCM is lost. A loss of SCM will most likely be due to a loss of RC volume due either to leakage (LOCA) or contraction (RCS overcooling). Initiating the HPI/LPI systems will ensure that mass inventory is added to the RCS to offset this loss. Initiation of LPI is as appropriate depending on RCS pressure. Rules 1.0, 2.0 and 3.0 provide specific guidance for initiating and controlling HPI and LPI.

NOTE: In all cases in this section where the term HPI is used, the equivalent term for Davis-Besse is MU/HPI.

Sequence

Proper operation of ECCS systems will ensure adequate core cooling even if SCM is not restored. Therefore it is important to ensure injection flow as quickly as possible. The ECCS systems may actuate automatically, but may not depending on initial conditions (e.g., ES bypassed, break size and location, etc.) or due to multiple failures. Therefore operator action to ensure ECCS performance must be accomplished as soon as possible following RCP trip.

TBD Volume 3 References

III.B.2.3, III.B.3.2, III.B.3.8, IV.B.2.A.2, IV.B.2.A.3, IV.B.2.A.4, IV.B.2.B.2, IV.B.2.B.3, IV.B.2.B.4, IV.B.3.1, V.1.0, V.2.0, and V.3.0

3.0 INITIATE EFW (Rules 1.0 AND 4.0).

Indicators and Controls

Indicators:
- EFW pump status
- EFW flow rate
- SG level
- SG pressure

Controls:
- EFW pump controls
- EFW valve controls

Purpose of Step

The purpose of this step is to maintain or establish primary to secondary heat transfer and ensure availability of the SGs for heat transfer.

Bases

When a loss of SCM occurs, water level in the SG(s) must be raised to the [loss of SCM setpoint]. EFW is used, if available, because the elevation of the EFW nozzles establishes a sufficiently high SG thermal center when EFW flow enters the SGs that will allow for BCC if RC level is low enough. The [loss of SCM SG level setpoint] ensures adequate condensing surface for BCC to ensure adequate core cooling for certain sized small break LOCAs. The Rules provide specific guidance on initiation and control of FW.

Certain small break LOCAs require heat removal by the SGs to satisfy the acceptance criteria of 10CFR50.46. SG levels must be increased to the [loss of SCM setpoint] at the required minimum SG fill rate or EFW flow rate until the setpoint is reached. The minimum SG fill rate or EFW flowrate is that rate necessary to ensure that sufficient energy is removed from the RCS. The [loss of SCM setpoint] provides sufficient surface area for BCC. Condensing the steam in the RCS via BCC removes some of the decay heat as well as reduces RCS pressure to allow increased injection flow. The more recent analyses indicate that the condensate on the RCS side provides a significant contribution to core cooling.

EFW should be used because the elevation of the EFW nozzles is high enough to provide the required condensing surface without level established in the SGs. The level setpoint is high enough to provide the required condensing surface during periods of no EFW flow.

EFW flow can be controlled (throttled) to minimize SG cooling during periods when no primary to secondary heat transfer exists. However, EFW flow cannot be throttled below the minimum fill rate or flow rate as previously discussed.

Sequence

RCS heat removal by the SGs during a LOCA aids the ECCS in maintaining or restoring core covery and therefore should be initiated as early as possible, but after RCP trip and ECCS actuation.

TBD Volume 3 References
III.B.2.4, III.B.3.3, IV.C.3.3, IV.C.4.2.2, IV.C.4.4.3, V.1.0, and V.4.0

4.0 <u>IF AT ANY TIME</u> RC PRESSURE < LPI OPERATIONAL PRESSURE <u>AND</u> LPI FLOW EXISTS, <u>THEN</u> GO TO SECTION IV.A, STEP 1.0.

<u>Indicators and Controls</u>

Indicators: - RCS pressure
- LPI flow rate

Controls: - N/A

<u>Purpose of Step</u>

The purpose of this step is to allow transfer to LOCA cooldown guidance in Section IV.A whenever LPI is verified.

<u>Bases</u>

This step is primarily a routing step. While a loss of SCM exists, the goal is to establish and maintain controlled core heat removal to cool and depressurize the RCS to the point where long-term cooling can be provided by LPI/DHR operation.

HPI and SG operation are important to achieving this goal, and many of the steps in this section are directed at proper operation of these systems. Thus once the LPI has been achieved, these steps can be bypassed. Any subsequent needs for HPI or SG operation are covered in Section IV.A.

<u>Sequence</u>

This step is a routing step within the GEOG structure. Once LPI flow has been achieved the remainder of this section is not necessary.

<u>TBD Volume 3 References</u>

III.B.2.13, III.B.3.8 and IV.B.3.0

5.0 IF HPI FLOW IS < FULL FLOW FROM ONE HPI PUMP, THEN PERFORM THE FOLLOWING:

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

5.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

5.2 Perform RCS cooldown at as fast a rate as possible.

5.3 Ensure PORV block valve is open. Manually cycle the PORV as necessary to maintain RCS pressure between the PORV setpoint and 1600 PSIG.

5.4 Ensure CFT isolation valves are open.

Indicators and Controls

Indicators:
- HPI flowrate
- HPI pump status
- HPI control valve position
- TBV/ADV position or status
- RCS pressure
- RCS temperature(incore thermocouple)
- SG pressure
- SG level
- EFW flowrate
- PORV position or status
- PORV block valve position
- CFT isolation valve position
- Secondary plant protection system status

Controls:
- HPI pump motor controls
- HPI valve controls
- TBV/ADV controls
- EFW pump controls
- EFW valve controls
- PORV controls
- PORV block valve controls
- CFT isolation valve controls
- Secondary plant protection system controls

Purpose of Step
The purpose of this step is to provide the necessary actions to be taken to cool down the plant as fast as possible in the unlikely event that sufficient HPI flow (MU/HPI flow for Davis-Besse) is not available.

Bases
As a general rule, successful mitigation of LOCAs requires the proper operation of at least one HPI pump. Plant design bases ensure that at least one HPI pump is available even with the most limiting single failure. Therefore, a loss of SCM without at least the full flow from one HPI pump is a serious event beyond the design bases of the plant. If this should occur, the LOCA may still be safely mitigated by a rapid RCS cooldown and depressurization to reduce loss of inventory out the break and to make additional ECCS injection available from the CFTs and LPI. The criterion of full flow from one HPI pump is intended to mean that the HPI flowrate appears to approximate the flow that would be expected from one HPI pump at the existing RCS pressure. It is not intended to mean verification of some specific minimum value accounting for instrument errors.

During the cooldown, the secondary plant protection system will have to be bypassed to prevent SG isolation.

During the cooldown, a loss of heat transfer can occur due to loop voiding, which may result in RCS repressurization until BCC is established. If the PORV setpoint is reached, then the PORV is manually cycled to reduce RCS pressure while minimizing automatic PORV cycling. The PORV is closed when RCS pressure decreases to about 1600 PSIG. The use of 1600 PSIG is a compromise between minimizing the necessary manual cycles and requiring long periods of the PORV being open which would add to the RC inventory loss. There is no specific bases for 1600 PSIG. If for some reason the PORV fails to close, with no HPI flow available, then the PORV block valve must be closed, if available, in order to conserve RCS inventory.

The criterion "HPI flow is < full flow from one HPI pump" is a target criterion given the existing RCS condition. Therefore no error correction is required and no [plant specific number] is expected to be inserted.

The plant-specific value for [allowable range for secondary plant protection bypass] is intended as a target value and therefore does not require error correction.

The GEOG value of 1600 PSIG is a target value and does not require error correction.

Sequence
This step should be performed as soon as possible once insufficient HPI flow is identified. The first 3 steps are mandatory LOCA mitigation steps that must always be performed, and step 4.0 provides a route to appropriate guidance for a condition where the rapid cooldown is not required.

TBD Volume 3 References
III.B.2.8, III.B.2.9, III.B.3.5 and III.B.3.6

6.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

Indicators and Controls

Indicators: - ES panel actuation alarms
- ES channel/equipment status

Controls: - ES actuated equipment individual controls

Purpose of Step

The purpose of this step is to ensure the proper operation and alignment of all equipment actuated by ES should an actuation setpoint be reached.

Bases

ES actuation setpoints may or may not be reached during a loss of SCM event. If a setpoint is reached, it is necessary to verify that all equipment and components operate and align properly. If any automatic actuations fail to occur, due to failures or bypass, then the appropriate actions must be performed manually.

Proper actuation of ES equipment includes appropriate ECCS operation and RB control. During a LOCA RC is released to the RB. This causes water mass and energy along with radioactive isotopes in the RC to be released to the RB. Loss of RCS water mass is accommodated by appropriate operation (automatic or manual) of the ECCS, thus providing water to the RCS and ensuring adequate core cooling. Deposition of RC mass and energy and radioactive isotopes to the RB is accommodated by the RB isolation and cooling systems. The release of RC mass and energy can cause the RB pressure and temperature to increase. Therefore, proper RB cooling system operation is ensured by automatic or manual operation. Release of radioactive isotopes to the RB, via the LOCA, can cause RB radiation levels to increase. This situation is accommodated by ensuring proper operation of the RB isolation (containment) system.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.B.3.2 III.H, III.F.2.0 and III.F.3.1

7.0 PERFORM [actions required for control room habitability].

Indicators and Controls

Plant specific.

Purpose of Step
The purpose of this step is to ensure the necessary actions are taken to maintain the control room environment within acceptable limits. This may involve actions such as realigning the control room ventilation.

Bases
Events such as tube rupture or LOCA can result in radiation releases that could exceed allowable doses for control room personnel under normal control room conditions. Therefore, it is typical to have emergency control room ventilation alignments that ensure the control room personnel are not unduly exposed during the mitigation of such events.

Sequence
There is no specific sequence requirement imposed by the TBD. The corresponding EOP step may have a plant-specific timing requirement, which may impose sequencing restrictions.

TBD Volume 3 References
None.

8.0 ISOLATE POSSIBLE RCS LEAKS. IF HPI COOLING IN PROGRESS, THEN DO NOT CLOSE PORV OR PORV BLOCK VALVE.

Indicators and Controls

Indicators: - Plant-specific valve position indications

Controls: - Plant-specific valve controls

Purpose of Step
The purpose of this step is to isolate all isolable leak paths from the RCS, in case the loss of SCM is due to a LOCA in one of these isolable paths.

Bases
A small break LOCA may be the cause of the loss of SCM. If the LOCA is unisolable, then the actions taken previous to this step are necessary to ensure that the core stays covered and adequately cooled. These actions should not be delayed while attempts are made to isolate the LOCA. The possible leak locations that can be isolated should be isolated by closing certain valves.

Sequence
There is no specific sequence requirement, however due to the structure of GEOG, this step is placed prior to the ICC check in step 9.0 because there is no step in III.F to isolate possible leaks.

TBD Volume 3 References
III.B.3.2.B

9.0 <u>IF AT ANY TIME</u> INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, <u>THEN</u> GO TO SECTION III.F, STEP 1.0.

<u>Indicators and Controls</u>
Indicators: - RCS pressure
- RCS temperature (incore thermocouple)

Controls: - N/A

<u>Purpose of Step</u>
The purpose of this step is to ensure transfer to the ICC guidance if ICC conditions occur.

<u>Bases</u>
Inadequate core cooling (ICC) is not expected as long as these guidelines are followed and the actions are successfully completed. However, any transient can progress into ICC conditions provided enough equipment failures occur. If the RCS is superheated, adequate core cooling no longer exists. Consequently, actions must be taken to restore the RCS to at least saturated conditions as quickly as possible.

The RCS P-T relationship will indicate when ICC conditions occur. The incore thermocouples are used to indicate the actual temperature conditions of the reactor coolant at the core exit because the hot leg RTDs may not be valid during saturated and superheated conditions or during times when natural circulation or forced circulation does not exist. Instrument and process errors can result in indicated ICC conditions when the RCS is still saturated. This is accommodated (i.e., acceptable) since the initial ICC actions are essentially the same actions performed for a loss of SCM. In addition, an error band, similar to the one used for SCM, could be used for ICC, or other alternatives such as the trend relative to the saturation curve.

A sustained loss of SCM can lead to ICC. Therefore, it needs to be checked continuously whenever inadequate SCM exists. A LOCA can result in an ICC condition temporarily, even with full ECCS injection.

<u>Sequence</u>
As soon as the RCS P-T relationship indicates a sustained loss of SCM, the RCS P-T relationship should be continuously checked to determine if superheat conditions are indicated (indicating entering ICC). This step is placed here because the previous steps (Step 1.0 through 8.0) are required mitigating actions for a loss of SCM or required routing step due to the structure of GEOG. The initial mitigating actions for ICC are essentially the same as for LSCM. Plants should not unduly delay entry into ICC by the addition of plant-specific steps.

<u>TBD Volume 3 References</u>
III.F.1.1, III.F.2.1, III.F.3.1 and IV.D.2.1.1

10.0 <u>IF AT ANY TIME</u> BWST LEVEL DECREASES TO [RB sump switchover level], <u>THEN</u> SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

Indicators and Controls

Indicators:
- BWST level
- RB level
- RB sump valve position
- LPI suction valve from BWST position
- LPI pump status
- LPI flow rate

Controls:
- RB sump valve controls
- LPI suction valve from BWST controls

Purpose of Step

The purpose of this step is to switch ES suction from the BWST to the RB sump when level in the BWST reaches the appropriate level.

Bases

During a LOCA or other event requiring injection, the initial suction source for HPI and LPI is the BWST. At some point in time, which is dependent on the break size, decay heat load, etc., the inventory in the BWST will be depleted sufficiently such that the suction for the LPI pumps must be switched from the BWST to the RB sump.

The plant-specific value for [RB sump switchover level] is a limiting value and should be error corrected.

Sequence

This step must be performed prior to BWST depletion.

TBD Volume 3 References

IV.B.3.2

11.0 IF HPI FLOW IS < FULL FLOW FROM ONE HPI PUMP AND SCM DOES NOT EXIST, THEN GO TO STEP 5.0.

Indicators and Controls

Indicators: - HPI flowrate
- RCS Pressure
- RCS Temperature (incore thermocouples)

Controls: - N/A

Purpose of Step

The purpose of this step is to maintain the maximum possible RCS cooldown rate until HPI flow and/or SCM is established by looping back to step 5.0.

Bases

Until HPI flow is established, the maximum possible RCS cooldown rate must be continued as long as SCM does not exist. SCM could be restored, even without full HPI flow, if a leak was isolated due to the actions of step 8.0.

This loop continues until HPI and/or SCM is restored or indications of superheat occur (step 9.0) or LPI flow exists (step 4.0).

The term "full flow from one HPI pump" is intended to be an approximate value and therefore does not require error correction.

Sequence

There is no specific sequence requirement. This step is placed here due to the GEOG structure.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

12.0 ESTABLISH APPROPRIATE COOLDOWN RATE.

12.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

12.2 IF the core exit is saturated, THEN establish desired cooldown rate using available SGs.

12.3 IF the core exit is subcooled, THEN limit the cooldown rate per technical specifications or to 50°F/hr (if a head void exists), whichever is lower.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SG pressure
- TBV/ADV position or status
- Secondary plant protection system status
- Plant specific indications of RV head void

Controls:
- TBV/ADV controls
- Secondary plant protection system controls

Purpose of Step

The purposes of this step are to ensure the appropriate cooldown rate is established and to prevent unnecessary actuation of the secondary plant protection system.

Bases

The secondary plant protection system is bypassed when permitted to prevent unnecessary actuation that would complicate the cooldown.

The allowable cooldown rate is dependent on the existence of SCM and RV head void. If SCM exists, then the cooldown rate should be reduced using the TBVs/ADVs to within the technical specification limits or 50°F/hr if a head void exists. If the core outlet is saturated then there are no cooldown limits. In this case, normal cooldown rate limits can be exceeded as necessary to maintain the SGs as heat sinks. HPI can only be throttled if SCM exists, and then only to control RC pressure, not to control cooldown rate.

The plant-specific value for [allowable range for secondary plant protection system bypass] is intended as a target value and therefore does not require error correction.

The GEOG value of 50°F/hr is a control parameter and therefore does not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.B.2.8, III.B.2.9, III.B.3.5 and III.B.3.6

13.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS NOT ADEQUATE, THEN PERFORM THE FOLLOWING:

13.1 IF SCM exists, THEN go to Section III.C, step 1.0.

13.2 Open the PORV and PORV block valve.

13.3 Go to Section IV.B, step 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouples)
- SG pressures
- SG levels
- FW flow rates
- PORV and block valve position indications
- SPDS
- SCM monitor
- P-T display

Controls:
- PORV and block valve controls

Purpose of Step

The purpose of this step is to ensure adequate core cooling by either restoring SG cooling or establishing HPI cooling.

Bases

For the purposes of this step, adequate primary to secondary heat transfer is relevant to the secondary heat removal needed. If the break/HPI flow is sufficient to remove core decay heat and stored heat then no secondary heat removal may be necessary. However, for small breaks or breaks that were isolated additional heat removal may be needed.

If SCM exists, then transfer is made to Section III.C where attempts to restore primary to secondary heat transfer will be made. If SCM does not exist, then Section III.C provides no additional actions for this condition (feedwater is established in III.B, therefore transfer to III.C is not necessary to establish feedwater). Therefore, since HPI already exists, the PORV and block valve are opened to initiate HPI cooling, and transfer is made to the appropriate cooldown section.

Sequence
Actions for the highest priority symptom, loss of subcooling margin, have been taken. Other symptoms are checked prior to exiting this section in relative priority, however, there is no specific sequence requirement. Monitoring for symptoms is a continuous requirement.

TBD Volume 3 References
III.B.2.8, III.B.2.11, III.B.3.5, III.B.3.7 and III.C.3.5.C

14.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS EXCESSIVE, THEN GO TO SECTION III.D, STEP 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{cold}, incore thermocouple)
- SG pressures
- SG levels
- FW flow rates
- SPDS
- SCM monitor
- P-T display

Controls:
- N/A

Purpose of Step

The purpose of this step is to check for excessive primary to secondary heat transfer and route to the appropriate section if necessary.

Bases

If RCS cooldown is excessive due to SG cooling, actions to mitigate the excessive heat transfer symptom need to be taken in accordance with Section III.D. If the RCS cooldown is excessive due to HPI/break flow alone, then there is no need to transfer. As long as SCM does not exist, full flow from two HPI pumps must be maintained, even if the RCS cooldown rate is excessive.

Sequence

Actions for the highest priority symptom, loss of subcooling margin, have been taken. Other symptoms are checked prior to exiting this section in relative priority, however, there is no specific sequence requirement. Monitoring for symptoms is a continuous requirement.

TBD Volume 3 References

II.B.3.2.3, III.B.2.11, III.B.3.7, III.D.1.1.1.B, III.D.2.1, and III.D.3.1

15.0 IF A SGTR IS INDICATED ON SG(s) IN USE, THEN GO TO SECTION III.E, STEP 1.0.

Indicators and Controls

Indicators:
- Steam line radiation monitors
- Condenser air ejector radiation monitors or vacuum pump exhaust radiation monitors
- SG level
- FW flow
- SG samples
- Other plant specific indications

Controls: - N/A

Purpose of Step

The purpose of this step is to check for a SGTR and route to the appropriate section.

Bases

This step checks for a SGTR. SGTRs complicate plant cooldowns and usually result in abnormal cooldowns. The unique complications due to the tube leak(s) are handled in the SGTR section. If the SG is not being used (i.e., the SG is isolated and not being steamed), then transfer is not made to the SGTR guidance.

Sequence

Actions for the highest priority symptom, loss of subcooling margin, have been taken. Other symptoms are checked prior to exiting this section in relative priority, however, there is no specific sequence requirement. Monitoring for symptoms is a continuous requirement.

TBD Volume 3 References

III.B.3.4, III.E.2.1.1 and III.E.3.1

16.0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

Indicators and Controls
Indicators: - HPI flow rate

Controls: - N/A

Purpose of Step
The purpose of this step is to route to the LOCA cooldown section if HPI flow is required.

Bases
At this point adequate core heat removal exists. If HPI is required, then the appropriate section for further guidance is IV.A, which covers cooldown with a LOCA.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

17.0 IF A SG IS ISOLATED OR HAS AN UNISOLABLE STEAM LEAK, THEN GO TO SECTION IV.C STEP 1.0.

Indicators and Controls

N/A

Purpose of Step

The purpose of this step is to transfer to the appropriate guidance for subsequent plant control.

Bases

At this point, controlled heat transfer and SCM have been restored, but a SG may have a problem that is forcing a plant cooldown. Guidance for this cooldown is provided in Section IV.C. For the purpose of this step, isolated SG means that the SG is not being used for heat transfer.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

18.0 GO TO SECTION III.A, STEP 3.0.

Indicators and Controls
N/A

Purpose of Step
The purpose of this step is to route back to the vital system status checks.

Bases
At this point adequate core heat removal and SCM exist. RCS makeup requirements are within the capacity of normal makeup and no transient or symptom exist. Routing back to III.A provides status checks of vital systems to ensure a stable plant condition. This also allows completion of these checks if the prior existence of a symptom required early exit from III.A.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION III.C - LACK OF HEAT TRANSFER

Strategy:

- Reestablish adequate core cooling by restoring FW and SG heat removal.
- Backup SG heat removal by establishing HPI cooling when required.
- Restore relatively stable conditions with controlled core cooling.

1.0 RESTORE FW (Rule 4.0).

Indicators and Controls

Indicators:
- EFW valve position
- EFW flow rate
- MFW valve position
- MFW flow rate
- SG level
- SG pressure
- [Alternate FW source indicators]

Controls:
- EFW valve controls
- MFW valve controls
- [Alternate FW source controls]

Purpose of Step

The purpose of this step is to establish a sufficient source of FW to remove decay heat.

Bases

The primary objective is to restore adequate primary to secondary heat transfer, which cannot be accomplished without an adequate source of FW. The intent is to restore any available FW source that has the capacity to remove decay heat. If FW is already established, then this step verifies FW exists. The term FW applies to any source.

Each possible source may have a limitation on the allowable flow rate addition to the SGs, if the SGs are dry. If neither EFW nor MFW is available, then an alternative feedwater source that is available should be used.

Feedwater should be restored in accordance with Rule 4.0. Rule 4.0 provides guidance on establishing feedwater flow and level to a potentially dry SG including initial flow rates and flow control criteria. Rule 4.0 also provides, if applicable, minimum flow rates that ensure adequate core cooling in the event a LOCA has occurred; these flow rates supercede dry SG feed rates.

Sequence

This step is first because adequate primary to secondary heat transfer cannot exist without adequate FW, and lack of adequate FW is a likely cause of the lack of heat transfer. In addition, actions necessary to restore FW can be time-consuming.

TBD Volume 3 References

III.C.2.5, III.C.3.4 and IV.C.4 and V.4.0

2.0 IF AT ANY TIME RCS HEATS TO THE POINT WHERE SCM IS LOST, THEN GO TO STEP 6.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- SPDS
- P-T display

Controls: N/A

Purpose of Step

The purpose of this step is to ensure HPI cooling is initiated when required.

Bases

There are several criteria for when HPI cooling must be established during a loss of heat transfer. Most of these criteria are provided in step 5.0. However, when FW is available, attempts to restore heat transfer can continue until a loss of SCM occurs. FW availability routes around step 5.0, thus the criterion of this step ensures the loss of SCM criterion is addressed whether FW exists or not, and ensures that HPI cooling will be initiated if SCM is lost.

Sequence

There is no specific sequence requirement. This step is placed here due to the way the GEOG is structured.

TBD Volume 3 References

II.B.2.2, II.B.3.2.1, III.C.2.2.A, and III.C.3.2.A

3.0 IF AT ANY TIME FW IS ESTABLISHED, THEN GO TO STEP 7.0.

Indicators and Controls

Indicators: - SG level
- EFW flow rate
- MFW flow rate
- [Alternate FW source flow rate]

Controls: - N/A

Purpose of Step

The purpose of this step is to determine whether a source of feedwater sufficient to remove decay heat is available. If one is, then this step routes forward to establish the available SG(s) as a heat sink.

Bases

If a feedwater flow sufficient to remove decay heat is available, then actions can be taken to establish the SGs as a heat sink and to attempt to restore heat transfer. If a source of feedwater is available, but is of insufficient capacity to remove decay heat, then transfer to step 7.0 should not be made. In this case, attempts to restore an adequate feedwater source must continue.

Sequence

There is no specific sequence requirement. This step is placed here due to the way the GEOG is structured.

TBD Volume 3 References

III.C.2.4

4.0 REDUCE RCP OPERATION TO A 1/1 CONFIGURATION AND RUN AS LONG AS SCM EXISTS AND SG TUBE – SHELL ΔT LIMITS ARE NOT EXCEEDED.

Indicators and Controls

Indicators:
- RCP status
- RCS pressure
- RCS temperature (T_{hot}, T_{cold}, incore thermocouples)
- SCM monitor
- SG shell temperatures
- P-T display
- SPDS

Controls:
- RCP motor controls

Purpose of Step

The purpose of this step is to limit the heat input to the RCS while maintaining forced flow in both loops.

Bases

FW is not yet restored, but RCS conditions do not yet require HPI cooling. Two RCPs are left running to reduce total heat input to the RCS. The preferred configuration is one RCP per loop so that forced flow exists in both SGs when feedwater is restored. Since it is not known in which SG(s) feedwater will be restored, or if it will be restored, one RCP should be left running in each loop if possible. The selection of RCPs to run should consider pressurizer spray flow capacity. While no heat transfer exists, SG tube-shell ΔT limits could be reached. If this occurs, the RCPs should be tripped to slow the temperature changes in the SG tubes.

The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.2.4 and III.G.3.6

(Step 5.0 is for all plants except Davis-Besse; for Davis Besse step 5.0 see attachment 1)

5.0 WHEN ANY OF THE FOLLOWING LIMITS IS REACHED:

- **RCS PRESSURE APPROACHES PORV SETPOINT**
- **RCS P-T LIMIT**
- **PORV AUTOMATICALLY LIFTS**

THEN CONTINUE.

Indicators and Controls
Indicators: - PORV position or status
- RCS pressure
- RCS temperature (incore thermocouple or T_{cold} if RCPs running)

Controls: N/A

Purpose of Step
The purpose of this step is to provide the criteria to initiate HPI cooling in step 6.0.

Bases
Analyses using 10CFR50 Appendix K assumptions indicate that, for a total loss of feedwater event, the core can be cooled, meeting the criteria of 10CFR50.46 if two HPI pumps are started within 20 minutes. Mass and energy removal is through the pressurizer safety valves (i.e., RCS pressure remains at the pressurizer safety valve setpoint). Additional analyses indicate that with 1.0 decay heat, one HPI pump is sufficient to adequately cool the core.

The 20 minutes in the analysis occurs after the RCS starts losing inventory through the pressurizer safety valves. Therefore starting HPI cooling when the PORV setpoint is reached is conservative to the analysis and also avoids using elapsed time as a criterion for manual actions.

HPI addition to the RCS must be established in a timely manner so that enough inventory is added such that HPI cooling will match decay heat before the core is uncovered. HPI addition is initiated as soon as RCS inventory starts being lost (PORV opens or reaches the setpoint where it should open). This action results in the highest RCS collapsed liquid level being maintained, thus ensuring adequate core cooling.

Loss of heat transfer may also occur at lower RCS pressures and temperatures (e.g., during plant cooldown). In these situations, opening the PORV and initiating HPI cooling may be necessary to prevent exceeding the RV P-T limit. The PORV setpoint limit includes the LTOP setpoint if applicable.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.C.2.2.B, III.C.3.2.B, III.G.3.9.1 and IV.G

NOTE
SCM may be lost when the PORV is opened and does not require transfer to III.B.

6.0 INITIATE HPI (MU/HPI) COOLING BY PERFORMING THE FOLLOWING:

6.1 Initiate HPI (MU/HPI) cooling (Rule 3.0).

THESE BASES ARE FOR ALL PLANTS EXCEPT DB

Indicators and Controls

Indicators:
- HPI pump status
- HPI valve position
- HPI flow rate
- PORV position or status
- PORV block valve position
- RCS pressure
- RCS temperature (T_{hot} or incore thermocouple and T_{cold})
- SCM monitor
- SG shell temperatures
- SPDS
- P-T display

Controls:
- HPI pump motor controls
- HPI valve controls
- PORV controls
- PORV block valve controls

Purpose of Step

The purpose of this step is to initiate HPI cooling.

Bases

After HPI pumps are started, HPI flow should be verified before the PORV is opened. HPI flow verification covers both HPI flow from one or two HPI pumps. With only one HPI pump, the PORV must be maintained open. In doing so, the net RCS inventory decrease is minimized (i.e., mass addition due to increased HPI flow at lower RCS pressure is greater than mass loss out the PORV to depressurize the RCS), ensuring adequate core cooling. Although it is not necessary to maintain the PORV open if two HPI pumps are on, it is the preferred option versus allowing the PORV to cycle because the highest RCS collapsed liquid level is attained. Maintaining the PORV open will also result in fewer PORV cycles, reducing the likelihood of PORV failure and will also produce a higher integrated HPI flow rate. If HPI flow cannot be established, then the PORV should be closed and manually cycled only as necessary to prevent its automatic lifting.

If SCM is lost when the PORV is opened, then RCPs must be tripped but it is not necessary to transfer to the loss of SCM guidance of Section III.B. This is because the loss of SCM is most likely a consequence of the action taken (i.e., opening the PORV). In this situation, the steam volume flow rate through the PORV exceeds the combination of a) the volume flow rate into the RCS (HPI) and b) the volume increase due to RC expansion (heatup of RC) resulting in loss of SCM. Even in the extremely unlikely event of a concurrent LOCA, transfer to III.B in this instance is not necessary. Before opening the PORV HPI flow was verified; therefore, the loss of SCM guidance to initiate HPI has already been taken. The RCPs are tripped per Rule 1.0, and attempts to restore FW and heat transfer have already been made. No other Section III.B actions are appropriate for this situation.

With HPI flow verified and the PORV opened, additional actions should be performed. The first is to maintain RCS pressure less than the RV P-T limit, by throttling HPI flow if necessary. This action must be taken as long as SCM exists. Pressurizer heaters should be turned off to ensure they will not be automatically energized when the RCS pressure is reduced during HPI cooling. Deenergizing the heaters also reduces the energy input to the RCS to reduce the HPI cooling heat removal demands and to help in reducing RCS pressure. This also protects the heaters should they become uncovered during HPI cooling.

If the PORV cannot be opened (with HPI flow verified) and this condition continues long enough, RCS temperature will begin to decrease due to flow through the code safeties while RCS pressure remains high. Along with continuing attempts to establish PORV flow, HPI flow should be throttled to prevent RCS temperature from decreasing below the RV P-T limit. If no RC pumps are operating, the RCS temperature should be kept near the SCM limit per the PTS guidance if applicable per Rule 3.0.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

<u>Sequence</u>
HPI cooling must be initiated when the criteria exist. When initiating HPI cooling, HPI flow must be verified prior to maintaining the PORV open.

<u>TBD Volume 3 References</u>
III.C.2.3.A, III.C.2.3.B, III.C.3.3.A, III.C.3.3.B, III.G.3.9, III.G.3.9.1, III.G.3.9.3 , III.H, IV.A.2.1, IV.A.2.3, IV.B.2.A.2, IV.B.2.B.2, IV.F.3.1, IV.G, V.2.0, and V.3.0.

THESE BASES ARE FOR DB ONLY

Indicators and Controls

Indicators:
- MU pump status
- MU flow rate
- MU valve position
- PORV position or status
- PORV block valve position
- HPV position
- Pressurizer vent position
- HPI pump status
- HPI control valve status
- HPI flow rate
- LPI pump status
- HPI/LPI piggyback valve status
- MU/LPI piggyback valve status
- SCM monitor
- SPDS
- P-T display

Controls:
- MU pump motor controls
- MU control valve controls
- PORV controls
- PORV block valve controls
- HPV controls
- Pressurizer vent controls
- HPI pump motor controls
- HPI control valve controls

Purpose of Step

The purpose of this step is initiate MU/HPI cooling.

Bases

The first thing the operator must do is verify that RCS inventory makeup is available before maintaining the PORV open. Verification of RCS inventory makeup means that there is flow to the RCS from MU and/or HPI or that HPI pumps are started but there is no flow due to high RCS pressure. If RCS inventory makeup is verified, then some injection flow is reaching the RCS or available when pressure is reduced, and the PORV can be opened. Initiating MU/HPI cooling means that the PORV, PORV block valve, HPVs and pressurizer vent are all opened to a) depressurize the RCS, thus reducing the possibility of the RCS pressurizing above the shutoff head of the piggybacked HPI pumps and b) provide a path for increased injection (cooling) flow through the core. The HPI pumps are piggybacked on the LPI pumps to increase the discharge pressure of the HPI pumps, thus increasing their shutoff head and maximizing HPI injection flow to the RCS.

If SCM is lost when the PORV is opened, then RCPs must be tripped but it is not necessary to transfer to the loss of SCM guidance of Section III.B. This is because the loss of SCM is most likely a consequence of the action taken (i.e., opening the PORV). In this situation, the steam volume flow rate through the PORV exceeds the combination of a) the volume flow rate into the RCS (MU/HPI) and b) the volume increase due to RC expansion (heatup of RC) resulting in loss of SCM. Even in the extremely unlikely event of a concurrent LOCA, transfer to III.B in this instance is not necessary. Before opening the PORV HPI flow was verified; therefore, the loss of SCM guidance to initiate HPI has already been taken. The RCPs are tripped per Rule 1.0, and attempts to restore FW and heat transfer have already been made. No other Section III.B actions are appropriate for this situation.

With MU/HPI flow verified and the PORV opened, additional actions should be performed. The first is to maintain RCS pressure less than the RV P-T limit, by throttling MU/HPI flow if necessary. This action must be taken as long as SCM exists. Pressurizer heaters should be turned off to ensure they will not be automatically energized when the RCS pressure is reduced during MU/HPI cooling. Deenergizing the heaters also reduces the energy input to the RCS to reduce the MU/HPI cooling heat removal demands and to help in reducing RCS pressure. This also protects the heaters should they become uncovered during MU/HPI cooling.

If MU/HPI flow cannot be established, then the PORV should be closed and manually cycled only as necessary to prevent its automatic lifting.

If the PORV cannot be opened (with HPI flow verified) and this condition continues long enough, RCS temperature will begin to decrease while RCS pressure remains high. Along with continuing attempts to establish PORV flow, HPI flow should be throttled to prevent RCS temperature from decreasing below the RV P-T limit and within the PTS guidance per Rule 3.0 if applicable.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

Sequence

MU/HPI cooling must be initiated when the criteria exist. When initiating MU/HPI cooling, MU/HPI flow must be verified prior to maintaining the PORV open.

TBD Volume 3 References

III.C.2.3.B, III.C.3.3.B, III.G.3.9, III.G.3.9.2, III.G.3.9.3, III.H, IV.B.2.B.2, IV.F.3.1, IV.G and V.3.0

6.2 Isolate letdown.

6.3 Reduce to one RCP and run as long as SCM exists and SG tube-shell ΔT limits are not exceeded.

Indicators and Controls

Indicators:
- Letdown valve position
- RCP status
- RCS pressure
- RCS temperature (T_{hot}, T_{cold}, incore thermocouples)
- SCM monitor
- SPDS
- P-T display
- SG shell temperatures

Controls:
- RCP motor controls

Purpose of Step

The purpose of this step is to isolate letdown and appropriately operate RCPs.

Bases

Letdown is isolated to preclude loss of inventory outside the RB, since HPI (MU/HPI) cooling may be long-term with sump recirculation. Further, all but one RCP should be tripped. This action reduces the energy input to the RCS but still provides some forced flow for better thermal mixing of the RCS. The one RCP can be run as long as SCM exists and the SG tube-shell ΔT limits are not exceeded.

The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.2.3.A, III.2.3.B, III.C.3.3.A, III.G.3.6, III.G.3.9.1, III.G.3.9.2, IV.A.2.1 and IV.A.2.3

6.4 IF HPI (MU/HPI) flow cannot be established, THEN perform the following:

6.4.1 Ensure the PORV is closed (close PORV block if PORV cannot be closed).

6.4.2 Trip running RCP(s).

6.4.3 Manually cycle the PORV as necessary to maintain RCS pressure between the PORV setpoint or RV P-T limit and minimum SCM (if subcooled) or 1600 PSIG (if saturated).

Indicators and Controls

Indicators:
- HPI flow rate
- HPI pump status
- (MU flow rate)
- (MU pump status)
- PORV position or status
- PORV block valve position
- RCP status
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- SPDS
- P-T display

Controls:
- PORV controls
- PORV block valve controls
- RCP motor controls

Purpose of Step

This step preserves RCS inventory and reduces heat input if HPI (MU/HPI) flow cannot be established.

Bases

If HPI cooling is attempted and no HPI (MU/HPI) flow exists, the PORV must not be maintained open. Because the only source of decay heat removal is the inventory that exists in the RCS, that inventory must be preserved as much as possible. The PORV should be closed and manually cycled only as necessary to prevent automatic lifting of the PORV. If the PORV fails open, then the PORV block valve is closed to isolate the PORV. These steps minimize the RCS inventory loss from the RCS as well as maximize its energy removal capability while reducing the number of PORV cycles that would occur if it remained in automatic. Any running RCP(s) are tripped to eliminate their energy input to the RCS and to reduce the SG tube heatup rate.

RCS pressure is manually controlled between the PORV setpoint and the SCM limit or 1600 PSIG if saturated. The high RCS pressure limit is the PORV setpoint (to prevent lifting the pressurizer

safety valves) and the RV P-T limit. The low RCS pressure limit is SCM limit (to prevent unnecessary loss of subcooling margin) or 1600 PSIG if saturated. The 1600 PSIG value is arbitrary; the intent is to 'deep cycle' the PORV sufficiently to reduce the number of cycles, while not requiring the PORV to be opened for an extended period. It may also be desirable to prevent unnecessary ES actuations, which may require a value above 1600 PSIG. If LTOP is established, it will require a much lower RCS pressure control point.

There is no HPI cooling and no feedwater for SG cooling. It is possible to experience a loss of SCM while opening the PORV to lower pressure. The reason this step does not lead to Section III.B upon loss of SCM is that success of the actions taken in Section III.B would require the availability of either HPI or FW. Section III.C explicity covers the conditions of no HPI and no FW.

The GEOG value of 1600 PSIG is a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement. Once the PORV is closed and the RCPs are tripped, the actions stay in a loop until exit can be achieved by either establishing HPI (MU/HPI) or FW or due to indications of superheat.

TBD Volume 3 References
III.C.2.3A, III.C.2.3.B, III.C.3.3.A,III.C.3.3.B, III.G.3.9.1, III.G.3.9.2, and IV.G

6.4.4 <u>IF AT ANY TIME</u> incore thermocouple temperatures indicate superheat, <u>THEN</u> go to Section III.F, step 1.0.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls: N/A

<u>Purpose of Step</u>

The purpose of this step is to ensure implementation of inadequate core cooling guidelines if required.

<u>Bases</u>

At this point, an extended loss of both feedwater and HPI (MU/HPI) has occurred. While continuing with attempts to restore feedwater and HPI (MU/HPI), close attention to the incore thermocouples is required because ICC will eventually occur unless FW or HPI (MU/HPI) is restored. If RCS conditions degrade to the point where the incore thermocouples indicate superheated conditions at the core exit, then transfer to the ICC guidelines in Section III.F must be made.

Instrument and process errors can result in indicated ICC conditions when the RCS is still saturated. This is accommodated (i.e., acceptable) since the initial ICC actions are essentially the same actions performed for a loss of SCM. In addition, an error band, similar to the one used for SCM, could be used for ICC, or other alternatives such as the trend relative to the saturation curve.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

III.F.1.2, III.F.2.1 and III.F.3.1

6.4.5 Continue attempts to establish HPI (MU/HPI) and FW.

Indicators and Controls

Indicators:
- HPI flow
- HPI pump and valve status
- (MU pump and valve status)
- (MU flow)
- FW flow
- FW pump and valve status

Controls:
- HPI pump controls
- HPI valve controls
- (MU pump controls)
- (MU valve controls)
- FW pump controls
- FW valve controls

Purpose of Step

The purpose of this step is to direct the continued attempts to restore feedwater and HPI (MU/HPI) flow.

Bases

A sustained loss of feedwater without HPI (MU/HPI) is occurring. Restoration of adequate core cooling requires FW or HPI (MU/HPI) therefore attempts to restore these systems must continue.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.3.2 and III.C.3.4

6.4.6 <u>IF AT ANY TIME</u> HPI (MU/HPI) is established while heat transfer does not exist, <u>THEN</u> open the PORV (and PORV block if necessary) and go to step 6.5.

<u>Indicators and Controls</u>

Indicators:
- HPI pump status
- HPI valve position
- HPI flow rate
- (MU pump status)
- (MU valve position)
- (MU flow rate)
- PORV position or status
- PORV block valve position

Controls:
- PORV control
- PORV block valve control

<u>Purpose of Step</u>

The purpose of this step is to establish HPI (MU/HPI) cooling by opening the PORV and then route to the appropriate cooldown section through step 6.5.

<u>Bases</u>

Once HPI (MU/HPI) flow is established, then the PORV is opened to establish HPI (MU/HPI) cooling. This restores the condition and routing that would have existed had HPI (MU/HPI) been available all along.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

<u>Sequence</u>

The PORV is not maintained open until HPI (MU/HPI) flow is verified.

<u>TBD Volume 3 References</u>

III.C.2.3.A, III.C.2.3.B, III.G.3.9.1 and III.G.3.9.2, III.H and IV.F.3.1

6.4.7 IF FW is established, THEN go to step 7.0 while continuing attempts to restore HPI (MU/HPI).

6.4.8 Go to step 6.4.3.

Indicators and Controls
Indicators: - EFW flow rate
- MFW flow rate

Controls: N/A

Purpose of Step
The purpose of these steps is to route to the appropriate step to attempt to establish primary to secondary heat transfer once feedwater has been established or to route back to continue actions to restore HPI (MU/HPI) and FW while controlling RCS pressure.

Bases
If feedwater has been restored, but HPI (MU/HPI) is still unavailable, then steps must begin to attempt to restore primary to secondary heat transfer to provide core cooling and prevent possible core damage. While these actions are taking place, attempts to start HPI (MU/HPI) must also continue.

If FW has not been restored, then step 6.4.8 loops back to continue actions to control RCS pressure while continuing attempts to restore HPI (MU/HPI) and FW.

Sequence
There is no specific sequence requirement. These steps are placed here due to the GEOG structure.

TBD Volume 3 References
III.C.2.6

6.5 Go Section IV.B, step 1.0.

Indicators and Controls

N/A

Purpose of Step
The purpose of this step is to transfer to the HPI Cooldown guidance.

Bases
HPI cooling has been established. Further guidance is contained in Section IV.B.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

7.0 IF AT ANY TIME HEAT TRANSFER IS ESTABLISHED, THEN GO TO STEP 14.0.

Indicators and Controls

Indicators:
- SG pressures
- RCS pressure
- RCS temperature (T_{hot}, incore thermocouple and T_{cold})

Controls: N/A

Purpose of Step

The purpose of this step is to route to the appropriate step depending on whether or not primary to secondary heat transfer has been restored.

Bases

If primary to secondary heat transfer has been restored or is restored during the performance of subsequent steps, then this step routes past remaining steps attempting to restore heat transfer.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

II.B.3.3, III.C.2.8 and III.C.3.5

8.0 MANUALLY CYCLE THE PORV AS NECESSARY TO MAINTAIN RCS PRESSURE BETWEEN THE PORV SETPOINT AND MINIMUM SCM (IF SUBCOOLED) OR 1600 PSIG (IF SATURATED).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- PORV position or status
- PORV block valve position
- P-T display
- SPDS

Controls:
- PORV controls
- PORV block valve controls

Purpose of Step

The purpose of this step is to control RCS pressure during the time steps are being taken to regain primary to secondary heat transfer.

Bases

During performance of the steps to restore primary to secondary heat transfer, RCS pressure must be continually monitored and controlled. The PORV is opened and RCS pressure is reduced to prevent excessive PORV cycling. The PORV is then closed when RCS pressure decreases to near minimum SCM or about 1600 PSIG, depending on SCM status. This should maintain the SGs as a heat sink while easing operator determination of when to close the PORV.

The low RCS pressure limit is the SCM limit (to prevent unnecessary loss of subcooling margin) or 1600 PSIG if saturated. The 1600 PSIG value is arbitrary; the intent is to 'deep cycle' the PORV sufficiently to reduce the number of cycles, while not requiring the PORV to be opened for an extended period. It may also be desirable to prevent unnecessary ES actuation, which may require a value above 1600 PSIG. If LTOP is established, it will require a much lower RCS pressure control point.

The GEOG value of 1600 PSIG is a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.3.5

9.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS (Rule 4.0)

10.0 REDUCE SG PRESSURE AS NECESSARY TO ESTABLISH A PRIMARY SECONDARY ΔT OF APPROXIMATELY 50°F.

Indicators and Controls

Indicators:
- SG levels
- SG pressures
- RCS temperature (incore thermocouple)
- EFW flow rate
- MFW flow rate
- Secondary plant protection system status
- TBV/ADV position or status

Controls:
- EFW pump controls
- EFW valve controls
- MFW pump controls
- MFW valve controls
- Secondary plant protection system controls
- TBV/ADV controls

Purpose of Step

The purpose of these steps is to make the SG(s) a heat sink for heat removal from the RCS.

Bases

Once feedwater has been established, the first action to restoring the SG(s) as a heat sink is to feed them and establish the appropriate level in accordance with Rule 4.0. Rule 4.0 provides guidance on establishing feedwater flow and level to a potentially dry SG including initial flow rates and flow control criteria. Rule 4.0 also provides, if applicable, minimum flow rates that ensure adequate core cooling in the event a LOCA has occurred; these flow rates supercede dry SG feed rates. The appropriate level depends on the RCS conditions (e.g., loss of SCM level if the RCS is saturated) or on the status of the RCPs if the RCS is subcooled (e.g., natural circulation level if no RCPs are on). Feeding the SG(s) to the appropriate level may restore primary to secondary heat transfer. It is also possible to establish primary to secondary heat transfer solely by feeding the SGs, especially if EFW is used, because of the high thermal center that is established.

If primary to secondary heat transfer is established during the performance of these steps then transfer to step 14.0 should be made (per step 7.0).

In order to establish the SGs as a heat sink for heat removal from the RCS, it may also be necessary to lower SG pressure, particularly if the RCS pressure stabilizes below the SG pressure. SG pressure should be adjusted to provide about 50°F temperature difference between the RCS (incore thermocouple temperature) and the SGs (T_{sat}). This temperature difference of about 50°F will ensure the SGs are a heat sink for the RCS. Note that here a 50°F ΔT should be sufficient during a loss of heat transfer but a higher ΔT may be necessary to overcome the large temperature gradient that can result from HPI cooling (in Section IV.B). The core exit thermocouples are used

because the hot leg and cold leg RTDs will not provide valid indications of RCS temperature. Since there is no RC circulation, the hot leg RTDs will not indicate the true core temperature. Since there is no RC circulation and HPI is on, the cold leg RTDs will not indicate true RV downcomer temperature.

The GEOG value of 50°F is a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
II.B.3.3, III.C.2.7, III.C.2.8, III.C.3.5, IV.D.2.1.1 and V.4.0

11.0 IF SCM EXISTS AND RCPs ARE AVAILABLE, THEN START A RCP, PREFERABLY IN A LOOP WITH FW (Section V.A).

Indicators and Controls

Indicators:
- RCP support equipment status (including power)
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- P-T display
- SPDS

Controls:
- RCP motor controls

Purpose of Step

The purpose of this step is to establish forced flow if possible.

Bases

Primary to secondary heat transfer has not been restored even though one or both SGs are available. If the RCS is subcooled, then likely causes for this are a voided loop or loops or thermal stratification. If RCP(s) are available, at least one should be started to attempt to restore heat transfer. There may be restrictions on starting RCPs due to boron dilution concerns. These restrictions must be considered in determining RCP availability.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.2.7.A, III.C.2.7.B, III.C.3.5.A and IV.A

12.0 OPEN HPVs IN LOOP(s) WITHOUT RUNNING RCP.

Indicators and Controls

Indicators: - RCP status
- HPV status

Controls: - HPV controls

Purpose of Step

The purpose of this step is to vent the hot legs to remove any steam or gas which may be blocking natural circulation flow or reverse forced flow of the RC.

Bases

At this point, the RCS may be subcooled, but RCP(s) are either: a) not available for restart or b) only available in the loop without feedwater and the opposite loop is voided sufficiently to prevent reverse forced flow. Therefore, forced flow through the available SG(s) to restore primary to secondary heat transfer is not possible at this time. Restoring the SGs as a heat sink did not restore primary to secondary heat transfer by initiating natural circulation. One reason for lack of natural circulation flow or reverse forced flow may be that the hot leg(s) are blocked by steam voids and/or non-condensible gases. Analyses indicate that venting through the hot leg vents is effective in removing steam and gases if the RCS at the core exit is subcooled. Since the RCS may be subcooled at this time, the hot leg vents should be opened, provided MU or HPI flow exists. To prevent additional steam formation due to RCS depressurization while venting, RCS pressure should be maintained constant or slightly increasing, using MU or HPI, while the vents are open. However, if PTS is invoked due to RCPs off and HPI on, the SCM should be maintained near the SCM limit. If the RCS is saturated, the HPVs may or may not help restore heat transfer, but their use under saturated conditions should not complicate restoration of heat transfer. Therefore they are used regardless of SCM status.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.2.7.B,III.C.2.7.C, III.C.3.5.A, III.C.3.5.B, III.G.3.8.2.1 and V.3.0

13.0 <u>WHEN</u> HEAT TRANSFER IS ESTABLISHED, <u>THEN</u> CONTINUE.

Indicators and Controls

Indicators:
- SG pressures
- RCS pressure
- RCS temperature (T_{hot}, incore thermocouple and T_{cold})
- P-T display
- SCM monitor
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is a hold point.

Bases

The appropriate conditions for restoration of heat transfer that can be controlled have been established. Barring further complications, from this point plant conditions can evolve in four basic directions. Heat transfer can be established at which time guidance will proceed at step 14.0. The RCS could heat to the point of losing SCM, at which time HPI cooling would be established per step 2.0. If HPI cooling had already been attempted but HPI did not exist, then restoration of HPI would lead to establishing HPI cooling per step 6.4.6. Finally, if HPI cooling was not possible due to no HPI, then the RCS could evolve into ICC conditions, resulting in a transfer to Section III.F per step 6.4.4. The hold at step 13.0 is the mechanism used in GEOG to subsequently route to the appropriate guidance.

The best indication that heat transfer has been established is close coupling between T_{cold} and the associated SG saturation temperature. Loop transport times may be on the order of minutes however. The ability to feed and steam the SG while maintaining steam pressure is another good indication. The incore thermocouple response is also a good indicator, again affected by possibly long loop transport times.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

II.B.3.3

14.0 CONTROL HEAT TRANSFER RATE.

15.0 ENSURE HPVs ARE CLOSED.

Indicators and Controls

Indicators:
- TBV/ADV position or status
- RCS pressure
- RCS temperature (incore thermocouple)
- SG pressure
- SG level
- EFW flow rate
- MFW flow rate
- HPV position or status

Controls:
- TBV/ADV controls
- EFW valve controls
- MFW valve controls
- HPV controls

Purpose of Step

The purpose of these steps is to maintain stable RCS pressure and temperature using the TBVs/ADVs to control heat removal by the SGs and to ensure the HPVs are closed.

Bases

With primary to secondary heat transfer restored, the SGs can be steamed to control RCS temperature. As steaming occurs, the feedwater flow to the SGs will have to be controlled at the appropriate level (e.g., at the [loss of SCM setpoint] if the RCS is saturated). Also, since heat transfer has been established, the hot leg HPVs are not needed and should be closed.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.2.9 and III.G.3.9.4

16.0 <u>WHEN</u> SCM EXISTS <u>OR</u> HPI FLOW IS ESTABLISHED, <u>THEN</u> CONTINUE.

<u>Indicators and Controls</u>

Indicators:
- SCM monitor
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI flow
- P-T display
- SPDS

Controls: N/A

<u>Purpose of Step</u>

The purpose of this step is a hold point.

<u>Bases</u>

At this point, heat transfer has been restored, but SCM and HPI flow may not exist, i.e., due to lack of HPI when HPI cooling was attempted in step 6.0. A hold is necessary under these conditions, due to the GEOG structure, to preclude a transfer to guidance that does not address a lack of both SCM and HPI. If either SCM or HPI flow exist, then a transfer in steps 17.0 or 18.0 would be allowable and no hold is required. During the hold, a transfer to section III.F due to indications of superheat (step 6.4.4) is also possible.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

17.0 IF SGTR INDICATED, THEN GO TO SECTION III.E, STEP 1.0.

Indicators and Controls

Indicators:
- Steam line radiation monitors
- Condenser air ejection radiation monitors or vacuum pump exhaust radiation monitors
- SG level
- FW flow
- SG samples
- Other plant specific indications

Controls: N/A

Purpose of Step

The purpose of this step is to transfer to the SGTR guidance in Section III.E if a tube rupture exists.

Bases

This step checks for a SGTR prior to continuing. SGTRs complicate plant cooldowns and usually result in abnormal cooldowns. The unique complications due to the tube leak(s) are handled in the SGTR guidance in Section III.E.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

18. 0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- HPI flow
- P-T display
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is to route to the LOCA cooldown section if continued HPI is required.

Bases

If the RCS makeup requirements exceed the MU system capacity then HPI must be maintained. Section IV.A provides the appropriate guidance for this condition, including the case where HPI may only be needed temporarily to restore SCM.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

19.0 <u>IF</u> A SG IS ISOLATED <u>OR</u> HAS AN UNISOLABLE STEAM LEAK, <u>THEN</u> GO TO SECTION IV.C, STEP 1.0.

<u>Indicators and Controls</u>
N/A

<u>Purpose of Step</u>
The purpose of this step is to transfer to the appropriate guidance for subsequent plant control.

<u>Bases</u>
At this point, controlled heat transfer and SCM have been restored, but a SG may have a problem that is forcing a plant cooldown. Guidance for this cooldown is provided in Section IV.C. For the purpose of this step, isolated SG means that the SG is not being used for heat transfer.

<u>Sequence</u>
There is no specific sequence requirement.

<u>TBD Volume 3 References</u>
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

20.0 GO TO SECTION III.A, STEP 3.0.

Indicators and Controls

N/A

Purpose of Step

The purpose of this step is to route back to the vital system status checks.

Bases

At this point adequate core heat removal and SCM exist. RCS makeup requirements are within the capacity of normal makeup and no transient or symptom exists. Routing back to III.A provides status checks of vital systems to ensure a stable plant condition. This also allows completion of these checks if the prior existence of a symptom required early exit from III.A.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

ATTACHMENT 1

LACK OF HEAT TRANSFER STEP 5.0 FOR DAVIS BESSE ONLY

5.0 INITIATE MU/HPI COOLING ALIGNMENT BY PERFORMING THE FOLLOWING:

5.1 Establish flow to the RCS from all available MU pumps with suction aligned to the BWST.

5.2 Align HPI and MU pumps to piggyback mode.

Indicators and Controls

Indicators:
- MU pump status
- MU control valve position
- MU suction valve from BWST position
- MU flow rate
- BWST level
- HPI pump status
- HPI valve position
- LPI pump status
- HPI/LPI piggyback valve status
- MU/LPI piggyback valve status
- PORV position
- PORV block valve position

Controls:
- MU pump controls
- MU control valve controls
- MU suction valve from BWST controls
- HPI pump controls
- LPI pump controls
- HPI/LPI piggyback valve controls
- MU/LPI piggyback valve controls
- PORV controls
- PORV block valve controls

Purpose of Step

The purpose of this step is to initiate flow to the RCS via the MU and, depending upon conditions, possibly the HPI system.

Bases
MU flow is required because RCS pressure may be above the shutoff head of the HPI pumps. Using all available MU flow, i.e., starting both MU pumps, aligning their suctions to the BWST and isolating their recirculation lines ensures the that the most flow available from the MU system will be pumped to the RCS as soon as possible. If both MU pumps are available with suction from the BWST, then all injection paths, i.e., normal and alternate, are used.

Both HPI pumps are aligned to the piggyback mode such that their suction is supplied from the discharge of the LPI pumps. The running MU pumps are also aligned to the piggyback mode with the LPI system. Aligning the HPI and MU pumps to the piggyback mode effectively shifts their head capacity curves upward. This means that the HPI pumps will be able to initiate flow to the RCS at a greater pressure and the MU pumps can supply more flow at the existing pressure.

Aligning these pumps ensures RCS injection sources are available and able to immediately start adding borated water to makeup for losses out the PORV..

The PORV may be cycled manually to control RCS pressure.

If RCPs are off and HPI or MU is on (PTS invoked), then SCM should be maintained near the SCM limit unless core exit thermocouple temperatures are not decreasing. In that case, HPI may not be throttled except to prevent exceeding the RV P-T limit.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.C.3.3.B, III.G.3.9.2, IV.B.2.B.2, IV.B.3.4, V.2.1 and V.3.0

5.3 IF flow cannot be achieved from both MU pumps, THEN go to step 6.0.

Indicators and Controls
Indicators: - MU pump status
- MU flow rate

Controls: N/A

Purpose of Step
The purpose of this step is to determine the status of MU pumps and route to the appropriate step.

Bases
With full MU flow from two MU pumps, analyses indicate that the core will remain covered and adequately cooled. After MU pumps are started, if full MU flow is achieved, then efforts to restore feedwater and heat transfer can continue. If full MU flow is not achieved, then additional actions to achieve maximum available MU/HPI cooling capability are immediately required.

Analyses indicate that, if full flow is provided from two MU pumps within 10 minutes of the core outlet temperature reaching 600°F, then the core will be adequately cooled. The core may also be adequately cooled if full flow is provided by only one piggybacked MU pump with the PORV open. However, to maintain conservative margin, this step will transfer to steps which immediately initiate MU/HPI cooling if both MU pumps are not available.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.C.3.3.B and III.G.3.9.2

5.4 <u>IF</u> the PORV fails open prior to core exit temperature reaching 600°F, <u>THEN</u> do not close PORV block valve and go to step 6.0.

Indicators and Controls

Indicators: - PORV position or status
- RCS temperature (incore thermocouple)

Controls: N/A

Purpose of Step
The purpose of this step is to provide the routing required if the PORV fails open before RC temperature at the core exit reaches 600°F.

Bases
As is explained in step 5.5 bases discussions, actions must be taken if feedwater and heat transfer have not been restored by the time RC temperature at the core exit reaches 600°F. If the PORV fails open before the core exit temperature reaches 600°F, then the PORV block valve must not be closed, and the routing to initiate MU/HPI cooling (step 6.0) must be taken now, without waiting for 600°F. This routing is necessary because, if the PORV block valve were closed and then could not be reopened, then RCS pressure could not be decreased such that the HPI pumps can be used (i.e., the RCS will saturate at a pressure above the shutoff head for the HPI pumps).

The 600°F core exit temperature is a limiting value and should be error corrected.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.C.3.3.B and III.G.3.9.2

5.5 **WHEN any of the following limits is reached,**

- **Core exit temperature reaches 600°F**
- **RC pressure increases to the RV P-T limit,**

THEN continue.

Indicators and Controls

Indicators: - RCS temperature (T_{hot} or incore thermocouple)
- RCP status
- RCS pressure

Controls: N/A

Purpose of Step

The purpose of this step is to provide criteria for MU/HPI cooling initiation in step 6.0.

Bases

Analyses have demonstrated adequate heat removal exists using only the two MU pumps. However, no margin exists for the possibility of a subsequent MU pump failure. Therefore, full HPI using piggybacked HPI pumps is initiated at 600°F. If the RCS saturates at 600^{0}F, RCS pressure will be below the shutoff head for the piggybacked HPI pumps (~1830 PSIG). Thus, a subsequent RCS heatup of ~23°F would have to occur to repressurize the RCS above the shutoff head for the HPI pumps. This provides some time to begin cooling the RCS before RCS pressure reaches 1830 PSIG and increases the probability of maintaining HPI injection flow.

Loss of heat transfer may also occur at lower RCS pressures and temperatures (e.g., during plant cooldown). In these situations, opening the PORV and initiating HPI cooling may be necessary to prevent exceeding the RV P-T limit. The PORV setpoint limit includes the LTOP setpoint if applicable.

The 600°F core exit temperature is a limiting value and should be error corrected.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.C.3.3.B and III.G.3.9.2

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION III.D - EXCESSIVE HEAT TRANSFER

Strategy:

- Terminate the overcooling transient.
- Restore controlled primary to secondary heat transfer.
- Stabilize RCS pressure and temperature.
- Backup SG heat removal by establishing HPI cooling if required.

1.0 CONTROL RCS INVENTORY.

Indicators and Controls

Indicators:
- Pressurizer level
- Letdown flow
- Makeup flow
- HPI flow
- RCS pressure
- RCS temperature ($T_{hot,}$ incore thermocouple)
- SCM monitor
- MU tank level
- P-T display
- SPDS

Controls:
- HPI pump controls
- HPI control valve controls
- Letdown flow control

Purpose of Step

The purpose of this step is to attempt to maintain pressurizer level through control of letdown and MU, and HPI if necessary.

Bases

The excessive heat transfer will contract the RCS inventory. This step covers actions to be taken to reduce the pressurizer level drop by normal means such as maximizing makeup flow and minimizing RCS letdown flow. If these actions are unsuccessful in keeping the pressurizer level from decreasing to the [low level] setpoint, then HPI should be used. HPI is not normally used post-trip to counter the expected pressurizer level change due to excessive thermal cycling of the HPI nozzles and to prevent possible subsequent complications if excessive inventory is added. HPI is used if necessary to try and maintain pressurizer level on-scale and prevent the surge line from draining. If the surge line empties, the RCS will saturate in some areas. This will normally not result in loss of core exit SCM nor will it interfere with the transient mitigation. Efforts to maintain pressurizer level should be controlled to not result in excessive subcooling, especially if HPI is used.

Sequence

There is no specific sequence requirement. This step is placed early in the section since it applies throughout and early attention to RCS inventory will increase the probability of maintaining SCM.

TBD Volume 3 References

III.D.1.1.1.A, III.D.2.2, III.D.3.2, V.2.0 and V.3.0

2.0 IF AT ANY TIME RC TEMPERATURE APPROACHES [core lift limit], THEN REDUCE TO < 4 RCP OPERATION.

Indicators and Controls
Indicators: - RCS temperature (T_{cold})

Controls: - RC pump motor controls

Purpose of Step
The purpose of this step is to trip at least 1 RCP when necessary due to the RCS cooldown.

Bases
Tripping 1 RCP before reducing RCS temperature < [core lift limit] prevents fuel assembly movement caused by flow of RCS at greater densities. In the event that the RCS cools to < [core lift limit] with all 4 RCPs still running, one or more RCPs should still be tripped as soon as possible.

The plant-specific value for [core lift limit] is a limiting value and should be error-corrected.

Sequence
There is no specific sequence requirement. Plant-specific values for the core lift limit vary. This step is placed here to reasonably bound all plants and to address transients starting at lower than normal post-trip temperatures. Each plant should place this step early enough in the mitigation to reasonably address the plant-specific limit, and to address transients that initiate at lower than normal post-trip temperatures.

TBD Volume 3 References
IV.A.2.5

3.0 <u>IF AT ANY TIME</u> BWST LEVEL DECREASES TO [RB sump switchover level], <u>THEN</u> SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

<u>Indicators and Controls</u>
Indicators: - BWST level
- Indicators in Section V.C

Controls: - Controls in Section V.C

<u>Purpose of Step</u>
The purpose of this step is to switch ES suction from the BWST to the RB sump when level in the BWST reaches the appropriate level.

<u>Bases</u>
This section can be entered with an RCS leak in progress and steps are not carried over between sections. During a LOCA or other event requiring injection, the initial suction source for HPI, LPI and RBS is the BWST. At some point in time, which is dependent on the break size, decay heat load, etc., the inventory in the BWST will be depleted sufficiently such that the suction for the ES pumps must be switched from the BWST to the RB sump.

The plant-specific value for [RB sump switchover level] is a limiting value and should be error-corrected.

<u>Sequence</u>
This step must be performed prior to BWST depletion.

<u>TBD Volume 3 References</u>
IV.B.3.2 and IV.B.7.0

4.0 IF AUTOMATIC SECONDARY PLANT PROTECTION HAS ACTUATED OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER RESPONSE.

Indicators and Controls

Indicators:
- SG pressure
- SG level
- MFW/EFW flow indication
- MFW/EFW pump status
- Plant specific secondary plant protection alarms
- MS/MFW isolation valve position indications

Controls:
- Plant specific secondary plant protection controls

Purpose of Step

The purpose of this step is to check for secondary plant protection systems actuations prior to taking manual control of feedwater valves and pumps in an attempt to mitigate the overcooling. If secondary protection systems have actuated, verification of proper actuation is made. If proper actuation did not occur but should have, then the appropriate actions should be taken manually.

Bases

Secondary plant protection systems may actuate during an extended or rapid overcooling. The main function of these systems is to prevent excessive overfill and/or excessive depressurization of the SGs. Proper actuation of these systems should be made prior to taking manual control of feedwater pumps and flow control valves. It is necessary to verify whether or not secondary system protection systems actuated properly and, if not, to perform the appropriate actions manually.

Sequence

There is no specific sequence requirement. It is logical to check for possible automatic SG isolation before performing manual isolation.

TBD Volume 3 References

III.D.2.4, and III.D.3.3

5.0 <u>IF AT ANY TIME</u> ES ACTUATES <u>OR</u> SHOULD HAVE ACTUATED, <u>THEN</u> ENSURE PROPER ACTUATION.

<u>Indicators and Controls</u>

Indicators: - ES panel actuation alarms
- ES channel/equipment status

Controls: - ES actuated equipment individual controls

<u>Purpose of Step</u>

The purpose of this step is to ensure the proper operation and alignment of all equipment actuated by ES should an actuation setpoint be reached.

<u>Bases</u>

ES actuation setpoints may or may not be reached during an excessive heat transfer event. If a setpoint is reached, it is necessary to verify that all equipment and components operate and align properly. If any automatic actuations fail to occur, due to failures or bypass, then the appropriate actions must be performed manually.

<u>Sequence</u>

There is no specific sequence requirement. It is suggested that each plant sequence the equivalent of steps 2.0, 4.0 and 5.0 based on plant-specific setpoints and needs.

<u>TBD Volume 3 References</u>

III.H.2.1, IV.B.2.A.2, IV.B.2.B.2, and IV.B.3.1

6.0 <u>IF</u> EXCESSIVE HEAT TRANSFER HAS <u>NOT</u> BEEN TERMINATED, <u>THEN</u> PERFORM THE FOLLOWING:

6.1 <u>IF</u> an MSSV is leaking <u>AND</u> both of the following conditions exist:

- **RCS cooldown rate is less than [T.S. limit]**
- **Proper level(s) can be maintained in affected SG(s)**

<u>THEN</u> perform the following:

6.1.1 Maintain the SG(s) available (do not continue to isolate).

6.1.2 <u>IF AT ANY TIME</u> SG pressure within [allowable range for secondary plant protection system bypass], <u>THEN</u> bypass low SG pressure actuation.

6.1.3 Go to step 8.0.

<u>Indicators and Controls</u>

Indicators:
- PT display or equivalent
- RCS temperature (T_{cold}, incore thermocouples)
- RCS pressure
- SG pressure
- SG level
- FW flows
- MSSV leak indications

Controls:
- Secondary plant protection system controls

<u>Purpose of Step</u>

The purpose of this step is to take actions if the transient has not been terminated by automatic system actuation. This includes allowing a 'controlled' cooldown if the transient is known to be due to a leaking MSSV.

<u>Bases</u>

If automatic actuation of a secondary plant protection system did not occur or did not terminate the overcooling transient, then further actions are necessary. In the event that the transient is due to a leaking MSSV and can be controlled within cooldown rate limits and SG level can be maintained, then SG isolation is not necessary. This allows a cooldown with reasonable control, which is preferable to isolation and dryout of a SG.

The [T.S. limit] is a fixed value that does not require error correction. The RCS cooldown rate is a value over time. Rates of change are not normally error corrected. [Allowable range for secondary plant protection system bypass] is a target value that does not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.D.2.3 and III.D.3.3

6.2 Sequentially control/isolate steam and feed on affected SG(s) as necessary to stop overcooling.

Indicators and Controls

Indicators:
- SG pressures
- SG levels
- RCS temperature (T_{cold}, Incore thermocouples)
- MFW/EFW flows

Controls:
- Plant specific list of feedwater and secondary steam isolation valves
- MFW/EFW pump controls

Purpose of Step

The purpose of this step is to initiate actions which will sequentially control or close all paths which could be contributing to secondary steam leaks or excessive feedwater flow.

Basis

Manual actions to terminate the overcooling depend on the severity of the transient. A fairly rapid cooldown may require isolation of steam and feed, followed by restoration of heat transfer, if possible. A slower cooldown may afford more time to attempt control prior to isolation. Sequential control/isolation intends for this graded approach, such that the actions taken are appropriate for the situation.

Termination of a rapid overcooling should include actions such as tripping of FW pumps and isolation of appropriate steam and feed lines. Actions for slower transients may include attempts to control feed flow rates and initial isolation of more probable steam release paths, followed in sequence by less probable paths.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.D.2.3, III.D.2.4, III.D.2.5 and III.D.3.3

7.0 ESTABLISH HEAT TRANSFER AS FOLLOWS:

7.1 IF one or both SG(s) available, THEN perform the following:

7.1.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass] THEN bypass low SG pressure actuation.

7.1.2 Stabilize RCS P-T using available SG(s) to minimize reheat (Rule 4.0).

7.1.3 Go to step 8.0

Indicators and Controls

Indicators:
- PT display or equivalent
- RCS temperature (T_{hot}, T_{cold} or incore thermocouples)
- RCS pressure
- SG pressure
- SG levels
- FW flows
- TBV/ADV position indication

Controls:
- MFW/EFW pump controls and flow control valve controls
- TBV/ADV controls
- Steam and feedwater isolation valve controls
- MU/HPI control valve controls

Purpose of Step

The purpose of this step is to stabilize RCS conditions using heat transfer to the operable SG(s).

Bases

Primary to secondary heat transfer is the preferred and most easily controlled method of core heat removal. If at least one SG is available, then attempts should be made to recover heat transfer to at least one SG. A SG is considered available if it appears to have relatively stable pressure. This could include a SG near atmospheric with a steam leak, which would become evident on attempted refeed. If the SG is not stable at an elevated pressure, then the potential steam leak location should be considered prior to reestablishing feed flow. Restoration of heat transfer is accomplished by reintroducing feedwater to the SGs and opening the TBVs/ADVs to begin steaming. Reintroduction of feedwater should be done in accordance with Rule 4.0. Rule 4.0 provides guidance on establishing feedwater flow and level to a potentially dry SG including initial flow rates and flow control criteria. Rule 4.0 also provides, if applicable, minimum flow rates that ensure adequate core cooling in the event a LOCA has occurred; these flow rates supercede dry SG feed rates.

Attempts to reestablish heat transfer to an isolated SG may result in re-initiation of the overcooling transient. If this occurs, the SG should be re-isolated. It is also possible to arrive at this step with one SG not operable and one SG still in service. In this case, it is not necessary to reestablish heat transfer to the isolated SG.

It is desirable to have forced flow present when introducing feedwater to a dry SG in order to minimize the SG tube-to-shell delta-T. Actions to limit the feed flow rate to [maximum allowable feed flow rate to a dry SG] should also be taken to minimize thermal stresses in the SGs.

When heat transfer has been reestablished to operable SG(s), TBVs/ADVs are adjusted to maintain RCS temperature at present value. The intent here is to stabilize primary to secondary heat transfer (prevent continued cooldown and or reheat/repressurization) as well as assess the plant status. Follow on actions may depend on PTS guidance, if invoked and/or plant equipment availability.

Makeup and/or HPI must be controlled to prevent repressurization of the RCS as the system stabilizes. Rule 2.0 provides additional guidance on controlling HPI and Rule 3.0 provides PTS guidance.

The [maximum allowable feed flow rate to a dry SG] is a target value. No error correction is required.

<u>Sequence</u>
There is no specific sequence requirement.

<u>TBD Volume 3 References</u>
III.D.2.7, III.D.3.5, IV.C.4.0, IV.G.2.2, V.2.0 V.3.0 and V.4.0

7.2 <u>IF</u> core cooling adequate due to break/HPI flow, <u>THEN</u> go to Section IV.A, step 1.0.

Indicators and Controls

Indicators:
- PT display or equivalent
- RCS temperature (incore thermocouple)
- RCS pressure

Controls: N/A

Purpose of Step

The purpose of this step is to route to the appropriate guidance depending on core cooling status.

Bases

Neither SG is available for normal heat transfer. The SG(s) may still be used if necessary by feeding even with an unisolable steam leak. However, if the core is already being adequately cooled due to a break and HPI, then it is not necessary to attempt feeding of broken SGs.

Adequate cooling by break/HPI flow is determined by the RCS response. If the RCS continues to cool and depressurize without heat removal by the SG(s), then adequate core cooling exists.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.B.3.3 and III.D.3.6

NOTE

Trickle feed should not be attempted using the MFW nozzles unless RCP(s) running.

7.3 IF steam leak location not detrimental to personnel or key equipment, THEN establish trickle feed to one or both SG(s) (Rule 4.0).

7.3.1 IF trickle feed is established, THEN perform the following:

- **Control RCS pressure (Section V.B).**
- **Adjust feed flow rate to control primary to secondary heat transfer.**
- **Adjust RCP combination to control RCS heat input if desired.**

7.4 IF Inadequate Heat Transfer OR Excessive Heat Transfer exists, THEN stop feed flow and go to step 18.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{cold}, incore thermocouples)
- MFW/EFW flow
- RCP status

Controls:
- MFW/EFW flow control
- RCP motor controls
- RCS pressure control (heaters, letdown, PORV, spray, etc.)

Purpose of Step

The purpose of step 7.3 is to attempt heat transfer through trickle feed of the SG(s). The purpose of step 7.4 is to terminate trickle feed if controlled heat transfer cannot be established and route to actions to initiate HPI cooling.

Bases

Trickle feed of SG(s) has been demonstrated by analyses to be an effective and controllable means of heat transfer under a range of RCS conditions. Under favorable conditions, trickle feed is preferable to HPI cooling. However, trickle feed should not be attempted if the steam leak location is detrimental to personnel or key equipment, including due to adverse environment.

When establishing feedwater for trickle feed, it should be done in accordance with Rule 4.0 which provides guidance for establishing trickle feed including initial flow rates and control criteria.

If trickle feed is not possible or controllable, then HPI cooling should be initiated.

Trickle feed using the MFW nozzles is only effective with forced flow. SG levels cannot be raised to the NC setpoint and the MFW nozzles do not introduce FW at a high enough elevation to initiate NC.

The plant-specific value for [flow rate] is a limiting value and should be error-corrected.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.D.2.8, III.D.3.6, III.G.2.6.4, III.G.3.10 IV.C.5.0 and V.4.0

8.0 CONTROL RCS INVENTORY.

Indicators and Controls

Indicators:
- P-T display
- RCS temperature (incore thermocouple)
- RCS pressure
- Pressurizer level
- MU/HPI flow
- MU tank level
- SPDS
- SCM monitor

Controls:
- MU/HPI flow control
- Letdown flow control

Purpose of Step

The purpose of this step is to restore and maintain proper RCS inventory.

Bases

The RCS inventory has been affected by the contraction caused by the cooldown and the actions to attempt inventory control per step 1.0. The transient has been terminated and controlled heat removal has been established, therefore RCS inventory control can be stabilized and, if applicable, letdown can be reestablished.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.D.3.5

9.0 IF PTS IS INVOKED, THEN LIMIT RCS PRESSURE PER RULE 3.0 (Section V.B).

Indicators and Controls

Indicators:
- P-T display
- RCS temperature (T_{cold}, incore thermocouple)
- RCS pressure
- SPDS
- SCM monitor

Controls:
- MU/HPI flow control
- Spray flow control
- PORV/pressurizer vent control

Purpose of Step

The purpose of this step is to ensure PTS restrictions are followed if applicable.

Bases

An overcooling transient can invoke PTS due to either HPI flow with RCPs off or due to the cooldown rate as defined in Rule 3.0. If PTS has been invoked, then RCS pressure must be maintained within the limits prescribed in Rule 3.0.

Sequence

There is no specific sequence requirement. However, rules apply anytime the reactor is shutdown, and steps to control RCS pressure within PTS restrictions must be placed soon enough after transient stabilization to minimize the possibility of violating the pressure restrictions.

TBD Volume 3 References

IV.G

10.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

Indicators and Controls

Indicators:
- Control rod position
- Plant specific reactivity balance curves
- RCS boron concentration
- RCS average temperature

Controls:
- Control rod drive control system
- Plant specific RCS boron addition controls

Purpose of Step

The purpose of this step is to ensure that the reactor remains adequately shutdown.

Bases

Positive reactivity has been added due to the overcooling transient. For this reason, shutdown margin should be determined and reactivity adjusted as required to maintain the required shutdown margin.

Sequence

Adequate shutdown margin should be verified as soon as reasonably possible following termination of an overcooling transient. In addition, SG status may require a forced cooldown, and adequate shutdown margin must be verified/established prior to intentional cooldown.

TBD Volume 3 References

III.G.3.1

11.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- SPDS
- P-T display

Controls:
- ES actuation bypass controls

Purpose of Step

The purpose of this step is to prevent unnecessary ES actuation during any subsequent controlled depressurization.

Bases

The transient has been terminated and RCS inventory is being controlled. RCS depressurization may be required for PTS or to minimize SG tube stress. As long as SCM exists and the RCS pressure is under control, the ES actuation should be bypassed when conditions permit to prevent unwanted and unnecessary actuation.

The plant-specific value for [allowable range for ES bypass] is intended as a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.2.5.1 and III.G.3.1

12.0 IF ANY SG IS DRY, THEN MAINTAIN MINIMUM SCM.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI flow
- MU flow
- SG level
- SG pressure
- SPDS
- SCM monitor
- P-T display

Controls:
- HPI pump controls
- HPI valve controls
- MU valve controls
- Pressurizer heater controls
- Letdown valve controls
- Pressurizer spray controls
- PORV/pressurizer vent controls

Purpose of Step

The purpose of this step is to reduce the tensile stress on the idle SG tubes due to the primary to secondary differential pressure.

Bases

SG tube to shell tensile stresses are a function of both temperature differential and primary to secondary pressure differential. Therefore, reducing the primary to secondary differential pressure will aid in reducing the overall tube tensile stresses. There is no intent or need to hold at this step until minimum SCM is achieved.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.D.3.5.

13.0 MAINTAIN SG TUBE TO SHELL ΔT WITHIN TENSILE AND COMPRESSIVE LIMITS.

Indicators and Controls

Indicators:
- SG shell temperature
- RCS temperature (T_{hot}, T_{cold})
- EFW flow
- SPDS
- SCM monitor
- P-T display

Controls:
- TBV/ADV controls
- EFW controls

Purpose of Step

The purpose of this step is to maintain SG tube to shell differential temperatures.

Bases

SG tube to shell differential temperatures should be maintained within limits. The RCS cooldown may have imposed tensile loads on the tubes, and a dry SG may subsequently develop compressive loads due to SG shell cooling. This may require RCS cooldown, if in forced circulation, to cool the idle SG tubes.

The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.6, IV.C.4.0 and IV.C.5.2

14.0 <u>IF</u> SGTR INDICATED, <u>THEN</u> GO TO SECTION III.E, STEP 1.0.

Indicators and Controls

Indicators:
- Steam line radiation monitors
- Condenser air ejector monitors or vacuum pump exhaust
- SG levels
- FW flow
- SG chemistry samples
- Any other plant specific indicators

Controls: N/A

Purpose of Step

The purpose of this step is to check for a SGTR prior to exiting the guideline.

Bases

This step performs a check to determine if a SGTR is present before exiting the guideline, as part of ensuring stable plant conditions. While it is unlikely that an overcooling would induce a tube leak, it is possible and therefore prudent to check for tube leak indications. For that reason, it is specifically stated here even though it is expected that continuous monitoring for symptoms will occur throughout the guidelines.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.D.2.9, III.E.2.2.1 and III.E.3.1

15.0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- HPI flow
- P-T display
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is to route to the LOCA cooldown section if continued HPI is required.

Bases

If the RCS makeup requirements exceed the MU system capacity then HPI must be maintained. Section IV.A provides the appropriate guidance for this condition, including the case where HPI may only be needed temporarily to restore SCM.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

16.0 IF A SG IS ISOLATED OR HAS AN UNISOLABLE STEAM LEAK, THEN GO TO SECTION IV.C, STEP 1.0.

Indicators and Controls

N/A

Purpose of Step

The purpose of this step is to transfer to the appropriate guidance for subsequent plant control.

Bases

At this point, controlled heat transfer and SCM have been restored, but a SG may have a problem that is forcing a plant cooldown. Guidance for this cooldown is provided in Section IV.C. For the purpose of this step, isolated SG means that the SG is not being used for heat transfer.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

17.0 GO TO SECTION III.A, STEP 3.0.

Indicators and Controls

N/A

Purpose of Step

The purpose of this step is to route back to the vital system status checks.

Bases

At this point adequate core heat removal and SCM exist. RCS makeup requirements are within the capacity of normal makeup and no transient or symptom exists. Routing back to III.A provides status checks of vital systems to ensure a stable plant condition. This also allows completion of these checks if the prior existence of a symptom required early exit from III.A.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

NOTE

SCM may be lost when the PORV is opened and does not require transfer to III.B.

18.0 ESTABLISH HPI COOLING.

18.1 Initiate MU/HPI cooling.

18.2 Isolate letdown.

18.3 Reduce to one RCP and run as long as SCM exists and SG tube–shell ΔT limits are not exceeded.

<u>Indicators and Controls</u>

Indicators:
- HPI pump status
- HPI flow rate
- RCS pressure
- RCS temperature (T_{hot} or incore thermocouple and T_{cold})
- SCM monitor
- HPI valve position
- PORV position or status
- PORV block valve position
- RCP status
- SG shell temperatures
- Letdown flow
- SPDS
- P-T display

Controls:
- HPI pump motor controls
- HPI valve controls
- PORV control
- PORV block valve control
- RCP motor controls
- Letdown flow control

<u>Purpose of Step</u>

The purpose of this step is to initiate the backup core cooling method of HPI cooling. Backup core cooling is necessary at this point because neither SG is capable of providing controlled primary to secondary heat transfer.

Bases

Neither SG can be used for controlled heat removal. An alternative core cooling method or backup method is needed to replace SG cooling. HPI cooling should be started. After HPI pumps are started, HPI flow should be verified before the PORV is opened. HPI flow verification covers both HPI flow from one or two HPI pumps. With only one HPI pump, the PORV must be maintained open. In doing so, the net RCS inventory decrease is minimized (e.e., mass addition due to increased HPI flow at lower RCS pressure is greater than mass loss out the PORV to depressurize the RCS), ensuring adequate core cooling. Although it is not necessary to maintain the PORV open if two HPI pumps are on, it is the preferred option versus allowing the PORV to cycle because the highest RCS collapsed liquid level is attained. Maintaining the PORV open will also result in fewer PORV cycles, reducing the likelihood of PORV failure and will also produce a higher integrated HPI flow rate.

If SCM is lost when the PORV is opened, then RCPs must be tripped but it is not necessary to transfer to the loss of SCM guidance of Section III.B. This is because the loss of SCM is most likely a consequence of the action taken (i.e., opening the PORV). In this situation, the steam volume flow rate through the PORV exceeds the combination of a) the volume flow rate into the RCS (HPI) and b) the volume increase due to RC expansion (heatup of RC) resulting in loss of SCM. Even in the extremely unlikely event of a concurrent LOCA, transfer to III.B in this instance is not necessary. Before opening the PORV HPI flow was verified; therefore, the loss of SCM guidance to initiate HPI has already been taken. The RCPs are tripped per Rule 1.0, and attempts to restore FW and heat transfer have already been made. No other Section III.B actions are appropriate for this situation.

With HPI flow verified and the PORV opened, additional actions should be performed. The first is to maintain RCS pressure less than the RV P-T limit, by throttling HPI flow. This action must be taken as long as SCM exists. Pressurizer heaters should be turned off to ensure they will not be automatically energized when the RCS pressure is reduced during HPI cooling. Deenergizing the heaters also reduces the energy input to the RCS to reduce the HPI cooling heat removal demands and to help in reducing RCS pressure. This also protects the heaters should they become uncovered during HPI cooling. Letdown is isolated to preclude loss of inventory outside the RB, since HPIC may be long-term with sump recirculation. Further, all but one RCP should be tripped. This action reduces the energy input to the RCS but still provides some forced flow for better thermal mixing of the RC. The one RCP can be run as long as SCM exists and the SG tube-shell ΔT limits are not exceeded.

If the PORV cannot be opened (with HPI flow verified) and this condition continues long enough, RCS temperature will begin to decrease due to flow through the code safeties while RCS pressure remains high. Along with continuing attempts to establish PORV flow, HPI flow should be throttled to prevent RCS temperature from decreasing below the RV P-T limit. If no RC pumps are operating the RCS temperature should be kept near the SCM limit per the PTS guidance in Rule 3.0.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

The GEOG values for tube-shell ΔT limits (provided in Volume3) are control parameters and therefore do not require error correction.

Sequence
If SGs are not available then HPI cooling should be initiated prior to any appreciable RCS reheat. When initiating HPI cooling, HPI flow must be verified prior to maintaining the PORV open.

TBD Volume 3 References
III.C.3.3A, III.C.3.3.B, III.D.2.8, III.D.3.6, III.G.3.9, III.G.3.9.1, III.G.3.9.2, III.G.3.9.3, III.H, IV.B.2.A.2, IV.B.2.A.3, IV.B.2.B.2, IV.B.2.B.3, IV.F.3.1 and IV.G

18.4 IF HPI flow cannot be established, THEN perform the following:

18.4.1 Ensure the PORV is closed (close PORV block valve if PORV cannot be closed).

> **NOTE**
> **Trickle feed should not be attempted using the MFW nozzles unless RCP(s) running.**

18.4.2 Reestablish trickle feed to at least one SG (Rule 4.0).

18.4.3 Limit RCS pressure per Rule 3.0 as appropriate.

18.4.4 IF AT ANY TIME incore thermocouple temperatures indicate superheat, THEN go to Section III.F, step 1.0.

18.4.5 WHEN HPI is established, THEN continue.

18.4.6 Stop trickle feed flow.

18.4.7 Open the PORV (and PORV block if necessary).

19.0 GO TO SECTION IV.B, STEP 1.0.

Indicators and Controls

Indicators:
- HPI flow rate
- HPI pump status
- PORV position or status
- RCS pressure
- RCS temperature (incore thermocouples)
- PORV block valve position
- SCM monitor
- RCP status
- MFW/EFW flow rate
- SPDS
- P-T display

Controls:
- PORV/PORV block valve controls
- Pressurizer spray controls
- AFW/EFW flow controls

Purpose of Step
These steps provides those actions that are necessary if HPI flow cannot be established in order to conserve RCS inventory while no injection flow is available and to attempt backup cooling using trickle feed.

Bases
If HPI flow is not immediately available, actions must be taken to ensure existing RCS inventory is conserved by closing or verifying closed the PORV and PORV block valve. If the PTS guidance is invoked per Rule 3.0, then RCS pressure should be reduced as necessary. Instrument and process errors can result in indicated ICC conditions when the RCS is still saturated. This is accommodated (i.e., acceptable) since the initial ICC actions are essentially the same actions performed for a loss of SCM. In addition, an error band, similar to the one used for SCM could be used for ICC, or other alternatives such as the trend relative to the saturation curve.

Since an overcooling transient has just occurred, it is not considered logical that neither SG would be available for trickle feed if HPI could not be established. The steam leak may be in a detrimental location or the cooldown rate with trickle feed may be excessive, but these are preferable conditions to a total loss of core heat removal.

When reestablishing trickle feed, it should be done in accordance with Rule 4.0 which provides guidance for establishing trickle feed including initial flow rates and control criteria.

When HPI flow is verified, the PORV and PORV block should be opened immediately to enable HPI cooling to begin. If the PORV cannot be opened (with HPI flow verified) and this condition lasts long enough, RCS temperature will begin to decrease due to flow through the code safeties at a high RCS pressure. In this situation, HPI should be throttled, when SCM exists, as necessary to prevent violating the PTS guidance or RV P-T limits, whichever is applicable. Once HPI cooling is initiated then step 19.0 routes to the appropriate cooldown guidance.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

The plant-specific value for [flow rate] is a limiting value and should be error-corrected.

Sequence
There is no specific sequence requirement for these steps other than the PORV should not be maintained open until HPI flow is verified.

TBD Volume 3 References
III.C.2.3, III.C.3.3, III.F.2.1, III.F.3.1, III.G.3.9.1, III.G.3.9.2, III.G.3.10, III.H, IV.F.3.1, IV.G, V.3.0 and V.4.0

GENERIC EMERGENCY OPERATING GUIDELINE BASES

SECTION III.E – STEAM GENERATOR TUBE RUPTURE

STRATEGY:

- Controlled shutdown and cooldown while controlling off-site release.
- Maintain SG parameters within limits.
- Minimize integrated tube leakage.
- Cool to DHRS operation where SGTR can be terminated.

1.0 CONTROL PRESSURIZER LEVEL

Indicators and Controls

Indicators:
- MU flow
- MU pump status
- MU tank level
- Pressurizer level
- MU valve(s) status
- Letdown flow
- Letdown valve status
- HPI flow
- HPI pump status
- HPI valve status
- Letdown bypass valve status

Controls:
- MU valve controls
- MU pump motor circuit breaker control switch
- Letdown valve controls
- HPI pump motor circuit breaker control switches
- HPI valve controls
- Letdown valve controls
- Letdown bypass valve controls

Purpose of Step

The purpose of this step is to attempt to maintain adequate pressurizer level such that a controlled plant shutdown and cooldown can be completed. If adequate pressurizer level cannot be maintained, then the reactor is tripped if applicable.

Bases

A major goal in SGTR mitigation is to conduct as normal a plant shutdown and cooldown as possible. Since the SGTR represents an RCS leak, it is necessary to ensure RCS inventory is maintained adequately in order to achieve this goal. If a SGTR occurs (primary to secondary leak) while at power, it is desirable to reduce reactor power and shutdown the reactor in a controlled manner. In particular, it is important to prevent MSSV lifting and possible MSSV failure which would provide a path for radiation release directly to the atmosphere. In order to accomplish a controlled reactor shutdown, it is necessary to control pressurizer level such that it does not continually decrease (due to the SGTR) and cause a low pressure reactor trip or require a trip on low level. This includes cases where maximum MU (including minimizing letdown flow) or HPI flow is required to keep up with the SGTR. However, if pressurizer level cannot be stabilized, then a reactor trip is unavoidable and the operator should trip the reactor and isolate letdown.

If the reactor is already shutdown, it is still important to control pressurizer level to allow normal pressure control and to avoid losing SCM if possible. Maintaining SCM and RCP operation will significantly aid the subsequent cooldown to DHRS operation.

<u>Sequence</u>
There is no specific sequence requirement. However, actions to control pressurizer level should commence early in SGTR mitigation to ensure the highest probability of success.

<u>TBD Volume 3 References</u>
III.E.2.1.2, III.E.2.2.1, III.E.3.2, III.E.3.3.1, and III.E.3.4.1.1

2.0 IDENTIFY AFFECTED SG(s).

2.1 Isolate non-essential steam loads from the affected SG(s) as time permits.

Indicators and Controls

Indicators:
- Steam line radiation monitors
- Condenser air ejector or vacuum pump exhaust radiation monitors
- SG levels
- FW flow
- SG samples
- Any other plant specific indication
- Appropriate plant specific valve status

Controls:
- Appropriate plant specific valve controls

Purpose of Step

The purposes of these steps are to identify the leaking SG(s) and to isolate possible radiation leak paths from the affected SG(s) thus minimizing any radiation releases.

Bases

When a SGTR occurs, it is important to diagnose the event and identify the affected SG(s) since subsequent actions depend on this information. The initial indications of a SGTR will usually be radiation readings/alarms on the steam lines and/or condenser off-gas and unidentified RCS inventory loss.

Releases should be limited to less than pre-determined limits. In an effort to achieve this goal, non-essential steam loads, from the affected SG(s), should be isolated as soon as possible to reduce potential release paths to the atmosphere.

Sequence

There is no specific sequence requirement, however these steps should be performed relatively early in the mitigation of a SGTR.

TBD Volume 3 References

III.E.1.1.2.B, III.E.2.1 and III.E.3.1

3.0 IF THE REACTOR IS TRIPPED, THEN GO TO STEP 6.0.

Indicators and Controls

Indicators:
- Reactor trip alarm
- Power range instruments
- Intermediate range instruments
- Control rod positions

Controls: N/A

Purpose of Step

The purpose of this step is to bypass actions for power reduction and reactor shutdown if the reactor is already tripped.

Bases

If possible, reactor power should be reduced to well within the turbine bypass system capacity before tripping the reactor. If a reactor trip occurs prior to entering this section, then the actions of steps 4.0 and 5.0, which allow power reduction and reactor shutdown and verification, will not be applicable.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

4.0 SHUTDOWN THE REACTOR

4.1 Perform a controlled reactor shutdown to prevent lifting MSSVs.

4.2 IF the reactor trips during shutdown, THEN go to step 5.0.

4.3 At < [reactor power that will prevent lifting MSSVs when reactor is tripped] perform [actions to trip turbine and reactor]. Do not continue until the reactor is tripped.

Indicators and Controls

Indicators:
- Average RCS temperature
- Reactor power
- Megawatt electric indication
- MFW and start up feedwater flow
- SG levels
- RCS pressure
- Pressurizer level
- Reactor trip alarm
- Power range instruments
- Intermediate range instruments
- Control rod positions
- SG pressure
- TBV position
- TBV setpoint vs. position error
- Main turbine stop/governor valve position

Controls:
- Main turbine controls
- ICS hand/automatic stations
- Diamond Power CRD panel
- Reactor trip control

Purpose of Step

The purpose of these steps is to perform a controlled plant shutdown, such that a controlled reactor trip can be accomplished (MSSVs not opened).

Bases

The intent is to prevent lifting MSSVs on the affected SG(s). If MSSVs on the affected SG lift there will be a path for radiation release directly to atmosphere. Also, there is a small but real possibility that a MSSV can fail to reseat after lifting. A failure to reseat on a SG with a SGTR will result in uncontrolled radiation releases, directly to atmosphere, since no practical method exists to terminate the SG tube leak flow or MSSV steam flow.

The plant-specific value for [reactor power] is intended as a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.E.2.1.2, III.E.3.2 and III.E.3.4.1.1

5.0 IMMEDIATELY PERFORM THE ACTIONS OF SECTION III.A, STEPS 1.0 - 2.0 AND CONTINUE WITH SECTION III.E STEP 6.0.

Indicators and Controls
Indicators: N/A

Controls: N/A

Purpose of Step
The purpose of this step is to verify reactor shutdown before proceeding with mitigation of the tube rupture.

Bases
If a reactor trip occurs after entering this section, then after verifying the reactor is adequately shutdown (Section III.A steps 1.0 and 2.0), the operator commences treatment of the SGTR (symptom). VSSV may be completed in parallel with treating the symptom (SGTR) or completed as soon as possible at a later time, but mitigation of the SGTR should not be delayed by VSSV.

Sequence
Verification of reactor shutdown must be performed before continuing with SGTR mitigation. The remainder of the actions are based on the reactor being shutdown.

TBD Volume 3 References
III.A.2.2, III.E.2.1.2 and III.E.3.2

6.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- P-T display
- SPDS

Controls:
- ES actuation bypass controls

Purpose of Step

The purpose of this step is to prevent unnecessary actuation of ES during the cooldown.

Bases

During normal cooldowns, ES is bypassed at the appropriate RCS pressure to prevent unnecessary actuation of emergency equipment. This same consideration applies during a cooldown with a SGTR except that some ES equipment may have already been actuated as a result of the SGTR. ES equipment actuation should not be bypassed if SCM does not exist or RCS pressure is not controlled, since a LOCA may be in progress.

The plant-specific value for [allowable range for ES bypass] is intended as a target value and therefore does not require error-correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.2.5.1

7.0 REDUCE RCS PRESSURE TO MAINTAIN MINIMUM SCM, AND IF APPLICABLE RCP NPSH, WITHOUT EXCEEDING [pressurizer emergency cooldown rate] (Rule 3.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouples)
- SCM monitor
- P-T display
- RCP status
- SPDS
- Spray valve position
- Auxiliary high pressure spray valve indication
- Pressurizer vent valve position
- PORV position

Controls:
- Spray valve controls
- Auxiliary high pressure spray valve controls
- Pressurizer vent valve controls
- PORV controls

Purpose of Step

The purpose of this step is to reduce RCS pressure as much as possible while still maintaining SCM and RCP NPSH if applicable.

Bases

During the cooldown it is desirable to maintain RCS pressure and temperature close to, but above, the minimum SCM. This minimizes the differential pressure between the RCS and the affected SG(s), thus minimizing the tube leak flow rate. If normal spray is not available (e.g., RCPs off) to reduce RC pressure, then high pressure auxiliary spray, if available, is used. In the absence of high pressure auxiliary spray, then the PORV or pressurizer vent is employed to decrease RCS pressure.

The RCS depressurization will require a pressurizer cooldown rate greater than the normal limit, but the cooldown rate should be kept within the [pressurizer emergency cooldown rate] for rapid depressurization, if possible.

If PTS guidance has been invoked, then the RCS pressure and cooldown rate must be maintained per PTS guidance.

The plant-specific control value for RCP NPSH does not require error correction.

The plant-specific value for [pressurizer emergency cooldown rate] is intended as a control parameter and therefore does not require error correction.

Sequence
There is no specific sequence requirement. However, minimizing RCS pressure is necessary to minimize the tube leak rate and should be accomplished as soon as reasonably achievable after reactor shutdown. It is important to reduce RCS pressure to less than 1000 PSIG before the affected SG overfills.

TBD Volume 3 References
III.E.2.2.1, III.E.2.3.1, III.E.3.3.1, III.G.3.2 and V.3.0

8.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

Indicators and Controls
Indicators: - SG pressure

Controls: - Plant specific controls

Purpose of Step
The purpose of this step is to prevent unnecessary actuation of Secondary Plant Protection System equipment during the cooldown.

Bases
The Secondary Plant Protection System monitors for major steam and feedwater upsets. During normal cooldowns, the Secondary Plant Protection System is bypassed at the appropriate SG pressure to prevent unnecessary actuation of emergency equipment.

The plant-specific value for [allowable range for secondary plant protection system bypass] is intended as a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.2.5.1

9.0 STEAM AVAILABLE SGs TO ESTABLISH DESIRED COOLDOWN RATE.

9.1 IF required to prevent exceeding [SG overfill setpoint] or [radiation limit], THEN use emergency cooldown rate limit to 500°F.

9.2 Maintaintain SG levels as appropriate per Rule 4.0.

Indicators and Controls

Indicators:
- TBV/ADV position
- SG pressure.
- RCS temperature/(T_{cold}, T_{hot} incore thermocouples)

Controls:
- TBV/ADV controls

Purpose of Step

The purpose of this step is to establish a cooldown at the desired rate. The desired rate will depend upon plant conditions such as level in the affected SG(s) and/or projected radiation release. If overfill of affected SG(s) or radiation releases greater than the limit are likely to occur before SG isolation can be accomplished at the normal cooldown rate, then the operator should increase the cooldown rate as much as possible up to 240°F/HR down to 500°F.

Bases

Once the reactor is shutdown, the intent is to commence cooldown with both SGs if available to reduce RCS hot leg temperature below 540°F. At this temperature, saturation pressure in an isolated SG should be below MSSV setpoint. Steaming both SGs with TBVs or ADVs should maintain SG pressure below the MSSV setpoint.

SG levels should be maintained as appropriate. This includes establishing levels for forced flow, NC and loss of SCM conditions. For all cases, Rule 4.0 provides appropriate guidance for establishing appropriate SG levels.

If SCM has been lost, then normally, level in both SGs is raised to the loss of SCM setpoint. However, this may cause subsequent inventory control problems in the affected (tube leaking) SG. Therefore, if SCM is lost with full flow from at least one HPI pump, then consideration may be given to filling only the affected SG (or least affected SG, if both SGs have tube leaks) to the loss of SCM setpoint. The remaining SG need only be fed as necessary to maintain primary to secondary heat transfer.

The cooldown rate should be increased, as much as possible up to 240°F/HR, until T_{hot} is $\leq$ 500°F if the affected SG(s) levels will reach the SG level limit or the radiation release is projected to reach the integrated limit before 500°F T_{hot}. The reason is, that for these two cases (high level and radiation release) several large tube leaks and/or a relatively high percentage of failed fuel already exist. Therefore, it is important to reduce T_{hot} to 500°F as quickly as possible (limits the duration of radiation release) and isolate the affected SG(s). Isolating the affected SG(s) below 500°F T_{hot} allows RCS pressure to be decreased to below the MSSV setpoint (allows SG isolation without lifting MSSVs with steam or liquid) while still maintaining SCM. It should be noted that below 500°F T_{hot}, the cooldown rate must be reduced to ≤ TS limit. It is acceptable to shift steaming to the most affected SG to limit SG level increase.

The plant-specific values for [SG overfill setpoint] and [radiation limit] are limiting values and should be error-corrected. 500°F T_{hot} is a target value that does not require error correction.

<u>Sequence</u>
The emergency cooldown rate only applies above 500°F, and the use of the emergency cooldown rate should be placed to reasonably achieve the objective of cooling to 500°F prior to overfilling a SG or exceeding radiation release limits.

<u>TBD Volume 3 References</u>
III.E.2.2.2, III.E.2.3.1, III.E.3.3.1 and V.4.0

10.0 PERFORM [actions required for control room habitability].

Indicators and Controls

Plant specific

Purpose of Step

The purpose of this step is to ensure the necessary actions are taken to maintain the control room environment within acceptable limits. This may involve actions such as realigning the control room ventilation.

Bases

Events such as tube rupture or LOCA can result in radiation releases that could exceed allowable doses for control room personnel under normal control room conditions. Therefore, it is typical to have emergency control room ventilation alignments that ensure the control room personnel are not unduly exposed during the mitigation of such events.

Sequence

There is no specific sequence requirement imposed by the TBD. The corresponding EOP step may have a plant-specific timing requirement, which may impose sequencing restrictions.

TBD Volume 3 References

None.

11.0 IF SCM EXISTS AND RCP(s) AVAILABLE, THEN ENSURE FORCED CIRCULATION (Section V.A).

Indicators and Controls

Indicators:
- RCS pressure
- P-T display
- SCM monitor
- SPDS
- RCS temperature (incore thermocouple)
- RCS flow
- RCP status
- RCP/RCP motor auxiliaries status

Controls:
- RCP auxiliaries controls
- RCP motor circuit breaker controls

Purpose of Step

The purpose of this step is to ensure forced flow and spray flow capability to enhance RCS control during the cooldown. Forced flow is ensured by verification or by starting RCP, if possible.

Bases

Forced flow circulation is preferable to natural circulation, especially during SGTRs where an expeditious cooldown is desired. Forced circulation cooldowns prevent void formation and their attendant complications and cooldown delays. In addition, forced circulation cooldowns provide pressurizer spray flow (optimizes RCS pressure control), lower RCS loop ΔTs (allows lower primary to secondary ΔPs which reduces tube leakage) and faster overall cooldown to DHR (minimizes integrated tube leak flow and radiation releases) assuming the condenser is available. Starting RCP combinations that maximize spray flow will provide for the maximum depressurization rates during the cooldown. Running one RCP in each loop balances heat transfer, however, other combinations may provide more spray flow or better NPSH characteristics.

There may be restrictions on starting RCPs due to boron dilution concerns. These restrictions must be considered in determining RCP availability.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.E.2.5.1, III.E.2.5.3, IV.A.3.0 and IV.A.3.1.

12.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

Indicators and Controls

Indicators:
- Control rod position
- Plant specific reactivity balance curves
- RCS boron concentration
- RCS average temperature

Controls:
- Control rod drive control system
- Plant specific RCS boron addition controls

Purpose of Step

The purpose of this step is to ensure that the reactor remains adequately shutdown during the cooldown.

Bases

Positive reactivity will be added to the reactor by moderator temperature coefficient during the cooldown. For this reason, shutdown margin should be determined during the cooldown and reactivity adjusted as required to maintain the required shutdown margin. It is preferable to perform this in conjunction with the cooldown if possible to minimize delays.

Sequence

Adequate shutdown margin for a given RCS temperature must be verified prior to intentionally cooling to that temperature.

TBD Volume 3 References

III.G.3.1

13.0 WHEN RCS PRESSURE < 1000 PSIG, THEN CONTINUE.

Indicators and Controls
Indicators: - RCS pressure

Controls: N/A

Purpose of Step
The purpose of this step is to hold until RCS pressure is low enough that a subsequent isolation and filling of a SG will not challenge the MSSVs.

Bases
The initial goal in mitigating a SGTR is to achieve plant conditions where an affected SG can be isolated with low risk of lifting MSSVs. This requires a primary system pressure less than the lowest set MSSV. For margin and ease of use, 1000 PSIG is used as the required RCS pressure limit, below which an affected SG may be isolated.

Depending on plant-specific values, depressurizing the RCS to < 1000 PSIG will require cooling the core outlet to 520°F or less in order to maintain SCM.

The GEOG value of 1000 PSIG is a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement. This step is placed here due to the GEOG structure.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

14.0 IF BOTH SGs ARE AVAILABLE AND CONTINUED STEAMING OF THE MOST AFFECTED SG NOT REQUIRED, THEN STOP FEEDING AND STEAMING THE MOST AFFECTED SG.

Indicators and Controls

Indicators:
- SG status
- FW valve positions
- TBV/ADV positions

Controls:
- FW valve controls
- TBV/ADV controls

Purpose of Step

The purpose of this step is to terminate unnecessary steam release from the most affected SG if conditions permit.

Bases

If both SGs are available and plant-specific criteria permit, then steaming of one SG can be terminated. If only one SG is available, it should continue to be used for heat removal until a limit that would prevent steaming is reached, since HPI cooling is a less desirable alternative. Plant-specific criteria are determined based on factors such as steam relief capacity, site boundary limits, available BWST inventory, etc.. The criteria should also include consideration for controlling tube-shell ΔT in both SGs.

Most affected SG denotes either the only SG with a tube leak or the SG with the larger tube leak if leaks exist in both SGs.

If steaming and feeding of the most affected SG is terminated, it should be done in a manner that allows restoration of heat transfer should it become necessary. Flow paths should not be isolated in a manner that involves considerable delay to reestablish.

Sequence

Isolation of an affected SG should not occur until RCS pressure is maintained below 1000 PSIG if at all possible, therefore this step is placed after the hold in step 13.0.

TBD Volume 3 References

III.E.3.3.2

15.0 MAINTAIN SG TUBE TO SHELL ΔT WITHIN TENSILE AND COMPRESSIVE LIMITS

Indicators and Controls

Indicators:
- SG shell temperature
- RCS temperature (T_{hot}, T_{cold})
- EFW flow
- SPDS
- SCM monitor
- P-T display

Controls:
- TBV/ADV
- EFW controls

Purpose of Step

The purpose of this step is to maintain SG tube to shell differential temperatures.

Bases

SG tube to shell differential temperatures should be maintained within limits. The RCS cooldown may have imposed tensile loads on the tubes, and a dry SG may subsequently develop compressive loads due to SG shell cooling. This may require RCS cooldown, if in forced circulation, to cool the idle SG tubes.

The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error corrections.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.6, IV.C.4.0 and IV.C.5.2

16.0 BEGIN MAKEUP TO THE BWST.

Indicators and Controls
Indicators: - HPI flow
- BWST level

Controls: - Plant specific BWST make up controls

Purpose of Step
The purpose of this step is to evaluate the BWST depletion rate and, if applicable, to commence make up to the BWST in order to replenish unrecoverable losses.

Bases
Reactor coolant that leaks through a SGTR may remain in the SG(s) or be steamed to the atmosphere. If it leaks to atmosphere it is not recoverable. If it remains in the SG(s) it may or may not be recoverable depending upon plant systems; in any case it is not easily recovered for addition to the RCS (e.g., at a minimum may require boron addition before use in RCS). Because of this, make up should be established to the BWST if the SGTR is large enough to require HPI to augment RCS losses. For SGTRs smaller than this, normal make up methods to the MU tank should be sufficient. Also, for these size leaks (no HPI required), there should be enough inventory in the BWST to accommodate a cooldown, provided there is no delay, even if normal make up is lost. If the only SG with a tube leak was isolated in step 14.0, then BWST makeup may also not be necessary.

Each instance requires evaluation of the BWST depletion and plant conditions, as input to control of the BWST and of the affected SG(s). Consideration should be given to the possibility of requiring HPI cooling, the ability to attain DHRS operation prior to depletion of available BWST inventory, and the relative leak integrity of the secondary side if the SG(s) are allowed to fill. Evidence of a concurrent LOCA will also affect BWST and SG control. In this case, sump recirculation may be inevitable, and makeup to the BWST must also consider not allowing sump level to get too high.

Sequence
The specific conditions during a tube rupture relative to BWST depletion may alter the mitigation path. Therefore, an assessment of the event and the BWST depletion should be performed as soon after the initial RCS cooldown and depressurization below 1000 PSIG as possible.

TBD Volume 3 References
III.E.3.3.1 and III.E.3.4.2

17.0 IF AT ANY TIME STEAMING WILL NOT PREVENT SG OVERFILL, THEN PERFORM THE FOLLOWING:

17.1 Use SG drains, if available, to maintain SG level below [overfill setpoint].

17.2 IF steaming and draining cannot prevent SG overfill, THEN isolate the affected SG(s).

17.3 IF at least one SG still available for heat transfer, THEN go to step 18.0.

Indicators and Controls

Indicators:
- SG level
- Feedwater flow
- Feedwater valve(s) position
- Steam valve(s) position
- SG drain system indications
- TBV/ADV position

Controls:
- SG drain system controls
- TBV/ADV controls
- Steam and feedwater valve(s) controls

Purpose of Step

The purpose of these steps is to govern the control of the affected SG(s) to prevent overfill into the steam lines while steaming the SG(s).

Bases

Note that there is no intent to intentionally exceed technical specification cooldown rate limits, if the RCS is subcooled, as an attempt to prevent overfill. This would only delay SG isolation for a short time.

If an affected SG is being steamed but level cannot be maintained below the [overfill setpoint] by steaming alone, then SG drains should be used if available. If the SG has been isolated with the intent to allow it to fill, then drains are not required.

If use of SG drains and varying steaming rates will not prevent exceeding [overfill setpoint] then the affected or most affected SG should be isolated. The isolation process, should not preclude subsequent use of TBVs, ADVs and SG drains (if available) to prevent lifting of MSSVs. These paths should be used to preclude challenges to the MSSVs even if radiation releases and/or liquid release will occur and is especially important if MSSVs would pass liquid, since failure to reseat becomes more probable.

Step 17.3 is a routing step that bypasses initiation of HPI cooling if a SG is still available. The plant-specific value for [overfill setpoint] is a limiting value and should be error-corrected.

Sequence

There is no specific sequence requirement. If there is a delay time in alignment of SG drains, then this should be considered in step placement.

TBD Volume 3 References

III.E.3.4, III.E.3.5 and III.E.3.6

> **NOTE**
> **SCM may be lost when the PORV is opened and does not require transfer to III.B.**

17.4 Initiate HPI cooling (Rule 3.0).

17.5 Maintain RCS pressure and isolated SG pressures < 1000 PSIG [primary and secondary relief paths] (Rule 2.0).

17.6 Reduce to 1 RCP and run as long as SCM exists and SG tube-shell ΔT limits are not exceeded.

17.7 Go to Section IV.B, step 1.0.

Indicators and Controls

Indicators:
- RC pump status
- HPI pump status
- HPI flow rate
- HPI valve position
- SG shell temperature
- RCS temperature (T_{cold}, T_{hot}, and incore thermocouple)
- SCM monitor
- RCS pressure
- SG pressure
- P-T display
- SPDS
- Letdown valve position
- SG drain system indication
- PORV position or status
- PORV block valve position

Controls:
- HPI pump controls
- HPI valves controls
- RC pump controls
- Letdown valve controls
- Pressurizer and HPV controls
- TBV and ADV controls
- SG drain system controls
- PORV controls
- PORV block valve controls

Purpose of Step

The purposes of these steps are to initiate HPI cooling, reduce heat input while maintaining forced flow, and prevent MSSV lift on the isolated SGs.

Bases

Total isolation of the SGs will eliminate both SGs as heat sinks; therefore, the core must be cooled by an alternate method. HPI cooling is initiated to provide core cooling. This includes not opening the PORV until HPI is verified and securing pressurizer heaters and letdown.

If SCM is lost when the PORV is opened, then RCPs must be tripped but it is not necessary to transfer to the loss of SCM guidance of Section III.B. This is because the loss of SCM is most likely a consequence of the action taken (i.e., opening the PORV). In this situation, the steam volume flow rate through the PORV exceeds the combination of a) the volume flow rate into the RCS (HPI) and b) the volume increase due to RC expansion (heatup of RC) resulting in loss of SCM. Even in the extremely unlikely event of a concurrent LOCA, transfer to III.B in this instance is not necessary. Before opening the PORV HPI flow was verified; therefore, the loss of SCM guidance to initiate HPI has already been taken. The RCPs are tripped per Rule 1.0, and attempts to restore FW and heat transfer have already been made. No other Section III.B actions are appropriate for this situation.

If no RC pumps are operating, the RCS temperature should be kept near the SCM limit per the PTS guidance if applicable per Rule 3.0.

All RCPs are tripped except one to reduce heat input to the RCS and provide fluid mixing until subcooling margin is lost or SG tube-to-shell ΔT limits are reached. The pressure in the RCS, and thus the isolated SGs, is limited to < 1000 PSIG by use of primary and secondary relief paths (e.g., PZR vents, HPVs, letdown, TBVs and ADVs), as necessary. This is to prevent MSSV lift on a full, isolated SG. MSSV lift could result in water entrainment and possible failure of the MSSV to close, resulting in an unisolable path for RCS leakage outside containment. The relief paths used on the SGs to keep pressure below 1000 PSIG all have backup isolation capability. If SCM is lost, full HPI flow must be maintained regardless of RCS pressure.

If the PORV fails to open, the RCS pressure can increase to the PSVs and remain there for some time, depending on decay heat and the ability to open other relief paths. This may result in SG pressures greater than the MSSV setpoints

In addition to throttling HPI as necessary to maintain minimum SCM (full HPI is still required when SCM does not exist), efforts to establish PORV flow and reduce RCS pressure must continue.

Since HPI cooling is being established, degradation of the RB environment may begin to occur. For this reason, RB pressure and temperature should be controlled to reduce the driving force for RB leakage and prevent damage to instrumentation and equipment located in the RB.

NOTE: HPI not being available is not addressed here as it is not credible. A SGTR sufficient to require HPI cooling would have required HPI before this, and a lack of HPI would have resulted in a loss of SCM and transfer to Section III.B.

The GEOG value of 1000 PSIG is a target value and therefore does not require error correction. The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

<u>Sequence</u>
HPI cooling must be initiated immediately following isolation of both SGs.

<u>TBD Volume 3 References</u>
III.B.2.2, III.C.2.3, III.C.3.3A, III.C.3.3B, III.E.3.7, III.G.3.2, III.G.3.9, III.G.3.9.1, III.G. 3.9.2, III.G. 3.9.3, III.G.3.9.5, III.H, IV.A.2.1, IV.A.2.3, IV.B.2.A.2.3, IV.B.2.B.2.2, IV.F.3.1, V.2.0, and V.3.0

18.0 IF AT ANY TIME [radiation limit] IS APPROACHED AND BOTH SGs ARE AVAILABLE, THEN TERMINATE STEAMING OF THE MOST AFFECTED SG.

Indicators and Controls

Indicators: - Plant specific radiation indications

Controls: - TBV/ADV controls

Purpose of Step

The purpose of this step is to balance core cooling and offsite release concerns by reducing releases if SG heat removal can be retained.

Bases

If the only limit reached is the radiation limit and the isolation of the SG will require HPI cooling, then the remaining SG should not be isolated. The reason is that HPI cooling can result in much higher off-site doses if an MSSV lifts and fails open due to entrained water in the steam flow. The radiation limit is very conservative and a tube rupture scenario that leads to HPI cooling is considerably beyond the design basis tube rupture. Continued steaming of the SG beyond the radiation limit should still result in off-site doses less than the design bases limits. This exception does not apply to the limit for SG overfill since continued steaming of a SG beyond the overfill limit could also lead to higher releases through the MSSVs.

The method of implementing the [radiation limit] is plant specific and therefore determination of "approach" to the limit is plant specific.

The plant-specific value for [radiation limit] does not require error correction due to the significant margin provided, assuming the limit is based on not exceeding an integrated thyroid dose of 1.5R.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.E.3.4.4

19.0 REDUCE TO < 4 RCP OPERATION PRIOR TO [core lift limit].

Indications and Controls
Indications: - RCS temperature (T_{cold})

Controls: - RCP motor controls

Purpose of Step
The purpose of this step is to prevent core lift due to 4 RCP operation below the plant specific core lift limit.

Bases
Operation of 4 RCPs below the plant specific core lift limit can cause core lift concerns. This is due to the increase in density of the reactor coolant at temperatures lower than the plant specific core lift limit. In the event that the RCS cools to < [core lift limit] with all 4 RCPs still running, one or more RCPs should still be tripped as soon as possible.

The plant-specific value for [core lift limit] is a limiting value and should be error-corrected.

Sequence
There is no specific sequence requirement. Plant-specific values for the core lift limit vary. This step is placed here to reasonably bound all plants and to address transients starting at lower than normal post-trip temperatures. Each plant should place this step early enough in the mitigation to reasonably address the plant-specific limit, and to address transients that initiate at lower than normal post-trip temperatures.

TBD Volume 3 References
IV.A.2.5

20.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for CFT isolation] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN CLOSE THE CFT ISOLATION VALVES.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{hot}, incore thermocouple)
- CFT isolation valve position
- SCM monitor
- P-T display
- SPDS

Controls:
- CFT isolation valve controls

Purpose of Step

The purpose of this step is to prevent unnecessary injection from the CFTs.

Bases

If the RCS is subcooled and RCS pressure reduction is being controlled, then the injection of the CFTs is not necessary, and could unnecessarily complicate the cooldown. However, if the RCS is not subcooled or RCS pressure reduction is not being controlled, then the CFT isolation valves must remain open. Subsequent restoration of both SCM and RCS pressure control would allow CFT isolation.

The plant-specific value for [allowable range for CFT isolation] is intended as a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.5.2

21.0 IF INDICATIONS OF AN RV HEAD VOID EXIST AND SCM EXISTS, THEN REDUCE COOLDOWN RATE TO < 50°F/HR.

Indicators and Controls

Indicators:
- Parameters used to recognize void development
- RCS temperature (incore thermocouples)
- SG pressure
- RCS pressure
- SCM monitor
- SPDS
- P-T display

Controls:
- TBV controls
- ADV controls

Purpose of Step

The purpose of this step is to ensure RV head stresses are maintained within acceptable limits.

Bases

If a head void exist with the RCS subcooled, then a 50°F/HR cooldown rate limit is required to ensure acceptable RV head stresses during the remainder of the natural circulation cooldown. If the RCS is saturated, then normal cooldown rate limits do not apply.

The GEOG value of 50°F/hr is a control parameter and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.7.4

22.0 IF INDICATIONS OF A LOCA EXIST, THEN GO TO SECTION IV.A, STEP 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (RTDs (only if RCPs on) or incore thermocouples)
- MU/HPI flow
- SCM monitor
- SPDS
- P-T display
- RB temperature, pressure, radiation, and sump level

Controls: N/A

Purpose of Step

The purpose of this step is to route to the appropriate section if a concurrent LOCA exists.

Bases

The cooldown route in the GEOG depends on whether a concurrent LOCA exists. If SCM exists and RCS make up requirements are within the normal MU system capacity, then it is unlikely a concurrent LOCA exists. If SCM does not exists or if RCS make up requirements are greater than normal MU system capacity, then a concurrent LOCA may exist. If the RCS remains saturated with HPI flows much greater than the tube leak or if RB conditions degrade, then a concurrent LOCA should be assumed. Section IV.A includes SGTR consideration.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

23.0 COOLDOWN TO DHRS OPERATION.

24.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

Indicators and Controls
Indicators: - N/A

Controls: - N/A

Purpose of Step
The purpose of these steps is to provide a transition from the GEOG guidance.

Bases
The RCS is subcooled and cooldown is being controlled. The remainder of the cooldown to DHRS operation is performed within this section, which addresses the potential for further complications such as impending SG overfill or approaching radiation limits.

Transition to DHRS operation is beyond the GEOG scope, thus the reference denotes leaving the generic guidance. In addition, other plant-specific aspects of plant cooldown with a SGTR are not covered by the GEOG, such as control of contaminated secondary inventory.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. These are only routing steps that are needed because of the manner in which the GEOG is structured.

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION III.F – INADEQUATE CORE COOLING

Strategy:

- Restore adequate core cooling:
  - Restore ECCS operation.
  - Restore SG heat transfer.
- Eliminate non-condensable gases from the RCS.
- Control RB environment.
- If necessary, transition to plant-specific SAG.

CAUTION

ICC conditions should not exist unless multiple equipment and system failures have occurred. Some of the equipment used in this section may be the same equipment that has failed. It is expected that attempts to restore equipment operation will continue throughout this section.

It is also expected that progression to the next region, including transition to severe accident management, will occur whenever conditions requiring the transition exist.

1.0 INITIATE HPI/LPI/CF

1.1 (Rules 1.0 and 2.0)

1.2 Maintain full HPI/LPI flow.

1.3 Ensure CFT isolation valves are open.

Indicators and Controls

Indicators:
- HPI flow rate
- LPI flow rate
- LPI valve position
- CFT pressures and levels
- CFT block valve position

Controls:
- HPI pump controls
- HPI valve controls
- LPI pump controls
- LPI valve controls
- CFT isolation valve controls

Purpose of Step

The purpose of this step is to provide core cooling water to the RCS.

Bases

During ICC, full flow from both HPI and LPI should be maintained. Also, the CFT block valves should be verified open at this time. Decreasing CFT levels should be verified when the RCS pressure decreases below the CFT actuation point. Most postulated ICC scenarios involve failure of HPI/LPI. Restoration of HPI/LPI at the onset of ICC will likely restore saturated or subcooled conditions. It should be noted that most of the ICC Region 2 guidance (GEOG steps 1.0 - 9.0) is the same guidance prescribed for loss of SCM. This is because the successful completion of these actions will restore adequate core cooling and the actions are not detrimental if ICC guidelines are entered inadvertently due to instrument errors.

Sequence
Actions to restore ECCS flow are placed first, even though attempts should have already been made in Section III.B. This is because actions do not carry over between sections and because successful implementation of these actions should restore adequate core cooling.

TBD Volume 3 References
III.B.2.3, III.B.3.2, III.F.2.2, III.F.3.3.2, IV.B.2.A.2.1, IV.B.2.A.3.1, IV.B.2.B.2.1, IV.B.2.B.3.1, IV.B.3.1, V.1.0 and V.2.0

2.0 IF AT ANY TIME FULL FLOW FROM AT LEAST ONE HPI(MU) PUMP EXISTS, THEN OPEN THE PORV AND PORV BLOCK VALVE AND LEAVE THEM OPEN.

Indicators and Controls

Indicators: - HPI flow
- PORV and PORV block valve position indication

Controls: - PORV and PORV block valve controls

Purpose of Step

The purpose of this step is to provide a flow path for core cooling once minimum ECCS flow is available.

Bases

If HPI is restored, then a sufficient LOCA or the PORV will provide a flow path to allow adequate core cooling. A LOCA may or may not exist, therefore the PORV is opened to ensure a flow path exists. If a LOCA does exist, an open PORV will not be detrimental, and may help depressurize the RCS to CFT and LPI operation.

If the PORV is not opened, and a LOCA does not exist, the RCS may pressurize to the PSV, which will provide a flow path. However, the flow from one HPI pump at PSV lift pressure may not provide adequate core cooling under these conditions.

The criterion of full flow from one HPI pump is intended to mean that the HPI flow rate appears to approximate the flow that would be expected from one HPI pump at the existing RCS pressure. It is not intended to mean verification of some specific minimum value accounting for flow errors.

The term "full flow from one HPI pump" is intended to be a target value and therefore does not require error correction.[1]

Sequence

The PORV and PORV block valve should be opened as soon as HPI flow is verified, to maximize the benefit of HPI cooling and thus the probability of achieving adequate core cooling.

TBD Volume 3 References

III.F.3.2

3.0 <u>IF AT ANY TIME</u> RCS PRESSURE INCREASES TO THE PORV SETPOINT, <u>THEN</u> PERFORM THE FOLLOWING:

3.1 Open the PORV.

3.2 <u>IF</u> step 2.0 does not apply, <u>THEN</u> close the PORV <u>WHEN</u> RCS pressure decreases to 100 PSI above SG pressure <u>OR</u> 100 PSI above the next higher ICC region curve, <u>WHICHEVER OCCURS FIRST</u>.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- ICC Region curves
- SG pressure
- PORV indication

Controls:
- PORV controls

<u>Purpose of Step</u>

The purpose of this step is to control RC pressure.

<u>Bases</u>

If RCS pressure increases to the PORV setpoint, then the PORV should be opened and RCS pressure reduced. If step 2.0 does not apply, then when RCS pressure has been reduced to within 100 PSI of SG pressure or the next highest ICC curve, then the PORV should be re-closed. This action minimizes PORV cycling, prevents lifting pressurizer safety valves and maximizes HPI/CFT/LPI flow to help cool the core and refill the RCS (which will help lead to faster restoration of primary to secondary heat transfer) while maintaining adequate positive primary to secondary ΔT (maintains SG(s) as a heat sink). Closing the PORV 100 PSI above the next higher ICC region curve ensures operator action, to control RCS pressure, does not cause the RCS to degrade into a more severe region.

The GEOG value of 100 PSI is a target value and therefore does not require error correction.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

III.F.2.2 and III.F.3.2

4.0 INCREASE SG LEVELS TO [loss of SCM setpoint].

Indicators and Controls
Indicators: - SG level
- FW flow rate

Controls: - FW valve controls

Purpose of Step
The purpose of this step is to increase SG levels to the [loss of SCM setpoint] to ensure the SGs are available as heat sinks.

Bases
When a loss of SCM occurs, water level in available SG(s) must be raised to the [loss of SCM setpoint]. Normally this is accomplished with EFW (or MFW through the upper nozzles) at a specified minimum flow rate or fill rate that will remove decay heat. The upper nozzles are used in order to provide the highest SG thermal center. Raising SG levels to the [loss of SCM setpoint] ensures that the condensing surface above the RCS water level in the SG tubes (based on pool height alone) is high enough to provide adequate boiler condenser cooling. If EFW is not available, then any available FW source should be used to raise SG levels to the [loss of SCM setpoint].

The plant-specific value for [loss of SCM setpoint] is a limiting value and should be error-corrected.

Sequence
This step is placed after steps to restore ECCS, since proper ECCS flows alone should provide adequate core cooling, while SG heat removal may not, by itself, provide adequate core cooling. SG heat removal will at least slow the core heatup, and therefore should be performed relatively early in the ICC section.

TBD Volume 3 References
III.B.2.4, III.B.3.3, III.C.2.5, III.C.3.4, IV.C.3.3 and IV.C.4.4.3

CAUTION

<u>DO NOT</u> reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available

5.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

5.1 <u>IF AT ANY TIME</u> SG pressure within [allowable range for secondary plant protection system bypass], <u>THEN</u> bypass low SG pressure actuation.

5.2 Depressurize SG(s) to achieve secondary T_{sat} about 100°F lower than T_{sat} for existing RCS pressure. Maintain this ΔT until heat transfer is established.

5.3 <u>IF AT ANY TIME</u> heat transfer is established, <u>THEN</u> continue to depressurize SG(s) as necessary to achieve saturated RCS conditions as fast as possible.

<u>Indicators and Controls</u>

Indicators:
- SG pressure.
- RCS pressure.
- RCS temperature (T_{cold}, incore thermocouple).
- TBV/ADV position.

Controls:
- TBV/ADV controls.
- Secondary plant protection system controls.

<u>Purpose of Step</u>

The purpose of this step is to decrease SG pressure, to establish a positive primary to secondary ΔT, in an attempt to establish heat transfer.

<u>Bases</u>

SG pressure(s) should be lowered in an attempt to induce heat transfer. The pressure should be reduced until primary to secondary heat transfer is restored or secondary T_{sat} is about 100°F lower than T_{sat} for the existing RCS pressure. This differential must be maintained as the RCS depressurizes until heat transfer is restored. Once heat transfer is restored, there is no cooldown rate limit as long as the RCS remains superheated. However, once the RCS returns to saturation, then SG pressure should be controlled to maintain the desired cooldown rate. The minimum steam pressure should not be decreased below that necessary to power the steam driven EFW pump, unless auxiliary steam is being used to power the pump or other FW pumps are being used. During these actions, it may be necessary, if not already done, to bypass the secondary plant protection system to prevent unwanted steam and feed line isolation.

In this situation, RCS superheated, large RCS (incore thermocouples) to SG T_{sat} ΔTs will exist as a consequence of RCS conditions (RCS to SG ΔT in this situation has little meaning). For this reason primary to secondary ΔT is established based upon T_{sat} for the existing RCS pressure and SG T_{sat}. This ensures that the SG(s) remain heat sinks when heat transfer is restored and the RCS returns to saturation.

The plant-specific value for [allowable range for secondary plant protection bypass] is intended as a target value and therefore does not require error correction.

The GEOG value of 100°F is a target value and therefore does not require error correction.

<u>Sequence</u>
This step is performed, like step 4.0, relatively early to ensure the SGs are available as a heat sink.

<u>TBD Volume 3 References</u>
III.F.3.2

6.0 ENSURE RB ISOLATION AND COOLING.

Indicators and Controls

Indicators:
- RB isolation valve positions
- RB temperature
- RB pressure
- RB emergency cooling system indications
- RB spray system indications

Controls:
- RB isolation valve controls
- RB emergency cooling system controls
- RB spray system controls

Purpose of Step

The purpose of this step is to ensure necessary re-alignment of fluid system penetrations and to ensure proper control of RB temperature and pressure.

Bases

During abnormal transients, the operator may need to use some of the fluid system penetrations to help maintain core cooling and to control the RB environment. The RB isolation valves may have to be selectively operated as choices are made between the need for RB isolation and fluid systems operation. The decision to open the valves should be accompanied by a judgement of possible consequences (e.g., the penetration path cannot be re-closed).

When mass and energy are released to the Reactor Building, via the PORV during HPI cooling or a LOCA, then the steam released will expand, cool and depressurize. In contrast, the RB air will heat up and pressurize. The decreasing steam temperature and increasing air temperature will come to equilibrium at a common temperature. This temperature and RB volume will determine the initial RB pressure. The RB pressure and temperature will continue to increase until the energy release is stopped or the RB cooling systems start removing as much energy as is being added.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H.2.1, III.H.3.1, III.H.3.1.2, III.H.3.2.1, IV.F.2.0 and IV.F.3.1

7.0 IF AT ANY TIME BWST LEVEL DROPS TO [RB sump switchover level], THEN PERFORM THE FOLLOWING:

7.1 Establish HPI piggyback operation in accordance with [plant-specific guidance].

7.2 Switch LPI suction to the RB sump (Section V.C).

7.3 Monitor and control H_2 in accordance with [plant specific method].

Indicators and Controls

Indicators:
- BWST level
- RB level
- RB sump suction valve indication
- LPI pump suction valve from BWST indication
- HPI pump suction valve from BWST indication
- HPI pump suction valve from LPI pump indication
- LPI flow rate
- HPI flow rate
- H_2 control system indications
- H_2 monitors

Controls:
- RB sump suction valve controls
- LPI pump suction valve from BWST controls
- HPI pump suction valve from BWST controls
- HPI pump suction valve from LPI pump
- H_2 control system controls
- H_2 monitor controls

Purpose of Step

The purpose of this step is to provide a suction to the LPI, HPI and RB spray pumps from the RB sump in the event the BWST drains (level drops to the RB sump switchover level).

Bases

The LPI suction must be changed from the BWST to the RB emergency sump when switchover conditions are met. The BWST water inventory remaining should provide sufficient time to make a transition to the RB emergency sump to prevent losing LPI suction water, provide adequate LPI NPSH and prevent air entrainment in the LPI flow.

During ICC, full flow from both HPI and LPI should be maintained. If core exit thermocouples are still indicating superheated conditions (even with the required LPI flow rate that normally allows HPI termination), then HPI pumps should be aligned in the piggyback mode in order to draw water from the RB sump. The method and order of establishing piggyback operation are plant-specific.

H_2 production from fuel metal water reactions is associated with RCS inventory depletion, but is not expected until entry into Region 3. Because of this, guidance to monitor and control RB H_2 concentration is included in Region 3 guidance. However, in the event that ICC conditions in Region 2 persist for an extended period of time, then this guidance ensures RB H_2 concerns are being addressed regardless of scenario or timing considerations. If RCS conditions never enter Region 3, then this guidance is considered conservative.

The plant-specific value for [RB sump switchover level] is a limiting value and should be error-corrected.

Sequence
This step must be reached prior to BWST depletion. However, the existence of ICC conditions is probably due, at least in part, due to inadequate ECCS flows such that BWST depletion would occur later than otherwise expected. Sequencing relative to the specific actions to accomplish sump switchover is discussed in Section V.C.

TBD Volume 3 References
III.B.3.8, III.F.2.11, III.F.3.3, III.H.3.2.3, IV.B.2.A.5.2, IV.B.2.B.5.2, and IV.B.3.2.

8.0 PERFORM [actions required for control room habitability].

Indicators and Controls

Plant specific

Purpose of Step
The purpose of this step is to ensure the necessary actions are taken to maintain the control room environment within acceptable limits. This may involve actions such as realigning the control room ventilation.

Bases
Events such as tube rupture or LOCA can result in radiation releases that could exceed allowable doses for control room personnel under normal control room conditions. Therefore, it is typical to have emergency control room ventilation alignments that ensure the control room personnel are not unduly exposed during the mitigation of such events.

Sequence
There is no specific sequence requirement imposed by the TBD. The corresponding EOP step may have a plant-specific timing requirement, which may impose sequencing restrictions.

TBD Volume 3 References
None.

9.0 TAKE ACTION BASED ON FIGURE 1.

9.1 Determine average incore thermocouple temperature and RCS pressure.

9.2 Determine which region of Figure 1 that the RCS is in based on step 9.1.

9.3 Using the region determined in step 9.2, take action as follows:

REGION	**ACTION**
1	**Go to the Section IV.A, step 1.0.**
2	**Continue steps 1.0 - 9.0 above.**
3	**Go to step 10.0.**
Severe Accident	**Go to step 17.0.**

Indicators and Controls

Indicators: - RCS pressure
- RCS temperature (incore thermocouple)
- ICC Region curve

Controls: N/A

Purpose of Step

The purpose of this step is to assess the effectiveness of the initial actions and determine the course of further actions based on plant status.

Bases

Volume 3, Figure III.F-1 (same as Volume 1 Figure 1), Core Exit Fluid Temperature for Inadequate Core Cooling, provides indication of how serious core conditions are based upon combinations of RCS pressure and incore thermocouple temperatures. If the RCS P-T point is superheated and in Region 2, then ICC conditions exist, but they are not serious enough to cause immediate core damage. In this case, the operator should continue efforts to restore HPI/LPI flow and primary to secondary heat transfer until the RCS returns to saturation.

If the RCS P-T point is in Region 3, then cladding temperature in the high power regions of the core may be 1400°F or higher. Above this temperature fuel clad may fail and clad water reaction forms H_2 that will collect in the loops and may escape to the RB. Region 3 is the onset of very serious ICC conditions, however, they are not serious enough to warrant abnormal use of equipment. Precautions in operating plant equipment should still be taken in an attempt to maintain future integrity of the equipment.

If the RCS P-T point enters the Severe Accident Region, then the cladding temperatures in the high power regions of the core may be 1800°F or higher. Significant clad oxidation is occurring with attendant H2 production and heat release. A badly damaged core may be unavoidable. A severe accident is occurring. Actions for severe accident management are beyond the scope of the GEOG, and transition to SAG will occur.

Sequence
There is no specific sequence requirement. The initial actions for ICC conditions have been performed, thus it is logical to check RCS status for further direction.

TBD Volume 3 References
III.F.2.4 and III.F.3.3

REGION 3

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

10.0 FURTHER LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

10.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

10.2 Depressurize SG(s) to 400 PSIG or less to achieve approximately 100°F decrease in secondary T_{sat}.

10.3 IF AT ANY TIME heat transfer is established, THEN continue to depressurize SG(s) as necessary to achieve saturated RCS conditions as fast as possible.

Indicators and Controls

Indicators:
- SG pressure
- TBV/ADV position
- RCS pressure
- RCS temperature (T_{cold}, incore thermocouple)

Controls:
- TBV/ADV controls
- Secondary plant protection system controls

Purpose of Step

The purpose of this step is to further decrease SG pressure in an attempt to establish heat transfer.

Bases

In order to induce primary to secondary heat transfer, SG pressure should be reduced to 400 PSIG or less to achieve a decrease in secondary saturation temperature of approximately 100°F. However, the minimum steam pressure should not be decreased below that necessary to power the steam-driven EFW pump, unless auxiliary steam is being used to power the pump or motor-driven EFW pump(s) are being used.

Once heat transfer is restored, there is no cooldown rate limit; the RCS should be cooled to saturation conditions as fast as possible. During these actions, it may be necessary, if not already done, to bypass the secondary plant protection system to prevent unwanted steam and feed line isolation. Note that there is no direction to maintain a ΔT, since this step does not establish a ΔT relative to T_{sat} of the RCS. In addition, there is no specific analytical bases for the 400 PSIG target value and no error correction is required.

The plant-specific value for [allowable range for secondary plant protection bypass] is intended as a target value and therefore does not require error correction.

The GEOG values of 400 PSIG and 100°F are target values and therefore do not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.F.2.5 and III.F.3.4

11.0 OPEN ALL HPVs.

Indicators and Controls
Indications: - HPV indications

Controls: - HPV controls

Purpose of Step
The purpose of this step is to remove non-condensables that may be preventing heat transfer to the SGs.

Bases
When the RCS P-T point enters Region 3 of Figure 1, clad temperatures in some regions of the core may be 1400°F or higher. H_2 and other non-condensable gases are being produced as a result of these elevated temperatures. To prevent these non-condensable gases from collecting in the high points of the RCS, all HPVs should be opened, including the pressurizer, hot legs, and RV head vents, if applicable. Venting these non-condensable gases will allow them to pass to the RB where they will eventually be removed by recombination and/or venting.

If sufficient quantities of non-condensable gases collect in the hot legs, NC flow can be stopped and boiler condenser cooling can be greatly impeded. Opening the hot leg HPVs in this condition can contribute significantly to restoring primary to secondary heat transfer.

If ICC is mitigated, then the HPVs will be closed in one of the cooldown sections. Otherwise they will remain open and be controlled in accordance with [plant specific SAGs] following transition to the SAGs at step 17.0.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.F.2.5, III.F.3.4 and IV.E.2.1

12.0 ENSURE RB H2 MONITOR(S) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

Indicators and Controls

Indicators: - H_2 monitor
- H_2 reduction system indications

Controls: - H_2 monitor controls
- H_2 reduction system controls

Purpose of Step

The purpose of this step is to place the H_2 monitor in service.

Bases

H_2 production from fuel metal water reactions is associated with RCS inventory depletion but not expected to occur before entry into Region 3. Therefore, it is now prudent to monitor for the presence of H_2 in the RB and control RB H_2 concentrations at acceptable levels.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H.3.2.3

13.0 IF THE RCS HAS RETURNED TO SATURATION CONDITIONS, THEN GO TO SECTION IV.A, STEP 1.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SCM monitor
- P-T display
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is to route out of the ICC guidance once core cooling has been reestablished and ICC conditions no longer exist.

Bases

Sufficient core cooling has been restored to return the RCS to saturated conditions. ICC conditions no longer exist, and further guidance is contained in Section IV.A. Section IV.A covers both heat transfer through the PORV and through the SGs, including SGTR, if applicable.

Since the RCS never exceeded Region 3 (clad temperatures did not exceed 1800°F) core damage is not expected to be significant and cooldown may be accomplished by normal post-LOCA cooldown guidance.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.F.3.4 and III.F.3.6

14.0 IF CF OR LPI AVAILABLE, THEN OPEN PORV AND LEAVE IT OPEN.

Indicators and Controls

Indicators:
- CFT status
- LPI status
- PORV indication
- PORV block valve indication

Controls:
- PORV controls
- PORV block valve controls

Purpose of Step

The purpose of this step is to depressurize the RCS to allow injection from the CFTs and/or LPI.

Bases

Adequate core cooling has not yet been established with HPI or the SGs. Therefore, if either the CFTs or LPI are available for injection, then the PORV and PORV block valve should be opened in an attempt to depressurize the RCS in order to achieve CF and/or LPI cooling. If neither the CFTs or LPI are available, then the PORV should only be cycled as necessary per step 3.2.

Sequence

This step is placed as the last action in Region 3 (though continued attempts to restore SGs and HPI are expected). Previous actions, if successful, should restore adequate core cooling without the additional loss of inventory that this step can cause.

TBD Volume 3 References

III.F.2.7 and III.F.3.4

15.0 IF AT ANY TIME THE RCS ENTERS THE SEVERE ACCIDENT REGION, THEN GO TO STEP 17.0.

Indicators and Controls

Indicators: - RCS pressure
- RCS temperature (incore thermocouple)
- ICC Region curve

Controls: N/A

Purpose of Step

The purpose of this step is to ensure transfer to the appropriate guidance should RCS conditions degrade to the Severe Accident Region.

Bases

While attempts continue to restore and maintain adequate core cooling, the RCS conditions could worsen. If the RCS P-T point enters the Severe Accident Region, the RCS has degraded beyond the scope of the GEOG and transfer must be made to the appropriate guidance.

Sequence

There is no specific sequence requirement. Checks of RCS P-T status are continuous.

TBD Volume 3 References

None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

16.0 <u>WHEN</u> THE RCS RETURNS TO SATURATION CONDITIONS, <u>THEN</u> GO TO SECTION IV.A, STEP 1.0. UNTIL THEN, CONTINUE ATTEMPTS TO RESTORE ECCS AND SG HEAT TRANSFER.

Indicators and Controls

Indicators:
- RCS temperature (incore thermocouple)
- RCS pressure
- SCM monitor
- P-T display
- SPDS

Controls: N/A

Purpose of Step

The purpose of this step is to rout to the appropriate guidance depending on the RCS response to continued attempts to restore core cooling.

Bases

If the RCS returns to saturation, then appropriate guidance is provided in Section IV.A. Since the RCS never exceeded Region 3 (clad temperatures did not exceed 1800°F) core damage is not expected to be significant and cooldown may be accomplished by normal post-LOCA cooldown guidance. In the meantime, attempts to restore core cooling with ECCS and the SGs must continue. If the RCS continues to heat up and enters the Severe Accident Region of Figure 1, then transition to SAG via step 17.0 should occur.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.F.3.6

TRANSITION TO SAG

17.0 TRIP RUNNING RCPs.

18.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

> **CAUTION**
>
> **The RCS P-T has entered the Severe Accident Region (Figure 1). The reactor core is highly oxidized and may become badly damaged in a short time. Core conditions are now beyond the scope of GEOG guidance. Further direction for accident mitigation will be provided by Station Management based on [severe accident guidelines]. Following use of [severe accident guidelines] and severe accident mitigation, DO NOT return to the GEOG for additional guidance.**
>
> **The PORV may be open at this point if either CF or LPI is available. If so, the PORV should remain open until directed otherwise by Station Management. The HPVs are open at this point and should remain open until directed otherwise by Station Management.**

Indicators and Controls
Indicators: - RCP status

Controls: - RCP motor controls

Purpose of Step
The purpose of these steps is to provide a transition to Severe Accident Guidance (SAG).

Bases
The RCS has entered the severe accident region. Plant conditions are now beyond the scope of the GEOG. A severe accident could not be prevented. Further guidance will be in accordance with the [plant specific SAGs]. It is the fundamental objective of the [plant specific SAGs] to:

- quench and cool the overheated core material
- protect remaining (uncompromised) fission product boundaries
- restore compromised fission product boundaries
- minimize fission product releases.

If RCPs are running, due to the remote possibility that they were not tripped within 2 minutes of loss of SCM, they are now tripped. Worsening RCS conditions are evidence of the RCPs inability steam and gas through the SG tubes was determined, during the development of the generic SAG, to increase the likelihood of tube failure due to creep rupture.

The PORV may be open if CF or LPI is available. The PORV should remain open until directed otherwise by Station Management.

The HPVs were opened previously to vent non-condensable gases from the high points of the RCS. Venting these non-condensable gases allows them to pass to the RB where they will eventually be removed by recombination and/or venting. The HPVs should remain open until directed otherwise by Station Management.

Sequence

The RCPs are tripped prior to transition to SAG. RCPs might be started again per SAG guidance, but SAG guidance does not typically trip RCPs for creep rupture concerns, because they are not assumed to be operating.

TBD Volume 3 References

I.B, II.D.2.2.6, III.F.2.7 and III.F.3.5

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION IV.A - LOCA COOLDOWN

Strategy:

- Cool and depressurize RCS to establish long-term core cooling with LPI
- Control RB conditions
- Manage concurrent SGTR if applicable
- Establish post-LOCA boron control

1.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

Indicators and Controls

Indicators: - ES panel actuation alarms
- ES channel/equipment status

Controls: - ES actuated equipment individual controls

Purpose of Step

The purpose of this step is to ensure the proper operation and alignment of all equipment actuated by ES should an actuation setpoint be reached.

Bases

ES actuation will normally occur during a LOCA, but may not depending on size and timing of operator actions or if ES had already been bypassed. If a setpoint is reached, it is necessary to verify that all equipment and components operate and align properly. If any automatic actuations fail to occur, due to failures or bypass, then the appropriate actions must be performed manually.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H.2.1, IV.B.2.A.2, IV.B.2.B.2, and IV.B.3.1

2.0 ESTABLISH DESIRED RCS CONDITIONS.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- MU/HPI flow
- [Loop void indications]

Controls:
- MU/HPI flow control
- Pressurizer heater controls

Purpose of Step

The purpose of this step is to ensure conditions are established to allow RCP operation.

Bases

Proper RCS conditions must be established prior to RCP start. These conditions include SCM, adequate NPSH, saturated pressurizer conditions and appropriate pressurizer level if possible to accommodate RCS pressure changes on pump start, and PTS restrictions, if applicable. Pressurizer saturation and level will not be achievable if HPI cooling is in progress. If PTS has not been invoked, then additional subcooling beyond SCM may be desirable to minimize the possibility of losing SCM on RCP start.

Sequence

RCS conditions must be established prior to RCP start.

TBD Volume 3 References

III.C.3.5.A, IV.A.3.0, IV.A.3.1, IV.A.3.1.A, IV.A.3.1.C, IV.A.3.2, IV.A.3.2.A, IV.A.3.2.B, and IV.A.3.2.C

3.0 ESTABLISH DESIRED SG CONDITIONS.

Indicators and Controls

Indicators: - SG pressure
- SG level

Controls: - TBV/ADV controls
- FW flow controls

Purpose of Step

The purpose of this step is to ensure SGs are established as heat sinks and to account for possible SG level swell on RCP start.

Bases

If the SGs are available for heat transfer, then this step ensures the desired SG conditions are established prior to RCP start. The rate of heat transfer to the SGs will increase on pump start. Therefore the SG pressure should be adjusted to allow heat transfer but not result in an overcooling. The SG level will swell initially due to the rapid increase in heat transfer. If the SGs had been at the [loss of SCM setpoint] and are still high even though now in subcooled NC, it may be preferable to allow the SG levels to decrease by boil-off before RCP start.

The SGs may not be available, as in some cases of RCP start while in HPI cooling. In this case the step would not apply.

Sequence

SG conditions, if applicable, should be established prior to RCP start.

TBD Volume 3 References

III.C.3.5and IV.A.3.0

4.0 ENSURE HPVs ARE CLOSED.

Indicators and Controls

Indicators: - HPV valve position indication

Controls: - HPV valve controls

Purpose of Step

The purpose of this step is to ensure the HPVs are closed to prevent loss of inventory following RCP start.

Bases

The HPVs may have been opened in an attempt to eliminate a loop void. The existence of forced flow will result in liquid discharge through the HPVs. This would be an unnecessary loss of RCS inventory and energy deposition to the RB; thus the HPVs should be closed prior to starting RCPs.

Sequence

The HPVs should be closed prior to RCP start.

TBD Volume 3 References

IV.A.3.0

5.0 START DESIRED RCP(s).

Indicators and Controls
Indicators: - RCP status

Controls: - RCP motor controls

Purpose of Step
The purpose of this step is to start the appropriate RCPs.

Bases
The appropriate RCP(s) to start depends on the plant conditions. Several considerations may apply. If only one loop is in NC, then it may be preferable to start an RCP in that loop. This minimizes the heat transfer upset and maximizes the possibility of regaining NC if the RCP must be tripped. If only one SG is available as a heat sink, then it is preferable to start a pump in that loop. All other conditions being equal, the RCP chosen should be one that maximizes pressurizer spray flow. The RCP start may be primarily for RV stress reduction during HPI cooling, and possibly to reduce the cooldown rate during HPI cooling. In this case, it may be desirable to start more than one RCP to further reduce the cooldown rate. However, running RCPs will significantly delay achieving DHRS operation if HPI cooling must be used for the entire cooldown.

The spray block valve may have been closed earlier during mitigation of a loss of SCM. If its reopening leads to a continuous RCS pressure decrease, it should be re-closed.

Sequence
The RCP(s) should not be started until after the conditions established by steps 1.0-4.0 are completed.

TBD Volume 3 References
III.G.3.9.3, IV.A.3.1, IV.A.3.2, and IV.G

5.0 PERFORM [actions required for control room habitability].

Indicators and Controls

Plant specific.

Purpose of Step

The purpose of this step is to ensure the necessary actions are taken to maintain the control room environment within acceptable limits. This may involve actions such as realigning the control room ventilation.

Bases

Events such as tube rupture or LOCA can result in radiation releases that could exceed allowable doses for control room personnel under normal control room conditions. Therefore, it is typical to have emergency control room ventilation alignments that ensure the control room personnel are not unduly exposed during the mitigation of such events.

Sequence

There is no specific sequence requirement imposed by the TBD. The corresponding EOP step may have a plant-specific timing requirement, which may impose sequencing restrictions.

TBD Volume 3 References

None.

6.0 **IF AT ANY TIME INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, THEN GO TO SECTION III.F, STEP 1.0.**

Indicators and Controls

Indicators: - RCS pressure
- RCS temperature (incore thermocouple)

Controls: - N/A

Purpose of Step

The purpose of this step is to provide the criterion for transferring to the ICC section.

Bases

Inadequate core cooling (ICC) is not expected as long as these guidelines are followed and the actions are successfully completed. However, any transient can progress into ICC conditions, provided enough equipment failures occur. If the RCS is superheated, adequate core cooling no longer exists. Consequently, actions must be taken to restore the RCS to at least saturated conditions as quickly as possible.

The RCS P-T relationship will indicate when ICC conditions occur. The incore thermocouples are used to indicate the actual temperature conditions of the reactor coolant at the core exit because the hot leg RTDs may not be valid during saturated and superheated conditions or during times when natural circulation or forced circulation does not exist. Instrument and process errors can result in indicated ICC conditions when the RCS is still saturated. This is accommodated (i.e., acceptable) since the initial ICC actions are essentially the same actions performed for a loss of SCM. In addition, an error band, similar to the one used for SCM, could be used for ICC, or other alternatives, such as the trend relative to the saturation curve.

A sustained loss of SCM can be due to an evolution leading to ICC. Therefore, it needs to be checked continuously whenever SCM does not exist. A LOCA can result in an ICC condition temporarily, even with full ECCS injection.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.F.1.1, III.F.2.1, III.F.3.1 and IV.D.2.1.1

7.0 IF AT ANY TIME RCS PRESSURE < LPI OPERATIONAL PRESSURE AND LPI FLOW EXISTS, THEN GO TO STEP 20.0.

Indicators and Controls
Indicators: - RCS pressure
- LPI flow

Controls: - N/A

Purpose of Step
The purpose of this step is to bypass unnecessary steps if LPI flow is already established.

Bases
If RCS pressure is low enough for LPI operation, and LPI flow is established, then steps to control cooldown rate with the SGs, PORV operation, etc., are no longer necessary.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

8.0 CONTROL HPI (Rules 2.0 and 3.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI pump status
- HPI flow rate

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to ensure that HPI flow is properly controlled.

Bases

Control of HPI flow is dependent on whether SCM and/or LPI flow exist and whether PTS has been invoked. Rules 2.0 and 3.0 provide specific requirements.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.2.A.4, IV.B.2.A.5, IV.B.2.B.4, IV.B.2.B.5, IV.G, V.2.0 and V.3.0

9.0 <u>IF AT ANY TIME</u> SCM IS RESTORED WITH RCS PRESSURE > LPI SHUTOFF <u>AND</u> HPI REQUIRED IS < NORMAL MAKEUP CAPACITY, <u>THEN</u> PERFORM THE FOLLOWING:

9.1 <u>IF</u> there is no primary to secondary heat transfer, <u>THEN</u> open PORV and PORV block valve and go to Section IV.B, step 1.0.

9.2 <u>IF</u> a SGTR exists, <u>THEN</u> go to Section III.E, step 1.0.

9.3 Go to Section III.A, step 3.0.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature ($T_{cold,}$ incore thermocouple)
- HPI pump status
- HPI flow rate
- LPI pump status
- LPI flow rate
- SG level
- SG pressure
- EFW flow rate
- EFW pump status
- MFW flow rate
- MFW pump status
- PORV and PORV block valve position indications.
- SCM monitor
- P-T display
- SPDS

Controls:
- HPI pump motor controls
- HPI valve controls
- PORV and PORV block valve

<u>Purpose of Step</u>

The purpose of this step is to route to the appropriate guidance depending upon the status of break flow and the SGs.

<u>Bases</u>

Once SCM has been restored, HPI flow can be throttled. If RCS pressure is above LPI shutoff, then continued RCS cooling is required by break/HPI flow and/or SG heat removal.

If RCS makeup requirements are less than normal makeup system flow, then the break has slowed due to changing RC pressure/temperature conditions and/or leak isolation. In this situation, if SGs are not available, then the PORV and PORV block valve are opened to establish HPI cooling. If

SG(s) are available, but a SGTR exists, then further guidance is provided in Section III.E. If SG(s) are available without a SGTR and normal makeup is sufficient to control RCS inventory, then transfer back to Section III.A is made. The transient has been terminated, possibly due to leak isolation, and a cooldown may not be required. Section III.A will provide guidance to complete status checks and ensure plant stability.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

10.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls:
- ES actuation bypass controls

Purpose of Step

The purpose of this step is to prevent unnecessary ES actuation during the cooldown and depressurization.

Bases

The Engineered Safeguards Actuation System (ESAS or ES) monitors parameters necessary to detect the occurrence of a LOCA and to actuate equipment necessary to protect the fuel and maintain RB integrity to prevent release of fission products to the environment. RCS pressure is one of the parameters that is monitored. In the case of a controlled cooldown, it may be appropriate to bypass certain ES actuations to prevent unwanted actuation of equipment. It is not appropriate to bypass if SCM does not exist or if RCS pressure is not being controlled by the operator. The RCS may be depressurizing due to a break, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step. Because this is a controlled cooldown with a LOCA, alignment of ES actuated equipment should be carefully checked so that needed equipment is not bypassed while unneeded equipment is bypassed.

The plant-specific value for [allowable range for ES bypass] is intended as a target value and therefore does not require error-correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.2.5.1

11.0 <u>IF AT ANY TIME</u> SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], <u>THEN</u> BYPASS LOW SG PRESSURE ACTUATION.

<u>Indicators and Controls</u>
Indicators: - SG pressure

Controls: - Secondary plant protection system controls

<u>Purpose of Step</u>
The purpose of this step is to prevent unnecessary actuation of the secondary plant protection system during the cooldown.

<u>Bases</u>
The secondary plant protection system monitors SG parameters and actuates equipment necessary to ensure feedwater (EFW) flow to the SGs and to isolate the SGs if necessary. SG pressure is one parameter which is monitored that initiates SG isolation. During a controlled cooldown, even if a LOCA or major secondary plant malfunction (e.g., steamline break) has occurred, it may be desirable to bypass this system to prevent unwanted actuation of certain SG isolation equipment. The appropriate alignment of this system should be carefully made such that necessary equipment is not bypassed while unnecessary equipment is not.

The plant-specific value for [allowable range for secondary plant protection system bypass] is intended as a target value and therefore does not require error-correction.

<u>Sequence</u>
There is no specific sequence requirement.

<u>TBD Volume 3 References</u>
III.G.2.5.1

12.0 IF AT ANY TIME A SGTR HAS OCCURRED AND THE AFFECTED SG APPROACHES OVERFILL, THEN PERFORM THE FOLLOWING:

12.1 IF steaming will not prevent SG overfill, THEN use SG drains, if available, to maintain SG level below [overfill setpoint].

12.2 IF steaming and draining cannot prevent SG overfill, THEN isolate the affected SG(s).

12.3 Maintain RCS and isolated SG pressures < 1000 PSIG by use of [primary and secondary release paths] (Rule 2.0).

Indicators and Controls

Indicators:
- SG pressure
- SG level
- RCS pressure
- [primary and secondary release paths] status

Controls:
- [primary and secondary release paths] controls

Purpose of Step

The purpose of this step is to prevent lifting of MSSVs on a SG if overfill of the SG cannot or will not be prevented.

Bases

The intent of this step is to attempt to keep the affected SG in use, if it is being steamed to aid the cooldown. If the SG has already been isolated with the intent to allow it to fill or if overfill cannot be prevented, then this step directs actions to ensure the MSSVs do no lift on the isolated SG.

If an isolated SG is filling due to tube leakage and SG level reaches the lower level of the SG steam nozzles, then RCS pressure must be maintained less than 1000 PSIG to prevent lifting the MSSVs. If the SG and steam lines are allowed to fill with water, then the SG pressure will tend to equalize with RCS pressure. The pressure in the RCS, and thus the isolated SGs, is limited to < 1000 PSIG by use of primary and secondary relief paths (e.g., PZR vents, HPVs, PORV, letdown, TBVs and ADVs), as necessary. This is to prevent MSSV lift on a full, isolated SG. MSSV lift could result in water entrainment and possible failure of the MSSV to close, resulting in an unisolable path for RCS leakage outside containment. The relief paths used on the SGs to keep pressure below 1000 PSIG all have backup isolation capability. If the MSSVs should fail to reseat, there is no way to prevent BWST inventory from being lost through them until the unit is cooled down and depressurized. That inventory would not be available in the RB sump if switchover from the BWST to the RB sump is necessary.

If SCM is lost, full HPI flow must be maintained regardless of RCS pressure.

The plant-specific value for [overfill setpoint] is a limiting value and should be error-corrected.

The GEOG value of 1000 PSIG is a target value and therefore does not require error correction.

Sequence
There is no specific sequence requirement. If there is a delay time in alignment of SG drains, then this should be considered in step placement.

TBD Volume 3 References
III.E.2.4.1, III.E.3.4.1.2, III.E.3.4.1.3, III.E.3.4.2, III.E.3.4.3, III.E.3.4.4. III.E.3.6.1, III.E.3.6.3, III.E.3.7, III.G.3.1.1, III.G.3.9.5 and V.2.0

13.0 IF AT ANY TIME [SGTR radiation limit] IS APPROACHED AND BOTH SGs ARE AVAILABLE, THEN TERMINATE STEAMING OF THE MOST AFFECTED SG.

Indicators and Controls

Indicators: - Plant specific radiation indications
- SG status

Controls: - TBV/ADV controls

Purpose of Step

The purpose of this step is to balance core cooling and offsite release concerns by reducing releases if SG heat removal can be retained.

Bases

If the SGs are being steamed to augment the cooldown, then the plant-specific criteria for SG isolation have not been met. The [SGTR radiation limit] is very conservative relative to design bases accident criteria. The existence of a SGTR with a LOCA is beyond the design bases. Therefore, if the SG is needed for adequate core heat removal, steaming should not be terminated solely due to [SGTR radiation limit] unless the other SG is available.

The plant-specific value for [SGTR radiation limit] is a limiting value and should be error-corrected.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.E.3.4.4

14.0 IF THE PORV IS OPEN, THEN GO TO SECTION IV.B, STEP 1.0.

Indicators and Controls
Indicators: - PORV position indication

Controls: - N/A

Purpose of Step
The purpose of this step is to route to the appropriate cooldown guidance.

Bases
The PORV may have been open when this section was entered, including from Section III.F where saturation may have been restored due to initiation of HPI cooling. The PORV may have also been opened in step 12.3 to help keep RCS pressure below 1000 PSIG. In either case, HPI and PORV flow would provide substantial core cooling, and therefore the guidance in Section IV.B is more appropriate. Section IV.B also covers the co-existence of a small break.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

15.0 <u>IF AT ANY TIME</u> THE RCS BEGINS TO REPRESSURIZE, <u>THEN</u> PERFORM THE FOLLOWING:

15.1 IF the SG(s) are not available, THEN open the PORV and PORV block and go to Section IV.B, step 1.0.

15.2 Cycle the PORV as necessary to maintain RCS pressure.

15.3 Ensure appropriate level and feed flow in available SG(s) (Rule 4.0).

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- SG level
- EFW/MFW flow
- PORV and PORV block position indications

Controls:
- PORV and PORV block controls
- EFW/MFW flow control

<u>Purpose of Step</u>

The purpose of this step is to ensure adequate core heat removal and RCS pressure control.

<u>Bases</u>

The RCS could begin to repressurize if a break had been isolated (in III.B, prior to transfer to this section) or if SG heat removal has been lost or degraded. SG heat removal could be affected by a SGTR, by cyclic boiler-condenser cooling, or by a compounding failure in the secondary plant. If an available SG has been removed from service per step 23.1 of IV.A and the RC begins to repressurize, then SG heat removal should be restored. When restoring SG heat removal, SG feed flow rate and level should be controlled in accordance with Rule 4.0 which provides guidance on use of EFW and MFW for forced flow, NC and loss of SCM conditions.

If the SGs are not available, then opening the PORV augments core cooling. In this case, more appropriate guidance is provided in Section IV.B. If the SGs are available, then the RCS may be pressurizing due to loss of boiler-condenser cooling. This can occur, and may be cyclic, due to the RCS refilling to the point where the effective condensing surface is lost. It could also occur due to secondary side problems, therefore proper SG level and feed flow should be ensured.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

III.B.3.5 and V.4.0

16.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

Indicators and Controls

Indicators:
- Control rod position
- Plant specific reactivity balance curves
- RCS boron concentration
- RCS temperature (incore thermocouple)

Controls:
- Control rod drive control system
- Plant specific RCS boron addition controls

Purpose of Step

The purpose of this step is to ensure the reactor remains adequately shutdown during the cooldown.

Bases

Adequate shutdown margin may not appear to be a concern during a LOCA cooldown with ECCS injection in progress. However, the RCS leak, and thus injection flow, may be relatively small with the cooldown aided by SG heat removal. Therefore it is prudent to verify adequate shutdown margin and add boron if necessary. Adequate shutdown margin can be complied with by RCS boron concentration or by boron injection as allowed by Technical Specifications.

Sequence

Adequate shutdown margin for a given RCS temperature must be verified prior to intentionally cooling to that temperature. If the RCS cooldown is being augmented by the SGs, then adequate time should be available to monitor RCS boron concentration and add boron if necessary. If the break and HPI flow dictate the RCS cooldown, the shutdown margin should still be verified as time permits.

TBD Volume 3 References

III.G.3.1

17.0 REDUCE TO < 4 RCP OPERATION PRIOR TO [core lift limit].

Indicators and Controls
Indicators: - RCS temperature (T_{cold})

Controls: - RCP motor controls

Purpose of Step
The purpose of this step is to prevent core lift due to 4 RCP operation below the plant specific core lift limit.

Bases
Operation of 4 RCPs below the plant specific core lift limit can cause core lift concerns. This is due to the increase in density of the reactor coolant at temperatures lower than the plant specific core lift limit. In the event that the RCS cools to < [core lift limit] with all 4 RCPs still running, one or more RCPs should still be tripped as soon as possible.

The plant-specific value for [core lift limit] is a limiting value and should be error-corrected.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
IV.A.2.5

18.0 ESTABLISH APPROPRIATE COOLDOWN RATE.

18.1 IF the core exit is saturated, THEN establish desired cooldown rate using available SGs.

18.2 IF the core exit is subcooled, THEN limit the cooldown rate per technical specifications or to 50°F/hr (if a head void exists), whichever is lower.

18.3 Maintain SG tube to shell ΔTs within tensile and compressive limits.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- SG pressure
- TBV/ADV position or status
- Parameters used to indicate RV head void
- SG shell temperature
- RCS temperature (T_{hot}, T_{cold})
- EFW flow
- SPDS
- SCM monitor
- P-T display

Controls:
- TBV/ADV controls
- EFW controls

Purpose of Step

The purpose of this step is to ensure the appropriate cooldown rate is established and to maintain SG tube to shell differential temperatures.

Bases

The allowable cooldown rate is dependent on the existence of SCM and RV head void. If SCM exists, then the cooldown rate should be reduced using the TBVs/ADVs to within the technical specification limits or 50°F/hr if a head void exists. If the core outlet is saturated then there are no cooldown rate limits. In this case, normal cooldown rate limits can be exceeded as necessary to maintain the SGs as heat sinks. HPI can only be throttled if SCM exists, and then only to control RCS pressure, not to control cooldown rate.

SG tube to shell differential temperatures should be maintained within limits. The RCS cooldown may have imposed tensile loads on the tubes, and a dry SG may subsequently develop compressive loads due to SG shell cooling. This may require RCS cooldown, if in forced circulation, to cool the idle SG tubes.

The GEOG value for cooldown rate (i.e., 50°F/hr) and tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.B.2.8, III.B.2.9, III.B.3.5 and III.B.3.6, III.G.3.6, IV.C.4.0, and IV.C.5.2

19.0 IF THE RCS IS SUBCOOLED, THEN MAINTAIN MINIMUM SCM AND IF APPLICABLE, RCP NPSH (Rules 2.0 and 3.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- RCP status
- P-T display
- SPDS
- SCM monitor

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to control RCS pressure.

Bases

If the RCS is subcooled RCS pressure should be maintained as close to the SCM limit as reasonable. This reduces the break flow and minimizes the pressure stress on the RV, which is particularly important if PTS has been invoked. If RCPs are operating, the required NPSH may require additional subcooling.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.B.3.4, IV.B.2.A.4.1, IV.B.2.B.4.1 and IV.G

20.0 <u>IF AT ANY TIME</u> RCS PRESSURE WITHIN [allowable range for CFT isolation] <u>AND</u> SCM EXISTS <u>AND</u> RCS PRESSURE IS BEING CONTROLLED, <u>THEN</u> CLOSE CFT ISOLATION VALVES.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- CFT isolation valve position
- P-T display
- SPDS
- SCM monitor

Controls:
- CFT isolation valve controls

<u>Purpose of Step</u>

The purpose of this step is to prevent unnecessary injection from the CFTs by isolating them from the RCS when RCS conditions allow.

<u>Bases</u>

If the RCS is subcooled and RCS pressure is controlled, core cooling is adequate and water from the CFTs is not needed for core cooling. To prevent the unnecessary injection of CFT inventory into the RCS, the CFT isolation valves are closed when RCS pressure has decreased to a value where isolation is allowed. Also, by closing the CFT isolation valves, the nitrogen cover gas from the CFTs, which may inhibit RCS depressurization or SG heat removal by collecting in the SGs or the RCS loops if injected into the RCS, cannot be injected into the RCS. The RCS may be depressurizing due to a break, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

The plant-specific value for [allowable range for CFT isolation] is intended as a target value and therefore does not require error-correction.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

IV.B.5.2

21.0 ENSURE RB H_2 MONITORS(s) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

Indicators and Controls

Indicators: - H_2 monitor
- H_2 reduction system indications

Controls: - H_2 monitor controls
- H_2 reduction system controls

Purpose of Step

The purpose of this step is to align the RB H_2 monitoring and control systems.

Bases

H_2 production from fuel metal water reactions is associated with RCS inventory depletion. Therefore, it is prudent to ensure H_2 concerns are addressed via monitoring and control of RB H_2. Unless RCS conditions have been in ICC, this is considered conservative guidance.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H.3.2.3

22.0 IF AT ANY TIME CONDITIONS PERMIT, THEN TERMINATE HPI (Rule 2.0).

Indicators and Controls

Indicators:
- LPI flow
- HPI flow
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls:
- HPI valve controls
- HPI pump motor controls

Purpose of Step

The purpose of this step is to allow securing HPI when HPI is no longer required.

Bases

HPI is no longer required when RCS inventory can be adequately controlled by LPI or normal makeup. This can occur at any time during a LOCA cooldown depending on break size, break isolation, LPI operability, etc. Therefore, the step is structured to allow subsequent HPI termination when and if termination criteria are satisfied. This also allows prevention or termination of HPI/LPI piggyback operation. The criteria for terminating HPI are discussed under Rule 2.0.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.2.A.5, IV.B.2.B.5 and V.2

23.0 <u>IF AT ANY TIME</u> LPI FLOW > [minimum flow rate], <u>THEN</u> THE FOLLOWING MAY BE PERFORMED:

23.1 SG cooling terminated.

23.2 RCPs secured.

<u>Indicators and Controls</u>
Indicators: - LPI flow

Controls: - TBV/ADV controls
- RCP motor controls

<u>Purpose of Step</u>
The purpose of this step is to allow termination of SG heat transfer and forced flow when no longer required.

<u>Bases</u>
Once the RCS pressure has been reduced sufficiently to allow LPI flow at greater than the plant specific minimum flow rate, SG cooling may no longer be required and may be secured. RCP operation is also no longer required, and securing RCPs will reduce the heat load imposed on the LPI system. Securing RCPs is allowed under these conditions even if they were required to be running due to failure to trip on loss of SCM.

If SG cooling was used to lower RCS pressure to establish LPI flow > [minimum flow rate], then it is not recommended to secure SG heat transfer if it is needed to maintain RCS pressure < LPI shutoff. If SG cooling is terminated and the RCS subsequently begins to reheat and repressurize, then SG cooling should be re-established per step 15.0.

The plant-specific value of [minimum flow rate] is a limiting value and should be error-corrected.

<u>Sequence</u>
There is no specific sequence requirement.

<u>TBD Volume 3 References</u>
III.B.3.8, IV.A.2.2, IV.A.2.4 and V.1.0

24.0 IF AT ANY TIME LPI FLOW > [minimum flow rate] OR RCS PRESSURE < 140 PSIG, THEN CLOSE CFT ISOLATION VALVES AND HPVs.

Indicators and Controls

Indicators:
- CFT valve indication
- LPI flow rate
- HPV valve indication

Controls:
- CFT valve controls
- HPV valve controls

Purpose of Step

The purpose of this step is to isolate the CFTs and high point vents when no longer required.

Bases

At RCS pressures low enough to allow the specified LPI flow, the CFTs have already performed their function. They should be isolated to preclude any further introduction of nitrogen into the RCS. The HPVs may have been opened to aid core cooling and elimination of non-condensable gases. At these low RCS pressures gases have already come out of solution and the presence of non-condensables will not hinder core cooling by LPI. Therefore the HPVs should also be closed.

The plant-specific value for [minimum flow rate] is a limiting value and should be error-corrected.

The GEOG value of 140 PSIG is a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.5.1 and IV.E.2.2

25.0 **<u>IF AT ANY TIME</u> THE RCS IS SUBCOOLED <u>AND</u> PTS IS INVOKED, <u>THEN</u> THROTTLE LPI TO MAINTAIN MINIMUM SCM.**

26.0 **<u>IF AT ANY TIME</u> THE RCS IS SATURATED <u>AND</u> [boron dilution criteria exist], <u>THEN</u> ESTABLISH POST-LOCA BORON CONTROL.**

27.0 **<u>IF AT ANY TIME</u> RBS IN OPERATION <u>AND</u> [termination criteria exist], <u>THEN</u> STOP RBS.**

28.0 **REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.**

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- LPI flow rate
- LPI valve position
- RBS system valve positions
- RBS system flow rate
- Plant specific indications for boron dilution criteria
- P-T display
- SPDS
- SCM monitor

Controls:
- LPI pump motor controls
- LPI valve controls
- RBS system valve controls
- RBS system pump motor controls
- Plant specific boron dilution controls

<u>Purpose of Step</u>

The purpose of these steps is to establish appropriate plant conditions for long-term post-LOCA cooling.

<u>Bases</u>

If PTS has been invoked, which is likely, then LPI must be throttled to maintain minimum SCM, once SCM has been restored. This minimizes the pressure stress on the RV.

While the RCS is saturated boron concentration in the RV can become a concern. Post-LOCA boron dilution methods should be implemented when plant specific criteria require them.

RBS flow should be stopped when RB pressure/temperature reduction and iodine removal objectives, if applicable, have been met.

Further long-term core cooling and plant control is beyond the scope of this guideline, thus further direction is referred to station management. The PORV may be open at this point and, if so, should remain open until core cooling is assured without PORV flow.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.B.3.8, III.H.3.2.1, III.H.3.2.2, IV.B.6.0, and IV.F.3.0

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION IV.B – HPI COOLDOWN

Strategy:

- Cool and depressurize RCS using HPI cooling
- Restore SG cooling if possible
- Control RB conditions
- Control isolated SG pressure as necessary if SGTR exists
- Establish long-term cooling with DHRS operation

1.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

Indicators and Controls

Indicators: - ES panel actuation alarms
- ES channel/equipment status

Controls: - ES actuated equipment individual controls

Purpose of Step

The purpose of this step is to ensure the proper operation and alignment of all equipment actuated by ES should an actuation setpoint be reached.

Bases

ES actuation may occur during HPI cooling, but may not depending on RB cooling or if ES had already been bypassed. If a setpoint is reached, it is necessary to verify that all equipment and components operate and align properly. If any automatic actuations fail to occur, due to failures or bypass, then the appropriate actions must be performed manually.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H.2.1, IV.B.2.A.2, IV.B.2.B.2, and IV.B.3.1

2.0 IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

Indicators and Controls

Indicators:
- BWST level
- RB level
- RB sump valve position
- LPI suction valve from BWST position
- LPI pump status
- HPI suction valve from BWST position
- HPI pump status
- HPI/LPI piggyback valve position
- LPI flow rate
- HPI flow rate

Controls:
- RB sump valve controls
- LPI suction valve from BWST controls
- LPI pump motor controls
- HPI suction valve from BWST controls
- HPI/LPI piggyback valve controls
- HPI pump motor controls

Purpose of Step

The purpose of this step is to maintain suction to the LPI, HPI and RB spray pumps (if applicable) from the RB sump when the BWST drains (level drops to the [RB sump switchover level]).

Bases

The initial suction source for HPI during HPI cooling is the BWST. At some point in time, if SG heat removal is not restored, the inventory in the BWST will be depleted sufficiently such that the suction for the HPI will have to be switched to piggyback off LPI from the RB sump. When switching to the RB sump, appropriate precautions must be taken to ensure the LPI/ HPI pumps (and RBS pumps if applicable) do not lose suction and to evaluate and monitor potential releases of radioactive gas or liquid.

The plant-specific value for [RB sump switchover level] is a limiting value and should be error-corrected.

Sequence

This step is placed early in this section since it must be reached prior to BWST depletion, and ECCS draw down of the BWST may have been occurring for some time prior to transfer to this section (actions are not carried over between sections), especially if a concurrent RCS leak exists. Sequence relative to the specific actions to accomplish sump switchover is discussed in Section V.C.

TBD Volume 3 References
IV.B.3.2, and IV.B.7.0

3.0 ENSURE RB ISOLATION AND COOLING.

Indicators and Controls

Indicators:
- RB temperature
- RB pressure
- RB emergency cooling system indications
- RB spray system indications
- RB isolation valve position indications

Controls:
- RB emergency cooling system controls
- RB spray system controls
- RB isolation valve controls

Purpose of Step

The purpose of this step is to ensure that proper RB cooling and integrity are maintained.

Bases

Since HPI cooling is in progress, degradation of the RB environment will occur. Areas of concern include RB cooling and isolation. Deposition of RC mass and energy and radioactive isotopes to the RB is accommodated by the RB isolation and cooling systems. The release of RC mass and energy can cause the RB pressure and temperature to increase. Therefore, proper RB cooling system operation is ensured by automatic or manual operation. Release of radioactive isotopes to the RB, via the PORV, can cause RB radiation levels to increase. This situation is accommodated by ensuring proper operation of the RB isolation (containment) system..

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.H, IV.F.2.0 and IV.F.3.1

4.0 PERFORM [actions required for control room habitability].

Indicators and Controls

Plant specific

Purpose of Step
The purpose of this step is to ensure the necessary actions are taken to maintain the control room environment within acceptable limits. This may involve actions such as realigning the control room ventilation.

Bases
Events such as tube rupture or LOCA can result in radiation releases that could exceed allowable doses for control room personnel under normal control room conditions. Therefore, it is typical to have emergency control room ventilation alignments that ensure the control room personnel are not unduly exposed during the mitigation of such events. HPI cooling is essentially a controlled LOCA and, while degraded core or significant releases are not expected, it is prudent to address control room habitability.

Sequence
There is no specific sequence requirement imposed by the TBD. The corresponding EOP step may have a plant-specific timing requirement, which may impose sequencing restrictions.

TBD Volume 3 References
None.

5.0 IF AT ANY TIME INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, THEN GO TO SECTION III.F, STEP 1.0.

Indicators and Controls
Indicators: - RCS pressure
- RCS temperature (incore thermocouple)

Controls: - N/A

Purpose of Step
The purpose of this step is to provide the criterion for transferring to the ICC section.

Bases
Inadequate core cooling (ICC) is not expected as long as these guidelines are followed and the actions are successfully completed. However, any transient can progress into ICC conditions, provided enough equipment failures occur. If the RCS is superheated, adequate core cooling no longer exists. Consequently, actions must be taken to restore the RCS to at least saturated conditions as quickly as possible.

The RCS P-T relationship will indicate when ICC conditions occur. The incore thermocouples are used to indicate the actual temperature conditions of the reactor coolant at the core exit because the hot leg RTDs may not be valid during saturated and superheated conditions or during times when natural circulation or forced circulation does not exist. Instrument and process errors can result in indicated ICC conditions when the RCS is still saturated. This is accommodated (i.e., acceptable) since the initial ICC actions are essentially the same actions performed for a loss of SCM. In addition, an error band, similar to the one used for SCM, could be used for ICC, or other alternatives, such as the trend relative to the saturation curve.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.F.1.1, III.F.2.1, III.F.3.1 and IV.D.2.1.1

6.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

Indicators and Controls
Indicators: - SG pressure

Controls: - Secondary plant protection system controls

Purpose of Step
The purpose of this step is to prevent unnecessary actuation of the secondary plant protection that could otherwise complicate restoration of SG heat removal.

Bases
The secondary plant protection system monitors SG parameters and actuates equipment necessary to ensure feedwater (EFW) flow to the SGs and to isolate the SGs if necessary. SG pressure is one parameter that is monitored that initiates SG isolation. Attempts to restore SG heat removal will continue to be made during an HPI cooldown. Unnecessary actuation of the secondary plant protection system may complicate restoration of SG heat removal. Therefore actuation is bypassed.

The plant-specific value for [allowable range for secondary plant protection system bypass] is intended as a target value and therefore does not require error-correction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.2.5.1

7.0 CONTROL HPI (Rules 2.0 and 3.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI pump status
- HPI flow rate

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to ensure that HPI flow is properly controlled.

Bases

Control of HPI flow is dependent on whether SCM exists and whether PTS has been invoked. Rules 2.0 and 3.0 provide specific requirements.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.2.A.4, IV.B.2.A.5, IV.B.2.B.4, IV.B.2.B.5, IV.G, V.2.0 and V.3.0

8.0 IF AT ANY TIME AN ISOLATED SG WILL OVERFILL DUE TO TUBE LEAKAGE, THEN MAINTAIN RCS AND SG PRESSURES < 1000 PSIG BY USE OF [primary and secondary release paths].

Indicators and Controls

Indicators:
- SG pressure.
- SG level.
- RCS pressure.
- [primary and secondary release paths] status.

Controls:
- [primary and secondary release paths] controls.

Purpose of Step

The purpose of this step is to prevent lifting of MSSVs on a SG if overfill of the SG cannot or will not be prevented.

Bases

The intent of this step is to ensure the MSSVs do no lift on the isolated SG.

If an isolated SG is filling due to tube leakage and SG level reaches the lower level of the SG steam nozzles, then RCS pressure must be maintained less than 1000 PSIG to prevent lifting the MSSVs. If the SG and steam lines are allowed to fill with water, then the SG pressure will tend to equalize with RCS pressure. All means available should be used to prevent lifting the MSSVs because they provide a direct path for RC to flow outside the RB. Also, if the MSSVs should lift and pass liquid, their failure to reseat becomes more probable. If the MSSVs should fail to reseat, there is no way to prevent BWST inventory from being lost through them until the unit is cooled down and depressurized. That inventory would not be available in the RB sump if switchover from the BWST to the RB sump is necessary, which is likely in sustained HPI cooling.

The GEOG value of 1000 PSIG is a target value and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.E.2.4.1, III.E.3.4.1.2, III.E.3.4.1.3, III.E.3.4.2, III.E.3.4.3, III.E.3.4.4. III.E.3.6.1, III.E.3.6.3, III.E.3.7, III.G.3.1.1 and III.G.3.9.5

9.0 ENSURE PRESSURIZER HEATERS ARE OFF.

Indicators and Controls
Indicators: - Pressurizer heater status

Controls: - Pressurizer heater controls

Purpose of Step
The purpose of this step is to eliminate heat input from the heaters.

Bases
Energized heaters add heat load to the RCS which must be removed and will delay the cooldown and depressurization.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.3.9

10.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

Indicators and Controls

Indicators:
- Control rod position
- Plant specific reactivity balance curves
- RCS boron concentration
- RCS temperature (incore thermocouple)

Controls:
- Control rod drive control system
- Plant specific RCS boron addition controls

Purpose of Step

The purpose of this step is to ensure the reactor remains adequately shutdown during the cooldown.

Bases

Adequate shutdown margin may not appear to be a concern during HPI cooling. However, it is prudent to verify adequate shutdown margin and add boron if necessary. Adequate shutdown margin can be complied with by RCS boron concentration or by boron injection as allowed by Technical Specifications.

Sequence

Adequate shutdown margin for a given RCS temperature must be verified prior to intentionally cooling to that temperature. Although the cooldown cannot be held at a stable point, HPI cooling should allow time to assess shutdown margin and add boron if necessary.

TBD Volume 3 References

III.G.3.1

11.0 ENSURE RB H_2 MONITORS(s) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

Indicators and Controls

Indicators: - H_2 monitor
- H_2 reduction system indications

Controls: - H_2 monitor controls
- H_2 reduction system controls

Purpose of Step

The purpose of this step is to align the RB H_2 monitoring and control systems.

Bases

H_2 production from fuel metal water reactions is associated with RCS inventory depletion. H_2 production is not expected to occur as a result of HPI cooling. However, the RCS could have previously been in ICC, and coolant is being released to the building. Therefore, it is prudent to ensure H_2 concerns are addressed via monitoring and control of RB H_2. Unless RCS conditions have been in ICC, this is considered conservative guidance.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.H.3.2.3

12.0 <u>IF AT ANY TIME</u> A SG BECOMES AVAILABLE FOR HEAT TRANSFER PRIOR TO ESTABLISHING DHR COOLING, <u>THEN</u> GO TO STEP 20.0.

13.0 <u>WHEN</u> SCM EXISTS, <u>THEN</u> CONTINUE.

<u>Indicators and Controls</u>

Indicators:
- SG status
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls: N/A

<u>Purpose of Step</u>

The purpose of these steps is to route to the appropriate guidance.

<u>Bases</u>

SG heat removal is preferred to HPI cooling. Therefore, if a SG becomes available at any time during the HPI cooldown, attempts should be made to restore heat transfer.

The remaining steps for HPI cooling all require SCM, therefore a hold is placed at step 13.0 to not proceed until SCM exists.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

None. These are only routing steps that are needed because of the manner in which the GEOG is structured.

14.0 <u>IF AT ANY TIME</u> RCS PRESSURE WITHIN [allowable range for ES bypass] <u>AND</u> ADEQUATE SCM EXISTS <u>AND</u> RCS PRESSURE IS BEING CONTROLLED, <u>THEN</u> BYPASS ES ACTUATION.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls:
- ES actuation bypass controls

<u>Purpose of Step</u>

The purpose of this step is to prevent unnecessary ES actuation during the cooldown and depressurization.

<u>Bases</u>

The Engineered Safeguards Actuation System (ESAS or ES) monitors parameters necessary to detect the occurrence of a LOCA and to actuate equipment necessary to protect the fuel and maintain RB integrity to prevent release of fission products to the environment. RCS pressure is one of the parameters that is monitored. In the case of a controlled cooldown, it may be appropriate to bypass certain ES actuations to prevent unwanted actuation of equipment. It is not appropriate to bypass if SCM does not exist or if the operator is not controlling RCS pressure. The RCS depressurization rate may be due to the PORV and possibly a concurrent RCS leak, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

The plant-specific value for [allowable range for ES bypass] is intended as a target value and therefore does not require error-correction.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

III.G.2.5.1

15.0 IF RCPs ARE AVAILABLE, THEN START A RCP (Section V.A).

Indicators and Controls

Indicators: - RCP status

Controls: - RCP motor controls

Purpose of Step

The purpose of this step is to establish forced flow if possible.

Bases

Forced flow will reduce the thermal stress imposed on the RV due to HPI. Forced flow will also facilitate establishing SG heat removal if a SG becomes available.

There may be restrictions on starting RCPs due to boron dilution concerns. These restrictions must be considered in determing RCP availability.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.9, IV.A.3.0 and IV.G

16.0 MAINTAIN MINIMUM SCM AND IF APPLICABLE, RCP NPSH.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- RCP status
- P-T display
- SPDS
- SCM monitor

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to control RCS pressure.

Bases

RCS pressure should be maintained as close to the SCM limit as reasonable. This reduces the thermal stress and the pressure stress on the RV, which is particularly important if PTS has been invoked. If RCPs are operating, the required NPSH may require additional subcooling.

If the PORV is not available and relief is through the PSV, then HPI throttling to control core outlet temperature may require allowing the RCS to periodically heatup. A reasonable temperature control band should be used, with RCS temperature maintained nearer the SCM limit than the NDT limit, to minimize the thermal stress on the RV.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.9 and IV.G

17.0 <u>IF AT ANY TIME</u> RCS PRESSURE WITHIN [allowable range for CFT isolation] <u>AND</u> SCM EXISTS <u>AND</u> RCS PRESSURE IS BEING CONTROLLED, <u>THEN</u> CLOSE CFT ISOLATION VALVES.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure.
- RCS temperature (incore thermocouple).
- CFT isolation valve position.
- P-T display
- SPDS
- SCM monitor

Controls:
- CFT isolation valve controls.

<u>Purpose of Step</u>

The purpose of this step is to prevent unnecessary injection from the CFTs by isolating them from the RCS when RCS conditions allow.

<u>Bases</u>

The Core Flooding System is part of the Emergency Core Cooling System (ECCS) that provides passive core protection for LOCAs. If the RCS is subcooled and RCS pressure is controlled, core cooling is adequate and water from the CFTs is not needed for core cooling. To prevent the unnecessary injection of CFT inventory into the RCS, the CFT isolation valves are closed when RCS pressure has been decreased to a value where isolation is allowed. Also, by closing the CFT isolation valves, the nitrogen cover gas from the CFTs, which may inhibit RCS depressurization or subsequent SG heat removal by collecting in the SGs or the RCS loops if injected into the RCS, cannot be injected into the RCS. The RCS depressurization rate may be due to the PORV and possibly a concurrent RCS leak, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

The plant-specific value for [allowable range for CFT isolation] is intended as a target value and therefore does not require error-correction.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

IV.B.5.2

18.0 COOLDOWN TO DHRS OPERATION.

19.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

Indicators and Controls
Indicators: N/A

Controls: N/A

Purpose of Step
The purpose of these steps is to denote ultimate transition to DHR cooling.

Bases
HPI cooling will continue until SG cooling becomes available (per step 12.0) or until DHR cooling can be established. DHR cooling is beyond the scope of GEOG, therefore reference is made to station management for further direction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. These are only routing steps that are needed because of the manner in which the GEOG is structured.

RE-ESTABLISHING HEAT TRANSFER TO A SG

20.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls:
- ES actuation bypass controls

Purpose of Step

The purpose of this step is to prevent unnecessary ES actuation during the cooldown and depressurization.

Bases

The Engineered Safeguards Actuation System (ESAS or ES) monitors parameters necessary to detect the occurrence of a LOCA and to actuate equipment necessary to protect the fuel and maintain RB integrity to prevent release of fission products to the environment. RCS pressure is one of the parameters that is monitored. In the case of a controlled cooldown, it may be appropriate to bypass certain ES actuations to prevent unwanted actuation of equipment. It is not appropriate to bypass if SCM does not exist or if the operator is not controlling RCS pressure. The RCS depressurization rate may be due to the PORV and possibly a concurrent RCS leak, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

The plant-specific value for [allowable range for ES bypass] is intended as a target value and therefore does not require error-correction.

Sequence

There is no specific sequence requirement. This step is a repeat of step 14.0, since step 14.0 could be bypassed by step 12.0.

TBD Volume 3 References

III.G.2.5.1

21.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS AND PRESSURES IN THE AVAILABLE SG(s) (Rule 4.0).

Indicators and Controls

Indicators:
- SG pressure
- SG level
- FW flow

Controls:
- FW flow controls
- TBV/ADV controls

Purpose of Step

The purpose of this step is to establish the SG as a heat sink.

Bases

Primary to secondary heat transfer requires that a heat sink be available in the SGs, i.e., either an appropriate level or EFW flow rate established, and that there be a positive primary to secondary ΔT. Reestablishing SG heat transfer should be accomplished in accordance with Rule 4.0. Rule 4.0 provides guidance on establishing feedwater flow and level to a potentially dry SG including initial flow rates and flow control criteria.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.9.4 and V.4.0

22.0 IF SCM EXISTS AND RCPs ARE AVAILABLE, THEN START A RCP, PREFERABLY IN A LOOP WITH FW (Section V.A).

Indicators and Controls

Indicators: - RCS pressure
- RCS temperature (incore thermocouple)
- FW flow

Controls: - RCP motor controls

Purpose of Step

The purpose of this step is to establish forced circulation.

Bases

Primary to secondary heat transfer may be difficult to restore during HPI cooling due to the temperature profiles in the RCS and the continued heat removal through the PORV. Forced circulation flow will significantly enhance the ability to restore heat transfer. Therefore, if RCPs are available, then forced flow should be established.

Loop voids could have developed during HPI cooling. Stating a RCP in a loop with FW available will ensure forced flow through the available SG. If a RCP is started in the opposite loop and loop voids exist, then forced flow may not be established in the available SGs. If both SGs are available, then other considerations, like eventual use of pressurizer spray, may be appropriate.

There may be restrictions on starting RCPs due to boron dilution concerns. These restrictions must be considered in determining RCP availability.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.8.2.2 , III.G.3.9.4, and IV.A.3

23.0 IF AT ANY TIME PRIMARY TO SECONDARY HEAT TRANSFER IS ESTABLISHED, THEN GO TO STEP 28.0.

Indicators and Controls
Indicators: N/A

Controls: N/A

Purpose of Step
The purpose of this step is to route to the appropriate guidance.

Bases
If heat transfer is restored, then steps 24.0-27.0 are not applicable.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

24.0 LOWER SG PRESSURE TO ACHIEVE ~50°F PRIMARY-SECONDARY ΔT.

25.0 OPEN HPV(s) IN LOOP(s) WITHOUT RUNNING RCPs.

26.0 LOWER SG PRESSURE TO ACHIEVE ~100°F PRIMARY-SECONDARY ΔT.

Indicators and Controls

Indicators: - SG pressure
- RCS temperature (incore thermocouple)

Controls: - TBV/ADV controls
- HPV controls

Purpose of Step

The purpose of these steps is to ensure the SG is established as a heat sink.

Bases

A positive primary to secondary ΔT is established to ensure the SG is a heat sink. A second attempt is made with a 100°F ΔT because the temperature profiles that can develop during HPI cooling may require more thermal driving force to overcome.

The HPVs are opened on loops without running RCPs to help eliminate voids that may be blocking the restoration of loop flow. The HPVs may not help if the RCS is saturated, but their use under saturation conditions should not hinder restoration of heat transfer. Therefore they are used regardless of SCM status.

The GEOG values of 50°F and 100°F are target values and therefore do not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.9.4 and IV.E.2.3

27.0 <u>IF</u> HEAT TRANSFER IS NOT RESTORED TO AT LEAST ONE SG, <u>THEN</u> GO TO STEP 13.0.

Indicators and Controls
Indicators: N/A

Controls: N/A

Purpose of Step
The purpose of this step is to route to the appropriate guidance.

Bases
If heat transfer is not restored, then routing back to step 13.0 provides coverage for continued HPI cooling. Subsequent attempts to restore SG heat removal can still occur due to the continued applicability of step 12.0.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

CAUTION

Care must be exercised in controlling HPI flow when the PORV is closed to prevent large RCS pressure increases, especially if PTS has been invoked.

28.0 IF HEAT TRANSFER HAS BEEN RESTORED TO AT LEAST ONE SG, THEN PERFORM THE FOLLOWING:

28.1 IF AT ANY TIME SCM exists, THEN establish makeup and letdown.

28.2 Establish a slightly decreasing RCS temperature and pressure.

28.3 Close the PORV (and PORV block valve if necessary).

28.4 Ensure HPVs are closed.

28.5 IF SCM exists AND RCS leakage < normal makeup capacity, THEN stop HPI.

28.6 IF SGTR indicated on SG(s) in use, THEN go to Section III.E, step 1.0.

28.7 IF HPI can not be terminated, THEN go to Section IV.A, step1.0.

28.8 Stabilize RCS P-T.

28.9 Establish a pressurizer bubble.

28.10 Further direction by station management.

Indicators and Controls

Indicators:
- SG pressure
- SG level
- FW flow
- RCS temperature (incore thermocouple)
- RCS pressure
- Makeup and letdown valve positions
- PORV and PORV block valve positions
- HPV valve positions
- SG tube leak indications
- HPI flow
- Pressurizer level
- Pressurizer heater status

- P-T display
- SPDS
- SCM monitor

Controls:
- FW flow controls
- TBV/ADV controls
- Makeup and letdown valve controls
- PORV and PORV block valve controls
- HPI valve and pump motor controls
- Pressurizer heater controls

Purpose of Step

The purpose of these steps is to transition off of HPI cooling once SG heat transfer has been restored.

Bases

Once primary to secondary heat transfer has been restored, HPI cooling can be terminated and normal RCS pressure control reestablished. Makeup and letdown are restored to restore normal RCS inventory control, as well as provide a pressure relief cushion for when the PORV is closed. If HPI can be terminated, then the RCS can be stabilized and a pressurizer bubble can be restored. If HPI is still required, due to a concurrent RCS leak, then transfer is made to the appropriate guidance in Section IV.A.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.9.4

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION IV.C – FORCED COOLDOWN

Strategy:

- Cool and depressurize RCS using SG(s)
- Maintain SGs and RCS within cooldown limits
- Restore normal plant conditions if possible
- Establish long-term cooling with DHRS operation

NOTE

If during the performance of the cooldown the condition forcing the cooldown ceases to exist, e.g., a steam leak is isolated, then the cooldown may be terminated. Further direction will be provided by station management.

1.0 <u>IF AT ANY TIME</u> THE COOLDOWN RATE CANNOT BE CONTROLLED WITHIN THE TECH SPEC LIMIT, <u>THEN</u> GO TO SECTION III.D, STEP 1.0.

<u>Indicators and Controls</u>
Indicators: - RCS temperature (T_{cold})

Controls: N/A

<u>Purpose of Step</u>
The purpose of this step is to route to the appropriate guidance if the cooldown can no longer be controlled within limits.

<u>Bases</u>
This section is entered with abnormal SG conditions that are forcing a cooldown. These conditions could lead to excessive cooldown rates, in which case the guidance of III.D is more appropriate. If the abnormal condition is corrected, then the forced cooldown may no longer be required.

<u>Sequence</u>
There is no specific sequence requirement.

<u>TBD Volume 3 References</u>
None. This is only a routing step that is needed because of the manner in which the GEOG is structured.

2.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS AND PRESSURES IN THE AVAILABLE SG(s) (Rule 4.0).

Indicators and Controls

Indicators:
- SG pressure
- SG level
- FW flow

Controls:
- FW flow controls
- TBV/ADV controls

Purpose of Step

The purpose of this step is to establish the SG as a heat sink.

Bases

Primary to secondary heat transfer requires that a heat sink be available in the SGs, i.e., either an appropriate level or EFW flow rate established, and that there be a positive primary to secondary ΔT. One or both SGs may be in a trickle feed mode, in which case establishing appropriate level and pressure may not be possible, at least initially. SG feed flow rate and level should be controlled in accordance with Rule 4.0 which provides guidance on use of EFW and MFW for forced flow, NC and loss of SCM conditions. Rule 4.0 also provides guidance for initiating feed to a dry SG and for trickle feeding.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.D.3.6, III.G.3.9.4 and V.4.0

3.0 <u>IF AT ANY TIME</u> RC TEMPERATURE APPROACHES [core lift limit], <u>THEN</u> REDUCE TO < 4 RCP OPERATION.

<u>Indicators and Controls</u>
Indicators: - RCS temperature (T_{cold})

Controls: - RCP motor controls

<u>Purpose of Step</u>
The purpose of this step is to prevent core lift due to 4 RCP operation below the plant specific core lift limit.

<u>Bases</u>
Operation of 4 RCPs below the plant specific core lift limit can cause core lift concerns. This is due to the increase in density of the reactor coolant at temperatures lower than the plant specific core lift limit. In the event that the RCS cools to < [core lift limit] with all 4 RCPs still running, one or more RCPs should still be tripped as soon as possible.

The plant-specific value for [core lift limit] is a limiting value and should be error-corrected.

<u>Sequence</u>
There is no specific sequence requirement. Plant-specific values for the core lift limit vary. This step is placed here to reasonably bound all plants and to account for the possibility that the RCS has already cooled due to a transient.

<u>TBD Volume 3 References</u>
IV.A.2.5

4.0 <u>WHEN</u> BWST REACHES [sump switchover setpoint], <u>THEN</u> PERFORM THE FOLLOWING:

4.1 Align LPI suction to the RB sump.

4.2 <u>IF</u> unable to establish sump suction to an LPI pump, <u>THEN</u> secure that LPI/HPI train prior to losing BWST suction.

4.3 Close LPI and HPI BWST suction valves.

<u>Indicators and Controls</u>

Indicators:
- LPI BWST and RB sump suction valve position indications
- LPI pump status
- HPI pump status
- HPI BWST suction valve position indications
- BWST level

Controls:
- LPI BWST and RB sump suction valve controls
- LPI pump motor controls
- HPI pump motor controls
- HPI BWST suction valve controls

<u>Purpose of Step</u>

The purpose of this step is to align suction to the RB sump.

<u>Bases</u>

The ECCS suction source must be switched to the RB sump at a plant specific low BWST level. Typically, there is a level range within which the swap-over must be completed. This range ensures adequate RB sump inventory while preventing air entrainment due to vortexing in the BWST outlet.

If sump suction cannot be established to an LPI pump, then the associated LPI/HPI train must be secured prior to losing suction from the BWST. This maintains the pumps available when the sump suction is established. If the pumps were not secured, air entrainment may require vent and refill, which may not be achievable from the sump due to radiological concerns.

Establishing RB emergency sump recirculation will result in radioactive liquid flow outside the RB (e.g., auxiliary building). Appropriate precautions should be taken for the potential exposure due to this flowpath and for the potential release of radioactive gas or liquid.

The plant-specific value for [sump switchover setpoint] is a limiting value and should be error-corrected.

Sequence
The switchover to the sump must be accomplished prior to reaching a plant specific low BWST level.

TBD Volume 3 References
III.H.3.2.5 and IV.B.3.2

6.0 CONTROL HPI (Rules 2.0 and 3.0).

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI pump status
- HPI flow rate

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to ensure that HPI flow is properly controlled.

Bases

Control of HPI flow is dependent on whether SCM exists and whether PTS has been invoked. Rules 2.0 and 3.0 provide specific requirements.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.B.2.A.4, IV.B.2.A.5, IV.B.2.B.4, IV.B.2.B.5, IV.G, V.2.0 and V.3.0

7.0 IF RCPs ARE AVAILABLE, THEN ENSURE FORCED CIRCULATION (Section V.A).

Indicators and Controls

Indicators: - RCP status

Controls: - RCP motor controls

Purpose of Step

The purpose of this step is to establish forced flow if possible.

Bases

Forced flow circulation is preferable to natural circulation. Forced circulation cooldowns prevent void formation and their attendant complications and cooldown delays. Forced circulation provides pressurizer spray flow for better RCS pressure control. Starting RCP combinations that maximize spray flow will provide for the maximum depressurization rates during the cooldown. Running one RCP in each loop may balance heat transfer, however, other combinations may provide more spray flow or better NPSH characteristics.

RCP availability includes consideration of possible boron dilution mechanisms. Subcooled margin exists on entry to this section, but would also be a requirement for RCP availability.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.A.3.0

8.0 MAINTAIN MINIMUM SCM AND IF APPLICABLE, RCP NPSH.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- RCP status
- P-T display
- SPDS
- SCM monitor

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step

The purpose of this step is to control RCS pressure.

Bases

RCS pressure should be maintained as close to the SCM limit as reasonable. At least one SG is in an abnormal condition and tube stresses must be controlled. Minimizing subcooling will minimize pressure stress on the tubes. This also reduces the thermal stress and the pressure stress on the RV, which is particularly important if PTS has been invoked. If RCPs are operating, the required NPSH may require additional subcooling. If RCPs are not operating (i.e., normal spray not available for depressurization), then high pressure auxiliary spray if available, is used. In the absence of high pressure auxiliary spray, then the PORV or pressurizer vent is employed to decrease RCS pressure.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.1, III.G.3.2, III.G.3.6 and IV.G

9.0 MAINTAIN SG TUBE TO SHELL ΔTs WITHIN TENSILE AND COMPRESSIVE LIMITS.

Indicators and Controls

Indicators:
- SG shell temperature
- RCS temperature (T_{hot}, T_{cold}, incore thermocouple)
- EFW flow

Controls:
- TBV/ADV controls
- EFW controls

Purpose of Step

The purpose of this step is to maintain SG tube to shell ΔTs.

Bases

SG tube to shell ΔTs should be maintained within limits. The RCS cooldown is forced due to a dry SG or an unisolable steam leak. These conditions can lead to excessive tube-shell ΔTs if not controlled.

The GEOG values for tube-shell ΔT limits (provided in Volume 3) are control parameters and therefore do not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.6, IV.C.4.0 and IV.C.5.0

10.0 ESTABLISH APPROPRIATE COOLDOWN RATE. IF INDICATIONS OF A HEAD VOID EXIST, THEN ATTEMPT TO MAINTAIN COOLDOWN RATE < 50°F/HR.

Indicators and Controls

Indicators:
- SG shell temperature
- RCS temperature (T_{cold}, incore thermocouple)
- EFW flow
- Parameters used to indicate RV head void

Controls:
- TBV/ADV controls
- EFW controls

Purpose of Step

The purpose of this step is to establish the desired cooldown rate for the plant conditions.

Bases

The cooldown rate may be somewhat dictated by the plant conditions forcing the cooldown. For example, if cooling down with a leaking MSSV, the initial cooldown rate will likely be a function of only the leak rate of the MSSV. However, as RCS conditions change the cooldown rate may need to be further adjusted to maintain tube-shell ΔT limits.

The existence of a head void would normally require that the cooldown rate be limited to < 50°F/hr. However, if the cooldown rate cannot be controlled to this value then continued SG cooling is preferable to HPI cooling. HPI cooling would induce greater thermal stress on the RV than continued SG cooling at > 50°F/hr with a head void.

The GEOG value of 50°F/hr is a control parameter and therefore does not require error correction.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.7

11.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

Indicators and Controls

Indicators:
- Control rod position
- Plant specific reactivity balance curves
- RCS boron concentration
- RCS temperature (incore thermocouple)

Controls:
- Control rod drive control system
- Plant specific RCS boron addition controls

Purpose of Step

The purpose of this step is to ensure the reactor remains adequately shutdown during the cooldown.

Bases

During a cooldown of the RCS, the reactor must remain sub-critical and adequate shutdown margin must be maintained. Keeping the reactor sub-critical reduces the core energy removal requirements to decay heat load only. Maintaining adequate shutdown margin will prevent reactor criticality due to any accident (e.g., rod ejection) during the cooldown. The boron concentration in the RCS is increased before the cooldown begins or during the cooldown as necessary to maintain adequate shutdown margin throughout the plant cooldown evolution. Increasing the RCS boron concentration during a cooldown is necessary because the temperature decrease adds positive reactivity to the system.

Sequence

Adequate shutdown margin for a given RCS temperature must be verified prior to intentionally cooling to that temperature. Although in this case it may not be possible to hold the cooldown at a stable point, adequate time should exist to assess shutdown margin and add boron if necessary.

TBD Volume 3 References

III.G.3.1

12.0 <u>IF AT ANY TIME</u> RCS PRESSURE WITHIN [allowable range for CFT isolation] <u>AND</u> SCM EXISTS <u>AND</u> RCS PRESSURE IS BEING CONTROLLED, <u>THEN</u> CLOSE CFT ISOLATION VALVES.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- CFT isolation valve position
- P-T display
- SPDS
- SCM monitor

Controls:
- CFT isolation valve controls

<u>Purpose of Step</u>

The purpose of this step is to prevent unnecessary injection from the CFTs by isolating them from the RCS when RCS conditions allow.

<u>Bases</u>

If the RCS is subcooled and RCS pressure is controlled, core cooling is adequate and water from the CFTs is not needed for core cooling. To prevent the unnecessary injection of CFT inventory into the RCS, the CFT isolation valves are closed when RCS pressure has been decreased to a value where isolation is allowed. Also, by closing the CFT isolation valves, the nitrogen cover gas from the CFTs, which may inhibit RCS depressurization or subsequent SG heat removal by collecting in the SGs or the RCS loops if injected into the RCS, cannot be injected into the RCS. A RCS leak may exist, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

The plant-specific value for [allowable range for CFT isolation] is intended as a target value and therefore does not require error-correction.

<u>Sequence</u>

There is no specific sequence requirement.

<u>TBD Volume 3 References</u>

IV.B.5.2

13.0 IF AT ANY TIME RBS IN OPERATION AND [termination criteria exist], THEN STOP RBS.

Indicators and Controls
Indicators: - RBS system valve positions
- RBS system flow rate

Controls: - RBS system valve controls
- RBS system pump motor controls

Purpose of Step
The purpose of this step is to terminate RB spray operation when conditions permit.

Bases
RBS flow should be stopped when RB pressure/temperature reduction and iodine removal objectives, if applicable, have been met. It is unlikely, but possible, that RBS was actuated prior to entry to this section, e.g. a small break that was isolated concurrent with an overcooling.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.H.3.2.1, III.H.3.2.2, and IV.F.3.0

14.0 IF AT ANY TIME [LTOP] APPLIES, THEN IMPLEMENT [LTOP actions].

Indicators and Controls

Indicators: - RCS pressure
- RCS temperature

Controls: - [LTOP actions] controls

Purpose of Step

The purpose of this step is to establish overpressure protection when conditions warrant.

Bases

Overpressure protection is required at low RCS temperatures to preclude inadvertently exceeding the P-T limit. The conditions requiring LTOP and the actions to implement LTOP are plant specific.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.10

15.0 COOLDOWN TO DHRS OPERATION.

16.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

Indicators and Controls
Indicators: N/A

Controls: N/A

Purpose of Step
The purpose of these steps is to denote ultimate transition to DHR cooling.

Bases
The forced cooldown using the SG(s) will continue until the cooldown can no longer be controlled (step 1.0), the condition requiring the cooldown is fixed, or until DHR cooling can be established. DHR cooling is beyond the scope of GEOG, therefore reference is made to station management for further direction.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
None. These are only routing steps that are needed because of the manner in which the GEOG is structured.

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION V.A – RCP RESTART

Strategy:

- Establish forced RC flow

CAUTION

Verify acceptability of RCP restart in accordance with potential boron dilution restrictions prior to implementing this section.

1.0 ENSURE RCP SERVICES ESTABLISHED.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI flow
- [Loop void indications]
- RCP seal injection/seal return status
- RCP cooling water status
- RCP lube oil status
- RCP power status
- RCP interlock status

Controls:
- RCP seal injection/seal return valve controls
- RCP cooling water controls
- RCP lube oil controls
- RCP motor bus breaker controls

Purpose of Step

The purpose of this step is to ensure conditions are established to allow RCP operation.

Bases

RCP services must be established prior to starting a RCP to preclude pump and motor damage. RCP services include power, seal injection, seal return, cooling water and lube oil. In addition, certain RCS conditions must be satisfied to preclude the possibility of a recriticality due to RCP restart with pockets of deborated coolant. Restrictions on RCP restart are imposed if SCM had been lost or if HPI cooling had been established and loop voids exist.

Sequence

RCP services must be established and boron dilution concerns must be addressed prior to RCP start.

TBD Volume 3 References

IV.A.3.0

2.0 ESTABLISH DESIRED RCS CONDITIONS.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- MU/HPI flow
- [Loop void indications]

Controls:
- MU/HPI flow control
- Pressurizer heater controls

Purpose of Step

The purpose of this step is to ensure conditions are established to allow RCP operation.

Bases

Proper RCS conditions must be established prior to RCP start. These conditions include SCM, adequate NPSH, saturated pressurizer conditions and appropriate pressurizer level if possible to accommodate RCS pressure changes on pump start, and PTS restrictions, if applicable. Pressurizer saturation and level will not be achievable if HPI cooling is in progress. If PTS has not been invoked, then additional subcooling beyond SCM may be desirable to minimize the possibility of losing SCM on RCP start.

Sequence

RCS conditions must be established prior to RCP start.

TBD Volume 3 References

III.C.3.5.A, IV.A.3.0, IV.A.3.1, IV.A.3.1.A, IV.A.3.1.C, IV.A.3.2, IV.A.3.2.A, IV.A.3.2.B, IV.A.3.2.C, IV.A.3.3 and IV.A.3.4.

3.0 ESTABLISH DESIRED SG CONDITIONS.

Indicators and Controls

Indicators: - SG pressure
- SG level

Controls: - TBV/ADV controls
- FW flow controls

Purpose of Step

The purpose of this step is to ensure SGs are established as heat sinks and to account for possible SG level swell on RCP start.

Bases

If the SGs are available for heat transfer, then this step ensures the desired SG conditions are established prior to RCP start. The rate of heat transfer to the SGs will increase on pump start. Therefore the SG pressure should be adjusted to allow heat transfer but not result in an overcooling. The SG level will swell initially due to the rapid increase in heat transfer. If the SGs had been at the [loss of SCM setpoint] and are still high even though now in subcooled NC, it may be preferable to allow the SG levels to decrease by boil-off before RCP start.

The SGs may not be available, as in some cases of RCP start while in HPI cooling. In this case the step would not apply.

Sequence

SG conditions, if applicable, should be established prior to RCP start.

TBD Volume 3 References

III.C.3.5and IV.A.3.0

4.0 ENSURE HPVs ARE CLOSED.

Indicators and Controls
Indicators: - HPV valve position indication

Controls: - HPV valve controls

Purpose of Step
The purpose of this step is to ensure the HPVs are closed to prevent loss of inventory following RCP start.

Bases
The HPVs may have been opened in an attempt to eliminate a loop void. The existence of forced flow will result in liquid discharge through the HPVs. This would be an unnecessary loss of RCS inventory and energy deposition to the RB; thus the HPVs should be closed prior to starting RCPs.

Sequence
The HPVs should be closed prior to RCP start.

TBD Volume 3 References
IV.A.3.0

5.0 START DESIRED RCP(s).

Indicators and Controls
Indicators: - RCP status

Controls: - RCP motor controls

Purpose of Step
The purpose of this step is to start the appropriate RCPs.

Bases
The appropriate RCP(s) to start depends on the plant conditions. Several considerations may apply. If only one loop is in NC, then it may be preferable to start an RCP in that loop. This minimizes the heat transfer upset and maximizes the possibility of regaining NC if the RCP must be tripped. If only one SG is available as a heat sink, then it is preferable to start a pump in that loop. All other conditions being equal, the RCP chosen should be one that maximizes pressurizer spray flow. The RCP start may be primarily for RV stress reduction during HPI cooling, and possibly to reduce the cooldown rate during HPI cooling. In this case, it may be desirable to start more than one RCP to further reduce the cooldown rate. However, running RCPs will significantly delay achieving DHRS operation if HPI cooling must be used for the entire cooldown.

The spray block valve may have been closed earlier during mitigation of a loss of SCM. If its reopening leads to a continuous RCS pressure decrease, it should be re-closed.

Sequence
The RCP(s) should not be started until after the conditions established by steps 1.0-4.0 are completed.

TBD Volume 3 References
III.G.3.9.3, IV.A.3.1, IV.A.3.2, IV.A.3.3, IV.A.3.4 and IV.G

6.0 IF SCM IS LOST, THEN IMPLEMENT RULES 1.0 AND 2.0.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- P-T display
- SPDS
- SCM monitor

Controls: N/A

Purpose of Step

The purpose of this step is to provide the appropriate direction in the event SCM is lost on RCP start.

Bases

Starting a RCP can result in a loss of SCM, thus it is prudent to specify this check here even though the operator is constantly alert for the presence of symptoms. SCM could be lost due to the collapse of a loop void or RCS temperature decrease and attendant outsurge from the pressurizer or a combination. If SCM is lost for these reasons, it will normally be for a very short period as temperatures and pressure stabilize and HPI restores subcooling. Therefore, an immediate RCP trip is not required per Rule 1.0, Note 1.

Sequence

The Rules must be implemented as soon as SCM is lost.

TBD Volume 3 References

IV.A.2.0, V.1.0, and V.2.0

7.0 CONTROL PRIMARY-SECONDARY HEAT TRANSFER.

Indicators and Controls

Indicators:
- SG pressure
- RCS temperature (T_{cold}, incore thermocouple)
- SG levels

Controls:
- TBV/ADV controls
- FW flow control

Purpose of Step

The purpose of this step is to adjust the heat transfer rate as necessary.

Bases

Starting a RCP can result in an increase in SG heat transfer. This step ensures the steam release is adjusted to establish the desired heat transfer rate and cooldown rate. This step also covers ensuring that SG levels are adjusted as necessary for forced flow conditions. If the SGs are not available (e.g., in HPI cooling) then this step would not apply.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

IV.A,3,0, IV,C,2,3 and IV.C.3.1

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION V.B – RCS PRESSURE CONTROL

Strategy:

- Provide centralized actions for controlling RCS pressure

1.0 IF RCS PRESSURE IS HIGHER THAN DESIRED, THEN PERFORM ONE OR MORE OF THE FOLLOWING, AS APPLICABLE:

1.1 Throttle MU/HPI (Rule 2.0).

1.2 Place pressurizer heaters in OFF.

1.3 IF RCP(s) running, THEN use manual spray control.

1.4 Increase letdown flow.

1.5 Cycle the PORV or pressurizer vent as necessary.

1.6 Use auxiliary spray control.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- MU/HPI flow
- Pressurizer heater status
- RCP status
- Letdown flow
- PORV indication
- Pressurizer spray indication

Controls:
- MU/HPI valve controls
- Pressurizer heater controls
- Pressurizer spray controls
- PORV control
- Letdown flow control

Purpose of Step

The purpose of this step is to provide actions to stabilize or reduce RCS pressure.

Bases

RCS pressure reduction capability will depend on RCS status and equipment availability. The pressurizer may have normal bubble control or may be solid. Pressurizer spray may be unavailable or ineffective. Conditions may not allow throttling of HPI. Therefore this step is structured to allow use of the most appropriate method to stabilize or reduce RCS pressure.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.3.2 and III.G.3.4

2.0 <u>IF</u> RCS PRESSURE IS LOWER THAN DESIRED, <u>THEN</u> PERFORM ONE OR MORE OF THE FOLLOWING, AS APPLICABLE:

2.1 Increase MU/HPI flow.

2.2 <u>IF</u> RCP(s) running, <u>THEN</u> ensure spray valve or spray block valve is closed.

2.3 Reduce letdown flow.

2.4 Energize pressurizer heaters.

2.5 <u>IF</u> HPI cooling is not in progress, <u>THEN</u> ensure PORV or PORV block valve is closed.

2.6 Ensure pressurizer vent valve is closed.

2.7 Ensure auxiliary spray secured.

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- MU/HPI flow
- Pressurizer heater status
- RCP status
- Letdown flow
- PORV, PORV block, and pressurizer vent valve indications
- Auxiliary spray flow indication
- Spray valve position indication

Controls:
- MU/HPI valve controls
- Pressurizer heater controls
- Pressurizer spray controls
- PORV, PORV block and pressurizer vent valve controls
- Letdown flow control

<u>Purpose of Step</u>

The purpose of this step is to provide actions to stabilize or increase RCS pressure.

<u>Bases</u>

RCS pressure may be low due to a number of possibilities, and the ability to control pressure will depend on RCS status and equipment availability. The pressurizer may have normal bubble control or may be solid. Pressurizer heaters may be unavailable. Therefore this step is structured to allow use of the most appropriate method to stabilize or increase RCS pressure.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.3.2 and III.G.3.4

3.0 CONTROL RCS PRESSURE WITHIN THE P-T LIMITS.

3.1 IF RCS leak exists, THEN maintain minimum SCM and if applicable RCP NPSH.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- MU/HPI flow
- RCP status
- PORV indication
- Pressurizer spray indication
- P-T display
- SPDS
- SCM monitor

Controls:
- MU/HPI valve controls
- Pressurizer spray controls
- PORV control

Purpose of Step
The purpose of this step is to minimize lost RCS inventory by minimizing RCS pressure.

Bases
Maintaining RCS pressure near the SCM limit will minimize the inventory lost through the leak. If RCPs are operating, then minimum NPSH must be maintained as well.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
IV.B.2.A.4, IV.B.2.B.4, IV.G and V.2.0

3.2 <u>IF</u> RCS pressure is controlled <u>AND</u> SCM exists, <u>THEN</u> perform the following:

3.2.1 bypass ES actuation when RCS pressure drops below [ES bypass permissive setpoint].

3.2.2 close the CFT isolation valves when RCS pressure within [allowable range for CFT isolation].

<u>Indicators and Controls</u>

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- ES status
- CFT isolation valve position
- P-T display
- SPDS
- SCM monitor

Controls:
- ES bypass controls
- CFT isolation valve controls

<u>Purpose of Step</u>

The purpose of this step is to prevent unnecessary complication of RCS pressure control during controlled depressurization.

<u>Bases</u>

The Engineered Safeguards Actuation System (ESAS or ES) monitors parameters necessary to detect the occurrence of a LOCA and to actuate equipment necessary to protect the fuel and maintain RB integrity to prevent release of fission products to the environment. RCS pressure is one of the parameters that is monitored. In the case of a controlled cooldown, it may be appropriate to bypass certain ES actuations to prevent unwanted actuation of equipment. It is not appropriate to bypass if SCM does not exist or if the operator is not controlling RCS pressure.

If the RCS is subcooled and RCS pressure is controlled, core cooling is adequate and water from the CFTs is not needed for core cooling. To prevent the unnecessary injection of CFT inventory into the RCS, the CFT isolation valves are closed when RCS pressure has been decreased to a value where isolation is allowed. Also, by closing the CFT isolation valves, the nitrogen cover gas from the CFTs, which may inhibit RCS depressurization or subsequent SG heat removal by collecting in the SGs or the RCS loops if injected into the RCS, cannot be injected into the RCS.

The RCS depressurization rate may be due to the PORV and possibly a concurrent RCS leak, but if the RCS pressure is being controlled above SCM by operator actions to control HPI, etc., then RCS pressure is controlled for the purpose of this step.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
III.G.2.5.1

3.3 IF the RCS will be taken solid, THEN limit RCS pressure increase by one or more of the following, as applicable:

3.3.1 Throttle MU/HPI (Rule 2.0).

3.3.2 Increase letdown flow.

3.3.3 Place pressurizer heaters in OFF.

3.3.4 Cycle the PORV or pressurizer vent as necessary.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- MU/HPI flow
- Letdown flow
- PORV and pressurizer vent indication
- Pressurizer heaters status

Controls:
- MU/HPI valve controls
- Letdown flow controls
- PORV and pressurizer vent controls
- Pressurizer heater controls

Purpose of Step

The purpose of this step is to ensure RCS pressure control to prevent large pressure swings and possible lift of the PSVs.

Bases

Primary pressure control is more sensitive during solid plant operation to small changes in inventory and temperature. It is especially desirable to prevent challenges to the PSVs to preclude passing water.

Sequence

There is no specific sequence requirement.

TBD Volume 3 References

III.G.3.4 and V.2.0

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION V.C – SUMP SWITCHOVER

Strategy:

- Ensure a continued suction source to running ECCS pumps
- Ensure actions that must be performed prior to recirculation are accomplished
- Ensure proper pump flows to prevent runout
- Ensure proper lineup on completion of switchover

1.0 PERFORM [actions required prior to switchover].

Indicators and Controls
Indicators: - Plant specific indications

Controls: - Plant specific controls

Purpose of Step
The purpose of this step is to cover those actions that must be performed prior to sump switchover.

Bases
There may be plant specific actions that are required to be performed prior to switching to recirculation from the RB sump. These may be local actions that won't be accessible following switchover due to radiological concerns. Actions may be required to repower equipment in order to accomplish the switchover.

Sequence
Any such actions must be accomplished prior to depletion of the BWST to the point requiring switchover to the sump.

TBD Volume 3 References
IV.B.3.2

2.0 ALIGN HPI AS REQUIRED (Rule 2.0).

2.1 IF HPI termination criteria are satisfied, THEN terminate HPI prior to loss of BWST suction AND go to step 3.0.

2.2 Align LPI pump discharge of running LPI pump(s) to suction of associated running HPI pump(s).

Indicators and Controls

Indicators:
- HPI flow
- RCS pressure
- RCS temperature (incore thermocouple)
- LPI flow
- BWST level

Controls:
- HPI valve and pump controls
- HPI/LPI piggyback valve controls

Purpose of Step

The purpose of this step is to terminate HPI if permitted or to ensure continued suction source for the HPI pumps if not permitted.

Bases

The HPI pumps can not draw suction directly from the RB sump. Therefore, if HPI operation will be required following transfer to the RB sump, then the running HPI pumps must be lined up to the discharge of the running LPI pumps.

If the HPI pumps have a suction line from the BWST separate from the LPI pumps, then this line should remain open during the transfer. This will ensure sustained HPI suction capability in the event of a momentary loss of the suction source provided by the LPI pumps during the transfer. If an LPI pump suction cannot be established from the sump, then the associated HPI pump must be secured prior to losing suction from the BWST.

Sequence

The HPI pumps must either be secured or aligned to the LPI pump discharge prior to switchover to the sump.

TBD Volume 3 References

III.B.3.8, IV.B.2.A.5, IV.B.2.B.5, IV.B.7.0 and V.2.0

3.0 THROTTLE RBS AND LPI AS NECESSARY TO ENSURE ADEQUATE NPSH ON TRANSFER TO THE SUMP.

Indicators and Controls

Indicators: - LPI flow
- RBS flow

Controls: - LPI flow controls
- RBS flow controls

Purpose of Step

The purpose of this step is to ensure adequate NPSH to the running RBS and LPI pumps on switchover to the RB sump.

Bases

The RBS and LPI pumps may have a lower flow limit when drawing suction from the RB sump, due to the lower available head and higher fluid temperature. If so, then the RBS and LPI pumps must be throttled to within these limits prior to switching suction to the RB sump.

Sequence

The RBS and LPI pumps must be throttled to within the appropriate flow limits prior to switchover to the sump.

TBD Volume 3 References

IV.B.3.2

4.0 WHEN BWST REACHES [sump switchover setpoint], THEN PERFORM THE FOLLOWING:

4.1 Align LPI suction to the RB sump.

4.2 IF unable to establish sump suction to an LPI pump, THEN secure that LPI/HPI train prior to losing BWST suction.

4.3 Close LPI and HPI BWST suction valves.

Indicators and Controls

Indicators:
- LPI BWST and RB sump suction valve position indications
- LPI pump status
- HPI pump status
- HPI BWST suction valve position indications
- BWST level

Controls:
- LPI BWST and RB sump suction valve controls
- LPI pump motor controls
- HPI pump motor controls
- HPI BWST suction valve controls

Purpose of Step

The purpose of this step is to align suction to the RB sump.

Bases

The ECCS suction source must be switched to the RB sump at a plant specific low BWST level. Typically, there is a level range within which the swap-over must be completed. This range ensures adequate RB sump inventory while preventing air entrainment due to vortexing in the BWST outlet.

If sump suction cannot be established to an LPI pump, then the associated LPI/HPI train must be secured prior to losing suction from the BWST. This maintains the pumps available when the sump suction is established. If the pumps were not secured, air entrainment may require vent and refill, which may not be achievable from the sump due to radiological concerns.

Establishing RB emergency sump recirculation will result in radioactive liquid flow outside the RB (e.g., auxiliary building). Appropriate precautions should be taken for the potential exposure due to this flowpath and for the potential release of radioactive gas or liquid.

The plant-specific value for [sump switchover setpoint] is a limiting value and should be error-corrected.

Sequence
The switchover to the sump must be accomplished prior to reaching a plant specific low BWST level.

TBD Volume 3 References
III.H.3.2.6 and IV.B.3.2

5.0 PERFORM [post-switchover actions and checks].

Indicators and Controls
Indicators: - Plant specific indications

Controls: - Plant specific controls

Purpose of Step
The purpose of this step is to cover those actions that must be performed following sump switchover.

Bases
There may be plant specific actions that are required after switching to recirculation from the RB sump. Typical actions that may be included are adjusting ECCS flow rates, verifying equipment lineups, sump chemistry control or verification, and health physics actions to check local radiation levels, evidence of back-leakage, etc.

In addition, depending on the plant condition, it may be beneficial to consider replenishing the BWST inventory for subsequent use if necessary. For example, the existence of a SG tube leak could result in continuing RCS inventory loss that could eventually reduce the inventory available in the RB sump.

Sequence
There is no specific sequence requirement.

TBD Volume 3 References
IV.B.3.2

GENERIC EMERGENCY OPERATING GUIDELINES BASES

SECTION VI – RULES

Strategy:

- Provide specific guidance that always applies unless explicitly stated otherwise.
- Provide more efficient execution of important guidance.
- Provide streamlined guidance by avoiding repetition.
- Only applies once reactor is verified as shutdown.

1.0 Loss of SCM Rule

Whenever SCM is lost, perform the following:

1.1 Trip all RCPs immediately.[1]

1.2 Initiate full flow [2] from at least two HPI pumps.

1.3 Initiate and control EFW flow per Rule 4.0.

1.4 Ensure full flow from two LPI pumps when RCS pressure permits.

NOTES

1. If RCPs not tripped within two minutes after a loss of SCM, then RCP operation (one RCP in each loop preferred) must be maintained until SCM restored or until LPI flow established. If a RCP trips, the other RCP in that loop must be started immediately.

If SCM is lost, immediately following RCP restart, then the RCPs do not need to be tripped immediately but must be tripped if SCM is not restored within two minutes.

2. Full HPI flow may require flow balancing or isolation of a broken HPI line accomplished by plant specific methods. The intent is to ensure minimum flows required for LOCA are met.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{hot} if valid or incore thermocouple)
- RCP status
- SCM monitor
- EFW valve indicators
- LPI valve indicators
- HPI Valve indicators
- HPI flow
- EFW flow
- EFW pump status
- LPI flow
- LPI pump status
- P-T display
- SPDS

Controls:
- RCP controls
- HPI pump controls
- HPI valve controls
- EFW pump controls
- EFW valve controls
- LPI pump controls
- LPI valve controls

Purpose of Step

The purpose of this rule is to ensure actions always required on a loss of SCM are performed immediately.

Bases

The RCPs are tripped immediately upon loss of SCM to prevent possible core damage which could occur if they were later tripped during certain size LOCAs. If the RCS void fraction is greater than about 70% when RCPs are tripped, the peak clad temperature can exceed the maximum temperature allowed by 10CFR50.46. A manual trip of the RCPs before the RCS void fraction reaches 70% prevents this possibility.

Analyses were performed which used both conservative and realistic Appendix K assumptions with the objective of meeting the requirements of 10CFR50.46. Using conservative Appendix K assumptions, it was shown that RCPs must be tripped within two minutes after losing SCM to prevent the RC from evolving to a high enough void fraction such that the core would be uncovered if the RCPs were tripped at a later time. Using realistic assumptions, the maximum allowed time for tripping the RCPs was 10 minutes.

These analyses showed that continued RCP operation could allow the RCS to evolve to a void fraction of 70% or greater if a certain range of break sizes were present. If the RCPs were tripped when the void fraction was 70% or greater, core uncovery would occur. Since RCP trip later in time cannot be absolutely prevented, it is necessary to trip RCPs before the RCS void fraction could increase to 70%. Once RCPs are tripped, the rate of loss of RCS inventory is reduced to the point where HPI (along with heat removal by the SGs in some cases) can keep the core covered.

These guidelines have been written to require that the RCPs be tripped immediately upon indication of loss of SCM. The primary reason for this is to make the action event dependent rather than time dependent. The margin (SCM) between subcooled conditions and saturation accounts for the ability to accurately measure RCS pressure and temperature (i.e., instrumentation errors) as well as pressure and temperature variations from the point of measurement (i.e., process errors such as elevation head).

The two minute criterion is used in these guidelines rather than ten minutes for three reasons. First, the realistic analysis assumed full flow from two HPI pumps. For the scenario where both HPI pumps start but for some reason full HPI flow does not exist, the process of achieving and verifying full HPI flow may well take more than two minutes. If, in fact, full HPI flow cannot be obtained, then the risk of core uncovery exist if the RCPs are tripped later than two minutes. The second reason is the complexity and likelihood for confusion if the RCP criteria had both a 2-minute and a 10-minute criterion. Finally, the RCP trip on loss of SCM is expected to be an immediate action due to the potential consequences of not performing the trip when required and to eliminate/reduce time-based decisions. Use of a 10-minute criterion would detract from this intent.

Based on the analyses performed, core cooling with saturated RCS is assured regardless of the predicted high RCS void fraction as long as the RCPs remain operative. Therefore, if the RCPs are not tripped within two minutes of loss of SCM, they must be operated until SCM is restored or LPI flow established. To prevent mechanical damage to all the RCPs and to extend the operability time for the RCPs, only one RCP in each loop should be operated. If they fail, the two pumps (which were idle) should be started even if mechanical damage is again likely. Thus, if the RCPs are not tripped within two minutes of the loss of SCM, then they must be operated even though RCP damage may occur.

Whenever a loss of SCM occurs, HPI flow to the RCS is required to add mass to the RCS and provide core cooling. Steps must be taken immediately to achieve full HPI flow to the RCS. When attempting to achieve full HPI flow, it should not be allowed to exceed the maximum allowable pump flow rate. The HPI system design may inherently prevent excessive HPI pump flow (pump runout). Full HPI flow must be maintained until SCM is restored or HPI termination criteria are satisfied (Rule 2.0).

If the loss of SCM is caused by excessive overcooling, HPI flow need only compensate for RCS contraction. If it is caused by a LOCA, HPI is required to replace RCS inventory that is being lost out the break. For certain break sizes, core cooling is provided solely by HPI, supplying subcooled inventory for energy absorption and ultimate heat transfer. Consequently, full HPI flow must be used to replace the RCS inventory that is being lost until SCM is restored.

Full HPI is achieved by operating two HPI pumps, if possible, and balancing the HPI flow through the injection lines. Balancing is necessary to ensure full flow to the RCS for certain failures such as a break in an HPI line. Balancing may be inherent in the HPI system design or may require manual action. The HPI valves should be verified open or opened as necessary to ensure full HPI flow.

Note that in determining loss of SCM, only valid T_{hot} indications should be used. If, for example, the plant is in single loop natural circulation T_{hot} in the idle loop should not be used. Incore thermocouple temperatures are always valid.

Initiation of EFW, if available, is always performed on a loss of SCM and therefore is referenced here, but specifics are provided in Rule 4.0.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
II.B.3.2.1, III.B.2.3, III.B.3.2, IV.A.2.1, IV.A.2.2, IV.B.2.A.2, IV.B.2.A.2.1, IV.B.2.A.3.1, IV.B.2.B.2, IV.B.2.B.2.1, IV.B.2.B.3.1 and V.1.0

2.0 HPI Throttling/Termination Rule

2.1 HPI flow <u>may not</u> be throttled unless SCM exists.[1]

Notes

1. HPI may <u>not</u> be throttled, even with SCM, if HPI cooling is in progress until core exit thermocouple temperatures are decreasing, except to prevent violating the RV P-T limit.

<u>Indicators and Controls</u>

Indicators:
- HPI pump status.
- HPI valve indication.
- HPI flow rate.
- RCS pressure.
- RCS temperature (incore thermocouples or T_{hot} if RCPs on)
- SCM monitor.
- LPI flow rate.
- P-T display
- SPDS

Controls:
- HPI pump controls
- HPI valve controls

<u>Purpose of Step</u>

The purpose of this rule is to prevent core overheating caused by inappropriate HPI flow throttling or termination.

<u>Bases</u>

The core transfers heat to the RCS. As long as the core is covered, sufficient heat transfer from the core will occur to keep the core adequately cooled. As long as the RCS is subcooled the core will be covered. However, when the RCS is saturated, core covering and, hence, cooling may not be adequate (depending upon conditions). Therefore, whenever SCM does not exist HPI flow may not be throttled.

The exception for HPI cooling ensures adequate HPI flow in the event the PORV is not available or is being allowed to cycle in automatic. If HPI cooling is initiated from lower pressures and temperatures, it is possible that throttling of HPI would still be required to prevent violating the RV P-T limit.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
II.A.3.1, IV.B.2.A.4, IV.B.2.A.5.2, IV.B.2.B.4, IV.B.2.B.5.2 and V.2.0

2.2 HPI flow <u>must</u> be throttled to prevent violating the RV P-T limit.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (incore thermocouple)
- HPI flow rate
- HPI valve indication
- HPI pump status
- SPDS
- P-T display
- SCM monitor

Controls:
- HPI pump controls
- HPI valve controls

Purpose of Step

The purpose of this rule is to prevent violating the RV P-T limit.

Bases

HPI flow must be throttled to prevent over-pressurizing the RCS when SCM exists by keeping RCS pressure < the RV P-T limit. If the RCS is water solid (may be on HPI cooling), small temperature changes can cause RCS pressure changes that may challenge the RV P-T limit. Even with a steam bubble in the pressurizer, rapid filling of the pressurizer and the resulting steam bubble compression can cause rapid RCS pressure increase. During such situations, HPI must be throttled to keep RCS pressure below the RV P-T limit.

Sequence

Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References

IV.B.2.A.4.1, IV.B.2.B.4.1, IV.G and V.2.0

2.3 HPI flow may not be terminated if any of the following conditions exist:

a. The core outlet temperature is superheated.

b. The core outlet temperature is saturated and LPI flow is less than [minimum flow rate].[5]

c. The core outlet temperature is subcooled and RCS injection required is greater than the makeup system capacity and LPI flow does not exist.

Notes

5. LPI minimum flow rates, not including instrument error, are:

177FA Plants except ANO-1	**1000 gpm in each line**
ANO-1 (2 LPI pumps)	**2630 gpm per pump**
ANO-1 (1 LPI pump)	**3020 gpm for pump**

Indicators and Controls

Indicators:
- RCS temperature (incore thermocouple)
- LPI flow rate
- HPI flow rate
- RCS pressure
- SCM monitor
- P-T display
- SPDS

Controls:
- None

Purpose of Step

The purpose of this rule is to ensure HPI flow, once initiated, is not terminated prematurely.

Bases

All available ECCS injection systems must be used at full capacity any time ICC conditions exist. If the core outlet is saturated, then HPI may only be terminated when LPI flow is > [minimum flow]. If the core outlet is subcooled, HPI can only be terminated if another injection method (makeup or LPI) of sufficient capacity exists.

The GEOG values for LPI minimum flow rates are limiting values and should be error-corrected.

Sequence

Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
III.F.2.2, IV.B.2.A.3, IV.B.2.B.3 and V. 2.0

2.4 HPI flow <u>may</u> be terminated if <u>any</u> of the following conditions exist:

a. The core outlet temperature is subcooled <u>and</u> RCS injection required (makeup and contraction) is within the capacity of normal makeup.

b. The core outlet temperature is subcooled <u>and</u> LPI flow exists <u>and</u> HPI has been throttled to [minimum allowable pump flow] <u>and</u> the RCS P-T is <u>not</u> increasing.[3]

c. The core outlet temperature is saturated <u>and</u> LPI flow > [minimum flow rate] exists.[3,4,5]

Notes

3. In these cases, HPI should not be terminated until switchover to RB sump suction is required.

4. When the core outlet temperature is saturated and LPI flow exists, the PORV may be opened in an attempt to increase LPI flow to > [minimum flow rate].

5. LPI minimum flow rates, not including instrument error, are:

177FA Plants except ANO-1	**1000 gpm in each line**
ANO-1 (2 LPI pumps)	**2630 gpm per pump**
ANO-1 (1 LPI pump)	**3020 gpm for pump**

<u>Indicators and Controls</u>

Indicators:
- RCS temperature (incore thermocouples)
- HPI flow rate
- LPI flow rate
- RCS pressure
- SCM monitor
- P-T display
- SPDS

Controls:
- HPI pump motor controls
- HPI valve controls

Purpose of Step
The purpose of this rule is to allow HPI termination when the specified criteria are satisfied. HPI termination is desirable, if possible, prior to depletion of the BWST to prevent HPI/LPI piggyback operation off the RB emergency sump.

Bases
HPI can be terminated when RCS injection requirements can be satisfied by other means, i.e., normal makeup system operation or by the LPI system. The LPI system is demonstrated to provide sufficient core cooling when the RCS is subcooled by throttling HPI to [minimum allowable pump flow] while maintaining stable or decreasing RCS pressure and temperature with LPI flow, and when the RCS is saturated by ensuring LPI flow >[minimum flow rate].

The GEOG values for LPI minimum flow rates and HPI [minimum allowable pump flow] are limiting values and should be error-corrected.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
IV.B.2.A.5.2, IV.B.2.A.5.3, IV.B.2.B.5.2, IV.B.2.B.5.3 and V.2.0

2.5 HPI flow <u>must</u> throttled to prevent exceeding [pump runout].[2]

2.6 HPI flow <u>must</u> be maintained greater than [minimum allowable pump flow].

Notes

2. When reducing flow to prevent pump runout, care should be taken to not reduce flow more than necessary to prevent exceeding the limit.

<u>Indicators and Controls</u>

Indicators:
- HPI flow.
- HPI pump status.
- HPI valve position indication.

Controls:
- HPI valve controls.
- HPI pump controls.

<u>Purpose of Step</u>

The purpose of these rules is to prevent HPI pump damage.

The plant-specific values for [pump runout] and [minimum allowable pump flow] are limiting values and should be error-corrected.

<u>Bases</u>

If these limits are not observed, then damage may result to the HPI pumps. This damage can range from degraded performance to total failure.

<u>Sequence</u>

Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

<u>TBD Volume 3 References</u>

IV.B.2.A.3.1.E, IV.B.2.A.4, IV.B.2.B.3.1.E, IV.B.2.B.4 and V.2.0

3.0 Pressurized Thermal Shock (PTS) Rule

3.1 The PTS guidance must be invoked whenever one of the following criteria are met:

a. RC pump on or natural circulation with HPI off:
Whenever T_{cold} is less than 338°F[1] and the rate of cooldown exceeds the allowed RCS Technical Specification cooldown rate.

b. RC pumps off and HPI on:[2]
Whenever all RC pumps are off and HPI is on.

3.2 If PTS guidance is invoked, then maintain core outlet temperature and pressure near the SCM limit.

NOTES

1. Temperature values must be adjusted for plant specific instrument and process errors.

2. HPI on is defined as one or more HPI pumps on while taking suction from the BWST and injecting through one or more of the HPI lines. For Davis Besse, this also means one or more MU pumps on while taking suction from the BWST during MU/HPI cooling.

Indicators and Controls

Indicators:
- RC pressure.
- RCS temperature (T_{cold}, incore thermocouple).
- SCM monitor
- P-T display
- SPDS

Controls: N/A

Purpose of Step

The purpose of this rule is to invoke PTS guidance.

Bases

Whenever the RV downcomer fluid temperature (T_{cold}) is less than 338°F and the RV downcomer fluid temperaturé rate of cooldown exceeds the allowed RCS Technical Specification cooldown rate, then the PTS guidance must be invoked. That is, if the RV downcomer cooldown rate does not return to within the Technical Specification limit before the RV downcomer temperature (T_{cold}) goes below 338°F, then the PTS guidance must be invoked.

Whenever all RC pumps are off and HPI is on, then the PTS guidance must be invoked. The operator does not know the downcomer fluid temperature whenever all RC pumps are off and HPI is on. The relatively cold HPI water can significantly cool the fluid entering the downcomer if forced flow does not exist and the resulting temperature of the fluid entering the downcomer cannot be determined. Because the RV downcomer temperature is not known, the operator must assume the RV downcomer temperature and cooldown rate which invoke the PTS guidance have been exceeded.

The GEOG values of 338°F is a limiting value and should be error-corrected.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
IV.G and V.3.0

4.0 Feedwater/SG Control Rule

4.1 Whenever SCM is lost, SG level(s) must be raised to the [loss of SCM setpoint] using EFW or MFW as follows:

a. EFW <u>must</u> be provided continuously at ≥ the [minimum fill rate (EFIC)] or at ≥ the [minimum total flow rate] until the [loss of SCM setpoint] is reached. EFW should not be throttled unless necessary[1].

	Loss SCM Setpoint[2]	Minimum Total EFW Flow Rate[2]	Minimum Fill Rate(EFIC)[2]
Davis Besse	100 inches SUR	N/A[3]	N/A
ANO-1 and CR-3	73% OR	400 GPM	2inches/minute
ON-1,2 and 3	79% OR	400 GPM	N/A
TMI-1	70% OR	400 GPM[4]	N/A

b. MFW using EFW nozzles <u>must</u> be provided at a total MFW flow rate ≥ 600 GPM (300,000 lbm//hr)[2]until the [loss of SCM setpoint] is achieved[5].

c. MFW using MFW nozzles <u>must</u> be provided to achieve the [loss of SCM setpoint] within 25 minutes of loss of SCM[6].

4.2 EFW pump flow must be maintained less than [pump runout].

4.3 Establish and control at the appropriate SG level setpoint ([low level limit setpoint], [NC setpoint], or [loss of SCM setpoint]).

4.4 When manually restoring feed flow to a dry SG (intact or trickle feed[7]), initially limit the flow rate as follows:

EFW nozzles, RCP on	:	≤ 450 GPM
EFW nozzles, RCPs off	:	≤ 200 GPM
MFW nozzles	:	≤ 200,000 lbm/hr

Once heat transfer has been restored in the SG, feed rates can be adjusted as necessary to control the cooldown and SG tube-shell ΔT.

If the minimum flow rate required by 4.1 applies and conflicts with these values, then the criteria of 4.1 supercede the criteria of 4.4.

NOTES

1. EFW manual flow control should only occur if either the automatic EFW control system is not functioning properly or if the SG becomes uncoupled (loss of heat transfer). Even under manual control, throttling should not be performed unless necessary. For level rate control systems, if the system does not initially feed due to a level error (actual level higher than target level), this is considered as not functioning properly for the purpose of this rule. Also, for the purpose of this rule, a SG becoming uncoupled is defined as EFW flow greater than the total minimum EFW flow causing the SG pressure to decrease substantially below RCS pressure.

2. These values do not include instrument errors.

3. Davis Besse need only feed to 100 inches SUR level, to achieve the loss of SCM setpoint. Because of this relatively low level, there is little time or need to throttle EFW before reaching the setpoint. For this reason, there is no minimum total EFW flow rate limit for Davis Besse and Davis Besse should not throttle EFW flow.

4. TMI-1 should not throttle EFW flow if only one motor-driven EFW pump is available.

5. EFW nozzle flow rates, while using MFW, could be substantially greater than those associated with EFW. For this reason, a total MFW flow rate approximately equivalent to normal full decay heat EFW flow rate (e.g., ~ 800 GPM) should be used. Throttling below this flow rate should not be performed unless necessary, e.g., MFW flow rate is causing the SG pressure to decrease substantially below RCS pressure. In any case, total MFW flow rate through the EFW nozzles must remain ≥ the prescribed limit until the [loss of SCM setpoint] is achieved.

6. When using MFW through the MFW nozzles, condensation heat transfer area sufficient to remove decay heat is not available until the [loss of SCM setpoint] is achieved. Achieving this level by 25 minutes after loss of SCM assures that PCTs remain within acceptable limits.

7. Trickle feed (feeding a SG with an unisolable steam leak) should not be attempted unless the steam leak is known to be in a location that is not detrimental to personnel or key equipment or no other method of core cooling is available. Trickle feed using MFW nozzles should not be attempted unless RCP(s) running.

Indicators and Controls

Indicators:
- RCS pressure
- RCS temperature (T_{hot} or incore thermocouple)
- SCM monitor
- EFW flow rate
- MFW flow rate
- SG level
- SPDS
- P-T display

Controls:
- EFW controls
- MFW controls

Purpose of Step

The purpose of this rule is to ensure appropriate SG conditions are established for primary to secondary heat removal and to limit the SG thermal stresses when reestablishing feed flow to a dry SG.

Bases

LOCAs require that SG levels be increased to the [loss of SCM setpoint]. In this situation, EFW flow rate should not be throttled during the SG level increase. Only if automatic systems fail to provide prescribed rates of level increase or do not function properly, or if SG(s) become uncoupled and depressurize substantially below RCS pressure, should EFW throttling occur. Even if EFW is controlled manually, it should not be throttled unless necessary to observe pump limits, control at the level setpoint, or due to SG uncoupling. If throttling is necessary, then any combination of flow to the SGs may be established as long as the total flow is not less than the [minimum total EFW flow rate]. Because the Davis Besse loss of SCM setpoint is only 100 inches SUR, there is little time or need to throttle EFW before reaching the setpoint. Hence, Davis Besse has no minimum total EFW flow limit and should not throttle EFW flow. TMI-1 has three EFW pumps and normally will have substantial EFW capacity available. However, in the unlikely event that only one motor-driven EFW pump is available, then EFW should not be throttled.

When FW is supplied through the EFW nozzles, a condensation heat transfer area is instantaneously established. The prescribed total minimum EFW and MFW flow rates assure that, during the fill period, condensation primary to secondary heat transfer will be sufficient to maintain peak clad temperatures (PCTs) within acceptable limits. The [loss of SCM setpoint] is high enough to provide the required condensing surface area during periods of no FW flow. When establishing MFW flow through the EFW nozzles, flow rates substantially greater than those associated with the EFW system are possible. For this reason, a flow rate of approximately the normal full decay heat EFW flow rate should be used. If it becomes necessary to reduce MFW flow rate, e.g., MFW flow causing substantially low SG pressure, then it <u>must</u> not be reduced, during the fill period, below the total minimum prescribed.

If MFW (using MFW nozzles) is used, then the [loss of SCM setpoint] must be established within 25 minutes of loss of SCM. Achieving the [loss of SCM setpoint] in this time period assures that PCTs remain within acceptable limits.

Feeding a SG with a tube rupture only as necessary to maintain natural circulation means to feed the SG sufficiently to maintain heat transfer. The SG level does not have to be increased to the [NC setpoint] or the [loss of SCM setpoint]. When feeding only one SG, e.g., due to a SGTR, then the minimum total EFW flow should be fed to that SG.

The EFW flow must be throttled if necessary to prevent exceeding [pump runout] values. The minimum total EFW flow rates associated with 4.1.a are within these values.

If SCM exists and at least one RCP is on, then SG level should be controlled at or above the low level limit setpoint. If no RCPs are operating (i.e., no forced RCS flow) and SCM exists, then SG level should be controlled at or above the natural circulation setpoint.

The limits for manually feeding a dry SG are derived from analyses of SG stresses during initial feeding from a dry condition. Limiting the initial flow rates to these values will minimize the potential for inducing excessive stresses in the SG. However, the flow rates required by 4.1, if applicable, are necessary to ensure adequate core cooling and therefore take precedence. If EFW is automatically initiated to a dry SG, manual throttling to these values is not required since automatic initiation should occur before large tube to shell ΔTs could develop. Trickle feed using MFW should not be attempted without RCP(s) running since a level cannot be established.

The plant specific values of [loss of SCM setpoint], [minimum total EFW flow rate], [minimum Fill Rate (EFIC)], [pump runout], [low level limit setpoint], [NC setpoint] and MFW flow rate using EFW nozzles are limiting values and should be error-corrected. The maximum flow rates for feeding a dry SG are also limiting values and should be error-corrected.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
III.B.3.3, III.C.3.4, III.G.3.10,IV.C.3.0, IV.C.3.1, IV.C.3.2, IV.C.4.4.3, IV.C.4.4.4, and V.4.0.

5.0 Reactivity Control Rule

Whenever[1] an unexpected increase in neutron flux is observed with rods inserted, perform the following:

5.1 Stop any dilution activities in progress.

5.2 Initiate emergency boration until adequate SDM is established.

5.3 Stabilize RCS temperature.

NOTES

1. **One exception is the case where a rapid cooldown is being performed due to a loss of SCM with HPI unavailable. In this case, the cooldown and depressurization of the RCS is more important, and a significant return to power should not occur.**

Indicators and Controls

Indicators:
- RCS temperature (T_{cold}, incore thermocouples)
- HPI flow rate
- RCS boron concentration
- Source range instrumentation
- Reactivity balance calculation curves
- Chemical addition indications

Controls:
- HPI pump motor controls
- HPI valve controls
- Chemical addition controls

Purpose of Step

The purpose of this rule is to ensure the reactor remains shutdown throughout the performance of mitigation actions and plant cooldowns within the scope of these guidelines.

Bases

Normally, plant evolutions are slow and controlled and adequate shutdown margin is assured. However, inadvertent addition of positive reactivity can occur during plant transients, especially during cooldowns and potentially diluting events such as boiler-condenser cooling. This rule ensures continual surveillance of reactivity and quick response to terminate reactivity changes and reestablishment of adequate shutdown margin.

An unexpected increase in neutron flux is an indication of inadvertent addition of positive reactivity. Note that a highly voided RV downcomer, which can occur during a large LOCA or in ICC conditions, can also result in an increase in indicated neutron flux.

The two main causes of possible reactivity changes, boron dilution mechanisms and RCS cooling, should be terminated and sufficient boron added to restore adequate shutdown margin. A positive reactivity addition, and an increase in neutron flux, can also occur during a rapid cooldown that is required if SCM is lost with HPI not available. In this case, the cooldown must continue as directed; a significant return to power should not occur. Note that boron addition with HPI is not available.

Adequate shutdown margin can be complied with by RCS boron concentration or by boron injection as allowed by Technical Specifications.

Sequence
Rules apply whenever the reactor is shutdown and the conditions exist that invoke the rule.

TBD Volume 3 References
II.C.2.1 and V.5.0