PROCEDURE COVER SHEET

SUSQUEHANNA STEAM ELECTRIC STATION PP&L	NUCLEAR DEPARTMENT PROCEDURE RPV CONTROL	EO-100-102 Revision 6 Page 1 of 45

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Supervisor

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Functional Unit Manager

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1.0 GENERAL

RPV Control establishes and maintains reactor in safe condition through control of three key parameters:

- Reactor power by entry to EO-100-113 or ON-100-101
- RPV water level (RC/L)
- RPV pressure (RC/P)

Purpose of this procedure is to:

- Shut down reactor
- Maintain adequate core cooling
- Cool down RPV to cold shutdown conditions (RPV water temperature ≤ 200°F)

In accordance with OP-AD-001, Operations Shift Policies and Work Practices, this procedure is exited:

1. When it can be positively determined an emergency no longer exists (i.e., problem is known and under plant control), or
2. an exit/transfer condition specified in this procedure is satisfied.

2.0 ENTRY

Entry conditions for this procedure are any of following:

- RPV WATER LVL < + 13"
- RPV PRESSURE > 1037 PSIG
- DW PRESSURE > 1.72 PSIG
- EXISTING SCRAM CONDITION AND PWR > 5% OR CANNOT BE DETERMINED

Conditions which require entry into RPV Control are symptomatic of an emergency condition or conditions which, if not corrected, could degrade into an emergency. Note that although all entry conditions require a scram (or cause a trip of RPS logic), a scram by itself is not an entry condition for this procedure.

The scram/power entry condition encompasses conditions where reactor power may be unknown. Loss of electrical power to APRMs does not, by itself, necessarily mean that reactor power cannot be determined. Reactor period, steam flow, RPV pressure and pressure trend, number of SRVs open, etc., can be used to evaluate reactor power level with respect to entry condition setpoint.

In many cases, entry into RPV Control is required because of Primary Containment Control, Secondary Containment Control, or Radioactivity Release Control considerations.

Occurrence of any one of these entry conditions requires entry into procedure and concurrent execution of all flowpaths. If symptom clears and then reappears, re-entry at beginning is required. Similarly, if a second entry condition occurs while procedure is being performed, re-entry at beginning is required.

If performing EO-100-113 Level/Power Control and a RPV Control entry condition occurs or reappears, re-entry at the beginning of EO-100-113 Level/Power Control is required, since control of RPV parameters has been completely transferred to that procedure.

3.0 PROCEDURE

RC-1 IF RX SCRAM HAS NOT BEEN INITIATED

SCRAM RX

This step can be accomplished by placing the reactor mode switch to shutdown or by arming and depressing the manual scram pushbuttons.

This step specifically addresses the potential for multiple sensor and sensor relay failures in the automatic RPS logic where an automatic reactor scram should have initiated but did not. The wording of this step also requires manual initiation of a reactor scram upon entry to RPV Control when no condition exists which would have automatically initiated a reactor scram (e.g., entry directed by Primary Containment Control because of high suppression pool temperature).

(Reference: SSES-EPG RC-1)

RC-2

HAS IT BEEN DETERMINED RX WILL REMAIN S/D UNDER ALL CONDITIONS W/O BORON

Appropriate actions for continued control of reactor power, RPV water level, and RPV pressure are dependent on the shutdown condition of the reactor. If reactor shutdown margin cannot be assured for all conditions by control rod insertion alone, reactor power and RPV level and pressure control actions are continued in EO-100-113.

Positive confirmation that the reactor will remain shutdown under all conditions is best obtained by observing that all control rods are full in. Criteria other than all control rods inserted to the full-in position may also be used. These include:

- One control rod full out with all other rods full in.
- Evaluation of shutdown margin.

The phrase "... under all conditions without boron" requires that the shutdown margin determination disregard any negative reactivity contribution due to injection of sodium pentaborate solution. A borated core may <u>not</u> respond to temperature changes with a negative coefficient of reactivity. <u>Reactor shutdown margin must be based on control rod position alone</u> so that subsequent changes in boron concentration and moderator temperature do not return the core to criticality.

(References: SSES-EPG override before RC/L-2; and 1st override before C1-1)

RC-3 MONITOR AND CONTROL RC/Q RC/L AND RC/P CONCURRENTLY

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

(Reference: SSES-EPG Monitored Control step following RC-1)

RC/Q-1 GO TO SCRAM PROCEDURE

Since Scram Immediate Operator actions are already performed prior to reading this step, entry to ON-100-101, Scram, is not required. The Scram Procedure may be entered and parts performed concurrent with this procedure after it has been determined the reactor will remain shutdown under all conditions without boron, since no power control actions are required here. The scram procedure is a lower tier document and must not interfere with operator actions required by symptom based emergency procedures.

(Reference: SSES-EPG override before RC/Q-1)

RC/L - RPV LEVEL CONTROL

RPV water level control (RC/L) section of RPV Control restores and maintains RPV water level to assure adequate core cooling.

Adequate Core Cooling is heat removal from the reactor sufficient to prevent rupturing of the fuel clad.

Three viable mechanisms of adequate core cooling exist; in order of preference they are:

1. Core submergence

2. Steam cooling with injection of makeup water to the RPV with RPV pressure maintained at or above the Minimum RPV Flooding Pressure (Non-ATWS), or Minimum Alternate RPV Flooding Pressure (ATWS)

3. Steam cooling without injection of makeup water to the RPV with indicated level at or above the Minimum Zero Injection RPV Water Level (-205")

RC/L-1 ENSURE ALL:

- ISOLATIONS
- ECCS INITIATIONS
- DG'S START

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

SPDS may be used to determine Containment Isolations.

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

Diesel generator initiation assures that there is redundant source of electrical power available for RPV water level control. A loaded diesel generator must be supplied with adequate ESW flow within 4½ minutes. This limit is extended to 8 minutes if diesel generator is running unloaded. Adequate ESW flow is described in OP-054-001, Emergency Service Water System. A diesel generator running in emergency mode can only be shut down locally by depressing Emergency Shutdown push button at OC521A(B)(C)(D)(E).

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

(Reference: SSES-EPG RC/L-1)

RC/L-2 IF LVL CANNOT BE DETERMINED

GO TO RPV FLOODING

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

If RPV water level cannot be determined, the actions specified in the subsequent steps cannot be performed since RPV water level and water level trend information is required for determining which actions to take. The transition to EO-100-114, RPV Flooding, is necessary to assure continued adequate core cooling under conditions where RPV water level cannot be determined.

Off-scale RPV water level indication alone is not an indication that "RPV water level cannot be determined". The decision is made based on knowing whether or not level can be determined with respect to restoring and maintaining adequate core cooling. If level indication is believed to be erroneous or unbelievable with respect to maintaining adequate core cooling, entry to EO-100-114 may be warranted. For example, if RPV water level is observed decreasing below the range of the Wide Range instrument and then continues below the range of the Fuel Zone instrument, RPV water level can be determined with respect to adequate core cooling. Entry to RPV Flooding is not required for this example. Even though water level is well below that which provides adequate core cooling, RPV Flooding should not be entered for this condition since EO-100-102 actions provide all the instructions needed to restore adequate core cooling.

Water level can be determined above TAF, assuring adequate core cooling using the following information.

1. A level trend, either increasing or decreasing, cannot, by itself, be used to determine if the actual level is above the variable leg tap, because other factors can cause level trends even when actual level is below the variable leg tap.

2. Determination can only be made when RPV pressure, drywell temperature and reactor building temperature are relatively stable.

3. <u>Use positive action to determine that level trend is a result of injection and thus above the variable leg tap</u>. This can be accomplished by increasing and then decreasing injection flowrate and observing a corresponding increase and decrease in indicated level.

4. All water level instruments except Fuel Zone have their variable leg taps near TAF (-161.5") or above TAF (-10.5").

The range of each RPV water level instrument and the location of their variable leg tap are as follows:

Instrument	Range	Variable Tap
Narrow Range	0" to +60"	-10.5"
Wide Range	-150" to +60"	-161.5"
Extended Range	-150" to +180"	-161.5"
Upset Range	0" to +180"	-10.5"
Shutdown Range	0" to +500"	-10.5"
Fuel Zone Range	-310" to -110"	-376"

CAUTION

1 RPV WATER LVL INSTR MAY BE USED WHEN DETERMINED USABLE IAW ON-145-004

OR

IT READS WITHIN BAND (INCHES):

SHUTDOWN	50	500
UPSET	45	180
EXTENDED	-85	180
NARROW	2	60
WIDE	-125	60
FUEL ZONE	-290	-110

This caution is applicable throughout this flowpath.

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

(Reference: SSES-EPG: override before RC/L-2; 1st override before C1-1; and override before C3-1)

RC/L-3

IF PC WATER LVL AND PRESS CANNOT BE MAINTAINED WITHIN FIG 10 MPCWLL

STOP INJECTION FROM SOURCES EXTERNAL TO PC IRRESPECTIVE OF ADEQUATE CORE COOLING UNTIL PC WATER LVL AND PRESS CAN BE MAINTAINED WITHIN FIG 10 MPCWLL

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

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

If injection into the RPV or primary containment is continued and the Maximum Primary Containment Water Level Limit (MPCWLL) is exceeded, the structural integrity of the primary containment is no longer assured. See step SP/L-12 of EO-100-103 for discussion of MPCWLL.

Injection from sources outside primary containment is stopped as necessary to remain less than MPCWLL, even if adequate core cooling can not be maintained.

Therefore, when the decision between maintaining either adequate core cooling or primary containment integrity must be made in any RPV water level control EOP, primary containment integrity takes precedence in order to protect against the uncontrolled release of radioactivity.

(Reference: SSES-EPG: override before RC/L-2; and 2nd override before C1-1)

CAUTION

LOSS OF I-A CAUSES LOSS
OF NORMAL FW INJECTION

Purpose of this caution is to alert the operator of the undesirable results from failure to promptly recover from the loss of instrument air.

(Reference: SSES-EPG Caution #9)

RC/L-4 RESTORE AND MAINTAIN LVL BETWEEN +13" AND +54" USING TABLE 3 SYSTEMS

TABLE 3
SYSTEMS

- FW
- COND
- CRD MAXIMIZED AS NECESSARY
- RCIC
  WITH SUCTION FROM CST ASAP
  BYPASSING LOW PRESS ISO
  IAW ES-150-001 AS NECESSARY
- HPCI
  WITH SUCTION FROM CST ASAP
  BYPASSING SUCT SWAP
  IAW ES-152-002 AS NECESSARY
- CORE SPRAY
  MAINTAINING FLOW LESS THAN FIG 7 VL
- LPCI WITH INJECTION THROUGH HX ASAP
  MAINTAINING FLOW LESS THAN FIG 7 VL

CAUTIONS

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

2200 OPERATING HPCI OR RCIC BELOW 2200 RPM MAY RESULT IN UNSTABLE SYSTEM OPERATION AND EQUIPMENT DAMAGE

11 HPCI INJECTIONS CAUSE THERMAL SHOCK TO RPV AT FEEDWATER PENETRATIONS

This step defines the preferred range in which RPV water level should be established and maintained, and specifies the preferred systems to use in doing so. Maintaining RPV water level below the high end of the identified control band preserves the availability of steam-driven equipment (HPCI, RCIC, feedwater, etc.). Maintaining RPV water level above the low end of the identified control band permits the scram to be reset (barring the existence of other scram signals), and allows the use of the normal shutdown cooling system to establish and maintain cold shutdown conditions.

Note that this step may also be reached when a high RPV water level condition exists, recovery from the RPV flooding evolution for example. In this situation, restoring RPV water level requires that water level be lowered through appropriate throttling and stopping of the listed injection systems.

This step is purposely written to provide an operator with the flexibility to control available systems as most appropriate for existing plant conditions. As a transient progresses, the most effective modes of system operation may change. For example: all ECCS pumps may inject following a large pipe break, but a single pump may be sufficient to maintain RPV water level once it is restored within the specified range. Continued manual control and adjustment of system lineups and injection flows may thus be required in order to remain within the preferred RPV water level control band.

Included in this step is a list of motor-driven and steam-driven injection systems appropriate for controlling RPV water level. The listed systems include both those used for RPV water level control during normal plant operations at power and those categorized as emergency makeup. Since symptom-oriented procedures must address a full spectrum of initial plant conditions and postulated transients, this step does <u>not</u> unconditionally prioritize use of one system over another.

Suction for HPCI and RCIC is always to be aligned to the condensate storage tank (CST) as soon as possible, defeating automatic suction transfer logic when necessary, because this source of water is of higher quality than the suppression pool and is not subject to the temperature increase that the suppression pool is. (Temperature of the water being pumped relates to pump NPSH and component cooling requirements.) Use of auxiliary systems and lineups may be required to keep water in the CST IAW ON-037-001, Loss of Condensate Transfer.

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

Directing LPCI flow through the RHR heat exchangers as soon as possible promotes rapid removal of decay heat from the primary containment, thus minimizing suppression pool heatup and prolonging the availability of the suppression pool as a heat sink. As used in this step, the phrase "as soon as possible" means the earliest practicable time within the constraints imposed by system conditions, valve control logic, and concurrently required operator actions.

(Reference: SSES-EPG RC/L-2)

RC/L-5

IF LVL CANNOT BE RESTORED AND MAINTAINED > +13"

MAINTAIN LVL > -161" USING TABLE 3 SYSTEMS

AUGMENTING AS NECESSARY WITH TABLE 5 ALTERNATE SUBSYSTEMS

TABLE 5
ALTERNATE SUBSYSTEMS

- RHRSW X-TIE
- FIRE SYSTEM IAW ES-013-001
- UNIT 2 CRD
- ECCS KEEP-FILL
- RHR SDC SUCTION FILL
- SLC BORON TANK
- SLC DEMIN X-TIE

This determination should be made as soon as possible.

If RPV water level cannot be maintained above +13 inches, an alternate control band with a lower limit is defined. The widened RPV water level control band provides added operational flexibility while still assuring adequate core cooling through core submergence. By establishing the broadened RPV water level control band, additional time may be available to place injection systems not yet operating into service. RPV water level should be restored to and maintained within the preferred band whenever system availability makes this possible.

Any one or combination of the alternate subsystems listed in Table 5 may be lined up and placed in service to maintain water level in the widened RPV water level control band. Included are those alternate subsystems which supply water of relatively low quality and those which entail more complex injection lineups (as compared to the preferred systems discussed previously).

Table 5 alternate subsystems are not required to be started but are provided here as an option. If Table 5 alternate subsystems are already being used because of a re-entry to RC/L section, their continued use is authorized.

(Reference: SSES-EPG RC/L-2)

RC/L-6 CAN LVL BE MAINTAINED > -161"

This step tests the success of the previous step and gives adequate time to allow actions to be initiated without RPV water level decreasing below -161" (TAF).

The determination that RPV level can or cannot be maintained above -161 inches must be made as soon as possible, so that subsequent actions can be performed in a timely manner.

(Reference: SSES-EPG RC/L-2)

RC/L-7 IF LVL CANNOT BE MAINTAINED > -161"

GO TO RC/L-11

This step is applicable to all subsequent steps within this flowpath.

Conditions may change causing level to drop again. If level cannot be maintained above TAF (-161"), it is appropriate to restore level by entering at step RC/L-11.

(Reference: SSES-EPG RC/L-2)

RC/L-8 IF ADS TIMER INITIATES

INHIBIT ADS

This step is applicable to all subsequent steps within this flowpath.

ADS actuation imposes a severe pressure and temperature transient on RPV and complicates efforts to restore and maintain RPV water level specified in RC/L. In certain cases ADS actuation may directly lead to loss of adequate core cooling and subsequent core damage which could otherwise have been avoided. Further, conditions assumed in design of ADS actuation logic (e.g., no operator action for 10 minutes) do not exist when carrying out actions specified in RC/L. Finally, operators have access to much more information than is available to ADS logic and can better judge when and how to depressurize the RPV to minimize transient loads and optimize adequate core cooling. For all these reasons, it is appropriate to prevent automatic initiation of ADS at this point.

Instructions for inhibiting ADS are located in OP-183-001.

(Reference: SSES-EPG RC/L-2)

RC/L-9 IF LVL > -129"

RESET MAIN GEN LOCKOUTS

Generator lockout combined with a LOCA signal from core spray logic (high drywell 1.72 psig or low level -129 inches) does not require low RPV pressure qualifier and will cause auxiliary bus load shed of such loads as: condensate pumps, service water pumps, circ water pumps, aux boilers and turbine building heating load centers. Implicit in this scheme is the assumption that a LOCA occurs followed by a unit trip which results in the need to shed loads to increase the available plant voltage.

The need for auxiliary bus load shed is when ECCS pumps are starting to provide adequate core cooling. It is important that generator lockouts <u>not</u> be reset when RPV level and pressure are decaying rapidly as would be the case if a LOCA were occurring.

(Reference: SSES-EPG RC/L-2)

RC/L-10 WHEN GO-100-005 IS ENTERED FROM RC/P-13

GO TO PLANT SHUTDOWN

Level will be above +13 inches and pressure below 98 psig before shutdown cooling interlocks clear. This procedure is exited from level and pressure control together when these conditions are met or when it is determined that an emergency no longer exists for these parameters.

(Reference: SSES-EPG RC/L-3)

RC/L-11 IF WATER LVL INCREASING

GO TO RC/L-1

This step is applicable to all subsequent steps within this flowpath.

This awareness step is important because all subsequent steps are based on RPV level decreasing.

If while performing subsequent steps RPV level trend is reversed, even when level is below TAF (-161"), return to step RC/L-1 is required.

If while performing subsequent steps, rapid depressurization is required at the same time as level begins to increase this step may be used to avoid the requirement of Rapid Depressurization. An example of this is HPCI becomes available while waiting for Steam Cooling and level trend is reversed, return to step RC/L-1 is required.

(Reference: SSES-EPG 1st override before C1-1)

RC/L-12 INHIBIT ADS

When it has been determined that level cannot be maintained above -161" and level is decreasing, it is appropriate to inhibit ADS.

ADS actuation imposes a severe pressure and temperature transient on RPV and complicates efforts to restore and maintain RPV water level. In certain cases ADS actuation may directly lead to loss of adequate core cooling and subsequent core damage which could otherwise have been avoided. Further, conditions assumed in design of ADS actuation logic (e.g. no operator action for 10 minutes) do not exist when carrying out actions specified in this procedure. Finally operators have access to much more information than is available to the ADS logic and can better judge, when and how to depressurize RPV to minimize transient loads on RPV and optimize adequate core cooling. For all these reasons, it is appropriate to prevent automatic initiation of ADS.

Instructions for inhibiting ADS are located in OP-183-001.

(Reference: SSES-EPG 1st override before C1-1)

RC/L-13

IRRESPECTIVE OF VORTEX LIMITS
WITH 2 OR MORE
TABLE 4 SUBSYSTEMS
PERFORM ALL:

1 LINE UP FOR INJECTION
2 START PUMPS
3 INCREASE INJECTION TO MAX

TABLE 4
SUBSYSTEMS

- COND
- LPCI LOOP A WITH INJECTION THROUGH HX ASAP
- LPCI LOOP B WITH INJECTION THROUGH HX ASAP
- CORE SPRAY LOOP A
- CORE SPRAY LOOP B

Purpose of lining up and starting pumps in Subsystems is to provide assurance that water will be injected into RPV during and following a blowdown from high pressure. At least two subsystems are required in this step to accommodate the possibility that one subsystem may not operate properly or that a break may exist in injection flowpath of one subsystem.

Subsystems are defined by physical separation of components, flowpaths, and injection points. A subsystem is a motor-driven system loop with any one pump running which is independently capable of supplying makeup water to RPV following a blowdown. For the Core Spray System only one pump is required for the definition of Table 4 Subsystem.

Steam driven systems are not classified as subsystems because they may not be available following a blowdown.

The undesirable consequences of uncovering the reactor core outweigh the risk of equipment damage which could result if Vortex limits are exceeded. In addition, immediate and catastrophic pump failure is not expected should operation beyond these limits be required; at most, degraded system or pump performance may result from prolonged operation under these conditions.

(Reference: SSES-EPG C1-2)

RC/L-14

IF LESS THAN 2
TABLE 4 SUBSYSTEMS CAN BE LINED UP

COMMENCE LINING UP AS MANY AS POSSIBLE
TABLE 5 ALTERNATE SUBSYSTEMS

TABLE 5
ALTERNATE SUBSYSTEMS

- RHRSW X-TIE
- FIRE SYSTEM IAW ES-013-001
- UNIT 2 CRD
- ECCS KEEP-FILL
- RHR SDC SUCTION FILL
- SLC BORON TANK
- SLC DEMIN X-TIE

If less than two Subsystems listed in Table 4 can be lined up, Alternate Subsystems must be lined up to assure water will be injected into RPV following a blowdown. If at least two Subsystems can be lined up with pumps running, time is better spent endeavoring to establish or increase high pressure injection than to establish alternate lineups.

Included in Alternate Subsystems are those systems and system interconnections capable of injecting water into RPV but not normally utilized for this purpose because of low water quality or relative difficulty of establishing injection lineup.

This step directs "commence lining up" Alternate Subsystems. Lineup need not be completed before proceeding to subsequent steps.

Use of Unit 2 CRD to augment Unit 1 alternate subsystems should be considered only if it does not jeopardize the safety of Unit 2.

Instructions for aligning systems for alternate injection alignments are given in the following procedures:

- RHRSW Cross-Tie
  OP-116-001 RHR Service Water System

- Fire System
  ES-013-001 Fire Protection System Cross-Tie to RHRSW

- Unit 2 CRD
  OP-255-001 Control Rod Drive Hydraulic System
- RHR Keep-Fill
  OP-149-001 RHR System
- Core Spray Keep-Fill
  OP-151-001 Core Spray System
- RHR SDC Suction Fill
  OP-149-002 RHR Operation in Shutdown Cooling Mode
- SLC Boron Tank
  OP-153-001 Standby Liquid Control System
- SLC Demin Cross-Tie
  OP-153-001 Standby Liquid Control System

(Reference: SSES-EPG C1-2)

RC/L-15 IS RPV PRESS ABOVE OR BELOW 125 PSIG

This question determines the applicability of subsequent steps.

125 psig is the highest RPV pressure at which the shutoff head of a low-water-quality alternate subsystem (excluding SLC) is reached.

(Reference: SSES-EPG: C1-3 and C1-4)

RC/L-16

IF RPV PRESS DROPS
< 125 PSIG

GO TO RC/L-24

This step is applicable to all subsequent steps within this flowpath.

While performing the following steps, RPV pressure may drop below 125 psig. Appropriate actions to control RPV level below this pressure are specified at step RC/L-24.

(Reference: SSES-EPG override before C1-3.1)

RC/L-17

IS ANY TABLE 4 SUBSYSTEM LINED UP WITH ITS PUMP RUNNING

With water level decreasing it must be assured that at least one motor-driven pump from a Table 4 Subsystem is running and lined up for injection prior to rapidly depressurizing.

This question allows bypassing the use of low-water-quality alternate subsystems when any subsystem is lined up with its pump running.

(Reference: SSES-EPG C1-3.1)

RC/L-18

START ALL PUMPS IN
TABLE 5 ALTERNATE SUBSYSTEMS
WHICH ARE LINED UP

If RPV water level is decreasing and <u>no</u> Table 4 Subsystem is operating, injection from Table 5 Alternate Subsystems is required to reverse RPV water level trend. Although Alternate Subsystem pumps are started in this step, injection into RPV will occur only when RPV is depressurized to below shutoff head of operating subsystems. All Alternate Subsystems pumps which are lined up are started to maximize potential rate of injection if unable to start other systems or subsystems and should depressurization ultimately be required.

(Reference: SSES-EPG C1-3.1)

RC/L-19 WHEN LVL DROPS TO -161"

CONTINUE

If the decreasing RPV water level trend has not been reversed, when RPV level drops to -161" (TAF), continue in this procedure.

(Reference: SSES-EPG C1-3.2)

RC/L-20 IS ANY INJECTION SOURCE LINED UP FOR INJECTION WITH ITS PUMP RUNNING

This step is applicable to all subsequent steps within this flow path.

This step tests success of starting a pump in a System, Subsystem or Alternate Subsystem. This step also recognizes time required to lineup Alternate Injection flowpaths. If no pump is running, direction is to establish Steam Cooling because <u>no source of makeup water is available</u>. If a pump is running and available to inject, Rapid Depressurization is required in order to maximize injection flow rate from that pump.

If water level trend is reversed, such as HPCI becomes available and injects, then override step RC/L-11 returns control to RC/L-1.

(Reference: SSES-EPG C1-3.2; and override before C3-1)

RC/L-21 RAPID DEPRESS IS REQ'D

If the decreasing RPV water level trend has not been reversed before RPV water level drops to -161" (TAF), and if at least one source of injection into the RPV is available, Rapid Depressurization is performed to maximize the injection flowrate from operating sources of injection.

The action to depressurize the RPV remains appropriate even if a steam-driven pump is the only source of injection to the RPV. For example: if HPCI is in operation, the steam demand of the HPCI turbine alone will depressurize the RPV to below the low RPV pressure automatic isolation setpoint of the system irrespective of the Rapid Depressurization being conducted.

If RCIC is in operation, the low RPV pressure automatic isolation of the system may be defeated IAW Table 3 since some measure of system performance may be achieved down to the RPV pressure corresponding to the turbine stall pressure.

Rapid Depressurization is not initiated until RPV water level has dropped to -161" (TAF) because:

- Adequate core cooling exists so long as RPV water level remains above -161" (TAF).
- The time required for RPV water level to decrease to -161" (TAF) can best be used to line up and start pumps, attempting to reverse the decreasing RPV water level trend before Rapid Depressurization is required to assure continued adequate core cooling.

(Reference: SSES-EPG C1-3.2)

RC/L-22

EXIT RC/P
AND
CONTROL PRESS ONLY AS FOLLOWS

If the decreasing RPV water level trend has not been reversed before RPV water level drops to -161" (TAF) and no source of injection into the RPV is available, the only mechanism able to provide adequate core cooling is Steam Cooling.

When these conditions are met, normal pressure control (RC/P) of this procedure is exited and pressure is controlled only per the following step.

Exit from pressure control will ensure that awareness steps in the pressure leg will not be used.

(Reference: SSES-EPG: C1-3.2; and 1st override before RC/P-2)

RC/L-23

WHEN RAPID DEPRESS REQ'D FOR REASONS OTHER THAN LVL
OR
LVL DROPS TO -205"

GO TO RAPID DEPRESS

Steam cooling is applicable when all the following conditions exist:

- Rapid Depressurization is not required for reasons other than RPV water level
- Entry to Level/Power Control is not required.
- Entry to RPV Flooding is not required.
- RPV level is decreasing and cannot be maintained above -161" (TAF).
- RPV pressure is above 125 psig.
- No system, subsystem or alternate subsystem is lined up to RPV with at least one pump running.

RPV level of -205 inches is the <u>minimum zero-injection RPV water level</u> and is defined to be the lowest RPV water level at which the covered portion of the reactor core will generate sufficient steam to preclude clad temperature in the uncovered portion of the core from exceeding 1800°F. This water level is utilized to preclude significant fuel damage and hydrogen generation for as long as possible.

The minimum zero-injection RPV water level is determined assuming:

1. Ten minute decay heat from rated power.
2. Top peaked power profile.
3. Zero injection flow.

The success of Steam Cooling is dependent on a large differential temperature between the fuel above water level and the steam passing upward. For this reason level should be allowed to decrease to -205 inches before the RPV is rapidly depressurized. This will allow the fuel above the water level to heat up enough to provide the necessary differential temperature, and still provide the required coolant inventory for steam cooling during depressurization (blowdown). The success of Steam Cooling is also dependent on the coolant in the core remaining at saturation temperature (not subcooled). For this reason Steam Cooling should not be used if there is any injection flow even if the flow is too low to recover level.

Direct entry into EO-100-112 is required here since RC/L-22 directed exiting the pressure leg, RC/P.

(Reference: SSES-EPG; override before C3-1; C3-1)

RC/L-24

IRRESPECTIVE OF VORTEX LIMITS WITH ALL
TABLE 3 SYSTEMS AND TABLE 4 SUBSYSTEMS
PERFORM ALL:

1 LINE UP FOR INJECTION
2 START PUMPS
3 INCREASE INJECTION TO MAX

Action taken in this step assures that all available injection systems and subsystems are operating (this includes the CRD System and all available steam-driven pumps). System operation is not restricted by pump Vortex limits since prompt injection of makeup water into the RPV to mitigate inadequate core cooling concerns takes precedence over adherence to precautionary limits on equipment operation.

(Reference: SSES-EPG C1-4.1)

RC/L-25

WHEN LVL DROPS TO -161"

RAPID DEPRESS IS REQ'D

If RPV pressure is below 125 psig and decreasing RPV water level trend is not reversed before RPV water level drops to -161" (TAF), RPV is depressurized to maximize flowrate from operating pumps.

(Reference: SSES-EPG C1-4.2)

RC/L-26

WITH ALL
TABLE 5 ALTERNATE SUBSYSTEMS
PERFORM ALL:

1 LINE UP FOR INJECTION
2 START PUMPS
3 INCREASE INJECTION TO MAX

If depressurization does not reverse the level trend then use of Low-water-quality Alternate Subsystem is required.

(Reference: SSES-EPG C1-4.2)

RC/L-27 WHEN LVL CANNOT BE RESTORED AND MAINTAINED > -161"

GO TO PC FLOODING

If the decreasing RPV water level trend has not been reversed and RPV Level is below TAF (-161"), as a measure of last resort, when all attempts to submerge the core through RPV injection prove unsuccessful, submergence of the core is achieved through primary containment flooding.

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

The additional contribution from the CSTs (and RWST if cross-tied) is insignificant compared to the volume required to fill primary containment to TAF. On the down side, while flooding primary containment, RPV and primary containment venting are required when water level reaches 58 ft. Therefore, there is no minimum time limit specified for making the decision to enter Primary Containment Flooding.

The RPV volume is 60,000 gallons from the RPV bottom head to top of active fuel. Alternate injection subsystems (Refer to Table 5) may have become available if rapid depressurization took place at TAF. Depending on which systems are presently injecting or expected to become available, the time to recover level to TAF will vary. As a general guideline, if injection systems are injecting long enough to inject 60,000 gallons and level is still not above TAF or trending up, it would be appropriate to make the transfer to Primary Containment Flooding.

(Reference: SSES-EPG C1-4.2)

RC/P-1 IF ADEQUATE CORE COOLING IS ASSURED

BEFORE DEPRESSURIZING < 600 PSIG

PREVENT UNCONTROLLED COND INJECTION

This step is applicable as long as it does not conflict with restoring or assuring adequate core cooling. If the RPV is depressurized to less than 600 psig without preventing uncontrolled condensate injection, then an uncontrolled flood of the RPV will take place as condensate water injects through the feed pumps into the reactor.

(Reference: SSES-EPG RC/P)

RC/P-2 IF ADEQUATE CORE COOLING IS ASSURED
<u>AND</u>
HI DW PRESS ECCS INITIATION
SIGNAL 1.72 PSIG EXISTS

BEFORE DEPRESSURIZING < 400 PSIG

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

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

Low pressure ECCS initiate automatically on a high drywell pressure signal in conjunction with < 436 psig RPV pressure and begin to inject when RPV pressure decreases below the shutoff head of the pumps. If injection from these pumps is <u>not</u> required to assure adequate core cooling, overriding them is appropriate since uncontrolled injection only complicates actions to maintain control of RPV water level.

This step does not require preventing injection when ECCS pumps start on RPV low level.

The term "prevent" permits securing pumps to preclude injection. The subsequent use of these systems is <u>not</u> prohibited by this override statement when plant conditions change such that system operation is required to assure adequate core cooling.

(Reference: SSES-EPG override before RC/P-1)

RC/P-3 IF RAPID DEPRESS IS ANTICIPATED

OPEN ALL BPV'S

CAUTION

100 COOLDOWN > 100°F/HR MAY BE REQ'D TO ACCOMPLISH THIS STEP.

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

If it appears that rapid depressurization may soon be required, it is appropriate to discharge as much energy as possible as quickly as possible from the RPV to a heat sink other than the suppression pool. Such action will preserve, for as long as possible, the heat capacity of the suppression pool should rapid depressurization actually become required. For this reason the main turbine bypass valves are the preferred method of depressurization.

Caution 100 is identified at this step to authorize exceeding the technical specification cooldown rate LCO. Cooling down at an accelerated rate is appropriate in order to avoid the need for Rapid Depressurization.

(Reference: SSES-EPG override before RC/P-1)

RC/P-4

IF RAPID DEPRESS IS REQ'D
AND
< 6 SRV'S ARE OPEN

GO TO RAPID DEPRESS

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

The consequences of not depressurizing the RPV under conditions requiring rapid RPV depressurization could include a loss of adequate core cooling or failure of primary containment. Actions to rapidly depressurize the RPV, therefore, take precedence over the actions specified in the RPV pressure control section of this procedure.

If six (6) SRVs are open, depressurization of the RPV is underway or already accomplished and EO-100-112 need not be entered.

Should more than one EOP step state that Rapid Depressurization is required, implementation of EO-100-112 more than once will be avoided by this step.

(Reference: SSES-EPG override before RC/P-1)

RC/P-5 IF ANY SRV IS CYCLING

MANUALLY OPEN SRV'S
UNTIL PRESS DROPS TO 935 PSIG

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

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

SRV cycling is terminated by manual action to reduce RPV pressure to substantially below 1076 psig (the lowest SRV lifting setpoint).

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

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

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

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

(Reference: SSES-EPG RC/P-1)

RC/P-6 IF SUPP POOL TEMP BELOW FIG 2 HCTL
AND
SUPP POOL TEMP CANNOT BE MAINTAINED BELOW FIG 2 HCTL

MAINTAIN RPV PRESS BELOW LIMIT

CAUTION

100 COOLDOWN > 100°F/HR MAY BE REQUIRED TO ACCOMPLISH THIS STEP

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

If suppression pool temperature cannot be maintained below Heat Capacity Temperature Limit (HCTL) the ability of the suppression pool to absorb all the energy from RPV blowdown may not be within the capacity of the primary containment system. Refer to step SP/T-4 in EO-100-103 for discussion of HCTL.

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

Control of suppression pool temperature is directed in the SP/T flowpath of EO-100-103. If the actions currently being taken in EO-100-103 to limit suppression pool temperature increase are inadequate and suppression pool temperature is less than HCTL, RPV pressure must be reduced in order to <u>remain</u> less than HCTL. Therefore, actions in this flowpath must accommodate these requirements. Failure to do so may lead to failure of containment or loss of equipment necessary for the safe shutdown of the plant. Once the HCTL is exceeded RPV pressure relief is not allowed unless it is external to the primary containment because RPV pressure reduction using SRV's would only worsen the situation.

Caution 100 is identified at this step to authorize exceeding the technical specification cooldown rate LCO. Cooling down at an accelerated rate is appropriate in order to avoid the need for Rapid Depressurization.

(Reference: SSES-EPG 1st override before RC/P-2)

RC/P-7

IF SUPP POOL LVL CANNOT BE MAINTAINED BELOW FIG 9 SRVTPLL

MAINTAIN RPV PRESS BELOW LIMIT

CAUTION

100 COOLDOWN > 100°F/HR MAY BE REQUIRED TO ACCOMPLISH THIS STEP

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

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

If suppression pool level cannot be maintained below the SRV Tail Pipe Level Limit (SRVTPLL) SRV system damage and containment failure may occur when SRV's are used. Refer to step SP/L-16 in EO-100-103 for discussion of SRVTPLL.

Control of suppression pool level is directed in the SP/L flowpath of EO-100-103. If the actions currently being taken in EO-100-103 to limit suppression pool level increase are inadequate, RPV pressure must be reduced in order to remain below SRVTPLL. Therefore, actions in this flowpath must accommodate these requirements.

Caution 100 is identified at this step to authorize exceeding the technical specification cooldown rate LCO. Cooling down at an accelerated rate is appropriate in order to avoid the need for Rapid Depressurization.

(Reference: SSES-EPG 1st override before RC/P-2)

RC/P-8 STABILIZE PRESS < 1037 PSIG USING BPV'S

AUGMENTING PRESS CONTROL WITH ANY:

- SRV'S USING OPENING SEQUENCE A, B, C, D, E

  IF SUPP POOL LVL < 5'
  OR
  CONTINUOUS GAS SUPPLIES UNAVAILABLE
  PLACE ALL SRV'S IN AUTO

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

CAUTIONS

11 HPCI INJECTIONS CAUSE THERMAL SHOCK TO RPV AT FEEDWATER PENETRATIONS

2200 OPERATING HPCI OR RCIC BELOW 2200 RPM MAY RESULT IN UNSTABLE SYSTEM OPERATION AND EQUIPMENT DAMAGE

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

This step specifies the desired RPV pressure control band (below the high RPV pressure scram setpoint) and the preferred system (the main turbine bypass valves) to use when controlling RPV pressure in this band. Controlling RPV pressure below this value avoids SRVs lifting due to a high pressure, and allows the scram logic to be reset (provided no other scram signal exists). Note that no low end of a pressure control range is specified, thereby permitting RPV pressure to be reduced to below the shutoff head of low pressure pumps, as long as the Technical Specification cooldown limit of 100°F/hr is not exceeded.

Cooling down at greater than 100°F/hr in order to get injection of low pressure pumps is not permitted because this would invalidate steps in RC/L leg that wait until level decreases to specific values before requiring Rapid Depressurization. Waiting to depressurize until required to enter EO-100-112, requires less inventory because a slow cooldown removes latent heat but also must remove decay heat that continues adding energy during cooldown.

Use of the main turbine bypass valves is preferred because RPV pressure can be closely controlled, and because discharging heat energy from the reactor to the main condenser preserves the heat capacity of the suppression pool. The direction in this step to use the main turbine bypass valves for RPV pressure control implies that re-establishing the main condenser as a heat sink is appropriate if it is available but not currently in service. However, no authorization is given in this step to override or otherwise defeat any MSIV isolation interlocks.

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

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

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

Total loss of the continuous pneumatic supplies to the SRVs limits the number of times that an SRV can be cycled manually since pneumatic pressure is required for this mode of valve operation. Even though the SRV accumulators contain a reserve pneumatic supply, leakage through in-line valves, fittings and actuators may deplete the reserve capacity. Thus, subsequent to the total loss of the continuous SRV pneumatic supplies, including ADS bottle headers, there is no assurance as to the number of SRV operating cycles remaining. For these reasons, if all the continuous SRV pneumatic supplies are/or become unavailable, the valves should not be opened manually to limit the number of cycles on the valves and <u>conserve pneumatic pressure so that, if Rapid Depressurization is subsequently required, the valves will be available for this purpose</u>. If other pressure control systems are <u>not</u> capable of maintaining RPV pressure below the lowest SRV lifting pressure, SRVs will still open when the lifting pressure is reached.

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

The suction paths for HPCI and RCIC are preferentially lined up to the condensate storage tank for the reasons discussed in Step RC/L-4.

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

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

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

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

- BPVs
  OP-193-001 Main Turbine Operation
- SRVs
  OP-183-001 Automatic Depressurization System and Safety Relief Valves
- HPCI
  OP-152-001 HPCI System
- RCIC
  OP-150-001 RCIC System
- SJAE
  OP-172-001 SJAE and Off Gas System
- Reactor Feed Pump Turbine
  OP-145-001 RFP and RFP Lube Oil System
- Steam Seal Evaporator
  OP-192-001 Seal Steam System
- Main Steam Line Drains
  OP-184-001 Main Steam System

(Reference: SSES-EPG RC/P-2)

RC/P-9 DEPRESSURIZE AT < 100°F/HR

This step requires that a cooldown be started and the Technical Specification cooldown rate be observed.

Observing the Technical Specification cooldown rate will prevent excessive RPV thermal stresses.

Depressurization of RPV has the following benefits:

1. Reduces the rate of drywell heating by heat transfer from the RPV. The heat transfer rate between the RPV and the drywell is a function of the differential temperature between RPV and the drywell.

2. Places the plant in a condition where low pressure injection can be more quickly accomplished should high pressure systems fail or become unavailable.

3. Reduces the rate of steam leaks in the drywell and reduces the energy of the steam that is leaking, thus reducing the rate of drywell temperature and pressure increase.

4. Places the RPV in a lower energy state such that the probability and affects of an RPV system breach (LOCA) are reduced.

For these reasons, especially during a Station Black Out, RPV depressurization is required.

Depressurization of RPV has the following detriment:

1. When no source of injection is available and RPV level is below -161" (TAF), the option to prolong core cooling while efforts are made to restore any injection source, depends on Steam Cooling. For this reason the pressure leg of RPV control is exited when Steam Cooling is required.

(Reference: SSES-EPG RC/P-3)

RC/P-10

IF SRV'S ARE BEING USED TO DEPRESSURIZE
AND
CONTINUOUS GAS SUPPLIES UNAVAILABLE

USE SUSTAINED SRV OPENING

Sustained SRV opening, instead of permitting the valves to cycle, conserves accumulator pressure when the source of pressure to the SRV pneumatic supply is isolated or otherwise out of service. Such action to reduce the number of cycles on the SRVs prolongs SRV availability should more degraded plant conditions later require SRVs to be opened for rapid depressurization of the RPV. However, the SRVs are operated so that the cooldown rate LCO is not exceeded unless authorized by Caution #100 in other steps which control pressure.

The term "continuous" encompasses any backup or alternate means of pressurizing the SRV pneumatic supply system in addition to the permanent (e.g., normal) SRV pneumatic source.

SRV use is authorized by other steps in this procedure which give the allowable cooldown rate.

The intent of this step is to remind the operator to conserve the limited gas supply provided by the local SRV accumulators in the event that gas supply external to the containment are lost.

(Reference: SSES-EPG RC/P-3)

RC/P-11 WHEN S/D COOLING INTERLOCK CLEARS

PLACE S/D COOLING IN SERVICE
USING ONLY THOSE RHR PUMPS NOT
REQ'D TO MAINTAIN LVL > +13"
IN LPCI MODE

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

Instructions for placing shutdown cooling in service are given in OP-149-002, RHR Operation In Shutdown Cooling Mode.

(Reference: SSES-EPG RC/P-4)

RC/P-12 IF S/D COOLING CANNOT BE PLACED IN SERVICE
AND
FURTHER COOLDOWN REQ'D

CONTINUE TO COOL DOWN WITH SYSTEMS
USED FOR DEPRESS

If shutdown cooling cannot be established, continued RPV depressurization and cooldown may be accomplished using any combination of the systems listed in Step RC/P-8. As RPV pressure and temperature decrease, it may be necessary to re-evaluate the most appropriate method for continuing to achieve further pressure and temperature reduction. Under certain conditions RPV pressure may be reduced to zero and temperature to below 212°F without employing shutdown cooling.

(Reference: SSES-EPG RC/P-4)

RC/P-13 GO TO PLANT SHUTDOWN

When shutdown cooling has been placed in service, or other methods of cooldown have been employed, exit from the RPV pressure control section of the RPV Control Guideline is permitted. GO-100-005 provides appropriate instructions for continued control of RPV pressure while proceeding to cold shutdown conditions.

(Reference: SSES-EPG RC/P-5)

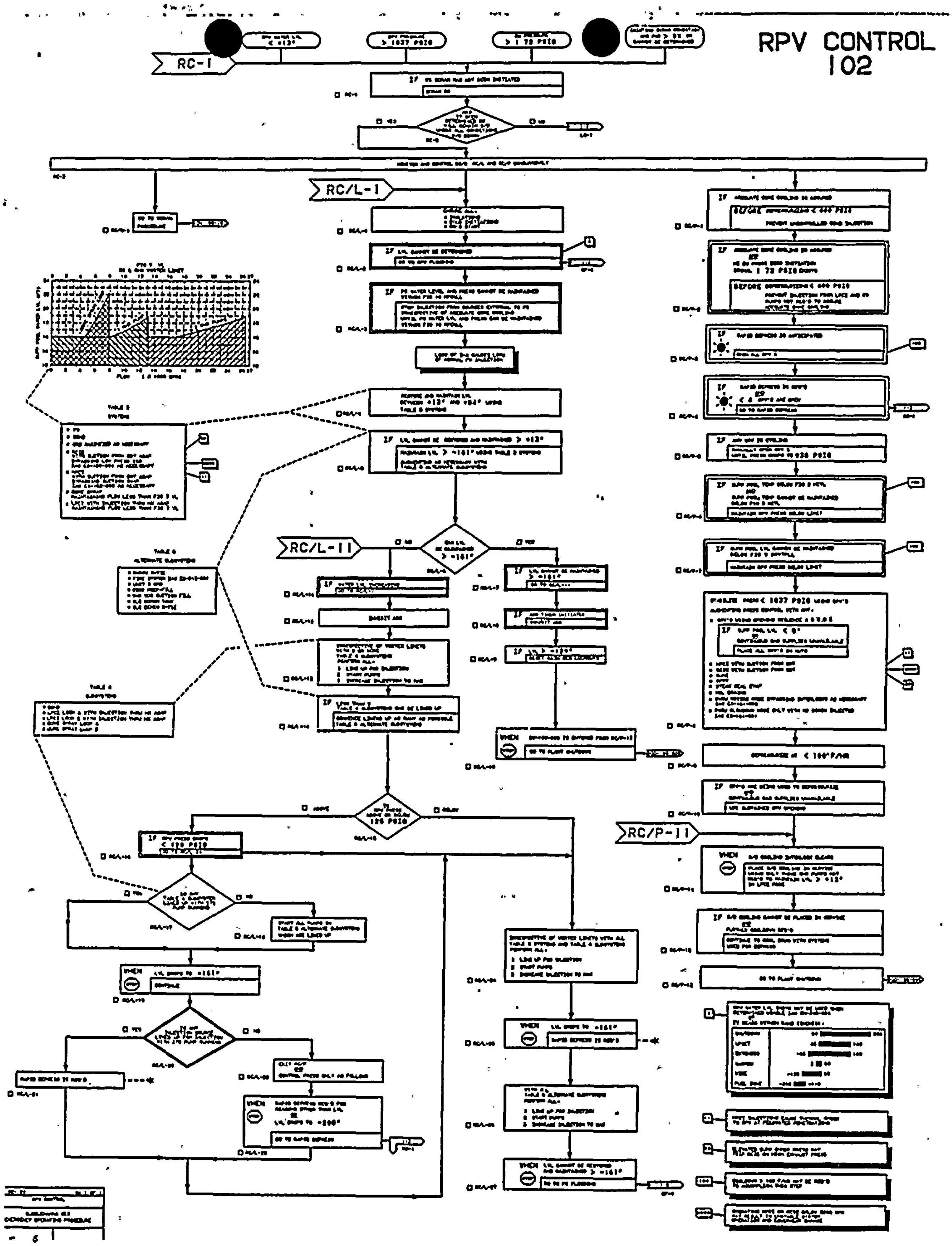
4.0 REFERENCES

4.1 Memo PLI-50339, C. Kukielka to B.R. Stitt, "Operation of the Diesel Generators Without ESW Flow", May 13, 1987

4.2 Safety Evaluation NL-92-023

4.3 SSES-EPG

RPV CONTROL 102



ENCLOSURE 2

SAFETY EVALUATION # 94-010

READ "INSTRUCTIONS FOR COMPLETING NDAP-QA-0726-1"
BEFORE ANSWERING EACH QUESTION

I. System/Procedure/Experiment Identification. (Name and Number)

SYSTEMS:

System 036, Fuel Pool
System 036C, Cask Storage Pit
System 035, Fuel Pool Cooling

PROCEDURES:

ON-135/235-001, "LOSS OF FUEL POOL COOLING/COOLANT INVENTORY"

OP-135/235-001, "FUEL POOL COOLING AND CLEANUP SYSTEM"

GO-100/200-006, "COLD SHUTDOWN, DEFUELED AND REFUELING"

NDAP-00-612, "OUTAGE SCOPE AND SCHEDULE DEVELOPMENT AND CONTROL"

NDAP-00-0613, "OUTAGE IMPLEMENTATION AND ASSESSMENT"

POLICY LETTER 1-88, "SHIPPING CASK STORAGE PIT GATES AND SHIELD BLOCKS"

TEAM MANUAL RULES 2.7 AND 2.8

FSAR SECTIONS 9.1.2.2, 9.1.2.3, 9.1.4.2.10.2, 9.1.4.2.10.3

II. Description and Implications of Proposed Action.

A. Fully Describe the Action and its Purpose.

Currently, the cask storage pit gates are maintained installed isolating the SSES Unit 1 and 2 fuel pools during all but refueling outage periods. This evaluation addresses the acceptability of maintaining the SSES fuel pools crosstied through the cask storage pit during nonrefueling and refueling outage periods.

Safety Evaluation NL-88-006 similarly addressed operation of the fuel pools with the cask pit gates out. NL-88-006 has been used as the basis to maintain the fuel pools crosstied during refueling outage periods. It found that operation with the cask storage pit gates removed has been analyzed and found to be completely enveloped by events previously discussed in the FSAR. No unanalyzed safety concerns have been identified....". This safety evaluation supersedes the NL-88-006 evaluation.

Implementation of crosstied pools requires changes to the above listed documents to fully describe operation of the fuel pools in this configuration and to administratively control this crosstied pool configuration.

This evaluation does not preclude the installation of the gates for specific plant evolutions such as transfer of fuel into fuel casks for storage. Operation with the gates installed, and thus fuel pools isolated, is the original plant design. It is intended for each evolution which requires installation of the cask pit gates that the installation of the gates will be procedurally controlled and limited in duration.

Maintaining the fuel pools crosstied through the cask storage pit is desirable for the following two reasons:

1. Time to boil in a loss of fuel pool cooling event is increased for the pool with the highest heat load. This provides additional time to take actions to reestablish pool cooling and prevent pool boiling.

2. With the pools crosstied, either unit's cooling systems (fuel pool cooling and RHR fuel pool cooling mode) can be used to cool both pools. This doubles the number of systems that could be used to prevent pool boiling. Prevention of pool boiling eliminates a potential challenge to SGTS. Also, it has been determined in EC-035-1004 for the crosstied fuel pool configuration, that both reactors and the crosstied pools can be cooled

following a safe shutdown earthquake and a credible independent single failure.

B. **Identify all the components that will be affected.**

The fuel pools, the cask storage pit, the cask storage pit gates, and the piping connected to the cask storage pit will be affected and thus are addressed herein.

The spent fuel stored in the fuel pools will not be adversely affected by a draindown event as long as the water level is above the fuel. Operation of the fuel pool cooling system or RHR fuel pool cooling mode will not be affected as long as adequate pool level is maintained to support their operation.

C. **List Safety Functions of affected components.**

The cask storage pit does not meet, nor does it have to meet, all the requirements applicable to the fuel pools since fuel is not stored in the cask storage pit. However, the crosstied pool configuration must not invalidate conformance to the requirements and design features of the fuel pools when crosstied to the cask storage pit.

The affected systems are considered in the SSES Safety Evaluation Report (NUREG 0776) to be auxiliary systems which are necessary to assure safe handling of fuel and adequate cooling of the spent fuel.

The relevant safe fuel handling function potentially affected by the change is the ability to maintain the minimum acceptable pool water inventory. The relevant design features and requirements are discussed. The crosstied pool configuration will be assessed and compared to the applicable design features of the fuel pools.

The SSES FSAR states that the fuel handling facility complies with Regulatory Guide 1.13 revision 1. The design basis defined in the regulatory guide details the acceptable means by which GDC 61 can be implemented. FSAR Section 3.13 and 9.1 delineate the SSES design features.

The important features per the regulatory guide are those that:

1. Prevent loss of water from the fuel pool that would uncover fuel.

2. Protect fuel from mechanical damage.
3. Provide capability for limiting the potential offsite dose exposures in the event of significant release of radioactivity from the fuel.

The regulatory positions delineated in the regulatory guide which are applicable to this evaluation of the maintenance of the minimum acceptable pool water inventory when in the crosstied pool configuration are:

1. The spent fuel pool facility should be designed to category I seismic requirements.
2. One of the following provisions for handling heavy loads:

    a. Cranes should be prevented by design or interlock from moving in the vicinity of the fuel pools.
    b. The fuel pool should be designed to withstand, without leakage that could uncover the fuel, the impact of the heaviest load carried by the crane.
3. Drains, permanently connected mechanical or hydraulic systems that by maloperation or failure could cause loss of coolant that would uncover the fuel should not be installed or included in the design. Systems for maintaining water quantity should be designed so that maloperation or failure (from a postulated SSE) will not cause fuel to be uncovered.

The FSAR section 9.1.2 identifies compliance to these requirements for the fuel pools as described below.

1. The pools and all gates are designed to seismic category I requirements. This is accomplished by design of the fuel pool boundary which includes the fuel pool walls and connected piping to the first isolation valve to seismic category I requirements. These seismic boundary valves are manual valves.
2. Accidental droppage of heavy objects into the fuel pools is precluded by administrative procedures and electrical interlocks to limit reactor building crane travel over the pools.
3. The fuel pools are formed by concrete walls which are lined with stainless steel to minimize leakage and to reduce corrosion product formation. The pools are designed so that they cannot be drained to a level that uncovers the top of the fuel. This is accomplished by not locating any piping connections through the bottom of the pools. Anti-

siphon devices are provided to preclude these lines from siphoning the pools. A leak collection and detection system is provided for the pool liner.

The SSES SER contained in NUREG 0776 identifies that the SSES spent fuel pools were determined to meet the requirements of GDC 2, 4 ,62 and 63 in addition to GDC 61 discussed above. GDC 2, as delineated in the SER, requires design of spent fuel pools to be capable of withstanding an earthquake. GDC 4, as delineated in the SER, requires the spent fuel pools to be capable of withstanding the effects of missiles and pipe breaks. The fuel pool structure is not affected by this change, thus conformance is not affected. GDC 62 addresses prevention of criticality and relates to fuel rack design and thus is not affected by the crosstied pool configuration. GDC 63 addresses pool monitoring for residual heat removal capability which is also not affected by the change.

Each fuel pool is provided with level instrumentation and low level alarms which annunciate on a local panel and in the control room (panel trouble alarm). Each fuel pool's level is also indicated and recorded in the control room. These instruments are powered from 1E sources. Thus when in the crosstied configuration, redundant alarm instrumentation and redundant level indication is provided in the control room. Additionally, each fuel pool skimmer surge tank is provided with a low level alarm which annunciates both locally and in the control room (panel trouble alarm). Indication of fuel pool level in the crosstied pool configuration is both diverse and redundant.

The cask storage pit design features are:

1. FSAR section 9.1.2 identifies that the cask storage pit is designed to seismic category I requirements. This includes design of the connected piping systems which are designed seismic category I past the first isolation valve.
2. No fuel is to be stored in the cask pit when crosstied to the fuel pools. Thus travel limitations for the reactor building cranes is not necessary.
3. The cask storage pit is formed by concrete walls and is lined with stainless steel to minimize leakage and to reduce corrosion product formation. A liner leak collection and detection system is provided as for the fuel pools. The cask storage pit provides the means for removing spent fuel from the fuel pools via fuel storage casks.

The cask pit was and is not required to have the same design features as the fuel pools regarding potential drainage paths through it's piping connections since spent fuel is not stored therein. Spent fuel will not be stored in the cask storage pit after implementation of the subject change.

One potential cask storage pit drain path is the 6" HCD-3024 drain line originating from a floor drain in the cask pit (elevation 777' 5") through hand wheel operated valve 153054 or 253054. This line is used to completely drain the cask pit when the cask storage pit gates are installed and placement or removal of fuel storage casks is required. The piping, including the valves is seismically designed. A portion of the pipe line is embedded in the concrete structure. These valves are normally closed. No leak detection capability is provided for these lines. Outboard of these valves, spectacle flanges have been installed per DCP's 93-9071A and B (hereafter referred to as the "DCPs"). These flanges provide visible positive isolation of the line. The flanges are located in the seismically designed and supported portion of the line.

The other potential cask storage pit drain path is through the 6" HCD-3023 cask pit supply line and hand wheel operated valve 053025. This valve is normally closed. No leak detection capability is provided on this line. The piping from the diffuser, which sits near the bottom of the cask pit (779' 2", to the valve (located in the valve pit at elevation 816' 8") including the valve are seismically designed. This valve and the vent valve 053082 are the only valves in the valve pit. The valve pit is covered with grating. Additionally, for this path to draindown the cask storage pit, the line must be filled with water for it to siphon. A portion of the pipe line is embedded in the concrete structure. Downstream hand wheel operated valves 153026 and 253026 are maintained closed. These valves are located in the nonseismic portion of the line.

Two additional paths are created by virtue of the removed cask storage pit gates. These are the two 3" gate leak detection drain lines HCD-157 and HCD-257, which are seismically designed past the hand wheel operated isolation valves 153050 and 253050. These lines originate at elevation 793' 11" on the top of the cask pit and fuel pool walls on the fuel

pool side of the wall curb. A portion of the pipe line is embedded in the concrete structure. These valves are maintained closed. The leak detection instrumentation will be utilized when the gates are removed and these valves are closed to detect any possible leakage past these valves. This leak detection instrumentation alarms on panel OC211, which is a local panel located on 818'. An OC211 panel trouble alarm would also annunciate on control room panel OC653.

These paths are the subject of NSAG report 1-88 "INADVERTENT DRAINING OF WATER FROM THE SPENT FUEL POOLS ON 9/12/87 VIA THE CASK STORAGE PIT". This report describes an event at SSES where one of the two 3" gate leak detection drain isolation valves was inadvertently opened creating a drain path from the crosstied pools. It identifies a drain rate of 35.2 GPM was experienced and that the leak detection alarms and skimmer surge tank low level alarms were actuated providing operator notification of the pool water inventory problem. As a result of this incident, alarm response procedures were revised and operator training performed to assure that operators are aware of the seriousness of potential draining of the fuel pools.

All relevant lines discussed above and the elevations are depicted on Attachment 1 to this safety evaluation.

As is shown on Attachment 1, the top of active fuel is at elevation 793' 1".

When the cask pit gates are out, two gates are hung on a cask pit wall and one on a wall of each fuel pool.

D. **Describe potential effects on Safety Functions.**

As delineated above, the safety function of the cask pit and the connected pipe lines when in the fuel pool crosstied configuration is to maintain pool water inventory such that fuel will not become uncovered. Potential boundary integrity challenges for this function could occur due to maloperation <u>or</u> failure of equipment as identified in the regulatory guide. The inventory boundary integrity could be affected by an earthquake event or LOCA event. Therefore, the discussion that follows addresses the potential for maloperation of equipment, seismic and LOCA events to challenge the pool boundary integrity such that inventory loss could occur. Note that inventory loss below the skimmer surge tank weir (817' 1/2 "), loss of fuel pool cooling would also occur.

It should be noted that each fuel pool has separate and diverse makeup sources in the ESW, condensate transter and fire protection systems. These systems are identified in the "Loss of Fuel Pool Cooling/Inventory ON-135/235-001.

Due to the seismic design of the cask pit, minimum draindown level would remain above the fuel. Attachment 1 exhibits this fact. Draindown via the cask storage pit drain or supply line would drain the cask storage pit level below the gate curb. However, the fuel pool level would only drain to the curb elevation at 794'- 5". This would result in 2'-3" of water above the fuel in each fuel pool. Draindown via either of the gate leak detection drain lines would result in draindown to the 793'-11" level, which would be 10" above the fuel. Thus, fuel would not be uncovered. Further, it would remain covered. ESW makeup would be available. Depending on equipment availability, numerous other makeup sources could also be used (condensate transfer, fire water etc.). The ESW system makeup rate is shown in M-FPC-011 to be greater than the maximum postulated boiloff rate.

Section 9.1.2.2 of the FSAR states that " in the unlikely event that the pool gates fail to contain the pool water, the fuel racks and their contained fuel are assured of maintaining water coverage at all times". The refuel pool gates (between the fuel pool and the reactor cavity) would drain the fuel pool to an elevation of 793' 5" should the gate seals fail. Thus the maximum level drop which can be postulated for the crosstied configuration is bounded by the refuel gate elevation of 793' 5". Therefore, a draindown event in the crosstied pool configuration represents a condition which is bounded by the current FSAR discussion.

In summary, minimum draindown levels introduced by the crosstied configuration are no lower than those discussed in the FSAR. Fuel will remain covered when in the crosstied pool configuration.

<u>However, draindown to the minimum level as described above is not deemed to be a credible occurrence for any of the subject potential drainpaths during any postulated boundary integrity challenge event.</u> The following describes why this is so for all possible boundary integrity challenge events.

Note that the regulatory guide 1.13 states that permanently connected hydraulic systems such as drains, which maintain water quantity, should be designed so that maloperation or failure from a postulated SSE will not cause fuel to be uncovered. It does not require consideration of equipment maloperation and failure of equipment. Probability analysis of pool draindown has been determined and is dicussed later in Section III.

EQUIPMENT MALOPERATION:

With the installation of DCP 93-9071A/B, multiple errors would be necessary for the draindown to the minimum levels to occur. The cask storage pit drain and supply lines contain multiple equipment which both must be mispostioned (i.e., two valves or a valve and a spectacle flange). The gate leak lines contain a valve and leak detection instrumentation. The valves in these lines are hand wheel operated thus deliberate operation is required to cause the valve to be mispositioned. Numerous alarms and indications of a fuel pool level problem (Unit 1 & 2 fuel pool level alarms, Unit 1 & 2 skimmer surge tank low level alarms, Unit 1 & 2 fuel pool cooling pumps alarms, among others) must fail or be ignored for draindown to the minimum levels to occur. Therefore, draindown via the potential drain paths due to equipment maloperation is not deemed credible.

SEISMIC EVENT:

As shown earlier, the fuel pool walls and the cask pit walls are seismically designed.

Each of the subject lines contain at least one valve within the seismic boundary as shown on Attachment 1. None of the valves have motor operators which could spuriously open the valves. The cask storage pit supply line contains an additional closed valve which is not within the seismic boundary. In the case of the cask pit drain line, a valve and a spectacle flange exists within the seismically analyzed section of piping. Thus, the boundary integrity is assured.

Since the seismic boundary integrity (fuel pool, cask pit, and connected piping systems) are analyzed for a seismic event, pool draindown resulting from a seismic event when in the crosstied configuration is not deemed credible.

When the cask pit gates are not installed, they are hung in storage locations on the cask pit and fuel pool walls.

EDR 94-013 and EC-012-0010 revision 0 evaluated this configuration. The calculation determined that the gates will not dislodge from the storage lugs considering safe shutdown earthquake + SRV + LOCA loads.

LOCA EVENT:

The only impact a LOCA event could have on the fuel pool inventory and the subject pipe lines is from the hydrodynamic loads. The pipe lines have been analyzed for hydrodynamic loads and shown to not be adversely impacted. Thus as with the seismic event, pool draindown resulting from a LOCA event when in the crosstied configuration is not deemed credible.

E. Describe the basis or assumptions used in supporting documentation for this safety evaluation.

1. SAFETY EVALUATION NO. 93-9071 A/B ;

Evaluates the installation of the "Spent Fuel Cask Storage Pit Drain Isolation" modification DCP 93-9071A/A.

2. SSES FSAR REVISION 46

3. EDR 94-013 and EC-012-0010, revision 0;

Evaluates the acceptability, under assumed seismic and hydrodynamic loading conditions, storage of the gates on the cask pit and fuel pool walls.

4. NSAG Report 1-88, "Inadvertent Draining of Water From The Spent Fuel Pools on 9/12/87 Via The Cask Storage Pit dated 2/8/88" ;

Describes the SSES draining incident which occurred through one of the 3 " cask gate leak lines.

5. SEA-ME-128, "Analysis of Potential Drainage Paths Resulting From Operation With The Cask Storage Pit Gates Removed" revision 0;

Determines the safety impact of potential fuel pool drainage paths identified by NSAG report 1-88 caused by operator error.

6. M-FPC-005, "Analysis of Potential Drainage Paths For The Spent Fuel Pools" revision 0;

This calculation determines maximum draindown flowrates and elevations.

7. NL-88-006, "NSAG Report #1-88" revision 0;

This safety evaluation justifies operation of SSES with the cask pit gates removed and reflects the results of the evaluations of items 5 and 6 above.

8. SSES SER NUREG 0776

9. Piping calculations:

These calculations establish the seismic & LOCA analysis boundaries for the affected lines.

a) Cask pit drain line

997-2 revision 2
2997-2 revision 0

b) Cask pit supply line

1018-2 revision 1

c) Gate leak lines

997-3 revision 1
2997-3 revision 0

10. Drawings

These drawings exhibit the gate elevations.

a) C981 revision 8

b) C987 revision 10

c) C990 revision 7

11. EC-035-1004, "Single Failure Review of RHR Fuel Pool Cooling Assist Mode and RHR SDC Mode", revision 0

This study evaluates the plant response in a seismic event concurrent with a LOOP and subsequent loss of the spent fuel pool cooling system. It evaluates crosstied and isolated fuel pool configurations.

12. M-FPC-011. "FSAR Appendix 9A Evaluation", revision 1;

This calculation determines the boiloff rate corresponding to the FSAR Appendix 9A scenario and that corresponding to a pool with the heat load corresponding to 25 hours time to boil.

13. EC-036-1003, "Probability of Draindown of Spent Fuel Pools While Cask Storage Pit Gates are Removed", revision 0;

This calculation determines the probability of draindown of water from the cask storage pit and compares the results to the probability of fuel pool boil. It takes no credit for the seismic design of piping or components.

III. Does the proposed action increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety, as previously evaluated in the SAR? (Include specific reference to FSAR questions that are applicable.)

YES	NO
	X

Provide a discussion of the basis and criteria used in arriving at the above conclusion.

As discussed above, pool draindown via the fuel pool gate seals has been addressed in the FSAR. Draindown via the four lines evaluated herein to the minimum level is not deemed credible given the multiple barriers, seismic design, numerous diverse and redundant level alarms and the alarm response procedures.

Calculation EC-036-1003 was performed to assess the probability of pool draindown in the crosstied pool configuration. This calculation takes no credit for seismic ratings of piping or components. It also assumes a seismic event and double failures or operator errors occur. Additionally, it takes no credit for operator response to the event. The highest probability of drain down is via either of the leak detection lines. It was determined that each of these lines has a 2.10E-9 probability of draindown. The probability of draindown due to each of the other two paths is 4.96E-11. Therefore, the total probability of pool drain down considering all paths is 4.30E-9. This probability is less than the total probability of fuel pool boiling for isolated fuel pools considering numerous initiating events, which is 9.68E-6. With the pools crosstied, the probability of fuel pool boil is much less. The probability of pool boiling is decreased by this change and the probability of pool draindown in the crosstied pool configuration is sufficiently low that it does not warrant further action other than those taken in

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the DCP 93-9071A/B and the procedure changes accompanying this safety evaluation.

Based on the above, the probability of occurrence of a draindown event to the minimum level is not deemed to be increased by this change.

Draindown consequences through the evaluated paths is bounded by the consequences of the gate seal leak addressed in the FSAR Section 9.1.2.2.

IV. Does the proposed action create a possibility for an accident or malfunction of a different type than any evaluated previously in the SAR? (Include reference to specific FSAR sections applicable.)

YES	NO
	X

Provide a discussion of the basis and criteria used in arriving at the above conclusion.

The drainage paths from the cask pit have been evaluated. Given the seismic design of the piping and boundary valves (and spectacle flanges) along with the numerous alarms that would be tripped in a loss of pool inventory event, maximum loss of inventory is not deemed credible. Draindown to the fuel level is not possible even should maximum loss of inventory occur.

Even if maximum loss occurs, the draindown level and fuel pool makeup would maintain the fuel covered.

The FSAR discusses draindown in Section 9.1.2.2. It determines that in the unlikely event of a pool gate seal failure, that the fuel would remain covered. The worst case gate seal failure would drain to an elevation lower than the drain elevation of the subject lines. The effect of losing pool inventory through a failed gate seal is no worse than losing pool inventory through one of the subject lines.

Thus, the proposed crosstied pool, configuration does not create a possibility for an accident or malfunction of a different type than any evaluated previously in the SAR.

V. Does the proposed action reduce the margin of safety as defined in the basis for any Technical Specification? (Include reference to specific Technical Specification sections that are applicable.)

	X
YES	**NO**

Provide a discussion of the basis and criteria used in arriving at the above conclusion.

Technical Specification 3/4.9.9 governing water level in the spent fuel pool requires 22 feet of water above the top of the irradiated fuel assemblies in the spent fuel storage racks. The basis for this specification is defined as that depth of water necessary to ensure 99% removal of the assumed 10 % iodine gap activity released from rupture of an irradiated fuel assembly.

The action statement for this specification requires that if the 22 foot requirement is not met, all fuel movement and crane operations with loads in the spent fuel pool area should be suspended after placing the fuel assemblies and crane in a safe condition.

As identified previously, the implementation of this change does not impact the ability to maintain fuel pool water inventory.

Any decrease in level caused by this leakage will be detected and alarmed locally and in the control room so that prompt actions can be taken. Alarm response procedures and offnormal procedures instruct that makeup be provided and actions be taken to isolate the leak.

Therefore, the margin of safety which forms the basis for Technical Specification 3/4.9.9 will not be reduced by operation in the crosstied configuration.

VI. Does the proposed action involve a change in a Technical Specification?

	X
YES	NO

If "YES", NDI-QA-3.2.1 "Technical Specification Changes" applies. A "YES" answer does not preclude activity up to a point just before it would physically affect the functioning of the plant.

Provide a discussion of the basis and criteria used in arriving at the above conclusion. If appropriate, describe the extent of the activity and why it should be allowed to proceed prior to the Technical Specification change.

The Technical Specification requirement for coverage of 22 feet of water is not affected by this operational condition. This safety evaluation addresses operation with the cask pit gates removed, which is not addressed in nor affects the applicability of this Technical Specification requirement.

VII. Does the proposed action create the need to make an application for amendment to the license other than to Appendix A?

	X
YES	NO

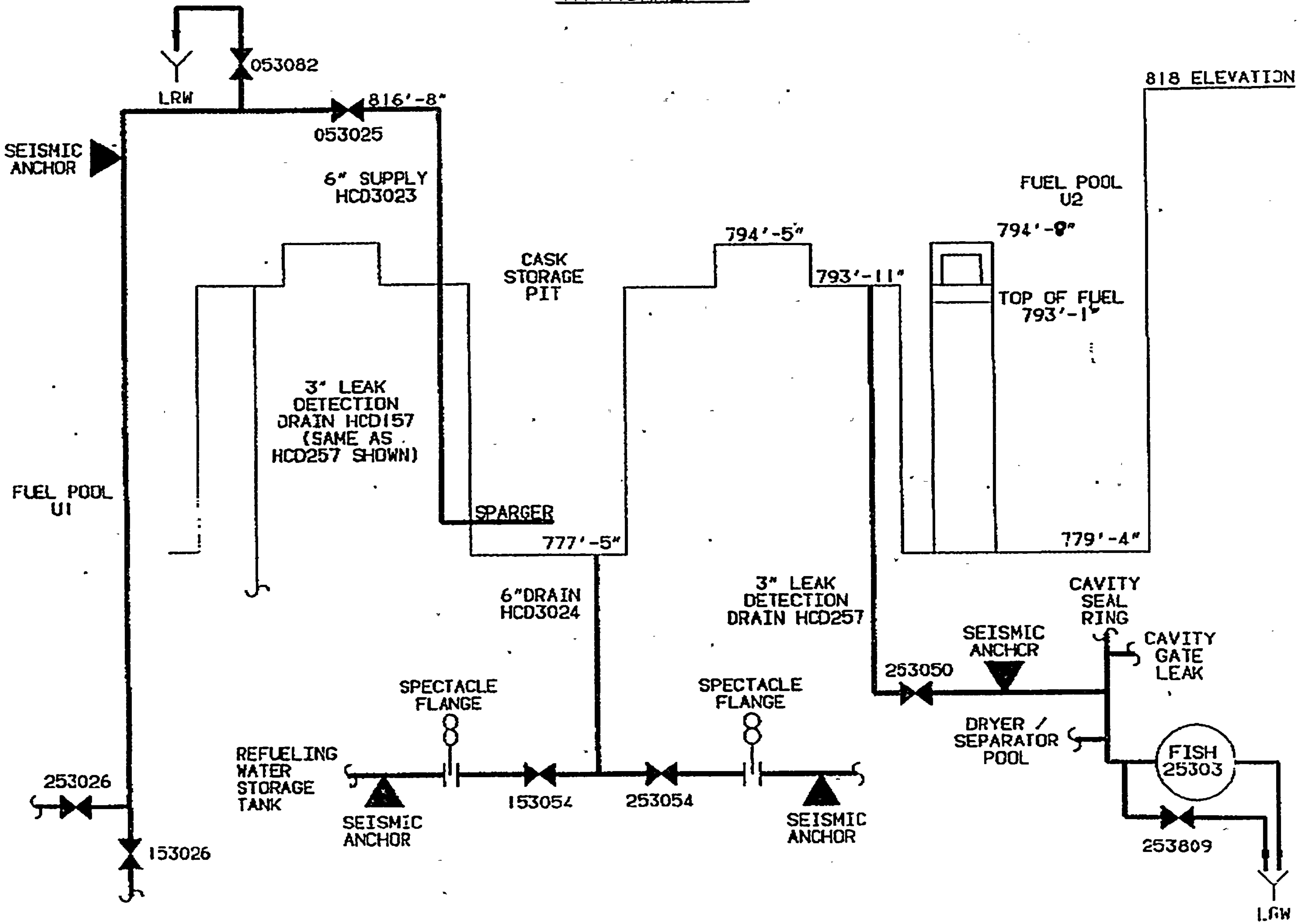
Provide a discussion of the basis and criteria used in arriving at the above conclusion.

Operation in the crosstied configuration has been assessed and determined to be within the operating envelope described by the SSES FSAR, SSES Technical Specifications and the operating license.

An amendment to the license is not required.

CROSSTIED FUEL POOL
NL-94-010

ATTACHMENT 1



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