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SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards util position & justification on dc sys indication for SER.

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Norman W. Curtis
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November 6, 1981

Mr. A. Schwencer, Chief
Licensing Branch No. 2
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docket Nos. 50-387
50-388

SUSQUEHANNA STEAM ELECTRIC STATION
DC SYSTEM INDICATION
ER 100450 FILE 841-2
PLA-959

Dear Mr. Schwencer:

As requested by the Power Systems Branch, the attached is Pennsylvania Power and Light Company's position and justification on the DC system indication.

If you have any questions, please contact us.

Very truly yours,

N. W. Curtis
Vice President-Engineering and Construction-Nuclear

CTC/mks

Attachment

cc: R. Perch - NRC

B001
S1/1

SUSQUEHANNA STEAM ELECTRIC STATION (SSES)

SER Open Item: Control Room Monitoring of Class 1E DC Power Systems

RESPONSE

The following indications and alarms for the Class 1E DC power systems are provided as follows:

ALARM or INDICATION	LOCATION		NOTES
	LOCAL	CONTROL RM.	
Bus Undervoltage Alarm	X		1,2
Bus Ground Alarm	X		1,2
Battery Monitor Alarm	X		1,2,4
Battery Charger Trouble Alarm	X		1,2,5
Battery Charger Overvoltage Alarm	X		1,2,6
Bus Ammeter	X		3
Bus Voltmeter	X		3
Battery Charger Ammeter	X		3
Battery Charger Voltmeter	X		3
DC System Trouble Alarm		X	7

NOTES:
1) See Table 1, Figure 2 for specific local annunciation.
2) These are locally indicated and actuate DC system Trouble Alarm, see Table 1 and Figure 1.
3) Meters provided locally, see Figure 3.
4) Battery monitor compares the voltage between battery halves and alarms when either the voltages aren't equal (degraded cell or discharged state) or an open circuit (such as an open fuse) exists in the battery circuit.
5) Battery Charger Trouble - indicates AC power failure, DC output breaker open, or charger current less than or equal to zero.
6) This monitor/alarm will be added by initial start for Unit 2, and prior to restart after first refueling outage for Unit 1.
7) One window for each channel/division Class 1E DC system.

The monitoring scheme provided for the DC power systems is based on the degree of control provided to the Control Room Operator. Instrumentation is provided locally in full compliance with the requirements of IEEE 308, 1974 and Regulatory Guide 1.47. A single system level DC trouble annunciator window for each channel/division is provided in the control room, consistent with the system level alarm criteria set forth in Section B of R.G. 1.47.

The following indications and alarms listed in the SER have not been specifically provided in the control room for the following reasons:

(1) Battery Current (ammeter - charge/discharge)

Under normal conditions, the floating charge current for the battery is very small, requiring a very sensitive ammeter. Shunt bypasses are employed to protect the meter movement from the much larger battery discharge currents (on the order of 2000 AMPS) possible in this circuit. These shunts must be manually removed when reading

the normal small current. Thus, this reading cannot be continuous and no automatic indications or alarms can be given.

Since the intent of indicating "Battery Current" is to determine the battery condition, the method used to accomplish this purpose should not be important. For the Class 1E batteries SSES employs a battery monitoring device which operates like an extremely sensitive undervoltage relay. This device compares the voltage of half of the battery's cells to the other half to determine if a voltage imbalance greater than $\pm$ 2% exists. Under these conditions (indicating a degraded cell or a discharged state) the general DC System Trouble alarm annunciates in the control room, and an operator is dispatched to locally assess the cause of the condition and initiate corrective action. Specific indication is provided on the local reflasher panels. This response is exactly what would be achieved if an improper state of battery current (which would cause the voltage imbalance) were indicated on an ammeter in the control room.

The SSES method is faster and more reliable since the condition is automatically alarmed. Furthermore, this approach is consistent with the human factors engineering goal to not overburden the operator with unnecessary information. Since the DC power system equipment cannot be remotely controlled, it serves no useful purpose for the control room operator to determine the exact cause of the problem. Rather, the analysis of the problem in the control room might distract the operator from more vital duties. The SSES design accomplishes the purpose of a battery current monitor in a manner better suited to the operation of the plant.

(2) Battery Charger Output Current (ammeter)

This ammeter is located on the front of the charger panel where it provides useful information to maintenance and service personnel. This information is not required in the main control room since any significant current deviations result in a DC system level trouble alarm in the control room due to actuation of the local charger trouble or overvoltage alarms. This alarm philosophy is consistent with general principle of giving the operator only necessary information so as not to overwhelm him with unnecessary inputs.

(3) DC Bus Voltage (voltmeter)

The purpose of a bus voltmeter would be to enable the operator to dispatch someone to take corrective action locally to correct abnormal bus voltage conditions. On SSES, bus undervoltage is monitored directly, overvoltage conditions are monitored at the charger output as detailed in discussions (4) and (6) below, and both are alarmed in the control room via the general system level trouble alarms. This design automatically alerts the operator to unusual voltage conditions without unnecessarily requiring his periodic attention and analysis. As a result, this voltmeter has been excluded from the Control Room and has been provided on the front of the load center where it provides useful information during surveillance and maintenance activities.

(4) Battery Charger Output Voltage (voltmeter)

This voltmeter is located on the front of the charger panel as an aid to maintenance and service personnel. With the charger output breaker closed (an open breaker will activate the system trouble alarm) the charger output and bus voltages are the same due to the close proximity of the charger to the load center. Thus, all abnormal voltage conditions are already monitored (see discussion (3) and (6)) and this voltmeter would not provide any additional necessary information.

(5) Battery High Discharge Rate Alarm

This condition can only occur if there is an undervoltage on the DC bus or a ground between the bus and the battery. Since the system trouble alarm will sound on either of these conditions, the addition of this alarm in the Control Room would not add to the operator's information on the situation and could be distracting. As such, this alarm would be inconsistent with the SSES alarm design philosophy and has been excluded.

(6) Direct Current Bus Overvoltage Alarm

We have reviewed the requirement for this additional alarm and alternatively decided to provide a local indication for battery charger overvoltage tied into the Control Room system level alarm. Per the previous discussion (4), bus and charger output voltage are the same except when the charger output breaker is open, and that condition is alarmed. Since overvoltage on the bus could occur only when the charger is connected to the bus, charger overvoltage monitoring provides sufficient information to meet the intended purpose of the proposed alarm. This condition is specifically indicated locally and alarmed on a system level in the Control Room, consistent with SSES design philosophy.

(7) Battery Fuse Open Alarm

This condition is detected via the battery monitor previously discussed (1). The battery monitor indicator will light on the local reflasher panel, and the DC system trouble alarm will sound in the Control Room. Since annunciating this specific condition would not provide any enhancement of the Control Room operator's ability to deal with the situation, it is inconsistent with the alarm design philosophy, and has been excluded on that basis.

The SSES design conveys sufficient DC system information to the operator without giving him more than he requires. The design is based on the general criteria that, if the operator can perform some corrective action in the Control Room in response to a specific input, that information has been specifically provided. However, if the only response required is to dispatch an operator to an area removed from the Control Room, then the only information required in the Control Room is general information with only the level of specificity required to direct that operator to the proper location. The DC system general trouble alarms and specific local indicators in conjunction with the 8 hour routine surveillance provide positive assurance that the Class 1E DC Power Systems will be maintained in a steady state ready to perform their intended function.

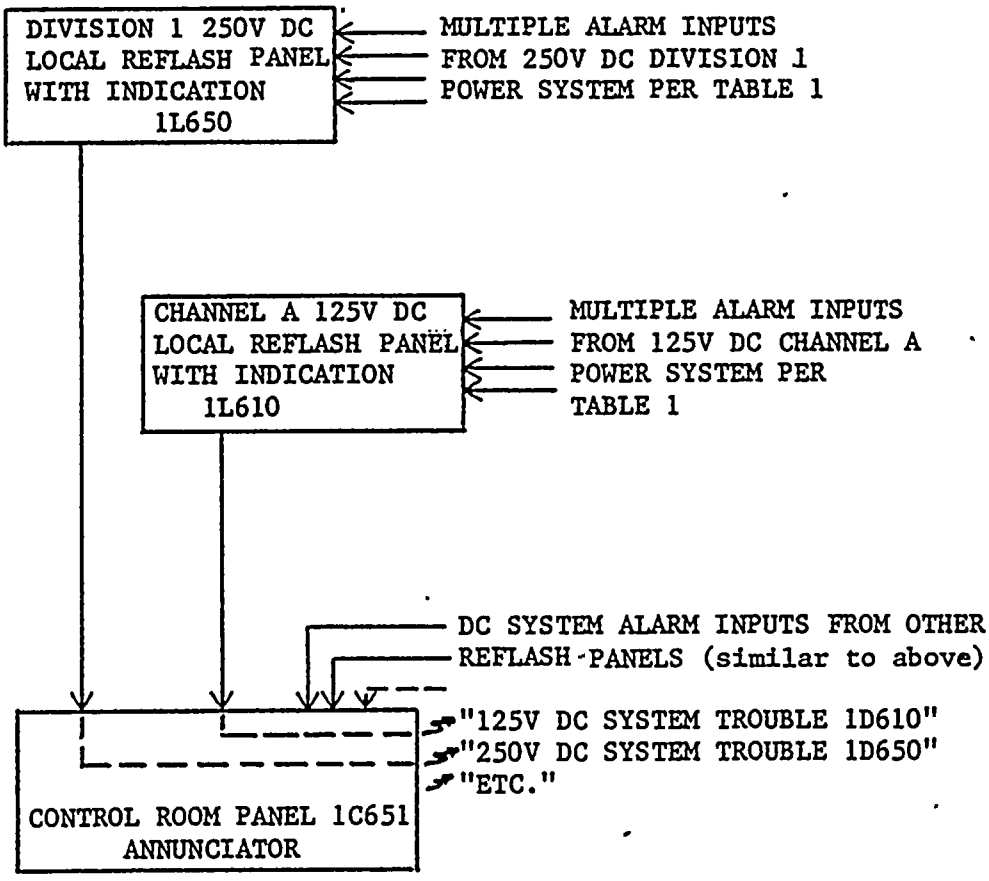
TABLE 1

250V DC System Reflash Panel Indicators (1L650)

1. 250V DC System Low Voltage
2. 250V DC System Ground
3. Battery Monitor (indicates battery degradation or open battery fuses)
4. Battery Charger Trouble (indicates (1) AC power failure, (2) DC output breaker open, or (3) charger current $\leq$ 0)
5. Load Center Incoming Breakers Trip 72-65212/22 (battery charger supplies)
6. RCIC & Isolation Valves Control Center 1D254 Trouble (load center breaker tripped)
7. Turbine Building Control Center 1D155 Trouble (load center breaker tripped)
8. Computer UPS Supply Breaker Trip
9. Battery Charger Output Overvoltage
10. Reflash Panel Loss of Power

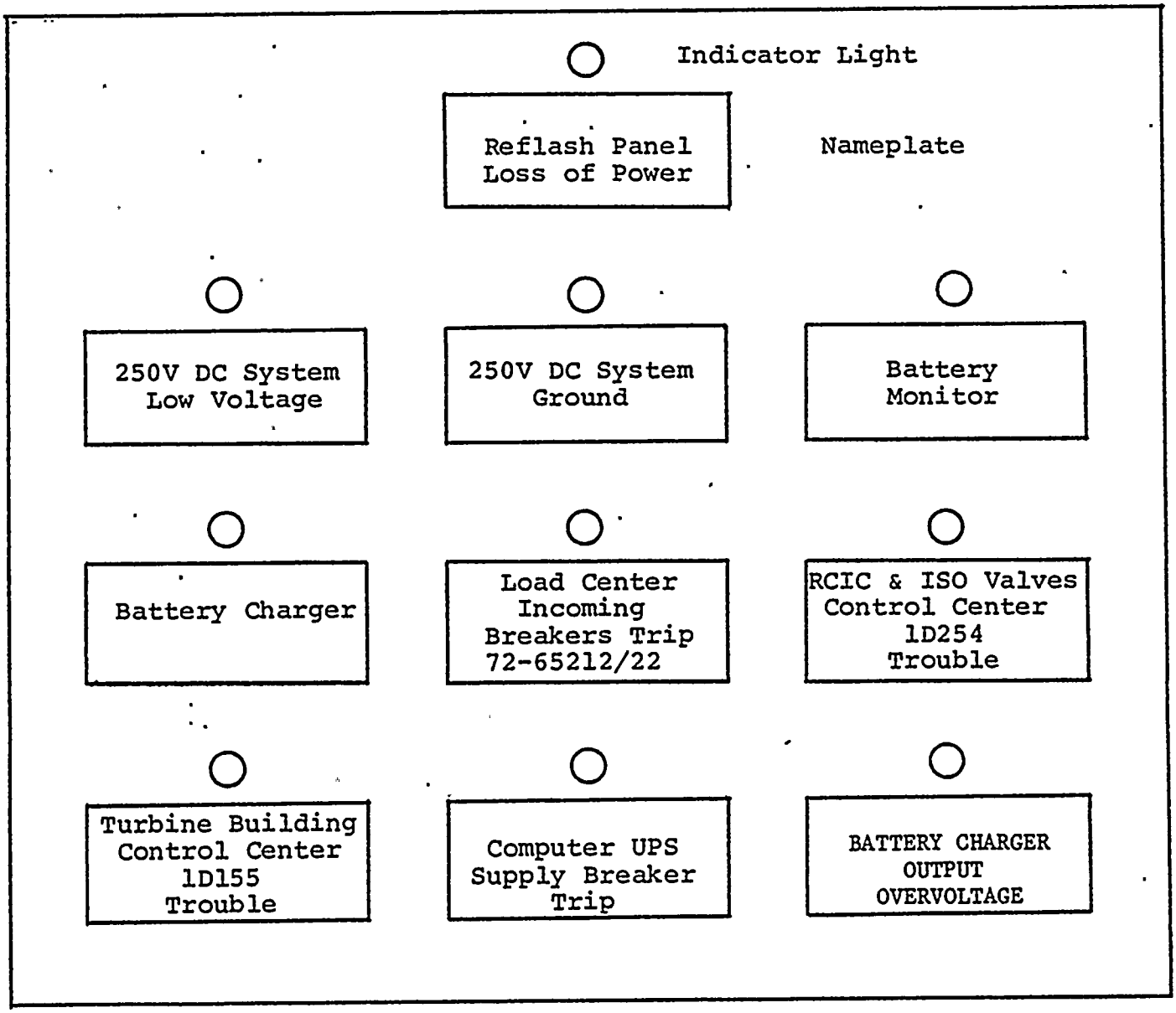
125V DC System Reflash Panel Indicators (1L610)

1. 125V DC System Low Voltage
2. 125V DC System Ground
3. Battery Monitor (indicates battery degradation or open battery fuses)
4. Battery Charger Trouble (indicates (1) AC power failure, (2) DC output breaker open, or (3) charger current $\leq$ 0)
5. 125V DC Distribution Panel 1D614 Low Voltage
6. 125V DC Distribution Panel 1D615 Low Voltage
7. Battery Charger Output Overvoltage
8. Reflash Panel Loss of Power



REF. DWGS.: E-323
E-328

FIGURE 1

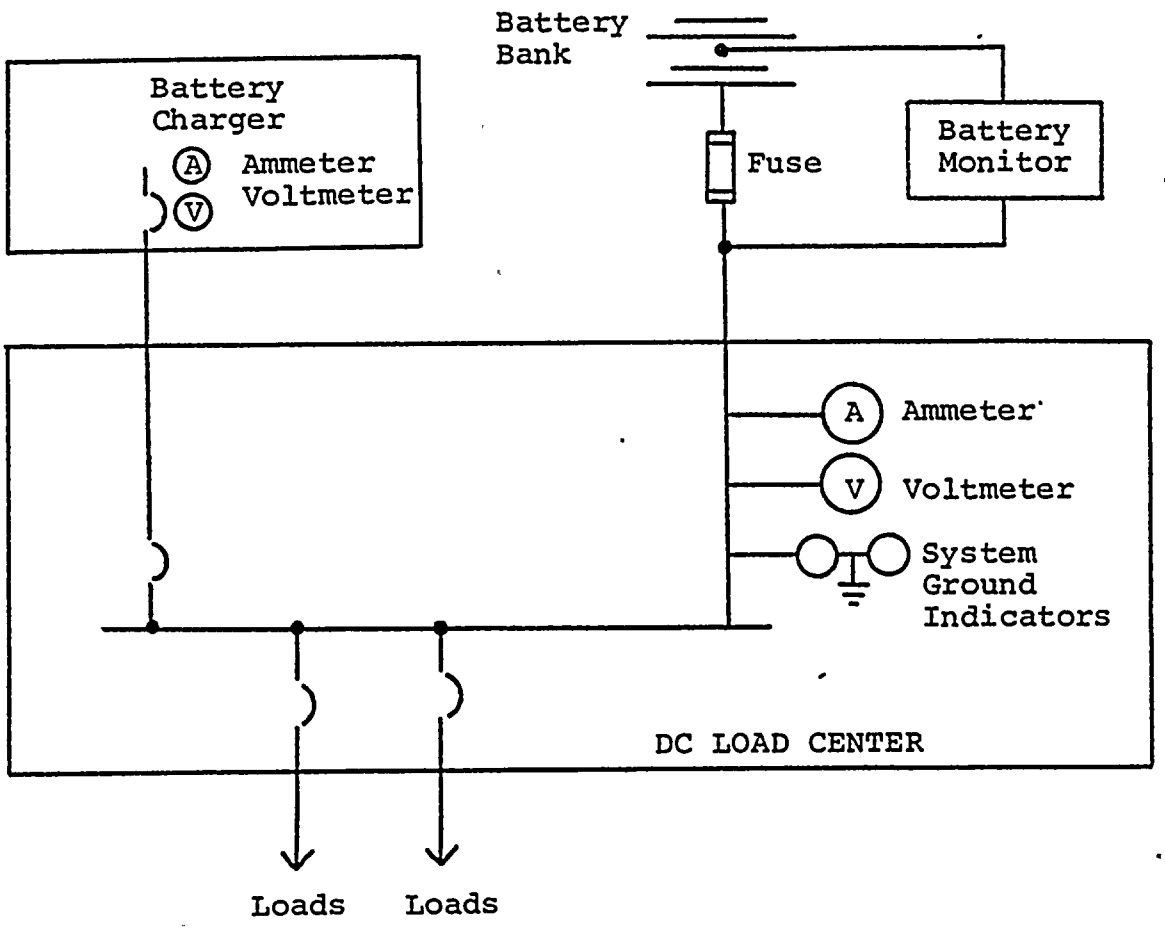


Front View

Local Annunciator Reflasher Panel (Typical)

The reflasher panel (one panel per battery system) is located in the battery area. When an alarm input is received, the reflasher panel simultaneously lights the respective indicator on the face of the reflasher and actuates the remote Main Control Room "DC System Trouble" alarm.

Figure 2



See Table 1 for Alarms

DC System Indication (Typical)

Figure 3