WRITTEN PRESENTATION TO
UTILITY DESIGN REVIEW BOARD

DESIGN TO ACHIEVE AND MAINTAIN COLD SHUTDOWN

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II. HISTORY

The ability to establish a stable condition for a nuclear reactor following a normal or emergency shutdown has always been a consideration in plant design. However, the design requirements for pertinent systems and the condition to be established have evolved over the years.

A significant emphasis has traditionally been placed on ensuring a stable condition following a large loss-of-coolant accident (LOCA) event. During a large LOCA, the reactor coolant system (RCS) pressure decreases and a safe shutdown condition is established by the emergency core cooling system. Because of the attention previously given to this event, it is not a current concern and will be addressed only peripherally in this review.

For a non-LOCA event in which RCS integrity is maintained, the stable condition to be achieved is the hot standby condition in which the RCS pressure and temperature remain near their normal operating values. This safe hot standby condition could be achieved without offsite power. The hot standby condition could be maintained until offsite power is restored and further cooldown is desired. Subsequently, emphasis was placed on ensuring that systems necessary to maintain hot standby were safety grade.

More recently, a similar emphasis has been placed on ensuring that systems necessary to achieve cold shutdown are safety grade. This situation evolved from a concern that the safe shutdown condition be cold shutdown. Previously, the safe shutdown condition was considered to be hot standby. Cold shutdown is achieved when the RCS temperature is $\leq$200F, and the reactor is at least 1% $\Delta k/k$ subcritical, assuming the highest worth rod stuck out, and no xenon. The event useful for evaluating the capability to achieve cold shutdown is the loss of offsite power coincident with a safe shutdown earthquake (SSE). This event is used as a basis to address Sections III (Preceding Design - Hot Standby Capability) and IV (Present Design - Cold Shutdown Capability) of this presentation. Other accident scenarios will be addressed in Section V (Cold Shutdown Following Chapter 15 Type Events).

Subsequent to the Three Mile Island (TMI) accident, the Midland project formed a task force to address some open issues that existed prior to TMI or were raised by the accident. One of the subjects addressed was cold shutdown. During this review, a number of design upgrades were recommended to enhance the hot standby and cold shutdown capability. Most of the design upgrades that have been implemented with respect to shutdown capability have evolved from this effort.

The present Midland design basis is that hot standby is a safe shutdown condition. This design basis is appropriate because hot standby is a safe, stable condition that can be maintained for an extended period of time with a minimal amount of operator action; therefore, it provides additional time to further evaluate the condition of the reactor. In addition, it frequently is preferable to maintain the reactor in this hot stable condition for an extended period of time rather than subjecting the plant to an immediate cooldown transient. The current Midland design provides for the ability to achieve and maintain, by safety-grade means, the hot standby condition following an SSE coincident with loss of offsite power. (Safety-grade systems are seismically designed and capable of being operated with or without offsite power.) Although it is not a design basis, the present Midland design incorporates the ability to be taken to the cold shutdown condition using only safety-grade equipment assuming only onsite or offsite power is available and considering a single failure. In addition, the present Midland plant design can achieve and maintain cold shutdown following a tornado by using equipment that is protected from the effects of a tornado.

III. PRECEDING DESIGN - HOT STANDBY CAPABILITY

This section briefly addresses previous design capabilities of the Midland plant to facilitate an understanding of the design upgrades that have been made. No comparison to the present design is made, because Section IV

12-100% power, the xenon reactivity is above its equilibrium value for at least 4 hours after a reactor trip. The xenon poison transient permits sufficient time to bleed the RCS and inject water from the BWST.

The boron concentration of the reactor is normally increased by using the makeup system to inject boric acid from the boric acid addition tanks of the chemical addition system. In the event of an accident, the borated water from the borated water storage tank (BWST) is available for injection into the RCS.

3. Inventory control

The makeup system normally controls the RCS inventory. Portions of the makeup system are used for high-pressure injection (HPI) to ensure adequate boron concentration and core cooling. Safety-grade portions of the makeup system are powered by Class 1E onsite power. The makeup water is from the BWST, which is also safety grade.

B. Pressure Control

The pressurizer safety valves prevent overpressurization of the RCS. In the event of loss of offsite power, the thermal inertia of the pressurizer allows it to maintain system pressure for some time after power is removed from the heaters. Thus, sufficient time exists to connect the pressurizer heaters to the emergency diesel generators.

C. Heat Rejection (Temperature Control)

1. Steam generator

a. Main steam isolation valve (MSIV) and main feedwater isolation valve (MFIV) closure

Heat transfer from the RCS to the secondary side of the steam generator must be established for cooldown. In the event of a main steam line break (MSLB), MSIV and MFIV closure ensure that the heat removal can be controlled. The MSIVs and MFIVs close automatically on low-steam pressure or an emergency core cooling actuation signal (ECCAS), or can be manually closed from the control room.

b. Auxiliary feedwater (AFW) operation

The auxiliary feedwater actuation system (AFWAS) initiates the automatic starting of both the turbine-driven and the motor-driven AFW pumps and the automatic positioning of AFW valves. This mitigates the consequences of the loss of main feedwater or a loss of offsite power accident, and provides feedwater to allow primary heat removal through the steam generators.

A motor-driven and a turbine-driven AFW pump provide redundancy of AFW supply and diversity of motive pumping power. Each pump has a rating of 885 gpm. Discharge piping from both pumps is cross-connected through two normally open valves, permitting each AFW pump to feed both steam generators.

In the safeguards mode, pump suction is normally from the condensate storage tank, with emergency backup provided from the service water system. Steam supply piping to the turbine driver is provided by each of the main steam lines inside the containment. A line from each steam generator, equipped with a normally closed, dc motor-operated isolation valve, supplies steam to a common header.

c. Main steam relief valves

The main steam relief valves lift to remove heat from the secondary system. The hot standby condition can be maintained by cycling of these relief valves. Cooldown to a temperature that corresponds to a pressure below the main steam relief valve setpoint could be accomplished by opening the modulating atmospheric dump (MAD) valve. If instrument air were unavailable, the MAD valve could be opened by local manual operation.

2. Natural circulation of reactor coolant

Natural circulation characteristics of the RCS have been calculated by Babcock & Wilcox with conservative values for all resistance and form loss factors, and have been found to provide adequate core cooling.

IV. PRESENT DESIGN - COLD SHUTDOWN CAPABILITY

The Midland design provides for the ability to achieve and maintain, by safety-grade means, the hot standby condition following a SSE coincident with loss of offsite power. Although it is not a design basis, the Midland design incorporates the ability to be taken to the cold shutdown condition using only safety-grade equipment, assuming only onsite or offsite power is available and considering a single failure. Therefore, in the unlikely event that a design basis earthquake occurs which results in the need to achieve cold shutdown expeditiously, design features exist to accomplish this evaluation. Reactivity control/inventory control, pressure control, and heat rejection are the essential functions that must be maintained.

Detailed treatment of necessary supporting systems and equipment (such as power and control systems, cooling water, and diesel generators) is not addressed in this presentation. However, plant design ensures that these systems and equipment fulfill the necessary design requirements to achieve cold shutdown.

The loss of offsite power coincident with an SSE is used as a basis for evaluating the capability of achieving cold shutdown.

The NRC design guidance and the guidance followed on the Midland plant to meet the functional requirements necessary to achieve cold shutdown follow.

a. Cold shutdown shall be achieved using safety-grade systems.

b. Systems shall have suitable redundancy in components and features to ensure that the system functions can be accomplished (assuming a single active failure).

c. Systems are capable of being operated from the control room. (Some systems require local manual alignment, but control can be performed from the control room.)

d. The necessary systems can function whether offsite power is available or unavailable.

The essential functions that must be maintained are individually addressed below.

A. Reactivity Control/Inventory Control

1. Control rods

The Midland design (per unit) incorporates 61 control rod drive mechanisms (CRDMs), excluding the axial power shaping rod assemblies (APSRAs), which do not perform a trip function. The CRDMs are the B&W Type C design, which is in use at the Oconee Unit 3 and Davis Besse Unit 1 plants. Rapid control rod insertion is activated by the reactor protection system (RPS), anticipatory reactor trip system (ARTS), loss of power to control rod drive (CRD) motors or a switch in the main control room. The reactivity control capabilities of the control rods are identical to those described in Section III.

2. Boration

For normal shutdown reactivity control, the design of the Midland plant includes two sources of borated water: BWST and the chemical addition system (CAS). With letdown available, either the BWST or the CAS is capable of maintaining the reactor at 1% $\Delta k/k$ subcritical at hot shutdown or during transition to cold shutdown at any time in core life for the most limiting normal fuel cycle, assuming xenon-free conditions and the maximum worth rod stuck out of the core. The use of only safety-grade equipment to maintain the reactor at 1% $\Delta k/k$ subcritical at hot standby, and the transition to a cold shutdown condition, requires the use of the emergency boration system (EBS).

The EBS is a safety-grade system designed to provide a 6 weight percent boric acid solution to the RCS via the makeup and purification system (MU&PS), in the event of a design basis tornado (DBT) or SSE, in conjunction with the maximum worth stuck control rod. The contents and concentration, in conjunction with the other contraction volume makeup sources, are sized to ensure the ability to maintain a 1% $\Delta k/k$ subcritical margin during hot standby and during the transition to cold shutdown. Adequate shutdown margin is maintained during the transition from hot standby to cold shutdown by using borated water from the BWST or the CAS. These borated water sources provide adequate compensation for reactivity changes that result from the change in moderator temperature.

Following any event which results in the loss of letdown capability and a stuck rod, the 6 weight percent boric acid solution from the EBS storage tank (which contains at least 1,800 gallons), and the contraction makeup from the BWST or CAS can be transferred to the RCS via the MU&PS. One of the three makeup HPI pumps is used to inject this 6 weight percent boric acid into the RCS.

Contraction volume makeup during cooldown is provided by the makeup and EBS tanks and either the BWST, which is designed for an SSE, or the CAS, which is designed to withstand the DBT.

3. Inventory control

As coolant is removed (or let down) from the RCS, this coolant must be replaced (or made up) by additional makeup water that is delivered to the RCS by the makeup portion of the MU&PS.

Even if reactor coolant is not let down, the makeup portion of the MU&PS is still required to ensure a safe shutdown condition. As the RCS cools, the specific volume of water decreases. It is necessary to keep the volume of water in the RCS approximately constant. Therefore, additional water is injected into the RCS via the makeup system.

The safety-grade source of makeup water is the BWST, which contains at least 300,000 gallons of 1.3 wt% boric acid solution. Because the BWST is not required after a design basis tornado, the BWST is not tornado-protected. In addition, three boric acid addition tanks (part of the nonsafety-grade CAS) are also available for makeup addition. These three 10,000 gallon tanks, which contain a total of at least 16,500 gallons of 3.5 wt% boric acid, can provide the required RCS contraction volume in conjunction with other available water sources. These water sources are tornado-protected and can be made available following loss of offsite power.

B. Pressure Control

1. Reactor coolant system pressure boundary [power-operated relief valve (PORV), PORV block valves, and pressurizer safety valves]

The RCS pressure is controlled by maintaining the RCS pressure boundary and keeping a steam bubble in the pressurizer.

The PORV is sized to limit the pressure during step load changes, including the maximum design load rejection, to a value less than the high-pressure trip setpoint. While contributing to plant safety by improving operating efficiency, the valve is not required for safety reasons. It may be isolated either manually or automatically upon a coincident signal that the PORV is not closed and a low RCS pressure exists. The isolation is accomplished by either of two Class 1E motor-operated PORV block valves installed upstream of the PORV. Both the PORV and the PORV block valves are Class A (as defined by Regulatory Guide (RG) 1.26), and, as such, are designed, fabricated, tested, installed, and certified by the requirements of the ASME Code of Class 1 valves.

The pressurizer safety valves ensure that the RCS is protected against overpressure. They are spring-loaded devices, and open automatically by direct action of the fluid pressure in the pressurizer as a result of forces acting against a spring. They are bellows-sealed to make the setpoint independent of backpressure and are equipped with an auxiliary piston to ensure pressure balance in the event of damage to the bellows. These valves are designed, fabricated, tested, installed, and certified in accordance with Article NB-7000, Section III of the ASME Code for Class 1 components. They are Class A components as defined in RG 1.26.

2. Pressurizer heaters

To maintain normal operating RCS pressure for more than a few hours after shutdown, operation of the pressurizer heaters is required.

The pressurizer must be maintained as the hottest point in the RCS to ensure the vapor bubble exists only in the pressurizer.

Power and controls for two banks of pressurizer heaters have been upgraded to safety-grade Class 1E standards. In the event of loss of offsite power, power to the two banks of heaters is controlled by a manual switch in the control room. One bank is sufficient to control RCS pressure via a steam bubble in the pressurizer when the reactor is shut down and the energy input to the RCS is decay heat.

3. Auxiliary pressurizer spray

The auxiliary HPI pressurizer spray is designed to depressurize the RCS from its normal operating pressure to a pressure associated with the emergency DHR system cut-in temperature, and is intended for use only during emergency cold shutdown. The spray system driving head is derived from the HPI pump discharge. Suction for the HPI pump is normally taken from the BWST. The boric acid addition tanks, via the makeup tanks, serve as an alternative suction source. The spray line discharges to the auxiliary DHR pressurizer spray line upstream of parallel, motor-operated globe valves; these valves permit manual control of flow into the pressurizer. The spray system requires local alignment prior to initiation, but is remotely initiated and controlled from the control room. Once initiated, the spray will be operator-controlled to provide the desired depressurization rate that is determined by the cooldown rate and plant status.

C. Heat Rejection (Temperature Control)

1. Steam generator (at high pressures/temperatures)

To remove heat via the steam generators, a source of water to the secondary side of the steam generators and a steam vent path for energy removal must be provided. The water is provided by the AFW system and steam is vented via the main steam relief valves or the power-operated atmospheric vent (POAV) valves.

a. Auxiliary feedwater

Auxiliary feedwater is automatically supplied at a controlled rate by redundant 100% capacity AFW pumps. One pump is an electric motor-driven pump; the other is a steam turbine driven pump with steam provided by the safety-grade portion of the main steam system. Power and controls to both pumps are safety-grade and Class 1E.

Normally, the 300,000 gallon non-Seismic Category I condensate storage tank serves as the water source for these pumps. The safety-grade service water system provides an alternate source. Because of concern for the quality of steam generator feedwater, automatic transfer is provided only upon coincident AFW actuation signal (AFWAS) and low AFW pump suction pressure.

b. Main steam relief valves

These spring-loaded pressure relief valves cycle to relieve steam, enabling the reactor to remain in the hot standby condition.

c. Power-operated atmospheric vent valves

Steam can be relieved through the POAV valves to maintain the reactor in a hot standby condition without cycling the main steam relief valves; steam can also be relieved to cool the reactor to a temperature where the DHR system can be used.

The POAV valves are safety-grade, motor-operated control valves located upstream of the MSIV. The POAV valves are sized so an inadvertent stuck-open POAV valve will not result in unacceptable consequences to the core.

The POAV valve capacity will permit the RCS to be cooled to the emergency DHR cut-in temperature of 325F within 36 hours assuming one operational POAV valve for each steam generator. The 325F cut-in temperature is discussed in Item 2 below.

Each POAV valve can be jog-controlled from a switch in the control room or the auxiliary shutdown panel. The operator will position the POAV valves until an acceptable temperature is maintained or until an acceptable cooldown rate is established.

Steam relief can also be accomplished by dumping steam to the condenser or opening the MAD valves. These components are downstream of the MSIVs and are not powered or controlled by safety-grade equipment. Thus, to ensure cold shutdown can be achieved using only onsite emergency power and safety-grade systems, credit is taken only for components upstream of the MSIVs.

2. Decay heat removal system

After the RCS pressure and temperature are reduced to approximately 300 psig and 280F (or 325F under emergency conditions), respectively, the DHR system operation may begin.

The previous design directed that the DHR system not be operated until the RCS temperature was 280F. The DHR system was analyzed to determine that operation of the DHR system at 325F is an acceptable, although not normal, mode of operation. The higher DHR cut-in temperature permits operation of the DHR system, within 36 hours assuming operation of one POAV valve on each loop.

Four parallel-series, motor-operated isolation valves are installed on the DHR dropline inside the containment. These are installed so a single failure of a valve to open will not inhibit the flowpath for DHR cooling.

3. Reactor coolant circulation

a. Natural circulation test

The Midland plant has been analyzed to ensure that natural circulation will occur during a cooldown without forced circulation of the reactor coolant. In addition, a natural circulation cooldown test will be referenced if it has been conducted on a plant similar to Midland. If such a test is unavailable, a test will be conducted to verify that operation of the POAV valves under natural circulation will satisfactorily remove heat required to cool down the plant. This test will cool the RCS approximately 50F under natural circulation. The data will be used to verify the adequacy of prior analytical results.

b. Auxiliary feedwater level control

The AFW system will be the subject of another presentation and details of that system operation are not addressed here. However, the system will include safety-grade, automatic control of the steam generator water level. The steam generator water level is normally maintained at a level of 2 feet when two or more reactor coolant pumps (RCPs) are operating. If 0 or 1 RCP is operating, the level is automatically increased to 20 feet; this ensures sufficient feedwater is present in the steam generator to promote natural circulation of the reactor coolant.

The automatic transition from the low-water level to the high-water level in the steam generator is made smoothly by ramping the setpoint between the two values at a controlled rate. This orderly transition prevents overcooling of the primary loop.

V. COLD SHUTDOWN CAPABILITY FOLLOWING CHAPTER 15 TYPE EVENTS

A. Purpose

This section describes the ability of the Midland plant to achieve cold shutdown from the postulated plant conditions and equipment availability that exist following the events addressed in Chapter 15. Previous sections have provided detailed descriptions of the equipment needed to achieve cold shutdown. This section addresses the general post-accident conditions that may exist and assesses the ability to proceed to cold shutdown conditions.

B. Discussion

All of the transients analyzed in Chapter 15, with the exception of anticipated transients without scram events, result in a reactor tripped, subcritical core condition with long-term decay heat removal being provided by one or more intact RC/steam generator loops, or HPI cooling.

The final plant condition and equipment remaining available for use in achieving cold shutdown are dependent on the transient and assumed equipment failures. Equipment failures assumed for Chapter 15 events are based on ensuring a bounding transient response with respect to the established acceptance criteria. This failure may not be the worst one with respect to achieving cold shutdown following the event.

For most events analyzed in Chapter 15, the design objective of achieving cold shutdown within 36 hours can be met. This is true of all transients where no failure of safety-grade instrumentation has been imposed. With the imposition of a single failure of one piece of safety-grade instrumentation equipment, the remaining minimum performance level is still sufficient to achieve cold shutdown.

The transient analyses of Chapter 15 demonstrate that the plant can reach a stable plant condition at hot standby with ensured decay heat removal. An event may rely on an operator action to ensure long-term heat removal or adequate continuous subcritical margin at hot standby. Sufficient time and indication is available to the operator to take the required action in such instances.

Design basis events, such as steam and feedwater line breaks or a LOCA, may result in the loss of forced RC flow and the loss of the use of one steam generator for timely decay heat removal. The essential control functions that must be maintained in order to ensure the capability of achieving cold shutdown are reactivity/inventory control, primary pressure control, and heat rejection. Any accident event, which, in combination with a single failure, results in the complete loss of any one of these functions would preclude cold shutdown with safety-grade equipment. However, the transients analyzed in Chapter 15 do not result in the complete loss of any one of these functions.

1. Reactivity/inventory control

   Short-term reactivity control is provided by the control rods. Upon reactor trip, a 1% Δk/k shutdown margin (the control rod assembly of greatest worth is assumed not to drop into the core) is provided by the rods at hot zero power (532F) temperatures. The EBS provides reactivity control to compensate for the decay of xenon. Replacement of the primary system contraction volume following reactor trip is provided from the makeup tank by the HPI system. The EBS water along with the contents of the makeup tank can be injected prior to cooldown below 532F. Reactivity control for long-term maintenance of hot standby is thus ensured.

Primary system inventory and reactivity control during the cooldown to cold shutdown must be provided by either the CAS or HPI system.

2. Pressure control

Pressure control is provided by auxiliary spray and the safety-grade banks of heaters during the cooldown following non-LOCA events. Letdown from the RCS is not required.

3. Heat rejection (temperature control)

The design method of primary heat removal for both normal and transient conditions is by use of the steam generators. This method requires a source of fluid (AFW) to the steam generators and a mode of steam relief (main steam relief or POAV valves), all of which are safety-grade components or systems for the Midland plant. A secondary system transient such as a steam or feedwater line break may result in the loss of controlled heat removal capability from one steam generator. Heat removal is then provided by the intact loop with AFW flow directed to the intact once-through steam generator (OTSG) by the feed only good generator (FOGG) logic system. After stabilizing plant conditions, the POAV valves on the intact steam generator may be operated to decrease RCS temperature.

If the reactor coolant pumps are not operating, reactor cooling will be maintained by natural circulation. The ability to achieve cold shutdown within a reasonable time frame under the conditions of natural circulation and one intact loop remains to be evaluated. The AFW system will be operated to control the OTSG level to promote natural circulation.

The capability to achieve cold shutdown following the design basis tornado (coincident with loss of offsite power) has also been considered. Reactor trip occurs either by manual trip or automatically by loss of onsite and offsite power. Continued reactivity and inventory control are accomplished by injection of borated water from one or more of the three following sources, depending on availability: BWST (not tornado protected), EBS (tornado protected), or chemical addition tanks (tornado protected). Heat rejection is maintained by steam generator pressure control using AFW, main steam safety valves, or by manual operation of the POAV valves. Natural circulation is maintained by proper operation of the AFW system to control OTSG level. Primary pressure control is accomplished by operation of safety-grade heaters or auxiliary pressurizer spray.

Hot standby conditions can be maintained indefinitely unless it becomes desirable to proceed to cold shutdown.

C. Summary

The capability of achieving cold shutdown exists for the conditions following the Chapter 15 events. Various operator actions may be required depending on the transient involved and the assumed equipment failure. Times in excess of 36 hours may be required under the conditions of natural circulation with only one intact loop. It may be desirable to stay at hot standby or cool more slowly if such an action would minimize radiation releases. Table V-I summarizes the capability and limitations relative to achieving cold shutdown for each Chapter 15 event.

V". COMPARISON OF PRESENT DESIGN TO APPLICABLE REGULATORY GUIDANCE

The Midland design has been compared with the NRC concerns and the design guidance related to the issue of cold shutdown. This section contains the comparison.

The design guides examined include the Standard Review Plan (SRP) 5.4.7; Branch Technical Position (BTP) RSB 5-1; Open Items Associated with NRC Sstaff Review: RSB-7, ASB-8, PSB-11, RSB-10, RSB-20; SRP 7.4, and RG 1.139. Table VI-1 is a cross index illustrating the origin of the applicable guidance; it also shows which guidance is incorporated into the Midland design.

A. SRP 5.4.7, Residual Heat Removal System

SRP 5.4.7 is primarily directed at review of the residual heat removal system that operates after the RCS has been initially cooled and depressurized. However, the SRP also directs that the chemical volume and control system (CVCS), residual heat removal system, atmospheric dump valves, and source of auxiliary feedwater be reviewed to meet the functional requirements of BTP-RSB 5-1. Therefore, the functional requirements of BTP-RSB 5-1 are examined in more detail. (The SRP and BTP refer to CVCS, residual heat removal (RHR), and atmospheric dump valves. On the Midland plant, the function of these systems is performed by the MU&PS, DHR system, and POAV valves, respectively. Future references are to the latter nomenclature.

B. BTP-RSB 5-1 (Revision 1), Design Requirements of the Decay Heat Removal System

This BTP states the functional requirements to take a reactor from normal operating conditions to cold shutdown. In addition, further guidance is given for the DHR system design, cold shutdown operation procedures, and AFW supply requirements.

Table VI-2 contains a summary of guidance contained in BTP-RSB 5-1. In addition, the far right column of this table contains the design being implemented on the Midland project that is associated with the design guidance of the preceding columns.

The individual positions of the BTP are addressed because they are the main substance of the cold shutdown issue. Most of the subsequent NRC questions and Open Items refer to the issues addressed in this table. A (G) designates the guidance a (D) designates the Midland design. (Note: Midland is a Class 2 plant because the construction permit (CP) was issued before January 1, 1978.)

1. Long-term cooling/decay heat removal dropline

(G) The DHR dropline shall be able to accommodate a single active failure or ensure that manual action is possible to rectify the situation.

(D) Midland has a single DHR dropline. The line divides into two lines inside the containment and each line has two motor-operated isolation valves inside the containment. The lines rejoin and exit the containment. Thus, a single failure can be accommodated and containment access is not required. The power supplies and controls to the valves are arranged to function with a single failure.

2. Safety-grade steam dump valves

(G) Provide safety-grade steam dump valves

(D) The Midland plant has two safety-grade POAV valves associated with each steam generator. These motor-operated valves ensure adequate steam removal from the secondary side coincident with a single failure. This steam removal can be accommodated without manual actions at the location of the valve. These valves are located upstream of the MSIVs.

3. Depressurization

(G) Review or upgrade RCS depressurization method

(D) The Midland plant has a safety-grade auxiliary pressurizer spray.

4. Boration for cold shutdown/chemical and volume control system, and boron sampling

(G) Revise shutdown reactivity requirements to ensure required shutdown margin by safety-grade systems at cold condition

(D) The Midland plant has the capability to attain a 1% $\Delta k/k$ shutdown margin, assuming the most reactive rod stuck out of the core, no xenon, no letdown, no offsite power, and using only safety-grade systems.

A safety-grade EBS is being added to ensure that an adequate shutdown margin can be accommodated without letdown.

The RCS boron concentration is normally measured with a boronometer that takes samples from the letdown system. A sample line is being installed on the letdown line upstream of the letdown valves to permit RCS samples to be taken with normal letdown isolated. Sample lines in the DHR system permit sample taking after the DHR operation.

The next two requirements are more specific to DHR design and are not cold shutdown concerns. However, they are included in the comparison for completeness.

5. Decay heat removal isolation

(G) Provide sufficient DHR system isolation

(D) The suction side of the DHR system has two parallel lines with two valves on each line, as described in long-term cooling/DHR dropline. These valves have interlocks to prevent opening unless RCS pressure is below DHR design pressure. The valves also have interlocks that close the valve if RCS pressure exceeds approximately 500 psig.

Overpressure protection of DHR system is accomplished by a relief valve that discharges to the reactor building sump.

The discharge side of the DHR system has two check valves in series between the RCS and the DHR system. The system will have provisions to permit periodic leak testing of the valves.

Compliance with the BTP is met, with a clarification required for the isolation valve closure interlock. Overpressure protection of the DHR system is ensured by the DHR system relief valve. This valve also provides one means of overpressure protection of the RCS at low temperature. To maintain this means of overpressure protection, the automatic closure interlock is not actuated until an RCS pressure of approximately 500 psig is reached; this exceeds the DHR relief valve setpoint (approximately 360 psig).

6. Decay heat removal pressure relief

(G) Collect and contain DHR pressure relief and discharge

(D) Relief valve discharge is routed to the containment sump. This fluid is contained and also available for suction from the sump if sump recirculation is necessary.

7. Test requirements

(G) Develop procedures for cooldown and natural circulation. Meet RG 1.68 and use analysis and testing to confirm adequate mixing and cooldown under natural circulation.

(D) The Midland plant will reference a natural circulation test if one has been conducted on a plant similar to Midland. If such a test has not been completed, Midland will perform a natural circulation cooldown test for 50F to verify previous calculations. A test to measure mixing is not anticipated. With this clarification, Midland will meet the testing requirements as delineated in the response to RG 1.68 in Appendix 3A of the FSAR.

8. Operational procedures

(G) Meet RG 1.33 and develop procedures for cooldown under natural circulation.

(D) Operating procedures for natural circulation cooldown will be written and made available to the operators before initial criticality.

9. Auxiliary feedwater supply

(G) Ensure that an adequate alternate Seismic Category I source of water is available.

(D) The AFW system has an automatic switch-over to safety-grade service water. This volume of water (i.e., the ultimate heat sink and the cooling pond) exceeds any inventory requirements for AFW.

C. Open Items Associated with Staff Review of Midland Plants (NRC Letter, 3/30/79; Meetings of 4/10-11/79 and 4/19-20/79)

1. RSB-7

(G) This open item states that the Midland design does not comply with SRP 5.4.7 and BTP-RSB 5-1 for Class 2 plants (NRC letter, 3/30/79).

(D) A revised response to 211.35 has been provided to respond to this issue. The question in 211.35 closely parallels the issues addressed in BTP-RSB 5-1; the response closely parallels the previous discussion of compliance to BTP-RSB 5-1. The question and response to 211.35 are included in the appendix, but are not addressed further here.

2. ASB-8, Manual operation of MAD valves

(G) This open item required demonstration of manual operation of the MAD valves (Meeting of 4/10-11/79).

(D) The safety function of the MAD valves has been eliminated. The safety function is now accomplished by redundant POAV valves that are operable from the control room. This obviates the need to demonstrate manual operation.

3. PSB-11, Decay heat removal letdown valve

(G) Midland should have motor-operated DHR letdown isolation valves to preclude the need for containment access (Meeting of 4/19-20/79).

(D) Midland meets this requirement as discussed in BTP-RSB 5-1.

4. RSB-10, Pressurizer heaters

   (G) Justify the use of nonsafety-grade pressurizer heaters (NRC letter, 3/30/79).

   (D) The plant design has been revised to provide safety-grade power and controls to two banks of pressurizer heaters. The power and controls are backed by onsite emergency power systems in the event of loss of offsite power.

5. RSB-20, Long-term cooling after a main steam line break (NRC letter, 3/30/79)

   (G) The effects of possible submergence of the DHR dropline valve motor operators inside containment following a main steam line break were questioned.

   (D) The response to Question 211.163 addresses this concern. The isolation valve operators are located at the approximate water elevation that would exist if a MSLB were to occur inside the containment and the entire contents of the BWST were also to be injected into the containment. However, the control room operator has safety-grade indication of the reactor containment building water level and has approximately 2 hours to terminate the spray. Thus, operator action will preclude water in the containment from reaching a level to be of a concern with respect to the DHR isolation valve operation.

D. SRP 7.4, Systems Required for Safe Shutdown

1. Purpose

   This section of the SRP provides review guidelines for instrumentation and control systems associated with parts of the nuclear steam supply system used to achieve and maintain a safe shutdown condition of the plant.

2. Controls required to achieve and maintain safe shutdown: The following controls are provided in the Midland design to achieve the necessary safety functions:

a. Reactivity control/inventory control

1) Control rod drive trip circuitry

2) Safety-grade portion of the MU&PS, BWST, and EBS

b. Heat rejection (temperature control)

1) Auxiliary feedwater controls - Main steam line and main feedwater line isolation valve controls

2) Power-operated atmospheric vent valve controls

3) Necessary service water and component cooling water (CCW) system controls

4) Control of natural circulation by proper operation of the AFW and POAV valve control systems

5) During hot shutdown and cold shutdown conditions, DHR system controls are provided.

c. Pressure reduction and control

1) Pressurizer heater controls for banks 5 and 6

2) Auxiliary pressurizer spray controls

3. Instrumentation required to achieve and maintain safe shutdown

The following instrumentation capability exists in the Midland design to monitor the safe shutdown condition:

a. Reactivity control/inventory control

1) Control rod drive trip breaker position indication (at the breaker)

2) Emergency boration system tank level indication

3) Source range neutron power

b. Heat rejection (temperature control)

1) Reactor coolant system hot and cold leg temperature

2) Decay heat removal heat exchanger outlet temperature (see note below)

3) Auxiliary feedwater flowrate

4) OTSG pressure and level

5) Power-operated atmospheric vent valve position

6) Reactor coolant system flowrate

7) Decay heat removal flowrate (see note below)

c. Pressure reduction and control

1) Reactor coolant system pressure

2) Pressurizer level

Note: Safety-grade indication is provided in the main control room for accident monitoring purposes and is available for safe shutdown monitoring. However, these indications are not immediately required for safe shutdown monitoring. Sufficient time exists to connect portable instruments to line-mounted equipment and, therefore, permanent instruments for these parameters are not provided outside the control room.

4. Conformance to SRP 7.4

Detailed design and procurement of the controls and instrumentation required for safe shutdown are nearing final stages for most items. The SRP acceptance criteria were considered and are being implemented. These criteria are summarized below.

a. Redundancy

(G) All instrumentation and controls essential to achieve and/or maintain the cold shutdown condition are redundant to their intended safety function.

(D) The project is implementing this SRP acceptance criterion.

b. Single failure criterion

(G) All instrumentation and controls essential to the achievement and/or maintenance of the cold shutdown condition meet the single failure criterion.

(D) The project is implementing this SRP acceptance criterion.

c. Capacity and reliability

(G) All instrumentation and controls essential to the achievement and/or maintenance of the cold shutdown condition have the capacity and reliability to perform their intended safety functions whenever necessary.

(D) The project is implementing this SRP acceptance criterion.

d. Qualification

(G) All instrumentation and controls essential to the achievement and/or maintenance of the cold shutdown condition are qualified to function during and after the design basis events for which their operation is essential, including earthquakes and all FSAR Chapter 15 accidents.

(D) The project is implementing this SRP acceptance criterion with the clarification provided in RG 1.97 that instrumentation should continue to read within the required accuracy following but not necessarily during an SSE.

e. Testing

(G) All instrumentation and controls essential to the achievement and/or maintenance of the cold shutdown condition satisfy applicable criteria for preoperational and periodic testing, quality assurance, and design provisions for indicating system availability.

(D) The project is implementing this SRP acceptance criterion.

f. Remote/local station capability

(G) SRP 7.4 states that equipment required for safe shutdown be operable from local control panels and that access to these local control panels should be administratively controlled. Appropriate readouts (such as steam generator level, steam generator pressure, pressurizer pressure, pressurizer level, and AFW flow) to monitor the status of the shutdown should be provided. This equipment should be designed to accommodate a single failure and should be capable of operating independently of the equipment in the main control room. The equipment should also be designed to the same standards as the corresponding equipment in the control room.

(D) The Midland design will comply with this SRP acceptance criterion with the following clarifications:

1) The Midland design provides redundant controls and indications outside the control room on local control panels. These controls and indications outside the control room are designed to operate without the mutual action of those in the control room. No single failure will defeat this capability for safe shutdown at either location. In addition, a study is in progress which responds to fire protection

guidelines. The study evaluates the feasibility of installation of transfer switches, relocation of signal processing equipment, and improved fire protection of safe shutdown control and instrumentation to ensure that the capability exists outside the control room to shut the plant down after a fire.

2) The Midland design provides instrumentation capability at the auxiliary shutdown panel and local control stations beyond the examples provided in SRP 7.4. Instrumentation for monitoring safe shutdown is consistent with the control room capability as described in Section VII.D.3 except as follows:

a) Source range neutron power for reactivity control monitoring

Control room: Safety-grade indication is provided.

Auxiliary shutdown panel: Computer terminal display of isolated safety-grade inputs to the computer is provided.

Discussion: Complete safety-grade indication of source range neutron power is not available outside the control room. Analysis indicates that in the worst-case scenario, upon completion of EBS injection, the reactor will remain subcritical. Safety-grade EBS tank level indication is provided on the auxiliary shutdown panel and this, together with valve indications, provides sufficient verification of proper EBS injection. Therefore, this precludes the need to monitor source range neutron power.

E. Regulatory Guide 1.139, Guidance for Residual Heat Removal to Achieve and Maintain Cold Shutdown

RG 1.139 has been made available to the industry and is intended to apply to CPs issued after January 1, 1978; therefore, it is not specifically applicable to Midland. The implementation section of the latest available version (Draft 2, Revision 1 transmitted to A.L. Cahn of Bechtel Power Corp. by G.A. Arlotto of the NRC on March 21, 1980) states that the guide will be used for plants docketed after January 1, 1980, and this excludes Midland. This section also states applications docketed before this date will be reviewed against this guide on a case-by-case basis.

Nevertheless, the guidance in RG 1.139 will be compared to the Midland design. This comparison will be made with Section C, Regulatory Position, of the regulatory guide.

1. Functional

a. (G) The design shall be such that the reactor can be taken from normal operating conditions to cold shutdown using only safety-grade equipment.

(D) Midland has this capability.

b. (G) The systems utilized are redundant, provide function assuming a single failure, and are capable of operation with onsite or offsite power.

(D) The systems used satisfy this guidance.

c. (G) The RCS shall be capable of being cooled and depressurized so DHR initiation can begin in 36 hours.

(D) The POAV valves that have been added can cool the reactor sufficiently enabling DHR operation to be initiated within 36 hours after shutdown.

d. (G) Instrumentation and controls conform to IEEE Std 279-1971, 323, 384, and 344; and RG 1.89, 1.75, and 1.100.

(D) All necessary instruments and controls will be safety grade.

e. (G) Safety-related systems should be Seismic Category I and meet RG 1.29.

(D) The Midland design is in accordance with this guidance except for the CAS, which is an alternate system that may be used to provide for RCS contraction volume following a tornado. A seismic event is not assumed to occur simultaneously with a design basis tornado.

2. Reactivity control

(G) A safety-related system shall exist to control and monitor the boron concentration.

(D) Safety-related systems exist to inject sufficient boron to ensure subcriticality. Operation of these systems ensures sufficient boron concentration. Boron concentration can be measured by sampling or by the nonsafety-grade boronometer when letdown is available. A safety-related boron measuring device is not installed.

3. Heat removal

a. Auxiliary feedwater

(G) A safety-related water source should exist to supply water for sufficient time.

(D) Refer to response to BTP RSB 5-1.

b. Steam relief

(G) Provide safety-related atmospheric vent valves.

(D) Refer to response to BTP RSB 5-1.

c. Steam generator inventory

(G) Provide safety-related steam generator water level indication and alarm.

(D) Safety-grade steam generator water level indication is provided. An alarm is provided that is actuated by a Class 1E signal transmitted through an isolation device.

4. Decay heat removal

(G) Provide redundant trains for the RHR system with capability to cool core by 4 hours after shutdown.

(D) The DHR system has redundant trains, but operation of DHR system within 4 hours after shutdown is not a design basis. However, the system will be capable of operation within 36 hours after shutdown.

a. Decay heat removal isolation

Refer to response to BTP-RSB 5-1. The requirements of BTP-RSB 5-1 and this regulatory guide are similar on this issue.

b. Decay heat removal system pressure relief

Refer to the response to BTP-RSB 5-1. The requirements of BTP-RSB 5-1 and this regulatory guide are similar on this issue.

c. Decay heat removal pump protection

(G) Procedures should be such that a single failure or operator error will not result in loss of RHR function due to pump damage.

(D) Operating procedures for the DHR system will be written and made available to the operator before initial criticality. In addition, the present design includes DHR pump protection by a nonsafety-grade low-flow trip. This trip is inhibited during ECCAS actuation.

d. Decay heat removal testing

Refer to the response to BTP-RSB 5-1. The requirements of BTP-RSB 5-1 and this regulatory guide are similar on this issue.

e. Decay heat removal system operation and indication DHR isolation valve position

(G) Provide isolation valve position indication, system pressure and flow, and pump operating status in control room.

(D) These indications are available in the control room.

f. Residual heat removal system integrity

1) Residual heat removal system leakage

(G) Monitor and control DHR system pump and valve leakage.

(D) The DHR pump rooms have floor drains that are normally closed. Safety-grade redundant water level indicators for those rooms are located in the control room. The valves may be opened locally (nonsafety-grade system) and drained to the auxiliary building sumps. The pump rooms are equipped with an engineered safety features (ESF) filtration system to collect airborne radiation after a postulated accident.

2) Shielding of personnel and personnel access

The present design is adequate for all design base scenarios.

3) Engineered safety features filtration system

(G) Service the DHR system, including leakage collection system, by an ESF filtration system

(D) The DHR pump room has an ESF filtration system. Leakage is contained in the pump room by closed drains.

g. Residual heat removal cooling water supply

(G) Provide safety-related cooling water to the DHR heat exhangers and monitor the water for radioactivity at the DHR heat exchanger outlet.

(D) The DHR coolers are serviced by a safety-grade CCW system. Each DHR cooler is serviced by a separate CCW train. Each CCW train is equipped with a nonsafety-grade radiation monitor in the line, but not at the output of the DHR heat exchanger.

5. Natural circulation cooling

(G) Provide redundant emergency power and controls to required number of pressurizer heaters, PORV and PORV block valves, and pressurizer level indicator channels.

(D) Safety-grade power and controls are provided for these instruments and components.

6. Reactor coolant system inventory

(G) Provide capability of supplying makeup and letdown control to accommodate cooldown shrinkage and letdown for boration.

(D) The Midland design can accommodate safety-grade cold shutdown without letdown. Sufficient inventory is available from the BWST. If the BWST is unavailable, RCS makeup can be provided by the tornado-protected, non-safety-grade, CAS. The letdown system is nonsafety grade, but the letdown isolation is safety grade.

7. Operational procedures

Refer to response to BTP-RSB 5-1.

LIST OF ABBREVIATIONS

AFW	Auxiliary feedwater
AFWAS	Auxiliary feedwater actuation signal
APSRA	Axial power shaping rod assemblies
BTP	Branch Technical Position
BWST	Borated water storage tank
CAS	Chemical addition system
CCW	Component cooling water
CP	Construction permit
CR	Control room
CRD	Control rod drive
CRDM	Control rod drive mechanism
CVCS	Chemical volume and control system
(D)	Design
DBT	Design basis tornado
DHR	Decay heat removal
DHRS	Decay heat removal system
ECCAS	Emergency core cooling actuation system
EBS	Emergency boration system
ESF	Engineered safety features
(G)	Guidance
HPI	High-pressure injection
LOCA	Loss-of-coolant accident
LPI	Low-pressure injection
MAD	Modulating atmospheric dump
MFIV	Main feedwater isolation valve
MSIV	Main steam isolation valve
MSLB	Main steam line break
MU&PS	Makeup and purification system
OTSG	Once-through steam generator
POAV	Power-operated atmospheric vent
PORV	Power-operated relief valve
RCS	Reactor coolant system
RG	Regulatory Guide
RPS	Reactor protection system
RHR	Residual heat removal
SER	Safety Evaluation Report
SF	Single failure
SRP	Standard Review Plan
SSE	Safe shutdown earthquake
TMI	Three Mile Island

TABLES

TABLE V-1

COLD SHUTDOWN CAPABILITY FOLLOWING CHAPTER 15 EVENTS

	Event	Cold Shutdown Achievable in 36 hours with Safety Grade Equipment	Assumptions	Cold Shutdown Limitations
15.1.1	Decrease in feedwater temperature	Yes	AFW available	none
15.1.2	Increase in feedwater flow	Yes	AFW available	none
15.1.3	Steam pressure mal-function resulting in increased steam flow	Yes	AFW available	Intermittent use of both steam generators may be required
15.1.4	Inadvertent opening of an atmospheric pump or safety valve	Yes	AFW available	Intermittent use of both steam generators may be required
15.1.5	Steam line break	No	Loop Loss of 1 HPI Pump	-only one intact loop available -time > 36 hours required
15.2.1	Steam pressure regulator malfunction resulting in decreasing steam flow	Yes	AFW available	none
15.2.2	Loss of external load (turbine trip)	Yes	EBS available even with LOOP	none
15.2.3	Turbine trip	Yes	EBS available	none
15.2.4	Inadvertent MSIV closure	Yes	AFW available to both steam generators	none

TABLE V-1 (Continued)

	Event	Cold Shutdown Achievable in 36 hours with Safety Grade Equipment	Assumptions	Cold Shutdown Limitations
15.2.5	Loss of condenser vacuum	Yes	AFW available to both steam generators	none
15.2.6	Loss of all nonemergency ac power	Yes		none
15.2.7	Loss of normal feedwater	Yes	AFW flow available to both steam generators	none
15.2.8	Main feedwater line break	No	AFW flow available to only one steam generator	With LOOP - natural circulation cooldown may require > 36 hours
15.3.1, 15.3.3, 15.3.4	Decrease in RCS flow rate	Yes	AFW flow to both steam generators following loss of RC flow up to four pumps	none
15.4.1, 15.4.2, 15.4.3, 15.4.4	Reactivity anomolies	Yes		none
15.4.6	Chemical addition system malfunction	Yes	Operator terminates source of dilution	Continued RC inventory increase may result in inability to borate without requiring letdown

TABLE V-1 (Continued)

	Event	Cold Shutdown Achievable in 36 hours with Safety Grade Equipment	Assumptions	Cold Shutdown Limitations
15.4.8	Control rod assembly ejection		Small LOCA	none
15.5.1	Inadvertent operation of ECCS	Yes		none
15.6.1	Inadvertent opening of a pressurizer safety or relief valve	Yes	HPI maintains primary pressure control AFW flow to both steam generators	none
15.6.2	Break in instrument line or line from primary system that panetrates containment	Yes	HPI maintains primary pressure control AFW flow to both steam generators	none
15.6.3	Steam generator tube failure	Yes	HPI maintains primary pressure control	Choosing to use one unaffected steam generator for cooldown may increase time to cold shutdown and ultimately increase radiation released
15.6.5	LOCA	Yes	HPI and LPI available	
15.8	Anticipated transient without scram	No		Time required

TABLE VI-1

LOCATION OF DESIGN REQUIREMENTS TO ACHIEVE/MAINTAIN SAFE SHUTDOWN

Requirement	Guidance Document: BTP RSB 5-1	QR 211.35	ASB-8	PSB-11	RSB-20	RSB-10	RG 1.139	Midland Design
DHR drop line that can accommodate single failure	Yes	Yes		Yes	Yes			Yes
Safety-grade steam dump valves	Yes	Yes	Yes				Yes	Yes
Provide aux. spray or show manual actions are acceptable	Yes	Yes						Yes
Provide safety-related boration system without letdown, or provide safety-grade letdown, or show that manual actions are acceptable	Yes	Yes					Yes	Yes(1)
Provide adequate RHR isolation	Yes						Yes	Yes
Discuss collection of RHR system pressure relief valve discharge	Yes	Yes					Yes	Yes
Conduct borated water mixing test	Yes	Yes						No
Conduct natural circulation test	Yes	Yes						Yes

TABLE VI-1 (Continued)

Requirement	Guidance Document: BTP RSB 5-1	QR 211.35	ASB-8	PSB-11	RSB-20	RSB-10	RG 1.139	Midland Design
Provide natural circulation procedures	Yes	Yes					Yes	Yes
Provide Seismic Category I AFW system water supply	Yes	Yes					Yes	Yes
Provide safety-grade means of monitoring boron concentration							Yes	No(2)
Provide safety-grade steam generator level indication and alarm							Yes	Yes(3)
Provide safety-grade makeup and letdown control							Yes	Yes(4)
Provide necessary safety-grade pressurizer heaters with Class 1E power and control						Yes	Yes	Yes

NOTES:

(1)Midland provides safety-grade boration without letdown

(2)Nonsafety-grade sampling is provided

(3)Alarms exist but are not safety-grade

(4)Letdown is safety-grade only for isolation of letdown

TABLE VI-2

DESIGN GUIDANCE OF BTP RSB 5-1 FOR CLASS 2 PLANTS AND COMPARISON

TO MIDLAND DESIGN[1]

Design Requirements of BTP RSB 5-1	Process and System or Component	Branch Technical Position Design Guidance for Midland	Midland Design
I. Functional requirement for taking to cold shutdown a. Capability using only safety-grade system b. Capability with either only onsite or only offsite power and with single failure (limited action outside CR to meet SF) c. Reasonable time for cooldown assuming most limiting SF and only offsite or only onsite power	Long-term cooling (RHR drop line)	Compliance will not be required if it can be shown that correction for single failure by manual actions inside or outside of containment, or return to hot standby until manual actions (or repairs) are complete, are found to be acceptable for the individual plant.	Midland complies. Midland has a single DHR dropline that divides into a series/parallel remote motor-operated valve arrangement inside containment; the line then reconverges to exit containment. Local manual actions in the auxiliary building are required for alignment.
	Heat removal and RCS circulation during cooldown to cold shutdown	Provide safety-grade dump valves, operators, and power supplies, etc so that manual actions should not be required after an SSE except to meet single failure.	Midland complies. Remote manual safety-grade POAV valves are provided and are operated by safety-grade power and controls. The single failure criteria is met. Remote manual action is required.
	Depressurization (pressurizer auxiliary spray or power-operated relief valves)	Compliance will not be required if a) dependence on manual actions inside containment after SSE or single failure, or b) remaining at hot standby until manual actions or repairs are complete, are found to be acceptable for the individual plant.	Midland complies. A safety-grade auxiliary pressurizer spray is provided. Local manual action in the auxiliary building is required for alignment. Control is accomplished from the control room.
	Boration for cold shutdown (CVCS and boron sampling)	Compliance will not be required if a) dependence on manual actions inside containment after SSE or single failure, or b) remaining at hot standby until manual actions or repairs are complete, are found to be acceptable for the individual plant.	Midland complies. Midland has the capability to borate without letdown. A safety-grade emergency boration system provides

Table VI-2 (Continued)

Design Requirements of BTP RSB 5-1	Process and System or Component	Branch Technical Position Design Guidance for Midland	Midland Design
			for boration to hot standby. The BWST or CAS provides for boration to cold shutdown. Local manual alignment is required. Boron concentration is normally measured after being let down. Sampling capability will be added on the cold-loop letdown line upstream of the isolation valve.
II. RHR isolation	RHR system	Comply with one of the allowable arrangements.	Midland complies. The DHR system suction is isolated by two series motor-operated valves on each of two lines. The DHR discharge is isolated by two series check valves on each of two lines.
III. RHR pressure relief			
b. Collect and contain relief discharge	DHR system	Compliance will not be required if it can be shown that adequate methods of disposing of discharge are available.	Midland complies. The DHR relief valve discharge is routed to the containment sump.
V. Test requirement			
b. Meet RG 1.68 for PWRs test plus analysis for cooldown under natural circulation to confirm adequate mixing and cooldown within limits specified in EOP.		Run tests and confirm analysis to meet the requirement.	Midland complies with clarification for boron mixing test. Midland will use the results of a natural circulation cooldown test on a similar plant to confirm existing calculations if a similar plant is tested before Midland. Otherwise, a 50F cooldown test will be performed on Midland. No separate boron mixing test is presently planned.

Table VI-2 (Continued)

Design Requirements of BTP RSB 5-1	Process and System or Component	Branch Technical Position Design Guidance for Midland	Midland Design
VI. Operational procedure			
a. Meet RG 1.33 for PWRs, include specific procedures and information for cooldown under natural circulation.		Develop procedures and information from tests and analysis.	Midland will comply. Appropriate procedures will be developed.
VII. Auxiliary feedwater supply			
a. Seismic Category I supply for AFW for at least 4 hours at hot shutdown (sic) plus cooldown to RHR cutin based on longest time for only onsite or only off-site power and assumed single failure.	Emergency feedwater supply	Compliance will not be required if it is shown that an adequate alternative Seismic Category I source is available.	Midland complies. An automatic switchover to a safety-grade source of AFW is provided upon low suction to the AFW pumps, coincident with an accident signal.

(1) Midland is a Class 2 plant because the construction permit was issued before January 1, 1978.