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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. Quay

SUBJECT: RNS CONTAINMENT PENETRATION ISOLATION, KEY ISSUE #10

Dear Mr. Quay:

In your letter of April 11, 1997 on AP600 Isolation Requirements for Normal Residual Heat Removal System (RNS) the staff rejected the Westinghouse position on containment isolation for the normal residual heat removal system outlined in our February 20, 1997 letter. The AP600 design was isolation of the normal residual heat removal system using the high containment radiation signal. The staff position is that diversity in sensed parameters for initiation containment isolation should be used to effect normal residual heat removal system containment isolation. This issue was identified as a key issue in your letter of December 6, 1996.

The AP600 design has been changed to conform to the staff position. The generic safeguards activation signal will be added to the logic to close the normal residual heat removal system containment isolation valves. The attached SSAR markups identify the changes that are required to implement this provision.

Provisions are available to block the high containment radiation and safeguards activation below P-11. The block is automatically cleared above P-11. This block is provided to prevent a potential interruption in decay heat removal due to a spurious signal. A reset of the safeguards activation signal is also provided at the valve level. The reset is provided to permit the defense in depth normal residual heat removal system function post accident without the need of resetting safeguards activation globally. The high containment radiation signal is not reset at the valve level to prevent aligning the normal residual heat removal system with a high source term in the containment. A high radiation signal would cause the valves to close and RNS pump to trip after a reset of the safeguards activation signal.

This change to the design and SSAR revision will close this issue. If you have any questions please contact D. A. Lindgren at (412) 374-4856.

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control valve as well as the letdown line containment isolation valve receives a signal to automatically close once the appropriate level is attained. Alarms actuate in the main control room if the level continues to drop to alert the operator to manually isolate the letdown line.

5.4.7.4.3 Refueling

Both residual heat removal pumps and heat exchangers remain operating during refueling. Water transfers from the in-containment refueling water storage tank to the refueling cavity are performed by the spent fuel pool cooling system (SFS). This function has traditionally been performed by residual heat removal systems. That capability still exists if the need arises. To improve clarity in the refueling cavity and reduce operational radiation exposure, the spent fuel pool cooling system is used to flood the refueling cavity without flooding through the reactor vessel.

As decay heat decreases and as fuel is moved to the spent fuel pool, one residual heat removal pump and heat exchanger may be taken out of service. However, the valves remain aligned should the need arise to start this pump quickly in case of a failure of the operating residual heat removal pump.

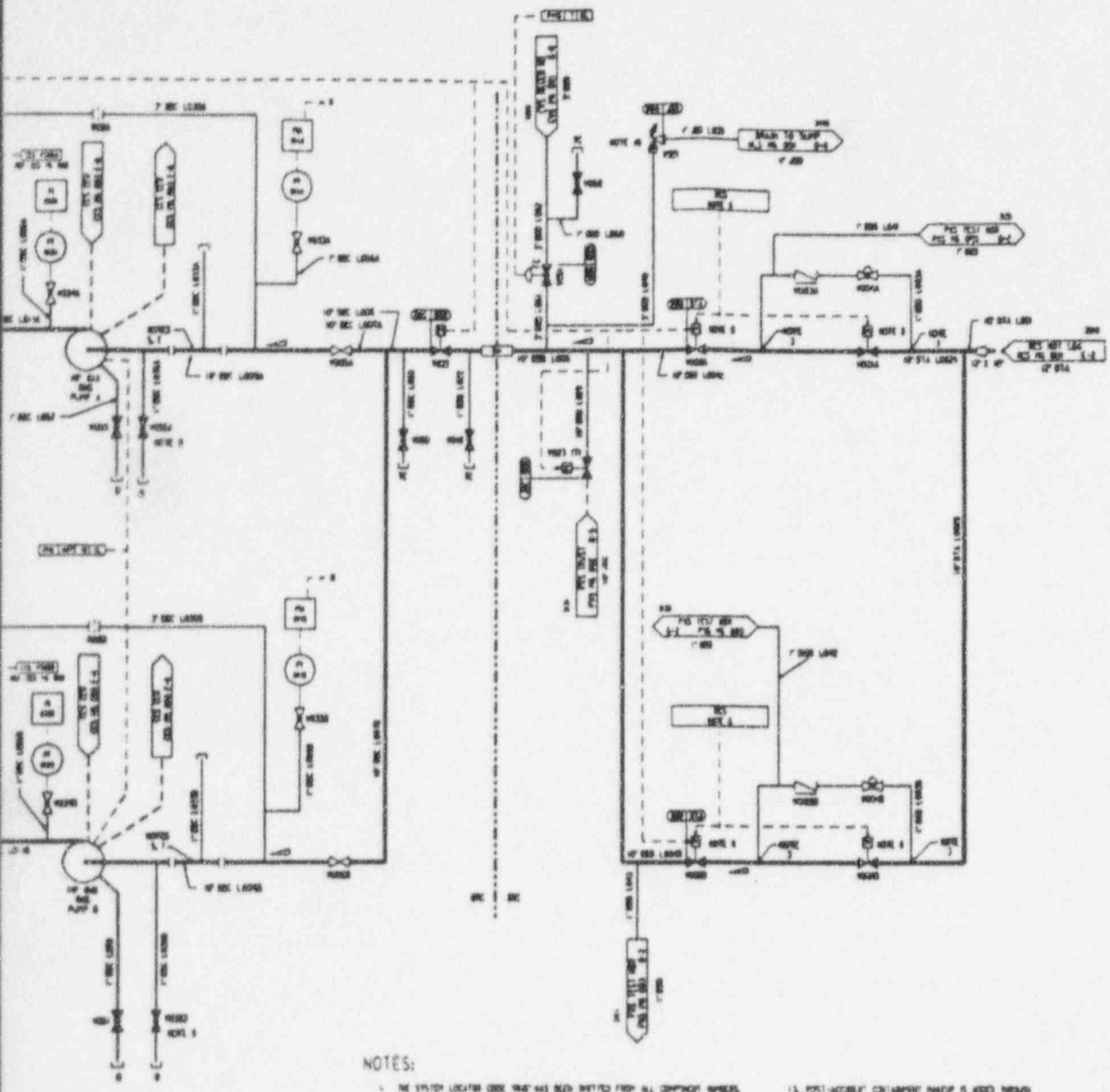
5.4.7.4.4 Accident Recovery Operations

Upon actuation of automatic depressurization, the normal residual heat removal system can be employed to provide low-pressure reactor coolant system makeup. Provided that radiation levels inside containment are below a high radiation value and after resetting the safeguards actuation signal to the valves as necessary, the operator may open the IRWST suction valves and the residual heat removal suction and discharge isolation valves and start the residual heat removal pumps. Water is pumped from the IRWST to the direct vessel injection lines. Operation of the normal residual heat removal system will not prevent the passive core cooling system from performing its safety functions.

5.4.7.4.5 Spent Fuel Pool Cooling

The normal residual heat removal system has the capability of being connected to supplement or take over the cooling function of the spent fuel pool cooling system. The normally closed valves in the cross-connecting piping are opened. One normal residual heat removal pump is started. Spent fuel pool water is drawn through the pump, passed through a heat exchanger and returned to the pool.

This mode of cooling is available when the normal residual heat removal system is not needed for normal shutdown cooling. The spent fuel pool water flow path between the spent fuel pool and the normal residual heat removal system is independent of the flow path used for spent fuel pool cooling by the spent fuel pool cooling system.



NOTES:

Valves close and pumps stop on high radiation and safeguards actuation signals.

Figure 5.4-7

Normal Residual Heat Removal System Piping and Instrumentation Diagram

6.2.3.2.3 System Operation

During normal system operation, approximately 25 percent of the penetrations are not isolated. These lines are automatically isolated upon receipt of isolation signals, as described in subsections 6.2.3.3 and 6.2.3.4 and Chapter 7. Lines not in use during power operation are normally closed and remain closed under administrative control during reactor operation.

6.2.3.3 Design Evaluation

A. Engineered safeguards and containment isolation signals automatically isolate process lines which are normally open during operation. The containment isolation system uses diversity in the parameters sensed for the initiation of redundant train-oriented isolation signals. The majority of process lines are closed upon receipt of a containment isolation signal. This safeguards signal is generated by any of the following initiating conditions.

- Low pressurizer pressure
- Low steam-line pressure
- Low T_{cold}
- High containment pressure
- Manual containment isolation actuation

The component cooling water lines penetrating containment provide cooling water to the reactor coolant pumps and chemical and volume control system and liquid radwaste system heat exchangers. The reactor coolant pumps are interlocked to trip following a safeguards actuation (S) signal but will continue to operated (if in service) following a containment isolation (T) signal. In order to provide reliable cooling to the reactor coolant pumps the component cooling lines are isolated on a safeguards actuation signal rather than on a containment isolation signal. The safeguards actuation signal is generated by any of the following conditions.

- Low pressurizer pressure
- Low steam line pressure
- Low reactor coolant inlet temperature
- High containment pressure
- Manual initiation

The chemical and volume control system charging line, normal residual heat removal system reactor coolant and IRWST cooling lines, and containment air filtration system containment purge lines are isolated on high containment radiation signals. Closure of the containment air filtration system isolation valves is based on providing rapid response to elevated activity conditions in containment to limit offsite doses and is initiated on either a high radiation signal or a containment isolation signal consistent with the requirements of NUREG-0737 (Reference 22) and NUREG-0718 Rev 2 (Reference 23). The isolation of the ~~normal residual heat removal system cooling lines and~~ chemical and volume control system charging line on a high radiation signal and normal residual heat removal system cooling lines on a high radiation or safeguards actuation signal with

provisions to reset safeguards actuation signal for the normal residual heat removal system valves permits a defense in depth response to a postulated accident by providing for normal residual heat removal system and chemical and volume control system operation ~~permitting these normal operating systems to continue to operate (when in service)~~ unless there is an ~~elevated~~ high radiation level present.

The remainder of the containment isolation valves are closed on parameters indicative of the need to isolate.

B. Upon failure of a main steam line, the steam generators are isolated, and the main steam-line isolation valves, main steam-line isolation bypass valves, power operated relief block valves, and the main steam-line drain are closed to prevent excessive cooldown of the reactor coolant system or overpressurization of the containment.

The two redundant train-oriented steam-line isolation signals are initiated upon receipt of any of the following signals:

- Low steam-line pressure
- High steam pressure negative rate
- High containment pressure
- Manual actuation
- Low T_{cold}

The main steam-line isolation valves, main steam line isolation valve bypass valves, main feedwater isolation valves, steam generator blowdown system isolation valves, and piping are designed to prevent uncontrolled blowdown from more than one steam generator. The main steam-line isolation valves and main feedwater isolation valves close fully within 5 seconds after an isolation is initiated. The blowdown rate is restricted by steam flow restrictors located within the steam generator outlet steam nozzles in each blowdown path. For main steam-line breaks upstream of an isolation valve, uncontrolled blowdown from more than one steam generator is prevented by the main steam-line isolation valves on each main steam line.

Failure of any one of these components relied upon to prevent uncontrolled blowdown of more than one steam generator does not permit a second steam generator blowdown to occur. No single active component failure results in the failure of more than one main steam isolation valve to operate. Redundant main steam isolation signals, described in Section 7.3, are fed to redundant parallel actuation vent valves to provide isolation valve closure in the event of a single isolation signal failure.

The effects on the reactor coolant system after a steam-line break resulting in single steam generator blowdown and the offsite radiation exposure after a steam line break outside containment are discussed in Chapter 15. The containment pressure transient following a main steam-line break inside containment is discussed in Section 6.2.

Table 6.2.3-1

Containment Mechanical Per

System	Containment Penetration			Valve/Hatch Identification	SSAR Subsectio
	Line	Flow	Closed Sys IRC		
PXS	N_2 to accumulators	In	No	PXS-PL-V042 PXS-PL-V043	6.3
RNS	RCS to RHR pump	Out	No	RNS-PL-V002A/B RNS-PL-V023 RNS-PL-V022 RNS-PL-V021 RNS-PL-V061 PXS-PL-V208A	5.4.7 5.4.7 5.4.7 5.4.7 5.4.7 6.3
	RHR pump to RCS	In	No	RNS-PL-V011 RNS-PL-V013	5.4.7
SFS	IRWST/Ref. cav. SFP pump discharge	In	No	SFS-PL-V038 SFS-PL-V037	9.1.3
	IRWST/Ref. cav. purif. out	Out	No	SFS-PL-V035 SFS-PL-V034	9.1.3
SGS	Main steamline 01	Out	Yes	SGS-PL-V040A SGS-PL-V027A SGS-PL-V030A,31A,32A SGS-PL-V036A SGS-PL-V240A	10.3
	Main steamline 02	Out	Yes	SGS-PL-V040B SGS-PL-V027B SGS-PL-V030B,31B,32B SGS-PL-V036B SGS-PL-V240B	10.3
	Main feedwater 01	In	Yes	SGS-PL-V057A	10.3
	Main feedwater 02	In	Yes	SGS-PL-V057B	10.3
	SG blowdown 01	Out	Yes	SGS-PL-V074A	10.3
	SG blowdown 02	Out	Yes	SGS-PL-V074B	10.3
	Startup feedwater 01	In	Yes	SGS-PL-V067A	10.3
	Startup feedwater 02	In	Yes	SGS-PL-V067B	10.3

etrations and Isolation Valves

Isolation Device			Test		
Position N-S-A	Signal	Closure Times	Type[1] & Note	Medium	Direction
O-O-C C-C-C	T None	std. N/A	C	Air	Forward
C-O-C C-O-C C-O-C C-C-C C-O-C C-C-C	HR, S HR, S HR, S None T None	std. std. std. N/A std. N/A	6 C C,4 C C C	Air	-- Reverse Forward Reverse Forward Forward
C-O-C C-O-C	HR, S None	std. N/A	C,4 C,4	Air	Forward
C-O-C C-O-C	T None	std. N/A	C,5	Air	Forward
C-O-C C-O-C	T T	std. std.	C,5	Air	Forward
O-C-C O-O-C C-C-C O-O-C C-C-C	MS LSL None MS MS	5 sec std. N/A std. std.	A,2	N_2	Forward
O-C-C O-O-C C-C-C O-O-C C-C-C	MS LSL None MS MS	5 sec std. N/A std. std.	A,2	N_2	Forward
O-C-C	MF	5 sec	A,2	H_20	Forward
O-C-C	MF	5 sec	A,2	H_20	Forward
O-O-C	PRHR	std.	A,2	H_20	Forward
O-O-C	PRHR	std.	A,2	H_20	Forward
C-O-C	LTC, SGL	std.	A,2	H_20	Forward
C-O-C	LTC, SGL	std.	A,2	H_2O	Forward

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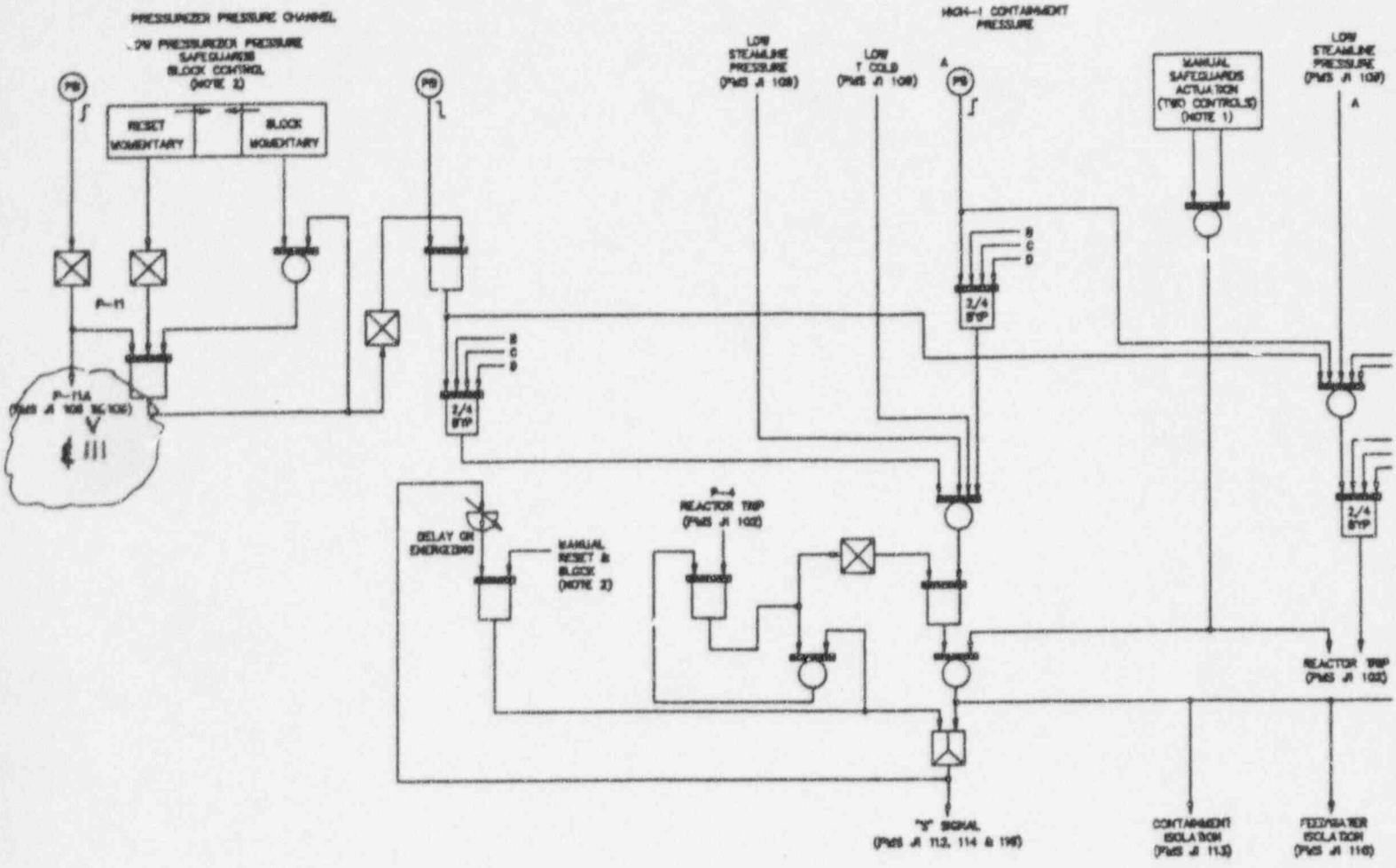

NOTES:

1. TWO MOMENTARY CONTROLS ON THE CONTROL BOARD. OPE CONTROL WILL ACTUATE ALL DIVISIONS.
2. SEPARATE MOMENTARY CONTROLS, ONE FOR EACH DIVISION

Figure 7.2-1 (Sheet 11 of 20)

Functional Diagrams
Safeguards Actuation

The functional logic relating to control room isolation and air supply initiation is illustrated in Figure 7.2-1, sheet 13.

7.3.1.2.18 Auxiliary Spray and Letdown Purification Line Isolation

A signal to isolate the auxiliary spray and letdown purification lines is generated upon the coincidence of pressurizer level below the Low-1 setpoint in any two of four divisions. This helps to maintain reactor coolant system inventory. This function can be manually blocked when the pressurizer water level is below the P-12 setpoint. This function is automatically unblocked when the pressurizer water level is above the P-12 setpoint. The functional logic relating to this is illustrated in Figure 7.2-1, sheet 12.

7.3.1.2.19 Containment Air Filtration System Isolation

A signal to isolate the containment air filtration system is generated upon the coincidence of containment radioactivity above the High-1 setpoint in any two of four divisions. This limits activity release to the environment. The functional logic relating to this is illustrated in Figure 7.2-1, sheet 13.

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7.3.1.2.20 Normal Residual Heat Removal System Isolation

A signal for isolating the normal residual heat removal system lines is generated upon the coincidence of containment radioactivity above the High-2 setpoint in any two of four divisions. This signal also isolates the chemical and volume control system as discussed in subsection 7.3.1.2.15. This limits activity release to the environment. The functional logic relating to this is illustrated in Figure 7.2-1, sheet 13.

7.3.1.2.21 Spent Fuel Pool Isolation

A signal for isolating the spent fuel pool lines is generated upon the coincidence of spent fuel pool level below the Low setpoint in two of three divisions. This helps to maintain the water inventory in the spent fuel pool due to line leakage. The functional logic relating to this is illustrated in Figure 7.2-1, sheet 13.

7.3.1.2.22 Chemical and Volume Control System Letdown Isolation

A signal to isolate the letdown valves of the chemical and volume control system is generated upon the occurrence of a low-1 hot leg level in either of the two hot leg loops. This helps to maintain reactor system inventory. The functional logic relating to this is illustrated in Figure 7.2-1, sheet 16. These letdown valves are also closed by the containment isolation function as described in subsection 7.3.1.2.1.

7.3.1.3 Blocks, Permissives, and Interlocks for Engineered Safety Features Actuation

The interlocks used for engineered safety features actuation are designated as "P-xx" permissives and are listed in Table 7.3-2.

7.3.1.2.20 Normal Residual Heat Removal System Isolation

Signals for isolating the normal residual heat removal system lines are generated from any of the following conditions:

1. Automatic or manual safeguards actuation signal (subsection 7.3.1.1)
2. High containment radioactivity

The isolation signal generated as a result of Condition 1 can be manually reset to block the isolation of the normal heat removal system lines. This is done to permit the normal residual heat removal system to operate after the occurrence of a safeguards actuation signal. Separate momentary controls are provided for resetting each division.

Condition 2 results from the coincidence of containment radioactivity above the High-2 setpoint in any two of the four divisions. This actuation can be manually blocked when pressurizer pressure is below the P-11 permissive setpoint. This actuation is automatically unblocked when the reactor coolant system pressure is above the P-11 setpoint.

The functional logic relating to normal residual heat removal system isolation is illustrated in Figure 7.2-1, sheet 13.

Table 7.3-1 (Sheet 7 of 8)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	No. of Channels/ Switches	Actuation Logic	Permissives and Interlocks
16. Main Control Room Isolation and Air Supply Initiation (Figure 7.2-1, Sheet 13)			
a. High-2 control room supply air radiation	2	1/2	None
b. Undervoltage to Class 1E battery chargers	2/charger	2/2 per charger and 2/4 chargers[3]	None
c. Manual initiation	2 switches	1/2 switches	None
17. Auxiliary Spray and Purification Line Isolation (Figure 7.2-1, Sheet 12)			
a. Low-1 pressurizer level	4	2/4-BYP[1]	Manual block permitted below P-12. Automatically unblocked above P-12.
18. Containment Air Filtration System Isolation (Figure 7.2-1, Sheet 13)			
a. High-1 containment radioactivity	4	2/4-BYP[1]	None
19. Normal Residual Heat Removal System Isolation (Figure 7.2-1, Sheet 13)			
b. High-2 containment radioactivity	4	2/4-BYP[1]	Manual block permitted below P-11 ~~None~~ Automatically unblocked above P-11
20. Spent Fuel Pool Isolation (Figure 7.2-1, Sheet 13)			
a. Low spent fuel pool level	3	2/3	None
21. Open In-Containment Refueling Water Storage Tank (IRWST) Injection Line Valves (Figure 7.2-1, Sheet 16)			
a. Automatic reactor coolant system depressurization (fourth stage)		(See items 3d and 3e)	
b. Coincident loop 1 and loop 2 low-2 hot leg level (after delay)	1 per loop	2/2	None
c. Manual initiation	4 switches	2/4 switches[3]	None
a Automatic or manual safeguards signal		(See items 1a through 1e)	

Table 7.3-2 (Sheet 1 of 3)

INTERLOCKS FOR ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Designation	Derivation	Function
P-4	Reactor trip switchgear open (reactor trip)	(a) Permits manual reset of safeguards actuation signal to block automatic safeguards actuation (b) Isolates main feedwater if coincident with low reactor coolant temperature (c) Trips turbine (d) Blocks boron dilution
$\overline{\text{P-4}}$	Reactor trip switchgear closed	Automatically resets the manual block of automatic safeguards actuation
P-6	Intermediate range neutron flux channels above setpoint	Allows manual block of flux doubling actuation of the boron dilution block.
$\overline{\text{P-6}}$	Intermediate range neutron flux channels below setpoint	Prevents manual block of flux doubling actuation, permitting block of boron dilution
P-11	Pressurizer pressure below setpoint	(a) Permits manual block of safeguards actuation on low pressurizer pressure, low compensated steam line pressure, or low reactor coolant inlet temperature (b) Permits manual block of steam line isolation on low reactor coolant inlet temperature (c) Permits manual block of steam line isolation and steam generator power-operated relief valve block valve closure on low compensated steam line pressure (d) Coincident with manual actions of (b) or (c), automatically unblocks steam line isolation on high negative steam line pressure rate (e) Permits manual block of main feedwater isolation on low reactor coolant temperature

Table 7.3-2 (Sheet 2 of 3)

INTERLOCKS FOR ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Designation	Derivation	Function
P-11 (continued)	Pressurizer pressure below setpoint	(f) Automatic block of chemical and volume control system isolation on high pressurizer water level
		(g) Permits manual block of startup feedwater isolation on low reactor coolant inlet temperature
		(h) Permits manual block of steam dump block on low reactor coolant temperature
$\overline{\text{P-11}}$	Pressurizer pressure above setpoint	(a) Prevents manual block of safeguards actuation on low pressurizer pressure, low compensated steam line pressure, or low reactor coolant inlet temperature
		(b) Prevents manual block of steam line isolation on low reactor coolant inlet temperature
		(c) Prevents manual block of steam line isolation and steam generator power-operated relief valve block valve closure on low compensated steam line pressure
		(d) Automatic block of steam line isolation on high negative steam line pressure rate
		(e) Prevents manual block of feedwater isolation on low reactor coolant temperature
		(f) Automatic unblock of chemical and volume control system isolation on high pressurizer water level
		(g) Prevents manual block of startup feedwater isolation on low reactor coolant inlet temperature

(i) Permits manual block of normal residual heat removal isolation on high containment radiation signal

(h) Automatic unblock of normal residual heat removal system isolation on high containment ~~isolation~~ radiation signal.

Table 7.3-3

SYSTEM-LEVEL MANUAL INPUT TO THE ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Manual Control	To Divisions	Figure 7.2-1 Sheet
Manual safeguards actuation #1	A B C D	2 & 11
Manual safeguards actuation #2	A B C D	2 & 11
Manual passive residual heat removal actuation #1	A B	8
Manual passive residual heat removal actuation #2	A B	8
Manual steam line isolation #1	B D	9
Manual steam line isolation #2	B D	9
Steam/feedwater isolation and safeguards block control #1	B	9
Steam/feedwater isolation and safeguards block control #2	D	9
Manual feedwater isolation #1	B D	10
Manual feedwater isolation #2	B D	10
Manual steam dump interlock selector #1	B	10
Manual steam dump interlock selector #2	D	10
Pressurizer pressure safeguards block control #1	A	11
Pressurizer pressure safeguards block control #2	B	11
Pressurizer pressure safeguards block control #3	C	11
Pressurizer pressure safeguards block control #4	D	11
Manual core makeup tank actuation #1	A B C D	12
Manual core makeup tank actuation #2	A B C D	12
Core makeup tank actuation block control #1	A	12
Core makeup tank actuation block control #2	B	12
Core makeup tank actuation block control #3	C	12
Core makeup tank actuation block control #4	D	12
Manual containment cooling actuation #1 & #2	A B	13
Manual containment cooling actuation #3 & #4	A B	13
Manual containment isolation actuation #1	A B C D	13
Manual containment isolation actuation #2	A B C D	13
Manual depressurization system stages 1, 2, and 3 actuation #1 & #2	A B C D	15
Manual depressurization system stages 1, 2, and 3 actuation #3 & #4	A B C D	15
Manual depressurization system stage 4 actuation #1 & #2	A B C D	15
Manual depressurization system stage 4 actuation #3 & #4	A B C D	15
Manual IRWST actuation #1 & #2	A B C D	16
Manual IRWST actuation #3 & #4	A B C D	16
Manual containment recirculation actuation #1 & #2	A B C D	16
Manual containment recirculation actuation #3 & #4	A B C D	16
Manual control room isolation and air supply initiation #1	A B C D	13
Manual control room isolation and air supply initiation #2	A B C D	13
RCS pressure CVS block control #1	A	6
RCS pressure CVS block control #2	B	6
RCS pressure CVS block control #3	C	6
RCS pressure CVS block control #4	D	6
RNS isolation safeguards block control #1	A B	13
RNS isolation safeguards block control #2	A B	13

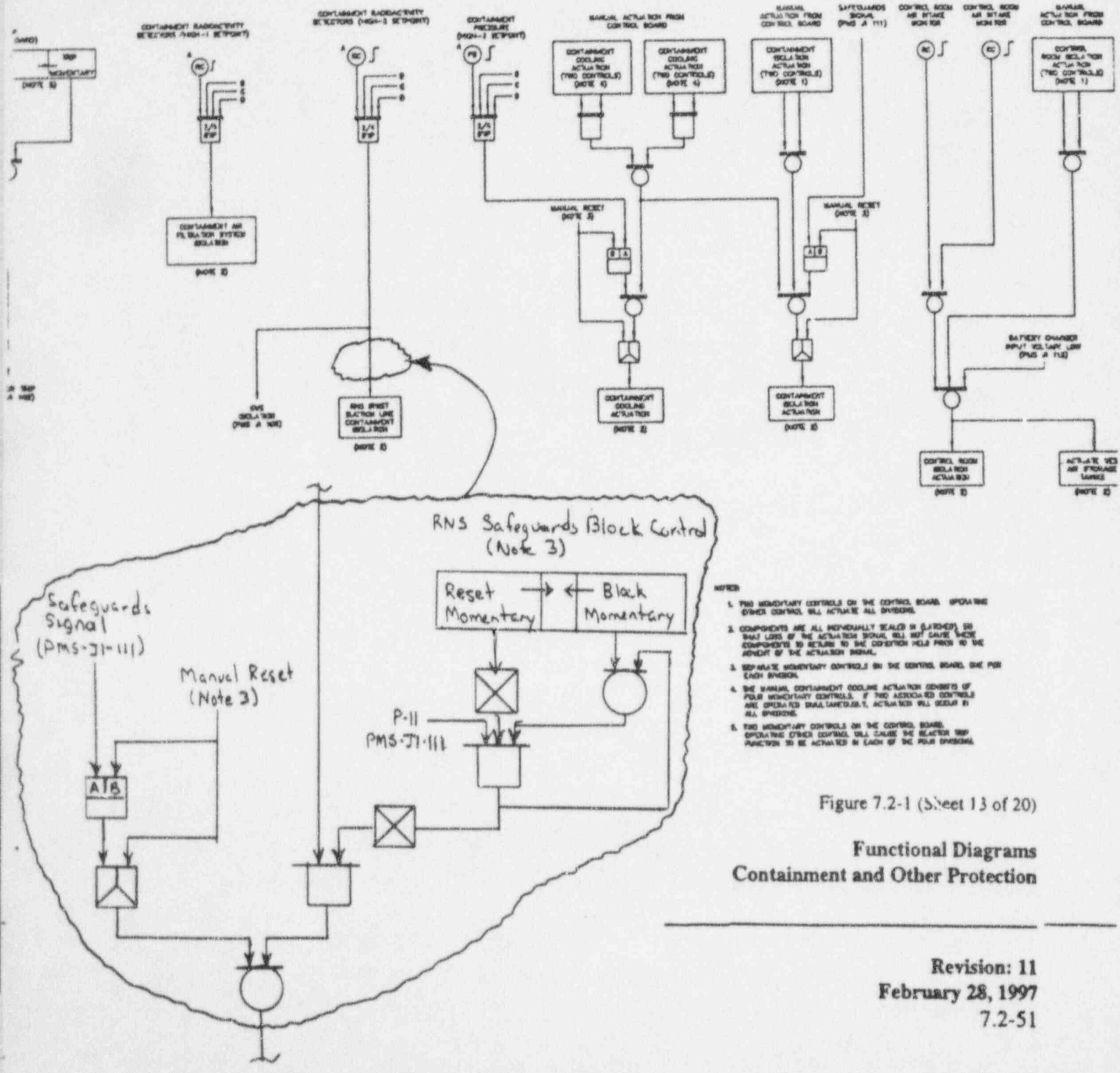

Figure 7.2-1 (Sheet 13 of 20)

Functional Diagrams
Containment and Other Protection