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REQUISITION

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FROM: N. V. BUIKEMA

SUBJECT: DESIGN SPECIFICATION FOR 125-VOLT DC SYSTEM

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DESIGN SPECIFICATION FOR 125-VOLT DC SYSTEM - 22A1115, Rev. 0

PL# 216X607P25

Referenced Drawing 148F997 will be distributed separately.

TITLE: 125 VOLT DC SYSTEM

22A1115, Rev. 0 SH. NO. 1 CONT ON SHEET 2

REFERENCED DOCUMENTS

The following APED - GE Drawing forms part of this Design Specification.

148F997 "One Line Diagram Plant DC and Reactor Protection System"

1.0 SCOPE

This document shall form the basis for design of the 125 volt d-c system, including a basis for sizing the equipment, arranging the buses, and distributing the loads in order to obtain a reliable system. The system consists of a station battery, two battery chargers, vital AC M-G set and the related switchgear and protective devices.

2.0 DESCRIPTION

A very reliable source of stored electrical energy must be available within the plant to perform certain vital functions when all other sources of power are unavailable. These vital functions include power for switching circuit breakers, operating motor operated valves, annunciators, emergency lighting, emergency lubrication of the turbine, and vital AC power for instrumentation. The system shall be designed so that the loads that are most needed have the highest probability of being served. A failure in any part of the system shall be isolated so that it does not disable the whole system.

3.0 FUNCTION

3.1 References

3.1.1 One Line Diagram Plant DC and Reactor Protection System, G.E. Drawing No. 148F997.

3.2 There are three primary 125 volt d-c buses, called A, B, and C. Buses A and B together feed all the 125 volt d-c system loads. Normally, power is fed to the system through either one of two battery chargers. Charger A is fed from motor control center (MCC) A and Charger B is fed from MCC B. The battery charge is maintained by one or the other (or both) battery chargers.

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Upon loss of power from MCC A, MCC B and Battery Charger B would sustain the system and vice versa. Upon loss of both sources of power and/or failure of both battery chargers, the station battery would continue to supply power to Bus A and Bus B until service is restored or until the battery is discharged.

In the event that Bus A or Bus B should develop a fault, the breakers are so arranged as to isolate the faulty bus and continue feeding the good bus from the associated charger or the battery. In the very unlikely event that the battery connection should develop a fault, it would be isolated in such a way that the two chargers would supply Busses A and B and all except the heaviest loads could still be served.

A D-C motor control center is dual fed from Bus A and Bus B through an automatic transfer switch.

The vital A-C M-G Set provides power through the vital A-C Bus for essential A-C instrumentation loads such as the Plant Computer, Electrohydraulic Steam Pressure Regulator and other loads. The vital a-c system is supplied with power from a MG set having a 480 volt a-c motor, a 125 volt d-c motor, a 120 volt 60 cycle a-c generator and a flywheel on a common shaft. The unit is normally powered by the a-c motor from a station 480 volt motor control center. In the event of failure of this a-c source, the d-c motor will be energized from the station battery and will continue to operate the a-c generator. The flywheel will provide sufficient inertia to maintain acceptable voltage and frequency on the vital a-c bus during this transfer period. An alternate a-c source to the vital a-c bus will be provided through a bypass transformer to permit removal of the MG set from service for maintenance purposes.

The d-c motor source circuit breaker is located in the D-C motor control center. The a-c generator is connected to the 120 volt a-c power distribution bus by way of an air circuit breaker. A circuit breaker is provided in each branch feeder from the bus.

Accessory control equipment shall include voltage regulator, frequency controller, field rheostat, a-c instrumentation, d-c and a-c control switches and indicating lights.

Bus C is dual fed from Bus A and Bus B through an automatic transfer switch. The balance of the 125 volt d-c loads are fed from Bus C. If the normal feed to this bus is from Bus A, there is an alternate feed from Bus B.

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4.0 REQUIREMENTS

4.1 Standards

Equipment shall conform to all applicable standards of the NEMA, ASME, ASA and IEEE.

4.2 Functional Requirements

4.2.1 Normal Mode of Operation

The 125 volt d-c system bus sections, switchgear, feeders, distribution control centers shall be physically isolated by a firewall and equipped with adequate protective devices so that a fault developing in a portion of the system will be confined to that portion.

Except for the station battery, the system is redundant with the ability to furnish alternate sources of power to each bus. It shall be possible to isolate any component from the system for inspection, testing and maintenance.

4.2.2 Emergency Mode of Operation

An emergency (abnormal) mode of operation which is caused by or results in a loss of the charging power to only one bus shall not cause any interruption of service to the 125 volt d-c system loads.

If both sources of charging power are lost, there shall be battery capacity adequate to maintain electrical power to the following equipment for the time spans indicated.

a.	All d-c operated isolation valves	for 2 minutes
b.	Turbine emergency bearing oil pump	for 1 hour
c.	Turbine emergency seal oil pump	for 1 hour
e.	Annunciators	for 4 hours
f.	Emergency lighting	for 4 hours
g.	Vital A-C MG set (e.g. rod worth minimizer, control rod position indication, etc.)	for 1 hours
h.	Intermittent operation of selected circuit breakers and control valves for an integrated interval of approximately 20 minutes out of the total 8 hours.	

The cell voltage at the end of the above discharge period shall not be less than 1.7 volts.

If the battery is lost, but one or more sources of charging power is available, service shall be maintained to all but the heaviest motor loads (for example , not to the above lubrication oil pumps).

If the battery and both sources of power are lost, the system is in a complete failure mode. Due to the very high inherent reliability of the battery, and due to the fact that the vital power sources are highly redundant and include power from the standby generator, the complete failure mode has a very low probability.

4.2.3 Recharging and Equalization Mode of Operation

Means shall be provided for recharging the batteries from a totally discharged condition, for maintaining full charge once achieved, and for periodically giving the battery an equalizing charge when required.

4.3 Detailed Requirements

4.3.1 Battery (one (1) required)

4.3.1.1 The battery shall consist of 60 cells (nominal 125 volt d-c) Lead-acid Plante' Type or equal rated to carry the loads described in 4.2.2.

4.3.1.2 The battery shall be mounted on a sturdy rack suitable for easy maintenance. The mounting shall be designed to meet the earthquake criteria as specified in Section V-3 of the Plant Design and Analysis Report Vol. 1 and ammendments. Earthquakes shall not cause loss of acid, breakage of cells, or interruption of electrical service from the battery.

4.3.1.3 The battery shall be housed in a room which is adequately ventilated to prevent a concentration of a combustable gas from the charging mode. Arcing contacts or brushes or other sources of ignition shall be excluded from the room.

4.3.2 Battery Chargers (two (2) required)

4.3.2.1 The battery chargers shall operate from the voltage of the MCC buses.

4.3.2.2 The battery chargers shall be capable of working independently or in parallel.

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4.3.2.3 Each battery charger shall have a charging capacity adequate to deliver the maximum charging rate recommended by the battery manufacturer, while also supplying the normal steady state d-c load of the plant.

4.3.2.4 The battery chargers shall be equipped with any necessary self-protective devices.

4.3.2.5 If static, each charger shall be housed in a free standing cabinet and rated and ventillated as necessary for operation in a 50°C ambient temperature. If auxiliary cooling is required, it shall be integrally supplied with malfunction alarms.

4.3.4 Vital A-C MG Set (one (1) required)

4.3.4.1 The a-c motor is started by closing the a-c motor magentic contactor with a control switch on the MG control panel. The a-c generator is connected to the distribution bus by closing the generator air circuit breaker on the MG set control panel.

4.3.4.2 The d-c motor speed is manually adjusted to match the synchronous speed of the a-c motor and the a-c generator voltage is manually adjusted to operating conditions, after which the voltage regulation is automatically held to ±1% and the frequency is automatically held to ± 2%.

4.3.4.3 The 125 volt d-c and 120 volt a-c manually-operated circuit breakers provide short circuit protection for their respective feeders. The 125 volt d-c magnetic contactors provide reduced voltage starting and overload protection for the motor. Instrumentation shall be provided for generation control and relays for alarming loss of power.

4.3.4.4 The MG set shall be rated for continuous duty service for all connected loads--with minimum capability of supplying rated power at a power factor of 0.8 lagging. The connected loads are:

a) Plant Computer and transducers

b) Rod Worth Minimizer

c) Electrohydraulic Steam Pressure Regulator

d) Control Rod Position Indication

e) Essential Recorders and Instrumentation

4.3.4.5 The normal operating mode of the MG set shall be from the 480V AC System with automatic transfer--within 10 cycles--to the alternate DC power source on AC under voltage.

4.3.4.6 The MG set shall be equipped with any necessary self-protecting devices.

4.3.5 Instrumentation

4.3.5.1 The system shall be equipped with a ground detector which will detect an extraneous path to ground and cause an alarm.

4.3.5.2 The charging rate of each charger shall be indicated in the battery charging room.

4.3.5.3 The voltage of Buses A, B and C shall be indicated on the battery charger control panel with an off normal alarm in the control room.

4.3.5.4 Provisions shall be included to measure and/or indicate the following items associated with the vital a-c M-G set in the Control Room:

a) Transfer from AC to DC Motor.

b) Under and over AC output voltage

c) Under and overput frequency