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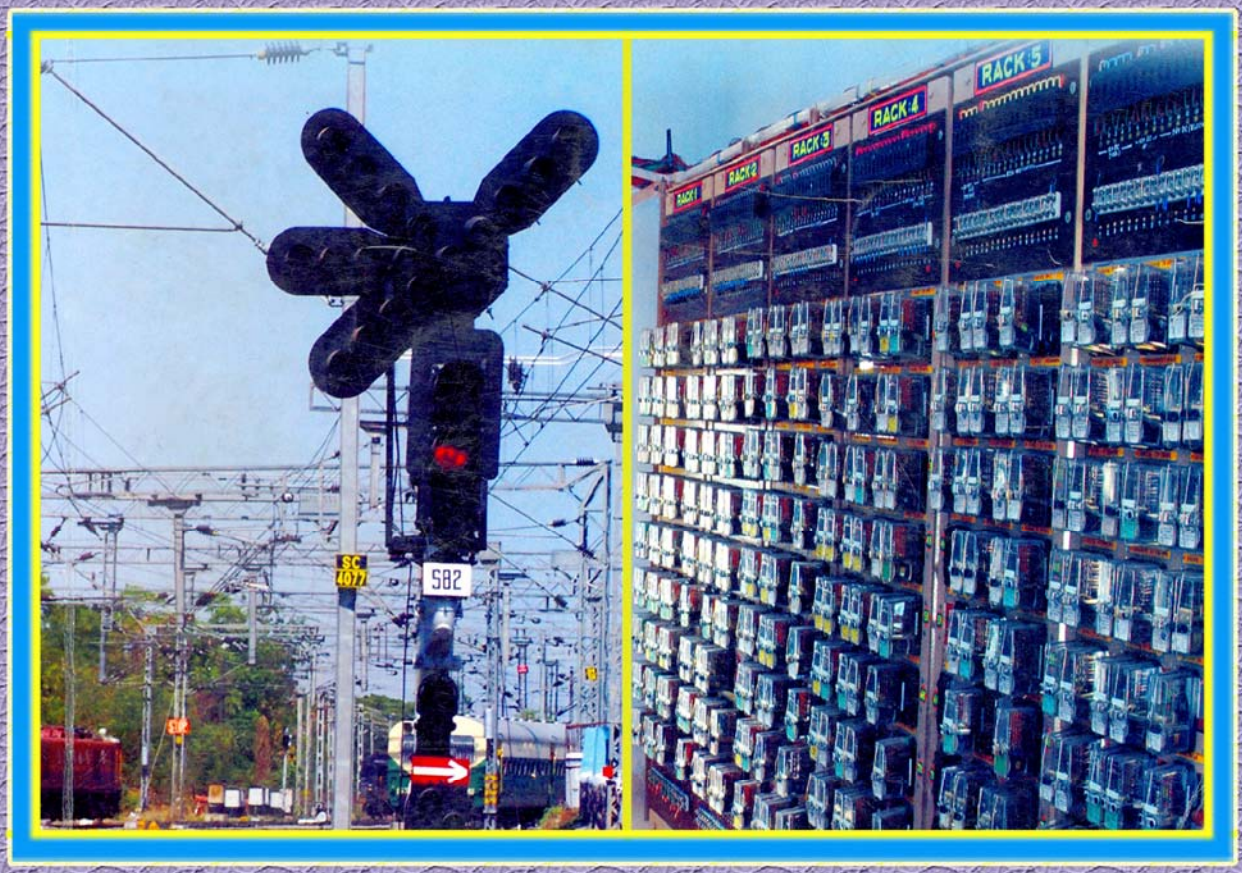
RAILWAY SIGNALLING INSTALLATION AND QUALITY HAND BOOK



Indian Railways Institute of
Signal Engineering and Telecommunications
SECUNDERABAD - 500 017

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RAILWAY SIGNALLING INSTALLATION AND QUALITY HAND BOOK

A COMPILATION FOR
S & T DEPARTMENT OF INDIAN RAILWAYS

Issued in April 2010

INDIAN RAILWAYS INSTITUTE OF

SIGNAL ENGINEERING & TELECOMMUNICATIONS

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RAILWAY SIGNALLING INSTALLATION AND QUALITY HAND BOOK

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CHAPTER- 1: POWER SUPPLY

1.1 INTRODUCTION

1.1.1 Scope of the Chapter

This Chapter covers Power Supply requirements, arrangement and installation for various types of signalling system. This Chapter shall be read along with SEM Part-II (2001) chapter-XVI, clause 22.11 of chapter-XXII, & directives issued by Railway Board vide joint circular letter no 82/RE/250/1 dated 10.9.2002 for power supply arrangement for S& T installation in 25 KV AC area (copy placed at Appendix -A).

1.1.2 Classification of signalling systems based on power supply requirements

Each signalling system shall require power supply. The signalling systems are classified for the purpose as follows: -

(a) Stations provided with semaphore signalling.

(b) Stations provided with Multi Aspect Colour Light Signalling (MACLS) operated by lever frames in non-electric traction area.

(c) Stations provided with MACLS, operated by lever frames in area provided with 25 KV AC traction.

(d) Stations provided with MACLS with Panel Interlocking /Electronic Interlocking in non-electric traction area.

(e) Stations provided with MACLS with Panel Interlocking/ Electronic Interlocking in area provided with 25 KV AC traction.

(f) Route Relay Interlocking (RRI)

(g) Block Huts.

(h) Intermediate Block Signal (IBS).

(i) Interlocked level crossing gates in block section.

(j) Automatic signalling.

(k) Yard provided with MACLS multiple cabins in 25 KV AC traction area

(l) Stations provided with 1500 V DC traction.

(m) Signalling sub Systems like: -

- (i) Single Section Digital Axle Counter (SSDAC).
- (ii) Multi Section Digital Axle Counter (MSDAC)
- (iii) Universal Axle Counter (UAC) for track circuits in the yard.
- (iv) Block proving by Axle Counters (Analog).
- (v) Block proving by Axle Counters (Digital).
- (vi) AFTC.
- (vii) Data loggers.
- (viii) Electrical Lifting barrier.
- (ix) Train actuated warning device.

1.2 POWER SUPPLY ARRANGEMENTS

Power Supply arrangement comprises of connecting power from the source provided at the station to the signalling system through suitable cabling and interface equipments and distributing the power supply among various constituents of signalling system.

Power supply arrangements for different types of signalling installations shall be in accordance with policy approved by the Chief Signal and Telecommunication Engineer of the Railway.

Normal power supply for signalling installation shall be 230 V AC (single phase), 415 V three phase or any other supply may be used with specific approval of Chief Signal and Telecommunication Engineer of the Railway to meet any specific requirements.

Power supply system shall be such that fixed stop signals for approaching train do not become blank when main power supply source fails.

1.2.1 Sources of Power Supply

Non-Railway Electrified Area: -

At the stations provided with CLS installations, in Non-Railway Electrified area, 230 V AC power supply shall be drawn from the station feeder.

In addition two standby diesel generators shall be installed. These generators should be of standard make as per approved specifications and of adequate capacity for reliable and trouble free service. The output of these DG sets shall be brought to the ASM's office and connected to Auto/Manual Change-Over Panel.

Solar panels or other renewable source of energy with battery back up of suitable capacity, may be provided as main/standby source of power supply wherever feasible.

Railway Electrified Area: -

For stations in Railway Electrified area, power supply for signalling system shall normally be provided through Auxiliary Transformers (ATs) of suitable capacity by tapping 25 KV OHE. At a station where AT of suitable capacity is installed at the traction switching post situated within 350 meters of the signal cabin or the station building, 230 V AC supply from the AT will be extended to station.

On double/multi line sections, the power supply shall be drawn from 25 KV OHE through ATs provided on UP and DOWN lines separately. It shall be ensured that supply from atleast one AT is available in the event of power block.

On single line section where power supply is drawn from a single AT, one no. DG set of suitable capacity shall be installed.

At stations where local power supply is also available, it shall act as a standby source of power supply.

In big yards, DG sets of adequate capacity shall be installed in addition to supply from ATs and local source.

Power supply from Auxiliary Transformers (ATs), Local source and DG set (s) shall be brought and terminated at a CLS power supply control & distribution panel (CLS Power Panel) in ASM's office/cabin or at LC gate as required. Power supply control & distribution panel for signalling supply shall be in conformity with RDSO Specification TI/SPC/PSI/CLS/0020 (or latest amendments). The CLS power panel shall be provided with the facilities for automatic changeover between these supplies as per availability in order of Main (AT)/First standby (Local Supply)/ Second standby (DG supply). In addition manual changeover facility shall also be provided in the control panel. The power supply control & distribution panel, cable (other than from DG room) and other associated arrangements shall be provided and maintained by Electrical Department.

Automatic changeover panel shall be provided as per approved RDSO specification.

The supply from CLS power panel as provided by Electrical Department shall be taken to various S&T installations by S&T department.

Supply from the CLS power panel shall be extended through separate MCBs to cabins, LC gates, Telecom installations etc. if these are falling within two KMs of CLS power panel. For locations beyond two KMs, a separate set of ATs and CLS power panel shall be provided.

1.2.2 Cabling from AT/Local Supply to CLS Power Panel and from CLS Power Panel to Signalling Equipment room

The size of cable to be used is to be determined, considering the load. Please refer **Table 1.2.2.**

The Power cable shall be 1100 V grade, armoured, PVC insulated, PVC sheathed, Al conductor, conforming to IS: 1554 Part - I (latest version) or XLPE cable conforming to IS: 7098 Part - I (amendment 1 or latest) as per RDSO's letter no. TI/PSI/PROTCT/CLS/03 Dtd 21-2-2003. Wherever power cable of lower coreage is provided, it shall be replaced in a phased manner, with proper coreage of cable or be supplemented by laying additional cable of appropriate coreage to make good the required cross section.

Source of power supply (AT/Local)	Size of cable
5 KV A	2 x 25 sq mm Aluminium Conductor
10 KV A	2 x 70 sq mm Aluminium Conductor
25 KVA	2 x 150 sq mm Aluminium Conductor
50 KV A	2 x 300 sq mm Aluminium Conductor

Table 1.2.2 Source of Power Supply -vs- Type of Cable

1.2.3 Power Supply Equipments associated with Signalling System

The Power Supply equipments associated with signalling system shall be procured as per approved specifications and in conformity to RDSO/IRS/IS specifications only.

The capacity of the equipment shall be worked out to be 1.2 times higher than actual site requirement under maximum load condition.

All power supply equipments i.e. transformer, battery charger, inverter, stabiliser, IPS etc. shall be housed in one room to be known as "equipment room" near relay room except the equipment specifically needed to be provided at site such as battery chargers for track circuits, etc.

Standby power equipments such as battery chargers, transformers, voltage regulators, transformer-rectifier sets etc. may be provided in power equipment room.

AC supply for signal transformers shall be derived from a voltage regulator of approved type conforming to the specification IRS: S-74/89 (Amendment-6 or latest).

It is desirable to provide AC supply for track transformers through voltage regulator in case there is heavy fluctuation in input AC power supply.

To ensure continuous power supply to signal aspects so as to avoid blanking off of signal aspects for approaching train, Inverters of appropriate capacity conforming to specification IRS: S-82/92 (amendment-1 or latest) may be provided for feeding to signal aspect through signal transformers.

Separate transformer of approved type conforming to the specification IRS: S-72/88 (Amendment-1 or latest) shall be used for feeding Signals and Track feed chargers.

All batteries shall be housed in a separate room/location box other than equipment room or any room where relays, circuit breakers or other equipments are likely to get [be] damaged due to acid fumes emitted by cells. The Battery Room shall be provided with acid proof tiles on floor/platform & on all walls up to a height of 1.5 Mtr. The battery room and location boxes shall be kept well ventilated and provided with exhaust fan. It shall be free from water, oil or dust.

Batteries of prescribed capacity shall be provided for DC Circuits, Inverters, DC-DC Converters with isolated outputs may be used to obtain different voltages from a common battery bank.

1.2.4 Distribution of Power Supply

PVC insulated indoor multi strand, single core copper conductor of size as per IRS Spec. IRS: S-76/89, IS: 694 shall be used for AC input to charger, for wiring between battery chargers and batteries and for connection from fuse board/Power distribution board to Relay room/Axle Counter room bus bar. The gauge of wire shall be such that the current density does not exceed 3 Amp per sq. mm. so as to ensure that, there is not more than 0.5% loss in voltage.

Fuse board/Power distribution board shall be made of Hylem sheet 12 mm thick. Battery chargers, transformers, Voltage stabilizer, inverters etc. shall be installed on brick masonry shelves/platform of single or two tier structure & of suitable size depending on the site requirements.

An appropriate size of cable shall be laid between Control and Distribution Panel for CLS Supply ("CLS Power panel" conforming to RDSO specification TI/SPC/PSI/CLS/0020 with latest amend.), provided by electrical department in ASM's office and the equipment room where signalling system is to be installed, as follows:

(a) Body of each power supply equipment i.e. Battery charger, transformer, Voltage stabilizer, inverters, IPS etc. shall be earthed for protection of equipment against shock to staff.

(b) Each battery charger shall be connected to independent Miniature Circuit Breaker (MCB)/ND Fuses of suitable capacity provided by the side of the equipment so that the equipment can be taken out of circuit without disturbing other equipment.

(c) Slotted PVC channels of ISI mark with removable double locking type cover shall be provided along the slabs/shelves/walls for wirings of equipments & batteries. The wirings shall run through these channels & shall be dressed wherever required with PVC bunching straps. In case more no. of power cable/wiring is to be drawn, it shall be taken through slotted PVC Channels as mentioned above which shall be supported on the Aluminium ladder of size 6" width & 3 mm thickness fitted on the side of the walls by means of angle iron, at an appropriate height.

(d) Power distribution board/switch fuse unit/LT Panel of suitable size shall be fixed on the wall with clamps of 50 mm GI flat embedded in the wall of equipment room. The equipment with corresponding battery bank shall be connected to the power distribution board through WAGO or any other approved type of terminals. The supply for each equipment shall be connected in relay room on a bus bar.

(e) Power supply to each circuit should be isolated & protected through HRC fuse to IS and BS specs. of capacity of 1.5 times of the rated requirement.

Power Supply viz. Battery & Chargers (voltage stabilisers if provided) for each Block instrument line circuit shall be independent and shall not be used for any other purpose under any circumstances whatsoever. Battery charger shall not directly feed the line circuit of Block Instrument and the same shall be taken from the battery bank. Power supply for each block telephone shall be independent and shall not be used for any other purpose including for any other telephone under any circumstances whatsoever.

Each station with colour light signals shall be provided with a stabilized power supply for colour light signals (CLS), through Ferro Resonant Voltage Stabilizer or of approved type of voltage regulator/inverters. Inverter to be provided for Signal feeding shall conform to the specification IRS: S-82/92 (Amendment-1 or latest).

1.2.5 Batteries

Low maintenance Lead Acid cells of approved type conforming to Specification IRS: S 88/93 (or latest) shall be used. Battery grade dilute sulphuric acid conforming to IS: 266 and distilled or demineralised water conforming to IS: 1069 shall only be used as electrolyte.

The batteries shall be kept on masonry surface of suitable height and provided with acid proof tiles. Insulator viz. hard rubber insulating pads etc. may be provided, below the batteries.

The initial charging of batteries shall be done as per manufacture's manual. Battery Capacity test shall be done at the time of installation & record shall be maintained.

The date of installation and cell no. of a battery bank shall be marked on each battery.

Battery leads shall be colour coded and cut to correct length. They shall be crimped/soldered to appropriate terminals. The battery terminals and connections shall be coated with petroleum jelly to prevent corrosion/sulphation. Grease/Vaseline shall not be used.

Electrolyte lost due to spillage shall be replaced with proper amount of electrolyte of the same specific gravity as that of other cells of the battery. Electrolyte shall not be added in any other circumstances.

To reduce the voltage drop between battery and corresponding system, appropriate size of cable shall be used i.e. PVC insulated indoor multi strand, single core copper conductor of suitable size & specification conforming to IRS: S 76-89/IS 694 shall be used for AC input to charger, for wiring between battery charger and batteries and connection from fuse board/Power distribution board to Relay room/Axle Counter room bus bar. The gauge of wire shall be such that the current density does not exceed 3 Amp per sq. mm. so that, there is not more than 0.5% loss in voltage.

Requirement of batteries for DC track circuits with different type of relays is shown below in table 1.2.5.

Track circuits in Non-RE area: -

Relay Type	**Battery/Cell required for track circuit Length**	
	Up to 100 Mts	**100 Mts and above**
Plug in type 4 ohm	2 V (Lead Acid)	4 V (Lead Acid)
Plug in Type 9 ohm	2 V (Lead Acid)	4 V (Lead Acid)

Track circuits in RE area: -

Relay Type	**Battery/Cell required for track cct. Length**		
	Up to 100 Mts	**100 – 450 Mts**	**Up to 750 Mts**
Plug in type (ACI) QTA-2, 9 ohms	4 V (Lead Acid)	6 V (Lead Acid)	-
Plug in Type (ACI) QBAT, 9 ohms	4 V (Lead Acid)	6 V (Lead Acid)	8 V (Lead Acid)

Table 1.2.5. Requirement of battery for DC track circuits with different type of relays

1.2.6 Battery chargers

Self-regulating battery chargers of adequate capacity conforming to specification IRS: S 86-2000 (Amendment-1 or latest) shall be provided for charging Low Maintenance Lead Acid Batteries.

The nominal Voltage of a lead acid secondary cell may be taken as 2.0 Volts and nominal output voltages of the charger shall be calculated accordingly. The output current rating of the battery charger may be calculated by adding the total equipment load to be supplied by the charger and one tenth of the AH capacity of the battery. Recommended capacity of chargers for some of the standard capacity secondary cells in use Railways shall be as shown in table 1.2.6.

S.N.	Cell Cap. (Amp. Hrs)	C/10 Rate	Recommended Current Ratings for Chargers (Amps)	Maximum Permissible Load (Amps)
1	40	4	10	6
2	80	8	20	12
3	120	12	30	18
4	200	20	50	30
5	40	4	5 (Track Feed)	1
6	80	8	10 (Track Feed)	2

Table 1.2.6 Recommended rating of Chargers for different AH cells

The current rating of 5, 10, 20, 30, 50, 75, 100 and nominal voltage rating of 12, 24, 48, 60, 110 Volts shall be adopted by railways, for the purpose standardization of the equipment and ultimately for testing & maintenance.

Track feed Battery chargers shall be provided in conformity to the specification IRS: S-89/93 (Amendment-1 or latest).

The battery charger for feeding electronic equipments viz. Axle counters etc. shall have inbuilt filters to maintain ripple content below specified values.

Battery chargers shall not directly feed the line circuits of Block Instruments and the same shall be taken from the battery bank.

For major battery chargers (>50 Amp rating) there shall be an additional Alarm resetting switch/button on the front panel, which shall be required to be pressed by Signal staff on duty to silence the buzzer/hooter. The visual indication shall continue till the fuse is replaced or the fault is rectified.

1.2.7 Alarms & Indications related to power supply in ASM's room

Alarm and indications shall be as per Amd.3 to IRS: S 86/2000 for self Regulating Battery Charger given below:

(a) Red LED indication shall appear with audible alarm (re-settable) when charger out put voltage is not available. When output voltage goes below 1.9 V/Cell Red indication (Run DG Set) shall appear with audible alarm (non-resettable type). The alarm function shall remain lit until AC supply is restored. This indication shall appear in both auto and manual mode of working. The potential free contact shall be provided for the same.

(b) The battery charger shall have a provision of battery isolation from the load if output voltage goes bellow 1.8 V/Cell. The visual indication shall remain lit until the DG set is started. Alarm/indication shall work even if mains fail.

1.3 INTEGRATED POWER SUPPLY (IPS)

1.3.1 IPS Configuration

On all new installations or installations where replacement of signalling system is being undertaken, IPS of suitable capacity shall be provided, except where specified by the CSTE of the Railway.

IPS system shall be procured along with the required low maintenance Lead Acid Battery set.

Installation of the IPS system shall be done by the original manufacturer of the equipment to ensure proper settings of various initial parameters viz. Batt. Path current setting, output voltages of DC-DC converters, ASM's panel indication & alarms etc.

Training to the maintenance staff shall be done along with installation & commissioning of IPS system.

The SMPS based integrated Power Supply (IPS) system suitable for 4/6 line RE/Non-RE way side station conforming to specification RDSO/SPN/165/2004 (amendment 4 or latest) shall be provided to give continuous supply to both AC & DC signalling circuits.

The calculations to determine the capacity of the IPS are given in Appendix-B.

1.3.2 Schematic and no. of modules required for IPS to meet specific requirement of the yard shall be worked out carefully considering following main factors

(a) Actual power requirement (under maximum load condition) for various signalling gears viz. Signals, Track circuits (including current for track battery @ C/10 of battery capacity & short circuit track cct current under track occupation condition), Relay Internal, Relay external (Two separate units for RE area), BPAC (separate units for each of the adjacent block section), Axle counter if any provided in lieu of Track circuit for proving track occupation, Data Logger, SSI as per manufacturer's specification if provided, etc. shall be worked in detail.

(b) Weightage/compensation factor due to loss in power as per conversion efficiency of various active modules shall be duly considered besides taking into account losses in the transmission medium (Cable loss etc.) to arrive at power capacity requirement of various sub assemblies of IPS viz. Inverter, CVT (for signal lighting &Track Circuits), DC-DC converters, Transformers, AH Capacity of Battery Bank, SMRs etc.

(c) Actual ratings/capacity of various modules of IPS shall be finally worked out considering additional 20 % i.e. at 1.2 times the requirement arrived at step (i) & (ii) above.

(d) Standard provision of N+1 configuration (where "N" stands for actual maximum load requirement as worked out at steps (i), (ii) & (iii) above) for SMRs and all modules of DC-DC converters, as per RDSO specifications shall be considered, besides this one Cold standby modules for important sub-assemblies viz. SMRs, DC-DC converters for Internal circuits may be duly considered, to work out overall requirement of no. of sub-modules.

(e) Besides the above spare modules as per RDSO specification shall be available at site.

1.3.3 Before installation of the IPS at site following important aspects shall be checked:

(a) Proper earthing arrangement shall be provided for the IPS power supply system as per the details given chapter-6 on "Earthing & Lightening Protection".

(b) Proper connection of approved type of Class-B (Power line protection at Distribution level), Class-C (Power line protection at Equipment level) & Class-D protection modules against Lightening & transients at various stages of input (AC) & output (AC/DC), besides protecting External DC and AC circuits using MOVs.

(c) Proper charging of battery by the manufacturer or the authorised dealer of the Battery Manufacturer as per specification shall be ensured.

(d) Current Limiting (Voltage droop) adjustments: -

IPS shall be capable of working satisfactorily with input voltage variation from 150V-275 V AC & frequency variation of 48 Hz to 52 Hz. However the SMR module gets disconnected at 150 V AC and gets reconnected only at 170 V AC.

The load test with “standard load test kit” shall be carried out to ensure that, the Local feeder/Supply from AT/DG set is capable of feeding the required maximum current at the worked out nominal input AC voltage. For 4 Line station yard in Double Line section 30 Amps at 230 V AC from feeder to the IPS system is required. In case with the increase in the Load current (within 30 Amps) the input voltage gets drooped to a value of 170 V AC, the input current shall be regulated at that value, to ensure minimum 170 V AC input to the IPS (SMR) for proper functioning of the same & also to limit excessive load on Local/AT/DG supply & corresponding drop in cable under the condition of complete discharge of battery. The battery path current is automatically controlled to the extent of the input current regulation. In other words the current regulation shall affect adversely the battery recovery time in proportion the amount of current regulation settings.

The float/boost charge current limiting shall be continuously adjustable between 50 to 100% of the rated output current between 2 V to 2.5 V per cell.

In case of excessive input AC voltage drop (below 170 Volts) of any of the source of supply under maximum signalling load condition, immediate action may be taken for early restoration of the same by rectification of faulty power cables or by augmenting the capacity of input source etc. as the case may be.

1.3.4 Installation of the IPS system shall be done strictly in accordance with the pre-commissioning checklist issued by RDSO (along with its latest amendments as may be issued time to time). Copy of the latest Precommissioning Check list issued by RDSO is enclosed as Appendix-B.

1.4 OTHER SOURCES OF POWER SUPPLY

1.4.1 Photovoltaic cells/Solar panels

Photovoltaic cells shall be used in conformity to specification IRS: S-84/92 (Amend.-2 or latest). Photo voltaic cells shall be arranged in parallel-series array to get desired current-voltage of each module of solar panel. Each photo voltaic cell is of 0.5 Volts and 2.2 Amp. The recommended module wattages are 4, 6, 9, 12, 30, 32, 35, 40, 50, 70, 80 & 100 Watts. Recommended nominal voltage of the modules are 4, 6, 9, 12 & 24 Volts.

Panel of photovoltaic cells for the purpose of providing power supply, should be resorted to judiciously as per site conditions, as a primary or secondary source of power supply to signalling system as per availability of other sources of power supply and requirement of signalling load as per site condition.

The recommended usage of photovoltaic cell is as follows: -

(a) Signal lighting, controlling relays/switching circuits, reversers, indications, HKT, Lever locks, Block Instruments, Axle counters etc. at a way station operated by Lever Frame or Central Panel Interlocking or at Mid section LC gates etc. if local power supply is not available or unreliable.

(b) Lighting of semaphore signals with electric lamp, through a twilight switch.

(c) Operation of signal motors, with a battery bank and inverters, provided on semaphore signals.

(d) Provision of power supply for telephones provided in mid section level crossing gates.

(e) Train actuated warning device based on axle counters for level crossing gate.

1.4.2 Diesel Generator (DG) Set

Diesel engine as a prime mover and the alternator, forming DG set shall be provided in conformity to IS: 10000 (Part-I to XII)-1980 for Diesel Engine and IS: 4722-1992 for Generator with latest amendments to specs. Each DG set shall have an hour meter and installed with a self-starting switch in the ASM's room/DG room.

The separate room for DG set shall be made at a distance from main building. The DG set shall be mounted on a cement concrete foundation held on foundation bolts, provided with suitable anti-vibration pad of 10 mm thickness.

The output power supply of DG set shall be connected to the power cable through ICDP switch. It shall be the last source of power supply to signalling system to be used in case of failure of all sources of power supply available, wired through DPDT switch in the ASM's room, for manual changeover of powers supply to signalling system from DG set.

Voltage and the frequency of the output of DG set shall be checked with the help of suitable measuring equipments, before installation. The same shall not vary significantly under full load condition.

D.G. set shall be overhauled after 1000 Hrs. of run, preferably by the manufacturer or their authorised representative/dealer.

DG sets where installed shall be provided with push button start/stop facility.

Whenever auto start function is not functioning reliably, the same shall be disconnected and steps taken for manual start/hand cranking of the generator during power failure and also to stop the engine as soon as the power supply resumes. Steps shall be taken to rectify the auto start as early as possible.

Adequate no. of spares of consumables and important accessories/sub-parts shall be kept ready with the in charge/section engineer (signal), at site for speedy maintenance replacements.

Power supply requirement or the rating of DG set shall be worked out based on schemes for relevant type of signalling.

1.5 POWER SUPPLY SCHEME FOR VARIOUS TYPES OF SIGNALLING INSTALLATIONS

1.5.1 Typical power supply scheme on stations provided with semaphore signalling with reliable power supply (in Non-RE area).

1.5.1.1 The requirement

Power supply scheme for a typical 3-line station on single line section and 4-line station on double line section is given in following paragraphs. The same should be modified according to actual load/station configuration. The arrangements for such stations provided with wire operated semaphore signals, kerosene oil lit lamps and rod operated points with approximately 14-15 track circuits for centrally operated & end cabin operated signalling gears are shown in fig. 1.5.1(a) & (b) respectively.

Power supply arrangement shall be provided for the following devices/circuits at such stations:

(a) Controlling relays/switching circuits, Reversers, Arm & light repeaters and indicators, HKT, Lever Locks etc.

(b) Track circuits.

(c) Lighting of signals with electric lamps (optional).

(d) Motor operated Signals (Optional).

(e) Motor operated points (Optional).

(f) Block working.

(g) Telephones.

1.5.1.2 The detailed scheme

The detailed power supply scheme for such stations on Single/Double line section shall be as follows: -

(a) 230 V AC local power supply (from the local State Electricity Board/Distribution Company) shall be the main source of power supply or a solar panel with battery bank and an inverter of adequate capacity shall be provided if the local power supply is not reliable/not available.

Two DG sets of 3.5 KVA capacity shall be provided as a second and third source of power supply.

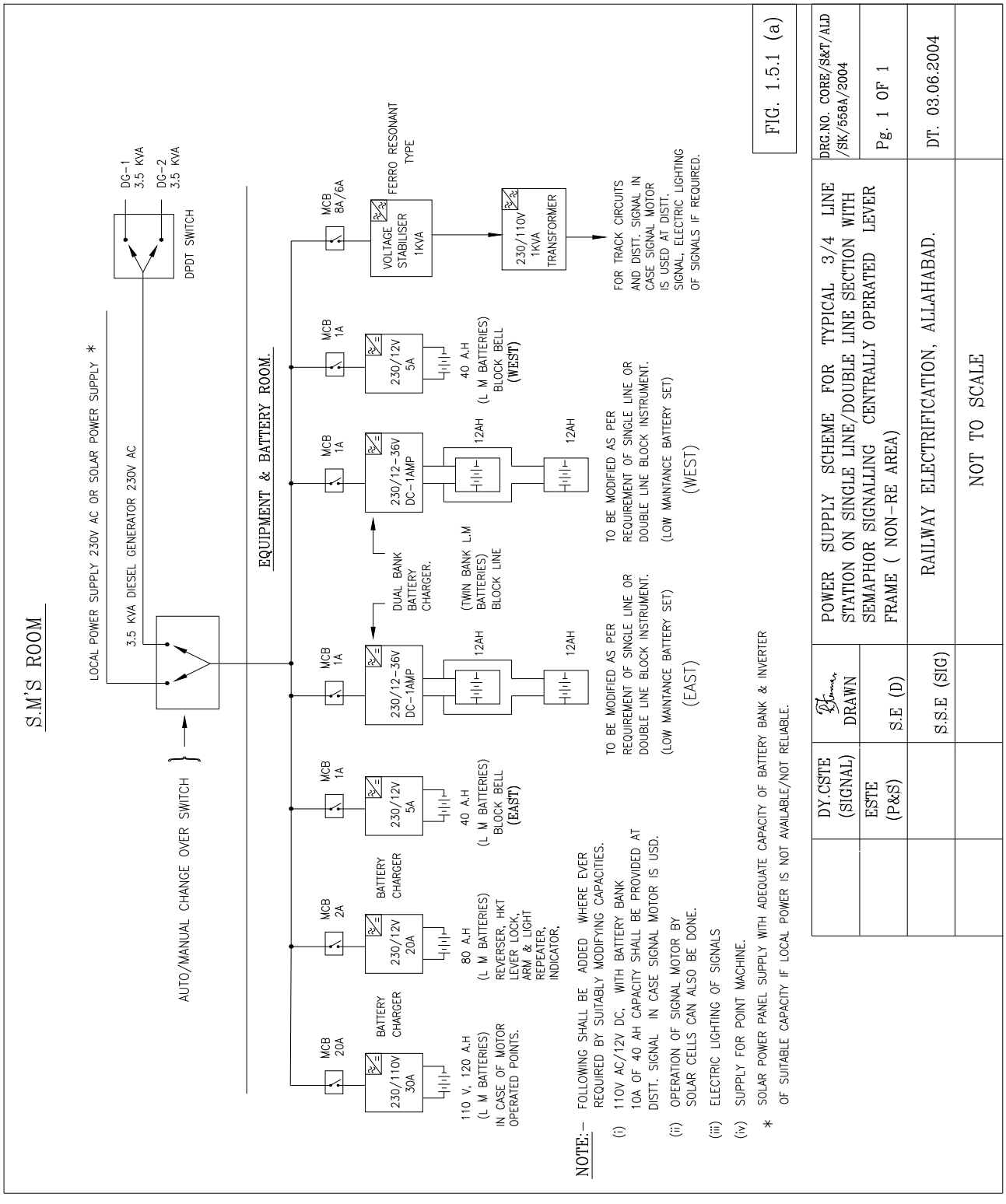
S.M'S ROOM
LOCAL POWER SUPPLY 230V AC OR SOLAR POWER SUPPLY *
3.5 KVA DIESEL GENERATOR 230V AC
DG-1 3.5 KVA
DG-2 3.5 KVA
DPDT SWITCH
AUTO/MANUAL CHANGE OVER SWITCH
EQUIPMENT & BATTERY ROOM.
MCB 20A
BATTERY CHARGER
230/110V 30A
110 V, 120 A.H (L M BATTERIES) IN CASE OF MOTOR OPERATED POINTS.
MCB 2A
BATTERY CHARGER
230/12V 20A
80 A.H (L M BATTERIES) REVERSER, HKT LEVER LOCK, ARM & LIGHT REPEATER, INDICATOR,
MCB 1A
230/12V 5A
40 A.H (L M BATTERIES) BLOCK BELL (EAST)
MCB 1A
230/12-36V DC-1AMP
DUAL BANK BATTERY CHARGER.
(TWIN BANK L.M BATTERIES) BLOCK LINE
12AH
12AH
MCB 1A
230/12-36V DC-1AMP
12AH
12AH
MCB 1A
230/12V 5A
40 A.H (L M BATTERIES) BLOCK BELL (WEST)
MCB 8A/6A
VOLTAGE STABILISER 1KVA
FERRO RESONANT TYPE
230/110V 1KVA TRANSFORMER
FOR TRACK CIRCUITS AND DISTT. SIGNAL IN CASE SIGNAL MOTOR IS USED AT DISTT. SIGNAL, ELECTRIC LIGHTING OF SIGNALS IF REQUIRED.
TO BE MODIFIED AS PER REQUIREMENT OF SINGLE LINE OR DOUBLE LINE BLOCK INSTRUMENT. (LOW MAINTANCE BATTERY SET) (EAST)
TO BE MODIFIED AS PER REQUIREMENT OF SINGLE LINE OR DOUBLE LINE BLOCK INSTRUMENT. (LOW MAINTANCE BATTERY SET) (WEST)
NOTE:- FOLLOWING SHALL BE ADDED WHERE EVER REQUIRED BY SUITABLY MODIFYING CAPACITIES.
(i) 110V AC/12V DC, WITH BATTERY BANK 10A OF 40 AH CAPACITY SHALL BE PROVIDED AT DISTT. SIGNAL IN CASE SIGNAL MOTOR IS USD.
(ii) OPERATION OF SIGNAL MOTOR BY SOLAR CELLS CAN ALSO BE DONE.
(iii) ELECTRIC LIGHTING OF SIGNALS
(iv) SUPPLY FOR POINT MACHINE.
* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
DY.CSTE (SIGNAL)
ESTE (P&S)
DRAWN
S.E (D)
S.S.E (SIG)
POWER SUPPLY SCHEME FOR TYPICAL 3/4 LINE STATION ON SINGLE LINE/DOUBLE LINE SECTION WITH SEMAPHOR SIGNALLING CENTRALLY OPERATED LEVER FRAME (NON-RE AREA)
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DRG.NO. CORE/S&T/ALD /SK/558A/2004
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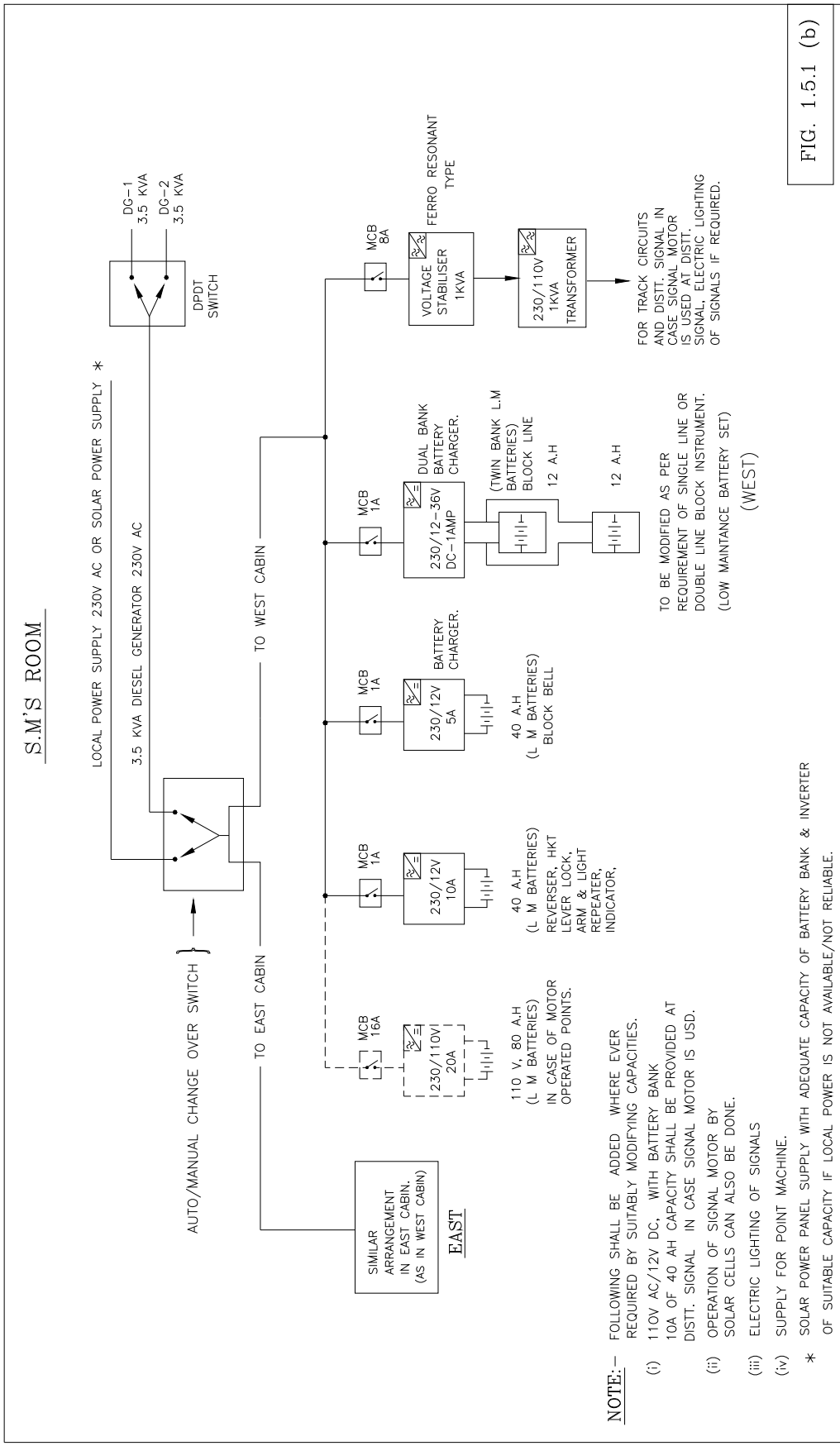
FIG. 1.5.1 (a)


S.M'S ROOM
LOCAL POWER SUPPLY 230V AC OR SOLAR POWER SUPPLY *
3.5 KVA DIESEL GENERATOR 230V AC
DG-1 3.5 KVA
DG-2 3.5 KVA
DPDT SWITCH
AUTO/MANUAL CHANGE OVER SWITCH
TO EAST CABIN
TO WEST CABIN
MCB 8A
VOLTAGE STABILISER 1KVA
FERRO RESONANT TYPE
230/110V 1KVA TRANSFORMER
FOR TRACK CIRCUITS AND DISTT. SIGNAL IN CASE SIGNAL MOTOR IS USED AT DISTT. SIGNAL, ELECTRIC LIGHTING OF SIGNALS IF REQUIRED.
MCB 1A
230/12-36V DC-1AMP
DUAL BANK BATTERY CHARGER.
(TWIN BANK L.M BATTERIES) BLOCK LINE
12 A.H
TO BE MODIFIED AS PER REQUIREMENT OF SINGLE LINE OR DOUBLE LINE BLOCK INSTRUMENT.
(LOW MAINTANCE BATTERY SET)
(WEST)
MCB 1A
230/12V 5A
BATTERY CHARGER.
40 A.H (L M BATTERIES) BLOCK BELL
MCB 1A
230/12V 10A
40 A.H (L M BATTERIES) REVERSER, HKT LEVER LOCK, ARM & LIGHT REPEATER, INDICATOR,
MCB 16A
230/110V 20A
110 V, 80 A.H (L M BATTERIES) IN CASE OF MOTOR OPERATED POINTS.
SIMILAR ARRANGEMENT IN EAST CABIN. (AS IN WEST CABIN)
EAST
NOTE:- FOLLOWING SHALL BE ADDED WHERE EVER REQUIRED BY SUITABLY MODIFYING CAPACITIES.
(i) 110V AC/12V DC, WITH BATTERY BANK 10A OF 40 AH CAPACITY SHALL BE PROVIDED AT DISTT. SIGNAL IN CASE SIGNAL MOTOR IS USD.
(ii) OPERATION OF SIGNAL MOTOR BY SOLAR CELLS CAN ALSO BE DONE.
(iii) ELECTRIC LIGHTING OF SIGNALS
(iv) SUPPLY FOR POINT MACHINE.
* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
FIG. 1.5.1 (b)
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
S.E (D)
S.S.E (SIG)
POWER SUPPLY SCHEME FOR TYPICAL 3/4 LINE STATION ON SINGLE/DOUBLE LINE SECTION WITH SEMAPHOR SIGNALLING OPERATED BY LEVER FRAMES IN END CABINS (NON-RE AREA)
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DRG.NO. CORE/S&T/ALD /SK/559A/2004
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(b) 230 V AC/12 V DC, 10 Amp Battery charger with 40 AH battery bank capacity at end cabins and 230 V AC/12 V DC 20 Amp Battery charger with battery bank of 80 AH capacity at the central cabins, shall be provided for reversers, arm & light repeaters, track circuit indicators and other banner type indicators.

(c) One Ferro resonant voltage stabilizer of 1 KVA capacity shall be connected to 230 V AC supply as made available from CLS power distribution panel, through MCB, for feeding power to Transformer for Signal and Track Circuits. 230 V/110 V AC, 1 KVA transformer shall be provided to feed power for track feed battery chargers. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

(d) 110 V AC/6 V DC, 5/10 A Track feed battery chargers shall be provided near feed end of each track circuit supported by a battery bank of 2V, 40/80 AH, 1, 2, 3 or 4 low maintenance cells in series as per requirement at site. In case of availability of power supply is poor, primary cells may be used instead of battery charger and battery bank.

(e) 110 V AC/12 V DC, 10 A Battery Charger with battery bank of 40 AH capacity shall be provided for motor operated signals, at the foot of each signal. In case of availability of power supply is poor, solar panel with battery bank of suitable capacity may be used.

(f) In case operation of all points at the station is done by point machines, one 230 V AC/110 V DC 30 Amp battery charger with battery bank of 120 AH low maintenance battery in central cabin or One 230 V AC/110 V DC, 20 Amp battery charger with battery bank of 80 AH low maintenance battery in case of end cabins, shall be provided for power supply for point machine operation.

(g) 230V AC Dual bank battery charger conforming to specification IRS: IRS: S-85/92 (amendment-1 or latest), supported with two banks with each 4 V twin cell of 12 AH capacity shall be provided for line circuit of each Block Instrument. This shall not be used for any others purpose. The circuit shall be so designed that at any stage of time only the fully charged battery bank is connected to line circuit while at the same time charger is charging the idle set & is not connected to line circuit. The line voltage shall be adjusted depending upon length of block section. In case availability of power supply is poor, primary cell of approved specification may be used in place of dual bank battery charger and battery bank. The requirement of battery charger & dual bank batteries shall be as follows: -

	Type of Block Instrument	**Type of Battery charger**
(i)	Single line token instrument (Neal's tablet or ball type)	230 V AC/12-24 V DC, 1 A
(ii)	Double line Block Instrument (SGE or Podanur type)	230 V AC/24-40 V DC, 1 A
(iii)	Single line push button type (Token less or Diado Block Instrument)	230 V AC/40-60 V DC, 1 A

(h) One 230/12 V DC, 5 Amp battery charger with battery bank of 12 V, 40 AH low maintenance battery shall be provided for Block bell circuit.

(i) 3V power supply shall be used for telephones connected with Block Instrument and magneto telephones connected between Station Master and End cabins or Station Master and Level crossing gates. Each telephone shall have independent power supply and shall not be used for any other telephone or circuit.

1.5.2 Power supply scheme on stations provided with multiple aspect colour light signalling (MACLS), operated by Lever Frame at End Cabins not provided with 25 KV AC traction (Non-RE area).

1.5.2.1 The requirement

Power supply scheme for typical 3 line station on single line section & 4 line station on double line section is given in following paragraphs. The same should be modified according to actual station load/station configuration. The power supply for signalling circuits is designed taking into account lighting of signals with 110 V AC used with unscreened cable. The load of such station has been worked out taking into account rod operated points & 14-15 track circuits. The arrangement for such end cabin operated station is shown in fig. 1.5.2. The arrangement shown in the figure is for one of the End Cabins.

Power supply arrangement shall be provided for the following devices/circuits at such stations:

(a) Lighting of signals.

(b) Track circuits.

(c) Motor operation of points (Optional).

(d) Block working.

(e) For controlling of relays/switching circuits for interlocking (Q-series relays have been considered).

(f) Indicators luminous/Disc/Banner type.

(g) Telephones.

1.5.2.2 The detailed scheme

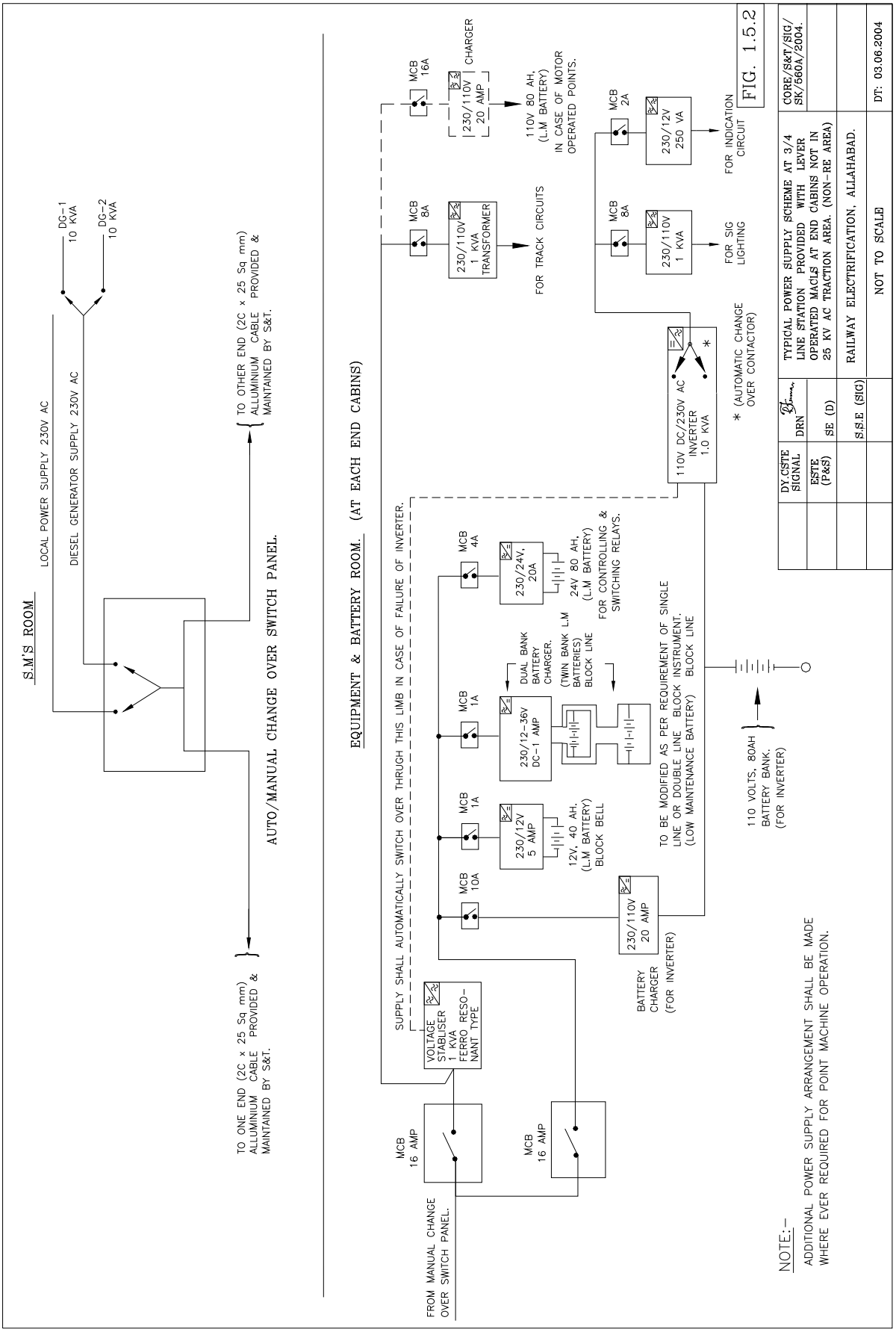
The detailed power supply scheme for such stations on Single/Double line section shall be as follows: -

Power supply to signalling system through Integrated Power Supply Equipment as mentioned in Para 1.3.3 may be provided in terms of SEM Para 16.4.5. Alternatively, the following conventional type of power supply arrangement may be adopted as approved by CSTE of the Railways.

(a) 230 V AC local power supply (from the local State Electricity Board/Distribution Company) shall be the main source of power supply or a solar panel with battery bank and an inverter of adequate capacity shall be provided if the local power supply is not reliable/not available.

Two diesel generator sets of 10 KVA capacity shall be provided with a self-starter switch provided in the ASM's room/DG room. A power cable of suitable capacity shall be laid by S&T department from the generator & terminated on CLS Power Panel wired for automatic/manual changeover, in case of failure of all other power supply.

(b) A Ferro Resonant Voltage Stabilizer of 1.0 KVA capacity shall be connected to 230 V AC General Supply through MCB. This shall be used to provide stabilized power supply for signal lighting only.


S.M'S ROOM
LOCAL POWER SUPPLY 230V AC
DIESEL GENERATOR SUPPLY 230V AC
DG-1 10 KVA
DG-2 10 KVA
TO ONE END (2C x 25 Sq mm) ALLUMINIUM CABLE MAINTAINED BY S&T. PROVIDED &
TO OTHER END (2C x 25 Sq mm) ALLUMINIUM CABLE MAINTAINED BY S&T. PROVIDED &
AUTO/MANUAL CHANGE OVER SWITCH PANEL.
EQUIPMENT & BATTERY ROOM. (AT EACH END CABINS)
SUPPLY SHALL AUTOMATICALLY SWITCH OVER THRUGH THIS LIMB IN CASE OF FAILURE OF INVERTER.
FROM MANUAL CHANGE OVER SWITCH PANEL.
MCB 16 AMP
MCB 16 AMP
VOLTAGE STABLISER 1 KVA FERRO RESO-NANT TYPE
MCB 10A
230/12V 5 AMP
12V, 40 AH. (L.M BATTERY) BLOCK BELL
MCB 1A
230/12-36V DC-1 AMP
DUAL BANK BATTERY CHARGER. (TWIN BANK L.M BATTERIES) BLOCK LINE
MCB 1A
MCB 4A
230/24V, 20A
24V 80 AH, (L.M BATTERY) FOR CONTROLLING & SWITCHING RELAYS.
230/110V 20 AMP
BATTERY CHARGER (FOR INVERTER)
TO BE MODIFIED AS PER REQUIREMENT OF SINGLE LINE OR DOUBLE LINE BLOCK INSTRUMENT. (LOW MAINTENANCE BATTERY) BLOCK LINE
110 VOLTS, 80AH BATTERY BANK. (FOR INVERTER)
110V DC/230V AC INVERTER 1.0 KVA
* (AUTOMATIC CHANGE OVER CONTACTOR)
MCB 8A
230/110V 1 KVA TRANSFORMER
FOR TRACK CIRCUITS
MCB 16A
230/110V 20 AMP CHARGER
110V 80 AH, (L.M BATTERY) IN CASE OF MOTOR OPERATED POINTS.
MCB 8A
230/110V 1 KVA
FOR SIG LIGHTING
MCB 2A
230/12V 250 VA
FOR INDICATION CIRCUIT
FIG. 1.5.2
NOTE:-
ADDITIONAL POWER SUPPLY ARRANGEMENT SHALL BE MADE WHERE EVER REQUIRED FOR POINT MACHINE OPERATION.
DY CSTE SIGNAL
ESTE (P&S)
DRN
SE (D)
S.S.E (SIG)
TYPICAL POWER SUPPLY SCHEME AT 3/4 LINE STATION PROVIDED WITH LEVER OPERATED MACLS AT END CABINS NOT IN 25 KV AC TRACTION AREA. (NON-RE AREA)
CORE/S&T/SIG/ SK/560A/2004.
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DT: 03.06.2004

(c) An Inverter of 110 V DC/230 V AC 1.0 KVA capacity supported with battery bank of 110 V, 80 AH Low maintenance cells shall be provided and connected for on line operation, which will switch over to General Supply only in case of failure of Inverter. A battery charger of 230 V AC/110 V DC, 20 Amp shall be provided to charge the battery bank.

(d) One 230 V/110 V AC transformer of 1.0 KVA capacity shall be provided for signal lighting. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting feed to various signal aspects.

(e) One 230 V/110 V AC transformer of 1 KVA capacity shall be provided for track feed battery chargers. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

(f) 110 V AC/6 V DC, 5/10 A Track feed battery chargers shall be provided near feed end of each track circuit supported by a battery bank of 2 V, 40/80 AH low maintenance 1, 2, 3 or 4 cells in series as per requirement at site.

(g) In case operation of all points is done with point machines, 230 V AC/110 V DC, 20 Amp Battery charger with battery bank of 110 V, 80 AH capacity low maintenance cells shall be provided for motor operation of points.

(h) Power supply for block instruments, shall be provided as described in para 1.5.1.2 (g).

(i) Power supply for block bell circuit shall be provided as described in para 1.5.1.2 (h).

(j) One 230 V AC/24 V DC, 20 Amp Battery charger with Low Maintenance Lead Acid battery bank of 24 V, 80 AH capacity shall be provided for controlling relays and switching relay circuits for interlocking (Q-series relays have been considered).

(k) One Indication transformer 230 V AC/12 V AC, of 250 VA capacity shall be provided for indication circuits through inverter provided for signal lighting.

(l) Power supply to telephones shall be provided as described in para 1.5.1.2 (i).

1.5.3 Power supply arrangement on stations provided with multi aspect colour light signalling operated by levers provided with 25 KV AC traction (RE area)

1.5.3.1. The requirement

AT supply shall be main source of power supply of signalling system while local commercial power supply shall be second source and DG sets shall be third source of power supply.

A power cable shall be laid between AT & Station Master's room and terminated on Colour Light Signal (CLS) Power Control and Distribution Panels (CLS Power Panel), by Electrical department. The CLS Power Panel shall contain automatic changeover switches between AT, Local & DG (in case of single Line section) power supply along with audio-visual indications for availability of UP and DOWN AT supplies.

In case of station being on single line section one DG set of 10 KVA capacity shall be provided at the station. The power supply from DG set to CLS panel shall be switched through a Double Pole Double Throw (DPDT) switch.

Supply from CLS Power Panel in the Station Master's room to each cabin shall be provided by S&T branch through a power cable of suitable size (clause number 1.2.2 may be referred to), which shall be terminated on an ICDP switch in the ASM’s/Cabinman's room.

There shall be an independent 24 V DC power supply for internal circuits. This power supply shall be completely isolated from any other circuit connected to or operating equipment out side relay room.

There shall be an independent 24 V DC power supply for operating relays/equipments provided out side relay room up to maximum distance of 2.8 KMs of length of parallelism. Another 24 V DC power supply shall be provided for operation of relays beyond 2.8 KMs of length of parallelism. These two power supplies shall be in perfect isolation of each other.

Two AC power supplies, one for lighting signals placed up to 200 Mtrs from the cabin whose controlling relays are placed in the cabin & other for those signals which are placed beyond 200 Mtrs from the cabin shall be provided. These two power supplies shall be in perfect isolation of each other.

Power supply Scheme for typical 3 line station on single line section and 4 line station on double line section is given below. The same should be modified according to actual station load/station configuration. The power supply for signalling circuits are designed for lighting with 110 V AC used with unscreened cable. The load of such station has been worked out taking into account rod operation of points and approx. 14 - 15 track circuits. The arrangement for such end cabin operated station is shown in fig. 1.5.3.1.

The arrangement is given for one of the End Cabins. Similar arrangement shall be made for other End Cabin.

Power supply of such stations shall be required for: -

(i) Lighting of signals.

(ii) Track circuits.

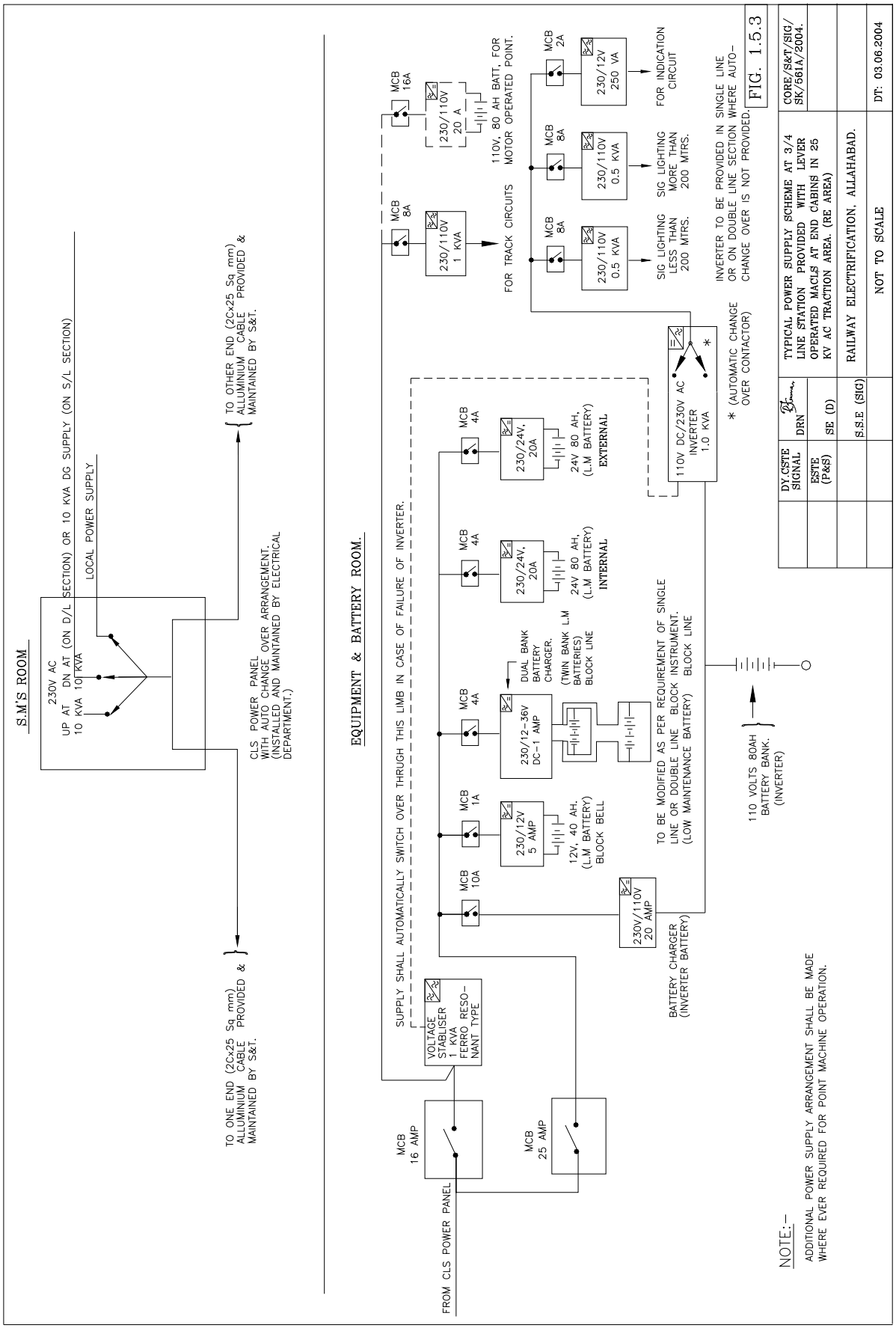
(iii) Motor operation of points (optional).

(iv) Block working.

(v) For controlling of relays/switching circuits for interlocking (Q-series Relays have been considered).

(vi) Indicators.

(vii) Telephones.


S.M'S ROOM
230V AC
UP AT DN AT (ON D/L SECTION) OR 10 KVA DG SUPPLY (ON S/L SECTION)
10 KVA 10 KVA
LOCAL POWER SUPPLY
CLS POWER PANEL
WITH AUTO CHANGE OVER ARRANGEMENT.
(INSTALLED AND MAINTAINED BY ELECTRICAL DEPARTMENT.)
TO OTHER END (2Cx25 Sq mm) ALLUMINIUM CABLE PROVIDED & MAINTAINED BY S&T.
TO ONE END (2Cx25 Sq mm) ALLUMINIUM CABLE PROVIDED & MAINTAINED BY S&T.
EQUIPMENT & BATTERY ROOM.
SUPPLY SHALL AUTOMATICALLY SWITCH OVER THRUGH THIS LIMB IN CASE OF FAILURE OF INVERTER.
FROM CLS POWER PANEL
MCB 16 AMP
MCB 25 AMP
VOLTAGE STABILISER 1 KVA FERRO RESO-NANT TYPE
MCB 10A
230V/110V 20 AMP
BATTERY CHARGER (INVERTER BATTERY)
MCB 1A
230/12V 5 AMP
12V, 40 AH. (L.M BATTERY) BLOCK BELL
MCB 4A
230/12-36V DC-1 AMP
DUAL BANK BATTERY CHARGER. (TWIN BANK L.M BATTERIES) BLOCK LINE
TO BE MODIFIED AS PER REQUIREMENT OF SINGLE LINE OR DOUBLE LINE BLOCK INSTRUMENT. (LOW MAINTENANCE BATTERY) BLOCK LINE
110 VOLTS 80AH BATTERY BANK. (INVERTER)
MCB 4A
230/24V, 20A
24V 80 AH, (L.M BATTERY) INTERNAL
MCB 4A
230/24V, 20A
24V 80 AH, (L.M BATTERY) EXTERNAL
110V DC/230V AC INVERTER 1.0 KVA
* (AUTOMATIC CHANGE OVER CONTACTOR)
MCB 8A
230/110V 1 KVA
FOR TRACK CIRCUITS
MCB 16A
230/110V 20 A
110V, 80 AH BATT. FOR MOTOR OPERATED POINT.
MCB 8A
230/110V 0.5 KVA
SIG LIGHTING LESS THAN 200 MTRS.
MCB 8A
230/110V 0.5 KVA
SIG LIGHTING MORE THAN 200 MTRS.
MCB 2A
230/12V 250 VA
FOR INDICATION CIRCUIT
INVERTER TO BE PROVIDED IN SINGLE LINE OR ON DOUBLE LINE SECTION WHERE AUTO-CHANGE OVER IS NOT PROVIDED.
FIG. 1.5.3
DY.CSTE SIGNAL
DRN
ESTE (P&S)
SE (D)
S.S.E (SIG)
TYPICAL POWER SUPPLY SCHEME AT 3/4 LINE STATION PROVIDED WITH LEVER OPERATED MACLS AT END CABINS IN 25 KV AC TRACTION AREA. (RE AREA)
CORE/S&T/SIG./ SK/561A/2004.
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DT: 03.06.2004
NOTE:-
ADDITIONAL POWER SUPPLY ARRANGEMENT SHALL BE MADE WHERE EVER REQUIRED FOR POINT MACHINE OPERATION.

1.5.3.2 The detailed scheme

The detailed power supply scheme for such stations on Single/Double line section shall be as follows: -

Power supply to signalling system through Integrated Power Supply Equipment as mentioned in Para 1.3.3 may be provided in terms of SEM Para 16.4.5. Alternatively, the following conventional type of power supply arrangement may be adopted as approved by CSTE of the Railways.

(a) Ferro resonant voltage stabilizer of 1 KVA capacity shall be connected to 230 V AC supply as made available from CLS panel in the Station Master's room, through MCB. This shall be used to provide stabilized power supply for signal lighting only.

(b) On stations on single line section or on double line section, an Inverter of 110 V DC/230 V AC 1 KVA capacity supported with battery bank of 110 V, 80 AH Low maintenance cells shall be provided and connected for on line operation, which will switch over to main power supply only in case of failure of Inverter. A battery charger of 230 V AC/110 V DC, 20 Amp shall be provided to charge the battery bank.

(c) On single line section, where only one AT is provided, a generator of 10 KVA capacity shall be provided with a self-starter switch provided in the ASM's room/DG room. A power cable of suitable capacity shall be laid by S&T department from the generator & terminated on CLS Power Panel wired for automatic/manual changeover, in case of failure of all other power supply.

(d) Two 230 V/110 V AC transformers of 0.5 KVA shall be provided for signal lighting, one for signals below 200 meters and other for signals beyond 200 mts from the cabin. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting feed to various signal aspects.

(e) One 230 V/110 V AC transformer of 1 KVA capacity shall be provided for track feed battery chargers. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

(f) 110 V AC/6 V DC, 5/10 A Track feed battery chargers shall be provided near feed end of each track circuit supported by a battery bank of 2 V, 40/80 AH low maintenance, 1, 2, 3 or 4 cells in series as per requirement at site.

(g) In case operation of all points is done with point machines, 230 V AC/110 V DC, 20 Amp Battery charger with battery bank of 110 V, 80 AH capacity low maintenance cells shall be provided for motor operation of points.

(h) Power supply for block instruments/block working shall be provided as described in para 1.5.1.2(g).

(i) Power supply for block bell circuit shall be provided as described in para 1.5.1.2(h)

(j) Two 230 V AC/24 V DC, 20 Amp Battery chargers, each with battery bank of 80 AH low maintenance cells shall be provided one for indoor controlling relays/switching relay circuits for interlocking and other for out door controlling relays for a distance of 2.8 KMs from the cabin. In case the controlling relay is placed at a distance of more than 2.8 KMs a separate power supply for the same shall be used. (Q series- relays have been considered). These circuits shall be in complete isolation of each other.

(k) One Indication transformer 230 V AC/12 V AC of 250 VA capacity shall be provided for indications through inverter provided for signal lighting.

(l) Primary cell shall be used for power supply to telephones connected with Block Instrument and magneto telephones connected between Station Master and End cabins or Station Master and Level crossing gates. Each telephone shall have independent power supply and shall not be used for any other telephone or circuit.

1.5.4 Power supply Scheme on station provided with MACLS operated with relay based route setting type Central Panel/Electronic Interlocking with block proving by axle counters, on section not provided with 25 KV AC Traction (Non-RE area)

1.5.4.1 The requirement

Power supply Scheme for typical 3 line station on single line section & 4 line station on double line section is given below. The same should be modified according to actual station load/station configuration. The power supply for signalling circuits is designed with lighting with 110 V AC used with unscreened cable. The load of such station has been worked out taking into account 25-30 track circuits. The arrangement for such central panel operated station is shown in fig. 1.5.4.1 Power supply of such stations has to cater for: -

(i) Lighting of signals with electric lamps.

(ii) Track circuits.

(iii) Motor operation of points.

(iv) Block proving by Axle counters with block panel.

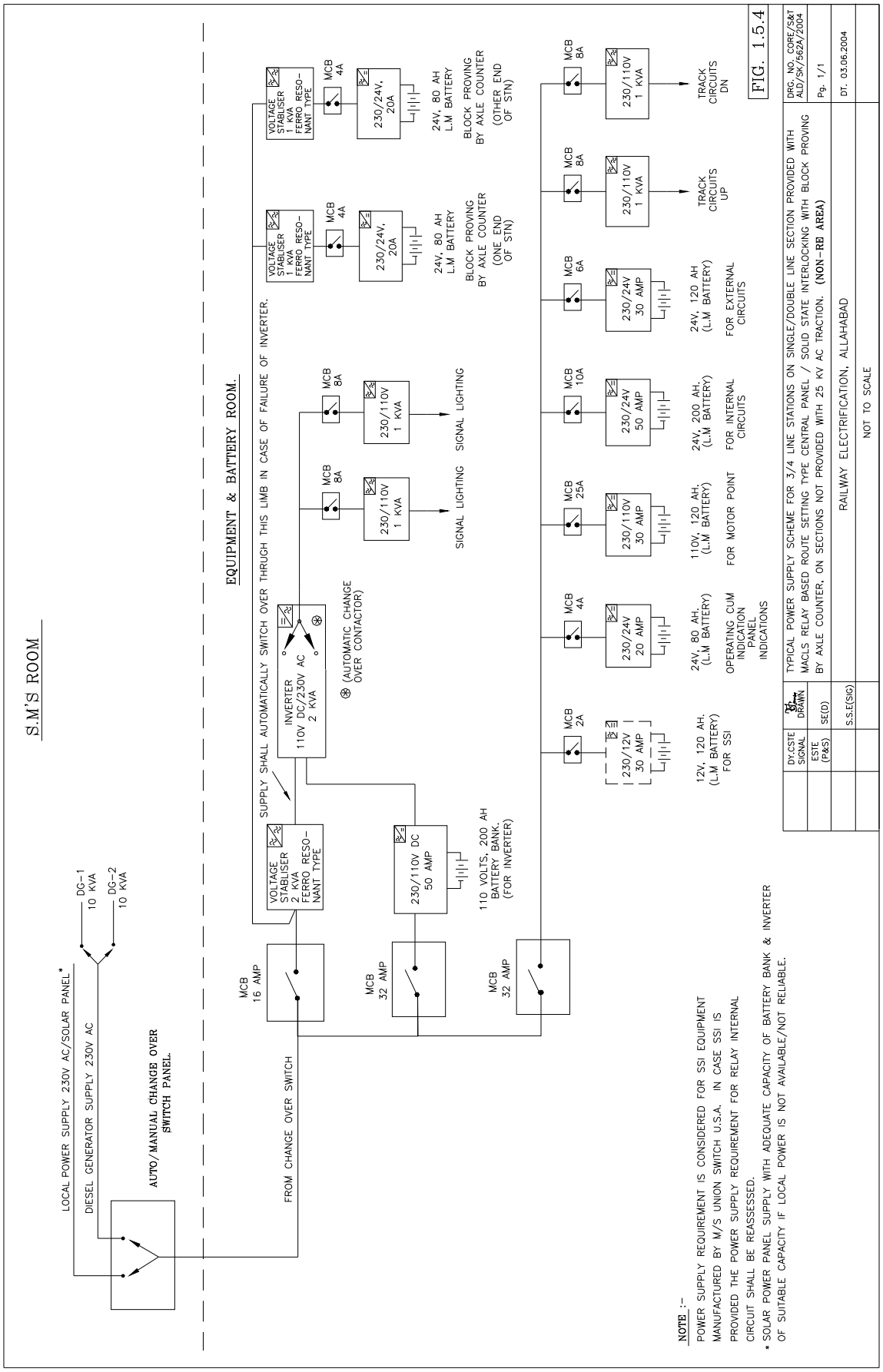
(v) For controlling of relays/switching circuits for interlocking (Q-series relays have been considered).

(vi) For Solid State Interlocking (SSI).

(vii) Indication Panel.

(viii) Data Logger.

(ix) Telephones.


S.M'S ROOM
EQUIPMENT & BATTERY ROOM.
LOCAL POWER SUPPLY 230V AC/SOLAR PANEL*
DIESEL GENERATOR SUPPLY 230V AC
DG-1 10 KVA
DG-2 10 KVA
AUTO/MANUAL CHANGE OVER SWITCH PANEL.
FROM CHANGE OVER SWITCH
MCB 16 AMP
MCB 32 AMP
MCB 32 AMP
VOLTAGE STABILISER 2 KVA FERRO RESO-NANT TYPE
INVERTER 110V DC/230V AC 2 KVA
SUPPLY SHALL AUTOMATICALLY SWITCH OVER THRUGH THIS LIMB IN CASE OF FAILURE OF INVERTER.
(AUTOMATIC CHANGE OVER CONTACTOR)
230/110V DC 50 AMP
110 VOLTS, 200 AH BATTERY BANK. (FOR INVERTER)
MCB 2A
230/12V 30 AMP
12V, 120 AH. (L.M BATTERY) FOR SSI
MCB 4A
230/24V 20 AMP
24V, 80 AH. (L.M BATTERY) OPERATING CUM INDICATION PANEL INDICATIONS
MCB 25A
230/110V 30 AMP
110V, 120 AH. (L.M BATTERY) FOR MOTOR POINT
MCB 8A
230/110V 1 KVA
SIGNAL LIGHTING
MCB 8A
230/110V 1 KVA
SIGNAL LIGHTING
MCB 10A
230/24V 50 AMP
24V, 200 AH. (L.M BATTERY) FOR INTERNAL CIRCUITS
VOLTAGE STABILISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/24V, 20A
24V, 80 AH L.M BATTERY
BLOCK PROVING BY AXLE COUNTER (ONE END OF STN)
VOLTAGE STABILISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/24V, 20A
24V, 80 AH L.M BATTERY
BLOCK PROVING BY AXLE COUNTER (OTHER END OF STN)
MCB 6A
230/24V 30 AMP
24V, 120 AH (L.M BATTERY) FOR EXTERNAL CIRCUITS
MCB 8A
230/110V 1 KVA
TRACK CIRCUITS UP
MCB 8A
230/110V 1 KVA
TRACK CIRCUITS DN
FIG. 1.5.4
NOTE :-
POWER SUPPLY REQUIREMENT IS CONSIDERED FOR SSI EQUIPMENT MANUFACTURED BY M/S UNION SWITCH U.S.A. IN CASE SSI IS PROVIDED THE POWER SUPPLY REQUIREMENT FOR RELAY INTERNAL CIRCUIT SHALL BE REASSESSED.
* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
SE(D)
S.S.E(SIG)
TYPICAL POWER SUPPLY SCHEME FOR 3/4 LINE STATIONS ON SINGLE/DOUBLE LINE SECTION PROVIDED WITH MACLS RELAY BASED ROUTE SETTING TYPE CENTRAL PANEL / SOLID STATE INTERLOCKING WITH BLOCK PROVING BY AXLE COUNTER, ON SECTIONS NOT PROVIDED WITH 25 KV AC TRACTION. (NON-RB AREA)
RAILWAY ELECTRIFICATION, ALLAHABAD
NOT TO SCALE
DRG. NO. CORE/S&T ALD/SK/562A/2004
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DT. 03.06.2004

1.5.4.2 The detailed scheme

Power supply to signalling system through Integrated Power Supply Equipment as mentioned in Para 1.3.3 may be provided in terms of SEM Para 16.4.5. Alternatively, the following conventional type of power supply arrangement may be adopted as approved by CSTE of the Railways.

(a) A Ferro resonant Voltage Stabilizer of 2 KVA capacity shall be connected to 230 V AC Local power supply through 16 Amp MCB. This shall be utilized to provide stabilized power supply for signal lighting.

Two Ferro resonant Voltage Stabilizer of 1 KVA capacity shall be connected to 230 V AC Local power supply through 8 Amp MCB, one each for each end of the BPAC equipments. This shall be utilised to provide stabilized power supply for block proving by axle counters only.

(b) On stations on single line section or on double line section, an Inverter of 110 V DC/230 V AC 2 KVA capacity supported with battery bank of 110 V, 200 AH Low maintenance cells shall be provided and connected for on line operation, which will switch over to main power supply only in case of failure of Inverter. A battery charger of 230 V AC/110 V DC, 50 Amp shall be provided to charge the battery bank.

(c) Two sets of diesel generator of 10 KVA capacity shall be provided with a self-starter switch provided in the ASM's room. A power cable of suitable capacity shall be laid between the generator and ASM's room by S&T department, terminated on a changeover switch wired for automatic/manual changeover in case of failure of all other power supplies.

(d) Two 230 V AC/110 V AC, 1 KVA transformer shall be provided for signal lighting, one each for UP & DOWN yards. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting feed to various signal aspects.

(e) Two 230 V AC/110 V AC, 1 KVA transformer shall be provided for track feed battery chargers, one each for UP & DOWN yards. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

(f) 110V AC output of the transformer shall be provided as omnibus Circuit for connecting track feed battery chargers. 110 V AC/6V DC 5/10 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 2 V each of capacity 40/80 AH, in series as per requirement at site.

(g) One battery charger of 230 V AC/110 V DC, 30 Amp with battery bank of 120AH Low maintenance cells shall be provided for motor operation of points.

(h) 1 KVA Stabilized power supply shall be provided for each set of Block Proving by Axle Counters. Power requirement for devices used for analogue axle counter is as follows:

(i)	Evaluator	21.6-28.8 V DC, 1.5 amps.
(ii)	Junction Box	21.6-28.8 V DC, <250 ma.
(iii)	Resetting Box	21.6-28.8 V DC, 500 ma (Only when resetting key is pressed).

(i) For power supply arrangement for Block proving by axle counter system, One 230 V AC/24 V DC, 20 Amp battery charger with a battery bank of 80 AH low maintenance cells shall be provided for power supply to DC-DC converter of Evaluator, Multiplexer and block panel, of block proving by axle counters. The PARD value (ripple and noise) of out put voltage of the charger shall be less than 10 mv rms and less than 50 mv PP. A 2x25 sq.mm. aluminium power cable shall be laid at both ends of the yard for connecting track devices at departure and reception signals. This power supply shall be suitably modified for each added set of Block section with block proving by axle counters.

(j) **Power supply for controlling relays/switching circuits**

In case of central panel with relay based interlocking

(i) Power supply for controlling relays and switching circuits for interlocking i.e. internal circuits, a 230 V AC/24 V DC, 50 Amp battery charger with battery bank of 200 AH L.M. batteries shall be provided.

(ii) One 230 V AC/24 V DC, 30 Amps battery Charger with a battery bank of 120 AH low maintenance cells shall be provided for external circuits.

In case of central panel with Solid State Interlocking

(i) Power supply for controlling relays and switching circuits for interlocking, a 230 V AC/24 V DC 30 Amp battery charger with battery bank of 120 AH L.M. batteries shall be provided. An additional power supply for SSI equipment shall be provided as per manufacturer's requirement. However, in the typical case of SSI with one out of one architecture, manufactured by M/s Union Switch USA, a 230 V AC/12 V DC, 30 Amps battery charger with a 120 AH battery bank of low maintenance cells shall be provided to cater load of 12 V DC, 18-20 Amps, for entire SSI system. The PARD values (ripple and noise) of output voltage of the charger shall be same as required for axle counters. Further requirement of power supply for Electronic Interlocking System shall be made by the manufacturer.

(ii) For external circuits the arrangement shall be same as described in above para 1.5.4.2. (k) (ii).

(k) In consideration of indication on Panel being LED lit, a 230 V AC/24 V DC-20 Amp battery charger with 80 AH Low Maintenance battery bank shall be provided. For panel with electric lamps, 230 V AC/24 AC, 500 VA transformer shall be provided for indication lamps through inverter provided for signals.

(l) Primary cell, conforming to Spec. No. IRS: S-95/96 (with latest amendments) shall be used for power supply to telephones connected with Block panel and magneto telephones connected between Station Master and Level Crossing gates. Each telephone shall have independent power supply and shall not be used for any other telephone or circuit.

1.5.5 Power supply scheme on stations provided with MACLS operated with relay based route setting type Central Panel/Solid State Interlocking along with block proving by axle counters on section provided with 25 KV AC Traction (RE Area).

1.5.5.1 The requirement

General Principals covered under sections 1.5.3 for provision of power supply in 25 KV AC traction area shall be applicable here also. Supply from CLS Power Panel in the Station Master's room to panel room shall be provided by S&T branch through a power cable of suitable size (clause number 1.2.2 may be referred to), which shall be terminated on an Iron Clad Double Pole (ICDP) switch in the ASM’s operating cum indication panel room.

Power supply scheme for typical 3 line station on single line section line and 4 line station on double line section is given below. The same should be modified according to actual station load/station configuration. The power supply for circuit is designed with signal lighting with 110 V AC used with unscreened cable. The load of such station has been worked out taking into account 25-30 track circuits. The arrangement for such central panel operated station is shown in Fig. 1.5.5.

Power supply of such stations shall be required for: -

(i) Lighting of signals with electric lamps.

(ii) Track circuits.

(iii) Motor operation of points.

(iv) Block proving by Axle counters and block panel.

(v) For controlling of relays/switching circuits for interlocking (Q-series relays have been considered).

(vi) For Electronic Interlocking.

(vii) Indication Panel.

(viii) Data Logger.

(ix) Telephones.

1.5.5.2 Detailed scheme

Power supply to signalling system through Integrated Power Supply Equipment as mentioned in Para 1.3.3 may be provided in terms of SEM Para 16.4.5. Alternatively, the following conventional type of power supply arrangement may be adopted as approved by CSTE of the Railways.

(a) A Ferro resonant Voltage Stabilizer of 2 KV A capacity shall be connected to 230 V AC power supply through 16 Amp MCB. This shall be utilized to provided stabilized power supply for signal lighting only.

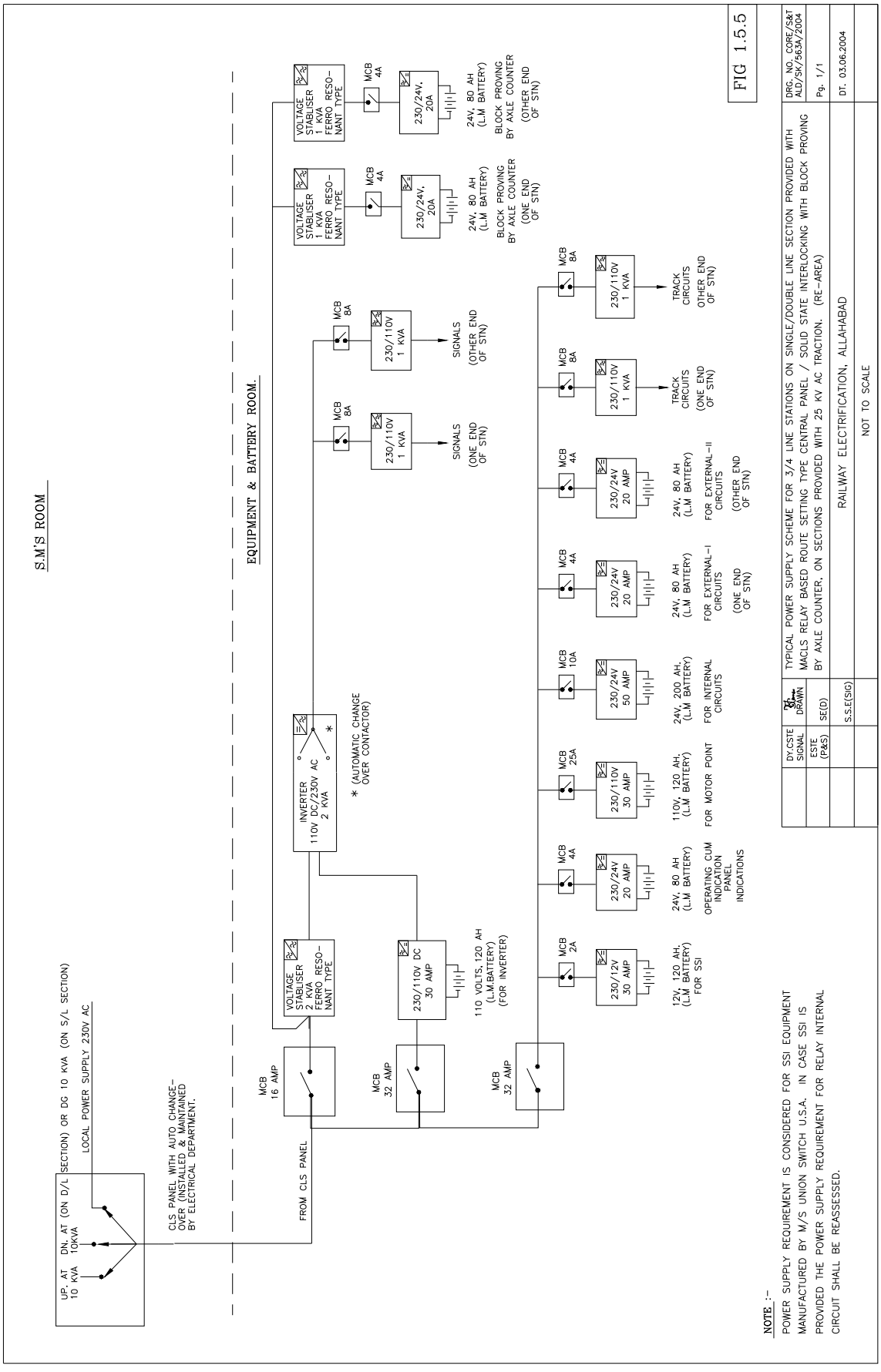
Two Ferro resonant Voltage Stabilizer of 1 KVA capacity shall be connected to 230 V AC General power supply through 8 Amp MCB, one each for each end of the BPAC equipments. This shall be utilised to provide stabilized power supply for block proving by axle counters only.

(b) On stations on single line section or on double line section, an Inverter of 110 V DC/230 V AC, 2 KVA capacity supported with battery bank of 110 V, 120 AH Low maintenance cells shall be provided and connected for on line operation, connected to lighting circuit for signals, which will switch over to main power supply only in case of failure of Inverter. A battery charger of 230 V AC/110 V DC, 30 Amp shall be provided to charge the battery bank.

(c) A generator of 10 KVA capacity shall be provided with a self-starter switch provided in the ASM's room on single line section only. A power cable of suitable capacity shall be laid between the generator and ASM's room by S&T department, terminated on a changeover switch wired for automatic/manual changeover in case of failure of all other power supplies.

(d) Two 230 V AC/110 V AC 1 KVA transformers one each for either end of the Yard shall be provided for signal lighting. 110 V AC output of the transformer shall be provided as omnibus circuit for connecting feed to various signal aspects.

(e) Two 230 V AC/110 V AC transformers of 1 KVA each shall be provided for track feed battery chargers on each side of the station separately. 110 V AC output of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.


S.M'S ROOM
EQUIPMENT & BATTERY ROOM.
UP. AT 10 KVA DN. AT (ON D/L SECTION) OR DG 10 KVA (ON S/L SECTION)
10KVA
LOCAL POWER SUPPLY 230V AC
CLS PANEL WITH AUTO CHANGE-OVER (INSTALLED & MAINTAINED BY ELECTRICAL DEPARTMENT.
FROM CLS PANEL
MCB 16 AMP
MCB 32 AMP
MCB 32 AMP
VOLTAGE STABLISER 2 KVA FERRO RESO-NANT TYPE
INVERTER 110V DC/230V AC 2 KVA
* (AUTOMATIC CHANGE OVER CONTACTOR)
230/110V DC 30 AMP
110 VOLTS, 120 AH (L.M.BATTERY) (FOR INVERTER)
MCB 8A
230/110V 1 KVA
SIGNALS (OTHER END OF STN)
MCB 8A
230/110V 1 KVA
SIGNALS (ONE END OF STN)
VOLTAGE STABLISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/24V, 20A
24V, 80 AH (L.M BATTERY)
BLOCK PROVING BY AXLE COUNTER (OTHER END OF STN)
VOLTAGE STABLISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/24V, 20A
24V, 80 AH (L.M BATTERY)
BLOCK PROVING BY AXLE COUNTER (ONE END OF STN)
MCB 2A
230/12V 30 AMP
12V, 120 AH, (L.M BATTERY) FOR SSI
MCB 4A
230/24V 20 AMP
24V, 80 AH (L.M BATTERY)
OPERATING CUM INDICATION PANEL INDICATIONS
MCB 25A
230/110V 30 AMP
110V, 120 AH, (L.M BATTERY)
FOR MOTOR POINT
MCB 10A
230/24V 50 AMP
24V, 200 AH, (L.M BATTERY)
FOR INTERNAL CIRCUITS
MCB 4A
230/24V 20 AMP
24V, 80 AH (L.M BATTERY)
FOR EXTERNAL-I CIRCUITS
(ONE END OF STN)
MCB 4A
230/24V 20 AMP
24V, 80 AH (L.M BATTERY)
FOR EXTERNAL-II CIRCUITS
(OTHER END OF STN)
MCB 8A
230/110V 1 KVA
TRACK CIRCUITS (ONE END OF STN)
MCB 8A
230/110V 1 KVA
TRACK CIRCUITS OTHER END OF STN)
NOTE :-
POWER SUPPLY REQUIREMENT IS CONSIDERED FOR SSI EQUIPMENT MANUFACTURED BY M/S UNION SWITCH U.S.A. IN CASE SSI IS PROVIDED THE POWER SUPPLY REQUIREMENT FOR RELAY INTERNAL CIRCUIT SHALL BE REASSESSED.
DY.CSTE SIGNAL
ESTE. (P&S)
DRAWN
SE(D)
S.S.E(SIG)
TYPICAL POWER SUPPLY SCHEME FOR 3/4 LINE STATIONS ON SINGLE/DOUBLE LINE SECTION PROVIDED WITH MACLS RELAY BASED ROUTE SETTING TYPE CENTRAL PANEL / SOLID STATE INTERLOCKING WITH BLOCK PROVING BY AXLE COUNTER, ON SECTIONS PROVIDED WITH 25 KV AC TRACTION. (RE-AREA)
RAILWAY ELECTRIFICATION, ALLAHABAD
NOT TO SCALE
DRG. NO. CORE/SAT ALD/SK/563A/2004
Pg. 1/1
DT. 03.06.2004
FIG 1.5.5

(f) 110 V AC/6 V DC, 5/10 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 2 V, 40/80 AH each, in series as per requirement at site.

(g) One battery charger of 230 V AC/110 V DC, 30 Amp with battery bank of 100 V, 120 AH Low maintenance cells shall be provided for motor operation of points. This shall be used to operate points to a maximum length of parallelism of 2.8 KMs. in case the maximum length of parallelism is increased beyond 2.8 KMs, another set of same power supply shall be used keeping one for one side of the station.

(h) Power supply for Block Proving by axle counters shall be provided as described in clause 1.5.4.2. (i).

(i) **Power supply for controlling relays/switching circuits**

Power supply for internal and external circuits shall be separate and completely isolated from each other.

In case of central panel with relay based interlocking: -

(i) For power supply for controlling relays and switching circuits for interlocking i.e. internal circuits, a 230 V AC/24 V DC, 50 Amps battery charger with battery bank of 24 V, 200 AH L.M. batteries shall be provided.

(ii) For power supply for external circuits two 230 V AC/24 V DC, 20 Amps battery chargers with a battery bank of 24 V, 80 AH low maintenance cells each, shall be provided for controlling relays and operation of equipment on either side of the station.

In case of central panel with Electronic Interlocking: -

(i) Power supply for controlling relays and switching circuits for interlocking i.e. for internal circuits, a 230 V AC/24 V DC, 30 Amp battery charger with battery bank of 120 AH L.M. batteries shall be provided. An additional power supply for SSI equipment shall be provided as per manufacturer's requirement. However, in the typical case of SSI with one out of one architecture, manufactured by M/s Union Switch USA, a 230 V AC/12 V DC, 30 Amps battery charger with a 12 V, 120 AH battery bank of low maintenance cells shall be provided to cater load of 12 V DC, 18-20 Amps load for entire SSI system. The PARD values (ripple and noise) of output voltage of the charger shall be same as required for axle counters. Further requirement of power supply to install and make the SSI system functional shall be made by the manufacturer.

(ii) For external circuits, the arrangement shall be same as given above.

(j) In consideration of indication on Panel being LED lit, a 230 V AC/24 V DC, 20 Amp battery charger with 24 V, 80 AH Low Maintenance battery bank shall be provided. For panel with electric lamps 230 V AC/24 V DC, 500 VA transformer shall be provided, through inverter provided for signal lighting.

(k) Primary cell, conforming to Spec. No. IRS: S 95/96 (with latest amendments) shall be used for power supply to telephones connected with Block panel and magneto phones connected between Station Master and LC Gates. Each telephone shall have independent power supply & shall not be used in any other circuit.

1.5.6 Power supply scheme for stations provided with Route Relay Interlocking

1.5.6.1 The Requirement

The power supply for all Route Relay Interlocking shall be provided to suit 25 KV AC traction. The Power Supply arrangements are different for the two different types of RRI Installations- RRI with Siemen's technology using relays with metal-to-metal contact & Route Relay Interlocking using relays with metal to carbon contacts.

Power supply scheme for a typical station having 500 to 600 routes, 40 main and 32 dependent. 65 independent shunt signals, 145 point machines and 174 track circuits, with Siemen's scheme, is given below. The same should be modified in accordance with actual load configuration. The typical power supply scheme is shown in fig. 1.5.6.2(A).

Power supply of such stations shall be required for: -

(i) For controlling of relays/switching circuits for interlocking.
(ii) Track circuits.
(iii) Motor operation of points (Siemen's type).
(iv) Block proving by Axle counters using multiplexer and block panel.
(v) Lighting of signals with electric lamps.
(vi) Indication Panel.
(vii) Telephones.

1.5.6.2(A) Power supply scheme with Siemen's technology

Power supply scheme is shown in fig. 1.5.6.2(A).

(a) 440 V, 3 phase Local supply, power supply from 440Volt 3 phase diesel generators and from three different ATs (25 KVA each) shall be terminated on an RRI CLS power control and distribution panel with automatic changeover switch, installed and maintained by electrical department. There shall be a power supply panel to manage and distribute power supply for RRI system, known as LT power panel.

(b) For controlling of relays/switching circuits for interlocking: -

(i) Internal circuits: A 230 V AC/60V DC, 70 Amp. transformer rectifier shall be provided for internal relays. A battery charger, 230 V AC/85 V DC, 50 Amp with a battery bank of 60 V, 300 AH L.M. batteries shall be provided & connected to the transformer rectifier through a switching relay contact which shall switch over power supply from the battery bank to the internal relay set in case of failure of power supply from the transformer rectifier. In order to prevent any change in the existing status of internal relays till the switching relay contact is made, the power supply from the battery bank shall be extended to internal relays set through a 70 Amp diode derived from the 52 V tapping from the same battery bank.

(ii) External circuits: Two 230 V AC/60 V DC 25 Amp transformer rectifiers shall be provided one for external relays of one end of the station and other for other end of the station. A 230 V AC/60 V DC 20 Amp battery charger, shall be provided with a battery bank of 60 V, 200 AH L.M. batteries & connected to each transformer rectifier through a switching relay contact which shall switch over power supply from the battery bank to the internal relay set in case of failures of power supply from the transformer rectifier. In order to prevent any change in the existing status of external relays, the power supply from the battery bank shall be extended to external relays set through a 40 Amp Diode derived from the 52 V tapping from the same battery bank, till the switching relay contacts are made.

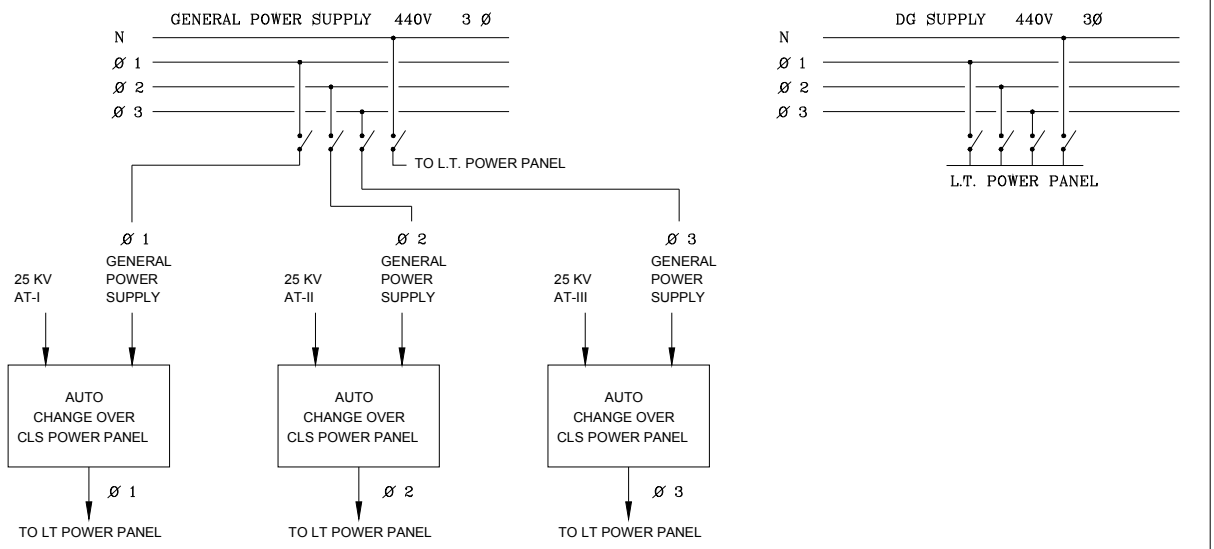


FIG. 1.5.6.2 (a) PART (I)

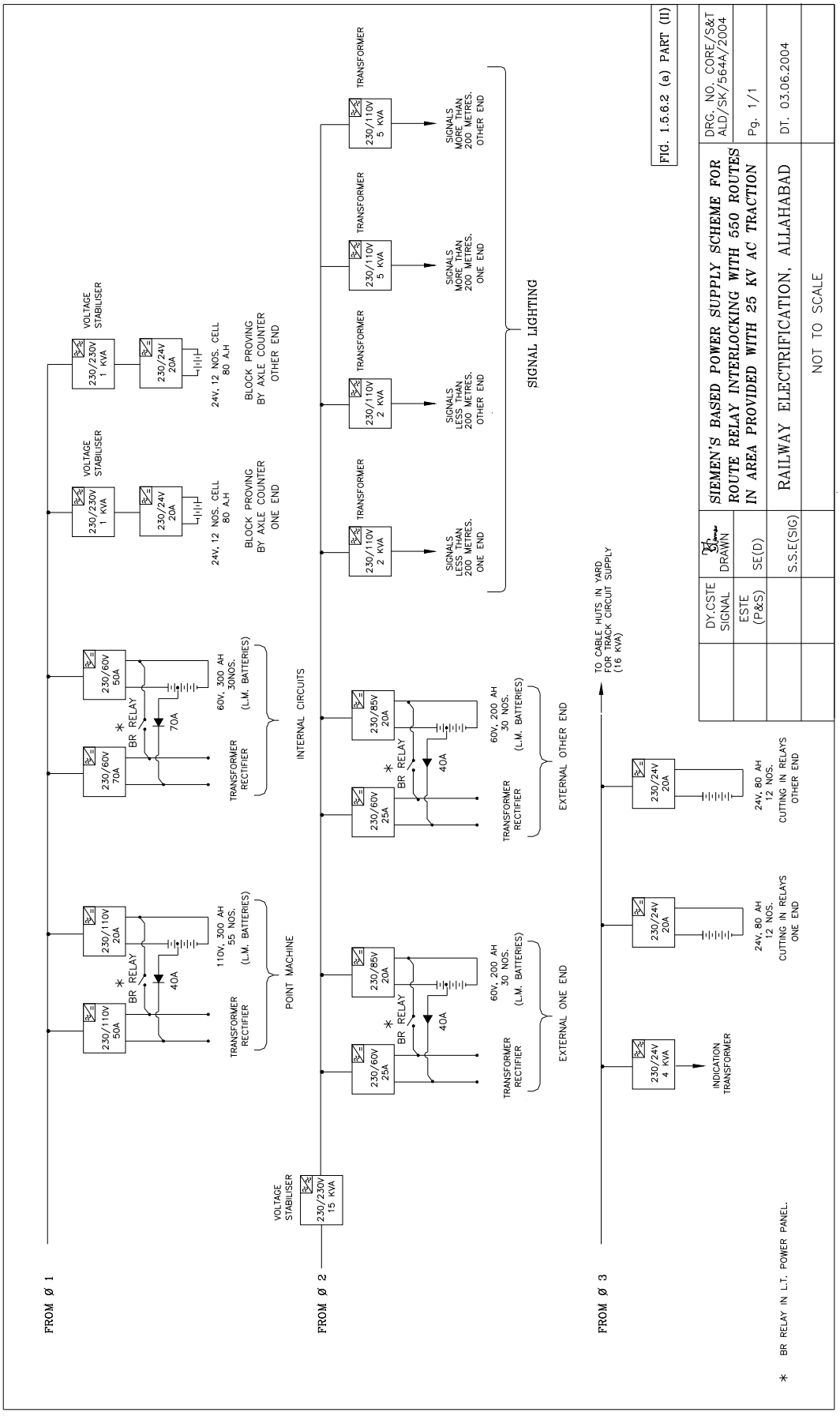
	DY.CSTE SIGNAL	DRAWN	*SIEMEN'S BASED POWER SUPPLY SCHEME FOR ROUTE RELAY INTERLOCKING WITH 550 ROUTES IN AREA PROVIDED WITH 25 KV AC TRACTION*	DRG. NO. CORE/S&T ALD/SK/564A/2004
	ESTE (P&S)	SE(D)		Pg. 1/1
		S.S.E(SIG)	RAILWAY ELECTRIFICATION, ALLAHABAD	DT. 03.06.2004
			NOT TO SCALE	

(c) For Cutting in relays: Q-series relays shall be provided for cutting relays. Two 230 V AC/24 V DC, 20 Amp battery charger, shall be provided with a battery bank of 24 V, 80 AH L.M batteries, one for each side of the station.

(d) For Track circuits: One transformer each of 230 V AC/110 V DC, 2 KVA shall be provided in different huts in the yard of the station for feeding power supply to track circuits, 110 V AC out put of the transformer supply shall be provided as omnibus circuit for connecting track feed battery chargers and distributed such that failure of one does not effect movement on more than one route as far as possible, the total requirement of power supply being 14 KVA. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

110 V AC/6 V DC, 5/10 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 40/80 AH 2 V each, in series as per requirement at site.

(e) Point Machines: A transformer rectifier of 230 V AC/110 DC, 50 Amp shall be provided to feed power supply for operation of point motors. A 230 V AC/150 V DC, 20 Amp battery charger with a bank of 110 V, 300 AH low maintenance cells shall be provided and connected to the transformer rectifier through a switching relay which shall switch over power supply from the battery bank to the point motors in case of failure of power supply from the transformer rectifier. In order to prevent any change in the existing status of the circuit, till the switching relay contact is made, the power supply from the battery bank shall be extended to the point circuit through a 40 Amp diode derived from the 98V tapping from the same battery bank.


FROM Ø 1
FROM Ø 2
FROM Ø 3
VOLTAGE STABILISER 230/230V 15 KVA
230/110V 50A
230/110V 20A
230/60V 70A
230/60V 50A
230/60V 25A
230/85V 20A
230/80V 25A
BR RELAY
40A
70A
110V, 300 AH 55 NOS. (L.M. BATTERIES)
60V, 300 AH 30NOS. (L.M. BATTERIES)
60V, 200 AH 30 NOS. (L.M. BATTERIES)
TRANSFORMER RECTIFIER
POINT MACHINE
INTERNAL CIRCUITS
EXTERNAL ONE END
EXTERNAL OTHER END
230/24V 4 KVA
INDICATION TRANSFORMER
230/24V 20A
24V, 80 AH 12 NOS. CUTTING IN RELAYS ONE END
24V, 80 AH 12 NOS. CUTTING IN RELAYS OTHER END
TO CABLE HUTS IN YARD FOR TRACK CIRCUIT SUPPLY (16 KVA)
VOLTAGE STABILISER 230/230V 1 KVA
230/24V 20A
24V, 12 NOS. CELL 80 A.H
BLOCK PROVING BY AXLE COUNTER ONE END
BLOCK PROVING BY AXLE COUNTER OTHER END
TRANSFORMER 230/110V 2 KVA
TRANSFORMER 230/110V 5 KVA
SIGNALS LESS THAN 200 METRES. ONE END
SIGNALS LESS THAN 200 METRES. OTHER END
SIGNALS MORE THAN 200 METRES. ONE END
SIGNALS MORE THAN 200 METRES. OTHER END
SIGNAL LIGHTING
* BR RELAY IN L.I. POWER PANEL.
FIG. 1.6.6.2 (a) PART (II)
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
SE(D)
S.S.E(SIG)
SIEMEN'S BASED POWER SUPPLY SCHEME FOR ROUTE RELAY INTERLOCKING WITH 550 ROUTES IN AREA PROVIDED WITH 25 KV AC TRACTION
RAILWAY ELECTRIFICATION, ALLAHABAD
NOT TO SCALE
DRG. NO. CORE/S&T ALD/SK/564A/2004
Pg. 1/1
DT. 03.06.2004

(f) Power supply for Block Proving by axle counters shall be provided in conformity to clause 1.5.4.2. (i).

(g) Signal lighting: Two 230 V AC/110 V AC 2 KVA, transformers shall be provided for lighting signals placed at up to distance of 200 Mtrs from relay room, where their controlling relays are placed, for each side of station. Two 230 V AC/110 V AC, 5 KVA transformers shall be provided for lighting signals placed at distance more than 200 Mtrs from relay room, for each side of the station. Feed to signal transformers shall be extended through a voltage stabilizer of Ferro resonant make 20 KVA capacity.

Wherever screened cables are provided (use of screened cable has been stopped forthwith), each transformer shall be 230 V AC/110 V AC 3 & 5 KV A for distances within 600 Mtrs & above 600 Mtrs respectively.

(h) Panel Indication: In case 24 V Electric lamps are provided for operating cum indication panel, one 230 V AC/24 V AC, 4 KVA transformer shall be provided for indication.

In case LED's are provided for indication, 230 V AC/24 V DC, 20 Amp battery charger with battery bank of 24 V, 80 AH L.M batteries shall be provided.

(i) Telephones: 3 V, conforming to Spec. No. IRS: S 95/96 (with latest amendments) shall be used for power supply to telephones connected with Block panel and magneto telephones connected between Station Master and Level crossing gates. Each telephone shall have independent power supply and shall not be used for any other telephone or circuit.

(j) The power supply requirement & equipment as given above shall be modified in conformity to manufacturer's scheme and as per actual site conditions.

1.5.6.2(B) Power supply scheme with Q-series relays

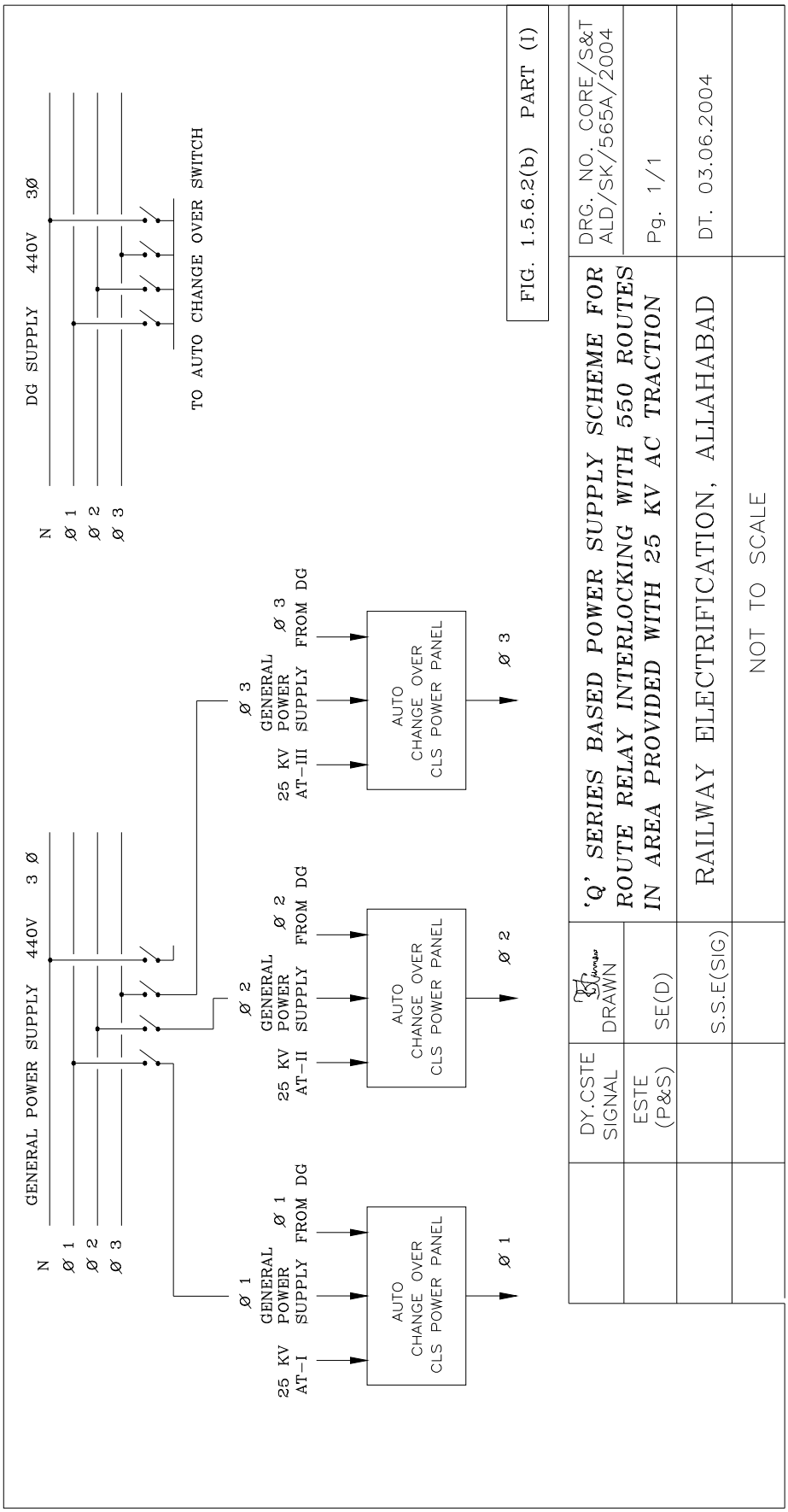
Power supply scheme is shown in fig. 1.5.6.2(B).

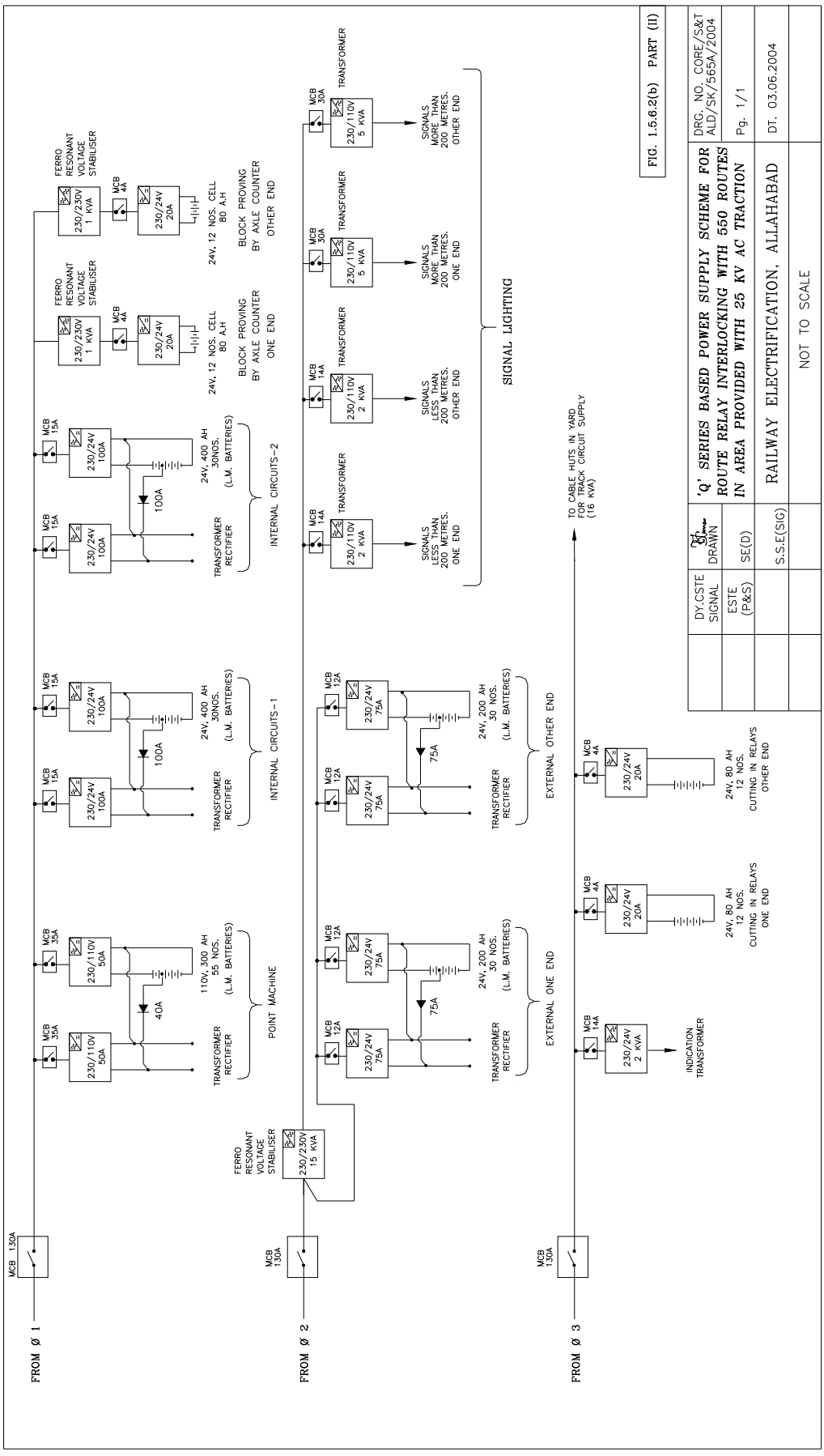
(a) 440 V, 3 phase Local supply, power supply from 440 Volt 3 phase diesel generators and from three different ATs (25 KVA each) shall be terminated on an RRI CLS power panel with automatic changeover switch, installed and maintained by electrical deptt. There shall be a power supply panel to manage and distribute power supply for RRI system viz. LT power panel.

(b) For controlling of relays/switching circuits for interlocking:

Internal circuits: Two 230 V AC/24 V DC, 100 Amp transformer rectifiers shall be provided for internal relays. A battery charger, 230 V AC/24 V DC, 100 Amp with a battery bank of 24 V, 400 AH L.M batteries shall be provided & connected to each transformer rectifier through a 100 Amp diode which shall conduct power supply from the battery bank to the internal relay set in case of failure of power supply from the transformer rectifier. The circuit shall be so designed as to equally distribute load on each set of transformer rectifier- Battery Charger Battery bank.

External circuits: Two 230 V AC/24 V DC, 75 Amp transformer rectifiers shall be provided, one for external relays of one end of the station and other for other end of the station. A 230 V AC/24 V DC 75 Amp battery charger, shall be provided with a battery bank of 24 V, 300 AH L.M batteries & connected to each transformer rectifier through a 75 Amp diode which shall conduct power supply from the battery bank to the external relay set in case of failures of power supply from the transformer rectifier.


GENERAL POWER SUPPLY 440V 3 Ø
N
Ø 1
Ø 2
Ø 3
DG SUPPLY 440V 3Ø
TO AUTO CHANGE OVER SWITCH
Ø 1 GENERAL POWER SUPPLY Ø 1 FROM DG
25 KV AT-I
AUTO CHANGE OVER CLS POWER PANEL
Ø 1
Ø 2 GENERAL POWER SUPPLY Ø 2 FROM DG
25 KV AT-II
AUTO CHANGE OVER CLS POWER PANEL
Ø 2
Ø 3 GENERAL POWER SUPPLY Ø 3 FROM DG
25 KV AT-III
AUTO CHANGE OVER CLS POWER PANEL
Ø 3
FIG. 1.5.6.2(b) PART (I)
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
SE(D)
S.S.E(SIG)
'Q' SERIES BASED POWER SUPPLY SCHEME FOR ROUTE RELAY INTERLOCKING WITH 550 ROUTES IN AREA PROVIDED WITH 25 KV AC TRACTION
RAILWAY ELECTRIFICATION, ALLAHABAD
NOT TO SCALE
DRG. NO. CORE/S&T ALD/SK/565A/2004
Pg. 1/1
DT. 03.06.2004


FROM Ø 1
FROM Ø 2
FROM Ø 3
MCB 130A
MCB 35A
230/110V 50A
110V, 300 AH 55 NOS. (L.M. BATTERIES)
TRANSFORMER RECTIFIER
POINT MACHINE
40A
FERRO RESONANT VOLTAGE STABILISER 230/230V 15 KVA
MCB 15A
230/24V 100A
24V, 400 AH 30NOS. (L.M. BATTERIES)
INTERNAL CIRCUITS-1
MCB 12A
230/24V 75A
24V, 200 AH 30 NOS. (L.M. BATTERIES)
EXTERNAL ONE END
EXTERNAL OTHER END
MCB 4A
230/24V 20A
24V, 80 AH 12 NOS. CUTTING IN RELAYS ONE END
24V, 80 AH 12 NOS. CUTTING IN RELAYS OTHER END
MCB 14A
230/24V 2 KVA
INDICATION TRANSFORMER
TO CABLE HUTS IN YARD FOR TRACK CIRCUIT SUPPLY (16 KVA)
FERRO RESONANT VOLTAGE STABILISER 230/230V 1 KVA
24V, 12 NOS. CELL 80 A.H
BLOCK PROVING BY AXLE COUNTER ONE END
BLOCK PROVING BY AXLE COUNTER OTHER END
INTERNAL CIRCUITS-2
MCB 30A
230/110V 5 KVA
TRANSFORMER
SIGNALS MORE THAN 200 METRES. ONE END
SIGNALS MORE THAN 200 METRES. OTHER END
230/110V 2 KVA
SIGNALS LESS THAN 200 METRES. ONE END
SIGNALS LESS THAN 200 METRES. OTHER END
SIGNAL LIGHTING
FIG. 1.5.6.2(b) PART (II)
'Q' SERIES BASED POWER SUPPLY SCHEME FOR ROUTE RELAY INTERLOCKING WITH 550 ROUTES IN AREA PROVIDED WITH 25 KV AC TRACTION
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
SE(D)
S.S.E(SIG)
RAILWAY ELECTRIFICATION, ALLAHABAD
NOT TO SCALE
DRG. NO. CORE/S&T ALD/SK/565A/2004
Pg. 1/1
DT. 03.06.2004

(c) Power supply requirement and arrangement for track circuits, Point machines, Block proving by axle counters, Signal lighting panel indication and telephones shall be in conformity to clause numbers 1.5.6.2(A) (d) to (j).

(d) IPS shall generally not be provided for RRI installation/big yards having more than 6 Lines.

1.5.7 Power supply scheme for Block Huts

1.5.7.1 Power supply scheme for Block Huts with semaphore signalling

(a) One 230 V AC/12 V DC, 10 Amp battery charger with a battery bank of 40 AH low maintenance cells shall be provided for reversers, controlling relays and indicators.

(b) One 230 V AC/110 V AC, 500 VA transformer shall be provided for track circuits. 110 V AC out put of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

(c) 110 V AC/6 V DC 5/10 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 2 V, 40/80 AH each, in series as per requirement at site.

(d) Power supply for Block instrument, Block bell and Telephones shall be in conformity to clause 1.5.1.2. (g), (h) & (i) respectively.

1.5.7.2 Power supply scheme for Block Huts provided with MACLS in area where 25 KV AC traction has not been provided (Non-RE Area)

(a) A Ferro resonant voltage stabilizer of 500 VA capacity shall be connected to 230 V AC Local supply through MCB. This shall be used to provide stabilized power supply for signal lighting only.

(b) An Inverter of 48 V DC/230 V AC 500 VA supported with battery bank of 40 AH Low maintenance cells shall be provided and connected for on line operation, which will switch over to Local supply only in case of failure of Inverter. A battery charger of 230 V AC/48 V DC, 10 Amp shall be provided to charge the battery bank of 40 AH capacity.

(c) Signal lighting: One 230 V AC/110 V AC, 500 VA transformers shall be provided for signal lighting.

(d) For relays and indications: One 230 V AC/24 V DC, 10 Amp battery charger with a battery bank of 40 AH low maintenance cells shall be provided for controlling relays and indications.

(e) Power supply for track circuits, Block instrument, Block bell and telephones shall be in conformity to clauses 1.5.1.2.(d),(g),(h),(i) respectively.

1.5.7.3 Power supply requirement and arrangement for Block Huts provided with MACLS in area where 25 KV AC traction is available (RE Area)

(a) A Ferro resonant voltage stabilizer of 2 KVA capacity shall be connected to 230 V AC Local Supply through MCB. This shall be used to provide stabilized power supply for signal lighting only.

(b) On stations on single line section or on double line section an Inverter of 48 V DC/230 V AC, 2 KVA supported with battery bank of 48 V, 80 AH Low maintenance cells shall be provided and connected for on line operation, which will switch over to Local/General Supply only in case of failure of Inverter. A battery charger of 230 V AC/48 V DC, 20 Amp shall be provided to charge the battery bank.

(c) Signal lighting: Two 230 V AC/110 V AC 500 VA transformers shall be provided for signal lighting, one each for signals placed at a distance of less than 200 mts from the relay room where its controlling relay is placed, for each side of the station. Two 230 V AC/110 V AC, 500 VA transformers shall be provided for signal lighting, one each for signals placed at a distance of more than 200 mts from the relay room where its controlling relay is placed, for each side of the station.

(d) Internal circuits: One 230 V AC/24 V DC, 10 Amp battery charger with a battery bank of 40 AH low maintenance cells shall be provided for, controlling relays, interlocking and indications.

(e) External circuits: Two 230 V AC/24 V DC, 5 Amp battery chargers with a battery bank of 40 AH low maintenance cells shall be provided for, controlling relays for each side of Block Hut.

(f) Power supply for track circuits, Block instrument, Block bell and telephones shall be provided in conformity to clauses 1.5.1.2. (d),(g),(h),(i) respectively.

1.5.8 Power supply scheme for Intermediate Block signalling (IBS)

Power supply is required at IBS location situated between two stations of long block section, for signal lighting and for operating repeaters relays shall be as follows:

1.5.8.1 Power supply scheme for IBS located in MACLS area not provided with 25 KV AC Traction (Non-RE Area)

Power supply scheme is shown in **fig.1.5.8.1**

(a) 230 Volt AC General Power Supply from the stations on either side of the IBH, to IBH location shall be taken through a two core power cable of adequate size, and terminated on CLS panel with an automatic changeover switch in location hut at IBS. 230 Volt AC Local power supply shall be provided as third source of power Supply, wired for automatic changeover.

(b) 1 KVA Ferro resonant voltage stabilizer, one 230V AC/110V AC, 500VA transformer for signal lighting, one 230V AC/110V AC, 500VA transformer for track circuits and a 230V AC/24V DC, 10 Amp battery charger with battery bank 40 AH low maintenance cells for controlling relays shall be provided.

(c) One 230V AC 10 Amp battery charger, PARD value (ripple and noise) of out put voltage of the charger shall be less than 10 mv rms and less than 50 mv PP with battery bank of 40 AH low maintenance cells shall be provided for power supply to track detection unit of axle counter.

(d) Primary cell, conforming to Spec. No. IRS: S 95/96 (with latest amendments) shall be provided for telephone.

1.5.8.2 Power supply scheme for IBS located in MACLS area provided with 25 KV AC Traction (RE Area)

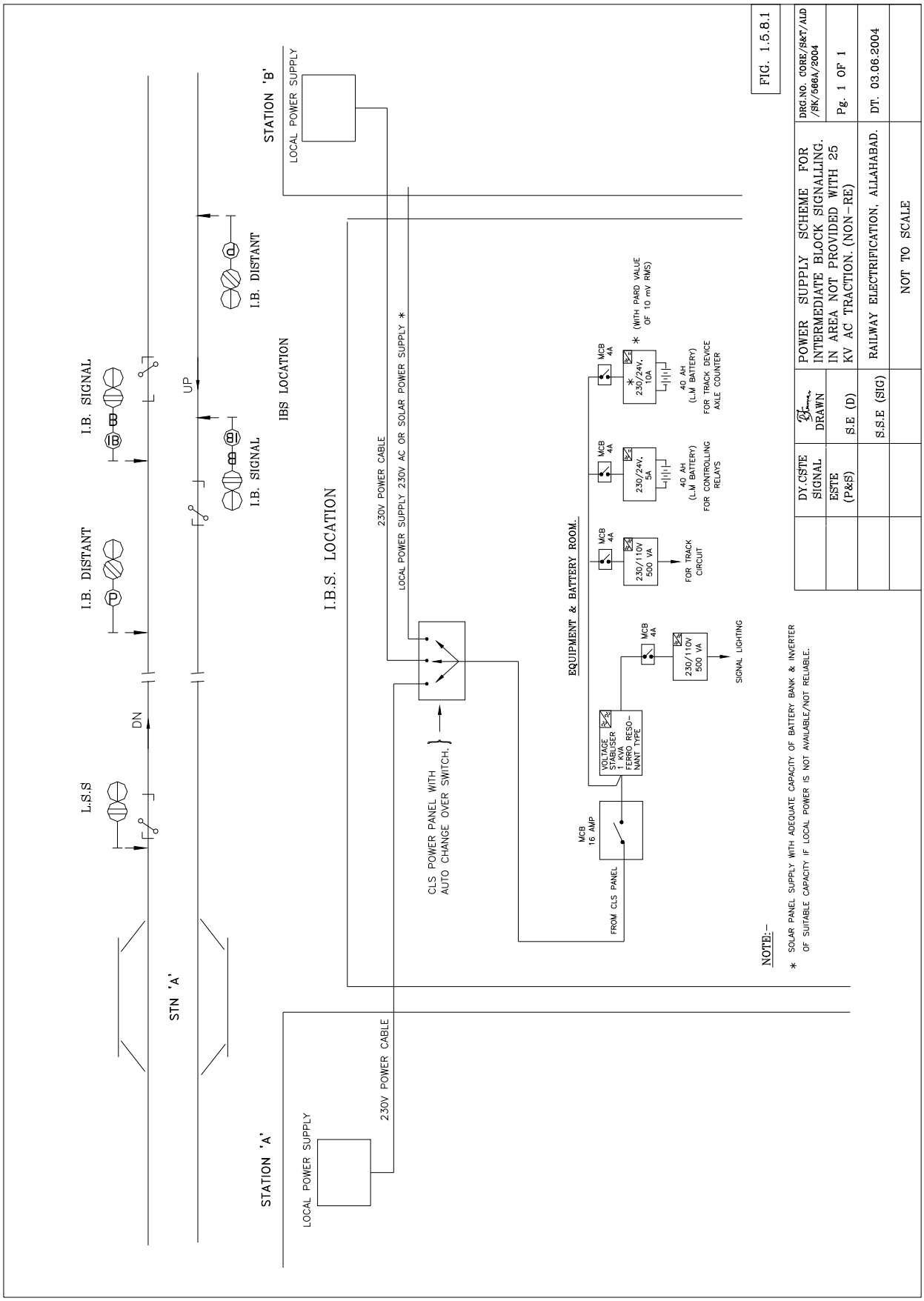
Power supply scheme is shown in fig.1.5.8.2.

(a) Two 5 KVA ATs shall be provided at location near to IBS location hut and terminated on CLS power panel with automatic change over switch installed and maintained by electrical department. 230 Volt AC Local power supply shall be provided as a third source of power Supply, wired for automatic changeover in case both of AT power supplies are not available. In case local power supply is not reliable/not available, Solar Panel with Inverter and Battery bank of adequate capacity may be provided as a third source of power supply.

(b) One no. 1 KVA Ferro resonant stabilizer, two 230 V AC/110 V AC, 500 VA transformers, one for either side of IBS location, for signal lighting, one 220 V AC/110 V AC, 500 VA transformer for track circuits and one 230 V AC/24 V DC, 10 Amp battery charger with battery bank 40 AH low maintenance cells for controlling relays for internal interlocking circuits shall be provided. Two separate 10 Amp battery charger with battery bank of 40 AH low maintenance cells one each for controlling relays for External controlling relay circuits of either end of the yard shall be provided.

(c) 2 x 25 sq.mm. power cable shall be laid from the IBS location to a location which is <2.8 Kms from the controlling station and 110 V AC shall be extended, a 110 V AC/24 V DC battery charger with a battery bank of 40 AH cells shall be provided for cutting relays.

(d) Primary cells, conforming to Spec. No. IRS: S 95/96 (with latest amendments) shall be provided for telephone.


STATION 'A'
STATION 'B'
L.S.S
I.B. DISTANT
I.B. SIGNAL
DN
UP
I.B. DISTANT
I.B. SIGNAL
IBS LOCATION
I.B.S. LOCATION
LOCAL POWER SUPPLY
LOCAL POWER SUPPLY
230V POWER CABLE
230V POWER CABLE
LOCAL POWER SUPPLY 230V AC OR SOLAR POWER SUPPLY *
CLS POWER PANEL WITH AUTO CHANGE OVER SWITCH.
EQUIPMENT & BATTERY ROOM.
MCB 16 AMP
FROM CLS PANEL
VOLTAGE STABILISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/110V 500 VA
SIGNAL LIGHTING
MCB 4A
230/110V 500 VA
FOR TRACK CIRCUIT
MCB 4A
230/24V. 5A
40 AH (L.M BATTERY)
FOR CONTROLLING RELAYS
MCB 4A
* 230/24V. 10A
40 AH (L.M BATTERY)
FOR TRACK DEVICE AXLE COUNTER
* (WITH PARD VALUE OF 10 mV RMS)
NOTE:-
* SOLAR PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
FIG. 1.5.8.1
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
S.E (D)
S.S.E (SIG)
POWER SUPPLY SCHEME FOR INTERMEDIATE BLOCK SIGNALLING. IN AREA NOT PROVIDED WITH 25 KV AC TRACTION. (NON-RE)
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DRG.NO. CORE/S&T/ALD /SK/566A/2004
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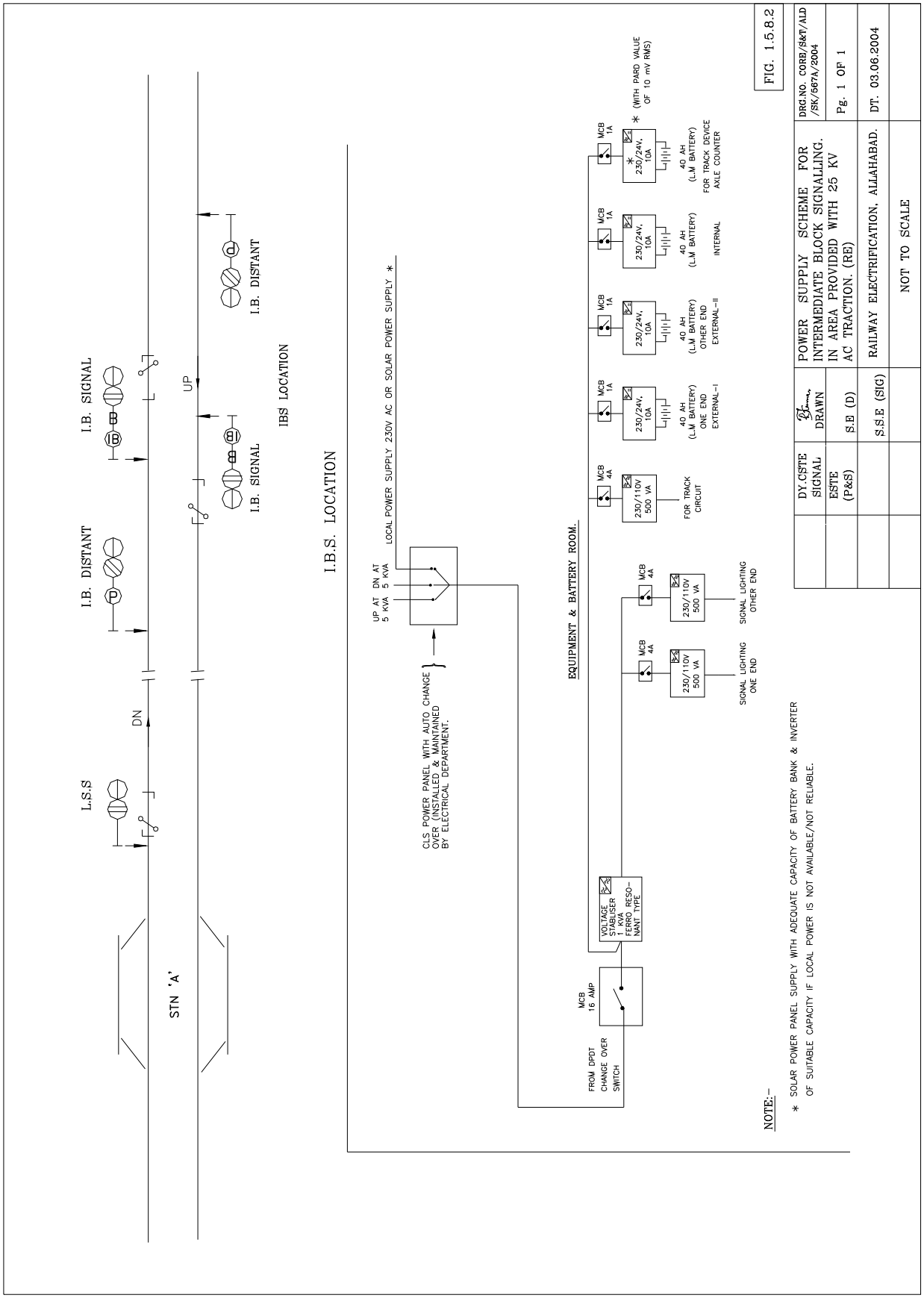
L.S.S
I.B. DISTANT
I.B. SIGNAL
DN
STN 'A'
UP
I.B. DISTANT
I.B. SIGNAL
IBS LOCATION
I.B.S. LOCATION
LOCAL POWER SUPPLY 230V AC OR SOLAR POWER SUPPLY *
UP AT 5 KVA
DN AT 5 KVA
CLS POWER PANEL WITH AUTO CHANGE OVER (INSTALLED & MAINTAINED BY ELECTRICAL DEPARTMENT.
EQUIPMENT & BATTERY ROOM.
FROM DPDT CHANGE OVER SWITCH
MCB 16 AMP
VOLTAGE STABILISER 1 KVA FERRO RESO-NANT TYPE
MCB 4A
230/110V 500 VA
SIGNAL LIGHTING ONE END
SIGNAL LIGHTING OTHER END
MCB 4A
230/110V 500 VA
FOR TRACK CIRCUIT
MCB 1A
230/24V, 10A
40 AH (LM BATTERY) ONE END EXTERNAL-I
MCB 1A
230/24V, 10A
40 AH (LM BATTERY) OTHER END EXTERNAL-II
MCB 1A
230/24V, 10A
40 AH (LM BATTERY) INTERNAL
MCB 1A
* 230/24V, 10A
40 AH (LM BATTERY) FOR TRACK DEVICE AXLE COUNTER
* (WITH PARD VALUE OF 10 mV RMS)
NOTE:-
* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
FIG. 1.5.8.2
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
S.E (D)
S.S.E (SIG)
POWER SUPPLY SCHEME FOR INTERMEDIATE BLOCK SIGNALLING. IN AREA PROVIDED WITH 25 KV AC TRACTION. (RE)
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DRG.NO. CORB/S&T/ALD /SK/687A/2004
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DT. 03.06.2004

1.5.9 Power supply scheme for Interlocked level crossing gates in block section.

1.5.9.1 Power supply scheme for Interlocked level crossing gates in block section provided with MACLS in area not provided with 25 KV AC traction (Non-RE Area): -

Power supply scheme is shown in fig. 1.5.9.1.

(a) 230 V AC power supply shall be extended to equipment room provided at the Level crossing gate from nearest station through 2 core 25 sq.mm. Aluminium conductor power cable, in case the gate is situated at a distance, which is within 2 kilometres of the station. In case the distance is more than 2 KMs, Local/General Power Supply shall be extended locally to the level crossing hut.

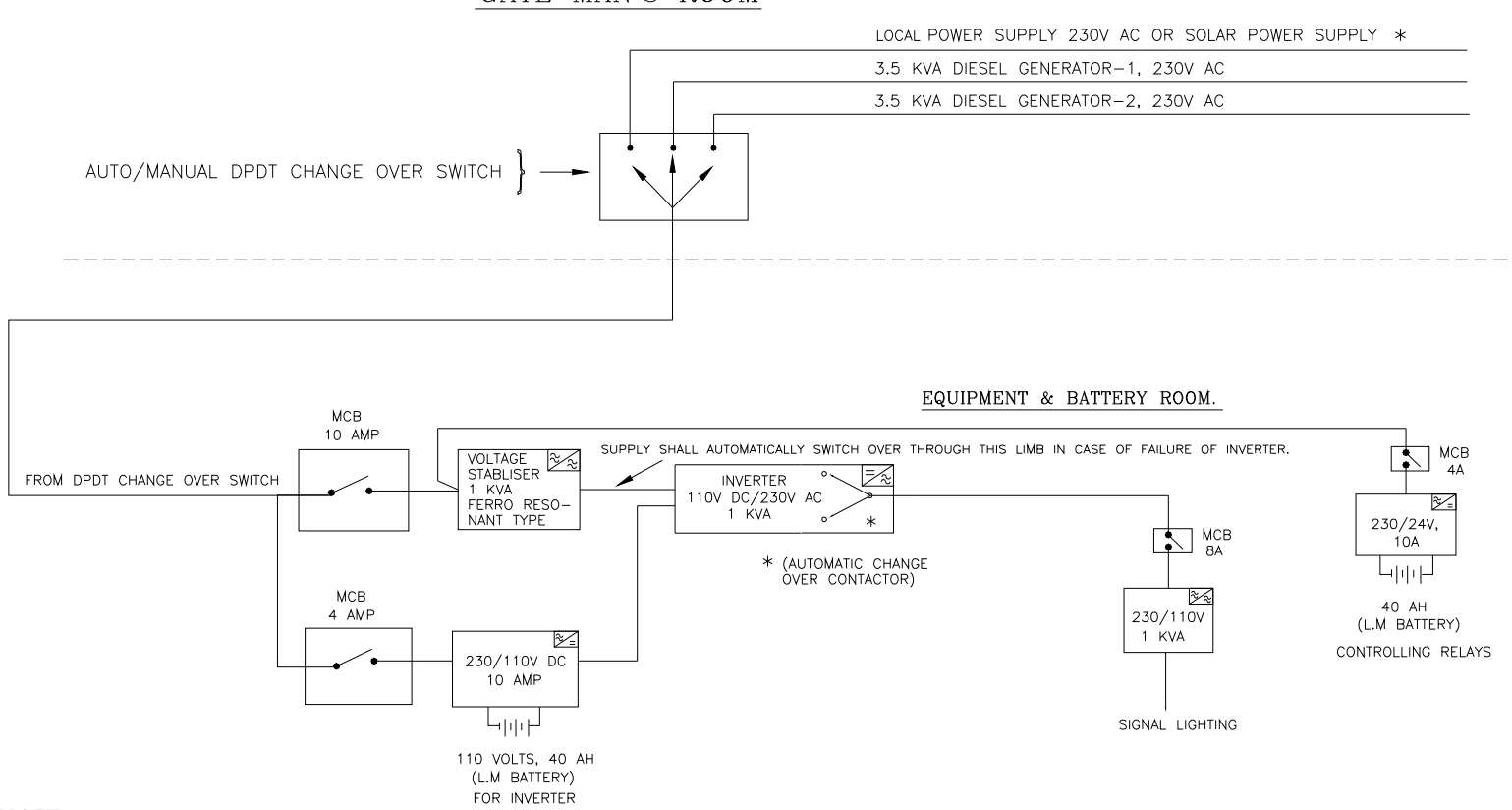
If, the Local power supply is not reliable/not available, Solar panel with Inverter and Battery Bank of adequate capacity shall be provided.

(b) An inverter of 48 V DC/230 V AC, 1 KVA shall be provided at Level Crossing gate hut, wired on line to extend power supply for signal lighting only. This shall be supported with a 230 V AC/48 V DC 10 Amp battery charger with a battery bank of 40 AH low maintenance cells.

(c) Two sets of diesel generators each of 3.5 KVA capacity, in conformity to RDSO specifications IRS: S-69/86 (or Latest) shall be provided with a self-starter switch provided in gatemen's room. The power supply output of the generator shall be wired for manual changeover of generator power supply to signalling system in case of failure of all other sources of power supply.

(d) A 220 V AC/110 V AC, 1 KVA transformer & a 220 V AC/24 V DC, 10 Amp battery charger with battery bank 40 AH low maintenance cells shall be provided for signal lighting and controlling relays respectively.

(e) Primary cells, conforming to Spec. No. IRS: S 95/96 (with latest amendments) shall be provided for telephone.



NOTE:-

(i) FOR TELEPHONE - PRIMARY CELLS OF APPROVED SPECIFICATION.

* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.

FIG. 1.5.9.1

	DY.CSTE SIGNAL	DRAWN	POWER SUPPLY SCHEME FOR L X-ING GATE ON SINGLE LINE/DOUBLE LINE SECTION WITH MACLS IN NON RE AREA SITUATED AT A DISTANCE OF MORE THAN 2 KMS FROM THE NEAREST STATION. (NON-RE)	DRG.NO. CORE/S&T/ALD /SK/568A/2004
	ESTE (P&S)	S.E (D)		Pg. 1 OF 1
		S.S.E (SIG)	RAILWAY ELECTRIFICATION, ALLAHABAD.	DT. 03.06.2004
			NOT TO SCALE	

1.5.9.2 Power supply Scheme for Interlocked level crossing gates in block section provided with MACLS in area provided with 25 KV AC traction (RE Area)

Power supply scheme is shown in **fig. 1.5.9.2.**

(a) 230 V AC power supply shall be extended to equipment room provided at the Level crossing gate from nearest station through 2 core 25 sq.mm. Aluminium conductor power cable, in case the gate is situated at a distance, which is within 2 kilometres of the station.

(b) In case the distance is more than 2 KMs, an independent 5 KVA AT on single line section and two ATs each of 5 KVA capacity, on double line section shall be provided at a location near the LC gate and terminated on CLS power panel with automatic change over switch installed and maintained by electrical department.

(c) In both the cases Local Power Supply shall be extended locally to the level crossing hut as second source of power supply.

If, the Local power supply is not reliable/not available, Solar panel with Inverter and Battery Bank of adequate capacity may be provided.

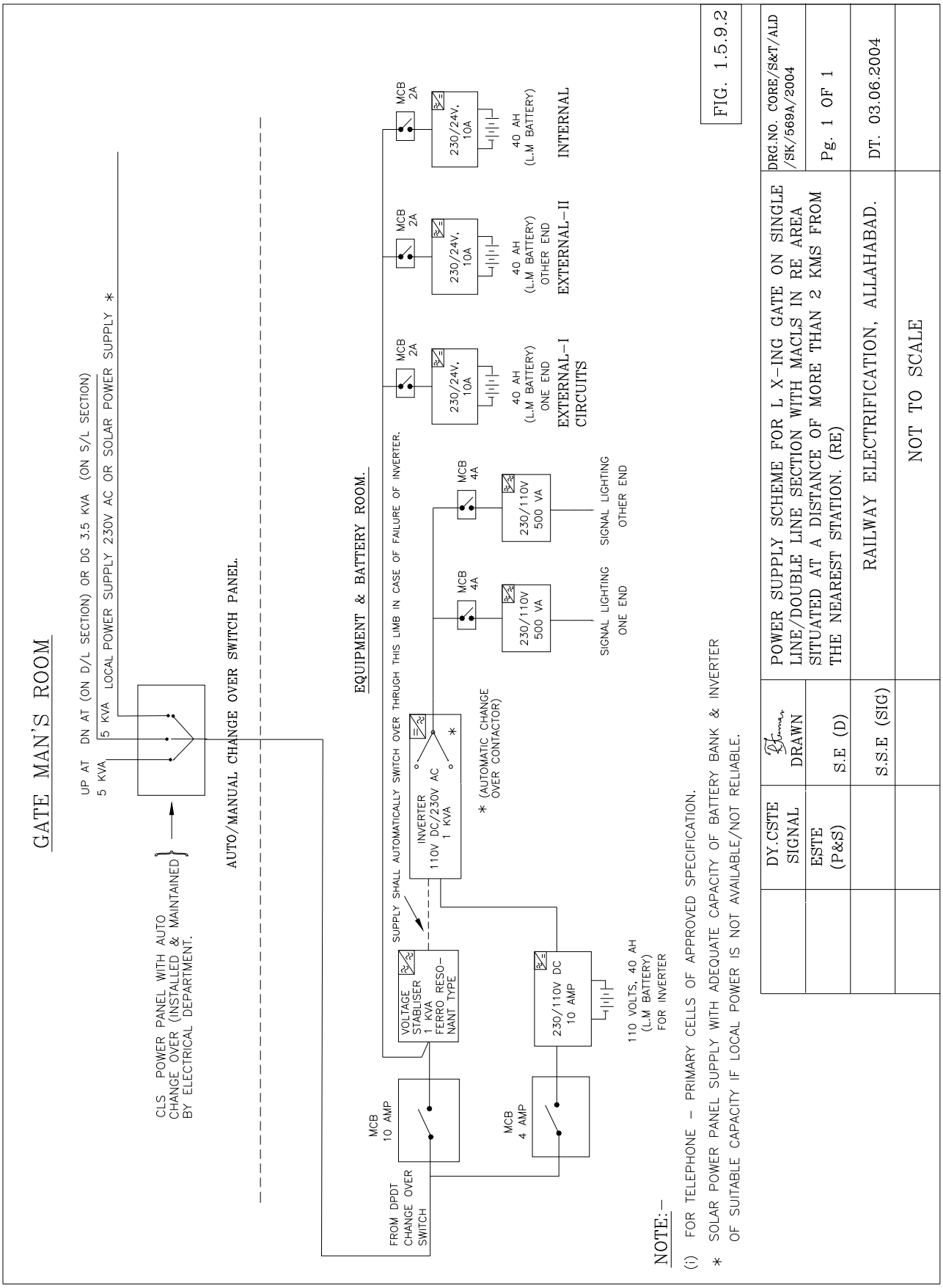
(d) On single line section only, an inverter of 48 V DC/230 V AC, 1 KVA shall be provided at equipment room, wired on line to extend power supply for signal lighting only. This shall be supported with a 230 V AC/48 V DC, 10 Amp battery charger with a battery bank of 40 AH low maintenance cells.

(e) On single line section only, a generator of 3.5 KVA capacity shall be provided with a self-starter switch, provided in gatemen's room. The power supply output of the generator shall be wired for manual changeover of generator power supply to signalling system in case of failure of all other sources of power supply.

(f) Two 230 V AC/110 V AC, 500 VA transformers shall be provided one each for lighting signals on either side of the LC gate.

(g) One 220 V AC/24 V DC 10 Amp battery charger with battery bank 40 AH low maintenance cells shall be provided for internal circuits/controlling relays and two 220 AC/24 V DC 5 Amp battery chargers with battery bank 40 AH low maintenance cells shall be provided for external circuits/controlling relays placed up to a maximum distance of 2.8 Kms from the relay room.

(h) Primary cell, conforming to Spec. No. IRS: S-95/96 (with latest amendments) shall be provided for telephone.


GATE MAN'S ROOM
UP AT DN AT (ON D/L SECTION) OR DG 3.5 KVA (ON S/L SECTION)
5 KVA 5 KVA LOCAL POWER SUPPLY 230V AC OR SOLAR POWER SUPPLY *
CLS POWER PANEL WITH AUTO CHANGE OVER (INSTALLED & MAINTAINED BY ELECTRICAL DEPARTMENT.
AUTO/MANUAL CHANGE OVER SWITCH PANEL.
EQUIPMENT & BATTERY ROOM.
SUPPLY SHALL AUTOMATICALLY SWITCH OVER THRUGH THIS LIMB IN CASE OF FAILURE OF INVERTER.
INVERTER 110V DC/230V AC 1 KVA
* (AUTOMATIC CHANGE OVER CONTACTOR)
VOLTAGE STABLISER 1 KVA FERRO RESO-NANT TYPE
MCB 10 AMP
FROM DPDT CHANGE OVER SWITCH
230/110V DC 10 AMP
MCB 4 AMP
110 VOLTS, 40 AH (L.M BATTERY) FOR INVERTER
MCB 4A
230/110V 500 VA
SIGNAL LIGHTING ONE END
SIGNAL LIGHTING OTHER END
MCB 2A
230/24V, 10A
40 AH (L.M BATTERY) ONE END
EXTERNAL-I CIRCUITS
40 AH (L.M BATTERY) OTHER END
EXTERNAL-II
40 AH (L.M BATTERY)
INTERNAL
NOTE:-
(i) FOR TELEPHONE - PRIMARY CELLS OF APPROVED SPECIFICATION.
* SOLAR POWER PANEL SUPPLY WITH ADEQUATE CAPACITY OF BATTERY BANK & INVERTER OF SUITABLE CAPACITY IF LOCAL POWER IS NOT AVAILABLE/NOT RELIABLE.
FIG. 1.5.9.2
DY.CSTE SIGNAL
ESTE (P&S)
DRAWN
S.E (D)
S.S.E (SIG)
POWER SUPPLY SCHEME FOR L X-ING GATE ON SINGLE LINE/DOUBLE LINE SECTION WITH MACLS IN RE AREA SITUATED AT A DISTANCE OF MORE THAN 2 KMS FROM THE NEAREST STATION. (RE)
RAILWAY ELECTRIFICATION, ALLAHABAD.
NOT TO SCALE
DRG.NO. CORE/S&T/ALD /SK/569A/2004
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DT. 03.06.2004

1.5.9.3 Cost Effective and Easy to Maintain Power Supply Scheme for Interlocked LC in Non-RE area provided with DC LED CLS

A cost effective and easy to maintain Power Supply Scheme for interlocked LCs in Non-RE areas is shown in Figure-1.5.9.3.

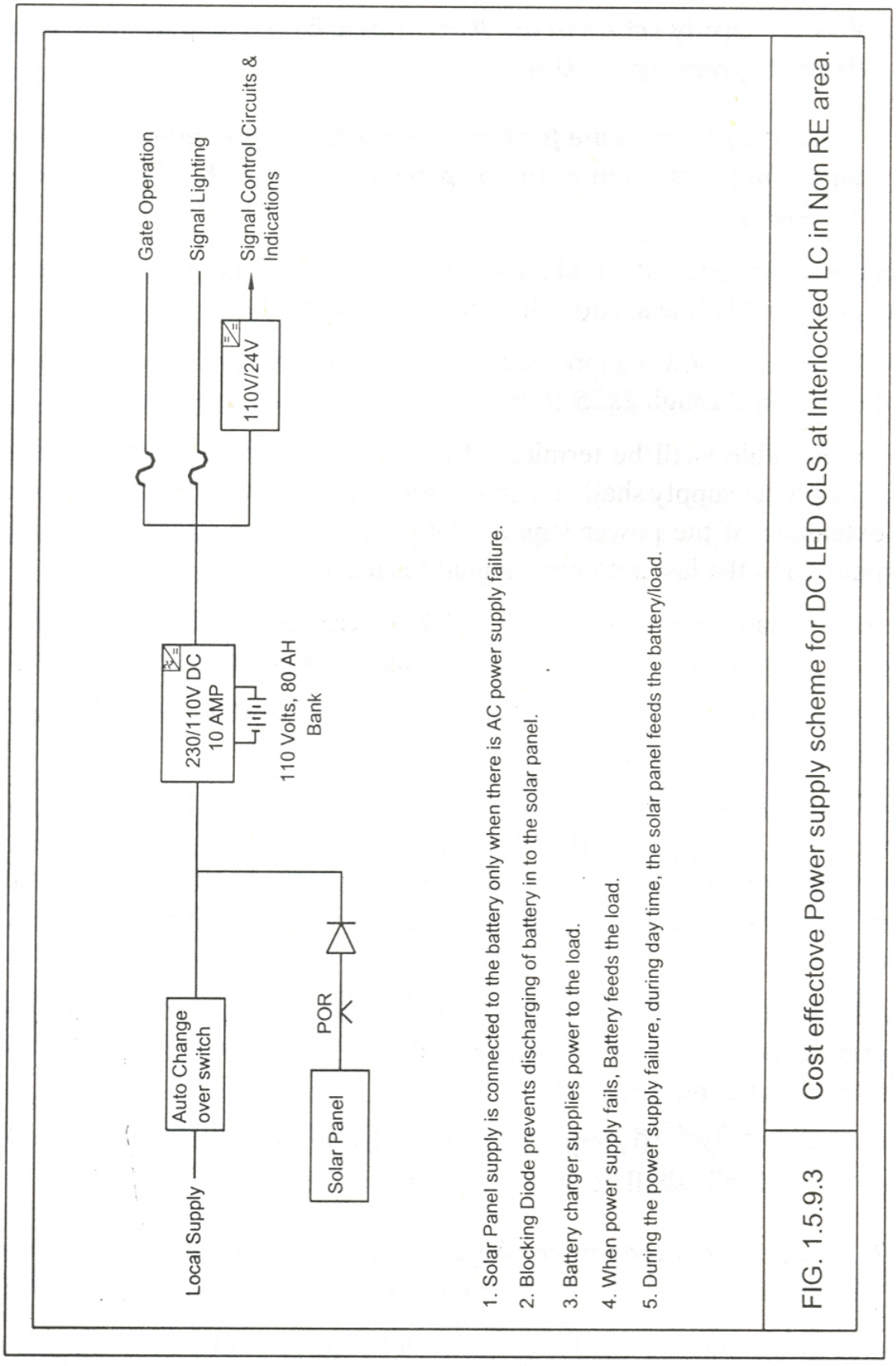
In this scheme, 230 V AC supply is taken from Local Electricity Board Supply 230 /110 V 10 Amps charger is provided for 110 V DC supply with battery backup. The 110 V DC is used for LC gate operations, DC lighting of LED CLS and also for deriving 24 V DC through DC-DC converter. The derived 24 V DC is used for signal control & indication circuits. Solar panel arrangement as shown in Fig. 1.5.9.3 takes care of local power supply failure.

The continuous load on the system is only in the range of 600 mA (corresponding to glowing of 6 aspects viz., 4 gate signal aspects and 2 road user signal aspects). This is equivalent to 15 AH load and hence, even at 50 rate of discharge, the 110 V battery bank can give back-up for more than 48 Hrs (i.e. 2 days). With 35 W solar panel, the back up can be extended up to a week.

This scheme has been at several mid section interlocked LCs in Non-RE area in SC Railway and proved to be successful. This arrangement is cost-effective as no generators are used and usage of power cable is less. Also, it is easily maintainable. Similar arrangement can be made even in RE territory, avoiding the expenditure of up & down ATs.

1.5.9.4 Power supply scheme for Interlocked level crossing gates in block section provided with semaphore signalling (Non-RE Area): -

Primary cells, conforming to Spec.No. IRS: S 95/96 (with latest amendments) shall be provided for telephone.



1. Solar Panel supply is connected to the battery only when there is AC power supply failure.
2. Blocking Diode prevents discharging of battery in to the solar panel.
3. Battery charger supplies power to the load.
4. When power supply fails, Battery feeds the load.
5. During the power supply failure, during day time, the solar panel feeds the battery/load.

FIG. 1.5.9.3 Cost effectove Power supply scheme for DC LED CLS at Interlocked LC in Non RE area.

1.5.10 Power supply scheme for Automatic Block Signalling/Permissive Block Signalling section

1.5.10.1 Power supply scheme for Automatic Block Signalling/Permissive Block Signalling section in area not provided with 25 KV AC traction (Non-RE Area)

The scheme for a section of 8 KM length provided with 4 automatic block signals on each line of a double line section shall be as follows: -

230 V AC General power supply shall be extended from both the stations on either end of the section through 2 x 25 sq.mm. power cable laid along the track.

The power cable shall be terminated in each location hut provided near other signals. The power supply shall be wired through DPDT switches in location huts, to enable extension of the power supply from the station at either end to adjoining location hut up to the last automatic signal location hut.

A Ferro resonant voltage stabilizer of 1 KVA capacity shall be provided in each location hut for providing stabilized power supply for signal lighting only.

A 230 V AC/110 V AC, 1 KVA transformer shall be provided in each location hut for lighting of corresponding signals on UP/DOWN lines.

A 230 V AC/110 V AC 1 KVA transformer shall be provided in each location hut, for track circuits, 120 mts ahead of the signal and all preceding track circuits except 120 mts track circuit of preceding signal, for both UP and DOWN lines. 110 V AC output of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

110 V AC/6 V DC, 5 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 2 V, 40/80 AH each, in series as per requirement at site.

A 230 V AC/24 V DC, 10 Amps DC battery charger with a 40 AH battery bank of low maintenance cells shall be provided for controlling relays.

1.5.10.2 Power supply scheme for Automatic Block Signalling/Permissive Block Signalling section in area provided with 25 KV AC traction (RE Area)

The scheme for a section of 8 KM length provided with 4 automatic block signal on each line of a double line section shall be as follows: -
Two 10 KVA ATs shall be provided in middle of the section but nearer to the corresponding location hut (to be known as main location hut) of the automatic signal and connected to CLS power panel with the automatic change over switch, through power cable, provided and maintained by the electrical deptt.

2 x 25 sq.mm. Power cable shall be laid along the track by S&T department and shall be terminated in each location hut provided near other signals. The power supply shall be wired through DPDT switches in location huts, to enable extension of the power supply from the main location hut to adjoining location huts on either end, up to the last automatic signal location hut.

A Ferro resonant voltage stabilizer of 1 KVA capacity shall be provided in each location hut for providing stabilized power supply for signal lighting only.

A 230 V AC/110 V AC, 1 KVA transformer shall be provided in each location hut for lighting of corresponding signals on UP/DOWN lines, the distance of such signals shall not be more than 200 meters from the location hut where the controlling relay for the concerned signal is kept.

A 230 V AC/110 V AC, 1 KVA transformer shall be provided in each location hut, for track circuits, 120 mts ahead of the signal and all preceding track circuits except 120 mts track circuit of preceding signal, for both up and down lines. 110 V AC output of the transformer shall be provided as omnibus circuit for connecting track feed battery chargers.

110 V AC/6V DC, 5/10 Amp Track feed battery chargers shall be provided near feed end of each track circuit with a battery bank of 1, 2, 3 or 4 cells of 2 V, 40/80 AH each, in series as per requirement at site.

A 230 V AC/24 V DC, 20 Amps DC battery charger with a 80 AH battery bank of low maintenance cells shall be provided for controlling relays.

1.5.11 Power supply scheme for yards provided with MACLS with multi-cabin arrangement where 25 KV AC traction has been provided (RE Area)

At big yards where a number of cabins are located, two to three cabins, depending upon load requirement, shall be grouped together and a set of two ATs of 10 KVA, one each connected to UP and DOWN catenary on double line section and one AT of 10 KVA on single line section will be provided at a convenient location to feed each group. A CLS power panel with auto changeover switch shall be provided and maintained by electrical department and the power supply shall be terminated on CLS power panel.

Local supply will be the stand by source of power supply. This shall be connected for auto changeover by electrical department.

DG sets as required shall be provided as third source of power supply.

1.5.12 Power supply requirements at stations provided with 1500 V DC traction

The power supply requirement at stations in area provided with 1500 V DC traction shall be in conformity to the stations in area where 25 KV AC traction is not provided, except for track circuits.

DC track circuits shall not be provided on such stations. One of the following types of track circuits shall be provided in such stations:

(a) Audio Frequency Track Circuit.

(b) 83⅓ Hz AC track circuit.

(c) Two position relay 50 Hz. AC track circuit.

(d) Three position relay 50 Hz. AC track circuit.

1.5.13 Power supply scheme for signalling sub systems

1.5.13.1 Single Section Digital Axle Counter (SSDAC), for one track section covered by two SSDACs

The load for each of SSDAC is 1.2 Amp @ 24 V DC.

One 230 V AC/24 V DC, 20 Amps. Battery charger with a 24 V 80 AH Low maintenance battery bank shall be provided at central location (station). This shall be extended to each SSDAC device through an aluminium power cable of 2x25 sq.mm. Maximum PARD value (ripple & noise) of out put voltage of the battery charger shall be less than 10 mv rms and less than 50 mv PP.

1.5.13.2 Typical power supply scheme for Multi Section Digital Axle Counter (MSDAC) with 16 detection points is given as follows:

The Power supply System shall be in conformity to the requirement of manufacturer. (The system is under developmental stage).

A 230 V AC/24 V DC 50 Amps. battery charger with a 24 V, 200 AH Low maintenance battery bank provided at location near to evaluator. This shall be extended to each Axle detector unit through a power cable of 2 cores, 25 sq.mm. Maximum PARD value (ripple & noise) of out put voltage of the battery charger shall be -rms value 10 mv and pp value 50 mv.

1.5.13.3 Universal Axle Counter (UAC) for track circuiting in the yard

Power requirement for devices used for analogue axle counter is as follows:

(i)	Evaluator 2-device	21.6 - 28.8 V DC	1.5 amps
(ii)	Evaluator 3/4-device	21.6 - 28.8 V DC	2 amps
(iii)	Junction Box	21.6 - 28.8 V DC	<250 ma
(iv)	Resetting Box	21.6 - 28.8 V DC	500 ma (Only when resetting key is pressed)

1.5.13.4 Block proving by analogue Axle Counters.

Please refer section 1.5.4.2. (i).

1.5.13.5 Block proving by Digital Axle Counters

The power supply requirement shall be same as that of Block proving by Analogue Axle Counters. Please refer section 1.5.4.2. (i).

1.5.13.6 Audio Frequency track circuit (AFTC)

Power supply shall be provided in conformity to the requirement of manufacturer. In general, power load of each track circuit shall be 5 Amps at 24 Volts.

Maximum permissible length of AFTC is up to 450 mts for end fed track circuit and between 450 mts and 700 mts for a central feed AFTC

(a) AFTC provided in yards

Centralized version, 110 V AC shall be fed to each 110 V AC/24 V DC Power Supply Unit (PSU) of the track circuit and wired locally on the Cable Termination Rack for the group of track circuits, provided at central place i.e. relay room.

In decentralized version the 110 V AC power supply shall be taken to the PSUs provided in field, through 2x25 sq.mm. power cable. A maximum of 40 track circuits shall be feed on such cable.

A 230 V AC/110 V AC 1 KV A transformer for each group of 8 track circuits shall be provide to feed power supply to PSUs.

(b) **Audio frequency track circuit provided in the block section**

(i) In a typical block section of length 8 Kms on double line, divided into 9 track circuits of central fed AFTC of 700 mts each track and one mid section level crossing gate, where 25 KV AC traction has not been provided, a 2 x 25 sq. mm. Aluminium power cable shall be laid along the track from station to station and terminated on DPDT switch in each equipment hut provided for PSU and other equipment of the AFTC and in the equipment room at level crossing gate.

The arrangement in the equipment hut shall be such that the power supply from one of the stations can be extended to adjoining hut in cases of cable cut, while at the same time power supply from one station shall remain isolated from the power supply from other station. The cable shall be terminated in The ASM's office and connected to output of 3 KVA Ferro resonant voltage stabilizer.

In case the section is provided with automatic signalling the power required shall increase due to the load of signal lighting and increased number of track circuits, resulting in a voltage drop of 15 - 18 V per KM. As such the power cable of 2 x 50 sq.mm. shall be laid from station to station, there shall be no voltage stabilizer provided at the stations, while voltage stabilizers of 3KVA shall be provided at each equipment hut for signal lighting and AFTC equipment loads, and 1 KVA at Level crossing gate.

In case automatic signalling section is less than 4 KMs length, 2 KVA voltage stabilizer shall be provided at both end stations and not in eqpt. huts at site.

(ii) In a typical block section of length 8 Kms on double line, divided into 9 track circuits of central fed AFTC of 700 mts each on each track and one mid section level crossing gate, where 25 KV AC traction has been provided UP and DOWN ATs of 5 KVA each shall be provided in mid section and power supply terminated in AFTC equipment hut, on CLS panel with an automatic changeover switch provided and maintained by electric department. A 2 x 25 sq.mm. Al. power cable shall be laid along the track and AT supply shall be extended to AFTC equipment huts, and mid section level crossing gate, and terminated on DPDT switch, up to a distance of 2 KMs at either end of the AT.

A 2 KVA voltage stabilizer shall be provided in each equipment hut for giving stabilized power supply to signal lighting and AFTC equipment, while 1 KVA voltage stabilizer shall be provided in equipment room of the level crossing gate. In case AFTC equipment are placed at distance of more than 2 KMs of AT supply and can not be provided power supply from the cable from the station, additional set of ATs shall be provided for each such case in the same manner as mentioned above.

Another 2 x 25 sq.mm. Aluminium power cable shall be laid along the track from station to station and terminated on DPDT switch in each AFTC equipment hut provided for PSU and other equipment of the AFTC, and in the equipment room at level crossing gate. The cable from the station shall be terminated in the ASM's room and connected to output of 2 KVA Ferro resonant voltage stabilizer and shall be used to feed power supply to AFTC Eqpt. placed at distance of 2 KMs or less from the stations, on either side.

The arrangement in the equipment hut shall be such that the power supply from one of the stations/ATs can be extended to adjoining hut in cases of cable cut, while at the same time power supply from one station shall remain isolated from the power supply from other station.

In case the section is provided with automatic signalling with LED lit signals, the power required shall increase due to the load of signal lighting and increased number of track circuits, resulting in a voltage drop of 15-18 V per KM. As such the power cable of 2 x 50 sq mm shall be laid from AT to CLS panel CLS panel to each equipment hut and station to station. The capacity of the AT shall be 10 KV A, voltage stabilizer at stations on either end shall be of 3 KV A and in each equipment hut shall be of 3 KV A.

In case automatic signalling section is of 4 KMs length or less, 2 KVA voltage stabilizer shall be provided at both end stations and not in equipment huts at site.

1.5.13.7 Power supply requirement for Data Logger

Power supply requirement for a datalogger of 512 digital and 32 analogue ports shall be 3 Amps at 24 V DC. 230 V AC/24 V DC, 20 Amps battery charger with a battery bank of 80 AH low maintenance cells shall be provided for data logger provided at the roadside station.

230 V AC, power supply for central monitoring unit at divisional head quarters office for Personal computer, monitor and printer and associated equipment. It shall be provided with UPS of adequate capacity to provide back up for at least 6 Hours.

1.5.13.8 Power supply requirement for electrical lifting barrier

The system shall work on low power 24 V DC or high power 110 V AC.

The current requirement for 24 V DC supply shall be 6-8 Amps for boom length of 8 Mts & for 110 V AC it shall be 10 Amps for boom length of 8 Mts.

Power supply arrangements shall be same as described in section 1.5.9.2

1.5.13.9 Power supply requirement for train actuated warning device based on axle counter technology for level crossing gate (TAWD)

(a) The power supply shall be required for: -

(i) Axle counter and track detectors.

(ii) TAWD equipment.

(iii) Lighting of LED lit road signals on both side of gates for road users.

(iv) Audio warning for road users.

(v) Monitoring unit for gate man at LC gate.

(vi) Monitoring unit for Stationmaster at the controlling station.

(b) Central power supply arrangement shall be provided in conformity to manufacturer's requirement. The system shall work on 110 V AC/110 V DC/24 V DC.

(c) If solar panel is provided then battery capacity at the LC gate shall be able to provide at least 96 hours backup.

(d) In area not provided with 25 KV AC traction, local/general power supply shall be provided at the level crossing gate. In area, which is provided with 25 V AC traction, one AT of 5 KVA on single line section and Two Auxiliary Transformers (ATs) on double line section shall be installed and connected on CLS panel with an automatic changeover switch and maintained by electrical department. In addition general power supply shall be provided at the level crossing gate as second source of power supply connected for automatic changeover.

(e) A 230 V AC/110 V AC, 1 KV A transformer shall be provided to derive Further power supply for equipment as mentioned above.

(f) Power supply for track detectors shall be taken on the same 4 quad cable used for carrying signal to central sensing unit and laid up to controlling station for Monitoring unit for Station master.

* * *

CHAPTER - 2: RELAY ROOM EQUIPMENT

2.1 INTRODUCTION

2.1.1 Scope of the chapter

This chapter covers the installation of various racks viz., relay racks, cable termination (CT) racks, power supply racks, fixing of devices/accessories on them, circuit wiring on relay racks, testing of wiring

2.1.2 Equipment / Accessories in relay room

Please refer fig.2.1 & 2.2. Relay Room shall have the provision to accommodate

(a) Relay Rack.

(b) Control Relays of sorts.

(c) CT Racks.

(d) Power supply rack for provision of:

  (i) Fuse Blocks & Bus Bars - 110 V AC

  (ii) Fuse Blocks & Bus Bars - 110 V DC

  (iii) Fuse Blocks & Bus Bars - 24 V/60 V DC

  (iv) Fuse Blocks & Bus Bars - 12 V DC

  (v) Fuse Blocks & Bus Bars - 3 V DC

(e) Rack with ARA terminals for termination of Indoor cable / Signalling cable from Panel Room to Relay Room.

(f) Evaluator for Axle Counter.

(g) IDF in case of metal to metal relays.

(h) Data-logger

Wherever AFTC is provided, a separate room is to be provided for AFTC equipment.

2.2 RELAY RACK'S ARRANGEMENTS

(a) Relay rack, universal type 1 way/2 way/3 way to be used for Q-series relay racks. Each rack shall have frames for fixing relays in a row with mounting arrangement.

(b) Not more than 48 relays of Q-style (8 rows of 6 relays) or 50 relays of K-50 type (7 rows of eight relays) or 90 relays of TMA type (18 rows of 5 relays) to be mounted on a 1-way relay rack.

(c) Relay rack shall be fabricated with 65mm x 65 mm angle (5mm thickness). The height shall be 2075 mm and width shall be 550mm (1 way), 1100 mm (2-way), and 1650 mm (3-way). The frames on which the relays are mounted in a row are made up of MS flats/angles of suitable size as per relay type to be mounted and fixed to the frame angle horizontally (using 20mm x 75 mm bolts and spring washers) to have the prescribed no. of rows. The clearance between two rows shall be 75 mm for visual inspection of the contacts and cleaning purposes.

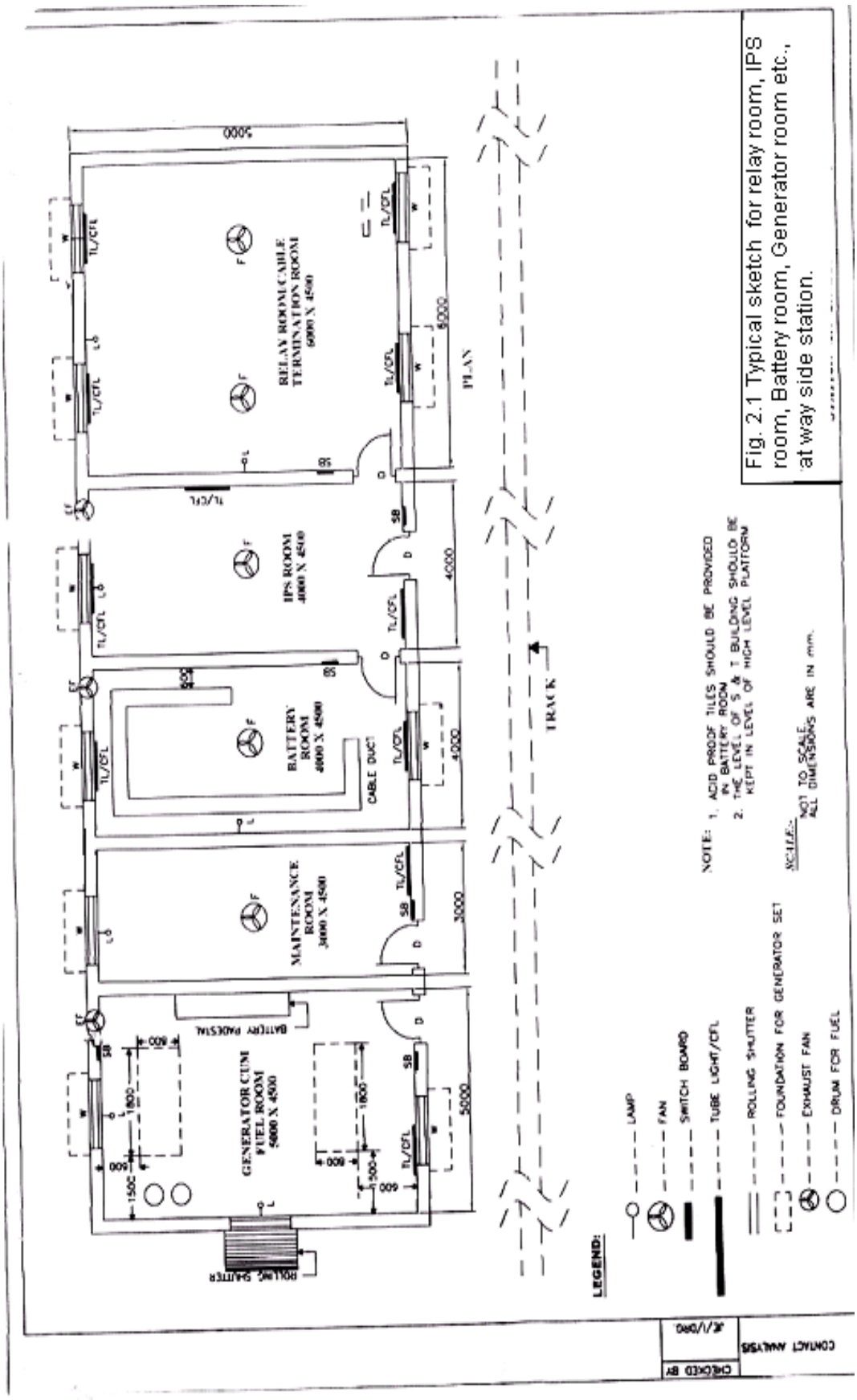


Fig. 2.1 Typical sketch for relay room, IPS room, Battery room, Generator room etc., at way side station.

Fig: 2.1

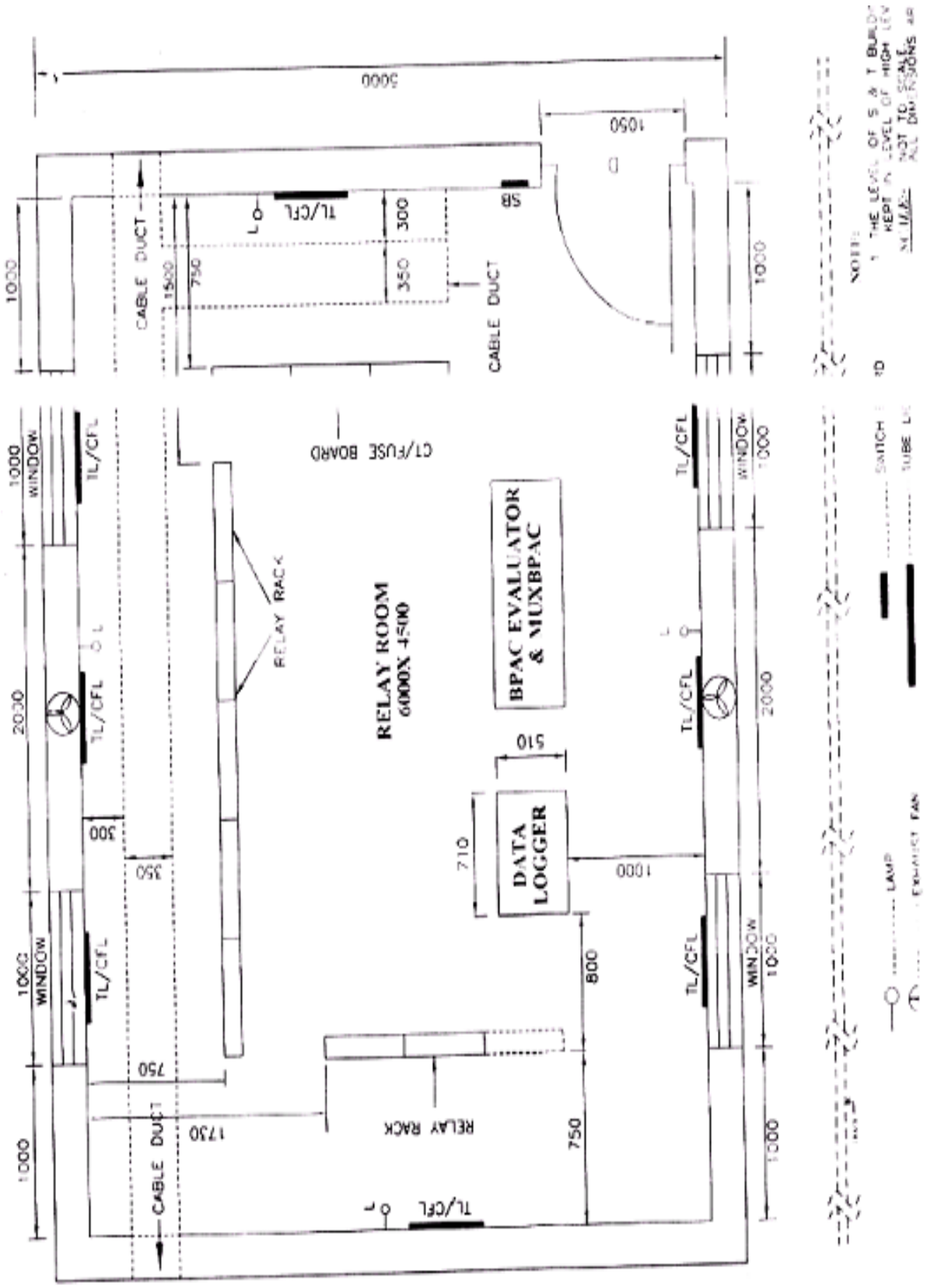


Fig: 2.2 Placement of Equipment in Relay Room

(d) The Racks shall be fixed firmly on triangular bases after correct leveling .The triangular bases of relay rack are anchored to the ground by means of J-type foundation bolts 12 x 100 mm with washer and spring washer. One insulator is to be provided on the bottom of relay rack i.e. on triangular base and on top of relay rack. Rack supporting angle to be provided from wall on top of the insulator to guard against vibrations.

(e) Angle plates 65 x 130 x 6 mm are welded to the vertical frame angle at the top to facilitate L-bracket fixing.

(f) Ladder is fixed to the ladder supporting angle by 12 x 30 mm bolts and nuts and washers & spring washers.

(g) **Positioning of the Relays : Two different methods are followed** :

(i) Grouping of similar relays at one location.

Ex. All ASRs and ASPRs are grouped; All RRs are grouped.

(ii) Grouping of relays pertaining to each function.

Ex. All the relays pertaining to a function (ex. Signal) are grouped &at one place.

Grouping to be done as per the Zonal Railway practice.

(h) Relay racks shall be fixed with minimum clearance of 90 cm from wall.

(i) Last row of the Relays on the relay racks shall be at least 600 mm above floor level.

(j) Nylon or fiber trunking shall be used for wire support

(k) Neoprene rubber pads shall be used at the base to provide insulation as well as shock resistance to the rack.

(l) Relay rack shall have space to accommodate relays for future alterations (15%).

(m) Relay rack shall be so arranged that maintainers are able to carry out visual checks on the relays.

(n) Relay rack shall not be earthed.

2.3 GENERAL INSTRUCTIONS REGARDING ARRANGEMENT OF RELAYS ON RELAY RACKS

(a) Plug in relays of approved design shall be used.

(b) Suitable type of lamp proving relays for ON, OFF aspect & Route shall be used. LED ECR's shall only be used for LED lit signals.

(c) Track relay shall be of metal to carbon contact type and normally be plug in type unless otherwise specially permitted.

(d) Time element relays (thermal or electronic timers) of approved type shall be used. Where Electronic Timers are used - they shall be two in numbers and their contacts shall be proved in series in concerned time release circuit.

(e) Code pin position of Q type relay and siemens K50 relay should not be tampered and correct relay plug boards should be used for each relay as per pin code.

(f) All relay clips shall be checked for proper locking in the base when plugged in.

(g) In all installation a relay index Board shall be provided for easy access to relays.

(h) Relays to be monitored by Data Loggers shall have one front & one back contact as spare to facilitate provision of Data Loggers in future. Similarly spare front contact of required relays to be kept for surveillance panel purpose.

(i) Name of the relay should be written on relay, relay plug board (rear side) and frame (front side).

(j) Condenser, resistance providing suitable time lag, shall be modular type identical in size to a 'Q' series relay to be mounted on relay rack. These shall be manufactured by standard reputed firms. These shall have 1% tolerance.

2.4 GENERAL INSTRUCTIONS REGARDING WIRING OF RELAY RACKS

(a) Wiring of various equipments shall be in accordance with the IRS specification S23.

(b) All wiring & cable termination shall be terminated on approved type of terminal block and tag block.

(c) Power supply is extended from power distribution board to relay room using 10 sq mm copper conductor.

(d) Power distribution within relay room from rack to rack is done using 3/20 wire.

(e) (1) Relay circuit wiring is carried out using 16/0.2 mm dia single core, multi-strand, flexible annealed tinned copper wire to IS 694 in case of Q style relays. (2) In case of metal to metal relays, single core 1 or 0.6 sq.mm. wire (multi colour) are to be used on tag block for wiring. Different colour codes to be used for 110 V AC, 110 V DC, 60 V DC, 24 V DC, 12 V DC circuit wiring.

(f) Nylon cable tags shall be used for dressing of cables wherever required.

2.5 PANEL TO RELAY ROOM WIRING

Panel to relay rack wiring is done using 40 core/60 core (multi-core) indoor cable (each core 1 mm dia annealed tinned copper wire to IS 694) if panel and relay room are in same building or 30 core signalling cable if panel and relay room are located separately. The cable used shall be arranged on ladder (if in-door cable) or protected in PVC/GI pipe/duct as per site condition (if signalling cable).

2.6 ARRANGEMENT OF CT RACK

(a) CT shall be fabricated with 65mm x 65 mm angle (5mm thickness). The height shall be 2400 mm and width shall be 600 mm.

(b) CT rack to be erected similar to the relay rack. It shall be painted before termination of cables.

(c) Hylam sheet of 6 mm thickness and size as per Zonal Railway practice shall be used for CT rack.

(d) Cable conductors of East and West ends shall be terminated separately. 6-Way terminal blocks or any other terminal (Phoenix, WAGO etc.) approved by RDSO shall be used.

(e) Cable terminations shall be grouped as under:

Signals, Track Circuits, Points, Others.

(f) Cable termination shall be arranged in accordance with geographical location of functions.

(g) Identification marker shall be provided on each terminal to identify the circuit for which it is used.

(h) Minimum clearance of the CT rack shall be 90 cm from wall.

(i) Minimum clearance of last terminal in CT rack from ground shall be 300 mm.

(j) The cable armours and the CT rack shall be earthed.

(k) Wiring and termination particulars are to be painted.

(l) All the cables shall be identified by punched labels tied on each cable. Also, cable termination index board to be prepared.

2.7 POWER SUPPLY RACK

(a) Fuse blocks for various power supplies and the corresponding bus bars shall be provided separately, preferably on different racks.

(b) Only **non detoriating type fuses** with visual indication shall be used.

(c) Bus bar terminal blocks shall be approved type.

(d) Terminal board shall be of Hylem sheet size 6.4 mm thickness to IS: 2036, Paper Base P-4.

(e) Fuses must be of proper rating and rating of the fuses shall be written on fuse block.

(f) A Voltmeter and Ammeter shall be provided for each set of power supply on the rack.

(g) For installations with WAGO/phoenix terminals, type of fuse shall be as required by fuse holders of such make.

2.8 RACK FOR TERMINATING INDOOR CABLES/SIGNALLING CABLES FROM PANEL ROOM

In case panel room is in same building and close to relay room, 40 core/60 core indoor cables are run from panel room to relay room. These cables get terminated on tag-blocks of the panel in the panel room and on ARA terminals on a separate rack in relay room. These cables are to be given suitable protection PVC pipe / trough encasing, plaster covering, routing through cable trays etc.

In case panel room is far away from relay room, signalling cables to be laid from panel room to relay room with suitable protection like GI pipe encasing, concreting after burial etc.

2.9 ARRANGEMENT OF AXLE COUNTER

(a) Evaluator shall be placed in relay room.

(b) Cable terminations on board for channel output shall be done in relay room.

2.10 GENERAL FACILITIES REQUIRED IN RELAY ROOM

(a) Ventilators in required number shall be provided in relay rooms. Provision of AC is optional. However, AC should be provided for major PI/RRI/Electronic Interlocking installations, wherever AFTCs are used and relay rooms which are prone to dust or in the vicinity of chemical factories, loco shed and other industrial installations.

(b) Fire extinguisher and smoke detectors shall be provided in equipment room.

(c) Ultra Sonic repellent shall be provided to prevent entry of reptiles & rodents.

(d) Cable duct shall be filled with sand and covered with cement slabs.

(e) Ceramic tiles/ polished stones (wall to wall) shall be used in the flooring work in the relay room.

(f) Sufficient lighting arrangement shall be provided to cover front & rear of all racks.

(g) Printed label stickers shall be used instead of sign writing by painter.

(h) Relay room shall have table and chair and arrangements for keeping spares.

(i) Space to be nominated for BPAC racks in relay room.

2.11 TESTING OF WIRING

THREE TYPES OF TESTS ARE CONDUCTED BEFORE TAKING-UP COMMISSIONING:

(a) Wire to Wire test or bell test and wire count test

(b) Energizing relays and testing using Simulation Panel

(c) Circuit wise test using simulation panel and as per table of control

2.11.1 Wire to wire test or bell test & Wire count Test

Purpose of the test

Wire-to-Wire test is done in two stages, once after the drawl of all the wires and the second time after soldering.

At the end of everyday, the Supervisor shall arrange for the departmental bell test of the wires drawn by the contractor wire-men. This not only helps in assessing the knowledge and the workmanship of the contractor's wire-men but also the accumulation of faults can be avoided and the final bell test can be carried out faster.

The supervisor does the two stage bell test. Officer does the bell test after the completion of soldering.

Bell Test is Carried out to Check

(a) Whether the wiring is done as per wiring sheet and circuit diagram.

(b) Whether the wire drawn has electrical continuity.

Arrangements for Bell Test

A 9 V Dry cell and a Piezo buzzer are connected in series. Two long wires are connected, one to the buzzer and the other to the cell. The other ends of the two wires are held by two wiremen. The tester reads out the two ends of the wire to be tested. Both wiremen touches the leads of the test wires with the wire to be tested by going to the rack and relay position. If the wiremen reach the correct location read by the tester and the wire is drawn correctly, the buzzer sounds.

By nature the bell test looks simple, however since the work is monotonous there is likely hood of making mistakes. The following are the pre-requisites of a tester and the wireman.

Tester: (Supervisor/Officer)

(a) He shall be systematic.

(b) Ready to accept delays – shall not be in hurry

(c) Shall have the basic knowledge of the circuit shall respect the record keeping and log all the faults.

(d) Shall give break for testing to avoid monotony.

(e) All not believe in the earlier stage work done even it is done by him.

Wireman (ESM/Contractor Wireman)

(a) Shall have patience.

(b) Shall not have over confidence.

(c) Communicative – he shall be able to give the information to the tester by observation even when not asked by the tester.

(d) Basic knowledge of wiring and contact nomination.

How to Carryout Bell Test:

(a) Before Soldering:

Wires are drawn and inserted in the relay base corresponding to the nominated contact. For testing the wires, the wires are accessed from the front side of the Relay Rack. Hence the wiremen stand before the Relay Rack.

Ensure painting of the Relay name on the back and front sides of the relay rack. By this, the wiremen can easily locate the relay while drawing the wire and also while testing the wiring.

Always start from single wire and continue testing until the wiring ends with single wire. The wireman shall give the following information to the tester after holding the wire.

(i) Name of the Relay

(ii) Colours of the wires

(iii) Number of Wires present

(iv) Non-availability of wire for complementary contact.

Ex. If the wire being tested is in A1, if there is no wire in A2, it shall be reported.

The tester in between shall check the movement of the wiremen i.e whether they are moving towards the right rack or not.

In case the last test ended with single wire, the tester shall always call out the complementary contact for the next testing so that only one wireman is moved for the next test.

The tester shall acknowledge the buzzer sounding only after his calling out the rack, relay and contact numbers fully. Some times short in the wiring may give false buzzer which is required to be ignored.

- Where double wires are present care shall be taken not to twist the wires while testing.

- The tester shall mark a tick or slash in the circuit diagram just above the wire tested.

(b) After Soldering:

Wires are soldered to the relay clips and inserted into the base. For testing the wires, the wires are accessed from the back side of the Relay Rack. Hence the wire men stand on the back side of the Relay Rack.

Bell test after the soldering is similar to the bell test before soldering except for testing of the double wires. In case more than one wire is encountered the test shall be continued until the test ends with single wire.

Wire Count Test

Each Q-style Relay base receptacle can accommodate only a maximum of two wires only. If more than two wires are drawn to any receptacle, while soldering itself, the mistake can be found out. If two wires are drawn in place of one wire or vice versa, it is not possible to find out the mistake while soldering. This type of faults can be identified while doing Bell Test. However, if Bell Test is not done correctly, it is quite possible that the some of the wiring mistakes can still remain. This type of wiring mistakes can be found out while energizing the circuit, but not all - some mistakes are left unattended which may cause failure after commissioning of the panel.

It is possible to avoid such mistakes by wire count test. The circuit is read by a supervisor giving the particulars of the each end of the wire drawn. The wireman after verifying the Relay Base receptacle shall loudly announce.

(a) The relay name

(b) The relay location

(c) The number of wires and

(d) The colour of the wires

The supervisor shall compare the circuit with the particulars given by the wireman and satisfy himself that the wires are drawn correctly. Otherwise, these are to be rectified.

Mistakes to be avoided in Bell test and wire-count test

Common Mistakes in Bell test& the aftermath are shown in fig. 2.6 **(to be avoided)**.

Common Mistakes	Result
1. No record of mistakes corrected in the wiring	The performance of the wire man or the person carried out the contact analysis can not be assessed and corrected.
2. Joints in the testing probe (wires).	When shorted with relay rack gives wrong buzzer.
3. Multi test probe	Causes confusion. May result in delay. Un economic usage of wiremen. Advisable in case of big. Yards of more than 15 racks only.
4. Non finalisation of field cables and panel particulars in time. OR Non co-ordination between field and relay room staff. OR Non-coordination between two supervisors in-charge of two adjacent cabins. OR Pending the nomination of fuses etc.	Results in re-wiring of tested wiring. More chances to commit mistakes which can go unnoticed.

Fig.2.6 Common Mistakes in Bell test & the aftermath

2.11.2 Energizing relays and testing using Simulation Panel

This activity consists of

(a) Plugging of Relays as per the contact configuration decided in the Contact Analysis.

(b) Energizing relays and testing by connecting the simulation panel.

Energizing relays by connecting the simulation panel

(a) Preliminary arrangements

For major yards, it is preferable to energize relays, circuit-wise and sheet-wise since it involves number of routes and parallel movements.

For way station, it is preferable to energize the circuit, route wise.

Before taking up the above energizing, the following works shall be completed.

(i) Wire to wire bell-test of all sheets before soldering and after soldering.

(ii) Plugging of all relays as per contact configuration.

(iii) Power supply arrangement with batteries.

(iv) Connecting the simulation panel.

- It shall be possible to control all TPRs, NWKRs / RWKRs, CHLRs, KLCRs, LXCPRs etc/. from the simulation panel by energizing all the relays.
- It is desirable to have the simulation panel adjacent to control panel so that the panel indication can be observed simultaneously while testing.

(b) Connecting Simulation Panel

(i) Board No. 1.

It depicts the yard (painted) with points, track circuits LC gates and slots. Switches are fixed on the board to simulate the conditions of the points, track circuits interlocked LC Gates, slots etc.

Track circuit switches are fixed on the track, point control switches are fixed nearer to the points for small yards. For major yards the switches are grouped as point switches and track circuit switches.

Functions requiring ON and OFF switch (with make and break facility i.e. two wires only) with facility to pick up a relay in one position and drop the same in other position.

Example: Switch OFF – Track Down - TPR dropped.

Switch ON -- Track pick up - TPR picked up.

For controlling the following function the above type switches shall be used.

- Track circuits
- Siding point
- Crank handle
- Slot
- LC Gate

Points require On and OFF switches with facility to pick up conflicting relays (i.e NWKR and RWKR) in two positions. (These switches require three wires).

(ii) Board No. 2.

To simulate the signals the following bulbs are used as dummy loads for the ECRs to pick up and also to observe the aspect of the signals during testing.

ON aspect -	110 V 40 W
OFF aspect -	110 V 25 W
Route aspect -	110 V 75 W
(Jn. Type Route Indicator.)	

(c) Wiring simulation panel to the relay room side wiring at MDF

Disconnect all the links on cable termination rack. Wires from the switches are connected to the relay room side termination. Similarly the wires from simulation panel Board No. 2 consisting of lamps are connected to the relay room side termination.

0.6 mm. Multicore cable is used for wiring the simulation boards. To reduce the voltage drop, more conductors are used for supply taken to the test panel and also to the negative since common return is used.

(d) Energizing the relays

(i) Relays are to be energized in the following sequence:

– Relays which are normally in picked up condition.

- No condition is required. Ex: TPR, TPPR, NWKR, NWKPR, CHLR, LXPR, SMR, SMPR, KLPR, CHFR, Knob relays of points.
- Conditions are to be satisfied: Ex: ASR, TSR, TRSR, TLSR.

– Relays which are normally in de-energised condition

ex: UCR, Signal knob Relay, HR, DR, ECRs, JSLR, NJPR, UYRS.

(ii) Energizing of specific Relays

Signal Clearance Circuit

– **ASR:**

- This is a stick Relay. There are 3 or 4 paths of energisation including stick path. (3 paths where Dead approach locking is provided and 4 paths where Approach locking is provided). **Stick Relay shall not be energised by the stick feed**. It shall be energised by Approach locking where available or cancellation path where dead approach locking is available.
- It shall be ensured that the ASR relay is energised through all the possible paths in the back lock portion of the track circuit.
- Similar procedure shall be adopted where sectional Route Release is provided to pick up TRSR and TLSR.

– **TSR:**

- This is a stick Relay. This Relay also shall not be picked up by stick feed. If all the ASRs pertaining to TSR are in picked up condition and the respective signal RRs are de-energised (i.e. knob normal) TSR picks up through TPR front contact of the controlling track circuit. When one TSR is used for more than one signal, the circuit is designed in such a way that the TSR does not drop when an unconnected track circuit fails or drops. The effectiveness of this aspect shall be checked.

– **UCR**

- This relay picks up after reversing of the signal knob and fulfilling certain conditions like, detecting of the required points, conflicting signals are not taken off , CHLRs and KLCRs where required are available.
- Check up all the parallel paths as per the circuit by setting all routes.
- Energisation of UCR drops the concerned ASR.

– **RR:**

- This relay picks up through UCR front contact and the Reverse band of the signal knob.
- This relay is required to reclear the signal automatically when point detection breaks momentarily and corresponding UCR also drops.

– **HR/DR**

- In addition to the conditions required for energizing UCR, keep all TPRs, TSRs and LXPR in picked up condition and observe that HR picks up (For diverging route, UGR picks up first, route lamps are lit on the illumination board, UECR picks up and then HR picks up). Check up whether the HG bulb is lit on the illumination board and HECR picked up. In case of indication transformer, check up whether indication is available on the panel.
- Wherever more than one OFF aspect is available for a signal, all the aspects shall be energised.

All panel indications shall be checked up separately from IDF.

Cancellation Circuits

– **JSLR**

- This relay initiates time delay cancellation circuit and shares the same circuit of the corresponding ASR. The same JSLR may pick up for different ASRs (in different paths).
- This relay is energised when the signal knob is normalized and all signal control Relays are de-energised, all the back lock tracks are in energised condition and, the concerned ASR is in the dropped condition, conflicting JSLRs are dropped (i.e. JSLRs sharing same timer) and cancellation button is pressed.
- JSLR picking up is indicated by lighting on the panel.

– **NJPR:**

- This relay picks up after 120 sec. after the picking up of JSLR.
- JSLR and NJPR front contacts together are used in the cancellation path of the ASR.
- When NJPR picks up, the indication on the panel is extinguished.

Route Releasing

– **UYRs**

- A group of conflicting signals which share the route partially or fully have common set of UYRs. Conditionally conflicting signals however shall have different UYRs since no two signals can be taken off within the group.
- The signal shall be cleared and the signal knob normalized. Then the train movement is simulated by dropping and picking up the track circuits sequentially. The required UYRs shall pick up. **While simulating the train movement, both the light engine and long formation conditions shall be checked.**
- When there is only one track circuit available to route releasing, in major stations where shunting is frequently done, use of TPSLR relay is made. This shall also be checked. **Dropping and picking up of track circuit momentarily shall not release the route.**
- UYRs shall be energised through all the paths provided.

Point Control Circuit

– **Siemen's Point Contactor Unit**

- Keep all required ASRs in energized condition, check whether free indication available near the point knob and operate point knob to reverse. Check up whether WLR picks up and outgoing supply is available for reverse control on cable termination rack. Keep test lamp (-) ve connected to W4 and check B24 outgoing is available on W1 and W3. For reverse to normal, check up B24 outgoing is available in W1 and W2.

– **Point Contactor unit with QBCA1 relays:**

- Keep all the required ASRs in required condition. Check whether 'Free' indication is available near the point knob and operate the point knob to reverse. Check up whether WLR picks up and out going supply is available for reverse control on cable termination rack. Check up the correct polarity out going is available on W1 & W2 as shown in circuit diagram (negative on W1 & positive on W2) and also, supply is available on W3 & W4 (positive on W3 and negative on W4).

  In case of reverse to normal operation, positive on W1 and negative on W2 shall be checked and there is no change in polarity on W3 and W4.

  NOTE: If the point contactor unit is in relay room, check up its operation and also B110/N110 outgoing is available in the cable termination rack.

Calling on Signals

– **Clearance**

- Keep the calling on track circuit in occupied condition, check whether approach bell rings (COAR picks up), reverse the calling on signal knob and press the calling on clearance button COGGN (COUCR picks up and COJSLR picks up). An indication will appear indicating the progress of the circuit. Timer starts functioning and after 120 seconds NJPR picks up and COHR picks up and calling on signal is taken OFF.

  NOTE: Calling on signal can be taken off even if home signal route is held up. In such cases where calling on cancellation is done, home signal route also gets released. This operation should be checked.

– **Cancellation**

- Separate ASR is provided for calling on signal. Whenever calling on signal is taken off, the route has to be cancelled every time whether train is received on calling on signal or not. Press the calling on cancellation button (COCAR picks up). Timer circuit is (240 sec.) triggered with an indication on the panel and after 240 seconds calling on ASR picks up, thus releasing the route.

  Calling on signal ASR also releases the Main signal route, if it is in locked condition.

2.11.3 Circuit testing using simulation panel and as per control table

This activity consists of Clearing of signals on the simulation panel and carrying out the following tests (As per table of control):-

(a) Negative tests.

(b) Dead / Approach locking tests

(c) Route / Back locking tests

(d) Testing of conflicting signals – Cross sheet testing

(e) All other circuits viz., SM's key, CHLR, LXPR, KLCPR are proved correctly in the respective signaling circuits.

(a) Negative test

(i) The negative test is conducted on the signals. The signal is cleared with the help of simulation panel. Controls like point detection, track circuits, LC gates, siding points, crank handle and slots are withdrawn one at a time and check in each case the signal responds correctly.

(ii) After clearing the signal when the unconnected Controls (points, track circuits, LC gates etc.) are disturbed, it shall have no effect on the signal.

(iii) In case of slotting, attempt shall be made to clear the signal with wrong slot.

(iv) Negative test shall be conducted with the Conditions as controls provided in the Table of Control.

(v) *Fouling track circuits are required to be checked in the field and even when they are not provided in the Table of Control, the same shall be incorporated and HQ advised*.

(b) Dead Approach Locking

(i) Dead Approach locking is provided for those signals (usually Home signals, shunt signals from siding) whose approach track is not track circuited. To normalize the route for such signals when a movement has not taken place, cancellation has to be applied.

For approach locking the path for picking up ASR is TSR pick up and approach track relay pick up. For cancellation process the path for picking up ASR is JSLR pick up and NJPR pick up.

(ii) Testing:

Clear the signal. Put back the signal by normalizing the knob. Check that the route is held. Apply cancellation. Route is released after 120 sec. And the respective counter is incremented.

(c) Approach Locking

(i) Approach locking is provided for those signals (usually starters and shunt signals) whose approach track is track circuited or provided with axle counters. If the approach track of the signal is not occupied, the route gets released immediately after putting back the signal knob to normal. In case the approach track is occupied, the route can be released only by cancellation process which is counted.

(ii) Approach locking is implemented by the signal in rear also.

Example: Main line starter is approach locked by the home signal for Main line i.e. when the pass through signals are taken off, normalizing the starter signal does not release the starter route, though the approach track circuit is clear.

Testing:

- Clear the signal. Keep the approach track clear. Put back the signal knob to normal. The route gets released immediately.
- Clear the signal. Drop the approach track circuit. Put back the signal knob to normal. The route shall not get released. The route is released by cancellation only.
- When approach locked by signals. Testing shall be done by taking off of the signal in rear. The route shall not get released when the signal (starter) knob is normalized. In case of conditional approach locking, the free condition of approach locking also shall be tested.

(d) Route/Back Locking Tests:

For testing back/route locking either of the following two methods may be adopted.

METHOD I:

Take off the signal for each and every route. Drop the track circuit and pick up the same sequentially, so as to energise UYRs correctly. Now drop the back lock track circuit. Put back the signal knob to normal. Route will be still in locked up condition (ASR dropped). Now all conditions are favorable for ASRs to pick up except the back lock track circuit, which is in dropped condition. Now pick up the above back lock track circuit and observe the route getting released. (ASR picks up).

This operation shall be repeated for each back lock track circuit and for each and every route of each signal.

The above method is suitable for way side stations.

METHOD II:

Take the ASR circuit (any ASR), put through the UYR1, UYR2 contacts in ASR circuit and disconnect the ASR stick circuit. As per the circuit drop the back lock track circuit one by one and observe the ASR drops and picks up as and when the track circuit has picked up. This test shall be done for all the conditions.

This has to be done for all the ASRs, individually, check up the parallel paths if any are defective in back lock circuit. The above method is most suitable for major yards.

Do not forget to remove the shorts for UYRI and UYR2 contacts after the testing is completed.

As part of route holding test, attempt shall be made to release the route by cancellation when back lock track circuit is in dropped condition. It shall not be possible to initiate cancellation.

***Note**: Apart from the above test, the following test also is to be conducted to check effectiveness of point locking:*

Clear the signal. Observe the points free indication and compare it with the Table of Control. Attempt shall be made to operate a locked point by operating the point starter knobs. The point indication shall remain steady.

Do not clear any signal. The point free indication shall be available. Drop the point controlling track circuits one by one and make attempt to operate the point. The point indication shall remain steady. In both these cases, observe the WLR relay in the Relay Room.

(e) Testing of Conflicting Signals (Cross sheet testing):

While testing conflicting signals, it shall be ensured that all the conditions are favourable for taking off both the signals under test and check that they lock each other. Conflicting signals are of two types. 1. Directly conflicting and 2. Indirectly conflicting (ex: Main line and loop line starters. Locking of Directly conflicting signals only is given in the Table of Control.

Where conditional locking is given, the testing shall include locking condition as well as free condition i.e. when the condition is broken, it shall be possible to take off.

To ensure that all possible conflicting movements are barred and all the parallel movements are available, a cross-sheet should be prepared. In the cross sheet, both on vertical column and horizontal row, all the signals with the permissible routes, crank handle release etc. should be recorded. Each signal column-wise should be tested with the signals row-wise and if cleared, ✓ mark to be made and if not X mark to be made. This should then be checked from the permissibility of simultaneous movements.

(f) Checking SM's lock, crank handle, Level crossing and Siding points

(i) Effectiveness of SM's key shall be checked for all functions (signals, points, crank handle, siding points, level crossing) i.e. when SM's key is Out with SM's control knob reverse, none of the above functions shall work when the knobs are operated. When SM's key is IN, with SM's control knob normal, it shall be possible to operate the functions. It locks the functions in the last operated condition.

(ii) For checking CHLRs, KLCRs LXPRs the converse locking also to be checked i.e when the signal is taken off, the key cannot be released. If the key is out, the signals cannot be taken off. For way stations the above testing has to be done for all signals and for every route. For major yards, CHFRs, LXFRs, KLYRs shall be tested, keeping the circuit sheet and breaking the conditions one by one and observe the relay drops every time the condition is broken check up all the parallel paths are effective.

(g) POINT LOCKING CIRCUIT

It is always preferable to test WLR circuits as per circuit sheet. Break the condition and observe WLR drops and picks up as soon as the condition is restored back. Check up whether all parallel paths are effective.

In addition o the above, after taking off a signal, the free indication of the points is to be observed and to be tallied with table of control. Then all the points should be operated, the locked points should not get operated while the free points should.

(h) Testing of Signals

(i) Check up Distant signal aspects for M/L and loop line. Green for M/L and double yellow for loop line shall be displayed at Distant signal. Remove Home signal HG bulb and observe the Distant signal goes to caution aspect.

(ii) In the same way Home signal green aspect may be checked by removing DG bulb of ML starter and DG bulb of Adv. Starter separately on the bulb panel. The home signal shall display caution aspect.

(iii) Check up M/L starter Green aspect is controlled by Adv. Starter green aspect by removing the DG bulb of the advance starter

(iv) Check up Adv. Starter proceed aspect is controlled by block instrument TGT condition.

(v) On double line sections, effectiveness of SR1 and SR2 is to be checked up in LSS Usually, LCPR picked up contact is bypassed by DECR picked up contact of LSS. This is done to prevent LSS flying back if the block is made to TOL before the train passes LSS. This should be checked.

(vi) TAR indication and block instrument release from TOL is to be checked. This is normally done at the time of reconnecting block with panel circuits.

(vii) Check up whether M/L starter is approach locked by Home signal i.e take off both Home and starter and put back starter signal knob. The starter ASR shall not pick up unless Home signal ASR picks up.

(viii) Remove route lamp and observe the Home signal assumes 'ON' position.

(ix) Individually all the signal lamps have to be removed and checked, that ECR drops or NA transformer does not give sufficient voltage to lit the indication lamp on the panel.

(x) Check up whether all parallel movements are functioning correctly**. This is very important as the wrong contact allotment will be known by this test.**

(xi) Panel indication for point, signals, crank handle, Level crossings and routes in track picked up and track dropped conditions are to be observed carefully.

(xii) Cancellation circuits functioning for all the ASRs to be checked. Proper cancellation indication shall appear in panel.

(xiii) By removing the signal lamp of the signal ahead, test the signal in rear does not clear for the respective line.

(i) RANDOM CHECKS

(i) Check up that indirectly conflicting signals cannot be taken off simultaneously.

(ii) Keep one or more points in the route in unfavourable position and try to take off signal which should not be possible.

(iii) For taking off calling on signal, keep all the track circuits in the dropped condition and check whether it could be taken off.

Special attention may be given for overlap point detection whether required or not as per circuit

* * *

CHAPTER - 3: INSTALLATION PRACTICES FOR LOCATION BOXES / APPARATUS CASES

3.1 INTRODUCTION

3.1.1 Scope of the Chapter

This chapter covers the Installation practices to be followed for Location Boxes/ apparatus cases used for Home signal, Starter signal, LSS, Cross over etc., the inside arrangements of Equipment, Relay wiring, the earthing arrangement of the location boxes/apparatus cases

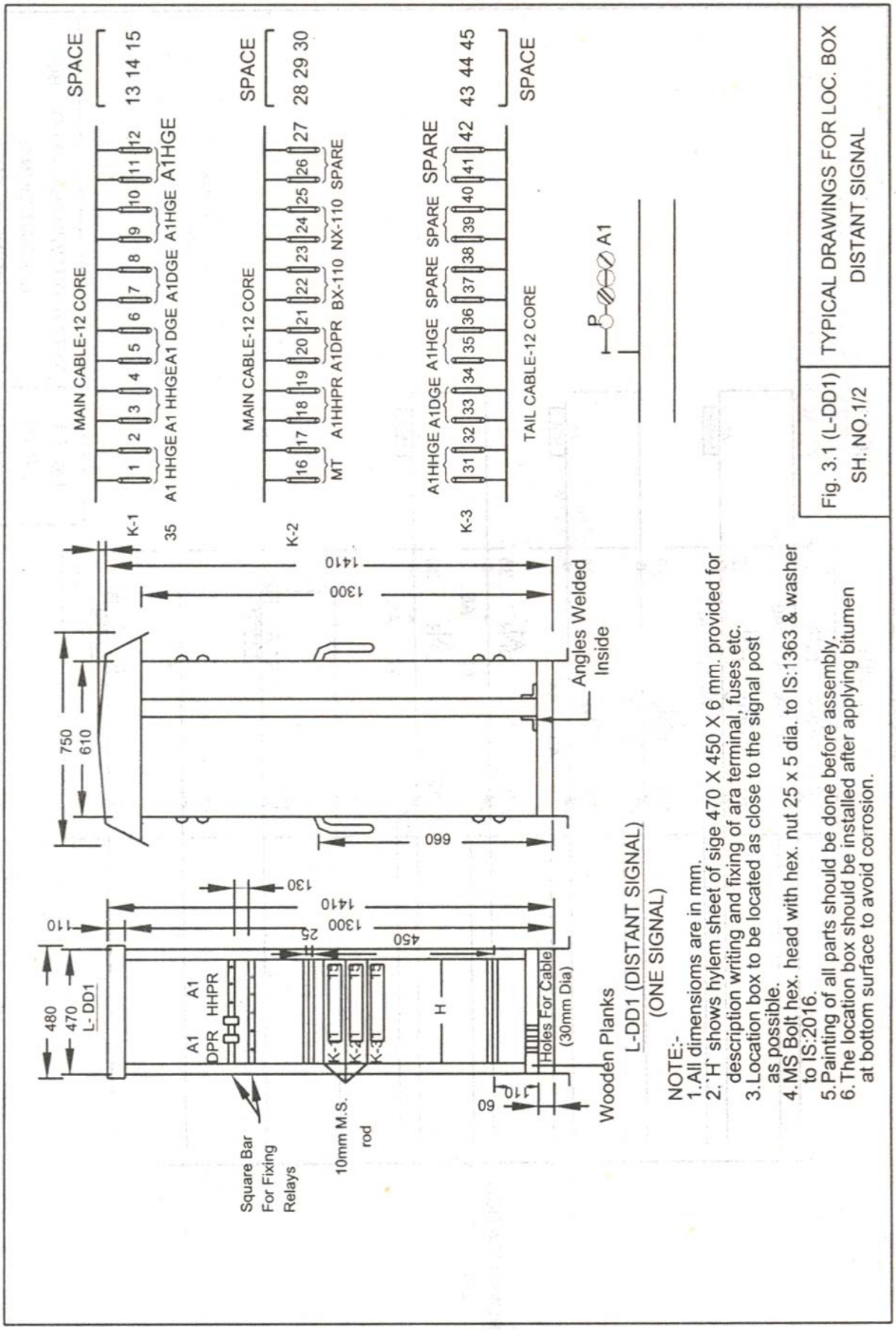
3.1.2 Related documents / drawings

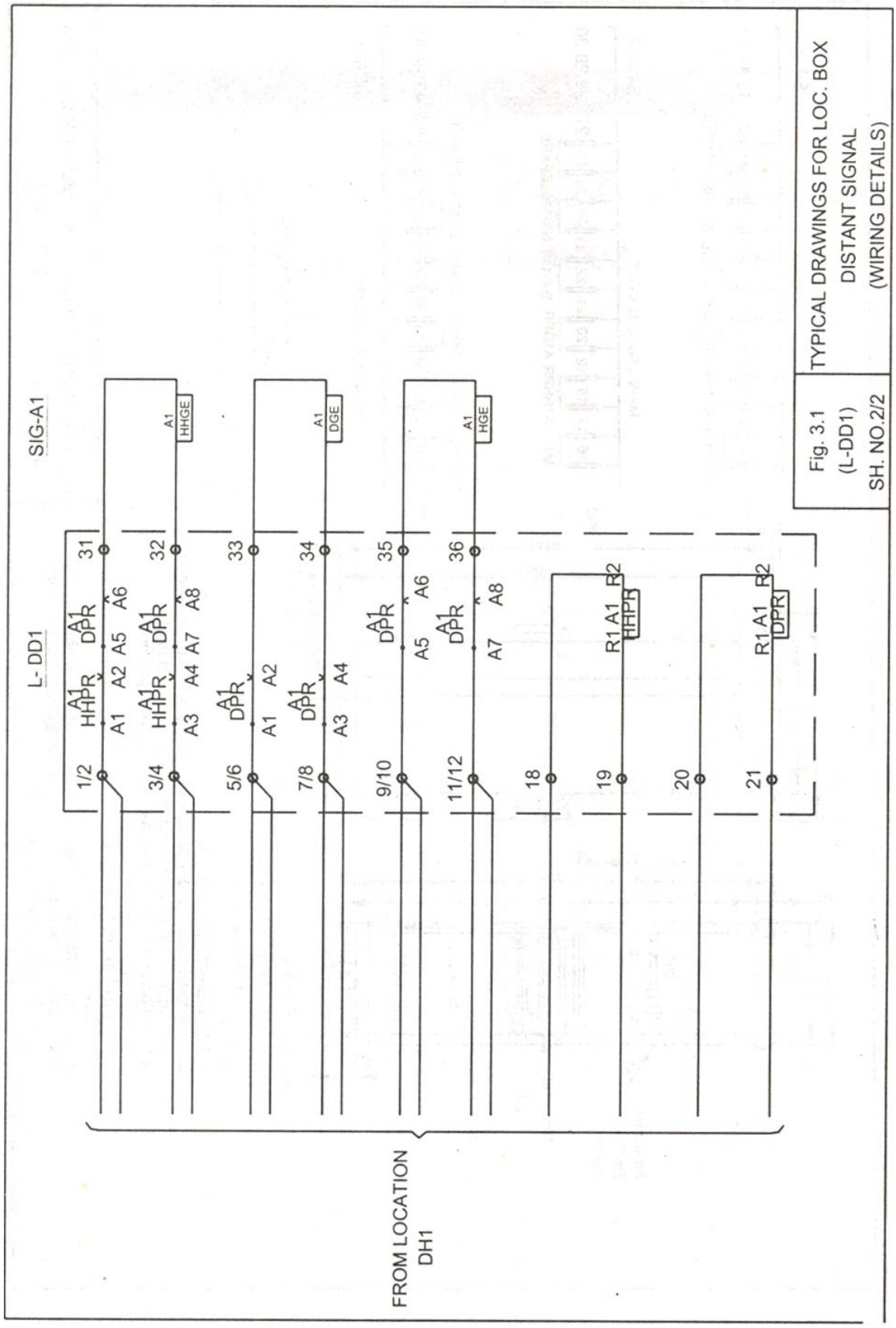
The location box / apparatus case single as per drawing no. RE/S&T/ALD/SK/219/82 with Alt. 'A' and 221/82 with Alt. 'B' shall be used for Advance Starter, Home, Starter, emergency cross-over locations whereas half location box / apparatus case as per drawing no. RE/S&T/ALD/SK/220/82 with Alt. 'A' and 221/82 with Alt. 'B' shall be used for Distant Location. The inside wiring, Outdoor cable inlet, cable termination, mounting of equipment etc. have been standardised. The following drawings shall be applicable for these types of location boxes / apparatus cases:

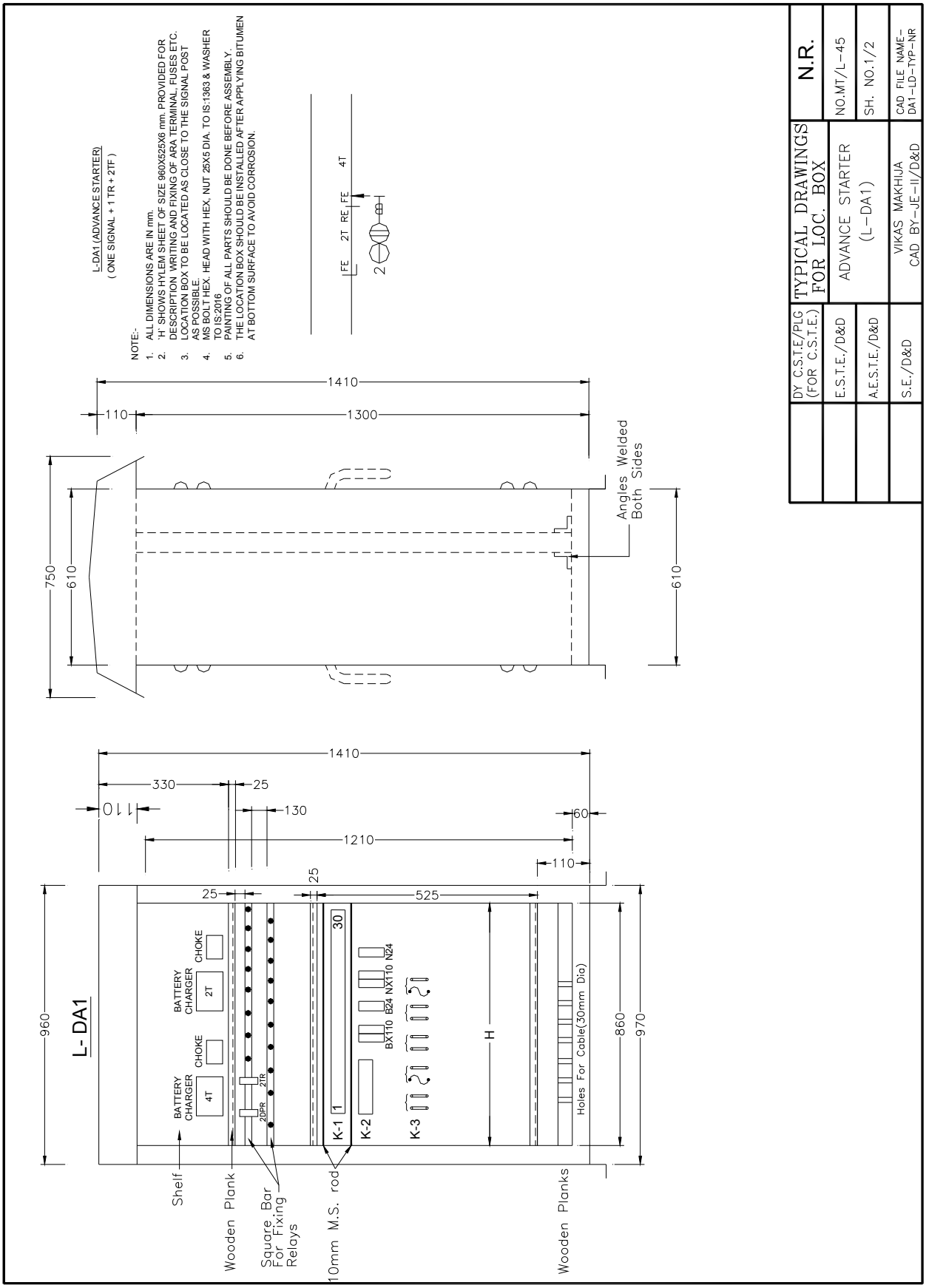
Location	Figure No. / Drg. Code	No. of Sheets
Distant Signal	Fig. 3.1 (L-DD1)	2
Advance Starter	Fig. 3.2 (L-DA1)	2
Home Signal	Fig. 3.3 (L-DH1)	3
Emergency Cross-Over	Fig. 3.4 (L-DPT)	4
Starter Signal	Fig. 3.5 (L-DST1 & DST-2)	7
	Fig. 3.6 (L-DST3 & DST-4)	7

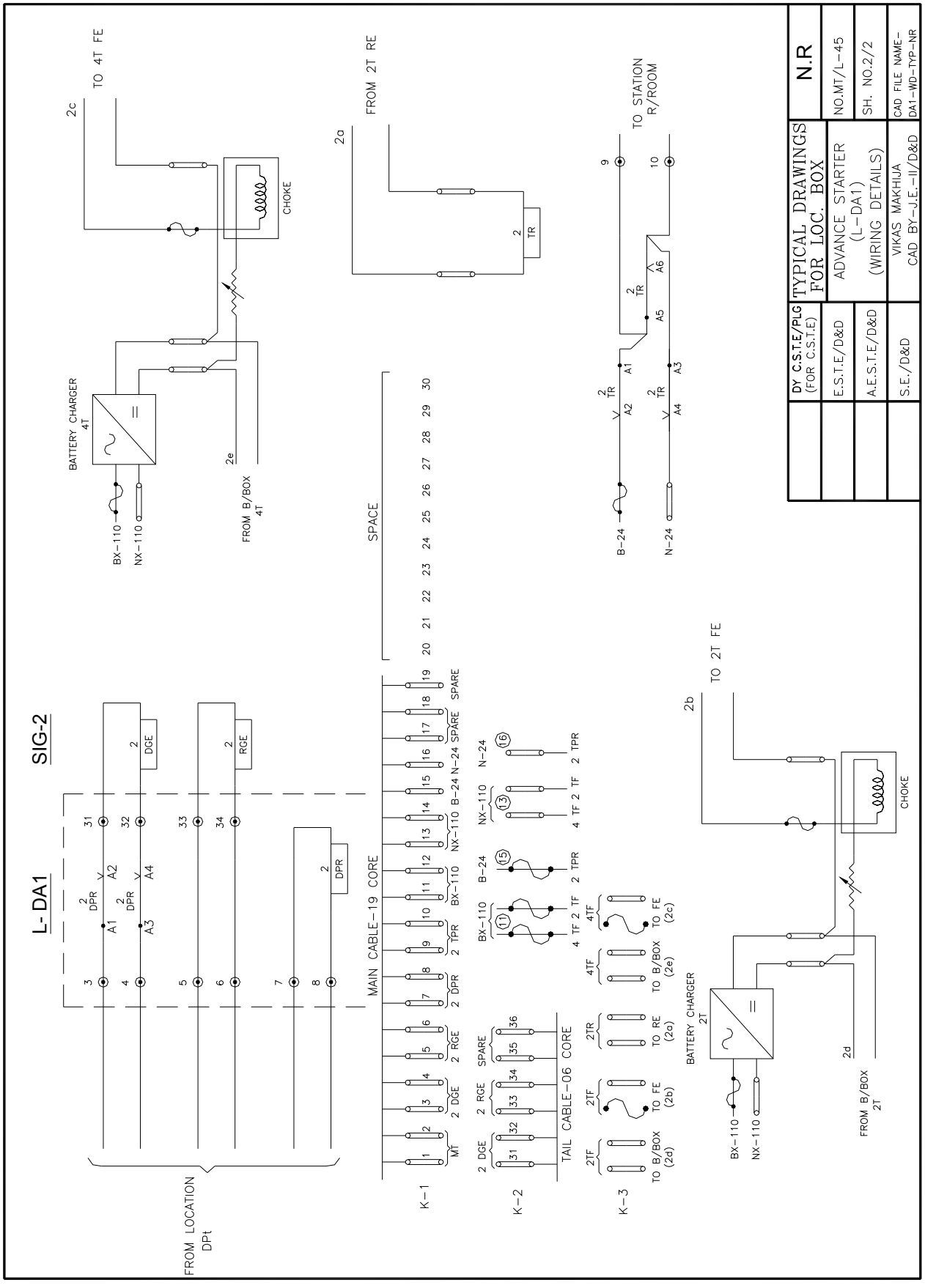
Non corrosive NFTC Apparatus case as per RDSO specification RDSO/SPN/184/2004 may be used in corrosion prone areas.

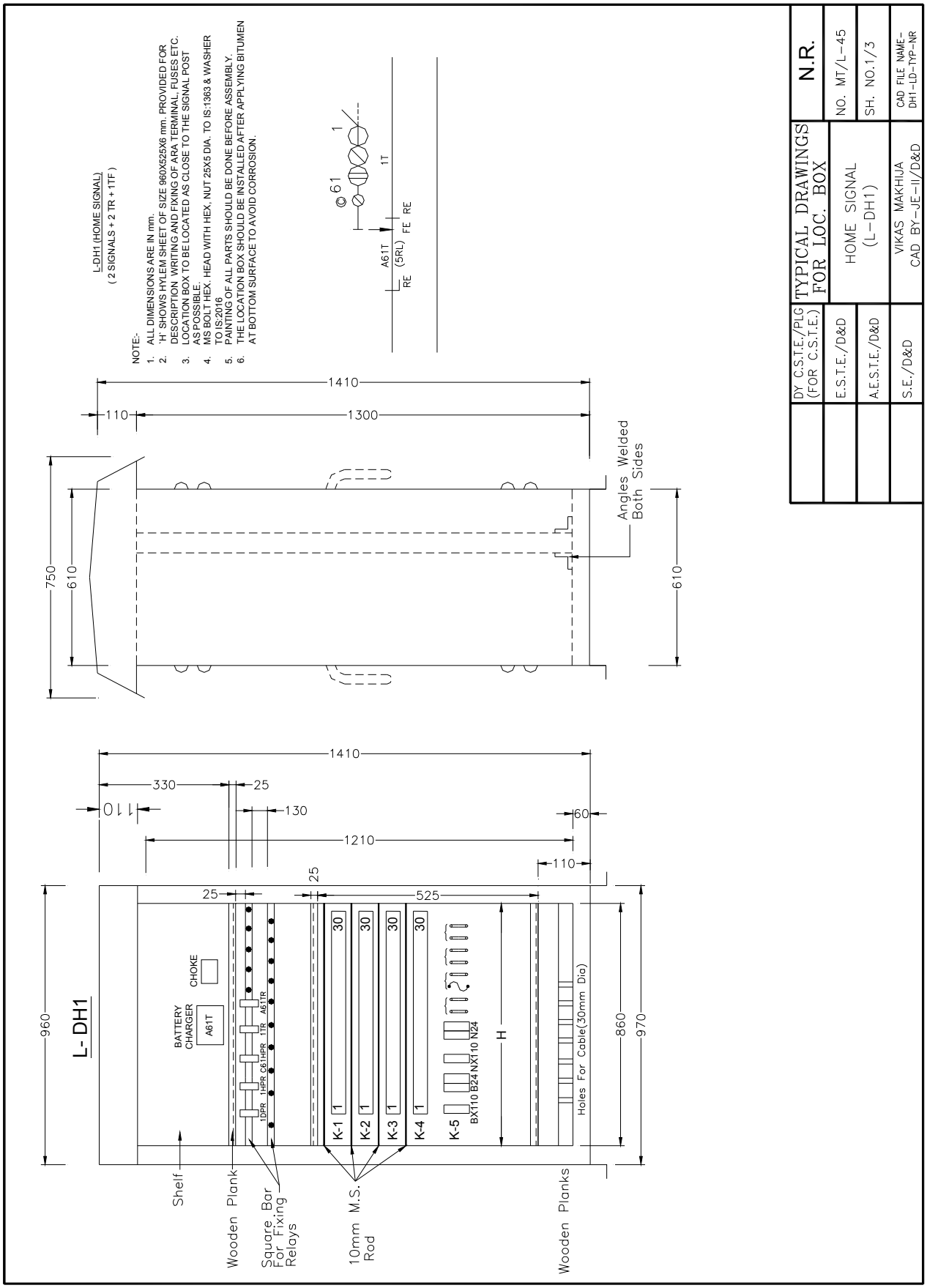
Large Apparatus case as per RDSO drawings RDSO/S-11500 and medium Apparatus case as per RDSO drawing RDSO/S-11507 may be incorporated.


MAIN CABLE-12 CORE
SPACE
13 14 15
A1HGE A1HGE A1DGE A1DGE A1HGE A1 HHGE
1 2 3 4 5 6 7 8 9 10 11 12
K-1
35
MAIN CABLE-12 CORE
SPACE
28 29 30
SPARE NX-110 BX-110 A1DPR A1HHPR MT
16 17 18 19 20 21 22 23 24 25 26 27
K-2
TAIL CABLE-12 CORE
SPACE
43 44 45
SPARE SPARE SPARE A1HGE A1DGE A1HHGE
31 32 33 34 35 36 37 38 39 40 41 42
K-3
P
A1
1410
1300
750
610
660
Angles Welded Inside
130
110
25
450
480
470
L-DD1
A1 DPR
A1 HHPR
K-1
K-2
K-3
T3
H
Holes For Cable (30mm Dia)
Wooden Planks
L-DD1 (DISTANT SIGNAL)
(ONE SIGNAL)
Square Bar For Fixing Relays
10mm M.S. rod
60
NOTE:-
1. All dimensions are in mm.
2. 'H' shows hylem sheet of sige 470 X 450 X 6 mm. provided for description writing and fixing of ara terminal, fuses etc.
3. Location box to be located as close to the signal post as possible.
4. MS Bolt hex. head with hex. nut 25 x 5 dia. to IS:1363 & washer to IS:2016.
5. Painting of all parts should be done before assembly.
6. The location box should be installed after applying bitumen at bottom surface to avoid corrosion.
Fig. 3.1 (L-DD1) SH. NO.1/2
TYPICAL DRAWINGS FOR LOC. BOX
DISTANT SIGNAL

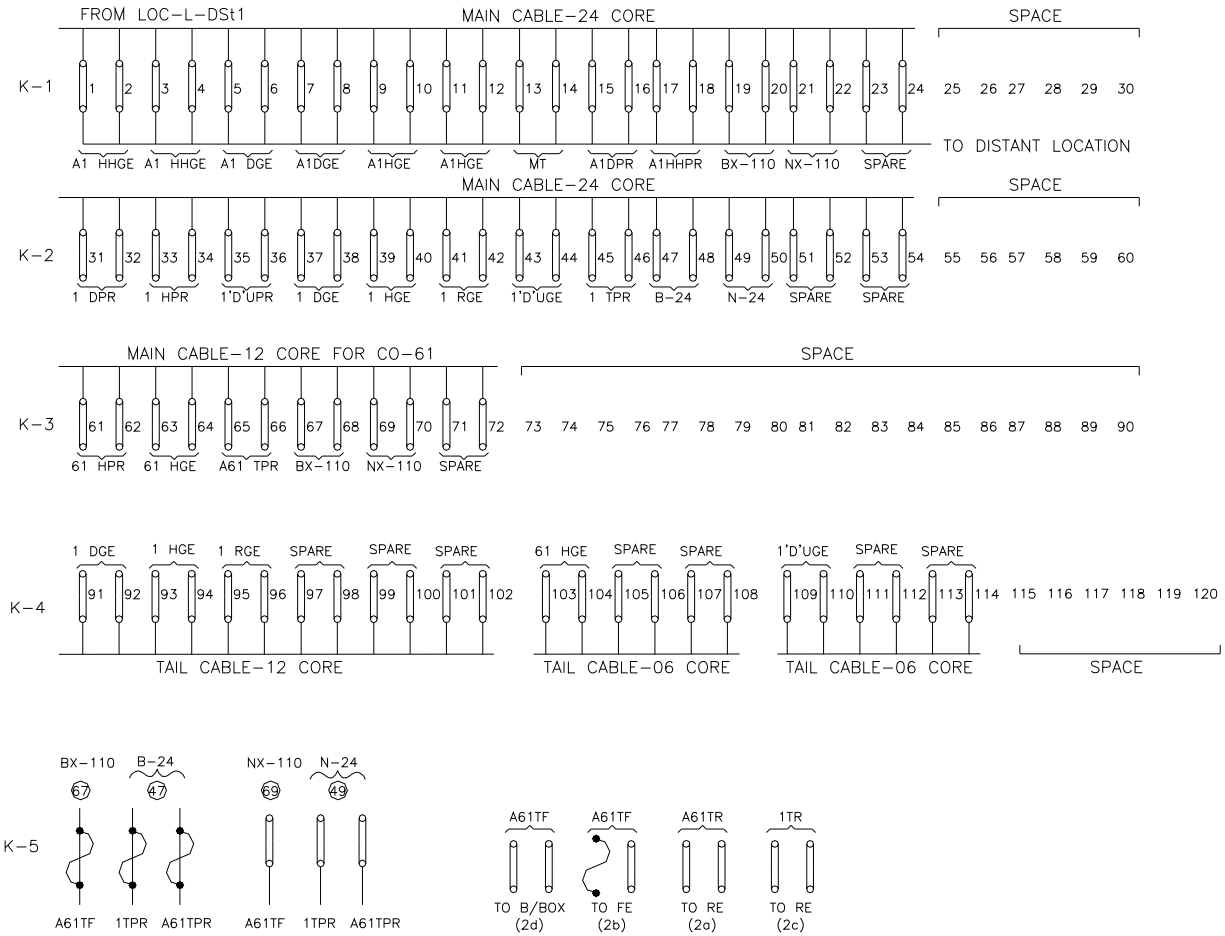

L- DD1
SIG-A1
1/2
3/4
5/6
7/8
9/10
11/12
18
19
20
21
31
32
33
34
35
36
A1 HHPR
A1 DPR
A1 HHGE
A1 DGE
A1 HGE
A1 HHPR R2
A1 DPR R2
A1 A2 A3 A4 A5 A6 A7 A8
R1
FROM LOCATION
DH1
Fig. 3.1
(L-DD1)
SH. NO.2/2
TYPICAL DRAWINGS FOR LOC. BOX
DISTANT SIGNAL
(WIRING DETAILS)


L-DA1 (ADVANCE STARTER)
(ONE SIGNAL + 1 TR + 2TF)
NOTE:-
1. ALL DIMENSIONS ARE IN mm.
2. 'H' SHOWS HYLEM SHEET OF SIZE 960X525X6 mm. PROVIDED FOR DESCRIPTION WRITING AND FIXING OF ARA TERMINAL, FUSES ETC.
3. LOCATION BOX TO BE LOCATED AS CLOSE TO THE SIGNAL POST AS POSSIBLE.
4. MS BOLT HEX. HEAD WITH HEX. NUT 25X5 DIA. TO IS:1363 & WASHER TO IS:2016
5. PAINTING OF ALL PARTS SHOULD BE DONE BEFORE ASSEMBLY
6. THE LOCATION BOX SHOULD BE INSTALLED AFTER APPLYING BITUMEN AT BOTTOM SURFACE TO AVOID CORROSION.
FE 2T RE FE 4T
2
1410
110
1300
750
610
Angles Welded Both Sides
610
1410
330
25
110
130
60
1210
110
25
25
525
960
L- DA1
BATTERY CHARGER
CHOKE
4T
2T
2PR
2TR
K-1
K-2
K-3
BX110 B24 NX110 N24
30
H
860
970
Holes For Cable(30mm Dia)
Shelf
Wooden Plank
Square Bar For Fixing Relays
10mm M.S. rod
Wooden Planks
DY C.S.T.E/PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
ADVANCE STARTER (L-DA1)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.1/2
CAD FILE NAME-DA1-LD-TYP-NR

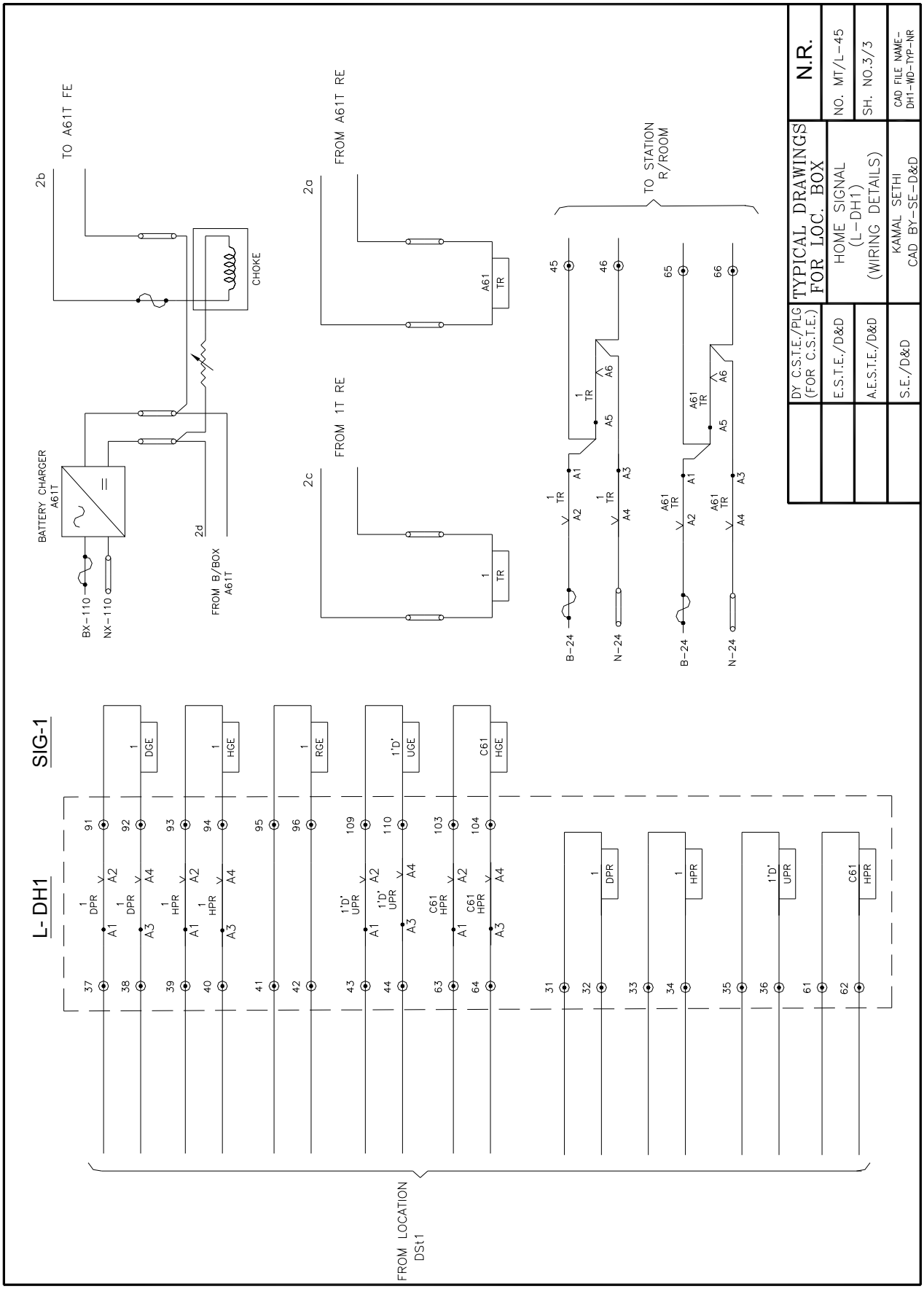

SIG-2
L- DA1
FROM LOCATION DPt
MAIN CABLE-19 CORE
TAIL CABLE-06 CORE
K-1
K-2
K-3
SPACE
TO 4T FE
TO 2T FE
FROM 2T RE
TO STATION R/ROOM
BATTERY CHARGER 4T
BATTERY CHARGER 2T
CHOKE
FROM B/BOX 4T
FROM B/BOX 2T
TO B/BOX (2d)
TO FE (2b)
TO RE (2a)
TO B/BOX (2e)
TO FE (2c)
BX-110
NX-110
B-24
N-24
DY C.S.T.E/PLG (FOR C.S.T.E)
E.S.T.E/D&D
A.E.S.T.E/D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
ADVANCE STARTER (L-DA1) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-J.E.-II/D&D
N.R
NO.MT/L-45
SH. NO.2/2
CAD FILE NAME- DA1-WD-TYP-NR


L-DH1 (HOME SIGNAL)
(2 SIGNALS + 2 TR + 1TF)
NOTE:-
1. ALL DIMENSIONS ARE IN mm.
2. 'H' SHOWS HYLEM SHEET OF SIZE 960X625X6 mm. PROVIDED FOR DESCRIPTION WRITING AND FIXING OF ARA TERMINAL, FUSES ETC.
3. LOCATION BOX TO BE LOCATED AS CLOSE TO THE SIGNAL POST AS POSSIBLE.
4. MS BOLT HEX. HEAD WITH HEX. NUT 25X5 DIA. TO IS:1363 & WASHER TO IS:2016
5. PAINTING OF ALL PARTS SHOULD BE DONE BEFORE ASSEMBLY.
6. THE LOCATION BOX SHOULD BE INSTALLED AFTER APPLYING BITUMEN AT BOTTOM SURFACE TO AVOID CORROSION.
A61T (5RL) FE RE
1T
RE
1
61
1410
110
1300
750
610
Angles Welded Both Sides
610
1410
330
25
110
130
60
1210
110
25
25
525
960
L- DH1
BATTERY CHARGER
A61T
CHOKE
10PR HPR C61HPR 1TF A61TR
K-1 1 30
K-2 1 30
K-3 1 30
K-4 1 30
K-5
BX110 B24 NX110 N24
H
860
970
Holes For Cable(30mm Dia)
Shelf
Wooden Plank
Square Bar For Fixing Relays
10mm M.S. Rod
Wooden Planks
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
HOME SIGNAL (L-DH1)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO. MT/L-45
SH. NO.1/3
CAD FILE NAME-
DH1-LD-TYP-NR

L–DH1



	DY C.S.T.E./PLG (FOR C.S.T.E.)	TYPICAL DRAWINGS FOR LOC. BOX	N.R.
	E.S.T.E./D&D	HOME SIGNAL (L–DH1) (WIRING DETAILS)	NO.MT/L–45
	A.E.S.T.E./D&D		SH. NO.2/3
	S.E./D&D	VIKAS MAKHIJA CAD BY–JE–II/D&D	CAD FILE NAME– DH1–TER–LD–TYP–NR


L- DH1
SIG-1
FROM LOCATION DSt1
2b
TO A61T FE
CHOKE
BATTERY CHARGER A61T
BX-110
NX-110
2d
FROM B/BOX A61T
2a
FROM A61T RE
2c
FROM 1T RE
TO STATION R/ROOM
B-24
N-24
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
HOME SIGNAL (L-DH1) (WIRING DETAILS)
KAMAL SETHI
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.3/3
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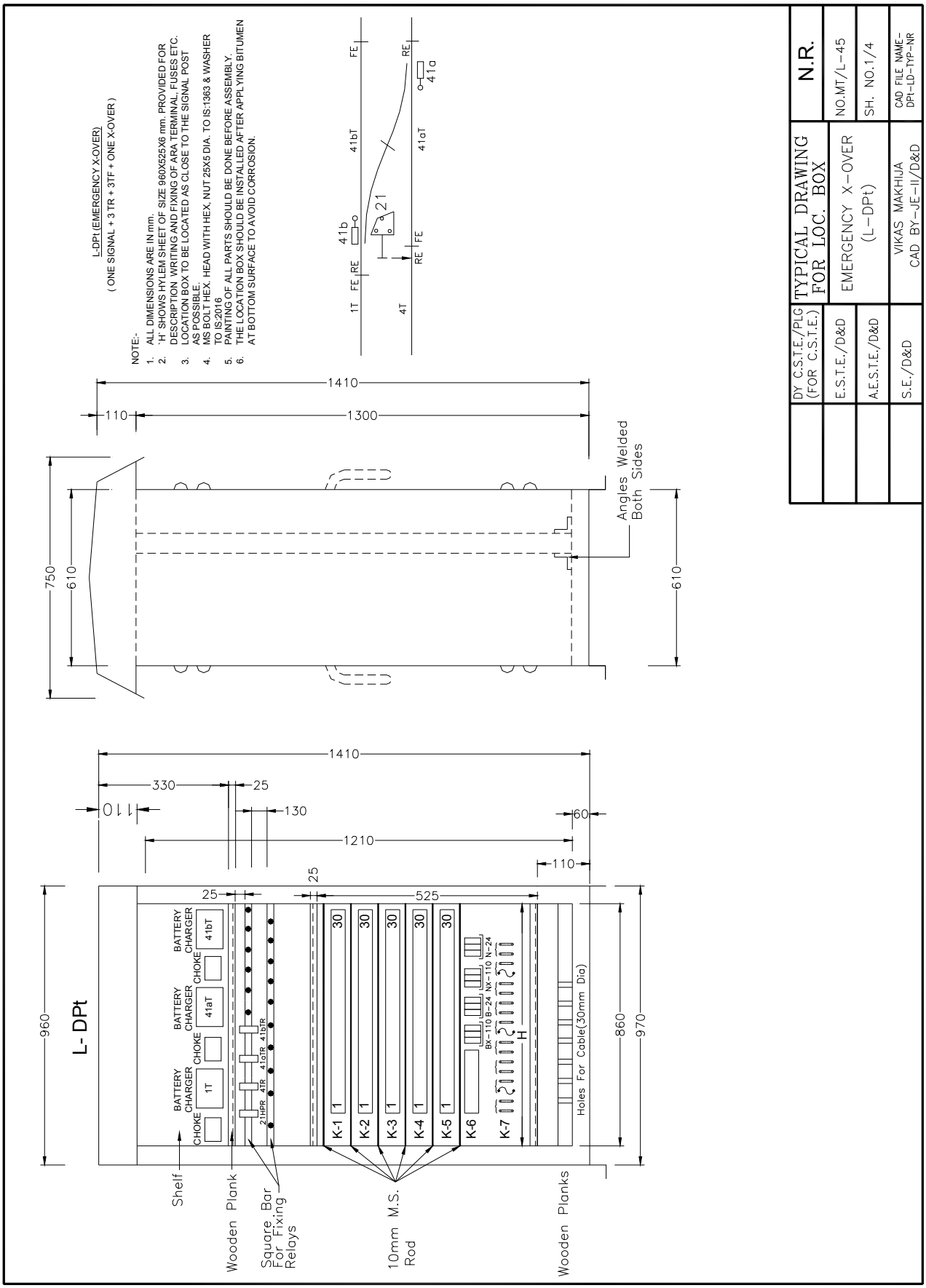
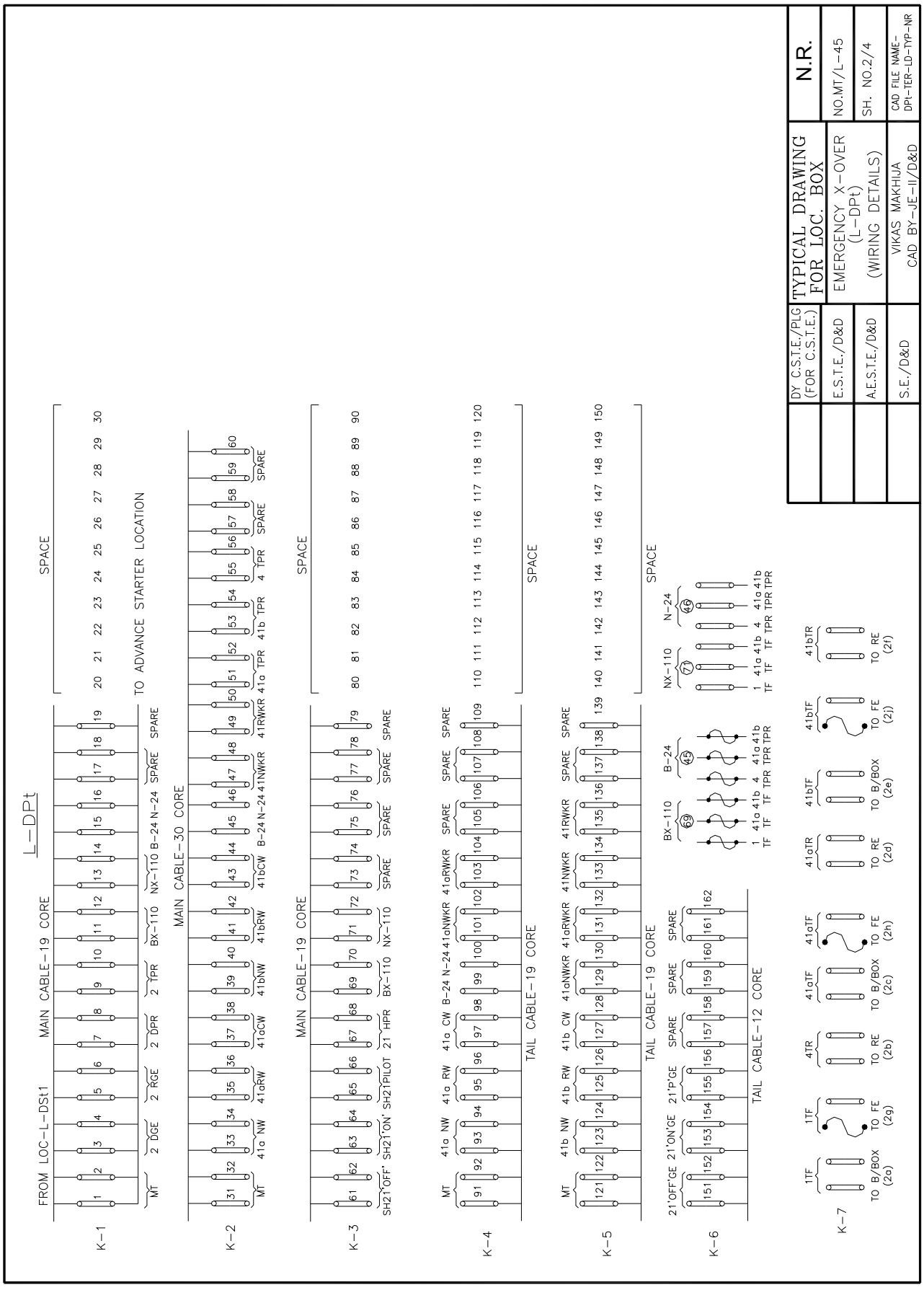
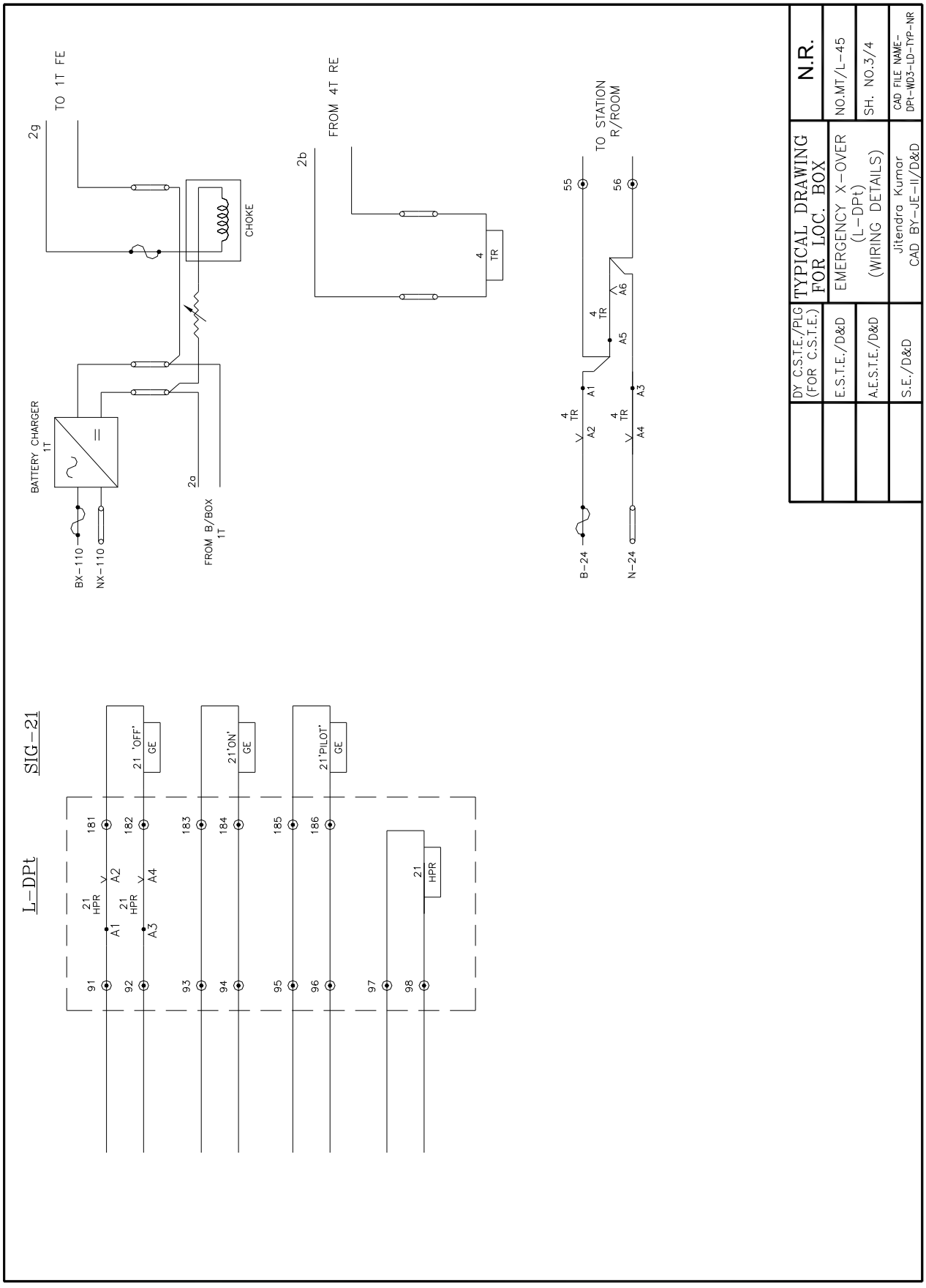
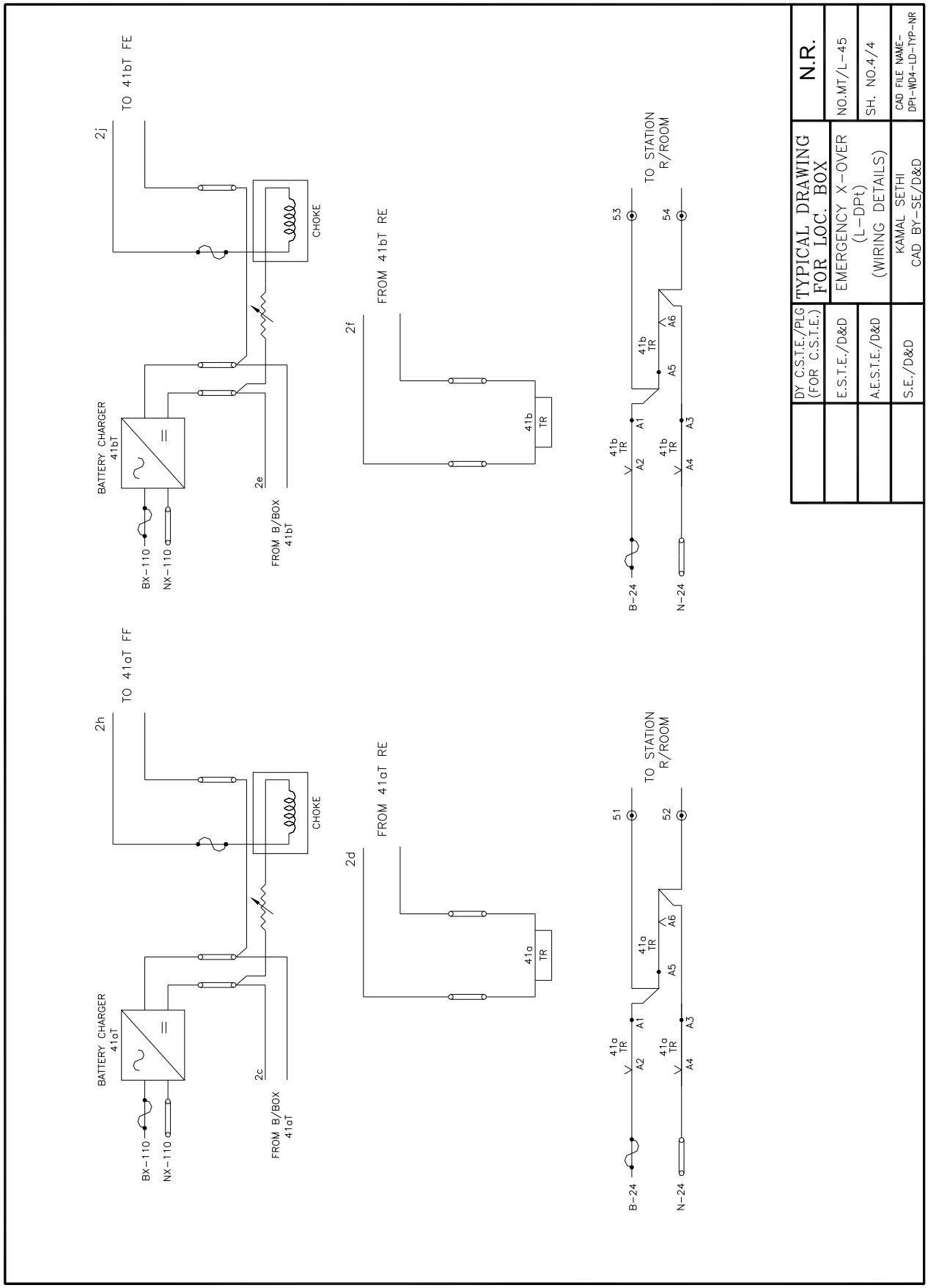
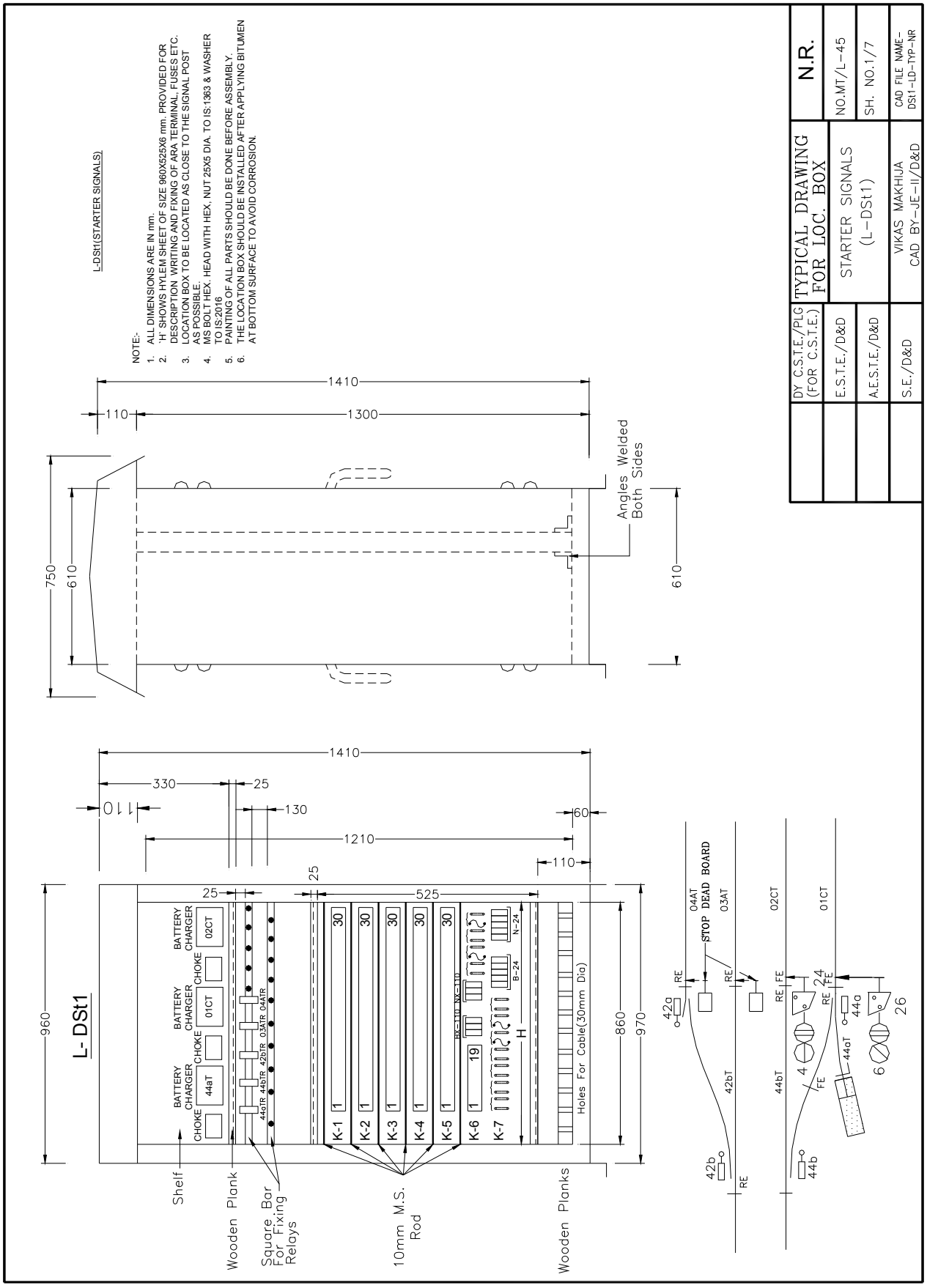


DY C.S.T.E./PLG (FOR C.S.T.E.)	TYPICAL DRAWING FOR LOC. BOX	N.R.	
E.S.T.E./D&D	EMERGENCY X-OVER (L-DPt)	NO.MT/L-45	
A.E.S.T.E./D&D		SH. NO.1/4	
S.E./D&D	VIKAS MAKHIJA CAD BY-JE-II/D&D	CAD FILE NAME- DPI-LD-TYP-NR	

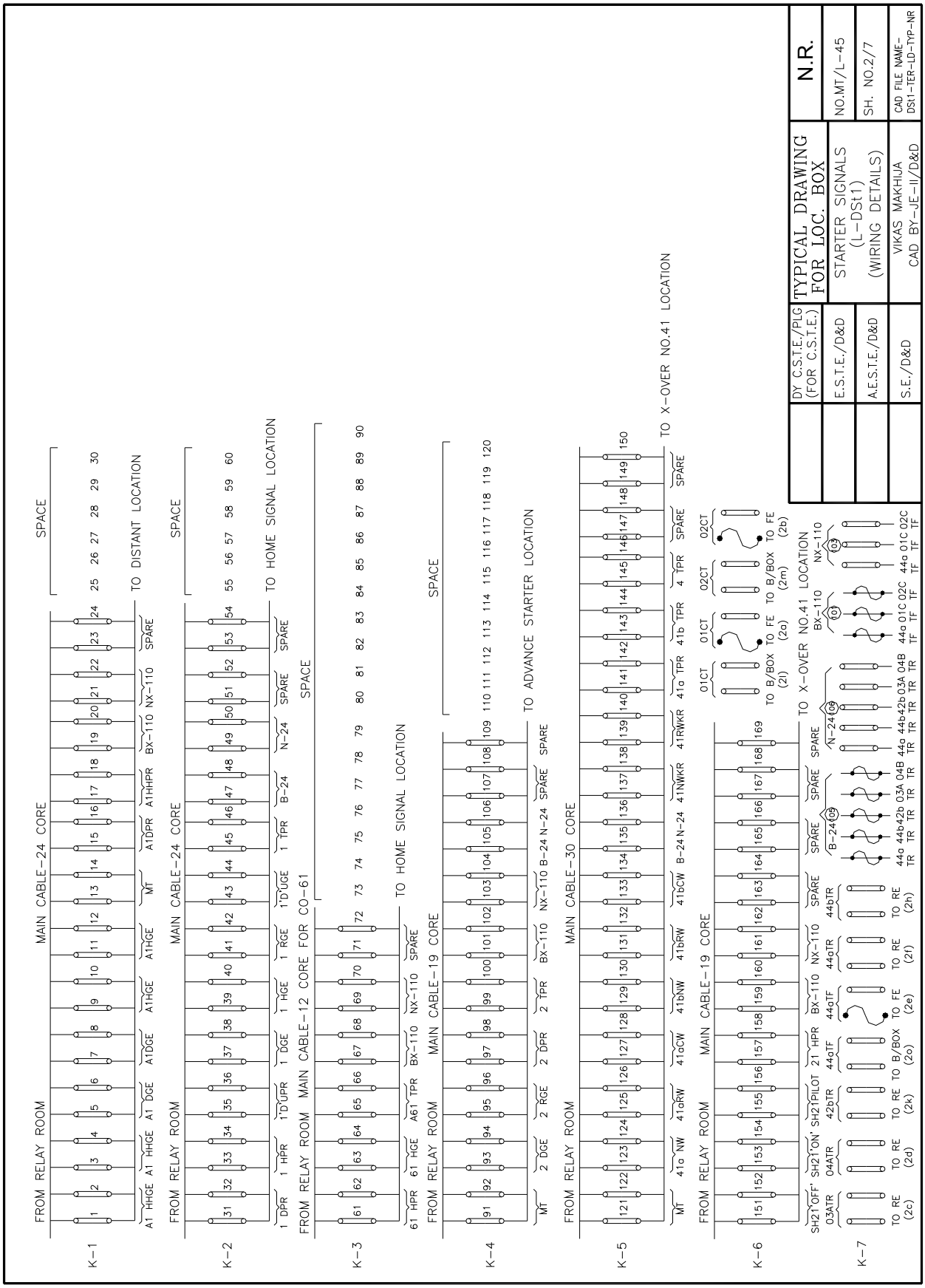

L-DPt
FROM LOC-L-DS1:1
MAIN CABLE-19 CORE
SPACE
TO ADVANCE STARTER LOCATION
MAIN CABLE-30 CORE
MAIN CABLE-19 CORE
TAIL CABLE-19 CORE
TAIL CABLE-12 CORE
K-1
K-2
K-3
K-4
K-5
K-6
K-7
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
EMERGENCY X-OVER (L-DPt)
(WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.2/4
CAD FILE NAME-
DPI-TER-LD-TYP-NR

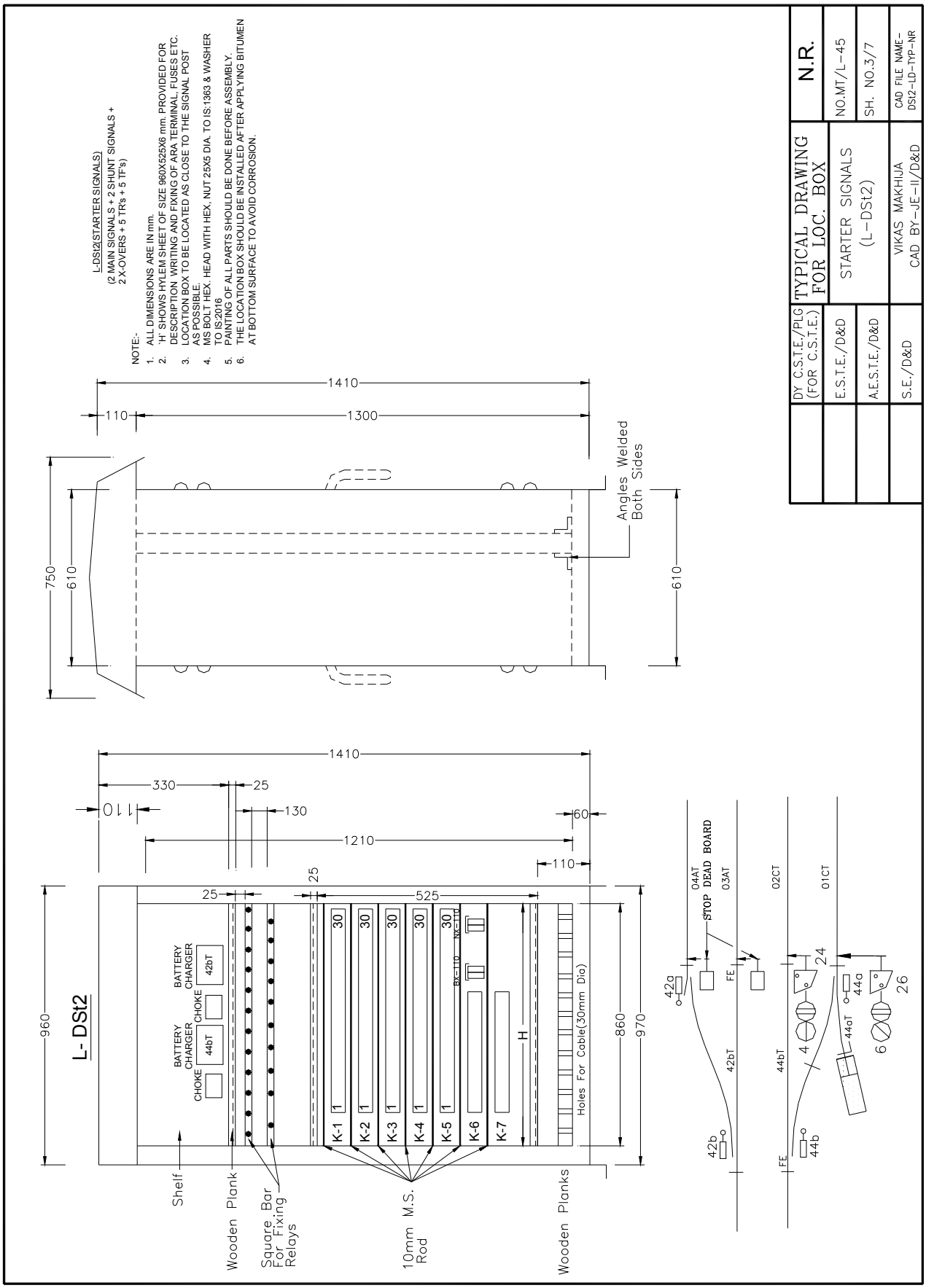

L-DPt
SIG-21
91
92
93
94
95
96
97
98
181
182
183
184
185
186
21 HPR
A1
A2
A3
A4
21 'OFF' GE
21'ON' GE
21'PILOT' GE
21 HPR
BATTERY CHARGER 1T
BX-110
NX-110
FROM B/BOX 1T
2o
2g
TO 1T FE
CHOKE
2b
FROM 4T RE
4 TR
55
56
TO STATION R/ROOM
4 TR
A1
A2
A3
A4
A5
A6
B-24
N-24
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
EMERGENCY X-OVER (L-DPt) (WIRING DETAILS)
Jitendra Kumar
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.3/4
CAD FILE NAME- DPt-WD3-LD-TYP-NR

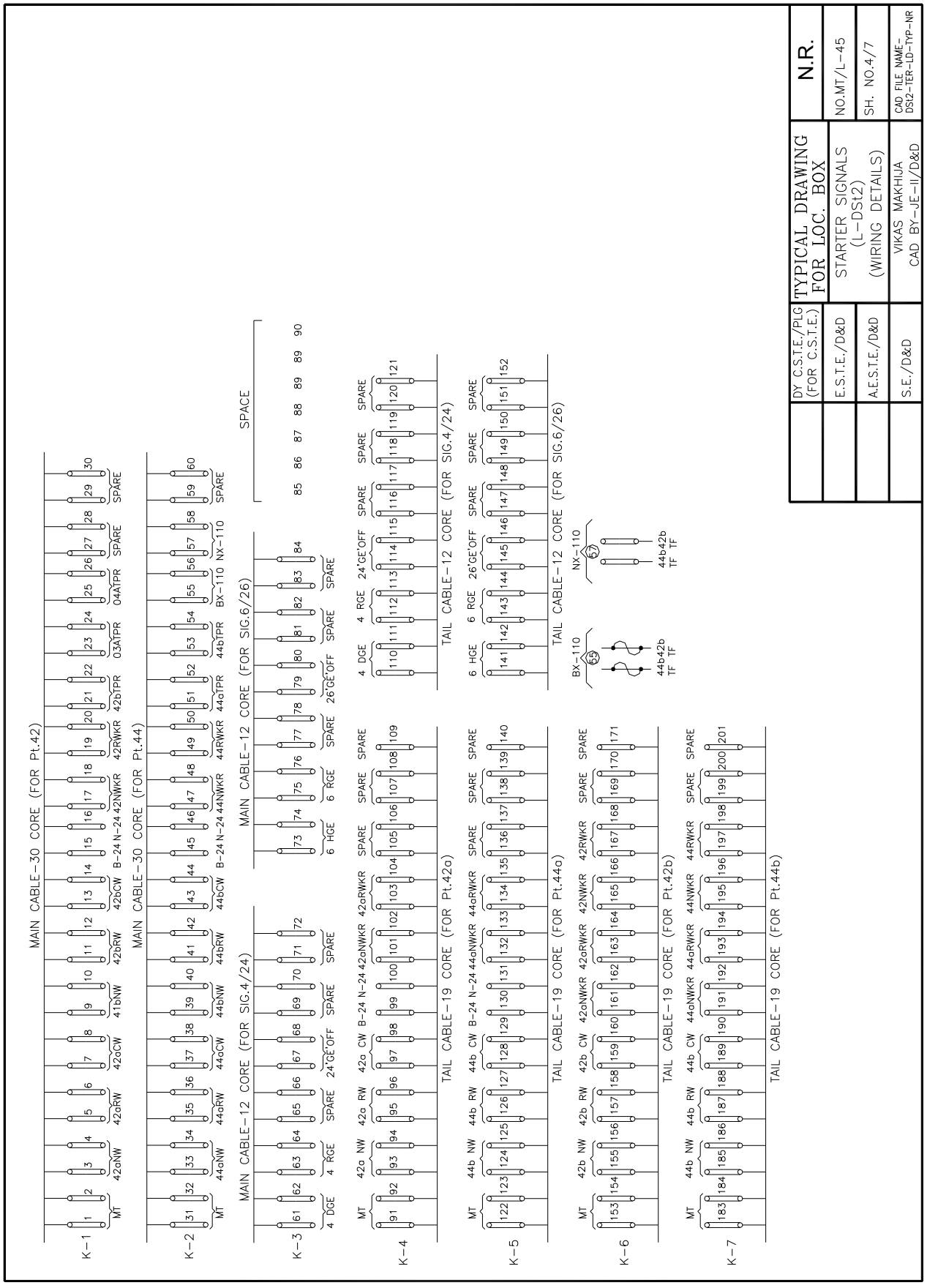

TO 41bT FE
2j
CHOKE
BATTERY CHARGER 41bT
BX-110
NX-110
2e
FROM B/BOX 41bT
FROM 41bT RE
2f
41b TR
TO STATION R/ROOM
53
54
41b TR
A1
A2
A3
A4
A5
A6
B-24
N-24
TO 41aT FF
2h
CHOKE
BATTERY CHARGER 41aT
BX-110
NX-110
2c
FROM B/BOX 41aT
FROM 41aT RE
2d
41a TR
TO STATION R/ROOM
51
52
41a TR
A1
A2
A3
A4
A5
A6
B-24
N-24
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
EMERGENCY X-OVER (L-DPt) (WIRING DETAILS)
KAMAL SETHI
CAD BY-SE/D&D
N.R.
NO.MT/L-45
SH. NO.4/4
CAD FILE NAME- DPt-WD4-LD-TYP-NR

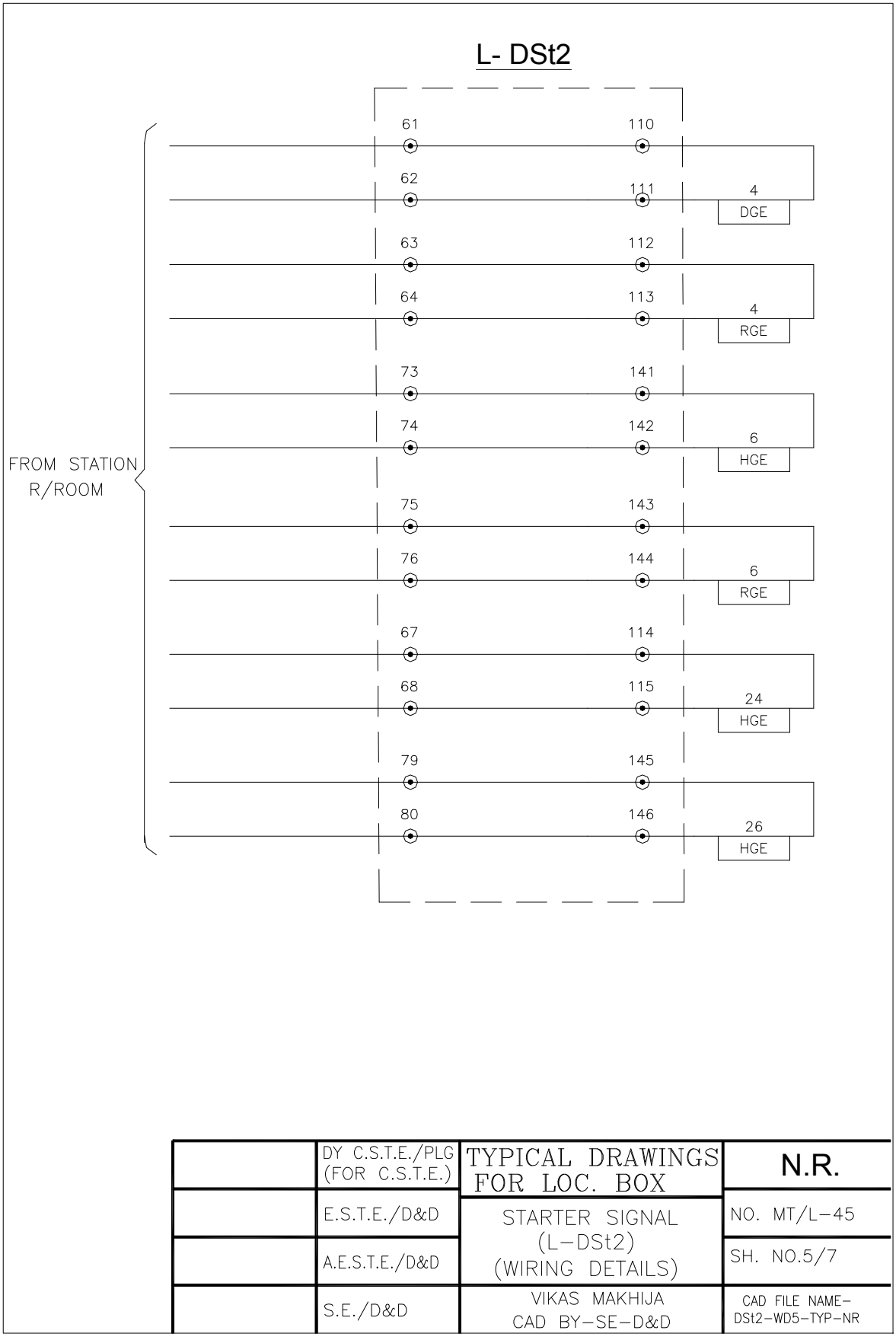


DY C.S.T.E./PLG (FOR C.S.T.E.)	TYPICAL DRAWING FOR LOC. BOX	N.R.	
E.S.T.E./D&D	STARTER SIGNALS (L-DSt1)	NO.MT/L-45	
A.E.S.T.E./D&D		SH. NO.1/7	
S.E./D&D	VIKAS MAKHIJA CAD BY-JE-II/D&D	CAD FILE NAME- DSt1-LD-TYP-NR	

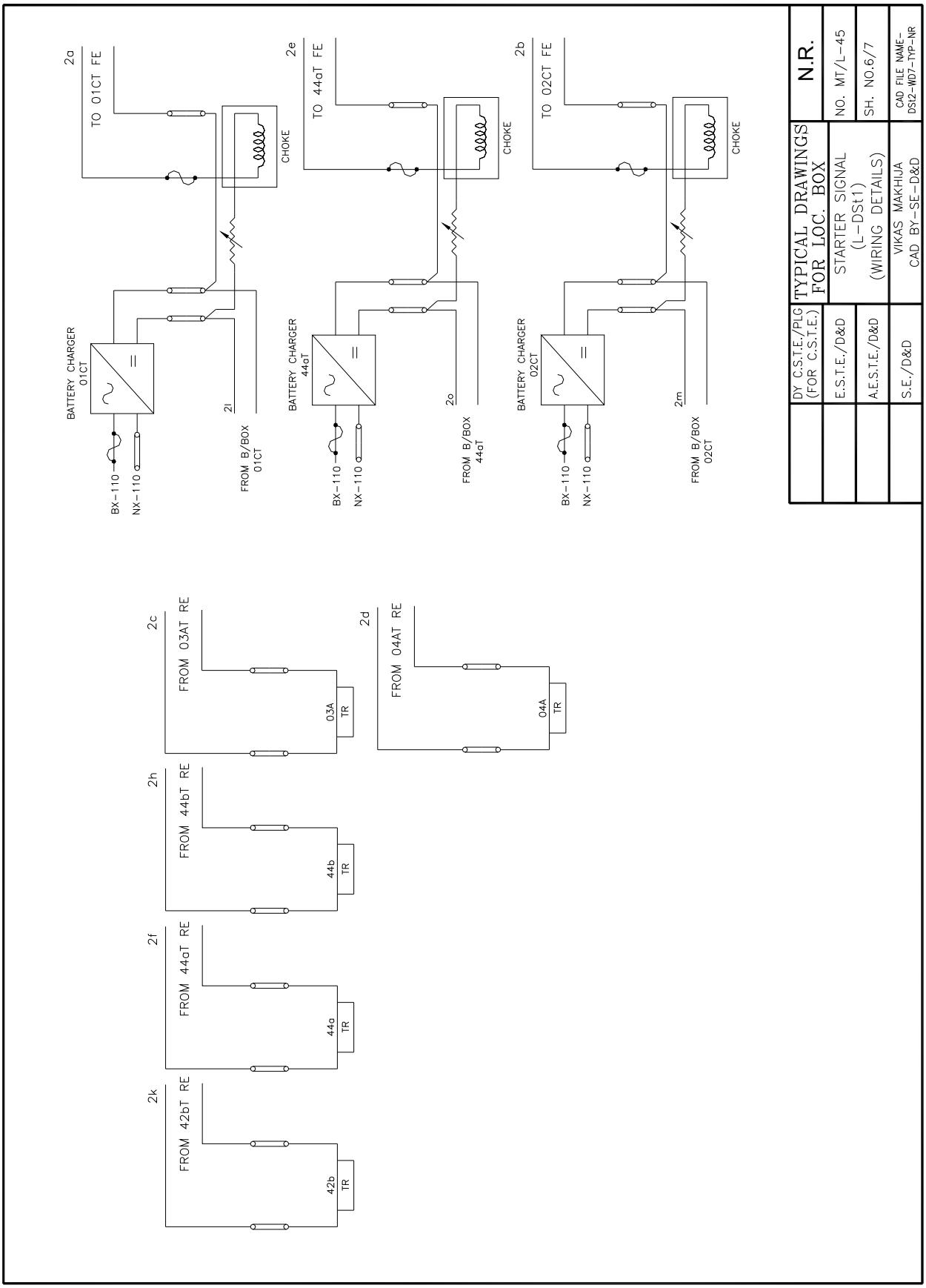

K-1
FROM RELAY ROOM
MAIN CABLE-24 CORE
SPACE
TO DISTANT LOCATION
K-2
FROM RELAY ROOM
MAIN CABLE-24 CORE
SPACE
TO HOME SIGNAL LOCATION
K-3
FROM RELAY ROOM
MAIN CABLE-12 CORE FOR CO-61
SPACE
TO HOME SIGNAL LOCATION
K-4
FROM RELAY ROOM
MAIN CABLE-19 CORE
SPACE
TO ADVANCE STARTER LOCATION
K-5
FROM RELAY ROOM
MAIN CABLE-30 CORE
TO X-OVER NO.41 LOCATION
K-6
FROM RELAY ROOM
MAIN CABLE-19 CORE
TO X-OVER NO.41 LOCATION
K-7
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSt1) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.2/7
CAD FILE NAME-
DS11-TER-LD-TYP-NR

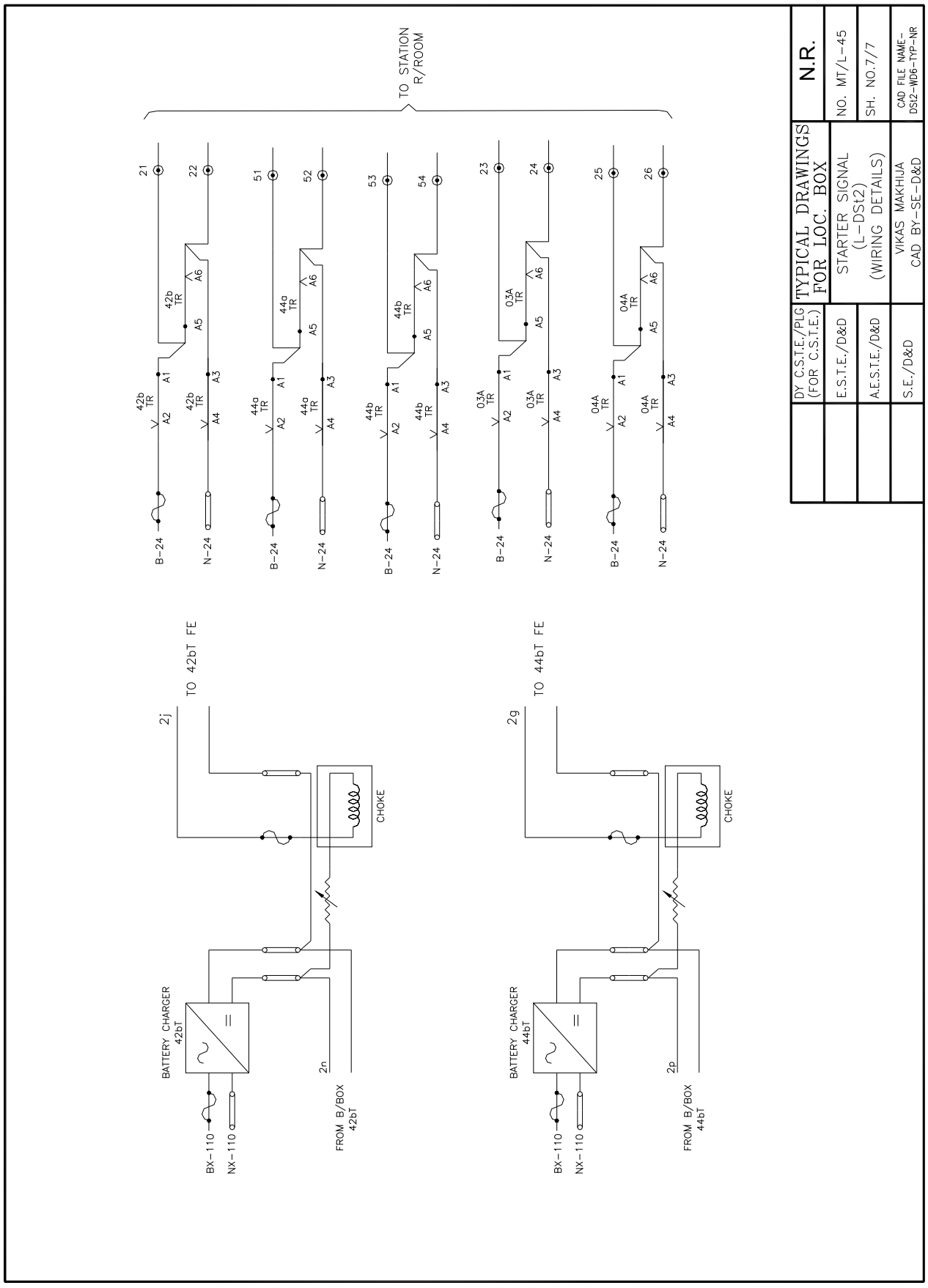

L-DSt2(STARTER SIGNALS)
(2 MAIN SIGNALS + 2 SHUNT SIGNALS + 2 X-OVERS + 5 TR's + 5 TF's)
NOTE:-
1. ALL DIMENSIONS ARE IN mm.
2. 'H' SHOWS HYLEM SHEET OF SIZE 960X525X6 mm. PROVIDED FOR DESCRIPTION WRITING AND FIXING OF ARA TERMINAL, FUSES ETC.
3. LOCATION BOX TO BE LOCATED AS CLOSE TO THE SIGNAL POST AS POSSIBLE.
4. MS BOLT HEX. HEAD WITH HEX. NUT 25X5 DIA. TO IS:1363 & WASHER TO IS:2016
5. PAINTING OF ALL PARTS SHOULD BE DONE BEFORE ASSEMBLY.
6. THE LOCATION BOX SHOULD BE INSTALLED AFTER APPLYING BITUMEN AT BOTTOM SURFACE TO AVOID CORROSION.
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSt2)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.3/7
CAD FILE NAME-DSt2-LD-TYP-NR
1410
110
1300
750
610
Angles Welded Both Sides
330
25
130
60
1210
525
960
L- DSt2
BATTERY CHARGER
CHOKE
42bT
44bT
K-1
K-2
K-3
K-4
K-5
K-6
K-7
H
Holes For Cable(30mm Dia)
860
970
Shelf
Wooden Plank
Square Bar For Fixing Relays
10mm M.S. Rod
Wooden Planks
04AT
DEAD
STOP
BOARD
03AT
02CT
01CT
42a
42b
FE
44bT
44aT
44a
44b
24
26
4
6

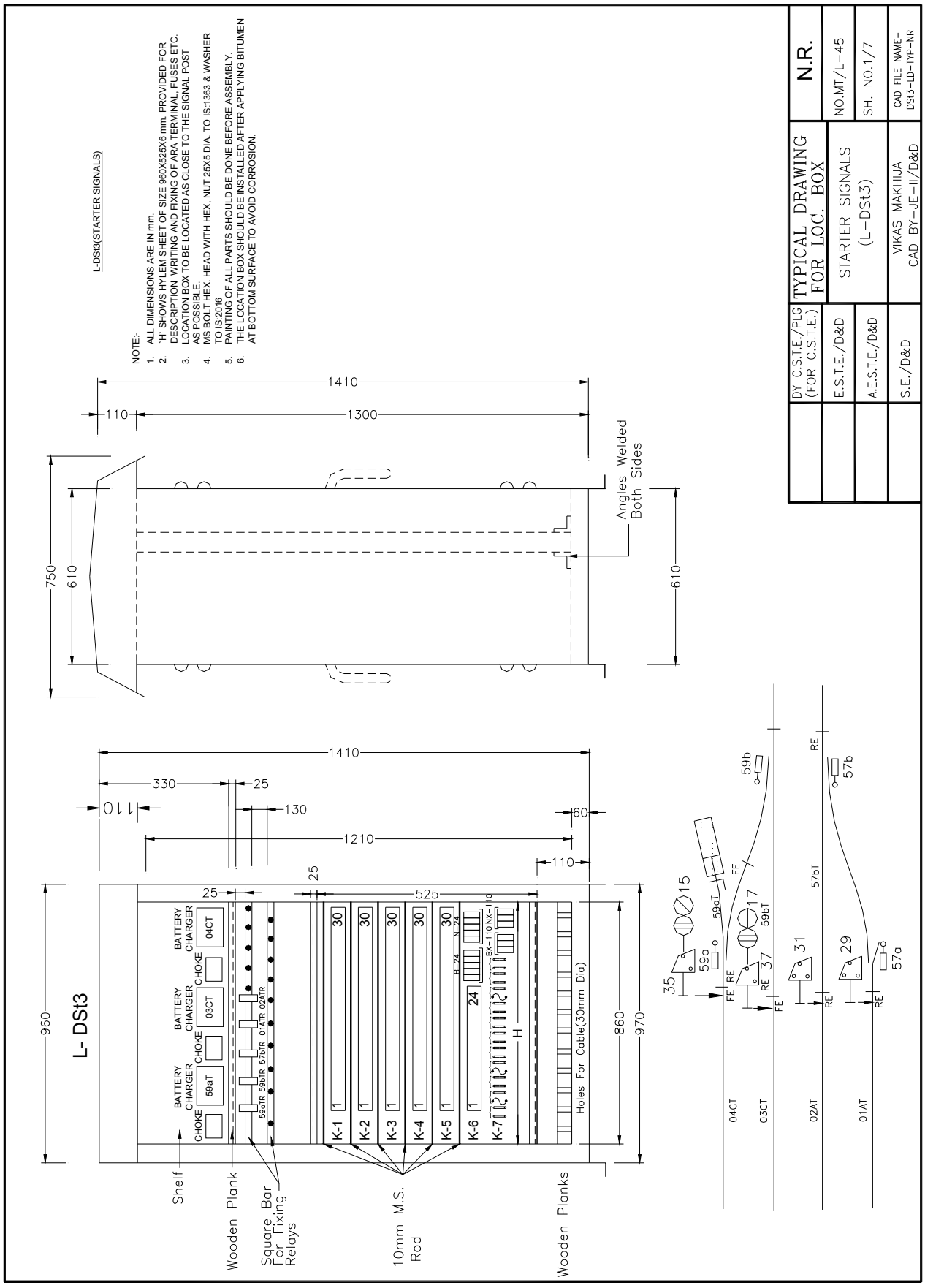

MAIN CABLE-30 CORE (FOR Pt.42)
MAIN CABLE-30 CORE (FOR Pt.44)
MAIN CABLE-12 CORE (FOR SIG.4/24)
MAIN CABLE-12 CORE (FOR SIG.6/26)
SPACE
TAIL CABLE-19 CORE (FOR Pt.42a)
TAIL CABLE-19 CORE (FOR Pt.44a)
TAIL CABLE-19 CORE (FOR Pt.42b)
TAIL CABLE-19 CORE (FOR Pt.44b)
TAIL CABLE-12 CORE (FOR SIG.4/24)
TAIL CABLE-12 CORE (FOR SIG.6/26)
K-1
K-2
K-3
K-4
K-5
K-6
K-7
BX-110
NX-110
44b42b TF TF
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSI2) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.4/7
CAD FILE NAME-
DSI2-TER-LD-TYP-NR

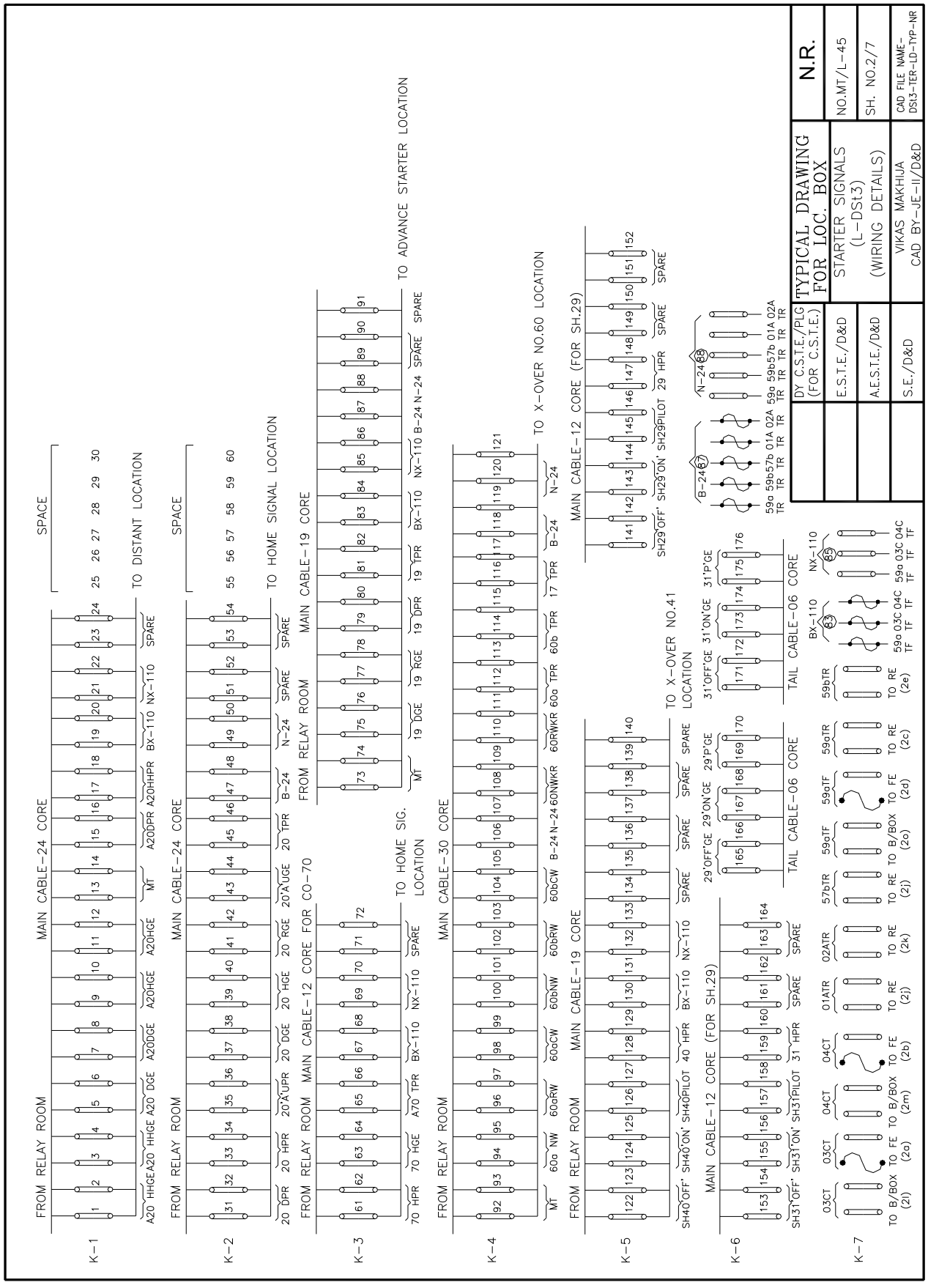


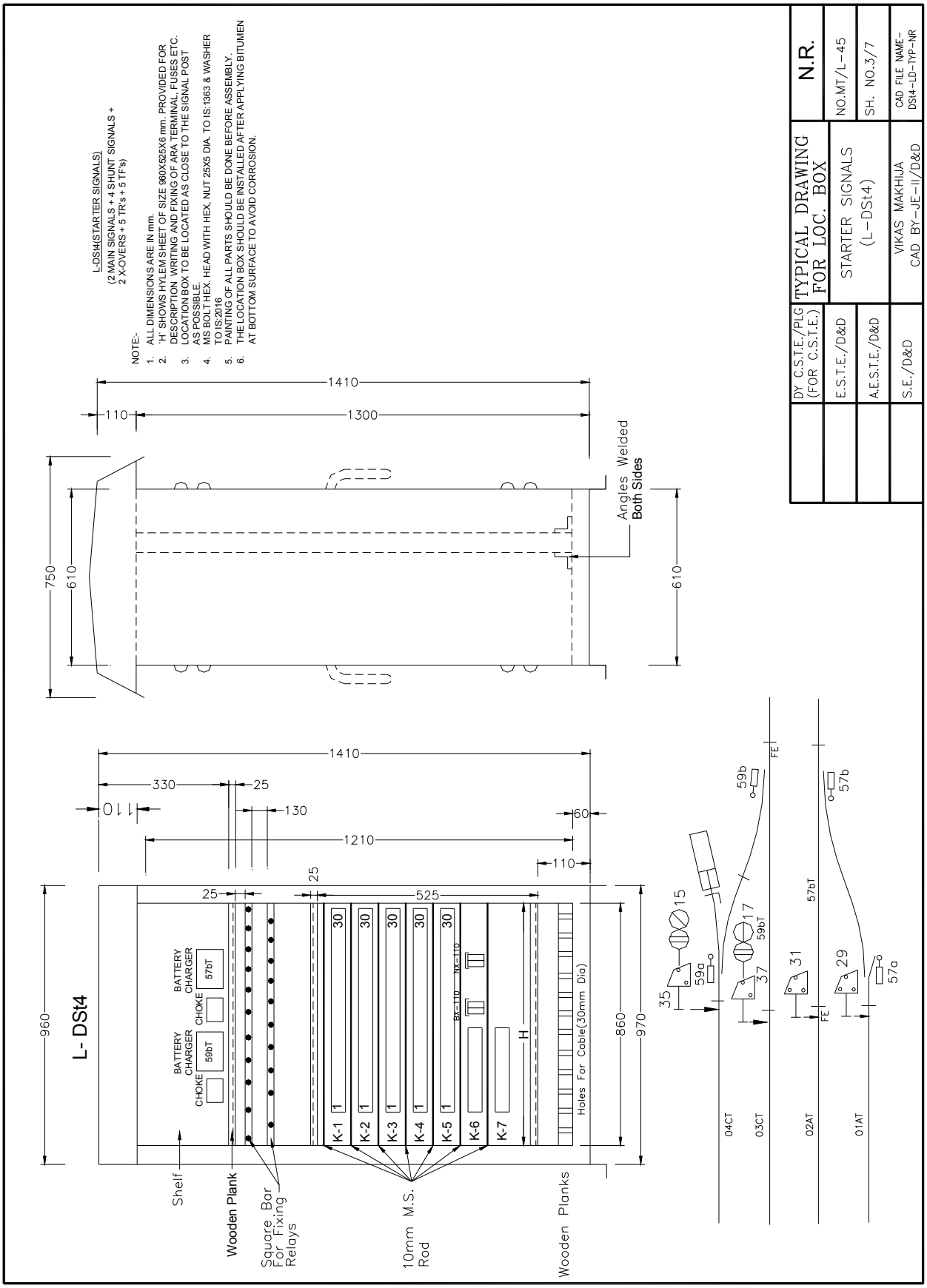
	DY C.S.T.E./PLG (FOR C.S.T.E.)	TYPICAL DRAWINGS FOR LOC. BOX	N.R.
	E.S.T.E./D&D	STARTER SIGNAL (L–DSt2) (WIRING DETAILS)	NO. MT/L–45
	A.E.S.T.E./D&D		SH. NO.5/7
	S.E./D&D	VIKAS MAKHIJA CAD BY–SE–D&D	CAD FILE NAME– DSt2–WD5–TYP–NR

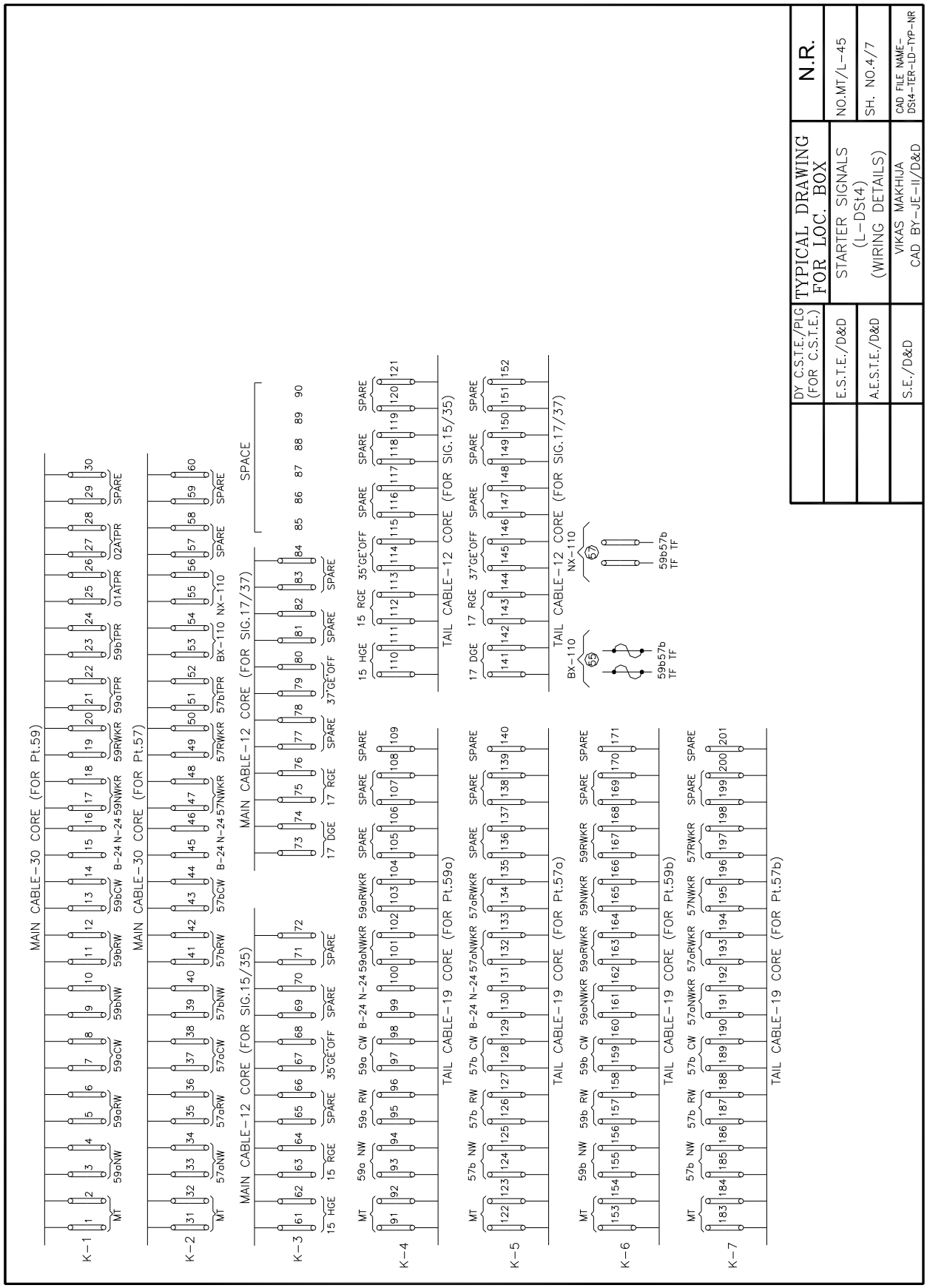

2a
TO 01CT FE
CHOKE
BATTERY CHARGER 01CT
BX-110
NX-110
2l
FROM B/BOX 01CT
2e
TO 44aT FE
CHOKE
BATTERY CHARGER 44aT
BX-110
NX-110
2o
FROM B/BOX 44aT
2b
TO 02CT FE
CHOKE
BATTERY CHARGER 02CT
BX-110
NX-110
2m
FROM B/BOX 02CT
2c
FROM 03AT RE
03A
TR
2d
FROM 04AT RE
04A
TR
2h
FROM 44bT RE
44b
TR
2f
FROM 44aT RE
44a
TR
2k
FROM 42bT RE
42b
TR
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
STARTER SIGNAL (L-DSt1)
(WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.6/7
CAD FILE NAME- DS12-WD7-TYP-NR

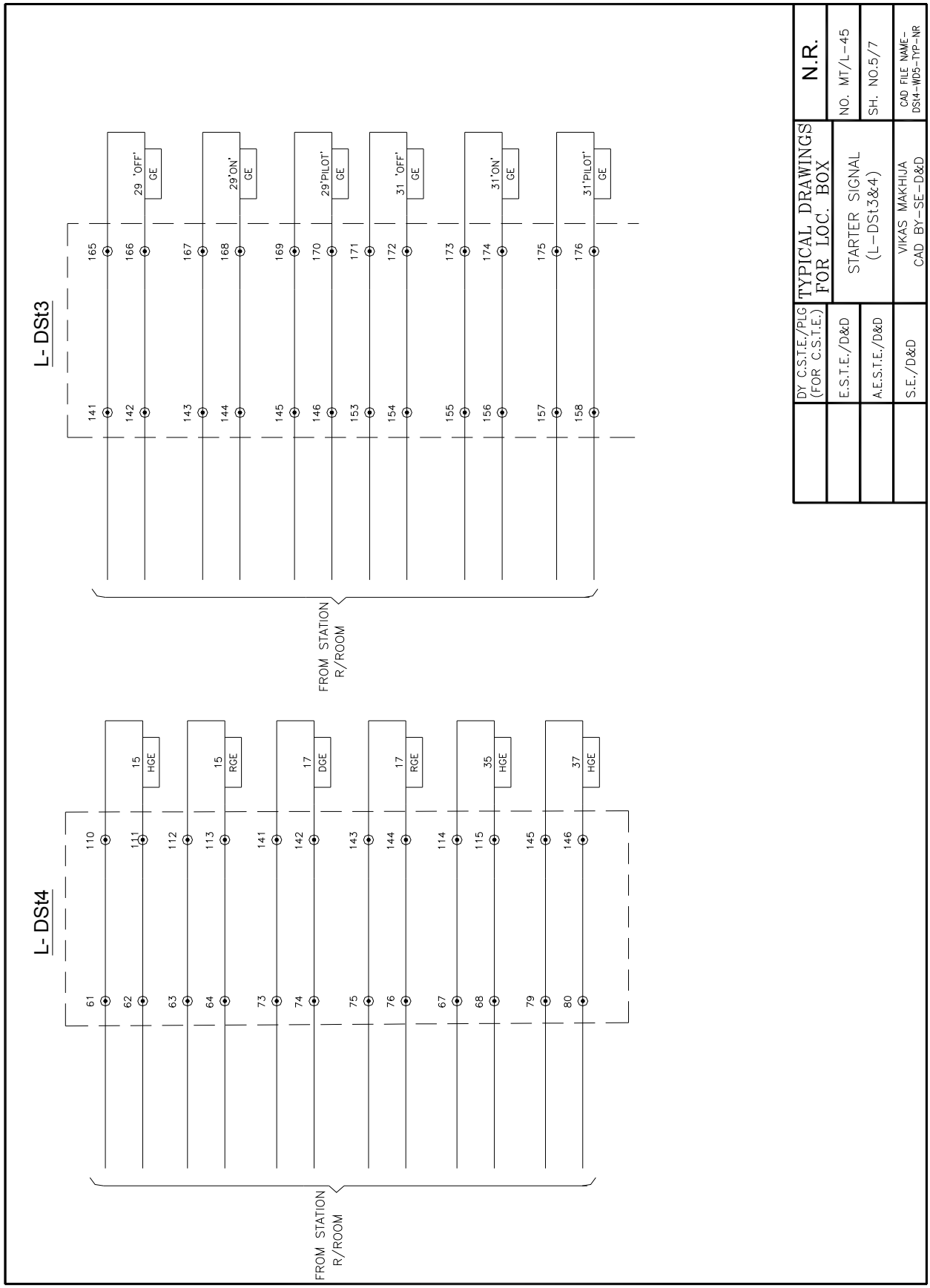

TO STATION R/ROOM
21
22
51
52
53
54
23
24
25
26
42b TR
44a TR
44b TR
03A TR
04A TR
A1
A2
A3
A4
A5
A6
B-24
N-24
2j
TO 42bT FE
2g
TO 44bT FE
CHOKE
BATTERY CHARGER 42bT
BATTERY CHARGER 44bT
BX-110
NX-110
2n
2p
FROM B/BOX 42bT
FROM B/BOX 44bT
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
STARTER SIGNAL (L-DS12) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.7/7
CAD FILE NAME- DS12-WD6-TYP-NR

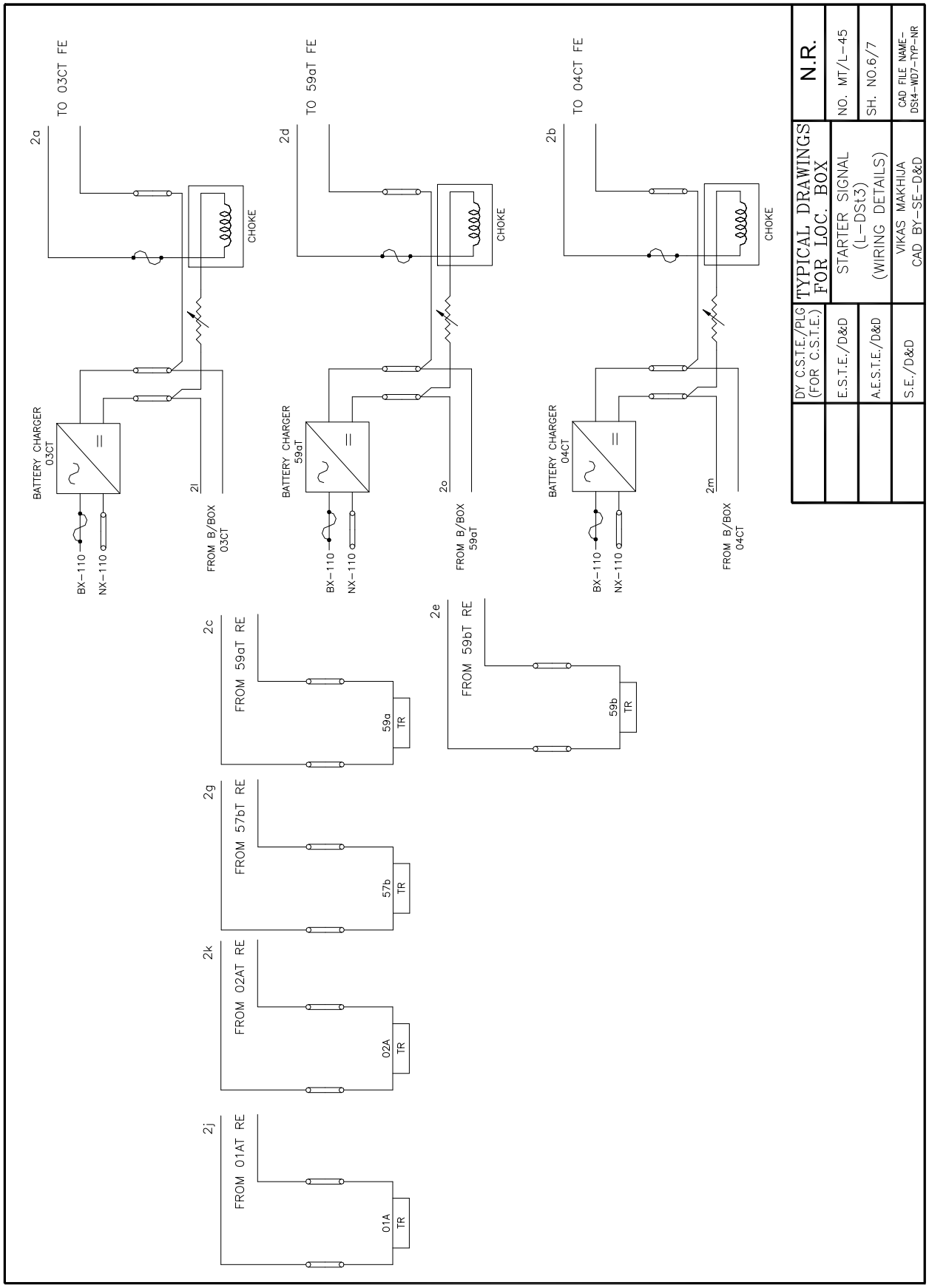

L-DSt3(STARTER SIGNALS)
NOTE:-
1. ALL DIMENSIONS ARE IN mm.
2. 'H' SHOWS HYLEM SHEET OF SIZE 960X525X6 mm. PROVIDED FOR DESCRIPTION WRITING AND FIXING OF ARA TERMINAL FUSES ETC.
3. LOCATION BOX TO BE LOCATED AS CLOSE TO THE SIGNAL POST AS POSSIBLE.
4. MS BOLT HEX. HEAD WITH HEX. NUT 25X5 DIA. TO IS:1363 & WASHER TO IS:2016
5. PAINTING OF ALL PARTS SHOULD BE DONE BEFORE ASSEMBLY.
6. THE LOCATION BOX SHOULD BE INSTALLED AFTER APPLYING BITUMEN AT BOTTOM SURFACE TO AVOID CORROSION.
1410
110
1300
750
610
Angles Welded Both Sides
330
25
130
60
1210
525
960
970
860
L- DSt3
BATTERY CHARGER
CHOKE
59aT
59bTR
67bTR
01ATR
02ATR
03CT
04CT
K-1
K-2
K-3
K-4
K-5
K-6
K-7
30
24
H
R-24
N-24
BX-110
NX-110
Holes For Cable(30mm Dia)
Shelf
Wooden Plank
Square Bar For Fixing Relays
10mm M.S. Rod
Wooden Planks
15
17
35
31
29
59a
59b
57a
57b
37
FE
RE
04CT
03CT
02AT
01AT
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSt3)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.1/7
CAD FILE NAME-DSt3-LD-TYP-NR

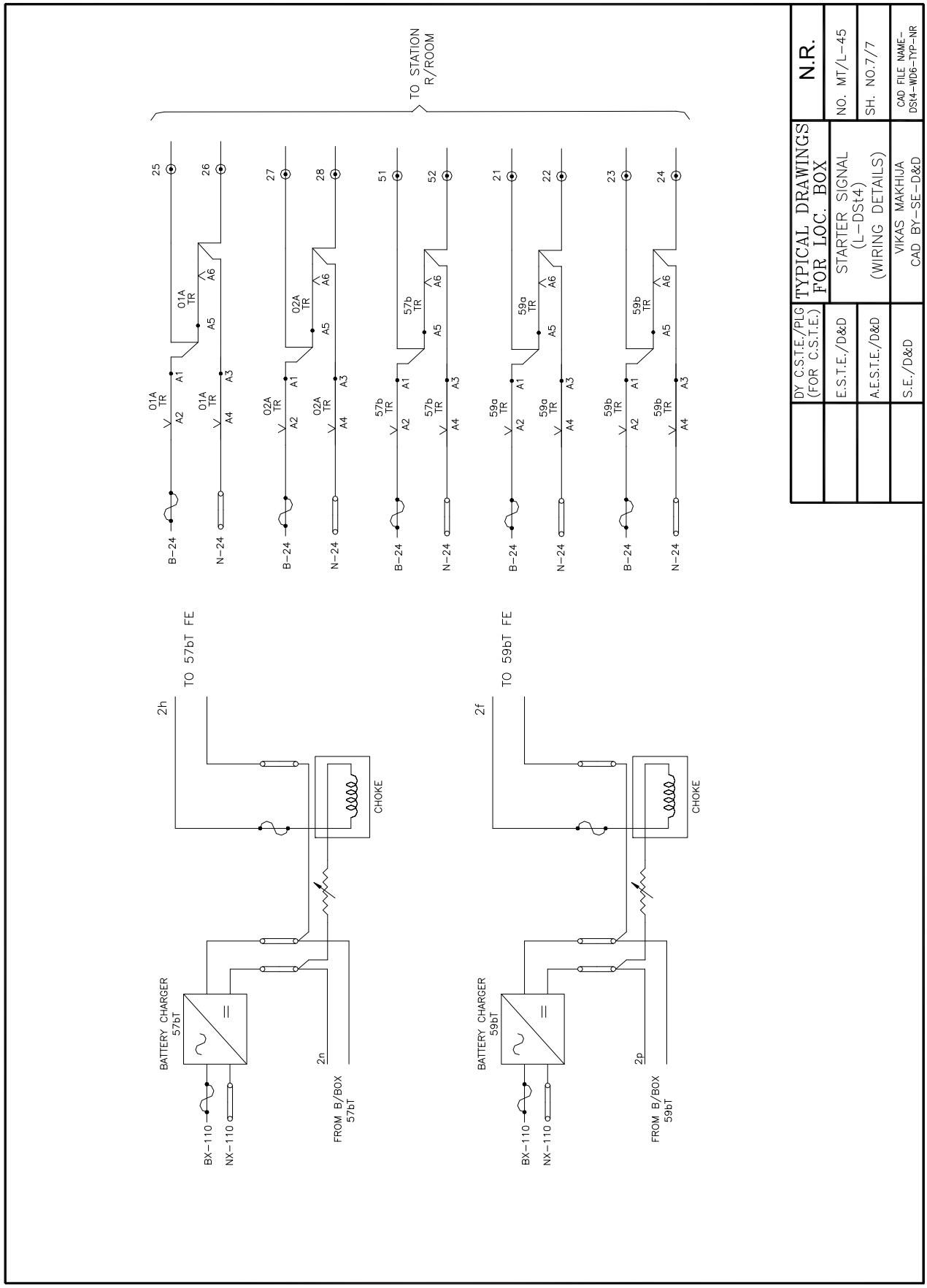

TYPICAL DRAWING FOR LOC. BOX
N.R.
STARTER SIGNALS (L-DSt3) (WIRING DETAILS)
NO.MT/L-45
SH. NO.2/7
VIKAS MAKHIJA
CAD BY-JE-II/D&D
S.E./D&D
E.S.T.E./D&D
A.E.S.T.E./D&D
DY C.S.T.E./PLG (FOR C.S.T.E.)
CAD FILE NAME- DSt3-TER-LD-TYP-NR
TO DISTANT LOCATION
TO HOME SIGNAL LOCATION
TO ADVANCE STARTER LOCATION
TO HOME SIG. LOCATION
TO X-OVER NO.60 LOCATION
TO X-OVER NO.41 LOCATION
MAIN CABLE-24 CORE
MAIN CABLE-12 CORE FOR CO-70
MAIN CABLE-19 CORE
MAIN CABLE-30 CORE
MAIN CABLE-12 CORE (FOR SH.29)
TAIL CABLE-06 CORE
FROM RELAY ROOM
SPACE
SPARE


L-DSt4(STARTER SIGNALS)
(2 MAIN SIGNALS + 4 SHUNT SIGNALS + 2 X-OVERS + 5 TR's + 5 TF's)
NOTE-
1. ALL DIMENSIONS ARE IN mm.
2. 'H' SHOWS HYLEM SHEET OF SIZE 960X525X6 mm. PROVIDED FOR DESCRIPTION WRITING AND FIXING OF ARA TERMINAL FUSES ETC.
3. LOCATION BOX TO BE LOCATED AS CLOSE TO THE SIGNAL POST AS POSSIBLE.
4. MS BOLT HEX. HEAD WITH HEX. NUT 25X5 DIA. TO IS:1363 & WASHER TO IS:2016
5. PAINTING OF ALL PARTS SHOULD BE DONE BEFORE ASSEMBLY.
6. THE LOCATION BOX SHOULD BE INSTALLED AFTER APPLYING BITUMEN AT BOTTOM SURFACE TO AVOID CORROSION.
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSt4)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.3/7
CAD FILE NAME-DS4-LD-TYP-NR
1410
1300
110
750
610
Angles Welded Both Sides
330
25
130
60
1210
525
960
860
970
L- DSt4
BATTERY CHARGER
CHOKE
57bT
59bT
K-1
K-2
K-3
K-4
K-5
K-6
K-7
H
Holes For Cable(30mm Dia)
Shelf
Wooden Plank
Square Bar For Fixing Relays
10mm M.S. Rod
Wooden Planks
15
59a
35
17
59bT
37
59b
FE
31
29
57bT
57b
57a
04CT
03CT
02AT
01AT


MAIN CABLE-30 CORE (FOR Pt.59)
MAIN CABLE-30 CORE (FOR Pt.57)
MAIN CABLE-12 CORE (FOR SIG.15/35)
MAIN CABLE-12 CORE (FOR SIG.17/37)
SPACE
TAIL CABLE-19 CORE (FOR Pt.59a)
TAIL CABLE-19 CORE (FOR Pt.57a)
TAIL CABLE-19 CORE (FOR Pt.59b)
TAIL CABLE-19 CORE (FOR Pt.57b)
TAIL CABLE-12 CORE (FOR SIG.15/35)
TAIL CABLE-12 CORE (FOR SIG.17/37)
BX-110
NX-110
59b57b TF TF
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWING FOR LOC. BOX
STARTER SIGNALS (L-DSt4) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-JE-II/D&D
N.R.
NO.MT/L-45
SH. NO.4/7
CAD FILE NAME- DSt4-TER-LD-TYP-NR


L- DSt3
141
142
165
166
29 'OFF'
GE
143
144
167
168
29'ON'
GE
145
146
169
170
29'PILOT'
GE
153
154
171
172
31 'OFF'
GE
155
156
173
174
31'ON'
GE
157
158
175
176
31'PILOT'
GE
FROM STATION R/ROOM
L- DSt4
61
62
110
111
15
HGE
63
64
112
113
15
RGE
73
74
141
142
17
DGE
75
76
143
144
17
RGE
67
68
114
115
35
HGE
79
80
145
146
37
HGE
FROM STATION R/ROOM
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
STARTER SIGNAL (L-DSt3&4)
VIKAS MAKHIJA
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.5/7
CAD FILE NAME- DSt4-WD5-TYP-NR


2a
TO 03CT FE
BATTERY CHARGER 03CT
BX-110
NX-110
2l
FROM B/BOX 03CT
CHOKE
2d
TO 59aT FE
BATTERY CHARGER 59aT
2o
FROM B/BOX 59aT
2b
TO 04CT FE
BATTERY CHARGER 04CT
2m
FROM B/BOX 04CT
2c
FROM 59aT RE
59a TR
2e
FROM 59bT RE
59b TR
2g
FROM 57bT RE
57b TR
2k
FROM 02AT RE
02A TR
2j
FROM 01AT RE
01A TR
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
STARTER SIGNAL (L-DSt3) (WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.6/7
CAD FILE NAME- DS14-WD7-TYP-NR


TO STATION R/ROOM
25
26
27
28
51
52
21
22
23
24
01A TR
02A TR
57b TR
59a TR
59b TR
A1
A2
A3
A4
A5
A6
B-24
N-24
2h
TO 57bT FE
2f
TO 59bT FE
CHOKE
BATTERY CHARGER 57bT
BATTERY CHARGER 59bT
BX-110
NX-110
2n
2p
FROM B/BOX 57bT
FROM B/BOX 59bT
DY C.S.T.E./PLG (FOR C.S.T.E.)
E.S.T.E./D&D
A.E.S.T.E./D&D
S.E./D&D
TYPICAL DRAWINGS FOR LOC. BOX
STARTER SIGNAL (L-DSt4)
(WIRING DETAILS)
VIKAS MAKHIJA
CAD BY-SE-D&D
N.R.
NO. MT/L-45
SH. NO.7/7
CAD FILE NAME- DSI4-WD6-TYP-NR

3.2 INSTALLATION

3.2.1 Foundation

(a) The foundation of Location boxes / Apparatus cases single and half shall be cast as per Fig.3.7 and Fig.3.8 respectively. The foundation work should not be done on loose earth. It should be installed on concrete foundation.

(b) As far as possible, location box/apparatus case should be installed perpendicular to the track. Marking of the foundation shall be done at a place where minimum prescribed clearance from track is available when the location box has been installed and doors are open. It should be preferably outside the track and close ahead of the signal post to facilitate maintenance, so that the aspect of the signal can be visible to the maintainer.

(c) Proper curing of the foundation shall be done and adequate setting time shall be permitted before installing the location box / apparatus case on the foundation.

(d) The depth of the foundation below the ground level shall be 50 (fifty) mm minimum and foundation bolt shall invariably be used.

3.2.2 Erection of Location Boxes/Apparatus cases

(a) Adequate protective works shall be done inside the location boxes / apparatus cases before installation in the field. All the fixtures should be fabricated, these fixtures should be painted /polished, the primer should be applied inside and outside the location box after cleaning the surface and one coat of paint should be applied inside the location box. The fixtures should then be assembled. It is preferable to prewire the location box at a central place before installation in field. Second coat of paint inside the box should be done at the time of commissioning.

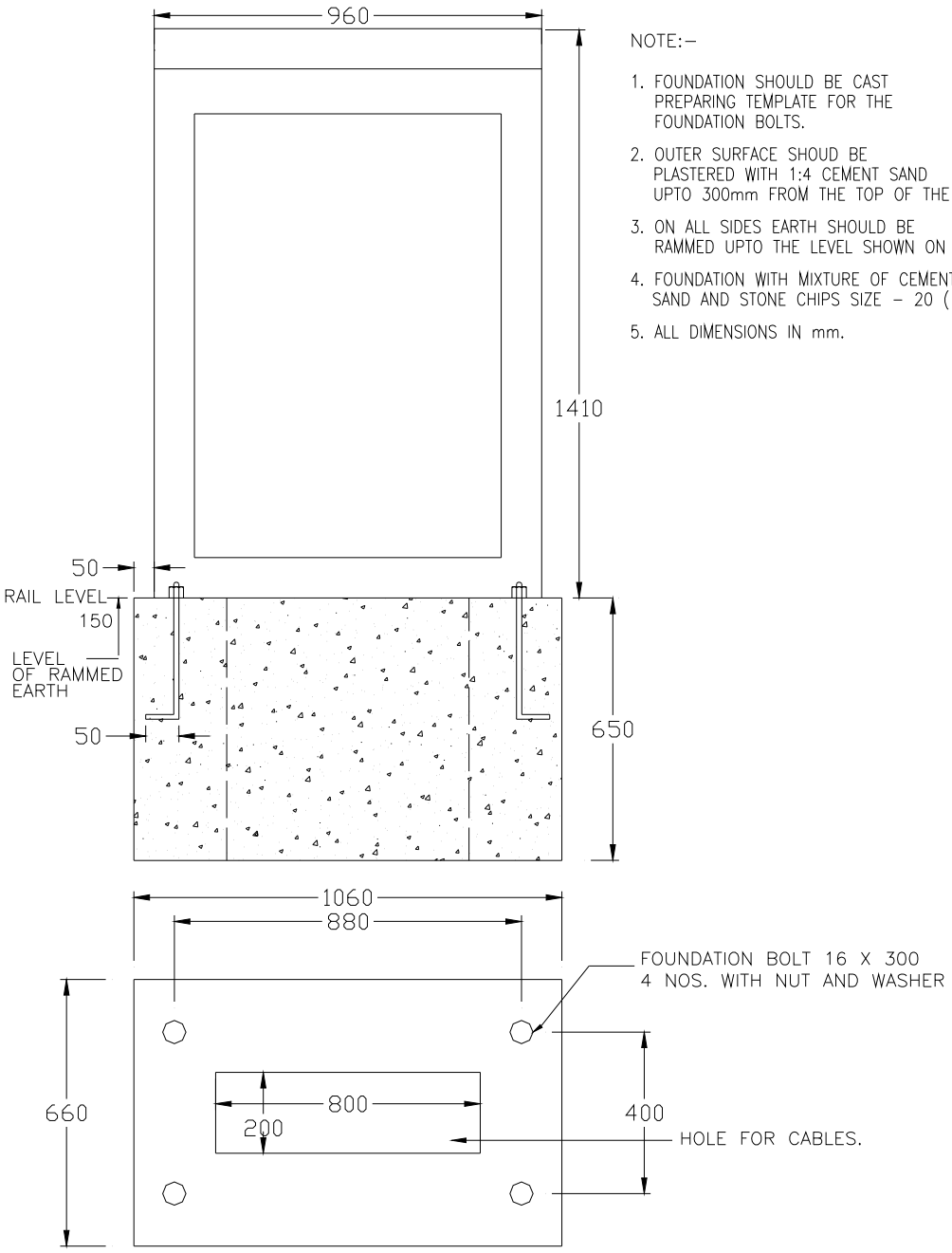
Colour scheme shall be in accordance with Para 19.106, Annexure 29 of SEM Pt.II which is reproduced below.

Electrical signalling equipment shall be painted in accordance with the colour scheme shown for the respective items in Annexure 29.

Item	**Colour Scheme**
The Junction Boxes, Battery Boxes, and Apparatus Cases	
Junction Boxes – Post type	
Inside	White
Outside	White (Aluminium paint shall be used)
Junction Boxes – Ground type and Apparatus Cases:	
Inside	White
Outside	White (Aluminium paint shall be used)
Battery Boxes:	
Inside	White
Outside	White (Aluminium paint shall be used)

(b) Apparatus Cases shall be erected vertical and plumb.

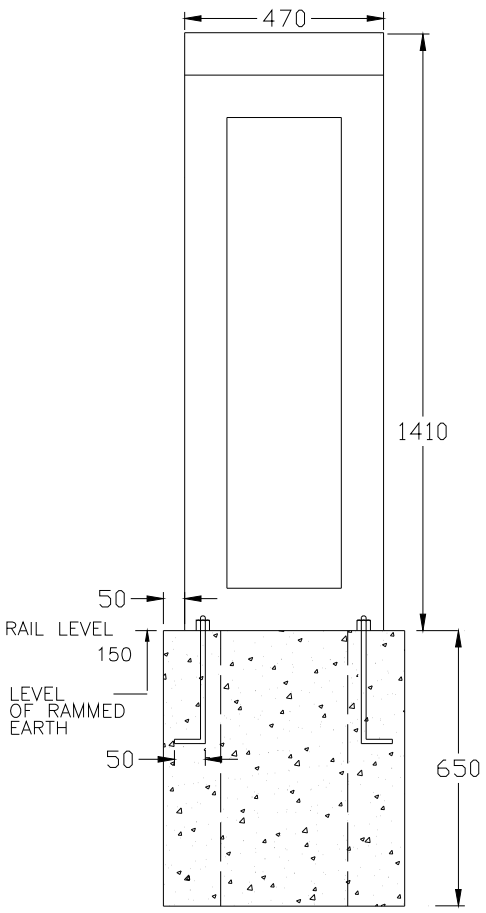
(c) Location Boxes should be installed after applying bitumen at the bottom surface to avoid corrosion. The bitumen compound should be poured over bolts to achieve this purpose.



NOTE:–

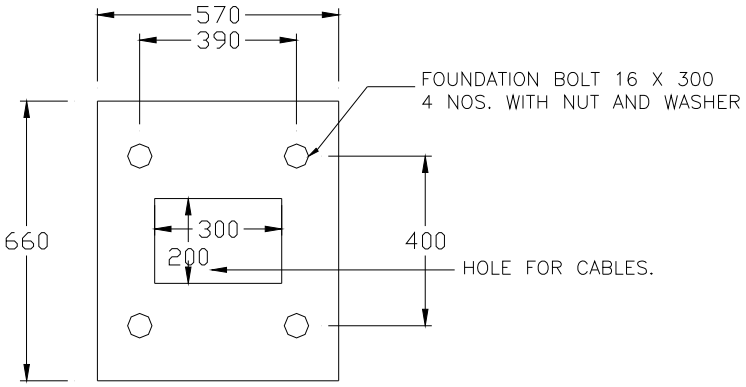
1. FOUNDATION SHOULD BE CAST PREPARING TEMPLATE FOR THE FOUNDATION BOLTS.
2. OUTER SURFACE SHOUD BE PLASTERED WITH 1:4 CEMENT SAND UPTO 300mm FROM THE TOP OF THE SURFACE.
3. ON ALL SIDES EARTH SHOULD BE RAMMED UPTO THE LEVEL SHOWN ON THE SKETCH.
4. FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS SIZE – 20 (1:3:6)
5. ALL DIMENSIONS IN mm.

	DY C.S.T.E/PLG (FOR C.S.T.E.)	FOUNDATION FOR APPARATUS CASE SINGLE	N.R.
	E.S.T.E./D&D		NO. MT/L–45
	A.E.S.T.E./D&D		SH. NO. LB1
	S.E./D&D	VIKAS MAKHIJA CAD BY–JE–II/D&D	CAD FILE NAME– LB1–LD–TYP–NR



NOTE:–

1. FOUNDATION SHOULD BE CAST PREPARING TEMPLATE FOR THE FOUNDATION BOLTS.
2. OUTER SURFACE SHOUD BE PLASTERED WITH 1:4 CEMENT SAND UPTO 300mm FROM THE TOP OF THE SURFACE.
3. ON ALL SIDES EARTH SHOULD BE RAMMED UPTO THE LEVEL SHOWN ON THE SKETCH.
4. FOUNDATION WITH MIXTURE OF CEMENT, SAND AND STONE CHIPS SIZE – 20 (1:3:6)
5. ALL DIMENSIONS IN mm.



	DY C.S.T.E/PLG (FOR C.S.T.E.)	FOUNDATION FOR APPARATUS CASE HALF	N.R.
	E.S.T.E./D&D		NO. MT/L–45
	A.E.S.T.E./D&D		SH. NO. LB2
	S.E./D&D	VIKAS MAKHIJA CAD BY–JE–II/D&D	CAD FILE NAME– LB2–LD–TYP–NR

3.2.3 Inside arrangement

(a) The Bakelite hylum sheet of size as per the drawings shall be fixed on angle iron piece inside the Apparatus Cases for fixing the ARA terminals. The size of the angle iron frame should be 25mm x 25mm x 3mm conforming to Specification no. IS:2062 or similar. Angle iron frame shall be secured by nuts and bolts. Square bars shall be fixed inside the Apparatus Cases for fixing the fuses, relays. The wires shall be connected to the ARA terminals using thimbles and sleeves.

(b) 50mm thick Hylum sheet shall be provided at the bottom in two halves as per Fig. No. 3.9. Holes shall be cut in the Hylum sheet separately for each cable. Armour of the cable shall be opened and jammed after passing the cable through the hole and earthed as per this drawing.

(c) Cable entry points in the location boxes shall be filled with sand and plastered with cement.

(d) Battery for the track circuits or for any other purpose shall be kept in a separate location box. It shall not under any circumstances be kept in the same location box in which charger or relays are kept. Shelf type relays, if provided, shall be with anti-tilting arrangement.

(e) The wires used for internal wiring inside the location boxes shall be of proper size and specifications as specified by CSTE/SEM.

(f) The cables of adequate lengths not less than 5 mts. should be kept in a circle of suitable diameter at 1m depth minimum before being taken into the Apparatus case. The cable loop should preferably be kept at a depth more than 1m.

(g) Description of the terminals shall be written neatly on the hylum board. Drawing of the circuits if required shall be provided on the inside surface of the door of the location boxes on hylum sheet of suitable size.

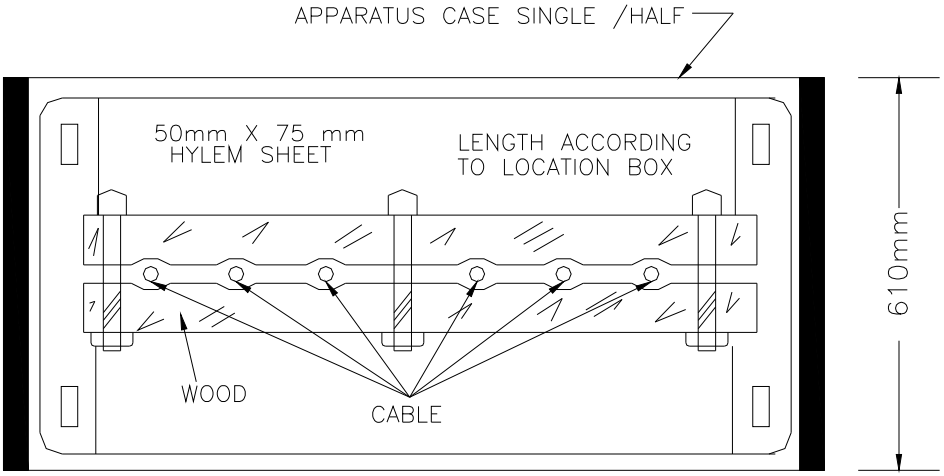
(h) Location Boxes in which cables carrying feed to signals are terminated should be located as close to the signal post as possible.

3.2.4 Earth work around Location Boxes/ Apparatus cases

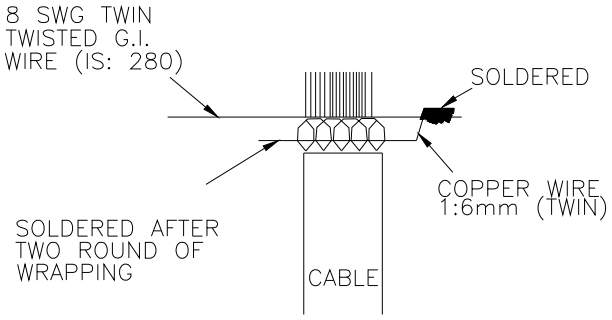
Earth work around location boxes where necessary shall be done as per the relevant drawing enclosed. The earth shall be rammed including breaking of clods, leveling and dressing. The earth work around the location boxes shall be up to the plaster level and for width sufficient for the maintainer to attend the box both from front and back side.

3.2.5 Earthing arrangement

Earthing arrangement of the cable armour shall be done conforming to Section-N, Para no.19.88 to 19.105 of the Signalling Engineering Manual, Part-II.



CABLE HOLDING CLAMP



JAMMING OF ARMOUR OF THE CABLE

	DY C.S.T.E/PLG (FOR C.S.T.E.)	CABLE HOLDING CLAMP AND JAMMING OF ARMOUR OF THE CABLE	N.R.
	E.S.T.E./D&D		NO. MT/L-45
	A.E.S.T.E./D&D		SH. NO. LB3
	S.E./D&D	VIKAS MAKHIJA CAD BY-JE-II/D&D	CAD FILE NAME- LB3-LD-TYP-NR

* * *

CHAPTER- 4: SIGNALLING CABLE: PLANNING & LAYING

4.1 INTRODUCTION

4.1.1 Scope of the Chapter

This chapter covers planning for cable (Quantity & core) and cable route; cable laying including protection, termination of cable.

4.1.2 Cables used in signalling installations

The cables used in signalling installations (out door), RDSO specification and the usage core-wise are given in fig.4.1:

Core & Cross Section	RDSO Specification	Usage
2 Core x 25 Sq.mm	IRS S 63/89 & IS 1554 (Amdt.4)	Power cable
6 Core x 1.5 Sq.mm	IRS S 63/89 (Amdt.5)	Tail Cable
12 Core x 1.5 Sq.mm	IRS S 63/89 (Amdt.5)	Tail Cable/LC Gate cct.
19 Core x 1.5 Sq.mm	IRS S 63/89 (Amdt.5)	Main Cable
24 Core x 1.5 Sq.mm	IRS S 63/89 (Amdt.5)	Main Cable
30 Core x 1.5 Sq.mm	IRS S 63/89 (Amdt.5)	Main Cable
2 Core x 2.5 Sq.mm	IRS S 63/89 (Amdt.5)	Track Cct lead connections

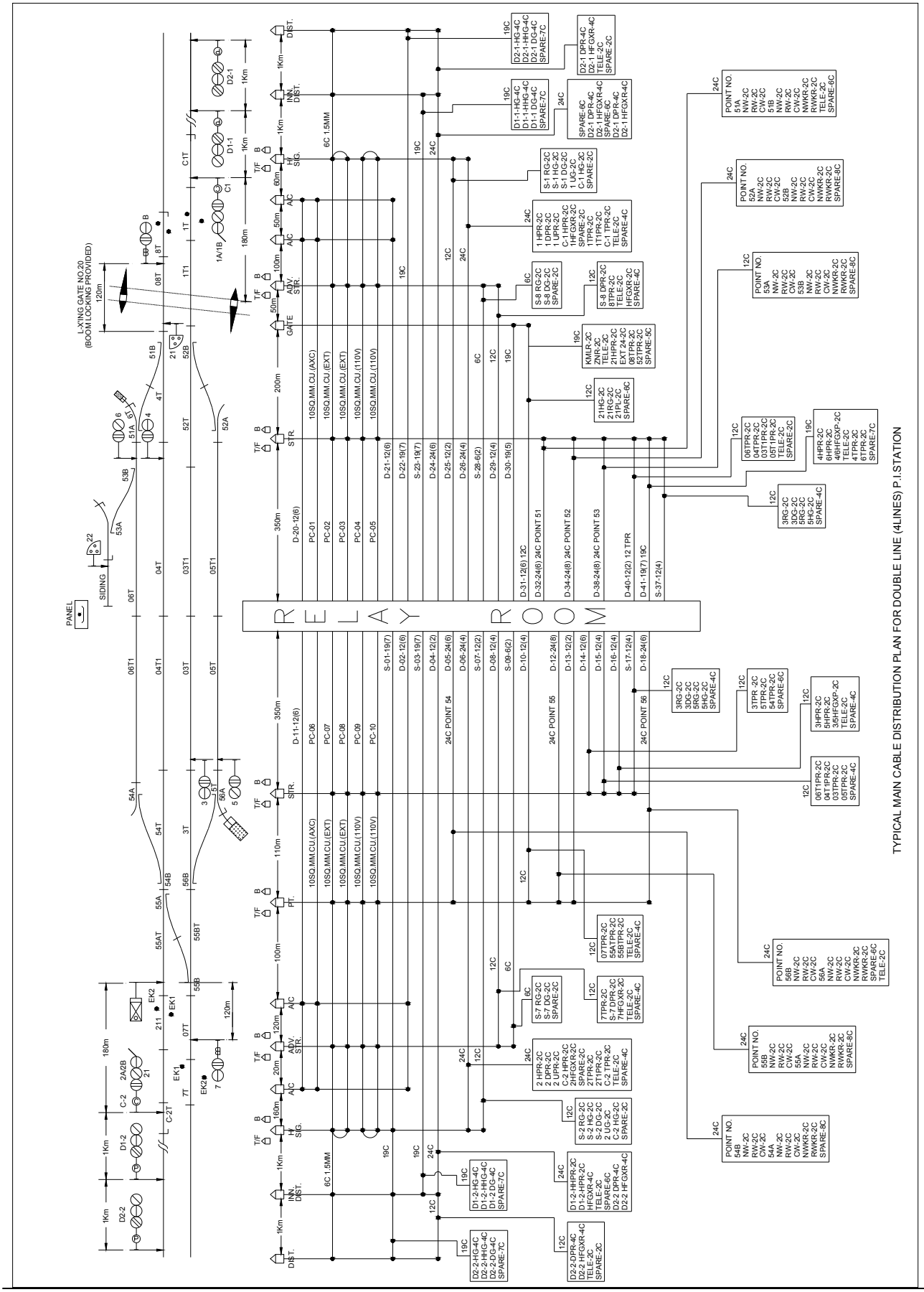
Fig. 4.1 Cable used in Signalling installations

4.2 DETERMINING REQUIREMENT OF CABLE

(a) Requirement of cable conductors is to be determined depending upon the circuits run from CT room/Relay room to function. It is desirable to use separate cable linewise and if necessary; functionwise from relay room/CT room to facilitate easy testing of cable without much disruption of traffic. In this regard, extracts of Para 15.3.3 of SEM Pt.II are reproduced below.

15.3.3 "*Where a number of cables have been laid along a route, the circuits shall be so distributed that cables can be disconnected for maintenance purpose with the least possible dislocation to traffic. Line wise and, if necessary: fuctionwise cable shall be provided. Auxilary signals shall be taken in different cables."*

A typical cable distribution plan is shown in fig.4.2 for information and guidance.


RELAY ROOM
PANEL
SIDING
LXING GATE NO.20
(BOOM LOCKING PROVIDED)
TYPICAL MAIN CABLE DISTRIBUTION PLAN FOR DOUBLE LINE (4LINES) P.I.STATION

(b) Cable size to be determined keeping spare conductors to a minimum of 20% of total conductors used in, each cable working between the outermost facing points of the station and a minimum of 10% of the total conductors used in each cable working beyond the points area and up to outermost signals. In this regard, extracts of Para 15.3.2 of SEM Pt.II are reproduced below:

15.3.2 *"Adequate spare conductors to a minimum of 20% of the total conductors used shall be provided for in each main cable up to the farthest point zone, beyond this there should a minimum of 10% spare conductors of the total conductors used. No spare conductors are required if the total number of conductors used is 3 or less. The spare conductors shall be provided on the outermost layer."*

(c) A cable core distribution plan to be prepared for each installation.

(d) The approximate cable requirement for a typical four line PI station using three pole lamp is shown in fig.4.3 :

Type of cable	Double line	Single line
Signalling Cable 24 Core	9 km	1 km
Signalling Cable 19 Core	10.6 km	2.4 km
Signalling Cable 12 Core	10.5 km	12.7 km
Signalling Cable 6 Core	5.7 km	3.3 km
Power Cable 10 Sq. mm	8.6 km	7.7 km

Fig.4.3 Approximate Cable Requirement for a Typical Four line Station

(e) Numbering of cable to be done in ascending order from right hand Side of the cable core distribution plan.

(f) Style of numbering should be indicated with specific information, as for example-

0112(4) - 1st two digits '01' indicate the cable no.;

Next two digits '12' indicate 12 core cable;

4 in bracket indicate, number of spare conductor.

All the cores of the cable should be numbered with plastics markers.

These markers should generally tally with the terminal numbers.

(g) Number of location boxes should be kept minimum and shall be as per typical cable distribution plan enclosed. For a typical four line station with double distant signal the number of location boxes required are 32 approximate.

(h) It is preferable to install masonry or pre-fabricated goomty (approx. size 10'ft.x10'ft) at 500 m on both side of PI building for maintenance ease and reduction in location boxes.

(i) All cable core shall be terminated on ARA terminal in location boxes. In relay room/CT room, cable core shall be terminated on "ARA or other approved Type" termination (Disconnection type preferable).

(j) Cable should be laid in split DWC/RCC pipe or in a pre-casted duct from Home Signal to Home Signal and DWC/GI pipe on track and road crossings.

(k) Provisions of SEM Pt.II Para 22.4.1 to 22.4.4 regarding cables are reproduced below:

22.4.1 *"Only unscreened cable shall be used."*

22.4.2 *"Screened signalling cable may be used on signalling installations where screened cable is already in use and site condition demand its further use."*

22.4.3 *"PVC insulated PVC sheathed and armoured unscreened cable to an approved specification (IRS-63) shall be used for carrying signalling circuits. Only approved type (IS-1554) power cable shall be used for signalling purposes."*

22.4.4 *"The screened cable, if used, shall be PVC insulated, armoured and to an approved specification IRS S-35."*

4.3 CABLE ROUTE PLAN

(a) Foot by foot survey to be done along the track to determine best possible cable routes. Cable route plan is to be prepared showing the actual alignment of track giving offsets from P/Way and permanent structure. Diagram should include road and track crossing, crossing with power cables, water & sewage main and other points of importance.

(b) Cable route plan thus prepared should also be approved by Engineering & Electrical department.

(c) Clearance from Maintenance wing of S&T to be obtained for cable route plan when alteration works/new works are taken up on existing installations/in the vicinity of existing installations.

(d) Cable Marker in regular interval shall be provided to identity the route.

4.4 CABLE LAYING

4.4.1 Cable laying in station section and beyond

(a) Cables should be laid underground, either directly in the trench, in ducts, in cement troughs or in pipes.

(b) Provisions of SEM Pt.11 Para 22.4.5 to 22.4.9 regarding cable laying are reproduced below:

22.4.5 *"The cable shall be so laid that it is not less than one meter from the nearest edge of the mast supporting the catenary or any other live conductor, provided the depth of the cable does not exceed 0.5 meters. When the cable is laid at a depth greater than 0.5 meters, a minimum distance of 3 meters between the cable and the nearest edge of the O.H.E structure shall be maintained. If it is difficult to maintain these distances, the cable shall be laid in concrete/heavy duty HDPE/Ducts or any other approved means for a distance of 3 meters on either side of the Mast. When so laid. the distance between the cable and the mast may be reduced to 0.5 meters. These precautions are necessary to avoid damage to the cable in the event of the failure of an overhead insulator.*

22.4.6 *"In the vicinity of traction sub-stations and feeding posts, the cable shall be at least one meter away from any metallic part of the O.H.E. and other equipment at the sub-station, which is fixed on the ground, and at lest one meter away from the sub-station earthing. In addition, the cable shall be laid in concrete or heavy -duty HDPE pipes /Split RCC pipes or other approved means for a length of 300 meters on either side of the feeding point. As far as possible, the cable shall be laid on the side of the track opposite to the feeding post."*

22.4.7 *"In the vicinity of the switching stations, the cable shall be laid at least one meter away from any metallic body of the station, which is fixed in the ground, and at least 5 meters away from the station Earthing. The distance of 5 meters can be reduced to one meter provided the cables are laid in concrete pipes/heavy-duty HDPE pipes /ducts or any other approved means. "*

22.4.8 *"Where an independent Earth is provided for an OHE structure, i.e. where the mast is connected to a separate Earth instead of being connected to the rail, the cables shall be laid at least one meter away from the Earth."*

22.4.9 *"Where there are O.H.E structures along the cable route, the cable trenches shall as far as possible, be dug not less than 5.5 meters away from the center of the Track."*

(c) Main signal cable from relay room/CT room to Home Signal on either side shall be laid inside 6" dia split DWC/RCC pipe at 1 m depth or in pre-casted duct. Laying in split pipe will reduce chances of cable damages due to outsider digging trenches in cable area. The RCC pipe have the required strength to withstand impact etc but it has no flexibility while laying in trenches which have some up or down in trench bed and lateral curves in trenches. Further, in long run due to soil settlement RCC pipe tends to develop cracks. DWC pipe have flexibility, longer life, light in weight and possess required mechanical strengths. Till RDSO issues specifications and list of approved firms, the supply of DWC pipe shall be taken as per specification given in Para 4.5 to ensure good quality. The approximate requirement of split pipe of 6" dia would be about 1.5 km per station.

(d) There must be holes on the bottom of the split pipe for draining away water that may collect.

(e) Protection of Cable at track crossing and road crossing.

(i) The track crossing, road crossing by main signal cables & tail cables shall be done through GI/DWC-HDPE pipe of 50 mm dia/75 mm dia at the depth of 1 meter below Rail flange (Para 15.12 SEM Pt.II). This depth shall be ensure to avoid cable cuts for various reasons. Cable in GI/DWC – HDPE pipe should crosses the track or road at right angle. It should not cross the track under points & crossings. Extreme care should be taken to ensure that outer PVC insulation and armouring of cable shall not get damaged while taking through pipes.

(ii) GI pipes should not be used as these damage the cable as these pipes are heavy and their joints open with vibration including breakage due to corrosion. Vibrations at such open joints hit and damage the cable.

(iii) All tail cables specially jumper cables for track circuit connection point operation & detection etc. should be protected by DWC pipes invariably.

(iv) DWC pipe should be suitable for signalling cable buried underground, non-metallic, corrugated double walled, normal / light duty, rigid/pliable with protection against chemical attack, anti-rodent and non-flame propagating type.

(f) Cable shall be laid at depth of 1 m parallel to the track, for cables laid between Home Signal and at 1 m below rail flange while track crossing and at 1.2 m depth for cables laid beyond Home Signals and Automatic Signal area, IBH & Level crossing gates.

(g) For Safety of track, cable should be laid at 5.5. m from centre of nearest track in area outside station limit and 3 m from centre of nearest track within station limit.

(h) The width of the cable trench shall normally be 0.5 metre. A layer of shifted earth or sand or 0.075 m (3") shall be spread over the ground before laying the cables. Also, cables shall be covered with shifted earth or sand of 0.075 m (3") thickness.

(i) Cable should be laid with ends having been sealed to avoid water entering through bare end and damaging the cables.

(j) Laying the cables in ducts:

(i) In big yard, the cables may be laid in RCC ducts or brick channels with removable top cover.

(ii) The location of cable duct should be such that due to derailment there is no possibility of damage of cable inside the duct.

(iii) The area should not be a theft prone area.

(iv) There must be holes on the bottom of the duct for draining away water that may collect.

(v) The ducts shall have suitable cover.

(vi) Use of concrete cable ducts from home to home will give ample protection and scope for subsequent additions and removal of cables. Use of concrete ducts should be invariably used for cabling in platform areas.

4.4.2 Laying different cables in the same trench

(a) Different cables in same trench can be laid in the following order from the main trackside, to facilitate recognition of cable in urgency.

(i) Derivation cable for axle counter.

(ii) Signalling cables.

(iii) L.T. Power cable (less than 60 volts, if necessary)

(b) Power cables laid with other cables should be separated by brick continuously placed vertically lengthwise.

(c) Power cables of Electrical department & Telecom Cables of BSNL etc must not be laid in the same trench along with signalling cables.

(d) 2nd Class brick should be used wherever required.

4.4.3 Paying out the cables

(a) Cable drum shall be mounted on cable wheel.

(b) Wheel to be brought to one end of the trench.

(c) End of the cable freed and laid in trench;

(d) The cable wheel shall then be drawn along the road or track.

(e) A party of labour follow the drum and guide the cable from the road into the trench carefully.

(f) In no case, shall the drum be rolled off on to the road for laying the cable and the cable dragged on the ground for laying purpose.

(g) Ensure no kink is formed while paying out the cable.

(h) Cable shall not be unfolded from the drum by keeping the cable drum flat on the ground and twisting the cables.

4.4.4 Cable laying on culverts & bridges

(a) Cable laid along culverts shall be suitably protected and supported.

(b) Cable shall be taken on the culvert, through a G.I. pipe not less than 2 " dia.

(c) The entry and exit ends of the cable from the pipe to the diversion point of the cable shall be laid in concrete duct.

(d) Cable laid along a metallic bridge should be placed inside a metallic trough which may be filled, as an anti theft measure, with sealing compound.

(e) Should be protected in a manner, which would involve minimum vibration and facilitate maintenance work.

(f) Extra length of 6 m to be kept at each end in the form of coil.

4.4.5 Laying Cable in solid and rocky soil

If the terrain is hard rocky, normal dimensions of the trench cannot be ensured. In such cases a chase of 255 mm depth and 150 mm width is to be cut on rocky soil. Sharp edges on the sides must be smoothened out and bottom of the chase should be leveled and the cable laid in sand or soft earth which should be filled and pressed down upto the step. A row of bricks should then be placed lengthwise on the top and jointed with cement mortar and a layer of concrete with cement plaster should be provided on the top of the same.

4.4.6 Cables leading to cabin/station building/Relay room/Goomties

(a) In the Cabin/Relay room/Goomty/Location hut, the entry point of cable from outdoor should be protected by masonry and plasterto-guard.

(b) The area enclosing the base of cables should be filled up with layer of sand in addition a thin layer of cement plaster with good top finish should be provided.

4.4.7 Jumper cables for track circuits

There are numerous instances of jumper cable cut due to Engg. Staff working. Such instances can be minimized if jumper cable is tied with the nearest sleeper. This should be done on wooden sleepers using iron clamps/hooks. On PSC sleepers jumper cable shall be tied using Track Circuit bonding kit using clamp, resin & hardener. A typical drawing for track jumper and continuity bond connection by Exothermic Welding is shown in figure 4.4(a) & 4.4(b) for information and guidance. Where sleeper ends, cable shall be buried under ground in the line of sleeper and taken to TLJB.

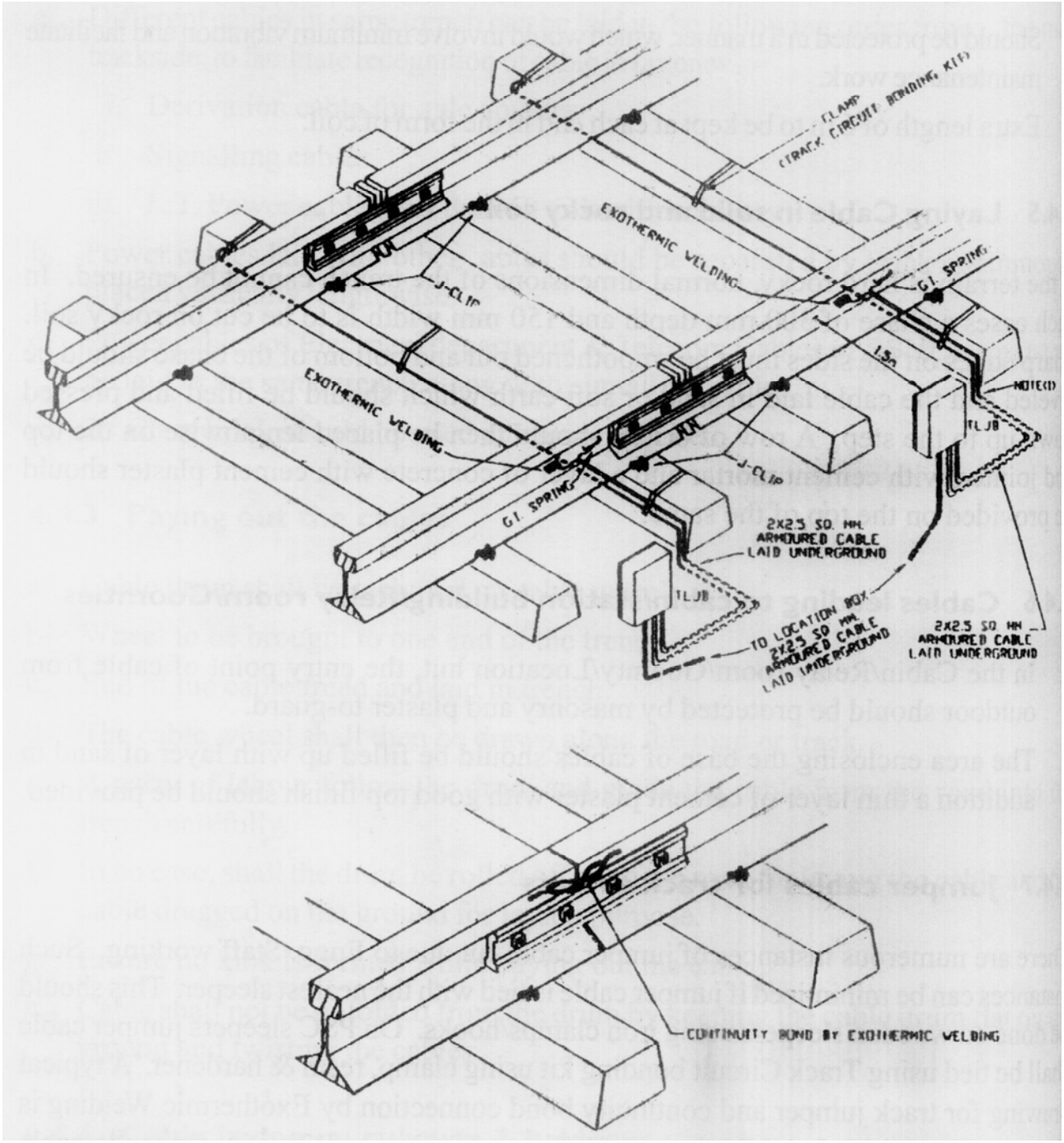


Fig: 4.4 (a) & 4.4 (b)

NOTE: 1. Jumper should be laid neatly in squared manner as shown and should not be kept in loose coil above the ground.

2. Jumper cable should be laid at least 0.5 m below ground level excluding ballast depth.

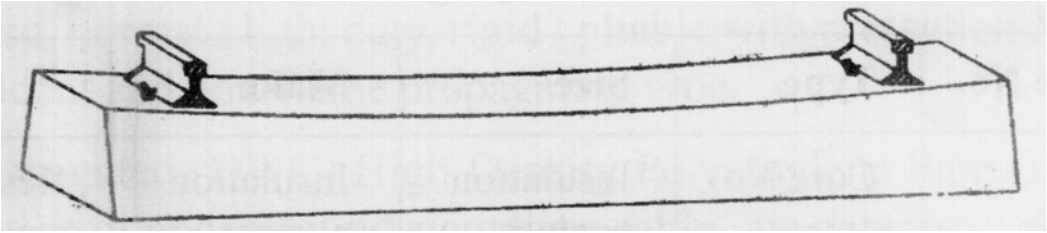
3. Top surface of TLJB should not be 1 feet above rail level.

Track jumper & continuity bond connection by exothermic welding.

TRACK CIRCUITING BONDING KIT FOR FIXING CONCRETE SLEEPER INSTRUCTION SHEET

SURFACE PREPERATION

1

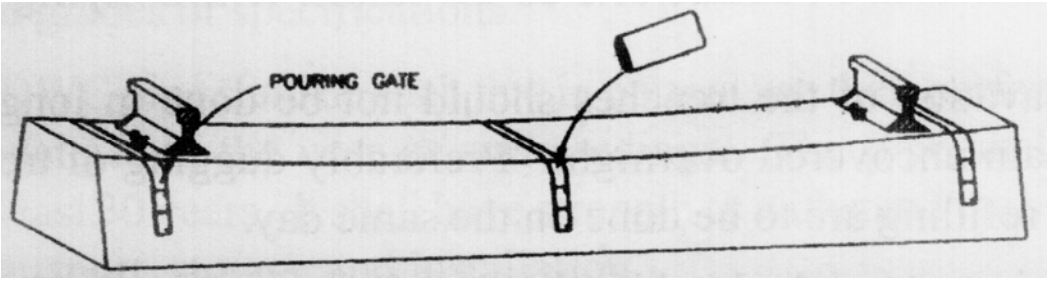


Chisel on the concrete sleeper for proper adhesion

2

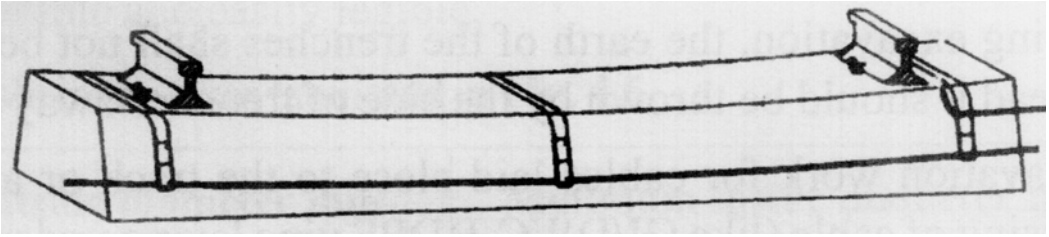
Mix track seal resin with hardner and stir thoroughly and wait for 4 to 5 minutes for compound to become warm.

3



Fix clamp on the concrete sleeper and pour the track seal compound from the pouring gate and hold it tight with distances on the concrete sleeper

4



Press the track lead wire through the holes

5 PROPERTY OF TRACK SEAL COMPOUND

1. Tensile strength : 175 Kg/cm^2
2. Flexural strength : 348 Kg/cm^2
3. Compression strength : 475 Kg/cm^2
4. Pot life : 10 min

4.4.8 Testing of cables before laying

(a) Visual inspection.

(b) Insulation test.

(c) Continuity test.

(d) Bedding & armouring shall also be inspected to see that there has been no damage during transit or in storage.

(e) Insulation measurement should be done before cable is unwound from the drum by removing the end seals.

(f) A cable register should be opened station and test results on cable insulation should be recorded after cable laying in the format of fig.4.5

Cable No.	**Type**	**Size**	**Make**	**Date of installation**	
Date of Test	Core No.	Insulation against earth	Insulation against conductor	Result of continuity Test	Remarks

Fig. 4.5 Record of Cable Insulation Test

4.4.9 General Precautions to be taken while laying cable

(a) Excavation of the trenches should not be done in long lengths and does not remain uncovered overnight. Preferably dugging of trenches, laying of cable and refilling are to be done on the same day.

(b) Shoring materials should be kept ready in hand for shoring the bank where ashes or loose materials are encountered.

(c) Back filling of the trenches should be done properly, rammed and consolidated.

(d) During excavation, the earth of the trenches shall not be thrown on the ballast instead it should be thrown by the side of trenches away from the track.

(e) Excavation work for cables laid close to the track or arrangements for track crossing of cable (like GI/DWC-HDPE pipe laying under track) should be done only just before laying the cables in the presence of an official from Engineering Department. Caution order, messages may be issued wherever necessary.

(f) The work shall be personally supervised by an S&T official not below the rank of JE-II.

(g) Extreme care should be taken to ensure that outer PVC insulation and armouring shall not be damaged while taking through pipes.

(h) All materials used for cable laying and terminations shall be of RDSO/IS specifications and from RDSO approved manufacturers.

4.5 PROTECTION OF CABLE

4.5.1 Double Wall Corrugated (DWC) pipes of HDPE for underground Signalling Cable protection

4.5.1.1 Description of DWC HDPE Pipe

DWC pipe should be suitable for signalling cable buried underground, non-metallic; corrugated double walled, normal / light duty, rigid / pliable with protection against chemical attack, anti-rodent and non-flame propagating type.

The Double Wall Corrugated (DWC) High Density Polyethylene Pipe (HDPE) shall be used for protection of underground signalling cable. Its outer wall shall be corrugated in longitudinal direction imparting high ring stiffness to the pipe. The stiffness should be such that it can withstand high degree of impacts caused by train movement. The inner wall shall be plain with solid permanent lubricant for easy insertion of cables. It shall have anti rodent property.

The DWC Pipe shall confirm to IS:14930 (Pt.I&II). The material of HDPE shall also confirm to approved grades or specifications.

The material used for DWC pipe shall be such that in normal use their performance is reliable and without danger to the user or surroundings. The pipe shall have normal service life of at least 30 years. It shall have strength to withstand the stresses likely to occur during transport, storage and installation.

The DWC Pipe shall be marked at eve4ry 1 mtr length in such a way that manufacturers name, Vendors name and year of manufacturer can be easily identified. The marking shall be durable and easily legible.

The DWC Pipe is available in the sizes tabulated in fig.4.6

Nominal size	Outside diameter mm	Minimum inside diameter mm
50	50	37
75	75	63
90	90	75
120	120	100
150	150	130

Fig. 4.6 Sizes of DWC-HDPE Pipe

4.5.1.2 Construction of DWC-HDPE Pipe

Within Conduit System there shall be no sharp edges, burrs or surface projections, which are likely to damage cables or inflict injury to the installer or user.

The material used in manufacture of DWC Pipes shall contain UV stabilizer of approved type and shall be minimum of 0.15.

The anti rodent & anti oxidant used shall be physiologically harmless.

4.5.1.3 Mechanical properties of DWC Pipes

Compression strength – The deflection of owe pipe should be less than 5%, when compressed withy applied force of 450 N. Also no crack should develop during this test. Test as per IS 14930 Pt.2.

Impact strength – A 5 kg striker load falling freely on owe pipe shall not crack or split the owe pipe when falls from a height of 300mm for pipe upto 60 mm dia, 400mm for pipes 61-90mm dia & from 570mm for pipes 91-140.

Bending strength – With DWC Pipe bent by 90 degrees, the sample ball should pass through the pipe without any hindrance. Test as per IS 14930 Pt.2.

Thermal Properties – Resistance to Flame Propagation: The DWC pipe shall have adequate resistance to flame propagation. On removing the sources of flame the fire should extinguish. Test as per IS 14930 Pt.2.

External Influences – DWC Pipe shall have Protection against ingress of dust and water when tested as per approved test methods. Test as per IS 14930 Pt.2.

Rodent Repellant Properties – The resistance to rodent bites at least 10 nos. shall not cause any crack or splitting of pipe. This shall be tested in approved lab like CAZRI, Jodhpur.

4.5.1.4 Quality Requirement

The manufacturer shall be certified under ISO9001 and shall submit copy of certificate.

The manufacturer shall submit source of raw materials used with content proportion in DWC Pipe of approx. 100 Mtr lengths. Based on above raw materials used, manufacturer shall submit Mechanical properties of DWC pipe tested by Govt. approved authorized laboratories. Any change in raw material sources and content proportion not permitted, thereafter.

The normal life of DWC Pipe under normal use shall be 30 years. A test report in support shall be submitted.

4.5.1.5 Test

The following shall constitute the type tests:

(a) Dimensions

(b) Construction

(c) Mechanical Properties

(d) Quality criteria

4.6 CABLE TERMINATION

Termination of signalling cable on CT rack in relay room and in location boxes shall be done as per drawing shown in Fig.4.7. Marking on cable and on conductors/ARA terminals shall be done as detailed in the Drawing. This will enable easy identification of conductors in case of any failures or cable disconnections or cable cut done by outsider/miscreants. A proper marking and termination practice ensures quick easy restoration during failures.

* * *

CHAPTER - 5: IRS TYPE POINT MACHINE

5.1 SCOPE OF THE CHAPTER

This chapter covers the installation, adjustment, testing and maintenance procedure of IRS type point machine with 143 mm stroke fitted to point layouts with wooden sleepers as per RDSO Drg. No. RDSO/S 3262-63 and PSC sleepers with curved switches as per RDSO Drg. No. RDSO/S 3361-62. The machine can also be fixed to double slip layout RDSO/S 3541-42-43. The IRS Type point machine with 220 mm stroke is to be used with clamp lock arrangement as per RDSO Drg. No. RDSO/S 3454-55 for 60 KG & 52 KG respectively with PSC sleepers, Where PRC sleepers are provided the arrangement shown in RDSO Drg. No. RDSO/S 3465 for both 60 KG & 52 KG to be used. Clamp locks for 52 KG should be as per RDSO Drg. No. RDSO/S 3376 which is sub-assembly Drg. of RDSO/S-3455.

(RDSO Drawing No.3465-66 to followed for installing 200 mm throw point machines without point clamp lock for 60 KG and 52 KG turn-outs respectively).

Reliability of IRS type point machine working can be ensured by complying with the following:

(a) P.Way provisions in the point layout are made to the required standards and the parameters are within permissible limits

(b) Proper installation of point machine and ground connections and other fittings

(c) Correct initial adjustment

(d) Wiring and electrical connections as per approved drawing

(e) Testing for proper functioning of point machine

(f) Proper maintenance as per schedule

5.2 CHECKING COMPLIANCE OF P.WAY REQUIREMENT BEFORE INSTALLATION OF POINT MACHINE

(a) Any new point layout shall conform to the provisions pertaining to Engineering as enumerated in SEM para 12.40 and (Annexure –5), reproduced below:

Before the interlocking work at points is undertaken, it must be ensured that the JE/SE (P-Way) has:

(i) Brought the track to correct level and alignment

(ii) Fully ballasted and packed all points which are to be interlocked and taken adequate measures to prevent lateral and longitudinal movement of points

(iii) Provided creep and level pillars

(iv) Arranged the sleepers on adjacent tracks in alignment, where rods and wires have to cross

(v) Seen that the gauge is correct

(vi) Provided and fixed special timbers as required

(vii) Provided means to prevent creep in the vicinity of points

(viii) Fitted gauge tie plates correctly

(ix) Made the stretchers of such a length so that the throw of switches is as per approved drawings.

(x) Adjusted loose heel switches so that:-

– They can be thrown both ways with ease and can be housed against the stock rail by hand and remain there when the pressure is removed

– The planed surface of the switch rail fully houses against the stock rail as per approved drawings.

(xi) Adjusted fixed heel switches to that:-

– They normally lie in the mid-position and flex equally in the normal and reverse positions

– The planed surface of the switch rails fully houses against the stock rails as per approved drawings.

(xii) Fitted flexible stretchers so that they flex equally in the normal and reverse positions

(xiii) Provided a stop for the open position of a single switch layout

(b) Initial track gauge measured at 15 mm behind the actual toe of the switch towards SRJ shall be within the limits of nominal track gauge.

(c) Initial opening of the Switch rail at the toe shall be ensured within limits of 115 mm ± 3 mm on BG and 100 mm ± 3 mm on MG.

(d) As per standard layout two long sleepers, either wooden or PSC shall be provided, for point machine mounting.

(e) Both long sleepers are to be fixed on equal horizontal level and are to be spaced to suit point machine fixing without any off- set in ground connections.

(f) Extended gauge Tie plate duly insulated shall be fixed on the first long sleeper i.e., on the toe sleeper.

(g) Leading stretcher bar / Antiraising bar shall be provided connecting both switch rails at the proper position for the requisite opening of switch rail for both Normal and Reverse setting of points leaving 1.5 mm to 3 mm gap below the bottom of the rail

(h) Following stretcher bars shall also be provided as per P.W. drawing to meet provisions of P.Way standards.

(i) Points shall be checked for proper housing of switch rail with stock rail for not less than 5 sleepers on both Normal & Reverse settings.

(j) Adequate ballast shall be provided and well packed for proper working of point machine, especially under/surrounding the long sleepers.

(k) All the wooden sleepers on which the point machines is installed shall be strapped on both sides with 50 mm x 20 mm MS strap. Necessary holes 21.5 mm dia. shall be drilled on the strap and 20 mm dia bolts and nuts shall be used for fixing to the sleepers.

5.3 INSTALLATION & INITIAL ADJUSTMENT

(a) Keep all necessary tools and meters as indicated below for installing the point machine.

(i) Spanner Set

(ii) 32 mm (1 ¼") single end spanner

(iii) Adjustable pipe wrench

(iv) Screw Driver

(v) Hammer

(vi) Tommy Bar

(vii) Measuring Tape

(viii) Test Gauge

(ix) Cutting pliers

(x) Wire Cutter

(xi) Insulation peeler

(xii) DC Ammeter with centre `0' in case of Analog (0- 30 Amp)

(xiii) DC Volt meter (0-250 V)

(xiv) Track shunt resistance

(b) IRS Point machine is to be installed with ground connections as per standard layout drawing on two long sleepers, either Wooden or PSC sleepers as per the instructions given under SEM para 19.34 to 19.37.

(c) Point machine can be fixed on the left hand side or Right Hand side of the Point layout and can be used for BG and MG with respective ground connections.

(d) Marking of Point machine mounting holes is to be taken from the gauge face of adjacent stock rail by keeping 1050 mm away as shown in the standard layout.

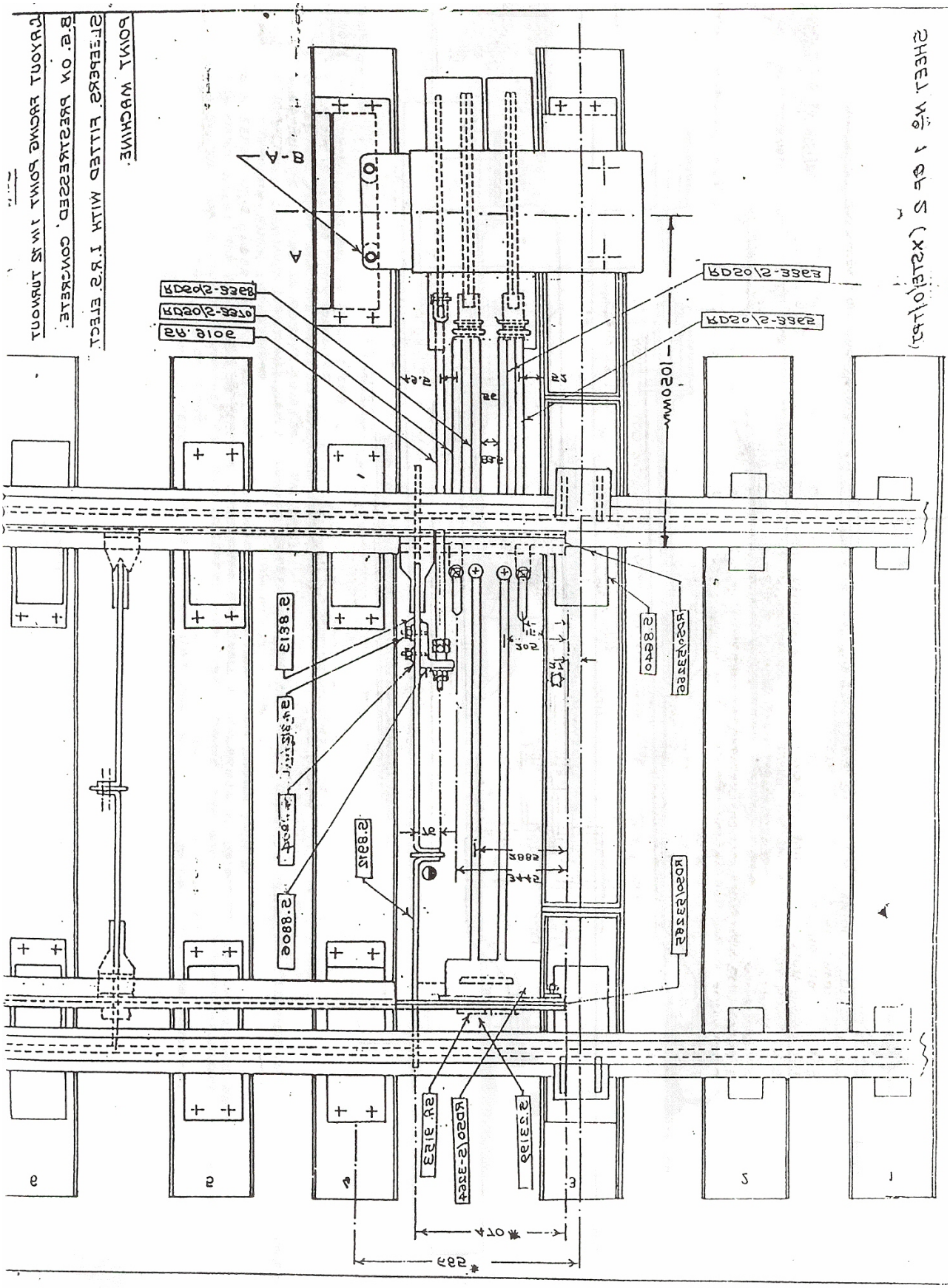
(e) Fixing of Point machine shall be done using proper size of Hexagonal bolts, Nuts and spring washers making correct size of holes through long sleepers to avoid lateral/longitudinal play on extended gauge-tie plate.

(f) Initially, Point switches can be kept center of requisite opening and the driving rod can be connected to the lug on the leading stretcher bar duly cranking the point machine to centre position.

(g) Point machine shall be cranked and throw rod nuts can be adjusted for Normal and reverse setting for proper housing of switch rails with the stock rails with adequate spring on switches.

(h) Then detection rods can be connected to the point machine with switch brackets. All the ground connection rods shall be as far as possible straight and level and clear from the bottom of the rail (minimum 25 mm and 40 mm in case of RE area).

(i) Fine adjustment of detector shall be done in such away that the roller falls inside the notches, only when the point is fully set and housed and simultaneously control disc with friction clutch drum completes its rotation to ensure that point is locked. It should also be ensured that the lock and detection slides are connected such that the detector rollers fall in short notch for close switch and long notch for open switch detection.



(j) Connect lock slides to the 'D' brackets, through lock rods and adjust them such that the locking segment can enter the notches only when the point is correctly set. Test that locking segment does not get the notch of locking slide when 5mm obstruction test piece is placed at 150mm from the toe of the closed switch.

(k) Check for tightness of all bolts and nuts, Check nuts with spring washer & split pins opened and again testing can be done for correct and fine adjustment, several times using Crank Handle.

(l) Ensure provision of insulation for

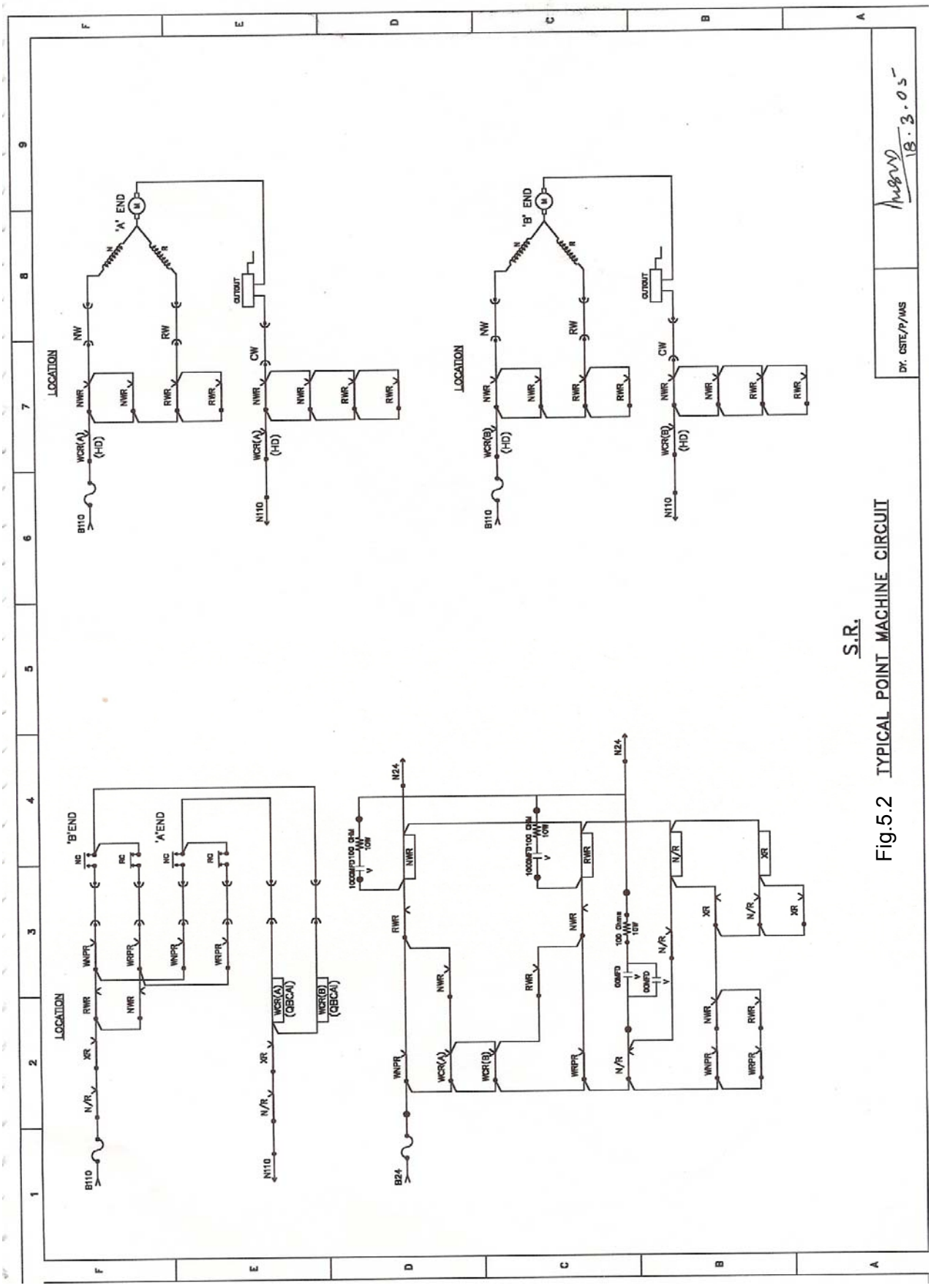
(i)	D bracket bush	–	S 23199	4 Nos. per sheet
(ii)	D bracket washer	–	S 8640	2 Nos. per sheet
(iii)	D bracket side plate – LH	–	S 3266	1 Nos. per sheet
(iv)	D bracket side plate – RH	–	S 3265	1 Nos. per sheet
(v)	Splice plate for insulated stretchers	–	T 10367	1 Nos. per sheet
(vi)	Bush for insulated stretchers	–	T 10368	2 Nos. per sheet
(vii)	L bracket insulating plate	–	S 8804	1 Nos. per sheet
(viii)	Bush insulating for stretcher bar	–	S 8813	2 Nos. per sheet
(ix)	Gauge Tie Plate Insulating Plate	–	T 10372/Alt.1	1 Nos. per sheet
(x)	Gauge Tie Plate Insulating Bush	–	T 10368/Alt.1	3 Nos. per sheet
(xi)	Gauge Tie Plate Insulating Washer	–	T 10371	6 Nos. per sheet
(xii)	Stretcher bar insulating washer	–	T 10371	4 Nos. per sheet

(m) Point machine control, operation and detection wiring shall be done inside the location box or relay hut as per approved circuit diagram.

(n) (i) Power for operation of point machine is extended from the nearest location box through PVC insulated Aluminum conductor cable of 3 core x 10 sq mm or equivalent copper cable (for 110 V DC operation of point machines) and PVC insulated copper conductor of 19C x 1.5 sq mm (for detection circuit) to the adjacent cable termination box as shown in fig. Practices of cable and conductor allocation in vogue on Railways should be used. Where heavy duty contactors of Andrew Yule make or similar contactors are provided with DC 110 V operation, they should be taken through a separate cable of 8 core proving NCR / RCR contacts and for detection circuit 12 core cable to be used. Where QBCA1 Relays are provided as heavy duty contactor relays (instead of Andrew-Yule relays), the supply for QBCA1 relays being 24 V DC, can be taken in the same cables along with detection circuits from location box to Point-CTB.

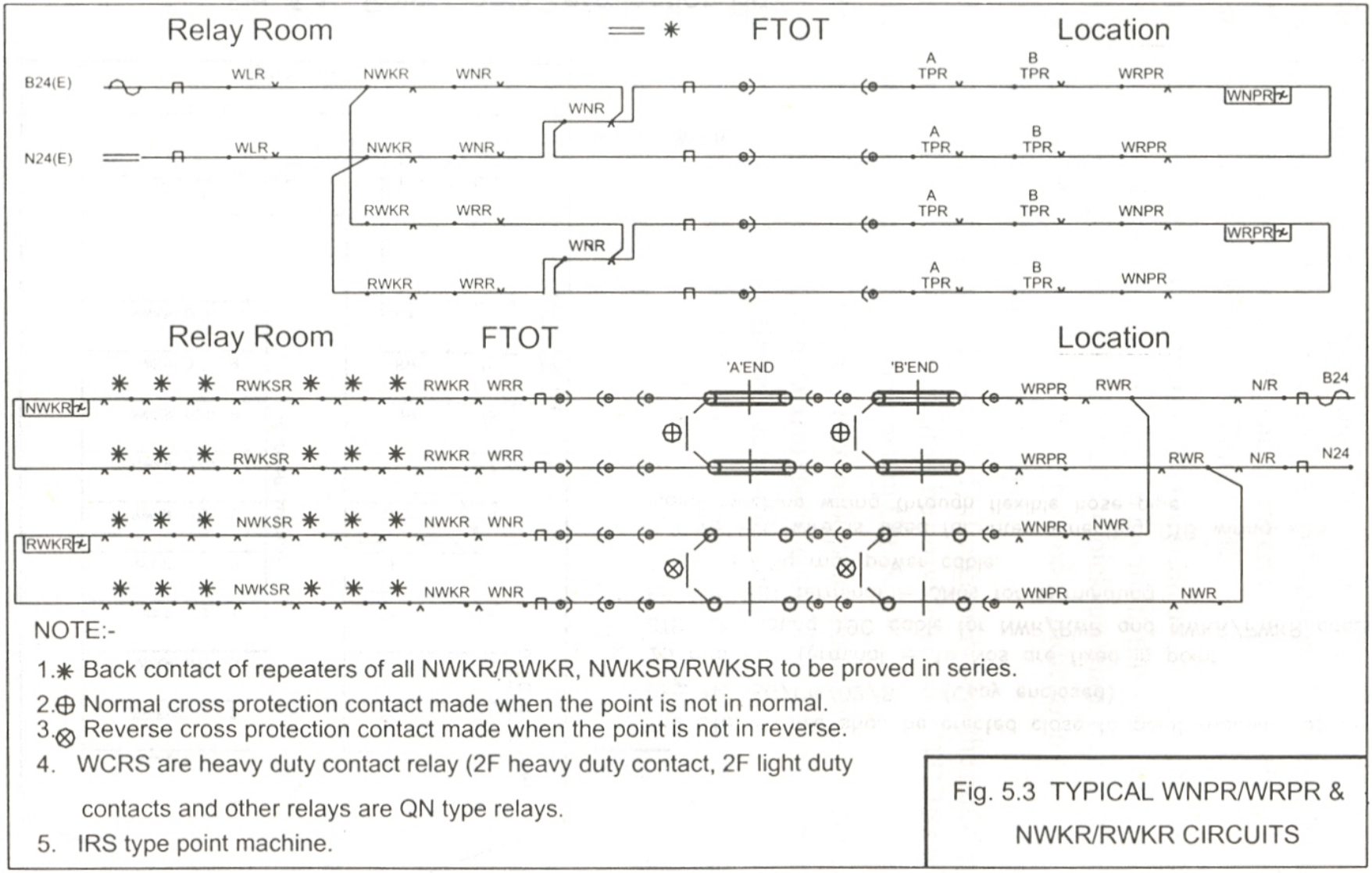
(ii) Normal position of WLR is in energized condition on some of the Railways. In order to avoid local operation of point from location, this relay should be made normally de-energized and should be made to pick-up when points are initiated. Accordingly, WLR back contact is to be proved in indication circuit, bridged with front contact of point initiation relay.

(o) Point CT Boxes/JBs to be installed clear of infringement near the point machines wherever provided. Telephone circuits to be provided up to CTB/JBs wherever feasible. Foundation for CT Box is as shown in Fig.5.5.



S.R.

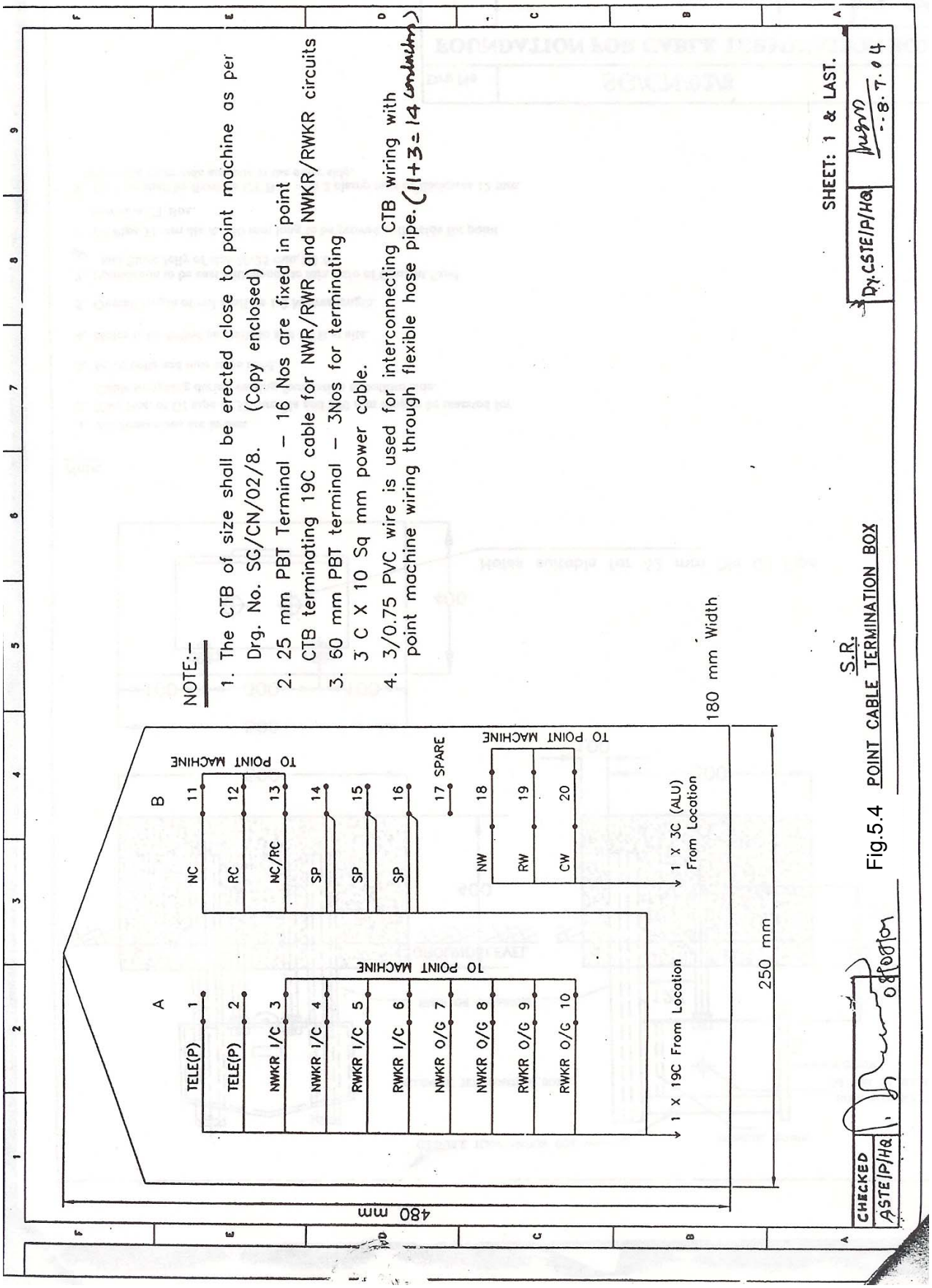
Fig.5.2 TYPICAL POINT MACHINE CIRCUIT



NOTE:-

1. ✳ Back contact of repeaters of all NWKR/RWKR, NWKSR/RWKSR to be proved in series.
2. ⊕ Normal cross protection contact made when the point is not in normal.
3. ⊗ Reverse cross protection contact made when the point is not in reverse.
4. WCRS are heavy duty contact relay (2F heavy duty contact, 2F light duty contacts and other relays are QN type relays.
5. IRS type point machine.

Fig. 5.3 TYPICAL WNPR/WRPR & NWKR/RWKR CIRCUITS


NOTE:-
1. The CTB of size shall be erected close to point machine as per Drg. No. SG/CN/02/8. (Copy enclosed)
2. 25 mm PBT Terminal – 16 Nos are fixed in point CTB terminating 19C cable for NWR/RWR and NWKR/RWKR circuits
3. 60 mm PBT terminal – 3Nos for terminating 3 C X 10 Sq mm power cable.
4. 3/0.75 PVC wire is used for interconnecting CTB wiring with point machine wiring through flexible hose pipe. (11+3=14 conductors)
A
B
TELE(P) 1
TELE(P) 2
NWKR I/C 3
NWKR I/C 4
RWKR I/C 5
RWKR I/C 6
NWKR O/G 7
NWKR O/G 8
RWKR O/G 9
RWKR O/G 10
1 X 19C From Location
TO POINT MACHINE
NC 11
RC 12
NC/RC 13
SP 14
SP 15
SP 16
17 SPARE
NW 18
RW 19
CW 20
1 X 3C (ALU) From Location
TO POINT MACHINE
480 mm
250 mm
180 mm Width
S.R.
Fig.5.4 POINT CABLE TERMINATION BOX
CHECKED ASTE/P/HQ
Dy.CSTE/P/HQ
SHEET: 1 & LAST.

(p) Electrical connections from Point CT Box to the point machine can be done using 3/0.75 mm stranded wire, PVC insulated to specification IRS-S 76/89(Amendment-1) through flexible weatherproof hose- pipe with requisite fixing arrangement. Cable connection between the CTB/JB to point machine through DWC pipe may also be provided as per Railway practice. Wherever the CTB / JB's are not provided the cable from the location may be directly terminated in the point machine. The wiring to be done as per the typical circuit diagram attached to it.

The cable coil is to be provided suitably to avoid cable cuts during lifting point lay-out or packing etc. The flexible hose between CTB/JB and point machine should not affect cranking operation or get cut while lifting point lay-out or packing etc.

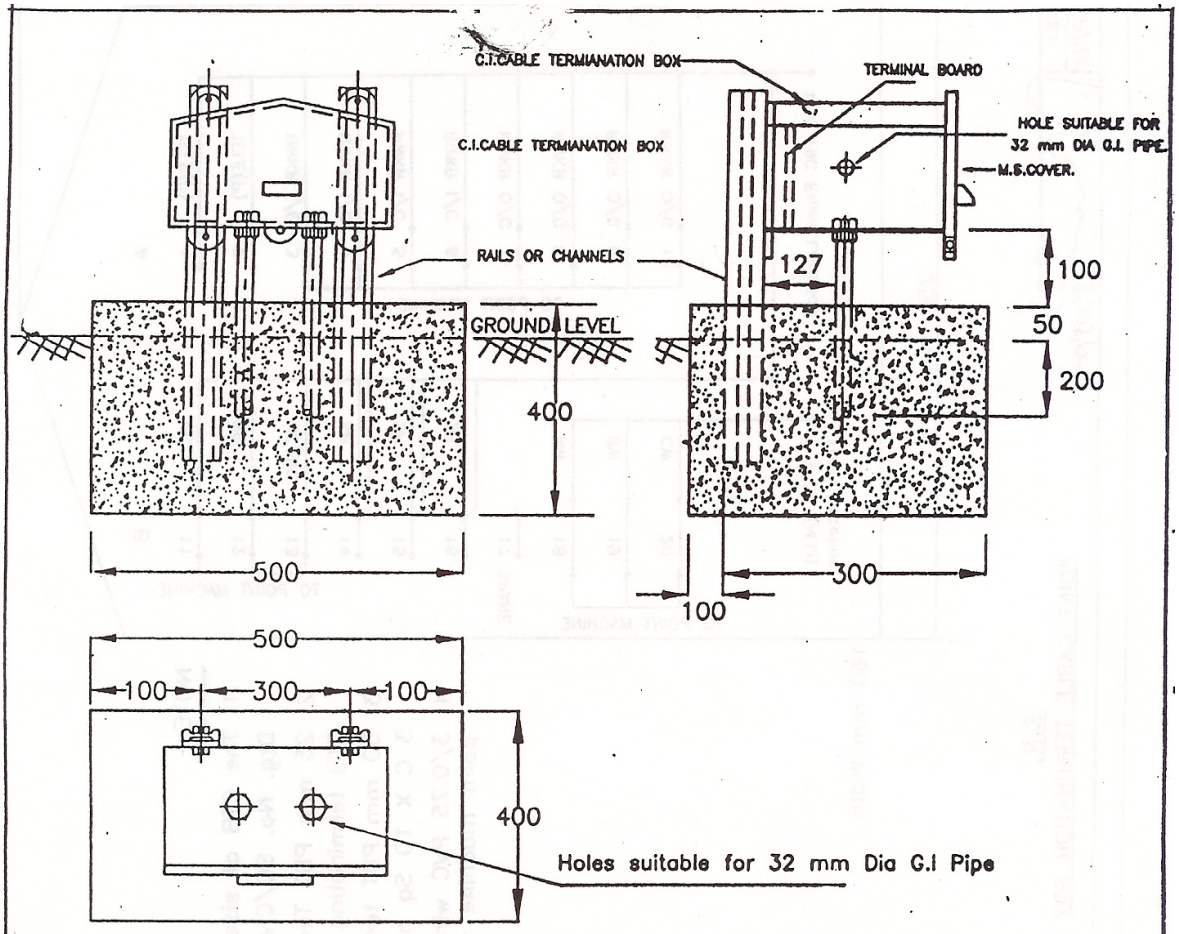
(q) The point CT Boxes/JBs to be painted and point nos to be painted neatly. Also, on the inner side of point machine cover, wiring diagram to be painted.

(r) Operate the Point machine electrically and ensure that detection contacts made only at the end of locking operation and both control contacts make with in the beginning of unlocking operation after detection breaks.

(s) Point machine working shall be checked for correspondence between the point, point operating lever/ point switch/ both ends of points, with point indication.

(t) Check point detection contacts for individual integrity by conducting contact break test.

(u) Operate the machine electrically and measure working current and voltage for both Normal/Reverse operations with and without obstruction. Ensure that the friction clutch de clutches during operation with obstruction. Also check the effectiveness of crank handle cut out contact.



Note:

1. All dimensions are in mm
2. Two Nos. of GI pipe of 32 mm dia and 300 mm long to be inserted for Cable troughing during casting foundation at bottom side.
3. M 20 bolts and nuts to be used.
4. Holes to be drilled on Rails to suit CTB at site.
5. Overall length of rail shall be 1.2 Metres length.
7. Foundation to be cast with concrete mix ratio of Cement,Sand and Stone Jelly of size 20/25 mm,1:3:6
8. GI Pipe 32 mm dia & 150 mm long to be proved at the side for point machine CT Box.
9. GI Pipe shall be fixed on CT Box with 2 clamp nuts of thickness 12 mm. one at the inner side and one at the outer side.

Drg No	SG/CN/02/8		
FOUNDATION FOR CABLE TERMINATION BOX			
Refrence	SG-1006	Checked	CASTE(CN)
Scale	NOT TO SCALE	Approved	

(v) The initial adjustment for point machine has to be done as per the provisions of SEM Pt.II Para 19.36, 19.37 & 19.38 which are reproduced below.

Para 19.36

*"**Adjustment of Detector Contacts**:- The machine shall be hand cranked to the end of the stroke to close the tongue rail. Insert 1.6mm test piece between stock rail and switch rail at 150mm from toe of the switch and operate the point. Ensure that detection contacts just make. A test gauge 3.25 mm shall be inserted between switch and stock rail at a distance of 150 mm from the toe of the switch. The detector connection for the closed switch shall be adjusted till the appropriate detection contacts are just broken. The same shall be repeated at the other end of the stroke. All the relevant nuts shall be tightened.*

***NOTE:** Where lock slide is provided in the machine, during switch detector adjustment the test shall first be done with fictitious locking. After completing the above test, the same test be repeated with machine properly locked. "*

Para 19.37

*"**Adjustment of Friction Clutch**:- Friction clutch should be so adjusted that slipping current is between one and half times to twice the normal operating current or as specified by the manufacturer. For rotary type point machines no attempt should be made to adjust friction clutch at site. Friction clutch can only be adjusted in authorized workshop. When difference between normal operating current and operating current under obstruction is less than 0.5 A, the clutch requires adjustment. Such machine should be replaced."*

Para 19.38

*"**Obstruction Test**:- The point driving rod and the lock connections of the machine must be so adjusted that with 5 mm thick test piece obstruction placed between the switch and the stock rail at 150 mm from the toe of the switch*

(i) The point can not be locked

(ii) The point detector contacts should not assume the position indicating point closure &

(iii) Friction clutch should slip."

(w) The cross protection wiring for operation and detection contacts as per the practice of the Railways may be provided

(x) Rodent entry points into point machine and CTB etc are to be plugged

(y) Maximum permissible length (Parallelism) in Mtrs. between Point Contactor and Point Motor.

The point machine is designed to be provided in both RE and Non-RE area.

For use in RE area the machine has the immunity level of 160 V AC as stipulated in SEM part-II under Para 28.8.2 Accordingly the maximum permissible length of parallelism between point contactor and point motor in single line section is 910 Mtrs. and in Double line section 1100 Mtrs.

For use in Non-RE area the point contactor can be installed in the relay room / location provided voltage available for its operation is adequate for reliable working of the motor.

(z) Painting of point machine.

The point machine shall be painted black, as stipulated in Annexure-29 of para 19.106, SEM Part-II.

5.4 TESTING

(a) Ensure that obstruction test is conducted using 'go' gauge and 'No go' gauge and obstruction/working current can also be recorded.

(i) 'No go' gauge i.e. 5 mm obstruction test piece, shall be placed between gauge face of stock rail and switch rail at 150 mm from the toe of closing switch and ensure that:

- Lock segment does not enter into the notches of locking slides
- Roller of the lock detection lies on the periphery of control disc
- Switch detection contacts do not make
- Friction clutch declutches the motor from mechanism.
- The slipping current of friction clutch is between 4-6 Amps. (1.5 to 2 times of normal working current)
- Feed for the motor gets cut off after 1.5 to 2 times the normal operating time of the point machine as stipulated under para 19.128 of SEM (Part-II)
- Friction clutches are to be replaced totally if defective; these are not to be adjusted at site.

(ii) 'Go' gauge i.e. 1.6 mm test piece shall be placed at 150 mm from the toe of the switch rail and observe that the machine gets locked & detection contacts make.

(iii) The throw rod of point shall be adjusted properly to give adequate spring to the point switches. The idle stroke of the throw rod shall be so adjusted that in case of 5mm obstruction between switch and stock rail, the throw rod slide will not get obstructed and only lock rod slide will get obstructed.

(iv) Track locking shall be tested as under:

Shunt the track with proper track shunt and ensure that the track indication is showing occupied. Operate the point from cabin / Panel as the case may be. Ensure that the point does not operate in the track shunted position. Remove the shunt and ensure that the point gets operated. This test shall be done both for normal to reverse and reverse to normal operation.

(b) Check track locking once in three months.

(c) The spring shall be checked once in three months.

(d) Check insulation of Point cables with 500 V Megger once in six months. Correspondence testing shall be done after Meggering.

(e) During installation and once in every six months or earlier as required based on the no. of operation of the point per day , pour lubricating oil SAE 30 through inlet into the reservoir for lubricating gearbox of the motor.

Point No.	Without obstruction				With obstruction			
	Voltage		Current		Voltage		Current	
	N to R	R to N	N to R	R to N	N to R	R to N	N to R	R to N

5.5 MAINTENANCE

(a) Ensure that all bolts and nuts including point machine mounting bolts are tight and split pins are opened properly, during every maintenance visit.

(b) Check that electrical wire connections inside the cable termination box and inside the machine are tight and the wiring is laced properly.

(c) Rodding connections shall be checked for tightness and friction free movement.

(d) Check that both carbon brushes are resting on commutator with sufficient pressure and commutator shall be cleaned using chamois leather piece.

(e) All moving parts are to be lubricated using lubricating oil SAE-30.

(f) Lubricate the periphery of control lift out disk and felt pad with lubricating oil SAE 30 and ensure that the roller rolls freely on the periphery of the discs.

(g) Check the contact pressure of control and detection contacts is adequate.

(h) Gauge Tie plate, stretcher bar and 'D' bracket insulations shall be checked for proper insulations.

(i) Apply 5 drops of spindle oil on the helical spring guide of contact assembly.

(j) Apply non-corrosive all temperature grease as per Specn. IS 507 / 508 through all the 8 grease nipples by using grease gun once in six months.

(k) On completing maintenance, Point machine working shall be tested using 'Go' gauge and 'No go' gauge for proper and trouble free working.

(l) Periodicity of maintenance/Inspection may be strictly followed as stipulated in SEM:

(m) Ensure that SAE 30 Lubricating oil poured once in three months and also all moving parts are periodically lubricated / greased as stipulated in SEM.

(n) For smooth working of points the slide chair plates shall be lubricated frequently either by S & T Staff or by Operating staff as per the practice of the Railways.

5.6 ADDITIONAL REQUIREMENTS FOR 220MM THROW IRS POINT MACHINE WITH CLAMP LOCK ARRANGEMENT

5.6.1 Introduction

(a) The operation of Thick Web Switches is with 220 mm throw point machine. These are installed with clamp point lock.

(b) With 115 mm switch opening, it is not possible to achieve adequate flange way clearance at junction of Rail Head (JOH). Flange way clearance is normally available to the tune of 35-45 mm only against required 60 mm. As a result, each passing wheel at JOH hits the open tongue rail, this causes rattling of tongue rail leading to severe fatigue, wear & tear of tongue rail, stresses on point machine, locking / detecting mechanism & connection with tongue rail. In the conventional arrangement of locking of point the toe of closed tongue rail is detected and locked indirectly in point machine and position of stock rail is not monitored.

(c) To overcome above limitations, direct locking for closed tongue rail with stock rail through clamp point lock to enhance safety and 160 mm opening at toe of open tongue rail along with use of spring setting devices (SSD) to improve track clearance at JOH are adopted as standard requirements of thick web switches.

(d) Provision & Maintenance of Clamp Point Lock are under purview of Signal Engineers while that of SSD pertain to Engineering Department.

(e) The Drawing showing ground connection and clamp point lock on 52 KG & 60 KG TWS layouts issued by RDSO are Drawing No. RDSO/S 3455 and RDSO/S 3454 respectively.

(f) Salient features of Clamp Point lock

(i) Provides direct locking between tongue rail and stock rail in closed position.

(ii) Firmly holds the tongue rail in open position.

(iii) Checks any relative movement between tongue and stock rail.

(g) Operation of Clamp point lock - During first 60mm throw of the point machine, clamp point lock of locked switch gets released and tongue rail of open switch moves by 60mm. During next 100mm throw, both tongue rails move by 100 mm. Tongue rail of open switch now completes its 160mm movement and gets closed. During next 60mm throw of the point machine, clamp point lock of closed switch gets locked while tongue rail of opening switch completes its movement of remaining 60mm and gets opened by 160mm.

5.6.2 Installation of 220 mm throw Electric Point Machine on TWS turnout on PSC sleepers

5.6.2.1 RDSO GUIDELINES:

(a) The installations and maintenance shall be carried out as per instructions contained in RDSO Report No. SS-85 on installation and maintenance of clamp point lock and 220mm throw Electric Point Machine on 60 KG TWS turnouts on PSC sleepers (Ref. DRG. No. RDSO/S 3454 for 60KG and 3455 for 52KG) released in feb.2000.

(b) RDSO Drawing No. 3465-66 to followed for installing 200mm throw point machines without point clamp lock.

5.6.2.2 Installation Procedure

Installation procedure contained in RDSO Report No. SS-85 (para-2) is reproduced below:

2.1 Essential requirements before interlocking work at points is taken on hand, it must be ensured that the JE/SE (P-Way) has

i. Fitted insulated gauge-tie plate correctly on sleeper no. 3 under the toe.

ii. Provided extended sleeper no. 3 & 4.

iii. Brought the toe 32 mm in advance of central line of sleeper no.3 and the distance between sleeper no. 3 & 4 to 745 mm (from C/L to C/L)

iv. Removed all leading and following stretcher bars

v. Provide spring setting device of approved design at JOH (between sleeper no. 13 & 14).

vi. Fully ballasted and packed the point and taken adequate measures to prevent lateral and longitudinal movement of the point.

vii. *Brought the track to correct level and alignment.*

viii. *Eased off rail joints on either side of points to be interlocked.*

ix. *Seen that gauge is correct.*

x. *Provided creep and level pillars*

xi. *Provided means to prevent creep in vicinity of points.*

xii. *Adjusted the switch rails to house against stock rail up to JOH as far as possible.*

2.2 The arrangement of interlocking for 60 KG turnout TWS shall be as per RDSO-S-3454.

2.3 For connecting the clamp-lock, sequence of action shall be as given below:

i. *Drill 2 holes of 22 mm dia in the web of stock rail for fixing stock-rail bracket.*

ii. *Drill 2 holes of 22 mm dia in the web of tongue rail for fixing switch rail bracket.*

iii. *Drill 2 holes of 24 mm dia in the foot of the switch rail (for connecting lock rod and detector rods)*

iv. *Connect the stock rail bracket to the stock rail.*

v. *Assemble the RH&LH lock arm assembly.*

vi. *Fix tongue rail bracket with the lock arm assembly.*

vii. *Remove both the stoppers from the locking bar assembly.*

viii. *Lock slides of the locking bar assembly are then inserted into the groove of the stock rail bracket (under the rail) through the guide of the lock arm. Fishtailed end of the lock arm should be housed in the notch of the lock slide, while inserting the lock slide in the stock rail bracket.*

ix. *The tongue rail brackets are then bolted to the web of the switch rail.*

x. *Fix the stopper of both the locking bar assembly. Bend longer end of the lock washer on the side of the stopper and shorter end on to the nut.*

xi. *The two lock bar assemblies are then bolted together with lug.*

2.4.1 Fixing of lock rods / detector rods / Drive rod

2.4.1 Connection of drive rod

i. *Connect drive rod lug to the throw slide of the point machine*

ii. *Connect the drive rod between the drive rod lug and end of locking bar assembly.*

iii. *Adjusting screw of the drive rod should be adjusted for 160 mm opening of the switch.*

iv. *Keeping the drive rod vertical to track, fix the point machine on the extended sleepers on gauge tie plate.*

2.4.2 Connection of lock rods and detector rods

i. *Lock and detector rods are to be assembled at site by inserting drop lug in the threaded portion of the rods. The drop lugs can be suitably turned to suit LH/ RH mounting.*

ii. *Put tapered washer on the foot of the switch rail such that the thicker portion of the washer is towards the edge of the rail. It will make the rail surface even and allow the lock rod/detector rods 'jaw befitted evenly on the rail, without any play.*

iii. *Now, connect the jaw of the detector / lock rods with the foot of the tongue rail and drop lug with the detector / lock slide of the point machine.*

5.6.2.3 Adjustment:

(a)

(i) Lubricate all moving parts of the clamp point lock assembly.

(ii) Put grease on bronze brush in the lock arm assembly.

(iii) Put grease on notches of lock slide and fish tail portion of lock arm.

(b) Loosen the nuts of stock rail brocket so that it can move freely in its oblong holes and takes its own position.

(c) Operate the machine with crank handle and adjust the lock and detector slides (near end first)

(d) For proper locking on both sides, add packing shims, as required, between switch rail and tongue rail bracket. (Six No. of packing shims are provided with each clamp point assembly).

5.6.2.4 Adjustment of detector obstruction test:

(a) The adjustment of detector, friction clutch, lock slide and other test shall be carried out as given for 143mm throw machine.

(b) The following precautions shall also be taken:-

(i) The detector slides, lock slides and drive rod must be so adjusted that with 5mm thick test piece placed between the switch and gauge face of stock rail at 150mm from the actual toe of the point, the point does not get locked either by clamp lock or in the point machine and detection contacts are not made.

(ii) To adjust the clamp point lock, if required, follow the same procedure as given in para for adjustment.

5.6.2.5 Maintenance:

(a) Regular maintenance, lubrication, tightening of all Nuts & Bolts, obstruction test and adjustment as defined for 143 mm throw machine shall be carried out regularly as per the periodicity given in SEM.

(b) In addition to above, the other installation, maintenance and inspection schedules of SEM and Railway to be followed.

5.6.2.6 Procurement guidelines and Description:

(a) Point machine specification IRS 24/2002 caters for 143/220 mm throw point machine. Specification also include ground connection, a suitable junction box with 2 numbers of telescopic pipes and the set of following tools with every 8 Nos. of point machines.

(b) The procurement description shall indicate:-

(i) Throw of the point machine 143/ 220 mm.

(ii) 143mm IRS point machine. Drawing ground connection for 52 / 60 KG PSC/ Wooden layouts.

– PSC sleeper for 52 KG and 60 KG–Drg. No.– RDSO/S 3361-62.

– Wooden sleeper for 52 KG & 90R – Drg No. RDSO/S 3262-63.

(iii) 220 mm IRS point machine, drawing of ground connection with point clamp locks for 52/60 KG PSC layouts.

Drg. No. RDSO/S 3454 for 60 KG.

Drg No. RDSO/S 3455 for 52 KG.

(iv) 220 mm IRS point machine, Drawing opf ground connection with out point clamp locks for 52 / 60 KG PRC layouts.

Drg. No. RDSO/S 3465 for 60 KG.

DRG No. RDSO/S 3465 for 52 KG.

(v) Clamp locks for 52KG – Drg No. RDSO/S 3376

(vi) The following set of tools in suitable box along with every set of eight point machine or less:-

- M6/M8/ M18/M20/M22 box spanners.
- M10/M12 spanners
- Adjustable wrench
- Screw Driver 300 mm long.

(vii) Junction box and two numbers of telescopic pipes of approved type shall be supplied as an integral part of the point machine.

* * *

CHAPTER - 6: LIGHTNING AND SURGE PROTECTION

6.1 INTRODUCTION

6.1.1 Scope of the Chapter

This document provides the requirements for proper grounding, and surge protection of Electronic installations on Indian Railways, which is essential for providing protection to personnel against electrocution hazards and to minimize equipment damage due to electrical surges caused by lightning or power faults.

Grounding and surge protection of equipment / installations can be stated in simple terms:

(a) For personnel protection, connect equipment enclosures, chassis, cardfiles and rack body to a single point, which in turn is connected to the ground. The ground is to be obtained by means of a suitable arrangement of grounding electrodes that are made an integral part of the surrounding earth or some other conducting material. The grounding arrangement called the earth ground (henceforth) shall have a resistance as low as possible (Refer section 2 of this document for details}.

(b) Provide staged surge protection based on protection zone concept of IEC specification with the help of suitable devices such as lightning arrestors, surge suppressors etc. Provide a low-impedance path to ground for surge currents, while also ensuring that the surge currents do not induce harmful voltages in 10 W ~ level signal circuits.

(c) Equipment must be shielded to minimize the susceptibility to radiated fields.

All Electronic Signalling and Telecommunication installations on Indian Railway are to be properly grounded and surge protected to minimize personnel injury and equipment damage due to lightning and power faults. The requirements of Electro Magnetic Compatibility (EMC) are to be followed to ensure safe and reliable operation of sensitive electronic equipment.

6.1.2 Acronyms used

AC - Alternating Current

DC - Direct Current

EMC - Electro Magnetic Compatibility

EMI - Electra Magnetic Interference

IEEE - Institute of Electrical and Electronic Engineers.

IEC - International Electro-technical Commission Input / Output

REB - Room Earth Bar.

UL - Underwriter's laboratories

UPS - Un-interruptible Power Supply

IPS - Integrated Power System

6.2 GROUNDING PRINCIPLES

Grounding system of an electrical installation comprises of earth mast electrode of the lightening and electrical protection system and common bonding network. The common bonding network (CBN) is the total of all protective conductor and bars, which are bound to an Earth bar. Modern wiring regulation requires every conductor to be connected to the network of protective conductors to create a Building CBN. It also requires the CBN to the connected to earth electrode of the protection system.

6.2.1 FUNCTIONS OF GROUNDING

Grounding should be implemented to perform the following functions:

(a) Limiting of touch voltage differences by proper bonding and grounding of panels, racks, enclosures, raceways etc., to avoid shock hazard.

(b) Providing low impedance ground fault current path to the power source, so as to enable the actuation of over current protection/disconnect devices.

(c) Reducing ground potential differences between various equipments to obtain a low and constant potential reference in order to minimize the effects of high frequency electrical noise on sensitive electronic circuits.

(d) Utilizing grounded conducting enclosures as electromagnetic and electrostatic shielding for sensitive circuits.

(e) Complying with individual equipment supplier guidelines.

6.2.2 GROUNDING TECHNIQUES

The basic grounding techniques that ensure satisfactory performance of the above functions are described in this subsection. The grounding requirements for the separately derived systems are as follows:

(a) The system grounded conductor (neutral) shall be grounded at only one point – at the source and ahead of any system disconnecting means or over current device.

(b) The grounding electrode shall be as near as practicable to the system connection.

(c) Stray load currents shall not be permitted to flow through the equipment grounding conductors. Only ground fault currents flow through equipment grounding conductors.

(d) Metal raceways, enclosures, frames and other. non-current-carrying metal parts of electrical equipment shall be kept at least 6 ft away from lightning rod conductors or shall be bonded to them at locations where the separation distance is less than 6 ft.

(e) Equipment grounding conductors bond conduit, cable tray and all enclosures together to form a low impedance path back to the separately derived source. Raceways and cable assemblies shall be mechanically secured to boxes, fittings, cabinets and other enclosures.

(f) The earth system of each equipment room shall be segregated from that of the other.

(g) The earths of equipment rooms shall meet only at one point the star point.

(h) All equipment within the Systems' equipment rooms, inclusive of the Power System shall be earthed with respect to the systems earth.

6.2.3 GROUNDING Considerations

The first step in providing effective personnel and equipment protection is preparing a low resistance grounding electrode or grounding electrode system at each equipment housing room.

Once the low resistance earth ground is established as described above for a signal housing the apparatus in the house should be connected to the earth ground as described in the following sections.

6.2.3.1 Earth Rods

When installing the outside earth rods, begin by auguring out the holes for the earth rods. Use a 10 ft rod, which is a standard length and practical for most installations. Augur the holes using an 8-inch diameter bit and drill for a depth: of 8 ft. Place the rod in the center of the hole and drive it into the earth 3 ft. This will put the head of the ground rod about 1ft below the ground surface. A trench of 24 inch deep and 1 ft wide should be made between all rod holes. The rods will sit concentrically in the augured holes and remain in place by the 3 ft driven depth at the bottom of the hole. Please refer fig. 6.1

Earth rods are subject to corrosion and installation procedure. As the earthing system is to have a long life span, comparable to that of installation, all earth rods should be to international standards. The earth rods should be molecularly bonded copper rods of size 50 mm dia.

Coupling between successive ground rods for greater depths shall be via Exothermic welding to UL 467 for greater reliability and a longer life span. Once the joints between Exothermic welding rods are secure, the augured holes and interconnecting trenches are to be filled with a sodium bentonite (or similar proprietary compound) water mix. The sacks of sodium bentonite are poured into the holes simultaneously with water until the top of the ground rods are just covered. The trenches are then filled with sodium bentonite and water mixture also to just cover just up to the copper straps. The remaining trench depth can be filled with ordinary soil.

The distance between adjacent earth rods shall not exceed twice the driven depth. In our case the distance between two earth rods should be less than 20 ft. Such earth rods installed along the perimeter of the equipment room and power room will be coupled together as explained in the following sections forms the building perimeter earth. This ring should be at a distance of 4-6 ft from the outer wall of the building.

Apart from the earth rods that form the perimeter earth, a separate earth rod is to be installed near the equipment room of the building. This earth rod forms the Low Voltage Earth Pit, which will be connected to the star connected equipment earth and perimeter earth. Please refer fig.6.2

Another earth rod shall be installed near the panel room of the building in case of signal installation where operator panel is housed in a separate building. This earth rod and the equipment room perimeter earth are coupled through copper tape as explained in the following sections.

It is recommended that all connections underground be exothermic bonded to UL 467 for long-term reliability.

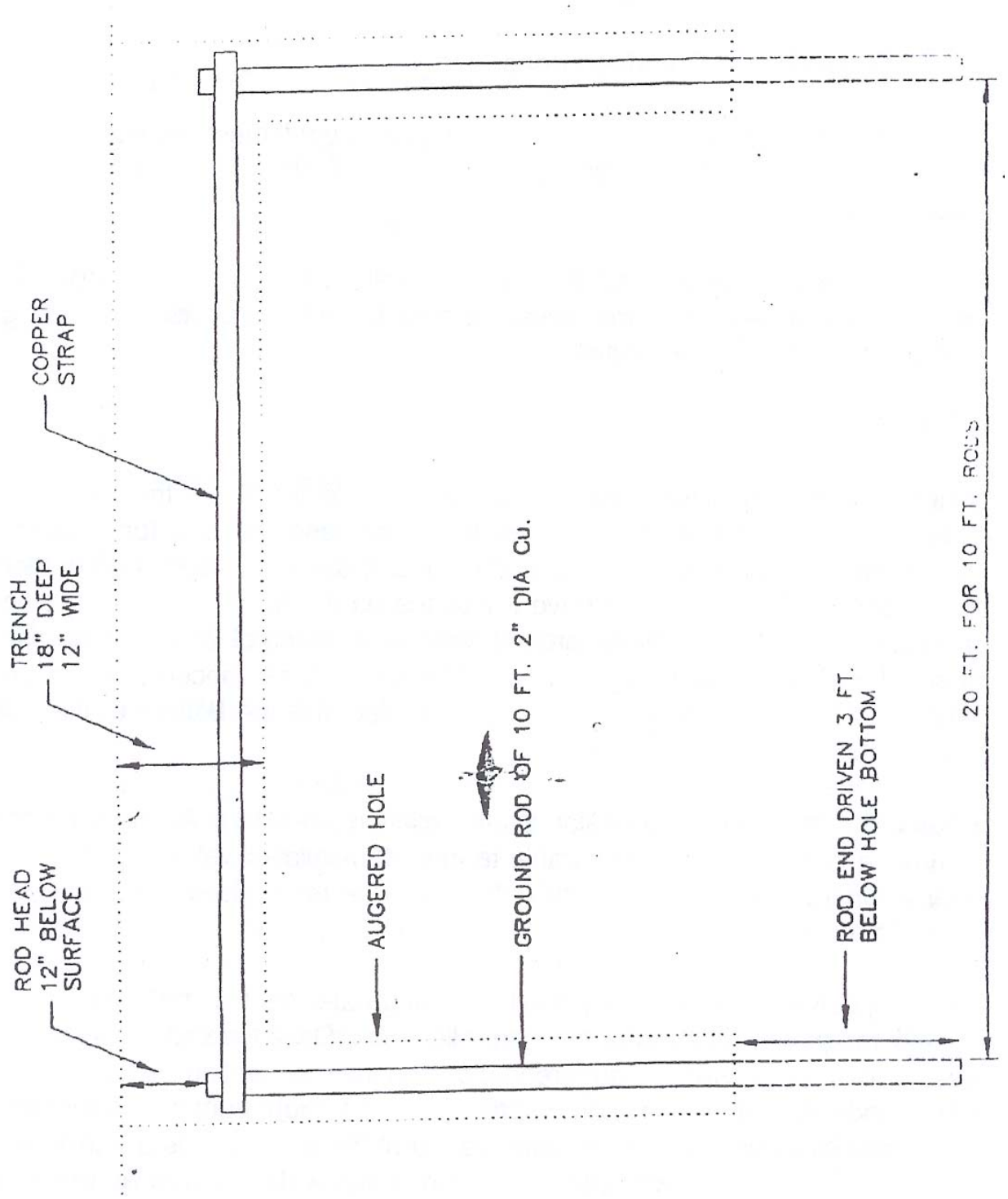


Fig 6.1 installation of out side earth rod

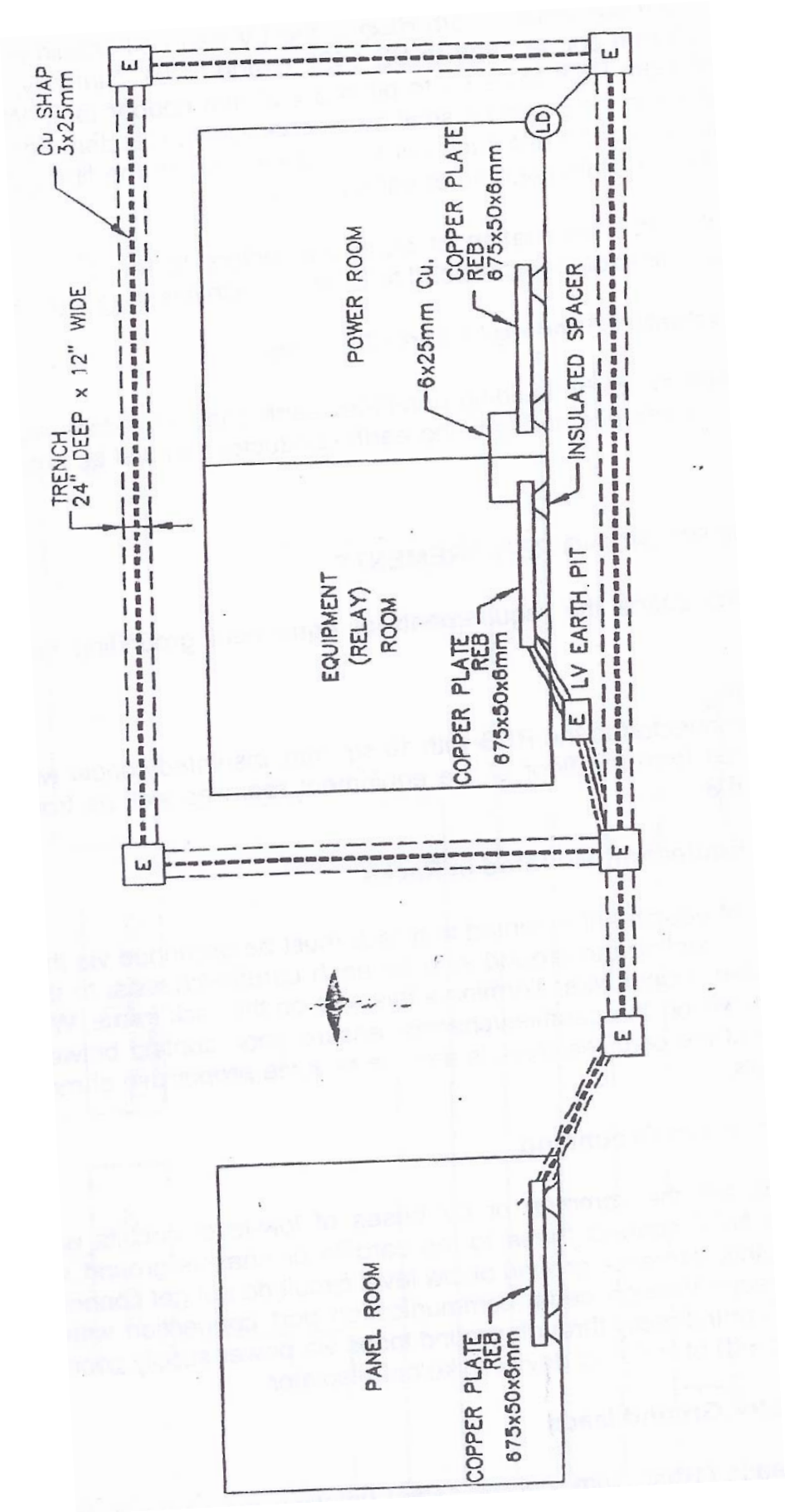


Fig: 6.2 Parimeter earth & REB-REP Bonding

6.2.3.2 Earth Resistance & Transient Impedance

The following values stated are the minimum earth resistance requirements prior to bonding the Low voltage earth pit (LV earth pit) to the building perimeter earth. The values apply to the readings obtained at the test point of each earth conductor.

Earth measurement points	Resistance	Surge Impedance *
LV Earth pit	1 Ohm	30 Ohms
Building perimeter Earth	1 Ohm	30 Ohms
Panel room Earth pit	1 Ohm	30 Ohms

Notes:

***** *In areas of high lightning activity it has been found that the surge impedance of the earthing system is a very critical actor. The surge impedance stated above is a* ***recommended value****. For lightning, the critical factors are the rate of rise of current, which is of the order of microseconds. Therefore, the* ***inductance of the earthing system is the predominant factor (in comparison to resistance) during the rising stage of the surge. Hence, in an installation with sensitive electronic equipment, the surge impedance needs to be kept as low as possible. To minimize the surge impedance, it is strongly recommended that.***

- ✓ *A radial earth system should be employed at the points, where earth conductors terminate at earth pits.*
- ✓ *Copper tapes, which have a much lower inductance than copper cables be used as the bonding conductors (equivalent in circular cross sections to the bond wires recommended, this is to minimise the skin effect and flux exclusion effect).*

6.2.3.3 Room Earth Bar (REB)

Room earth bar is provided in each room for terminating directly. The ground connections are connected to all the equipments in the room and form the interface point with the external earth system. **The room earth bar (REB) shall be a tinned copper bus bar to 881432 Grade C101 having the following dimension**s 675 x 50 x 6 (mm). The REB shall be predrilled with 12 holes of M10 size suitable for termination of bolted cable lugs. This size will accommodate the required number of connections with spare capacity as required.

There shall be one REB for **each room**, which includes thePanel room; Equipment room and Power supply room.

(a) To avoid circulating earth loops, the **REBs shall be insulated from the building structure**. Each REB **shall be installed against the wall, with low voltage insulator spacers of height 60 mm and 6 KV insulation. Insulators shall be of halogen free conforming to UL94 fire rating**. The REBs shall be installed at the following heights in the respective rooms:

(b) Panel Room at 0.5 metres.

(c) Equipment room at 0.5 metres.

(d) Power supply room at 0.5 metres.

All terminations on the REB shall be by bolted lugs with spring washers. The earth leads shall however be bonded to the lugs by cad welding (exothermic bonding) to UL467.

6.2.3.4 RES-REB Bonding Conductors

To minimize the effect of circulating earth loops, noise pick-up and to provide equipotential bonding, **star point earthing is required which is to be achieved as follows**.

Equipment *room* and Power supply *room* REBs mentioned above should be directly connected to the REB within the Power supply room. To facilitate this, it is proposed that a REB be installed within the Power supply *room* at a height of 0.5 m.

For low inductance and to minimize skin effect, flat copper tape to BS1432 Grade C101 shall be used as the bonding conductors. Furthermore, for mechanical rigidity, the copper tape shall have a cross section of 6 x 25 mm.

To avoid circulating earth loops, the bonding conductors shall be insulated from the building structure. The bonding conductor shall be installed alongside the wall and ceiling with low voltage insulator spacers of height 60 mm, 6 KV insulation, at an interval of every 0.6 meter. The insulators shall be of halogen free conforming to UL94 fire rating. When the conductor passes through the wall it shall be sleeved and insulated accordingly.

The installation of the bonding conductors shall have a bending radius not less than 200 mm. These bonding conductors will be routed as illustrated in fig. 6.2

The bonding conductors shall be bonded to their respective lugs by exothermic bonding to UL467.

6.2.3.5. Earth Conductors

Earth conductors are typically those conductors that carry the surge to the main point of injection into the ground. These would typically be,

(a) Copper conductors for equipotential bonding or fault protection, that come out of the building and which are finally terminated in an earth pit.

(b) The copper conductors that come down the sides of a building (for lightning protection) and which are finally terminated in an earth pit.

It is recommended that the earth conductors are copper tapes instead of copper cables to minimize the effect of inductance and skin effect.

The earth conductor from equipment room REB to the LV earth pit should not be less than 3 x 25 mm copper tape to SS 1432 Grade C101. Similarly, the earth conductor from panel room REB to its earth pit should be 3 x 25 mm copper tape. Where this earth conductor is buried in the ground it shall be mechanically protected. For diversity, it is proposed that there shall be two such earth conductors up to the first LV earth pit and then on to the nearest building perimeter earth pit.

It is recommended that the termination of earth conductors to the earth pit of the building perimeter earth be exothermic welded to UL467 to achieve long term reliability.

6.2.3.6 Equipotential Bonding of Earth Systems

Bonding of the LV earth pit to the building perimeter earth should be done external to the building i.e. neither earth pits nor lightning earth conductors should be brought into the building.

6.3 EQUIPMENT GROUNDING REQUIREMENTS

The Following sections define the requirements of equipment grounding inside the equipment rooms.

6.3.1 Rack Grounding

Each rack should be connected to the REB with 10 sq. mm. insulated copper wire. The racks should be isolated from the floor of the equipment room as well as from each other. Please refer fig.6.3.

6.3.2 Grounding of Equipment Mounted in Racks

Card files and chassis of equipment mounted in a rack must be grounded via the rack. Connecting the ground stud on each card file/chassis, to the rack using 4 sq. mm. insulated copper wire can do this. Terminate this wire on the rack frame. When no ground studs are provided on the cardfiles/chassis, ensure good contact between the metallic mounting ears of the cardfiles/chassis and the rack via proper use of mounting screws and star washers.

6.3.3 Signal Reference Bus Grounding

Signal reference buses are the common or OV buses of low-level circuits within a card file or chassis. Do NOT connect these to the card file or chassis ground stud. It should be ensured that this reference ground of low level circuit do not get connected to main ground either directly through serial communication port connection with other external module like PC or indirectly through ground loops via power supply connection (not having isolated ground) of isolating devices like optoisolator.

6.3.4 Lightning Arrestor Ground leads

Run separate ground leads (10 sq. mm. copper cable) between the ac line to ground arrestors, DC line to ground arrestors and the RES. Locate the arrestors as close to the RES as possible. Avoid sharp bends in the ground wires. Locate electronic equipment away from the arrestors. Arrestors should be provided at the interface point between two-surge protection zones. The concept of surge protection zone has been explained in the sections on lightening protection.

6.3.5 Grounding Miscellaneous Equipment Frames

On racks or frames containing lightning arrestors, run a separate 10 sq mm insulated copper wire from the arrestor to the REB.

The frames of equipment such as transformers, power supplies etc, (which are not generally located on racks) can be connected to the REB directly by an insulated 10 sq. mm copper wire.

6.3.6 Cable Shields

Shielded cables within a particular location are considered to be non-exposed. These cable shields should be grounded at one end only. This end should be at the lowest impedance point with respect to the RES and the end closest to the REB.

Cables, which run between buildings, or are exposed, should be terminated on protected terminal blocks. The cable shield should be grounded to the protected terminal block ground terminal. A 10 sq mm-insulated copper conductor should be run from this ground. Either GD tubes, MOVs or Optoisolators of specified rating as per design requirement, can achieve protection at terminal blocks.

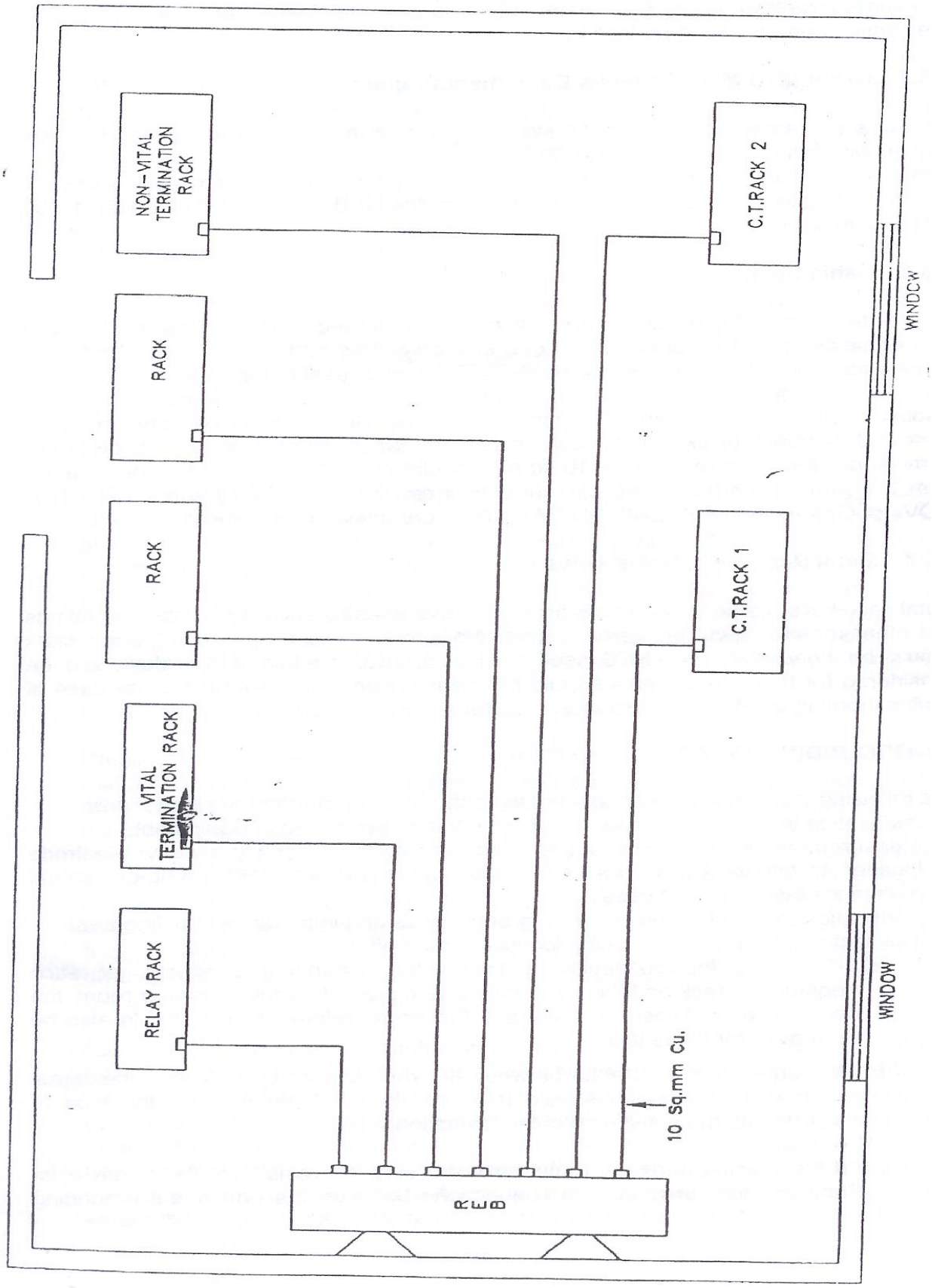


Fig: 6.3 Equipments earthing to REB

6.3.7 Metal Raceways, Cable Trays etc.

Metal raceways, cable trays, cable armour, cable sheath, enclosures, frames, fittings and other metal non-current-carrying parts that are to serve as grounding conductors should be bonded together. These items should be isolated from equipment racks, for ease of troubleshooting unintentional grounds.

6.3 GROUNDING TESTS

The following tests should be conducted to verify proper grounding at all locations:

(a) Installation inspection of power distribution to and grounding of equipment.

(b) Measurement of the single-point ground resistance at each grounding electrode location to ensure it is below the specified value. A commercially available clamp type ground resistance tester would be the most easy to use.

(c) Verification that no floating grounds, ground loops and impedance coupling exist. This should be done, with all power to the location turned off, according to the following procedure

(i) Removing the connection between the grounding conductor of each equipment rack and the electrical system ground. In the computer room, the connection between the rack and the signal reference grid should also be removed for these tests.

(ii) Measuring the resistance between the rack copper bus bar and the signal reference grid, which should read infinity, or ‘depending' on the type of instrument, the resistance of the insulation.

(iii) If the reading turns out to be zero or a very low resistance there may exist one or more unintentional connections between the equipment-grounding conductor under test and the electrical system ground. Such connections should be found and removed, and the measurement should be repeated to ensure it is infinity or very high.

With all ground connections restored to normal state and all equipment powered look for stray currents in the grounding conductors using a clamp-on current probe connected to an ammeter. If stray currents are found, locate and eliminate their sources.

6.5 SURGE PROTECTION PRACTICES

6.5.1 Surge Protection guidelines

Please refer fig.6.4 for surge protection and EMC requirements.

SURGE PROTECTION PRINCIPLE

Here the characteristics of current waveforms from lightning events will be reviewed. This is major Source of surges (but not the only source). Coordination of surge protective devices for enhanced surge protection of equipment and structures in cases where built in equipment surge immunity is not sufficient will be laid down Signal and Telecommunication installation in outdoor shelters and enclosures are good example of cases where enhanced surge immunity is required.

6.5.2 Peak Pulse Current from Lightning Events

Studies of the vast majority of current levels of lightning strikes that are from cloud-to-ground show up a range from 10,000 A to 40,000 A. Only 6% of the currents rise above 60,000 A and less than 2% of tile currents were above 100,000 A. If 100 KA lightning strike is assumed to terminate on the primary conductors (those that enter a facility), the lightning current will divide into several paths to earth ground. This will be according to the inverse of the impedance of each path of the parallel combination. Worst-case direct strike lightning event could induce 100 KA, 8 x 20 µs energy onto a single phase ac power system (please refer fig.6.5). After dividing 100 KA by the number of parallel conductors, one can assume the most current per conductor would be 33 KA, 8 x 20 µs.

A key point is the introduction of a new waveform with different decay characteristics than the previously discussed 8 x 20 µs waveform. This is the 10 x 350 µs lightning impulse waveform, which [please refer fig.6.6 (a) & 6.6 (b)]

The primary lightning threat is given by three lightning current components.

(a) First short stroke

(b) Subsequent short stroke

(c) Long stroke

All three components are effective as impressed currents. The first short stroke is the decisive factor, because the subsequent short stroke has lower value for specific energy charge and amplitude.

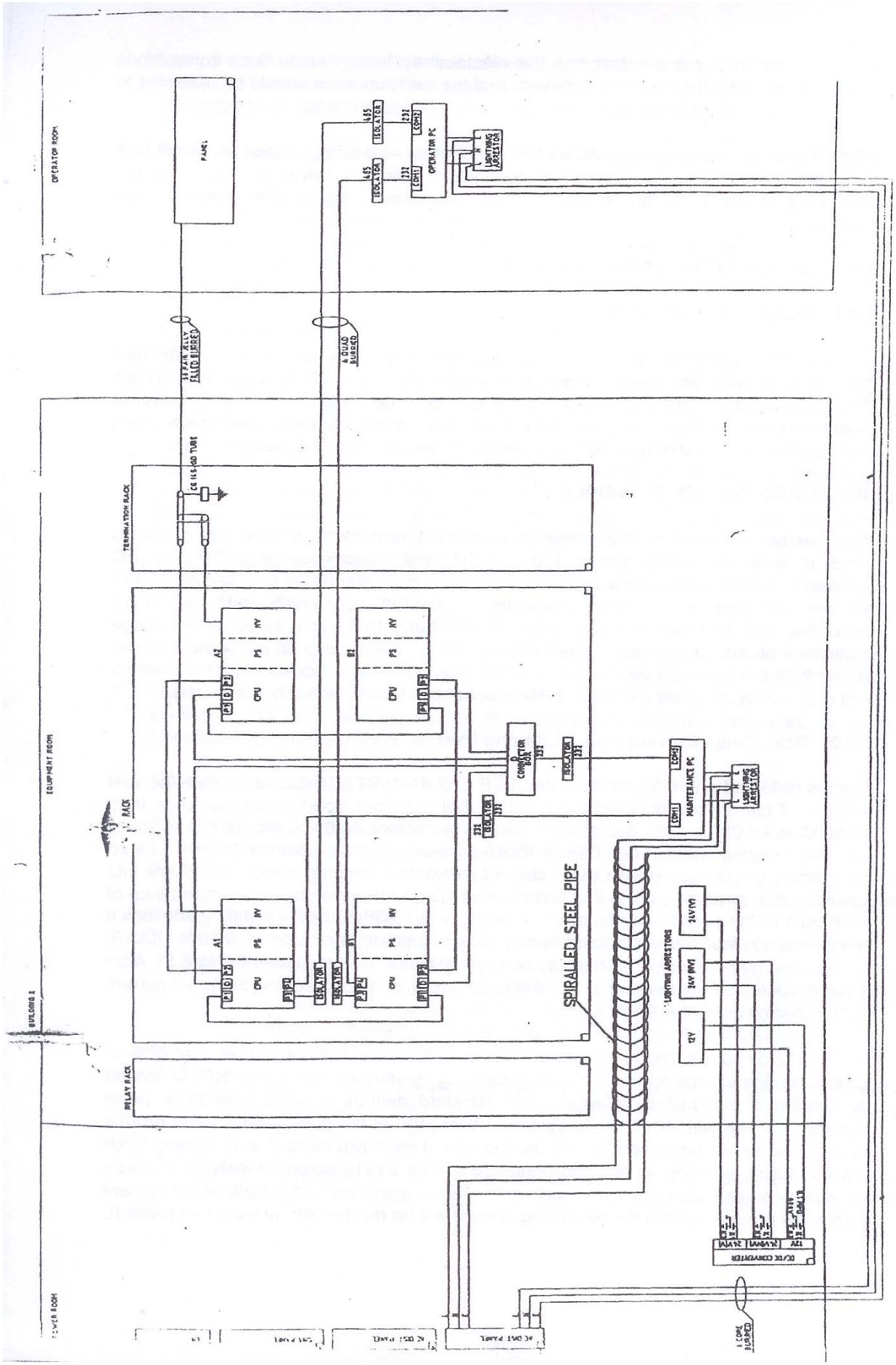


Fig: 6.4 Surge Protection & EMC

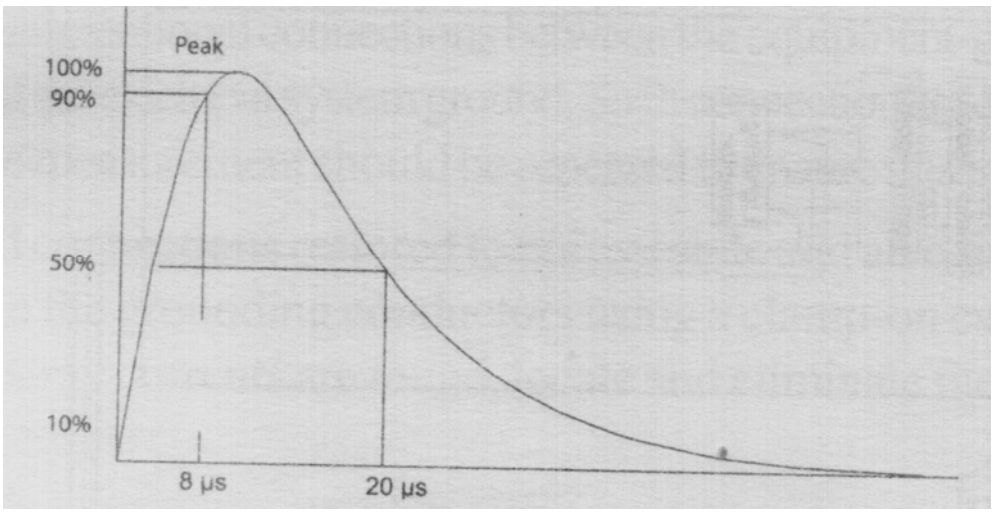


Fig: 6.5 8/20 µs waveform of lightning (IEEE)

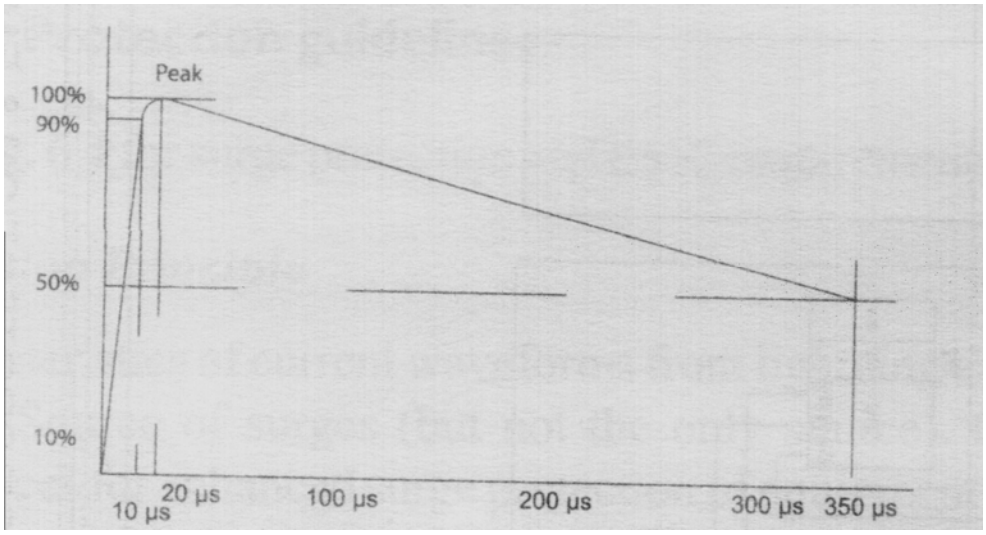


Fig: 6.6 (a) 10/350 µs waveform of lightning (IEEE)

Typical performance of the four main type of SPD

(Ignoring the effect of inductance in their wiring or earth bonding)

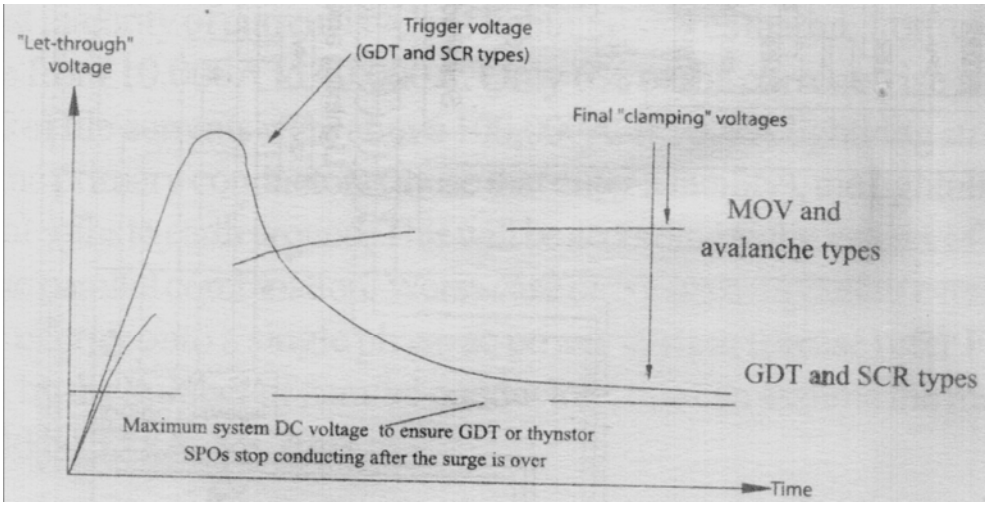


Fig: 6.6 (b) performance of the main type of SPD

6.5.3 Protection of Structures against Lightening

A structure can be anything from a high-rise building to an outdoor shelter containing S& T equipments. This has to be understood in terms of ligtning protection zones (LPZs).

Basic zone concept: Purpose of LPZs is to divert the surge energy from lightning and other disturbances away from vulnerable equipments. The majority of energy should be diverted at the lowest zone boundaries. The number of required zone is determined by the physical properties of the structure and the sensitivity of the vulnerable equipment. Sensitive equipments installed in outdoor shelters particular1y when a poor physical ground is present, require a high number of zones. The basic lightening protection zones are explained below.

LPZ 0A

This zone is subject to direct lightening strokes and may have to carry full lightening currents. The magnitude and duration of the current may be 100 kA for 10/350 μs, 200 A for 0.5 sand 25 kA for 0.25/100 μs.

LPZ 0B

This zone is not subject to direct lightening strokes. The un-attenuated electromagnetic field occurs here in the range of 10 kV, 1.2/50 μs and 5 kA, 8/20 μs.

LPZ 1

This zone is not subject to direct lightening strokes and current or: all conductive pans within the zone are further reduced from various zones. The electromagnetic field may also be attenuated depending on the screening measures.

LPZ 2

When a further reduction of the conducted currents and and/or magnetic field required the subsequent zone can be introduced. In general the higher the number of zones the lower the electromagnetic parameters.

LPZ3

This zone should contain the protected equipment. The requirement for the zone three is that the remnant surge voltage does not exceed the test level specified in IEC 1000-4-5.

6.5.4 Protection against Electro Magnetic Impulse through Surge Protection Devices

Surge arrestors are variable resistance devices, whose resistance is a function of the applied voltage. They are designed so that they provide a clamping effect when voltage across them exceeds a certain level, rather like a zener diode.

6.5.5 Types of Surge Protection Devices

(a) Gas discharge tube (GD Tube), essentially just a spark gap, slow but very high power Metal-Oxide varistor (MOV), first and available in a wide rang of energy ratings.

(b) Avalanche Devices, semiconductor with a zener type action, very fast but not very high power

(c) SCR devices, another type of semiconductor device, slow but will handle high currents

Figure 6.7 shows the voltage/time curves of this four type of SPD when exposed to the leading edge of a typical surge test waveform. It shows that GD tube and SCR devices are slow to start suppressing. They have to reach a trigger voltage before they begin to conduct, and during this time they let surge voltages, which may be potentially damaging. MOV and avalanche devices act like zener diodes with a knee voltage where they start to draw current. As there current increases their clamping voltage rises slowly.

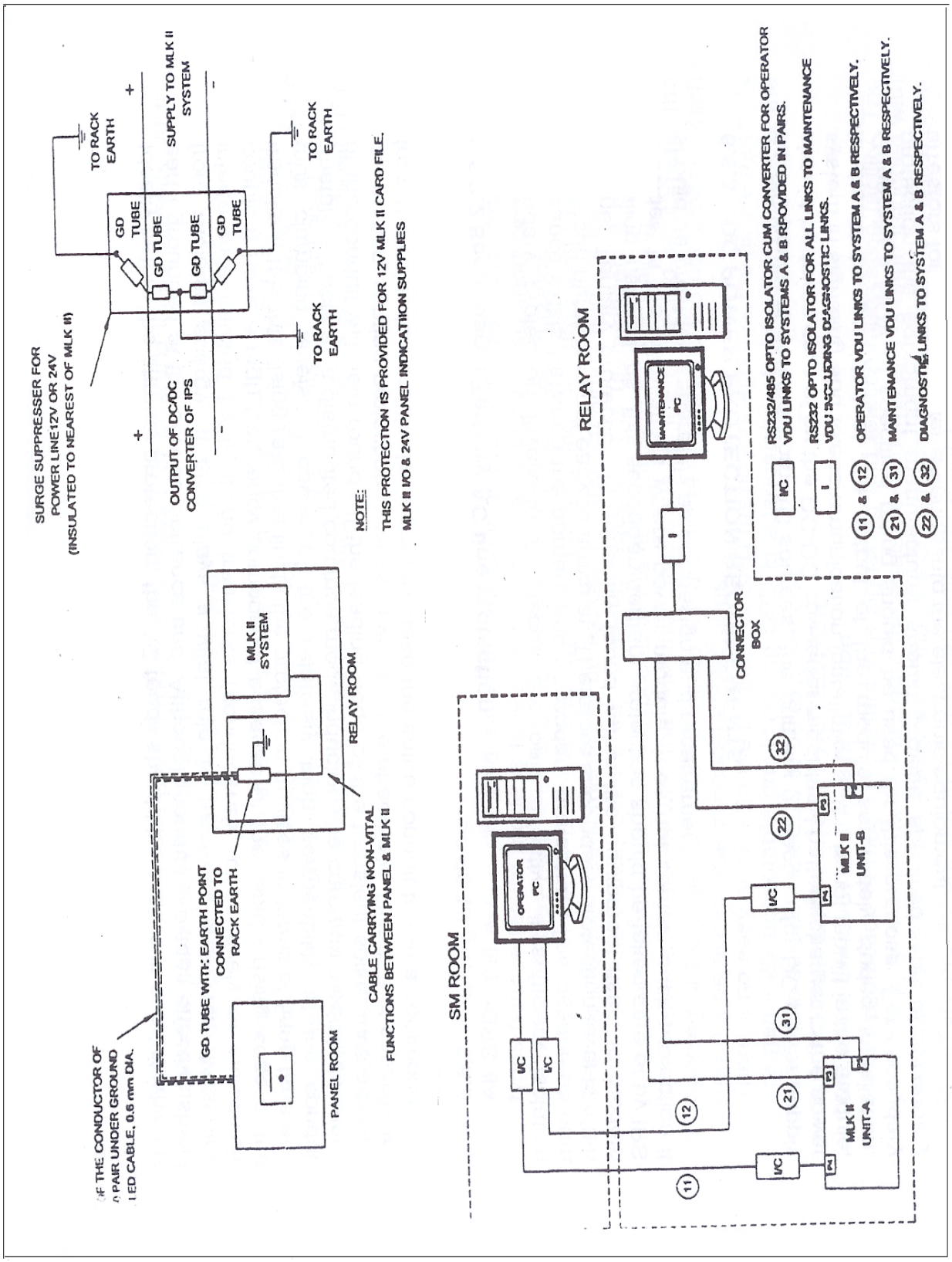


Fig: 6.7 Vital & Non Vital Interface Protection

6.5.6 Rating of SPDs

The rating of SPDs is decided on the protev1ion level it is required to protect which are listed below.

Lightning Current Parameters	Protection Class		
(for 10/350μs wave form)	I	II	III-IV
Peak Current (KA)	200	150	100
Charge of the impulse current (C)	100	75	50
Specific Energy (MJ/ohm)	10	5.6	2.5

The energy coordination of all SPDs installed in the system, including those inside tile equipments to be protected, is decisive for the efficiency of the protection. The original manufacturer of the equipment should invariably specify basic parameters for coordination of the individual SPD. Vagueness about this by the OEM should be considered a disqualification.

6.5.7 Fusing of SPDs

All SPDs fail eventually, and since the majority of products use metal-oxide-varistor types (whose failure mode is to leak increasingly and finally to go short-circuit) in their mains inputs. They need to be fused to prevent fire or shock hazards.

If the fuse is in the SPD circuit only, when it opens during the surge event that kills the SPD the protected equipment may be exposed to the remaining parts of the surge and damaged. Afterwards, even if the protected equipment is undamaged, it has lost its surge protection and so is very exposed to the next surge that comes along.

If the fuse is in series with the line that also goes to the protected equipment, the opening of the fuse due to SPD failure will disconnect the line to the equipment, which may not be acceptable in critical applications.

There is no easy answer to the problem of SPD fusing, but either of the above methods are generally acceptable providing the SPD is adequately rated for the number of the maximum surges expected to be experienced.

6.6 POWER LINE SURGE PROTECTION

6.6.1 The concept of surge protection

Power protection is much important in a signalling and telecommunication facility. The power supply is distributed throughout the equipment rooms and is often troughed with other wiring. Much of the equipments that are driven from power supply has some built in tertiary protection, but in no way can bear the brunt of a major surge. Such levels must be handled properly by staged protection. The staged protection refers to primary, secondary and tertiary levels based on surge protection zone concept of IEC specifications.

6.6.2 AC POWER PROTECTION REQUIREMENTS

6.6.2.1 Primary AC line protection

In AC line feeds, primary protection begins at the service entrance. In sever lightning areas; primary protection begins at the service entrance inside the equipment rooms. The preference for primary side protection is the block type MOVs. These MOVs are 60mm diameter discs capable of handling enormous amounts of energy, while maintaining reasonable clamping levels of for an AC system. It is better to use two or more in a fused, parallel fashion with indicator lamps across the fuse. In this way, it will be known if one MOV is shorted and because of the parallel redundant configuration, line protection continues.

In signalling installations, the IPS is connected to the AC service entrance and IPS manufacturer should install specified surge arrestor as primary AC line protection device.

Ideally before the primary protection, the AC feeds should be captive in conduit which is earth grounded at the service entrance end. Although conduit provides effective shield from radiated energy, it also plays a vital role in transient protection. Most line interference caused by lightning transients (conductively, capacitively or inductively coupled) have a high frequency component because of the rapidly rising edge of the transient. It is this rising rate that limits the protection devices in terms of firing time and thus clamping levels. Because of the relatively high permeability of the conduit (metallic) it acts as a distributed common mode inductor The common mode inductance of the conduit will help round off the leading edge of the transient spike, thus allowing the primary lighting projection devices to work more effectively, Distributed capacitance from the cable to conduit also works to make the entire conduit to run a common-mode filter.

6.6.2.2 Secondary / Tertiary AC line protection

Secondary protection levels in AC feeds are only effective if sufficient isolation impedance exists between the primary and secondary protectors. The needed amount of isolation number is not easy to arrive at. Therefore secondary protection level is often forgone. Tertiary protection is generally found within the equipment itself. In modem signalling installations, this secondary/tertiary protection should be taken care of by IPS provider. In the installations where power module does not contain such protection it should be provided separately as per design and requirement.

6.6.3 DC POWER PROTECTION REQUIREMENTS

As DC power is derived from AC sources, the primary protection for DC power supply should be taken care of by the DC-DC converter modules/ battery charger in the power system in signaling and telecommunication installations. If it is not inbuilt in the module, it should be provided at the output of the module separately during installation. Generally a MOV of specified rating should be used for this purpose. For secondary protection the equipment manufacturer should provide specified type of secondary arrestors for the DC power entering into the electronic equipment.

The tertiary protection is normally available in the Power supply PCB of the electronic equipment.

6.7 INTERFACE PROTECTION REQUIREMENTS FOR SIGNALLING INSTALLATIONS

The signalling installations based on solid state interlocking equipments (SSI) require a large no. of I/O wires/cables for the interface with outdoor gears as well as operating cum indication panel. Normally the electronic interlocking equipments contain two different interface modules for connecting the vital (outdoor signalling gears) and non-vital (operator panel) connections. Here we will discuss the installation requirement for both type of interface. (Please refer fig. 6.7)

6.7.1 NON-VITAL 1/0 INTERFACE PROTECTION REQUIREMENTS

The non-vital inputs and outputs from/to the panel are directly connected to the SSI non-vital I/O cards. As per standard practice it should be ensured that the panel room and SSI room are in the same building adjacent to each other or one over other in two floors. This will completely eliminate the surge and noise coming to SSI equipment directly through panel interface cable. But in some of the stations where it is not possible and the panel room is away from the equipment room, under ground cables should be run between the panel room and equipment room. The armour of the cable should be connected to REB at both rooms. Under no circumstances the cable should be run overhead in pipe or otherwise between two buildings.

The non-vital cables are terminated to Gas Discharge tubes (GD tube) before they are connected to SSI. The GD tubes are essential only when the panel room is away from the equipment room and underground cables are interconnecting panel room and equipment room GD tubes of specific rating and make as recommended by the SSI manufacturer to be provided for the non-vital I/O terminations where the panel room is away from the equipment room.

GD tube arrestors are typically used to quickly and safely protect modern electronic equipment from damage caused by transient surge voltages. Lightning and equipment switching operations are two common causes of those short duration surge voltages. Gas tube arrestor operation does not generate any significant heat during these events, which normally last a few microseconds or less.

GD tubes return to their high impedance "off state automatically after the transient falls to a certain voltage. Depending on the magnitude of the current passing through the GD tube during its "on" state the GD tube withstand hundreds of operations before reaching it's end of life state.

6.7.2 VITAL I/O INTERFACE PROTECTION REQUIREMENTS

The vital inputs from the field to the SSI equipment are read through a relay contact or a surge protection device. When SSI is reading through relay contacts which provides galvanic isolation to the vital inputs, there is no need of providing any surge protection devices for the vital inputs. But where relays are not used for isolation use of surge protection device as per the recommendation of manufacturer is mandatory.

The vital outputs from the SSI equipment to the field are through vital relays. Since output vital relays provide galvanic isolation, there is no need of providing any surge protection devices for the vital outputs. However, relay coil snubs are to be introduced across the coils of the vital output relays. Relay coil snubs are intended to dissipate large electro magnetic surges that are dissipated from the inductance of relay coils and to prevent these surges from interfering with normal operation of SSI system. Transzorbs type GE / Motorola 6KE62A are recommended for relay coil snub.

Noise reduction in the cables should be taken care of by using twisted cables for vital I/O from the termination racks. All the vital output cables from SSI equipment should be gathered in a bundle. Similarly input wires and power wires should be gathered in separates bundles. Each of these bundles should be physically separated from each other (preferably 6") and all bundles should be physically separated from other house wiring. It is particularly important to maintain this physical separation from high current "dirty" wiring.

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6.7.3 SERIAL INTERFACE PROTECTION REQUIREMENTS

Whenever it is necessary to connect SSI serial ports, which are not located in the same equipment room, some type of communication device should be introduced. This communication device MUST provide serial common isolation and secondary surge protection.

It is to be noted that the serial commons for all the SSI serial ports are connected directly to negative vital battery (N12 of the power supply board input) and each other. This means that anything connected to serial port signal common is also connected to negative vital battery. So any device connected to SSI through serial ports is connected to the negative vital battery through SSI. It should be noted that most commercial data modems or computers connect their serial common to earth ground in some day either directly or through a low resistance. This condition creates a problem since it introduces a connection between negative vital battery and earth ground, as SSI requires negative vital battle floating from earth ground for trouble free operation. This effectively means that devices like commercial modems and computers should be connected to SSI serial ports through serial line isolators, which provides a high level of isolation between its inputs and outputs.

Isolation between serial commons is also necessary when connecting two SSI equipments that are powered from different batteries. As the battery for SSI equipments considered to be vital and are required to float with respect to ground, significant potential difference call develop between battery negatives. These potential differences can wind up being equalized by the connection between serial commons. Interconnection between battery commons by any means is not a recommended practice. This situation can be remedied by introducing a serial line isolator between SSI equipments that are connected to different batteries.

All the serial ports that are connected to SSI from computers or other modems or serial port from another SSI powered by different battery should be connected through specified serial Optoisolators (e.g. B&B electronics serial optoisolator model 9POP4 has been used in KGP division of SE Railway in all SSIs. The 9POP4 isolator provides 2500 V isolation between its DTE and DCE sides and protection against lightning damages).

Operator VDU computers can be provided as standby operator panels. These Operator VDU computers are placed in panel room. The RS232 standard serial ports from computers and SSI equipment supports a maximum distance of only 50 feet. In stations where, the distance between the panel room and the SSI equipment room is more than 50 feet, the RS232 standard signals are converted to RS485 standard which supports a longer distance. In such cases, B&B electronics RS232 to RS485 converters type 485LDRC or similar should be used. These converters offer an isolation of 2000 V AC and surge suppression between its input and output. Wherever, 485LDRC converters are used, Optoisolators are not necessary as the converters provide in-built isolation also.

6.8 EMI PROTECTION

6.8.1 Electro Magnetic Interference Concepts

Interference fields arising in the environment can disturb a device and the operation of the device can at the same time itself produce interference that affects the environment. . This applies both to industrial applications and to applications used in the home. The basic demands made on devices with regard to electromagnetic compatibility (EMC) are thus:

(a) Attainment of a defined interference immunity (protection against external in1.erference fields)

(b) Prevention or reduction of emitted interference (protection for the environment against own interference fields)

Possible sources or subjects of electromagnetic disturbance are:

(a) Mains connection cables

(b) Signal and control cables

(c) Electrical of electronic modules which emit electromagnetic fields or which can themselves be disturbed by such fields

The EM coupling between all the electrical and electronic circuits within a zone and the environment outside the zone is controlled using filtering and shielding (and other techniques such as optical isolation of fibre optics) at the zone boundary.

There are five types of EM coupling which may need to be controlled at zone boundaries.

(a) Common impedance conducted coupling

(b) Conducted coupling other than common-impedance

(c) Capacitive radiated coupling

(d) Inductive radiated coupling

(e) EM field radiated coupling

Conducted coupling can occur through anything metallic. It can also occur through conductive liquids such as impure water, some industrial solvents, and materials such as soil and human bodies. Common impedance coupling is caused by the inevitable impedances in common electrical circuits, most usually 'the earth' or Common Bonding Network and shared power supplies such as AC (mains) or DC. Techniques for reducing common-impedance coupling are use of different supply distribution transformers for different categories of equipment and the use of MESH-CBNs and parallel earth conductors (PECs). Other conductive coupling is usually due to metallic signal interconnections. Noise coming out of the signal connection port of one unit is connected via signal cables to the signal port of a different unit. Often the best way to eliminate conducted coupling is not to use conductors at all. Electronic units with built-in power sources communicating by wireless (radio), infra-red, laser, or optical fibres (metal-free types) and having no metallic conductors attached to them at all clearly can't suffer conducted coupling. Even where cables are used, conducted coupling can be reduced by galvanic isolation techniques such as 1:1 transformers and optoisolators. Some of these may need to be combined with filters to give broadband isolation.

When cables carry signals or noise with a wavelength comparable with the cable's length then they start to behave as quite efficient RF transmitting antennas - launching EM plane waves (radio waves) into the air - to be picked up by other conductors behaving as RF receiving antennas. Radiated coupling travels through the air, but also travels through wood, glass, plastics, fiberglass, insulating liquids and gasses, and vacuum. There are a number of ways of reducing cable-radiating efficiency such as by using twisted pairs and/or screening.

Parasitic' or 'stray' capacitance and mutual inductance between conductors causes capacitive and inductive coupling, traditionally known as cross talk. Both are reduced by increasing the spacing between source and victim conductors and running them close to PECs (Parallel Earth conductors). .

6.8.2 ELECTRO MAGNETIC INTERFERENCE (EMI): SHIELDING

Shielding the equipment is most effective way of dealing with EM coupling between different zones. Equipment must be shielded to minimize the susceptibility to radiated fields. Shielding can be achieved by locating the equipment in cardfiles that are as fully enclosed as possible by means of external enclosures, where such enclosures are appropriate for the equipment under consideration.

Most of the electrical and electronic equipment are supplied in metal (or metallised) enclosures. It is often most cost-effective to make the enclosure the zone boundary, and make the manufacturer of the equipment deal with all the necessary filtering and shielding (and surge suppression, optical isolation, mains harmonics etc.). Shielding a zone or a room, which is not an equipment enclosure, is governed by the same physical laws of shielding as the shielding of an enclosure. A three-dimensional MESH-CBN with very low resistances can attenuate external very low frequency fields within a zone. So steel framed building under an overhead power line or near an OHE can reduce the 50/60 Hz electric field to one-twentieth of the level present outside. But the low frequency magnetic fields created by the currents in the overhead lines have very low impedance and are difficult to reduce with shielding because the skin depth at such low frequencies would require very thick metal surfaces. The three-dimensional mesh created by a MESH-CBN is also more effective at shielding at these frequencies with the shielding effectiveness (SE) achieved related to the size of the mesh. Mesh sizes not exceeding 3 or 4 metres are recommended for helping to protect zones against the effects of lightning. A much smaller mesh can easily be achieved by electrically bonding all the re-bars used in the concrete construction of a building, along with any metal-lined roofs or floors at each cross-over and joint (needs to be planned early). If it is not possible to join all the rods these must be at the interval of 1 m each.

Cladding a room with mesh, or expanded metal can provide quite acceptable -values of shielding effectiveness provided that all the seams are bonded along their lengths. Where the

zone is a subset of a room, a framework may easily be made using equipment rack of suitable material and metallic paint with its body connected to the CBN of the room. Higher conductivity, higher permeability, or thicker materials are all good for improving protection against lower frequencies. Higher conductivity materials with small apertures are good for high frequencies.

Aluminum and steel are the two materials that are being considered in high lightning areas in electrified territory. The important parameters for the electromagnetic shielding are the permeability below 1 KHz and the absorption loss and reflection losses above 100 KHz.

Steel has superior permeability, but lacks in the losses category. However, the thickness of the steel case makes up the difference in the railway environment. In a very strong RF field all seams, doors, hinges and vents would need to be gasketed to prevent disruptive RF fields from reaching the equipment. As the equipment card file is made of steel material and the equipment rack is also a steel rack used with gasketed doors, the equipment is protected from the EMI interference. There is no need to have special EMI shielding. However for extra sensitive equipments like SSI in heavy lightening prone area room can be shielded with mesh of copper wire (.5 m -1.0 m) bonded to RES of the room.

Shielded cables are very effective in minimizing susceptibility to fast transient and conducted disturbances. Shielded 110 cables should be used to the fullest extent practicable. This is especially true for serial link cables.

There is a confusion existing in grounding the shield. The conventional view point is that cables should be grounded at one end only at low frequencies and at both ends for high frequencies. This practice is valid in the case of circuits that use the ground plane as a return path. The transition point from low to high frequency occurs at 5 times the shield cutoff frequency, which varies according to cable type. Typical values of shield cutoff frequency range from 600 Hz to 7 KHz. The objective is to maximize immunity to external magnetic fields by reducing total loop area of the circuit, which is accomplished by forcing noise current to return through the shield rather than the ground plane. This only occurs at higher frequencies, where the shield impedance becomes small compared to the ground plane impedance. At lower frequencies, the effect of IR drop produced in the shield tends to predominate, producing an effective noise voltage in the circuit.

However in the case of ungrounded circuits, the preceding analysis does not apply. Since most applications are ungrounded circuits. in which neither the shield nor ground plane are part of the return path, the following cabling practice should be followed:

Utilize twisted pairs 10 minimize the effects of low frequency magnetic fields.

For short cables (both ends in the same room) ground shields at both ends to minimize the effects of high frequency noise. This is the preferred configuration in installations where an equipotential grounding system exists.

For long cables (between signal rooms), there is a possibility of significant differences in ground potential between locations. This could lead to high levels of circulating current in the shield. In such cases, the shield should be floated at one end and insulated to prevent inadvertent current.

As much as possible, cable shields should be bonded to the outside skin of the enclosure, at the point of cable entry. A wire poked through an aperture in a shielded enclosure will completely destroy any shielding effectiveness (SE). Figure 6.8 shows the main aspects of how to install a shielded enclosure without ruining it. The screens and connectors (or glands) of all screened cables that penetrate a shielded enclosure and their total bonding, are as vital a part of any "Faraday Cage" as the enclosure metal work itself. The thoughtful assembly and installation of filters for unshielded external cables is also vital. Pigtail connections to the shield have been shown to negate the overall effectiveness of the shield and are to be avoided. Grounding should be accomplished by direct contact between the shield and enclosure.

6.8.3 NOISE REDUCTION CHECK LIST

The following check list is intended to summarize the commonly used noise reduction techniques that can be applied to S&T installations

(a) Enclose noise sources in a shielded enclosure

(b) Place sensitive equipment in sensitive enclosure

(c) Relay should be provide the some form of surge damping

(d) Twist and shield noisy leads together

(e) Ground both end of the shield used to suppress radiated coupling

(f) Twist low level signal leads

(g) Place low level leads near chassis

(h) Shielded cable used to protect low frequency, low level signal leads should be grounded at one end only.

(i) Separate the low level signal leads and noisy leads

(j) Keep main hardware ground separate from circuit grounds

(k) Keep ground leads as short as possible

(l) Keep the length of leads extending beyond cable shield as short as possible

(m) Use conductive coatings in place of non conductive coatings for protection of metallic surfaces

(n) Separate noisy and clean leads

(o) Filter or decouple any leads entering enclosure containing sensitive equipment

(p) Avoid ground loops in low-level circuits. Opto couplers, isolation transformer common mode chokes etc can be used for breaking ground loops.

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CHAPTER-7: AXLE COUNTERS (UNIVERSAL & DIGITAL)

7.1 INTRODUCTION

This chapter covers the planning guidelines for axle counters, their installation, testing and commissioning for track circuits and BPAC applications. The concepts and practices described in this chapter apply to Analogue & Digital Axle Counters. The additional special requirements of Digital Axle Counters of various make in use on Railways are specifically indicated separately.

7.1.1 Important Notes

(a) The Analogue / Digital Axle Counters sets shall always be procured as per the latest specifications and amendments conforming to IRS specifications or cross acceptance as approved by RDSO, wherever applicable.

(b) Any additional installation, adjustment, testing and maintenance feature specific to a make of axle counter shall also be followed along with these concepts and practices.

(c) Axle counters shall always be got installed through the manufacturer and to ensure this necessary condition should be incorporated in the indenting documents irrespective of the procurement mode.

7.1.2 List of abbreviations used

AC	Alternate Current
ACE	Axle Counter Evaluator
Ah	Ampere Hour
Amp.	Ampere
BPAC	Block Proving by Axle Counters
CRO	Cathode Ray Oscilloscope
DC	Direct Current
DWC	Double Wall corrugated
EJB / EJBs	Electronic Junction Box/ Electronic Junction Boxes
EVR	Evaluator Relay
Fig.	Figure
GI	Galvanised Iron
HFTC	High Frequency Track Circuit
IBS	Intermediate Block Signal
IEC	International Electro-technical Commission
IRS	Indian Railway Specification
IS	Indian Standards
K	Kilo
Kg.	Kilogram
KM	Kilometer

MFVR	Maintenance Free Valve Regulated
mm	millimeter
mV	Milli Volt
PCB	Printed Circuit Board
PF	Platform
PVC	Poly Vinyl chloride
No.	Number
RDSO	Research Design and Standard Organisation
RE	Railway Electrification
RX	Receiver
SEM	Signal Engineering Manual
SM	Station Master
Sq. mm	Square millimeter
SPN	Specification
SSDAC	Single Section Digital Axle Counter
MSDAC	Multi Section Digital Axle Counter
SUPR	Supervisory Relay
TX	Transmitter
Ver.	Version
μF	Micro Farad

7.2 PLANNING GUIDELINE FOR AXLE COUNTERS

7.2.1 Axle Counters Plan & Material schedule

(a) Before taking up installation of Axle Counters, it is necessary to draw the complete scheme of Axle Counter plan on the signalling / interlocking plan of concerned station or section, assess the requirement of No. of Axle Counters, quantum of materials schedule and define the system of working and resetting. These information and data are the key components for finalizing room size, cable plan, power supply and trolley suppression track circuits arrangements (Analogue & Digital).

(b) The track circuits / track section to be controlled through a single entry or multi entry axle counters shall be marked in the signalling plan. The Track Sections must be longer than the maximum wheelbase of the trains.

(c) The locations of entry / exit points i.e. detection point shall also be marked for the corresponding axle counters, to work out requirement of (transmitter / receiver coils) / track devices, EJBs / trackside unit.

(d) Transitions of Track Sections to other train detection by overlapping of the neighbouring Track Sections are necessary to ensure that continuous train detection.

(e) The Track sections shall be marked with their names. The detection points shall also be marked with their names and positions.

(f) In digital axle counter a maximum of 3 detection points can be assigned to a track section and a maximum of 2 Track Sections may be assigned to one detection point.

(g) The Conditional Hard Reset (Cooperative) or line verification resetting locations as the case may be shall also be indicated on the plan.

(h) The axle counter reference direction must be defined for the complete layout, independent of direction of travel of the trains and turn outs and cross over encountered along the line. The use of the axle counter reference direction will ensure that the correct order of counting into and out of a Track Section is maintained throughout a series of detection points. Without the axle counter reference direction the system cannot be correctly configured.

(i) Required quantity of single entry or multi entry axle counters or both along with EJBs and (transmitter / receiver coils) / track devices, shall be worked out based upon key plan prepared above.

(j) In case of Digital Axle Counter, its configuration shall be decided based upon the No. of track sections / detection points. The No of central evaluator and their configuration for single section or multi section / entry also to be decided based upon this information.

(k) In case of multi section / entry Axle Counter or single section Axle Counter used for continuous Track Circuits, the common detection point or separate detection points for two consecutive track sections shall also be indicated in the plan and materials schedule worked out accordingly. This information shall further be used for making cable plan and deciding housing arrangements of EJB / trackside units and their interface cards.

(l) One SSADC is one pair (two units) named as Entry & Exit units for monitoring single section. The one SSDAC system comprises of a set of Axle Detectors i.e. Tx coils & Rx coils, SSDAC 2 Nos each, Deflectors for Axle Detectors and a Reset Box for common resetting and 2 Nos. for independent resetting. Event logger card although it is part of axle counter, it shall be specifically mentioned while procuring to avoid ambiguity.

(m) In analogue axle counters the common track device & EJB can be used for two evaluators, if the distance between EJB and evaluator is not more than 2 KM. The parallel connection of channels should be made in axle counter room.

(n) The EJB and its type shall be suitably selected depending upon the plan to feed the output of common detection point to one or more multi section / entry axle counters or single section axle counter for continuous track circuit applications.

(o) Provision of interface units shall be made for EJB / trackside unit of digital axle counter when the output of common detection point is fed to more than one evaluator.

(p) Relay rack and relays for BPAC with universal Axle counter, Receiver and transmitter multiplexer, EJB with 4 W / 2 W converter card and combiner/converter card and SM's panel for BPAC, all in two numbers for each block section are required.

(q) The reset box / reset relay circuit as per the requirement shall be specifically procured in addition to Axle counter.

(r) Track device cable lead from track to location housing EJB / trackside units shall be taken into the DWC pipe laid through out its length from track to the cable terminals in location. This will make the replacement easier. The arrangement is shown in Fig 7.1.

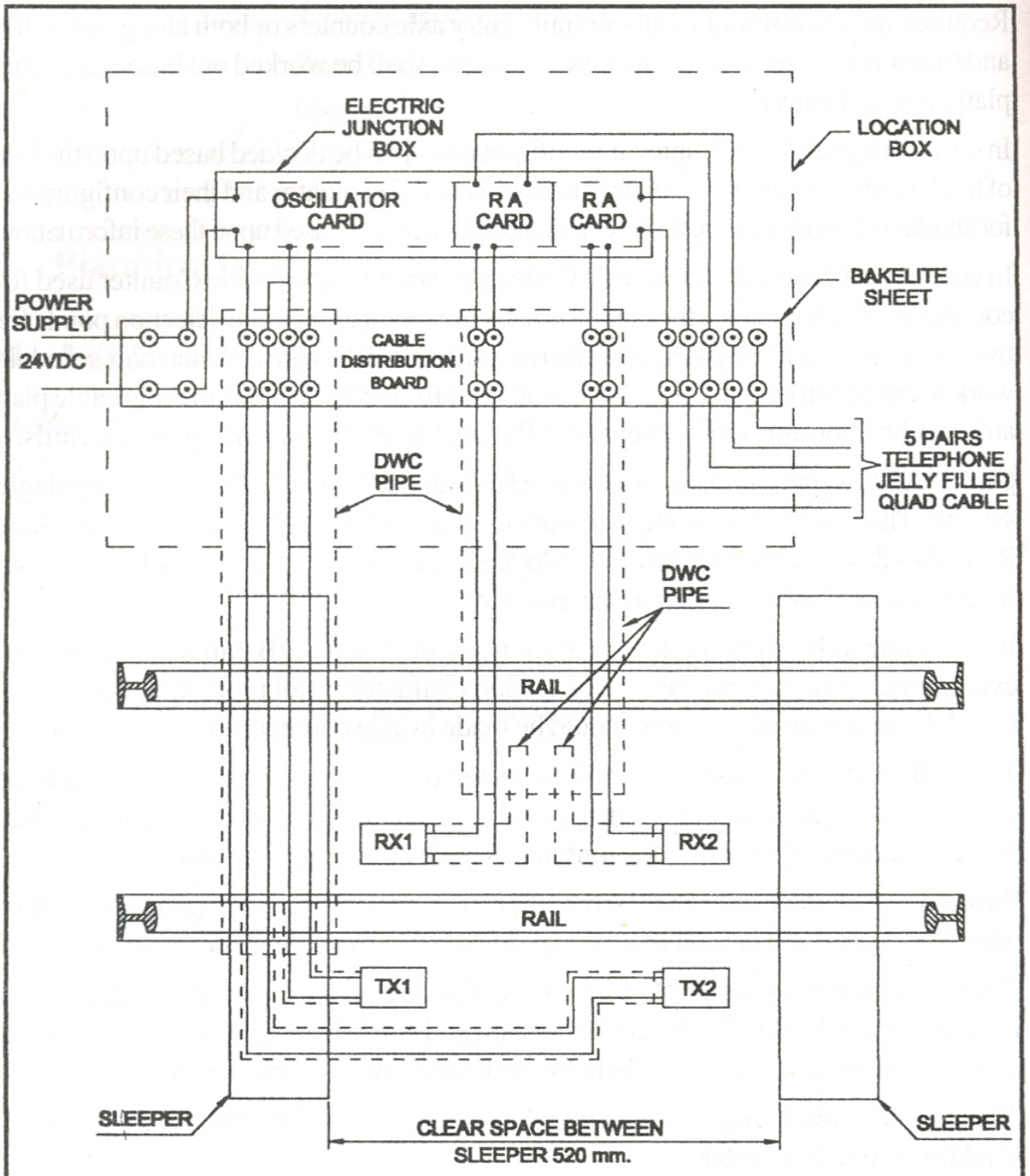

Fig. 7.1 DWC Pipe protection for Track Device Lead Cables

NOTE

THE CABLE CONDUCTOR LENGTH BETWEEN LOCATION BOX-RAIL INDUCTOR SHOULD NOT EXEED 15 METRES.

(s) DWC pipe of IS standards IS-14930 Part II/BSEN 50086 shall be used.

(t) The requirement of location boxes / hut shall be decided after finalizing the axle counter plan and material schedule.

(u) The deflectors on either side of the detection point / track device shall be provided with 'Yellow' reflective strip on its outer surface, so that-the location of track device is conspicuously visible while carrying out track maintenance work during night through machines and damages are prevented. These requirements shall also be taken into consideration while preparing the material schedule.

(v) The portable test unit consisting of Test case, Measurement adapter with diagnostic plug, Digital voltmeter and Dummy wheel including a cable for connection to a special diagnostic socket on the sub-rack of the axle counter, shall also be procured for digital axle counters or as prescribed by manufacturer.

7.2.2 Axle Counter location & space requirement

(a) The working space of about 0.60 - 0.80 Mtr. shall be kept on front and backside of axle counter evaluator unit and generally a room size approx. 6 Mtr. x 4 Mtr. is adequate to house 12 evaluators in 3 rows of 4 Nos. each. The size of the room can be proportioned according to the actual requirement and future plans. The arrangement is shown in Fig 7.2.

(b) The Axle Counter room shall be designed to create a dust free environment inside. The platform for keeping axle counters, duct / ladders for wiring from axle counters to cable terminations and other works like ventilators should be completed well before final finishing of axle counters room is done.

(c) The Axle Counters floors shall be provided with glazed tiles / PVC flooring so that it does not accumulate dust and can be cleaned easily.

(d) Normal windows shall not be planned in the Axle Counters room. Instead of windows, ventilators with dust filters should be provided on the opposite walls. No other opening other than ventilators need be provided in the axle counters room. Drawing No. 6102 Typical Details of Pressed Steel Ventilators are shown in Fig.7.3.

(e) The direct opening of door into the axle counter room from outside shall be avoided as far as possible. A flush door leaving no opening at the top or bottom for dust to come in, with entry through other room shall to be provided.

(f) Axle counters may also be housed in relay room, if adequate space is available.

(g) In cases where there is only a single axle counter / evaluator and there is no alternative accommodation available, it can be provided in the location box.

(h) Trackside unit / EJB of Single Section Digital Axle Counter / Evaluator, which are located along with trackside equipment near detection points to be housed in the location box or a suitable hut. EJB of Analogue Axle Counter to be housed in the location boxes.

(i) All the location boxes / Junction Boxes housing axle counters / evaluators / EJBs should be painted with thermal resistance paint on the external surface to reduce the inside temperature.

(j) In case of axle counters & relay racks for BPAC, the location shall be as close as possible to SM/Cabin Man Room because a standard 15-meter long cable is provided with the system for connecting SM's panel to relay rack. Therefore while finalizing space arrangements, it should be ensured that the distance between SM's panel and relay rack does not exceed 15 Mtr. However, in special cases, 25 Mtr. long cable can be used and procured. The distance between SM's panel and relay rack should in no case exceed the maximum limit of 25 Mtr.

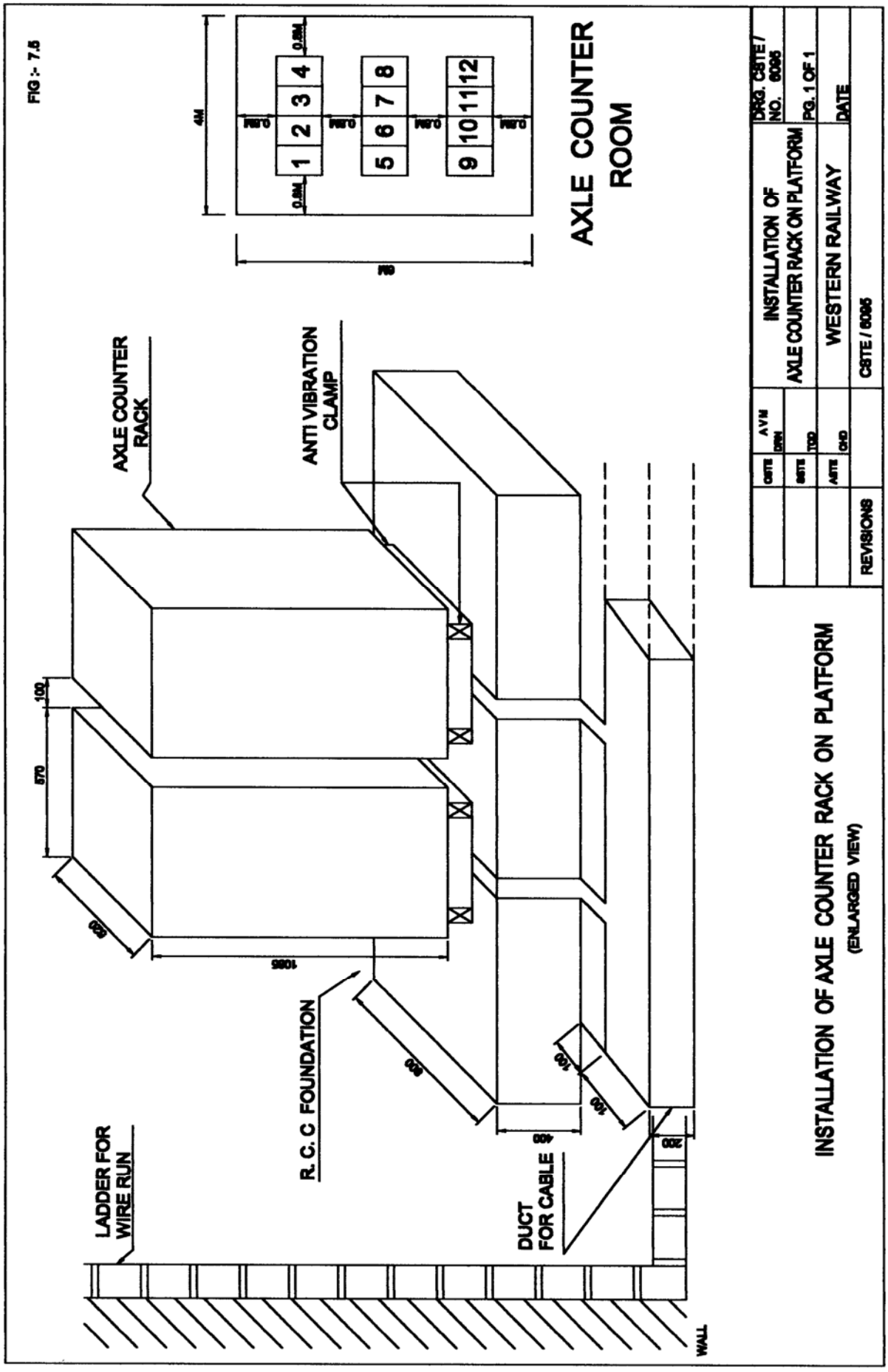

Fig: 7.2 Installation of Axle Counter Rack on Platform

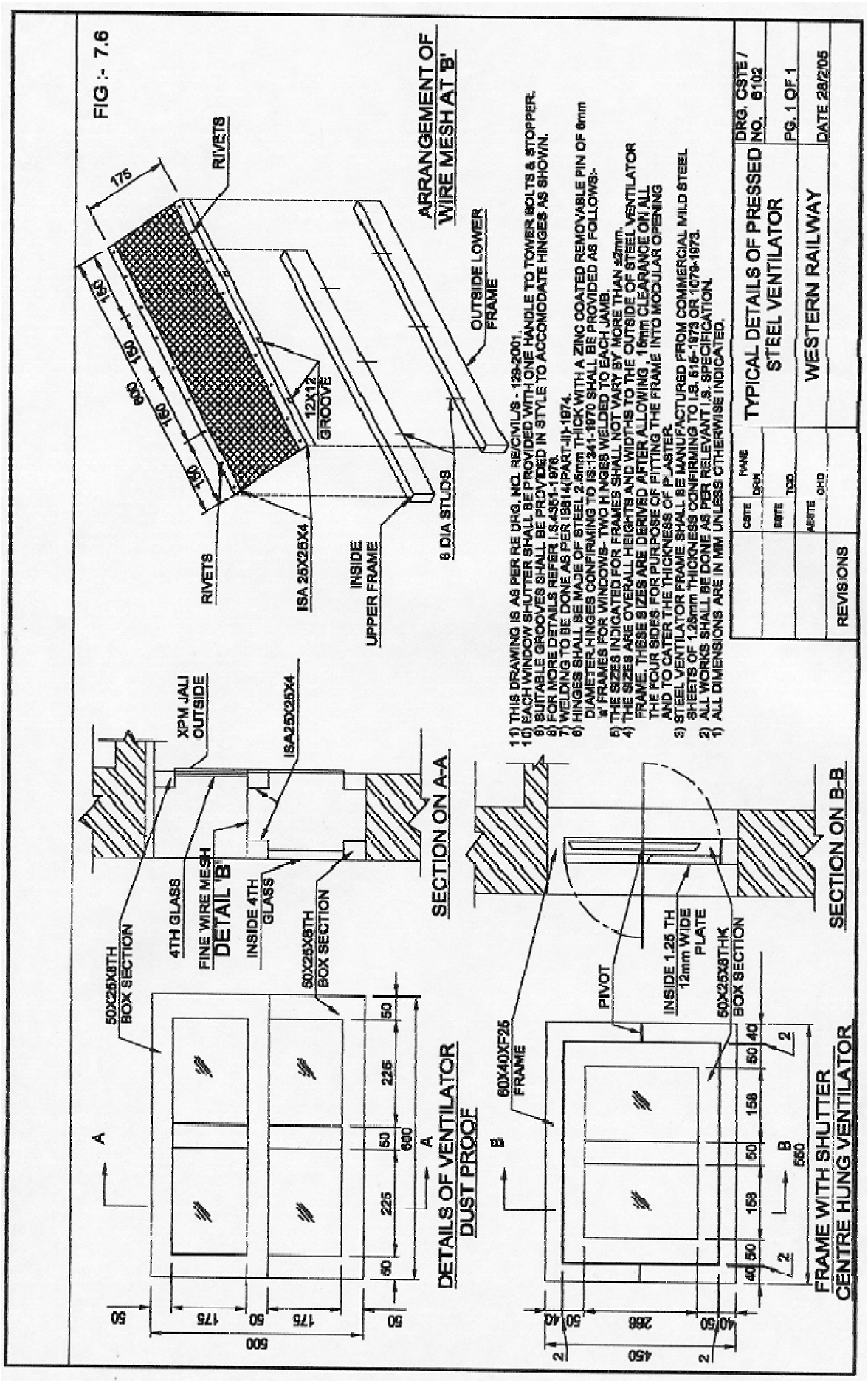

Fig: 7.3 Detail of pressed steel Ventilators

7.2.3 Trolley Suppression Track Circuit

(a) Trolley Suppression Track Circuits wherever required, shall be provided for Analogue Axle Counters in the section where trolley are used, to prevent the operation of Axle Counters by insulated wheels. It shall be of close type.

(b) In Phase reversal type Axle Detectors, track circuit connection into the system is not required for trolley suppression.

(c) The requirement of number of Track circuits has to be worked out taking into consideration the existing track circuits, electrical detectors / point machine detection and route section relays that can also be used for this purpose.

(d) Track circuit boundaries of the existing track circuit portion wherever available in the vicinity of detection point, can be utilized by locating the detection points within it.

(e) The electrical detectors / point machine detection, route section relays, contacts of approved relays to be used for Trolley Suppression Track Circuit to reduce the No of additional track circuits. Trolley Suppression Track Circuits for 2D, 3D &4D Axle Counters are shown in Fig.7.4.

(f) In completely non-track circuited areas or wherever feasible, HFTC can be used as Trolley Suppression track circuit to eliminate the need for a glued joint / insulated block joint.

(g) Shelf type track relay or line relay shall not be used for Trolley Suppression Track Circuit.

(h) Track circuit length and the location of detection point to be decided depending upon the direction of movement. The standard length stipulated in SEM 17.43.5 to be used keeping in view and considering the provision of 17.43.3 & 17.43.4.

(i) **SEM17.43.5** - Subject to consideration in 17.43.3, 17.43.4 & 17.43.8, the distance between track device and insulation joint / glued joint of track circuit in the direction of movement shall be as per following table:

Speed in kmph	Min. distance for 'Q' style relay
15	1.0 m
50	6.3 m
90	12.5 m
100	13.8 m
120	16.6 m
140	19.5 m
160	22.2 m
200	27.6 m

(ii) **SEM 17.43.3** -The trolley protection track circuits shall be of adequate length to permit the track repeater relay in the cabin to drop before the first wheel comes within the sphere of influence of track devices. Since the track repeater relays in AC electrified areas are AC immunized and slow to drop, the length of track circuits has to be carefully decided to prevent malfunction of the axle counter.

(iii) **SEM 17.43.4** - On double line section where shunting movements are frequent in the opposite direction, track circuit length shall be such that even during the opposite shunt move the track repeater relay de-energizes before the first wheel comes within the sphere of influence of track devices at the maximum shunting speed.

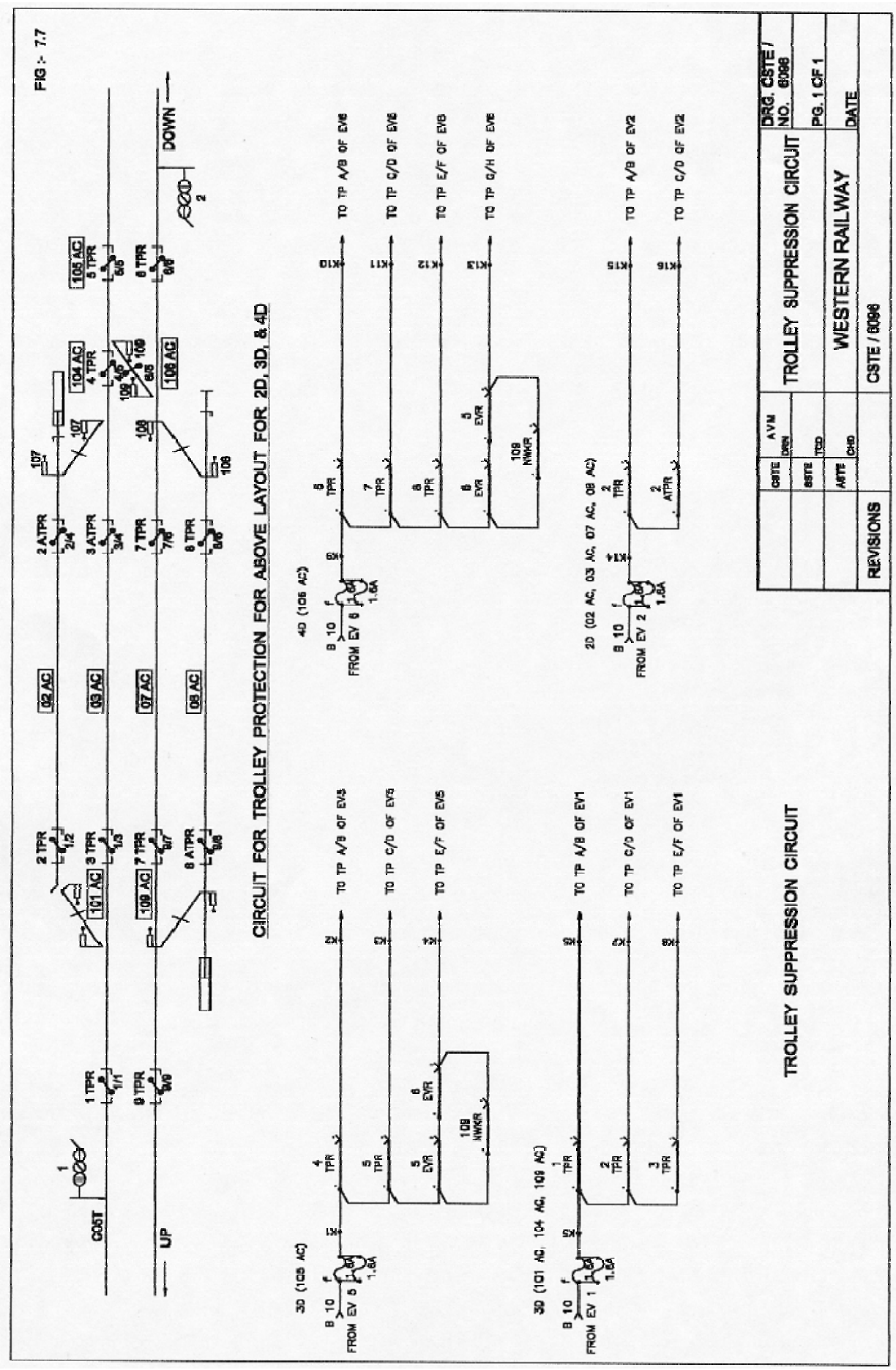

Fig: 7.4 Trolley Suspension Circuit

(i) In case the trolley suppression track circuit is taken to other station through multiplexer or other carrier system, length of the track circuit shall be suitably increased on either side to compensate for the time delay in transmission.

(j) On electrified sections, a minimum distance of 20 meters shall be maintained between the rail inductor and the nearest block joint, in case of double rail track circuits

7.2.4 Power Plant

7.2.4.1 General

(a) Power supply to axle counters/BPAC can be fed through IPS by catering DC-DC converters, Battery and chargers or through independent DC-DC converters with main and standby connected to external battery sets if available at a location/station.

(b) Battery chargers suitable for axle counter only, as per IRS specifications depending upon the type of batteries i.e. maintenance free or low maintenance being used shall be provided.

(c) Peak to Peak noise voltage shall be less than 50mV at full load for battery charger fit to be used with axle counter and IPS module (Ref: clause 5.4.2 of IRS: S.86/2000 for battery charger & clause 9.5.23 of RDSO/SPN/165/2004. This requirement should be clearly mentioned while procuring. Additional condensers filter of 5000 μF can also be provided to reduce to the noise voltage, when it goes beyond the limit.

(d) Power supply for EJB / Trackside unit shall be extended from the same set of power equipment except at the scattered locations where power supply of one evaluator can be used for EJB / trackside evaluator of other.

(e) 6 Sq. mm multi strand insulated copper conductor to be used for wiring of power supply equipment to connect battery charger from mains, charger to batteries and battery to load / distribution.

(f) Multiple and redundant fuses shall not be provided in power supply distribution system. Only one fuse at the input and output of charger shall be provided with each in parallel dividing the total capacity into 2 fuses. The charger fuses, if any other than this, shall be made through.

(g) Power supply from batteries for the axle counters / EJBs / trackside unit, shall be distributed by connecting these through individual fuses in parallel, from bus bar. The common fuse at battery supply before distribution fuses shall not be provided.

(h) Battery charger and battery alarm indication for each set of power equipment to be provided at all the manned location and also at remote locations wherever feasible to extend.

7.2.4.1 Specific to Universal Axle Counter

(a) DC-DC converter module of 24 Volt 5A shall be catered in the IPS wherever provided. The normal load of a 2D axle counter including EJB is 1.5 A and 2.0 A of 4D. Generally 3 sets of 2D or 2 sets of 2D and one set of 4D are connected to the each DC-DC converter module in n+1 configuration. Depending upon the total axle counters and load thereof the number of sets of DC-DC converter module each in n+1 configuration shall be provided. At non-IPS location chargers and battery shall be provided.

(b) The capacity of maintenance free or low maintenance batteries shall be chosen to normally 200 Ah in Non-RE areas and 120 Ah in RE areas or depending up on power availability in the area. Battery charger for these batteries shall be of capacity 30 Amp and 20 Amp respectively.

(c) Composite battery bank 6 Volt or 12 Volt set can also be provided where power equipments are installed in location boxes / cabin basement for continuous track circuiting / isolated applications.

(d) The No. of Analogue axle counters to be connected to a set of power supply equipments consisting of batteries and charger shall be restricted to 4 for 2 detection points and 3 for multi detection points axle counters.

7.2.4.2 Specific to Single Section Digital Axle Counter (CEL)

(a) Single section digital axle counter shall be grouped for connection to common power supply equipment set or individual power equipment, depending upon the locations.

(b) The current consumption of each SSDAC unit is 0.8 A and of complete system (2 SSDAC units) 1.6 A at 24 V.

(c) Normally a set of 24 V, 5 A Battery Charger with 24 V, 40 AH low maintenance battery is required for each SSDAC location. It shall be installed and connected to battery on auto mode. Based on the above load the number of SSDAC to be connected to a set power equipment or capacity of it shall be decided.

(d) In IPS, 24 V, 3 Amp module of DC-DC converter in n+1 configuration shall be provided for a single or pair of SSDAC. In case of more equipment, the DC-DC converter of 5 A capacity in n+1 configuration based upon the total number of SSDAC shall be provided.

7.2.4.3 Specific to Single / Multi Section Digital Axle Counter (Eldyne)

(a) Individual set of power equipment and batteries to be provided for each central evaluator of digital multi entry axle counter.

(b) The Single section Axle Counter works on DC input voltage in the range of 21.5 V - 27.6 V (24 V version) or 55 V -124 V DC (60 - 120 V version). The DC input range shall be specifically mentioned while procuring.

(c) To power consumption of ACE equipped with one evaluator board is typically 17 W / 14 W + cable losses. If two evaluator boards are used for on detection point then consumption is 5 W more.

(d) The capacity of charger and battery or DC-DC converter set each in n+1 configuration for IPS locations shall be decided based on the above power consumption and the number of ACE connected.

(e) The trackside equipment also works on 24 V DC or 60 – 120 V DC for which power supply to be extended to the location.

7.2.5 Cable plan

(a) The requirement of cable size and conductor's cross-section shall be decided from Axle Counter plan and the distances of detection points from evaluator.

(b) Normally 4 conductors are required from EJB to Axle Counter evaluator for single section analogue Axle Counter. If the distance from EJB to evaluator is more than 2 KM, additional two pairs of conductors shall be catered for feeding the EJB output to two axle counters.

(c) The double line block system with universal axle counter and multiplexer requires only one and a half quad cable for the block operation.

(d) Digital Axle counter normally requires two conductors from each EJB / trackside evaluator to central evaluator or between evaluator to evaluator in case of single section Axle Counter. (Fig. 7.7, 7.9).

(e) The additional pair of cable conductors between stations to station or station to location as the case may be, shall also be catered for Conditional Hard Reset (co-operative resetting) feature and also for preparatory reset of SSDAC.

(f) OFC channels can also be used between stations for no signal loss, in preference to copper cable.

(g) Two wires per detection point are required for the power supply to the detection point of digital axle counter.

(h) The maximum length of section of digital axle counter is limited by the power supply to the detection point or if the detection point is locally fed by the data communication between the detection points of the ACE. Normally, maximum transmission distance is 13 Kms. with the cable having resistance of 56 Ohm/Km.

(i) Calculation of induced voltages in the cabling shall be done to ensure that the noise is within the tolerance prescribed by the manufacturer.

(j) The output of EJB shall not be looped at cable termination in equipment room for feeding to two axle counters, if distance of track device is more than 2 KM. These shall be brought from EJB locations through separate pairs of cable conductor connected to second output of EJB.

(k) The cable for each EJB / trackside evaluator shall be terminated in the individual location boxes. If more than one each EJB / trackside evaluator are used at a place, the main cable shall be terminated in a location box and then taken to individual location boxes through separate cable.

(l) Cable size shall be suitably selected considering the above requirements and keeping sufficient spares. In case of big yards, directions / line wise segregation of cables shall be planned to avoid multiple failures.

(m) The type of quad cable and RE / Non-RE shall be selected with minimum size of 0.9 sq. mm conductor. In RE area, PE insulated Quad cable to specification TC – 14, axle counter cable to specification TC – 30 or PIJF Telecommunication cable to specification TC – 41 shall be used for transmission of signal between track side electronic equipment and evaluator. In non-RE area 4 quad cable to specification TC – 31 or PIJF Telecommunication cable to specification TC – 41 shall be used

(n) Normally quad cable shall be laid from evaluator to EJB / trackside evaluator. Paired telecommunication cable of approved type can also be used for these local connections.

(o) The special type of cable for carrying out channels from EJB / or trackside evaluators to central evaluator can also be selected depending upon its distance and as prescribed by the manufacturer.

7.2.6 Training

The concerned officers, supervisors and technicians installing and maintaining axle counters shall be trained for the type of axle counters being installed. Factory and field level training shall be given. Suitable clauses for these training shall be incorporated at the procurement stage, so that training becomes a part of procurement.

7.2.7 Spares

(a) Requisite spares shall be procured along with axle counters.

(b) Supervisor in-charge shall have the information of spares of various components of axle counter vis-à-vis the population of different type of axle counters.

(c) Each sectional supervisor shall have minimum a set of axle counters as spares along with its component for each type of axle counters installed in the section.

(d) New / repaired materials received as spares shall be first tested by putting it into live circuit for at least a week, than only it should be kept as spares.

(e) All the cards, equipment and spare components shall be kept completely wrapped with air bubble plastic sheet and ends sealed with tape or kept in thermocol containers so that they are not subjected to impact and dust.

(f) Card shall be placed vertically in the container so that PCB and soldering is not damaged.

(g) All the spares & cards shall be kept in a cupboard or thermocol box.

(h) The transportation of cards / axle counter equipment shall be carried in the sealed conditions with above protections.

(i) The transmitter / receiver coil or track devices or axle detector deteriorate over the period and channel / signal output variation is observed. These shall be planned for replacement in 3 / 4 years or early if there is wide variation in the channel voltage / signal output.

7.3 INSTALLATION OF AXLE COUNTERS

7.3.1 Installation of track devices

7.3.1.1 Installation of track devices – General

(a) Electrical continuity of track devices shall be checked before installation.

(b) Track devices shall not be fixed at rail joints or within the sleepers carrying rail joints.

(c) The track devices /detection units / Axle detector shall be fixed minimum 6 sleepers away from the nearest rail joint.

(d) On double- track lines the rail contact should be mounted preferably on the outside rail.

(e) The location must not have any variable horizontal magnetic short circuit windings, for example non-insulated steel sleepers with a poor electrical contact to the rails. To avoid problems three sleepers must be insulated from the rail on either side of the rail contact.

(f) The track devices of different axle counter system should be separated by 3 to 5 meters or as prescribed by the manufacturer to avoid mutual interference.

(g) Rail clamp of flange mounted track devices should be fixed in the space between two sleepers.

(h) The sleepers spacing at the track devices locations fixed on rail clamps should be minimum 550 mm.

(i) Rails on which track devices are fixed shall not be badly worn out beyond schedule of dimension and such rails should be got replaced to avoid grazing of wheel flanges over track devices.

(j) The hole for the web mounted track devices shall be drilled in the space between two sleepers considering the above principle. Care shall be taken to ensure that track device is aligned with the rail section, for proper measurement and marking for drilling hole using proper jig provided by the manufacturer.

(k) The normally the following method to be followed for drilling holes, unless specified otherwise by manufacturer:-

  (i) Grind off the embossments on the rail web.

  (ii) Fix punch guide/zig to the foot of the rail and set to the value depending upon Rail section or as calculated. Mark the position for the first two holes with the punch.

  (iii) Drill the first two holes.

  (iv) Insert a bolt into the center hole, which shall now be used as the new reference point for the punch guide/zig. Mark the drilling position for the third hole.

  (v) Deburr the drilled holes (45° equivalent to 1 mm depth) from both sides

  (vi) Clean the rail web with a wire brush before mounting the rail contacts.

(l) The fixtures of track devices shall be adjusted and should be suitable for fixing on 90R, 52 or 60 Kg. rails depending upon the track section.

(m) Track devices come with connecting cable. These cables should not be extended or cut during installation of maintenance.

(n) The standard cable length of track devices shall be maintained. Normally the track devices are provided with flexible cable of 24/0.2 of 10 meter length.

(o) The cable from track devices to EJB / trackside evaluator locations shall be taken throughout in DWC pipe up to the cable terminals in location boxes to facilitate easy replacement, whenever required. (Fig. 7.4 - Drawing No. 6094, Installation of Outdoor equipment & TX/RX wiring)

(p) Transmitter and receiver cables of individual track devices shall be laid in different pipes laid at minimum 1-meter depth from bottom of the sleepers.

(q) A separation of minimum 500 mm shall be maintained between cables of transmitter and receiver.

(r) The transmitter and receiver coils or the composite track devices of web-mounted type shall be fixed as per installation manual supplied by manufacturer.

(s) Rail deflector shall be provided on either side of transmitter / receiver or track device. These shall be fixed next to the track devices approximate 30 to 40 centimeters away or in the first sleeper spacing from track devices.

(t) The deflector plates shall be fitted on deflector clamp and secured properly through nuts and bolts.

(u) The deflector plates shall be corresponding to the transmitter and receiver size and shall be provided as prescribed by the manufacturer. Normally a smaller width is provided for transmitter and longer for receiver.

(v) The incoming cables from rail conductors / track detection devices and evaluator first shall be terminated on a cable distribution board to provide facility for testing oscillator / amplified units / track devices.

7.3.1.2 Specific to Universal Axle Counter

(a) A packing piece of 6 mm or as prescribed by the manufacturer should be provided to adjust the height of track devices for Universal Axle Counter.

(b) RX marking on base clamp should be on inner side of rail and TX marking should be on outer side of the rails.

(c) The base clamp wherever provided should be properly fixed and its nuts and bolts tightened and locked through lock washers to prevent its movement due to passage of trains.

(d) A proper gap shall be maintained between receiver coil assembly and rail web. It shall be in parallel with transmitter coil. The required packing may be made if needed for Universal Axle Counter.

(e) Proper staggering as specified by the manufacturers shall be maintained between the sets of two transmitter and receivers.

7.3.1.3 Specific to fixing of Axle Detectors of SSDAC (CEL)

Both at the entry & exist of the section, the axle detectors should be fixed on same rail i.e. either on left side or on right side rail of the track. (Fig. 7.7)

7.3.1.4 Fixing of Axle Detectors SSDAC (CEL)- Transmitter & Receiver Coil

(a) The Axle detector shall be fixed on web of the rail at the drilled holes by means of M12 bolts and nuts.

(b) M 12 x 100 mm – 3 Nos. bolts and nuts shall be used for fixing the axle detectors. Nut with Nylon Washer shall be used on each bolt.

(c) Transmitter coil assembly (21 KHz & 23 KHz) should be fixed on the outer side of rail. The transmitter assembly should sit properly on the web of the rail.

(d) Receiver coil assembly (21 KHz & 23 KHz) should be fixed on the inner side of rail. The receiver assembly should sit properly on the web of the rail.

(e) It should be ensured that transmitter coil assembly and receiver coil assembly are facing opposite to each other (21 KHz Tx to 21 KHz Rx & 23 KHz Tx to 23 KHz Rx) on either side of rail with centerline of coil matching each other.

(f) The Tx coil cables 21 KHz & 23 KHz are taken together in one DWC pipe upto the location box terminals. Similarly both 21 KHz & 23 KHz Rx coils are taken together but separately from Tx coils cables to the location box terminals.

(g) The incoming and outgoing cables from the Axle Detectors, SSDAC unit, modem and cable going to the remote SSDAC shall be terminated on M6 terminals inside the location box.

(h) All three M12 bolts must be tightened with torque wrench set of 88 NM.

7.3.1.5 Specific to Rail Contact Installation (Eldyne)

(a) The rail contact is to be fitted by three bolts to the web of the rail. The position of the respective mounting holes shall be marked and drilled depending on the rail section. The Tx heads are adjustable to adapt the system to a wide variety of rail profiles, fine adjustment can be done by electronic adjustment.

(b) All metallic parts shall be insulated from the rail by means of insulating bushes and insulating plates.

(c) Each Tx/Rx head is provided with fixed cables of 4 m length for connection to the electronic unit. If required, Rail Contact with longer cable lengths shall be procured depending upon the site requirement.

(d) The Rail Contact shall be at $\geq$ 1 m distance from a rail joint Fish plated or Welded or insulated joint and at $\geq$ 2 m distance from the rail contact of a neighbouring detection point.

(e) A punch guide or a drilling jig shall be used to ensure the correct position of the holes.

(f) Three 13 mm holes shall be drilled into the web of the rail. The middle point between two sleepers shall be taken as the reference middle for the mounting holes.

(g) The rail contact must be mounted on the rail in such a way that the Tx heads are on the outside and the Rx heads on the inside of the rail.

(h) The three M12 bolts must be tightened through the torque wrench set to 45 Nm

(i) Each Tx head is to be mounted on an aluminum casting with two M8 bolts. It shall be checked that the teeth and grooves of the aluminum casting and the Tx head are correctly lined up. The M8 bolts shall be tightened by means of the torque wrench set to 25 Nm.

(j) After tightening, the bolts shall protrude a minimum 2 mm, otherwise transmitter head and aluminum casting must be checked for proper fitting.

(k) The brackets for the protective hosing must be insulated from the rail through the nylon bushes, which are to be inserted into the holes of the bracket.

7.3.2 Installations of EJB / Trackside evaluator units and locations

7.3.2.1 General

(a) The locations of EJB or trackside evaluator units shall be erected as close as possible to the detection point such that the cable lead of standard length connected to track devices and as supplied by manufacturer does not fall short and shall be able to reach up to the terminals in the location box.

(b) It shall also be checked and ensured that the site is such that, location boxes including its door in fully open condition do not infringe with the schedule of dimension and are at minimum of 2.5 meters away from center of track.

(c) If due to unavoidable reasons like point and crossings at the locations of detection point involves track crossing, the provided cable lead of track devices may fall short, then track devices with longer cable length of 15 meters or as prescribed by manufacturer shall be procured and provided for these locations.

(d) The location boxes foundation, erection and fixing of shelf shall be carried out as per standard practices in vogue on the Railways. Care shall be taken to ensure that height of location boxes is kept more than rail level, ground level or flood level of the area which ever is more.

(e) The EJB / trackside evaluator of the different axle counters shall be installed in the individual location boxes.

(f) EJB / trackside evaluators shall be secured on the shelf provided on location box so that it does not displace or fall and fail due to vibrations.

(g) The couplers / connectors to EJB or trackside evaluators shall be fixed and secured tightly. The termination and connection scheme prescribed by the manufacturer shall be followed.

(h) The extra length of a cable from track device shall not be cut or jumbled up inside the locations. This should be dressed up properly in "ZIG -ZAG" manner or as prescribed by manufacturers.

(i) The power supply coming from relay room through distribution fuse for EJB or trackside evaluators shall be fed directly to EJB without any fuse.

(j) The power supply for EJB or trackside evaluator locations from equipment room / relay room shall be extended through 25 sq. mm aluminum or 10 sq. mm copper cable or of higher cross section depending upon distance, so that voltage drop is minimum and 24 Volt supply is available at the EJB / trackside evaluator locations.

7.3.2.2 Specific to Universal Axle Counter

(a) If the distance of a common detection point feeding two analogue evaluators is less than 2 KM, the output of EJB / track devices shall be paralleled in equipment room / central evaluator room for connecting channels to different axle counters.

(b) If the distance of common detection point feeding two analogue evaluators is more than 2 KM, the second output of EJB shall be used by removing the resistance in EJB card and channels brought to equipment room / central evaluator room through additional pairs of cable conductors.

7.3.2.3 Specific to BPAC with Universal Axle Counter

(a) Axle Counters used for block working applications require 2-wire system for EJB of remote end. The 4 wire / 2 wire converter card for EJB and 2 wire / 4 wire for axle counter evaluators of adjacent sections shall be procured and used.

(b) For detection of axles at the advance starter of sending end a 24V EJB with 4W/2W converter card to be used.

(c) The procedure of installation is similar except that the output of 2 channels (A & B) is available over a single pair of cable.

7.3.3 Installation of Evaluator / Central Evaluators / Relay Rack of BPAC

7.3.3.1 General

(a) Evaluator shall be installed on raised Platform of minimum 30 cm height or more so that the axle counter terminals and cards come at eye level, when they are attended by sitting on floor. The platform height can be further increased in flood prone areas and shall be more than flood level.

(b) Evaluators are normally in the vicinity of trackside room / location, therefore shall always be installed on anti vibration clamps fixed on the platforms.

(c) The Axle Counter locations as far as possible shall be avoided from vicinity of electro magnetic interference, like industrial machinery, motor / generator or welding plants.

(d) The evaluator / central evaluator units / relay rack of BPAC shall be installed and test conducted as per the installation manual prescribed by manufacturer.

(e) The output of DC / DC converter shall not be used for any other applications except evaluator or multiplexer.

(f) Shielded wire of minimum 1 mm diameter shall be used for wiring the evaluator, relays and channels from cable termination to evaluator. Power supply to DC/DC converter shall be connected through a separate 2 core shielded cable.

(g) Different connections of DC/DC converter, batteries and battery charger shall not be bunched with any other wires. The separation of minimum 150 mm shall be maintained of axle counter cable from any other cable bunch.

(h) The couplers / connectors shall be checked before fixing on evaluators, ensuring that all the connections are firm and soldering is proper. The couplers shall be properly tightened and there shall not be any looseness.

(i) Evaluators / supervisory / track section relays shall be plug-in type and mounted properly on the place provided on the evaluator.

(j) Evaluator or multiplexer card should not be removed or inserted without switching off power supply.

(k) The cards shall not be provided without aluminum plate.

(l) Recommended tools set and measuring instruments shall be procured along with axle counters. Installation and maintenance shall be carried out with these tools and measuring instruments.

(m) Installation and maintenance manual shall be supplied with every axle counters and available at each axle counter locations.

7.3.3.2 Specific to Universal Axle Counter

(a) A separate DC/DC converter shall be provided for each evaluator or multiplexer.

(b) DC/DC converter shall be fitted inside evaluators and DC supply connected in proper polarity.

(c) In trolley suppression track circuits, the contacts of Track Relay or its 1st repeater relay shall be used.

(d) The pick up voltage of the type of EVR and SUPR relays used shall be less than axle counter output.

7.3.3.3 Specific to BPAC with Universal Axle Counter, Relay Rack

(a) The relay racks to be installed at either end of the block section should have one odd and even serial number. This will automatically ensure the availability of two different sets of frequency for a block section. This care shall be taken while transporting the Double Line Axle Counter block system to the site to avoid inconvenience later during the phase of testing and commissioning.

(b) The axle counters to be kept at the receiving end of the line.

(c) Battery bank (+ 24V) supply connections to relay rack shall be made only at the final stage i.e. after completing and checking of all wiring. Power on switches of Tx-MUX, Rx-MUX must be kept in 'OFF' position and switched on only after ensuring the correctness of wiring.

7.3.3.4 Specific to SSDAC (CEL)

(a) One SSDAC Unit of the system to be used for BPAC is to be installed at each end of the block section (Block limits) along with one set of Tx & Rx coil Axle detectors.

(b) The entry unit is to be installed at the beginning of a section i.e. Advance starter and the Exit unit is to be installed at end of the section i.e. Home of block section. The units shall be connected to Axle detectors, vital relay, Reset Box and other wiring as per the wiring diagram supplied by the manufacturer.

(c) The SSDAC units installed for a Track section should not be both Entry type or Exit type for a 2-detection point track section. This may result in continuous Error in the system. To avoid mismatch, the same serial no. units should be installed for one track section.

(d) The cards must be inserted in order or card 1 to 8 from left to right in the sub rack. Card 5 is for Event logger that shall be specifically indented. The output pick up a Q Type Vital Relay 24 V, 1000 Ohm at both the locations.

(e) One Shelf should be provided in the location box for keeping SSDAC Counting Unit & Vital Relay Box.

(f) The SSADC is installed inside the location box and shall be firmly fixed using clamps, nuts & bolts.

(g) The Vital Relay box shall also be installed by the side of SSDAC, in the location box. The Vital Relay box shall be firmly fixed using clamps, nuts & bolts. The output from the SSDAC unit is to be connected to the vital relay. There is no adjustment required.

(h) Address setting is to be defined as per manufacturer's manual.

7.3.3.5 Specific to Digital Axle Counter (Eldyne)

(a) In RE area, it is necessary to ensure that the maximum induced voltage is not beyond the maximum isolation voltage of the equipment. The specified values are – Maximum continuous induced voltage = 250 V AC and Maximum transient induced voltage (0.1 s) = 1500 V AC.

(b) In continuous Track Circuit application a second slot for an evaluator board shall be used for using a single rail contacts to supervise a second neighbouring section. In multi-entry axle counter, an evaluator board with interface to the ACE of the respective multi entry axle counter system to be used.

7.3.4 Installation of SM's panel

(a) The SM's panel shall be installed in such a way so that the marked layouts of TGT / TCF provided on the SM's panel is in parallel to the train direction. In case of space or any other constrains, it may be installed as per the site requirement.

(b) The SM's panel should be installed on the operating table of the SM/Cabin man or as near as possible for easy accessibility.

(c) The SM's panel shall be mounted firmly on the table /stand by means of 4 Nos. of M10 x 50 mm bolts. The SM's panel should have sufficient space for opening the back door for connecting the M.S. couplers and for maintaining the circuits inside SM's panel. A hole shall be made on the table /stand at the cable outlet of SM's panel bottom for taking out cables from SM's panel to relay rack.

(d) The wiring of SM's panel with relay rack and relay rack to axle counter shall be carried out as per the installation manual & Wiring diagram standardized by the manufacturers.

(e) Stress relieving loops shall be provided inside SM's panel for relieving tension on the 15 Mts./25 Mts. cables.

(f) SM's panel shall be locked and sealed after completion of wiring, testing and commissioning.

7.3.5 Installation of Reset box

7.3.5.1 General

(a) Each resetting box shall be provided with a counter to count the every resetting action. Resetting box shall be placed in the SM's / Cabin Man room.

(b) The Rest Box to be firmly fixed to the table / stand by means of bolts & nut.

(c) Cooperative resetting shall be provided for the Axle Counter used for block working / IBS applications and continuous track circuiting for automatic signalling. The circuitry of cooperative feature shall be such that it shall not be possible for controlling station to reset axle counter system without the co-operation of far end verifying that the controlled track section is free from trains.

(d) Line verification box shall be provided outside SM office, near line or opposite the point and crossing location as the case may be, when axle counters are used in the station yard for main / loop line or point zone track circuiting.

(e) The system of resetting and procedure shall be in accordance with the current guidelines in force and circuit shall be accordingly designed. Normally all axle counters for straight application except for block proving shall have preparatory reset feature. Preparatory reset feature is not provided for the axle counters used for point zone track circuiting, because the alteration of the route or setting of point towards non occupied lines will be not possible, if axle counter fails after arrival of the train.

(f) Connection between resetting boxes and the cable termination shall be made through flexible / switch board cable taken in the DWC pipe / ladder.

(g) The Reset Box to be wired as per Manual supplied by manufacturers.

(h) The Rest box body to be connected to the earth in SM's room. The earth available for other equipment can be connected.

(i) The Reset Box top cover is to be sealed after wiring has been completed. The seal can be broken for maintenance etc.

7.3.5.2 Specific to SSDAC (CEL)

(a) B24 used for SSDAC is to be connected / extended to reset box for power ON and other indications.

(b) 2 Nos. of Rest Box (1 No. at each end) are to be wired for block section application.

(c) 1 No. of Reset Box is to be wired for station section track circuiting.

7.3.6 Cable laying practices and termination

(a) The standard cable laying practices in vogue on Railways shall be adopted.

(b) Special precautions shall be taken for track crossing of cable. It shall be minimum 1.0 M below bottom of sleeper and taken through out the crossing in DWC pipe of required size.

(c) Cable armouring shall be earth with the axle counter or other earth if in the vicinity or through a separate earth.

(d) The Axle Counter cable in location and equipment room shall be terminated on the M-6 terminal. The other approved type of connector like non-screw type can also be used if required and suits for the particular locations.

(e) 8-way terminal strips in locations and equipment room shall not be used for terminating axle counter cable as these are liable for giving disconnections / intermittent disconnections, contributing to axle counter resetting for unknown reasons.

7.3.7 Lightening and Surge Protection

(a) Lightening and surge protection level shall be suitable selected to protect axle counter and its allied equipment from lightening and surge. The chapter on earthing and lightening protection to be referred for further details.

(b) Class 'A' protection also to be provided specially in areas prone to lightening.

(c) The surge protection devices connected to power distribution system shall comply with relevant standards of IS: 2309 - 1989 and IEC 61024, 61643 & 61312.

(d) Class 'B' & 'C' protection shall be provided as per RDSO Drawing No. RDSO/SPN/165/2004 Ver.2 or its latest amendment / updated specification. (Fig. 7.5 - Connection of Lightening Arrester)

(e) Class 'B' protection is the 1st stage of protection which shall be provided at the mains side distribution panel of battery charger. 'B' class protection one each between Phase & Neutral and Neutral and Earth to be provided. The types of Class' B' protection shall be chosen form the specification depending up on the make.

(f) Class 'C' protection i.e. next protection stage shall be provided to achieve the effective surge protection. It shall be provided between Phase & Neutral.

(g) Class 'D' protection, which consists of combination of MOVs and GD tube, shall be provided at both ends of the cable conductors at equipment room and field location end. Class 'D' protection is required at the areas highly pone for lightening. Its need shall be decided depending the area.

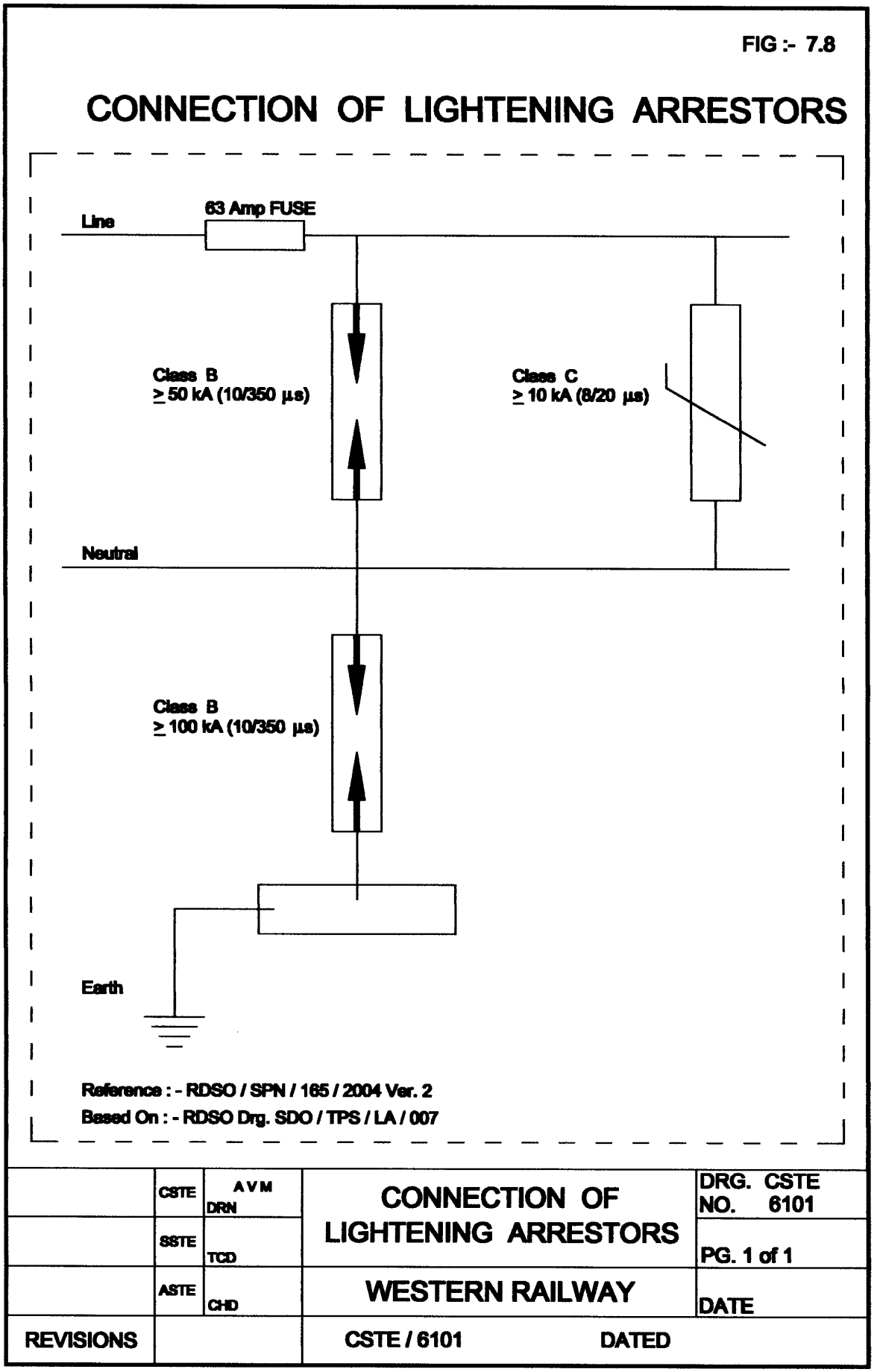

Fig: 7.5 Connection of lightning Arrester

7.3.8 Earthing arrangement

(a) Evaluator, EJB, field side evaluator and power supply equipment shall be connected to the earthing arrangement.

(b) Power supply equipment can be connected to the existing earthing system at the locations / stations if it meets the standards.

(c) Evaluators, trackside units and EJBs shall be connected to the separate common earth or individual earth if at the different locations.

(d) The earth resistance value shall be less than 2 ohms.

(e) The earth electrode shall be of high conductivity material like GI pipe reinforced with copper / copper alloy wire or the copper plate earth. (Fig. 7.9 Drawing No. 6097, Earthing arrangement)

(f) Soil resistance improvement compound shall be provided around each electrode for sustaining its low earth resistance value for at least 5 years.

(g) Earth as provided above should be brought to the equipment room through the copper / copper alloy cable and terminated on a copper bus bar to form an equipotential bus bar.

(h) Individual equipment, evaluator, trackside unit or EJB shall be connected to the equipotential bus bar through a copper conductor of minimum 2.5 sq. mm size. Individual equipment should be connected through a separate copper conductor from equipment to equipotential bus bar.

(i) In no case equipotential bus bar shall be looped from equipment to equipment.

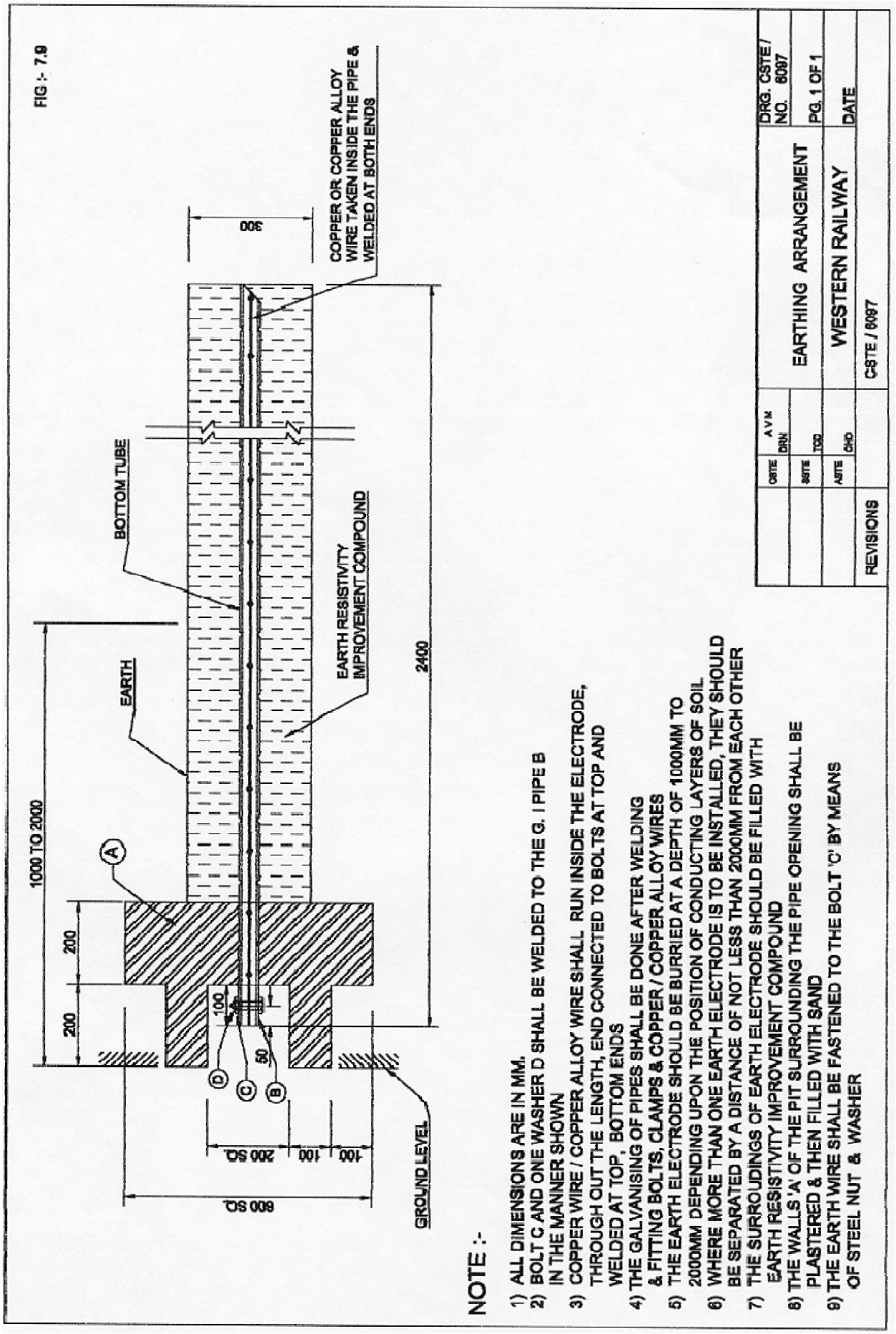

Fig: 7.6 Earthing Arrangement

7.3.9 Adjustment and commissioning of track devices

7.3.9.1 General

(a) Power supply to EJB / Trackside evaluator shall be connected after ensuring proper polarity. Connect dummy load at all locations & measure voltage with charger ON as well as 15 minutes after switching OFF charger.

(b) EJB / trackside coupler / connectors shall be tight.

(c) Various parameters shall be within the permissible limit as defined by manufacturer.

(d) Transmitter coil / track device shall be adjusted for maximum output signal level of receiver / track devices.

(e) Phase reversal output signal of digital axle counter track devices shall be within limit of the manufacturer's test report.

(f) The initial adjustment of track device & wheel dip / phase reversal and output frequencies shall be checked through CRO at the time of installation.

(g) After completion of adjustment, test with a push trolley to see that its wheels are not counted.

7.3.9.2 Specific to Universal Axle Counter

(a) Wheel dip shall be as per installation / commissioning manual of the manufacturer. It must be ensured that there is no double dip.

(b) Wheel dip shall be checked with dummy wheel by setting it at the rail section mark as per site requirement.

(c) The minimum combined output of EJB with 4W/2W card used for BPAC should be at least 1.0 V rms. The output of EJB with 4W/2W card will necessarily be around 1.2 V to 1.6 V rms. If the output is less than it has to be increased by readjusting the position of Tx and Rx track devices installed in the advance starter track circuit at the same time ensuring proper adjustment of ‘dip’.

7.3.9.3 Specific to Digital Axle Counter (Eldyne)

(a) After commissioning at least one count in and out against the axle counter reference direction must be executed.

(b) For double utilization of a rail contact in one EJB, it shall be ensured that all detection point processors of the two involved sections have different addresses.

7.3.10 Adjustment and commissioning of evaluator

7.3.10.1 General

(a) Supply of DC-DC converters shall be checked for correctness of output.

(b) Excess loss between EJB / trackside evaluator and cable termination in equipment room shall be checked. Cable connectors / terminals and cables to be re-checked for rectifying defects and eliminating loss.

(c) High input impedance digital multi meter with proper calibration shall be used for measurement of Axle Counter parameters. The measuring set for the digital axle counters shall be procured for measurement of high frequency outputs.

(d) System check as per manufacturer's installation manual shall be carried out after initial adjustment of all components is completed and axle counter is reset.

7.3.10.2 Specific to Universal Axle Counter

(a) Diode (type BY 127) shall be provided across relay coil of EVR and SUPR to suppress transient voltage spikes.

(b) In Analogue axle counters, the attenuator pads shall be adjusted in the channel card. The 5 K potentiometers shall be kept full in circuit to get at card level the channel output of 150 mV for each channel and attenuators setting shall be fixed at this level. After fixing attenuators value the channel voltage shall be adjusted to 105 mV.

7.3.10.3 Commissioning of BPAC

(a) The commissioning of the system must be done after installations are completed.

(b) Correctness of wiring shall be ensured before the system is switched 'ON' and the block section is clear when the system is being commissioned.

(c) Connect power supply. Ensure proper feed is reaching relay rack, evaluator and field side location boxes. Power supply is within limit of + 24 V – 10% + 20%. Switch the 'Power on' switch of Tx and Rx-MUX to 'ON' position at both stations.

(d) Tx- MUX at both stations shall be reset by operating reset push button switch in Tx-8 module. Before resetting, it shall be ensured that the potentiometer provided in Tx-3 module is in the center position.

(e) With a high impedance digital multi-meter, the voltage levels in Tx-MUX at both the stations shall be checked and set the Signal – Tx-3 module 1.5 V $\pm$ 0.2 V rms (AC) by adjusting the potentiometer provided in the same module.

(f) The output of combined/converter at both stations shall be checked and set to:-

  (i) 3.5 kHz + 5.0 kHz Jn. box – 1.2 V to 1.6 V rms.

  (ii) Tx-MUX –1.0 V to 1.2 V rms.

  (iii) Comparator out to next station more than 1.5 V rms.

  (iv) Comparator in from next station should be at least 200 mV rms.

  (v) Comparator in to filters will be roughly 50% to 70% of comparator in from next station.

(g) Rx-MUX at both stations shall be reset by operating the reset push button switch provided in Rx-10 module.

(h) With a high impedance digital multi-meter, signal output of Rx-MUX shall be checked and set to 1.5 V $\pm$ 0.2 V rms (AC) by adjusting the potentiometer provided in Rx-7 module.

7.3.10.4 Specific to Installation and setting up SSDAC (CEL)

Installation of SSDAC (CEL) is shown in Fig.7.7 and Block Working arrangement is shown in Fig.7.8. The track circuit arrangements for stations with SSDAC (CEL) are shown in Fig.7.9.

(a) After making connections to Tx & Rx coils, the presence of Rx coil signals shall be checked. If no signal is there, the connection of Rx coil cable shall be checked otherwise shall be reversed.

(b) The Rx coil signal connected to the Signal Conditioner Card and with normal phase shift of 180 degrees, the DC voltage should be 2.2 Volts. Otherwise the Rx coil cable polarity connected to the card to be interchanged for getting the same voltage.

(c) Measurements of Signal levels – The various signal input & output levels and shall be within limit as prescribed by manufacturer. These should be recorded and adjusted to correct levels wherever necessary.

(d) A detailed list of tests to be conducted before commissioning SSDAC (CEL) are given in Appendix-E. These are optional and may be conducted considering the available time.

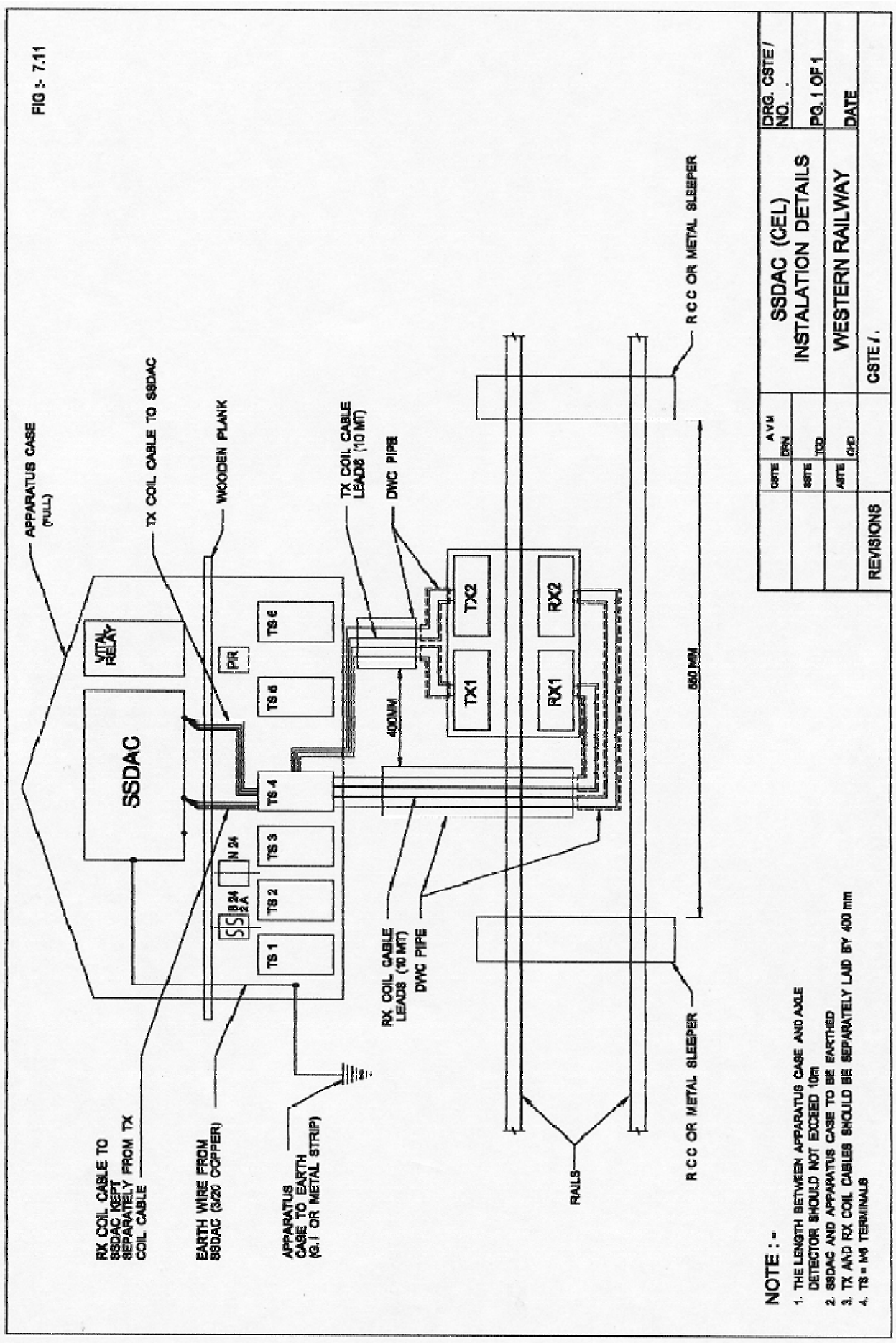

Fig: 7.7 Installation of SSDAC (CEL)

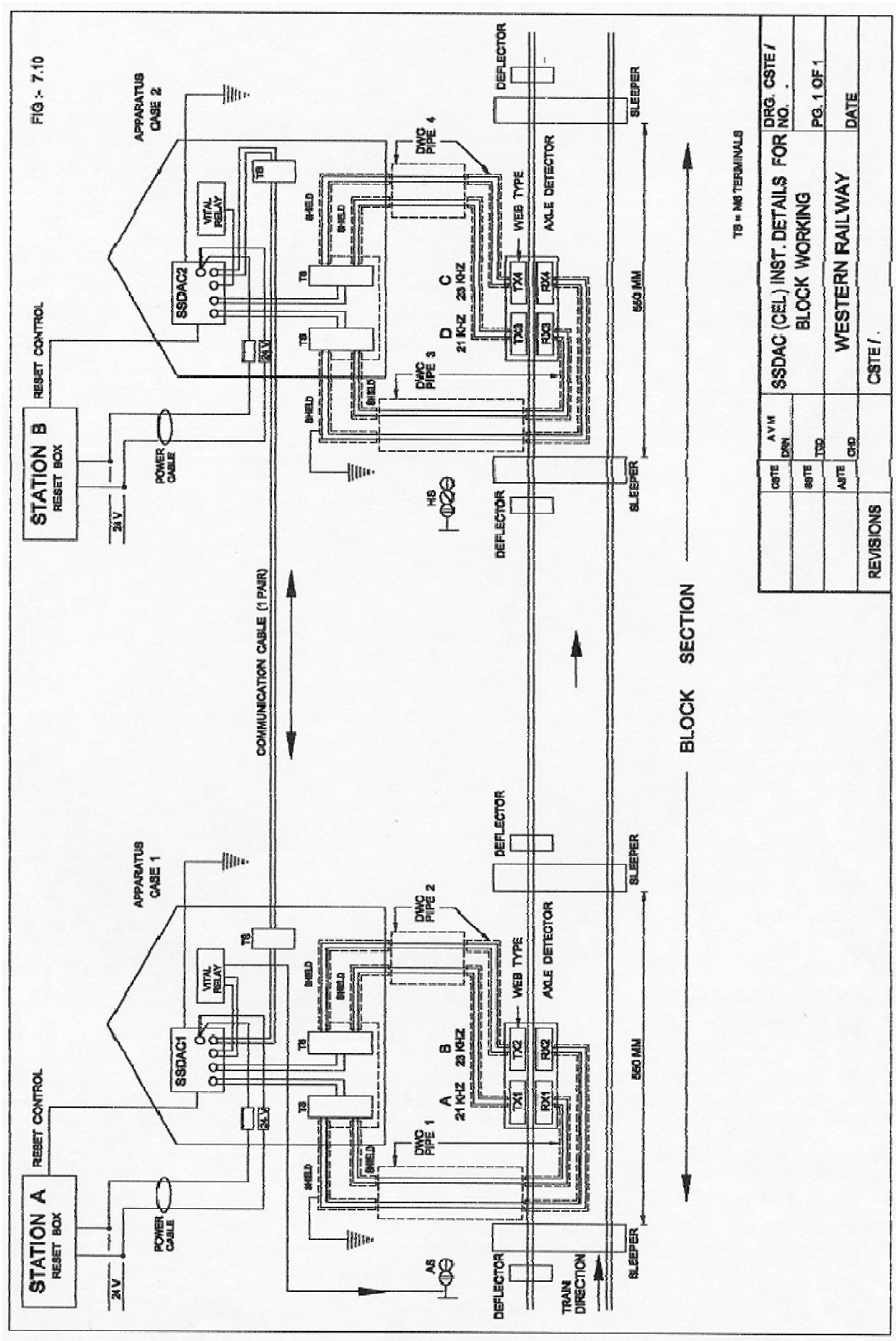

Fig: 7.8 BPAC with SSDAC (CEL)

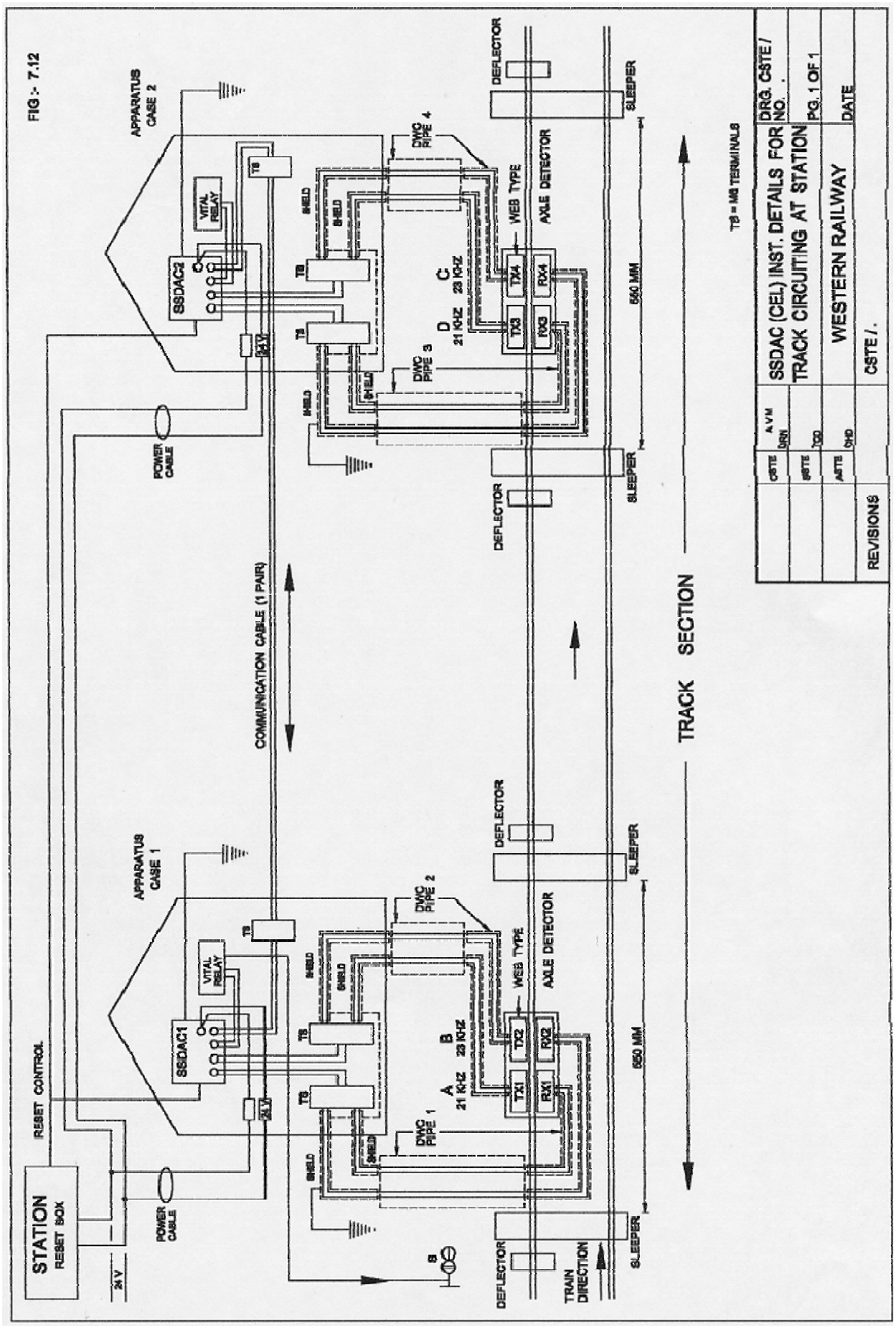

Fig: 7.9 Track Circuiting at Station with SSDAC

7.3.10.5 Specific to Digital Axle Counter (Eldyne)

(a) Measure power supply without load at Test Points by removing analogue PCB. The value must be within the specified tolerance of the used power. The under load measurement shall done at maximum cable resistance and lowest voltage at the power supply. A minimum of 66% of the source power supply voltage must appear at the ACE.

7.3.11 Tests

(a) A complete list of tests must be prepared and the guidelines of the axle counter manual shall be taken into consideration for the preparation of the test list. In general the following functional tests are required.

(b) Correspondence tests - The on-site correspondence tests is required when a new equipment is commissioned, when an indoor or trackside equipment including cabling has been changed and when site specific data has been down loaded.

(c) Counting Sequence and Assignment of Detection Points - Check the correct counting sequence and assignment of detection points by counting axles into and out of a section using a dummy wheel. The test must be repeated for every detection point and section.

(d) Track occupation - The following procedure has to be carried out and to be documented for each track section. It checks that all detection points are installed according to the plans and that there is a correct correspondence with the interlocking.

(i) Reset each axle counter section.

(ii) Check that the status of the reset section is correct.

(iii) Check that the information within the interlocking and on the indication panel is correct.

(e) Boundaries to other Train Detection System - If the axle counter track section is bordering on sections with other train detection systems, it has to be checked that the sequence of occupation at the boundary is correct.

7.3.12 measurements, Records and Maintenance

(a) **Filling in the Log Sheet** - After having adjusted and configured the detection point, the measurements shall be carried out according to the log sheet and the tolerances checked.

(b) Maintenance of indoor & outdoor equipments i.e. track devices, EJB / trackside evaluator & central evaluator / evaluator shall be carried out in accordance with the maintenance manual of the respective axle counter and the periodicity as defined in SEM.

(c) Maintenance of batteries, power supply equipments shall be carried out as per the maintenance schedule of these equipments. The charging current of the battery and its voltage shall be within limits.

(d) The counting of the axles shall be verified after passage of a train and compared for its correctness with actual No. of axles.

(e) The connection on evaluator / central evaluator shall correspond with resetting box.

(f) EVR / SUPR and track relay voltage shall be measured to see that they are within limit.

(g) The counters of reset boxes shall be checked to ensure that they increment by one after each resetting.

(h) All the fixtures of base clamp, transmitter / receiver, track devices, evaluators and EJBs and their cards shall be checked to ensure that these are fully tight. Periodical check of frequencies shall be carried out.

(i) Wheel dip / phase reversal of the track devices shall be checked to ensure that it is correct.

(j) The staggering of the track devices / Transmitter or Receiver coils shall be periodically checked.

(k) The axle counter equipment either at indoor or outdoor shall not be disturbed for any adjustment when a train is in axle counter controlled section.

(l) After completion of work, or adjustment or any other change, axle counter unit shall not be reset when there is a train in the section.

(m) The initial records of various measurements at the time of installation and commissioning shall be kept as reference and comparison of performance, through out the equipment life.

(n) Output signal of all the channels of EJB / track devices shall be measured and record kept.

(o) The measurements shall be compared with initial and previous readings to ensure that it is within the limit and difference is not more than 10%. The deviations if any shall be analysed with proper record of observations indicating the extent and type of action required or no action required.

(p) If there is large variation with respect to previous / initial measurement and these are beyond defined limit, then defects shall be isolated and defective components replaced to bring the measurements at initial level.

(q) Channel voltages shall also be measured at cable termination in equipment room and the checks and procedure as mentioned in above Para shall be followed.

(r) The axle counter resetting shall be analyzed and cause identified. The remedial action shall be taken on the identified cause for minimizing the resetting. Records of resetting shall be kept separately and its monthly / periodical summary shall be prepared.

(s) Records of the measurements of various parameters and maintenance of EJB / trackside evaluator shall generally be kept as per the specimen Format given in Fig. 7.10 for Analogue' Axle Counter.

(t) Records of the measurements of various parameters and maintenance of Evaluator / Central evaluator shall generally be kept as per the specimen Format given in Fig. 7.11 for Analogue' Axle Counter.

(u) Records of the measurements of various parameters and maintenance of Digital Axle Counter (CEL) shall generally be kept as per the specimen Format given in Fig. 7.12.

(v) Generally the records shall be maintained as per the Format and any addition or deletion if required be done by Railways suiting to the type of axle counters used.

7.3.13 Documentation

(a) Wiring and cable termination diagram of locations, EJB, from EJB to evaluator and evaluators shall be drawn for ready reference. These wiring documents, circuit diagram connected with axle counters should be kept at all locations. Cable route plan shall be kept at a central location. The copies of installation and maintenance manuals, records of maintenance and measurements shall be kept at every axle counter location.

(b) The highlights of technical manual should be prepared in Hindi or local language covering the maintenance / adjustment procedure.

(c) Trouble shooting chart should be prepared and kept at axle counter locations.

Installation date						Axle Counter No.					Location	
Date	Input Volt. 24V DC	Oscillator Voltage	TX 1 (1&2)	TX 2 (1&2)	Rx 1/Rx2	RX 1 Dip	RX 2 Dip	RX 1 Out	RX 2 Out	Staggering	Observations	Sign / Time
Acceptable voltage	21.6 -28.8V	Not more than 54-66 V	29 – 31.5 V	29 – 31.5 V	650 – 1000 m V / 650 – 1000 m V /	Less than 5-10%	Less than 5-10%			165 - 180 mm		

Fig: 7.10 EJB /Trackside Evaluator Card

Installation date						Axle Counter No.							Location				
Date	Input supply 24V DC/ Ripples	DC – DC Converter			Channel Voltage				Card Voltage				EVR Volt.	SUPR Volt.	No. of resetting due to failures since last resetting	Observa-tions	Sign/ Time
		5V	10V	10V ISO	A	B	C	D	A	B	C	D					
Acceptable voltage	21.6 -28.8 V/40 mV Max.	5.0 – 5.2	10 – 10.2		More than 700 mV	More than 700 mV	More than 700 mV	More than 700 mV	105 - 115 mV	105 - 115 mV	105 - 115 mV	105 - 115 mV	11.0 - 13.0 mV	11.0 - 13.0 mV			

Fig: 7.11. Evaluator /Central Evaluator Card

Installation date						Axle Counter No.					Location								
Date	24V DC supply (Battery) - near SSADC	DC – DC Converter for 24V DC input fed to the SSDAC				Oscillator Output			Receiver Coil Output		SSC Cards w/o Dummy wheel		SSC Cards with Dummy wheel		Modem Output (Card6)	Relay drive Output to the Vital Relay	No.of resetting due to failures since last resetting	Observ-ations	Sign/ Time
		5V	12V	24V	15V ISO	Tx Coils	Frequency (i)	Frequency (ii)	Rx Coil 1 21 KHz	Rx Coil 2 23 KHz	SSC1	SSC2	SSC1	SSC2					
Acceptable voltage	18V to 30V	4.75 to 5.25V	11.8 to 12.2V	23.8 to 24.2V	14.8 to 15.2V	30V to 40V rms	20.80 to 21.20 KHz	20.80 to 23.20 KHz	350 to 650 mV rms	350 to 650 mV rms	2.0V to 2.5V DC	2.0V to 2.5V DC	<0.7V	<0.7V	>125mV	>20V			

Fig: 7.12 SSDAC (CEL)

7.4 DO'S AND DON'TS

(a) Planning documents for installation shall be prepared including the list of all track sections with axle counters and marked on signallig Plan, Cabling plan (Cable types and use of cables conductors, Earthing arrangement, Calculation and measurement of induced voltages on cables and the measures to be taken to reduce the induced voltages.

(b) In Axle Counter plan the track sections and detection points shall be numbered consecutively.

(c) Axle counter reference direction shall be decided.

(d) Rail profiles and section of location of detection points shall be examined and fixing of track devices to be done accordingly.

(e) Any embossments on the rail web must be removed or another location which can meet all requisite standards for the rail contact /track device, must be selected.

(f) Before commissioning the trackside equipment, ensure that the cable parameters meet the specification of the used cable and measure Insulation, Capacitance (wire to wire), Attenuation, and Cross talk.

7.4.1 UNIVERSAL AXLE COUNTER

7.4.1.1 Installation of Outdoor Equipment - Do's

(a) At the time of fixing of base clamp, ensure that the base clamp is oriented properly so that its longer side meant for receiver assembly is mounted inside the rail and short side is meant for transmitter assembly is mounted outside.

(b) Ensure that proper nylon packing has been used for getting maximum output from receiver coil.

(c) Ensure that proper sizes of nuts & bolts for base clamp, transmitter and receiver assemblies have been used.

(d) After tightening the nuts and bolts, use proper adhesive on nuts for proper grip.

(e) At the time of initial adjustment of track devices, the maximum output is obtained by selecting number of packing for transmitter and receiver and keeping transmitter in its lowest position. Also proper dip is to be obtained by moving the transmitter coil backward if necessary.

(f) Ensure that receiver coil cables and transmitter coil cables have been laid in different pipes.

(g) Ensure that both transmitter & receiver coils are having same alignment.

(h) Ensure that the ballast packing of sleeper on both sides of track device is proper.

(i) Ensure that the track device is installed at a requisite distance on a track circuit.

(j) Check that the metal sheath of outdoors cables are connected to the Earth at both ends in RE area and at one end in non-RE area (evaluator end.)

(k) Ensure the electrical continuity of transmitter & receiver coils before installation.

7.4.1.2 Installation of Outdoor Equipment – Don'ts

(a) Don’t install the track device near the rail joint; it should be more than 6 sleepers away.

(b) Don’t install the track device where the rail is badly worn out beyond the schedule dimensions.

(c) Don’t cut or join the transmitter/receiver cable supplied along with the coil. It would result in change of frequency of signal.

(d) Don’t lay the Rx & Tx coil cables in the same pipe.

(e) Don’t use any other outdoor cables except the prescribed.

7.4.1.3 Installation of Indoor Equipment - Do’s

(a) Check if the power supply to DC-DC converter is within the range of 24 V –10%: + 20% (21.6 V to 28.8 V).

(b) Before switching ‘ON’ DC-DC converter, check that the polarity of power supply is correct.

(c) Check that the Peak-to-Peak noise voltage of battery charger is less than 50mV at full load.

(d) Check that the EVR and SUPR relay pick up voltage is less than the prescribed output voltage of evaluator.

(e) Check that BY 127 diode is connected across EVR and SUPR relay coils.

(f) Ensure that the wiring of EVR and SUPR Relay is done with shielded wire.

(g) Ensure that the SM reset box indications and Evaluator panel indications are same.

(h) Ensure that DC-DC converter is of required rating.

(i) Check that the trolley suppression wiring, reset wiring and final track clear proving relay wiring has been done as given by in the installation Manual supplied by the manufacturer.

(j) Ensure that the output of channel cards is adjusted by keeping the 5 K potentiometer in extreme clockwise position and dropping the voltage across the attenuator pads till approximately 150 mV is available at output of card.

(k) Check that proper size of cable/core has been used for wiring.

(l) Make sure that either the contact of main relay or first repeater relay of trolley suppression track circuit is used.

7.4.1.4 Installation of Indoor Equipment - Don’ts

(a) Don’t use + 10 V available on evaluator for indication on SM reset box and evaluator.

(b) Don’t use +10 V for resetting purpose.

(c) Don’t insert cards meant for 3D axle counter into 4D axle counter and vice versa.

(d) Don’t use A.C immunized and shelf type relay for EVR and SUPR.

(e) Don’t give any bend to display card flat cable.

7.4.2 BPAC with Universal Axle Counter

7.4.2.1 Relay Rack – Do's

(a) The lugs used for connecting different wires to the terminals of the relay rack should be properly crimped and soldered.

(b) Different cables / connections coming to the relay rack from the field should be properly terminated.

(c) All the couplers provided in the combiner/converter, Mux-Receiver / Mux-transmitter should be properly tightened.

(d) The fuse holders provided in the relay rack should be properly inserted.

(e) Ensure proper feed of DC-voltage at relay rack terminals for proper functioning of the system (24 V + 20% - 10%).

(f) Terminal strips should be provided with insulating cover to avoid shock hazard. If the cover is to be removed, take care to re-fix the cover after completion of work.

(g) All the cards of Mux-Tx, Mux-Rx, and combiner/converter should be properly inserted.

(h) The captive screws provided in the front plate should be properly tightened.

(i) The output levels as prescribed should be maintained for proper functioning of the system.

7.4.2.2 Relay Rack – Don'ts

(a) Don’t insert or remove cards from Mux-Transmitter or Mux Receiver when the ‘Power ON’ switch is in ‘ON’ position.

(b) Don’t rough handle of relays while inserting and removing.

(c) Don’t reverse connection of relay output connections coming from Mux-Receiver during installation or maintenance. Carry out the connections as per the wiring diagram supplied by the manufacturer.

(d) The card modules of Mux-Tx, Mux-Rx, and Combiner/converter should not be used without the aluminum shields. Care should be taken to re-fix shielding plates after the work is done.

(e) Don’t do unnecessary operation of reset switches provided for resetting Mux-Tx, Mux-Rx and remote reset switch.

7.4.2.3 SM’s Panel – Do’s

(a) The SM’s panel should be fitted in such a way so as to provide a convenient accessibility for operation and maintenance of SM’s panel.

(b) The coupler should be properly tightened.

(c) The SM’s key & LCB key must be kept in proper position.

(d) The buzzer volume selector switch should be kept in proper position so as to provide the required audibility to the operating SM for receiving the buzzer message coming from other station.

(e) SM’s panel should be properly anchored.

(f) SM’s panel should be properly sealed.

(g) The SM’s panel back door must be properly locked and key should be kept under safe custody.

7.4.2.4 SM's Panel – Don'ts

(a) Don't do unnecessary operations of push buttons provided in the SM's panel.

(b) Don't allow unauthorized persons to operate the panel.

(c) The Bell-Plunger push button should not be operated for exchanging block codes when telephonic conversation is taking place.

7.4.3 Single Section Digital Axle Counter (CEL)

7.4.3.1 Do's

(a) The inter connection drawings supplied by manufacturer shall be followed for connecting the Transmitter & Receiver coils. Tx1 is 21 KHz. Tx2 is 23 KHz & Rx1 & Rx2 coils are 21 KHz & 23 KHz respectively.

(b) Ensure that both the Tx coils & Rx coils are having proper alignment on Rail.

(c) The cable connections should not be connected loosely.

(d) The M.S. Circular connectors of SSADC shall be checked and maintained firmly.

(e) The SSDAC & Reset box is provided with sealing arrangement. They should be sealed at site.

(f) Resetting should be done only after ensuring that there is no train in the section.

(g) Heat resisting paint (Heat block additive mixed with paint available in the market) is to be used on the apparatus case so that the temperature inside apparatus case is maintained lower in comparison to other normal paints.

7.4.3.1 Don'ts

(a) Don't lay the Tx & Rx coil cables in the same pipe.

(b) Don't use any other outdoor cable other than the recommended cables.

(c) Avoid installing the Axle detectors on curve of rail / too much slope of rail to be possible extent.

(d) Don't remove the cards from SSDAC units under power ON condition of system.

7.4.4 Digital Axle Counter (Eldyne)

7.4.4.1 Do's

(a) Axle counter definition table including addresses of detection points, power supply to distant detection points, power supply for detection point is local or via data line shall be prepared before installation.

(b) Check the connection of the earthing cable of the EJB to ground potential before working on the detection point. If the connection is cut, then dangerous voltage may be induced at housing.

(c) When the housing cover is removed, care must be taken to avoid touching parts carrying dangerous voltages.

(d) Precautions must be taken to protect the PCBs from getting wet when the housing cover is removed.

(e) Use the integrated levers to remove the PCBs.

(f) Ensure that the PCB is firmly pressed home in the sub rack to ensure a reliable connection.

(g) The Rail mounting holes shall be drilled in the correct position. This must be observed in order to adjust the Tx heads correctly.

(h) Before Setting Address codes switches pull out the analogue PCB.

(i) Ensure that the switches have been firmly set to the correct position.

7.4.4.2 Don'ts

(a) Don't remove and insert PCBs in the sub rack while the power supply is switched on.

(b) Don't leave the heads loose; these may be damaged on the rail.

(c) The transmitter head shall not touch the rail.

(d) Do not use a pencil for Setting Address codes; a ball pen may be used.

7.5 LIST OF SPECIFICATIONS

1. Surge Protection Devices - IS: 2309 – 1989 and IEC 61024, 61643 & 61312
2. Battery Chargers: IRS S-86/2000 (Amendment – I) with peak-to-peak noise voltage limit to be specified as not more than 50 mV. & IRSS-93/96 for MFVR Batteries. Also refer RDSO/SPN/165/2004.
3. DC – DC Converters: IRS – 96/2000
4. Secondary Cells – Low Maintenance – IRS S-88/93
5. Secondary Cells –Maintenance Free – IRS S-93/96(A)
6. Axle Counters (Analogue Universal Type) – IRS.S-42/85 & Drg. S.156/02-04.
7. Single Section Digital Axle Counters: RDSO/SPN/177/2003 Vers.1 (With Amendment 2) & Manufacturers' Specification.
8. Multi Section Digital Axle Counters: RDSO/SPN/176/2002 Vers.1 & Manufacturers' Specification.
9. Quad Cable in RE area –IRS TC-30/96(Amendment 3)
10. IS - DWC Pipe: IS – 14930 Pt. II/BSEN 50086.

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CHAPTER – 8: SIGNALS AND MISCELLANEOUS EQUIPMENT

8.1 SCOPE OF THE CHAPTER

This chapter covers the practices to be followed for location of signals, installation, wiring, focusing, testing of Colour Light Signals including Triple-pole double filament lamp systems, LED lit CLS units.

This chapter also covers installation practices for miscellaneous equipment like winch operated lifting barrier gates, electrical lifting barriers, EKTs, siding control mechanisms etc.

8.2 LOCATION OF SIGNALS

(a) Signals shall be located as per approved signalling plan. While giving marking for signal foundations, the provisions of paras 12.51 to 12.53 and 19.8 of SEM Pt.II to be kept in mind, which are reproduced below:

12.5.1 *Signals shall be so located that they do not infringe the Schedule of Dimensions. Deviations shall be sanctioned by the competent authority.*

12.5.2 *Signal posts shall normally be on the left side and adjacent to the line to which they refer, and signals shall be located so that they are normally on the left of, or above the line to which they-apply, unless authorised by special instructions.*

12.5.3 *Signals shall be inspected by a Signal sighting committee consisting officials of Signal, Traffic and Mechanical / Electrical Departments before being brought into use.*

19.8 *Location: The location and spacing of signals shall be in accordance with approved plans. The signals shall be so located that a clear view is available to the driver of an approaching train and is as close to the track as permissible. The height of normal aspect of the signal shall be approximately at 3.65 meter from the rail level. Wherever this is not feasible due to local terrain, height of* the signal post may be suitable increased or decreased to get a clear view of the signal. The actual visibility of signal shall be checked by a sighting committee and action to improve the visibility taken on recommendation of the committee before commissioning a new signal.

- *Distance between adjacent track centers in straight portion shall be min. 5.3 m for new lines. For existing yards, less clearance may be available. To install a signal post between tracks (in non – platform area), clearance of [2.36+2.36+0.6 m (ladder width)] to be available.*
- *As per clearance available between lines, the location of signal ensuring minimum clearance of 2.3 6m from immediate adjacent track center to be ensured. If left side location is not feasible, right side location to be considered. However, me same has to be incorporated in approved signalling plan with approval of competent authority.*

  In case the clearance of 2.36 meters is not possible even with right side location of signal, provision of gantry signal to be done or sanction from Railway Board to be obtained for clearance less than 2.36 meters.
- *On platforms, signal post clearance to be 4.72 m from centre of adjacent track.*
- *Main line and loop-line starter signals to be located in same alignment wherever feasible. If same alignment is not feasible, the main line starter shall be located protecting loop-line point also.*
- *The starter signal shall be located with minimum clearance of 11 m in rear of block joint of control track circuit, to avoid pre-mature fly-back of signal in case of long-hood diesel engine.*

(b) Regarding visibility of signals, the provisions of SEM Pt.II Para 22.1.3,22.2 and 22.3 are to be followed which are reproduced below:

22.1.3 *Visibility of Signals is taken care by the proper implantation of OHE structure during the design stage ofOHE. Where electrical clearances are not possible to maintain, suitable protective shields for signal structures shall be provided.*

22.2 Signal Structure:

22.2.1 *Colour light signals shall only be used in electrified area.*

22.2.2 *On electrified sections, the masts, insulators, wires and supports obstruct the visibility of signals. In addition, the signals have to be so erected that they maintain a minimum clearance from the live parts of the O.H.E. The instructions in this section shall be strictly followed in so far as the electrical clearance is concerned. These instructions may be taken as a rough guide in determining the location of signals, which would afford the best visibility to the drivers of approaching trains. However, the actual visibility shall in all cases, be checked by a Signal Sighting Committee and action to improve the visibility taken on the recommendations of the Committee.*

22.2.3 *The location of signals and the protection required shall be worked out from the following signal clearance diagram.*

Broad Gauge	*Drg. No.22.1*	*For tangent tracks & tracks with super elevation less than 60 mm.*
	Drg. No.22.2	*For curved tracks with super elevation 60 mm. to 140 mm.*
	Drg. No.22.3	*For curved tracks with super elevation 140 mm to 185 mm.*
Meter Gauge	*Drg. No.22.4*	*For uncompensated O.H.E for straight track.*
	Drg. No.22.5	*For uncompensated O.H.E for track on curve.*

22.2.4 *In these diagrams the un-shaded portion shown above the standard moving dimensions is the area into which a signal post or any of its fittings shall, under no circumstances, be allowed to infringe. The shaded envelope around this is the area into which a signal or its fittings shall not normally be allowed to infringe. If due to unavoidable reasons, a portion of the signal post or its fittings has to infringe into this shaded area, special protective measures as detailed in para 22.2.6 shall be taken. The dotted outline in Drawing Nos. 22.1,2,3 for Broad Gauge and 22.4 & 22.5 for Metre Gauge tracks is applicable when there are two sets of catenary and contact wires parallel to each other in the same span, viz. insulated and uninsulated overlap locations. It is to be noted that these diagrams are not applicable to (i) anchor spans, (ii) turnouts, (iii) 3 meters on either side of masts, and (iv) in loco sheds and inspection pits. The diagrams are also not applicable when there is a feeder line running along with masts or where booster transformers and return conductors are provided.*

22.2.5 *The normal height of the contact wire is 5.60 meters at supports. The normal height of the catenary at its highest point is 7.05 meters. In tunnels as well as underneath bridges, where clearances are limited, the contact wire may be as low as 4.58 meters for Broad Gauge and 4.02 meters/or Meter Gauge and the catenary is also lowered suitably or terminated at the face of Bridges or Tunnels. The clearance diagrams have, however, been drawn to suit the extreme positions of the catenary and the contact wire. In addition, the diagrams make allowances for the stagger as well as displacement of wires by wind.*

22.2.6 *In the matter of electrical clearances, the fundamental rule to be observed is that no one is allowed, under normal conditions, to approach closer than 2 meters from the extreme positions of the live parts of the O.H. E. The following protective measures shall, therefore, be adopted.*

22.2.6.1 *If any portion of a signal post or its fittings where signalling staff have to work, falls within 2 meters of a 25 KV live conductor, or any metal part electrically connected to this conductor such portion shall as far as practicable be protected by an iron screening of approved design solidly connected to the structural work.*

22.2.6.2 *If for any reason it is not practicable to provide the protective iron screening as given in para 22.2.6.1 above, a Caution Board of approved design shall be provided on the signal post at a height of 3 meters above the rail level, to caution the signal staff.*

Note: 'Technical personnel shall exercise particular care to protect themselves while working on signal posts not provided with protective screens. If there is any likelihood of any part of their tools or equipment coming within 2 meter of live equipment, they shall take a power block as detailed in Chapter-VI of the Manual of AC Traction- Volume -II (Part-1). The same precautions are also required in the vicinity of return conductors, which should be treated as live.'

22.2.6.3 *The SSE/SE/JE (Signal) shall explain these instructions to the staff working under them and ensure that they are correctly complied with.*

22.2.7 *Drg. Nos.22.6 & 22.7 illustrate the location of signals on the left-hand side and right hand side of Broad Gauge track and the figures indicate the minimum heights and distances of Signal from the track to avoid electrical infringements.*

22.2.8 Location of neutral section:

22.2.8.1 *Neutral section shall be located away from stop signals, level crossing.*

22.2.8.2 *If neutral section is provided after a stop signal, the distance * between signal and neutral section shall be such that after stopping, the train shall be able to pick up enough speed to coast through the neutral section without any risk of stalling.*

***Note:** The distance should be preferably 1600 meter away on section with gradient up to 1 in 300 and 2500 meter with higher gradient up to 1 in 200, if unavoidable. If PTFE type short neutral section has been used this distance can be reduced to at least 400 meter after the stop signal and 200 meter before the stop signal. Where, however, modifications require to comply with these guide lines are difficult or entail heavy investment, the Chief Electrical Engineer of the Railway may direct any other arrangement to be followed consistent with safety and reliability.

22.3 Visibility of Signals:

22.3.1 *Normally, all signals should be located on the left side of the track for which it refers. In exceptional cases the signals may be located on the right side. To ensure adequate visibility of signals the OHE masts should be implanted as per the ACTM. In case it is not possible, offset brackets may be used for signal units without affecting the schedule of dimensions. Further the following steps should be taken to achieve adequate visibility.*

(i) The distance between the signal post and traction mast shall be as large as possible. In case the traction mast is located in front of the signal post, the distance between the traction mast and signal post should not be less than 30 meters. In addition, it should be ensured that no traction mast is located in advance of the signal post at a distance less than 10 meters.

(ii) The signal post should be sufficiently high so as to be seen clearly.

(iii) On tangent tracks it is desirable that the signal should be located within the OHE structure, i. e. the implantation of the signal from the track center shall be less than the implantation of the OHE mast from the track center. The setting of OHE masts in the vicinity of the colour light signals shall be as per para 20.5 of Appendix-1 of the AC Traction Manual, Vol-II (Part-11). Relevant extracts as in Annexure-31.

(iv) On curved track or in areas, where other obstructions such as buildings, trees etc. exist, the site should be individually examined by the 'signal sighting committee 'for deciding the most appropriate location of the signal.

***22.3.2** No portion of a post or fittings of a colour light signal shall infringe with the schedule of dimensions from the center line of the nearest track.*

***22.3.3** Signals without Junction Indicators outside tracks:*

***22.3.3.1** Setting distance of OHE masts shall be in accordance with Drg.No.22.8.*

***22.3.3.2** The signal units shall be w fixed that the height of the center line of the red signal shall be approximately 3.65 meters above rail level. No part of Signal without a route indicator shall normally be higher than 5.2 meters above rail level.*

***22.3.4** Signals without Junction Indicators between tracks:*

***22.3.4.1** If signals are located between tracks no OHE structures shall be provided in the same track space for at least 600 m. in rear of the signals.*

***22.3.4.2** Portal drop arms shall not normally be located in the track space where signals are located at least for a distance of 600 meters before the signal.*

***22.3.4.3** If a portal drop arm has to be unavoidably located in rear of signal itself, the signal shall be mounted on an offset bracket. In addition special study shall be made in each case to see whether the portal drop arm should also be offset from the center line of the track space in the direction opposite to the offset of the signal. This special study shall be made for at least three portal drop arms in rear of the signal and shall also cover the possibility of shortening the portal drop arm.*

***22.3.5** Signals with Junction Indicators outside tracks:*

***22.3.5.1** Setting distances of OHE masts shall be in accordance with Drg.No.22.9.*

***22.3.6** Signals with Junction Indicators between tracks:*

***22.3.6.1** Precautions and parameters for location of portal drop arms shall be as specified under Para 22.3.4.*

***22.3.6.2** For details of drawings, illustrating the above principles for Colour Light Signals, reference may be made to Drawing No.22.IO.*

***22.3.7** The visibility of the signal shall be checked by day as well as by night by the Officials in charge (Signal) of the section after each phase of the O.HE. work, i.e. erection of masts, provision of brackets, wiring, etc. If at any stage the official feels that the visibility is not adequate, he shall impose suitable speed restrictions and take such steps as are required to improve the visibility.*

(c) The minimum distances of visibility for signals in MACLS territory as stipulated in Para 7.7.6 & 7.7.7 of SEM Pt.I are to be ensured. These paras are reproduced below:

***7.7.6** Distant Signal - 400 meters. An inner Distant Signal where provided, shall be visible from a minimum distance of 200 meters.*

***7.7.7** All Stop Signals: 200 Meters. If it is not possible to ensure 200 meters continuous visibility of any stop signal while approaching it, a suitable speed restriction shall be imposed.*

8.3 ERECTION OF SIGNALS (CLS)

8.3.1 General instructions regarding installation of CLS

General instructions regarding installation of CLS are contained in Paras 19.6 to 19.15 of SEM Pt.II which are reproduced below:

19.6 *Type : Colour Light Signals shall be multi unit of approved type.*

19.7 *The signal shall have a minimum visibility as indicated in Chapter VII. Spread light lenses may be used on curvatures and gradients to ensure continuous visibility of signals.*

19.8 *Location: The location and spacing of signals shall be in accordance with approved plans. The signal shall be so located that a clear view is available to the driver of an approaching train and is as close to the track as permissible. The height of normal aspect of the signal shall be approximately at 3.65 metre from the rail level. Wherever this is not feasible due to local terrain, height of the signal post may be suitable increased or decreased to get a clear view of the signal. The actual visibility of signal shall be checked by a sightings committee and action to improve the visibility taken on recommendation of the committee before commissioning a new signal.*

19.9 Mounting and Fixtures:

19.9.1 *Colour Light Signals may be mounted on a rigid ground post or a signal gantry clear of standard dimensions.*

19.9.2 *Each signal unit shall be rigidly fixed in position.*

19.9.3 *Signal posts shall be kept plumb and lead wool packed.*

19.9.4 *Lead wool pacing may be used to close the excess gap room post to signal unit, surface base to post. The cable entry at the signal unit should be provided with wooden plug along the cable to close excess gap to prevent rodent entry.*

19.9.5 *Signal number plate shall be provided.*

19.10 *Alignment: Each signal unit shall be aligned correctly to the required and instance and direction by employing the sighting hole along the side of the signal unit and by manipulating the separate horizontal and vertical adjustments.*

19.11 *Focusing: Each aspect shall be properly focused.*

19.12 *Hoods and Back Screens: Hoods of adequate size to counteract the effects of sunrays shall be provided. Where required, metallic mesh at suitable spacing shall be provided to protect lenses from outside interference.*

19.13 *Cables: Cables shall be used from the point of operation to the location box/signal unit and/or location box to the signal unit. Cable shall be protected suitably at the entry points of location box and signal post.*

19.14 *Gaskets and Sealing: All openings shall be gasketted and cable/wire entrance shall be sealed to make the enclosure water tight, dust-proof and vermin-proof.*

19.15 *Locking. The housing shall be kept locked.*

8.3.2 Work Specific Instructions regarding installation of CLS

(a) Excavation of pit and casting of foundation shall be as per drg shown in fig. 8.1(normal soil) & fig.8.2(rocky soil)

(b) Foundation for signal post should be of cement concrete in the ratio of 1:3:6 using stone ballast of 25 x 25 mm size and to be cast at location shown/marked by section engineer-in-charge. The foundations are to be plastered on all sides. The anchor bolts of size 25 mm x 900 mm (min.) to be used for CLS post and SPI post.

(c) While casting foundation, PVC pipe/GI pipe of 100 mm dia to be used to create gap for cable path through foundation and the pipe to be removed later. The path so formed in the foundation shall be useful for routing the cable later.

(d) Signal pole shall be securely fixed to surface base and erected on signal foundation and plumbed. The gap between the signal pole and surface base shall be filled-up with lead wool or any other approved substance to avoid tilting.

(e) CLS unit (2/3/4) aspect shall be properly mounted on signal post. The mounting shall be done using rope and pulley and taking adequate precaution against movements on adjacent lines, if any.

(f) Soon after mounting, the pole and unit shall be painted first with primer (2 coats) and then with aluminium/white enamel.

(g) Wherever route indicator junction type or stencil type is to be erected, it shall be mounted on top of the signal pole on an off-set bracket fixed with 'U' bolts of 20 mm dia. (2 nos.) on the signal pole. A through hole of 21.5 mm dia to be drilled on pole just below off-set bracket and through bolt with check-nut provided to prevent the off-set bracket from sliding down.

(h) To take wires to the CLS unit, a vertical slot of not less than 25 mm x 50 mm tobe made on signal pole. Suitable protection to be provided on slotted pole before cable is taken through it. Care shall be taken that the insulation of tail cable is not damaged.

(i) The tail cable shall first be terminated on the route-indicator and separate wiring (PVC 3/0.75 copper) shall be run to CLS unit from Route-indicator.

(j) In case of Jn type route indicator, the lamps shall be LED lit CLS or 110 V / 25 W / 3 pin. In case of stencil type, the lamps shall be 110 V / 75 W / 2 pin.

(k) (i) Signal voltages to be checked both at the primary and secondary of the signal transformer to maintain 90% of rated voltage at the bulb. The no-load current of signal transformer shall also be checked to see that it is not more than 15 mA.

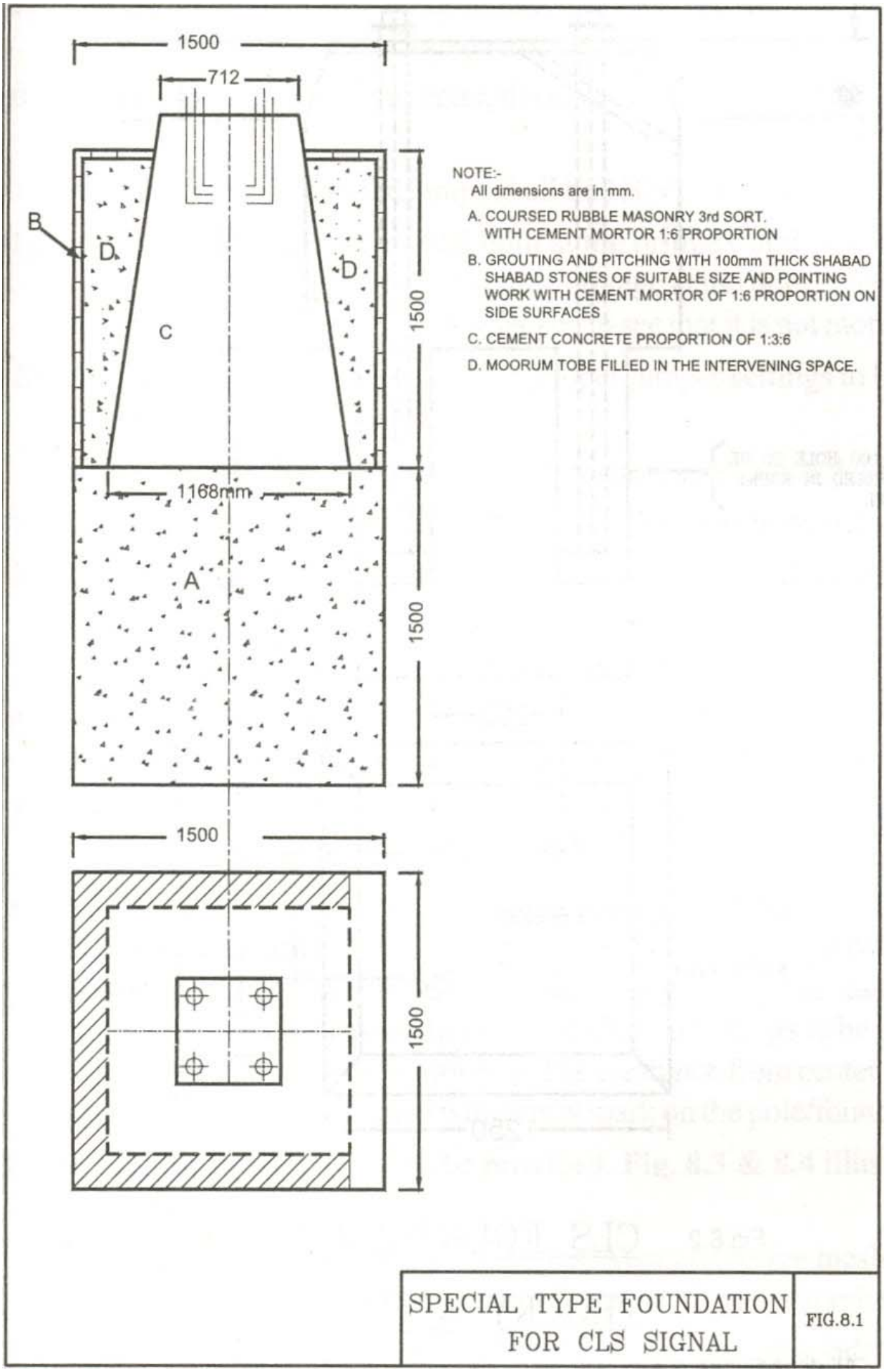
(a) In case LED lit CLS units are used, proper jumper settings to be made on current regulator :

(a) AC/DC lit (b) Blanking/non-blanking mode (c) conventional/ LED-CLS type ECR.

(b) The ECRs shall be used in accordance with the table given in section 8.9

(l) Tail cable to be terminated on 6-way block in the Terminal unit & 3/20 wire to be run from there to the aspects.

(m) Signal unit doors shall be locked using Universal locks.



NOTE:-
All dimensions are in mm.

A. COURSED RUBBLE MASONRY 3rd SORT. WITH CEMENT MORTOR 1:6 PROPORTION

B. GROUTING AND PITCHING WITH 100mm THICK SHABAD SHABAD STONES OF SUITABLE SIZE AND POINTING WORK WITH CEMENT MORTOR OF 1:6 PROPORTION ON SIDE SURFACES

C. CEMENT CONCRETE PROPORTION OF 1:3:6

D. MOORUM TOBE FILLED IN THE INTERVENING SPACE.

SPECIAL TYPE FOUNDATION FOR CLS SIGNAL	FIG.8.1

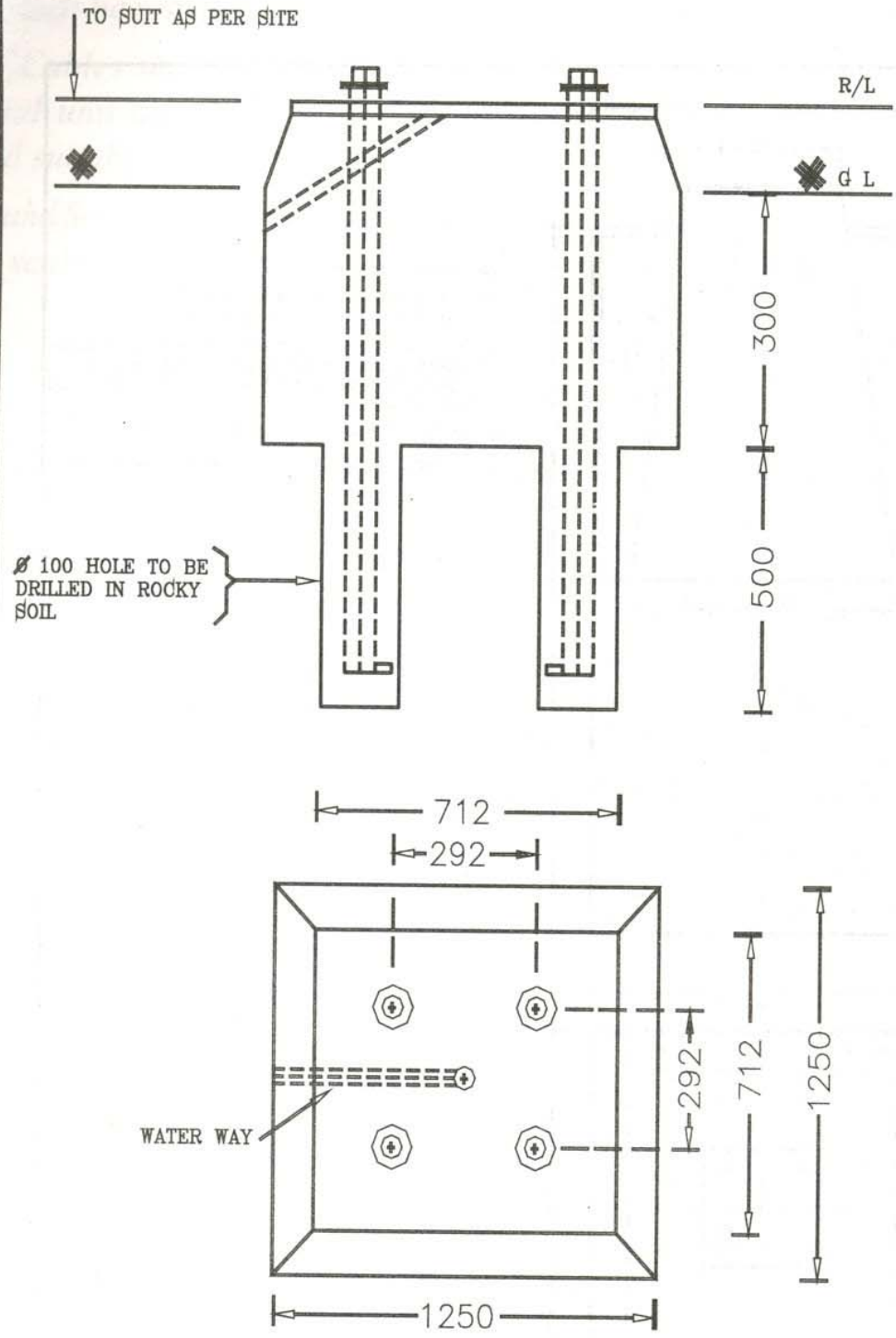


Fig.8.2 CLS FOUNDATION (ROCKY AREA)

All dimensions are in mm.

(n) Earthing of signal post to be done using 7 SWG GI wire run from unit to foundation bolt and then to earth electrode in earth pit.

(o) The signal post shall be properly plumbed and fitted with ladder having platform and guarding on top and adequate supports for ladder as per fig.8.3.

(p) All signal posts including ladders shall be clear of infringement (i.e.2.36m from center line of the nearest track). Markers and number plates shall be fixed wherever necessary as per Signalling plan using suitable clamps. Signal number has to be painted on the number plate as well as on the door out-side. All fittings to be tightened properly. Signal unit shall be locked properly. The clearance from center lines of immediate adjacent tracks to be painted with arrow mark on the pole/foundation.

(q) Hoods for signal aspects to be provided. Fig.8.3 & 8.4 illustrate the complete arrangement.

(r) Mesh to be provided for signal aspects. Also protective mesh shall be provided incase of nearby RE live conductors. The protective wire mesh shall be earthed.

(s) Earth-work shall be made around the foundation and consolidated.

(t) In case of embankments, stone-pitching to be done, if soil erosion is likely.

(u) Wooden pieces of size 50 mm x 1000 mm, painted white, shall be provided as a cross on erected signal unit & the unit to be turned-off from the track till it is commissioned.

(v) Painting of Signal post shall be as per Annexure 29 Para 19.106 of SEM Pt.II which; is reproduced below:

Colour Light Signal:

1. Post	In double distant territory, distant signal post shall be painted with alternate black and yellow strips @ 300 mm. All other signals shall be painted with white aluminium paint
2. Fittings (Hood & Mechanism Box)	Black
3. Back cover and	Painted black with diagonal cross of aluminium background, if any

(w) Signal feed circuitry and maximum permitted length of direct feed of signal in 25 KV AC RE area may be defined as per Para 22.7 of SEM Pt.II which is reproduced below:

22.7 *Signal feed Circuitry*

22.7.1 *Signal feed system shall be of the 110 V 50 Hz type. 300 V signal feed system where already working may continue. 110 V feed system can replaced 300 feed system as per the site requirements or when it has out lived its life.*

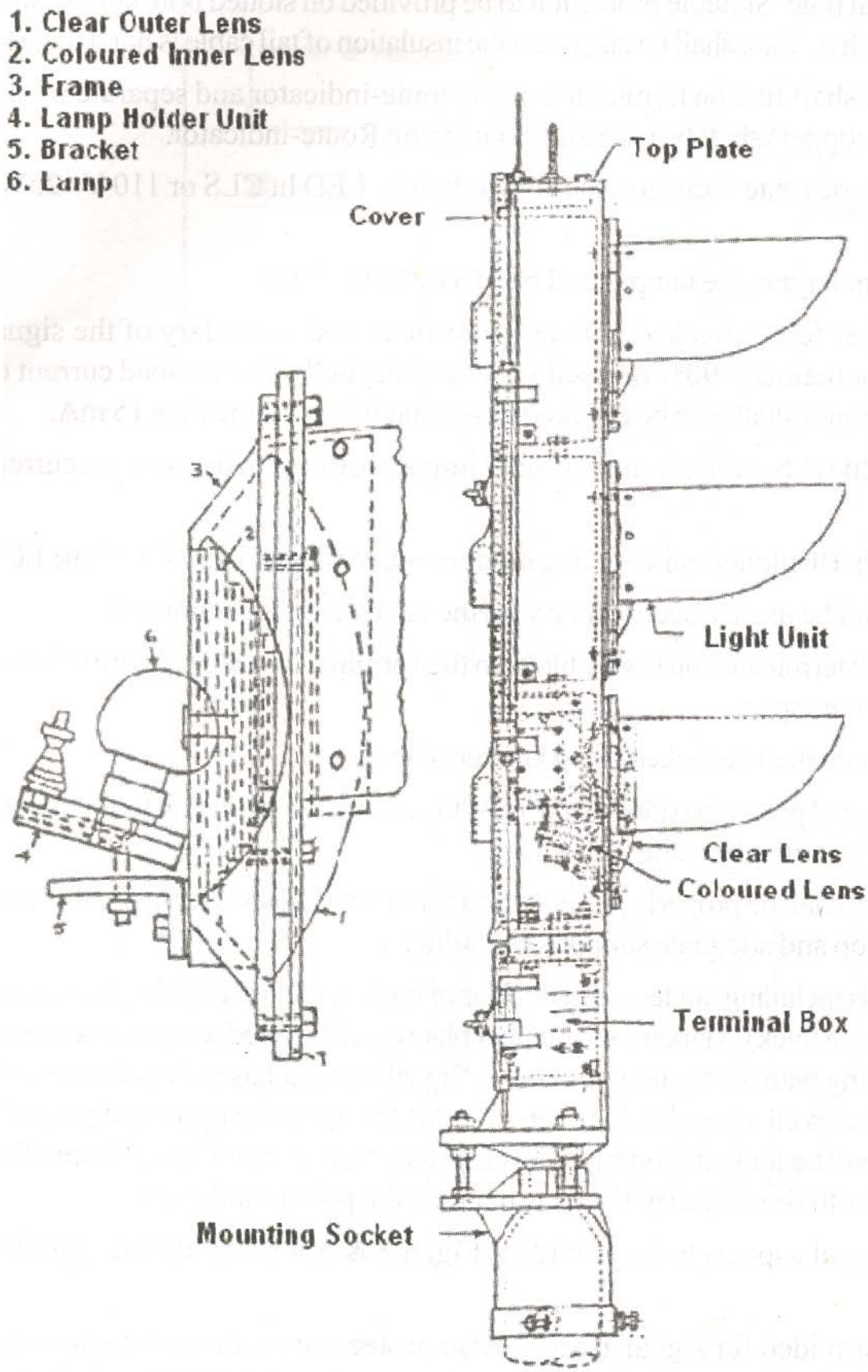


Fig. 8.3 & 8.4 Fixing MACLS unit to the post & positioning of CLS lamp

22.7.2 *The distance between the signal control relays and the signal must not exceed the prescribed limits in electrified zone, measured along the line of way. This will ensure that the voltage induced in the circuit will be inadequate to illuminate the lamps, even under the most adverse circumstances and with one or more earth faults present.*

22.7.3 *Maximum permitted length of direct feed of signal in various configuration for 110V feed system shall be as per tabulation below.*

Type of Cable	***110 V Feed System***	
	Single Track	***Double Track***
Screened	*600 m*	*600 m*
Un-screened	*180 m*	*220 m*

22.7.4 *When a signal I s located at a distance greater than that specified in para 22.7.3 the signal shall be fed locally by controlling relays located at the location. Such signals may also be remotely fed from the cabin by using, a corresponding relay at the location. Typical circuit is given in Drg No 22 11 of SEM Pt.II.*

22.7.5 *It shall be ensured that the power transformer for feeding circuits as per section 22.7.2 shall be different from the transformer feeding longer circuits.*

(x) RDSO Drawings and specification related to CLS are given below:

Item	**Specification No.**
Signal lamp	IRSS57
Signal lens:	IRS : S7
CLS Unit	IRS : S 26
CLS transformer	IRS S 59
Filament switching unit	IRS S 100
Route indicator Director type 5 lamps units areas (1 to 6 way)	IRS S 66

Drawing No.	Description
SA21281	Route indicator stencil type.
SA 23401-06	Route Indicator director type unit Arm 1 way to 6 Way.
SA23761	Route indicator multi lamp unit type.
SA23840	Shunt signal position light type.
SA24351	Calling On Signal.
SA23001AM	Signal colour light, multi nit type (4 aspect) without side light.
SA23002A/M	Signal colour light, multi unit type (3 aspects) without side light.
SA223003A/M	Signal colour light, multi unit type (2 Aspects) without side light.
SA 24831	Light unit - CLS lamp holder unit (for triple pole lamp)

(y) If stencil type route indicators is necessary, then to avoid speed restriction, direction type route indicators can be used in conjunction with stencil type route indicator.

8.5 CLS LENSES

CLS lenses are to be procured as per RDSO specification IRS-S 7/92 Amendment 3 from RDSO approved vendors. The types of lenses (CLS and also others) and their applications are given below:

Sl. No	APPLICATION	DIAMETER AND COLOUR	TYPE	NOMINAL FOCAL LENGTH
1	Colour light signals multi unit type.	140 mm Red / green / Yellow	Outside step	13 mm#
2	Colour light signals multi unit type (for stop signals only).	213 mm Clear	Inside step with spread light.	102 mm
3	Colour light signals, multi unit type (for stop signals only).	213 mm Clear	Inside step with moulded prism for close up indication	102 mm
4	Colour light signals multi unit type (for permissive signals only).	213 mm Clear	Inside step without moulded prism for close up indication	102 mm
5	Route indicator & Direction type indicator	92 mm Lunar white	Out side step	16 mm*
6	Route indicator & Direction type indicator	127 mm Clear.	Inside step with moulded prism for close up indication	70 mm
7	Point & trap indicators, target type (clear only)	101 mm Red/ Green/ lunar white/Clear	Inside step	89 mm
8	Hand and temporary engg. Signal lamps, semaphore signal lamps (clear only)	136 mm Red, yellow, Green,& clear	Inside step	89 mm
9	Semaphore signal lamps.	136 mm Clear	Inside step	89 mm

* The focal length refers to doublet combination of the lens with 127 mm dia x 70 mm focal length inside step clear lens.

\# The focal length refers to doublet combination of the lens with 213 mm dia x 102 mm focal length inside step clear lens.

The inside step clear lens, moulded out of polycarbonate material, confirming to Drg. No: S – 24845 can be used as outer lens to avoid breakage.

8.4 FIXING OF CALLING ON SIGNAL/POST TYPE SHUNT SIGNAL

(a) An off-set bracket to be fixed with 'U' bolts of 20 mm dia. (2 nos.) on the signal post. A through hole of 21.5 mm dia to be drilled on pole just below off-set bracket and through bolt with check-nut provided to prevent the off-set bracket from sliding down.

(b) To take wires to the signal unit, a vertical slot of not less than 25 mm x 50 mm to be made on signal post. Suitable protection to be provided on slotted post before cable is taken thru' it.

(c) Signal unit doors shall be locked using Universal locks.

(d) In case LED lit units are not used, the rating of the bulb for calling-on signal is 110V/25W/3 pin and for shunt signal 110V/25W/2 pin.

8.6 FOCUSING OF STOP SIGNALS

Focussing to be done under bright day - light condition at 90% of rated voltage. To ensure good visibility, it is essential that lamp is focussed to align the beam of light towards the driver. Red aspect is kept at driver's eye level (3.65 m approx. above rail level)

(a) For the purpose of sighting, all signals are provided with lugs drilled with small apertures at the bottom of the unit. These two holes are aligned in the direction from which signals are to be sighted.

(b) The mounting socket is fixed on the post with three bolts, the entire unit can be tilted either vertically or horizontally for correct alignment of the beam of light.

(c) For focussing of individual aspect, ensure that the inner and outer lenses are parallel and fixed properly in their position.

(d) Keep the main filament of bulb at the center of inner/outer lens by proper adjustment of the lamp holder.

(e) To improve the visibility at close range or on curve, use spread light lens.

(f) The lenses shall be so fitted that the subsidiary beam through the close-in view prism on the lens reaches driver depending on position of signal i.e. left/right w.r.t. track (when the Driver stops very close to signal)

8.7 SIGNAL LAMPS

8.7.1 Signal Lamps used in CLS

Sl. No	REF. TYPE	RATING VOLT	RATING WATT	PURPOSE
1	SL 5	12	4	Repeaters and Indicators, multilamp type route indicator with parallel connection.
2	SL18	12	24	Multi aspect colour light signal.
3	SL 21	12 Main filament 16 Auxi. Filament	24 12	Multi aspect Colour Light Signals
4	SL33	110	25	Direction type route indicators.
5	SL35A	12	24/24	(Triple pole with/parallel filaments) Multi aspect colour light signals.
6	SL35B	12	33/24	(Triple pole with/parallel filaments) Multi aspect CLS

8.7.2 Pre-heat testing of signal lamps

(a) Signal lamps must be tested for 45 Hrs. before they are provided on signal. A record of testing of lamps should be maintained as per table given below:

Table for Bulb Testing

Sl. No.	Type of lamp	Firm's Name	Lot No.	Manufacturing Date	Date of Testing		Total no. of bulbs for Testing	Bulbs fused during Testing
					Start	Finish		

(b) Pre Stressing of Triple lamp should be done at 10.5 V for 3 hours for each filment.

8.7.3 Direct Feed to Signals in R.E Area - Calculation *of Safe Limiting Distance*

8.7.3.1 Calculation of permissible induced voltage

Glow is observed when 2.3 V is applied to the signal lamp (12 V) .2.3 V on secondary side is equivalent to 21 V on 110V side.

Induced voltage on Double line is 95 V per km

Induced voltage on Single line is 116 V per km

The parallelism permitted for 21 V on double line: (21/95) x 1000 m ~ 220 m

The parallelism permitted for 21 V on single line: (21/116) x 1000 m ~ 180 m

Hence -

DIRECT FEED PERMITTED ON DOUBLE LINE : 220 M

DIRECT FEED PERMITTED ON SINGLE LINE: 180 M

8.7.3.2 Maximum Permissible length of parallelism for external circuits

Sl. No	Type of Relay	on Single Line Section in Km	On Double line Section in Km
1	Shelf type Relay D-5	2.1	2.8
2	QNAI/QSA3/QSPA	2.1	2.8
3	K-50(B-1)	1.0	1.2
4	K-50	0.75	0.9

8.8 TRIPLE POLE LAMPS

8.8.1 Installation of Triple pole lamps

In Triple pole lamps, there are two filaments of equal wattage. The main filament is lit normally and the auxiliary filament serves as a standby, to be switch ON when main filament fuses. Since both the filaments have the same ratings and lumen output, the visibility of CLS is not so affected when the main filament is fused and the auxiliary filament is switched ON. The new design of the lamp has been developed with RDSO in which the two filaments are provided in parallel configuration to avoid possibilities of hot-spot formation.

The circuit arrangement for triple pole lamp is shown as per **RDSO Drg.No.SDO/RRI-263**. In this H-type transformer is used as per IRS:S62 with certain modifications in the secondary side of the signal transformer MECR unit can be connected to the signal lamp circuit. (Please refer fig.8.5)

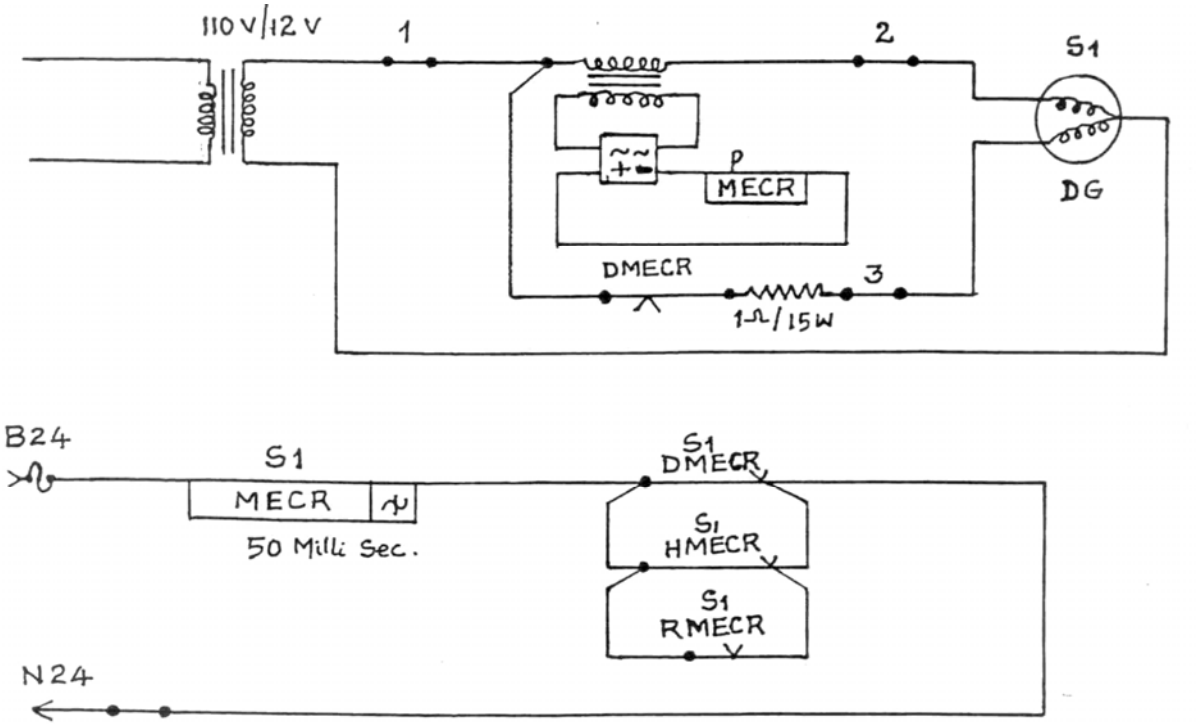


Fig.8.5 RDSO TRIPLE POLE LAMP CIRCUIT WITH MECR

MECR unit shall be fixed inside the signal unit or in the signal location box. This MECR unit basically consists of one H-type current transformer and the transformer secondary output voltage is rectified and the rectified out voltage is connected to one miniature relay (MECR). This relay gives the condition of main filament of the triple pole lamp.

This relay picks up when the main filament is burning. It drops when the main filament is fused. Then through the back contact of this relay auxiliary filament lits. In the auxiliary filament circuit path 1 Ohm, 15 W resistance is provided in series with the MECR back contact, to bring the main filament first in circuit when the aspect is switched ON.

In the new installations and in the old installations wherever possible, the railways may cater for the additional conductors required for providing the individual "Signal MECR" indication shall be provided.

S1 MECR is normally up and made slow to release to avoid wrong indication at the time of aspect changing. S1 MECR down indicates that main filament is fused for its aspect burning at that time. In the existing installations due to shortage of available conductors, railways may decide, to give a common indication to the maintenance staff by suitable grouping of signals.

Signal lamp main filament checking (MECR) indication and alarm circuit using triple pole signal lamp is shown in Fig.8.5.

Filment switching unit should be fixed inside the signal unit preferably.

8.8.2 Usage of Triple pole lamps

The following are the triple pole lamps used in our Indian Railways:

Bulb No.	Rating	Life	Applications
SL35A	12V/24W, 24W	1000 hours	Normally used for OFF Aspect in CLS, with or without cascading arrangement.
SL35AL (Longer life)	12V/24W, 24W	5000 hours	Normally used for OFF Aspect in CLS, with or without cascading arrangement.
SL35B	12V/33W, 33W	1000 hours	Normally used for ON Aspect.
SL35BL (Longer life)	12V/33W, 33W	5000 hours	Normally used for ON Aspect.

8.8.3 Inputs required for Triple pole lamps

Materials:

(a) Triple pole double filament lamps SL 35 A - 12 V 24 W / SL 35 B - 12 V 33-W.

(b) Triple pole lamp holder with base.

(c) Switching unit (MECR).

(d) Push button switch.

(e) Buzzer, indication lamps.

(f) PVC wire.

(g) ARA terminals & other accessories.

Additional requirements:

(a) 2- spare core from, signal location to relay room for MECR is required.

(b) 1-extra core for each aspect in tail cable form location to signal post.

(c) If there is no space in the location for providing RMECR, HMECR, DMECR relay & indication transformers then extra location is also required.

8.9 LED SIGNAL

8.9.1 Brief Description of LED Signal

LED Signal lighting Unit as per RDSO specn. No.RDSO/SPN/153/2002 consists of the following:-

(a) LED Aspect: This goes and retrofits in the existing inner roundel location on the 4 existing mounting holes. It replaces bulb, bulb holder, inner lens and outer lens.

(b) Universal AC/DC Current Regulator: This replaces the bulb, step down transformer and retrofits into its location on the 4 Mounting holes.

(c) Universal AC or DC Health Monitor Unit (HMU) for ESM & ASM: This is installed at the cabin end and Monitors the performance of signal unit and its lighting circuit, cable etc. ***It has following components:-***

(i) A Pre-wired/Mother Board for combining the lamp signal of 8 Aspect Units.

(ii) 19" rack to house the following:-

– *Mother Board (Common for AC or DC lighting)*

– *Aspect Monitoring (Health Indicator) Cards – 8 Nos AC type or DC type. AC type has selection jumpers for LED or conventional ECR's.*

– *Power supply Card – 1 No (AC type or DC type)*

Mother Board provides the input/output terminals for each aspect cable pair to let-in and then go-out to respective ECRs.

The Health Monitoring Unit preferably is to be placed in the relay room. Each aspect supply cable pair first connects into Health Monitoring Unit shelves and then goes to respective ECR. The Health Monitoring Unit also monitors any leakage out of the aspect or its cable pair. The alarm signal provides preventive information.

(d) Audio/Visual Alarm for ASM:

The alarm signal can be made common in multiples of 8. Thus on each station, we can cascade such 19'' shelves to have common alarm signal for entire station.

8.9.2 Operational requirements of LED Signals

(a) Operate on AC/DC (110 V).

(b) Operate on Conventional and LED ECR's.

(c) Conventional ON aspect metal to metal or metal or carbon ECRs are recommended (other than Siemens ECRs) and off aspect Siemens ECRs.

(d) HMU shelves (Mother Boards) are common for AC/DC, but , aspect monitoring/ Power cards are different

8.9.3 Suitability of ECRs

It is better to use LED ECRs developed for LED signals for better reliability. However, in case of non-availability, conventional ECRs can also be used as per the table below:

Recommended Usage of ECRs with LED lit CLS Units

Make	Conventional ECR	Suitability with LED signals			
		Main	C-ON	Route	Shunt
M/s ABB	ON-Metal to Metal	YES	YES	-	-
	OFF-Metal to Metal	-	-	-	-
	Route-Metal to Metal	-	-	-	-
	Shunt-Metal to Metal	-	-	-	-
M/s Siemens	ON-Metal to Metal	-	-	-	-
	OFF-Metal to Metal	YES	YES	-	-
	Route-Metal to Metal	-	-	-	-
	Shunt-Metal to Metal	-	-	-	-
M/s CGL & M/s Hytronics	ON-Metal to Carbon	YES	YES	YES	YES
	OFF-Metal to Carbon	-	-	-	-
	Route-Metal to Carbon	-	-	-	-
	Shunt-Metal to Carbon	-	-	-	-
	LED ECR	-	-	-	-
M/s CGL & M/s Hytronics	LED ECR AC Metal to Carbon	YES	YES	YES	YES
	LED ECR DC Metal to Carbon	YES	YES	YES	YES

8.9.4 Settings on Current Regulator

The jumper settings on current regulator to be done referring the manual given by the Manufacturer. The selections involved are:

Power Supply – 110 V AC / 110 V DC

ECR – AC LED / DC LED / Conventional ECR(AC)

Aspect Mode – Blanking / Non-blanking

There is no uniform setting as the LED units are from two different suppliers (as on date) viz., M/s Sanarthi International, New Delhi and M/s Power Technologies, Solan. M/s Sanarthi has different models (types). Hence, the manufacturer's manual to be referred to know the correct jumper setting on current regulator.

8.9.5 Detailed installation procedure

8.9.5.1 Procedure to install Signal Aspect & Current Regulator

(a) Remove both the lenses of the aspect.

(b) Remove the bulb holder, bulb & transformer.

(c) Install from the rear side the LED aspect on the four mounting screws of the roundel.

(d) Install Current Regulator on the mounting screws of Signal Transformer. Ensure jumper setting as per ECR being used and AC/DC supply.

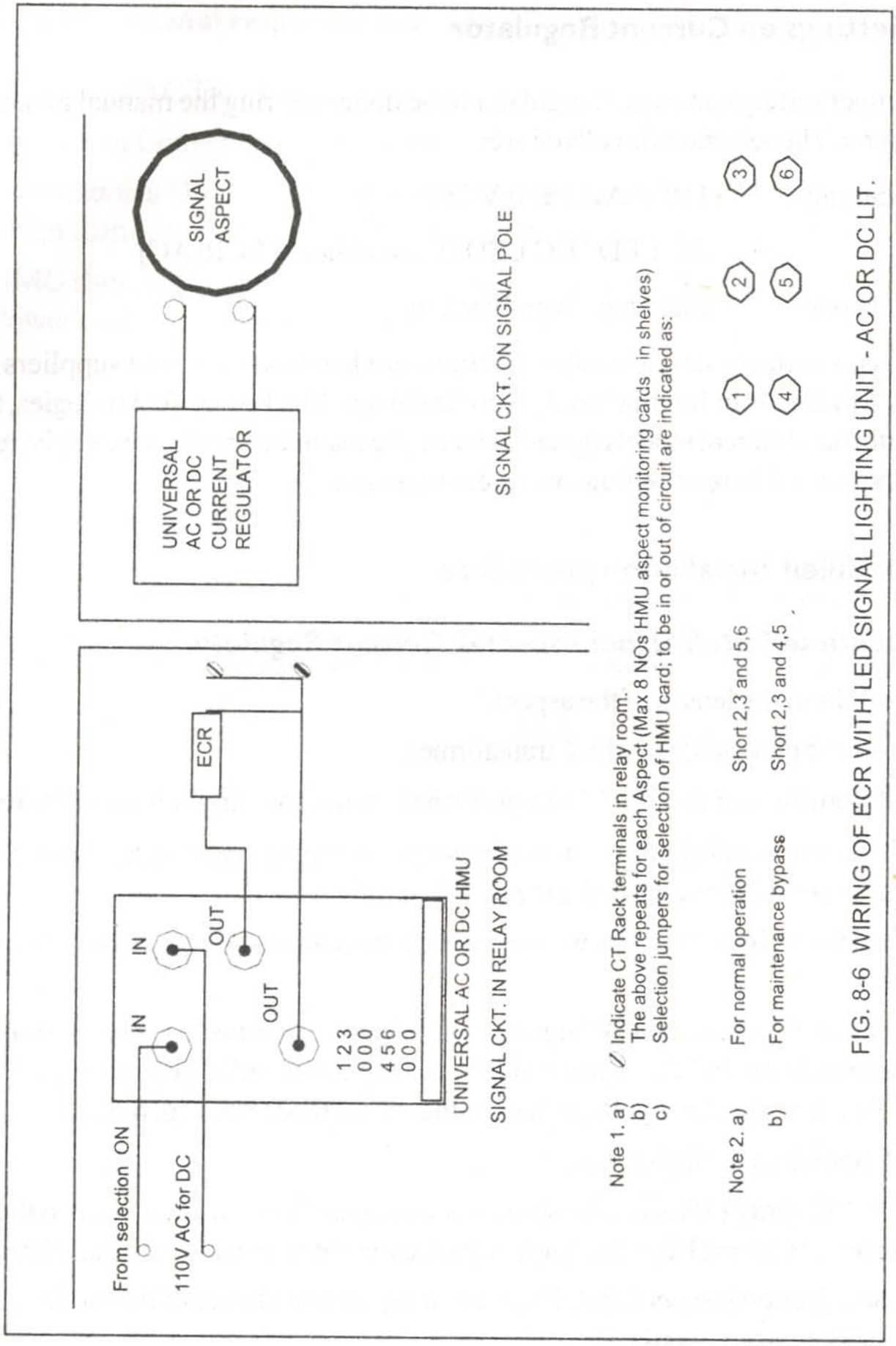
(e) Connect the 3 pin & 2 pin screw – on output connector of the current Regulator to the aspect.

(f) Connect AC (DC in case of DC signal) input through the respective Aspect Monitoring card terminals on 19" shelves rear side to the Mother board to connect to go to ECR, the CT rack & the Current Regulator at the signal post (See Fig. 8.6).

(g) Check operation through cabin.

(h) Spray CRC spray (Plastic film spray which causes hermetic sealing) on the input Connector of Current Regulator and put protection cover to avoid external interference.

(i) Seal the selection jumper CAP. Ensure that the correct sticker of the mode selection is put on the current regulator.



Note 1. a) Indicate CT Rack terminals in relay room.
b) The above repeats for each Aspect (Max 8 NOs HMU aspect monitoring cards in shelves)
c) Selection jumpers for selection of HMU card; to be in or out of circuit are indicated as:

Note 2. a)	For normal operation	Short 2,3 and 5,6	①	②	③
b)	For maintenance bypass	Short 2,3 and 4,5	④	⑤	⑥

FIG. 8-6 WIRING OF ECR WITH LED SIGNAL LIGHTING UNIT - AC OR DC LIT.

8.9.6 Procedure to install Universal AC or DC Health Monitoring Unit

Health Monitoring Unit is provided in series for each aspect through cable pair between the selection circuit and ECR. It connects in & then out on the Mother board for the respective aspect card locations.

(a) Mark the HMU card in a shelf for the nominated aspect (see Fig. 8.7)

(b) Connect phase and Neutral (+/- in case of DC lit), (Aspect supply cable pair coming out of selection circuit) to the input of HMU card for the selected aspect.

(c) Connect the aspect cable pair to CT rack from o/p of the HMU aspect and through its ECR.

(d) Each shelf contains –

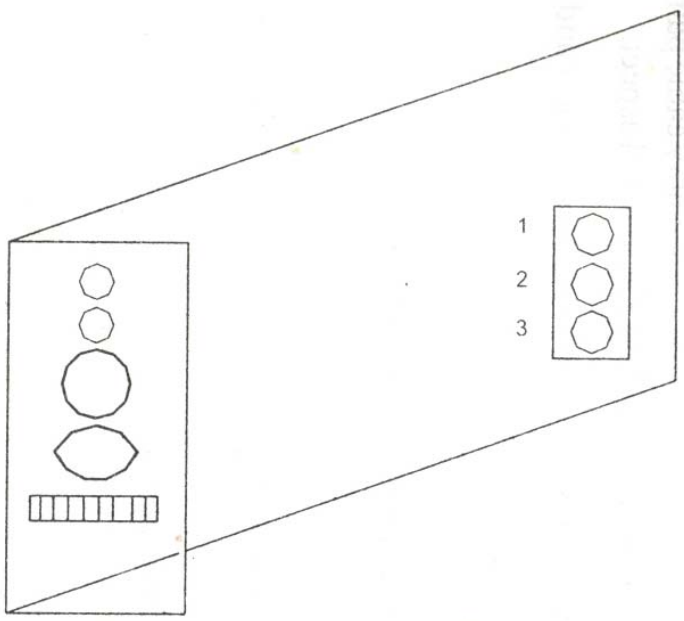
(i) Eight aspect monitoring aspect cards One Power Supply Card.

(ii) One Mother Board Card.

(e) The 19" Eight aspect shelves are cascaded to provide common alarm (see wiring diagram in Fig.8.8).

(f) Audio/Visual Unit is connected through QNA 1 Relay with last cascaded shelf of HMU (see Fig.8.8).

(g) Connect the Power Supply input 110 V AC for AC lit (24 V DC for DC Lit) signals and 24 V DC for operation of Audio/Visual Unit (see wiring diagram in Fig.8.8) and observe that the indicators on Health Monitoring Unit for all aspects are ON. This will confirm that all aspect cards are active and that the aspects which are ON are working well.



Aspect monitoring card of HMU

*Selection on HMU card (internally)

ECR Type	Current seting	Jumper selection
For LED ECR	125ma rms	short 1 and 2
For conventional ECR	220 + ma rms	short 2 and 3

(pin 1 counted from bottom edge of the card)

Fig 8.7 Making HMU card for nominated aspect

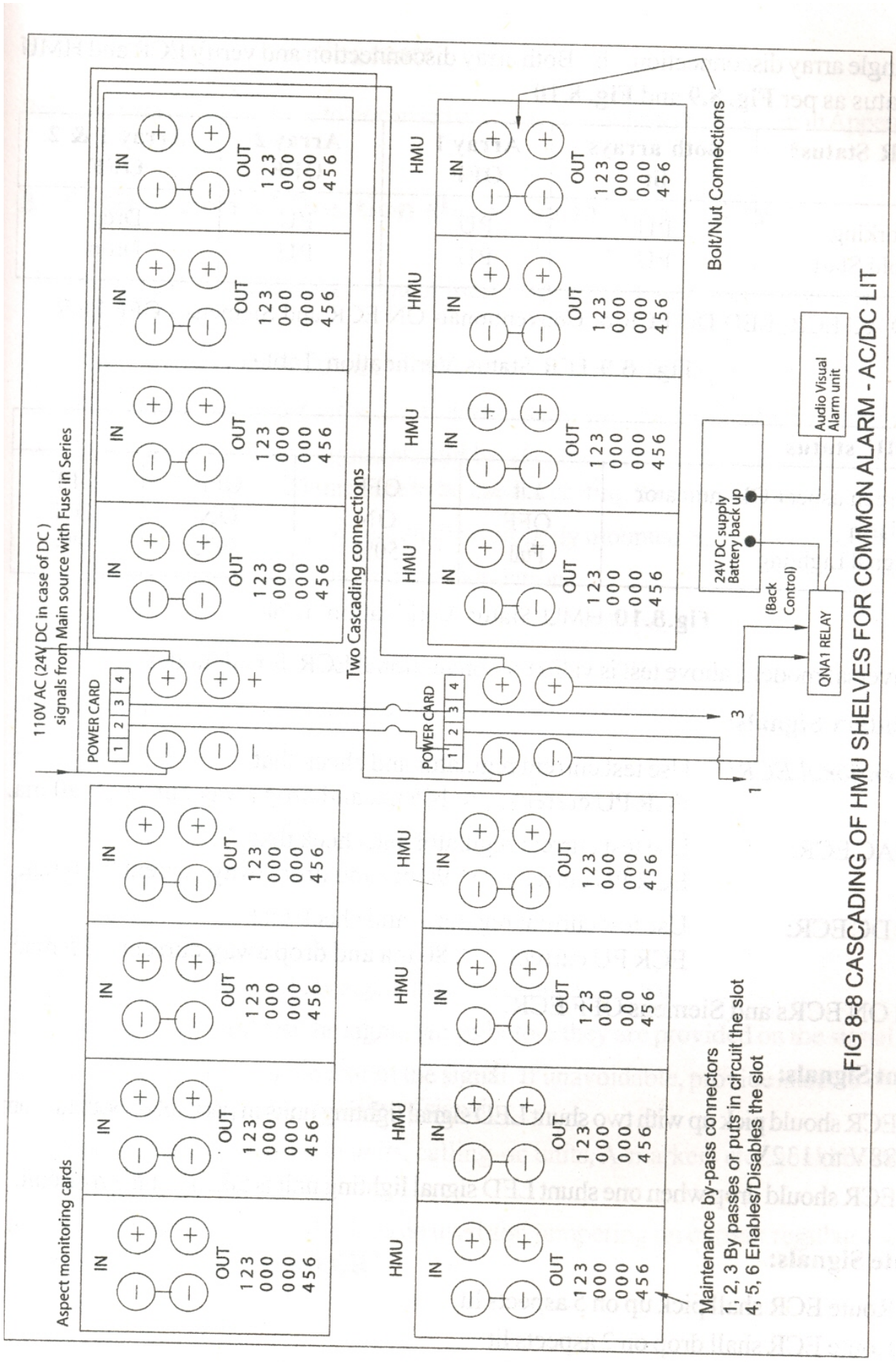


FIG 8-8 CASCADING OF HMU SHELVES FOR COMMON ALARM - AC/DC LIT

8.9.7 ECRs & Workability Test

Main Signals:

The main signals are configured in double array, thus functioning as a double filament lamp. It is desirable that on 50% illumination single array failure the ECR shall remain picked up. This is to avoid double aspect situation. Use a test jig which facilitates the following tests –

(a) Single array disconnection

(b) Both array disconnection and verify ECR and HMU status as per fig. 8.9 and fig.8.10

ECR Status*	Both arrays lit	Array 1 OFF	Array 2 OFF	Array 1 & 2 OFF
- Working	PU	PU	PU	Drop
- Cold Start.	PU	PU	PU	Drop

* LED AC ECR, LED DC ECR or Conventional- ON ECR and Siemens - OFF ECR

Fig. 8.9 ECR Status Verification Table

HMU status				
- Green aspect Ok indicator	Lit	OFF	OFF	OFF
- Alarm	OFF	ON	ON	ON
- Signal Lighting	Full	50%	50%	0%

Fig.8.10 HMU Status Verification Table

In universal models, above test is valid for conventional ECR for all modes.

Secondary Signals:-

Conventional ECR*: Use test current regulator and check that

ECR PU current < 145 ma and drop away current > 90 ma.

LED AC ECR : Use test current regulator and check that

ECR PU current < 90 ma and drop away current > 60 ma.

LED DC ECR : Use test current regulator and check that

ECR PU current < 80 ma and drop away current > 55 ma.

* All ON ECRs and Siemens OFF ECR.

Shunt Signals:-

(a) ECR should pick up with two shunt LED signal lighting units in parallel & both lit from 88V to 132V.

(b) ECR should drop when one shunt LED signal lighting unit is taken out from circuit.

Route Signals:-

(a) Route ECR shall pick up on 5 aspects lit.

(b) Route ECR shall drop on 2 aspects lit.

8.9.8 Pre – Commissioning Tests

Pre – commissioning tests are to be carried out as per RDSO check list given in Appendix-D.

8.10 ERECTION OF POSITION SHUNT SIGNAL GROUND TYPE

(a) Pit to be excavated and casting of foundation to be done as per standard drg. of the Zonal Railway

(b) Anchor bolts of size 20 mm x 450 mm to be used to fix the post.

(c) Foundation to be cast at the locations marked by Section engineer in-charge.

(d) Foundation for shunt signal should be of cement concrete type with 1:3:6 ratio. Stone ballast of 20/25 mm size to be used in casting the foundation.

(e) The position light shunt signal shall be properly mounted on post and plumbed.

(f) Earth-work to be done around the foundation.

(g) Focusing to be done in bright day-light at rated voltage.

(h) Cables to be taken inside through the post to the unit.

(i) Terminations can be done direct or interposing terminal block.

(j) Unit back door covers to be locked.

DO s and DON'T s of Signal Installation

DO s

(a) Please ensure signal post is plumb

(b) Ensure proper focusing of signal before it is put in service

(c) Carry out pre-heat test the signal lamps before they are provided on the signal

(d) Avoid any bright light in rear of the signal. If unavoidable, provide sheet to obstruct false light to have clear visibility of signal.

(e) Proper gasketing of signal units, calling-on units, A-markers etc should be done to avoid phantom indications

(f) In LED signals, proper ECR to be used and jumpering on current regulator should match type of LED and ECR**.**

DON'T s

(a) Never keep un-commissioned signal unit facing approaching train without cross

(b) Never open the rear cover in face of approaching train for doing adjustments

(c) Never commission green aspect LED in blanking mode**.**

8.11 WINCH OPERATED LIFTING BARRIER GATES

The installation consists of Excavation & foundation work, fixing the lifting barrier mechanism including transmission gear arrangement, and testing.

8.11.1 Excavation & Foundation work

The work consists of casting foundations with cement concrete in the proportion 1:3:6 with approximately 40 mm graded stone and river sand, plastering the exposed portion including the portion on the sides upto a depth of 150 mm below the ground level for:

(a) 2 nos. of lifting barrier pedestal using 6 nos. of anchor bolts of size 25 mm x 900 mm for each pedestal.

(b) 2 nos. of lifting barrier stands using 4 nos. of 20 mm x 450 mm anchor bolts and nuts for each stand.

(c) Lifting barrier winch mechanism using 4 nos of 20 mm x 450 mm anchor bolts and nuts.

Also, the metal/tar road to be cut and a duct of 300 mm width to be excavated with 300 mm depth and 100 mm dia GI pipe to be laid for transmission rodding and closed, rammed & leveled.

8.11.2 Fixing the lifting barrier mechanism and transmission gear

Lifting barrier pedestal, booms, winch stop posts, carex reflectors, fringes (if any) to be fixed and boom-balancing to be done by fixing sufficient no. of cylindrical and flat weights on booms . The wire transmission mechanism to be run duly coupling both the booms with the winch. The transmission wire to be adjusted using wire adjustment screws.

At interlocked LCs, circuit controller activated road- warning lights to be provided to display red when the gate is being closed and white when gate is open.

Boom locking mechanisms, rodding connections to be fixed.

GF lever / Rack & pinion lever for boom-lock key to be provided.

Winch for operation of lifting barrier shall be located at a place(including cabin) not exceeding 150 m from the gate and having clear visibility of the road.

8.11. 3 Testing

By operating the winch, the barriers to be closed and only with complete closure of barriers, RDSO boom lock plunger gets operated and only then boom-lock lever can be operated. The key released from winch is put on boom-lock lever (GF/Rack & pinion) and then operated to lock the boom and release the control key.

The control key is utilized for releasing signal/ signal control through SM slide/Lever frame/Panel knob/Key transmission.

The above interlocking to be tested.

It shall be possible to extract the key from the winch only when the gate is fully closed. Boom locking should effective & it should not be possible to lift the boom by more than 10 cm. from closed position.

8.12 ELECTRIC LIFTING BARRIER

Specifications for Electric Lifting Barrier (ELB) are issued by RDSO vide IRS: S41/70 (Amendment-2) or latest. Electric Lifting Barriers are to be provided as per the above specifications. Wherever availability of power supply is inadequate or power Supply is not available. Electric Lifting Barrier with hand-generator back-up as per RDSO Specification RDSO/SPN/180/2005 may be provided.

The description given below is only for explanation of the ELB and it's working.

8.12.1 GENERAL FEATURES

(a) Lifting barrier is manufactured according to the IRS specification No. S: 41-70.

(b) Lifting barrier is robust and operating mechanism is protected against unauthorised interference.

(c) The boom of the barrier is light in construction and extends across the full width of the road.

(d) When the gate is closed to road traffic, clearance between road surface level and the boom shall be 0.8 to 1 m.

(e) Fringes, if provided, are made clear of road surface by not more than 15 cms. when the boom is in the horizontal position..

(f) The raised or open position of the lifting barrier is with in 80°- 85° from the horizontal and lowered or closed position is within 0°- 10° from the horizontal.

(g) At the centre of the boom, the lifting barrier is provided with a 600 mm dia. red disc having red reflector buttons facing the road traffic.

(h) Lifting barrier can be stopped, reversed or its movement obstructed at any point during operation without damage.

(i) The mechanism is so designed and booms are so balanced that in case of failure of power supply, the barrier remains in the last operated position.

(j) The mechanism is so designed that if the boom is obstructed during operation, it stops and on removal of the obstruction assumes the position corresponding to the control apparatus, unless protected devices have operated.

(k) Lifting barrier have two booms one across the road on either side of the level crossing, operated by independent mechanism.

(l) Arrangements are provided to adjust the counter balance of the lifting barrier.

(m) The operating mechanism also includes a suitable device which locks the lifting barrier in the vertical and horizontal positions.

(n) Electrical contacts are easily accessible and independently adjustable and confirm to IRS specification No. S-23.

(o) Bearing confirms to IRS specification No. S-23 and is constructed so as to prevent entry of water.

(p) Exposed oil holes, cups or grease nipples are provided with waterproof spring loaded covers.

(q) In case of power failure, lifting barrier is operated manually by a crank handle. The insertion of hand-crank disconnects the power supply to the motor and it is not possible to reconnect the power supply until the hand-crank is withdrawn, and a switch is operated.

Hand generator is another option for facilitating operation from central place instead of cranking on two sides (i.e. both barrier booms)

(r) The type, rated voltage and current of the lifting barrier is as follows:

(s) Boom shall be either painted with 300 mm bands of alternate black and yellow colour or provided with approved type of retro-reflective strips.

TYPE	RATED VOLTAGE AND CURRENT
Low voltage	24 V DC / 6-8 Amps. For boom length up to 8 m. 8-12 Amps for boom length above 8 m.
High voltage	110 V AC, 50 Hz, single phase, 2 Amps

(t) Lifting Barrier shall be capable of operating satisfactorily between the limits of 75% - 125% of the rated voltage applied at its terminals, and where as is used, with a frequency variation of +/- 3%. The gate mechanism shall operate uniformly and smoothly and complete all movements without rebounding. It shall be securely held in clear position, until conditions require the gate to be lowered.

8.12.2 Sequence of operation

The operation of Lifting Barrier takes place in following sequence:

(a) Open of detection contacts

(b) Unlock the boom

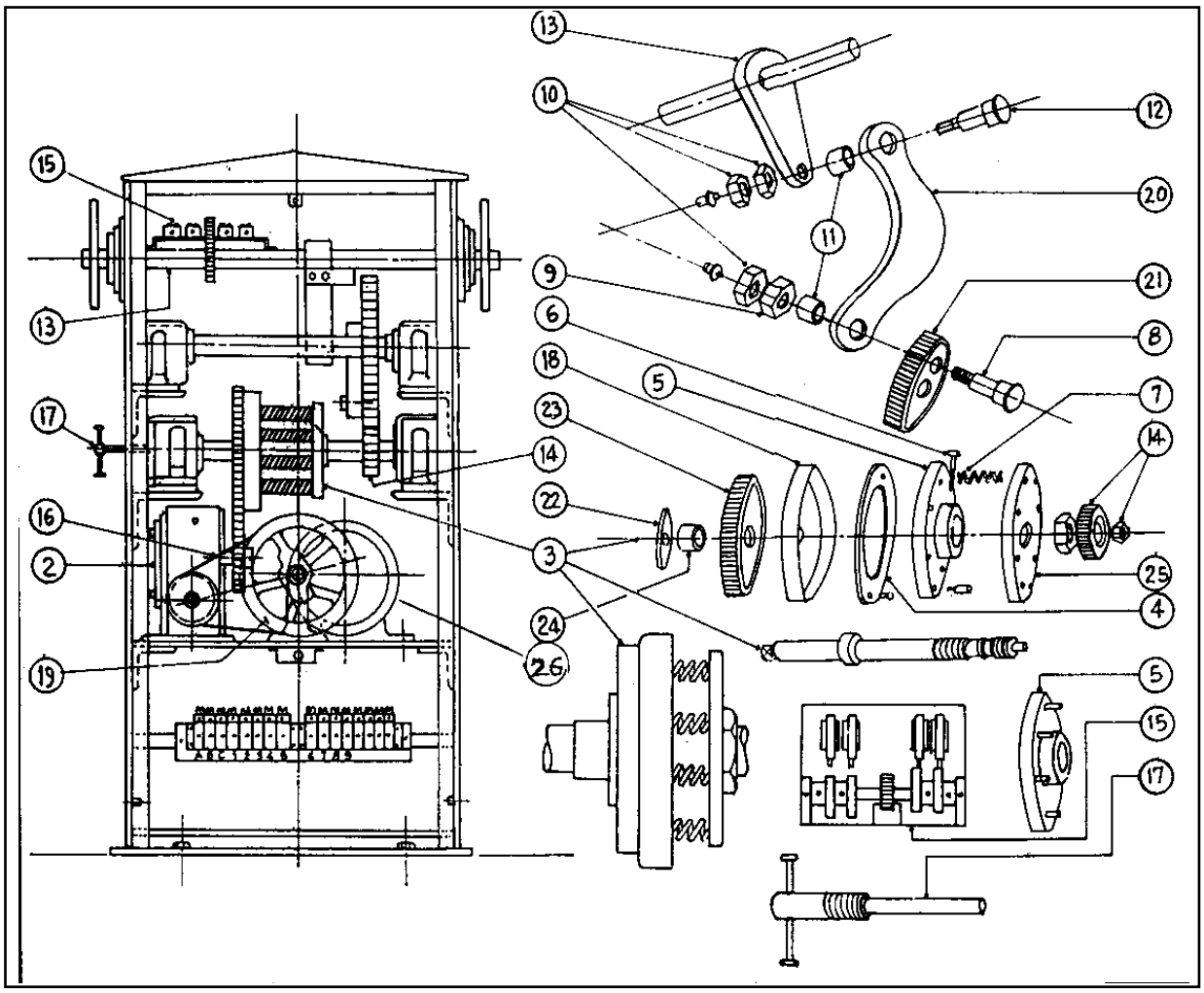
(c) Move boom

(d) Lock the boom in full horizontal or vertical position.

(e) Close the detection contacts

8.12.3 Parts of ELB

An electrically operated device for closing the level crossing against road traffic comprises of an operating panel, an electric motor, operating mechanism, circuit controller, road signals, audible devices, boom etc. A typical Fig.8.11 is shown below:



NAME OF PART	S.NO.	NAME OF PART	S.NO.
Reduction gearbox -	2	18 teeth gear with round nut -	14
Friction clutch complete -	3	Circuit controller with limit switch 4 way -	15
Clutch facing -	4	Drive belt-2 different size -	16
Friction plate with pin -	5	De-clutching bolt -	17
Cross bolt -	6	Clutch lever -	18
Compression spring -	7	Hand attachment pully -	19
Gear pin -	8	Moon cover -	20
Gear pin hex head nut -	9	72 teeth gear -	21
Hex head nut -	10	Bearing cover -	22
Needle bearing -	11	Clutch gear -	23
Lever pin -	12	Sleeve -	24
Shaft no.1 with gear levering -	13	Pressure plate -	25
		Crompton motor -	26

Fig. 8.11 Electrical Lifting Barrier Parts

8.12.4 Control Panel for ELB

(a) A control panel is provided to operate the two booms individually as well as simultaneously.

(b) The control panel may be either of the miniature lever type or push-button type with suitable arrangements to stop the barrier at any position.

(c) In case of power supply failure during operation of the barrier, it is not possible to revert back to normal working on resumption of power supply, unless an additional switch provided for this purpose is operated.

(d) Approved type contactors are provided in control panels for the operation of lifting barrier.

(e) Two push buttons red and green are provided to open and close the lifting barrier, respectively.

(f) Suitable protective devices are provided to disconnect the circuit in case of overloading of motor.

8.12.5 Electric Motor of ELB

Motor is totally enclosed type complying with B.S. 170 with class- 'A' insulation. Motor is an integral part of the mechanism and removable there-from. Motor bearing is so designed that lubricant used can not reach to brushes, commutator or winding. Suitable protective device like circuit breaker in addition to friction clutch is provided to disconnect the circuit in case of over-loading of motor.

8.12.6 Mechanism Case

Mechanism case is of metal, strong and weatherproof. It has ample space to accommodate various apparatus and wiring. A suitable gasket is provided on the mechanism case between case and its door to protect it from entry of water and dust. Arrangement is provided for rigidly securing and padlocking the door of the mechanism case. The door or cover when open, permits easy access to all parts.

8.12.7 Road Signals

Road signals shall be provided as per Para 12 of RDSO/SPN/180/2005 which is re – produced below:

12.1.1 *Where required by the purchaser, audible and/or visual warning arrangements for the road traffic shall be provided along with the lifting barrier.*

12.1.2 *The audio- visual warning equipment shall be installed on the left side of the road on the top of a post, on either side of the level crossing, or at a location specified by the purchaser.*

12.1.3 *The Audio- Visual unit for road traffic shall consist of red and yellow aspects of LED signal/Signal lamp from RDSO approved sources and Ding-Dong bell fitted in three aspect signal units as per RDSO drawing number SA23002A/M. The red aspect, yellow aspect and Ding-Dong bell shall be fixable in the three slots available in the three Aspect CLS unit. The operation of Ding-Dong bell and signal aspects shall be on the same voltage (24 V/110 V DC) as of the barrier operation.*

12.1.4 *The traffic signals on each side of the railway line shall be positioned / provided so as to face outwards from the crossing towards approaching road traffic and shall give 400 m continuous visibility except curves, where it is not possible to achieve specified visibility due to geographical conditions.*

12.1.5 *Audio and visual warning arrangements for the road traffic shall start operating when the barrier moves from its vertical or open position and shall continue till both the booms reach within 10 degree of the horizontal position.*

12.1.6 *A steady red light shall continue to be displayed when the boom is horizontal and when the boom is being raised till the boom assumes the vertical position. Thereafter a steady yellow light shall be exhibited to the road traffic.*

12.1.7 *Audio warning shall operate with a clear DING-DONG sound and shall be audible for a distance of not less than 30 meters in a direction that the sound waves are not obstructed on a clear day, with the wind velocity and the extraneous /wises negligible.*

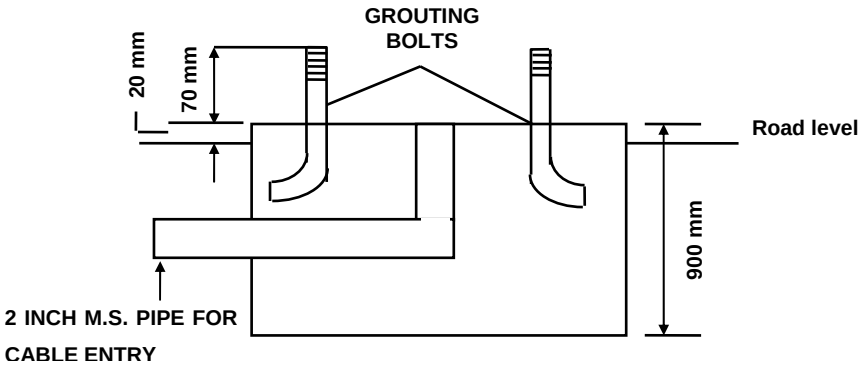


Fig 8.12 Foundation Drawing: Side View

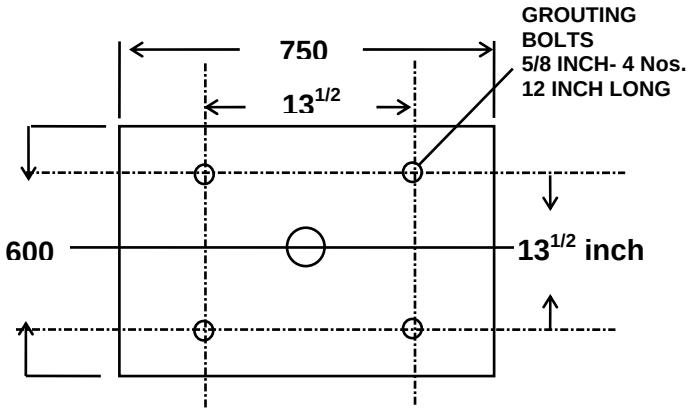


Fig 8.13 Foundation Drawing: Top View

8.12.8 Installation, adjustment & Maintenance of ELB

The detailed procedures of Installation, adjustment and Maintenance are given below.

8.12.8.1 Foundation

(a) A small concrete foundation is required for mounting the barrier machine as shown in foundation drg. Shown in fig.8.13.

(b) GI/ PVC bend pipe is installed at the centre of the 4 foundation bolts for entry of power and control cable.

(c) For exact fitting of barrier machine, position of the bolts i.e. inter-space of bolts is maintained properly**.**

8.12.8.2 Fitting mechanism

(a) Lift the mechanism box and place it on foundation in such a manner that the 4 grouting bolts protrude through the 4 holes provided at the bottom of this mechanism box.

(b) Mechanism box is so fixed that the double-ended shaft protruding from mechanism is parallel to the road.

(c) Ensure verticality of mechanism box (suitable packing may be placed below mechanism to achieve verticality, if required), and tighten the 4 nos. of grouting nuts, along with washer and lock washer.

The function of the gear drive unit is to reduce the speed and provide locking. A typical figure is shown. (Fig.8.14)

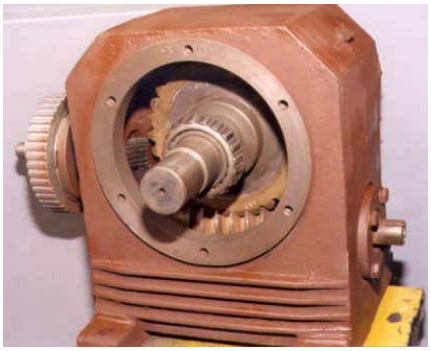


Fig.8.14 Gear Drive Unit

8.12.8.3 Equipment assembly

(a) The serial number of machine is marked on rear door. Similar serial number is also marked on counter, balance channels, aluminum booms and boom lock hook.

(b) Fit channel boom and boom hook on respective machine only to ensure matching.

(c) The counter-balance channels are first mounted on the mechanism shaft on both sides and fixed together in front with the 3/8” nuts and bolts, along with the 3/4” nuts on the shaft.

(d) After assembling of channel, the boom is fixed by 8 nos. 3/8” bolts, followed by the balance weights. While boom is being installed, support the tip of the boom until balance weights are in place, otherwise the gear unit may get damaged.

(e) The balance weights are suitably adjusted until boom is properly balanced. This may be checked by ensuring that the effort required for opening and closing barrier by crank handle or the current consumption is the same.

8.12.8.4 Solenoid boom lock

After completion of installation of the barrier machine, counterbalance channels, boom, boom hook, balance weight, etc. Mark the position of the boom tip support cum locking device and grout it at required position and height, so that boom falls in between the Y- shaped fork and the boom hook into the lock as shown below. (fig.8.15)

Fig.8.15 SOLENOID BOOM LOCK

8.12.8.5 Electrical connection

Terminal details of barrier machine and control panel are given below: -

(a) Terminals in barrier machine

TERMINAL NO.	
1 and 2	Motor running winding 110 V AC and solenoid lock coil in parallel
3 and 4	Motor starting winding 110 V AC
5 and 6	LS 1 contact (limiting switch) breaks at 2° and below.
7 and 8	LS 2 contact breaks at 88° and above
9 and 10	LS 3A contact makes at 88° and above
11 and 12	LS 3B contact makes at 88° and above
13 and 14	LS 4A contact makes at 2° and below
15 and 16	LS 4B contact makes at 2° and below
17 and 18	LS 5A contact makes at 2° and below
19 and 20	LS 5B contact makes at 2° and below
21 and 22	Crank handle cut-out switch
23 and 24	Boom light 12 V AC

(b) TERMINALS IN CONTROL PANEL

TERMINAL NO.	DETAILS
1 and 2	Key switch N-O contact
3 and 4	Push button OPEN N-O contact
5 and 6	Push button CLOSE N-O contact
7 and 8	Lamp open 110 V AC
9 and 10	Lamp close 110 V AC
11 and 12	Lamp power 1 110VAC
13 and 14	Lamp power 2 110VAC

Note: *Terminal number may vary as per Railway requirement.*

8.12.8.6 Adjustments

Limit Switch

(a) Two limit switches LS1 and LS2 are provided on rear box shaft to control auto stop in the fully open and closed position of the barriers.

(b) Three more limit switches with double contacts, LS3, LS4 and LS5 are provided to give back indications in fully open and closed positions.

(c) The limit switches are actuated by contoured cams fixed on boom shaft and position of these cams can be adjusted as follows –

(i) Loosen the cam fixing screws using an allen key.

(ii) Adjust the position of cam as required, by rotating it on boom shaft.

(iii) Tighten one of cam fixing screws and check the position of cam by operating the barrier.

(iv) Tighten all fixing screws after cam position is properly adjusted.

Cam

A typical figure showing CAM is given on next page. Positions of the cams are to be adjusted as given below: (fig.8.16)

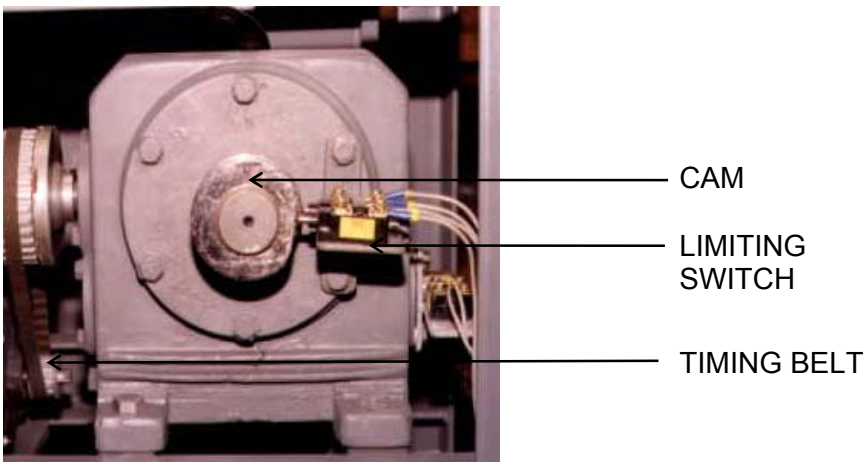


Fig.8.16 CAM

(a) The cam for LS1 is to be adjusted such that its contacts just break in the fully closed position of barrier.

(b) The cam for LS2 is to be adjusted such that its contacts just break in the fully open position of barrier.

(c) The cam for LS3 is to be adjusted such that its contacts just make in the fully open position of barrier.

(d) The cams for LS4 and LS5 are to be adjusted such that its contacts just make in the fully closed position of barrier.

Friction clutch

The friction clutch is mounted on the input shaft of the gear drive unit and connected with the motor by a timing belt. An adjusting nut is provided on the clutch. Tightening this nut increases spring tension and hence slippage -torque. The slippage torque adjustment is to be done as follows:

(a) Completely loosen adjusting nut until gate fail to operate when motor is started and the clutch slips continuously.

(b) Tighten the nut in 1-1/2 turn stages and check for gate operation at every stage to locate the position of the nut where the slippage torque of clutch is just sufficient to drive the barrier.

(c) Tighten the adjusting nut by another ½ turn.

Timing belt

The tension of the timing belt transmitting the power from the motor to the clutch system can be adjusted by adjusting the vertical position of the motor as follows: -

(a) Loosen 4 motor fixing bolts.

(b) Adjust position of motor, until desired belt tension is achieved by providing suitable packing below motor.

(c) Re-tighten 4 fixing bolts.

(d) Ensure that motor is parallel to the clutch shaft to avoid excess wear of belts.

(e) As timing belt does not transmit power by friction it is left a little loose and `not tightened fully.

8.12.8.7 Maintenance

For trouble-free performance of electric lifting barrier, the following checks are recommended in addition to provisions of SEM:

(a) Check that operation of gate is smooth.

(b) Clean inside and outside of mechanism, boom and channels.

(c) Check for auto stop of gate in fully open and closed position. Adjust limiting switches, if required.

(d) Check tightness of all fixing nuts and bolts of mechanism base, gear box, motor, boom, counter-balance channels and adjusting screws of cams which operate the limiting switches.

(e) Clean inside solenoid locking device and ensure that lever falls to lock position by gravity.

(f) Check operating current and voltage of electric lifting barrier and ensure that they are within limits.

(g) Check clutch slippage current. Adjust if required.

(h) Check belt tension. Adjust if required.

(i) Check contacts of limit switches and Contactors. Clean if required.

(j) Apply a little grease to cam surface, which operate the limit switches.

(k) Megger tail cable and ensure that the values are with in limit i.e. insulation of cable conductor is more than 10 Mega ohm.

8.12.8.8 Trouble Shooting

(a) Barrier fails to operate for opening or closing

(i) Check power supply at terminals 1 and 2. If no supply, restore supply.

(ii) Check power at MCB at terminals 3 and 2. If no supply, change MCB.

(iii) Check power supply after “STOP” button at terminals 4 and 2. If no supply, change contact of stop button.

(iv) Check power supply after the crank handle (CHS) switch at terminal 3 and 13 of CHS. If no supply, clean limit switch.

(v) Check power supply after timer contact TR between terminal 4 of timer and terminal 3. If no supply change timer.

(b) Barrier Opens But Fails To Close

Check in sequence keeping close button pressed.

* Check supply after close button between terminals 5 and 2. If no supply, change contact of close button.

(i) Check supply after limit switch LS1 between terminals 7 and 2. If no supply, clean/adjust limit switches contacts.

(ii) Check supply after back contact of open contact between terminal 12 of OC (Open Contact) 7 terminal 2. If no supply, clean contact of OC.

(iii) Check supply across coil of CC (closed contact). If supply is present but contactor does not operate, change coil of CC.

(c) BARRIER CLOSES BUT FAILS TO OPEN

Check in following sequence, keeping open button pressed:

(i) Check supply after open button between terminals 6 and 2. If no supply, change contact of open button.

(ii) Check supply after limiting switches LS2 between terminals 8 and 2. If no supply, clean/ adjust limit switch contact.

(iii) Check supply after back contact of CC between terminals 12 of CC and terminal 2. If no supply, clean CC.

(iv) Check supply across coil of OC open contact). If supply is present but contactor does not operate, change coil of OC.

(d) Contactors Operate But Motor Does Not Operate

(i) Check that after contactor operates, supply is available between terminals 9 and 10 as well as between terminals 11 and 12. If no supply, clean contactor contacts.

(ii) Check that motor running winding is connected to terminals 9 and 10 and starting winding between terminals 11 and 12. If not, correct motor winding.

(iii) Check motor capacitor.

(iv) Check motor.

(e) Motor Operates But Barrier Does Not Move

(i) Check timing belt. Adjust/ replace as required.

(ii) Check for any obstruction to boom or counterbalance channels, by operating manually. Remove obstruction.

(iii) Check for slippage of friction clutch. Adjust if required.

8.12.8.9 Interlocked Key chain working

(a) An independent stand by emergency key chain interlocking arrangement is provided for regulating rail/road traffic in case of damage/mechanical failure of gate machine.

(b) A post of about 1meter (i.e. boom height from rail level) is provided at one side of the road. A metallic chain is fixed to this post. A sheet metal round board with legend "STOP" in red (with luminous paint) on white background is provided in the middle of this chain. A loop with E-type lock key is rigidly fixed to other end of the chain.

(c) On the other side of the road, a lever lock with an E-type is provided on a post. The E-type lock plunger normally locks the lever lock plunger in normal position. The post at this side has a hook. In which a chain with a key is hanging to lock the lever lock.

(d) When booms are immobilized due to damage or any other reason, chain is thrown across the road. The loop in chain is then engaged in the hook on lever lock post and E-type lock key is inserted in E-type lock and turned. Turning of key releases plunger of lever lock, which can now be reversed.

(e) The reversing of lever enables transmission of slot of cabin/gate lodge. Once reversed, lever remains locked till slot for opening gate to road traffic is received.

(f) When due to necessity, emergency chain interlocking is used, signals can assume only caution aspect even if other conditions for clear aspect exits.

(g) Thus traffic can be run with the help of emergency key chain interlocking in interim, albeit in restrictive caution aspect, till barrier working is restored.

(h) The arrangement is useful in CLS. (colour light signals) as shown in fig.8.17 on next page.

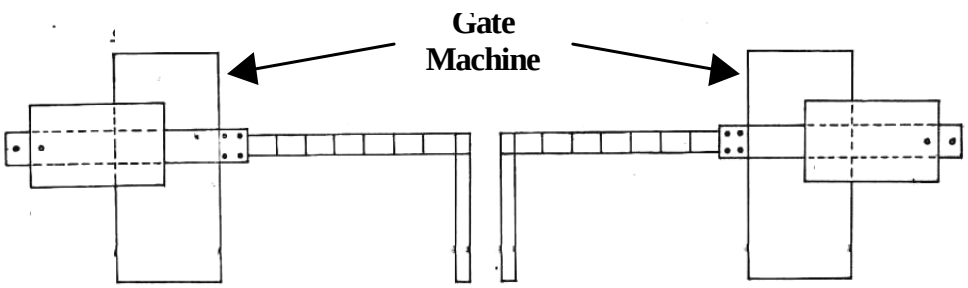
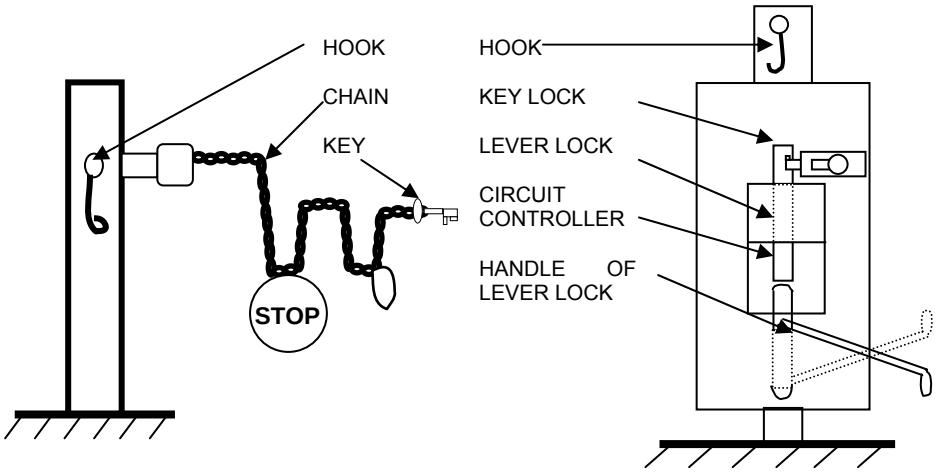


Fig.8.17 Interlocked Key-Chain Mechanism



***Note**:*

(a) The length of chain will be according to width of the road.

(b) Electric lever lock and circuit controller combined 200-mm stroke with one proving contact confirming to RDSO SA 22701 IRS-23.

(c) Chain signal steel galvanised 2 SWG 1 7/16 x 7/8 inches outside dia.

(d) Stop board – 300 mm dia 3 mm thick, galvanised steel plated with fluorescent red paint back ground with stop in white letters.

8.13 EKT

8.13.1 Parts of EKT

An EKT or RKT consist of two portions.

(a) Outer portion

(b) Inner Portion

(a) Outer Portion

It is essentially consist of a glass window at the top for visual indication, a key hole to insert key for the transmission and a sealing stud to seal the equipment (see fig.8.18)

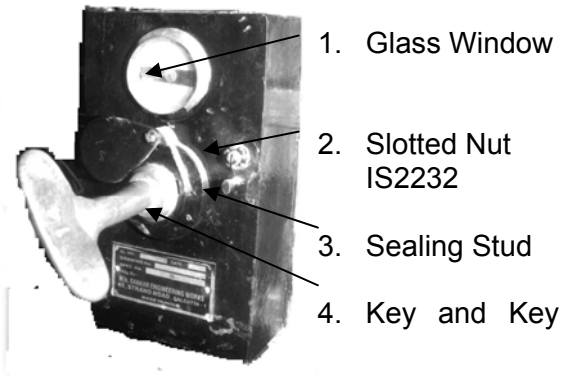


Fig.8.18 EKT (Outer)

(b) Inner Portion

The RKT is of robust construction. It consists of following parts (see fig.8.19 below).

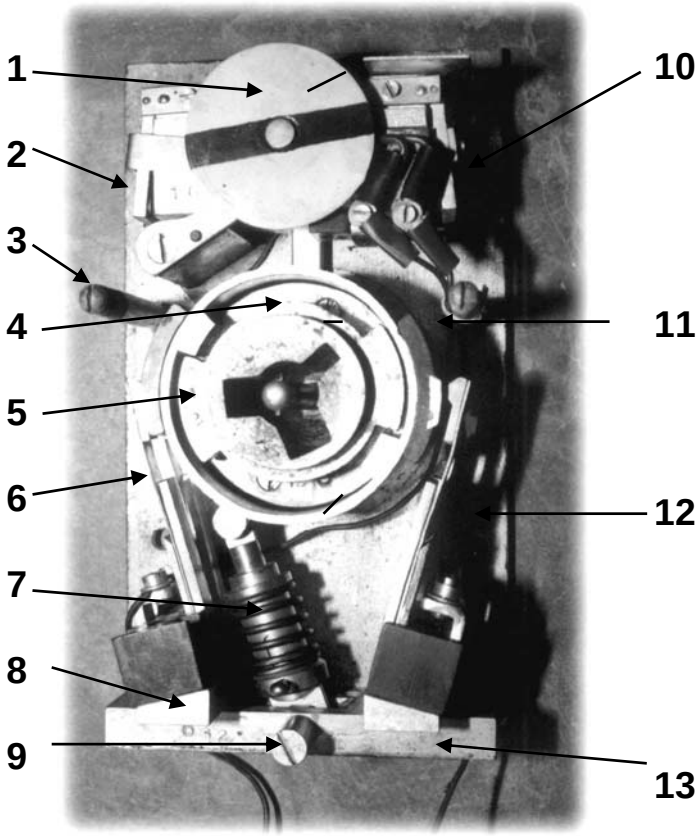


Fig.8.19 ELECTRIC KEY TRANSMITTER (ROTARY TYPE) SA – 22601 (Inner portion)

EKT components shown in figure are as follows:

1. Indicator
2. Armature
3. Stud (S-22607)
4. Tumbler Housing Assembly (SA-22648)
5. Operating Piece (S-22655)
6. Contact Spring Assembly (SA-22678-B)
7. Quick Return Gear (SA-22669)
8. Metallic Base (S-22606)
9. Thumb Screw (SA-22604)
10. Electromagnet (SA-22617)
11. Drum Assembly (SA-22661)
12. Contact Spring Assembly (SA-22678-A)
13. Base (S-22602)

Inner Portion: This portion consists of metallic base (S-22606) whose parts are as under:

(i) Electromagnet (SA-22617)

This is fixed in upper portion of the case. When energised, its main pole face attracts armature which in turn helps in releasing the key, while auxillary pole face deflects the indicator (see fig.8.20)

Fig.8.20 Electromagnet Coil

(ii) Contact Spring assembly (SA-22678 A-B)

It consists of five numbers of finger contacts which are insulated from each other and make with drum assembly (see fig.8.21)

Fig.8.21 Finger Contact

Of these five contacts, two contacts (No4&5) (SA-2267-B) are mounted on the left side of the drum assembly while the other three contacts i.e. No.1, 2 and 3 (SA- 2267A) are on its right side.

Depending upon the position of key i.e. IN, OUT or TURNED are in RKT, these contacts make or break which in turn control the line circuit.

Key Position	Finger Contact Position
Transmitting End	
1. When key is "IN" 2. When key is turn to RHS	2 & 3, 4 & 5 1 & 2, 4 & 5
Receiving End	
1. For extracting key (Key turned to LHS) 2. When key is out	2 & 3, 4 & 5 will make. All contacts will break.

(iii) Quick Return Gear (SA 22669)

Spring loaded quick return gear attached with the drum assembly with split cotter pin help to force the drum assembly back to its normal or reverse position.

The gear is fixed with the thumb screw (S-22604) on the metallic base as shown in the **fig. 8.22** below.

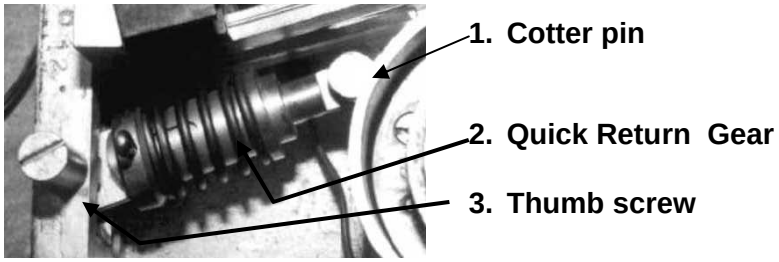


Fig. No.8.22 Quick Return Gear

(iv) Drum assembly (SA 22661)

Rotary type drum assembly provided with metallic piece help to make finger contact. Please refer **fig.8.23** below

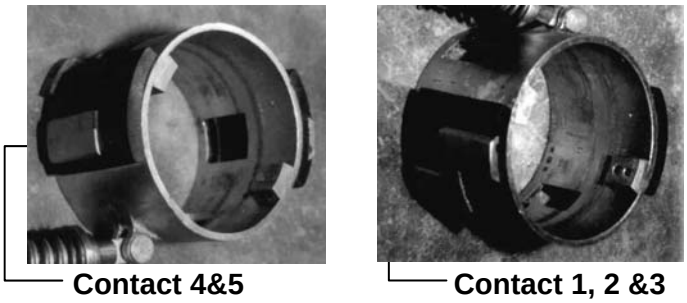


Fig.8.23 Drum Assembly

(v) Tumbler Wards (S 22656, 22657, 22658)

Three numbers of brass tumblers control the movement of key. A proper combination of wards and tumblers ensures that only right key can be inserted with the transmitter (fig.8.24).

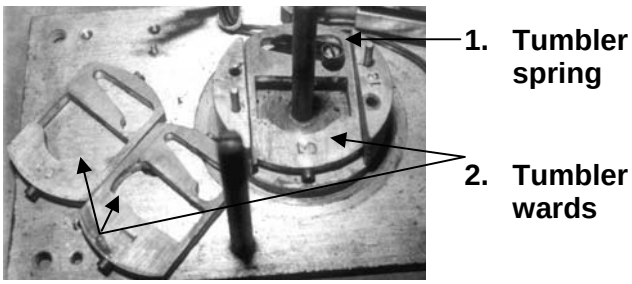


Fig.8.24 Tumbler Wards

The tumblers proving the wards of the key are to be provided with an tumbler spring arrangement to restore them back to their normal position before the key is extracted.

(vi) Tumbler Housing Assembly (SA 22648)

Tumbler wards 1, 2 and 3 are housed under the tumbler housing assembly and hold with LH pin (S 22659) and RH screw (IS 1366).

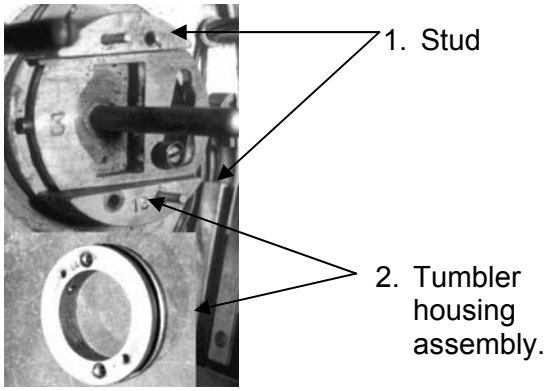


Fig.8.25 Tumbler Housing Assembly

(vii) Operating Piece (S 22655)

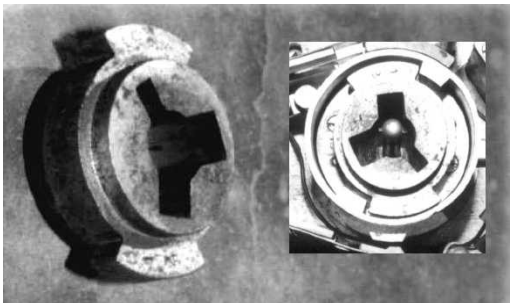


Fig.8.25 Operating piece

Operating piece is placed in side the drum assembly as shown in figure below. On operation of key, the operating piece rotates the drum assembly with the help of extention portion provided with it.

(viii)Force drop arrangement & Lock Pawl

To avoid unsafe extraction of key due to residual magnetism or mechanical jamming force drop arrangement is provided in this instrument too, as provided in other electromagnetic signalling devices. Force drop arrangement is provided by means of a counter weight attached with the armature which causes the armature to drop forcefully.

(ix) Lock Pawl

Lock pawl engages with the drum assembly when the electro magnet is de-energised. When the electro magnet is energised, lock armature attracts and the lock moves up and releases drum assembly.

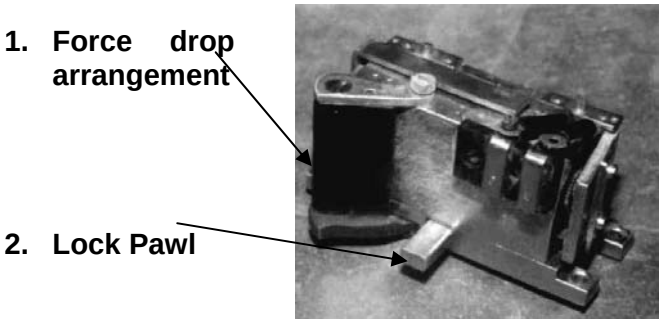


Fig. 8.27 Lock Pawl

8.13.2 Installation

Installation of EKT is described in Para 19.70 to 19.75 of SEM Pt.II which are reproduced below:

19.70 *Type: Electric key transmitter of an approved type shall be used.*

19.71 *Fixing: Electric key transmitters shall be securely fixed vertically. There shall not be any opening giving access to the interior of the key transmitter through which it is possible to operate the mechanism by any irregular means.*

19.72 *Location: Electric key transmitters shall befitted as near as possible to the gear they control.*

19.73 *Communication: Telephonic communication shall be provided between the pair of electric key transmitters when they are in different locations. Where direct communication is not possible, a bell shall be provided near each electric key transmitter.*

19.74 *Keys: It shall not be possible to insert and operate the key transmitter by any key other than the one for which the key transmitter is intended. It shall also be ensured that the key of any one transmitter at a station does not fit in any other key transmitter at the same station except its counterpart.*

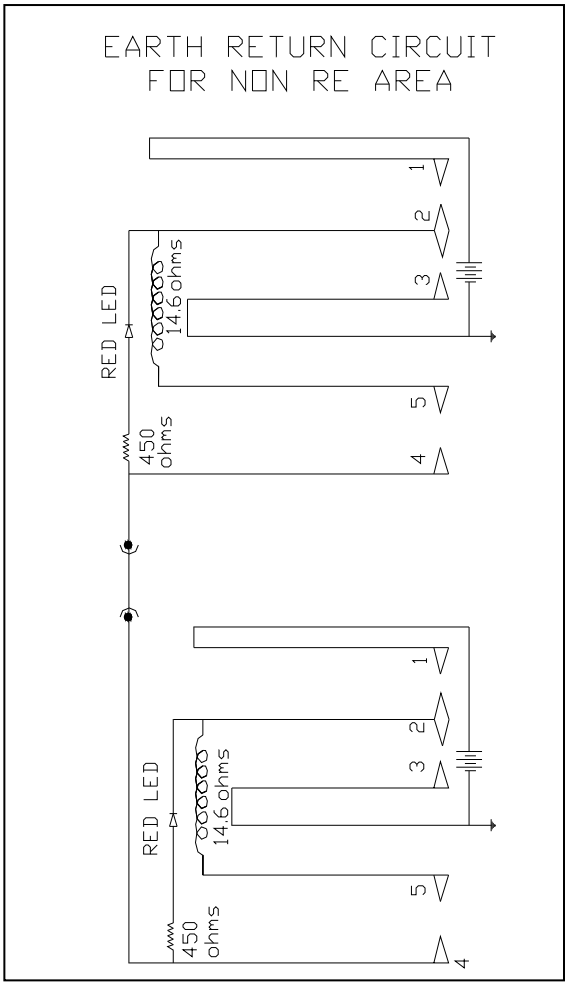
19.75 *Sealing: Electric key transmitter cover shall be securely sealed.*

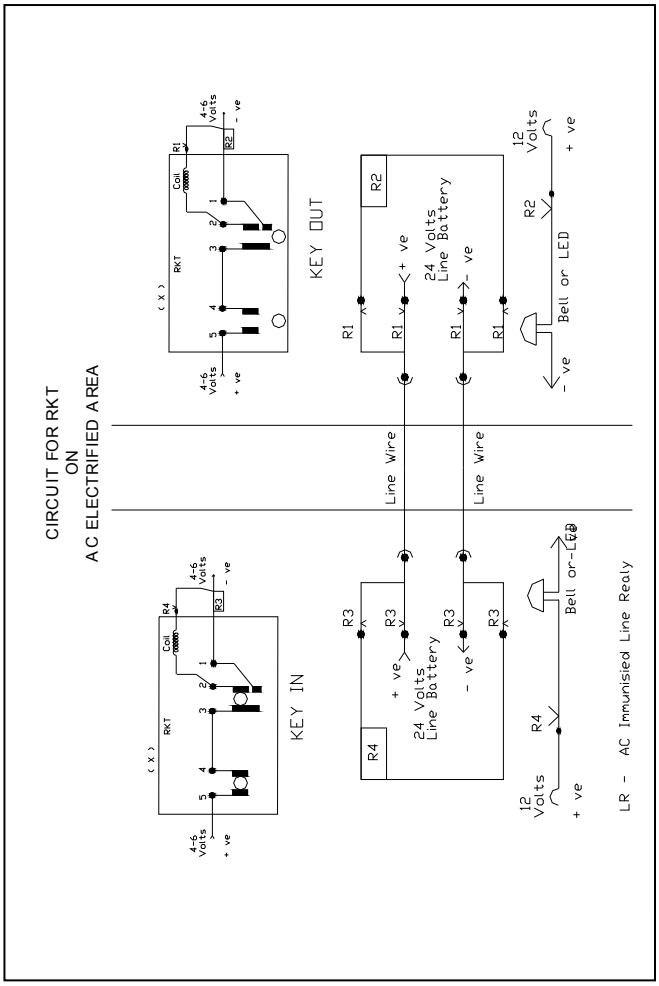
8.13.2.1.1 Earth return circuit:

Electrical connection and working of EKT with earth return circuit is given in fig.8.28.

8.13.2.1.2 EKT circuit in RE area:

Electrical connection and working of EKT circuit in RE area is shown in fig.8.29





8.14 SIDING CONTROL MECHANISMS

Method-1

A single lever frame to be erected near the siding point on A-type foundation and rod-run to be provided between the ends of cross-over points duly interposing the compensator. The facing end of the siding point shall be provided with a hand plunger lock normally locking the points. This gets unlocked by the key from the EKT fixed near the single lever frame. The apparatus case near the siding points will have to be fitted with Electric Key Transmitter and a magneto telephone. Trap points are to be fitted with trap indicator**.**

Method-II

Locally operated points through spring-lever mechanism are provided in this method. For this, holes to be drilled on switch rails and sleepers; switch extension pieces to be fixed; notches to be cut on split-lock stretcher; HP lock to be fixed & lock- plunger movement through notches of switch extension pieces to be checked and adjusted w.r.t. opening of switches and spring along with P-way officials.

Fixing of E-type lock on HP lock for succession-key-locking arrangement to be done and tested.

* * *

CHAPTER – 9: INSTALLATION & MAINTENANCE OF D.C TRACK CIRCUIT AND AFTC

9.1 INTRODUCTION

The automatic track vacancy indication is aimed to reliably locate track vehicles on track Sections. The free or occupied State of these track sections is essential for allowing movement of trains.

Track circuit is provided to detect the free or occupied State of track section. DC track circuit is installed in AC electrified and non-electrified area and AC track circuit is installed in DC electrified area, to avoid interference from traction supply.

DC Track circuit materials always shall be procured and installed as approved by RDSO & as per SEM provisions.

9.2 PLANNING & MATERIAL SCHEDULE

(a) The following materials are required for carrying out the installation of DC Track Circuit:

(i) Track lead wires

(ii) Track lead junction boxes one for each track rail connection

(iii) 'B' type choke to Spec. No.IRS.S.65/83 with latest amendments.

(iv) Adjustable track feed resistance 0-30 ohms as per RDSO Spec. DRG No.SA-20161-66.

(v) Track feed battery charger to Spec. no. IRS:S-89/93 with latest amendments

(vi) 2V 40/80 AH secondary cell to Spec. no. IRS:S-88/93 with latest amendments

(vii) DC track relay.

(viii) GI wires 8 SWG (4 mm dia) or Insulated wire ropes, connected to rail by RDSO approved exothermic welding for track jumpers in track circuit portion.

(ix) Insulation rail joint (Nylon as per IRS S 40/84 OR TPU as per RDSO Specn.168/2002.)

(b) It is necessary to plan complete Scheme on Signalling plan of the station or Section to process for installation of DC track circuit.

(c) The assessment shall be done for total requirement of materials for DC track circuit.

(d) All the materials should be procured from RDSO approved sources and as per RDSO specifications wherever available.

(e) The track section to be controlled through DC track circuit shall be marked on signalling plan of the station/section.

(f) The working of DC Track circuit i.e. Single Rail or Double Rail shall be defined as per length of Track circuit on Electrified/Non-Electrified area.

(g) Single Rail DC Track circuit shall be installed in AC electrified area. Where in one of the rail is reserved for traction return current.

(h) The cross bonding shall be provided at the either end of the track circuit in AC electrified area as per approved Track insulation/Bonding Plan.

(i) The return rail shall be staggered in case of adjacent track circuits.

(j) Double Rail DC Track Circuit shall be installed in non-electrified area.

(k) The locations of Feed & Relay Ends shall be marked to assess the requirement of Secondary Lead Acid Cells, Battery chargers, Regulating Variable Resistances, Track Relays, Track Lead Junction Boxes, Channel Pins, Rail Bond Plates, Bonding Wires, Insulated Rail Joints, Cables, Location boxes etc.

(l) Cable/Track crossing as per cable chapter 4.4.6

(m) For track circuited portion, complete jumpering plan in double line diagram and all short and long jumpers should be indicated on the diagram as positive rail required proved in series connection. A typical sketch is shown in Fig.9.1.

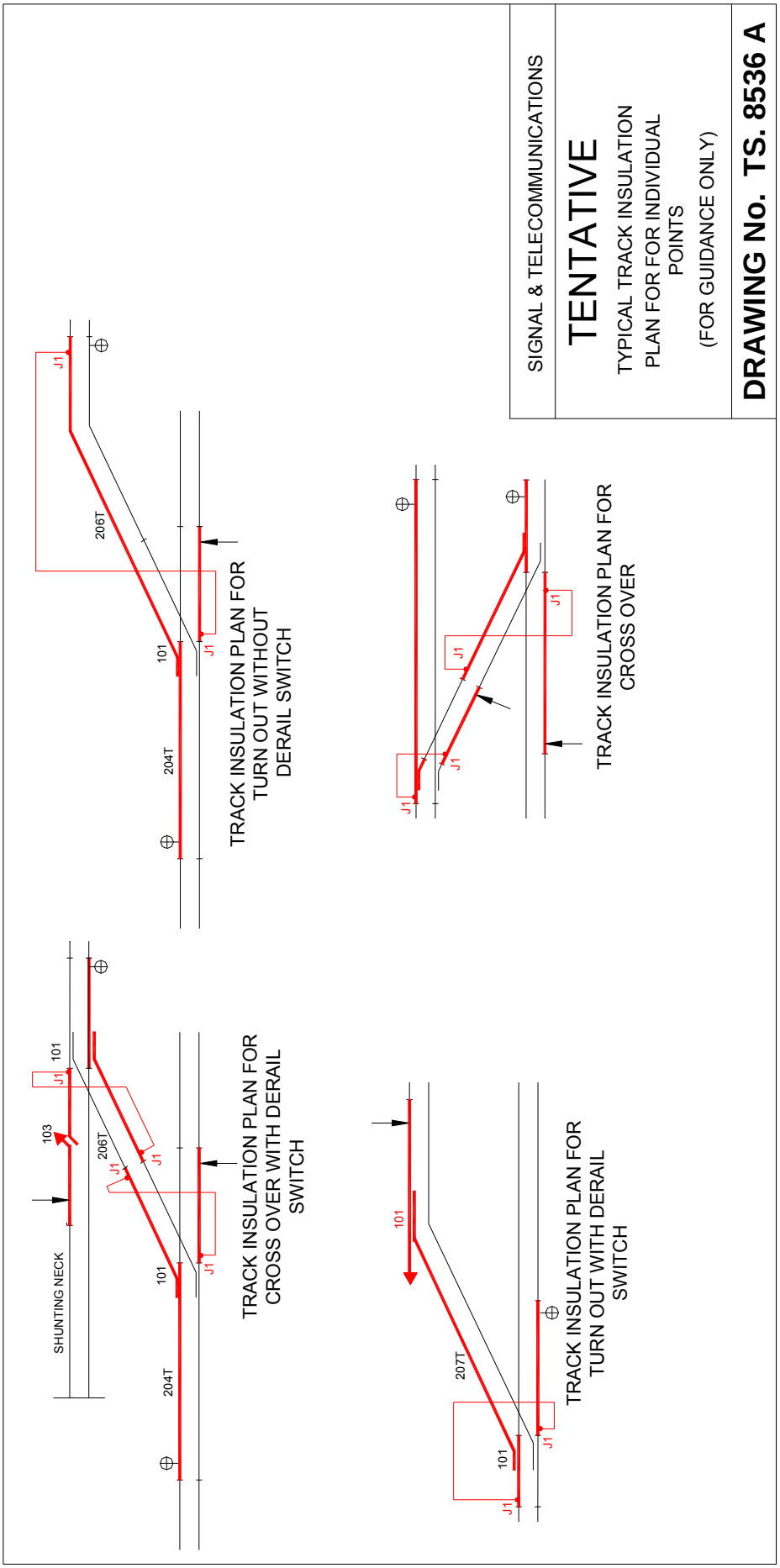


Fig: 9.1 Typical Track Insulation Plan for Individual Point

9.3 INSTALLATION

(a) The installation should confirm to Chapter XVII of SEM, Part – II

(b) Low maintenance secondary Lead acid cells 2.2 V/80 V or 40 AH as per IRS specification shall be provided, in parallel connections.

(c) The above Secondary Lead Acid Cells shall be provided in a location box on rubber mat, or similar insulating material resistant to corrosion due to acid. The battery should be placed away from heat radiating equipment.

(d) When Secondary cells are used, these shall be used along with battery charger/Solar panel of adequate capacity.

(e) Only approved design Battery charger 110V.AC/5-12 DC 5 Amp capacity, as per RDSO Specification IRS-S-89/93 with latest amendments, shall be provided to charge Secondary Lead Acid cells. Since, initial charging and usage after initial charging is critical for better performance battery, the following guidelines may be followed while charging battery.

(i) Initial charging including the number of charge discharge cycles, rate of charge/discharge and capacity/load test of the batteries be done only as per the instructions of the manufacturer (Make sure that the instruction set is supplied along with battery).

(ii) Battery grade dilute sulphuric acid conforming to IS266 and distilled/demineralised water conforming to IS1069 shall be used as electrolyte for charging (Always add acid to water).

(f) The output of Secondary Lead Acid Cells/Battery charger shall be fed to track circuit at feed end through RDSO approved design regulating/variable resistance 0-30 ohm capacity.

(g) RDSO Approved cartridge (Non deteriorating) fuses of suitable capacity in both positive and negative limb at feed and relay ends shall be provided to protect equipments from short circuit/Lightening.

(h) The earth resistance of all the locations should be maintained as per SEM, which is currently below 10 ohms.

(i) Approved type of Track Lead Junction Boxes (TLJB) RDSO Drg.No./Specn shall be provided at about 2.5/4 m from track centre & foundation shall be cement concreted with proper securing. The TLJBs should be of fibre glass to safeguard against corrosion due to weathering. TLJB should be erected and fastened to an angle of suitable size. The cable going to TLJB from foundation onwards should be protected by taking it through out the length in DWC pipe of suitable size.

(j) The output of Secondary Cells/Battery Charger shall be connected to TLJB through 2.5 Sq.mm copper cables suitably. Care should be taken to ensure proper washers & nuts are used to make the connection rigid to avoid loose connection.

(k) The connection from TLJB to the web of rails at feed end & relay end shall be provided with approved type of lead wire or bond plates or exothermic weld as per Railway practice. The connection should be done in such a way so that it facilitates easy visual inspection. The connection should provide good electrical contact with rail web and strong mechanical Rail web should be properly cleaned before fixing track lead wires. The lead wires shall preferably be of Copper Steel Alloy PVC insulated 7-strand wire with anti corrosion property. Copper conductor, if used, should have a minimum cross section of 2.5 sq. mm

(l) The track-circuited portion shall be provided with GFN liners and pads on MBC Sleepers or Wooden sleepers provided on track-circuited portion.

(m) Ballast clearance of 50mm from rail flange should be ensured for reliable performance of TC (Ref Para No. 279(8) of Indian Railways Permanent Way Manual).

(n) In the track circuited portion rail joints shall be provided with rail bonding with 8 SWG G.I. wires in duplicate. The wires may be fixed by using channel pins in the holes or by brazing/welding. The connection should be made immediately after drilling the hole in the rail (Refer clause 17.10 of SEM Part-II). A very good connection resistant to vibration is essential to prevent bobbing of track circuits. Bond shall be painted with aluminium paint or transparent anti-rust paint where bond corrosion is excessive.

(o) Regarding jumpers, the provisions of Para 17.8.4 of SEM Pt.II is reproduced below:

17.8.4 For short jumpers G.I. wires and Long Jumpers of Cables may be used. Where GI jumper is used duplicate jumper shall be run. Where cables are used, the size shall not be smaller than 7/0.750 mm.

(p) The distance between track circuit termination and fouling mark shall not be less than 3.0 meters.

(q) All the insulation joints should be preferably Glued Joints type. (Ref : Para 281 of Indian Railway Permanent way Manual)

(i) Wherever a fishplate joint is provided, it shall be ensured that the insulated liners are provided.

(ii) Where pandrol clips are touching the fishplate, use of 'J' type pandrol clips or grinding of pandrol clip shall be made.

(iii) 'J' type pandrol clips shall be used on glued joints to prevent shorting of rail foot to the fishplate.

(iv) Insulated rail shall be kept clear of ballast by 50 mm.

(r) **PSC Sleeper**

(i) PSC sleepers used in track-circuited area must be tested before inserting into track, to ensure minimum 500 ohm insert to insert resistance.

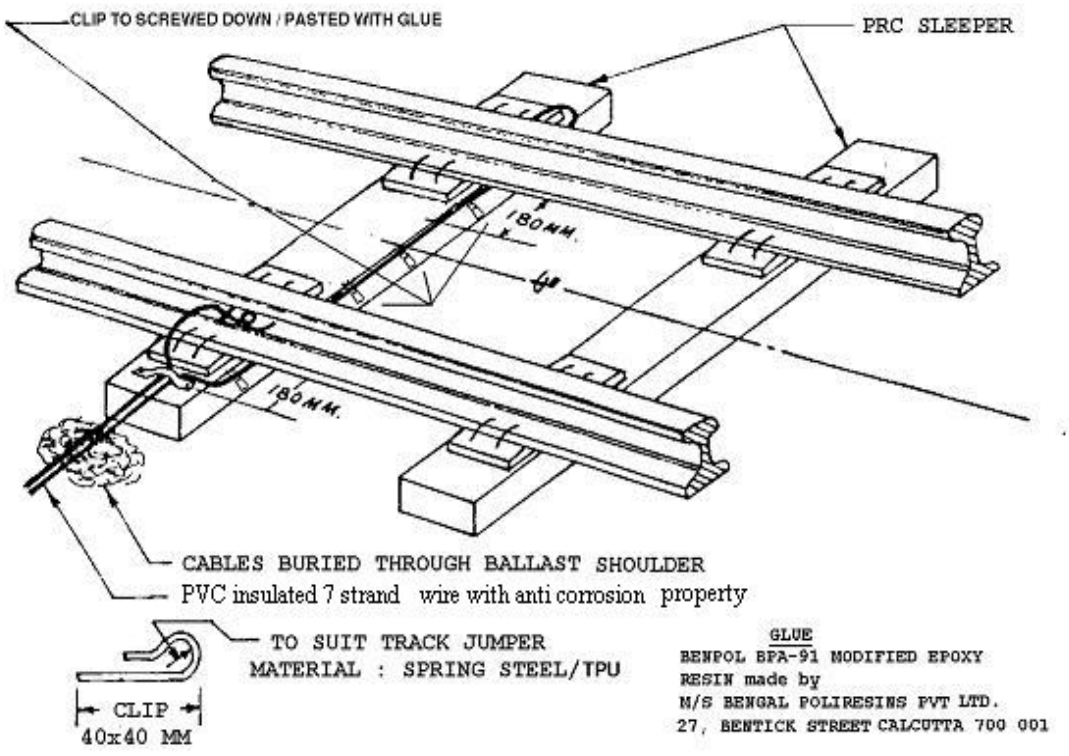
(ii) For first two years after manufacture, PSC sleepers offer a low insert to insert resistance. Therefore, efficient working of track circuit can only be ensured through insulated liners and pads. Hence during first installation emphasis shall be for 100% liners and pads.

(iii) In 25 KV AC 50 Hz electrified traction area DC track circuits are always single rail track circuit. Hence, it is only insulated rail, which has to be perfectly insulated from earth. Hence 100% liners and pads have to be ensured in this rail during installation. Missing liners or pads will greatly reduce the ballast resistance. As per SEM-Part II Para 17.28 availability of 97% insulated liners/pad is to be ensured.

(s) Ballast shall be kept clean through out electrified section & clearance of ballast from flange of the rail should not be less than 50mm (Ref Para 17.5.6 of SEM & Ref Para No. 279(8) of Indian Railways Permanent Way Manual).

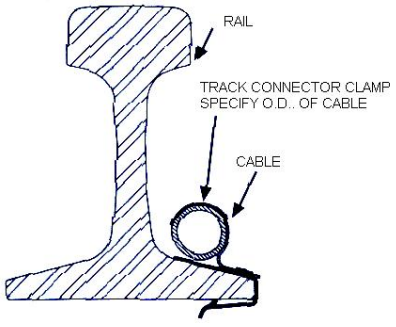
(t) BX Jumper TLJB at both ends of BX jumpers should be marked with identical numbers like (BX-1, BX-1), (BX-2, BX-2) and so on. This practice will be helpful while replacing/reconnecting cable and thus it will be ensure that cable at one end for BX-1 is connected to corresponding TLJB at other end of BX-1 and not BX-2, otherwise in case a mistake is made in connecting BX-1 to BX-2, a portion of track circuit will be by passed.

(u) Fixing of Rail Jumpers to PSC sleeper: - Rail jumpers can not be fixed to PSC sleepers as was possible with tacks nailed into wooden sleeper. Pedestrian, track machines, etc tear loose jumpers. A scheme worked out for fixing jumpers on PSC sleepers is shown in Fig.9.2.



If copper cable is used for rail jumper, the copper cable at joint should be clamped to rail to prevent hardening of copper and subsequent breakage.

A scheme is shown in Fig.9.3 below



(v) **Bonding**

(i) Only single rail DC track circuits are feasible in AC traction area. With single rail track circuits, one of the rails is reserved for the traction return current. This rail is referred to as the un-insulated rail. Any connection from the OHE mast or other structure shall be made only to the un-insulated rail. Similarly, connections for the return current at feeding points and return conductors shall be made only to the un-insulated rail. As far as practicable, the rail adjacent to the O.H.E. Masts shall be utilized as the un-insulated rail.

(ii) In the event of a break in the non-insulated rail in single rail track circuits, very heavy current will flow through the track relay as well as the equipment at the feed point. To avoid this, the un-insulated rails of the adjacent tracks should be cross-bonded at intervals of not more than 100 meters. In case the track circuit is less than 100 meters, the cross bonding may be provided on the non-insulated rail at either end of the track circuit.

(iii) The bonding on the insulated rails of single rail track circuits should be provided with Copper Steel Alloy Bond 3/16" dia" through Exothermic / Pin Brazing Bonding Technique. Standard 8 SWG GI soft wire and channel pins may also be used for this purpose. All other bonding is to be provided by the Electrical Department. The Signal & Telecommunication Department may also provide bond on the non-insulated rail, where necessary and these bonds shall be in addition to the bonds provided by the Electrical Department.

(iv) The bonding on a non-track-circuited track adjacent to a track circuit shall be extended for a distance of 50 meters beyond the track circuit. In addition, the two rails of the non-track circuited track outside any track circuit or in between two track circuits shall be bonded together immediately after the block joints.

(v) Bond wires and traction jumpers shall neither touch the pandrol clip or the insert. Bond clips should invariably be used to hold GI wire bond (where used). GI Bond wires shall be visible and never be inside the fishplate.

9.4 LENGTH OF TRACK CIRCUIT

Minimum length of track circuit:

Length of track circuit should not be less than the maximum distance between two consecutive axles of a vehicle or of two adjacent vehicles. It is to be ensured that while travelling upon track circuit portion, track repeater relay shall drop during the occupancy of track circuit. In case of trolley protection track circuit, relay shall drop before track device is influenced by first wheel of vehicle.

To achieve this, minimum length of the track circuit should be such that track circuit occupying time is more than the drop away time of (Track relay + TPR + safety margin) at the maximum permissible speed of train. It is also necessary that while travelling upon two consecutive track circuits, route do not get released inadvertently during movement of the train from first track to second track circuit. To meet this, it is to be ensured that after clearance of first track, track relay shall not pickup, until the track repeater relay of second track has dropped. Therefore drop-away time of track relay and its repeater relay shall always be less than -

T = (PU time of TR + TPR + Time required between occupation of second TC and last vehicle leaving the first track by vehicle with minimum wheel base at its maximum speed.

Calculation for minimum track length of TC

Where,

SF – Safety factor

LT = SF × SP × [TDA of (TR+TPR)] – LV

SP – Speed in Metre/Second

TDA – DA time in Seconds

LV – Length of vehicle at outermost wheel centres.

Typical minimum track circuit lengths required shall be as under -

To achieve this it is necessary that proving circuit shall register the dropping and pickup of each TR. It means operating time of register relay will further limit the maximum speed of train in the section.

Table – 3

Maximum permissible speed (KMPH)	Wheel base in Metres	Minimum length of track circuit required in Metres
100	3.2	25
100	6.1	22
100	12.33	16
130	12.33	24
160	12.33	32
200	12.33	43

Above calculations are based on the use of QTA2/QBAT & QSPA1 relays. Use of shelf type track/line relays is not recommended due to its sluggish operation.

For speeds up to 130 & 160 KMPH, it is necessary to use minimum 2 & 3 rail length track circuits respectively for safe working of shorter track circuit.

The Maximum length of Track circuits shall be regulated in terms of Para 17.15.5 of SEM. The present values are reproduced below:

Sl. No	RE/Non RE	Sleeper	Section (Yard/Block)	Min. ballast resis. in ohm per KM	TSR in ohms	Max. lengh of T/Ckts in meter	Type of track relay to be used.
1	Non RE	Wooden/ PSC	Block	4	0.5	1000	QT type4 or 9 ohm or shelf type relay.
2	Non RE	Wooden/ PSC	Yard	2	0.5	670	-do-
3	RE	Wooden	Block	4	0.5	450	QT 9 ohms AC immune or Shelf type 9 ohms AC immune.
4	RE	Wooden	Yard	2	0.5	450	-do-
5	RE	PSC	Block	4	0.5	450	-do-
6	RE	PSC	Yard	2	0.5	350	-do-
7	RE	PSC	Yard	2	0.5	750	QBAT in conjunction with QSPA1 with B type choke at relay end.

It may please be noted that as per Para 17.15.2 of SEM Pt.II -

i. In non-electrified sections, the resistance of the shelf type track relay shall be 9 ohms, except that for track circuits of more than 100 ohms laid on wooden sleepers, where it shall be 2.25 ohms.

ii. In electrified areas shelf (9 ohm only) or plug in type AC immune relays shall be used.

iii. In future installations, only plug in type track relays (4 or 9 ohm) shall be used.

9.5 TRACK RELAYS

(a) Track Relays shall be provided at the train entering end of the track circuits whenever possible.

(b) In new installations plug in type Q series track relays as per RDSO Specification shall be used.

(c) 'Q' series track relay shall be used in conjunction with 'Q' series slow to pick up relay as a 1st repeater relay (QSPA1).

(d) The connections between track relays and track repeating relays shall be done in accordance with the approved wiring diagram.

(e) The connections must invariably incorporate both cross protection and double cutting arrangements.

9.6 INSTALLATION

(a) Excitation of track relay shall be done as per para 17.15.4 of SEM Pt.II which states that:

"The relay shall be excited at minimum 125 of its rated pick up voltage under minimum ballast resistance condition and normal working voltage of the supply. The maximum excitation shall not exceed 250 of the rated pick up value for shelf type relays and 300 for plug-in type relays."

(b) Secondary Lead Acid Cell voltage & specific gravity shall be measured and recorded by keeping charger switched off. The limits should be maintained.

(c) Battery charger, output voltage on load & without load shall be measured & recorded.

(d) Secondary Lead Acid Cell shall be tested with one-ohm resistance across the battery terminals to check the battery health.

(e) Voltage at track feed location & at rails shall be measured & recorded.

(f) Voltage at relay end rails & at relay terminals shall be measured & recorded.

(g) Train Shunt Resistance 0.5 ohm shall be placed across the rails and track relay must de-energize, if not, track circuit shall be adjusted immediately.

(h) The voltage should reduce gradually across the rails from feed end to relay end in normal ballast resistance condition.

(i) The documents required as per Para 17.32.1 of SEM Part-II may be prepared and the readings recorded at the time of initial commissioning itself.

(j) Detailed instructions for 'Measurement of DC Stray currents' are given in Annexure-32 of Para No. 22.10.4.9 of SEM Part-II. Before installation of single rail DC track circuits in A.C Electrified areas, measurements of stray D.C currents shall be taken in accordance with the instructions. The total stray current as measured, shall not exceed:

(i) 10 milli-amperes, if length of track circuit is less than 100 meters.

(ii) 100 milli-amperes, if length of track circuit is 100 meters and above. If measured value of current exceeds the specified limit as above, other type of track circuit suitable to work in A.C. traction area shall be used.

(The Detailed Instructions for measurement of stray DC Stray Currents contained Annexure-32 of Para No.22.10.4.9, SEM Part-II are reproduced below)

1. Before installing a D.C. Track Circuit in areas, which are to be A.C. Electrified, stray Direct Current tests shall be carried out so as to ensure that D.C. Track Relays shall not operate with the stray currents.
2. These Tests shall be carried out only on non-electrified sections.
3. If there are already existing track circuits in the area, these shall be disconnected to safeguard against false readings being recorded in case of leakage of Block Joints.
4. The length of the track required being track circuited should be insulated by means of Block Joints on either end of the rails. The rail joints in the track-circuited length may or may not be bonded for purpose of these tests.
5. Selecting a suitable earth, which shall not exceed 5 ohms in resistance, test shall be carried out.
6. A suitable type of milli-volt meter and milli-ammeter shall be sed for recording voltages.
7. These stray current and rail earth voltage measurements shall be recorded in accordance with the diagram for measurements indicated below: -

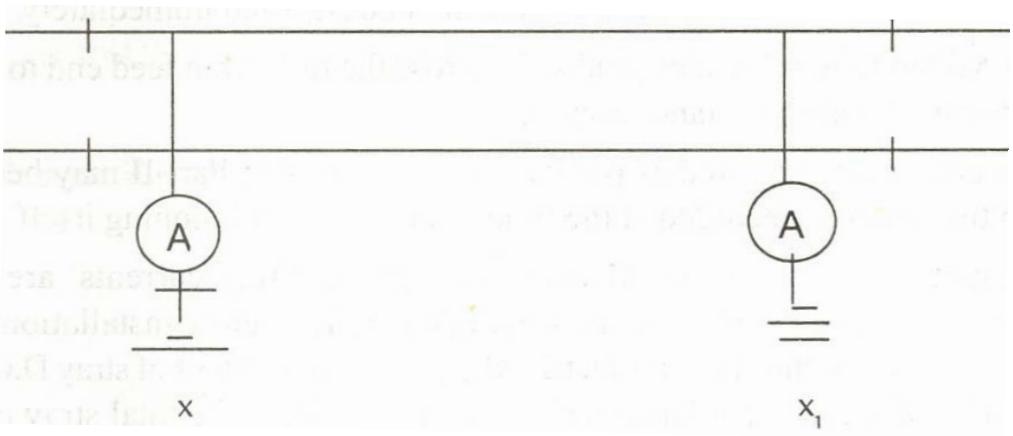


FIG.A - Measurement of Stray current

Note: - For measurement of stray current set up the circuit as shown above and measure the current simultaneously.

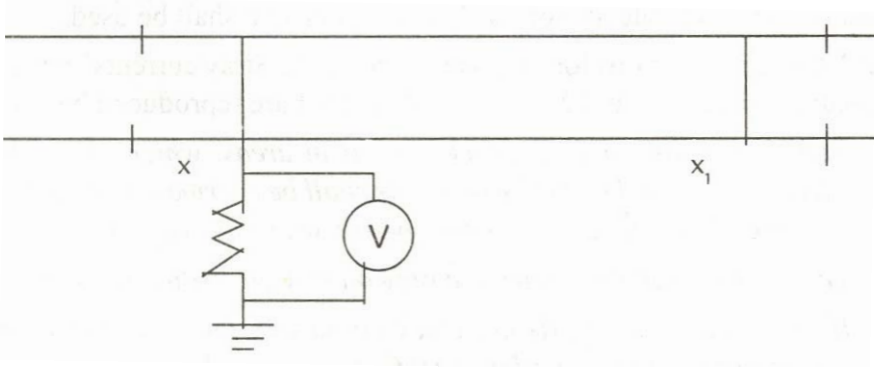


FIG.B- Measurement of Rail – Earth Voltage

Note:- Where 9 ohms, 4 ohms or 2.25 ohms relays are used, use 9 ohms, 4 ohms or 2.25 ohms resistance and measure the voltage once at 'X' and next at 'X1'.

8. These measurements shall be recorded at different periods of the day – one in the morning, one in the afternoon and one in the evening. These tests shall be extended for three days.

9. Where stray current/voltages are observed, the length of the Direct Current track circuit shall be cut down so as not to exceed the following limits for each length of Track Circuit:

   – The Rail-Earth voltage as measured across 9 ohms, 4 ohms or 2.25 ohms shall not exceed 0.1 volt.

   – The total stray current as measured shall not exceed 100 mA. Where all track circuit to be installed on the line are less than 100 metre long, the highest acceptable figure of stray current is 10 mA.

9.7 ADJUSTMENT OF DC TRACK CIRCUIT

DC track circuits are expected to work reliably in a fail-safe manner under varying condition of track parameters including fluctuations in the ballast resistance values. Since prevailing maximum and minimum values of ballast resistance are not readily available, adjustment of track circuit can be done as given below:-

(a) Determination of ballast resistance and rail resistance of Track Circuit: Short the relay end by a thick wire and apply a 2 V battery voltage through a 3 Ω resistance. Record the voltage & current at the feed end. This will give composite ballast and rail resistance. Then open the shunt at the relay end and record the voltage and current at the feed end. This will give the value of ballast resistance. Rail resistance value can be obtained from the above two resistance values. Ensure that values so obtained are within specified limit as given in SEM.

(b) Short the rails at the relay end by a thick wire firmly connected to the rails. Choose an appropriate value of E_1 and RT_1 from tables in the Appendix 2 and connect the relay to this supply through R_{T1} and the rails at the feed end. The relay should now pickup. Connect a 0.5 W resistance at A, B as shown in the Fig.9.4 & 9.5 and observe front contacts of the relay to just open. In case it fails, increase the value of regulating resistance to achieve the same. This adjustment represents the condition of infinity (maximum) ballast resistance. As under maximum ballast resistance condition, TSR will be minimum. Therefore for any other value of ballast resistance, TSR will always be higher than 0.5 W Disconnect relay from feed end & connect it at relay end along with the 0.5 W resistance in final position. Check whether relay drops. Remove 0.5 W resistance from AB & check voltage across relay coils. This voltage should not exceed 2.5 times (for shelf type) / 3 times (for 'Q' series track relay) of the rated pickup voltage of the relay. If relay voltage exceeds the limit, an additional regulating resistance R_{T2} should be inserted in series with the relay. The value of the resistance R_{T2} should be such as to reduce voltage across the relay terminals for excitation of relay used. Shunting of the track circuit by 0.5 W should be rechecked.

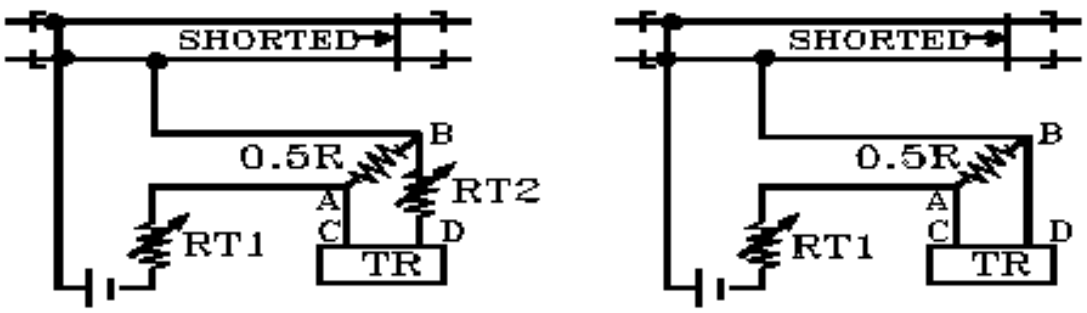


Fig 9.4 & 9.5 Adjustment of DC Track Circuit

Based on ballast resistance value as calculated in Para above, an artificial resistance necessary to simulate R_B minimum condition shall be connected across rails at relay end. At least 125% of rated PU value shall be ensured. In case of failure to achieve at least 125% of rated PU value, track circuit length has to be reduced.

During extreme weather conditions, drop shunt and pick-up shunt values must be measured. The drop shunt value should be minimum 0.5 ohm. Measured pick-up shunt and ballast resistance value will give an idea, for maintenance staff, of minimum ballast resistance which the track circuit can handle for its reliable working.

9.8. AUDIO FREQUENCY TRACK CIRCUITS [AFTC]

Planning of AFTC Length

(a) In the track circuits the standard parameter of maximum receiver current / Voltage at the maximum gain setting is to be achieved. This standard criterion of TC parameters is considered as the deciding factor to use as an end fed or center fed configuration.

(b) Detection of rail discontinuity on inner and outer rail depends on current / Voltage and corresponding gain setting. The track circuit receiver current / Voltage of the track circuit on which discontinuity is created, reduces to 50%. However, the other associated track circuit of the tuning zone does not have much affect of rail discontinuity because its receiver current / Voltage does not reduce substantially. Therefore, to ensure dropping of, at least one track circuit of the tuning zone with discontinuity, it is necessary to keep the receiver current / Voltage at the maximum with lower gain setting so that the 50% reduction is less than the lower limit of dynamic range of receiver and thus ensuring dropping of track circuit relay when there is rail discontinuity.

(c) A higher initial RX current / Voltage also gives wide margin for variation in various climatic conditions and will practically avoid gain adjustment in monsoon. Therefore it will also drastically reduce the maintenance effort and hardly any maintenance work or adjustment would be needed. This will result in lesser failure during rainy weather.

System design of track circuits shall be as follows.

(a) Berthing track circuit 700 meters and overlap of 300 meters or from 120 to 300 meters depending on the inter signal distance and gates.

(b) The length of end fed track circuit should be limited to about 450 meters.

(c) Centre fed arrangement (with receivers at either end) should be adopted for track circuit length above 450 meters and up to 700 meters. In case of AFTC track circuit length more than 700 m length, two end-fed track circuits can be adopted.

(d) On longer bridges, reliable functioning of track circuits is not certain due to worn out timbers, spikes shorting with girders and insulation problems. Girder Bridges of about 300 meters length or more are provided with Axle Counter, where reliable working of track circuit cannot be ensured due to condition of bridge timbers; however this will complicate the system due to co-operative re-set arrangements. A separate 4 quad cable other than that carrying Tx and Rx signals of AFTC will also be required to be laid from the nearest relay hut /station for axle counter.

(e) Track circuit connections from tuning unit to rail are to be provided with duplicate connections using 50 sq. mm. aluminum wire or copper and steel alloy wire and connected through exothermic bonds(in case of alloy wire).. The cable connections should be taken through double wall-corrugated pipe, across the track. This arrangement will also prevent the theft in mid section locations Double connections with exothermic weld /Pin Brazing are expected to improve the receiver current.

Quad Cable

(a) The cabling scheme for AFTC should be designed to work each transmitter or receiver on one pair.

(b) Two pairs to be used for feeding the transmitter **tuning unit** at more than 1.5 KM from the hut/station.

Power supply Equipment

(a) 230/110 V transformer for AFTC, each duplicated and a stabilizer at each / station will be required.

Earthing arrangements and Lightning protection arrangements:

Class B and C of lightning protection at the input of each stabilizer is included for protection of signal equipment from lightning/voltage surge, apart from lightning protection arrangements recommended by the supplier of AFTC and LED signals. The lightning protection arrangements for power supplies should be at the same level as applicable to telecom installations.

A ring earth should be provided at each cable hut /station with a earth resistance value as applicable to telecom installations and all devices requiring earthing should be connected to the ring earth.

GENERAL

(a) The architecture of AFTCs differs depending on the manufacturer. While carrying out the installation the installation manual of the relevant manufacturer should be strictly followed.

(b) The installation in general should conform to Para 17.19.7 of SEM Part-II.

(c) The tuning area should be devoid of checkrails, level crossings etc. that are likely to interfere with the performance of AFTC.

(d) The fishplate joint shall be joined with jumpers similar to the practice adapted for DC track circuits.

(e) The tuning unit should be firmly and rigidly connected to the rails.

(f) The frequency scheme should be decided and approved in advance and the same should be followed while installation.

(g) Terminal junction on insulation joint to track circuits with the same frequency is prohibited.

(h) Cores of the same cable should not be used for connecting the transmitter and receiver of the same track circuit.

(i) When wiring and installation track circuit use conductors from same pair to avoid cross talk in adjacent circuit.

(j) Protection against atmospheric voltage surges shall be installed on each pair of conductors providing a link to the outside in order to limit the harmful effect of lightening on electronic equipment. This pro-active arrangement shall cover against both common mode and differential mode voltages on line. The protective arrangement shall be of approved type as recommended by manufacturer.

(k) Transmitter, Receiver and Power supply shall be mounted in standard relay rack in manner to allow maintenance and testing staff to view the track relay while making adjustments.

(l) TUs and ETUs shall be mounted at a minimum distance of 2 meters away from the near rail as its gives good safety margin to the staff.

(m) Near the sub-station impedance bonds of approved design may be used for collection of traction return current and its connection to the sub-station.

(n) Suitable Z bond, S bond and Alfa Bond etc., as recommended by the manufacturer may be provided which should be mechanically sturdy.

* * *

APPENDIX - A: POWER SUPPLY ARRANGEMENTS FOR S&T INSTALLATIONS IN 25 KV AC AREAS

1.0 SCOPE

1.1 Power supply arrangements for signalling & telecommunication installations in 25 KV AC electrified areas.

1.2 Responsibilities of Electrical and S&T Departments.

2.0 PROVISION OF ATS/LOCAL SUPPLY/DG SETS/INVERTERS

The following provisions will be made.

2.1 Way side stations/IBH/IBS on double line section

2.1.1 Two ATs of 10 KVA each connected to up and down catenaries will be provided.

2.1.2 Local supply will be the standby source of supply.

2.2 Way side stations/IBHS/IBSS on single line section

2.2.1 One AT of 10 KVA connected to the centenary will be provided.

2.2.2 Local supply will be the standby source of power supply.

2.2.3 One DG set of adequate capacity will be provided.

2.2.4 One inverter of suitable capacity may also be provided by S & T, if required.

2.3 Station situated within 350 m from traction switching post

At a station where an AT of suitable capacity is installed at the traction switching post situated within 350 meters of signal cabin or a station building, 240 V supply from the AT will be extended to the station. However, a second AT of suitable capacity will also be provided at the station connected to other line in case of double line section.

2.4 Big yards (multi cabin stations) / RRI installations

2.4.1 Big yards (multi cabin stations)

(a) At big yards where a number of cabins are located, two/ three cabins, depending upon load requirement, shall be grouped together and a set of two ATs of 10 KVA. one each connected to up and down catenaries on double line section and one AT of 10 KVA on single line section will be provided at a convenient location to feed each such group.

(b) Local supply will be the standby source of power supply.

(c) DG sets as required will also be provided by S&T Deptt

2.4.2 RRI installations

(a) The main source of supply will be three phase local power supply.

(b) The second source of supply will be provided by three numbers of 10/25/50 KVA ATs as per load requirement.

(c) Two sets of DG of adequate capacity will also be provided by S&T Deptt. as standby source of supply.

2.4.3 Relay huts in RRI installations

(a) For relay huts located less than 2 KMs. from the RRI cabin, me supply will be extended from the cabin by S&T deptt. In case local power supply is also available at the relay hut, an automatic change over switch of suitable capacity will also be provided by S&T Deptt

(b) For relay huts located beyond 2 KMs. from the RRI cabin, a separate set of ATs will be provided along with one local power supply by Electrical Deptt. Where load requirement so requires, two relay huts may be grouped. In this case, extension of power supply to the other relay hut will be done by S&T.

2.4.4 End panel stations

(a) The main source of power supply will be through two ATs in case of stations on double line and one AT in case of stations on single line Capacity of ATs will be 10/25 KVA depending upon the load requirement.

(b) Local supply will be the second source of power supply.

(c) One DG set of adequate capacity will be provided for single line sections.

(d) One inverter of suitable capacity may also be provided by S&T if required.

2.5 Interlocked level crossing gates

2.5.1 In case of double line sections, two ATs of 5 KVA each shall be provided and in case of single line sections one AT of 5 KVA each shall be provided at interlocked level crossing gate located more than 2 KMs. away from the station. Whenever interlocked level crossing gates are located within 2 KMs. of a station or other interlocked level crossing gate where a set of ATs has been provided, the power supply from the same ATs will be extended to these level crossing gates by S&T deptt.

2.5.2 Local power supply will be the standby source at the level crossing gates in the block sections.

2.6 Automatic block signalling installations

2.6.1 Installations within 2 kms. From station Power supply to all signals within 2 kms. from the RRI cabin or stations, shall be extended through signalling cable laid by S&T Deptt.

2.6.2 Installations beyond 2 kms. from station

For signals located beyond 2 kms. a set of ATs will be provided from each up and down line in case of double line sections and one AT on single line sections.

3.0 MAIN/STANDBY SUPPLIES

3.1 Power supply from ATs will be the main source for all way stations, multi cabin Stations, end panel stations, L.C. Gates, IBHs, IBSs, Auto relay huts. Local power will be the standby source.

3.2 In case of RRI installations, if local supply is reliable, it will be the main source of power supply while supply from ATs shall be the standby source of power supply.

4.0 POWER SUPPLY ARRANGEMENT /AUTO CHANGE OVER ETC.

4.1 Way side stations/IBS/IBH/Multi cabin stations/LC gates/End panel stations/Auto signalling sections

4.1.1 Auxiliary Transformers (ATs), local supply, supply from inverter or supply from DG set, as the case may be, will be terminated on an automatic change over switch/ panel provided by Electrical Deptt. The auto-change over panel would conform to approved RDSO specifications.

4.1.2 Power supply will be extended from automatic change over panel to other cabins/ S&T equipment through a cable of suitable size and capacity. The cables will be laid from the panel in ASMs office/Cabins/gate lodge as the case may be to other cabin/ S&T equipment by S&T Deptt.

4.1.3 Normally, the change over will be automatic .In case the change over panel is in manual mode in existing installations, the manual operation would be done by ASM/Cabin man/Gateman as the case may be. This should be incorporated in the station working rules (SWR) of the station /cabin/ gate.

4.1.4 The manual change over switches in existing installations would be replaced by automatic changeover switches by Electrical Deptt. on a programmed basis.

4.1.5 Wherever in existing installations, the cables from changeover panel to the cabin/equipment are maintained by Electrical Deptt. it will be continued to be so maintained till replaced by S&T on a programmed basis.

4.1.6 In existing RRI installations and large stations, requiring ATs of higher capacity, 10 KVAATs shall be replaced by 25/50 KVAATs as per load requirement.

4.2 RRIs including RRI relay huts

4.2.1 Three phase local supply will be extended to the RRI power supply room and terminated on a distribution board by Elect. Deptt.

4.2.2 Supply from all ATs will also be terminated by Elec. Deptt. on the distribution board.

4.2.3 AT supply and local supply from the distribution board and supply from DG sets will be extended to the main power panel/panels of RRI by S&T Deptt.

4.2.4 The power panels will have automatic changeover facility for the three sources of power supply.

5.0 TELECOMMUNICATION INSTALLATIONS

5.1 At stations, where telecom repeaters (for OFC, microwave or cable) are located within 2 KMs. of stations, a power cable of suitable size will be laid from the automatic change over panel in ASM's room to the repeater stations by Electrical Department to provide standby power supply Electrical Department will also provide an automatic changeover switch between local supply and AT supply. An emergency light and fan point will also be provided at each repeater station by Electrical Department. For installations beyond two KMs. separate ATs will be provided by Electrical Department.

5.2 DG supply may also be provided by S&T as a standby to AT supply and local supply. It will also be terminated on the automatic change over switch.

6.0 TYPES OF LOAD PERMISSIBLE ON AT POWER SUPPLY

6.1 The supply from ATs and DG sets will be exclusively used for signalling and Telecommunication equipment only. No other load will be connected except the following.

6.1.1 At wayside stations where local supply is not available, a lighting circuit shall be provided, covering one light point in ASM's room, two points on the platform outside the station building, one at the ticket windows/waiting hall, on the FOBs and one in each cabin. Where local supply is available but prone to long interruption this requirement may be met by drawing a separate emergency circuit.

6.1.2 In each case a light point shall be provided in apparatus room, relay room, battery and equipment room, cabin basement where signaling equipments are provided and in telecom. Repeaters/cable huts.

7.0 MAINTENANCE RESPONSIBILITIES

The equipments installed by the Electrical Department will be maintained by the Electrical Department and those provided by the S&T department will be maintained by the S&T department.

8.0 SCHEMATIC DIAGRAMS

The schematic diagrams for various types of installations are enclosed as Annexure 1 to 4. In the diagrams the dotted line depicts the jurisdiction of S&T department and the thick line the jurisdiction of the Electrical Department. These standard layouts are representative in nature. Wherever conditions are different, local changes may be made keeping these principles in view.

9.0 These Instructions supersede all earlier instructions issued on the subject as well as provision contained in paras 20713- (i) (a) (b) (c), 20713- (3) (i) to (v), 20713 - (2) (i) to (vii) of actm.

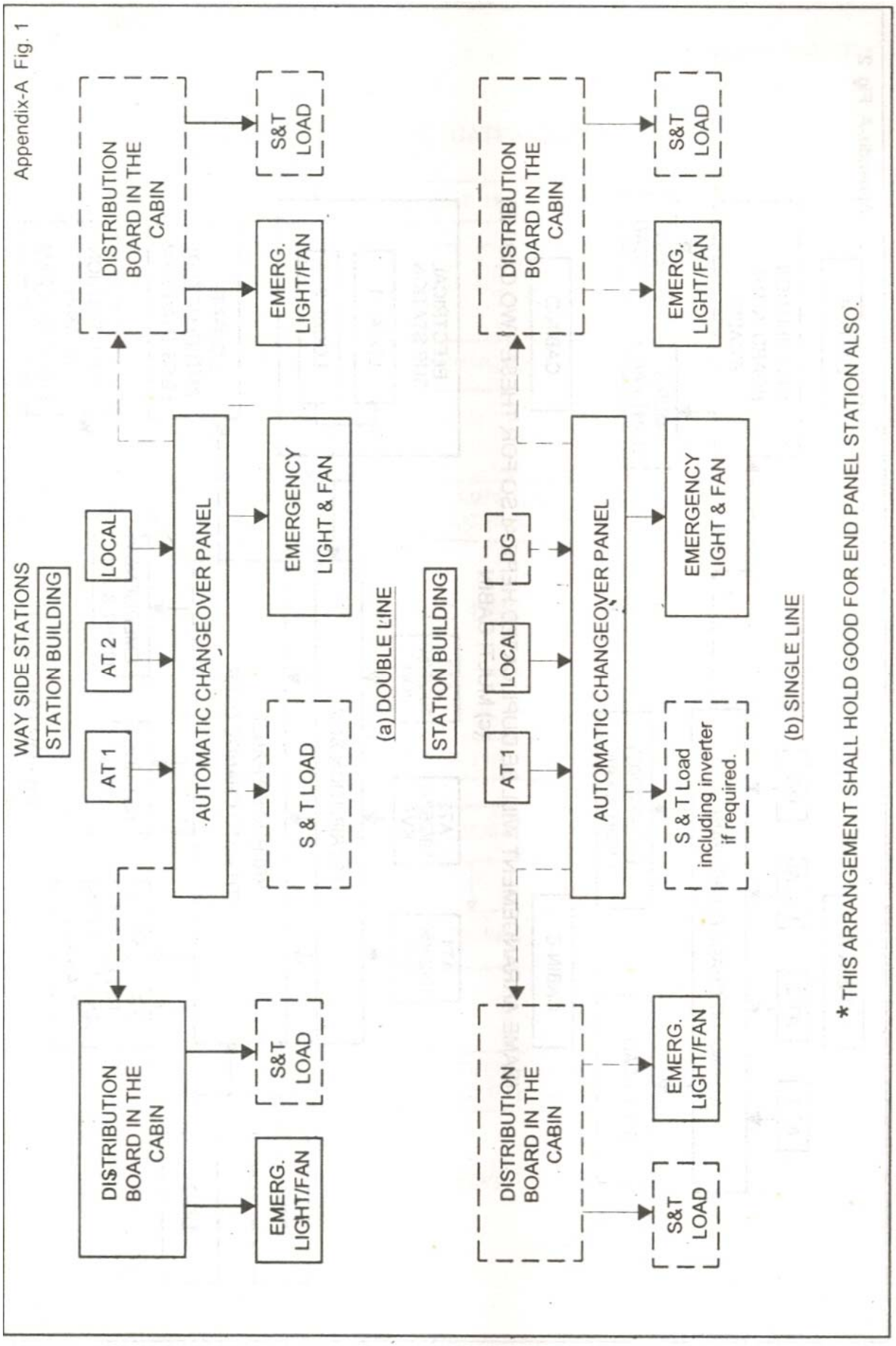
10.0 The above issues with the approval of M.L.

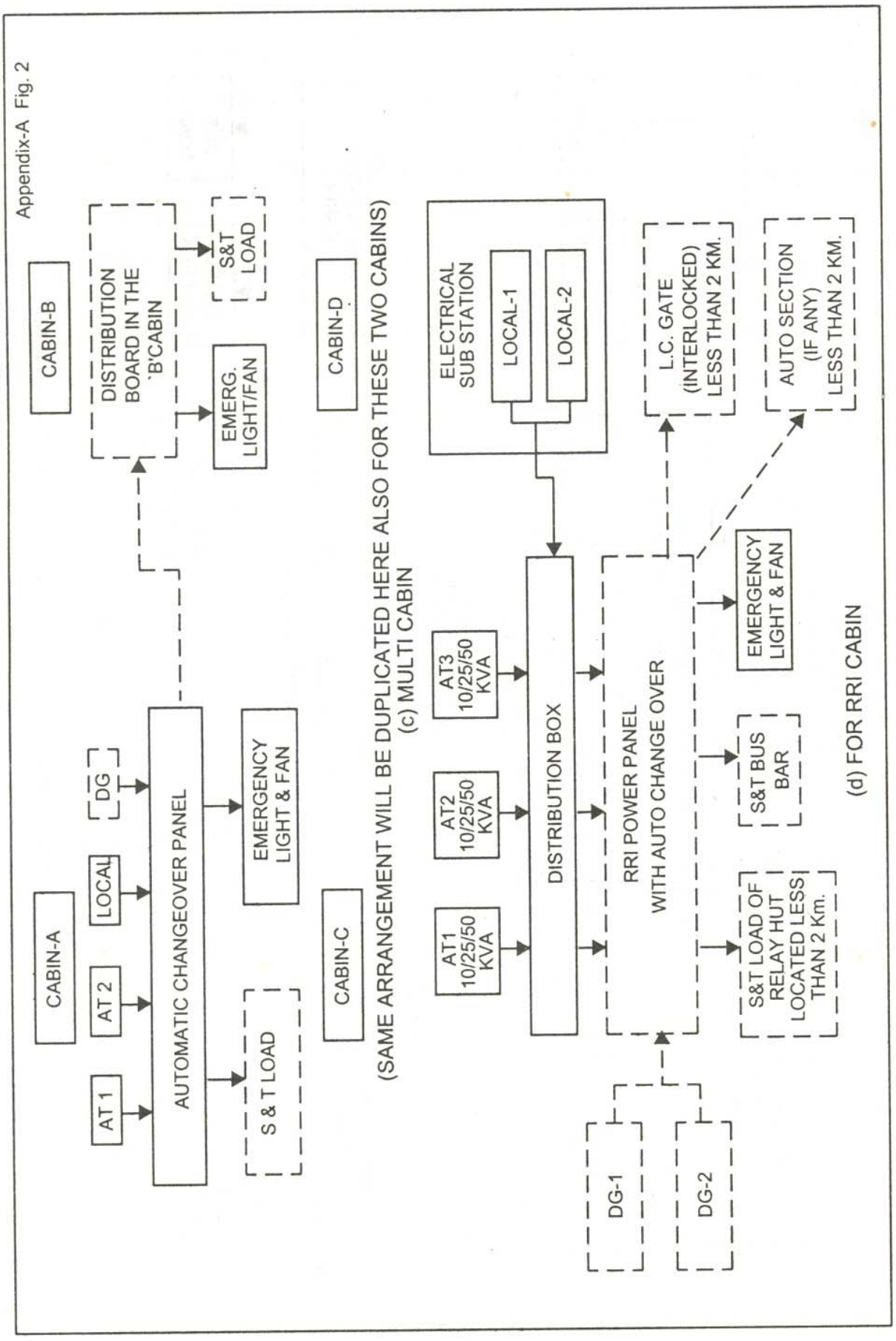
No. 82/RE/250/1 Vol.II

Dated: 10.09.2002.

-Sd--
(MEHTANB SINGH)
Executive Director, Riy. Electrification

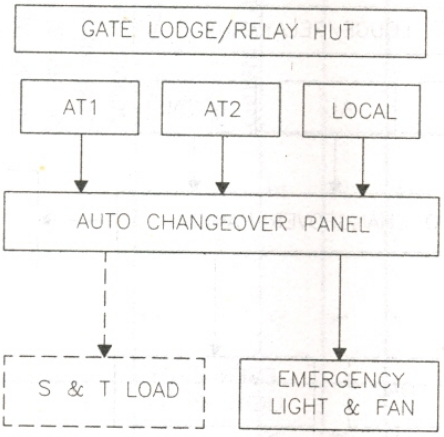
Sd-
(MAHESHKUMAR)
Executive Director/Signal


Appendix-A Fig. 1
WAY SIDE STATIONS
STATION BUILDING
AT 1
AT 2
LOCAL
AUTOMATIC CHANGEOVER PANEL
EMERGENCY LIGHT & FAN
S & T LOAD
DISTRIBUTION BOARD IN THE CABIN
EMERG. LIGHT/FAN
S&T LOAD
(a) DOUBLE LINE
STATION BUILDING
AT 1
LOCAL
DG
AUTOMATIC CHANGEOVER PANEL
EMERGENCY LIGHT & FAN
S & T Load including inverter if required.
DISTRIBUTION BOARD IN THE CABIN
EMERG. LIGHT/FAN
S&T LOAD
(b) SINGLE LINE
* THIS ARRANGEMENT SHALL HOLD GOOD FOR END PANEL STATION ALSO.

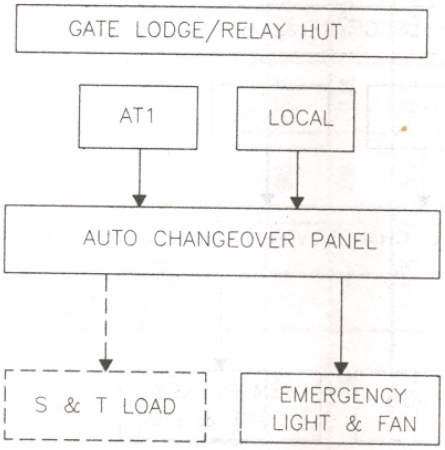

Appendix-A Fig. 2
CABIN-A
AT 1
AT 2
LOCAL
DG
AUTOMATIC CHANGEOVER PANEL
S & T LOAD
EMERGENCY LIGHT & FAN
CABIN-B
DISTRIBUTION BOARD IN THE 'B'CABIN
EMERG. LIGHT/FAN
S&T LOAD
CABIN-C
CABIN-D
(SAME ARRANGEMENT WILL BE DUPLICATED HERE ALSO FOR THESE TWO CABINS)
(c) MULTI CABIN
ELECTRICAL SUB STATION
LOCAL-1
LOCAL-2
AT1 10/25/50 KVA
AT2 10/25/50 KVA
AT3 10/25/50 KVA
DISTRIBUTION BOX
RRI POWER PANEL WITH AUTO CHANGE OVER
L.C. GATE (INTERLOCKED) LESS THAN 2 KM.
AUTO SECTION (IF ANY) LESS THAN 2 KM.
EMERGENCY LIGHT & FAN
S&T BUS BAR
S&T LOAD OF RELAY HUT LOCATED LESS THAN 2 Km.
DG-1
DG-2
(d) FOR RRI CABIN

Appendix–A Fig. 3

LEVEL CROSSING GATES/IBH



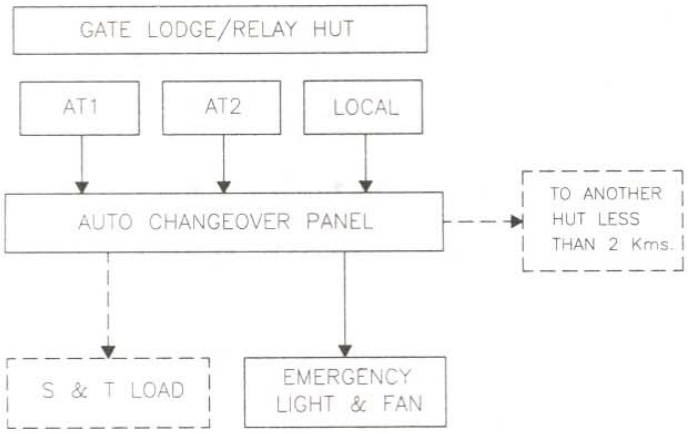
(e) DOUBLE LINE



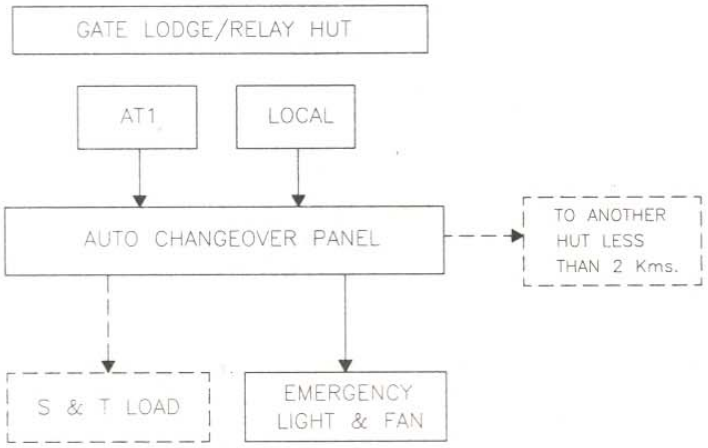
(f) SINGLE LINE

Appendix–A Fig. 4

AUTO HUT/RELAY HUT



(g) DOUBLE LINE



(h) SINGLE LINE

Sizing of IPS upto 4 Line RE/Non-RE with AC lit LED Signal — Appendix-B

Load	Application	No of relays / sub systems	Current per Relay/ Sub system (A)	Voltage (V)	Current (A)	Power (VxA)	Eff (n)	Total Power (VxA/n)	Module Rating	Basic Module reqmt	No of Modules as Hot Standby	Total No of Modules	Remarks / Assumptions
1	2	3	4	5	6	7	8	9	10	11	12	13	14
DC-DC Converters	Relay Internal	150	0.07	24	10.5	252	0.8	315.00	24-32V/ 5A	2	2	4+1 Cold standby	Total relays considered are 375 but 40% of relays assumed to be drawing current at a time . This being a critical application , n+2 configuration has been adopted for hot standby.
	Relay External	52	0.1	24	5.2	124.8	0.8	156.00	24-32V / 5A	1	1	2	Total relays considered are 130 but 40% of relays assumed to be drawing current at a time.
	Block Local	-	-	24	4	96	0.8	120.00	24-32V / 5A	1	1	2	
	Axle-24V (BPAC)	2	2	24	4	96	0.8	120.00	24-32V / 5A	1	1	2	
	Panel Ind & Hkt	-	-	12	4.5	54	0.8	67.50	12-28V/ 5A	1	1	2	
	Magneto Telephone	-	-	24	0.8	19.2	0.8	24.00	12-28 V/ 1A	1	1	2	
	Block Line Up	-	-	40	0.5	20	0.5	40.00	12-40V / 1A	1	1	2	Alternatively 60-110V / 1 Amp may also be used depending upon requirement.
	Block Line Dn	-	-	40	0.5	20	0.5	40.00	12-40V / 1A	1	1	2	
	Block Tel Up	-	-	4	0.1	0.4	0.3	1.33	3-6V / 0.1 A	1	1	2	
	Block Tel Dn	-	-	4	0.1	0.4	0.3	1.33	3-6V / 0.1 A	1	1	2	
	Spare cell Chargers	-	-	12	5	60	0.8	75.00	2-12V / 5 A	1	1	2	

	Wired Spare slot-1	-	-	24	8	192	0.8	240.00	24-32V/ 5A	2	2	4	Wired slots may be utilised for any other application like SSI etc.
	Wired Spare slot-2	-	-	24	4	96	0.8	120.00	24-32V/ 5A	1	1	2	Wired slots may be utilised for any other application like Datalogger etc.
	Total Equipment DC Load (VA)							**1320.17**					
	Equipment DC Load at 110 V (Amp)							**12.00**					
Inverter	Main Sig	14	0.140	110	1.96	215.6	0.93	231.828					
	Route	10	0.140	110	1.4	154	0.93	165.591					
	Shunt Sig	4	0.140	110	0.56	61.6	0.93	66.2366					
	Calling on	0	0.140	110	0	0	0.93	0					Not required in addition to Main and route signal
	Total power at the output of inverter (VA) =							**463.66**					
	Hence inverter capacity required (VA) =							**579.57**					Taking into account efficiency of inverter 80%
	Selected inverter capacity (VA) =							**1000.00**					Taking into account overloading etc.
	Inverter input current at 110V DC (Amp.) =							**5.27**					
	Total Load Current at 110V D.C. (Amp) =							**17.27**					
Battery	Battery Backup required (in hrs) =							7					Since the protected DC and AC loads shall not be activated always , the battery back up is expected to increase by 2 or 3 hrs
	Depth of Discharge in % =							70					
	Battery AH Required (considering aging factor of 1.1 & Design Factor							208.97					
	Hence Battery AH (select the nearst standard value) =							**200.00**					
	C/10 charging rate =							20.00					
	Total DC load at 110V busbar (i.e. SMR O/P current) (Amp) =							**37.27**					

	Total Power at the output of SMRs at 110V D.C. (VA) =	4099.74					
	Total current at Input of SMRs at 230V A.C. (Amp) =	**19.81**					Efficiency of SMR 90%
	Total current at Input of SMRs at 150V A.C. (Amp) =	**30.37**					Under lowest Voltage condition
	Track circuit Load calculation						
	Each track circuit wattage =	12.00					
	Each track circuit VA including Track feed charger and Track Transformer =	24.24					Considering track feed charger efficiency 55% and transformer efficiency 90%
	No of Track Circuits =	20					
	Total Track circuit load (VA) =	484.85					
	Total Wattage of track circuits at the input of CVT (VA) =	606.06					
	Total Current at Input of Track CVT at 230V A.C. (Amp) =	2.64					
	Total Current on IPS Input at 230 V = SMR I/P Current + Track	**22.44**					
	Required Generator source capacity= Total current on IPS I/Px230x1.3 (safety factor)=	6709.72					
	Hence the nearest standard Generator Capacity selected =	**7.5KVA**					
	Notes :						
	1.0 The above Calculations are made at the source voltage of 230 V AC and the DC nominal of 110 V DC. The input current at Source will increase at 150 VAC to a value as shown above and the source may be ensured to provide this power						
	2.0 Point load is not considered for this calculation as its is momentary (<10secs) and that the surge current required by point machines is provided by battery during this period						
	3.0 Track Circuits are directly fed from the mains / DG Set through a CVT and Step Down Transformers and not through Inverter						

APPENDIX – C: PRE - COMMISSIONING CHECKLIST FOR SMPS BASED IPS SYSTEM

1. STATION DETAILS

Zonal Railway		Number of main signals	
Division		Number of shunt signals	
Station Name		Number of point machines	
IPS Make		Number of Axle Counters	
RE/Non RE		Number of Track Circuits	
No. of lines/Roads		Type of Track Circuit (AFTC/DC)	
Power availability hours/day		Number/Type of Indoor relays	
DG set rating		Number/Type of outdoor relays	
Type/capacity of battery(LM/VRLA)		Interlocking(RRI/SSI)	

2. PRE-COMMISSIONING REQUIREMENTS

S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)
A	**Ambience of IPS Room**			
A1	Availability of working Space for maintenance.	1 M (min.) from sides and rear. 2 M (min.) in front of the IPS		
A2	Provision of flooring to Ensure proper cleaning.	Pucca floor/Ceramic tiles		
A3	Provision of forced Ventilation	Fresh Air fans with dampers		
A4	Arrangement for protection against dust.	(i) Tight closing of doors & windows; use gaskets if necessary (ii) Washable dust filters on windows. (iii) Provision of double door or entry through adjoining room to reduce dust ingress.		
A5	Provision of Ventilators	As per RE Drg. No. RE/Civil/S-129-2001 (Annexure-I).		

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)
B	**Batteries**			
	Installation of secondary cell as per para 16.6 of SEM Pt.	Installed in separate room/ apparatus case. Acid proof flooring and tiles Exhaust fan Initial charging as per instruction of battery manufacturer Use of battery grade sulphuric acid conforming to IS:266. Use of distilled or de-mineralized water conforming to IS:1069		
B2	Storage period of VRLA batteries for IPS	Less than 03 months (If the battery is being stored for more than 3 months, freshening charge should be given once in 3 months as given below. The charging current should be 10 to 20 (max.) of rated capacity:- Float Charge @ 2.25 V/cell for 24 hours Boost Charge-@ 2.30 V/ cell for 15 hours)		
B3	Measured capacity of battery after capacity test on batteries.	Rated AH		
B4	Feeder cable from battery to charger 120 AH 200 AH 300 AH	 10 sq.mm copper 16 sq.mm copper 25 sq.mm copper		
	Availability of Spare cell in charged condition at site	05 Nos.		
C	**Commercial/AT Supply**			
	Availability of commercial supply (Ref: RB letter No. 2002/SIG/SGF/3dt. 24.6.03).	More than 6 hours in 24 hours with least fluctuations (Note: Nominal incoming AC supply shall be 230 V, 50 Hz single phase AC. The specified AC voltage range for IPS is 150 V-270 V.)		

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)
C2	Voltage drop in input feeder at full load.	Lessthan30volts		
C3	Provision of sources of power supply as per para 16.2 of SEM Pt.II.	**RE Area** Power supply drawn from AT UP/DN/Commercial supply/ Gen. set with auto/manual changeover facility in the control panel. On double/multiple line sections, at least one AT is available to ensure power supply in the event of power block. On single line sections where power supply is drawn from a single AT, a DG set of suitable capacity has been provided. In big yards, a DG set of adequate capacity in addition to supply from ATs and local source **Non RE Area** Power supply drawn from commercial feeder. In addition two standby diesel generators have been provided.		
C4	Size of input feeder cable as Per TI Directorate's note no. TI/PSI/Project/CLS/01dt. 04.01.02.(Annexure II) from Auxiliary Transformer (AT)/Distribution transformer to IPS room for 5 KVA AT 10 KVA AT 25 KVA AT 50 KVA AT	 2 x 25 sq.mm Al 2 x 70 sq.mm Al 2 x 185 sq.mm Al 2 x 300 sq.mm Al		

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)
C5	Sanctioned Commercial feeder load (KVA)=S			
	General Electrical Lighting load (KVA)=L			
	Balance available for Signalling Load (KVA) = S-L 4 Line Non-RE 4 Line RE 6 Line Non-RE 6 Line RE	 7.4 KVA 6.25 KVA 8.1 KVA 7.0 KVA		
C6	MCB/Changeover switch (Ref: RB letter No. 2004/SIG/SGF/3dt. 25.3.2004.	63 Amp of Merlin Gerlin (Telemecanique)/Siemen's, Schneider or ABB.		
D	**DG Set supply**			
D1	Provision of adequate capacity DG set (without) AFTC) 4 Line Non-RE 4 Line RE/6 Line RE 6 Line Non-RE with AFTC in yard	 10 KVA 10 KVA 12.5/15 KVA At least 25 KVA		
D2	Checking of DG set at 5KW dummy load: Waveform Voltage Regulation Frequency	 Sinusoidal Within 3% 50 Hz ± 5% from no load to full load		
D3	Proper termination of earth and neutral.	Good workmanship		
E	**Earthing**			
E1	Earth resistance of earthing arrangement.	Less than 2 Ohm (without adding water prior to measurement) Preferably maintenance free earth.		
E2	Extension of earth to equipotential bus bar.	Provided		

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)
E3	Connection of individual equipment to equipotential bus bar: - IPS racks - DG sets - Surge protection devices	With individual copper insulated cable of size 4 Sq.mm 4 Sq.mm 16 Sq.mm		
F	**Lightning & Surge Protection**			
F1	Provision of lightning & surge arresters (As per Cl. 3.12of RDSO/SPN/165/2004Ver2)	One set		
G	**Instruction Manual**			
G1	Instruction Manual consisting of Layout drgs., Circuit/System diagram, PCB Layout etc.(Ref: Cl. 7.1 of RDSO/SPN/165/ 2004 Ver2)	Two sets		
H	**Training**			
H1	Imparting on job training to SE/SSE/JE and ESM	3 days		

3. IPS LOAD DETAILS

N = Number of modules provided in hot standby

S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)	
				OK	Not OK
1.	Signalling Equipment load (KVA)	80% the DG Set capacity provided at station			
2.	Relay internal 24-32V/5A	5 *(N-2) Amp			
3.	Relay external 24-32V/5A	5 *(N-1) Amp			
4.	Axle counter 24-32V/5A	5 *(N-1) Amp			
5.	Block local 12-28V/5A	5 *(N-1) Amp			
6.	Panel Indication 12-28V/5A	5 *(N-1) Amp			
7.	HKT/magneto 12-28V/1A	1 *(N-1) Amp			
8.	Block UP 12-40V/1A	1 *(N-1) Amp			
9.	Block DN 12-40V/1A	1 *(N-1) Amp			

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)	
				OK	Not OK
10.	Block Tele UP 3-6V/0.1A	0.1*(N-1) Amp			
11.	Block Tele DN 3-6V/0.1A	0.1*(N-1) Amp			
12.	Data logger 24-32V/5A	5*(N-1)Amp			
13.	SSI 24-32V/5A	5*(N-2) Amp			
14.	Load on each Signal Tx UP	500 VA.			
15.	Load on each Signal Tx DN	500 VA			
16.	Load on Inverter 4 Line 6 Line	 1.5 KVA 2.0 KVA			
17.	Load on Signalling AVR 4 Line 6 Line	 1.5 KVA 2.0 KVA			
18.	Load on Track Tx UP DN	 500 VA 500 VA			
19.	Load on Track AVR 4 Line 6 Line	 1.0 KVA 1.5 KVA			
20.	High voltage disconnect	275 V			
21.	Low voltage disconnect	160 V			
22.	Battery capacity	300/200 AH			
23.	Battery charging current	30/20A = Y			
24.	Total Current drawn from FRBC at 110V after one hour of discharge.	20*(N-2)Amp = X			
25.	Current drawn from FRBC at 110V when battery is in float condition	X-Y			
26.	Input feeder current at full load 4 Line Non-RE 4 Line RE 6 Line Non-RE 6 Line RE	 32 Amp 27.2 Amp 35 Amp 30.2 Amp			
27.	Input feeder voltage at full load	160 Volts(Minimum)			
28.	Functioning of dynamic current control	Operational			
29.	Supply fuse	63 A			

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S.N.	ITEM	Specified Value/provision	Measured Value/ Observation	Remark (OK/Not OK)	
				OK	Not OK
30.	Working of Status Monitoring Panel (Para 4.10 of spec.) DOD 50% 60% 70% Stop DG Set	 RED & Audio alarm RED & Audio alarm RED & Audio alarm till DG is started GREEN & Audio alarm			
31.	Call S&T due to failure of any module	RED & Audio alarm			
32.	Changeover inv. 1 to 2 and vice versa	Inverter failure			
33.	Changeover inv. to CVT and vice versa	Both inverter fail			
34	DC-DC Converter for spare cells 2-12 V, 5 Amp	02 Nos.			
35	Temperature compensation	Provided for VRLA battery			

4. Performance Monitoring of IPS

S.N.	ITEM	Specified Provision	Observation	Remark
1	Monthly calculation of MTBF/ MTTR and sending it to Zonal Railways for onward transmission to RDSO.	As per Annexure-III		

Signature of IPS Manufacturer's Representative Name Designation Date	Signature of Railway Supervisor Name Designation Date

* * *

Telephone: 2451200 Extn. 42394
Tele Fax: 91-0522-2452332
E-mail: dsig4@rdso.railnet.gov.in
No. TI/PSI/PROJECT/CLS/01

Annexure-II
Government of India - Ministry of Railways
Research Designs & Standards Organisation
LUCKNOW-226011

The Chief Electrical Engineer

Dated 04.01.2002

(i) Central Railway, Mumbai CST-400 001.
(ii) Western Railway, Churchgate, Mumbai-400 020.
(iii) Eastern Railway, Fairlie Place, Kolkata-700 001.
(iv) South Eastern Railway, Garden Reach, Kolkata-700 043.
(v) Northern Railway, Baroda House, New Delhi-110 001.
(vi) Southern Railway, Park Town, Chennai-600 003.
(vii) South Central Railway, Rail Nilayam, Secunderabad-500 371.
(viii) CORE, Nawab Yusuf Road, Civil Lines, Allahabad-211 001.

Sub: The cable sizes between Auxiliary Transformer and Distribution Panel.

The existing cable between auxiliary transformer and distribution panel is of 2 x 25 Sq.mm Aluminium cable for 5 KVA and 10 KVA auxiliary transformers. The problem of excessive voltage drop and failure of fuse / tripping of MCB in distribution panel especially during low OHE voltage have been reported by the Signal Directorate. The cable size has been accordingly reviewed considering the voltage drop as well as energy loss in the cable.

Presently, 10 KV ATs are being provided at the end of platforms at the stations for signalling loads. 5 KVA ATs are being provided at IBH stations and level crossing gates. The signalling load for 3/4 line station in double line section on 10 KV AT is about 8.5 KVA. The signalling load at IBH and level crossing gate is about 2.0 KVA. 50 KVA ATs are presently planned for Mumbai area under DC-AC conversion where the requirement of load is higher. The estimated maximum signalling load on 50 KVA AT is about 40KVA. These 50 KVA ATs may be used in future in other areas depending on the requirement of load.

Due to provision of voltage stabilizer, the signalling load is normally of constant VA type i.e. if the voltage decreases the current will increase correspondingly. The input voltage range of the voltage stabilizer is 160-270 V. Considering this the optimum cable sizes for different types of ATs are worked out and are given as follows:

AT type	Cable sizes
5 KVA	2 x 25 Sq.mm Aluminium
10 KVA	2 x 70 Sq.mm Aluminium
50 KVA	2 x 300 Sq.mm Aluminium

The above cable sizes of 1100 V, PVC insulated, PVC sheathed, Al-conductor, Armoured Power cable as per IS: 1554-Part-I are to be provided for the respective type of ATs. The cable lugs and connectors are to be suitably provided. The taps of ATs should be judiciously kept so that the available voltage is maintained in the range of 160-270 V, which is the input voltage range of signalling voltage stabilizer.

(B.P.Singh)

for Director General/TI

Annexure-III

Suggested Format of Held MTBF to be submitted by Zonal Railways

Make	Total working hours				Total number of failures				MTBF			
	IPS	SMR**	Inv**	DC-DC Conv**	IPS*	SMR	Inv	DC-DC Conv	IPS	SMR	Inv	DC-DC Conv
AMR												
BSMC												
HBL												
Statcon												

*IPS failures shall be those failures which have affected the final performance of signalling system i.e. failures affecting signals, complete shut down, failure of complete function.

**Total working hours of SMR = ∑ number of SMR provided x working hours, of IPS system

Total working hours of Inverter = ∑ number of Inverters provided x working hours of IPS system

Total working hours of DC-DC Conv. = ∑ number of DC-DC Conv. Provided x working hours of IPS system

$$\text{MTBF} = \frac{\text{Total working hours}}{\text{Number of failures of sub system}}$$

Format of Held MTTR to be submitted by Zonal Railways

Make	**Total number of failures**	**Total duration of failures (hours)**	**MTTR (hours)**
AMR			
BSMC			
HBL			
Statcon			

APPENDIX – D: TESTES TO BE CONDUCTED ON SSDAC SYSTEM BEFORE COMMISSIONING

Tests to be conducted on SSDAC system before commissioning can be grouped as:

- Tests to be conducted creating failure of 24 V DC at entry /exit ends at various stages of train movement.
- Tests to be conducted creating failure of data link at various stages of train movement.
- Tests to be conducted creating failure of data link & 24 V DC at various stages of train movement.
- In-out count tests in preparatory reset mode.
- Miscellaneous tests

A. Tests to be conducted creating failure of 24 V DC at entry /exit ends at various stages of train movement.

Sl. No.	Test to be conducted	Observation
1	When counting is in progress at entry end, disconnect 24 V dc to the SSDAC at exist end & restore when counting is still under way at entry end	Vital Relay should remain dropped at both ends. (Failure on safe side)
2	When counting is in progress at entry end, disconnect 24 V dc to the SSDAC at exit end & restore when train in mid-section.	Vital Relay should remain dropped at both ends. (Failure on safe side)
3	After counting is over at entry end & train is in mid-section, disconnect 24 V dc to the SSDAC at exist end & restore when train is still in mid-section.	Vital Relay should remain dropped at both ends. (Failure on safe side)
4	After counting is over at entry end, train is in mid-section and counting commenced at exit end, disconnect 24 V dc to the SSDAC at entry end & restore when train clears exit end.	Vital Relay should remain dropped at both ends. (Failure on safe side)
5	Disconnect 24 V dc at far end when the last wheel of the shunting formation is on transducers while performing shunting in to the block section & re-connect immediately (last wheel cleared transducer after re-connecting)	Vital Relay should remain dropped at both ends. (Failure on safe side)
6	Disconnect 24 V dc at entry end prior to in-count and restore after total in-count.	Vital Relay should remain dropped (Failure on safe side)
7	After completion of in-count at entry end and train in mid-section, disconnect 24 V dc to Electronic Counting Unit at entry end & reconnect.	Vital Relay should remain dropped (Failure on safe side)
8	After counting is over at entry end, train passed through mid-section and counting commenced at exit end, disconnect 24V dc to the electronic counting unit at entry end & re-connect when out-count is still in progress.	Vital Relay should remain dropped (Failure on safe side)

B. Tests to be conducted creating failure of data link at various stages of train movement.

Sl. No.	Test to be conducted	Observation
1	Disconnect data link at entry end when in-count is in progress and re-connect when in-count is still going on.	Vital Relay should remain dropped at both ends. (Failure on safe side)
2	Disconnect data link at entry end when in-count is in progress and re-connect after train is in mid-section.	Vital Relay should remain dropped at both ends. (Failure on safe side)
3	Disconnect data link at entry end when in-count is in progress and re-connect when out-count is in progress at exit end.	Vital Relay should remain dropped at both ends. (Failure on safe side)
4	Disconnect data link at entry end when in-count-is in progress and re-connect when out-count is just over at exit end.	Vital Relay should remain dropped at both ends. (Failure on safe side)
5	Disconnect data link at entry end before in-count commenced and re-connect when out-count is over at exit end.	Vital Relay should remain dropped at both ends. (Failure on safe side)
6	Disconnect data link at exit end when train in mid-section & re-connect when out-count is over at exit end.	Vital Relay should remain dropped.(Failure on safe side)
7	Disconnect data link at exit end when train in mid-section & re-connect when out-count is in progress at exit end.	Vital Relay should pick up at both ends on clearance of train at exit end.
8	Disconnect data link at exit end when train in mid-Section & re-connect when out-count is over at exit end.	Vital Relay should pick up at both ends on restoration of link.

C. Tests to be conducted creating failure of data link & 24 V DC at various stages of train movement.

Sl. No.	Test to be conducted	Observation
1	(i) When in-count is in progress at entry end, disconnect data-link & then 24 V dc at exit end. (ii) After train is in mid-section, restore 24 V dc at exit end. (iii) With train still in mid-section, disconnect 24 V dc at entry end & restore. (iv) With train still in mid-section, restore data-link at exit end.	After step (iv), with train still in midsection, both sides SSDACs are in Preparatory reset Mode. After train leaves exit end, both sides in failure mode. (Failure on safe side)
2	(i) When in-count is in progress at entry end, disconnect 24 V dc & then data link at exit end. (ii) After train is in midsection, restore 24 V dc & data link at exit end. (iii) With train still in midsection, disconnect 24 V dc at entry end & restore.	After step (iv), with train still in midsection, both sides SSDACs are in Preparatory reset Mode. After train leaves exit end, both sides in failure mode. (Failure on safe side)

Sl. No.	Test to be conducted	Observation
3	(i) Before commencement of in count at entry end, disconnect data link at exit end and then 24 V dc. (ii) After in count is over and train is in midsection, reconnect data link & 24 V dc at exit end.	Both sides SSDACs in failure mode when train in mid section and continue to remain so, even after train leaves exit end. (Failure on safe side)
4	Simulate a slow- train movement as follows: (i) Give few in-counts (C1) at entry end (ii) Disconnect 24 V dc at entry & exit ends simultaneously (iii) Restore 24 V dc at both ends (iv) Give additional in counts (C2) at entry end (v) Give out-counts (C2) at exit end.	After re-connection of 24 V dc at both ends, SSDACs enter preparatory reset. After count out-count C2 at exit end, Vital Relays pick up at both ends.
5	Repeat above test for shunt back movement at entry end with insulated trolley placed on detection points at exit end (wheel of trolley between TxRx coils of detection points)	Vital Relay should remain dropped even after clearance of section. (Failure on safe side)
6	Disconnection data-link and 24 V dc in that order at entry end prior to in-count and reconnect after total in count.	Vital Relay drops at both ends and remains dropped after train leaves exist end. (Failure on safe side)
7	Disconnection data-link and 24 V dc in that order at entry end after some in counts and reconnect after total in count.	Vital Relay drops at both ends and remains dropped after train leaves exist end. (Failure on safe side)
8	Simulate a slow-train movement as follows: (i) Give few in counts (C1) at entry end (ii) Disconnect data link at entry end (iii) Disconnect 24 V dc at exit end & restore (iv)Give additional in-counts (C2) at entry end. (v) Restore data link (vi)Give out-counts (C2) at exit end.	Vital Relay remain dropped at both ends. (Failure on safe side)
9	Before in count commences at entry end, place insulated trolley on detection points at exit end (wheel of trolley between Tx & Rx coils of detection points) and remove after total in count i.e. train is in mid section.	Vital relays pick up at both ends after clearance of section.
10	When in count commences at entry end, place insulated trolley on detection points at exit end (wheel of trolley between Tx & Rx coils of detection points) and remove after total in count i.e. train is in mid section.	Vital relays pick up at both ends after clearance of section.

D. In-out count tests in preparatory reset mode

Sl. No.	Station	Tests to be done in Preparatory Reset Mode	Observation
1	Entry End	4 out counts followed by 4 in counts.	
2	Exit End	4 out counts followed by 4 in counts.	
3	Entry End	4 in counts followed by 4 out counts.	
4	Exit End	4 in counts followed by 4 out counts.	
	(Tests 3 & 4 prove that shunt movements at any end in preparatory reset mode do not bring the system to clear state in spite of count balance)		
5	Entry End	4 in counts	System showed clear indication & VR picked up
	Exit End	4 out count	
6	Exit End	4 in counts	System showed clear indication & VR picked up
	Entry End	4 out count	
	(Tests 5 & 6 prove that, in preparatory reset mode, entry & exit movement of a train with count balance will bring the system to clear state)		
7	Entry End	4 in counts followed by	System shows clear indication & VR picked up
	Entry End	4 out counts followed by	
	Exit End	4 in counts followed by	
	Entry End	4 out count	
8	Entry End	4 in counts followed by	
	Entry End	4 out counts followed by	System shows clear indication & VR picked up
	Exit End	4 in counts followed by	
	Exit End	4 out count followed by	
	Entry End	4 in counts followed by	
	Exit End	4 out count	
	(In tests 7 & 8, combination of shunt movement & train movements with ultimate count balance and with out any in out error have cleared the system)		
9	Entry End	4 in counts followed by	System shows clear indication & VR picked up. (The above test ensures clearance of system in PR mode for movements of train in parts after parting or for clearance in emergencies, provided the recount balance & no in-out error)
	Entry End	4 out counts followed by	
	Exit End	4 in counts followed by	
	Entry End	4 out count followed by	
	Exit End	4 out count	

E. Miscellaneous Tests:

Sl. No	Tests to be conducted	Observation
1	Connect & disconnect trolley Suppression relay in quick succession a) Test conducted when section is clear. b) Test conducted when train in section.	 No effect on vital relay No effect on vital relay
2	Disconnect channel voltages & reconnect at Entry End with "Trolley protection Track Relay picked up. a) RX A disconnected & reconnected. b) RX B disconnected & reconnected.	 VR dropped at both places. VR dropped and picked up.
3	Disconnect channel voltages & reconnect at Entry End with Trolley protection Track relay in dropped condition. a) Rx A disconnected reconnected. b) Rx B disconnected reconnected.	 VR dropped at both places. VR not picked up; VR dropped at both places and Remained dropped.
4	Disconnect & reconnect channel voltages in quick succession. Receive coil output of channels disconnected and reconnected quickly for a) R x A b) R x B	 VR dropped. Remained dropped. VR dropped. Remained dropped
5	Check mid-section entrance Out count was given first at Exit End and next equal in count was given at Entry End.	VR dropped. Remained dropped
6	Incomplete counting (with trolley protection tack relay in dropped condition) Dummy wheel up to A channel & back Dummy wheel over A channel & back Dummy wheel up to B channel & back Dummy wheel over B channel & back	 VR in picked up condition. VR dropped & picked up. VR dropped & picked up. VR dropped. Not picked up again.
7	Create loose connections at Entry End while counting is under progress. Loose connections created in Rx input during the progress of counts	 VR in dropped condition after the train has cleared the block section.
8	Disconnect power supply at Entry End when counting is under progress. 24 V DC input fuse removed & inserted	 VR in dropped condition after the train has cleared the block section.
9	Disconnect one of the channels when counting is under progress 'A' channel disconnected & re-connected after the passage of few vehicles	 VR in dropped condition after the train has cleared the block section.

Sl. No	Tests to be conducted	Observation
10	Disconnect data link when section is occupied. Data link disconnected & reconnected when section is not occupied.	VR dropped at both places & remained in the same condition after insertion.
11	Disconnect data link when section is occupied. Data link disconnected & reconnected when section is not occupied.	VR dropped and picked up.
12	Disconnect data link in quick succession Data link disconnected & reconnected in quick succession with block section clear.	Two possibilities: If disconnection & reconnection is to quick, VR is not dropping. If disconnection & reconnection are with time gap, VR drops after approx. 2 sec after first disconnection and picks up approx. 2 sec. After last reconnection.
13	With trolley suppression track relay connected, observe the functioning of the system with dummy wheel movement. Trolley suppression reconnected & Dummy wheel placed over A&B channels.	
	A-Rx (Occupied) A-Rx (Clear) B-Rx (Occupied) B-Rx (Clear)	VR (Drop) VR (Pick up) VR (Drop) VR (Pick up)
14	Disconnect power supply when section not occupied 24 V input to Electronic Counting Unit disconnected & reconnected with section clear.	VR remained dropped.
15	Move the trolley over transducers at exit end when count in progress at the other end (with trolley suppression available)	VR picked up at both ends & clear indication shown.

APPENDIX - E: PRE COMMISSIONING CHECK LIST FOR LED SIGNALS

Name of Station

I. GENERAL

Sl No.	Check Points			Requirement	Actual At Site
1	**General Requirements:**			YES	
i.	LED signals are procured form RDSO approved sources with RDSO inspection.			YES	
ii	Installation / maintenance staff is trained at manufacturer's premises			True RMS	
iii	Meter used for measurement in case of AC power supply			YES	
iv	LED signal lighting units have undergone Burn-in for 72 hours before putting in to use.			YES	
v	Rating of fuse used in signal lighting circuit.			600 mA	
vi	Current regulators (CRs) of Man signals have been configured in Blanking mode for OFF aspects and Non-Blanking mode for ON aspects.			YES	
vii	HMU along with audio-visual alarm unit has been provided for Main signals – HMU in relay room and audio – visual alarm unit in ASM's room.			YES	
viii	HMU is not provided for other than Main signals.			YES	
2	**ECR for Use:**				
i	LED ECR (preferable) is used for all signal aspects			YES	
ii	Conventional ECR, if used, is as given below:			If used, to be as per table as given in previous column.	Main Signal
	Make	Convl. ECR	Suitability with LED Signals		
	ABB	ON-Metal to Metal	Main & C-ON signals only		Route Indicator
	Siemens	OFF- Metal to Metal			Shunt signal
					C-ON signal
	CGL	ON-Metal to Metal	All signals		
	Hytronics				
iii	Individual ECR is used for every signal aspect.			YES	
3	**Circuit Requirement for Main LED Signals**				
i	Signalling circuit is such that in case of failure of an aspect, more restrictive aspect starts lighting i.e. cutting-in of aspects provided.			YES	
ii	Red lamp protection provided.			YES	
iii	Every aspect has individual return path			YES	

Date:

Signature

Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

II. CHECKS FOR MAIN LED SIGNALS

Sl. No.	Check Points	Requirement	Signal No. & Aspect (e.g.1-R, 1-Y.....)						Remarks
1	Input voltage available to signal aspect on load at site	> 95 V							
2	Voltage fed to Power Supply of HMU for Main signals, as per manufacturer's manual	22-26 V DC > 95 V AC, as applicable							
3	**Jumper Selection and Wiring Termination**								
i	Proper Jumper selection and wire termination on CR is done as per manufacturer's manual as applicable	Jumper Selection: (i)Blanking/Non-Blanking (Blanking Mode for OFF aspects, Non-Blanking mode for ON aspects)							
ii	Proper Jumper selection and wire termination in HMU is done as per manufacturer's manual, as applicable	Jumper Selection (i) ECR type: AC LED, AC conventional or DC LED. (ii)Power Supply: AC/DC.							
iii	Terminations on CR & HMU are proper and properly tight	YES							
iv	Inter connecting cable between CR & LED signal lighting unit is properly connected & tight.	YES							
v	Mounting screws of LED signal lighting unit, CR & HMU are properly tight.	YES							

Date:

Signature
Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

Sl. No.	Check Points	Requirement	Signal No. & Aspect (e.g.1-R, 1-Y.....)						Remarks
4	**Check for HMU, Audio Visual Alarm & Correspondence of ECR**								
i (a)	After taking off an aspect, disconnect inter connecting cable between CR & LED signal lighting unit-disconnect the cable other than optical sensing cable. The cable with 2 pin connector is optical sensing cable)	(i) Aspect at site extinguishes & more restrictive aspect lights (In case of Red aspect, signal in rear goes to danger). (ii) Aspect fail status appears in HMU as per manufacturer's manual. (iii) Audio visual alarm appears in audio visual alarm unit in ASM's room. (iv) On acknowledgement, audio alarm silences but visual alarm continues. (v) ECR of the aspect drops.							
i (b)	Reconnect disconnected cable and take off the aspect again	(i) Aspect at site lights normal. (ii) Aspect OK indication lights in HMU (iii) ECR of the aspect							

Date:

Signature
Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

II. CHECKS FOR MAIN LED SIGNALS

Sl. No.	Check Points	Requirement	Signal No. & Aspect (e.g.1-R, 1-Y.....)						Remarks
4	Check for HMU, Audio Visual Alarm & Correspondence of ECR. (Applicable in case there are 2 interconnecting cables between CR & LED signal lighting unit – Sanarti & Power Tech. makes)								
ii(a)	Disconnect the optical sensing cable (i.e. the cable with 2 pin connector) from LED signal lighting unit.	(i) ***Incase CR is configured for Non - Blanking mode -*** Aspect at site lights with deteriorated illumination with input current of CR restricted to 40 mA. ***In Blanking mode-*** Aspect at site extinguishes. (ii) More restrictive aspect lights (In case of Red aspect, signal in rear goes to danger). (iii) Aspect fail status appears in HMU as per manufacturer's manual. (iv) Audio visual alarm appears in audio visual alarm unit in ASM's room. (vi) On acknowledgement, audio alarm silences but visual alarm continues. (vi) ECR of the aspect drops.							
ii.(b)	Reconnect disconnect cable	(i) Aspect at site lights normal. (ii) Aspect OK indication lights in HMU. (iii) ECR of the aspect picks up.							

Date:

Signature
Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

Sl. No.	Check Points	Requirement	Signal No. & Aspect (e.g.1-R, 1-Y....)						Remarks
	Check for HMU, Audio Visual Alarm & Correspondence of ECR. (Applicable in case there are 2 interconnecting cables between CR & LED signal lighting Sanarti & Power Tech. makes								
4.iii (a)	After taking off an aspect, remove fuse from its aspect monitoring card in HMU.	(i) Aspect at site extinguishes & more restrictive aspect lights. (In case of Red aspect, signal in rear goes to danger) (ii) Aspect fail status appears in HMU as per manufacturer's manual. (iii) Audio visual alarm appears in audio visual alarm unit in ASM's room (iv) On acknowledgement, audio alarm silences but visual alarm continues (v) ECR drops.							
4.iii (b)	Restore fuse	(i) Aspect at site lights normal. (ii) Aspect OK indication lights in HMU. (iii) ECR of the aspect picks up.							
4.iv (a)	After taking off an aspect, remove fuse from Power supply card of HMU.	(i) Aspect at site lights normal. (ii) All indications of HMU extinguish. (iii) Audio visual alarm appears in audio visual alarm unit in ASM's room (iv) On acknowledgement, audio alarm silences but visual alarm continues. (v) ECR remains pick up.							
4.iv (b)	Restore fuse	All indications pertaining to normal status of HMU reappear.							

Date:

Signature
Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

III. CHECKS FOR LED SIGNALS OTHHER THAN MAIN SIGNALS

Sl No.	Check Points	Requirement	Signal No. & Aspect (e.g. Sh.25, CO-2.)						Remarks
1	Input voltage available to signal aspect on load at site.	> 995 V							
2	**Jumper Selection and Wiring Termination**								
i	Proper Jumper selection and wire termination is done on LED signal lighting units as per manufacturer's manual, as applicable.	**Jumper Selection** (i) ECR type: AC LED, AC conventional or DC LED (ii) Power Supply: AC or DC							
ii	Terminations on LED signal lighting unit are proper and properly tight.	YES							
iii	Mounting screws of LED signal lighting unit are properly tight.	YES							
3	**Performance Test for Shunt Signal**		ECR						
i.a	Performance of shunt signal with 2 shunt lighting units and ECR in cct.	ON Aspect	ECR						
i.b		OFF Aspect	ECR						
ii.a	Performance of shunt signal with only pilot lamp unit and ECR in cct. (The other shunt lighting unit to be disconnected)	ON Aspect	ECR						
ii.b		OFF Aspect	ECR						
iii.a	Reconnect the disconnected shunt lighting unit	ON Aspect	ECR						
iii.b		OFF Aspect	ECR						
iv.a	Performance of shunt signal with shunt lighting unit other than pilot lamp and ECR in cct.(Pilot lamp unit to be disconnected)	ON Aspect	ECR						
iv.b		OFF Aspect	ECR						
v.a	Reconnect the disconnected pilot lamp unit	ON Aspect	ECR						
v.b		OFF Aspect	ECR						

Date:

Signature
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Pre Commissioning Check List for LED Signals

Sl. No	Check Points	Requirement					
			Sig. No	Sig. No	Sig. No	Sig. No	Remarks
4	**Performance Test for Route Indicator**						
	After taking off Route Indicator with ECR in cct.						
i	Disconnect any one Route lighting unit						
ii	Disconnect one more Route lighting unit (Total Two route lighting units disconnected)	**ECR**					
iii	Disconnect one more Route lighting unit (Total 3 route lighting units disconnected)	**ECR**					
iv	Reconnect any 2 disconnected Route lighting units.	**ECR**					
v	Reconnect remaining third disconnected Route lighting unit.	**ECR**					

Date:

Signature
Name & Designation of Inspecting Official

Pre Commissioning Check List for LED Signals

DO's		DON'Ts	
1	Use 600 mA fuse in signaling circuit	**1**	Don't leave loose connectors between LED signal lighting unit and current regulator. This may cause false operation.
2	Select Blanking mode for OFF aspects and Non Blanking mode for ON aspects in current regulator of Main LED signals.	**2**	Don't leave loose wire on input terminals of LED signal lighting unit and current regulator. This may cause false operation.
3	Ensure all terminations in CT rack, Junction Box, LED signal lighting unit, current regulator and HMU are tight and clean.	**3**	Don't connect wires at wrong input terminals for AC/DC power supply.
4	Polycarbonate cover of LED signal lighting unit may be cleaned with soft and anti static cloth periodically.	**4**	Don't try to interchange connections of LED signal lighting unit, current regulator or HMU.
5	Check installation once a year by disconnecting the interconnecting cable between CCR & LED signal lighting unit of main signal to check audio-visual alarm and correspondence of ECR.	**5**	Don't use fuse of more than 600 mA rating in signaling circuit.
6	Ensure upgradation / modification, If any, as advised by RDSO.	**6**	Don't try to give direct supply to the LED signal lighting unit of main signals.
		7	Don't carry current regulator by its cable.
		8	Don't carry hanging LED signal lighting unit connected with current regulator.
		9	Don't insert or remove cards / units when system is ON.

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No.98/W1/Genl/0/30-Pt. New Delhi, Dated 13.08.08

The General Managers,
All Indian Railways.

Joint Engineering & S&T Circular

Sub: Standardization of service building for S&T requirement

1. In the estimates for new line, gauge conversion & doubling projects being submitted to Railway Board, area of service buildings proposed by Railways for S&T at a block section are varying. In order to standardize and keep it to bare minimum the requirement of buildings for S&T have been reviewed. Separate rooms for Axle counters, data loggers and telecom room for quad cable communication (except for OFC) are not considered necessary.

2. It has been decided that following rooms for S&T requirement be provided:-

   a) Stations having ASM room:-
      - Relay cum Axle counter room(7.1 x 4.6m)
      - IPS & Data logger Equipment room (3.7 x 4.6m)
      - Battery room (3x4.6m)
      - DG cum solar room (3.7x4.6m)
      - Panel may be kept in the ASM room

   Total area to be constructed is 79.7 sqm.

   b) In case ASM room does not exit (NL projects) or is not usable, a new ASM/Panel room (6.1x4.6m) may be constructed. Total area including ASM room is 107.6 sqm.

   c) In case the work involves provision of OFC system, an OFC room (3.6x4.6m) may also be constructed for housing OFC equipments.

3. A typical building plan for S&T requirement at ¾ line stations is enclosed as annexure. It is also desirable that above buildings may be constructed away from PF area to ensure obstruction free movement of the passengers.

4. While framing estimates of Railways projects, above guidelines should be strictly followed.

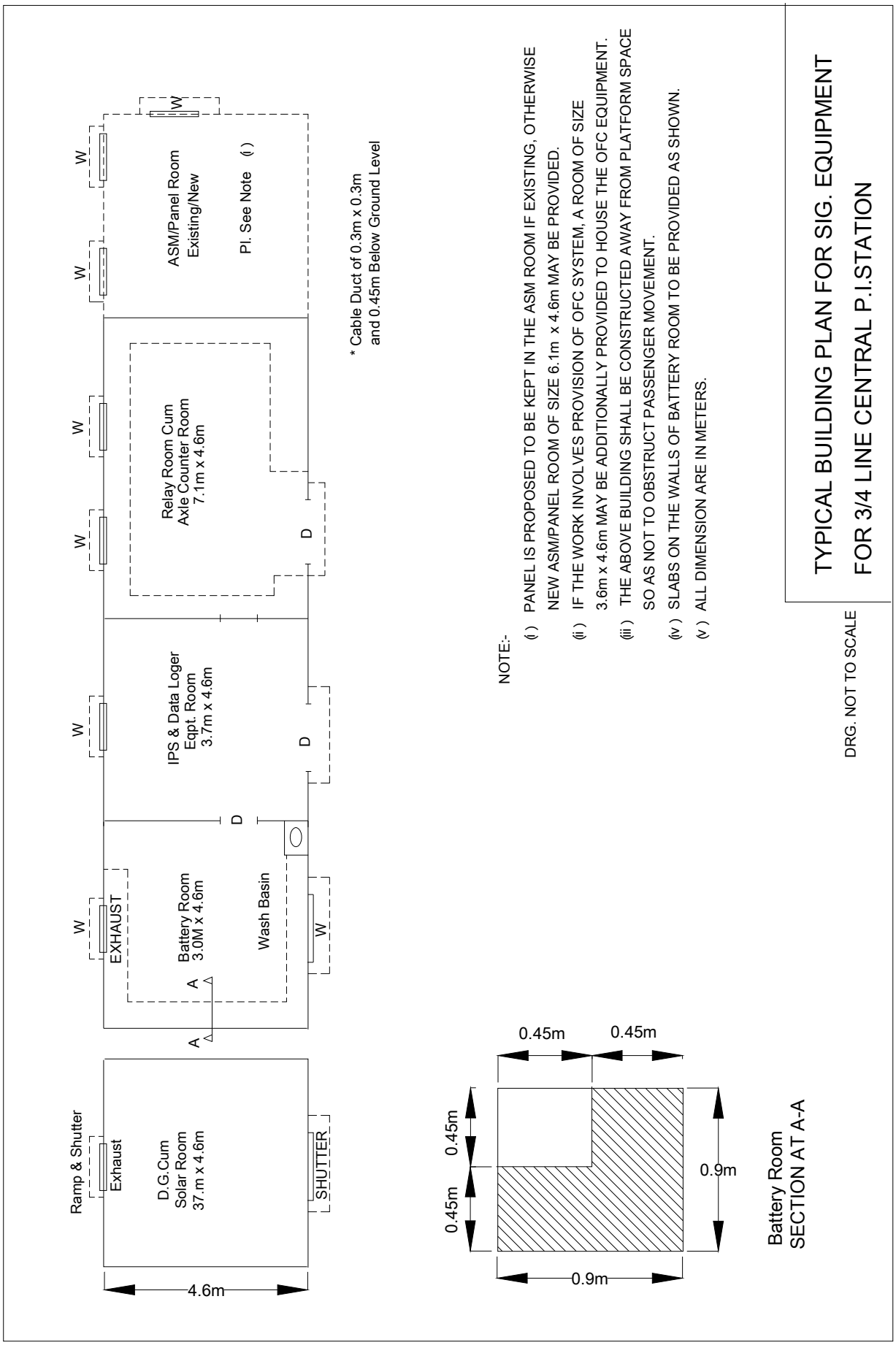
This issues with the approval of Board (ME&ML).

Signed By

(R.L.Gupta)
Executive Director/Signal

(P.K.Sanghi)
Executive Director/Works

DA: As above,
Copy to: CAO/Cs & CSTEs, PCEs All Indian Railways.


TYPICAL BUILDING PLAN FOR SIG. EQUIPMENT
FOR 3/4 LINE CENTRAL P.I.STATION
DRG. NOT TO SCALE
NOTE:-
(i) PANEL IS PROPOSED TO BE KEPT IN THE ASM ROOM IF EXISTING, OTHERWISE NEW ASM/PANEL ROOM OF SIZE 6.1m x 4.6m MAY BE PROVIDED.
(ii) IF THE WORK INVOLVES PROVISION OF OFC SYSTEM, A ROOM OF SIZE 3.6m x 4.6m MAY BE ADDITIONALLY PROVIDED TO HOUSE THE OFC EQUIPMENT.
(iii) THE ABOVE BUILDING SHALL BE CONSTRUCTED AWAY FROM PLATFORM SPACE SO AS NOT TO OBSTRUCT PASSENGER MOVEMENT.
(iv) SLABS ON THE WALLS OF BATTERY ROOM TO BE PROVIDED AS SHOWN.
(v) ALL DIMENSION ARE IN METERS.
* Cable Duct of 0.3m x 0.3m and 0.45m Below Ground Level
ASM/Panel Room Existing/New
Pl. See Note (i)
Relay Room Cum Axle Counter Room 7.1m x 4.6m
IPS & Data Loger Eqpt. Room 3.7m x 4.6m
EXHAUST
Battery Room 3.0M x 4.6m
Wash Basin
Ramp & Shutter
Exhaust
D.G.Cum Solar Room 37.m x 4.6m
SHUTTER
4.6m
0.45m
0.45m
0.45m
0.45m
0.9m
0.9m
Battery Room
SECTION AT A-A

* * *