Auxiliary Systems Branch
Safety Evaluation Report
Midland Plant Units 1 & 2
Docket Nos. 50-329/330

3.4 Water Level (Flood) Design

Our review of the Midland Plant protection against flooding included the applicant's design to protect safety related systems, structures and components from the effects of flooding, and the ability of the design to maintain the capability for a safe plant shutdown during a design basis flood. General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena" requires that structures, systems and components important to safety be designed to withstand the effects of floods. The following evaluation describes the methods by which the Midland plant meets this criterion by demonstrating safe plant shutdown will not be precluded due to flooding.

The plant grade for the Midland Plant site is located at a minimum elevation of 634 feet which is above the conservatively calculated probable maximum flood (PMF) level of 631 feet. Further information on the evaluation of the methods used to determine the probable maximum flood level can be found in Section 2.4 of this report. All entrances to safety related structures are at elevation 634.5 feet or higher, and therefore, above the PMF level. During a postulated PMF all safety related structures are protected from flooding up to elevation 635.5 feet by sandbagging to protect against wind and wave effects. Sandbagging is an acceptable

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alternative to "hardened protection"[1] and meets the guidelines of positions C.2.a, b, and c, Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants" since sufficient warning time is available to implement the sandbagging, and the sandbagging is not required for any flooding events less than the PMF. Also, sandbagging is only necessary to protect against wind and wave effects, and does not have to withstand the static forces of the PMF water level.

The **sandbagging** is also an alternative to position C.2.[illegible] of Regulatory Guide 1.59, which recommends "hardened protection" for those structures, systems and components necessary for cold shutdown. We find this an acceptable alternative because the sandbagging is used where permanent protection is not considered feasible due to access requirements for trucks and train cars or personnel access doors which are already constructed. Midland has also provided a technical specification for the implementation of emergency procedures to assure adequate time and procedures for sandbagging. Further information on the evaluation of this Technical Specification and the sandbagging can be found in Section 2.4 of this Report.

The external walls of the auxiliary building and the containment are protected from flood waters by a waterproof membrane up to elevation 632 feet. These are the only buildings that contain safety related equipment at levels below the PMF. The safety related service water structure also extends below the PMF level, but contains no components below the PMF that could be affected by flood waters so a waterproof membrane is not required.

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[1] "Hardened protection" as defined in Regulatory Guide 1.59 means structural provisions incorporated in the plant design that will protect safety-related structures, systems and components from the static and dynamic effects of floods.

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All exterior construction joints of safety related structures are sealed with water stops to grade level and piping penetrations are provided with watertight seals. Electrical penetration and personnel access between the turbine building and the auxiliary building are provided with seals and watertight doors designed to withstand the hydrostatic loading associated with the turbine building flooded to elevation 634.5 feet. Since these flood protection methods use barriers incorporated into the design of the plant, the design meets the guidelines of Regulatory Guides 1.59 "Design Basis Floods for Nuclear Power Plants" and 1.102 "Flood Protection for Nuclear Power Plants," which recommend "hardened protection" including penetration seals, watertight doors and construction joint seals.

The Midland plant is protected against flooding caused by local precipitation by a site drainage system which is designed to remove water buildup caused by the probable maximum precipitation (PMP). The drainage system removes precipitation from the roofs and the areas surrounding the safety related structures and conveys the water via sloped drains to the cooling pond or the Tittabawassee River. The site drainage system, and the locating of outside openings to safety related structures above the plant grade, provide acceptable methods of protecting safety related equipment from the effects of flooding due to precipitation.

As a result of our review, we conclude that the facility design meets the requirements of General Design Criterion 2 and the guidelines of Regulatory Guides 1.59 and 1.102 as described above. On that basis, we conclude that the water level (flood) design is acceptable.

3.5 MISSILE PROTECTION

3.5.1.1 INTERNALLY GENERATED MISSILES (OUTSIDE CONTAINMENT)

Protection against postulated internally generated missiles outside containment associated with plant operation, such as missiles generated by rotating or pressurized equipment, is provided by any one or a combination of barriers, separation, restraint of potential missiles, strategic orientation and equipment design. The primary means of providing protection to safety related equipment is through the use of plant physical arrangement. The majority of safety related systems are physically separated (within separate compartments) from non-safety related systems and the redundant components of safety related systems are physically separated such that a potential missile could not damage both trains of the safety related system. Where separation is not feasible, one of the other methods described above is used.

As recommended by Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," the spent fuel is protected from internally generated missiles by the fuel pool walls and by designing the fuel handling system such that a seismic event will not result in missile generation. The ultimate heat sink is also protected from the effects of internally generated missiles in accordance with Regulatory Guide 1.27, "Ultimate Heat Sink," by having one pump of each train in a separate compartment, and an installed spare pump in a third compartment that can be used for either unit.

The applicant has provided an analysis of the affects of potential sources of internal missiles in areas outside containment. Typical postulated missile sources include 6 inch boric acid evaporation system valves, 6 inch auxiliary steam generator valves, steam generator recirculation pump, service and component cooling water pumps and fuel pool cooling pumps. We have reviewed the applicant's analysis and agree that the postulated missiles are representative of typical missiles and that the applicant has shown to our satisfaction that the affects of the potential missiles will not prevent safe plant shutdown. Information regarding the evaluation of the design of the Midland plant for protection against turbine missiles can be found in Section 3.5.1.3 of this Report.

We have reviewed the adequacy of the applicant's design to maintain the capability for a safe plant shutdown in the event of an internally generated missile outside containment. We have concluded that through the use of separation, barriers, restraints, orientation and equipment design, the Midland plant design is in conformance with General Design Criterion 4 "Environmental and Missile Design Basis," as it relates to the systems being capable to withstand the effects of internally generated missiles outside containment.

Based on our review as discussed above, we find that the design meets the guidelines of Regulatory Guide 1.13 and 1.27 and the requirements of General Design Criterion 4. We, therefore, conclude that the facility's design against internally generated missiles outside containment is acceptable.

3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles

General Design Criterion 4 requires that all components essential to the safety of the plant be protected from the effects of externally generated missiles. All safety related structures except portions of the auxiliary building roof over the new fuel storage area are designed to withstand the effects of tornado generated missiles. All safety related systems and components, with the exception of the borated water storage tank are located within tornado missile protected structures or otherwise protected with barriers.

The evaluation of the adequacy of the design the Midland plant for the protection of safety related systems and components are included in the individual evaluations of this report for the systems or areas that require protection. As an example refer to Section 9.1.2 (New Fuel Storage) for the evaluation of the portion of the auxiliary building roof, mentioned above, that is not protected against tornado missiles. The evaluation of the tornado protection for the borated water storage tank is located in Section 9.3.4 "Chemical and Volume Control System."

Based on our evaluations and conclusions of the individual systems and components as put forth in the individual sections of this report, we conclude that the overall plant design meets the requirements of General Design Criterion 4 as it relates to tornado missile protection. For the evaluations of how the requirements of Criterion 4 are met, for a particular section refer to the individual sections of this report.

3.6.1 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping (Outside Containment)

[The applicant has not completed the pipe break analysis for certain high energy piping systems outside containment. We will evaluate the results of the applicant's analysis after it has been submitted. We will report our findings in a supplement.]

9.0 Auxiliary Systems

The auxiliary systems evaluated in this report which are necessary for safe plant shutdown include: the service water systems, component cooling water system, ultimate heat sink, portions of the makeup and purification system, chemical addition system, safety related chilled water system, and safety related ventilation systems.

Systems evaluated in this report necessary to assure safe handling of fuel and adequate cooling of the spent fuel include: new and spent fuel storage facilities, the spent fuel pool cooling and purification system and the fuel handling system.

Other auxiliary systems evaluated in this report include: the equipment and floor drainage system, the compressed air system, condensate storage system, and the fire protection system. These systems have been evaluated since their failure could either be a direct or indirect source of radioactive release to the environs or could have adverse effects on systems necessary for safe shutdown.

We have also reviewed other auxiliary systems that are not safety related to assure their failure would not prevent safe shutdown nor result in a potential source of radiological release to the environment. These systems include: the pressurizer relief tank, potable and sanitary water system, demineralized water makeup system, non-safety related chilled water system and non-safety related ventilation systems. The acceptability of these systems was based on our review which determined that: (a) where the system interfaces or connects to a seismic Category I system or component, normally closed or automatically operated seismic Category I isolation valves are provided to physically separate the non-essential portions from the essential system or component, and (b) the failure of the non-safety related system or portions of the system will not preclude the operation of safety related systems or components located in close proximity. Based on our review of the above listed systems' design, piping and instrumentation diagrams, and plant layout drawings we conclude that since their failure will not result in radiological releases or damage to safety related equipment or prevent safe plant shutdown, they are acceptable.

9.1 Fuel Storage and Handling

9.1.1 New Fuel Storage

The new fuel storage racks are designed for dry storage of approximately 70% of a full core load (124 assemblies). There are two new fuel storage pits (one pit for each unit) equally sized to store one-half the total of new fuel assemblies. The auxiliary building, which houses the fuel pits and racks for both units, and the pits and racks themselves are designed to seismic Category I requirements in accordance with Regulatory Guide 1.29 "Seismic Design Classification" and General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena."

The stainless steel new fuel racks have a center-to-center spacing of 21 inches which is sufficient to maintain K_{eff} less than 0.95 even if the racks are flooded with unborated water. The fuel pits are also provided with drains to reduce the likelihood of flooding of the fuel pits. The 21-inch center-to-center spacing is also sufficient to maintain Keff equal to or less than 0.98, assuming optimum moderation, such as by aqueous foam. The spacing between racks is such that a fuel assembly cannot be inserted in other than a prescribed location, assuring that the 21-inch spacing is not threatened. Therefore, the design meets General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling," which requires that criticality be prevented by physical systems or processes, preferably by use of geometrically safe configurations.

In accordance with Section 9.1.1 "New Fuel Storage" of the Standard Review Plan, we requested the applicant to design the racks to withstand the maximum uplift forces that could be exerted by the fuel handling system without an increase in Keff. In Amendment 14, the applicant provided verification that excessive forces could not be applied by the fuel handling system and therefore Keff would not be increased. All hookups to the new fuel assemblies with the fuel handling system are done directly by hand so that the handling system will not be attached to the racks. The new fuel racks are used only for storage of new fuel such that a fuel assembly cannot become stuck due to swelling as is possible with the spent fuel, therefore, excessive forces cannot be transmitted to the fuel racks via the fuel assemblies. For these reasons, we agree with the applicant that excessive fuel handling forces that would result in an increased Keff will not be transmitted to the new fuel racks. Therefore, they have an acceptable alternative to the standard review plan recommendation that the new fuel racks and the anchorages be designed to withstand the maximum uplift forces that can be exerted by the fuel handling system.

The new fuel storage area is located in a portion of the auxiliary building that does not have a tornado missile protected roof. Therefore, no protection of the new fuel from vertical tornado missiles is provided. The applicant gives the following reasons why the new fuel storage area is not protected:

1. The new fuel is stored dry and the pit is provided with drainage, and because there is no water, changing of the geometry due to external missiles will not result in criticality;
2. There are no fission products in the new fuel, therefore there will be no radioactivity released as a result of fuel damage.

We agree with the applicant's basis for no tornado vertical missile protection, and since protection is provided against damage due to horizontal missiles, by locating the new fuel in seismic Category I storage pits, we find that the applicant's design is an acceptable alternative to Section 9.1.1 of the Standard Review Plan, because the safety function (No-Criticality) is maintained following a postulated tornado event. Therefore, General Design Criterion 62 "Prevention of Criticality in Fuel Storage and Handling," as related to the prevention of criticality in fuel storage systems, is met.

Based on our review of the new fuel storage design as described above, we find that the design meets the guidelines of Regulatory Guide 1.29, and the requirements of General Design Criteria 2 and 62 as described above. We therefore conclude that the new fuel storage system is acceptable.

9.1.2 Spent Fuel Storage

[In Amendment 15 the applicant proposed to increase the spent fuel storage capacity from 1-2/3 cores to 5-2/3 cores. The design of the high density storage system is not complete. We will provide our evaluation after the applicant submits details of his final design.]

9.1.3 Spent Fuel Pool Cooling and Purification System

The spent fuel pool cooling and purification system is designed to maintain the water quality and clarity of the fuel pool water and to remove the decay heat generated by the stored spent fuel assemblies.

The Midland plant uses one storage pool for both units; therefore, one spent fuel pool cooling and purification system is provided and shared between units. General Design Criterion 5 "Sharing of Structures, Systems and Components," allows sharing if it is shown that such sharing will not significantly impair their ability to perform their safety function, including shutdown and cooldown of both units following an accident. Because a failure of either cooling train will not prevent adequate spent fuel cooling nor affect safe shutdown of either unit, the requirements of General Design Criterion 5 are met.

The spent fuel pool cooling portion of the system is designed to seismic Category I requirements as recommended by Regulatory Guides 1.13 "Quality Group Classification" and 1.29 "Seismic Design Classification." It consists of two cooling trains, one pump and one heat exchanger per train, both of which are operated during normal plant conditions. To meet the guidelines of Regulatory Guide 1.13 "Spent Fuel Storage Facility Design Basis," redundant seismic Category I sources of makeup water are available from the essential service water system in addition to the normal makeup which is taken from the primary water storage tank. The fuel pool cooling system is arranged and provided with syphon breakers where necessary to prevent inadvertant draining of the fuel pool to less than ten feet above the fuel. Therefore, the requirements of General Design Criterion 61 "Fuel Storage and Handling and Radioactivity Control," as related to the design of the system to prevent significant reduction in fuel storage coolant inventory under accident conditions are met.

In Amendment 17, the applicant provided the results of the spent fuel decay heat load calculations for the revised storage capacity of 5-2/3 cores. The calculations were performed assuming 6-month refueling intervals using the methods set forth in our Branch Technical Position ASB 9-2 "Residual Decay Energy for Light Water Reactors," and therefore are acceptable. Since the increase in fuel storage capacity, from 1-2/3 to 5-2/3, increases the heat load by less than 10 percent, the design parameters of the spent fuel pool cooling system were not required to be changed as a result of the high density storage. For the highest "normal" heat load conditions, (4-2/3 normal semi-annual refueling batches in the spent fuel pool, with the last batch placed in the pool 96 hours after reactor shutdown) two trains of the spent fuel pool cooling system in operation will maintain pool water temperature below 125°F. With one train operating, the spent fuel pool cooling system will maintain pool water temperature below 163°F for the highest normal storage conditions. This temperature is acceptable for these conditions. For the highest "abnormal" storage conditions (4-2/3 cores of normal semi-annual refueling batches, plus one full core unload placed in the pool 96 hours after reactor shutdown) the decay heat removal system of the affected unit can be used to supplement the spent fuel pool cooling system to maintain pool water temperature below 125°F. The decay heat removal system will only be used to supplement the spent fuel pool cooling system when a full core unload is necessary. The ability to remove decay heat with redundant components as described above meets the requirements of General Design Criteria 44 and 61 as they relate to the removal of decay heat assuming a single active failure. The system meets the isolation requirements of General Design Criterion 44 by using seismic Category I isolation valves to separate non-safety related systems, such as the non-seismic purification portion of the system, from the safety related portions.

By providing adequate accessibility to conduct the required examinations in accordance with the ASME Code, Section XI, the safety related portions of the system can be periodically inspected as required by General Design Criterion 45 "Inspection of Cooling Water System." Since the system is continuously operated, the requirements of General Design Criterion 46 "Testing of Cooling Water System" are met with regards to structural and leaktight integrity and the operability of the active components in the system.

The system is housed in a portion of the seismic Category I auxiliary building which is tornado missile proof and flood protected, therefore the fuel pool cooling and purification system is protected against natural phenomena in accordance with General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena."

Based on our review as described above, we find that the spent fuel pool cooling and purification is in conformance with Branch Technical Position ASB 9.2 with respect to decay heat loads, is designed in accordance with Regulatory Guides 1.13 and 1.29, and meets the requirements of General Design Criteria 2, 5, 44, 45, 46, 61 and 62. We, therefore, conclude that the spent fuel pool cooling and purification system is acceptable.

9.1.4 Fuel Handling System

[In Amendment 15, the applicant proposed to provide a single failure proof auxiliary building cask handling crane. The crane design has recently been submitted as a Topical Report and is under review. The applicant will also provide further details of how portions of the system not included in the Topical Report meet the guidelines of Regulatory Guide 1.104 "Overhead Handling Systems for Nuclear Power Plants." We will provide our evaluation after the review is completed.]

9.2 Water Systems

9.2.1 Service Water System

The service water system (SWS) supplies auxiliary cooling water for essential as well as non-essential components throughout the plant. The SWS is shared between Units 1 & 2 and consists of five 100 percent capacity pumps connected to a header which is sectionalized into the A and B trains for each unit. One of the pumps is an installed spare that can be manually connected to either train. Train A supplies half the safety related loads of each unit, while train B supplies the other half. Each train is powered from the Class 1E power system as recommended by Regulatory Guide 1.29. One of the two pumps in each train is normally operated with the other pump in automatic standby. The standby pump will start upon loss of the operating pump or an engineered safety features actuation signal. No single active failure will result in loss of cooling water to more than one safety related component of one unit. Since there is redundancy of all safety related components that are cooled by the SWS and a failure will not preclude safe shutdown of either unit, the system design meets General Design Criterion 5 with regards to sharing of safety related systems, which requires that the sharing shall not significantly impair their ability to perform their safety functions. Within the pump house structure, the train A pumps of both units are located in one compartment and train B pumps of both units are located in a second compartment, and the installed spare pump is located within a third compartment. By this method of separation and compartmentalization, including the pumphouse structure designed to protect the pumps from tornado missiles, the requirements of GDC 4 "Environmental and Missile Design Bases" are met with regards to protection against missiles.

In accordance with the guidelines of Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification," the safety related portions of the system are designed to Quality Group C, seismic Category I requirements. Portions of the system that supply cooling water to non-safety related systems and components, such as to the turbine building, are automatically isolated from the safety related portion of the system by seismic Category I isolation valves following an engineered safety features actuation signal (ESFAS). Upon loss of power all isolation valves fail in the safe position they would assume following an ESFAS. A single active failure of any one isolation valve or SWS pump with or without offsite power will not affect the ability of the system to perform its safety function because only one redundant train could be affected. By providing the isolation capabilities and redundancy in components described above, the requirements of GDC 44 "Cooling Water" are met, including the single active failure criterion.

Safety related heat loads that are served by the SWS, in accordance with GDC 44, with regards to heat transfer during normal and accident conditions are: the containment recirculation air cooling units, emergency diesel generators, component cooling water system, and the essential chilled water system. The SWS also serves as an automatic seismic Category I supply of water to the auxiliary feedwater system during accident conditions if the non-seismic condensate storage tank is not available. Another safety related function of the service water system is to provide an alternate seismic Category I supply of makeup water to the spent fuel pool.

The safety related pumps, valves, heat exchangers and piping of the system, to the extent practicable, are designed and located to facilitate periodic inspection as required by GDC 45 "Inspection of Cooling Water System." This is accomplished by providing adequate accessibility to conduct the required examinations in accordance with the ASME Code, Section XI.

To meet the requirements of GDC 46, "Testing of Cooling Water System" the service water system is designed to include the capability for testing through the full operational sequences that brings the system into operation for reactor shutdown and for loss-of-coolant accidents, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources. These tests have been included in the surveillance requirements of the plant Technical Specifications.

The service water system heat load is normally rejected to the plant cooling pond which incorporates the seismic Category I emergency cooling pond as described in Section 9.2.5 of this report. A design basis for the emergency cooling pond is not to exceed 96°F as an initial temperature for accident conditions. There are periods when the service water system heat load could not be dissipated by the plant cooling pond without the pond exceeding 96°F, such as during the mid-summer months. During these periods the service water system heat loads will be rejected to the atmosphere by non-safety related mechanical draft cooling towers and the plant cooling pond is isolated. For this latter mode of operation the SWS supply and return automatically shifts to the emergency cooling pond in the event of an engineered safety features (ESF) signal. We requested the applicant to verify no service water pump damage would occur and safe shutdown would not be precluded in event the mechanical draft cooling towers were lost without the presence of an ESF signal. As a result, in Amendment 8, the applicant provided safety grade low water level detectors in the pump pit to automatically shift the water supply to the cooling pond, thereby, assuring a cooling water source for all postulated conditions.

The essential portions of the service water system meet the requirements of GDC 2 "Design Basis for Protection Against Natural Phenomena" since they are housed in seismic Category I, tornado missile protected structures, and all components that could be affected by flooding are adequately protected against the probable maximum flood as discussed is Section 3.4 of this report.

Based on our review as described above, we find that the service water system meets the guidelines of Regulatory Guides 1.26 and 1.29, and the requirements of General Design Criteria 2, 4, 5, 44, 45 and 46. We, therefore, conclude that the service water system is acceptable.

9.2.2 Component Cooling Water System

The component cooling water system (CCWS) provides an intermediate closed cooling loop for removing heat from reactor plant auxiliary systems and transferring it to the service water system. Each unit has its own CCW system consisting of two independent 100 percent capacity closed loop flow paths each supplied by one CCW pump for safety related systems, and a common supply to nonessential systems. This evaluation is applicable to the component cooling water system for either unit. Either of the two redundant flow paths will meet the minimum engineered safety feature flow requirements during a design basis accident (DBA). A fifth full capacity CCW pump is provided and may be manually aligned to either of the independent loops for either unit by use of a normally isolated cross-connect between the two units' systems, should one of the pumps fail. These provisions assure adequate water supply and heat removal in the event of a single failure of a system component in accordance with General Design Criterion 44 "Cooling Water."

Essential portions of the CCW system are designed to Quality Group C, seismic Category I requirements as recommended by Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification" and are protected against adverse environmental occurrences, such as tornadoes and floods by locating the system within the seismic Category I auxiliary and reactor buildings, thereby meeting the requirements of General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena."

The component cooling water system uses separation and compartmentalization, and is housed within the tornado missile proof auxiliary building to meet the requirements of General Design Criterion 4 "Environmental and Missile Design Basis" regarding dynamic effects associated with pipe whip, jet impingement and missiles. Each train is powered from a separate essential AC bus. The non-essential portions of the system are automatically isolated from the essential portions of the system in the event of an engineered safety features (ESF) signal by seismic Category I isolation valves. In the event of a single failure of an isolation valve, only one of the two 100 percent trains would be affected. In Amendment 3, the applicant provided at our request, automatic closure of the isolation in the event of a low surge tank level to protect both essential loops in the event of a pipe break or crack in the common non-essential portion of the system. By providing the automatic isolation described above, the requirements of General Design Criterion 44, regarding isolation capability and a single active failure are met.

By providing adequate accessibility to conduct the required examinations in accordance with the ASME Code, Section XI the safety related pumps, valves, heat exchangers and piping can be periodically inspected as required by General Design Criterion 45 "Inspection of Cooling Water System."

To meet the requirements of General Design Criterion 46 "Testing of Cooling Water System," the CCW system is designed to include the capability for testing through the full operational sequence that brings the system into operation for reactor shutdown and for loss-of-coolant accidents, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources. These tests are performed in accordance with the surveillance requirements of the plant Technical Specifications.

Based on our review as described above we have determined that the component cooling water system meets the guidelines of Regulatory Guide 1.26 and 1.29, and the requirements of General Design Criteria 2, 4, 44, 45 and 46. We, therefore, conclude that the component cooling water system is acceptable.

9.2.5 Ultimate Heat Sink

The ultimate heat sink (UHS) provides cooling water to the service water system following design basis accidents. The UHS is a seismic Category I depression below the bottom of the plant cooling pond. The plant cooling pond is used to supply cooling water to the service water system during the winter months and any time the mechanical draft cooling towers are out of service. When the plant cooling pond is in use, the UHS is already lined up to supply the service water system in the event of an accident. When the cooling tower is in use, a loss of cooling water flow or an ESF signal automatically transfers the service water system supply to the plant cooling pond and therefore , the UHS.

The UHS is shared between Units 1 & 2 and meets General Design Criterion 5 "Sharing of Structures, Systems and Components" regarding sharing of systems because no postulated single failure will impair the UHS's capability to dissipate the heat loads following a LOCA in one unit and an orderly shutdown and cooldown of the other unit.

The UHS meets the recommendations of Regulatory Guide 1.27 "Ultimate Heat Sink" and the requirements of General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4 "Environmental and Missile Design Basis", because it is designed to seismic Category I requirements, protected against the design basis flood, and by virtue of its location below the plant cooling pond is protected against the effects of tornadoes and tornado missiles.

Prior to the FSAR submittal at the applicant's requests, we performed a "Regulatory Guide Review" to evaluate the degree of conformance of the Midland design with the Regulatory Guides that were issued since the Construction Permit was issued. As a result of this special review, we provided a safety evaluation (March 2, 1976) of the ultimate heat sink with respect to Regulatory Guide 1.27. During the review, we requested the applicant to provide a heat removal transient analysis to demonstrate the UHS has the capability to provide adequate water inventory (30 day) supply and provide sufficient heat dissipation to keep SWS temperature within acceptable design limits in accordance with the guidelines of Regulatory Guide 1.27. The analysis provided by the applicant was not complete because actual station auxiliary heat loads were not available, and the applicant used a conservative safety margin instead of the actual heat loads. That analysis showed that the maximum heat sink temperatures attained would be 3.5°F above the service water system design temperature. We, therefore, concluded in our safety evaluation that during the OL review, we would require the applicant to demonstrate that all safety related equipment whose design temperature is exceeded would be able to function for as long as the emergency lasted, or we would require the plant Technical Specifications to include a power level limit to conform with position C.4 of Regulatory Guide 1.27, when the UHS reached a predetermined temperature.

The applicant's final transient heat removal analysis based on actual loads and using the methods set forth in our Branch Technical Position ASB 9-2 "Residual Decay Heat Energy for Light Water Reactors for Long Term Cooling" showed that the actual design temperature of the service water system may be exceeded by only 0.3°F for a short period of time (approx. 2 hrs.).

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Based on the conservatism of the applicant's analysis and the insignificance of such a small excess temperature, we conclude that the UHS meets position C.4 of Regulatory Guide 1.27 and no change in plant Technical Specifications is necessary.

In accordance with the guidelines of Regulatory Guide 1.27, the applicant has shown by analysis that the UHS is capable of providing, without makeup, susficient cooling for at least 30 days following an accident in one unit and safe shutdown and cooldown of the other unit. We have reviewed the applicant's analysis and conclude his methods of analysis are acceptable and concur with his conclusions.

Based on our review described above, we have determined that the ultimate heat sink meets the guidelines of Regulatory Guide 1.27 and our Branch Technical Position ASB 9-2, and meets the requirements of General Design Criteria 2, 4 and 5. We, therefore, conclude that the ultimate heat sink is acceptable.

9.2.6 Condensate Storage Facilities

The condensate storage facilities consist of two 300,000 gallon storage tanks, one per unit, each of which has one transfer pump and one transfer jockey pump. 145,000 gallons of each tank is reserved for auxiliary feedwater supply, which is sufficient for maintaining the plant in hot shutdown for 4 hours followed by a 6 hour reactor cooldown.

The condensate storage facilities are not safety related and are not designed to seismic Category I requirements and are not protected against tornado missiles. The applicant proposed to manually transfer the auxiliary feedwater supply from the condensate storage tank to the service water system in the event of failure of the condensate storage tank. At our request, in Amendment 16, the applicant provided an automatic switchover of the auxiliary feedwater from the condensate storage tank to the service water system (See Section 10.4.9 of this Report for an evaluation of the automatic switchover).

As a result of our review, we conclude that with the automatic switchover to a safety grade auxiliary feedwater supply, the condensate storage facilities are not safety related, and that failure of the system will not result in damage to safety related equipment nor will it prevent safe plant shutdown. We, therefore, conclude the condensate storage facilities are acceptable.

9.3.1 Compressed Air System

The compressed air system is shared between the two units providing both instrument and service air from three air compressor trains, each including a compressor unit, intercooler, aftercooler and air receiver. The instrument air passes through a drying/filtering train while the service air goes directly to distribution.

The function of the compressed air system is not safety related. However, the piping and valves at containment penetrations are designed to Quality Group B, seismic Category I requirements in accordance with Regulatory Guide 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification." All air operated valves in safety related systems are designed to fail in the safe position upon loss of air. We have reviewed the applicant's list of safety related air operated valves and the plant P&ID's and conclude that the failure modes of these valves are acceptable.

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Based on our review of the compressed air system we find that the piping and valves at containment penetrations meet the guidelines of Regulatory Guides 1.26 and 1.29 as described above, and that failure of the compressed air system will not prevent safe plant shutdown. We, therefore, conclude that the compressed air system is acceptable.

9.3.3 Equipment and Floor Drainage System

The equipment and floor drainage system (EFDS) accommodates drains from potentially radioactive sources as well as non-potentially radioactive sources. The system is designed to prevent potentially radioactive liquid wastes from draining to nonradioactive areas. This is accomplished by using separate drain systems for potentially radioactive and nonradioactive areas.

The potentially radioactive waste system collects liquid waste, including waste resulting from piping or tank ruptures, from the containment, auxiliary building, and fuel storage areas and transfers the waste, depending on the source, to the liquid waste system drain tank, chemical waste receiver tanks, laundry drain tanks, or to the boron recovery system. The radioactive liquid waste system is further discussed in Section 11 of this report. Drains from non-potentially radioactive sources, such as the turbine building and process steam evaporator building are conveyed to sumps and then pumped to the oil waste basin. The floor drainage system from the ESF equipment rooms are provided with remotely operated isolation valves which are located outside the area they serve. These isolation valves are normally shut to prevent flooding of the ESF equipment rooms due to backflow through the equipment and floor drainage system. Each ESF equipment room is provided with high water level detectors which alarm in the control room. Additional flood protection is provided for

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engineered safety features equipment rooms by watertight doors.

The equipment and floor drainage system is classified as non-safety related. However, the piping and valves at containment penetrations are designed to Quality Group B, seismic Category I requirements in accordance with Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification."

Based on our review, we conclude that the equipment and floor drainage system is sufficient to protect safety related areas and components from flooding and to prevent the inadvertent release of radioactive liquids to the environs, meets the guidelines of Regulatory Guides 1.26 and 1.29 as described above, and that the system's failure will not prevent safe plant shutdown. We, therefore, conclude that the system is acceptable.

9.3.4 Chemical and Volume Control System

The chemical and volume control system consists of the makeup and purification (MUP) system, chemical addition system, and the boron recovery system (BRS). These systems are used to control and maintain reactor coolant inventory to control the boron concentration in the reactor coolant through the process of makeup and letdown; supply seal injection to the reactor coolant pumps; and to purify the primary coolant by demineralization.

[We requested the applicant to demonstrate that a single active failure following a loss of offsite power will not result in reactor coolant pump (RCP) seal damage. In Amendment 16, the applicant committed to provide, an analysis of this event to determine the effects on the RCP seal integrity. The Midland plant is currently being reviewed for cold shutdown capability using only safety grade equipment in accordance with Branch Technical Position RSB 5-1. Refer to Section 5.4 of this report for an evaluation of the CVCS system in this regard. We will complete our evaluation of the CVCS following our review of the applicant's analysis.1

9.4 Air Conditioning, Heating, Cooling and Ventilation Systems

9.4.1 Control Room Area Ventilation System

There is one common control room for Units 1 and 2. The safety related portions of the control room area ventilation system (CRAVS) consists of the control room heating, ventilating, and air conditioning (HVAC) system; the switchgear and battery room HVAC system; and the control room pressurization system. All of these systems are designed to seismic Category I requirements and, therefore, meet the guidelines of Regulatory Guide 1.29 "Seismic Design Classification."

The CRAVS includes two supply/recirculation air handling units, two recirculation air filtration trains, two makeup air filtration trains, four switchgear room unit coolers, four battery room exhaust fans and unit coolers, and two pressurization tanks. Each of these components has 100 percent ventilation capacity for the areas they serve, thereby meeting the single failure criterion.

There is a single common control room for the two Midland units. The control room HVAC system meets the requirements of General Design Criterion 5 "Sharing of Structures, Systems and Components" because a single active failure will not impair the system's safety function as all safety related components are 100 percent redundant. The switchgear and battery rooms emergency HVAC systems are not shared between units, since each individual room has its own 100 percent capacity emergency cooling unit, and the battery rooms each have their own 100 percent capacity emergency exhaust fan. During normal operation the emergency HVAC systems for the battery rooms and switchgear rooms are not operating, and the rooms are ventilated by the control room HVAC system.

During normal operation, one of the two air handling units operates to supply air of controlled temperature and humidity to the control room, the cable spreading rooms, the switchgear rooms and the battery rooms. During accident conditions the individual cooling units for the switchgear rooms and battery rooms are automatically started to maintain these rooms within the design temperature limits for their respective equipment. During emergencies the air handling units serve only the control room. The air handling units are designed to maintain the control room within the environmental limits required for operation of plant controls and uninterrupted safe occupancy during all operational modes, including design basis accident conditions as required by General Design Criterion 19 "Control Room." This is accomplished by isolating the control room from the outside and other plant areas and starting the recirculation air filtration trains.

The control room pressurization system is automatically initiated, following accidents, using pressurized air tanks to pressurize the control room to prevent infiltration of radioactive gases, hazardous chemicals, possible steam from a steam line break, or smoke. The pressurization system has sufficient capacity to maintain 1/8" w.g. in the control room for a period of 3 hours. The pressurization system is designed with sufficient redundancy to perform its safety function following any single active failure. The habitability of the control room following accidents is evaluated in Section 6.4 of this report.

To meet the requirements of General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4 "Environmental and Missile Design Basis," regarding natural phenomena and external missile protection, the CRAVS outside air intakes are tornado missile protected and the rest of the system is located within the tornado proof, seismic Category I, flood protected auxiliary building. The CRAVS exhaust stack is also designed to seismic Category I requirements and to withstand tornado missiles without loss of function. The system design meets requirements of General Design Criterion 4 regarding protection against pipe whip and jet impingement and internally generated missiles as evaluated in Sections 3.6 and 3.5 of this report.

At our request, in Amendment 8, the applicant provided a battery room exhaust system designed to limit the concentration of hydrogen to below 2 volume percent and to alarm in the control room when battery room ventilation is lost. Hydrogen monitors are also provided and will alarm in the control room if the battery room hydrogen concentration reaches 3 volume percent.

Based on our review as described above, we have determined that the control room area ventilation system meets the guidelines of Regulatory Guide 1.29, and the requirements of General Design Criteria 2, 4, 5 and Criterion 19 as it relates to providing adequate protection to permit access and occupancy of the control room under accident conditions. We, therefore, conclude that the system design is acceptable.

9.4.2 Spent Fuel Pool Area Ventilation System

The function of the spent fuel pool area ventilation system (SFPAVS) is to maintain a suitable environment for equipment operation and to limit potential radioactive release to the atmosphere during normal operation and postulated fuel handling accidents.

During normal operations the spent fuel storage area is served by two non-safety related, 50 percent capacity trains, and four unit coolers which maintain a controlled environment suitable for personnel access and equipment operation. The system also filters the air before discharging to the auxiliary building exhaust stack. During emergencies, such as a fuel handling accident that may result in high radioactive releases, redundant radiation detectors in the exhaust duct isolate the normal ventilation system and automatically starts a safety related standby exhaust system. The standby exhaust system consists of two 100 percent capacity trains, each having an air filtration unit which meets Regulatory Guide 1.52, and an exhaust fan. The standby exhaust system and redundant isolation valves from the normal ventilation system are designed to seismic Category I requirements and powered from the Class 1E power system as recommended by Regulatory Guide 1.29 "Seismic Design Classification." The guidelines of Regulatory Guide 1.13 "Spent Fuel Storage Facility Design Basis" are met because the system has the capability to limit radioactive releases to acceptable levels during normal operation and following fuel handling accidents by virtue of air filtration and maintaining a negative pressure in the area to limit exfiltration.

The safety related portions of the system are in accordance with General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4 "Environmental and Missile Design Basis" regarding protection against natural phenomena and missiles by locating them within separate compartments in a missile protected portion of the auxiliary building. Protection against damage due to pipe break is evaluated in Section 3.6 of this report.

Based on our review of the spent fuel pool area ventilation system we have determined that safety related portions of the system meet the guidelines of Regulatory Guides 1.13 and 1.29, and the requirements of General Design Criteria 2 and 4. We, therefore, conclude that the system is acceptable.

9.4.3 Auxiliary and Radwaste Area Ventilation System

The auxiliary and radwaste area ventilation system (ARAVS) is presently designed to perform no safety functions as the applicant contends that it is required only during normal operation. The safety related areas that are served by the ARAVS during normal operation each contain their own safety related cooling units which are used during emergencies and are evaluated in Section 9.4.5 of this report. [Although the ARAVS is not necessary for safe plant shutdown, leakage from some ESF rooms due to pump seal failure following a loss-of-coolant accident could result in untreated radioactive releases to the environs. We required the applicant to provide a safety grade system for preventing these radioactive releases. The doses due to these radioactive releases are evaluated in Section 15.2 of this report. We will provide our evaluation of the auxiliary and radwaste area ventilation system following resolution of this item.]

9.4.5 Engineered Safety Features Ventilation System

The engineered safety features ventilation system (ESFVS) is designed to maintain a suitable environment during emergencies for the ESF equipment located in the areas of the auxiliary building which during normal operation are served by the auxiliary and radwaste area ventilation system.

The system has individual unit coolers which have chilled water cooling coils that receive water from the (safety-related) safeguards chilled water system.

All components of the system are designed to seismic Category I requirements as recommended by Regulatory Guide 1.29 "Seismic Design Classification." Each ESF area has at least one individual cooler that is powered from the same emergency bus as the equipment that it serves. This meets the single failure criterion since each ESF area or equipment room has a 100 percent capacity redundant counterpart. The requirements of General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4 "Environmental and Missile Design Basis" regarding protection against natural phenomena, missiles, pipe whip and jet impingement forces are met by locating the equipment in separate areas or rooms of the tornado missile protected portion of the seismic Category I auxiliary building. During normal plant operation, the auxiliary and radwaste area ventilation system provides ventilation of the ESF areas which is evaluated in Section 9.4.3 of this report. The ventilation is supplemented as necessary to control temperature by the unit coolers which are controlled thermostatically. A unit cooler also automatically starts whenever the ESF pump in its area is started. The unit coolers may also be started remotely from the control room.

Based on our review as described above we have determined that the engineered safety features ventilation system meets the guidelines of Regulatory Guide 1.29 and the requirements of General Design Criteria 2 and 4. We, therefore, conclude that the system is acceptable.

9.4.7 Other Safety Related Ventilation Systems

Other safety related ventilation systems are the diesel generator building HVAC system and the service water pump structure HVAC system. There are four separate diesel generator buildings at the Midland site, each of which has its own 100 percent capacity HVAC system. Each diesel generator building HVAC system is started automatically when its respective diesel starts and is powered from the same emergency bus as its associated diesel generator. The system functions automatically to maintain temperature in the diesel building below 120°F during diesel operation and above 50°F when the diesel is idle. Since each diesel generator has its own HVAC system, the design meets the single failure criterion.

There is one service water pump structure for both units housing 5 essential service water pumps within 3 rooms. (2-2-1 split - see Section 9.2.1) Each pump in each room has its own HVAC supply system such that a single failure will affect only one pump. Each system is automatically started whenever its respective service water pump is started, and temperature is automatically controlled by exhaust damper modulation and recirculation. Each system is powered from the same emergency bus as its respective service water pump. The system is designed to maintain a temperature within the structure suitable for pump operation.

Safety related portions of both the diesel generator HVAC system and the service water pump structure HVAC system are designed to seismic Category I requirements as recommended by Regulatory Guide 1.29 "Seismic Design Classification." Both systems are also protected against tornado missiles, housed in seismic Category I structures which are protected against the design basis flood, and are adequately protected against internal missiles and pipe break in accordance with General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4 "Environmental and Missile Design Basis."

Based on our review we have determined that the diesel generator building and service water pump structure HVAC systems meet out single failure criterion, the guidelines of Regulatory Guide 1.29 and the requirements of General Design Criteria 2 and 4. We, therefore, conclude that the systems are acceptable.

9.5.1 Fire Protection System

[At our request, the applicant has provided a detailed fire hazards analysis and a comparison of his plant design to Appendix A of our Branch Technical Position ASB 9.5-1 "Fire Protection for Nuclear Power Plants." We are currently reviewing their submittal and will provide our evaluation in a future supplement.]

10.3 Steam and Power Conversion Systems

Main Steam Supply System

This section of the report evaluates the safety-related portion of the main steam system (outside containment) which includes the portion of the system between the containment up to and including the main steam isolation valves (MSIVS). Portions of the main steam system downstream of the MSIV's are evaluated here only as they may affect the safety related portions of the system in the event of a main steam line break.

In accordance with the guidelines of Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification", those portions of the main steam system from the steam generators up to and including the first MSIV's are designed to Quality Group B, seismic Category I requirements.

Each unit provides steam from two steam generators via two 36-inch steam lines to a high pressure turbine for electrical power generation. During normal operation, steam is also delivered from the steam lines of Unit 1 through two 26-inch lines to a 36-inch header and to the process steam evaporators where it is used to generate tertiary steam that is supplied to Dow Chemical Co.

The Midland main steam system is a unique design having cross-connects between the two units downstream of the MSIV's, since the first priority in steam demand is the supply to Dow Chemical rather than electrical power generation. Sections 10.3.1 through 10.3.3 of this report describe the 4 operating modes of the main steam systems for supplying steam for Dow. Process flow diagrams, Figures 10.3-1 through 10.3-6 of this report, show the interties between units and the valve lineup for the 4 modes of operation for the main steam and feedwater systems.

During operating Modes 1 and 2, Unit 1 will supply process steam plus the Unit 1 turbine generator. If a main steam line break were to occur upstream of an MSIV in Unit 1 while it was operating in Mode 1 or 2, a blowdown path from the unaffected steam generator would be available through the process steam system to the evaporator system if the MSIV of the unaffected steam generator failed to close. The applicant claimed that their MSIV's were single failure proof since all active components were redundant. We did not agree with the applicant that their MSIV's could not fail to close and required that they revise the design such that a failure of an MSIV to close would not result in a blowdown of both steam generators of Unit 1. In Amendment 15, the applicant revised the design to include main steam line break closure signals to the process steam isolation valves and the backup MSIV's (non-safety grade) which are provided for Unit 1. These closure signals are necessary to protect the plant only if the break is upstream of the MSIV's. We do not postulate such a break as a result of a seismic event because that portion of the main steam system is designed to seismic Category I requirements. Therefore, dependence on non-safety grade isolation valves is acceptable to protect against a break upstream of an MSIV together with an assumed failure of the safety grade MSIV on the unaffected steam generator.

During operating Modes 3 and 4, the Unit 2 steam generators are supplying process steam to the evaporator building. These modes are used less frequently, when the Unit 1 reactor is unavailable. During these modes, protection against a Unit 2 steam line break upstream of an MSIV coincident with a failure to close of the unaffected Unit 2 steam generator's MSIV is provided in the same manner as operating Modes 1 and 2 as discussed previously. However, the Unit 2 steam system does not have backup MSIV's because they are not required by state codes (see Section 10.3.3). The required protection is provided by the main steam intertie isolation valves which close upon receipt of a main steam line break signal. We find this acceptable on the same basis that we described for Modes 1 and 2.

During Mode 4 operation the main steam systems of the two units are shared, with the Unit 2 steam generator supplying steam to the Unit 1 turbine generator. The Unit 1 NSSS is shut down with two MSIV's in series isolating the Unit 1 steam generators from the rest of the steam system and the Unit 2 turbine is shut down and isolated from the main steam system by the turbine stop and control valves. General Design Criterion 5 "Sharing of Structures, Systems and Components", allows sharing if it is shown that such sharing will not significantly impair their safety functions. In the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units must not be precluded. When the main steam systems are being shared, Unit 1 is already shutdown and cooled down. Therefore, if the sharing does not affect the ability to perform the system's safety function in the event of an accident in Unit 2 the requirements of General Design Criterion 5 are met. During times when the main steam system is shared, the Unit 2 steam supply system uses only the non-safety related portion of Unit 1's main steam system, from the outboard MSIV to the turbine. This portion of the main steam system does not perform any safety function or generate any signals to close the MSIV's or the main steam intertie isolation valves. The main steam line break instrumentation of Unit 2 still senses only the Unit 2 parameters to provide protection against a steam line break. Similarly, for all other accidents, the Unit 2 protection system and input parameters are used to provide protection for the Unit 2 plant by closing the Unit 2 MSIV's. We, therefore, conclude that the requirements of Criterion 5 are met since the ability to protect against design basis accidents is not impaired by the sharing.

The MSIV's and main steam intertie isolation valves are designed to close in five seconds upon receipt of a main steam isolation valve closure signal. The valves are designed to stop steam from either direction. Failure of one MSIV to close, coincident with a steam line break, will not result in the uncontrolled blowdown of more than one steam generator. To summarize our previous evaluations of a steam line break upstream of an MSIV and a failure of the other MSIV to close blowdown of the affected steam generator is prevented by the closure of the non-seismic Category I main steam intertie isolation valves, turbine stop valves, turbine bypass valves, and for Unit 1, the backup MSIV's which serve as an acceptable backup for this accident.

Seismic Category I safety valves and power relief valves are provided for each steam generator immediately outside the containment structure upstream of the main steam isolation valves. The power relief valves are air operated and fail in the closed position on loss of air supply. The power relief valves are also equipped with hand wheels to facilitate manual operation if required. In accordance with Branch Technical Position RSB 5-1 "Design Requirements of the Residual Heat Removal System," which requires safe cold shutdown capability following an earthquake using only safety grade equipment, we required that the applicant perform manual testing of the power relief valves to demonstrate that a controlled cooldown can be accomplished. [The applicant has not committed to perform this test.]

The safety related portion of the main steam lines, including the MSIV's are located above the auxiliary building roof. At our request, in Amendment 9, the applicant provided barriers to protect the safety related portions of the main steam lines and MSIV's from tornado missiles. With the addition of the tornado missile barriers the safety related portions of the main steam system meet the requirements of General Design Criteria 2 "Design Basis for Protection Against Natural Phenomena" and 4"Environmental and Missile Design Basis." Section 3.6 of this report evaluates the main steam system design with respect to high energy pipe break protection.

Based on our review, as described above, we find that the main steam system (outside containment) up to and including the MSIV's meets the guidelines of Regulatory Guides 1.26 and 1.29 and the requirements of General Design Criteria 2, 4 and 5. We therefore conclude that the main steam system, outside containment, up to and including the MSIV's is acceptable.

10.4 Other Features of the Steam and Power Conversion

The other features of the steam and power conversion systems evaluated in this report are the safety related portions of the main feedwater system, the auxiliary feedwater system, and the circulating water system.

We have also reviewed the condensate system, non-safety related portions of the feedwater system, the cooling pond blowdown and makeup system,

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condensate cleanup system, and the steam generator recirculation system. The condensate cleanup systen includes the condensate demineralizer system and the feedwater chemical addition system. The failure of these systems would not prevent safe plant shutdown nor result in potential radioactive releases.

The acceptability of these systems was based on our review which determined that: (a) where the system interfaces or connects to a seismic Category I system or component normally closed or automatically operated seismic Category I isolation valves are provided, and (b) the failure of these systems will not preclude the operation of safety-related systems or components located in close proximity. We find that the design of the condensate system, non-safety related portions of the feedwater system, cooling pond blowdown and makeup system, condensate cleanup system and the steam generator recirculation system, meet the above criteria, and, therefore, they are acceptable.

10.4.5 Circulating Water System

The circulating water system is designed to remove the heat rejected from the main condensers via the cooling pond. The circulating water system is not required to maintain the reactor in a safe shutdown condition or mitigate the consequences of accidents. However, it is the largest source of internal flooding within the turbine building.

At our request, in Amendment 3, the applicant provided an analysis of the effects of a complete rupture of the circulating water expansion joint at the main condenser. The analysis showed that the water level in the turbine building would rise at a rate of 1.05 feet per minute. Two level alarms provide indication in the control room. In the event of no operator action the turbine building could fill to grade level. Flow paths to the outside would limit the flooding to that level. Flooding of the turbine building to grade level as a result of the probable maximum flood has been evaluated and found acceptable in Section 3.4 of this report. Since a failure of the circulating water system cannot result in more severe flooding than the design basis flood, we find the analysis acceptable.

Based on our review, we find that a failure of the circulating water system will not damage any safety related equipment or prevent safe plant shutdown. We, therefore, conclude that the circulating water system is acceptable.

10.4.7 Main Feedwater System

The safety related portions of the main feedwater system consist of a main feedwater isolation valve outside containment and a second main feedwater isolation valve inside containment, and the interconnecting piping up to the steam generator. Separate connections to the steam generators are provided for auxiliary feedwater injection (Section 10.4.9 of this report).

The safety related portions of the main feedwater system from the steam generator out to and including the outermost containment isolation valve are designed to Quality Group B, seismic Category I requirements in accordance with Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification."

All safety related portions of the main feedwater system are housed within the tornado missile proof auxiliary building and are therefore protected against natural phenomena in accordance with General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena." The requirements of General Design Criterion 4 "Environmental and Missile Design Basis" regarding missiles, pipe whip and jet impingement are met as evaluated in Sections 3.5 and 3.6 of this report.

There are certain modes of operation, described in Section 10.3.3 of this report, which are unique to the Midland plant due to process steam demand to Dow Chemical. During one of these modes the feedwater systems are shared between units. Specifically, by manual cross connection, steam from the Unit 2 steam generators may be routed to the Unit 1 turbine, and via part of the Unit 1 feedwater system the condensate is returned to the Unit 2 steam generator. During this mode of operation, General Design Criterion 5 "Sharing of Structures, Systems and Components" allows sharing if it is shown that such sharing will not significantly impair the systems safety functions. In the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units must not be precluded. Because Unit 1 is already shutdown and cooled down when this mode of operation is used, if the sharing does not affect the ability of the system to perform its safety function, then

General Design Criterion 5 is met. The Unit 2 main feedwater system uses only the non-safety related portion of Unit 1's feedwater system which performs no safety function and does not generate any protection signals to close the main feedwater isolation valves. The safety related portions of Unit 2's main feedwater system still serve Unit 2 and the isolation valves receive ESF signals from the Unit 2 detectors and protection circuitry. The safety related portions of Unit 1's main feedwater system are isolated and not shared. We, therefore, conclude that the requirements of General Design Criterion 5 regarding sharing of safety related systems and components are met.

There are two safety grade main feedwater isolation valves on each feedwater line which receive a signal to close in the event of a main steam or feedwater line break; therefore, a single failure will not result in continued feedwater supply to the affected steam generator. The feedwater system design, therefore, is not subject to the concern of generic Task A-22, "PWR Steam Line Break, Core, Reactor Vessel and Containment Building Response," because reliance is not placed on non-safety grade feedwater system valves to mitigate the consequences of a main steam or feedwater line break.

A generic concern of pressurized water reactors is feedwater hammer in the feedlines to the steam generators. Feedwater hammer may occur in PWR's with a feedring in the steam generator when the feedring is drained and cold water is injected causing the steam in the feedring and feedwater line to condense rapidly and accelerate a slug of water which can create a pressure wave. The steam generators of the Midland units are of the once-through type with no feedrings. No normal operating conditions could drain the feedwater line without emptying the steam generator. In addition cold auxiliary feedwater is introduced through a separate steam generator connection. For these reasons we consider that the B&W once-through steam generator is not subject to feedring type feedwater hammer experienced in recirculating type steam generators, and therefore, that this generic item does not apply to Midland.

Based on our review of the main feedwater system, we find that the system's design is in accordance with the guidelines of Regulatory Guides 1.26 and 1.29 and the requirements of General Design Criteria 2, 4 and 5. We, therefore, conclude that the system is acceptable.

10.4.9 Auxiliary Feedwater System

The auxiliary feedwater (AFW) system is an engineered safety feature designed to supply feedwater to the steam generators during normal operations, including startup, shutdown and hot standby, and in the event of loss of main feedwater supply. The system provides feedwater for the removal of decay heat from the reactor until the reactor coolant system decreases to a temperature (280°F for Midland) where the decay heat removal system may be placed in operation.

The auxiliary feedwater system consists of two 100 percent capacity pumps for each unit, one turbine driven and one motor driven. In response to our request, in Amendments 3 and 5, the applicant provided design details to verify diversity in power supplies to each of the AFW systems in accordance with our Branch Technical Position ASB 10-1 "Design Guidelines for Auxiliary Feedwater System Pump Drive and Power Supply Diversity for Pressurized Water Reactors." The turbine driven pump is available to supply auxiliary feedwater independently of onsite or offsite AC power. Steam to the turbine driven pump is taken from each of the steam generators via DC motor operated valves. There are two auxiliary feedwater isolation valves arranged in parallel isolating the AFW discharge header from each steam generator, one valve is AC operated, the other is DC operated. The flow control valves and the header valves which crossconnect the discharge from the two pumps are motor operated and fail in the normal "throttled open" position on loss of power. The above diversity in power to pumps and valves assure an available source of auxiliary feedwater supply in the event of loss of all AC or DC power.

The AFW system is normally lined up to take suction from the non-seismic condensate storage tank. In the event of an accident, this design could lead to AFW pump damage due to low suction pressure in the event the non-safety grade storage tank were lost and the AFW pumps started. At our request, in Amendment 16, the applicant provided an automatic rather than manual switchover of the AFW pump suction to both trains of the safety grade service water system. These motor operated valves are powered from the same emergency bus as the SW pumps to which they are connected, thereby meeting the single failure criterion. The valves need not meet our power diversity requirements because the condensate storage tank will still be available following a complete loss of AC or DC power. Since the condensate storage tank is also not tornado missile protected, the automatic switchover is also necessary to assure an automatic source of AFW in the event of a tornado. The AFW system is designed to Quality Group C and seismic Category I requirements, in accordance with the guidelines of Regulatory Guides 1.26 "Quality Group Classification" and 1.29 "Seismic Design Classification." With the addition of the automatic switchover to the tornado protected, seismic Category I service water system, the system also meets the requirements of General Design Criterion 2 "Design Basis for Protection Against Natural Phenomena." The power diversity of the AFW system as described above, provides suitable redundancy of components and features to assure the system will be available for decay heat removal assuming offsite, or onsite power is not available, as required by General Design Criterion 34 "Residual Heat Removal."

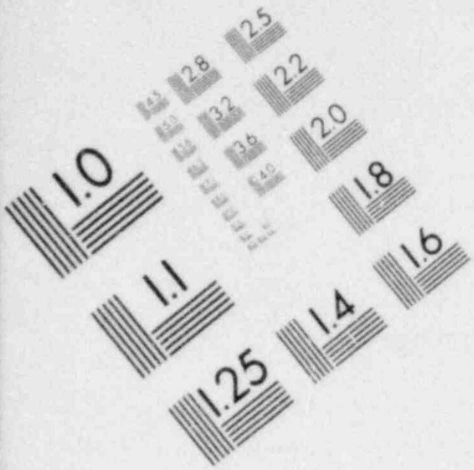
The AFW system consists of two 100 percent pumps. In Amendment 8 the applicant at our request provided a failure analysis to show how the system design meets our requirements regarding a high energy pipe break in the AFW system coincident with a single active failure. During normal operation when the AFW pumps are not operating, the system is pressurized between the steam generators and the upstream check valves (two in series), with normally closed isolation valves acting as a backup to the check valves. A break in this portion of the AFW piping could result in turbine trip and loss of offsite power, and an AFW start signal. Since both AFW pumps are normally lined up in parallel, both AFW pumps could lose water through the pipe break and AFW flow to the unaffected steam generator could be reduced. The AFW system is therefore provided with automatic interlocks

(FOGG system - Feed Only Good Generator) to sense the faulted steam generator and isolate it from the AFW system, such that the remaining AFW pump will feed only the intact steam generator. The FOGG system is powered from redundant Class 1E busses and need not meet our power diversity requirements because we do not postulate a complete loss of AC or DC power following a pipe break. The design features described above meet our criteria regarding high energy line break in the AFW system coincident with single failure during normal operation when the AFW pumps are secured. During periods when the AFW system is in operation such as startup and shutdown, the motor driven pump supplies both steam generators, and the entire AFW system is pressurized. Operation of the turbine driven pump during normal operation is precluded by plant Technical Specifications so that a pipe break in the steam header to the turbine, downstream of the isolation valves need not be postulated. During these periods, a pipe break could occur in the discharge piping of the operating AFW pump, and a coincident single active failure of the turbine driven pump could result in no AFW flow. Since the turbine generator is not on the line during this period, no electrical transients will occur as a result of the break, and therefore loss of offsite power need not be assumed. Two check valves in series prevent blowdown of either steam generator due to this event. We agree with the results of the applicant's failure mode analysis and conclude that the AFW system design meets our Branch Technical Position APCSB 3-1 "Protection Against Postulated Piping Failures in Fluid System Components Outside Containment" regarding high energy line break in the AFW system coincident with single active failure.

During our review we also requested the applicant to demonstrate a single active failure could not prevent feeding the unaffected steam generator following a mainsteam or feedwater line break. It was our concern that an electrical failure that caused the motor operated level control valve to the unaffected steam generator to close would result in no AFW flow to that generator. In Amendment 14, the applicant provided revised control system drawings for the level control valve to show redundant contacts and circuitry in the controller to show that no single electrical fault could cause the motor operated valve to close. This design has been reviewed and accepted as evaluated in Section 8.3 of this report. With these design features the AFW system meets the requirements of our Branch Technical Position ASB 3-1 regarding high energy line break in the main steam or feedwater system coincident with single active failure in the AFW system.

The AFW system design meets the requirements of General Design Criterion 4 "Environmental and Missile Design Basis" regarding protection against missiles, pipe whip and jet impingement since each train is located in separate compartments of the auxiliary building. Protection against high energy line breaks is evaluated in Section 3.6 of this report.

As a result of the new Branch Technical Position RSB 5-1 "Design Requirements of the Residual Heat Removal System", the Staff is currently reviewing the overall Midland plant design with respect to bringing the plant to a safe cold shutdown with and without offsite power using only safety grade equipment and assuming any single failure. Refer to Section 5.4 of this SER for an evalaution of this aspect of the Midland design.



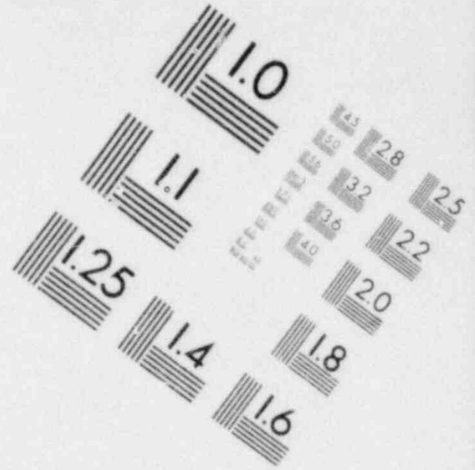
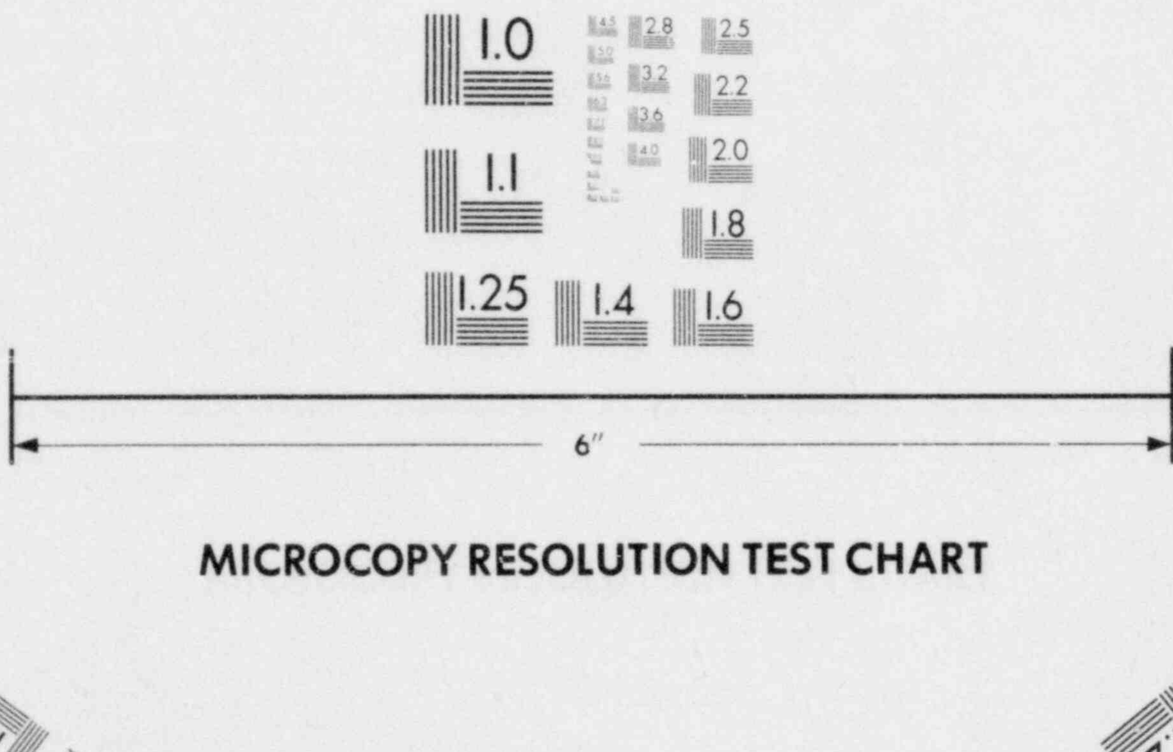


IMAGE EVALUATION TEST TARGET (MT-3)



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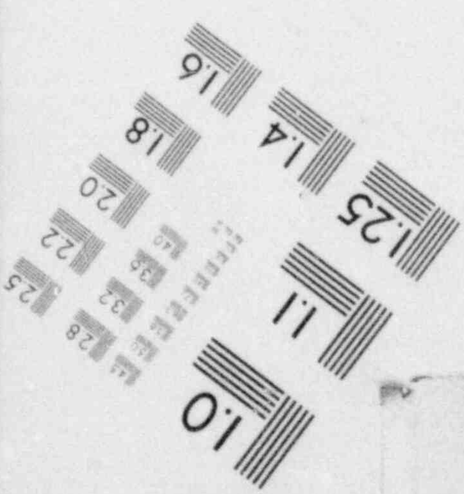

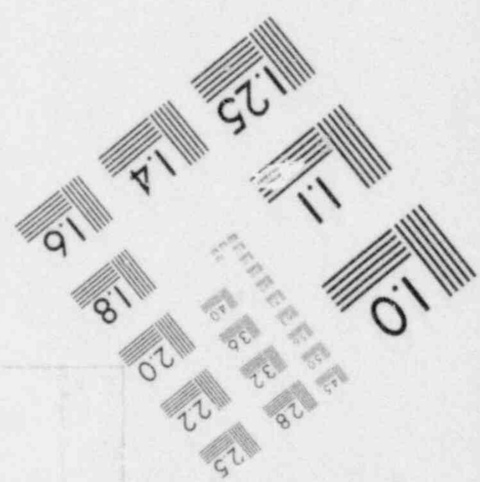

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6″

MICROCOPY RESOLUTION TEST CHART

As a result of our review as discussed above, we have determined that the AFW system meets the guidelines of Regulatory Guide 1.26 and 1.29, the requirements of General Design Criteria 2, 4, and 34 and the requirements of Branch Technical Positions 3-1 and 10-1. We, therefore, conclude that the AFW system is acceptable.