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AUTH.NAME	AUTHOR AFFILIATION
PARKER,W.O.	Duke Power Co.

RECIP.NAME	RECIPIENT AFFILIATION
DENTON,H.R.	Office of Nuclear Reactor Regulation, Director
STOLZ,J.F.	Operating Reactors Branch 4

SUBJECT: Forwards results of seismic qualification review of emergency feedwater sys per NRC 810210 ltr.

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DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

January 28, 1982

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

Attention: Mr. J. F. Stolz, Chief
Operating Reactors Branch No. 4

Re: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

By letter dated February 10, 1981, the Staff requested certain information concerning the seismic qualification of the Oconee emergency feedwater systems. My letter of October 16, 1981 provided an interim status report and provided the schedule for submittal of the final report.

Please find attached a report that provides the results of the seismic qualification review of the Oconee emergency feedwater system.

Very truly yours,

William O. Parker, Jr.

RLG/php
Attachment

cc: Dr. T. Y. Chuang
Lawrence Livermore National Laboratory
7000 East Avenue
P.O. Box 808
Livermore, California 94550

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OCONEE EMERGENCY FEEDWATER SEISMIC QUALIFICATION REVIEW

This report contains the results of the Duke Power Company seismic qualification review of the Oconee Nuclear Station Emergency Feedwater System. The review was requested by Darrell G. Eisenhut of the Nuclear Regulatory Commission in his February 10, 1981 letter.

The Oconee Emergency Feedwater System (EFW) is described in Oconee FSAR Sections 1C.2.3 and 10.2.3. More information about the system has been provided to NRC in Duke Power Company letters dated July 23, 1980; April 3, 1981; December 21, 1979; October 8, 1980; and October 16, 1981. Attachment 2 to the July 23, 1980 letter provided a detailed description of the EFW and its related and support systems. The October 16, 1981 letter presented an interim response to the February 10, 1981 NRC seismic review request. This final report supercedes the October 16, 1981 interim response. The response herein is discussed on a per unit basis and organized as follows for the purpose of discussion of seismic qualification review:

I. EFW System (Including Components and Piping)
II. Support Systems (Including Components and Piping)
III. Instrumentation and Controls
IV. Electric Power
V. Structures
VI. NRC IE Bulletins
VII. Overall EFW Seismic Adequacy and Standby Shutdown Facility

I. EFW System (Including Components and Piping)

The mechanical piping and components of the EFW System have generally been designed, procured, and constructed to withstand the Oconee Safe Shutdown Earthquake (SSE) (which is equivalent to the FSAR Maximum Hypothetical Earthquake) utilizing the analytical, testing, and evaluation methods consistent with other similar Oconee safety-related systems. The following portions of the system are included as seismically qualified (refer to Figure 1):

1. The primary water source (Upper Surge Tanks) and piping and valves to each of the three EFW pumps per unit (suction piping), including connected piping through the first valve;

2. Two electric-motor-driven EFW pumps and motors and one steam-turbine-driven EFW pump and turbine; and

3. Piping and valves from each of the three EFW pumps to the Steam Generators including redundant train crossover piping and valves, all including connected piping through the first valve.

4. Cross connections between the three units' EFW systems, including connected piping through the first valve.

The above piping and valves were designed, purchased, and installed to Duke Power Company Piping Class F (see FSAR Section 1C.3.1 for description) which requires compliance with ANSI B31.1.0 and seismic design. A review

of Duke drawings, calculation files, piping system specifications, equipment specifications and files, and safety-related lists confirms the seismic design. The original EFW system and additions were initially analyzed as seismic systems, and this is being confirmed by reanalysis performed for the NRC IE Bulletin 79-14 program. A description of the seismic analysis criteria and methodology is presented in FSAR Section 1C.3.4. Allowable stresses are those permitted by ANSI B31.1.0. Non-seismic piping attachments were separated from seismic piping by an effective anchor or supported such that the loadings would not cause failure of the seismic piping. This effective anchor is either an actual anchor or a series of at least three orthogonal restraints.

The Upper Surge Tanks were designed and built to ASME Section VIII and have been seismically analyzed and supported. This analysis utilizes a static seismie method.

The turbine-driven EFW pumps along with their steam-driven turbines have been certified by their manufacturers as being capable of withstanding seismic loads. The motor-driven EFW pumps and motors have also been certified to be seismically qualified.

A documentation search for valve and valve operator qualification indicates that, in general, EFW valves were seismically specified, certified, and/or tested commensurate with valves and operators of similar safety systems; however, not every specific valve or operator had retrievable documentation. It should be noted that every valve was built to at least ANSI B31.1.0 and modelled into the stress analyses as "equivalent" pieces of pipe for structural purposes.

There are no valves in the suction lines to the EFW pumps which must actively function for the EFW system to operate as designed; all manual valves are locked in their desired positions. All motor-operated valves are already in their desired positions and are designed to fail as-is on loss of power. See Sections III and IV for a discussion of the seismic capability of controls and electric power to EMO valves.

In the discharge lines from the pumps to the Steam Generators all manual valves are locked in their desired positions and all motor-operated valves are already positioned as desired and fail as-is on loss of power. Two control valves, one in the line to each Steam Generator, must open to permit flow. These are pneumatically (air) operated valve operators dependent upon the instrument air system which is not seismically qualified; however, each valve is provided with a backup nitrogen bottle which (via a check valve) will automatically supply gas pressure to the operator. Although the gas supply to these operators has not been seismically designed, the valves will fail open upon loss of gas pressure and permit EFW flow. If this is not the case, EFW flow can be aligned through the main feedwater startup line (also seismic Class F) on either Steam Generator, bypassing the EFW control valves, and into either the normal or EFW Steam Generator nozzles. In addition, these control valves can be operated manually and are located in the penetration room near the main control room.

II. Support Systems (Including Components and Piping)

The following support systems are required for proper EFW operation:

A. Main Steam (MS) from Steam Generators for steam to turbine-driven EFW pump (Figure 1)

B. Low Pressure Service Water (LPSW) and Condenser Circulating Water (CCW) for cooling water to the two motor-driven EFW pumps and to the turbine-driven EFW pump oil coolers and pump coolers (Figures 2 and 3)

C. Turbine-driven EFW pump turbine oil system (Figure 2)

The following portions of the above systems are included as seismically qualified equivalent to that described in Section I for the EFW system:

1. MS piping and valves from Steam Generators through the Turbine stop valves, including the Main Steam Relief Valves and connected piping through the first valves;

2. The steam supply piping and valves from the MS lines to the EFW pump turbine including valve AS-38 and that portion of the auxiliary steam supply downstream of the valve, including connected piping through the first valve;

3. The CCW system from intake to the LPSW pumps to the EFW pump and oil coolers, including connected piping through the first valve.

Portions of the turbine-driven EFW pump oil system and oil cooling system such as oil pumps and valves and one water cooling pump have not been substantiated as seismically qualified due to lack of documented analyses or tests; however, credit for seismic design of this portion of the system is not necessary as described later.

III. Instrumentation and Controls

A simplified logic diagram and description of the initiation and control of the EFW system was provided in Duke's letters of April 13, 1979; July 23, 1980 (Section 2.4), and April 3, 1981. As stated in these letters, Duke has provided safety grade instrumentation and controls for the EFW and support systems. Briefly, this includes the automatic initiation of EFW and support systems, EFW flow indication in the Control Room, and automatic Steam Generator level control.

This safety grade I&C system has been designed and installed as seismically qualified commensurate with other safety grade I&C systems at Oconee. Power for this I&C is provided by the seismically-designed vital power system.

Controls to motor-operated valves other than those included in the auto-initiation and auto-control of EFW above have not been designed seismically. This includes controls to branch line isolation valves off the main steam header which are to be closed by the operator (per procedure) to assure a steam supply to the turbine-driven EFW pump turbines. This also includes EMO valves in the EFW suction and discharge lines which are normally aligned for EFW operation but are not normally required to operate. The above are provided with handwheels for manual operation.

IV. Electric Power

Seismically-qualified electric power is provided to the LPSW pumps and the motor-driven EFW pumps. Power to other pumps and to EMO valves has not been seismically designed; however, these valves are equipped with handwheels for manual operation and credit for the seismic design of these other pumps is not necessary as described later.

V. Structures

The EFW and supporting mechanical, electrical, and I&C systems are located primarily in the Oconee Turbine Building with portions in the Auxiliary Building and Reactor Building. The Reactor and Auxiliary Buildings are seismic Class 1 structures and the Turbine Building is a seismic Class 2 structure. The description of these categories and their methods of analysis and design are described in FSAR Sections 5.1 (RB), 5.7.1 (AB), 5.7.2 (TB), and Appendix 5A (all).

VI. NRC IE Bulletins

The Oconee EFW and supporting systems have been included in NRC IE Bulletins as follows:

A. IEB 79-02 Pipe Support Base Plate Designs Using Concrete Anchor Bolts

The EFW and supporting piping systems (those portions of the mechanical systems qualified as seismic in Sections I and II) have been included in this Bulletin commensurate with other Oconee safety systems.

B. IEB 79-04 Incorrect Weights for Velan Check Valves

The EFW and supporting mechanical systems qualified as seismic in Sections I and II have been included in this Bulletin commensurate with other Oconee safety systems.

C. IEB 79-07 Seismic Stress Analysis of Safety Related Piping (Algebraic Summation Method)

The analyses relating to the EFW and supporting mechanical systems qualified as seismic in Sections I and II have been included in this Bulletin commensurate with other Oconee safety systems.

D. IEB 79-14 Seismic Analysis of Safety Related Piping

The EFW and supporting mechanical systems qualified as seismic in Sections I and II have been included in this Bulletin commensurate with other Oconee safety systems.

E. IEB 80-11 Seismic Review of Masonry Walls

The EFW and supporting mechanical, electrical, and I&C systems qualified as seismic in Sections I, II, III, and IV are being included in this Bulletin commensurate with other Oconee safety systems.

F. IEN 80-21 Anchorage and Support of Safety-Related Electrical Equipment

When originally received, this IEN was reviewed for possible application to Oconee safety-related electrical systems. Duke determined no action was required. No specific action had been requested by NRC.

VII. Overall EFW Seismic Adequacy and Standby Shutdown Facility

In looking at the overall seismic adequacy of the Oconee EFW system, reference the Duke response to Question 1 of Request 17 in Duke's April 3, 1981 letter to NRC. Information in this response identified the design basis EFW flow for design basis transients and accident conditions. The minimum required flow to remove decay heat was shown to be within the capability of any one of the three EFW pumps.

The original turbine-driven EFW portion of the system and necessary supporting systems have not been fully seismically designed and substantiated by documentation. Discounting the turbine-driven portion for a seismic event, either of the two motor-driven EFW pumps and redundant delivery paths to the Steam Generators are capable of effectively removing decay heat from the reactor coolant system for about 100 minutes at 500 gpm from the seismically-qualified primary water source of approximately 50,000 gallons in the Upper Surge Tanks. Although EMO valves in the system do not have seismically-qualified controls or power, no actuation is required for EFW flow and the valves will fail as-is upon loss of power. Manual control of these valves is provided if necessary to accomplish the EFW functioning for each unit or to open a seismically-qualified manual valve flow path to or from an adjacent unit.

Notwithstanding the above, or as a long term source of water for the EFW system, the Oconee Standby Shutdown Facility (SSF) is being constructed to provide a dedicated separate train of auxiliary (or emergency) feedwater. The NRC B&W Reactor Transient Response Task Force has stated that as an alternative to the EFW being classified as (and upgraded to) an Engineered Safety Feature (and therefore seismically qualified), consideration would be given to the addition of a dedicated AFW train. In response (in Section 3.1 (Evaluation) of Attachment 2 to Duke's July 23, 1980 letter to NRC) Duke Power stated, "The Oconee emergency feedwater system coupled with the dedicated Standby Shutdown Facility (SSF), currently under construction, meet this recommendation and no additional modifications to the system are necessary". This continues to be Duke's position.

Duke Power has made the following submittals describing (and answering NRC questions on) the design of the SSF:

Type Document	Date Submitted
Conceptual SSF Design	February 1, 1978
Conceptual SSF Design - responses to NRC questions	June 19, 1978
SSF Design	March 28, 1980
SSF Seismic Design - responses to NRC questions	February 16, March 31, and April 13, 1981

Rather than re-describe the various structures, systems, and components herein, reference is made to these submittals. NRC has found the conceptual design of the SSF acceptable in R. W. Reid's December 6, 1978 letter to W. O. Parker of Duke Power.

As stated in these documents, the Oconee SSF is a dedicated facility whose function is, among other things, to provide an alternative means of supplying feedwater in the event both normal and emergency feedwater systems are unavailable. The SSF Structure and associated components of the System are designed to withstand the Safe Shutdown Earthquake.

For the purpose of this review (EFW function) the SSF is considered to be the following:

Mechanical Systems (Including Pumps, Valves, Piping)

1. Condenser Circulating Water (CCW) - that portion of the buried piping used for SSF ASW water supply

2. SSF Auxiliary Service Water (ASW) System

3. SSF Service Water Systems (comprised of the HVAC Service Water System and Diesel Generator Service Water System)

4. SSF Diesel Generator Support Systems, specifically
   a. Starting System (compressed air)
   b. Intake and Exhaust
   c. Fuel Oil
   d. Lube Oil
   e. Jacket Cooling

SSF Instrumentation & Controls

1. Steam Generator Level (each Steam Generator)

2. SSF ASW Pump Suction Pressure and Temperature

3. SSF ASW Pump Discharge Pressure (to each unit)

4. Controls to all active SSF EMO valves and SSF ASW pump

SSF Electric Power

1. Diesel Generator

2. All components and cable from Diesel Generator for AC power to components listed and included above

3. Batteries

4. All components and cable from batteries for DC power to components listed and included above

Structures

1. SSF Structure

2. Auxiliary Building

3. Reactor Building

The mechanical systems described above are designed to Duke Power Company Piping Classifications B, C, and F which are seismically-designed ASME Section III, Classes 2 and 3 and ANSI B31.1.0 piping systems respectively. With the following exceptions, these systems include seismic design on connected branch piping up to and including the second of two normally closed valves or normally closed valve and check valve. Exceptions to this are some small piping vents and drains with one normally closed valve and capped lines, tank vents, and a recirculation line from the Diesel fuel oil storage tank. The recirculation line is seismically designed through the first valve which is readily accessible to the SSF operators.

The methodology and acceptance criteria for mechanical systems and components seismic analysis is described in FSAR Section 1C.3.4 and Duke's April 13, 1981 letter to NRC in response to questions on the seismic analysis of the SSF. The methodologies and acceptance criteria for the seismic design of structures is described in FSAR Sections 5.1 and 5.7.1 for the Reactor and Auxiliary Buildings, respectively, and in Section 2.2.5 of the attachment to Duke's March 28, 1980 letter to NRC for the SSF structure.

SSF Consideration in NRC IE Bulletins

The Oconee SSF is a new design and was not specifically included in the NRC IE Bulletins listed in the NRC Request For Information on Auxiliary Feedwater Seismic Design; however, the equivalent of the Bulletins' concerns and action items has been applied to the SSF design as follows:

A. IEB 79-02 Pipe Support Base Plate Designs Using Concrete Anchor Bolts

The concerns on concrete anchor bolts in this Bulletin have been resolved and included in design and installation specifications for SSF pipe supports. In addition all seismically-designed pipe supports are subject to Duke Power as-built verification and quality assurance programs.

B. IEB 79-04 Incorrect Weights for Velan Check Valves

No Velan check valves are being used in SSF systems in addition to any which were originally installed in connecting systems and already considered in this Bulletin.

C. IEB 79-07 Seismic Stress Analysis of Safety Related Piping (Algebraic Summation Method)

Stress analysis methodology for existing systems connecting to SSF has been reviewed and found acceptable with respect to concerns in this Bulletin. The same methodology is being used for new SSF additions.

D. IEB 79-14 Seismic Analysis of Safety Related Piping

The concerns in this Bulletin have been resolved and included in the design, analysis, and installation specifications for seismic SSF piping. In addition all seismically-designed piping systems are subject to Duke Power as-built verification and quality assurance programs.

E. IEB 80-11 Seismic Review of Masonry Walls

Existing seismically-designed Oconee mechanical, electrical, and I&C systems which are used for the SSF function have been included in this Bulletin program. Consideration of masonry walls is being included in the design of new SSF systems. The SSF structure includes no masonry walls which could affect safety-related systems.

F. IEN 80-21 Anchorage and Support of Safety-Related Electrical Equipment

This IEN is not being applied to the SSF per se. The anchorage and support design for seismic SSF electrical equipment is being performed by Duke Power personnel experienced in seismic structural design. This is a new design which specifically includes safe shutdown earthquake loads and which is subject to independent verification as required by Duke Power's quality assurance program for design. In addition Duke Power's quality control and assurance program for construction assures these designs are properly installed. For these reasons special consideration of the concerns in the IEN is not warranted.

SSF Procedures

The NRC request asked for a summary of the procedures which would be followed to switch to a secondary water supply or path of emergency feedwater. Because the SSF is currently being installed and is not operational, procedures have not yet been written, and a summary is not available at this time. Procedures will be developed on a schedule commensurate with SSF startup.

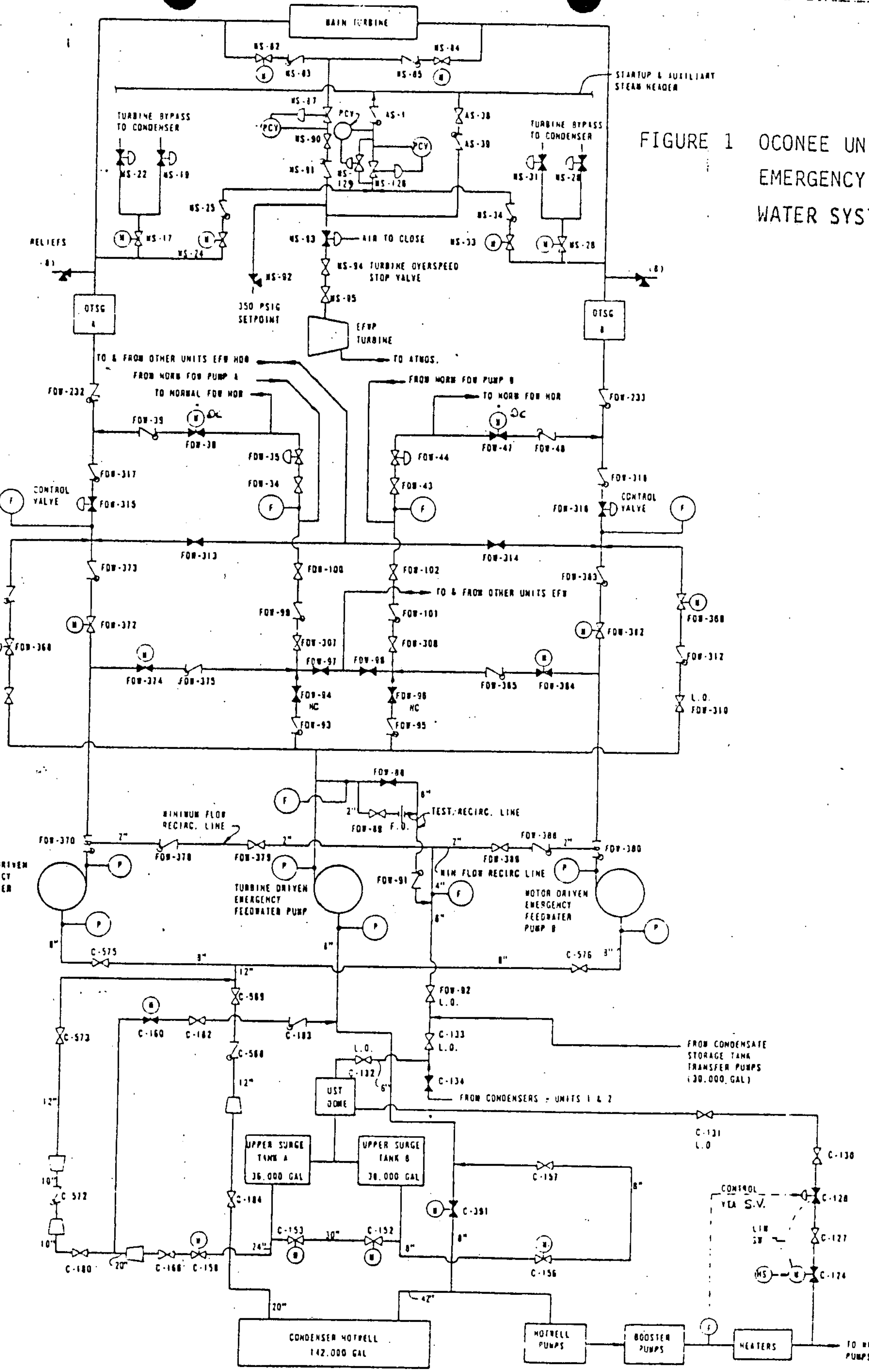

FIGURE 1 OCONEE UNITS-EMERGENCY FEEDWATER SYSTEM

Figure 2 OCONEE UNIT-EFW TURBINE AND PUMP SUPPORT SYSTEMS

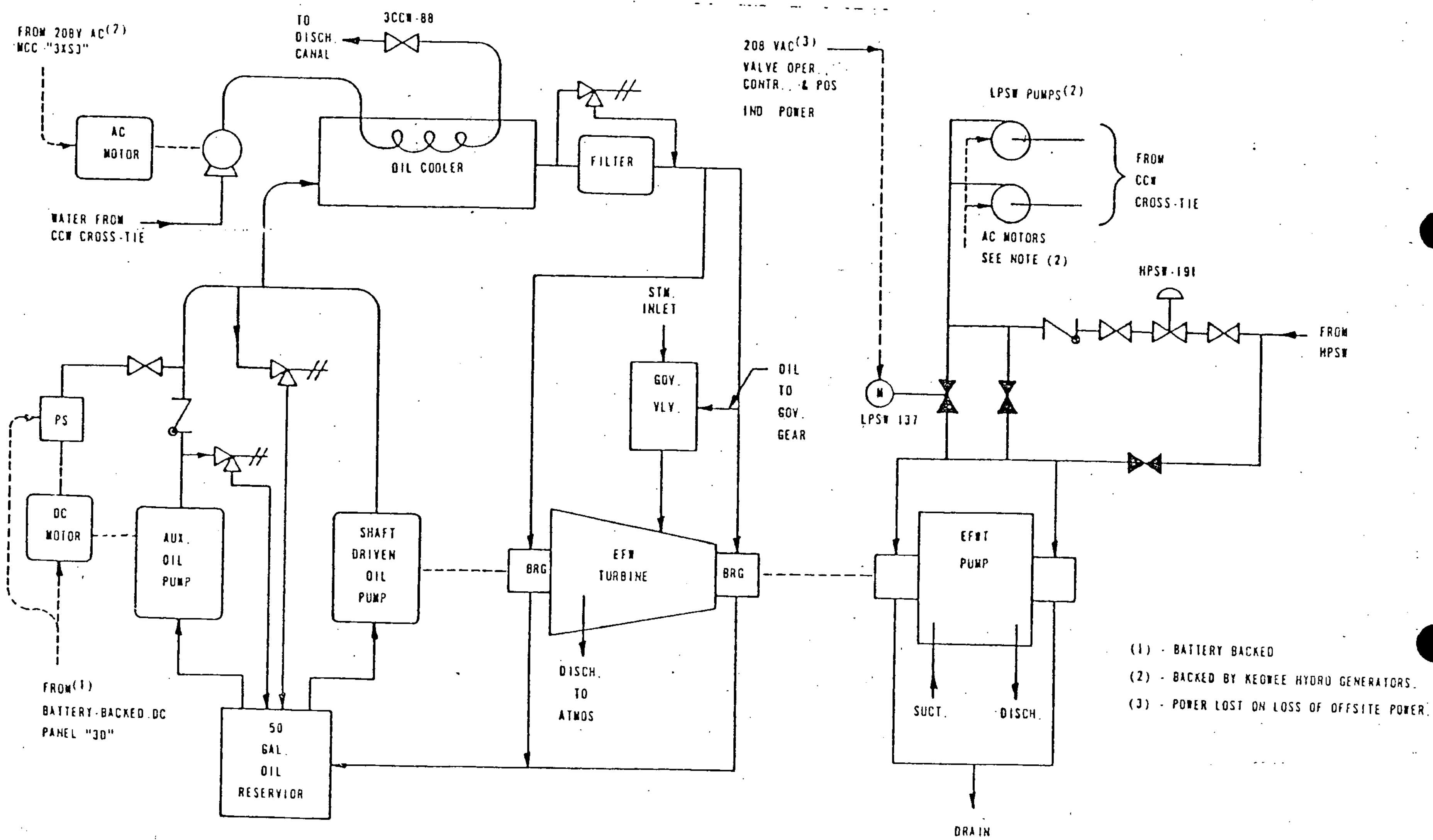

Figure 3 OCONEE UNITS-MOTOR-DRIVEN EMERGENCY FEEDWATER PUMP MOTOR COOLING WATER (NOTE OCONEE UNITS 1 & 2 SHARE 3 LPSW PUMPS OCONEE UNIT 3 HAS 2 LPSW PUMPS AS SHOWN)