5.2 ISOLATION SYSTEM

5.2.1 DESIGN BASIS

The general design basis governing isolation valve requirements is that the leakage through all fluid penetrations not serving engineered safety feature systems is to be minimized by a double barrier so that no single, credible failure or malfunction of an active component can result in loss of isolation or intolerable leakage. The installed double barriers take the form of closed piping systems, both inside and outside the Containment Structure, and various types of isolation valves. These double barriers support containment integrity requirements in Modes 1-4. During refueling operations, containment closure is established. As required by Reference 1, containment closure is also established during reduced inventory operations. These containment integrity and closure requirements are defined in the Technical Specifications.

Containment Structure isolation (Containment Isolation Signal and Safety Injection Actuation Signal) is initiated at a setpoint between the Technical Specification high pressure value and a value that is based on the minimum pressure compatible with normal operating conditions. Valves which isolate penetrations that are directly open to the Containment Structure, such as the purge valves and sump drain valves, will also be automatically closed on an isolation signal.

As required by Three Mile Island Action Item II.E.4.2, Containment Isolation Dependability, non-essential fluid systems shall be automatically isolated. Essential and non-essential fluid systems were defined in Reference 2 and approved in Reference 3. Essential fluid systems are those that are actively required during the early stages of an accident to control and mitigate the consequences of an accident. The essential fluid systems are: high and low pressure safety injection (penetrations 3, 4, 5, 6), containment spray (penetrations 9, 10), service water to the containment air coolers (penetrations 25, 26, 27, 28), auxiliary feedwater (penetrations 21, 22), Reactor Coolant System charging (penetration 2B), sump recirculation (penetrations 11, 12), service water outlet (penetrations 29, 30, 31, 32), main steam lines (penetrations 35, 36) and containment pressure instrument lines (penetrations 72, 77, 78, 83). These essential fluid systems are not automatically isolated by safety injection actuation signal or containment isolation signal. The remaining fluid lines are considered non-essential. These penetrations are normally locked closed, close on safety injection actuation signal, containment isolation signal, steam generator isolation signal, or containment radiation signal or close via check valves because of a loss of pipe integrity. Three containment penetrations are not classified as either essential or non-essential. They are instrument air (penetration 19A), component cooling water to the reactor coolant pumps (penetration 16), component cooling water from the reactor coolant pumps (penetration 18). These three penetrations are isolated on a containment isolation signal.

Fluid penetrations serving engineered safety feature systems also meet the design basis double barrier criterion, but do not close upon a containment isolation signal.

All containment isolation valves are designed to ensure leak-tightness and reliability of operation. Containment isolation globe, check, and gate valves meet the requirements of MSS-SP-61 and containment isolation butterfly valves meet the requirements of American Water Works Association C-504. Required valve closing times are achieved by appropriate selection of valve, operator type, and operator size.

Upon receiving the appropriate Engineered Safety Features Actuation Signal as described in Chapter 7, all isolation valves required to isolate the containment from the surrounding environment and other systems within the plant close automatically, if not already closed.

With the exception of the containment sample solenoid valves associated with the Post-Accident Monitoring System, the containment isolation valves are provided with handswitches, located in the Control Room, for normal and backup control during an emergency. The normally closed and deenergized containment sample solenoid valves, associated with the Post-Accident Monitoring System are key operated from 1C101 and 1C102 on the 45' Elevation of the Auxiliary Building.

In most systems, standard valve operators are sufficient to close their respective valves in an acceptable time limit as determined by the size of the line and the system it is serving.

Isolation valves of other systems are sized and actuating times determined, depending on the amount of radioactivity those systems could release from containment in the event of a LOCA. Automatic actuation of the isolation valves not required by the engineered safety features will ensure a rapid closure independent of the reactor operator.

All system isolation valves are located either within the Containment Structure or within the adjoining penetration rooms. In order to provide protection from missile damage, all isolation valves located within the Containment Structure are backed up by a valve located outside the containment.

The two penetration rooms are located approximately 180° apart to insure adequate separation of redundant piping and valving. Both penetration rooms are within the Auxiliary Building which is a Seismic Category I structure up to Elevation 69'0" (Section 5A.2.1), designed to protect against potential horizontal tornado missiles and turbine missiles by virtue of a 2'6"-thick reinforced concrete roof and walls and a 3'0"-thick concrete wall between the Auxiliary and Turbine Buildings.

5.2.2 SYSTEM DESIGN

The fluid penetrations which require isolation after an incident may be classed as follows:

Type I. Each line connecting directly to the RCS has two Containment Structure isolation valves. One valve is external, and the other is internal to the Containment Structure. These valves may be either a check valve and a remotely-operated valve, or two remotely-operated valves, depending upon the direction of normal flow. (Except Penetration No. 2A which is described in Figure 5-10 and Table 5-3.)

Type II. Each line connecting directly to the Containment Structure atmosphere has two isolation valves. At least one valve is external, and the other may be internal or external to the Containment Structure. These valves may be either a check valve and a remotely-operated valve or two remotely-operated valves, depending upon the direction of normal flow. The containment sump recirculation line has one remotely-operated valve, which is external to the Containment Structure. The valve is located as close to the containment as valve size will permit.

Type III. Each line not directly connected to the RCS or not open to the Containment Structure atmosphere has at least one valve, either a check valve or a remotely-operated valve. The valve is located external to the Containment Structure.

Type IV. Lines which penetrate the Containment Structure and are connected to either the Containment Structure atmosphere or the RCS, but which are never opened during reactor operation (except as permitted under Footnote “A” of Table 5-3), have valves with provisions for locking in a closed position.

There are additional subdivisions in each of these major groups. The individual system flow diagrams show the manner in which each Containment Structure isolation valve arrangement fits into its representative system. Each valve may be tested periodically either during normal operation or during shutdown conditions to insure its operability when needed.

For convenience, each different valve arrangement is shown in Figure 5-10. Figure 5-10 identifies the containment isolation valves for all containment penetrations, including those exempted from local leak rate testing. Figure 5-10 defines the containment isolation valves for Technical Specification 3.6.3. The symbols on these figures are identified on Figure 9-1. Figure 5-10 lists the mode of actuation, the type of valve, its position during normal plant operation (Mode 1), and the position of each containment isolation valve under Containment Structure isolation conditions. The valves shown are for Unit 1. Some manual valves and check valves on Unit 2 have different equipment identification numbers. The specific system penetrations to which each of these arrangements is applied are also presented. Table 5-3 identifies the penetrations and associated containment isolation valves which are subject to Type C local leak rate testing. The table gives signals and closure times for each containment isolation valve.

The failure characteristics of the isolation valves are presented with the respective system evaluation of which the valve is a part, e.g., containment spray system.

There is sufficient redundancy in the instrumentation circuits of the engineered safety features protective system to minimize the possibility of inadvertent tripping of the isolation system. Further discussion of this redundancy and the instrumentation signals which trip the isolation system is presented in Chapter 7.

Those containment penetrations which communicate directly between the containment atmosphere and the outside environment are provided with normally closed isolation valves and/or blind flanges.

Some lines which penetrate the containment are not open to the containment atmosphere. Where these lines are located between the secondary shield wall (missile barrier) and the containment shell, they are considered to be "closed systems," not subject to rupture following a LOCA. The main steam lines, the feedwater lines, and the service water lines which provide cooling water to the coolers in the ventilation air handling units all fall within this category. The portions of the main steam lines and the feedwater lines located inside the secondary shield wall also fall within this category since the portions of these lines that are inside the secondary shield are protected from missiles by the concrete floor within the containment at Elevation 69'0" (refueling level floor).

Any leakage through these closed lines would have been detected as part of the preoperational integrated leak test of the containment.

Some lines which penetrate the containment are part of the closed piping systems located outside the Containment Structure and, consequently, are not supplied with remotely-operated isolation valves outside the containment. The following lines fall within this category:

a. The reactor coolant pump cooling water supply lines
b. The shutdown coolant inlet line

These lines are in systems which are normally water filled and normally operate at positive pressures. Any significant leakage from these lines will be detected during plant operation.

Penetration 1B, the containment vent header to the waste gas surge tank, is not connected directly to the RCS nor open to the containment atmosphere and is classified as a Type III penetration. However, two containment isolation valves are provided outside of the containment structure. Both of the valves are periodically local leak rate tested.

Penetration 8, the containment sump normal drain, is imbedded in the containment base slab. Although this is a Type II penetration, it would be highly impractical to locate one of the automatic valves inside the containment. These two automatic valves are located in a pipe tunnel in the Auxiliary Building. The first valve is located as close as practicable to the containment, and both valves are remote from any source of external damage.

Penetrations 9 and 10, the containment spray lines, do not have remotely-operated valves, but have two check valves for each penetration. Although classified as Type II penetrations, they are required to be open following an incident to allow the containment spray system to operate.

If a pipe near the inside containment wall at penetration 3, 4, or 5 were to fail during a LOCA, there would be no adverse consequences. Water from the safety injection system is continually pumped through these penetrations during the LOCA, thus preventing any release of fission products or contamination to the site boundary.

Penetration 20 consists of three individual lines (20A, 20B, 20C) in one penetration assembly, each with a check valve outside the containment. Penetrations 20B and 20C are also provided with a check valve inside containment. These lines are not directly connected to the RCS. They are connected to vessels which, in turn, may be isolated by valving from the RCS.

Penetration 39, which is connected to the RCS, is a Type IV penetration. The containment isolation valves outside the Containment Structure are normally closed and locked closed during reactor operation. Inside the Containment Structure between Penetration 39 and the connection to the RCS, there are remotely-operated valves which are normally in the closed position and serve as an additional barrier to prevent a potential leakage path to the environment (Figure 5-10, Sheet 26).

Containment penetrations 62 and 64 were originally designated for the plant heating system, but the system was never used to heat containment. Therefore, the plant heating containment subsystem was retired, and the penetration piping was cut, capped, and welded inside containment. The caps and their associated welds provide the only necessary containment barrier, and isolation valves exterior to the Containment Structure are not required.

5.2.3 TESTING AND INSPECTION

All isolation valves were tested by the manufacturer for leak-tightness and reliability of operation prior to delivery. Valves were subjected to the manufacturer's standard tests on an individual basis to insure reliability. An acceptable leak-rate was determined and specified for each valve purchased.

Each valve was tested after installation to insure its leak-tightness. The valve operators specified for these valves have a proven record of a number of years of reliability in respect to method of operation and material used. Throughout plant life, these valves will be tested periodically. Those which cannot be tested during operation (those which must remain open or closed), will be tested during the scheduled shutdowns and plant outages.

5.2.4 REFERENCES

1. Generic Letter 88-17, Loss of Decay Heat Removal, 10 CFR 50.54(f), dated October 17, 1988

2. Letter from A. E. Lundvall, Jr. (BGE) to D. G. Eisenhut (NRC), dated November 20, 1979, Follow-up Actions Resulting from TMI-2 Incident (Lessons Learned Short Term)

3. Letter from R. W. Reid (NRC) to A. E. Lundvall, Jr. (BGE), dated April 7, 1980, Staff Evaluation of the Implementation of Category "A" Lessons Learned Requirements

TABLE 5-3

CONTAINMENT ISOLATION VALVES SUBJECT TO TYPE C LOCAL LEAK RATE TESTING

PENETRATION NO.	TYPE	ISOLATION CHANNELS	UNIT	ISOLATION VALVE IDENTIFICATION NO.	FUNCTION	ISOLATION TIME (Seconds)
1A	I	SIAS A	1,2	PS-5465-CV	Reactor Coolant and Pressurizer Sampling	≤ 7
		SIAS A	1,2	PS-5466-CV		≤ 7
		SIAS A	1,2	PS-5467-CV		≤ 7
		SIAS B	1,2	PS-5464-CV		≤ 7
1B	III	SIAS A	1,2	WGS-2180-CV	Containment Vent Header to Waste Gas	≤ 10
		SIAS B	1,2	WGS-2181-CV		≤ 10
1C	I	SIAS A	1,2	CVC-506-CV	Reactor Coolant Pump Seals Controlled Bleedoff	≤ 7
		SIAS B	1,2	CVC-505-CV		≤ 7
1D	IV	NA	1,2	PS-6529-SV[a]	Post Accident Sampling Liquid Return to Reactor Coolant Drain Tank	NA
2A	I	SIAS A	1,2	CVC-515-CV	Letdown Line	≤ 13
		SIAS B	1,2	CVC-516-CV		≤ 13
		NA	1,2	CVC-105		NA
		NA	1,2	CVC-103		NA
2B	I	NA	1,2	CVC-517-CV[b]	Charging Line	NA
		NA	1,2	CVC-518-CV[b]		NA
		NA	1,2	CVC-519-CV[b]		NA
		NA	1,2	CVC-435-RV[b]		NA
		NA	1,2	CVC-184[b]		NA
7A	IV	NA	1,2	Blind Flange	Integrated Leak Rate Testing	NA
		NA	1,2	ILRT-1		NA
7B	IV	NA	1,2	Blind Flange	Integrated Leak Rate Testing	NA
		NA	1,2	ILRT-2		NA
8	II	SIAS A	1,2	EAD-5462-MOV[b]	Containment Normal Sump	≤ 13
		SIAS B	1,2	EAD-5463-MOV[b]		≤ 13
13	IV	CRS A	1	CPA-1410-CV[g]	Purge Air Inlet	≤ 15[g]
			1	Blind Flange[g]		NA
		CRS A	2	CPA-1410-CV[g]	Purge Air Inlet	≤ 15[g]
			2	Blind Flange[g]		NA

TABLE 5-3

CONTAINMENT ISOLATION VALVES SUBJECT TO TYPE C LOCAL LEAK RATE TESTING

PENETRATION NO.	TYPE	ISOLATION CHANNELS	UNIT	ISOLATION VALVE IDENTIFICATION NO.	FUNCTION	ISOLATION TIME (Seconds)
14	IV	CRS A	1	CPA-1412-CV[g]	Purge Air Outlet	≤ 15[g]
			1	Blind Flange[g]		NA
		CRS A	2	CPA-1412-CV[g]	Purge Air Outlet	≤ 15[g]
			2	Blind Flange[g]		NA
15	II	SIAS A	1,2	RE-5291-CV	Purge Air Monitor	≤ 7
		SIAS B	1,2	RE-5292-CV		≤ 7
16	III	CIS A	1,2	CC-3832-CV	Component Cooling Water Inlet	≤ 18
18	III	CIS B	1,2	CC-3833-CV	Component Cooling Water Outlet	≤ 18
19A	III	NA	1	IA-337	Instrument Air	NA
		NA	2	IA-175		NA
		CIS A	1,2	IA-2080-MOV		≤ 13
19B	IV	NA	1	PA-1040[a]	Plant Air	NA
		NA	2	PA-137[a]		NA
		NA	1,2	PA-1044[a]		NA
20A	III	NA	1	N2-344	Nitrogen Supply	NA
		NA	2	N2-347		NA
		NA	1,2	N2-612-CV[a]		NA
		NA	1,2	N2-622-CV[a]		NA
		NA	1,2	N2-632-CV[a]		NA
		NA	1,2	N2-642-CV[a]		NA
20B	III	NA	1	N2-389	Nitrogen Supply	NA
		NA	1	N2-345		NA
		NA	2	N2-348		NA
		NA	2	N2-395		NA
20C	III	NA	1	N2-346	Nitrogen Supply	NA
		NA	1	N2-392		NA
		NA	2	N2-349		NA
		NA	2	N2-398		NA
23	III	SIAS A	1,2	RCW-4260-CV	Reactor Coolant Drain Tank Drains	≤ 10
24	III	SIAS B	1,2	PS-6531-SV	Oxygen Sample Line	≤ 7

TABLE 5-3

CONTAINMENT ISOLATION VALVES SUBJECT TO TYPE C LOCAL LEAK RATE TESTING

PENETRATION NO.	TYPE	ISOLATION CHANNELS	UNIT	ISOLATION VALVE IDENTIFICATION NO.	FUNCTION	ISOLATION TIME (Seconds)
37	II	NA	1	PSW-1019	Plant Water	NA
		NA	1	PSW-1008		NA
		NA	2	PSW-1020		NA
		NA	2	PSW-1009		NA
38	III	NA	1,2	DW-5460-CV[a]	Demineralized Water	NA
39	IV	NA	1,2	SI-463	Safety Injection Tank Test Line	NA
		NA	1,2	SI-455		NA
44	III	NA	1	FP-141-A	Fire Protection	NA
		NA	1	FP-141-B		NA
		NA	2	FP-145-A		NA
		NA	2	FP-145-B		NA
47A	II	NA	1,2	PS-6540A-SV[a]	Hydrogen Sample Outlet	NA
		NA	1,2	PS-6507A-SV[a]		NA
47B	II	NA	1,2	PS-6540E-SV[a]	Hydrogen Sample Outlet	NA
		NA	1,2	PS-6507E-SV[a]		NA
47C	II	NA	1,2	PS-6540F-SV[a]	Hydrogen Sample Outlet	NA
		NA	1,2	PS-6507F-SV[a]		NA
47D	II	NA	1,2	PS-6540G-Sa[a]	Hydrogen Sample Return	NA
		NA	1,2	PS-6507G-Va[a]		NA
48A	II	SIAS B	1	HP-6900-MOV[f]	Containment Vent Isolation	≤ 15
		SIAS A	2			
		SIAS A	1	HP-6901-MOV[f]		≤ 15
		SIAS B	2			
48B	II	NA	1,2	HP-104	Hydrogen Purge Inlet	NA
		NA	1,2	HP-6903-MOV		NA
49A	II	NA	1,2	PS-6540B-SV[a]	Hydrogen Sample	NA
		NA	1,2	PS-6507B-SV[a]		NA
49B	II	NA	1,2	PS-6540C-SV[a]	Hydrogen Sample	NA
		NA	1,2	PS-6507C-SV[a]		NA

TABLE 5-3

CONTAINMENT ISOLATION VALVES SUBJECT TO TYPE C LOCAL LEAK RATE TESTING

PENETRATION NO.	PENETRATION TYPE	ISOLATION CHANNELS	UNIT	ISOLATION VALVE IDENTIFICATION NO.	FUNCTION	ISOLATION TIME (Seconds)
49C	II	NA	1,2	PS-6540D-SV[a]	Hydrogen Sample	NA
		NA	1,2	PS-6507D-SV[a]		NA
50	IV	NA	1,2	Blind Flange	Integrated Leak Rate Testing	NA
		NA	1,2	Blind Flange		NA
59	IV	NA	1	SFP-170	Refueling Pool Inlet	NA
			NA	1	SFP-171	NA
		NA	2	SFP-178		NA
		NA	2	SFP-179		NA
60	IV	NA	1,2	ES-144	Steam to Reactor Head Laydown	NA
		NA	1,2	ES-142		NA
61	IV	NA	1	SFP-176	Refueling Pool Outlet	NA
		NA	1	SFP-174		NA
		NA	1	SFP-172		NA
		NA	1	SFP-189		NA
		NA	2	SFP-184		NA
		NA	2	SFP-182		NA
		NA	2	SFP-180		NA
		NA	2	SFP-186		NA
84	IV	NA	1, 2	Blind Flange	Integrated Leak Rate Testing 12” Vent	NA
		NA	1, 2	Blind Flange		NA

[a] May be open on an intermittent basis under administrative control. An evaluation under the rules of 10 CFR 50.59 shall be performed if additional valves are identified that could be opened on an intermittent basis under administrative control. This evaluation shall include, but not be limited to, actions necessary to place the valve in its post-accident condition. These actions could include the need to station an operator at the valve controls who is in constant communication with the Control Room; instructions to this operator to close the valve in an accident situation; or evaluating the environmental conditions to assure that an operator would have access to close the valve and that this action will prevent the release of radioactivity outside the containment. Plant procedures would have to be revised to include any additional administrative controls deemed necessary to allow safe opening of these valves.

TABLE 5-3

CONTAINMENT ISOLATION VALVES SUBJECT TO TYPE C LOCAL LEAK RATE TESTING

[b] This valve is not tested as part of the Local Leak Rate Test Program. This valve is located in a water filled penetration and does not constitute a potential primary containment atmospheric leak path.

[d] Deleted.

[f] Containment vent isolation valves shall be opened for containment pressure control, airborne radioactivity control, and surveillance testing purposes only.

[g] Containment Purge Inlet and Outlet Penetrations are closed by a blind flange during Modes 1-4. During Modes 5-6, closure is provided by CV-1410 and CV-1412. Closure times for these CVs are only applicable during Mode 6 when the valves are required to be operable and they are open.