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SUBJECT: Forwards addl info to complete NRC review of NUREG-0737, Item III.D.3.4, "Control Room Habitability," in response to NRC 840320 request.W/one oversize drawing.Aperture card is available in PDR.

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April 20, 1984

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

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Response to Request for Additional Information
NUREG-0737 Item III.D.3.4
Control Room Habitability

Dear Mr. Denton:

Attached you will find the additional information necessary to complete your review of NUREG-0737 Item III.D.3.4, "Control Room Habitability," as requested in your March 20, 1984 letter. In review of this issue, please keep in mind that Oconee Nuclear Station design pre-dates General Design Criterion 19 (GDC-19) of Appendix A to 10 CFR 50; however, control room habitability was a design consideration at Oconee. Thus, the control room ventilation system was designed and installed in accordance with HVAC Industry Standards and practice for commercial and industrial systems at that time. Any additional information needed will be provided upon request.

Very truly yours,

H.B. Tucker / [illegible]

Hal B. Tucker

JCP/php

Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
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Duke Power Company
Response to NRC Request for Additional Information
Control Room Habitability - Oconee Nuclear Station

1. Provide justification for all active components of the proposed control room emergency ventilation system (such as fans, isolation dampers, chillers and radiation monitors) that will not be redundant and/or single failure proof following the proposed modifications.

Response:

The proposed modifications to the Control Room Ventilation Systems will maintain the redundancy capabilities as currently addressed in Section 9.4.1 of the Oconee FSAR. Other components of the system not addressed in Section 9.4.1 of the Oconee FSAR are isolation dampers being installed in ducts supplying air to the elevator lobbies and stairwells. The dampers are not redundant and are being installed as a precautionary measure to help maintain a positive pressure in the control room.

Since outside air is introduced to the control room from the single outside air intakes through two 50 percent capacity outside air filter trains, failure of a single filter train would result in a reduced capacity to maintain control room pressurization. Dose control for this case depends upon occupancy and respirator use.

Radiation monitors monitoring contamination levels in the return air ducts from the control rooms are not redundant. Area monitors are provided in the control room which would detect high radiation levels should the monitors in the duct fail.

As clarification to Section 9.4.1 of the FSAR, the Plant Chilled Water System referenced in the FSAR is comprised of two chillers, two chilled water pumps, and two condenser water pumps. The system is designed such that should any of the components fail, sufficient chilled water would be available to serve the needs of the control rooms with one chiller, one chilled water pump, and one condenser water pump in operation.

The dose assessment model is described in the answer to question 5.

2. Identify proposed technical specification requirements for periodic leak testing of (1) control room emergency zone, (2) filter bypass dampers, (3) outside air dampers and/or valves, and ESF leakage outside containment, or justification if these leak tests are not proposed.

Response:

Control Room Emergency Zone - Proposed technical specifications for periodic leak testing of the Control Room emergency zone are currently in preparation. Following review and approval by both Corporate and Station Safety Review Boards, they will be submitted.

Filter Bypass Dampers - Filter bypass dampers are not part of the Oconee design; as such, periodic leak testing technical specifications are not necessary.

Outside Air Dampers and/or Valves - Proposed technical specifications for periodic leak testing of the outside air valve are currently in preparation. Following review and approval by both Corporate and Station Safety Review Boards, they will be submitted.

ESF Leakage outside Containment - As the NRC is aware, the concern of integrity of systems outside containment likely to contain radioactive materials (Engineered Safety Systems and Auxiliary Systems) has been previously addressed by NUREG-0578, Item 2.1.6.a. Periodic leak detection programs and preventive maintenance programs have been in effect at Oconee for some time. An evaluation of the Oconee program is provided in an NRC SER dated April 7, 1980. Existing technical specifications which address this are 3.1.6, Leakage, which addresses High Pressure Injection and other auxiliary systems outside containment contiguous with the Reactor Coolant System; and 4.5.4, LPI Leakage, which addresses the Low Pressure Injection (decay heat removal) System. Furthermore, License Condition 3.4, Systems Integrity, requires that a program be implemented

> "...to reduce leakage from systems outside containment that would or could contain highly radioactive fluids during a serious transient or accident to as low as practical levels. This program shall include the following:
>
> 1. Provisions establishing preventive maintenance and periodic visual inspection requirements, and
>
> 2. Integrated leak test requirements for each system at a frequency not to exceed refueling cycle intervals."

Such a program is in place at Oconee. Thus, it is considered that existing license requirements adequately address periodic leak testing of ESF systems outside containment. As such, no additional technical specifications are deemed necessary.

3. Identify the locations of radiation release points from design basis accidents, other than the LOCA, relative to control room outside air intake location. Provide bases for the identification, for example, through the use of layout drawings.

Response:

Radioactive material originating from postulated accidents is discharged through the unit vent for each of the Oconee units as shown on Attachment 1. Exception to this pathway is main steam safety valve discharge following either a steam line break or a steam generator tube rupture. Both of the main steam safety valve discharge accidents are enveloped by the MHA analyses for control room dose assessment.

4. Provide information which shows that the control room emergency ventilation system is designed to function properly in the event of a loss-of-offsite power, or pipe breaks in areas adjacent to the control room.

Response:

The Oconee distribution system consists of various electrical systems designed to provide reliable electrical power during all modes of station operation and shutdown conditions.

Power sources feeding Oconee include the 230KV switchyard, 500KV switchyard, 100KV line from Lee Steam Station (does not feed through 230 or 500KV swithyard), Keowee Hydro Unit via 230KV switchyard and Keowee Hydro Unit via 13.8KV underground feeder. Reference Oconee FSAR Section 8 Figure 8.1-1.

With the distribution system that is installed, it is unlikely that any situation could occur that would cause a loss of all offsite power sources feeding Oconee. However, if this highly improbable situation did occur, then the 13.8KV underground feeder from Keowee Hydro would supply emergency power to the 4160V standby bus at Oconee as referenced in 8.3.1.1.3. In this situation, the majority of the non-essential loads would be load shed. As shown in Table 1, most of the Control Room HVAC loads are load shed. However, the control operators can, at their discretion, manually connect or disconnect loads on the Keowee underground circuit as necessary per Emergency Procedure EPOA1800/16 (Loss-of-Offsite Power). This procedure gives the operators the capability of operating beyond the design basis for Oconee since none of the Control Room HVAC loads are safety related.

Also attached are five figures which show the distribution system below the switchgear level that is required to feed the respective Control Room HVAC loads. Use these figures with attached Table 1 for correlation of HVAC equipment bus assignment and respective power source distribution.

The pipe rupture analyses originally performed for Oconee do not explicitly address the control room emergency ventilation system in the event of pipe breaks. It is our engineering judgment that the emergency ventilation system would not be adversely affected by pipe breaks in the areas adjacent to the control room.

5. Provide analysis of control room operator doses following postulated design basis accidents. It may be necessary to look at DBAs other than a LOCA if the radiation release point is closer than that for LOCA to the control room air intake. The analysis should include a detailed listing of data and assumptions used, as well as the results.

Response:

Maximum Hypothetical Accident (MHA) - Control Room Operator Dose Model

The Oconee MHA is equivalent to the more current use of the term LOCA whereas the use of "LOCA" for Oconee analysis was restricted to a loss-of-coolant-accident which did not result in core damage beyond a pre-existing 1% fuel defect activity level. The initial post accident containment airborne activity consists of 100 percent core noble gases and 25 percent core iodines similar to Regulatory Guide 1.4. Containment source term depletion includes radiological decay, containment leakage, and elemental and particulate iodine removal by the containment sprays. Sump source term depletion consists of radiological decay only. Sources of activity released to the environment are containment bypass leakage, Penetration Room Ventilation System discharges, and ECCS leakage. See Figure 6 for model schematic. Assumptions and data are divided into the areas in which they are used.

Containment Building

1. Initial source term - (1) Containment Atmosphere - (a) 100% core noble gases (b) 25% core iodines (2) Containment Sump - 50% core iodines.
   Ref. 1

2. Iodine specie fractions - 91% elemental, 5% particulate, 4% organic.
   Ref. 1

3. Containment net free volume - 1.96E6 $ft.^3$
   Ref. 2

4. No credit is taken for source dilution into the Penetration Room free volume.

5. Containment leak rate - .25% volume per day 0-1 day
   .125% volume per day 1-30 days
   Refs. 1 and 3

6. Fraction of containment leak rate which bypasses the penetration room and is therefore released directly to the environment - .5
   Ref. 4

7. Penetration Room air discharge rate to maintain negative pressure - 1000 cfm.
   Ref. 5

8. Penetration Room Ventilation System filter efficiency - 90% elemental, particulate; 65% organic.
   Ref. 6

9. Containment spray removal rate for elemental iodine - 1.1 hr^{-1} for the injection period (0-30 min) and 0.7 hr^{-1} for the recirculation period (30-46 min.). For the particulate iodine, the effectiveness of the sprays was assumed to terminate when the particulate activity had been reduced by a factor of 100.
   Ref. 7

10. Sump water mass - 3.46E6 lbm
    Ref. 8

Auxiliary Building

1. ECCS leak rate following MHA 0-30 min 0.cc/hr
   30 min + 7570. cc/hr

   Ref. 9

2. Credit for iodine removal by the Auxiliary Building Filter Exhaust System Filters is not assumed.

3. Iodine partition factor for ECCS leakage outside containment following MHA - .1
   Ref. 10

Dispersion Factor - X/Q

Methods employed in the calculations of the X/Q follow recommendations in "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 10," 13th AEC Air Cleaning Conference by K. G. Murphy and Dr. K. M. Campe. The applicable equation is found in Section V.B.1.b for a diffuse source - point receptor,

where: $X/Q = [u(\pi \sigma_y \sigma_z + \frac{a}{K+2})]^{-1}$

where: $K = \frac{3}{(s/d)^{1.4}}$

s = distance between containment surface and receptor locations = 7 meters (See Attachment 1)

d = containment diameter = 38 m

a = containment building surface area = 2300 m^2

Specific X/Q values for the various averaging times were determined using meteorological data at Oconee for the period March 15, 1970 - March 14, 1972.

Time following MHA	X/Q (sec/m^3)
0-8 hours	8.5E-03
8-24 hours	6.0E-03
1-4 days	4.1E-03
4-30 days	2.15E-03

Control Room

1. Control Room intake rate of outside air following a MHA - 2700 cfm
   Ref. Attachment 2

2. Unfiltered infiltration flow rate assumed for the control room following a MHA - 10 cfm
   Ref. 11

3. Iodine removal efficiency of Control Room Ventilation System Filters - 99% elemental, particulate; 65% organic.
Ref. 12

4. Control Room Occupancy factor following MHA 0-30 days 33%

5. Breathing rates are per Regulatory Guide 1.4.

It should be noted that the Technical Specification value of 50% containment bypass leakage is considered extremely unrealistic (Ref. 13) which is a major contributing factor to the thyroid dose. A value of 10% bypass leakage, though still conservative, is more realistic. Periodic Integrated Leak Rate Tests (ILRT) have shown the Oconee Units 1, 2, and 3 containment integrity to be much better than the technical specification values of .25% volume leakage per day. The highest value for any of the three units has been .152% volume leakage per day. Using the most recent periodic ILRT results (see Attachment 3; note: Unit 1 had the highest integrated leak rate of the three Oconee units and was therefore used), coupled with a 10% bypass leakage assumption, gives an estimated control room operator dose (Rem) for a 30 day period of:

WHOLE BODY	THYROID	SKIN
1.6	16.7	33.3

Present Regulatory Guide 1.4 source term assumptions are now generally considered grossly conservative with the source term debate concentrating mainly on the degree of conservatism assumed. Assuming a more realistic post-accident containment source term would further reduce the dose linearly according to the source term reduction.

Duke has additional provisions to protect its control room operators under conservative MHA conditions. These provisions include:

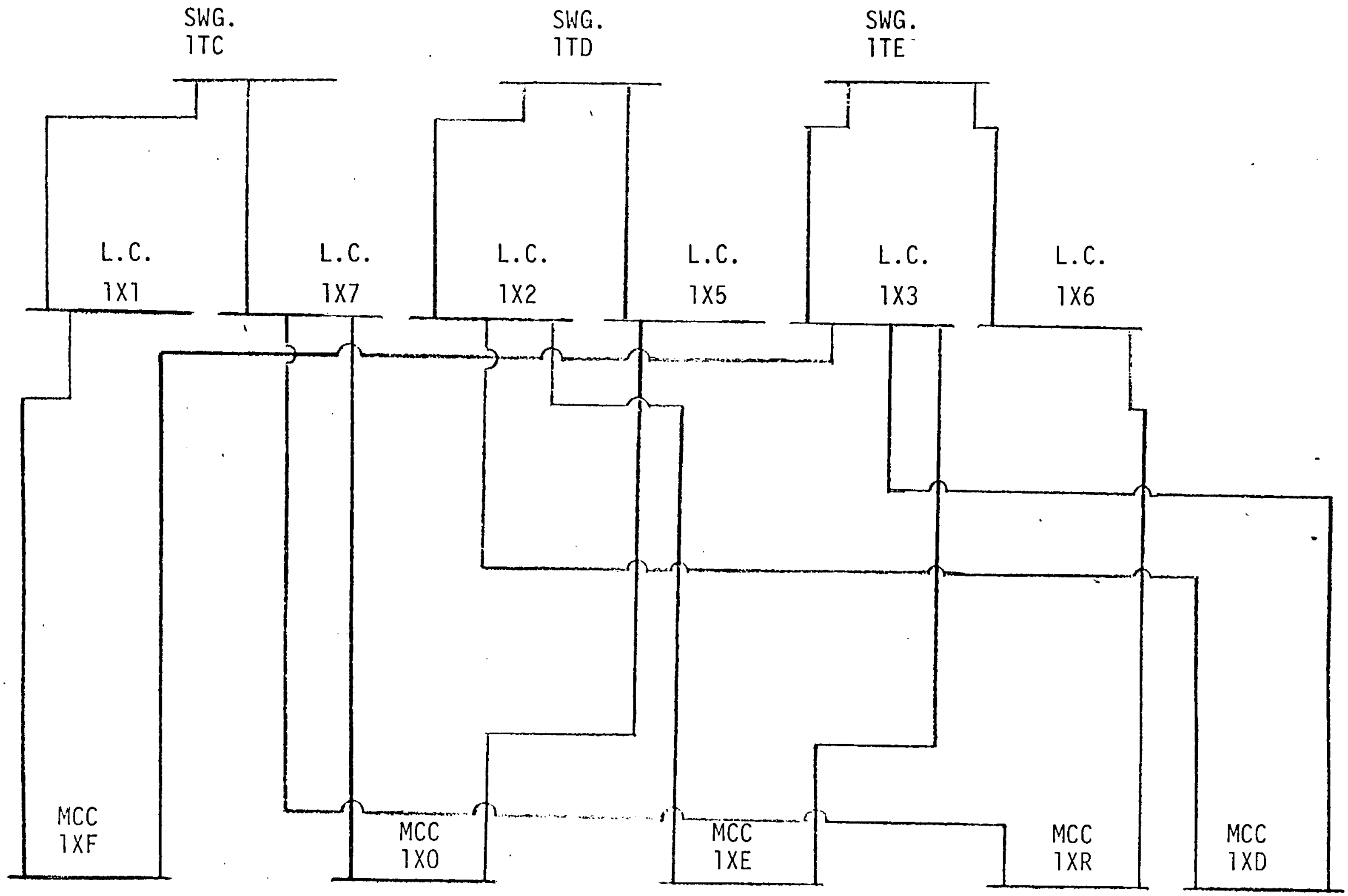
- Respirators
- Anticontamination Clothing
- Reduced Control Room Occupancy
- Potassium Iodide Tablets

The very conservative analysis presented above results in a calculated control room dose below 10 CFR 100 values. An assumption adjustment based on physical data from the station, such that actual bypass leakage is shown to be a much smaller fraction of total leakage and that overall leakage is shown to be smaller than previously assumed, results in a calculated (still conservative source term and X/Q) dose which approaches regulatory guidance on more modern stations. Control room occupancy rates and breathing apparatus can be used to prevent excess dose even under the worst postulated set of calculational assumptions.

TABLE I

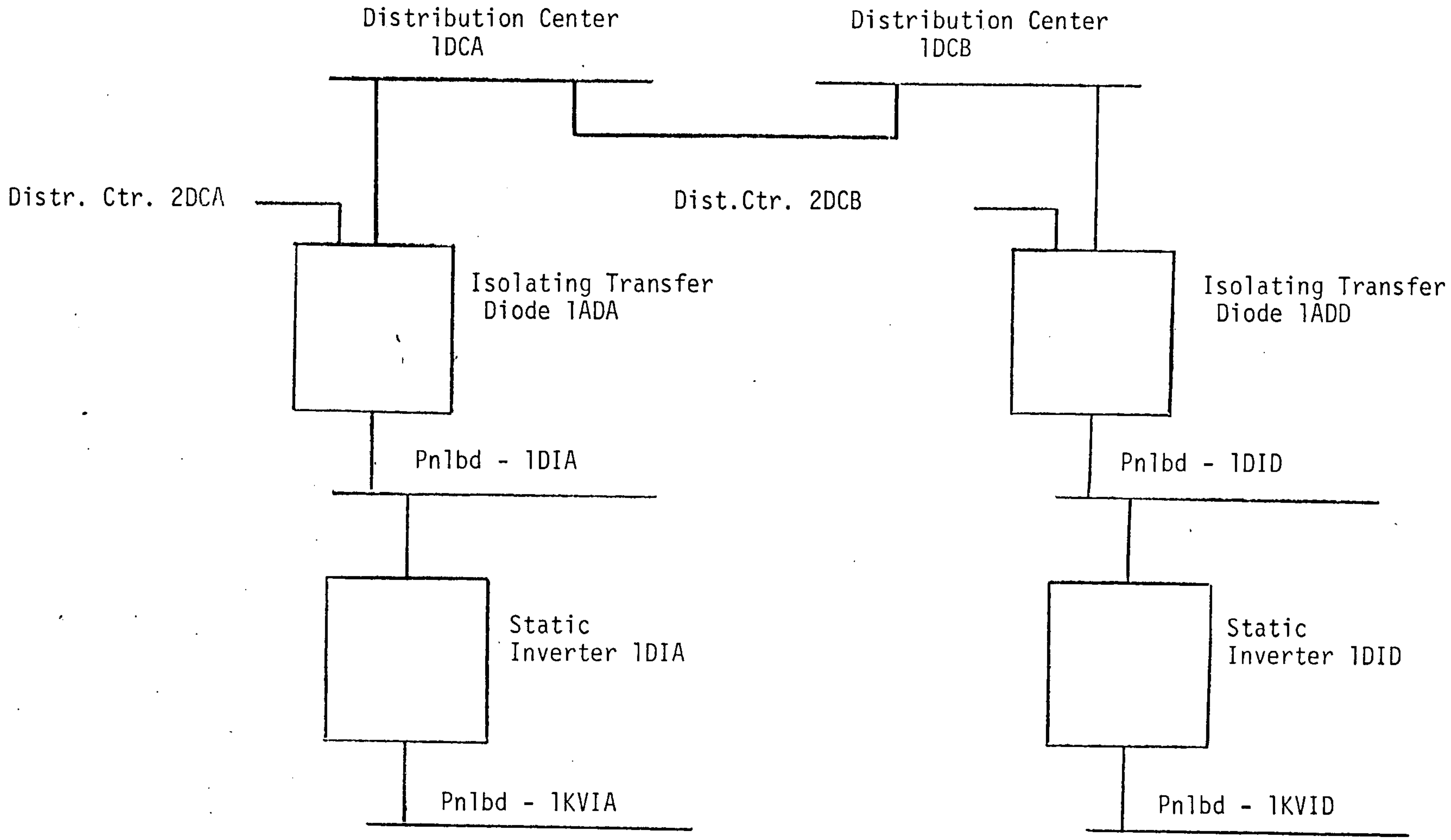
COMPONENT	BUS
AHU - 11 Fan Motor 25HP Mtr.	MCC 1XR
AHU - 12 Fan Motor 25HP Mtr.	MCC 2XR
AHU - 13 Fan Motor 3HP Mtr.	MCC 1XR
AHU - 14 Fan Motor 3HP Mtr.	MCC 2XR
AHU - 3-13 Fan Motor 15HP Mtr.	MCC 3XT
AHU - 3-14 Fan Motor 15HP Mtr.	MCC 3XT
*AHU - 3-11 Fan Motor 15HP Mtr.	MCC 3XO
*AHU - 3-12 Fan Motor 15HP Mtr.	MCC 3XP
*AHU - 3-15 Fan Motor 7½HP Mtr.	MCC 3XO
*AHU - 3-16 Fan Motor 7½HP Mtr.	MCC 3XP
Outside Air Booster Fan #22	MCC 1XR
Outside Air Booster Fan #23	MCC 2XR
Outside Air Booster Fan 3-8	MCC 3XT
Outside Air Booster Fan 3-9	MCC 3XR
*Smoke Purge Exhauster (Unit 1&2)Motorized Damper 3/4HP 208V	MCC 2XP
*Smoke Purge Exh. Fan F3-7	MCC 3XP
*W/Motorized Damper	MCC 3XP
AHU - 11 Various Elec. Duct Heaters	MCC 2XR
AHU - 12 Various Elec. Duct Heaters	MCC 1XR
AHU - 13 12KW Elec.Duct Heater	MCC 1XR
AHU - 14 12KW Elec.Duct Heater	MCC 2XR
*3-15&3-16 Electric Duct Heater 27KW	MCC 3XO
*3-11&3-12 Electric Duct Heater 54KW	MCC 3XP
3-13&3-14 Various Electric Duct Heaters (Total 80KW)	MCC 3XR MCC 3XT
Chilled Water Pump A 30HP	MCC 1XE
Chilled Water Pump B 30HP	MCC 2XE
Compressor Motor A 350KW	SWG-1TE
*Compressor Motor B 350KW	SWG-2TE
Condenser Water Pump A 10HP	MCC 1XE
Condenser Water Pump B 10HP	MCC 2XF
Chilled Water Booster Pump 15HP	MCC 2XC
AHU - 34 (Unit 1 Cable Rm) 25HP	MCC 1XO
*AHU - 35 (Unit 2 Cable Rm) 25HP	MCC 2XO
AHU - 22 (Unit 1 Equip Rm) 5HP	MCC 1XO
*AHU - 23 (Unit 2 Equip Rm) 5HP	MCC 2XO
Instrument Air Compressor B	MCC 1XF
Instrument Air Compressor A	MCC 1XD
Instrument Air Compressor C	MCC 2XF
Condensate Return Units (2) Fractional HP	MCC 1XO MCC 2XP
*Control Rm. Rad Monitor 1RIA-1	Pnlbd-1KVID
*Control Rm. Rad.Monitor 1RIA-39	Pnlbd-1KVIA
*Control Rm. Rad.Monitor 3RIA-1	Pnlbd-3KVID
*Control Rm. Rad.Monitor 3RIA-39	Pnlbd-3KVIA

NOTE: * non-load shed



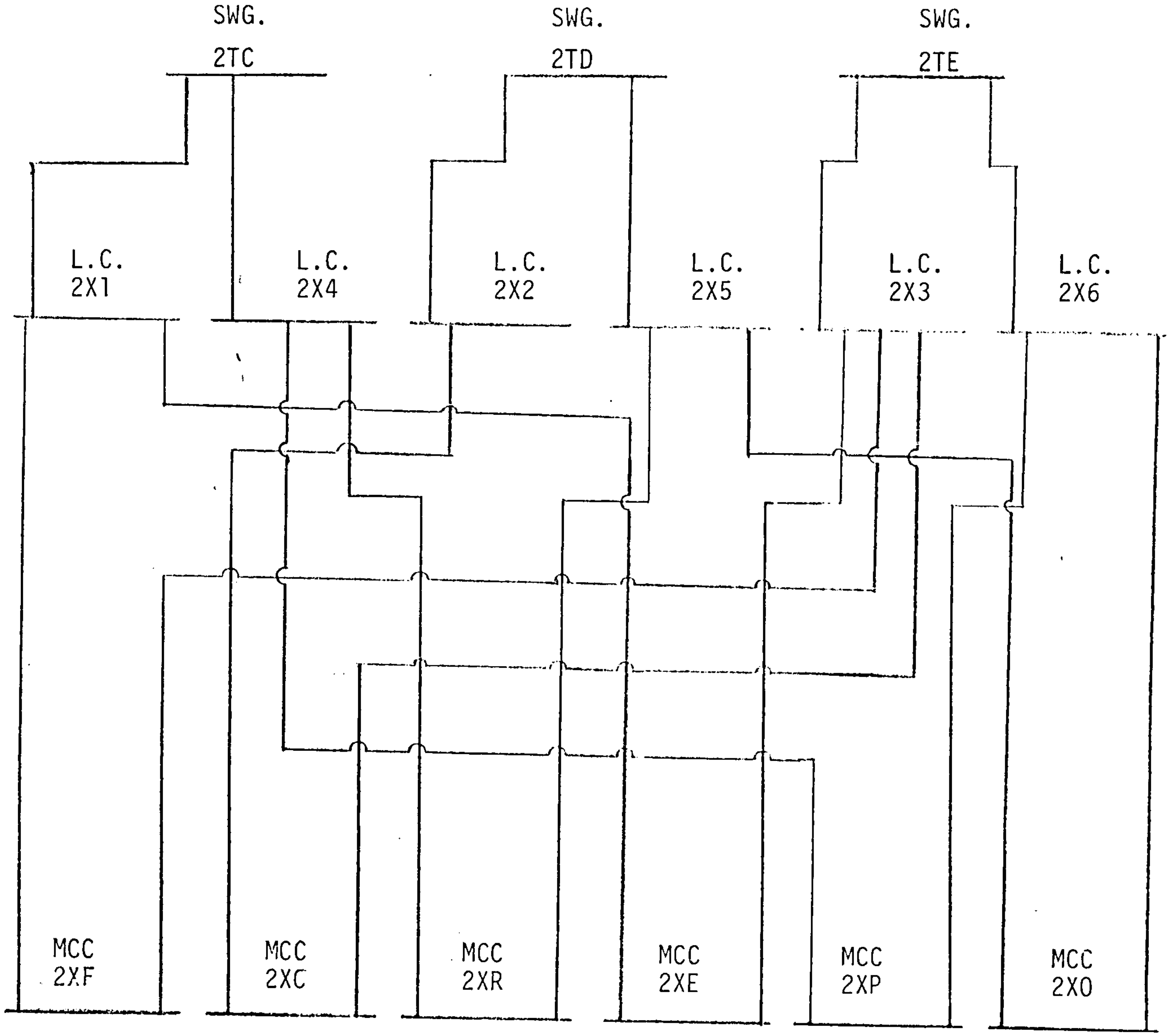
Power Distribution for Unit 1 Control Room HVAC Components

Figure 1



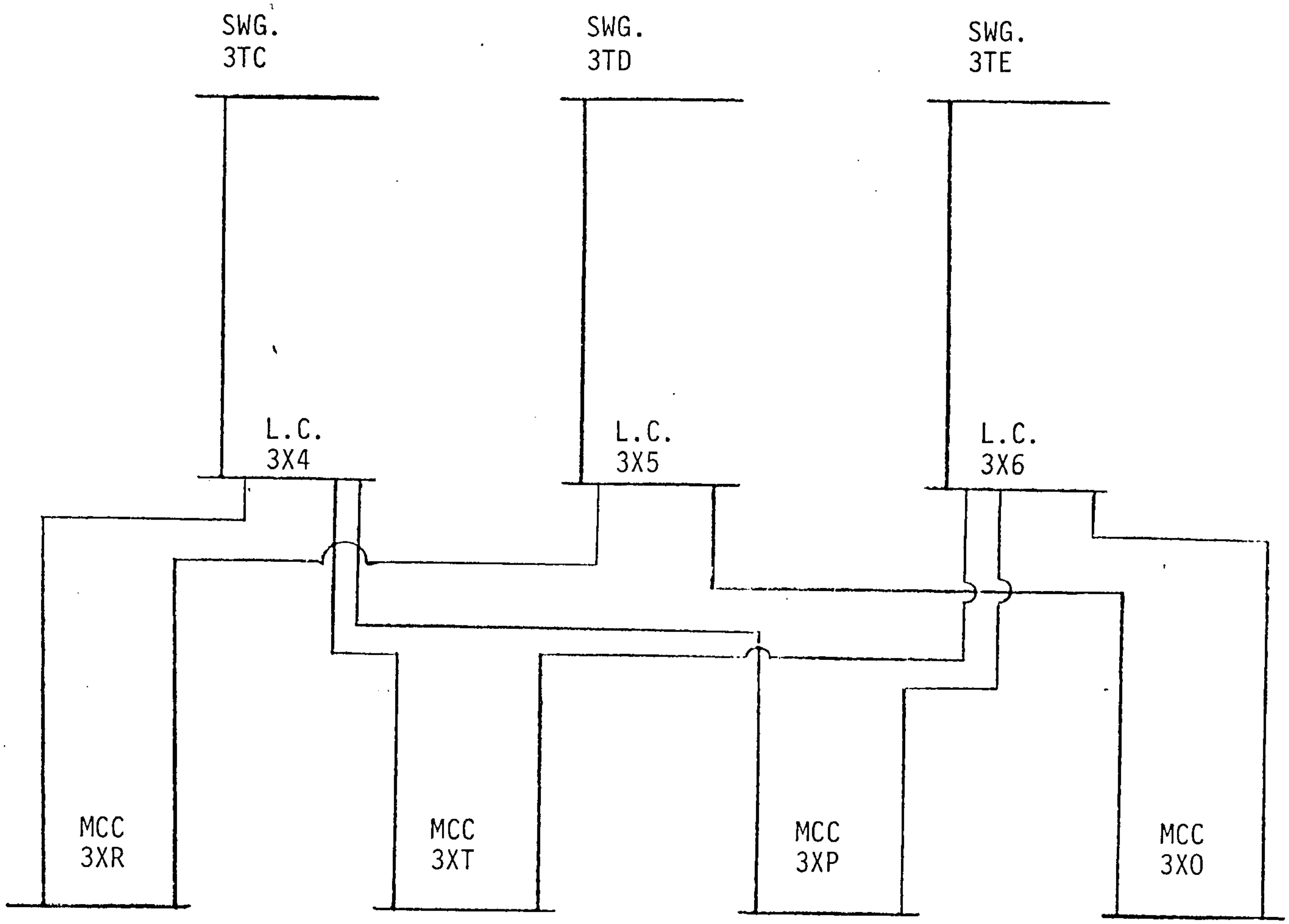
Power Distribution for Units 1 and 2 Control Room Radiation Monitors

Figure 2



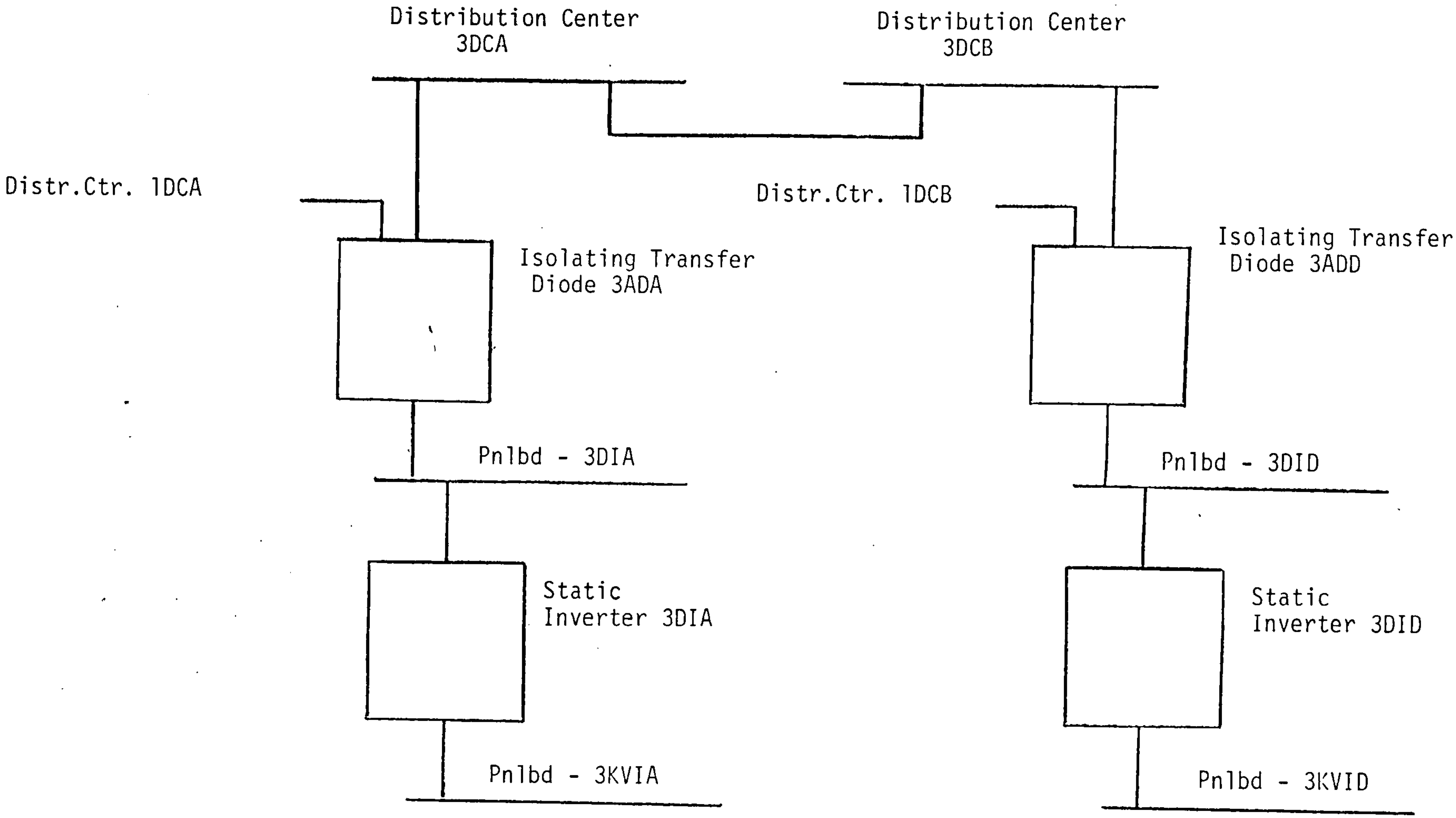
Power Distribution for Unit 2 Control Room HVAC Components

Figure 3



Power Distribution for Unit 3 Control Room HVAC Components

Figure 4



Power Distribution for Unit 3 Control Room Radiation Monitors

Figure 5

MODEL SCHEMATIC

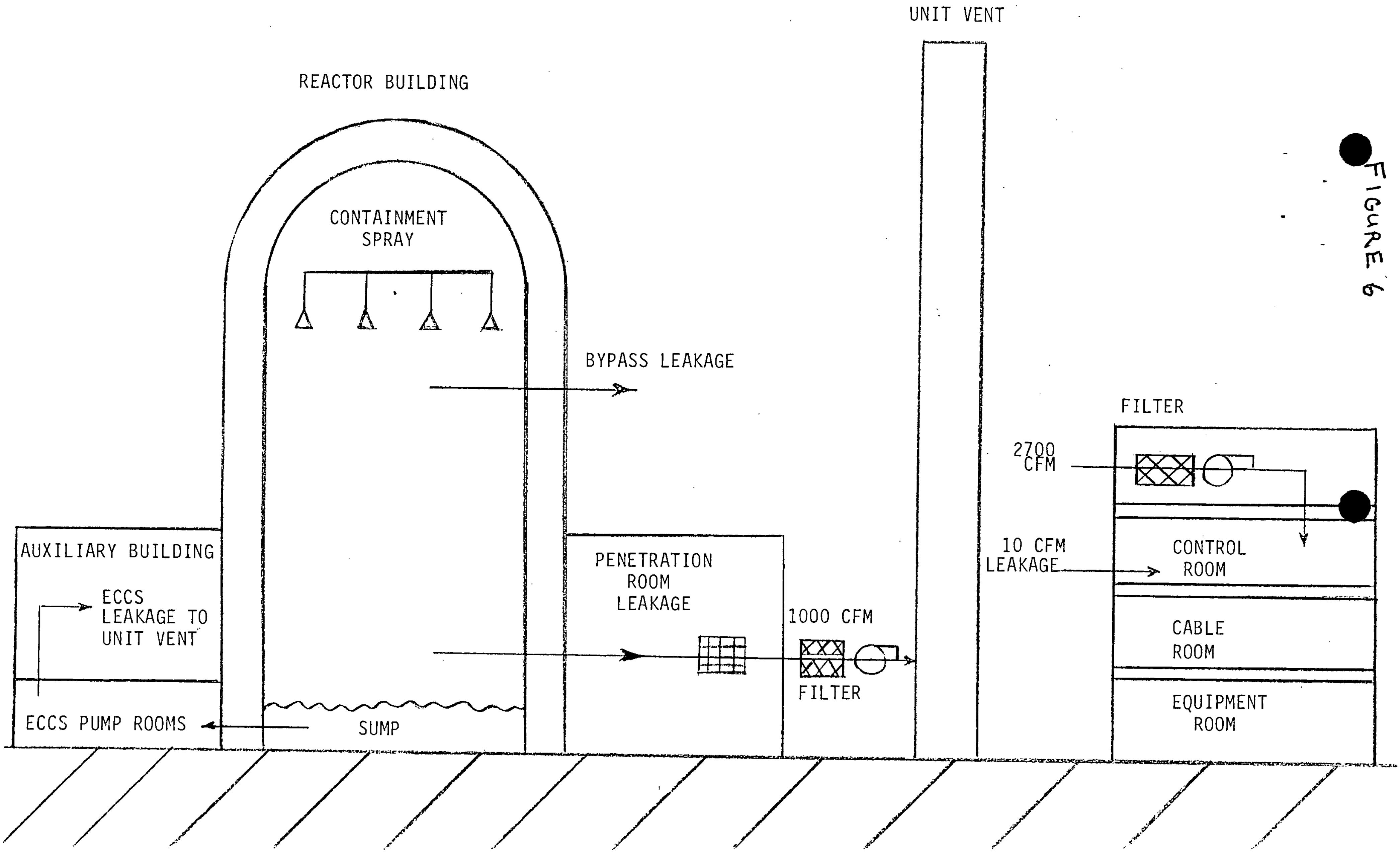


FIGURE 6

REFERENCES

1. Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," U.S. Nuclear Regulatory Commission, Rev. 2, June 1974.

2. Oconee Nuclear Station Final Safety Analysis Report, pg. 3.8-1, 1982 updated version.

3. Oconee Nuclear Station Technical Specifications, Section 4.4.1.1, "Integrated Leak Rate Tests", July 19, 1974.

4. Oconee Nuclear Station Technical Specifications, Section 4.4.1.1.5, July 19, 1974.

5. Oconee Nuclear Station Final Safety Analysis Report, pg. 9.4-16, 1982 updated version.

6. Oconee Nuclear Station Final Safety Analysis Report, pg. 15.14-20, 1982 updated version.

7. Safety Evaluation by the Directorate of Licensing U.S. Atomic Energy Commission in the Matter of Duke Power Company Oconee Nuclear Station Units 2 and 3, Chapter 11.0.

8. Oconee Nuclear Station Final Safety Analysis Report, Section 6.0.3.1, 1982 updated version.

9. Oconee Nuclear Station Technical Specifications, Section 4.5.4.1, "Low Pressure Injection System Leakage," July 19, 1974.

10. "Radiological Consequences of a Design Basis Loss-of-Coolant Accident: Leakage From Engineered Safety Feature Components Outside Containment", Section 15.6.5 Appendix B of U.S. Nuclear Regulatory Commission Standard Review Plan Office of Nuclear Reactor Regulation, NUREG-0800, Rev. 2, July 1981.

11. "Control Room Habitability System", Section 6.4 of U.S. Nuclear Regulatory Commission Standard Review Plan Office of Nuclear Reactor Regulation, NUREG-0800, Rev. 2, July 1981.

12. Oconee Nuclear Station Final Safety Analysis Report, pg. 9.4-3, 1982 updated version.

13. Oconee Nuclear Station Final Safety Analysis Report, Section 6.2.4, 1982 updated version.