6.2.4.3.3 Evaluation Against General Design Criteria 56

6.2.4.3.3.1 Containment Purge

The drywell and suppression chamber purge lines have isolation capabilities commensurate with the importance of safely isolating these lines. Each line has two normally closed, air opened, spring closed valves located outside the primary containment. Containment isolation requirements are met on the basis that the purge lines up to the outboard isolation valves are normally closed, low pressure lines, constructed to the same quality standards as the containment. The isolation valves for the purge lines are interlocked to preclude opening of the valves while a containment isolation signal exists as noted in Table 6.2-12 and fail closed on loss of electrical signal with the following exceptions:

1. After a time delay of 45 minutes, a manual override of the LOCA isolation is available using the valve hand switches on the following valves: HV-15713, HV-15703, SV-15737, SV-15767, SV-15768, SV-25789, HV-15705, HV-15711, and SV-15738.

2. Target Rock valves, SV-15742A,B; SV-15740A,B; SV-15752A,B; SV-15750A,B; SV-15774A,B; SV-15776A,B; SV-15734A,B; SV-15736A,B; SV-15782A,B and SV-15780A,B can be opened 10 minutes after receipt of a LOCA isolation signal by using the valve hand switches.

Screens are provided on the drywell inlet and outlet purge lines. The purpose of the screens is to prevent debris generated by an accident, such as a pipe break, from entering the purge lines and preventing the containment isolation valves from closing. The screen is an expanded metal mesh with openings of .750 by 1.687 inch. The screens are safety related components designed to withstand the design basis earthquake.

Purge line debris screens are not required in the wetwell since the wetwell contains no high energy lines or insulation. Additionally, there is no mechanism that would allow debris, such as insulation from the drywell, to reach the penetrations in the wetwell before the containment isolation valves close. Therefore, debris screens have been provided in the drywell only.

TABLE 6.2-12
CONTAINMENT PENETRATION DATA

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E. S. F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION: NORMAL	VALVE POSITION: SHUTDOWN	VALVE POSITION: LOCA	VALVE POSITION: POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-7A	Main Steam and MSIV LCS	Steam	26	55	Yes	1F028A	Compressed Air	Spring	II/RPSB	O	A	GB	Open	Closed	Closed	Closed	3-5	(a)		(3)(26)
			2			1F001B	AC Mot	Manual	II	O	A	GT	Closed	Closed	Closed	As Is	13	-		(25)(27)
			26			1F022A	Inst Gas	Spring	I/RPSA	I	A	GB	Open	Closed	Closed	Closed	3-5	(a)		(26)(4)
X-8	Main Steam	Water	3	55	No	1F016	AC Mot	Manual	I	I	G	GT	Open	Closed	Closed	As Is	10	(a)	6'	
	Drain		3			1F019	DC Mot	Manual	II	O	G	GT	Open	Closed	Closed	As Is	10	(a)	0	
X-9A	Feed Water and HPCI,	Water	24	55	Yes	1F032A	AC Mot	Manual	I	O	B	CK	Open	Closed	-	As Is	120	-	17	(14)(11)
	RCIC, and		14			1F006	DC Mot	Manual	II	O	B	GT	Closed	Closed	Open	As Is	20	-		X-9B Only
	RWCU pump					155038	Manual	-	-	O	B	GB	Closed	Closed	Closed	Closed	-	-		X-9B Only
	discharge		6			1F013	DC Mot	Manual	I	O	B	GT	Closed	Closed	Open	As Is	15	-		X-9A Only
						149020	Manual	-	-	O	B	GB	Closed	Closed	Closed	Closed	-	-		X-9A Only
			4			1F042	DC Mot	Manual	I	O	B	GB	Open	Open	Open	As Is	80	-		(8)
			4			1F104	AC Mot	Manual	I	O	B	GB	Closed	Closed	Closed	As Is	80	-		(8)
			24			1F010A	Flow	-	-	I	B	CK	Open	Open	-	-	-	-		(11)(5)
X-10	Steam to RCIC	Steam	4	55	No	1F007	AC Mot	Manual	II	I	C	GT	Open	Closed	Open	As Is	20	(k)		(4)(15)
	Turbine		1			1F088	Inst Gas	Spring	II	I	C	GT	Open	Closed	Open	As Is	20	(k)		(4)(18)
			4			1F008	DC Mot	Manual	I	O	C	GT	Open	Closed	Open	As Is	20	(k)	0'	(15)
X-11	Steam to	Steam	10	55	Yes	1F003	DC Mot	Manual	II	O	C	GT	Open	Closed	Open	As Is	50	(1)	0'	(15)
	HPCI		1			1F100	Inst Gas	Spring	I	I	C	GB	Closed	Closed	Closed	Closed	3	(1)		(18)(4)
	Turbine		10			1F002	AC Mot	Manual	I	I	C	GT	Open	Closed	Open	As Is	50	(1)		(15)(4)
X-12	RHR Shut-	Water	20	55	No	1F008	DC Mot	Manual	II	O	H	GT	Closed	Open	Closed	As Is	100	(b)	0	
	down Supply		20			1F009	AC Mot	Manual	I	I	H	GT	Closed	Open	Closed	As Is	100	(b)		
			1			PSV1F126	Water	-	-	I	H	RLF	Closed	Closed	Closed	-	-	-		(4)
X-13A	RHR Shut-	Water	24	55	Yes	1F015A	AC Mot	Manual	I	O	N	GT	Closed	Open	Open	As Is	24	-	0	(11)
	down Return		24			1F050A	Flow	Spring	I	I	N	TCK	Closed	Open	Open	-	-	-		(11)(5)
			1			1F122A	Inst Gas	Spring	I	I	N	GB	Closed	Closed	Closed	Closed	3	-		(11)

TABLE 6.2-12 (Cont'd)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E.S.F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION: NORMAL	SHUTDOWN	LOCA	POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-14	Reactor Water Clean Up Supply	Water	6	55	No	1F001	AC Mot	Manual	I	I	G	GT	Open	Open	Closed	As Is	30	(c)		
			6			1F004	DC Mot	Manual	II	O	G	GT	Open	Open	Closed	As Is	30	(d),I	0	
X-16A	Core Spray	Water	12	55	Yes	1F005A	AC Mot	Manual	I	O	N	GT	Closed	Closed	Open	As Is	12	-	0	(11)
			12			1F006A	Flow	-	I	I	N	TCK	Closed	Closed	Open	-	-	-		(11)(5)
			1			1F037A	Inst Gas	Spring	I	I	N	GB	Closed	Closed	Closed	-	3	-		(11)
X-17	RPV Head Spray	Water	6	55	No	1F023	DC Mot	Manual	II	O	U	GB	Closed	Open	Closed	As Is	20	(d)	0	
			6			1F022	AC Mot	Manual	I	I	U	GT	Closed	Open	Closed	As Is	30	(d)		
X-19	Instrument Gas	N_2/Air Mix	3	56	No	SV12651	AC Coil	-	I	O	I	GB	Open	Open	Closed	Closed	2	F, G		
						126074	Flow	-	-	I	I	CK	Open	Open	Closed	-	-	-		(5)
X-21	Instrument Gas	N_2/Air Mix	1	56	Yes	SV12654B	DC Coil	-	I	O	I	GB	Open	Open	Open	Open	1	-		
						126152	Flow	-	-	I	I	CK	Open	Open	Open	-	-	-		(5)
X-23	Closed Cooling Water Supply	Water	4	56	No	HV11314	AC Mot	Manual	I	O	Z	GT	Open	Closed	Closed	As Is	30	F, G		
						HV11346	AC Mot	Manual	II	I	Z	GT	Open	Closed	Closed	As Is	30	F, G		
X-24	Closed Cooling Water Return	Water	4	56	No	HV11313	AC Mot	Manual	I	O	Z	GT	Open	Closed	Closed	As Is	30	F, G	0	
						HV11345	AC Mot	Manual	II	I	Z	GT	Open	Closed	Closed	As Is	30	F, G		
X-25	Drywell Purge Supply	Air/N_2	24	56	No	HV15722	Comp Air	Spring	I(IB)	O	Y	BF	Closed	Closed	Closed	Closed	30/15	B,F,R	0	(4)(32)
			24			HV15723	Comp Air	Spring	II	O	Y	BF	Closed	Closed	Closed	Closed	30/15	B,F,R	14	(8)(32)
			6			HV15721	Comp Air	Spring	II	O	Y	BF	Closed	Closed	Closed	Closed	6	B,F,R		
			18			HV15724	Comp Air	Spring	II	O	Y	BF	Closed	Closed	Closed	Closed	19/15	B,F,R	10	(8)(32)
X-26	Drywell Purge Return	Air/N_2	24	56	No	HV15713	Comp Air	Spring	I(IB)	O	E	BF	Closed	Closed	Closed	Closed	30/15	B,F,R	0(4)	(22) 45 min.(32) (23)HS-1750SAA (24)HS-15713A
			24			HV15714	Comp Air	Spring	II	O	E	BF	Closed	Closed	Closed	Closed	30/15	B,F,R		(32)
			2			HV15711	Comp Air	Spring	II	O	E	GB	Closed	Closed	Closed	Closed	5	B,F,R		(22) 45 min. (23)HS-17508BA (24)HS-15711B

TABLE 6.2-12 (Cont'd)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E. S. F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION NORMAL	VALVE POSITION SHUTDOWN	VALVE POSITION LOCA	VALVE POSITION POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-35A and C thru F	TIP Drivers		3/8	56	No	J004	AC Coil	None		O	W	BL	Closed	Closed	Closed	As Is	5	A, F	2'	(70)(21)
						J004	AC Explosion	None		O	W	Shear	Open	Open	Open	Open	1	-	2'	(20)(21)
X-37A,B C,D	CRD Insert	Water	1	55	Yes															(19)
X-38A,B C,D	CRD Withdrawal	Water	3/4	55	Yes															(19)
X-39A	Drywell Spray	Water	12	54	Yes	1F016A	AC Mot	Manual	I	O	D	GB	Closed	Closed	Closed	As Is	90	F,G	7'	(6)(11)
X-41	Instrument Gas	N_2/Air Mix	1	56	Yes	SV12654A	DC Coil	-	I	O	I	GB	Open	Open	Open	Open	1	-		
						126154	Flow	-	-	I		CK	Open	Open	Open		-	-		(5)
X-42	Standby Liquid Control	Water	1-1/2	55	Yes	1F006	AC Mot	Manual	I	O	K	GCK	Open	Open	Open	As Is	34	-	6'	
						1F007	Flow	-	-	I	K	CK	Closed	Closed	Closed	-		-	16'	(5)
X-53	Chilled Water Supply "B"	Water	8	56	No	HV18781B1	Comp Air	Spring	II	O	L	GT	Open	Open	Closed	Closed	40	F,G	0	
						HV18782A1	Inst Gas	Spring	I	I	L	BF	Open	Open	Closed	Closed	6	F,G		
X-54	Chilled Water Return "B"	Water	8	56	No	HV18781B2	Comp Air	Spring	II	O	L	GT	Open	Open	Closed	Closed	40	F,G	0	
						HV18782A2	Inst Gas	Spring	I	I	L	BF	Open	Open	Closed	Closed	6	F,G		
X-55	Chilled Water Supply "A"	Water	8	56	No	HV18781A1	Comp Air	Spring	I	O	L	GT	Open	Open	Closed	Closed	40	F,G	0	
						HV18782B1	Inst Gas	Spring	II	I	L	BF	Open	Open	Closed	Closed	6	F,G		
X-56	Chilled Water Return "A"	Water	8	56	No	HV18781A2	Comp Air	Spring	I	O	L	GT	Open	Open	Closed	Closed	40	F,G	0	
						HV18782B2	Inst Gas	Spring	II	I	L	BF	Open	Open	Closed	Closed	6	F,G		
X-60A	Sample & Analyzer	Gas	1	56	Yes	SV15740A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15750A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15742A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15752A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.

TABLE 6.2-12 (Cont'd)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E.S.F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION NORMAL	SHUTDOWN	LOCA	POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-60A	Recirc Pump Seal Water Supply	Water	1	55	No	XV1F017A	Flow	-	-	O	BB	XFC	Open	Open	Open	-	-	-	0	(20) "B" Valves o
						1F013A	Flow	-	-	I	BB	CK	Open	Open	Open	-	-	-		(20) penetration X-31B
X-60B	Sample & Analyzer	Water	3/4	55	No	1F019	Inst Gas	Spring	I	I	Q	GB	Closed	Closed	Closed	Closed	2	B,C		
			1			1F020	Comp Air	Spring	II	O	Q	GB	Closed	Closed	Closed	Closed	2	B,C	2'	
X-61A	Demin. Water	Water	1	56	No	141018	Manual	-	-	I	-	GB	Closed	Closed	Closed	Closed	-	-		
						141017	Manual	-	-	O	-	GB	Closed	Closed	Closed	Closed	-	-		
X-61A	ILRT Leak	Gas	1	56	No	Inbd. 157193 (Unit 1) 257200 (Unit 2)	Manual	-	-	I	-	GB	Closed	Closed	Closed	Closed	-	-		
	Verification					Outbd. 157194 (Unit 1) 257199 (Unit 2)	Manual	-	-	O	-	GB	Closed	Closed	Closed	Closed	-	-		
X-72A	Equipment Drain	Water	3	56	No	HV16116A1	Comp Air	Spring	I	O(IB)	F	GT	Closed	Closed	Closed	Closed	15	B,F	0	
						HV16116A2	Comp Air	Spring	II	O	F	GT	Closed	Closed	Closed	Closed	15	B,F		
X-72B	Floor Drain	Water	3	56	No	HV16108A1	Comp Air	Spring	I	O(IB)	F	GT	Closed	Closed	Closed	Closed	15	B,F	0	
						HV16108A2	Comp Air	Spring	II	O	F	GT	Closed	Closed	Closed	Closed	15	B,F	1	
X-80C	H_2O Analyzer & Drywell N_2 Makeup	Gas	1	56	Yes	SV15750B	AC Coil	Spring	II	O(IB)	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15740B	AC Coil	Spring	II	O(IB)	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15776B	AC Coil	Spring	II	O(IB)	Q	GB	Open	Open	Closed	Closed	1	B,F,R		(22) 10 Min. (24) HS 15736B
						SV15742B	AC Coil	Spring	II	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15752B	AC Coil	Spring	II	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15774B	AC Coil	Spring	II	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15767	AC Coil	Spring	II	O	Q	GB	Closed	Closed	Closed	Closed	1	B,F,R		(27) 45 Min.
X-85A	Chilled Water to Recirc Pump A	Water	3	56	No	HV18791A1	Comp Air	Spring	I	O	L	GT	Open	Closed	Closed	Closed	15	B,F	6	
						HV18792B1	Inst Gas	Spring	II	I	L	BF	Open	Closed	Closed	Closed	4	B,F		
X-85B	Chilled Water from Recirc Pump A	Water	3	56	No	HV18791A2	Comp Air	Spring	I	O	L	GT	Open	Closed	Closed	Closed	15	B,F	6	
						HV18792B2	Inst Gas	Spring	II	I	L	BF	Open	Closed	Closed	Closed	4	B,F		

TABLE 6.2-12 (Cont'd)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E. S. F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION NORMAL	VALVE POSITION SHUTDOWN	VALVE POSITION LOCA	VALVE POSITION POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-86A	Chilled Water to Recirc Pump B	Water	3	56	No	HV18791B1	Comp Air	Spring	II	0	L	GT	Open	Closed	Closed	Closed	15	B,F	0	
						HV18792A1	Inst Gas	Spring	I	I	L	BF	Open	Closed	Closed	Closed	4	B,F		
X-86B	Chilled Water from Recirc Pump B	Water	3	56	No	HV18791B2	Comp Air	Spring	II	0	L	GT	Open	Closed	Closed	Closed	15	B,F	0	
						HV18792A2	Inst Gas	Spring	I	I	L	BF	Open	Closed	Closed	Closed	4	B,F		
X-87	Instrument Gas Return	N_2/Air Mix	2	56	No	SV12605	AC Coil	Spring	II	0	T	GB	Open	Closed	Open	Closed	1	F,G	0	(4)
						HV12603	AC Mot	Manual	I	1	T	GB	Open	Closed	Open	As Is	20	F,G	-	
X-88B	H_2O_2 Analyzer & Ctmt. Rad. Det. Return	Gas	1	56	Yes	SV-15776A	Comp Air	Spring	I	O(IB)	Q	GB	Open	Open	Closed	Closed	1	B,F	0	(22) 10 Min.
			1	56	Yes	SV-15774A	Comp Air	Spring	I	0	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
X-93	TIP Instruments	N_2/Air Mix	1	56	No	SV12661	AC Coil	Spring	I	0	AA	GB	Open	Closed	Closed	Closed	1	B,F		
						126072	Flow	-		I	AA	CK	Open	Closed	-	-	-	-	-	
X-201A	Suppression Chamber Purge Supply	Air/N_2	18	56	No	HV15725	Comp Air	Spring	I	O(IB)	Y	BF	Closed	Closed	Closed	Closed	19/15	B,F,R	0	(4)(32)
			18			HV15724	Comp Air	Spring	II	0	Y	BF	Closed	Closed	Closed	Closed	19/15	B,F,R	10	(8)(32)
			6			HV15721	Comp Air	Spring	II	0	Y	BF	Closed	Closed	Closed	Closed	6	B,F,R		(8)
			24			HV15723	Comp Air	Spring	II	0	Y	BF	Closed	Closed	Closed	Closed	30/15	B,F,R	14	(8)(32)
X-202	Suppression Chamber Purge Exhaust	Air/N_2	18	56	No	HV15703	Comp Air	Spring	I	O(IB)	E	BF	Closed	Closed	Closed	Closed	19/15	B,F,R	0	(22)45 Min. (32) (24)HS-15703A (23)HS-17508AA
			18			HV15704	Comp Air	Spring	II	0	E	BF	Closed	Closed	Closed	Closed	19/15	B,F,R	15	(32)
			2			HV15705	Comp Air	Spring	II	0	E	GB	Closed	Closed	Closed	Closed	5	B,F,R	-	(22)45 Min. (23)HS-17506FA (24)HS-15705B
X-203A	RHR Pump Suction	Water	24	56	Yes	1F004A	AC Mot	Manual	I	0	O	GT	Open	Closed	Open	As Is	123	-	0	(4)(6)(29)
X-204A	RHR Pump Test Line & Steam Condensing Recirc.	Water	18	56	Yes	1F028A	AC Mot	Manual	I	0	X	GT	Closed	Closed	Closed	As Is	90	F,G	24	(8)(6)(11)(28)
			4		No	1F011A	AC Mot	Manual	I	0	X	GT	Closed	Closed	Closed	As Is	23	F,G	150	(8)(6)(11)

TABLE 6.2-12 (Cont'd)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E. S. F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION (13)	ARRANGEMENT (12)	VALVE TYPE (1)	VALVE POSITION NORMAL	VALVE POSITION SHUTDOWN	VALVE POSITION LOCA	POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-205A	Containment Spray	Water	18	56	Yes	1F028A	AC Mot	Manual	I	O	X	GT	Closed	Closed	Closed	As Is	90	F,G		(8)(6)(11)(28)
			4		No	1F011A	AC Mot	Manual	I	O	X	GT	Closed	Closed	Closed	As Is	23	F,G	137	(8)(6)(11)
X-206A	Core Spray Pump Suction	Water	16	56	Yes	1F001A	AC Mot	Manual	I	O	O	GT	Open	Open	Open	As Is	83	-	0	(4)(6)(11)
X-207A	Core Spray Pump Test & Flush	Water	10	56	Yes	1F015A	AC Mot	Manual	I	O	R	GB	Closed	Closed	Closed	As Is	60	F,G	0	(4)(6)(11)
X-208A	Core Spray Pump Min. Recirc	Water	3	56	Yes	1F031A	AC Mot	Manual	I	O	R	GT	Open	Closed	Closed	As Is	20	-		(4)(6)(11)
X-209	HPCI Pump Suction	Water	16	56	Yes	1F042	DC Mot	Manual	II	O	O	GT	Closed	Closed	Open	As Is	90	(1)	0	(4)(16)
X-210	HPCI Turb Exhaust	Steam	20	56	Yes	1F066 1F049	DC Mot Flow	Manual -	II	O(IB) O	H H	GT CK	Open Closed	Open Closed	Open Open	As Is -	111	-	0	(4)(5)(9)
X-211	HPCI Pump Min. Recirc	Water	4	56	Yes	1F012 1F046	DC Mot Flow	Manual -	II	O(IB) O	H H	GT CK	Closed Closed	Closed Closed	Closed Closed	As Is -	10	-	0	(4) (5)(9)
X-214	RCIC Pump Suction	Water	6	56	No	1F031	DC Mot	Manual	I	O	O	GT	Closed	Closed	Open	As Is	35	-		(4)(16)
X-215	RCIC Turb Exhaust	Steam	10	56	No	1F059 1F040	DC Mot Flow	Manual -	I -	O(IB) O	H H	GT CK	Open Closed	Open Closed	Open Open	As Is -	60	- -	0	(4) (5)(9)
X-216	RCIC Pump Recirc	Water	2	56	No	1F019 1F021	DC Mot Flow	Manual -	I -	O(IB) O	H H	GB CK	Closed Closed	Closed Closed	Closed Closed	As Is -	5 -	- -		(4) (5)(9)
X-217	RCIC Vacuum Pump Disch.	Air	2	56	No	1F060 1F028	DC Mot Flow	Manual -	I	O(IB) O	H H	GB CK	Open Closed	Open Closed	Open Open	As Is -	25 -	- -		(4) (5)(9)
X-218	Instrument Gas	N_2	1	56	No	SV12671 126164	AC Coil Flow	Spring -	I -	O O(IB)	CC CC	GB CK	Closed Closed	Closed Closed	Closed Closed	Closed -	1 -	B,F -		 (9)(5)
X-221A	H_2O_2 Analyzer,	N_2/Air	1	56	Yes	SV15780A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min. (11-Unit 2 Only)
	Ctmt. Rad Det., Sample Pts	Mix				SV15782A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min. (11-Unit 2 Only)

PENETRATION NO.	SERVICE	FLUID	PIPE SIZE (IN)	NRC DES. CRIT.	E.S.F. (30)	VALVE NUMBER	PRIMARY ACTUATION METHOD	SECONDARY ACTUATION METHOD	POWER SOURCE (17)	VALVE LOCATION(13)	ARRANGEMENT(12)	VALVE TYPE (1)	VALVE POSITION NORMAL	VALVE POSITION SHUTDOWN	VALVE POSITION LOCA	VALVE POSITION POWER FAILS	CLOSURE TIME (SECS)	ACTUATION SIGNAL (2)	LENGTH PIPE TO VALVE (OUTER)	REMARKS
X-226A	RHR Min. Recirc	Water	6	54	Yes	1F007A	AC Mot	Manual	I	O	R	GT	Open	Closed	Closed	As Is	32.5	-	0	(6)(4)(11)
X-233 (Unit 1 Only)	H_2O_2 Analyzer, Ctmt. Rad Det., Sample Pts	N_2/Air Mix	1	56	Yes	SV15782B	AC Coil	Spring	II	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
						SV15780B	AC Coil	Spring	II	O(IB)	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
X-238A	H_2O_2 Analyzer Return, Ctmt. Rad Det. & Post-Accident Sample	N_2/Air Mix	1	56	Yes	SV15736A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min. (24)HS-15736A
						SV15734A	AC Coil	Spring	I	O	Q	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
X-238B	H_2O_2 Analyzer & Ctmt. Rad Det. Return and LNG Makeup	N_2/Air Mix	1	56	Yes	SV15734B	AC Coil	Spring	II	O(IB)	DD	GB	Open	Open	Closed	Closed	1	B,F		(22) 10 Min.
					Yes	SV15736B	AC Coil	Spring	II	O	DD	GB	Open	Open	Closed	Closed	1	B,F,R		(22) 10 Min.
					No	SV15737	AC Coil	Spring	II	O	DD	GB	Closed	Closed	Closed	Closed		B,F,R		(22) 45 Min.
X-243	Suppression Pool Cleanup & Drain	Water	6	56	No	HV15766	AC Mot	Manual	I	O(IB)	S	GT	Closed	Closed	Closed	As Is	35	A,F	0	(4)
						HV15768	DC Mot	Manual	II	O	S	GT	Closed	Closed	Closed	As Is	30	A,F	1	
X-244	HPCI Vacuum Breaker	N_2/Air Mix	3	56	Yes	1F079	DC Mot	Manual	I	O(IB)	P	GT	Open	Open	Open	As Is	15	F,L B	0	(4)
						1F075	DC Mot	Manual	II	O	P	GT	Open	Open	Open	As Is	15	F,L B	7	
X-245	RCIC Vacuum Breaker*	Air/N_2	2	56	No	1F084	DC Mot	Manual	II	O(IB)	P	GT	Open	Open	Open	As Is	10	F,K B		(4)
						1F062	DC Mot	Manual	I	O	P	GT	Open	Open	Open	As Is	10	F,K B		
X-246A	RHR Relief Valve Discharge	Water/ Steam/ Air/Gas	8	56	Yes	PSV1F055A	Water Press	-		O	J	RLF	Closed	Closed	Closed	-		-		(6)(11)
			1			PSV15106A	Water Press	-		O	J	RLF	Closed	Closed	Closed	-		-		(6)(11)
			1			HV1F103A	AC Mot	Manual	I	O	J	GB	Closed	Closed	Closed	As Is		-		(6)(4)(11)(31)
			4			PSV1F097	Water Pressure	-		O	J	RLF	Closed	Closed	Closed	-		-		X-246B only

TABLE 6.2-12 (Continued)

NOTES

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(1) Valve Type

Ball	BL
Butterfly	BF
Check	CK
Gate	GT
Globe	GB
Globe Stop Check	GCK
Pressure Relief	RLF
Testable Check	TCK
Excess Flow Check	XFC
Explosive (Shear)	SHEAR

(2) Isolation Signal Codes

All power-operated isolation valves are capable of being operated remote-manually from the control room. Automatic isolation signals are listed and described below:

Signal	Description
A	Reactor Vessel Water Level - Low Level 3
B	Reactor Vessel Water Level - Low Level 2
C	Main Steam Line Radiation - High
D	Main Steam Line Flow - High
EA	Reactor Building Steam Line Tunnel Temperature - High
EB	Reactor Building Steam Line Tunnel Differential Temperature - High
EC	Turbine Building Steam Line Tunnel Temperature - High
F	Drywell Pressure - High
G	Reactor Vessel Water Level - Low, Low, Low Level I
I	Standby Liquid Control System Manual Initiation
JA	RWCS Differential Flow - High
JB	RWCS Differential Pressure - High
KA	RCIC Steam Line Pressure - High

TABLE 6.2-12 (Continued)

NOTES

Signal	Description
KB	RCIC Steam Supply Pressure - Low
KC	RCIC Turbine Exhaust Diaphragm Pressure - High
KD	RCIC Equipment Room Temperature - High
KE	RCIC Equipment Room Temperature - High
KF	RCIC Pipe Routing Area Temperature - High
KG	RCIC Pipe Routing Area Temperature - High
KH	RCIC Emergency Area Cooler Temperature - High
LA	HPCI Steam Line Pressure - High
LB	HPCI Steam Supply Pressure - Low
LC	HPCI Turbine Exhaust Diaphragm Pressure - High
LD	HPCI Equipment Room Temperature - High
LE	HPCI Equipment Room Temperature - High
LF	HPCI Emergency Air Cooler Temperature - High
LG	HPCI Pipe Routing Area Temperature - High
LH	HPCI Pipe Routing Area Temperature - High
MA	RHR Equipment Area Differential Temperature - High
MB	RHR Equipment Area Temperature - High
MC	RHR System Flow - High
P	Turbine First Stage Pressure - Low
R	SGTS Exhaust Radiation - High
UA	Main Condenser Vacuum - Low
UB	Reactor Vessel Pressure - High

TABLE 6.2-12 (Continued)

NOTES PAGE 10

Signal	Description
WA	RWCS Area Temperature - High
WB	RWCS Area Ventilation Differential Temperature - High

Isolation Actuation Groupings

(a)	B, C, D, EA, EB, EC, P, UA
(b)	A, MA, MB, MC, UB
(c)	B, JA, JB, WA, WB
(d)	A, F, MA, MB, MC, UB
(k)	KA, KB, KC, KD, KE, KF, KG, KH
(l)	LA, LB, LC, LD, LE, LF, LG, LH

(3) Test pressure is less than operating pressure - see Section 6.2.6.

(4) Test pressure is applied in reverse direction.

(5) Unassisted check valve is used as one containment boundary.

(6) External piping system provides one containment boundary.

(7) Intentionally deleted.

(8) Valve isolates two piping penetrations.

(9) Exemption required for check valve outside containment.

(10) Intentionally deleted.

(11) 'B' penetration data is identical with 'A' penetration data but with 'B' suffix except that, where applicable, power for 'A' penetration isolation valves are supplied from Division I power and power for 'B' penetration isolation valves are supplied from Division II.

(12) See Figure 6.2-44. Letters in this column refer to details in the figure.

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(13) For valve location, I indicates a valve inside the primary containment; O indicates a valve outside the primary containment. (IB) indicates the inboard of two or more series isolation valves located outside the containment.

(14) Check valve closed on reverse flow if feedwater is not available. Closure may be assisted remote-manually with motor-operator.

(15) Valve does not receive a LOCA signal but does receive a closure signal (k or l) for a break in the steam line to the turbine.

(16) Opens on condensate storage tank low level or suppression pool high level, and system isolation signal is not present.

(17) For air or gas operated valves, the power source listed is for the associated solenoid valve.

(18) These valves do not receive an isolation signal but they cannot be opened when a steam line break signal (k or l) is open.

(19) No containment isolation valves are provided. For explanation, refer to Subsection 4.6.1.

(20) The containment isolation scheme for this penetration has been analyzed "on some other defined basis" than CDC 55. See Subsection 6.2.4.3.2.

(21) Isolation of the Traversing Incore Probe (TIP) guide tube is accomplished normally be a solencid-operated ball valve when the TIP cable is withdrawn. The explosive (shear) valve is fired only when the cable jams in the inserted position.

(22) Interlock of the valve is designed to close upon LOCA signal but can be reopened after noted time (See 7.3.1.1b.1.3 and 6.2.4.3.3.1).

(23) Interlock of the valve is designed to close upon LOCA signal, but that signal can be bypassed and the valve can be reopened by noted handswitch (HS). LOCA bypass has no effect on H. H. Radiation closure and H. H. Radiation override has no effect on LOCA closure.

(24) Interlock of the valve is designed to close upon high radiation signal from the Standby Gas Treatment System exhaust, but that signal can be overridden and the valve reopened by noted handswitch (HS). LOCA bypass has no effect on H. H. Radiation closure and H. H. Rad Override has not effect on LOCA closure.

TABLE 6.2-12 (Continued)

(25) MSIVLCS isolation valves E32-F001 B, F, K & P are controlled by combined logic of MSIV position, time, and RPV pressure. The valve is normally-closed and locked out when the RPV pressure is greater than 35 psig or the inboard MSIV is not closed.

(26) Data in table for A penetration and valve also applies to B, C, and D penetrations and valves.

(27) The MSIVLCS isolation valves associated with steam lines A, B, C and D are E32-F001 B, F, K and P respectively.

(28) These valves can be opened post-LOCA if LPCI injection valve E11-F015 is closed or by manual isolation signal bypass, E11A-S18.

(29) "C" penetration data is identical to "A" penetration data but with "C" suffix. "B" and "D" penetration data is identical to "A" penetration data but with "B" and "D" suffixes and power supplied by Div. II.

(30) Engineered safety features systems are defined in Section 6.0.

(31) Valve HV-F103A must be remote-mannually opened when taking liquid samples post-accident.

(32) For these valves the first closure time is for Unit 1 valves and second is for the Unit 2 valves.

exists. The operator may control the RHR system manually after initiation to use its capabilities in the other modes of the RHR system, if the core is being cooled by other ECCS. Temperature, flow, pressure, and valve position indications are available in the main control room for the operator to assess the IPCI system operation accurately. Valves have indications of full open, intermediate, and full closed positions. Pumps have indications for pump running and pump stopped. Alarm and indication devices are shown in Figures 5.4-13 and 7.3-10.

7.3.1.1a.1.6.11.3 Set Points

Refer to the Technical Specifications for safety set points.

7.3.1.1a.2 Primary Containment and Reactor Vessel Isolation Control System - for NSSS Instrumentation and Controls

7.3.1.1a.2.1 System Identification

The PCRVICS includes the instrument channels, logics and actuation circuits that activate valve closing mechanisms associated with the valves, which, when closed, effect isolation of the primary containment or reactor vessel or both.

The PCRVICS include the following instrumentation and control subsystems:

(1) Reactor Vessel - Low Water Level

(2) Main Steamline - High Radiation

(3) Main Steamline Tunnel - High Temperature & Differential Temperature

(4) Main Steamline - High Flow

(5) Main Turbine Inlet - Low Steam Pressure

(6) Drywell - High Pressure

(7) Reactor Water Cleanup System - High Differential Flow

(8) Reactor Water Cleanup System - Area - High Temperature & Differential Temperature

(9) RHRS Area - High Temperature & Differential Temperature

(10) Main Steamline - Leak Detection

(11) Main Condenser - Vacuum Trip

(12) Reactor Water Cleanup System - High Flow

This system provides initiation to non-NSSS systems as follows:

(1) Containment Isolation (See Subsection 7.3.1.1b.1)

(2) Standby Gas Treatment System (See Subsection 7.3.1.1b.4)

(3) Reactor Building Isolation and HVAC Support System (See Subsection 7.3.1.1b.6)

The purpose of the system is to prevent the gross release of radioactive material in the event of a breach in the RCPB by automatically isolating the appropriate pipelines that penetrate the primary containment. The power generation objective of this system is to avoid spurious closure of particular isolation valves as a result of single failure. Identification of NSSS and non-NSSS valves closed by the PCRVICS is provided in Table 6.2-12.

7.3.1.1a.2.2 System Power Sources

Power for the system channels and logics of the isolation control system and main steamline isolation valves are supplied from the two electrical buses that supply the reactor protection system trip systems. Each bus has its own motor-generator set and can receive alternate power from the preferred power source. Each bus can be supplied from only one of its power sources at any given time. Motor-operated isolation valves receive power from emergency buses. Power for the operation of any two valves mounted series is supplied from separate or different sources. Inboard isolation valves are powered from the Division I ac power source. Outboard isolation valves use a Division II dc power source.

7.3.1.1a.2.3 System Equipment Design

Pipelines that penetrate the primary containment and drywell and directly communicate with the reactor vessel generally have two isolation valves, one inside the primary containment and one outside the primary containment. These automatic isolation valves are considered essential for protection against the gross release of radioactive material in the event of a breach in the RCPB.

Power cables run in raceways from the electrical source to each motor-operated isolation valve. Solenoid valve power goes from its source to the control devices for the valve. The main steamline isolation valve controls include pneumatic piping, and an accumulator for the gas operated valves as the emergency motive power source in addition to the springs. Pressure, temperature, and water level sensors are mounted on instrument racks or locally in either the secondary containment or the turbine building. The location of these sensors is shown on FSAR Figures 032.16-1 through 032.16-29. Valve position switches are mounted on motor and gas-operated valves. Switches are encased to protect them from environmental conditions. Cables from each sensor are routed in raceways to the control structure. All signals transmitted to the main control room are electrical; no piping from the reactor pressure coolant boundary penetrates the main control room. The sensor cables and power supply cables are routed to cabinets in the control or electrical equipment rooms, where the sensor signals and supplied power are arranged according to system logic requirements.

7.3.1.1a.2.4 System Initiating Circuits

During normal plant operation, the isolation control system sensors and trip controls that are essential to safety are energized. When abnormal conditions are sensed, contacts in the trip logic initiate isolation. Loss of both power supplies also initiates isolation.

Each main steamline isolation valve is fitted with two control solenoids. For any valve to close automatically, both of its solenoids must be deenergized. Each solenoid receives inputs from two logics; a signal from either can deenergize the solenoid.

For the main steamline isolation valve control, four instrument channels are provided for each measured variable. The four channels (A, B, C, and D) are independent and separate. One output of the Channels A and C logic actuators control one solenoid in both the inboard and outboard valves of all four main steamlines. One output of the Channels B and D logic actuators control the other solenoid in both inboard and outboard valves for all four main steamlines.

The main steamline drain valves and inboard valves close if two of the main steamline isolation logics are tripped, and the outboard valves close if the other two logics are tripped.

The reactor water cleanup system and RHR system isolation valves are each controlled by two logic circuits; one for the inboard valve and a second for the outboard valve.

7.3.1.1a.2.4.1 Isolation Functions and Settings

The isolation trip settings of the PCRVICS are listed in Table 7.3-5. The functional control diagram (Figure 7.3-8) illustrates how these signals initiate closure of isolation valves.

7.3.1.1a.2.4.1.1 Reactor Vessel Low Water Level

7.3.1.1a.2.4.1.1.1 Subsystem Identification

A low water level in the reactor vessel could indicate that reactor coolant is being lost through a breach in the RCPB and that the core is in danger of becoming overheated as the reactor coolant inventory diminishes.

Reactor vessel low water level initiates closure of various valves. The closure of these valves is intended to isolate a breach in any of the pipelines in which the valves are contained, conserve reactor coolant by closing off process lines, or prevent the escape of radioactive materials from the primary containment through process lines that communicate with the primary containment interior.

Three reactor vessel low water level isolation trip settings are used to complete the isolation of the primary containment and the reactor vessel.

The first low water level setting (which is the RPS low water level scram setting, Low Level 3) is selected to initiate isolation at the earliest indication of a possible breach in the reactor coolant pressure boundary, yet far enough below normal operational levels to avoid spurious isolation. Isolation of the following pipelines is initiated when reactor vessel low water level falls to Level 3:

(1) RHR-Reactor Vessel head spray

(2) RHR shutdown cooling suction

(3) TIP guide tube

(4) Non-NSSS system isolation as described in Subsection 7.3.1.1b.

The second (and lower) reactor vessel low water level isolation setting (the same water level setting at which the RCIC system is placed in operation, Low, Low Level 2) is selected low enough to allow the removal of heat from the reactor for a predetermined time following the scram and high enough to complete isolation in time for ECCS operation in the event of a large break in the RCPB. Isolation of the following pipelines is initiated when the reactor vessel water level falls to Level 2:

(1) Main steamlines

(2) Main steamline drain

(3) Reactor water sample line

(4) RWCU system suction

(5) Non-NSSS system isolation as described in Subsection 7.3.1.1b

The third (and lowest) reactor vessel low water level isolation setting (Low Low Low Level 1) is selected low enough to allow operation of those systems which may alleviate the effects of a LOCA inside of containment, yet high enough to allow isolation of those systems when an uncovered core may be imminent. Isolation of the following pipelines is initiated when the reactor vessel water level falls to Level 1:

(1) RHR - Drywell Spray

(2) RHR - Suppression Pool Spray

(3) RHR - Heat Exchanger Drain to Suppression Pool

(4) Core Spray Test Line

(5) Non-NSSS System isolation as described in Section 7.3.1.1b

Reactor vessel low water level signals are initiated from indicating type differential pressure switches. One contact on each of four redundant switches per trip system is used to indicate that water level has decreased to Low Level 3; one contact on each of four other redundant switches per trip system are used to indicate that water level has decreased to Low, Low Level 2 or low, low, low level 1 as required.

Three instrument lines, one common line above water level and one from each differential pressure switch to the below water level taps, are provided for each redundant pair of level switches. Each switch pair provides signals into one trip logic. There is a different trip logic for each switch pair. The three lines of each pair terminate outside the primary containment and inside

the reactor building; they are physically separated from each other and tap off the reactor vessel at widely separated points. The reactor vessel low water level switches sense level from these pipes. This arrangement assures that no single physical event can prevent isolation, if required. Cables from the level sensors are routed to the control structure. Temperature equalization is used to increase the accuracy of the level measurements.

7.3.1.1a.2.4.1.1.2 Subsystem Power Supplies

For the power supplies for main steamline isolation valves and other isolation valves, see Figures 7.3-2 and 7.3-3, respectively.

7.3.1.1a.2.4.1.1.3 Subsystem Initiating Circuits

Four level sensing circuits monitor the reactor vessel water level. One level circuit is associated with each of four logic channels. Four level switches at two separate locations on the reactor vessel allow the earliest possible detection of reactor vessel low water level.

7.3.1.1a.2.4.1.1.4 Subsystem Logic and Sequencing

When a significant decrease in reactor water level is detected, trip signals are transmitted to the PCRVICS, which initiates closure of the main steamline isolation valves, main steamline drain valves, RHR process sampling valve, RHR discharge valve to radwaste, reactor water sample valve, and TIP system valves.

There are four instrumentation channels provided to assure that protective action occurs when required but prevents inadvertent isolation resulting from instrumentation malfunctions. The output trip signal of each instrumentation channel initiates a logic channel trip. Logic channel trips are combined as shown in Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.1.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation for each reactor vessel low water level setpoint is provided by four level switches installed at separate locations in secondary containment. Each trip system is

powered from diverse and redundant power supplies.

Diversity to reactor vessel low water level (level 3) for pipe breaks inside the primary containment is provided by drywell high pressure. RHR leak detection instrumentation provides diversity to reactor vessel low water level for pipe breaks outside of primary containment. No diversity is provided for pipe breaks outside the primary containment for TIP guide tube isolation.

Diversity to reactor vessel low low water level (Level 2) which results in isolation as indicated in Subsection 7.3.1.1a.2.4.1.1.1, for pipe breaks outside the primary containment, is provided by main steamline and RWCS leak detection instrumentation. No diversity is provided for breaks inside the primary containment.

7.3.1.1a.2.4.1.1.6 Subsystem Bypasses and Interlocks

There are no bypasses for reactor vessel low water level trip.

Reactor vessel low water level trip has provisions to initiate the standby gas treatment system.

7.3.1.1a.2.4.1.1.7 Subsystem Testability

Testability is discussed in Subsections 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.2 Main Steamline High Radiation

7.3.1.1a.2.4.1.2.1 Subsystem Identification

High radiation in the vicinity of the main steamlines could indicate a gross release of fission products from the fuel. High radiation near the main steamlines initiates isolation of the following pipelines:

(1) All main steamlines

(2) Main steamline drain

(3) Reactor water sample line

The high radiation trip setting is selected high enough above background radiation levels to avoid spurious isolation, yet low enough to promptly detect a gross release of fission products from the fuel.

Refer to Section 11.5 for subsystem description.

The objective of the main steamline radiation monitoring subsystem is to monitor for the gross release of fission products from the fuel and, upon indication of such release, to initiate appropriate action to limit fuel damage and contain the released fission products.

This subsystem classification is provided in Table 3.2-1..

7.3.1.1a.2.4.1.2.2 Subsystem Power Sources

The 120 V ac RPS Buses A and B are the power sources for the main steamline radiation monitoring subsystem. Two channels are powered from one RPS bus and the other two channels are powered from the other RPS bus.

7.3.1.1a.2.4.1.2.3 Subsystem Initiating Circuits

Four gamma-sensitive instrumentation channels monitor the gross gamma radiation from the main steamlines. The detectors are physically located near the main steamlines just downstream of the outboard main steamline isolation valves. The detectors are geometrically arranged to detect significant increases in radiation level with any number of main steamlines in operation. Their location along the main steamlines allows the earliest practical detection of a gross fuel failure.

Each monitoring channel consists of a gamma-sensitive ion chamber and a log radiation monitor, as shown in Figure 7.3-11. Capabilities of the monitoring channel are listed in Table 7.3-6. Each log radiation monitor has three trip circuits. One upscale trip circuit is used to initiate scram, isolation, and alarm. The second circuit is used for an alarm and is set at a level below that of the upscale trip circuit used for scram and isolation. The third circuit is a downscale trip that actuates an alarm in the main control room and produces an isolation and scram trip signal. The output from each log radiation monitor is displayed on a six-decade meter on back row panel in the main control room.

7.3.1.1a.2.4.1.2.4 Subsystem Logic and Sequencing

When a significant increase in the main steamline radiation level is detected, trip signals are transmitted to the reactor protection system, the PCRVICS, and to condenser air removal systems. Upon receipt of the high radiation trip signals, the RPS initiates a scram; the PCRVICS initiate closure of all main steamline isolation valves.

Four instrumentation channels are provided to assure protective action when needed and to prevent inadvertent scram and isolation resulting from instrumentation malfunctions. The output trip signals of each monitoring channel are combined as shown in Figures 7.3-2 and 7.3-3. Failure of any one monitoring channel does not result in inadvertent action.

7.3.1.1a.2.4.1.2.5 Subsystem Bypasses and Interlocks

No operational bypasses are provided with this subsystem. However, the individual log radiation monitors may be bypassed for maintenance or calibration by the use of test switches on each monitor. Bypassing one log radiation monitor will not cause an isolation, but will cause a single trip system trip to occur.

The main steamline radiation monitor isolation signals provide interlocks to prevent operation of the condenser mechanical vacuum pump.

7.3.1.1a.2.4.1.2.6 Subsystem Redundancy and Diversity

The number of monitoring channels in this subsystem provides the required redundancy and is verified in the circuit description.

The single failure criterion has been met in the design by providing redundant sensors, channels, division logics and trip systems, which are seismically and environmentally qualified. The failure of a single component will not prevent the system from functioning in the event protective action is required. In addition, a single failure will not initiate an isolation function, due to the use of two independent trip systems.

7.3.1.1a.2.4.1.2.7 Testability

A built-in source of adjustable current is provided with each log radiation monitor for test purposes. The operability of each monitoring channel can be routinely verified by comparing the outputs of the channels during power operation.

7.3.1.1a.2.4.1.2.8 Environmental Considerations

This subsystem is designed and has been qualified to meet the environmental conditions indicated in Section 3.11. In addition, this subsystem has been seismically qualified as described in Section 3.10a.

7.3.1.1a.2.4.1.2.9 Operational Considerations

In the event of a high or low radiation level trip within any of the channels, the subsystem will automatically activate the appropriate alarm annunciator and provide a meter indication in the main control room. Similarly, the occurrence of a high-high or an inoperable trip within any of the channels of the system will result in a signal being sent to the RPS and the PCRVICS.

The panels in the main control room, associated with the PCRVICS, are identified by colored nameplates which indicate the panel function and identification of the contained logic channels.

The only direct support required for the PCRVICS is the electrical power system, which is provided from 120 V ac RPS Buses A and B as described in Subsection 7.3.1.1a.2.4.1.2.2 and Chapter 8.0.

7.3.1.1a.2.4.1.3 Main Steamline Tunnel High Temperature and Differential Temperature

7.3.1.1a.2.4.1.3.1 Subsystem Identification

High temperature in the tunnel in which the main steamlines are located outside of the primary containment could indicate a breach in a main steamline. Also, such a breach may be indicated by high differential temperature between the outlet and inlet ventilation air for this steamline tunnel. The automatic closure of various valves prevents the excessive loss of reactor coolant and the release of a significant amount of radioactive material from the RCPB. Main steamline tunnel temperatures are monitored in the Reactor Building and Turbine Building portions of the steam tunnel; steam tunnel differential temperature is monitored only in the Reactor Building portion of the steam tunnel. When high temperatures occur in the main steamline tunnel, the following pipelines are isolated:

(1) Main steamlines

(2) Main steamline drain

The main steamline tunnel high temperature trips are set far enough above the temperature expected during operation at rated power to avoid spurious isolation, yet low enough to provide early indication of a steamline break.

High temperature in the vicinity of the main steamlines is detected by four dual element thermocouples in each portion of the steam tunnel with remote readout in the control room. These thermocouples are located along the main steamlines between the drywell wall and the Reactor Building wall, and between the Turbine Building wall and the turbine. The detectors are located or shielded so that they are sensitive to air temperature and not the radiated heat from hot equipment. The temperature sensors activate an alarm at high temperature. The main steamline tunnel temperature detection system is designed to detect leaks equivalent to 25 gpm water. A total of four main steamline space high temperature channels are provided in each portion of the steam tunnel. Each main steamline isolation logic receives an input signal from one main steamline Reactor Building tunnel high temperature, one Turbine Building tunnel high temperature, and one Reactor Building tunnel ventilation high differential temperature channel.

7.3.1.1a.2.4.1.3.2 Subsystem Power Supplies

For the power supplies for the main steamline isolation valves and other isolation valves, see Figures 7.3-2 and 7.3-3, respectively.

7.3.1.1a.2.4.1.3.3 Subsystem Initiating Circuits

Four space and four differential temperature sensing circuits monitor the Reactor Building main steamline area temperatures. Four space temperature sensing circuits monitor the Turbine Building main steamline area temperatures. One space temperature circuit from each portion of the steam tunnel and one Reactor Building differential temperature circuit is connected to each of four instrumentation channels. Both sets of space temperature elements are physically located near the main steamlines in the main steamline tunnel. The eight temperature elements for differential temperature monitoring are located in the ventilation supply and exhaust ducts for the Reactor Building portion of the main steamline tunnel. The locations of the temperature elements provide the earliest practical detection of main steamline breaks.

7.3.1.1a.2.4.1.3.4 Subsystem Logic and Sequencing

When a significant increase in main steamline tunnel temperature or differential temperature is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all main steamline isolation and drain valves.

Four instrumentation channels are provided to assure protective action when needed and to prevent inadvertent isolation resulting from instrumentation malfunctions.

The output trip signal of each instrumentation channel initiates a logic trip. The output trip signals of the logic are combined as shown in Figure 7.3-2 and 7.3-3. Failure of any one logic does not result in inadvertent action.

7.3.1.1a.2.4.1.3.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals for high space temperature is provided by four temperature elements installed at different locations within both portions of the main steamline tunnel. Each device is associated with one of four logic divisions. Temperature elements A and B are supplied from one power source, and C and D are supplied from a different power source.

Redundancy of trip initiation signals for high differential temperature is provided by four temperature element pairs installed at different locations within the ventilation supply and exhaust areas of the Reactor Building portion of the main steamline tunnel. Each pair of temperature elements is associated with one of four logic divisions.

Diversity of trip initiation signals for main steamline break is provided by main steamline tunnel temperature, high differential temperature, main steamline high flow, low pressure instrumentation and reactor vessel low low water level, Level 2. An increase in tunnel temperature, Reactor Building steam tunnel differential temperature, main steamline flow, or a decrease in pressure will initiate main steamline and main steamline drain valve isolation.

7.3.1.1a.2.4.1.3.6 Subsystem Bypasses and Interlocks

There are no bypasses associated with this subsystem or interlocks to other systems from main steamline high space or differential temperature trip.

7.3.1.1a.2.4.1.3.7 Subsystem Testability

Testability is discussed in Subsections 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.4 Main Steamline High Flow

7.3.1.1a.2.4.1.4.1 Subsystem Identification

Main steamline high flow could indicate a break in a main steamline. Automatic closure of various valves prevents excessive loss of reactor coolant and release of significant amounts of radioactive material from the RCPB. On detection of main steamline high flow, the following pipelines are isolated:

(1) Main steamlines

(2) Main steamline drain

The main steamline high flow trip setting was selected high enough to permit isolation of one main steamline for test at rated power without causing an automatic isolation of the other steamlines, yet low enough to permit early detection of a steamline break.

High flow in each main steamline is sensed by four indicating type differential pressure switches that sense the pressure difference across the flow element in that line.

7.3.1.1a.2.4.1.4.2 Subsystem Power Supplies

For power supplies, refer to Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.4.3 Subsystem Initiating Circuits

Sixteen differential pressure sensing circuits, four for each main steamline, monitor the main steamline flow. One differential pressure circuit for each main steamline is associated with each of four logics. Four differential pressure indicating switches are installed on each main steamline and provide the earliest practical detection of a main steam line break.

7.3.1.1a.2.4.1.4.4 Subsystem Logic and Sequencing

When a significant increase in main steamline flow is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all main steamline isolation and drain valves.

Four instrumentation logics are provided to assure protective action when required and to prevent inadvertent isolation resulting from instrumentation malfunctions. The output trip signal of each instrumentation channel initiates a logic trip. The output trip signals of the logics are combined as shown in Figures 7.3-2 and 7.3-3 in a one-out-of-two-twice and two-out-of-two logics. Logic A or C and B or D are required to initiate main steamline isolation. Logics A and B or C and D are required to initiate main steamline drain isolation. Failure of any one logic does not result in inadvertent action.

7.3.1.1a.2.4.1.4.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals for high flow is provided by four differential pressure switches for each main steamline. Each differential pressure switch for each main steamline is associated with one of four logics. Two differential pressure switches for each main steamline are supplied from one power source and two are supplied from a different power source.

Diversity of trip initiation signals is described in Subsection 7.3.1.1a.2.4.1.3.5.

7.3.1.1a.2.4.1.4.6 Subsystem Bypasses and Interlocks

There are no bypasses associated with this Subsystem or interlocks to other systems from main steamline high flow trip signals.

7.3.1.1a.2.4.1.4.7 Subsystem Testability

Testability is discussed in Subsections 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.5 Main Turbine Inlet - Low Steam Pressure

7.3.1.1a.2.4.1.5.1 Subsystem Identification

Low steam pressure at the turbine inlet while the reactor is operating could indicate a malfunction of the steam pressure regulator in which the turbine control valves or turbine bypass valves become fully open, and causes rapid depressurization of the reactor vessel. From part-load operating conditions, the rate of decrease of saturation temperature could exceed the allowable rate of change of vessel temperature. A rapid depressurization of the reactor vessel while the reactor is near full power could result in undesirable differential pressures across the channels around some fuel bundles of sufficient magnitude to cause mechanical deformation of channel walls. Such depressurizations, without adequate preventive action, could require thorough vessel analysis or core inspection prior to returning the reactor to power operation. To avoid these requirements following a rapid depressurization, the steam pressure at the turbine inlet is monitored. Pressure falling below a pre-selected value with the reactor in the RUN mode initiates isolation of the following pipelines:

(1) Main steamlines

(2) Main steamline drain

The low steam pressure isolation setting was selected far enough below normal turbine inlet pressures to avoid spurious isolation, yet high enough to provide timely detection of a pressure regulator malfunction. Although this isolation function is not required to satisfy any of the safety design bases for this system, the discussion is included to complete the listing of isolation functions.

Main steamline low pressure is sensed by four bourdon-tube-operated pressure switches that sense pressure downstream of the outboard main steamline isolation valves. The sensing point is located at the header that connects the four steamlines upstream to the turbine stop valves. Each switch is part of an independent channel. Each channel provides a signal to one isolation logic.

7.3.1.1a.2.4.1.5.2 Subsystem Power Supplies

For power supplies, refer to Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.5.3 Subsystem Initiating Circuits

Four pressure sensitive circuits, one for each main steamline, monitor main steamline pressure. One pressure circuit is associated with each of four logics. The locations of the

pressure switches provide the earliest practical detection of low main steamline pressure.

7.3.1.1a.2.4.1.5.4 Subsystem Logic and Sequencing

When a significant decrease in main steamline pressure is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all main steamline isolation and drain valves.

Four instrumentation channels are provided to assure protective action when required and to prevent inadvertent isolation resulting from instrumentation malfunctions. The output trip signal of each instrumentation channel initiates a logic division trip. The output trip signals of the logics are combined as shown in Figures 7.3-2 and 7.3-3. Failure of any one channel does not result in inadvertent action.

7.3.1.1a.2.4.1.5.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals for low pressure is provided by four pressure switches, one for each main steamline. Each pressure switch is associated with one of four logics. Two pressure transmitters are supplied from one power source and the other two are supplied from a different power source.

Diversity of trip initiation signals is described in Subsection 7.3.1.1a.2.4.1.3.5.

7.3.1.1a.2.4.1.5.6 Subsystem Bypasses and Interlocks

The main steamline low pressure trip is bypassed by the reactor mode switch in the Shutdown, Refuel, and Startup modes of reactor operation. In the RUN mode, the low pressure trip function is operative.

There are no interlocks to other systems for main steamline low pressure trip signals.

7.3.1.1a.2.4.1.5.7 Subsystem Testability

Testability is discussed in Subsections 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.6 Containment Drywell-High Pressure

7.3.1.1a.2.4.1.6.1 Subsystem Identification

High pressure in the drywell could indicate a breach of the RCPB inside the drywell. The automatic closure of various valves prevents the release of significant amounts of radioactive material from the primary containment. On detection of high drywell pressure, the following pipelines are isolated:

(1) HPCI, RCIC Vacuum Relief Valves
(2) RHR-Reactor Vessel Head Spray Valves
(3) Traversing in-core probe guide tubes
(4) RHR-Drywell, Suppression Pool sprays
(5) RHR-Heat Exchanger Drain to Suppression Pool
(6) Core Spray Test Line Valve
(7) Non-NSSS System isolation valves as described in Subsection 7.3.1.1b

The drywell high pressure isolation setting was selected to be as low as possible without inducing spurious isolation trips.

7.3.1.1a.2.4.1.6.2 Subsystem Power Supplies

For power supplies, refer to Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.6.3 Subsystem Initiating Circuits

Drywell Pressure is monitored by locally mounted pressure switches which are located outside of containment. Three separate sets of pressure switches, consisting of four switches each, monitor Drywell pressure for various isolation valves. Instrument sensing lines connect the switches with the Drywell interior. All Drywell pressure sensing lines are wholly contained within the Reactor Building/secondary containment. The switches are divisionally separate such that no single failure will prevent isolation trip system initiation on high Drywell pressure.

7.3.1.1a.2.4.1.6.4 Subsystem Logic and Sequencing

When a significant increase in drywell pressure is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate

closure of those system isolation valves identified in Subsection 7.3.1.1a.2.4.1.6.1.

Four instrumentation channels are provided to assure protective action when required and to prevent inadvertent isolation resulting from instrumentation malfunctions. The output trip signals of the instrumentation channels are combined as shown in Figures 7.3-2 and 7.3-3. Failure of any one channel does not result in inadvertent action.

7.3.1.1a.2.4.1.6.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals for drywell high pressure is described in Subsections 7.3.1.1a.2.4.1.6.3 and 7.3.1.1a.2.4.1.6.4.

Diversity of trip initiation signals for line breaks inside of the primary containment is provided by drywell high pressure and reactor low water level. An increase in drywell pressure or a decrease in reactor water level will initiate isolation, except for HPCI and RCIC vacuum relief isolation valves which isolate on Drywell Pressure-high or Reactor Vessel/System Steam Supply low pressure. In these cases, Reactor Vessel low pressure provides the diverse isolation signal.

7.3.1.1a.2.4.1.6.6 Subsystem Bypasses and Interlocks

There are no bypasses for drywell high pressure trip signals.

7.3.1.1a.2.4.1.6.7 Subsystem Testability

Testability is discussed in Subsections 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.7 and 7.3.1.1a.2.4.1.8

These Subsection numbers were not used.

7.3.1.1a.2.4.1.9 Reactor Water Cleanup (RWCU) System-High Differential Flow and High Flow

7.3.1.1a.2.4.1.9.1 Subsystem Identification

High differential flow or high flow in the reactor water cleanup system could indicate a breach of the RCPB in the cleanup system. The RWCU system flow at the inlet to the heat exchanger is compared with the flow at the outlet of the filter/demineralizer; high flow in the RWCU suction line is also monitored. High differential flow or high flow initiates isolation of the cleanup system.

7.3.1.1a.2.4.1.9.2 Subsystem Power Supplies

For power supply arrangements, see Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.9.3 Subsystem Initiating Circuits

Two differential flow sensing circuits monitor the reactor water cleanup system flow. One circuit monitors the flow from recirculation suction to the main condenser and one circuit monitors the flow from recirculation suction to feedwater system. Each flow circuit is associated with two instrumentation channels. The flow transmitters are located on the line to the main condenser, the line to feedwater, and the suction line from the recirculation system. The locations of the flow transmitters provide the earliest practical detection of RWCU system line break.

Two high flow (differential pressure switches) sensors monitor the suction line to detect the line break.

7.3.1.1a.2.4.1.9.4 Subsystem Logic and Sequencing

When a significant increase in reactor water cleanup system differential flow or high flow is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all RWCU system isolation valves.

Two instrumentation channels are provided to assure protective action when required. The output trip signal of each instrumentation channel initiates a division logic trip and closure of either the inboard or outboard RWCU system isolation valve.

7.3.1.1a.2.4.1.9.5 Subsystem Redundancy and Diversity

Each of two instrumentation channels are supplied from a different power source. One channel is supplied to inboard logic and the other to outboard logic.

Diversity of trip initiation signals for RWCU system line break is provided by high differential flow, high flow, ambient and differential temperature, and Reactor Vessel low, low water level, Level 2. An increase in differential flow, space temperature, differential temperature or low Reactor vessel water level will initiate RWCU system isolation.

7.3.1.1a.2.4.1.9.6 Subsystem Bypasses and Interlocks

The RWCU system high differential flow trip is bypassed automatically during RWCU system startup by a time delay.

There are no interlocks to other systems from reactor water cleanup system high differential flow, or high flow trip signals.

7.3.1.1a.2.4.1.9.7 Subsystem Testability

Testability is discussed in Subsection 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.10 Reactor Water Cleanup (RWCU) System-Area High Temperature and Differential Temperature

7.3.1.1a.2.4.1.10.1 Subsystem Identification

High temperature in the area of the RWCU system could indicate a breach in the RCPB in the cleanup system. High area temperature and high differential temperature in the area ventilation system initiates isolation of the RWCU system.

7.3.1.1a.2.4.1.10.2 Power Supplies

For the power supply arrangements, see Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.10.3 Subsystem Initiating Circuits

Six space temperature and six differential temperature sensing circuits monitor the RWCU system area temperatures. Three space

and three differential temperature circuits are associated with each of two instrumentation channels. Redundant space temperature measurements and inlet and outlet differential temperatures of the Reactor Water Cleanup pump room, heat exchanger room and filter demineralizer room are used to detect system line breaks.

7.3.1.1a.2.4.1.10.4 Subsystem Logic and Sequencing

When a significant increase in RWCU system area space or differential temperature is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all reactor water cleanup system isolation valves.

Two instrumentation channels are provided to assure protective action when required. The output trip signal of each instrumentation channel initiates a division logic trip and closure of either the inboard or outboard RWCU system isolation valve. In order to close both the inboard and outboard isolation valves, both division logics must trip. Protection against inadvertent isolation due to instrumentation malfunction is not provided.

7.3.1.1a.2.4.1.10.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals from high space temperature is provided by two space temperature elements installed in each RWCU system area, and which are associated with one of two division logics.

Redundancy of trip initiation signals for high differential temperature is provided by four temperature elements in each RWCU system area. Each pair of sensors is associated with one of two division logics.

Diversity is discussed in Subsection 7.3.1.1a.2.4.1.9.5.

7.3.1.1a.2.4.1.10.6 Subsystem Bypasses and Interlocks

The RWCU system high space and differential temperature trips have no automatic bypasses associated with them.

There are no interlocks to other systems from the RWCU system high space and differential temperature trip signals.

7.3.1.1a.2.4.1.10.7 Subsystem Testability

Testability is discussed in Subsection 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.11 RHR System-Area High Temperature and Differential Temperature

7.3.1.1a.2.4.1.11.1 Subsystem Identification

High temperature in the area of the RHR system pumps could indicate a breach in the RCPB in the RHR shutdown cooling system. High area temperature and high differential temperature in the area ventilation system initiates isolation of the RHR shutdown cooling system.

High temperature in the spaces occupied by the reactor shutdown cooling system piping and the RWCU system piping outside the drywell is sensed by thermocouples that indicate possible pipe breaks.

Temperature sensors in the equipment area and the inlet and outlet ventilation ducts of the RHR shutdown cooling system and the RWCU system will, when a high differential temperature is detected, cause isolation.

7.3.1.1a.2.4.1.11.2 Power Supplies

For power supply arrangements, see Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.11.3 Initiating Circuits

Four space temperature and four differential temperature sensing circuits monitor the RHR system area temperatures. Two space and two differential temperature circuits are associated with each of two instrumentation channels. The space temperature elements are located in each RHR equipment area. Four pairs of temperature elements are located in the ventilation supply and the ventilation exhaust of each RHR equipment area. The locations of the temperature elements provides the earliest practical detection of any RHR system line break.

7.3.1.1a.2.4.1.11.4 Subsystem Logic and Sequencing

When a significant increase in RHR system area space temperature or differential temperature is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all RHR system isolation valves.

Two instrumentation channels are provided to assure protective action, when required. The output trip signal of each instrumentation channel initiates a division logic trip and closure of either the inboard or outboard RHR system isolation valve.

In order to close both the inboard and outboard isolation valves, both division logics must trip.

Protection against inadvertent isolation due to instrumentation malfunction is not provided.

7.3.1.1a.2.4.1.11.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation for high space temperature is provided by two space temperature elements installed in each RHR equipment area. Each sensor is associated with one of two division logics. Within each area, each temperature element is supplied from a different power source.

Redundancy of trip initiation signals for high differential temperature is provided by four temperature elements in each RHR equipment area. Each pair is associated with one of two division logics.

Diversity of trip initiation signals for RHR line break is provided by space temperature, differential temperature, excess flow and Reactor Vessel water level instrumentation. An increase in space temperature, differential temperature, or flow or a decrease in Reactor Vessel water level will initiate RHR system isolation.

7.3.1.1a.2.4.1.11.6 Subsystem Bypasses and Interlocks

There are no bypasses associated with the RHR system high space or differential temperature trip signals.

RHR system high space and differential temperature trips are interlocked with the RHR system to provide system isolation when leakage is detected.

7.3.1.1a.2.4.1.11.7 Subsystem Testability

Testability is discussed in Subsection 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.12 Main Steamline Leak Detection

7.3.1.1a.2.4.1.12.1 Subsystem Identification

The main steamlines are constantly monitored for leaks by the leak detection system (Figures 5.1-3a and 5.1-3b). Steamline leaks will cause changes in at least one of the following monitored operating parameters: Reactor Building steam tunnel ambient or differential temperatures, Turbine Building steam tunnel ambient temperature, flow rate, low turbine inlet pressure, or low water level in the reactor vessel. If a leak is detected, the detection system responds by triggering an annunciator and initiating a steamline isolation trip logic signal.

The main steamline break leak detection subsystem consists of three types of monitoring circuits: a) ambient and differential temperature monitors, which cause an alarm and main steamline isolation to be initiated when an observed temperature rises above a preset maximum, b) steamline mass flow rate monitors, which initiate an alarm and closure of isolation valves when the observed flow rate exceeds a preset maximum, and c) reactor vessel water level detectors which send a trip signal to the isolation valve logic when level decreases below a pre-selected set point.

The area temperature monitoring feature is discussed in Subsection 7.3.1.1a.2.4.1.3.

The main steamline flow monitoring feature is discussed in Subsection 7.3.1.1a.2.4.1.4.

The reactor vessel level monitoring feature is discussed in Subsection 7.3.1.1a.2.4.1.1.

The main steamline pressure monitoring feature is discussed in Subsection 7.3.1.1a.2.4.1.5.

7.3.1.1a.2.4.1.13 Main Condenser Vacuum Trip

7.3.1.1a.2.4.1.13.1 Subsystem Identification

In addition to the present turbine stop valve trip resulting from low condenser vacuum which is a standard component of turbine

system instrumentation, a main steamline isolation valve trip from a low condenser vacuum instrumentation system is provided, and meets the safety design basis of the PCRVICS.

The main turbine condenser low vacuum signal would indicate a leak in the condenser. Initiation of automatic closure of various Class A valves will prevent excessive loss of reactor coolant and the release of significant amounts of radioactive material from the RCPB. Upon detection of turbine condenser low vacuum, the following lines will be isolated:

(1) Main steamline

(2) Main steamline drain

The turbine condenser low vacuum trip setting was selected far enough above the normal operating vacuum to avoid spurious isolation, yet low enough to provide an isolation signal prior to the rupture of the condenser and subsequent loss of reactor coolant and release of radioactive material.

7.3.1.1a.2.4.1.13.2 Subsystem Power Supplies

For power supply arrangements, see Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.13.3 Subsystem Initiating Circuits

Four pressure sensing circuits monitor the main condenser vacuum. One pressure circuit is associated with each of four instrumentation channels. Four pressure switches are installed to provide the earliest practical detection of main condenser leak.

7.3.1.1a.2.4.1.13.4 Subsystem Logic and Sequencing

When a signficant decrease in main condenser vacuum is detected, trip signals are transmitted to the PCRVICS. The PCRVICS initiate closure of all main steamline isolation and drain valves.

Four instrumentation channels are provided to assure protective action when required, and to prevent inadvertent isolation resulting from instrmentation malfunctions. The output trip signal of each instrumentation channel initiates a logic trip. The output trip signals of the logics are combined as shown in Figures 7.3-2 and 7.3-3. Failure of any one channel does not result in inadvertent isolation action.

7.3.1.1a.2.4.1.13.5 Subsystem Redundancy and Diversity

Redundancy of trip initiation signals for low condenser vacuum is provided by four pressure switches. Each pressure signal is associated with one of four logics. Two pressure switches are supplied by one power source and the other two are supplied from a different power source.

Diversity of trip initiation signals is not provided.

7.3.1.1a.2.4.1.13.6 Subsystem Bypasses and Interlocks

Each main condenser low vacuum trip system isolation signal can be bypassed manually when the appropriate turbine stop valve is less than 90% open, the reactor pressure is below the high pressure scram initiation setpoint, and the reactor mode switch not in run.

There are no interlocks to other systems from the main condenser low vacuum trip signals.

7.3.1.1a.2.4.1.13.7 Subsystem Testability

Testability is discussed in Subsection 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.1.14 RHR System High Flow

7.3.1.1a.2.4.1.14.1 Subsystem Identification

High flow in the RHR system suction line could indicate a breach in the RCPB in the RHR system. High flow initiates closure of either the inboard or outboard RHR-Shutdown Cooling system isolation valve.

7.3.1.1a.2.4.1.14.2 Subsystem Power Supplies

For power supply arrangements, see Figures 7.3-2 and 7.3-3.

7.3.1.1a.2.4.1.14.3 Subsystem Initiating Circuits

Two redundant differential pressure switches monitor the RHR shutdown cooling mode suction line. The output trip signal of

each sensor initiates closure of either the inboard or outboard RHR system isolation valve.

7.3.1.1a.2.4.1.14.4 Subsystem Logic and Sequencing

When RHR system high flow is detected, trip signals are transmitted to the RHR system suction line isolation valves. Two instrumentation channels are provided to assure protective action when required. The output trip signal of each instrumentation channel initiates a division logic trip and closure of either the inboard or outboard RHR system suction line isolation valve.

7.3.1.1a.2.4.1.14.5 Subsystem Redundancy and Diversity

Each of two instrumentation channels are supplied from a different power source. One channel is supplied to inboard logic and the other to outboard logic.

Diverse signals for isolation of the RHR system suction line isolation valves are provided by vessel low level (level 3), and RHR area high temperature, in addition to excess flow.

7.3.1.1a.2.3.1.14.6 Subsystem Bypasses and Interlocks

There are no interlocks or bypasses associated with RHR system high flow trip signals.

7.3.1.1a.2.4.1.14.7 Subsystem Testability

Testability is discussed in Subsection 7.3.2a.2.2.3.1.10.

7.3.1.1a.2.4.2 System Instrumentation

Sensors providing inputs to the PCRVICS are not used for the automatic control of the process system, thereby achieving separation of the protection and process systems. Channels are physically and electrically separated to reduce the probability that a single physical event will prevent isolation. Redundant channels for one monitored variable provide inputs to different isolation trip systems. The functions of the sensors in the isolation control system are shown in Figures 7.3-2 and 7.3-3. Table 7.3-5 lists instrument characteristics.

7.3.1.1a.2.5 System Logic

The variables and logic arrangements that initiate automatic actuation of all subsystems associated with the PCRVICS are provided in Subsection 7.3.1.1a.2.4.

7.3.1.1a.2.6 System Sequencing

A discussion of all sequencing of all subsystems of the PCRVICS is provided in Subsection 7.3.1.1a.2.4.

7.3.1.1a.2.7 System Bypasses and Interlocks

Bypasses and interlocks for all subsystems associated with the PCRVICS are detailed in Subsection 7.3.1.1a.2.4.1.

7.3.1.1a.2.8 System Redundancy and Diversity

The variables which initiate isolation are listed in the circuit description, Subsection 7.3.1.1a.2.4.1. Also listed there are the number of initiating sensors and channels for the isolation valves.

7.3.1.1a.2.9 System Actuated Devices

To prevent the reactor vessel water level from falling below the top of the active fuel as a result of a pipeline break, the valve closing mechanisms are designed to meet the closure times specified in Table 6.2-12.

The main steamline isolation valves are spring-closing, pneumatic, piston-operated valves. They close on loss of pneumatic pressure to the valve operator. This is fail-safe design. The control arrangement is shown in Figure 7.3-4. Closure time for the valves is adjustable between 3 and 10 seconds. Each valve is piloted by two three-way, packless, direct-acting, solenoid-operated pilot. An accumulator located close to each isolation valve provides pneumatic pressure for valve closing in the event of failure of the normal gas supply system.

The sensor trip channel and trip logic relays for the instrumentation used in the systems described are high

reliability relays. The relays are selected so that the continuous load will not exceed 50% of the continuous duty rating. Chapter 16, Technical Specifications lists the minimum numbers of trip channels needed to ensure that the isolation control system retains its functional capabilities.

7.3.1.1a.2.10 System Separation

Sensor devices are separated physically such that no single failure (open, closure, or short) can prevent the safety action. By the use of separated raceways, the single failure criterion is met from the sensors to the logic cabinets in the relay control rooms. The logic cabinets are so arranged that redundant equipment and wiring are not present in the same bay of a cabinet except as noted in Section 3.12. A bay is a cabinet section separated from other cabinet sections by a fire barrier. Normally the barrier is of full cabinet height and depth. Redundant equipment and wiring may be present in control room bench boards, where separation is achieved by surrounding redundant wire and equipment in metal encasements. From the logic cabinets to the isolation valves, separated raceways are employed to complete adherence to the single failure criterion.

7.3.1.1a.2.11 System Testability

The main steamline isolation valve instrumentation is capable of complete testing during power operation. The isolation signals include low reactor water level, high steamline radiation, high main steamline flow, high main steamline tunnel temperature, low condenser vacuum, and low turbine pressure. The water level, turbine pressure, and steamline flow sensors are pressure or differential pressure type sensors which may be valved out of service one at a time and functionally tested using a test pressure source. The radiation measuring amplifier is provided with a test switch and internal test source by which operability may be verified.

Functional operability of the temperature switches may be verified by applying a heat source to the locally mounted temperature sensing elements. Control room indications include annunciation and panel lights. The condition of each sensor is indicated by at least one of these methods in addition to annunciators common to sensors of one variable. In addition, the functional availability of each isolation valve may be confirmed by completely or partially closing each valve individually at reduced power using test switches located in the control structure.

The RWCU system isolation signals include low reactor water level, equipment area high ambient temperature and differential temperature, high flow, high differential flow, high temperature downstream of the non-regenerative heat exchanger, and standby liquid control system actuation. The water level sensor is of the differential pressure type and can be periodically tested by valving each sensor out of service and applying a test pressure. The temperature switches may be functionally tested by removing from service and applying a heat source to the temperature sensing elements. The differential flow switches may be tested by applying a test input. The various trip actuations are annunciated in the main control room. Also, valve indicator lights in the main control room provide indication of RWCU isolation valve position.

7.3.1.1a.2.12 System Environmental Considerations

The physical and electrical arrangement of the PCRVICS was selected so that no single physical event will prevent achievement of isolation functions. Motor operators for valves inside the drywell are of the totally enclosed type; those outside the containment have weatherproof-type enclosures. Solenoid valves, whether used for direct valve isolation or as a gas pilot, are provided with watertight enclosures. All cables and operators are capable of operation in the most unfavorable ambient conditions anticipated for normal operations. Temperature, pressure, humidity, and radiation are considered in the selection of equipment for the system. Cables used in high radiation areas have radiation-resistant insulation. Shielded cables are used where necessary to eliminate interference from magnetic fields.

Special consideration has been given to isolation requirements during a LOCA inside the drywell. Components of the PCRVICS that are located inside the drywell and that must operate during a LOCA are the cables, control mechanisms, and valve operators of isolation valves inside the drywell. These isolation components are required to be functional in a LOCA environment (See Tables 3.11-1, 3.11-2, and 3.11-3). Electrical cables are selected with insulation designed for this service. Closing mechanisms and valve operators are considered satisfactory for use in the PCRVICS only after completion of environmental testing under LOCA conditions or submission of evidence from the manufacturer describing the results of suitable prior tests.

7.3.1.1a.2.13 System Operational Considerations

7.3.1.1a.2.13.1 General Information

The PCRVICS are not required for normal operation. The system are initiated automatically when one of the monitored variables exceeds preset limits. No operator action is required for at least 10 minutes following initiation.

All automatic isolation valves can be closed by manipulating switches in the main control room, thus providing the reactor operator with control which is independent of the automatic isolation functions.

7.3.1.1a.2.13.2 Reactor Operator Information

In general, once isolation is initiated, the valve continues to close even if the condition that caused isolation is restored to normal. The reactor operator must manually operate switches in the main control room to reopen a valve that has been automatically closed. Except where manual override features are provided in the manual control circuitry, the operator cannot reopen the valve until the conditions that initiated isolation have cleared.

A trip of an isolation control system channel is annunciated in the main control room so that the reactor operator is immediately informed of the condition. The response of isolation valves is indicated by OPEN-CLOSED status lights in the main control room. All motor-operated and gas-operated isolation valves have OPEN-CLOSED status lights in the main control room.

Inputs to annunciators and indicators are arranged so that no malfunction of the annunciating or indicating equipment can functionally disable the system. Direct signals from the isolation control system sensors are not used as inputs to annunciating or indicating equipment. Relay isolation is provided between the primary signal and the information output. (Refer to Section 7.7 for further discussion of information available to the reactor operator.)

7.3.1.1a.2.13.3 Set Points

Refer to Technical Specifications for the safety set point information.

7.3.1.1a.3 MSIV-LCS-Instrumentation and Controls

7.3.1.1a.3.1 System Identification

The MSIV-LCS is designed to minimize the release of fission products which could bypass the Standby Gas Treatment System after the postulated LOCA. This is accomplished by directing the leakage through the closed main steamline isolation valves (MSIVs) to bleed lines which pass the leakage flow into an area served by the Standby Gas Treatment System.

The instrumentation and controls of the MSIV-LCS are shown on Figures 6.7-1 through 6.7-3.

The instrumentation necessary for control and status indication of the MSIV-LCS are classified as essential and as such are designed and qualified in accordance with applicable IEEE Standards, to function under Seismic Class IE and LOCA environmental loading conditions appropriate to their installation with the control circuits designed to satisfy the mechanical and electrical separation criteria.

7.3.1.1a.3.2 Power Sources

The instrumentation and controls of the main steamline isolation valve leakage control system (MSIV-LCS) is powered by separate 120 V ac divisional power with each subsystem (inboard and outboard) powered by a different division (II and I, respectively).

7.3.1.1a.3.3 Equipment Design

The instrumentation components for the MSIV-LCS are located outside the containment. Cables connect the sensors and transducers to control circuitry within the logic panel. A functional test of the system instrumentation can be performed during normal reactor power operation. However, the MSIV-LCS isolation valves can only be tested one at a time. Inboard and outboard subsystem controls and instrumentation are electrically and mechanically separated to assure that no single failure event can disable the MSIV-LCS. The MSIV-LCS is designed to operate from normal offsite auxiliary power sources or from a divisional diesel generator set if offsite power is not available.

7.3.1.1a.3.4 Initiating Circuits

The MSIV-LCS can be manually actuated after a LOCA has occurred, provided that the reactor and steamline pressure are below the pressure permissive interlock set points and the inboard MSIVs are fully closed. The outboard subsystem is provided with one

remote manual initiating switch, while the inboard subsystem is provided with one remote manual initiating switch per steamline.

The inboard subsystem has individually controlled process lines provided for each steamline (see Figures 6.7-1a and 6.7-1b).

When the inboard subsystem is initiated, the exhaust blower is actuated. When dilution air flow is established by the exhaust blowers, the bleed and bypass valves are opened, heaters are actuated and timers are initiated. If the steamline pressure is greater than 5 psig after one minute, the bleed valves will close. If the pressure is not excessive, the bleed valves will remain open. After another minute, the bypass valve is closed. The flow is thus routed through the flow element. Within the next minute, a third timer allows flow to be monitored and the bleed valves to be closed if necessary by high flow.

The outboard subsystem process lines from each main steamline are connected to a header connecting to the depressurization and bleed off branch (see Figure 6.7-1).

When the outboard subsystem is initiated, depressurization valves are opened and the exhaust blowers are activated. When the steamlines have depressurized to approximately atmospheric pressure, the depressurization branch valves are closed and flow is diverted to the blower suction lines.

7.3.1.1a.3.5 Logic and Sequencing

A LOCA is signalled by high drywell pressure and low-low water level. After a LOCA has occurred, the MSIV-LCS system can be manually initiated.

Indicators for both reactor and steamline pressures for the inboard and outboard subsystems are available on the control cabinet.

7.3.1.1a.3.6 Bypasses and Interlocks

Both the inboard and outboard subsystem are provided with reactor and steamline pressure interlocks to prevent inadvertent system initiating during normal reactor power operation. An inboard MSIV closure interlock is provided for each of the lines by a position switch which will prevent initiation of the MSIV-LCS if the inboard valve is open.

During test operation, the two motor-operated isolation valves in any flow path from the main steamlines cannot be opened simultaneously.

7.3.1.1a.3.7 Redundancy and Diversity

The MSIV-LCS consists of two subsystems; namely, inboard and outboard. Each subsystem has instrumentation, controls and power sources which are separate and independent from each other. Either system may be manually initiated after a LOCA. This manually initiated system is not required to be diverse. It is interlocked by diverse parameter inputs.

7.3.1.1a.3.8 Actuated Devices

All actuated devices can be individually tested during normal plant operation.

7.3.1.1a.3.9 Separation

The instrumentation, controls and sensors of each subsystem have sufficient physical and electrical separation to prevent environmental, electrical or physical accident consequences from inhibiting the MSIV-LCS from performing its protective action.

Physical and electrical separation is maintained by use of separate divisional cabinets, racks, and raceways for each subsystem.

7.3.1.1a.3.10 Testability

The operation of each subsystem up to and including the actuators can be independently verified during normal plant operation. Instrument setpoints are tested by simulated signals of sufficient magnitude to verify the alarm points.

7.3.1.1a.3.11 Environmental Conditions

Controls and indicators are located on backrow panel in the main control room. The sensors are located outside the containment. All control instrumentations and sensors have been selected to meet the normal, accident and post-accident worst case

environmental conditions of temperature, pressure, humidity, radiation, chemical and vibrations expected at their respective locations (Refer to Table 3.11-1 and 3.11-3 for equipment qualification).

7.3.1.1a.3.12 Operational Considerations

7.3.1.1a.3.12.1 General Information

The MSIV-LCS is designed to permit manual actuation within approximately 20 minutes after a LOCA. All controls and instrumentation and indicators needed for effective operation are on back row panels in the main control room.

7.3.1.1a.3.12.2 Reactor Operator Information

The mechanical system description and performance evaluations in Subsections 6.7.2.1 and 6.7.2.2 provide a detailed discussion of the operators information and the necessary action to complete the system functional objectives. Refer also to Figures 6.7-1 through 6.7-3.

7.3.1.1a.3.12.3 Set Points

There are no setpoints. The system is manually actuated. The ranges of safety-related instrumentation used within the MSIV-LCS are described in Table 7.3-27.

7.3.1.1a.4 RHRS/Containment Spray Cooling System - Instrumentation and Controls

7.3.1.1a.4.1 System Identification

The containment spray cooling system is an operating mode of the Residual Heat Removal System. It is designed to provide the capability of condensing steam in the suppression pool air volume and/or the drywell atmosphere and removing heat from the suppression pool water volume. The system is manually initiated when necessary.

The RHR system is shown in Figure 5.4-13.

7.3.1.1a.4.2 Power Sources

The power supplies for the RHR system are described in Subsection 7.3.1.1a.1.6.

7.3.1.1a.4.3 Equipment Design

Control and instrumentation for the following equipment is required for this mode of operation:

(1) Two RHR main system pumps

(2) Pump suction valves

(3) Containment spray discharge valves

Sensors needed for operation of the equipment are drywell pressure switches, reactor water level indicating switches, and valve limit switches.

The instrumentation for containment spray cooling operation allows the operator to assure that water will be routed from the suppression pool to the containment spray system for use in the drywell and/or suppression pool air volumes.

Containment spray operation uses two pump loops, each loop with its own separate discharge valve. All components pertinent to containment spray cooling operation are located outside of the drywell. The system can be operated such that the spray can be directed to the drywell and/or suppression pool air volume.

7.3.1.1a.4.4 Initiating Circuits

A loop A containment spray cooling mode of the RHR System may be initiated by the operator when the following conditions (permissive) have been satisfied:

(1) A LOCA signal must be present, i.e. reactor vessel low water level and/or drywell high pressure in a one out of two twice logic configuration.

(2) The LPCI injection valve must be closed.

These permissives may be bypassed by a manual override switch. The Loop B containment spray cooling mode of the RHR System initation is identical to that of Loop A.

7.3.1.1a.4.5 Logic and Sequencing

The operating sequence of containment spray following receipt of the necessary initiating signals is as follows:

(1) The RHR system pumps continue to operate.

(2) Valves in other RHR modes are manually positioned or remain as positioned during LPCI.

(3) The RHR service water pumps are started.

(4) RHR service water discharge valves to the RHR heat exchanger are opened.

The containment spray system will continue to operate until the operator closes the containment spray injection valves. The operator can then initiate another mode of RHR if appropriate permissives are satisfied.

7.3.1.1a.4.6 Bypasses and Interlocks

No bypasses are provided for the containment spray system.

7.3.1.1a.4.7 Redundancy and Diversity

Redundancy is provided for the containment spray function by two separated logics, one for each divisional loop. Redundancy and diversity of initiation permissive sensors is described in Subsection 7.3.2a.4.

7.3.1.1a.4.8 Actuated Devices

Figure 7.3-10 shows functional control arrangement of the containment spray system.

The RHR A and RHR B loops are utilized for containment spray. Therefore, the pump and valves are the same for LPCI and containment spray function except that each has its own discharge valve. See Subsection 7.3.1.1a.1.6.7 for specific information.

7.3.1.1a.4.9 Separation

For separation, refer to Subsection 7.3.1.1a.1.6.8

7.3.1.1a.4.10 Testability

Containment spray cooling system is capable of being tested up to the last discharge valve during normal operation.

Testing for functional operability of the control logic relays can be accomplished by use of plug-in test jacks and switches in conjunction with single sensor tests. Other control equipment is functionally tested during manual testing of each loop. Adequate indication in the form of panel lamps and annunciators are provided in the main control room.

7.3.1.1a.4.11 Environmental Considerations

Refer to Table 3.11-1 and 3.11-3 for environmental qualifications of the containment spray system components.

7.3.1.1a.4.12 Operational Considerations

7.3.1.1a.4.12.1 General Information

Containment spray is a mode of the RHR and is not required during normal operation.

7.3.1.1a.4.12.2 Reactor Operator Information

Sufficient temperature, flow, pressure, and valve position indications are available in the control room for the operator to accurately assess containment spray operation. Alarms and indications are shown in Figures 5.4-13 and 7.3-10.

7.3.1.1a.4.12.3 Set Points

Setpoints for the containment spray permissives (drywell pressure and reactor vessel water level) are shown in the Technical Specifications.

7.3.1.1a.5 RHRS/Suppression Pool Cooling Mode- Instrumentation and Controls

7.3.1.1a.5.1 System Identification

Suppression pool cooling is an operating mode of the Residual Heat Removal System. It is designed to provide the capability of removing heat from the suppression pool water volume. The system is manually initiated when necessary.

7.3.1.1a.5.2 Power Sources

Power for the RHR system pumps is supplied from four ac buses that can receive standby ac power. Motive and control power for the two loops of suppression pool cooling instrumentation and control equipment are the same as that used for the two LPCI loops; see Subsection 7.3.1.1a.1.6.

7.3.1.1a.5.3 Equipment Design

Control and instrumentation for the following equipment is required for this mode of operation:

(1) RHR pumps,
(2) Pump suction valves, and
(3) Suppression pool return valves

Suppression pool cooling uses two pump loops, each loop containing two pumps. All components pertinent to suppression pool cooling operation are located outside the drywell.

The suppression pool cooling mode is manually initiated from the control room. This mode is put into operation to maintain the water temperature in the suppression pool within specified limits.

7.3.1.1a.5.4 Initiating Circuits

Initiation of either suppression pool cooling loop is performed manually by the control room operator.

7.3.1.1a.5.5 Logic and Sequencing

The operating sequence of suppression pool cooling mode is as follows:

(1) Valves are manually positioned.

(2) The RHR pumps operate.

(3) The RHR heat exchanger service water system is placed into service.

The suppression pool cooling mode will continue to operate until terminated by manual operator action.

7.3.1.1a.5.6 Bypasses and Interlocks

No bypasses are provided for the suppression pool cooling mode. The suppression pool cooling mode is interlocked with reactor water level and drywell pressure functions by the repositioning of valves associated with the initiation of the LPCI mode on LOCA signal. See Subsection 7.3.1.1a.1.6.4.

7.3.1.1a.5.7 Redundancy and Diversity

Redundancy is provided for the suppression pool cooling mode by separate logics, one for each loop.

7.3.1.1a.5.8 Actuated Devices

Figure 7.3-10 (RHR FCD) shows functional control arrangement of the pumps and valves used during the suppression pool cooling mode.

7.3.1.1a.5.9 Separation

Suppression pool cooling is a two divisional system. Manual control, logic circuits, cabling, and instrumentation for suppression pool cooling are mounted so that divisional separation is maintained.

7.3.1.1a.5.10 Testability

Suppression pool cooling is capable of being tested during normal operation.

Testing for functional operability can be accomplished during manual testing of each loop. Panel lamps and annunciators provide control room indications.

7.3.1.1a.5.11 Environmental Considerations

Refer to Section 3.11 and the Susquehanna SES Environmental Equipment Qualification Program for environmental qualifications of the system components.

7.3.1.1a.5.12 Operational Considerations

7.3.1.1a.5.12.1 General Information

Suppression pool cooling is used to limit suppression pool temperature.

7.3.1.1a.5.12.2 Reactor Operator Information

Temperature, flow, pressure, and valve position indications are available in the control room for the operator to assess suppression pool cooling operation. Annunciator identification and system logic are shown in Figure 7.3.10 (RHR FCD).

7.3.1.1a.5.12.3 Set Points

There are no set points. The system is only manually initiated.

7.3.1.1b System Description (Non-NSSS)

7.3.1.1b.1 Primary Containment Isolation Control System for Non-NSSS - Instrumentation and Control

The isolation described in this subsection as non-NSSS and that described in Subsection 7.3.1.1a.2 as NSSS provide the complete containment isolation ESF.

7.3.1.1b.1.1 System Description

The primary containment isolation for non-NSSS is designed to ensure the containment integrity in the event of a LOCA. The system includes divisionalized logic and actuation circuits that initiate the closing of non-NSSS containment isolation valves.

The initiating contact for each division is provided by the NSSS initiating logic for the primary containment isolation control system and is a combination of the following:

(1) Reactor vessel - low water level

(2) Drywell - high pressure

In addition, containment purge supply and exhaust lines isolate on high radiation measured at the SGTS exhaust stack.

Sensors and initiating circuits are provided in the NSSS-PCRVICS. Refer to 7.3.2a.2.2.3.1.9 and 7.3.2a.2.2.3.1.10 for discussion of calibration and testing. For discussion of test provisions of the non-NSSS circuits refer to Subsection 7.3.2b.2-4.10. For description of the SGTS exhaust radiation monitors, refer to Subsection 11.5.2.1.4.

The objective of the system is to provide automatic isolation of all non-NSSS pipeline penetrations of the primary containment upon a LOCA.

A specific identification of containment isolation valves is provided in Table 6.2-12.

Isolation of the following pipelines is initiated by this system:

(1) Reactor Building Closed Cooling Water Supply and Return

(2) Drywell & Suppression Chamber Purge Supply and Exhaust Lines

(3) Drywell & Suppression Chamber Gas Sampling and Return Lines

(4) Instrument Gas Supply and Return Lines

(5) Drywell Floor Drain to Radwaste

(6) Equipment Drain to Radwaste

(7) Chilled Water Supply and Return Lines

(8) Suppression Pool Cleanup

The following interlocks are provided:

(1) Initiation of the Standby Gas Treatment System

(2) Trip of the Drywell Cooling Fans

7.3.1.1b.1.2 Initiating Circuits and Logic

The non-NSSS isolation logics are derived from inputs from the PCRVICS. Refer to Subsection 7.3.1.1a.2 for description of initiating circuits, logic, bypasses, interlocks, redundancy and diversity of the NSSS portion of this system.

Two relay contacts, one per division, represent the interface from NSSS to non-NSSS containment isolation. These relays will be deenergized and initiate isolation on any of the following conditions:

(1) Manual Isolation

(2) Low Reactor Water Level

(3) High Drywell Pressure

For Containment Purge lines, these signals are combined with trip signals from the SGTS Exhaust Radiation - high sensors.

Normally energized relays are used to multiply these signals. The assignment of electrical divisions to containment isolation valves is as shown in Table 6.2-12.

7.3.1.1b.1.3 Bypasses, Interlocks and Sequencing

Interlocks are provided to initiate the standby gas treatment system, to isolate the reactor building ventilation system, and to trip the drywell cooling fan units.

No sequencing is required for this system.

A timing circuit is implemented to allow manual opening of isolation valves after the isolation signal is received and the timer times out. These timing circuits reset when the isolation signal is manually reset to ensure closure upon receiving the next isolation signal. The time varies to meet post LOCA monitoring of the containment. Four valves in the Containment Atmosphere Control System have provisions for manually bypassing their isolation signals. Refer to Table 6.2-12, Remarks column, for identification of valves, times, and bypasses.

7.3.1.1b.1.4 Redundancy and Diversity

The Division I initiation circuit is independent and redundant to the Division II circuit.

Diversity of measurements is discussed in Subsection 7.3.1.1a.

7.3.1.1b.1.5 Actuated Devices

Table 6.2-12 lists all valves actuated by the containment isolation control system.

7.3.1.1b.1.6 Supporting Systems

The power sources for the isolation logic are supplied from two divisionalized and redundant 120 V ac buses. Refer to Chapter 8.0 for division.

Two additional divisionalized and redundant 125 VDC Power sources are supplied to auxiliary isolation timing logics for drywell and suppression chamber purge supply and exhaust lines, drywell and suppression chamber sampling and return lines, and drywell burp and purge line.

7.3.1.1b.1.7 Instrument Sensing Lines

All instrument line penetrations of the primary containment are equipped with excess flow check valves which isolate upon a high flow and differential pressure across the valve. This would be caused by either a downstream line break on a high pressure system or a downstream line break concurrent with a LOCA on a low presure system. When isolation of any excess flow check valve occurs, control room alarm alerts the operator. Two position indicating lights on a backrow panel in the main control room panel provide the status of each valve. A test push button allows a circuit test for the indicating lights as well as the annunciating logic for all excess flow check valves. Annunciation is provided on the unit operating benchboard to indicate excess flow check valve operation.

7.3.1.1b.2 Combustible Gas Control System

The concentration of the combustible gas inside the primary containment may increase after a LOCA as described in Subsection 6.2.5.

7.3.1.1b.2.1 System Description

Two pair of redundant hydrogen recombiner units are controlled from two divisionalized panels located in the upper and lower relay rooms. The instrumentation and controls for each hydrogen recombiner are listed in Subsection 6.2.5.5.1. Refer to Subsection 6.2.5.4 for periodic test requirements.

7.3.1.1b.2.1.1 Initiating Circuits, Logic, Bypasses, Interlocks and Sequencing

Each hydrogen recombiner is initiated by manual on-off control from the divisionalized system panels. Bypasses of hydrogen recombiners are identified in the description for the Bypass Indication System (BIS) in Section 7.5.

No interlocks or sequencing is provided for this system.

7.3.1.1b.2.1.2 Redundancy and Diversity

Two redundant hydrogen recombiners are located in the primary containment and two redundant units are in the suppression chamber. Controls and instrumentation are redundant and divisionalized on a one-to-one basis with the mechanical equipment.

7.3.1.1b.2.1.3 Supporting Systems

The primary containment atmospheric monitoring system (hydrogen and oxygen analyzers) indicate the performance of the hydrogen recombiner system. Pefer to Subsection 6.2.5.2 for system description and to Section 7.5 for safety-related display instrumentation.

7.3.1.1b.3 Primary Containment Vacuum Relief - Instrumentation and Control

7.3.1.1b.3.1 System Description

The system is designed to allow periodic testing of all 5 pairs of primary containment vacuum relief valves to ensure their functional capability. This is accomplished by opening each valve by remote actuation of the solenoid valve. Status indicating lights of the relief valve position verifies the operation.

7.3.1.1b.3.2 Initiating Circuits, Logic, Bypasses, Interlocks and Sequencing

One test selector switch per division permits the testing of each relief valve in that group. A momentary test pushbutton will cause a selective opening of each valve. All valves will close again when the selector switch is returned into normal position.

No system bypasses, interlocks or sequencing are provided.

7.3.1.1b.3.3 Redundancy and Diversity

Redundancy is given by the divisionalized system design. Diversity is not required for this manually operated system.

7.3.1.1b.3.4 Actuated Devices

The vacuum relief valves are the only actuated devices.

7.3.1.1b.4 Standby Gas Treatment System (SGTS)

For the description and operation of the SGTS, refer to Subsections 6.5.1.1. and 9.4.2.

7.3.1.1b.4.1 Initiating Circuits

Each train of the SGTS may be initiated or stopped in a protective function mode as follows:

a) High radiation sensed by any of the five gamma sensors located as follows (See Section 11.5 and Table 11.5-1):

   1) Unit 1 - Refueling floor high exhaust duct

2) Unit 2 - Refueling floor high exhaust duct

3) Unit 1 - Refueling floor wall exhaust duct

4) Unit 2 - Refueling floor wall exhaust duct

5) Railroad access shaft exhaust duct

b) LOCA signals provided by NSSS to non-NSSS output initiating contacts (See Subsection 7.3.1.1b.1.1).

c) Primary Containment vent and purge operation will be stopped by high radiation detected at the SGTS exhaust vent.

d) An operating train will be stopped by low pressure differential between outdoors and any of the three zones of the reactor building, and the standby train will be started.

e) An operating train will be stopped by low air flow and the standby train initiated.

f) Secondary protection is provided by sensors monitoring an operating filter train for malfunction conditions that will trip an operating train and cause the standby train to start. Malfunction conditions are as follows:

1) High-high charcoal filter temperature (also controls fire protection deluge water valves and drain valves)

2) Low differential temperature across the electric air heater (heater failure)

g) High inlet header static pressure of the SGTS will initiate a SGTS train.

h) System protection (not safety-related) is provided to initiate the filter train fan in a cooling mode on high charcoal temperature (pre-ignition temperature).

Each channel provides:

1) Continuous monitoring of radiation

2) Alarms in the control room for downscale/inoperative, high, and high-high radiation

3) Analog signals for the radiation indicator and recorder and trip circuit for initiating, isolation and stop signals

Capability for sensor checks and capability for test and calibration is provided as described in Subsection 7.3.2b.2-4.10.

7.3.1.1b.4.2 Logic and Sequencing

The two SGTS redundant filter trains are normally set up in a "lead-lag" fashion. When an emergency start signal exists, the lead train automatically starts and the other train remains on standby. An airflow switch in the common discharge duct monitors the operation of the lead train. If the lead train fails and the system loses airflow, the standby train will start.

The flow control of the operating SGTS uses inlet header pressure to outside air pressure differential as a set point to ensure the inlet header pressure is less than atmospheric. This prevents reactor building air exhaust to the atmosphere, through the outside air intake plenum.

The SGTS is provided with redundant control loops to control the following variables:

a) Total airflow of the system

b) Relative humidity of air entering the charcoal adsorber

c) Pressure in the SGTS inlet header

d) Air pressure in the reactor building

e) Rate of flow of cooling air through the charcoal adsorbers

Operation of the above loops is described in Subsection 6.5.1.1.

7.3.1.1b.4.3 Interlocks

No outputs of reactor building zone pressure differential controllers (PDIC-07554A&B) are present under the following conditions:

a) No reactor building isolation signal

b) Respective SGTS fan is not running

TABLE 7.3-6

PROCESS RADIATION MONITORING SYSTEM CHARACTERISTICS

MONITORING SUBSYSTEM	RANGE (1)	INSTRUMENT SCALE	UPSCALE TRIPS PER CHANNEL	DOWN-SCALE TRIPS PER CHANNEL
Main Steamline	1 to 10^6 mr/hr	6 Decade log	2	1
Air Ejector Offgas	1 to 10^6 mr/hr	6 Decade log	1	1
Offgas Vent	10^{-1} to 10^6 counts per second (2)	7 Decade log	2	1
Liquid Process	10^{-1} to 10^6 counts per second (2)	7 Decade log	1	1
Reactor Bldg.	0.01 mr/hr to 100 mr/hr	4 Decade log	1	1

(1) Range of measurements in dependent on items such as the source of geometry, background radiation, shielding, energy levels, and methods of sampling

(2) Readout is dependent upon the pulse height discriminator setting

(3) The main steamline radiation monitoring system output is part of the primary containment and reactor vessel isolation control system (PCRVICS) See Subsection 7.3.1.1a. 2.4.1.2

(4) The reactor building ventilation exhaust high radiation monitoring system ouput is part of the PCRIVICS. See Subsections 7.3.1.1b.4, 7.3.1b.5, 9.14.2.1 and Table 7.3-5.

7.6.1a.4.3 Equipment Design

7.6.1a.4.3.1 General

The systems or parts of systems which contain water or steam coming from the reactor vessel or supply water to the reactor vessel, and which are in direct communication with the reactor vessel, are provided with leakage detection systems.

The main steamlines within the steam tunnel inside the containment are monitored by temperature detectors within the tunnel.

Outside the drywell, the piping within each system monitored for leakage is in compartments or rooms separate from other systems wherever feasible so that leakage may be detected in drains, by area temperature indications, or high process flow.

7.6.1a.4.3.2 Main Steamline Leak Detection

The Main Steamline Leak Detection subsystem is discussed in Subsection 7.3.1.1a.2.4.1.12.

7.6.1a.4.3.3 RCIC System Leak Detection

7.6.1a.4.3.3.1 Subsystem Identification

The steamlines of the RCIC system are constantly monitored for leaks by the leak detection system. Leaks from the RCIC will cause a change in at least one of the following monitored operating parameters: area temperature, steam pressure, or steam flow rate. If the monitored parameters indicate that a leak may exist, the detection system responds by activating an annunciator and initiating a RCIC isolation trip logic signal.

The RCIC leak detection subsystem consists of three types of monitoring circuits. The first of these monitors ambient and differential temperature, triggering an annunciator when the temperature rises above a preset maximum. The second type of circuit utilized by the leak detection system monitors the flow rate (differential pressure) through the steamline, triggering an annunciator when the differential pressure rises above a preset maximum. The third type of circuit utilized by the leak detection system monitors the steamline pressure upstream of the

differential pressure element and also is annunciated. Alarm outputs from all three circuits are also used to generate the RCIC auto-isolation signal. For instrument specifications and setpoints, refer to the Technical Specifications.

7.6.1a.4.3.3.2 RCIC Area Temperature Monitoring

7.6.1a.4.3.3.2.1 Circuit Description

The area temperature monitoring circuit is similar to the one described for the HPCI area temperature monitoring system. (See Subsection 7.6.1.1a.4.3.9.2).

7.6.1a.4.3.3.2.2 Logic and Sequencing

Using one-out-of-two logic, the RCIC area temperature monitoring circuit activates an annunciator and initiates a RCIC isolation signal when the temperature rises above a preset limit.

7.6.1a.4.3.3.2.3 Bypasses and Interlocks

A bypass/test switch is provided in each logic for the purpose of testing the temperature monitor without initiating RCIC system isolation.

Placing the keyswitch in Bypass position in one division will not prevent operation of the temperature monitor in the opposite division when required for RCIC system isolation. No interlocks are provided from this subsystem.

7.6.1a.4.3.3.2.4 Redundancy and Diversity

Two physically and electrically independent channels of leak detection are supplied to those systems designed to isolate upon receipt of the leak detection signal(s) and required to meet the single failure and redundancy criteria.

7.6.1a.4.3.3.3 RCIC Steamline Pressure Monitoring

7.6.1a.4.3.3.3.1 Circuit Description

Steamline pressure to the RCIC turbine is monitored to detect gross system leaks that may occur upstream of the dP element (elbow), causing the line pressure to drop to an abnormally low level. This line pressure is monitored by the pressure sensors (see Subsection 7.4.1.1.3.6).

7.6.1a.4.3.3.3.2 Logic and Sequencing

Pressure sensors using two-out-of-two logic detect abnormal low steamline pressure and initiate RCIC isolation signal.

7.6.1a.4.3.3.3.3 Bypasses and Interlocks

No bypass or interlock provided.

7.6.1a.4.3.3.3.4 Redundancy and Diversity

Redundancy is provided by redundant pressure sensors. No diverse method is employed to detect gross system leaks upstream of the elbow.

7.6.1a.4.3.3.4 RCIC Flow Rate Monitoring

7.6.1a.4.3.3.4.1 Circuit Description

The steamline from the nuclear boiler to the RCIC turbine is instrumented with two differential pressure switches, one connected across each of two elbows in the line. The steam flow rate through the line is monitored by the switches, and a trip (isolation) occurs when leakage creates a steam line high flow condition. A time delay is incorporated to prevent inadvertent isolation. RCIC isolation is discussed in Subsection 7.4.1.1.3.6.

7.6.1a.4.3.3.4.2 Logic and Sequencing

Redundant instrumentation consists of one differential pressure switch in each logic, sensing high flow through the RCIC inlet steam line.

Since isolation of the RCIC system is accomplished by independent actuation of either logic, a single failure of a system component in either logic will not prevent the required isolation function. A 3 sec. time delay in each logic division prevents inadvertent system isolations due to pressure spikes.

7.6.1a.4.3.3.4.3 Bypass and Interlocks

No bypasses or interlocks are provided.

7.6.1a.4.3.3.4.4 Redundancy and Diversity

Isolation of the RCIC system is accomplished using two separate logics, each feeding their respective inboard and outboard isolation valves. Each logic incorporates a single channel of RCIC high steam flow monitoring instrumentation.

7.6.1a.4.3.4 Recirculation Pump Leak Detection

7.6.1a.4.3.4.1 Subsystem Identification

The purpose of the recirculation pump leak detection subsystem is to monitor the rate of coolant seepage or leakage past the pump shaft seals. Excessively high rates of coolant flow past the seal will result in annunciator activation.

There are two recirculation pump leak detection systems, one for each of the pumps in the recirculation loop. The recirculation pump leak detection system consists of two types of monitoring circuits, (Figure 7.6-1). The first of these monitors the pressure levels within the seal cavities, presenting the plant operator with a visual display of the sensed pressure in each of the two cavities. The second type of monitoring circuit utilized by the leak detection system monitors the rate of liquid flow from the seal cavities.

7.6.1a.4.3.4.2 Pump Seal Cavity Pressure Monitoring

7.6.1a.4.3.4.2.1 Circuit Description

The pressure levels within seal cavity No. 1 and seal cavity No. 2 are measured with identical instruments arranged similarly. Only one circuit, seal cavity No. 1 pressure monitoring, will be discussed. The pressure within seal cavity No. 1 is measured using a pressure transmitter. The pressure transmitter, produces an output signal whose magnitude is proportional to the sensed pressure within its dynamic range. This output signal is then applied to pressure indicators for plant operator readout.

7.6.1a.4.3.4.2.2 Logic and Sequencing

No action is initiated by the pump seal cavity pressure monitoring circuit.

7.6.1a.4.3.4.2.3 Bypasses and Interlocks

No bypass and interlocks are provided.

7.6.1a.4.3.4.2.4 Redundancy and Diversity

No redundancy is provided in this monitoring circuit. The pump seal cavity pressure monitoring is a diverse method of leak detection to the seal cavity flow rate monitoring.

7.6.1a.4.3.4.3 Liquid Flow Rate Monitoring

7.6.1a.4.3.4.3.1 Circuit Description

All condensate flowing past the recirculation pump seal packings and into the seal cavities is collected and sent by one of two drain systems to the drywell equipment sump for disposal. The first drain system drains the major portion of the condensate collected within the No. 2 seal cavity. The condensate flow rate through the drain system is measured (high/low) by a flow switch. The point at which the microswitch closes can be adjusted so that switch actuation occurs only above or below certain flow rates.

Excessively high or low flow rates through this drain system will activate an annunciator in the main control room.

The second drain system drains the cavity beyond the No. 2 seal cavity collecting the condensate that has seeped (or leaked) past the outer seal. The condensate flow rate through this drain system is also measured (high), using a flow switch. The physical construction of this switch is similar to the flow switch described above, with only one contact set used to indicate the high flow rate. A high flow rate through this system will activate an annunciator in the main control room.

7.6.1a.4.3.4.3.2 Logic and Sequencing

7.6.1a.4.3.4.3.3 Bypasses and Interlocks

The function of the pressure and flow rate instrumentation is to provide indication and annunciation. There are no bypasses or interlocks associated with this subsystem.

7.6.1a.4.3.4.3.4 Redundancy and Diversity

Redundant pressure and flow sensing instrumentation for detecting shaft seal leakage is not provided since the function of this instrumentation is to provide indication and annunciation. Back-up indication of seal leakage is provided, however, by monitoring both seal cavities to allow verification of seal failure. Excessive shaft seal leakage is collected by the drywell equipment sump.

7.6.1a.4.3.5 RHR System Leak Detection

7.6.1a.4.3.5.1 Subsystem Identification

The steamline of the RHR system are constantly monitored for leaks by the leak detection system. Leaks from the RHR system are detected by ambient and differential temperature monitoring, and in addition, by flow rate, and system pressure. Logic from all these channels is used to generate RHR auto isolation signals and alarm communication. If the monitored parameters indicate that a leak may exist, the detection system responds by activating an annunciator and initiating a RHR isolation trip logic signal. The RHR leak detection subsystem consists of three

types of monitoring circuits. The first of these monitors ambient and differential temperature, triggering an annunciator when the temperature rises above a preset maximum. The second type of circuit utilized by this leak detection subsystem monitors the flow rate (differential pressure) through the steamline, triggering an annunciator when the differential pressure (flow) rises above a preset maximum. The third type of circuit utilized by this subsystem monitors the line pressure upstream of the differential pressure element and also is annunciated. Outputs from all three circuits are also used to generate the RHR auto-isolation signal.

7.6.1a.4.3.5.2 RHR Area Temperature Monitoring

7.6.1a.4.3.5.2.1 Circuit Description

The area temperature monitoring circuit is similar to the one described for the main steamline tunnel temperature monitoring system (See Subsection 7.3.1.1a.2.4.1.12 and Figure 7.6-2).

7.6.1a.4.3.5.2.2 Logic and Sequencing

Using one-out-of-two logic, the RHR area temperature monitor activates an annunciator and initiates RHR isolation signal when the observed temperature exceeds a preset limit.

7.6.1a.4.3.5.2.3 Bypasses and Interlocks

No bypasses or interlocks are associated with this subsystem.

7.6.1a.4.3.5.2.4 Redundancy and Diversity

Dual channels of ambient and differential temperature monitoring are provided for leak detection in the RHR system equipment area for each of the two logic trains A and B. Since RHR system isolation is accomplished by independent actuation of the inboard and outboard isolation valves from their respective logic trains, a single failure of a system component in either train will not prevent the required isolation function.

7.6.1a.4.3.5.3 RHR Flow Rate Monitoring

7.6.1a.4.3.5.3.1 Circuit Description

Flow rate monitoring is provided on the RHR shutdown cooling return line and the RHR steamline to the RHR condensing heat exchanger.

Flow rates in excess of the predetermined maximum are indicative of a line leak or break, and will generate differential pressure heads of sufficient magnitude to cause dPIS actuation and provide automatic closure of RHR inboard and outboard isolation valves.

7.6.1a.4.3.5.3.2 Logic and Sequencing

Using one-out-of-two logic, the flow rate monitoring circuit initiates a signal to isolate RHR inboard and outboard isolation valves when flow rate exceeds a preset limit.

7.6.1a.4.3.5.3.3 Bypasses and Interlocks

There are no bypasses or interlocks in this system.

7.6.1a.4.3.5.3.4 Redundancy and Diversity

RHR steamline isolation is accomplished using the combined RCIC/RHR flow-monitoring system described in Subsection 7.6.1a.4.3.3.4.1. An independent flow monitoring channel is provided for each logic (i.e., A and B). Flow monitoring in the shutdown cooling return line utilizes two differential pressure switches, one for each logic. In both cases, RHR isolation is accomplished by independent actuation of either logic; consequently, a single failure in either logic will not prevent the required isolation function.

7.6.1a.4.3.5.4 RHR Process Line Pressure Monitoring

Process line pressure for the common RHR/HPCI steamline is monitored to detect gross system leaks that may occur upstream of the flow element, causing the line pressure to drop to an abnormally low level. Line pressure is monitored by four

pressure switches actuating on low pressure. Additionally, differential pressure of the common steamline (Figures 5.4-13, 6.3-1a and 6.3-1b) is monitored by differential pressure indicating switches to detect HPCI line break. Annunciation is provided in the main control room. These monitoring systems are described in Subsections 7.6.1a.4.3.9.3 and 7.6.1a.4.3.9.4.

7.6.1a.4.3.6 Reactor Water Clean-Up System Leak Detection

See Subsection 7.3.1.1a.2.4.1.9.

7.6.1a.4.3.7 Safety/Relief Valve Leak Detection

7.6.1a.4.3.7.1 Subsystem Identification

Normally, the safety/relief valves are in the shut tight condition and are all at about the same temperature. Steam passage through the valve will elevate the sensed temperature at the exhaust, causing an "abnormal" temperature reading on the recorder. Switch contacts on the recorder, adjusted to actuate at a predetermined set point, close to complete an annunciator circuit. Safety valve operation usually occurs only after relief valve actuation. Leakage from a valve is usually characterized by a temperature increase on a single input. As discussed in Subsection 18.1.24.3, each of the sixteen safety/relief valves are provided with a safety grade accoustic monitoring system to detect flow through the valve.

7.6.1a.4.3.7.2 Safety/Relief Valve Discharge Line Temperature Monitoring

7.6.1a.4.3.7.2.1 Description

A temperature element (sensor) is placed in the discharge pipe of each of the sixteen (16) safety/relief valves for remote indication of leakage. The outputs of the temperature elements are sequentially sampled and recorded by one common temperature recorder. Each temepratures element is compared against a set point valve which if exceeded will be annunciated by one common annunciator. Thus, when the annunciator sounds, it is possible to ascertain which specific valve(s) may be leaking by observing the recorder print-out.

7.6.1a.4.3.7.2.2 Logic and Sequencing

No action is initiated by the safety/relief valve temperature monitoring circuit.

7.6.1a.4.3.7.2.3 Bypasses and Interlocks

There are no bypasses or interlocks associated with this subsystem.

7.6.1a.4.3.7.2.4 Redundancy and Diversity

No redundancy or diversity is required for this system.

7.6.1a.4.3.8 Reactor Vessel Head Leak Detection

7.6.1a.4.3.8.1 Subsystem Identification

A pressure between the inner and outer head seal ring will be sensed by a pressure indicator. If the inner seal leaks, the pressure indicator will monitor the pressure.

The plant will continue to operate with the outer seal as a backup and the inner seal can be repaired at the next outage when the head is removed. If both the inner and outer head seals leak, the leak will be detected by an increase in drywell temperature and pressure.

7.6.1a.4.3.8.2 Head Seal Integrity Pressure Monitoring

7.6.1a.4.3.8.2.1 Circuit Description

A pressure indicator will monitor the pressure between the inner and outer head seals.

7.6.1a.4.3.8.2.2 Logic and Sequencing

No action is initiated by the reactor vessel head pressure monitoring circuit.

7.6.1a.4.3.8.2.3 Bypasses and Interlocks

There are no bypasses or interlocks associated with this subsystem.

7.6.1a.4.3.8.2.4 Redundancy and Diversity

Redundant pressure-sensing instrumentation for detecting inner seal failure is not provided. The outer seal assembly provides back-up in the event that inner seal leak should occur.

7.6.1a.4.3.9 HPCI System Leakage Detection

7.6.1a.4.3.9.1 Subsystem Identification

The steamline of the high pressure coolant injection (HPCI) system are constantly monitored for leaks by the leak detection system. Leaks from the HPCI steamline will cause a change in at least one of the following monitored operating parameters: sensed area temperature, steam pressure, or steam flow rate. If the monitored parameters indicate that a leak may exist, the detection system responds by activating an alarm and, depending upon the activating parameter, initiates HPCI autoisolation action.

The HPCI leakage detection system consists of three types of monitoring circuits. The first of these monitors area ambient temperature, triggering the alarm circuit when the temperature rises above the preset maximum. The second type of circuit utilized by the leakage detection system monitors the flow rate, or differential pressure, through the steam line, triggering an alarm circuit when the flow rate exceeds a preset maximum. The third type of circuit utilized by the HPCI leakage detection system monitors the steam line pressure upstream of the differential pressure element. Alarm outputs from all three circuits are also used to generate the HPCI auto-isolation signal. The ambient temperature monitoring is similar to that described in main steamline leakage detection system.

7.6.1a.4.3.9.2 HPCI Area Temperature Monitoring

7.6.1a.4.3.9.2.1 Circuit Description

The HPCI area and tunnel ambient and differential temperature sensing elements are thermocouples. Their outputs go to temperature switches set to activate at a preset temperature. Closing the temperature switches will light the point module alarm indicator and sound the high temperature alarm in the main control room. In addition, activation of the tunnel temperature switches will start the timer, which after a suitable delay period, initiates HPCI isolation valve closure. If at any time during the timing cycle, the temperature switch contacts are opened, the timer will automatically reset and no isolation valve closure will result. Before timer timeout, the operator can initiate isolation by depressing pushbutton switch HPCI ISOLATE. This action will bypass the timer circuits and, providing no logic test is in progress, the HPCI isolation valves will close.

HPCI equipment area ambient temperatures are monitored by local and emergency area cooler inlet temperature sensors.

High ambient and differential temperature from the HPCI area initiates isolation valve closure.

The HPCI isolation valves do not receive an isolation signal for approximately one (1) second following actuation of either HPCI area temperature monitoring system or the tunnel temperature monitoring system. This time delay prevents false isolation signals from being sent to HPCI logic every time the temperature switches are energized.

7.6.1a.4.3.9.2.2 Logic and Sequencing

The two division HPCI temperature monitors work on a one out of two logic that initiates the isolation logic. There are five temperature monitors per division which consist of three area (two ambient and one differential) and two tunnel (one ambient and one differential) temperature monitors. The tunnel temperature signals are time delayed before initiating the isolation logic.

7.6.1a.4.3.9.2.3 Bypasses and Interlocks

A bypass/test switch is provided in each logic division for the purpose of testing the HPCI logic without initiating HPCI system isolation. Placing the keyswitch in Bypass position in one division will not prevent operation of the temperature monitor in the opposite division when required for HPCI system isolation. No interlocks are provided from this subsystem.

7.6.1a.4.3.9.2.4 Redundancy and Diversity

There are two independent HPCI leakage detection divisions. The HPCI area ambient temperature monitoring is a diverse method of HPCI leak detection to the HPCI steam line pressure and flow rate (differential pressure) monitoring.

7.6.1a.4.3.9.3 HPCI Steam Flow Monitoring

7.6.1a.4.3.9.3.1 Description

The steamline from the nuclear boiler leading to the HPCI turbine is instrumented so that the steam flow rate through it, and its pressure, can be monitored and used to indicate the presence of a leak or break. In the presence of a leak, the HPCI system responds by operating the auto-isolation signal. This portion of the discussion on HPCI system leakage detection is limited to the flow rate instrumentation and does not cover the system isolation procedures. Steam flowing through the steam line will develop a differential pressure head across the elbow located inside the primary containment. The magnitude of the head proportional to the square of the flow rate is measured by a dPIS. Flow rates in excess of the predetermined maximum indicative of a line leak or break will generate differential pressure heads of sufficient magnitude to cause a dPIS actuation. Actuation occurs following a preset time delay to prevent inadvertent isolation. HPCI isolation is discussed in Subsection 7.3.1.1a.1.3.7.

7.6.1a.4.3.9.3.2 Logic and Sequencing

Using one-out-of-two logic, the HPCI steam flow monitoring circuit initiates a HPCI isolation signal when the flow rate exceeds a preset limit.

7.6.1a.4.3.9.3.3 Bypasses and Interlocks

See paragraph 7.6.1a.4.3.9.2.3.

7.6.1a.4.3.9.3.4 Redundancy and Diversity

There are two independent HPCI leakage detection channels.

7.6.1a.4.3.9.4 HPCI Steamline Pressure Monitoring

7.6.1a.4.3.9.4.1 Circuit Description

Steamline pressure to the HPCI turbine is monitored to detect gross system leaks that may occur upstream of the dP element, causing the line pressure to drop to an abnormally low level. Line pressure is monitored by pressure switches, actuating on low pressure to also generate the auto-isolation signal.

7.6.1a.4.3.9.4.2 Logic and Sequencing

Using two-out-of two logic, the HPCI steamline pressure monitoring circuit initiates a HPCI isolation signal when the pressure falls below a preset limit.

7.6.1a.4.3.9.4.3 Bypasses and Interlocks

See Subsection 7.6.1a.4.3.9.2.3 for discussion

7.6.1a.4.3.9.4.4 Redundancy and Diversity

There are two independent HPCI leakage detection channels.

7.6.1a.4.4 System and Subsystem Separation Criteria

See Section 3.12 for discussion on separation.

7.6.1a.4.5 System and Subsystem Testability

The proper operation of the sensor and the logic associated with the leak detection systems is verified during the leak detection system preoperational test and, during inspection tests that are provided for the various components during plant operation. Each temperature switch, both ambient and differential types, is connected to dual thermocouple elements.

Each temperature switch contains a trip light which lights when the temperature exceeds the set point. In addition, keylock test switches are provided so that logic can be tested without sending an isolation signal to the system involved. Thus, a complete system check can be confirmed by checking activation of the isolation relay associated with each switch.

RWCU differential flow leak detection alarm units are tested by inputting a millivolt signal to simulate a high differential flow. Alarm and indicator lights monitor the status of the trip circuit.

Testing of flow, reactor vessel level, and pressure leak detection equipment is described in Subsections 7.3.1.1a.1, and 7.3.1.1a.2.

7.6.1a.4.6 System and Subsystem Environmental Considerations

The sensors, wiring, and electronics of the leak detection system which are associated with the isolation valve logic are designed to withstand the envelope conditions that follow a LOCA. (See Tables 3.11-1, 3.11-2, and 3.11-3.)

All portions of the leak detection system which provide for isolation of other systems or portions of systems are environmentally qualified to meet the requirements for Class I electrical equipment (See Section 3.11.).

7.6.1a.4.7 System and Subsystem Operational Considerations

The operator is kept aware of the status of the leak detection system through meters and recorders which indicate the measured variables in the control room. If a trip occurs, the condition is continuously annunicated in the main control room.

Leak detection system bypass switches are provided on a backrow panel in the main control room to allow bypassing of certain trip functions during testing.

The operator can manually operate valves which are affected by the leak detection system during normal operation. When a trip conditions exists, the isolation logic must be reset before further manual valve operations can be performed. Manual reset switches are provided in the main control room.

There is no vital supporting system which supplies direct support for the leak detection systems.

7.6.1a.5 Neutron Monitoring System-Instrumentation and Controls

The neutron monitoring system consists of six major subsystems:

(1) Source range monitor subsystem (SRM),

(2) Intermediate range monitor subsystem (IRM),

(3) Local power range monitor subsystem (LPRM),

(4) Average power range monitor subsystem (APRM),

(5) Rod block monitor subsystem (RBM), and

(6) Traversing in-core probe subsystem (TIP).

7.6.1a.5.1 System Identification

The purpose of this system is to monitor the power in the core and provide signals to the RPS and the rod block portion of the reactor manual control system. It also provides information for operation and control of the reactor.

The IRM and APRM subsystems provide a safety function, and have been designed to meet particular requirements established by the NRC. The LPRM subsystem has been designed to provide a sufficient number of LPRM inputs to the APRM subsystem to meet the APRM requirements. All other portions of the Neutron Monitoring System have no safety function. The system is classified as shown in Table 3.2-1. The safety related subsystems are qualified in accordance with Sections 3.10 and 3.11.

7.6.1a.5.2 Power Source

7.6.1b.2.5 Standby Gas Treatment System Exhaust Vent Radiation Monitoring Subsystem

The description of the instrumentation and its function is provided in Subsection 11.5.2.1.4.

7.6.1b.3 Diesel Generator Initiation-Instrumentation and Controls

Interlocks between NSSS systems and non-NSSS systems in Unit 1 and 2 provide the initiation for the start of the diesel generators and are identified as follows:

Diesel Generator A Start Signal (one signal each from Units 1 and 2)

Diesel Generator B Start Signal (one signal each from Units 1 and 2)

Diesel Generator C Start Signal (one signal each from Units 1 and 2)

Diesel Generator D Start Signal (one signal each from Units 1 and 2)

7.6.1b.3.1 Initiation

The initiation circuit for the diesel generator start signal originates in the NSSS system logic. High drywell pressure and/or low reactor water level, arranged in two instrument channels taken twice, will initiate each of the four diesel start circuits. NSSS componenets in the RHR and core spray systems are utilized. Manual initiation of a RHR or core spray system will start the diesel associated with that system. Loss of offsite power also automatically initiates diesel start.

Individual manual start is also provided on the plant operating benchboard.

TABLE 18.1-10
CONTAINMENT ISOLATION ACTUATION PROVISIONS (12)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-113	NE	1.	X-24	HV-11313	AI	F,G	NO	(6)
REAC				-11345	AI	F,G	NO	(6)
BLDG	NE	1.	X-23	HV-11314	AI	F,G	NO	(6)
CCW				-11346	AI	F,G	NO	(6)
M-126	E	2.	X-41	SV-12654A	RM	-	-	-
INSTRUM				-126154	CKV	-	-	-
GAS	E	2.	X-21	SV-12654B	RM	-	-	-
				-126152	CKV	-	-	-
	NE	3.	X-19	SV-12651	AI	F,G	NO	-
				-126074	CKV	-	-	-
	NE	3.	X-93	SV-12661	AI	B,F	NO	-
				-126072	CKV	-	-	-
	NE	3.	X-87	SV-12605	AI	F,G	NO	-
				HV-12603	AI	F,G	NO	-
	NE	3.	X-218	SV-12671	AI	B,F	NO	-
				-126164	CKV	-	-	-
M-139 MSIV LEAKAGE CONTROL SYSTEM	NE	4.	X-7A (B,C,D)	E32-1F001B (F,K,P)	AC	(3)	N/A	-
M-141 NUCLEAR BOILER	NE	4.	X-7A (B,C,D)	B21-1F028A (B,C,D)	AI	(a)	NO	(4)(11)
				-1F022A (B,C,D)	AI	(a)	NO	(4)(11)
	NE	4.	X-8	B21-1F016	AI	(a)	NO	(4)
				-1F019	AI	(a)	NO	(4)
	E	5.	X-9A	B21-1F032A	RM	-	-	-

TABLE 18.1-10 (Continued)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-141				B21-1F010A	CK	-	-	-
NUCLEAR	E	5.	X-9B	B21-1F032B	RM	-	-	-
BOILER				-1F010B	CK	-	-	-
(CONT.)	NE	30.	X-35A,	J004	-	A,F	NO	-
			C,D,E,F	J004	-	-	-	-
M-143	NE	8.	X-60B	B31-1F019	AI	B,C	NO	(5)(11)
REACTOR				-1F020	AI	B,C	NO	(5)(11)
RECIRC	NE	29.	N-60A	B31-1F013A	CK	-	-	-
				-1F017A	XFC	-	-	-
	NE	29.	X-31B	B31-1F013B	CK	-	-	-
				-1F017B	XFC	-	-	-
M-144	NE	7.	X-14	G33-1F001	AI	(c)	NO	-
RWCU				-1F004	AI	(c)	NO	-
	NE	7.	X-9A/B	G33-1F042	RM	-	-	-
				-1F104	RM	-	-	-
M-148	E	9.	X-42	C41-1F007	CK	-	-	-
STANDBY				-1F006	RM	-	-	-
LIQUID								
CONTROL								
M-149	E	6.	X-9A	E51-1F013	AC	-	NO	-
RCIC	E	6.	X-10	E51-1F088	AI	(k)	YES	(11)
				-1F007	AI	(k)	YES	-
				-1F008	AI	(k)	YES	-
	E	6.	X-216	E51-1F019	AC	-	N/A	-
				-1F021	CK	-	-	-
	E	6.	X-245	E51-1F084	AI	F,K,B	N/A	-
				-1F062	AI	F,K,B	N/A	-

TABLE 18.1-10 (Continued)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-149	E	6.	X-215	E51-1F059	RM	-	-	-
RCIC				-1F040	CK	-	-	-
(CONT.)	E	6.	X-217	E51-1F060	RM	-	-	-
				-1F028	CK	-	-	-
	E	6.	X-214	E51-1F031	RM	-	-	-
M-151	NE	10.	X-17	E11-1F023	AI	(d)	NO	-
RHR				-1F022	AI	(d)	NO	-
	E	11.	X-39A	E11-1F016A	AC	F,G	(9)	-
	E	12.	X-13A	E11-1F015A	AC	-	NO	
				-1F050A	AC	-	NO	(11)
				-1F122A	AC	-	NO	(11)
	E	11.	X-205A	E11-1F028A	AC	F,G	(9)	-
	NE	13.	X-205A	E11-1F011A	AI	F,G	NO	-
	E	13.	X-204A	E11-1F028A	AC	F,G	(9)	-
	NE	13.	X-204A	E11-1F011A	AI	F,G	NO	-
	E	14.	X-226A	E11-1F007A	AC	-	N/A	-
	E	15.	X-246A	E11-1F055A	PSV	-	-	-
				-15106A	PSV	-	-	-
				-1F103A	RM	-	-	-
	E	15.	X-246B	E11-1F055B	PSV	-	-	-
				-15106B	PSV	-	-	-
				-1F103B	RM	-	-	-
				-1F097	PSV	-	-	-
	E	16.	X-203A	E11-1F004A	RM	-	-	-
	E	16.	X-203C	E11-1F004C	RM	-	-	-
	E	11.	X-39B	E11-1F016B	AC	F,G	(9)	-
	E	12.	X-13B	E11-1F015B	AC	-	NO	-
				-1F050B	AC	-	NO	(11)
				-1F122B	AC	-	NO	(11)
	E	12.	X-12	E11-1F008	AI	(b)	NO	-
				-1F009	AI	(b)	NO	-
				-1F126	PSV	-	-	-
	E	11.	X-205B	E11-1F028B	AC	F,G	(9)	-

TABLE 18.1-10 (Continued)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-151	NE			E11-1F011B	AI	F,G	NO	-
RHR	E	13.	X-204B	E11-1F028B	AC	F,G	(9)	-
(CONT.)	NE			-1F011B	AI	F,G	NO	-
	E	14.	X-226B	E11-1F007B	AC	-	N/A	-
	E	16.	X-203D	E11-1F004D	RM	-	-	-
	E	16.	X-203B	E11-1F004B	RM	-	-	-
M-152	E	17.	X-16A	E21-1F005A	AC	-	(10)	-
CORE				-1F006A	RM	-	-	(11)
SPRAY				-1F037A	RM	-	-	(11)
	E	17.	X-16B	E21-1F005B	AC	-	(10)	-
				-1F006B	RM	-	-	(11)
				-1F037B	RM	-	-	(11)
	NE	18.	X-207A	E21-1F015A	AC	-	(10)	-
	NE	18.	X-207B	E21-1F015B	AC	F,G	(10)	-
	E	19.	X-208A	E21-1F031A	AC	F,G	N/A	-
	E	19.	X-208B	E21-1F031B	AC	-	N/A	-
	E	20.	X-206A	E21-1F001A	RM	-	-	-
	E	20.	X-206B	E21-1F001B	RM	-	-	-
M-155	E	21.	X-11	E41-1F002	AI	(1)	YES	-
HPCI				-1F003	AI	(1)	YES	-
				-1F100	AI	(1)	YES	(11)
	E	22.	X-211	E41-1F012	AC	-	N/A	-
				-1F046	CK	-	-	-
	E	21.	X-244	E41-1F079	AI	F,LB	N/A	-
				-1F075	AI	F,LB	N/A	-
	E	21.	X-210	E41-1F066	RM	-	-	-
				-1F049	CK	-	-	-
	E	23.	X-209	E41-1F042	AI	(1)	NO	-
	E	5.	X-9B	E41-1F006	AC	-	(10)	-

TABLE 18.1-10 (Continued)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-157	NE	24.	X-26	HV-15711	AI	B,F,R	NO	(7)
CONTMT				-15713	AI	B,F,R	NO	(7)
ATMOS				-15714	AI	B,F,R	NO	(7)
CONTROL	E	25.	X-60A	SV-15740A	AI	B,F	NO	(8)
				-15742A	AI	B,F	NO	(8)
	E	25.	X-60A	SV-15750A	AI	B,F	NO	(8)
				-15752A	AI	B,F	NO	(8)
	NE	24.	X-202	HV-15703	AI	B,F,R	NO	(7)
				-15704	AI	B,F,R	NO	(7)
				-15705	AI	B,F,R	NO	(7)
	E	25.	X-221A	SV-15780A	AI	B,F	NO	(8)
				-15782A	AI	B,F	NO	(8)
	E	25.	X-238A	SV-15736A	AI	B,F	NO	(8)
				-15734A	AI	B,F	NO	(8)
	E	25.	X-80C	SV-15740B	AI	B,F	NO	(8)
				-15742B	AI	B,F	NO	(8)
	E	25.	X-80C	SV-15750B	AI	B,F	NO	(8)
				-15752B	AI	B,F	NO	(8)
	E	25.	X-80C	SV-15776B	AI	B,F,R	NO	(8)
				-15774B	AI	B,F	NO	(8)
				-15767	AI	B,F,R	NO	-
	NE	24.	X-25	HV-15722	AI	B,F,R	NO	(7)
				-15723	AI	B,F,R	NO	(7)
				-15721	AI	B,F,R	NO	(7)
				-15724	AI	B,F,R	NO	-
	NE	24.	X-201A	HV-15725	AI	B,F,R	NO	(7)
				-15724	AI	B,F,R	NO	(7)
				-15721	AI	B,F,R	NO	-
				-15723	AI	B,F,R	NO	-
	E	25.	X-238B	SV-15734B	AI	B,F	NO	(8)
				-15736B	AI	B,F,R	NO	(8)
				-15737	AI	B,F,R	NO	(7)
	E	25.	X-233	SV-15780B	AI	B,F	NO	(8)
				-15782B	AI	B,F	NO	(8)
	E	25.	X-88B	SV-15776A	AI	B,F	NO	(8)

TABLE 18.1-10 (Continued)

P&ID SYSTEM	E OR NE	BASIS (1)	PENETR. NO.	VALVE NO.	VALVE ACTUATION	AUTOMATIC ACTUATION SIGNALS (2)	AUTO OPEN ON ISO SET	OTHER REMARKS
M-157				SV-15774A	AI	B,F	NO	(8)
CONTMT	NE	26.	X-243	HV-15766	AI	A,F	NO	-
ATMOS				-15768	AI	A,F	NO	-
CONTROL								
(CONT.)								
M-161	NE	27.	X-72B	HV-16108A1	AI	B,F	NO	(11)
LIQUID				-16108A2	AI	B,F	NO	(11)
RADWASTE	NE	27.	X-72A	HV-16116A1	AI	B,F	NO	(11)
CONTROL				-16116A2	AI	B,F	NO	(11)
M-187	NE	1.	X-85B	HV-18791A2	AI	B,F	NO	(11)
REACTOR				-18792B2	AI	B,F	NO	(11)
BLDG	NE	1.	X-85A	HV-18791A1	AI	B,F	NO	(11)
CHILLED				-18792B1	AI	B,F	NO	(11)
WATER	NE	1.	X-54	HV-18781B2	AI	F,G	NO	(11)
				-18782A2	AI	F,G	NO	(11)
	NE	1.	X-53	HV-18781B1	AI	F,G	NO	(11)
				-18782A1	AI	F,G	NO	(11)
	NE	1.	X-86B	HV-18791B2	AI	B,F	NO	(11)
				-18792A2	AI	B,F	NO	(11)
	NE	1.	X-86A	HV-18791B1	AI	B,F	NO	(11)
				-18792A1	AI	B,F	NO	(11)
	NE	1.	X-56	HV-18781A2	AI	F,G	NO	(11)
				-18782B2	AI	F,G	NO	(11)
	NE	1.	X-55	HV-18781A1	AI	F,G	NO	(11)
				-18782B1	AI	F,G	NO	(11)

TABLE 18.1-10 (Continued)

REMARKS

(1) Essential or non-essential classification basis codes are described in Table 18.1-11.

(2) Automatic actuation signal codes are described in Table 18.1-12. Actuation signals not for Primary Containment or for system isolation are not listed. All power-operated isolation valves are capable of remote-manual operation from the Control Room.

(3) E32-1F001B automatic actuation signal is dependent upon action of MSIV's, time, RPV pressure. The valve is normally closed and interlocked when RPV pressure is greater than 35 psig. The valve cannot be opened unless the inboard MSIV is closed. Information presented is representative of that for main steam lines B, C and D.

(4) Automatic signal for isolation UA can be bypassed (B21-S25A, B, C, D) when the mode switch is not in Run, turbine stop valves are closed, and RPV pressure is less than the high pressure scram setpoint.

(5) Reactor recirculation system sample line valves B31-1F019 and 1F020 receive high radiation signals for isolation but since the line does not provide an open path from the containment to the environs, the radiation isolation signal may be considered a diverse signal in accordance with Standard Review Plan 6.2.4. This judgement is based on our definition of an open path as a direct, untreated path to the outside environment.

(6) Either valve opening (or closing) will energize a common open (close) status light. HS-11314 controls both valves. Typical for HV-11345 and HV-11346.

(7) Closes on "LOCA" signal but can be reopened after 45 minutes. Valves can be administratively reopened if the high drywell pressure is due to plant heat up or loss of drywell cooler.

TABLE 18.1-10 (Continued)

(8) Closed on "LOCA" signal but can be reopened after 10 minutes.

(9) Initiation reset will automatically reopen valve if valve handswitch is in open position.

(10) Initiation reset will not automatically reopen valve.

(11) Pneumatic actuated valve.

(12) Hand valves and instrument sensing line excess flow check valves are listed in Tables 6.2-12 and 6.2-12a.

TABLE 18.1-11

ESSENTIAL/NON-ESSENTIAL PENETRATION CLASSIFICATION BASIS

(1) Closed Cooling Water - Non-essential since used during normal operation only for reactor recirculation pump cooling, reactor water cleanup and other system components. Not required for design basis accident situation.

(2) Containment Intstrument Gas - Essential to support safety equipment.

(3) Instrument Gas - Non-essential support to non-safety related equipment, and for testing of safety related equipment.

(4) Main Steam Line and MSIV Leakage Control System - Non essential for shutdown.

(5) Feedwater Line - Not essential for shutdown but desirable for makeup water to vessel. Portion between reactor vessel and outermost containment isolation valve is essential for HPCI and RCIC injection.

(6) Reactor Core Isoltion Cooling - Essential for core cooling following isolation from turbine condenser and feedwater makeup.

(7) Reactor Water Cleanup - Not essential during or immediately following an accident. Maybe important in long term recovery operations.

(8) Reactor Water Sampling - Not essential for safe shutdown. Post-accident samples will be taken utilizing the post-accident sampling system developed in response to item II.B.3.

(9) Standby Liquid Control - Essential as backup to CRD system.

(10) Residual Heat Removal (RHR) Head Spray - Not essential for safe shutdown.

(11) RHR Containment/Suppression Pool Spray - Essential for pressure control.

(12) RHR Shutdown Cooling - Essential to achieve cold shutdown.

(13) RHR Steam Condensing Recirc./Test Return Line - Not essential since not a safety function. Used during hot standby and pump tests.

TABLE 18.1-11 (Continued)

(14) RHR Pump Minimum Flow Recirculation - Essential for protect pumps for safety function.

(15) RHR heat Exchanger Relief Valve Discharge Line - Essential to protect HX from overpressurization for use in safety function.

(16) RHR Suppression Pool Suction - Essential for vessel injection and pool cooling safety functions.

(17) Core Spray Injection - Essential safety function.

(18) Core Spray Pump Test Return Lines - Non-essential. Used only during testing of pumps.

(19) Core Spray Pumps Min. Flow Bypass - Essentail to protect pumps for safety function.

(20) Core Spray Suppression Pool Suction - Essential for vessel injection safety function.

(21) High Pressure Coolent Injection (HPCI) Turbine Steam Supply and Exhaust-Essential to drive HPCI pump for vessel injection safety function.

(22) HPCI Pump Min. Recirc. - Essential to protect pump for safety function.

(23) HPCI Suppression Pool Suction - Essential for vessel injection safety function. Backup to Condensate Storage Tank supply.

(24) Containment Atmospheric Purge - Non-essential vent path to Standby Gas Treatment System. Backup to four hydrogen recombiners.

(25) Containment Atmoshere Sampling - Essential. Not required for shutdown, but would be necessary for post-accident assessment.

(26) Suppression Pool Water Filtration - Not essential. Used only for periodic cleanup of pool water.

(27) Liquid Radwaste Collection - Non-essential for safe shutdown.

(28) Reactor Bldg. Chilled Water - Non-essential supply to recirculation pump motor coolers, drywell coolers.

TABLE 18.1-11 (Continued)

(29) Reactor Recirc. Pump Seal Water Supply - Non-essential Recirc. Pump operation is not required for safe shutdown.

(30) TIP Guide Tube Isolation - Non-essential. TIP system not required for safe shutdown.

TABLE 18.1-12

ACTUATION/ISOLATION SIGNAL CODES
& CORRESPONDING ACTUATING SWITCHES

Isolation actuation signals are listed and described below. Interlocks and bypasses are identified and described in Sections 7.3.1.1a.2 and 7.3.1.1b.2.

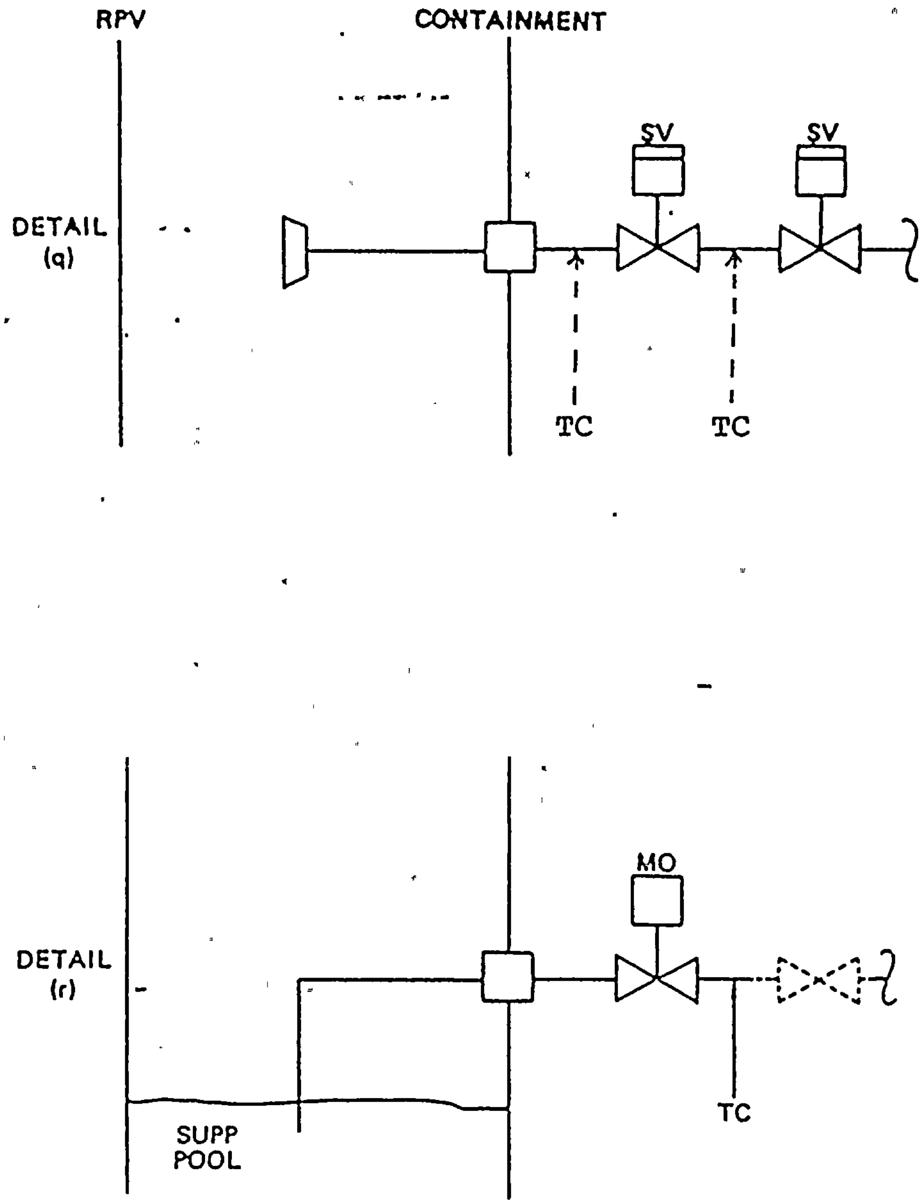
A	Reactor Vessel Water Level - Low Level 3
B	Reactor Vessel Water Level - Low Level 2
C	Main Steam Line Radiation - High
D	Main Steam Line Flow - High
EA	Reactor Building Steam Line Tunnel Temperature - High
EB	Reactor Building Steam Line Tunnel Differential Temperature-High
EC	Turbine Building Steam Line Tunnel Temperature - High
F	Drywell Pressure - High
G	Reactor Vessel Water Level - Low, Low, Low Level I
I	Standby Liquid Control System Manual Initiation
JA	RWCS Differential Flow - High
JB	RWCS Differential Pressure - High
KA	RCIC Steam Line Pressure - High
KB	RCIC Steam Supply Pressure - Low
KC	RCIC Turbine Exhaust Diaphragm Pressure - High
KD	RCIC Equipment Room Temperature - High
KE	RCIC Equipment Room Temperature - High
KF	RCIC Pipe Routing Area Temperature - High
KG	RCIC Pipe Routing Area Temperature - High
KH	RCIC Emergency Area Cooler Temperature - High
LA	HPCI Steam Line Pressure - High
LB	HPCI Steam Supply Pressure - Low

TABLE 18.1-12 (Page 2 of 2)

LC	HPCI Turbine Exhaust Diaphragm Pressure - High
LD	HPCI Equipment Room Temperature - High
LE	HPCI Equipment Room Temperature - High
LF	HPCI Emergency Area Cooler Temperature - High
LG	HPCI Pipe Routing Area Temperature - High
LH	HPCI Pipe Routing Area Temperature - High
MA	RHR Equipment Area Differential Temperature - High
MB	RHR Equipment Area Temperature - High
MC	RHR System Flow - High
P	Turbine First Stage Pressure - Low
R	SGTS Exhaust Radiation - High
UA	Main Condenser Vacuum - Low
UB	Reactor Vessel Pressure - High
WA	RWCS Area Temperature - High
WB	RWCS Area Ventilation Differential Temperature - High

Isolation Actuation Groupings

(a)	B, C, D, EA, EB, EC, P, UA
(b)	A, MA, MB, MC, UB
(c)	B, JA, JB, WA, WB
(d)	A, F, MA, MB, MC, UB
(k)	KA, KB, KC, KD, KE, KF, KG, KH
(l)	LA, LB, LC, LD, LE, LF, LG, LH



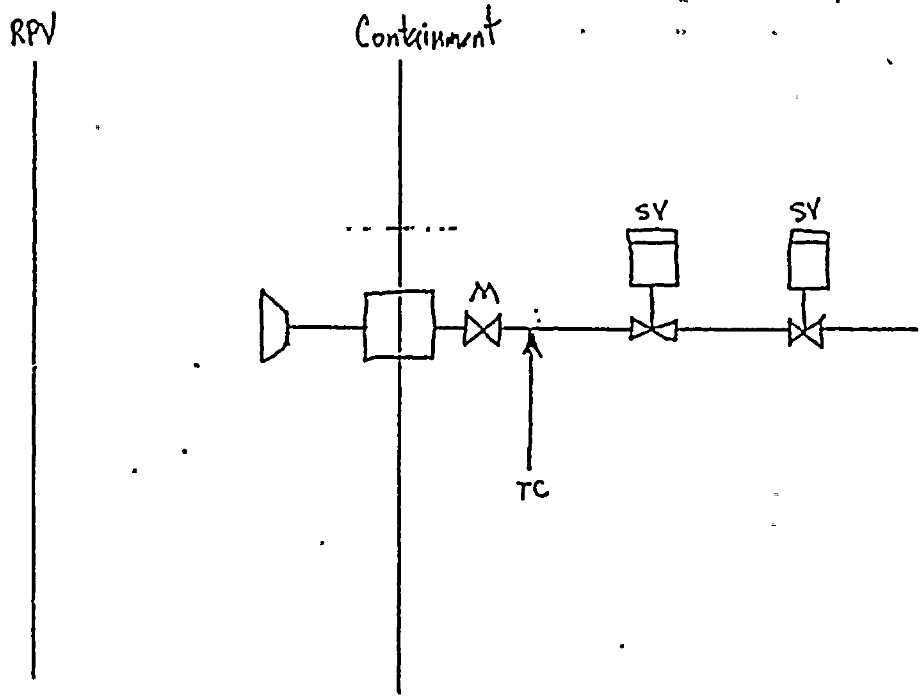
MO – MOTOR OPERATED
SV – SOLENOID VALVE
TC – TEST CONNECTION

REV 1 (7/78)

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

CONTAINMENT PENETRATION DETAILS

FIGURE 6.2-44g



Detail (dd)

SV - Solenoid Valve

TC - Test Connection

M - Manual

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

CONTAINMENT PENETRATION DETAILS

FIGURE 6.2-44n