



इ रि से ट
विद्युत सिग्नल प्रयोगशाला
प्रयोग नं: ई एस एल -41

IRISET
ELECTRICAL SIGNALLING LABORATORY
EXPERIMENT NO. : ESL – 41

नाम

Name : _____

अनुक्रमांक

Roll No : _____

पाठ्यक्रम

Course : _____

दिनांक

Date : _____

प्राप्त अंक

Marks Awarded : _____

अनुदेशक का अधाक्षर

Instructor's Initial : _____

STUDY OF INTEGRATED POWER SUPPLY SYSTEM (RDSO/SPN/165/2004)

Introduction:

In CLS territory, Signal may go “Blank”. A blank Signal is a grave safety risk. Driver missing a blank signal may not take action to control his train in time. CRS recommended that adequate protection against blank signal must be taken. Railway Board has accepted the recommendations.

Signal may go blank either due to fusing of Signal lamp or due to interruption in power supply. The first case can be prevented by using the “Triple pole AC lamps & LED signals ” and the later case can be prevented by using “Un-interrupted power supply system for signals. Un-interrupted power supply system for signals and signal equipments can be efficiently and economically maintained by using Integrated Power Supply system.

Integrated power supply system delivers both AC & DC Power supplies as an output with the output voltage tolerance of $\pm 2\%$.

Other advantages of IPS are: -

- 1) Reduces maintenance cost on Batteries, Battery charger & overall maintenance.
- 2) It's construction is in modules and restoration of failures will be easy.
- 3) Provides centralized power system for complete signalling installation with continuous display of working status of system for easier monitoring.
- 4) Defect in sub-units of system is shown both by visual & audible indication. Reflects the condition of battery with warning.
- 5) Replacement of defective modules is quick & easy without disturbing the working of the system.
- 6) It uses (n+1) modular technology hot stand by arrangement and hence gives high reliability and more availability.

IPS consists of :

- 1) SMR (Switch Mode Rectifier) Panel / SMPS based Float Regulating cum Boost Charger (FRBC) Panel.
- 2) A.C. Distribution Panel.
- 3) D.C. Distribution Panel.
- 4) Battery Bank. (110V DC).
- 5) Status Monitoring Panel.

IPS works satisfactorily for A.C input variation of 150V AC to 275V AC with single-phase power supply and frequency variation from 48 Hz to 52 Hz. The input 230V AC is fed to SMPS charger, which converts it into 110 V.D.C as output. It is fed as input to three sub units

- i) To battery bank for charging the cells.
- ii) To ON line inverters that converts 110 V.D.C in to 230 VAC $\pm 2\%$ as output.
- iii) To 110 V.D.C bus bar of D.C Distribution Panel as an input to various D.C-D.C converters located in it.

A 110 V Battery Bank of VRLA cells are connected to SMPS Panel. IPS Status Monitoring Panel is located at ASM room or at S&T staff room if round the clock S&T staff are available at Station.

1. **SMR (Switch Mode Rectifier) Panel / SMPS based Float Regulating cum Boost Charger (FRBC) Panel:-**

It consists of SMR / FRBC modules and Supervisory & Control Unit. SMPS based FRBC modules are provided with (n+2) modular technology hot stand by arrangement with active load sharing basis and 1 additional module as a cold standby is also provided. **Supervisory & Control Unit** controls and monitors the complete system. It has various indications on the panel, reflecting the working status of the panel. FRBC modules are suitable for operating in parallel on active load sharing basis with one or more modules of similar type, make and rating.

n= required no. of modules to cater for actual load current requirement.

2. **A.C Distribution Panel: -**

It is made of ON-Line inverters with (1+1) modular technology hot stand by arrangement & CVT (Constant Voltage Transformer) / AVR (Automatic Voltage Regulator) and set of step down transformers.

The inverter is protected against overload and short circuit with auto reset facility. Whenever the failure occurs, it trips and restarts automatically after about 10 to 20 sec. But if the problem persists, the protection is permanently gets latched and it will not be switched ON again unless the fault is cleared followed by pressing of reset button. The output of inverters is regulated to 230V AC $\pm 2\%$, 50Hz $\pm 1\text{Hz}$ for an input voltage variation of 90V DC to 140V DC.

Normally both the Inverters are powered ON and both are delivering the Output voltage but only one (main) inverter is connected to the Load. If main inverter is failed then only the stand-by inverter will come on Load automatically with in 500msec. At 70% Depth of Discharge (DOD) of the battery bank 110VDC

supply to the inverters will be cut-off. Hence the Signals feed is cut-off in that condition.

The auto-change over arrangement is also provided to connect the load to the CVT with in 500msec, when both the inverters fail. It has various indications on the panel reflecting the working status of the panel.

3. D.C Distribution Panel: -

It takes care of D.C Power supply requirements of our signalling. It consists of sets of D.C-D.C converters for individual D.C power requirements with (n+1) modular technology hot stand by arrangement with active load sharing basis. The DC-DC converters of Relay Internal are provided with (n+2) modular technology hot stand by arrangement with active load sharing basis and 1 additional module as a cold standby.

The DC-DC converter works satisfactorily with the input voltage variation of 98VDC to 138VDC. At 90% Depth of Discharge (DOD) of the battery bank 110V input supply to all the DC-DC converters is cut-off, except for Block Tele DC-DC converters. The supply for Point operation is also catered through a 20A fuse by this unit. It is also provided with various indications that reflect its working status.

4. Status Monitoring Panel:

IPS status monitoring panel has been provided in the ASM room for giving the important alarms and indications to ASM. Status Panel tells present working status of IPS displaying battery voltage continuously and five other indications, which will light according to IPS status. During normal working these indications will not lit. Whenever the battery has come on to the load and has discharged by 50% D.O.D.(Depth Of Discharge) then first **Red** indication lit with description "START GENERATOR" with audio Alarm. i.e. DG set is to be started and put on the load. If DG set is not started with this warning, then if battery gets further discharged to 60% D.O.D, a second **Red** indication appears with description "Emergency Start generator" with audio alarm. Even now if DG set is not started, the battery further gets discharged to 70 % D.O.D and a 3rd **Red** indication appears with description " System shut down" with audio alarm, which will continue till Generator is started, resulting in A.C output from inverters is automatically cut off, which causes all the signals to go blank.

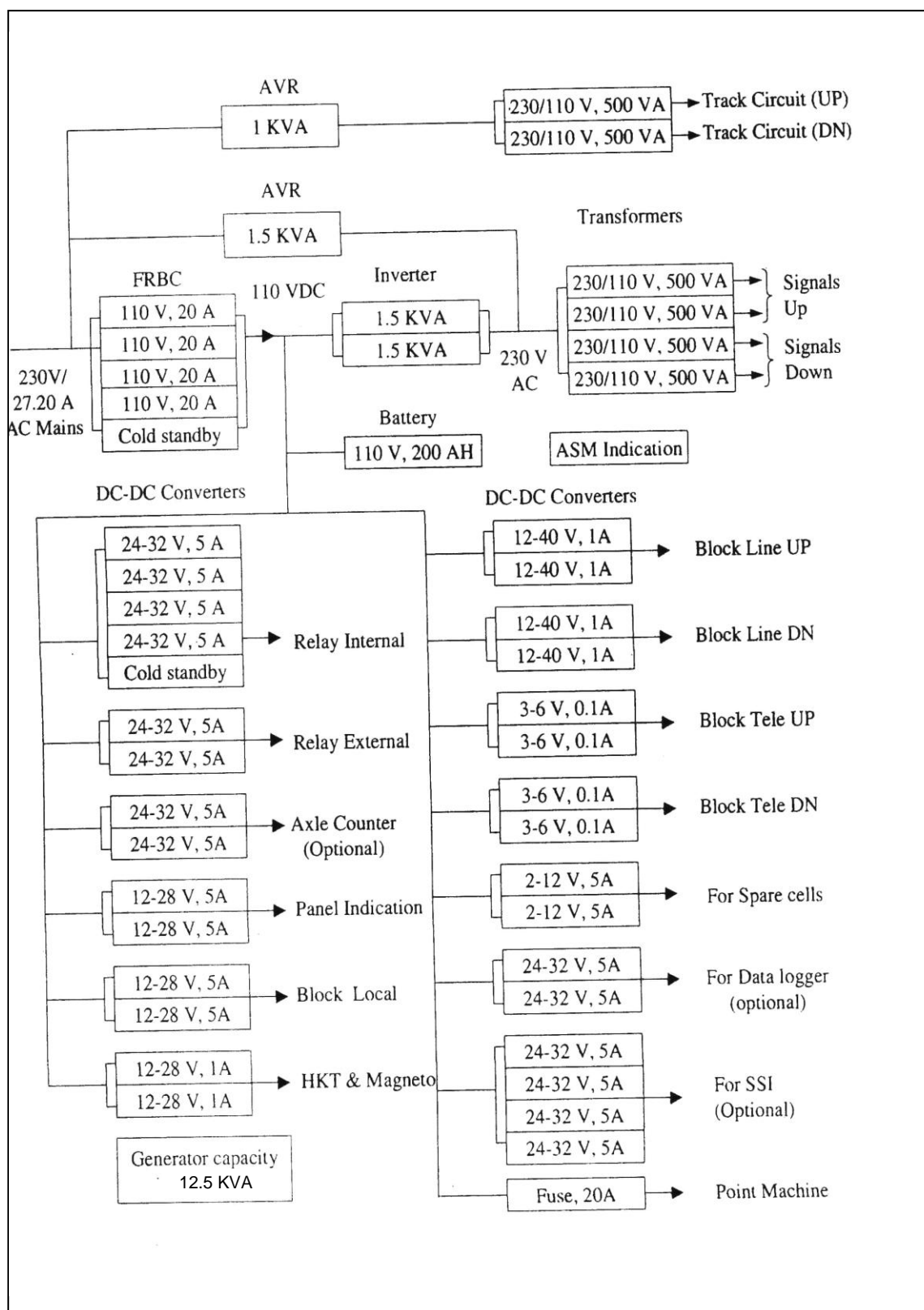
Whenever there is any defect in any sub module of IPS even without affecting the working of system, the 4th Red indication appears with description "Call S&T Staff" with audio alarm, so the ASM advises S&T staff accordingly. A Green LED 5th indication comes with the description "Stop Generator" with audio alarm, when the DG set is running and the Battery bank is in fully charged condition or if the main source of AC supply is restored.

Details of alarms and indications provided in status monitoring panel are as under:

S.No	Instruction	Condition	LED indication	Remarks
1.	Start Generator	50% DOD	RED	Audio/ visual alarm can be acknowledged for audio cut off.
2.	Emergency Start Generator	60% DOD	RED	Audio/ visual alarm can be acknowledged for audio cut off.
3.	System Shut-down	70% DOD	RED	Signal feed cut off and all DC-DC converters to work. Audio alarm will continue till Generator is started.
4.	Call S & T Staff	Equipment fault.	RED	Failure of any module will give the alarm in ASM's panel. Alarm can be acknowledged for audio cut off.
5.	Stop Generator	FRBC change over to float mode	GREEN	Audio / Visual Alarm.

DOD – Depth of discharge of battery bank.

Block diagram of IPS used in RE area up to 4 lines without AFTC: -



Earthing :

The IPS systems and its individual modules are having earth terminals and all these are properly earthed with earth resistance not more than 1 Ω . Earth provided shall preferably be maintenance free using earth enhancing compound.

Lightning and Transient Protection:

Class B & Class C arrestor is provided in a separate wall mounting type enclosure in IPS room. IPS manufacturer will provide Stage1 & Stage2 protection along with the IPS. He will provide the Stage3 protection depending upon the requirement.

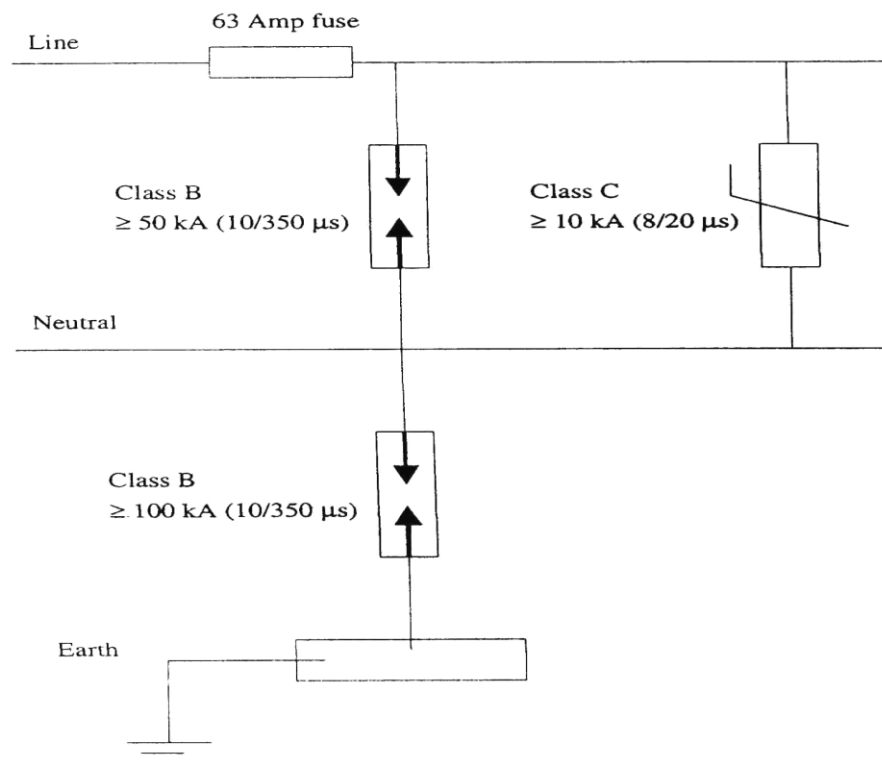
Stage1 protection is of Class B type, against Lightning Electro-Magnetic Impulse (LEMP) & other high surges, provided at Power Distribution Panel. It is provided with a 63Amp fuse in phase line and is connected between Line and the Neutral and also between the Neutral and Earth.

Stage2 protection (Power line protection at Equipment level) is of Class C type, against low voltage surges, provided at the equipment input level. This is thermal disconnecting type and equipped with protection against SPD (surge protection device) failure due to open & short circuit of SPDs and is connected between the Line and the Neutral.

Stage3 protection (Protection for signalling/data line) is of Class D type. All external data/ signalling lines (AC/DC) shall be protected by using this Class D type device. It consists of a combination of Varistors and Gas Discharge Tube with voltage and current limiting facilities.

If supply / data / signalling lines (AC/DC) are carried through overhead wires or cables above ground to any nearby building or any location outside the equipment room, additional protection of Stage2 type shall be provided at such locations.

Connection of Lightning Arrestors



Observations

SMR Panel: -

- i) Measure I/P AC Voltage = _____ V AC.
- ii) Check the I/P AC current = _____ AC Amps
- iii) Measure O/P DC Voltage = _____ V DC.
- iv) Total out put current = _____ Amps.
- iii) Battery current = _____ Amps.
- iv) List out indications of SMR Panel by observing the SMR :
 - 1)
 - 2)
 - 3)

4)

5)

6)

7)

8)

AC Distribution panel: -

a) A.C Out put voltage of inverter 1 = _____ V AC.

b) A.C Out put voltage of inverter 2 = _____ V AC.

c) Note the indications available on AC distribution panel: -

i) Inverter : - 1).....

2).....

3).....

4)

ii) Signal Transformer: -

1).....

2).....

3).....

d) Switch off the inverter- 1 and note the observations?

All its indication becomes blanks on inverter-1 & its out put also reads zero, and now inverter-2 is on load with =. V AC and there is no change in signal transformer working.

e) Restore inverter-1 & switch off inverter-2 and note the observations?

Inverter-2 indication becomes blank & its out put also reads zero and there is no other change on AC bus-bar voltage. Inverter-1 is on load with.....V AC.

Restore Inverter 2 to normal after the observations.

D.C Distribution Panel: -

- a) D.C Bus bar voltage V DC.
- b) Write the Indications available on the DC-DC Converter ?
 - 1.
 - 2.
 - 3.
- c) Observe and note down the voltage of second DC-DC converter and after switching ON first DC-DC converter, switch OFF the second DC-DC converter. Observe and note the voltage of first DC-DC converter.

(It is observed that with switching off one DC-DC converter, O/P DC voltage is maintained by other DC-DC converter.)

- d) List out various DC-DC converters provided in this panel with their ratings and measure their output voltages?
 - 1.
 - 2.
 - 3.
 - 4.

5.

6.

7.

8.

- e) Write the advantages & disadvantages of IPS on your section as per your experience, if any?

Date:

Signature of the Trainee.