SNUPPS

Standardized Nuclear Unit
Power Plant System

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September 14, 1981
SLNRC 81-101 FILE: 0541
SUBJ: RSB Review

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket Nos. STN 50-482, STN 50-483, and STN 50-486

Ref: 1. SLNRC 81-83, dated September 1, 1981, same subject
2. SLNRC 81-96, dated September 9, 1981, same subject

Dear Mr. Denton:

The referenced letters provided additional information for the NRC's Reactor System Branch in order to complete their review of the SNUPPS FSAR. Two additional matters require added information and are discussed below.

Agenda item #5 of the July 21, 1981 meeting concerned Refueling Water Storage Tank sizing and setpoints. Enclosure A to this letter is FSAR changes that provide the required information and will be incorporated in the next revision to the SNUPPS FSAR.

Agenda item #15-10, which was discussed in the August 12, 1981 meeting, concerned protection afforded the centrifugal charging pumps in a situation where they could be running against a shutoff head pressure. Safety-related instrumentation and controls will be added to the SNUPPS design to protect the centrifugal charging pumps when subjected to these conditions. The additional instrumentation and associated control will reopen motor-operated valves HV-110 and HV-111 in the miniflow lines when the pumps' flow rate approaches minimum flow conditions. The valves will reclose when the miniflow line function is no longer required. Details of this design change will be provided in the FSAR when engineering is more complete. This information should be available later in 1981, but will be provided at least four months prior to fuel load of the first SNUPPS plant. This design change concept was discussed with the NRC on August 12 and it is felt that the above information should provide the NRC with sufficient

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information to resolve the issue for the Callaway SER. Confirmation and final NRC acceptance of the design change could then be given after engneering detail is available.

Very truly yours,

Nicholas A. Petrick

RLS/jdk
Enclosure
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On coincidence of two-out-of-four low level signals from the RWST level transmitters, the emergency core cooling system (ECCS) pumps switch suction to the containment recirculation sump, as described in Section 6.3.2. The low level setpoint indicates that 128,900 usable gallons remain in the RWST. Switchover for the spray pumps is manually initiated when the low-low level in the RWST is reached. The low-low level indicates imminent depletion of the RWST. Switchover initiated at the time of the low-low level alarm ensures that the system piping remains full of water and that adequate NPSH for the spray pumps is maintained. The RWST low-low level alarms and level indicators inform the operator of the need to make this switchover.

The time length of the containment spray injection phase is given in Table 6.2.2-4. These times are based on the minimum RWST volume and are given for credible combinations of minimum and maximum containment spray and ECCS operation and runout flow rates of these pumps. The containment spray additive design flow rate is given in Table 6.5-2.

RECIRCULATION PHASE - The recirculation phase initiated by the operator manually shifting containment spray pump suction from the RWST to the containment recirculation sump. The accident chronology for the containment spray system for the recirculation phase of a LOCA is provided in Table 6.2.2-3.

The RWST suction line valves remain open during the switchover to the recirculation phase to preclude the loss of supply to the containment spray pumps in the highly unlikely event that the isolation valve in the recirculation line is delayed in opening. The operator then remote manually closes the motor-operated valves in the RWST suction lines. If the predetermined amount of spray additive defined in Section 6.5.2 has been added, a permissive signal from the spray additive tank level switches allows the operator to remote manually close the motor-operated valves in the spray additive supply lines to the containment spray additive eductor. If this minimum level in the spray additive tank has not been reached, the valves cannot be manually closed.

The suction line from the containment recirculation sump to the spray pump is a sloped line which precludes air from entering the system. The single valve in the containment sump recirculation line for the containment spray pump is encapsulated and located outside the containment. The flow paths from the spray pumps are the same as in the injection phase. Check valves are provided in the recirculation sump suction lines to prevent the establishment of a flow path between the RWST and the containment sump.

SAFETY EVALUATION FOUR - The CSS is initially tested with the program given in Chapter 14.0. Functional testing is done in accordance with Section 6.2.2.1.4.

Section 6.6 provides the ASME Boiler and Pressure Vessel Code, Section XI requirements that are appropriate for the CSS.

SAFETY EVALUATION FIVE - Section 3.2 delineates the quality group classification and seismic category applicable to the safety-related portion of this system and supporting systems. Section 6.2.2.1.2.2 shows that safety-related components meet the design and fabrication codes given in Section 3.2. All the power supplies and the control functions necessary for the safe function of the CSS are Class IE, as described in Chapters 7.0 and 8.0.

SAFETY EVALUATION SIX - Section 6.2.2.1.2.1 describes provisions made to identify and isolate leakage or malfunction and to isolate the nonsafety-related portions of the system.

SAFETY EVALUATION SEVEN - Sections 6.2.4 and 6.2.6 provide the safety evaluation for the system containment isolation arrangement and testability.

SAFETY EVALUATION EIGHT - As shown by the containment analysis and the description of the analytical methods and models given in Section 6.2.1, the containment spray system, in conjunction with the emergency core cooling system and the containment fan coolers, is capable of removing sufficient heat energy and subsequent decay heat from the containment atmosphere following the hypothesized LOCA and MSLB inside the containment to maintain the containment pressure below the design pressure. Curves showing sump temperature, heat generation rates, heat removal rates of the containment heat removal systems, and containment total pressure, vapor pressure, and temperature as a function of time for minimum engineered safety features performance are also given in Section 6.2.1.

During the injection phase, all pressure transient analyses take credit for a spray system capable of delivering borated 100 F spray water at the design flow rate. For the design basis LOCA and MSLB accident, credit is taken for spray flow initiation within 60 seconds.

A minimum storage volume of 378,900 usable gallons is available in the RWST to ensure that, after a LOCA, sufficient water is injected for emergency core cooling and for rapidly reducing the containment pressure and temperature. In addition, this minimum volume ensures that sufficient water is available in the containment sump to permit recirculation

TABLE 6.2.2-3 (Sheet 2)

Recirculation Phase

Time (Min)	Action
0.0	Reach Lo-Lo-2 level in RWST.
0.5	Manually initiate opening the containment sump recirculation valves (opening time max 30 sec).
1.0	Verify sump recirculation valves are open.
1.5	Manually initiate closing of RWST isolation valves. If low level in the NaOH tank has been reached, manually initiate closing of NaOH tank outlet isolation valves. If low level in the NaOH tank has not been reached, manually initiate closing of the above valves upon that level being reached.

The time that Lo-Lo-2 level in the RWST is reached following the event depends on whether full or partial ECCS and containment spray flow is attained, and can be between 17.4 and 51.5 minutes. ECCS switchover occurs prior to reaching Lo-Lo-2 level.

TABLE 6.2.2-4

SPRAY INJECTION PHASE DURATION

Case	Flow Condition	Single Failure	Operator Action for Spray Switchover	Time Length of Injection (min.)	Remarks
1.	2 trains ECCS 2 trains of Spray	None	30 seconds after receipt of the low-low 2 alarm	26.4	Refer to Table 6.3-11.
2.	2 trains ECCS 2 trains Spray	RHR/RWST Valve fails to close	30 seconds after the end of step 5 of ECCS switchover	19.9	Refer to Table 6.3-12. 25,400 gallons remain in RWST above the empty alarm. This remaining volume would provide an additional 2 minutes for operator action prior to receipt of the RWST empty alarm. (Based on an outflow of 12,680 gpm from the completion of ECCS switchover until the empty alarm.)
3.	2 trains ECCS 1 train Spray	One Spray train fails	30 seconds after receipt of the low-low 2 alarm	43.7	
4.	2 trains Spray 1 train ECCS	One train of ECCS pumps assumed to fail	30 seconds after receipt of the low-low 2 alarm	53.2	ECCS one train flow rates are as follows: RHR 5100 gpm SI 660 gpm CC 550 gpm
5.	2 trains Spray 2 trains ECCS	CTMT Spray sump valve fails to open	30 seconds after receipt of the low-low 2 alarm	26.4	Operator shuts down one spray train to protect the pump.

TABLE 6.2.2-6

WATER SOURCES AND WATER LOSSES WHICH CONTRIBUTE TO THE WATER LEVEL WITHIN THE REACTOR BUILDING

Water Sources	
Reactor coolant inventory	504,640 Lbm
Accumulator tanks inventory	210,300 Lbm
RWST minimum volume, @ 100 F	3,140,210 Lbm
Initial atmosphere water vapor	3,700 Lbm
Containment spray additive solution	28,814 Lbm
Total	3,887,664 Lbm
Weight of Vapor Water Losses	
Water vapor at the time of containment spray recirculation	120,200 Lbm
Total Water in Liquid State	
Volume of water, liquid, @ 212 F	61,750 ft^3
Volume of Liquid Water Losses	
Incore instrumentation tunnel	9,100 ft^3
Reactor cavity (includes RCS volume)	10,500 ft^3
Incore instrumentation tunnel sump	100 ft^3
Containment recirculation sumps	1,000 ft^3
Containment normal sumps	150 ft^3
Refueling pool and upending pit	500 ft^3
Miscellaneous wetted surfaces	1,200 ft^3
Total	22,550 ft^3
Surface Area Available for Buildup	
@ El 2,000 ft	7,000 ft^2
@ El 2,001 ft-4 in.	11,750 ft^2
Results	
Elevation of water @ initiation of ECCS switchover	2,002 ft - 4 in.
Elevation of water @ containment spray switchover	2,003 ft - 10 in.

Accumulator pressure is provided by a supply of nitrogen gas, and can be adjusted, as required, during normal plant operation. However, the accumulators are normally isolated from this nitrogen supply. Gas relief valves on the accumulators protect them from pressures in excess of design pressure. Accumulator gas pressure is monitored by indicators and alarms. Solenoid-operated vent valves are provided to depressurize the accumulators during emergency cold shutdown conditions.

The accumulators are located within the containment but outside of the secondary shield wall which protects the tanks from missiles generated from a postulated LOCA.

Refueling Water Storage Tank

The borated refueling water storage facility consists of a large outside storage tank (i.e., RWST) with connections for borated demineralized water delivery to and receipt from the fuel pool cooling and cleanup system, the chemical and volume control system, the containment spray system, and the ECCS.

The RWST is a passive seismic Category I component and is required only during the short term following a LOCA, MSLB, or any other accident requiring ECCS. Therefore, neither redundancy nor tornado missile protection is required. The safety-related level instrumentation and the temperature monitoring instrumentation associated with the RWST are designed with redundancy.

The RWST is vented directly to the atmosphere. Tank overflow is directed to the waste holdup tank in the liquid radwaste system via the floor and equipment drain system. Sample connections are also provided to allow periodic analysis of the RWST contents.

An automatic heater system is provided to prevent the contents of the RWST from freezing. The heater system consists of steam coils wrapped around the outside of the RWST, insulation on the RWST, electrical heat tracing on the exposed nonessential piping, and a heated enclosure for the essential piping, valves, and instrumentation. These steam coils are serviced by the auxiliary steam system. For freeze protection during colder periods of the year, the RWST is automatically maintained above 50 F by using a temperature control valve to control steam flow to the steam coil heaters. Redundant temperature instrumentation is provided to inform the operator of any degradation of the heating capability for the RWST.

Since the RWST is not normally used as a source of water during power operation, the tank level is administratively maintained. The water level is maintained above the minimum level consistent with the 250,000 gallons required for injection, transfer allowances, and instrument error allowances. The RWST levels and volumes shown on Figure 6.3-7 are based on the following considerations.

RWST

Injection Mode Allowance

The injection mode of ECCS operation consists of the ECCS pumps (charging pumps, safety injection pumps, and residual heat removal pumps) and the containment spray pumps taking suction from the RWST and delivering to the reactor coolant system (RCS) and containment, respectively. The RWST volume available for ECCS pump injection mode operation is 250,000 gallons.

Containment and RCS pressures are conservatively assumed to be 0 psig to maximize flow out of the RWST.

Flow out of the RWST during the injection mode includes conservative allowances for two pumps of each type operating at the following flow rates:

Safety injection pump	-	450 gpm per pump
Charging pump	-	450 gpm per pump
RHR pump	-	4,500 gpm per pump
Spray pump	-	3,725 gpm per pump

Total RWST outflow rate during injection mode operation is 18,250 gpm.

Based on the above minimum available RWST volume for injection mode operation and the maximum total flow rate out of the RWST, the shortest injection mode operation time is approximately 13.7 minutes.

Transfer Allowance - RHR, Charging, SI

During the injection mode of ECCS operation, the operator monitors the RWST level and containment recirculation sump level in anticipation of switchover. Upon receipt of the RHR auto switchover alarm (Lo-Lo-1), the operator is required to initiate the manual operations required to complete switchover in a timely manner.

The ECCS switchover from injection to cold leg recirculation is initiated automatically upon receipt of the RHR auto switchover trip signal and is completed via timely operator action at the main control board. Switchover is initiated via automatic opening of the containment recirculation sump isolation valves (8811 A/B). This automatic action aligns the suction of the RHR pumps to the containment recirculation sump to ensure continued availability of a suction source. Manual actions 1 through 5 of Table 6.3-8 must be performed following switchover initiation prior to loss of the RWST transfer allowance to ensure that all ECCS pumps are protected with suction flow available from the containment sump. The ECCS switchover procedure is structured so that the operator simultaneously switches both trains of the ECCS from injection to recirculation, repositioning functionally similar switches as part of the same procedural steps.

 RWST

The time available for switchover is dependent on the flow rate out of the RWST as the switchover manual actions are performed. As ECCS valves are repositioned, the flow rate out of the RWST is reduced in magnitude. In order to analyze the time available for switchover, the following conservative bases are established:

1. The RWST transfer allowance available for ECCS pump switchover is 100,000 gallons.

2. Containment and RCS pressures for large break conditions are conservatively assumed to be 0 psig. Thus, no credit is taken for the reduction in RWST outflow that will result with higher containment and RCS pressures following a large break.

Based on the above criteria, the flow rates out of the RWST as a function of switchover manual action are itemized in Table 6.3-11 for large breaks. The large break with single failure constitutes the condition where RWST outflow is the greatest. Operator action times assumed per switchover step and change in RWST volume per switchover step for this condition are itemized in Table 6.3-12. Flow rate data for small breaks are less than for large breaks and are not included in Table 6.3-12. The flow rate out of the RWST for the large LOCA with the single failure of the RHR/RWST isolation valve (8812 A or B) to close requires 60,330 gallons for performing ECCS switchover manual actions. This volume is less than the transfer allowance of 100,000 gallons, which ensures that the switchover steps necessary to protect all ECCS pumps can be accomplished before the transfer allowance is depleted.

Transfer Allowance - Containment Spray

The RWST volume between the Lo-Lo-2 setpoint and the empty setpoint is required for containment spray pump switchover from the RWST to the sump. The available volume is 15,650 gallons. With both spray pumps operating, this volume provides a minimum switchover time of 2.1 minutes. This switchover time is consistent with the operator action time of 1.75 minutes provided in Table 6.2.2-3.

As shown on Figure 6.3-7, the total transfer allowance for ECCS and containment spray pump switchover is 115,650 gallons. In the worst single failure case, the total outflow from the RWST during ECCS pump switchover is 68,330 gallons, leaving 47,320 gallons for containment spray pump switchover. At the completion of the switchover steps listed in Table 6.3-12, 12,680 gpm is being drawn from the RWST by two containment spray pumps, and the RHR pump and sump line are still lined up to the RWST due to failure of HV 8812A or B to close.

RWST

Failure of HV 8812A or B to close will be mitigated by operator action to immediately proceed with containment spray pump switchover at the completion of step 5 on Table 6.3-12 rather than waiting for the Lo-Lo-2 alarm. HV 8812A/B position lights will indicate if the valve is not fully closed and also indicate loss of control or motive power to the valve by being unlit.

The time required to complete containment spray pump switchover is 1.75 minutes. This will draw another 22,190 gallons from the RWST at a flow rate of 12,680 gpm. Since the available transfer allowance is 47,320 gallons, the containment spray pumps can be switched over prior to depletion of the RWST.

Instrument Error

The level measurement system for the RWST includes four level transmitters, each of which have five setpoints, High, Low, Lo-Lo-1, Lo-Lo-2, and Empty. Two out of four level transmitters sensing an individual setpoint will initiate the appropriate alarm or automatic action.

If any single transmitter's setpoint drifts high or low at one tank level, its setpoint at all other levels will drift in the same direction. Therefore, all available RWST volumes are verified under two separate cases, all setpoints drifting high and all setpoints drifting low. This results in a 1.35 foot plus margin on the Low setpoint and a 1.35 foot negative margin on the Empty setpoint in order to assure the required injection/recirculation volume above the top of the ECCS discharge header.

The RWST must be sampled prior to accepting makeup water from the CVCS to ensure the proper final boron concentration in the tank.

for use in testing operability. Additional information on testing can be found in Section 6.3.4.2.

6.3.2.8 Manual Actions

No manual actions are required of the operator for proper operation of the ECCS during the injection mode of operation. Only limited manual actions are required by the operator to realign the system for the cold leg recirculation mode of operation, and, after approximately 24 hours, for the hot leg recirculation mode of operation. These actions are delineated in Table 6.3-8. Based on the containment pressure-temperature analyses provided in Section 6.2.1, which assume runout flows of all pumps, including the containment spray pumps, which draw from the RWST, switchover of the RHR pumps occurs approximately 13.7 minutes after the accident. |

The changeover from the injection mode to recirculation mode is initiated automatically and completed manually by operator action from the main control room. Protection logic is provided to automatically open the two safety injection system recirculation sump isolation valves when two out of four RWST level channels indicate an RWST level less than a low-low-1 level setpoint in conjunction with the initiation of the engineered safeguards actuation signal (SIS). When the containment sump recirculation valves are fully opened, RHR pump suction from the RWST is automatically isolated. This automatic action aligns the two RHR pumps to take suction from the containment sump and to deliver water directly to the RCS. The RHR pumps continue to operate during this changeover from injection mode to recirculation mode.

The two charging pumps and the two safety injection pumps continue to take suction from the RWST, following the above automatic action, until manual operator action is taken to align these pumps in series with the RHR pumps.

The RWST level protection logic consists of four level channels with each level channel assigned to a separate process control protection set. Four RWST transmitters provide level signals to corresponding normally de-energized level channel bistables. Each level channel bistable would be energized on receipt of an RWST level signal less than the low-low-1 level setpoint.

A two-out-of-four coincident logic is utilized in both protection cabinets, A and B, to ensure a trip signal in the event that two-out-of-four level channel bistables are energized. This trip signal, in conjunction with the SIS, provides the actuation signal to automatically open the corresponding containment sump isolation valves.

The low-low-1 RWST level signal is also alarmed to inform the operator to initiate the manual action required to realign the charging and safety injection pumps for the recirculation mode.

The manual switchover sequence that must be performed by the operator is delineated in Table 6.3-8. Following the automatic and manual switchover sequence, the two RHR pumps take suction from the containment sump and deliver borated water directly to the RCS cold legs. A portion of the number 1 RHR pump discharge flow is used to supply the two centrifugal charging pumps, which also deliver water directly to the RCS cold legs. A portion of the discharge flow from the number 2 RHR pump is used to provide suction to the two safety injection pumps, which also deliver directly to the RCS cold legs. As part of the manual switchover procedure (see Table 6.3-8, Step 4), the suctions of the safety injection and centrifugal charging pumps are cross connected so that one RHR pump can deliver flow to the RCS and both safety injection and centrifugal charging pumps, in the event of the failure of the second RHR pump.

See Section 7.5 for process information available to the operator in the control room following an accident.

The consequences of the operator failing to act altogether will be loss of the high head safety injection pumps and centrifugal charging pumps.

6.3.3 SAFETY EVALUATION

Safety evaluations are numbered to correspond to the safety design bases in Section 6.3.1.1.

SAFETY EVALUATION ONE - Except for the RWST, the ECCS is located in the reactor and auxiliary buildings. These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7(B), and 3.8 provide the bases for the adequacy of the structural design of these buildings.

The events which could result in the loss of function of the RWST (i.e., tornado missile) will not also cause a DBA. Since the BIT is available to provide a borated source of water to achieve and maintain the plant in a safe shutdown, no protection of the RWST is required.

SAFETY EVALUATION TWO - The ECCS is designed to remain functional after an SSE. Sections 3.7(B).2, 3.9(B), and 3.9(N) provide the design loading conditions that were considered. Sections 3.5, 3.6, and 9.5.1 and Appendix 3B provide the hazards analyses to assure that a safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

TABLE 6.3-1 (Sheet 2)

Discharg head at shutoff, ft	3,545
Required NPSH	25
Available NPSH	44
Design code	ASME III, Class 2
Seismic design	Category I
Driver:	
Type	Electric motor
Horsepower, hp	450
Rpm	3,600
Power	4,160 V, 60 Hz, 3-phase, Class IE
Start time	≤5 sec
Design code	NEMA
Seismic design	Category I
Residual Heat Removal Pumps	
Number	2
Design pressure, psig	600
Design temperature, F	400
Design flow, gpm	3,800
Design head, ft	350
NPSH required at 4,800 gpm, ft	21
Available NPSH at 4,800 gpm, ft	22.2
Design code	ASME III, Class 2
Seismic design	Category I
Driver:	
Type	Electric motor
Horsepower, hp	500
Rpm	1,800
Power	4,160 V, 60 Hz, 3-phase, Class IE
Start time	≤5 sec
Design code	NEMA
Seismic design	Category I
Residual Heat Exchangers (See Section 5.4.7 for design parameters)	
Refueling Water Storage Tank	
Quantity	1
Maximum volume	433,000
Normal usable capacity, gal	407,000
Minimum usable capacity, gal	378,900
Boric acid concentration, ppm boron (nominal)	2,000
Type	Vertical, field erected

TABLE 6.3-8

SEQUENCE OF CHANGEOVER OPERATION FROM INJECTION TO RECIRCULATION

The operator initiates component cooling water to the RHR heat exchangers and terminates cooling water to the fuel pool cooling heat exchangers as the level in the RWST nears the low-low-1 level setpoint. Without being stopped, the RHR pumps are realigned for the recirculation mode by the automatic opening of the sump isolation valves, which occurs upon receipt of the RWST low-low-1 level signal and an SIS. The isolation valve in each RHR suction line from the RWST is then automatically closed. The following remote manual operator actions from the control room are required to complete the changeover operation from the injection mode to the recirculation mode.

1. Close the two remote motor-operated valves in the crossover line downstream of the residual heat removal heat exchangers (8716 A and B).

2. Close the three motor-operated isolation valves in the safety injection pump miniflow lines (8814 A and B; 8813).

3. Open the motor-operated valve in the line from the number 1 RHR pump discharge to the charging pump suction and the motor-operated valve in the line from the number 2 RHR pump discharge to the safety injection pump suction (8804 A and B).

4. Open the two parallel motor-operated valves in the common suction line between the charging pump suction and the safety injection pump suction (8807 A and B).

5. Close the two parallel motor-operated valves in the line from the RWST to the charging pump suction and the valves in the line from the RWST to the safety injection pump suction (LCV 112 D and E; 8806 A and B).

TABLE 6.3-11

RWST OUTFLOW (LARGE BREAK) - NO FAILURES

Step[(1)]	Time Required[(3)(5)] Per Step (sec)	RWST Outflow [(2)(6)] Per Step (gpm)	Change in RWST Volume Per Step (gal)	Total RWST Volume Change (gal)
RHR Pump Switchover	60[(4)]	19,380[(7)]	19,380	19,380
1	45	9,250	6,950	26,330
2	40	9,250	6,170	32,500
3	40	9,250	6,170	38,670
4	40	9,250	6,170	44,840
5[(8)]	40	9,250	6,170	51,010
-	6.58 min	7,450	48,990	100,000
CS pump switchover	105	7,450	13,050	113,050
RWST empty	NA	NA	NA	115,650

NOTES:

(1) See Table 6.3-8 for a description of the steps 1 through 5. See Table 6.2.2-3 for a description of containment spray pump switchover.

(2) Flow rates are based on runout flows which are conservatively high:

RHR pump = 4,500 gpm per pump
CCHG pump = 450 gpm per pump
SI pump = 450 gpm per pump
CS pump = 3,725 gpm per pump

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TABLE 6.3-11 (Sheet 2)

RWST OUTFLOW (LARGE BREAK) - NO FAILURES

NOTES: (Continued)

(3) Valve operating times are maximum operating times.

(4) Includes an extra allowance of time (30 seconds) for valves 8811 A/B to automatically open and valves 8812 A/B to automatically close.

(5) Time required to complete the required action includes a conservative 30 seconds for operator response time for each manual procedure.

(6) The flow rate in this column is assumed to occur during the entire time interval for its respective step. This is conservative, since valve repositioning may reduce the flow rate during the time interval.

(7) Flow out of the RWST during switchover includes allowances for both pumped flow to the RCBS and containment and backflow to the containment sump.

(8) Following the completion of this step, all ECCS pumps are aligned with suction flow from the containment sump. The containment spray pumps continue to take suction from the RWST until the RWST low-low level alarm informs the operator to initiate switchover of the containment spray system.

RWST

TABLE 6.3-12

RWST OUTFLOW (LARGE BREAK) - WORST SINGLE FAILURE (9)

Step(1)	Time Required(3)(5) Per Step (sec)	RWST Outflow (2)(6) Per Step (gpm)	Change in RWST Volume per Step (gal)	Total RWST Volume Change (gal)
RHR Pump Switchover	60(4)	19,380(7)	19,380	19,380
1	45	14,315	10,750	30,130
2	40	14,315	9,550	39,680
3	40	14,315	9,550	49,230
4	40	14,315	9,550	58,780
5(8)	40	14,315	9,550	68,330
CS pump switchover	105	12,680	22,190	90,250
RWST empty	NA	NA	NA	115,650

NOTES:

(1) See Table 6.3-8 for a description of the steps 1 through 5. See Table 6.2.2-3 for a description of containment spray pump switchover.

(2) Flow rates are based on runout flows which are conservatively high:

RHR pump = 4,500 gpm per pump
CCHG pump = 450 gpm per pump
SI pump = 450 gpm per pump
CS pump = 3,725 gpm per pump

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TABLE 6.3-12 (Sheet 2)

NOTES: (Continued)

(3) Valve operating times are maximum operating times.

(4) Includes an extra allowance of time (30 seconds) for valves 8811 A/B to automatically open and valves 8812 A/B to automatically close.

(5) Time required to complete the required action includes a conservative 30 seconds for operator response time for each manual procedure.

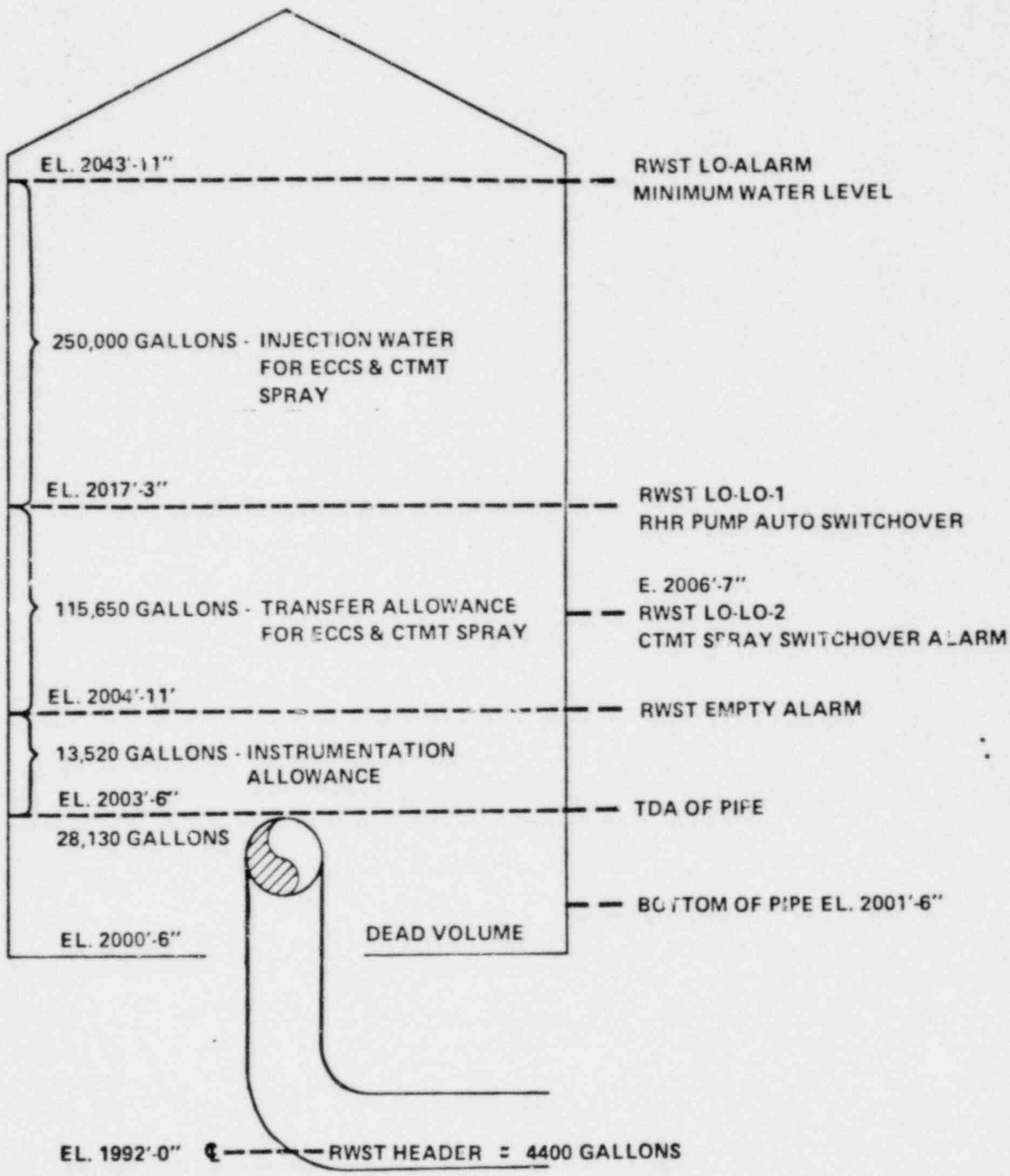
(6) The flow rate in this column is assumed to occur during the entire time interval for its respective step. This is conservative, since valve repositioning may reduce the flow rate during the time interval.

(7) Flow out of the RWST during switchover includes allowances for both pumped flow to the RCBS and containment and backflow to the containment sump.

(8) Following the completion of this step, all ECCS pumps are aligned with suction flow from the containment sump with the exception of one residual heat removal pump due to the single failure.

(9) Based on a large break LOCA in conjection with a single failure of one of the RWST to residual heat removal pump isolation valves (8812 A or 8812 B fails to close on demand).

RWST



NOTE: TANK VOLUME IS 9380 GAL/FT.

SNUPPS

FIGURE 6.3-7

RWST LEVELS
AND VOLUMES