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July 15, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: McGuire Nuclear Station
Docket Nos. 50-369, 50-370

Dear Mr. Denton:

Attached is Duke Power Company's response to NRC Generic Letter 81-14, dated February 14, 1981 for McGuire Nuclear Station. The attached report demonstrates that all appropriate seismic criteria were utilized in the design of the Auxiliary Feedwater System. If there are further questions regarding this matter, please advise.

Very truly yours,

William O. Parker, Jr.

GAC:pw
Attachment

cc: Ms. M. J. Graham (w/attach.)
Resident Inspector - NRC
McGuire Nuclear Station

Mr. James P. O'Reilly, Director (w/attach)
U.S. Nuclear Regulatory Commission
Region II

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DUKE POWER COMPANY

McGUIRE NUCLEAR STATION

SEISMIC QUALIFICATION

OF THE

AUXILIARY FEEDWATER SYSTEM

FOR

USNRC GENERIC LETTER NO. 81-14

JULY 9, 1981

1.0 INTRODUCTION

This report is a description of the seismic design and qualification of the McGuire Auxiliary Feedwater (CA) System and is in response to the NRC's Generic Letter No. 81-14. The report is structured to address Enclosure 1, Items A and B of that letter. It is Duke Power's opinion that Items C and D of Enclosure 1 and Enclosure 2, in its entirety, are not applicable to the CA System.

Although part of the system is non-seismically designed, this portion is not required for any safety function. It is used during the normal operation, start-up and shut-down of the plant. For this reason, the non-seismic portion of the system will not be addressed in this response and will not be considered a secondary source for the safety-related portion. Isolation of the non-seismically designed portion of the system from the safety-related portion will be discussed in Section 3.

Duke Power has reviewed the CA System with respect to the above-mentioned generic letter. The results of that review are outlined in the following sections.

2.0 SYSTEM DESCRIPTION

The CA System provides a backup to the Main Feedwater System to ensure the safety of the plant and protection of equipment. It is a safety-related system design to meet the requirements of ASME Section III, Classes 2 and 3. A detailed description of the function, operation and control of this system is provided in Section 10.4.7.2.2 of the McGuire FSAR.

3.0 BOUNDARY CONDITIONS

3.1 Water Source and Pump Suction

The assured water source for the safety-related portion of the CA System is the safety-related Nuclear Service Water (RN) System. This system is designed for seismic loads and meets all requirements for an ASME Class 3 system. There are two essential headers in the RN System with sufficient crossover piping to ensure redundancy required for the CA System. (See Figure 3.1.)

The pump suction piping for the safety-related portion of the CA System is ASME Class 3. This safety-related suction piping is isolated from the non-safety piping by a safety-related electric motor-operated (EMO) valve and a check valve in series located in each pump suction header upstream of the RN System connection. The EMO valves are operated remotely from the control room or can be operated at the pumps. (EMO valve tag numbers are 1CA7A, 1CA9B and 1CA11B. The check valve tag numbers are 1CA8, 1CA10 and 1CA12.)

The piping upstream of the EMO valves is Duke Class F. This is safety designated piping and is designed per ASME Class 3 because rupture of this portion of the CA System would cause flooding of equipment essential for the operation of other safety systems. Therefore, the non-safety side of each EMO valve listed above is protected beyond the required three orthogonal restraints.

3.2 Pump Discharge and Heat Sink

The main headers from the Auxiliary Feedwater Pump discharge nozzles to the Steam Generators are designed to meet Class 2 and 3 requirements. The non-safety branches to the minimum flow and test headers are isolated by air-operated, fail-shut isolation valves 1CA27A, 1CA32B and 1CA20AB (Figure 3.1). However, as on the suction side, the piping downstream of these valves is designed to Duke Class F requirements which are identical to ASME Class 3. Therefore, these valves are protected by at least three orthogonal restraints.

Other branch piping that is structurally coupled to the CA discharge boundary includes two connections to the Main Feedwater (CF) System and one connection to the Steam Generator Wet Layup (BW) System for each steam generator header. The CA System is isolated from the major part of each of the CF branches by an EMO valve and a check valve. The BW branches are isolated from CA by a locked-shut isolation valve. These valves and their respective tag numbers are shown in Figure 3.2. Portions of these branch lines up to a point of at least three orthogonal restraints have been included in the CA System analysis to account for their structural coupling effects.

4.0 SEISMIC CLASSIFICATION AND QUALIFICATION

The safety-related portion of the CA System was designed and constructed in accordance with the Seismic Category I requirements applicable to other safety-related systems. The same methodologies and acceptance criteria are applicable to the CA System; and, therefore, the information requested by Generic Letter 81-14 is generally available in the McGuire FSAR. Figures 3.1 and 3.2 graphically show the seismic classification of all piping, valves, equipment and branch connections in the CA System. The safety-related portion of the CA System is also included in the scope of seismic related Bulletins 79-02, 79-04, 79-07, 79-14 and 80-11 and IE Information Notice 80-21. Duke Power's responses to these Bulletins have been submitted previously and will not be repeated here.

The seismic qualification of the components comprising the safety-related portion of the CA System is discussed in the following paragraphs. The seismic analysis methods, seismic input, load combinations and allowable stresses are addressed for each major category of equipment requested in Table 1 of Enclosure 1. Again, the equipment and valves in the non-safety portion of the CA System will not be addresse[illegible]use it is not relied upon for any safety function and does [illegible] into the scope or intent of this report.

4.1 Pumps

4.1.1 Seismic Analysis Methods

The CA pumps, turbine and motor driven, are considered to be rigid bodies which are rigidly attached to the building structures. (See FSAR Section 3.7.2.1.1.9.) Therefore, the pumps are designed to operate during the influence of the rigid accelerations, vertical and horizontal, of the floor on which it rests. The analysis also includes the nozzle loads from the piping system. Casing, rotating parts and mounting connections are all considered in the analysis report generated by the vendor.

The turbine for the turbine-driven pump is analyzed similarly to the pumps by the vendor. In addition, the turbine is tested under similulated seismic conditions with applied nozzle loads. The results of the test are documented in the vendor seismic report.

4.1.2 Seismic Input

The seismic input for the pumps and turbines are supplied to the vendors in the pumps specification and consists of the floor spectra for the elevation on which the unit rests.

4.1.3 Loading Combinations

Loading combinations are outlined in the equipment specification and include a combination of the normal operating conditions (deadweight plus thermal) and the SSE loads.

4.1.4 Allowable Stresses

The allowable stresses for the critical components for the pumps and turbine are from 1971 ASME Section III Code, Winter 1971 Addenda and the AISC Steel Construction Manual.

4.2 Pump Motors

4.2.1 Seismic Analysis Methods

The qualification of the CA pump motors was achieved by a combination of testing and analysis. The testing was done to determine the natural frequency of the motor. Static methods were employed to analyze all parts of the motor. The seismic accelerations from the appropriate floor acceleration were imposed using these static methods. A factor of 1.5 was applied to the SSE accelerations and all components were analyzed for deflection and stresses.

4.2.2 Seismic Input

The appropriate floor spectra was supplied to the vendor in the motor specification. The peak SSE acceleration values were picked from the spectra graph and multiplied by 1.5 for conservative SSE loads.

4.2.3 Load Combinations

The SSE accelerations were combined with deadweight and loads on pump nozzles from the piping system.

4.2.4 Allowable Stresses

The motors are qualified to requirements outlined in the Standard IEEE 344, 1971 for Class 1 electrical equipment (Section 3.10.1.3 of the McGuire FSAR). Allowable stresses were obtained for different components from the handbook of American Welding Society, AISC Steel Construction Manual and ASME Section III, 1971 Winter Addenda.

4.3 Piping

4.3.1 Seismic Analysis Methods

The piping for the CA System was analyzed using methods described in Section 3.7.2.1.2 of the McGuire FSAR. Generally, this involves the use of response spectrum methods which idealize the piping as lumped masses connected by flexible members. The flexibility and mass matrices are determined and then the mode shapes and frequencies of all significant modes are calculated. All parameters (displacements, forces, moments, etc.) are determined using structural analysis for each mode and then combined by the square root of the sum of the squares.

All CA piping was analyzed using a computer (PISOL) program which was benchmarked against appropriate test problems and verified against other accepted programs used throughout the industry.

4.3.2 Seismic Input

The seismic input to the CA piping system is the envelope of the steam generator spectra (top elevation) and all floor spectra to which the piping attaches.

4.3.3 Loading Combinations

Loading combinations for CA piping (Class 2 and 3) are summarized in Table 3.9.2-1 of the FSAR.

4.3.4 Allowable Stresses

The allowable stresses for the CA piping are listed in Table 3.9.2-1 of the FSAR for each loading condition. The 1971 ASME Section III, Winter Addenda is the code applicable to the CA piping.

4.4 Valves/Actuators

4.4.1 Seismic Analysis Methods

The valve specifications contain operability requirements for valves and actuators subject to seismic loads. The type of qualification done by the vendor, either by stress reports or testing, is reviewed by Duke Power. We have not attempted to summarize the various methods of analysis used for the large number of CA System valves. However, Section 3.7.2.1.1.8 of the McGuire FSAR outlines Duke requirements on the qualification of valves and actuators.

4.4.2 Seismic Input

Valves and actuators must be designed for an acceleration value supplied in the valve specification and must be able to withstand a simultaneous horizontal and vertical acceleration. Piping imposed accelerations are determined from the piping analysis and compared to the values which have been determined acceptable for each valve.

4.4.3 Loading Combinations

Valves and actuators are designed to withstand a combination of normal operating loads (deadweight and thermal) and SSE loads.

4.4.4 Allowable Stresses

Allowable stresses are from the 1971 Edition of the ASME Section III Code, 1971 Winter Addenda.

4.5 Cable Trays

4.5.1 Seismic Analysis Methods

Cable trays are used to transport cable to equipment motors and active EMO valves in the CA System. A structural analysis is

performed on each safety-related cable tray and the analysis includes all components of the cable tray and its supporting system. (See Section 3.10.2.1 of the McGuire FSAR.)

The maximum weight of a span of tray is computed considering the weight of the tray as well as the maximum allowable weight of the cable. This weight is then used as a center load on a pinned beam. The peak acceleration from the appropriate spectra is then multiplied by a factor of 1.5 and applied to the weight. Stresses and support loads are computed using static methods. An analysis of the supports is then performed using structural methods.

4.5.2 Seismic Input

The seismic input used for cable trays is from the appropriate spectra for the floor immediately above the floor to which the cable tray is attached.

4.5.3 Loading Combinations

Cable trays are designed for a combination of the deadweight and SSE loads.

4.5.4 Allowable Stresses

The allowable stresses for cable tray components are from the AISC Steel Construction Manual.

4.6 Instrumentation and Control Systems

4.6.1 Seismic Analysis Methods

Piping analysis methods were employed in developing generic seismically-qualified instrumentation configurations for that part of the instrumentation line from the equipment or pipe attachment point out to the root valve at which the line becomes tubing. All instrument lines are then compared to these configurations. When the configurations are in agreement, no further analysis is required. If the instrument lines are different than the appropriate generic configuration, a separate calculation using piping analysis methods and computer programs is performed.

4.6.2 Seismic Input

The seismic input is from the appropriate equipment or floor spectra.

4.6.3 Loading Combinations

Instrument lines described above are subject to pressure and deadweight in combination with the SSE loads.

4.6.4 Allowable Stresses

The allowable stresses were obtained from the 1971 ASME Section III Code, Winter 1971 Addenda.

4.7 Structures Housing the CA System

4.7.1 Seismic Analysis Methods

The seismic analysis of the two structures (Auxiliary and Reactor Building) housing the CA system is described in detail in Section 3.7.2.1 of the McGuire FSAR.

4.7.2 Seismic Input

The seismic input for the analysis of structures is described in Section 3.7.2.1 of the McGuire FSAR.

4.7.3 Load Combinations

Table 3.8.1-2 of the FSAR provides loading combinations for the design of the Reactor Building. Table 3.8.4-2 provides this information for the Auxiliary Building.

4.7.4 Allowable Stresses

The tables mentioned in 4.7.3 above provide allowable stress information for these structures.

4.8 Power Supplies

Power for Class 1E pump motors, active EMO valves and instrumentation and controls is provided by redundant diesel generator systems and a series of seismically-designed battery stations when off-site

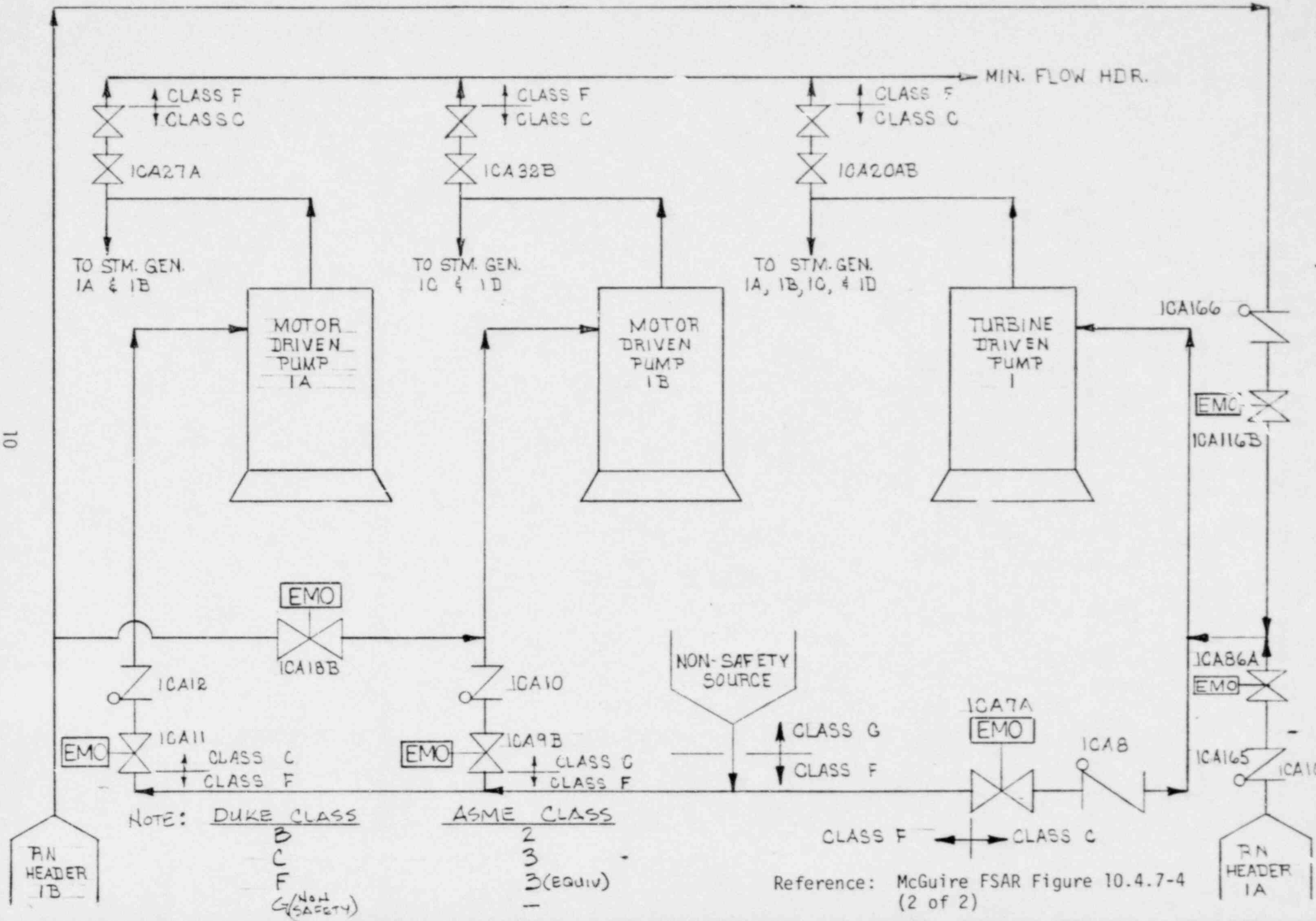
power is lost. All components of these systems have been seismically qualified by analytical or test methods. We have not attempted to summarize the various methods of analysis used for the large number of components for these systems. (These systems are described in detail in Sections 7.0 and 8.0 of the McGuire FSAR.)

5.0 CONCLUSION

Duke Power has reviewed the McGuire Auxiliary Feedwater systems as required by the applicable sections of Generic Letter No. 81-14. The information provided in this report provides sufficient information to verify that all components in the safety-related portion of the CA System have been seismically qualified. Also, this report provides evidence that the safety-related portion of the CA System can be isolated from the non-safety portion and the boundaries are extended sufficiently to include all piping which is seismically coupled to this part of the system.

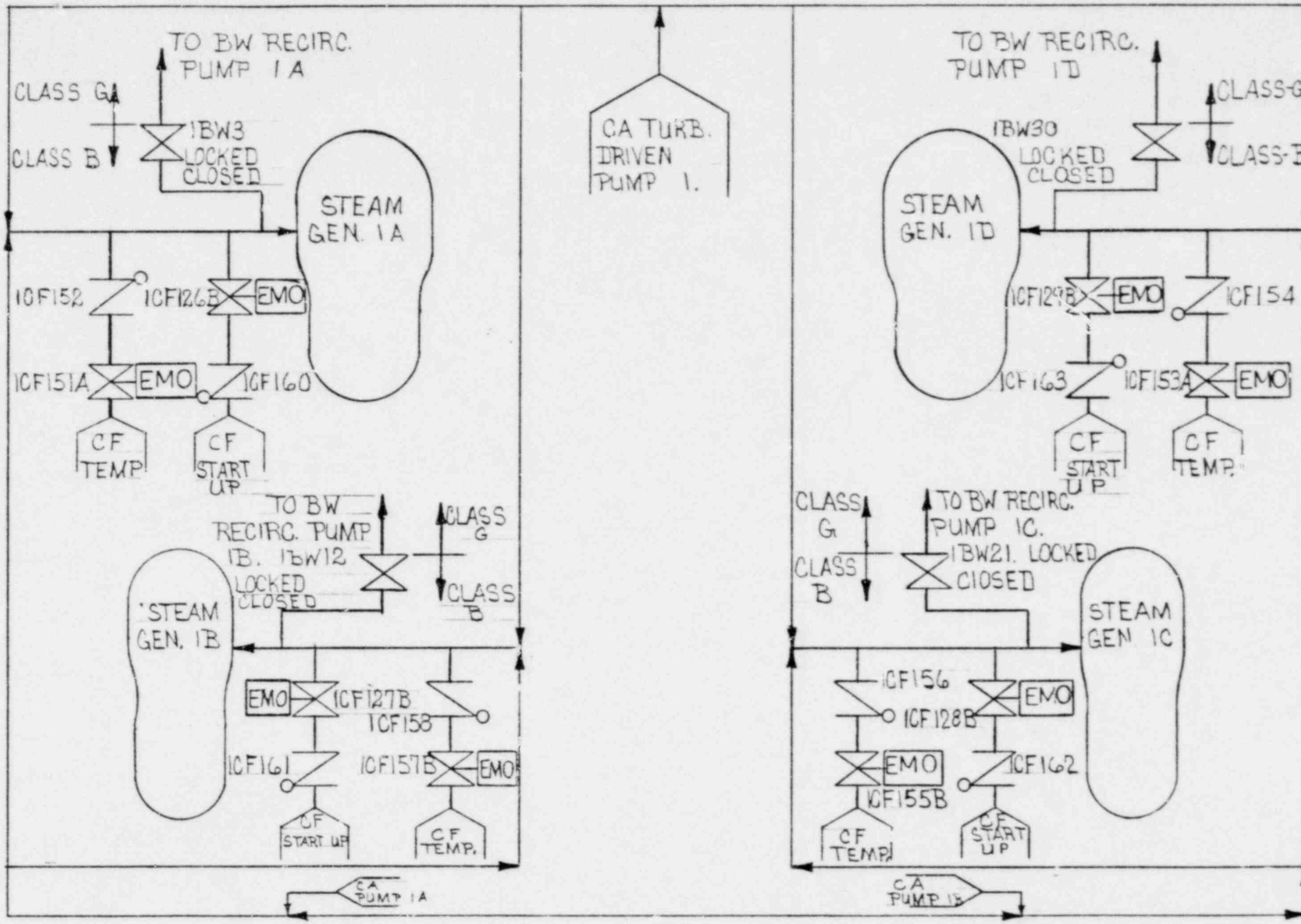
The McGuire Nuclear Station's Auxiliary Feedwater System is adequately designed to withstand the Safe Shutdown Earthquake and has sufficient redundancy to perform its intended function.

FIGURE 3.1
CA SYSTEM
PUMP SUCTION & DISCHARGE



Reference: McGuire FSAR Figure 10.4.7-4 (2 of 2)

FIGURE 3.2
CA SYSTEM
STEAM GENERATOR SIDE



Reference: McGuire FSAR Figure 10.4.7-4 (1 of 2)