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October 5, 1982

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Attn: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
Response to Request for Additional Information

Gentlemen:

Enclosed is additional information in response to your request of September 21, 1982. This information concerns proposed changes to the technical specifications for leak rate testing of certain isolation valves using water in lieu of gas. The valves are in lines designed to be filled with liquid for at least 30 days subsequent to a DBA.

Attached are:

A. Drawings which show the elevation, piping class and penetration number of the isolation valves that may be tested using water as the pressure fluid.

	Valve No.	Drawing No.	Line No.	Penetration No.
(1)	1SI-10	375	6"SI-74-1502Q1	61
	1SI-11	375	6"SI-73-1502Q1	61
	1SI-12	375	6"SI-72-1502Q1	61
	1SI-13	220	6"SI-33-1502Q1	60
	1SI-14	220	6"SI-32-1502Q1	62
	1SI-83	200	3"SI-130-1503Q1	7
	1SI-84	377	3"SI-134-1503Q1	33
	1SI-94	192	3"SI-81-1503Q1	113
	1SI-95	378	3"SI-140-1503Q1	96
	1SI-91	1484	1"SI-61-1503Q1	113
	MOV-1SI-836	275	3"SI-140-1503Q1	96
	MOV-1SI-869A	275	3"SI-130-1503Q1	7
	MOV-1SI-867C	274	3"SI-81-1503Q1	113
	MOV-1SI-867D	274	3"SI-57-1503Q1	113
	MOV-1SI-869B	368	3"SI-134-1503Q1	33
	1SI-451	N/A	3/4" Q2	60
	1SI-452	N/A	3/4" Q2	62

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	Valve No.	Drawing No.	Line No.	Penetration No.
(1)	MOV-1SI-890A	109	10"SI-15-1502Q1	60
	MOV-1SI-890B	109	10"SI-28-1502Q1	62
	MOV-1SI-890C	109	10"SI-18-1502Q1	61
(4)	MOV-1SI-860A	83	12"SI-7-153AQ2	68
	MOV-1SI-860B	83	12"SI-8-153AQ2	69
(3)	MOV-1QS-101A	113	10"SI-3-153BQ2	64
	MOV-1QS-101B	111	10"QS-4-153BQ2	63
(1)	1CH-31	170	3"CH-125-1503Q1	15
	MOV-1CH-289	268	3"CH-125-1503Q1	15
	1CH-170	191	2"CH-140-1503Q1	46
	FCV-1CH-160	273	2"CH-140-1503Q1	46
	1CH-181	196	2"CH-93-1503Q1	35
	MOV-1CH-308A	267	2"CH-93-1503Q1	35
	1CH-182	195	2"CH-94-1503Q1	36
	MOV-1CH-308B	267	2"CH-94-1503Q1	36
	1CH-183	190	2"CH-95-1503Q1	37
	MOV-1CH-308C	267	2"CH-95-1503Q1	37
(2)	TV-1BD-100A	240	3"WGCB-4-601Q2	39
	TV-1BD-100B	240	3"WGCB-8-601Q2	40
	TV-1BD-100C	240	3"WGCB-12-601Q2	41
	TV-1SS-117A	N/A	3/8"SS-16-N9Q2	56
	TV-1SS-117B	N/A	3/8"SS-18-N9Q2	105
	TV-1SS-117C	N/A	3/8"SS-17-N9Q2	97

(1) These valves are either in the various SIS flow paths during safety injection or have LHSI or HHSI pump discharge pressure on their inboard side during recirculation thereby preventing communication of the containment atmosphere to the contiguous areas outside.

(2) These valves are on the secondary side of the steam generators and therefore are not directly exposed to containment pressure during an accident inside containment and therefore should not have any leakage requirements imposed on them.

(3) These valves would be open during a high energy line break (CIB) in containment. The valves would not be subjected to containment pressure beyond the first hour after the accident due to inherent system design and a subatmospheric containment which reduces the containment to subatmospheric condition within one hour post accident. This is shown in Figure 14.3-55A of the Updated FSAR. The source of sealing water is the RWST and Chemical Addition Tank.

(4) These valves are described on page 5.3-6 of the Updated FSAR and would be water sealed by the sump water following a LOCA. The source of sealing water for valves in groups (1) and (4) is the containment sump water.

B. Criteria for leakage testing certain isolation valves using water as the test pressure fluid.

The minimum water inventory available in each system is adequate to fulfill the system function even though one pump may be out of service (single active failure criteria) because each train is cross-connected to allow flow in each flowpath. Water evaporation and boiling is not considered a problem because after the initial one hour time period following a LOCA, the containment pressure and temperature profiles assure that containment pressure is subatmospheric and containment temperature is within the normal containment operating range of 75°F to 105°F.

These valves function during the course of normal plant operation in a manner that demonstrates functionally adequate seat tightness and therefore should not be required to have specific leakage requirements.

C. Description of valve actuation on a DBA

Reactor Coolant System Charging - (Pent. 15)

1CH-31 MOV-1CH-289	Close on DBA actuation; valves would see HHSI discharge pressure of approx. 2500 PSIG for 30 days.

Seal Inj. Water to Reactor Coolant Pump - (Pent. 35, 36, 37)

1CH-181, 1CH-182, 1CH-183, MOV-1CH-308A MOV-1CH-308B, MOV-1CH-308C	Close on DBA actuation; valves would see HHSI discharge pressure of approx. 2500 PSIG for 30 days.

Steam Gen. Blowdown - (Pent 39, 40, 41)

TV-1BD-100A, TV-1BD-100B, TV-1BD-100C	Close on DBA actuation, valves are located within a sealed system and would not be subject to cnmt. atmosphere.

Steam Gen. Blowdown Samples - (Pent. 56, 105, 97)

TV-1SS-117A, TV-1SS-117B, TV-1SS-117C	Close on DBA actuation, valves are located within a sealed system and would not be subject to cnmt. atmosphere.

High Head Safety Inj. to Hot Legs - (Pent. 7, 33)

1SI-83, 1SI-84 MOV-1SI-869A MOV-1SI-869B	Open on DBA actuation (long term recirc. mode) valves would see HHSI discharge pressure of approx. 2500 PSIG for 30 days.

Low Head Safety Inj. (Pent. 60, 61, 62)

1SI-451, 1SI-452 1SI-10, 1SI-11, 1SI-12 1SI-13, 1SI-14, MOV-1SI 890A, MOV-1SI-890B, MOV-1SI-89C	Open on DBA actuation, valves would see LHSI discharge pressure of approx. 111 PSIG for 30 days.

Quench Spray Pump-Discharge (Pent. 63, 64)

MOV-1QS-101A, MOV-1QS-101B	Opens on DBA actuation, valves would see QS pump discharge pressure of approx. 116 PSIG for 1 hr. at which time cnmt. will be subatmospheric. Valves are then closed and will have RWST head pressure against them for 30 days.

Boron Injection (HHSI to cold legs) (Pent. 113)

1SI-94, 1SI-91 MOV-1SI-867C, MOV-1SI-867D	Open on DBA actuation, valves would see HHSI discharge pressure of approx. 2500 PSIG for 30 days.

High Head Safety Inj. to Cold Legs (Pent. 96)

1SI-95 MOV-1SI-836	Open on DBA actuation, valves would see HHSI discharge pressure of approx. 2500 PSIG for 30 days.

Low Head S.I. Pump Suct. from Cont. Sump (Pent. 68, 69)

MOV-1SI-860A, MOV-1SI-860B	Open on DBA actuation, these valves are in the LHSI suction piping from the cont. sump and would be water covered for 30 days.

Reactor Coolant System Fill (Pent. 46)

1CH-170 FCV-1CH-160	Close on DBA actuation, these valves would see HHSI pump discharge pressure of approx 2500 PSIG for 30 days.

D. BVPS-1 Updated FSAR References

Section 5.5 Design Evaluation states that "Through the use of the containment depressurization system, the containment returns to subatmospheric pressure within 60 minutes after initiation of a LOCA, thus terminating outleakage from the containment".

Section 5.3, Containment Isolation System, describes the design Bases, Penetration Classifications, Isolation Valve Arrangements, and the 1971 General Design Criteria to which the Containment Isolation System is designed.

Section 5.2.6.3, Criteria for Protection Against Dynamic Effects Associated with a Major Pipe Rupture discusses the routing of pipe and placement of components to minimize the possibility of damage.

Section 6.2.2.1, Definition of Piping Classifications describes the seismic design piping codes of Classes I, II and III as encompassed by the Q1, Q2 and Q3 designations on the line numbers.

E. FSAR Figure 1.2-14, Key to Line Designation Numbers
F. FSAR Figure 14.3 - 55A Containment Pressure Profile
G. FSAR Figure 14.3 - 58 Containment Temperature Profile
H. FSAR Figure 6.4-2 Containment Sump Elevation
I. Drawings (167A, 167B, 159A) showing highlighted flow paths for:

Highlighted		Operational Mode
Yellow	-	High Head Safety Injection = Injection Mode
Blue	-	Low Head Safety Injection = Injection Mode
Green	-	Cold leg recirculation mode
Pink	-	Simultaneous hot & cold leg recirculation mode

Very truly yours,

J J Carey

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5.5 DESIGN EVALUATION

The reactor containment concept is based upon the use of a dry containment maintained at a subatmospheric pressure of between 9.5 and 11.5 psia during normal operation. This total pressure allows restricted personnel access to the containment. Following a Design Basis Accident, the containment pressure rises above atmospheric to a maximum possible peak of about 38.3 psig, with subsequent outleakage.

Through the use of the containment depressurization system (Section 6.4), the containment returns to subatmospheric pressure within 60 minutes after initiation of a LOCA, thus terminating outleakage from the containment. The amount of activity released to the environment as a result of a DBA is much less than would be released from an atmospheric containment, thereby reducing the size of the required exclusion area and the low population zone as defined and determined by 10CFR100. The population center distance requirement is correspondingly reduced below that required for an atmospheric containment (Section 2.1).

The containment depressurization system is considered to be an engineered safety features system. The containment vacuum system (Section 5.4.2) is not considered to be an engineered safety features system; however, after a DBA it may have to be used periodically to remove air which may have leaked into the containment as a result of the containment having been returned to subatmospheric pressure.

At the design containment leak rate of 0.1 percent of containment volume per day, air inleakage is not significant for a considerable length of time after a DBA. Ultimately, air inleakage could result in the containment pressure increasing to atmospheric, with ambient barometric pressure fluctuation possibly resulting in a containment pressure slightly above atmospheric. To prevent this, the containment vacuum system maintains the containment pressure below the lowest expected atmospheric pressure, simultaneously minimizing air inleakage. Vacuum cannot be lost rapidly because of the inherent low-leakage design features of the containment.

Containment isolation features, such as penetrations, access hatches, and isolation valves, meet the requirements of 10CFR50 Appendix A (Section 1.3 and Appendix 1A).

The containment structural design is in accordance with the best current design practices for steel lined reinforced concrete reactor containment structures. The design procedures incorporate accepted analytical methods. Rigid controls were maintained for all materials and construction practices as indicated in Section 5.2 and 10CFR50 Appendix A. The proposed subatmospheric pressure operation results in no significant effect on the structural design.

It is concluded that the subatmospheric containment system does not depart from the state of the art for atmospheric containment in any significant characteristic; yet it provides a substantial increase in public safety.

5.3 CONTAINMENT ISOLATION SYSTEM

5.3.1 Design Bases

Except where noted, BVPS-1 conforms to Appendix A of 10CFR50, General Design Criteria for Nuclear Power Plants, Criteria 55 through 57 (Section 1.3 and Appendix 1A).

The following are the design bases for containment isolation:

1. During accident conditions, at least two barriers are provided between the atmosphere outside containment and:
    a. The atmosphere inside the containment
    b. The reactor coolant system
    c. Systems which could become connected to either the containment atmosphere or the reactor coolant system as a result of, or subsequent to, a loss-of-coolant accident (LOCA).
2. The two barriers consist of one of the following arrangements:
    a. One normally closed, administratively controlled isolation valve inside, and one normally closed, administratively controlled isolation valve outside containment; or
    b. One automatic isolation valve inside and one normally closed, administratively controlled isolation valve outside containment; or
    c. One normally closed, administratively controlled isolation valve inside, and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment; or
    d. One automatic isolation valve inside and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment.
    e. A sealed system inside containment and one isolation valve outside containment which is either automatic or normally shut and administratively controlled, or capable of remote manual operation. A sealed system is one which is connected neither to the atmosphere inside the containment nor the reactor coolant system during normal conditions or following LOCA.

f. In the case of the containment sump suction pipe and valve arrangements, a conservatively designed and fabricated single valve and suction pipe arrangement to prevent gross system leakage. A major portion of this special class piping is encased in the reinforced concrete containment. Minimum lengths of suction piping are employed between the single isolation valve and the point where the piping exits the concrete to ensure maximum integrity. This valve is equipped with a highly reliable remote operator. Provisions for detecting leaks in these lines and valves are provided.

   The design of this portion of the installation is compatible with letters from the Advisory Committee on Reactor Safeguards to the AEC.(1)(2)

g. Details of containment isolation arrangements which differ in some manner from the specific arrangements described in 5.3.1.2 (a) through (f) above, such as instrument lines included in the exception to General Design Criteria 55 and 56, are discussed in Section 5.3.3.

3. The design pressure of all piping and connecting components within the isolated boundary is equal to, or greater than, the design pressure of the containment.

4. The containment isolation system meets the single failure criteria described in Section 1.3.1.

5. Operation of the containment isolation system is automatic.

6. The containment isolation system components (piping, valves, penetrations, etc.) are protected from internally or externally generated missiles and water jets.

7. All remotely actuated valves of the containment isolation system have their positions indicated in the main control room by separate limit switches installed directly on the valve actuator.

8. Containment isolation system valves outside containment are located so as to require a minimum length of piping between the isolation valves and their penetrations. All outside containment isolation piping and valves are located in missile protected structures located contiguous to the containment structure.

9. The containment penetrations are designed in a manner such that special operational test procedures, when used in conjunction with test connections (where required) can be used to provide the capability to periodically test the operability of the isolation valves and associated apparatus and to determine if valve leakage is within acceptable limits.

10. Instrumentation and adjunct control circuits associated with automatic valve closure shall fail in the position that provides greater safety upon loss of voltage or control air. Circuits which control redundant automatic valves are redundant to the extent that no single failure will preclude isolation.

11. Penetrations conform to the safety classes and codes discussed in Section 6.2.2. Note that those portions of any systems used to effect isolation of containment are piping Class I (Q1) or piping Class II (Q2) (Section 6.2.2).

5.3.2 Penetration Classifications and Isolation Valve Arrangements

The penetrations are classified according to whether the piping is connected to the reactor coolant system, the containment atmosphere, a sealed system, or whether the line is open during normal unit operation.

Class A Penetrations

Class A penetration piping is connected to the reactor coolant system (or connecting systems), or is open to the containment atmosphere and is used during unit operation. Any normal operating systems piping which could become connected to either the reactor coolant system or the containment atmosphere as a result of LOCA are also classified as Class A. Class A penetrations are provided in accordance with the arrangements described in Section 5.3.1.2(d) except as noted in Section 5.3.3.

Class B Penetrations

Class B penetration piping is separated from the reactor coolant system (or connecting systems) and the containment atmosphere by a membrane barrier (i.e., sealed inside containment) and is used during normal plant operation. Class B penetrations are provided in accordance with the arrangements described in Section 5.3.1.2(e).

Class C Penetrations

Class C penetration piping must remain open after a LOCA; accordingly, associated valves are not made to close upon failure. Class C penetrations, where they differ in some respects from the arrangements described in Section 5.3.2, are described in detail in Section 5.3.3.

Class D Penetrations

Class D penetration piping has a normally closed valve outside the containment, and is separated from the reactor coolant system by a closed valve or a membrane barrier. These penetrations are therefore, closed during normal operation. Class D penetrations are provided in accordance with the arrangements described in Section 5.3.1.2(a), (b) and (d) except as noted in Section 5.3.3.

5.3.2.1 Conformance to the 1971 AEC General Design Criteria

Those AEC general design criteria covering isolation of lines penetrating containment are discussed in Sections 1A.54 through 1A.57. The penetration classifications specified in Subsection 5.3.2 conform with the following 1971 General Design Criteria:

a. Lines in Class A and Class C, which are connected to the reactor coolant pressure boundary, are in conformance with General Design Criteria 55

b. Lines in Class A and Class C, which are connected to the containment atmosphere, are in conformance with General Design Criterion 56

c. Lines in Class B are in conformance with General Design Criteria 57

d. Lines in Class D are in conformance with General Design Criterion 56

e. All penetrations conform with General Design Criterion 54.

In order to provide the greatest degree of overall unit safety, it is necessary in certain cases to provide containment isolation arrangements which differ in some manner from the specific arrangements listed above. Such cases are described in detail in Section 5.3.3.

5.3.3 Description

Table 5.3-1 lists each line penetrating the containment structure and indicates the isolation criterion to which it conforms. As indicated, most isolation arrangements conform exactly with the 1971 General Design Criteria. The details of containment isolation arrangements which differ in some manner from the specific arrangements allowed by the General Design Criteria are indicated below:

1. Safety Injection Pump Discharge (Penetration Nos. 7, 33, 60, 61, 62, 96, and 113)

The safety injection system (Section 6.3) must be operated after a DBA to keep the reactor core covered with water following the accident (refer to Figures 6.3-1 and 6.3-2 for a diagram of the following valve arrangements). The boron injection (high head safety injection to reactor coolant cold legs) containment isolation valves are designed to be opened upon receipt of a safety injection signal. The remote manual valve affecting containment isolation in the low head safety injection header to the reactor coolant cold legs is normally open and remains open during the accident. The other valves affecting high head safety injection headers and in the low head safety injection headers to the reactor coolant hot legs are administratively controlled closed.

The high head safety injection lines to the reactor coolant hot legs and the high head safety injection line to the reactor coolant cold legs are each provided with normally closed, remotely controlled, motor-operated isolation valve located outside the containment, and a check valve inside the containment.

The boron injection line (high head safety injection to cold legs) is provided with two normally closed, remotely controlled, motor-operated isolation valves located in parallel in the line outside the containment and a check valve inside the containment. Connecting to the boron injection line between the containment penetration and the containment isolation valves is a one inch line bypassing the boron injection tank. This line is provided with a normally closed, administratively controlled, manually operated isolation valve.

Two of the low head safety injection penetrations are provided with check valves inside the containment in the lines leading to the reactor coolant hot legs. These valves are located downstream of the point at which the two lines form a common header and split into three lines, but upstream of the point where the three lines connect to the high head safety injection line to each of the reactor coolant hot legs. The third low head safety injection line penetrating the containment branches into three lines leading to the reactor coolant cold legs, each of which is provided with a check valve inside containment. These valves are located upstream of the point at which each line connects to the high head safety injection line to each of the reactor coolant cold legs. Outside the containment, the three low head safety injection lines are connected to the discharge lines from the two low head safety injection pumps. The two discharge lines leading to the reactor coolant hot legs are provided with normally closed, remotely controlled, motor-operated isolation valves. The discharge line leading to the reactor coolant cold legs is provided with a normally open, remotely controlled, motor-operated isolation valves. The discharge line leading to the reactor coolant cold legs is provided with a normally open, remotely controlled, motor-operated valve. Before the refueling water storage tank (RWST) is empty following a DBA, valves in the low head safety injection (LHSI) system are closed to isolate the RWST from the containment. The safety injection pump discharge conforms to the intent of General Design Criterion 55. The only difference being the isolation valves located outside containment are opened during containment isolation either automatically or administratively to perform a post DBA safety injection and containment depressurization function.

These containment isolation arrangements conform with the design bases specified in Section 5.3.1, and also allow the safety injection system to perform its designed post DBA function.

2. Low Head Safety Injection Pumps and Outside Recirculation Spray Pumps Suction Lines (Penetration 66, 67, 68, and 69)

The suction lines for the low head safety injection pumps and the recirculation spray pumps are very conservatively designed to prevent gross system leakage. The major portion of this special class piping is buried in the reinforced concrete base mat and only a short length of piping exists between the mat and the isolation valves.

The motor-operated isolation valves (one in each line) at the suction of the outside recirculation spray pumps are normally open and remotely controlled. The motor-operated isolation valves (one in each line) for the low head safety injection pump suction lines are normally closed and remotely controlled. The remote operators used for these valves are designed to be highly reliable.

Assuming the worst possible single passive failure occurs to any suction line, as postulated in Section 1.3.1, the safeguards area suction valve pit becomes flooded. This provides a water seal between the containment and the outside atmosphere which prevents leakage into or out of the containment.

The low head safety injection pumps and outside recirculation spray pump suction lines connect directly to the containment atmosphere and are required to have two barriers for containment isolation, as described in General Design Criteria 56. The use of only one containment isolation valve, located outside containment provides a greater degree of reliability for supply of water to these pumps for operation following a DBA.

The design of this portion of the installation ensures a reliable source of water for the low head safety injection pumps, which are required as engineered safety features after a DBA, and meets the containment isolation design basis described in Section 5.3.1. This design is compatible with letters from the Advisory Committee on Reactor Safeguards to the USAEC.(1)(2)

3. Fuel Transfer Tube (Penetration 55)

The arrangement of the fuel transfer tube (Section 9.12.2) consists of a normally closed, administratively controlled, remote manually operated valve outside the containment and a blind flange inside the containment. The blind flange isolates the transfer tube inside the containment at all times except when the reactor is shut down for refueling. This arrangement conforms with the design bases described in Section 5.3.1.

The following sections of the transfer tube are subject to leak testing:

a. The joint between the blind flange and the fuel transfer tube in the reactor containment

b. The weld attaching the transfer tube to the transfer tube flange in the reactor containment

c. The weld attaching the transfer tube to the containment liner

d. The gate valve in the fuel building.

The joint between the blind flange and fuel transfer tube, and the weld attaching the transfer tube to the transfer tube flange are tested simultaneously. The blind flange is bolted to the fuel transfer tube flange using two concentric gaskets. Between these two gaskets is an annular space. Enclosing the welded joint attaching the transfer tube to the transfer tube flange is a test channel. The transfer tube flange contains three interconnecting drilled holes, one through the outer edge, one through the front face of the flange, and one through the back face. These interconnecting holes allow test gas to pressurize the test channel at the transfer tube flange and tube interface, and the annular space between the two gaskets at the same time. Maintenance of test pressure indicates leaktightness of both the blind flange joint and the tube transfer tube flange joint. Testing is performed using 70 psig dry air.

The welded joint attaching the transfer tube to the containment liner is provided with a test channel. This channel is pressurized with 70 psig dry air and checked for leakage.

The gate valve on the fuel building end of the transfer tube is leak tested as follows. With the fuel transfer tube gate valve closed and the blind flange removed, a blank flange modified with a test fitting will be attached in place of the original blind flange. A temporary run of piping or hose will connect the primary grade water system with the test connection to fill the tube. The tube will then be pressurized to 50 psig using a hand pump. The leakage rate will be determined using a graduated container connected to the suction of the hand pump to measure water make-up, or by a catch basin device attached to the outside of the gate valve.

Figure 5.3-1 is a simplified sketch showing the test arrangement for the transfer tube.

The fuel transfer tube provides a direct connection to the containment atmosphere. This containment isolation arrangement meets the intent of General Design Criterion 56(3). The blind flange inside containment is considered to conform to the criteria of a locked-closed valve inside containment.

4. Pressurizer Dead Weight Calibrator (Penetration 110) Containment Leakage Monitoring and Containment Wide Range Pressure Monitoring System - Open Taps (Penetration 55, 57-1, 97, and 57-2)

These instrument lines contain no isolation valve inside the containment, but have two isolation valves in series outside the containment. The one-eighth inch pressurizer dead weight calibrator line (Section 4.2) is used only infrequently during unit operation. The outside isolation valves are normally closed, administratively controlled, manually operated isolation valves. The open taps lines portion of the containment leakage monitoring system and containment wide range pressure monitoring system (Section 5.4.2.2 and 5.4.2.3) are used during normal operation. Four of these instrument lines penetrate the containment. Each of these lines is three-eighths inch nominal tubing but has a one-eighth inch orifice as near as practical to the inside containment wall, consistent with the requirements of Safety Guide 11. These lines connect into a single line outside the containment. Two auto trip valves are arranged in series in this line. The auto trip valves shut on receipt of a containment isolation Phase A signal. These arrangements conform with the design bases specified in Section 5.3.1 and with the exception allowed for instrument lines in General Design Criterion 56 and in Safety Guide 11.

The containment leakage monitoring system and containment wide range pressure monitoring system containment isolation arrangements (Penetrations No. 55, 57-1, 97, and 57-2) connect directly to the containment atmosphere and are required to have one isolation valve inside containment and one isolation valve outside containment per General Design Criterion 56. The containment leakage monitoring instrument lines are required for monitoring containment pressure for actuation of containment isolation signals. Due to the safety related function of these instrument penetrations, the containment isolation valve inside containment has been eliminated and two isolation valves in series close to the containment penetration as well as leakage limiting provisions have been provided in accordance with the Safety Guide 11. The containment wide range pressure monitoring system instrumentation, which tap off containment penetrations 57-1 and 57-2, monitor post accident containment pressure for indication only.

The pressurizer dead weight calibrator (Penetration No. 110) consists of a closed system inside containment that is provided by the pressure transmitter and the capillary tubing. The diaphragm in the transmitter will withstand full reactor coolant system pressure in either direction, and the transmitter body and tubing will withstand external pressure equal to the containment design pressure. Since the diaphragm is flexible, any possible thermal expansion of the fluid in the line will deflect the diaphragm and not result in overpressurization. The containment isolation barrier consists of a locked closed manual valve outside containment located as close to the containment as practical. Therefore, Penetration No. 110 conforms to the intent of General Design Criterion 57.

5. Containment Depressurization System Pump Discharge Lines (Penetrations 63, 64, 70, and 71)

The containment depressurization system (Section 6.4) must be operated after a DBA to return the containment to subatmospheric conditions. The valves affecting containment isolation in the system are therefore designed to be opened upon receipt of a containment isolation Phase B (CIB) signal, if not already opened.

Containment depressurization system pump discharge containment isolation valve arrangements conform to the intent of Criterion 56 (4), the only difference being the isolation valves located outside containment are opened during containment isolation either automatically or administratively to perform a post DBA safety injection and containment depressurization function.

Each of the quench spray pump discharge lines is provided with two CIB opened, motor operated, isolation valves arranged in series outside containment and a weight-loaded check valve inside containment.

Each of the outside recirculation spray pump discharge lines is provided with a normally open motor-operated isolation valve (which opens with a CIB signal if not already open) outside containment and a weight-loaded check valve inside containment.

These arrangements conform with the design bases described in Section 5.3.1, and also allow the containment depressurization system to perform its designed post DBA function.

6. Seal Injection Water to Reactor Coolant Pumps (Penetrations 35, 36, and 37)

The reactor coolant pumps seal water injection lines are each provided with a normally open, remotely controlled, motor-operated isolation valve located outside the containment and a check valve inside the containment. Motorizing the outside containment isolation valves minimized the possibility of accidental closure due to loss of air in the valve which would result in a loss of injection flow to a reactor coolant pump. To preclude the possibility of a spurious signal causing closure and, therefore, loss of injection flow to the reactor coolant pumps, automatic closure signals are not provided to the motor-operated valves. There is no need to automatically close these valves since:

a. To do so unnecessarily could cause damage to the reactor coolant pump

b. The fluid entering the containment via these paths either enters the RCS or the containment sump if the line is ruptured inside containment and is not irretrievably lost

c. The operator can remote manually close the valves at any time.

Also, in determining the high head injection curves for a loss of coolant accident for the safety injection analysis, no credit need be taken for any injection flow through the reactor coolant pumps seal injection lines, i.e., the fluid injected to the reactor coolant system during a loss of coolant accident with minimum engineered safety features can be shown to be adequate if the charging/injection flow of one pump minus the reactor coolant pump seal injection flow is used. However, an analytical techniques exist which permit taking credit for the flow injected through the reactor coolant pump seals and, hence, strengthen the position for not automatically closing the seal water injection isolation valve.

Upon loss of actuating power, these valves fail "as is" which is the position that provides greater reactor coolant pump safety during normal operation and has been shown above to be satisfactory during a LOCA. Failure of these valves "as is" is also acceptable because the seal injection lines:

a. Do not communicate with the atmosphere outside containment

b. Have safety classifications the same as those for engineered safety systems

c. Have an internal design pressure and temperature rating at least equal to containment design pressure and temperature

d. Have check valves provided inside containment for isolation should a single failure prevent the outside motor operated valves from operating.

Shortly after a DBA, the ambient temperature within the containment may be as high as 280 F. Although such high temperatures are short lived (the containment is reduced to subatmospheric conditions in less than 60 minutes as the containment depressurization system, Section 6.4 cools the containment atmosphere), it is possible that water trapped in the lines of the systems isolated by the containment isolation system may expand more rapidly than the associated piping. This could result in pressures exceeding the design pressure of the piping. To ensure that such overpressurization of isolated piping cannot adversely affect containment isolation integrity, a relief valve set to relieve at a pressure below the design pressure of the associated piping is installed in the few affected lines inside the containment between the containment wall and the inside isolation valve. These relief valves are designed to reseat when overpressure conditions subside.

Weight and spring loaded check valves used for containment isolation are designed to require, in order to open, a differential pressure across the valve in the normal flow direction exceeding the expected post DBA differential pressure between atmosphere and containment (about 1.2 psi). As a result, leakage into the containment through incoming lines with check valves inside the containment caused by passive failures of such lines between the containment penetration and the outside isolation valve is prevented. The use of spring and weight loaded check valves inside the containment on outgoing lines ensures positive seating of such valves after the containment has been returned to subatmospheric pressure following a DBA.

5.3.4 Containment Isolation Valves

5.3.4.1 Stone & Webster Valves

To ensure reliability, containment isolation motor-operated and trip valves meet the minimum design requirements for containment isolation valves as specified in American National Standards Institute, ANSI B31.1,(3) 1967, ANSI B16.5,(4) and Manufactures Standardization Society Standard Practice, MSS-SP-66,(5) with additional nondestructive testing of pumps and valves in accordance with ASME Boiler and Pressure Vessel Code (Draft issue) dated November 1968.

The selection of valve operators and types was made on the basis of best part experience and practices.

Gate valves are used extensively for remote operated containment isolation valves because of their tight seating characteristics, essential deep stuffing box features for handling radioactive fluid, and availability in a larger size of pressure ratings and sizes.

Butterfly containment isolation valves are selected in lieu of gate valves in certain applications for their use in low pressure, large line sizes.

Globe valves are used exclusively on closed conduit systems as the type of containment isolation trip valves because of the short stem travel; and therefore, quick closing capability. This requirement ensures integrity of containment isolation to limit release of radioactivity to the environment. Because of liquid pressure buildup due to transient temperature conditions following a DBA, overpressure protection is providing relief under the valve seat. External relief is not required, thus maintaining system integrity.

In addition to the code requirements, additional quality assurance and test programs are imposed on these valves to achieve optimum reliability.

Motor-operated isolation valve bodies are hydrostatically tested at a pressure equal to twice the nominal pressure rating, and the duration of the test is 10 minutes for valves with minimum wall thickness up to and including 1 inch and 30 minutes for valves with larger wall thicknesses. Motor-operated valves are tested for seat tightness at the nominal pressure rating of the valve for not less than 5 minutes. The permissible seat leakages are in accordance with MSS-SP.61.(6)

Valves listed below are subjected to special testing requirements:

1. MOV-RS-156A and MOV-RS-156B in the recirculation spray system are subjected to zero seat leakage and backseat tests

2. Weight loaded check valves WLC-1-Q, WLC-2-Q, WLC-3-2, and WLC-4-2 in quench spray and recirculation spray systems are subjected to seat tightness test in accordance with MSS-SP61 with differential pressure of 9 to 45 psi in the reverse flow direction and 2 psi in normal flow direction

3. MOV-FW-156A, MOV-FW-156B, and MOV-FW-156C - motor-operated check valves in the main feedwater system are designed to seal against 5.5 psi pressure differential in the normal flow direction.

4. Ventilation isolation valve (dampers), which serves as containment isolation, are subjected to the following tests:

    a. Shell test - valves are tested at 70 psig for a period of at least 10 minutes (during which there shall be no leakage allowed)

    b. Seat test - the valves are air tested under water at 70 psig for a period of 15 min, during which time there is no visible leakage

    c. Steam test - the valves are steam tested at 45 psig saturated for 30 minutes during which time there is no leakage through any part of the valve allowed.

All parts of containment isolation trip valves, subject to line pressure are tested both for mechanical functioning and tightness of the valve seat and shell. Hydrostatic test pressures are equal to or greater than required by ANSI B16.5 and MSS-SP-61 for the conditions of service. In addition to hydrostatic tests, maximum operating pressure backseat leakage is less than 5 X 10^{-4} cubic centimeters per minute per PSI differential pressure per inch of port diameter. Maximum leakage below valve seats must not exceed 6 X 10^{-7} standard cubic centimeters per second inch of valve diameter.

All containment isolation valve radiographic examination is in accordance with American Society for Testing Materials ASTM Specifications E-94(7) and E-142(8).

In addition to radiographic examination requirements, magnetic particle inspection on ferrous isolation valves is performed in accordance with ASTM E-709(9) previously ASTM E-109, and stainless steel isolation valves are liquid penetrant inspected in accordance with ASTM E-165(10).

Motor operators are of the Limitorque design. These operators are used extensively in nuclear applications. Limitorque operators are designed to be operable during the life of the plant and are tested to operate during DBA conditions. Valve actuators are designed to operate under seismic conditions.

Motor operators supplied by Limitorque Corporation Torque duty motors conform to all applicable National Electrical Manufactures Association (NEMA) and Institute of Electrical and Electronic Engineers (IEEE) Standards and are tested to NEMA MG-1-10.35(11). Motor operators are tested in accordance with IEEE Std. 382(12). To demonstrate satisfactory operation in the combined pressure, temperature, atmospheric and radiation conditions. These tests have been conducted by Franklin Institute Research Laboratories and are documented in their final report(13). Limitorque operators were also subjected to seismic test.

Regarding bearing lubrication, motor operators are provided with seals to prevent lubricant escape or foreign particle entrance. Lubricants used are either Humble Oil Co.'s NEBULA-EPI or Sunoil Company's Prestige-740 AEP, both are suitable to withstand environmental conditions during DBA.

Pilot valves such as solenoid valves are subjected to dielectric test in accordance with ANSI C19.1, Section 15.15.658.(14)

Based on previous successful operating experiences of Limitorque operator in other nuclear plants, Limitorque motor operators have been accepted for BVPS-1. In order to ensure the operability of motor-operated valves, manufacturers have performed the operability test in a dry condition in their plant, have certified that valve and motor operator will withstand the specified environmental conditions and have submitted a static seismic analysis which was approved by Stone & Webster.

Containment isolation trip valves are designed to be operable under normal operating environmental conditions during the life of the plant and during seismic conditions. They are designed to trip shut at the onset of a DBA and remain closed during post accident environmental conditions.

All trip valves have the Masoneilan reverse operator, which consists of a cast iron yoke with the diaphragm casing above and opposed by a spring.

Air pressure is applied below the diaphragm which compresses the spring. Release of air pressure relaxes the spring of the preload force and closes the valve.

The diaphragm material is rubber reinforced with woven fabric and will meet the 40 year radiation dosage, although during a DBA condition the material will decompose. Should the diaphragm fail, the valve will close and indicate on the main board via limit switches.

To prevent repressurization through solenoid vent ports during high pressure transient conditions, containment isolation trip valves inside containment have two, half inch diameter holes drilled in the spray barrel of the actuator, thus ensuring that the trip valves remain closed.

All containment isolation valves are traceable to mill test reports. All welding procedures, welder qualifications, and weld repair procedures for manufacture of valves are in accordance with ASME Boiler and Pressure Vessel Code Section IX.

All containment isolation valves which receive signals to close from either a containment isolation phase A or B or signal to close in the event of a refueling accident have valve closure times as fast as possible consistent with the design of the valves and valve operators with consideration given to water hammer effects.

Stone & Webster components have been analyzed for stresses due to operating and seismic loads as discussed in Appendix B.2.2.

5.3.4.2 Westinghouse Valves

The design requirements for containment isolation valves are based on the requirement of ANSI B16.5 or MSS-SP-66. To assure that specification for these valves are met, inspections and tests are witnessed by Westinghouse at the place of manufacture.

The selection of operators and types of valving was made on the basis of best practices and past experience. The motor operators are of the Limitorque Design which was discussed in Section 5.3.4.1.

The containment isolation system conforms to Appendix A of 10CFR50 General Design Criteria for Nuclear Power Plants, Criteria 55 through 57 and as modified by Section 5.3. To ensure safe and reliable system operation, the following design features have been incorporated.

The design pressure of all the isolation valves are in excess of the containment design pressure.

All check valves, when used as containment isolation valves, are loaded to close against a 2 psi positive differential pressure.

All remotely actuated valves have their positions indicated in the main control room.

Circuits which control redundant automatic valves are redundant to the extent that no single failure will preclude isolation.

The closure time for valves in the pipelines, which might have the potential of releasing radioactive elements to the atmosphere, have been limited to as small a period as possible consistent with the design of valves and operators.

Westinghouse component analysis is discussed in Appendix B.3.

5.2.6.2 Exterior Missiles

The containment has not been analyzed for exterior missiles generated by hypothetical aircraft accidents due to the site being located more than 5 miles from any airport (Table 2.1-7).

Tornado generated missiles discussed in Section 2.7 include one potential missile equivalent to a 35-ft long wooden utility pole impacting at a velocity of 150 mph.

5.2.6.3 Criteria for Protection Against Dynamic Effects Associated with a Major Pipe Rupture

The containment vessel and all essential equipment within the containment are adequately protected against the effects of blowdown jet forces and pipe whip resulting from a postulated pipe rupture of reactor coolant (Class 1), main steam, and feedwater (Class 2) lines. The criteria for adequate protection permits limited damage when analysis or experiment demonstrates that:

1. Leakage through the containment will not cause offsite dose consequences in excess of 10CFR part 100 guidelines.
2. The minimum performance capabilities of the engineered safety systems are not reduced below that required to protect against the postulated break.
3. A pipe break which is not a loss of reactor coolant will not cause a loss of reactor coolant or steam or feedwater line break. Also, a reactor coolant system pipe break will not cause a steam-feedwater system pipe break and vice versa.

This level of protection is assured by adherence to the following design criteria.

Placement of Piping and Components

The routing of pipe and the placement of components minimize the possibility of damage.

The polar crane wall serves as a barrier between the reactor coolant loops and the containment liner. In addition, the refueling cavity walls, various structural beams, the operating floor, and the crane wall, enclose each reactor coolant loop into a separate compartment, thereby preventing an accident, which may occur in any loop, from affecting another loop or the containment liner. The portion of the steam and feedwater lines within the containment have been routed behind barriers which separate these lines from all reactor coolant piping. The barriers described above will withstand loadings caused by jet forces and pipe whip impact forces.

Other than for the Emergency Core Cooling System lines, which must circulate cooling water to the vessel, the engineered safety features are located outside of the crane wall. The Emergency Core Cooling System lines are routed outside of the crane wall so that the penetrations are in the vicinity of the loop to which they are attached.

Supplemental Protection

In those regions where the careful layout of piping and components cannot offer adequate protection against the dynamic effects associated with a postulated pipe rupture, restraints to prevent excessive pipe movement or special shielding is provided.

The careful layout of piping and components offers adequate protection against the dynamic effects associated with a postulated pipe rupture except in the case of the main steam and feedwater lines outside the crane wall and the pressurizer surge line.

In the case of the pressurizer surge line, a sufficient number of restraints are provided such that, following a single break, the unrestrained pipe movement of either end of the ruptured pipe about a plastic hinge formed at the nearest pipe whip restraint cannot impact any structure, system or component important to safety.

The basis for selecting break locations in the main steam and feedwater systems, whose piping is similar to ASME Boiler and Pressure Vessel Code, Section III, Class 2 piping, is discussed below.

Since the probability of rupture is strongly related to stress, only a limited number of break locations are postulated. Supplemental protection is provided on the main steam and feedwater lines for breaks at all locations where the stress exceeds 80 percent of the allowable stress. A minimum of three break locations were postulated by the following criteria:

1. At the two terminal points
2. At the point of maximum primary plus secondary stress
3. At any other point where the primary plus secondary stress exceeds 80 percent of its allowable; i.e., $0.8 (S_A + S_m)$, or the secondary stress exceeds 80 percent of its allowable; i.e., $0.8 S_A$, or the primary stress exceeds 80 percent of its allowable; i.e., $0.8 (1.2 S_m)$.

The main steam and feedwater piping (similar to ASME Boiler and Pressure Vessel Code III, Class 2 piping) requires pipe break restraints in order to protect the integrity of the containment lines. Of the six piping runs, five runs each contain a total of four or more postulated break points. The break locations are picked where there is a sharp change in stress level along the length of pipe. There seems to be no reasonable method to pick one point versus another when the stress level does not vary appreciably along the pipe run.

Table 5.2-16 gives the pipe break locations postulated for the three main steam and three main feedwater pipe runs inside the containment building. The loop A main steam line contains three break points and/or areas. Figures 5.2-33 through 5.2-38 coordinate the point numbers, given in Table 5.2-16 to a location along the pipe run. The restraint locations for main steam lines and for main feedwater lines are provided in Figures 5.2-39 and 5.2-40 respectively. Restraint locations are based upon what were, at the time of design fixing, the prevailing criteria for number and type of break.

Restraints offer good supplemental protection since pipe displacements are minimized and large kinetic energies are prevented.

The placement of the restraints will prevent excessive pipe displacements in the event of either a longitudinal split or circumferential break, or both, depending on the state of stress in the line.

In the area where the feedwater and the main steam piping penetrate the containment shell, the liner is also protected by an overlay of 1 1/2 inch thick quenched and tempered steel plate.

Methods of Analysis

Analyses are performed for pipe impact and jet impingement. In addition, major equipment supports are analyzed to ensure adequacy under postulated pipe rupture loads transmitted by attached piping.

For the purposes of design, unless otherwise stated, the pipe break event is considered a faulted condition, and the pipe, its restraint or barrier, and the structure to which it is attached are designed accordingly.

Restraints which require plastic deformation are based on 50 percent of ultimate strain.

The forces associated with both longitudinal and circumferential ruptures are considered in the design of supports and restraints in order to ensure continued integrity of vital components and engineered safety features.

The break area for both postulated break types is the cross-sectional area of the pipe. The break length for the postulated longitudinal breaks is assumed to be equal to twice the pipe diameter.

The analysis takes advantage of limiting factors on the blowdown thrust force, such as line friction, flow restrictors, pipe configuration, etc. A rise time is applied to the thrust force to simulate the crack opening time. A one millisecond rise time is assumed for circumferential breaks. For longitudinal splits, a rise time is computed based on the growth of a crack from a critical length to a length of two pipe diameters at a propagation rate of 500 ft/second.

Pipe Restraints

The restraints are designed with a gap sufficient to prevent interference with the normal thermal dynamic motion of the lines. This permits the pipe to acquire kinetic energy which must be dissipated upon impact into the restraint. This energy was conservatively set equal to the product of peak thrust times displacement. No energy dissipation mechanisms operating prior to impact, such as plastic deformation in the pipe, were considered. Static analyses of the deformation of the restraints and bolts provided the force displacements characteristics of the restraints. The area (energy) under this force-displacement curve was matched to the kinetic energy of the impacting pipe to determine the deformation and load. Based on recent, more detailed analyses, the conservatism of this design approach has been proven.

Figures 5.2-39 and 5.2-40 show the configurations of typical piping restraints and locations of such restraints for the main steam system and feedwater system, respectively. Figures 5.2-41 and 5.2-42 show the similar information for the pressurizer surge line.

The restraints consist of a circular arch (or yoke) and a welded base support structure that is bolted to a supporting wall. These restraints are designed so that, by the use of self-adjusting shims, the gap between the pipe and the inner surface of the restraint is kept as small as practicable while still allowing free thermal expansion of the pipe during plant operation.

The barrier provided near the containment penetration is attached to the pipe penetration sleeve.

Equipment Supports

The internal structural system of the containment is designed to mitigate loading due to rupture in the main reactor coolant lines and the main steam and feedwater lines. Incident rupture is considered in only one line at a time. The support system is designed to preclude damage to or rupture of any of the other lines as a result of the incident. The snubber and key systems are designed to deliver rupture thrusts on the steam generator into the internal structural system. In determining the steam generator support reactions, the system is reduced to a dynamic model consisting of a suitable number of masses and resistance elements. The dynamic problem is solved by numerical methods, using a thrust time history as loading. Resistance, dynamic amplification of the thrust, and rebound forces are calculated as a function of time. The reactor vessel and support system is similarly treated.

5.2.6.4 Pipe Whip Analysis

The analysis of the restrained piping within the containment was completed and the fabrication of restraints begun before any officially acceptable criteria for analysis was published. Subsequent to the completion of the analysis, analytical methods and criteria to be used in determining pipe whip analysis was transmitted to DLC from the AEC. The analytical methods and criteria are provided in Attachment A to Section 5.2, "Pipe Whip Analysis Guidelines". The analytical methods and criteria used were similar to, but not identical with, those outlined in Attachment A. To facilitate a comparison, the original criteria is provided in Attachment B using the format of Attachment A and a point-by-point comparison is presented. Emphasis is placed on those criteria which differ.

5.2.7 Corrosion Protection and Coatings

5.2.7.1 Steel Liner

The exterior of the steel liner is not coated because it is in intimate contact with the concrete and has adequate protection from corrosion. The interior of the steel liner has an inorganic zinc coating with a white epoxy topcoating which provides protection for both normal operating and accident conditions.

5.2.7.2 Concrete and Structural Steel

All interior concrete and structural steel surfaces in the containment structure were given a coating suitable for service under DBA conditions. The steel floor grating is galvanized.

The coating system used on the preponderance of carbon steel surfaces within the reactor containment consists of a zinc-rich inorganic vehicle primer, topcoated with one or more coats of polyamide epoxy. Some items of equipment and certain other items, with relatively small amount of surface area, were coated with a straight organic system. Concrete surfaces are coated with at least two coats of polyamide epoxy.

The criterion for the selection of the above coating systems was the performance of these systems when subjected to tests simulating the environment anticipated within the containment in the event of a DBA. The coating systems indicated have demonstrated the ability to retain their integrity under DBA conditions, similar to those described in Section 7, in such a

6.2.2.1 Definition of Piping Classifications

The classifications listed below determine the fabrication, inspection and documentation requirements in the procurement and erection of piping. It should be noted that Table B.1-1 in Appendix B lists structures, systems and components which are safety related and which, therefore, are designed for seismic loadings. The usage of the term "Class I" for systems and structures subject to seismic design antedates the adoption in piping codes of Classes I, II and III which have a different definition. Thus, some piping which would be identified from the following listing as Class II or III for fabrication, inspection and documentation purposes is identified as Class I for seismic design purposes in accordance with Appendix B.

The following definitions are intended to require computations, inspection and documentation consistent with the severity of the service. The definition of Class I conforms with the requirements stated in the Federal Register[2]. All line numbers on flow diagrams and piping drawings for "Nuclear" systems will have a suffix, Q1, Q2 and Q3 to indicate the line's appropriate piping class. Portions of systems which are not required to meet functional requirements (i.e., test lines) and are normally isolated from the system may be excluded from the following Q1, Q2 and Q3 classifications:

Piping Class I (Q1)

This classification encompasses the reactor coolant system and portions of auxiliary systems and emergency core cooling systems connected to the reactor coolant system. For piping of those auxiliary systems and emergency core cooling systems which penetrate containment, the piping Class I boundary extends to and includes the first containment isolation valve outside the containment capable of external actuation (simple check valves are excluded). For piping of those auxiliary systems which contain two valves, both of which normally are closed during normal operation, the piping Class I boundary extends to and includes the second of these valves. This second valve (excluding simple check valves) must be capable of external actuation, whether or not the system piping penetrates the containment. For piping of those emergency core cooling systems which does not penetrate the containment, the piping Class I boundary extends to and includes the second of two valves normally closed during normal operation. For piping of those auxiliary systems and emergency core cooling systems which contain a relief or safety valve, the piping Class I boundary extends to and includes the relief or safety valve.

Piping Class II (Q2)

This classification encompasses the following:

1. Residual heat removal system
2. Reactor coolant letdown and charging portions of chemical and volume control system
3. Portions of the emergency core cooling and containment depressurization systems that may recirculate reactor coolant
4. Portions of the main steam and feedwater systems extending from and including the secondary side of the steam generator up to and including the outermost containment isolation valves and connected piping up to and including the first isolation valve
5. Those portions of any other system used to effect isolation of containment
6. High pressure portion of gaseous waste disposal system.

Piping Class III (Q3)

This classification encompasses the following:

1. Chemical and volume control system, excluding portions defined above as Class II and including piping from boric acid tanks to charging pumps
2. Containment depressurization system excluding those portions covered in Class II
3. Accumulator and refueling water supply subsystems of the emergency core cooling system
4. Auxiliary feedwater system
5. Portions of the component cooling and river water systems that transfer heat from systems for emergency core cooling, containment depressurization, residual heat removal and reactor coolant letdown
6. Vents and drains from Class I and Class II systems
7. Any portion of primary plant not classified as Class I or II
8. The reactor vessel flange leak detection lines up to and including valve SOV-RC-544 as shown on Figure 4-1.

RESIDUAL HEAT REMOVAL SYSTEM	RH
CHEMICAL AND VOLUME CONTROL SYSTEM	CH
SAFETY INJECTION SYSTEM	SI
GASEOUS WASTE SYSTEM	GW
CHEMICAL FEED SYSTEM	CMF, CMPD, CPPD, CPF, CHMV, CHPD
STEAM GENERATOR BLOWDOWN SYSTEM	WGCB, WBTD, SBTV
CONTAINMENT DEPRESSURIZATION SYSTEM	QS, RS
CONTAINMENT VACUUM AND LEAKAGE MONITORING	CV, IM
REACTOR COOLANT SYSTEM	RC

PIPE CLASS

Body Material	Nominal Design Pressure Rating, Psig								
	50	125	150	300	600	900	1,000	1,500	2,500
CARBON STEEL PIPE		121	151	301	601	901		1501	
304 STAINLESS STEEL PIPE			152, 153A, 153B, 154	302	602			1503	
316 STAINLESS STEEL PIPE								1502	
COPPER PIPE			218						
304 or 316 STAINLESS STEEL TUBING							IC-N6		IC-N8 IC-N9
COPPER TUBING	IC-N7		IC-N1						

FIGURE 1.2-14
KEY TO LINE DESIGNATION NUMBERS
BEAVER VALLEY POWER STATION UNIT NO. 1
UPDATED FINAL SAFETY ANALYSIS REPORT

EXAMPLE: 3" SHP 27 601 Q2

NOMINAL PIPE DIAMETER (IN.) — 3"

SYSTEM DESIGNATION — SHP

LINE NUMBER — 27

PIPE CLASS — 601

QUALITY CONTROL CLASS — Q2
See Section 6.2.2.1
and Table 6.2-1

SYSTEM DESIGNATION

MAIN STEAM SYSTEM	SHP, SAE, SDHV, SMSV, SHPD, MS, SCUD, SRD, SRE, SRSV
AUXILIARY STEAM AND AIR REMOVAL	AJA, ACA, SA, GA, SLPD
CONDENSATE SYSTEM	WCPD, WCPR, WCPS, WCMU, WCPV
FEED WATER SYSTEM	WAPD, WFPD, WFPR, WD
CIRCULATING WATER SYSTEM	WC, ARWP, WRS
RIVER WATER SYSTEM	WR, WSW, WBTB
COMPONENT COOLING SYSTEM	CC, NSL, CW, WCC
COMPRESSED AIR SYSTEM	ASC, ACC, ASC
WATER TREATING SYSTEM	CCD, CCF, CCWT, CHF, CHL, CMPD, CPF, CPPD, CHPD, CSA, SAD, WCW, WDM, WD, WDMD, WDMS, WDMV, WCL, WSPD, WSS
BORON RECOVERY SYSTEM	BR, H, PG, RL
LIQUID WASTE DISPOSAL SYSTEM	LW, DA
FUEL POOL COOLING AND PURIFICATION SYSTEM	FP, FC
SAMPLE SYSTEM	SS
SOLID WASTE DISPOSAL SYSTEM	SW
VENT AND DRAIN SYSTEM	VA, DA, DG, VG

FIGURE 1.7-14 (CONT.)

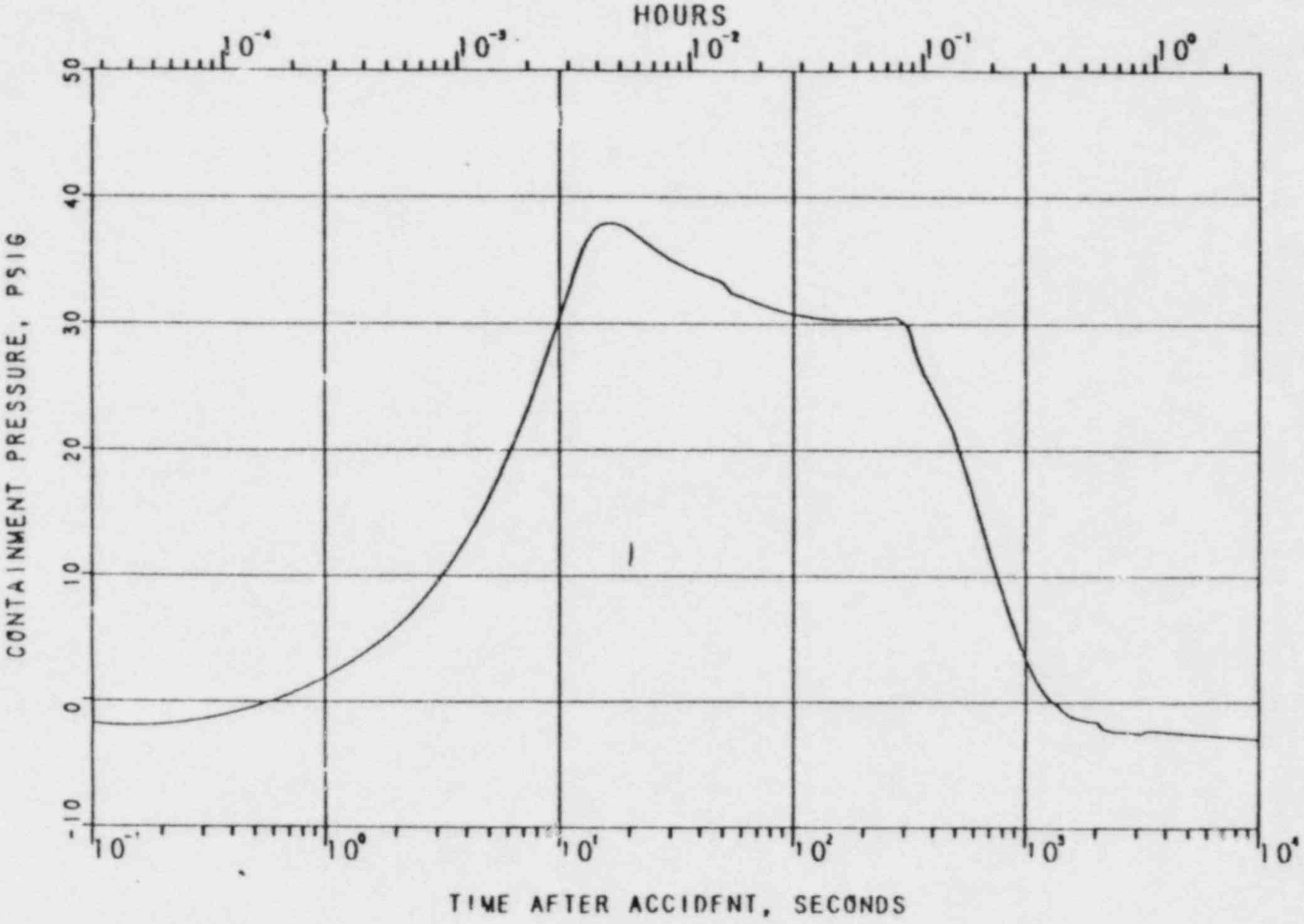

FIGURE 14.3-55A
CONTAINMENT PRESSURE DER OF COLD LEG
WINTER - NORMAL ECCS - MINIMUM
QUENCH SPRAYS
BEAVER VALLEY POWER STATION UNIT NO. 1
UPDATED FINAL SAFETY ANALYSIS REPORT

REV. 0 (1/82)

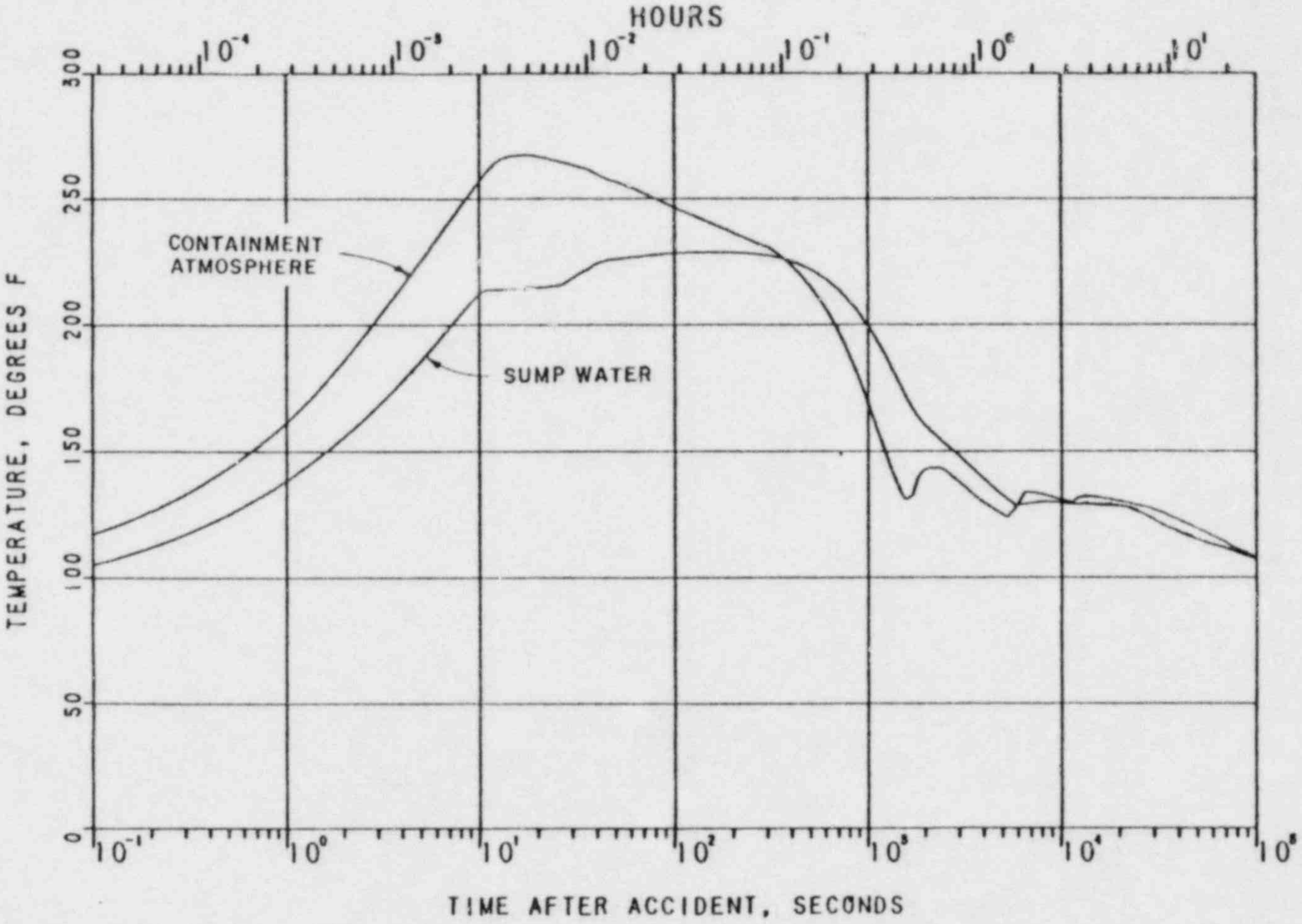

FIGURE 14-3-58
TEMPERATURES FOR 1 DAY FOLLOWING
ACCIDENT - HOT LEG DER -
MINIMUM SAFEGUARDS
BEAVER VALLEY POWER STATION UNIT NO. 1
UPDATED FINAL SAFETY ANALYSIS REPORT

REV. 0 (1/82)

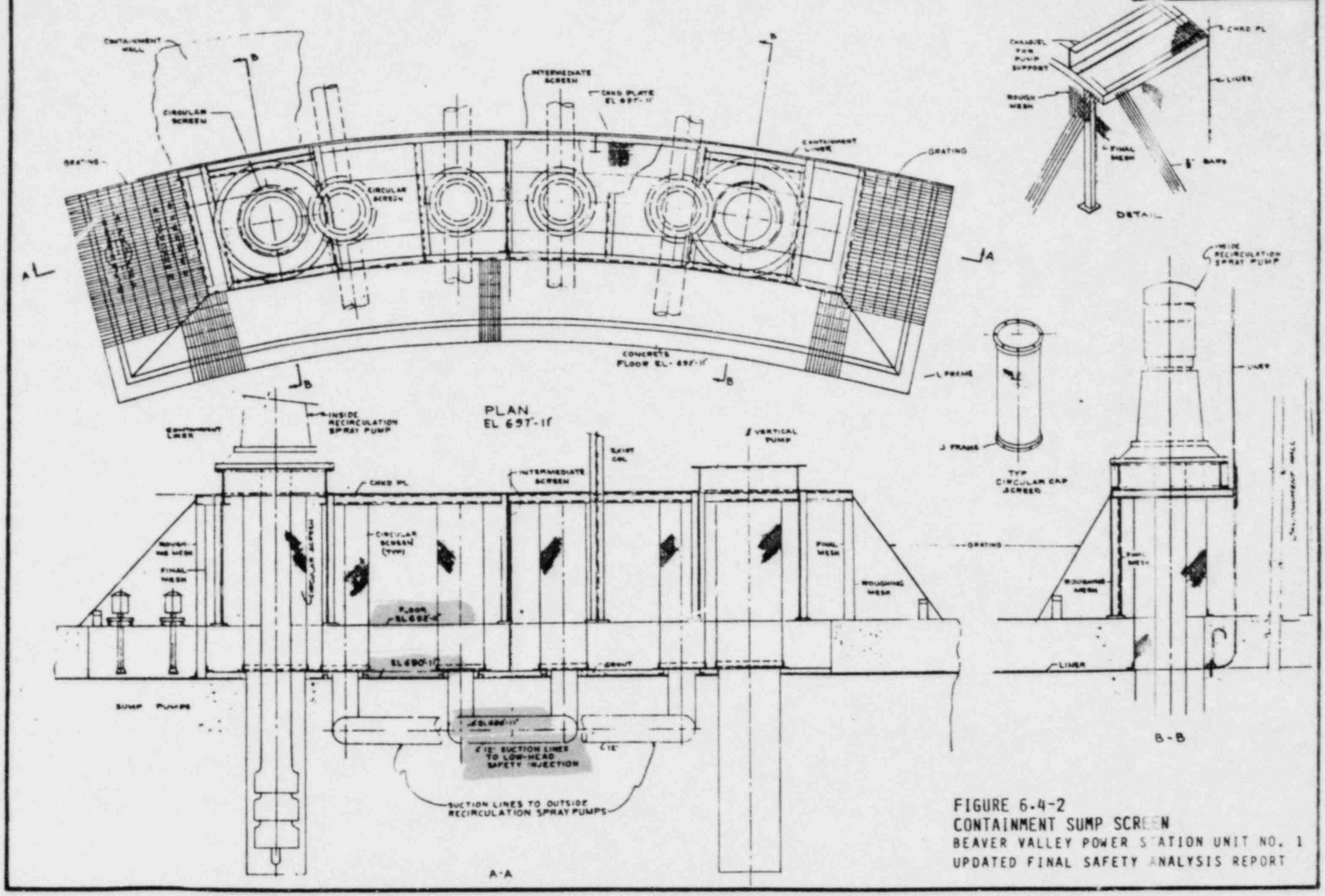

FIGURE 6.4-2
CONTAINMENT SUMP SCREEN
BEAVER VALLEY POWER STATION UNIT NO. 1
UPDATED FINAL SAFETY ANALYSIS REPORT