VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION

UNITS 1 AND 2

SUMMARY REPORT

MAIN CONTROL ROOM AND EMERGENCY SWITCHGEAR ROOM AIR CONDITIONING SYSTEM

December 29, 1988

135-BWF-3770-1

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1.0 INTRODUCTION

The Main Control Room and Emergency Switchgear Room (MCR & ESGR) Air Conditioning System is a shared system that cools the Surry Unit 1 and Unit 2 main control rooms, emergency switchgear rooms, and relay rooms. The MCR & ESGR Air Conditioning System cools only the air within the area boundaries and does not serve to pressurize the control room pressure boundary nor condition incoming outside air.

The system consists of one operating full capacity air conditioning train and one full capacity back-up air conditioning train. Each train contains one chiller refrigeration unit and four air handling units (AHU) - a dedicated AHU for each of the areas served, i.e., the Unit 1 MCR, Unit 2 MCR, Unit 1 ESGR, and Unit 2 ESGR (reference to the ESGR implies reference to the relay rooms also). A third chiller is provided as a maintenance swing chiller. A schematic diagram is presented in Figure 1.1. The alpha-numeric designators, 1H, 1J, 2H, and 2J refer to the emergency electrical distribution buses from which the equipment is powered.

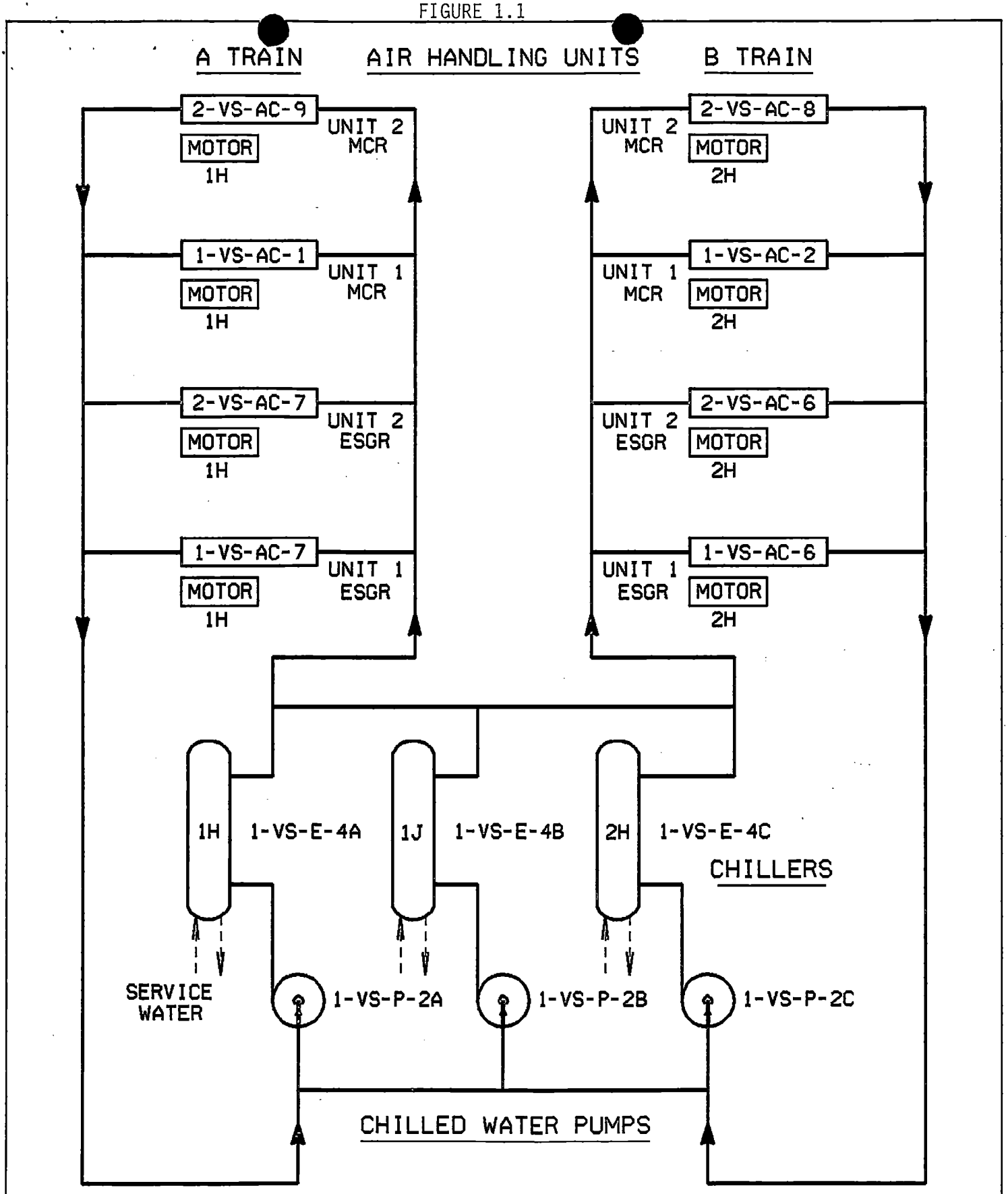
The design basis of the MCR & ESGR Air Conditioning System is to maintain the following design bulk air temperatures under the following design basis assumptions.

Location	Normal Operation	Accident
Main Control Rooms	75°F	75°F
Emergency Switchgear Rooms	80°F	87°F

The design basis assumptions used in the design of the MCR & ESGR Air Conditioning System are a single unit Loss of Coolant Accident (LOCA), a Loss of Offsite Power (LOOP), and Single Failure Criterion.

On September 9, 1988, a Station Deviation Report was issued to address the potential inadequacy of the MCR & ESGR Air Conditioning System to maintain these design room temperatures. The following discussion describes the approach used to assess this potential deficiency.

FIGURE 1.1



SCHEMATIC DIAGRAM - MCR & ESGR
CHILLED WATER SYSTEM
BEFORE MODIFICATION

2.0 APPROACH AND TEST FINDINGS

To make a determination of system adequacy, a special test (ST-220) was developed to obtain system and equipment performance data. This test was conducted from October 11 to October 13, 1988 with both Unit 1 and Unit 2 in cold shutdown. The data was used to form the basis of a design heat load calculation and to assess actual equipment performance relative to equipment design performance.

The data obtained from ST-220 was used to calculate a base case heat load, i.e. the heat load that existed at the time of test. The base case heat load was then extrapolated by calculation to arrive at design heat loads associated with normal operation and accident conditions. The results of this calculation substantiate that the design accident heat load (worst case heat loads due to the operation of equipment necessary to mitigate a LOCA) in the main control rooms is within the design capacity of a single train of MCR air handling units; therefore, it is concluded that the main control room portion of the MCR & ESGR Air Conditioning System is adequate to maintain design MCR temperatures. The calculation results also indicate that the design accident heat load in the emergency switchgear rooms exceed the design capacity of a single train of ESGR air handling units. A summary of the design heat loads as compared to the design capacity of the ESGR air handling units is presented in Table 2.1.

Referring to Table 2.1, column one provides a best estimate of original design heat loads - the original design heat load calculation cannot be located. Column two shows the design heat loads developed from the special test data and column three shows the furnished capacity of a single ESGR air handling unit. Although two air handling units are installed in each emergency switchgear room, only one air handling unit can be taken credit for given the single failure design consideration. This table illustrates that a single air handling unit in each ESGR is not adequate to maintain design room temperatures. The special testing also identified that calculated ESGR design heat loads added to the MCR design heat loads exceed the capacity of a single chiller refrigeration

unit. Data from the special test further indicate that certain system equipment was not performing adequately, e.g. inadequate air handling unit fan speeds and inadequate chilled water flows.

LER 88-033-0 was issued on December 2, 1988 to address these deficiencies. The deficiencies were attributed to 1) the cumulative effect of adding incremental heat loads to the emergency switchgear rooms, i.e. the installation of new electrical equipment over the years exceeded the system heat removal capacity and 2) the lack of adequate preventative maintenance and surveillance test programs.

The remaining discussions address long term and short term resolutions and will focus primarily on the ESGR air handling units and chillers.

TABLE 2.1

SUMMARY

EMERGENCY SWITCHGEAR ROOM AHUs

(10^3 BTU/HRr)

CONDITION	HEATLOAD REQUIREMENTS		AHU CAPACITY
	DESIGN*	SP.TEST	CURRENT**
NORMAL			
UNIT 1	245	440	355
UNIT 2	245	475	355
ACCIDENT			
UNIT 1	333	595	355
UNIT 2	333	635	355

NOTES:

* BEST ESTIMATE

** SPEC. 333, INSTALLED 355 - SINGLE AHU CAPACITY

3.0 RESOLUTION

To maintain design basis room temperatures and the original system design configuration, i.e., two 100% capacity air conditioning trains, a permanent modification must be implemented to replace undersized equipment with new, higher capacity equipment. This permanent modification is entitled "The Pressure Boundary AC Upgrade Project". Due to the long lead time for safety related, custom designed equipment, this modification is scheduled for implementation during the next Surry refueling outages.

In the interim, the MCR & ESGR Air Conditioning System will be modified to utilize the existing equipment to meet the system design basis, i.e. maintain design room temperatures under design basis assumptions (LOCA, LOOP, Single Failure). Specifically, the interim system modification will require the operation of two air handling units in each emergency switchgear room and two chillers to maintain design ESGR temperatures under design heat load conditions. As indicated in Section 2.0, one operating air handling unit in each main control room is adequate to maintain the MCR design temperatures; therefore, no modifications to the MCR air handling units are necessary.

Modifications to the ESGR air handling units and chillers will be required to provide the necessary heat rejection capability and to maintain design basis assumptions. The ESGR air handling units must operate in parallel at higher total volumetric air flows to reject the maximum design heat loads. As such, the ESGR AHU fan speeds will be increased by approximately 100 RPM and minor duct modifications will be installed to prevent air velocities from exceeding duct design limits. The ESGR air handling units will also be modified to account for credible equipment failures (Please refer to Section 5.0 for a discussion of failure scenarios). To ensure that operation of an ESGR air handling unit can be quickly restored in the event of drive motor or power source failure, a redundant drive motor will be installed on each ESGR air handling unit and will be powered from a different emergency power source than that of the primary drive motor. The modified arrangement is

schematically shown in Figure 3.1. The redundant motor will be mounted on each air handling unit opposite the primary drive motor and will be mechanically coupled to the shaft by sheave and belt arrangement. The redundant drive motor control switch will be mounted local to the equipment and will be appropriately labeled. The ESGR air handling units' motorized inlet air dampers and chilled water temperature control valves will be decoupled from their operators and locked in the full open position to ensure full capacity AHU operation and to remove them from active failure consideration.

A chiller modification will also be necessary to account for credible equipment failure. Because only two of the three existing chillers are required to operate under maximum design heat loads, modifications to the chillers are less extensive than those for the ESGR air handling units. However, in one of the failure scenarios considered for the existing design configuration, emergency power will be lost to two of the three chillers.

The Surry Power Station emergency electrical distribution system has a three emergency diesel generator (EDG) arrangement - EDG No. 1 powers the Unit 1 "H" bus (1H), EDG No. 2 powers the Unit 2 "H" bus (2H), and EDG No. 3 is a swing diesel and can be aligned to either the Unit 1 "J" bus (1J) or the Unit 2 "J" bus (2J). The failure scenario under discussion would involve a loss of offsite power and single failure of EDG No. 2 which would require that EDG No. 3 be aligned to the unit without power, i.e. to the Unit 2 "J" bus or 2J. Since chiller 1-VS-E-4B is powered from the 1J bus and chiller 1-VS-E-4C is powered from the 2H bus, both chillers would be without power. To accommodate this failure scenario, the interim modification will install a manual power transfer switch to enable chiller 1-VS-E-4B to be powered from either the 1J emergency bus or the 2J emergency bus. The transfer of power to the 1-VS-E-4B chiller includes the transfer of power to the necessary chiller auxiliary equipment, e.g. chilled water pump, chilled water MOV, and chiller condenser service water pump. No other modifications to the chillers are necessary.

Table 3.1 provides a summary of the maximum design heat loads developed from the results of special test ST-220, the capacity of a single ESGR air handling unit (current design can take credit for only one), and the resultant heat rejection capability from the operation of two ESGR air handling units which is provided for by the interim modification. To further increase the margin between maximum calculated heat load and interim system capacity, the elimination of unnecessary heat loads was investigated. Column three in Table 3.1 titled "As Modified" shows the resulting maximum ESGR design heat loads which have been reduced by de-energizing unnecessary strip heaters located in the 4KV switchgear. Therefore, a comparison of the "As Modified" heat load requirements and the interim ESGR system capacity (Column 5) yields the system capacity margin for the emergency switchgear rooms under normal operating and accident conditions. Making this comparison shows that the least margin exists in the Unit 2 emergency switchgear room and is approximately 35,000 Btu/Hr. The Unit 1 emergency switchgear room margin is approximately 75,000 Btu/Hr.

As indicated in Section 2.0, the special test results also indicate that certain system equipment was not performing to design requirements. To enhance system performance, a rigorous program was established to clean, refurbish, and replace, as necessary, system equipment. This program includes, but is not limited to, the internal and external cleaning of AHU cooling coils, cleaning of the AHU fans, refurbishment of the chilled water pumps, refurbishment of the service water PCV's, inspection and repair of system valves, and adjustment of AHU fan speeds. Inspections and refurbishment, as necessary, of the ESGR air handling units' fan assemblies will be performed during this present outage to ensure reliable operation during the interim operating period.

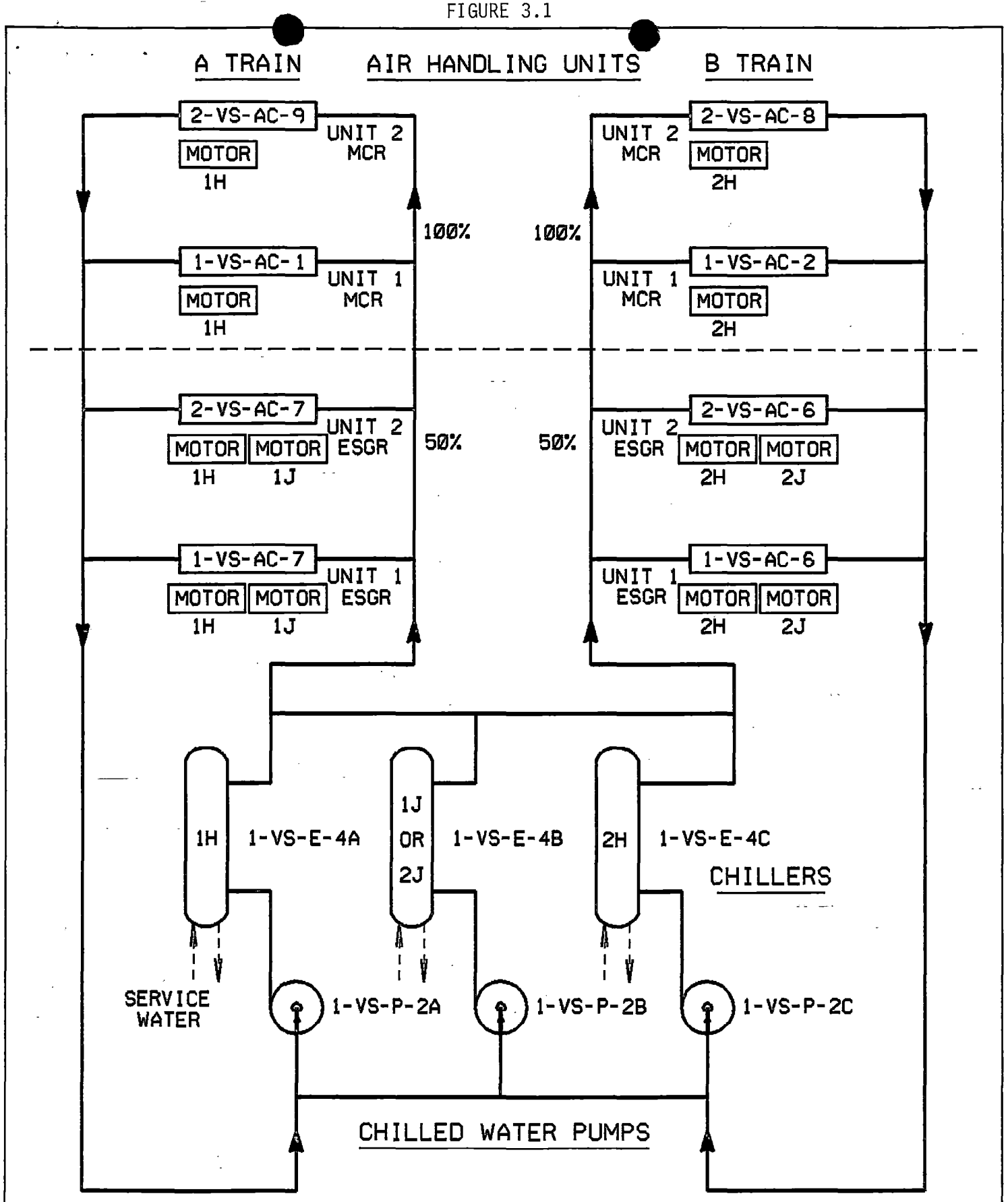
In addition to the identified hardware modifications, deficiencies in the current maintenance and surveillance programs will be reviewed and enhanced to ensure that system reliability and performance is maintained throughout the interim operating period. In addition, the existing Nuclear Design Control Program will be reviewed and enhanced, as appropriate, to ensure that the cummulative effects of incremental heat

load additions to critical areas are properly assessed and taken into consideration.

In summary, a permanent modification to return the MCR & ESGR Air Conditioning System to its original design configuration of two 100% air conditioning trains will be implemented during the next Surry refueling outages. In the interim, the current system will be modified to utilize existing equipment for maintaining design room temperatures under system design basis assumptions. Completion of the current outage maintenance program to restore proper equipment operation coupled with the enhancement of preventative maintenance and surveillance test programs will ensure that the interim system operates reliably and within acceptable performance envelopes.

Additional discussion regarding operating restrictions, failure scenarios and the unreviewed safety question evaluation is included in Sections 4.0, 5.0 and 6.0 respectively.

FIGURE 3.1



SCHEMATIC DIAGRAM - MCR & ESGR
CHILLED WATER SYSTEM
AFTER MODIFICATION

TABLE 3.1

SUMMARY

EMERGENCY SWITCHGEAR ROOM AHUs

(10^3 BTU/Hr)

CONDITION	HEATLOAD REQUIREMENTS			AHU CAPACITY	
	DESIGN[1]	SP.TEST	AS MODIFIED[2]	CURRENT[3]	INTERIM MOD[4]
NORMAL					
UNIT 1	245	440	420	355	650
UNIT 2	245	475	460	355	650
ACCIDENT					
UNIT 1	333	595	575	355	650
UNIT 2	333	635	615	355	650

NOTES:

1 BEST ESTIMATE

2 DE-ENERGIZE 4KV SWITCHGEAR HEATERS

3 SPEC. 333, INSTALLED 355

4 LIMITED BY DUCTWORK CAPACITY (17,000 cfm)

4.0 SINGLE FAILURE ANALYSIS

A single failure evaluation was conducted to assure that the modified system would perform its intended safety function during credible single failure scenarios. Both mechanical and electrical failures were considered in the evaluation.

Certain mechanical failures were not considered credible during the interim operating period for the following reasons.

Chilled Water Piping and AHU Coils

The chilled water piping and AHU coils are passive components which contain a low energy fluid, i.e. 40-50°F temperature and approximately 80 psig pressure chilled water. Given the mild service conditions to which these components are subjected, mechanical failure during the interim operating period is considered unlikely.

AHU Fan Shaft Assembly

The fan assembly rotates at a relatively low speed (less than 1300 rpm) therefore, stress fatigue failure during the interim operating period is considered unlikely.

NOTE: The chilled water piping, AHU coils, and fan assemblies will be inspected, and repaired as necessary during the ongoing outage, to ensure that this equipment will operate reliably during the interim operating period thereby validating the above mechanical failure assumptions.

AHU Inlet Air Dampers

The ESGR AHU inlet air dampers are actuated by motor operators and are designed to close on loss of power. The interim modification will decouple the operator/damper linkage and physically lock the dampers in the wide open position to effect maximum air flow. The dampers

will then become passive components and failure is considered unlikely.

AHU Chilled Water Temperature Control Valves (TCV)

The ESGR AHU chilled water TCVs modulate on thermostat control to bypass chilled water around the AHU cooling coil. The TCVs are actuated by motor operators. The interim modification will de-energize the motor operator and place the TCV in the wide open position to effect maximum chilled water flow through the cooling coil. In addition, the bypass line isolation valve will be closed for further assurance. The TCVs will become passive components and failure is considered unlikely.

Ductwork

The existing ductwork in each area is common to the redundant air handling units. Although the interim modification will not affect the original design commonality, a failure evaluation was performed. As in the case of the chilled water system piping and AHU coils, the ductwork contains a low energy medium, i.e., 50-60°F air at less than or equal to 2.0 inches static pressure. The interim modification design accounts for the higher air flows by rebalancing the system to ensure that ductwork design limits are not exceeded. Given these considerations, mechanical failure is considered unlikely and is consistent with original design assumptions.

The remaining credible failure scenarios which are accounted for by the interim modification design are summarized in Table 4.1. This table also indicates the corresponding action(s) which are required to restore equipment operability and the system margin pertaining to each failure scenario. The system margin qualitatively illustrates the difference between system capacity (which does not change) and heat loads which are inherently reduced as a result of certain failure scenarios. For example, loss of an emergency bus also results in the loss of associated heat producing electrical equipment. (NOTE: It would be helpful to refer to Sketch 3.1 during review of Table 4.1).

Based on the above failure evaluation, it is concluded that the interim modification design ensures that the MCR & ESGR air conditioning system will reliably perform its intended safety function for all credible failure scenarios. This conclusion also forms the basis for Section 6.0 "Unreviewed Safety Question Evaluation".

TABLE 4.1

FAILURE ANALYSIS SUMMARY

FAILURE SCENARIOS	ACTION	SYSTEM MARGIN CAPACITY VS. HEAT LOAD
1. ESGR AHU Motor Failure	Energize back-up AHU motor with alternate power source	No Change
2. MCC Failure	Energize back-up AHU motors with alternate power sources/energize back-up chiller if necessary.	No Change (i.e. Negligible Increase)
3. Load Center Failure	Energize back-up AHU motors with alternate power sources/energize back-up chiller if necessary.	Increase
4. Bus Failure	Energize back-up AHU motors with alternate power sources/energize back-up chiller if necessary.	Increase
5. Loss of Offsite Power (LOOP) EDG No. 3 Failure	ESGR AHUs are unaffected/energize back-up chiller if necessary.	Increase
6. LOOP/EDG No. 1 Failure	Energize back-up AHU motors with alternate power sources/energize back-up chiller if necessary.	Increase
7. LOOP/EDG No. 2 Failure	Energize back-up AHU motors with alternate power sources/transfer power source from 1J to 2J for chiller 4B / energize back-up chiller	Increase
8. Chiller Failure	Energize back-up chiller	No Change
9. Chiller Chilled Water or Service Water Pump Failure	Energize back-up chiller	No Change

5.0 INTERIM OPERATING RESTRICTIONS

System operating restrictions will be imposed on the modified MCR & ESGR Air Conditioning System until the permanent upgrade is implemented in 1990. The restrictions will supplement the current Technical Specification limiting conditions for operation and will be administratively implemented. These operating restrictions are presented in Table 5.1. The basis for the operating restrictions is as follows.

The modified system will require the operation of two chillers, two of the four MCR air handling units, and four ESGR air handling units to maintain design temperatures under maximum heat load conditions. Taking credible single failures into consideration requires that redundant equipment be available during operation. As such, the interim limiting conditions for operation will require that three chillers and eight air handling units be operable when at power operation. Further, the interim limiting conditions for operation will require that both drive motors on each ESGR air handling unit be operable. In addition to the equipment restrictions above, fire watches will be required during this interim period in both unit's ESGR and MER #3 to address Appendix R considerations.

Action statements will allow that redundant equipment be inoperable for a period not to exceed seven (7) days to facilitate preventative and corrective maintenance. If the inoperable equipment is not returned to operable status within seven (7) days, the appropriate reactor unit(s) must be brought to the shutdown condition. The action statements only allow continued operation (i.e., seven day window) when sufficient equipment is operable to maintain design room temperatures under maximum design heat loads. The action statements require that the appropriate reactor unit(s) be shutdown whenever less than the requisite equipment is operable.

TABLE 5.1

OPERATING RESTRICTIONS

SURRY POWER STATION UNITS 1 AND 2

CHILLER REFRIGERATION UNITS - LIMITING CONDITIONS FOR OPERATION

A. Chillers 1-VS-E-4A, 4B, and 4C must be operable whenever either unit is above Cold Shutdown.

B. If one chiller becomes inoperable, return the inoperable chiller to operable status within seven (7) days or bring both units to Hot Shutdown within the next six (6) hours and be in Cold Shutdown within the following 30 hours.

AIR HANDLING UNITS - LIMITING CONDITIONS FOR OPERATION

A1. Unit 1 air handling units, 1-VS-AC-1, 1-VS-AC-2, 1-VS-AC-6, and 1-VS-AC-7, must be operable whenever Unit 1 is above Cold Shutdown.

A2. Unit 2 air handling units, 2-VS-AC-8, 2-VS-AC-9, 2-VS-AC-6, and 2-VS-AC-7 must be operable whenever Unit 2 is above Cold Shutdown.

A3. Unit 1 ESGR AHU drive motors, 1-VS-FMO-6A, 1-VS-FMO-6B, 1-VS-FMO-7A, and 1-VS-FMO-7B must be operable whenever Unit 1 is above Cold Shutdown.

A.4 Unit 2 ESGR AHU drive motors, 2-VS-FMO-6A, 2-VS-FMO-6B, 2-VS-FMO-7A, and 2-VS-FMO-7B must be operable whenever Unit 2 is above Cold Shutdown.

B1. B1a. If one Unit 1 MCR AHU becomes inoperable, return the inoperable AHU to operable status within seven (7) days or bring Unit 1 to Hot Shutdown within the next six (6) hours and be in Cold Shutdown within the following 30 hours.

B1b. If one Unit 1 ESGR AHU becomes inoperable, bring Unit 1 to Hot Shutdown within the next six (6) hours and be in Cold Shutdown within the following 30 hours.

B2. B2a. If one Unit 2 MCR AHU becomes inoperable, return the inoperable AHU to operable status within seven (7) days or bring Unit 2 to Hot Shutdown within the next six (6) hours and be in Cold Shutdown within the following 30 hours.

B2b. If one Unit 2 ESGR AHU becomes inoperable, bring Unit 2 to Hot Shutdown within the next six (6) hours and be in Cold Shutdown within the following 30 hours.

B3. If a Unit 1 ESGR AHU drive motor becomes inoperable, return the inoperable drive motor to operable status within seven (7) days or bring Unit 1 to Hot Shutdown within six (6) hours and be in Cold Shutdown within the following 30 hours.

TABLE 5.1 (Continued)

B4. If a Unit 2 ESGR AHU drive motor becomes inoperable, return the inoperable drive motor to operable status within seven (7) days or bring Unit 2 to Hot Shutdown within six (6) hours and be in Cold Shutdown within the following 30 hours.

Nomenclature: ESGR - Emergency Switchgear Room
MCR - Main Control Room
AHU - Air Handling Unit

6.0 UNREVIEWED SAFETY QUESTION EVALUATION

A 10 CFR 50.59 evaluation was made to examine the impact of installing the MCR & ESGR air conditioning system interim modification. This modification assures that main control room and emergency switchgear room design temperatures are maintained for design basis conditions. The results of this evaluation are as follows:

a) The implementation of this modification does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety and previously evaluated in the Final Safety Analysis Report.

The installation of the interim modification will ensure that design temperatures are maintained under design basis conditions and credible single failure scenarios; therefore, the main control rooms and emergency switchgear rooms will remain at temperatures which afford habitability and reliable equipment operation. The imposition of interim system operating restrictions will ensure that the requisite equipment is operable to maintain design room temperatures.

The installation of additional air conditioning equipment will occur during the cold shutdown or refueling mode. This modification will not adversely affect other safety related equipment or the operation of other safety systems.

b) The implementation of this modification does not create a possibility for an accident or a malfunction of a different type than any evaluated previously in the Final Safety Analysis Report.

The interim modification will uprate the existing air conditioning system to ensure that it will perform its safety related function of maintaining design temperatures in the main control rooms and emergency switchgear rooms during normal and accident conditions. The design considers and accounts for design basis conditions and credible single failure scenarios.

This interim modification requires manual action be taken to energize redundant mechanical equipment which is consistent with the original design basis. The manual action required as a result of this modification must be taken locally at the equipment. However, adequate time is available for local operation of equipment to be accomplished.

c) The implementation of this modification does not reduce the margin of safety as defined in the basis of any Technical Specification. This interim modification will restore the main control room and emergency switchgear room air conditioning system to its design basis by ensuring that safety equipment reliability and control room habitability is maintained under normal and accident conditions. This modification will restore equipment redundancy to provide single failure protection under credible equipment failure scenarios. Interim operating restrictions will require that the requisite equipment be operable.

It is concluded, based on the above evaluation results, that implementation of the CR & ESGR air conditioning system interim modification does not constitute an unreviewed safety question as defined in 10 CFR 50.59. Further, this modification ensures that design temperatures in the control rooms and emergency switchgear/relay rooms are maintained under normal and accident conditions therefore, the plant safety analysis is not affected.