



SOUTH WESTERN RAILWAY HUBBALLI

TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS





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TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS

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Technical Guidelines for S&T Contractual works

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1.0	GENERAL :
	<p>a. The detailed guidelines for execution of contractual work which are to be carried out, are stipulated here. This booklet is a compilation of best practices, aimed at bringing quality, a uniformity among all executing agencies working in S.W.Rly. However, the field engineer for the work may advise minor changes without compromising on quality/ Standards if site condition warrants them. Such deviation if any shall be taken only officers at JAG & above and they shall keep detailed reasons for any scrutiny for deviation.</p>
	<p>b. The work shall be carried out as per the drawings approved by the Railways duly using guidelines mentioned in the booklet as supplementary to existing provisions in Codes, Signal Engineering Manual Part-I & II, Telecom Manual, RDSO Specifications, OEM's Installation guidelines (if better than Rlys), Railway Board guidelines, RE Manual, Block Manual, Schedule of Dimensions and policies & instructions issued from time to time by the HQrs, are deemed to be a part of the Contract Agreement and both contractor & Field officers are responsible for the proper execution of the work up to Functionality, Quality, Reliability, Availability and Maintainability shall be kept in view of all times. All the works/circuit diagram shall be to suit RE standards.</p>
	<p>c. The guidelines in the booklet must be followed unless exceptions are specified either in Tender schedules or special conditions of contract. Mismatch between these guidelines and tender schedules/ special condition of contract shall be brought to the notice of Field executive unit and written clarification shall be obtained by contractor.</p>
	<p>d. In case of any dispute regarding soil conditions/type of trenching and /or any other stipulation the decision of the Engineer for the work shall be final and binding on the contractor .</p>
	<p>e. The Recommended Drawing are also enclosed in subsequent pages. Any other relevant drawings may be obtained from the Office of the Field Executive Incharge.</p>
	<p>f. Check for update: Please check updates of these guidelines at web page https://swr.indianrailways.gov.in. Always download latest one from the above address. The copy as updated one week before date of tender opening shall be considered, while submitting tender offers.</p>

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2.0	CABLE LAYING:		
	2.1 Cable Plan:		
	Cable plan with distribution chart for each cable shall be prepared jointly by contractor and Railway for each station and block section leaving adequate spare conductors overall as laid down in SEM Part-II Para No.15.3.2/ Indian Railway Standard Specification SI no: S36/87 i.e., adequate spare conductors to a minimum of 20% of total conductors used shall be provided in each main cable up to the farthest main point zone and beyond this there should be a minimum of 10% of spare conductors of total conductors used. No spare conductors are required if the total no. of conductors used is 3 or less. Typical cable core plan for upto 4 Roads and 6 Roads are enclosed.		
	2.2 Cable Trenching:		
	<p>a. Excavation of cable trench shall be made in all kinds of soils including clearing roots of trees, rocks etc. to a depth of 1 Mtr and to a width of not less than 0.30 Mtr as required, providing proper protection as required by Railways while crossing power cables, pipe lines etc. The bottom of the trench shall be leveled and got rid of any sharp materials. Trenches shall be straight as far as possible and steep angles shall be avoided. Railways will decide alignment of the main cable route as well as track/road crossings, after deciding route with other departments.</p>		
	<p>b. Through Signaling / Power cables within station limits shall be laid as close to the railway boundary as possible. The cable, track separation distance generally be about 6 Meters, where ever feasible. In block section they shall be laid within 1 Mtr from the Railway land boundary as far as possible. Cables shall be laid only after obtaining the approval of cable route plan and cable core plan as applicable.</p>		
	<p>c. Whenever the cable route is very near or over the embankment due to non-availability of space, the route marking shall be given in consultation with Railway Civil Engineering Officials. In these stretches the contractor shall complete the work in minimum possible time.</p>		
	<p>d. The progress of trenching, availability of cable, bricks, pipes etc., shall be closely co-ordinate to ensure that the trenches remain open for minimum possible time.</p>		
	<p>e. Whenever the track crossing is to be done or trenching in proximity of track, the same shall be done in least possible time in the presence of Railway Civil Engineering Representative.</p>		
	<p>f. It is desirable that the excavation of trenches is not done in long lengths and does not remain uncovered overnight. It is preferable that trenches are dug, cable laid and refilling done on the same day.</p>		
	<p>g. In all such cases of lower depth, the Railway supervisor shall record the reasons for such low depth in the site register. No payment shall be made for any extra excavation carried out of additional depth or width of the trench other than schedule item.</p>		
	<p>h. The following criteria of cable laying shall be adopted as per the site condition in conjunction with the relevant item of SOR :</p> <p>Types of trenches:</p>		
	Depth of Trench	Protection arrangement	Drawing No.
	Full Rock and no trench at the ground level	GI Pipe with 300 mm X 300mm concrete block at every 2mtr.	<u>SG/SWR/ 065.</u>
	Rock faced at about 400 mm depth	HDPE with continuous concrete of 300 mm X 300mm	<u>SG/SWR/063.</u>
	Rock faced at about 600 mm depth	HDPE with 300x300 mm concrete block interval of every 2 Mtr	<u>SG/SWR/ 064.</u>
	Rock faced at greater than 600 mm less than 1000mm depth	RCC duct	<u>RDSO DRG No: SDO/cable laying/007</u>
	Trench of full depth		
	<p>i. Between Home signal to Home signal 1000mm.</p> <p>ii. Between the stop signals of LC gate/IB</p> <p>iii. Power cable along with other signaling cables where separation is mandatory.</p>	Normal trench with RCC duct	<u>RDSO DRG No: SDO/cable laying/007</u>

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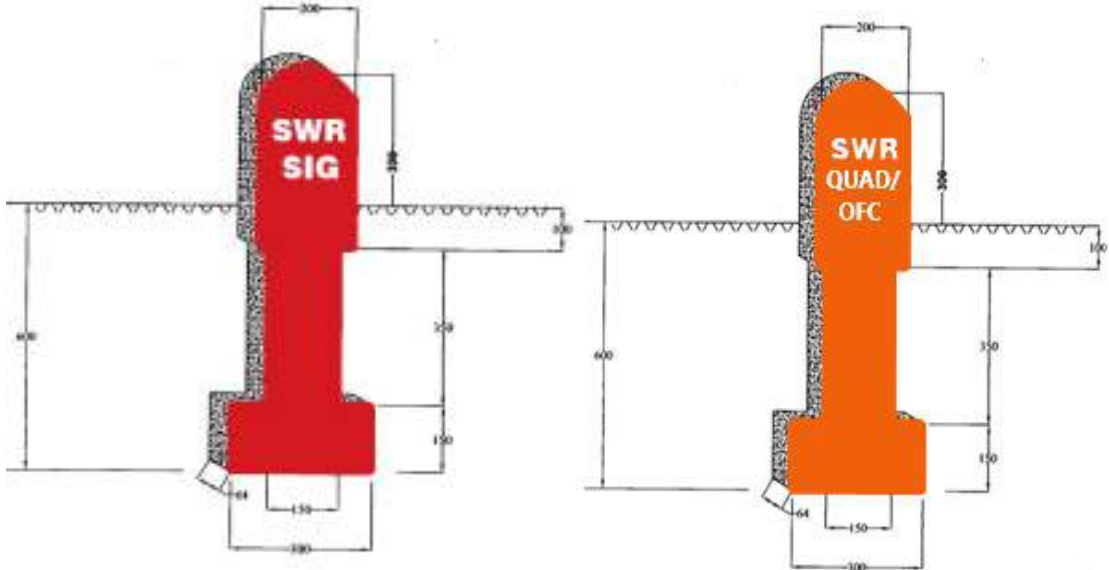
	iv Between Home signal to permissive signal(s) 1200mm. v. Between stop signal and permissive signal(s) of LC gate/IB	Half cut DWC pipe	<u>SG/SWR/069</u>
	i. During excavation of the trenches, earth should be preferably thrown away from the track and care shall be taken that the same should not fall on the track ballast. Complete excavated earth shall be back filled in the trench after laying the cable and rammed well.		
	2.3 Cable Laying Practice:		



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	a. Provisions of Para 15.10 of Part-II SEM shall be broadly followed.
	b. Before the cables are laid, a visual inspection of cable shall be made and it shall be tested for insulation and continuity of cores. The insulation resistance (Dry) of each core shall not be less than 10.0 MΩ per kilometer and insulation resistance (Wet) shall not be less than 7.5 MΩ per kilometer for cable conductor sizes upto 2.5 sq. mm. For cable conductor sizes more than 2.5 sq. mm, the insulation resistance (Dry and Wet) shall be 5 MΩ / Km as per RDSO SPN:IRS S 63/2014(Rev.4) As per SEM-II Para no. 15.23.1 Annexure 12. The insulation resistance so measured should not be less than 5MΩ per KM at buried temperature.
	c. If there is wide disparity between insulation of different conductors, the conditions of the cable should be thoroughly checked before permitting its use. Bedding and armoring shall be inspected to see that there has been no damage during transit or in storage.
	d. Cable wheels shall be used normally to mount the drums before rolling them. In case where the Cable wheels not available or the area is not convenient for rolling the Wheel Drums along the route, the drum shall be mounted on the axle at one end of trench and cable unwinded using adequate number of men ensuring that the insulation of the cable is not damaged and no kink/twist is formed.
	e. Before laying of cable in the trench, a visual inspection shall be adequate for any damage or defect throughout its length. <u>A Video recording with clear depth of Trench & it's location . to affixed structure shall be made before laying the cable.</u> The depth of the trench shall be measured at interval of every 100m and captured with video recording by executing agency and handed over to Division,(which shall be uploaded in the RCILs server by the division) in DVD with clear labels Viz., Section, Date, Work etc.,.
	f. A red Colour Tape printed with details of: 1. SWR, 2. type of cable, 3. contact no of test room. It shall be laid at 0.3 M while covering the normal trench so as to alert any digger at a future date about buried cable underneath.
	g. Cable numbering with lead/plastic strap at every 10m distance to be tagged to identify the cable at a future date.
	h. Normally, cable laying should be commenced only after the construction of ducts in relay room and Location boxes on the route and the cable should be fully terminated at the relay room/ Location boxes immediately after the cables are laid. However, if for any reasons the cables are to be laid in advance, special care should be taken to ensure that the coiled cable near the relay room/ Location boxes is fully protected before and during final termination. The coiled cable should be fully covered suitably and necessary protection arrangements shall be done by the contractor to avoid damages and thefts. On no occasion the ends of the cable should be left unprotected.
	i. Cable laying shall commence only after ensuring the depth and width of the trench, quality of protective arrangements meets as per standards with joint inspection by the Railway Engineers Representative and Contractor's representative.
	j. Cables shall never be taken over the running tracks at the time of cable laying by the contractor as this is likely to cause unsafe incidents and damage to cables. In case where the cable is required to be transported across the tracks, the same shall be done in the presence of Railway Supervisory staff after safety precautions have been taken to post flagmen on all the sides as may be required to stop any train approaching the site of the fouled line.
	k. At each end of the main cable/tail cable/power cables an extra coil length of 6 to 8 meters should be kept.
	l. At the time of commissioning of the cables, the insulation values of the cable should again be checked and the value obtained shall not be below 5 MΩ per km. If there is wide disparity between insulation of different conductors, the conditions of the cable should be thoroughly checked before permitting its use. The readings shall be recorded in the register for all cables.
	m. The contractor and supervisor in-charge shall jointly record actual cable core plan and cable route plan showing the distance of cables from the nearest track center at every 20 M interval, diversion, track/road crossings and location of apparatus cases.
	n. Supply of draft Actual Cable Route Plan and cable core plan and DVD of actual cable route and depth by the contractor shall be a pre-requisite for releasing payment towards trenching. The Engineer may split the Total trench (yard/ work area) into suitable no of sub locations for release of quantities pertaining to that area.
	o. Refilling of the cable trenches with the earth and placing and concreting of cable markers at an interval of 20 M within station limit and 50 Mtrs in the block section, throughout the cable route and also on either side of track crossings along the cable route shall be done. RCC cable markers to be preferred. The cable marker shall be concreted to a depth of 0.60 M in case of

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	concrete marker. The grouting of concrete marker shall be for 30 Cm to avoid theft and shall be provided with cement coping as per RDSO Drg No: SDO/cable laying/020 & SWR Drg SG/SWR/067.
	p. The detailed procedure for undertaking digging work in the vicinity of signalling, electrical and telecommunication cable is issued as JPO vide RB It no 2003/Tele/RCIL/1Pt IX dtd 24.06.13. should be followed.
	<p>2.4 Cable Markers :</p> <p>a. Either concrete cable markers or Passive markers or RFID markers with locators shall be used as defined in schedules. If specifically RFID markers are not included, then concrete markers shall be provided.</p> <p>i. Concrete Markers for signal: RCC markers with body in Red colour engraved with letters SWR SIG in white colour.</p> <p>ii. Concrete Markers Telecom : RCC markers with body in Orange, Letters Engraved : White</p> <p>Note : For signalling Cable the Lettering shall be SWR SIG For Telecom the lettering shall be SWR OFC or SWR Quad or SWR OFC & Quad as the case may be. The letters shall be of about 75mmx 35 mm size.</p>
	
	<p>2.4.1. Passive Markers : Passive markers may also be provided in addition to concrete Markers.</p> <p>2.4.2. RFID Marker:</p> <p>The RFID marker software database designed for localization and identification of both analog and smart RFID makers. The RFID marker locator should be able to find a marker and define the place and depth of marker imposition. In addition, the RFID Marker Locator should have capability to save record number(RFID serial number) of maker being installed On Site during installation-with an inbuilt GPS module that should allow the RFID Marker Locator with GPS module to assign to each marker (selected point) GPS coordinates and therefore allow navigation back to the RFID marker that is buried.</p> <p>RFID Cable Markers:- Technical details.</p> <p>a. Type: Passive with RFID</p> <p>b. Out/Operating Frequency: Output frequency: 101.kHz (Telephone cables/ telecommunications)</p> <p>c. RFID: The marker should have unique fixes 10 digit ID in hexadecimal mode</p> <p>d. Construction: High impact polystyrene plastic casing sealed to IP65.</p> <p>e. Size: Minimum 220mm diameter x min 24 mm thicknesses.</p> <p>f. Weight: >=250grms.</p> <p>g. Power Source: self generated. No batteries required for signal transmission.</p> <p>h. Working: Unit should have capability to receive signal and transmit back.</p> <p>i. Depth Range : 1.5 meters.</p> <p>j. Working life : 50 yrs.</p>
	<p>2.4.3. RFID Marker Locator:</p> <p>a. Controls: Should be based on push button controls, separate, for each of the following function: Locate; Memory; GPS module; Navigate Controls should allow menu based navigation.</p>

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<ul style="list-style-type: none"> b. c. d. e. f. g. h. i. j. 	<p>RFID Marker Data Acquisition: RFID Marker locator should be in a position to acquire and save the marker ID for RFID markers even after installation in trench and at depth upto 1.5m. RFID Marker Locator should have capability to save optional text information about each marker during marker installation in the field. Minimum length of the text information is 20 characters.</p> <p>GPS & Navigation : RFID marker locator should have built in GPS module for logging GPS coordinates of marker during installation. Locator should provide audio guidance function to allow Operator to navigate to location of marker.</p> <p>Visual indications:- Large, easy to read liquid crystal display, 4x20 digit display with backlight.</p> <p>Memory:- RFID marker locator should have ability to store 8000 marker records.</p> <p>Frequency: Should be in a position to transmit and receive frequency of 101.4 kHz.</p> <p>Power Source: 10 x 1.5V "C" Batteries Battery life: Approx 45 hours intermittent use.</p> <p>Depth Measurement: Marker locator should be able to measure depth of buried marker.</p> <p>Accuracy of Depth: +/- 2cms.</p> <p>Output & Software: Marker locator should contain USB to allow data output to computer to marker database software allowing report generation in the form of database including RFID marker 10 digit unique ID, text description of marker for attribute definition e.g. connection point, corner, manhole, cable turning towards road and GPS coordinates for marker installed. Soft: should be provided with software providing capability to see data output both database format and google maps. The software should allow the facility to share data on the Internet cloud for different users to access marker database based on user name and pass word.</p>
	<p>2.5 Track/Road Crossings: Whenever signaling/power cable has to cross the track/road, it shall be done preferably with horizontal boring method.</p>
	<p>a. In case of horizontal boring is not feasible, manual track/road crossing shall be done as per RDSO DRG No: SDO/cable laying/009 using RCC pipe/DWC/HDPE pipes of appropriate sizes to avoid more pipes. In case of RCC pipes, each of 2M long with collars shall be provided. In case of DWC/HDPE pipe, suitable couplers shall be used to avoid gaps.</p>
	<p>b. The cable crosses the track/road at right angles.</p>
	<p>c. The cable normally does not cross in between or inside points and crossings.</p>
	<p>d. The track/road crossings to be carried out as per the drawings.</p>
	<p>e. The work includes removal of ballast, cutting of trench across track/road at the places indicated by the Railways and covering the trenches after placing RCC/DWC/HDPE pipes in position.</p>
	<p>f. Payment for RCC/DWC/HDPE pipes shall be made separately or supplied by Railways, in accordance to item operated as per SOR.</p>
	<p>2.6 On Bridges: On bridges, the cables are to be laid through GI pipe/trough of appropriate size and taken through GI pipe on either ends suitably buried on both sides of the bridges for a sufficient depth so as to meet the bottom of the cable trench, then fixing the pipe in concrete of size 0.5m x 0.5m in both abutments, length may be decided as per site condition so that bend should not exceed 30 degrees. Separate pipes/troughs shall be used for power/signaling cables. Suitable supporting clamps shall be manufactured as required by Railways at the rate of 1 clamp/meter depending upon the type of girder. Before fixing GI pipes, perforated holes of 5mm dia shall be drilled at an interval of 0.3 Mtrs. to avoid theft of GI pipes. All the above works shall be carried out in presence of Railway representative only. The work shall be executed as per RDSO DRG No: SDO/cable laying/013 for girder Bridges and On RCC bridges cable shall be laid through GI pipe with 300mm x 300mm size concrete blocks at an interval of 2 Mtrs with sufficient layer of concrete protection on either ends or through RCC channel trough made along with the bridge length.</p>

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3.0	POWER SUPPLIES:		
	3.1 Lead Acid Cells / Maintenance Free Batteries:		
	a. The charged batteries shall be provided in the battery room/ locations as per instructions.		
	b. Charged lead acid batteries of required capacities shall be installed in the battery room and placed over concreted steps provided with acid proof tiles on top. The cells shall be arranged neatly with sufficient working space for maintenance along with floats and vent plugs.		
	3.1.1. Charging of Battery:		
	a. Proper arrangements must be provided preferably at site or at SSE office.		
	b. For good performance of a battery, strictly manufacturer's instructions must be followed for preparation of electrolyte and the charging of batteries.		
	c. In the absence of manufacturer's instructions the following method shall be followed		
	d. All the cells, which are to be charged, must be of same capacity preferably of same make.		
	3.1.2. Preparation of Electrolyte:		
	a. Porcelain or Glass or Rubber or PVC or any other container with lead lining shall be taken. metallic containers should not be used.		
	b. Always use suitable goggles, rubber gloves and wear an apron, while working with electrolyte.		
	c. Always add acid to distilled water only, but not water to acid.		
	d. Mix acid and distilled water in the ratio as given below:		
	Sp.Gr. Of conc. H2SO4	Required Sp.Gr. of solution Dil. H2SO4	Ratio of acid : distilled water
	1825	1400	7:11
	1825	1190	1:5
	1400	1190	5:6
	e. With a Wooden rod (or) glass rod the solution must be stirred continuously, while adding the acid little by little.		
	f. Temperature of the solution must be monitored continuously during the preparation and it should not be allowed more than 45° C .		
	g. Allow the solution to cool at least for 10 to 12 hours		
	h. After cooling measure the specific gravity. It shall be 1190 to 1200 at 27° C. Specification of distilled water = IS 1069.		
	i. Since Sp.gravity is inversely proportional to temperature, temperature correction must be applied. Sp.gravity at 27°C = Sp.gr. At T°C + [(T-27) x 0.7] T = Room temp. (Electrolyte temp) Change in specific gravity = 0.7 /° C Specification of acid = IS 266.		
	j. Clean all the new cells with distilled water and fill them with electrolyte.		
	k. The level of the electrolyte should be 12mm to 15 mm (1/2") above the plates (electrodes).		
	l. The charger output terminal must be correctly connected to the Battery set. I.e. '+' to '+' and '-' to '-'.		
	3.1.3. Initial Charging:		
	a. Apply charge for 35 hours at the starting current rate of 4% of the AH capacity of the cells.		
	b. Starting I = capacity of cell x 0.04 amps for 35 hrs		
	c. Check specific gravity & voltage readings at every 8 hrs.		
	d. Stop charging when Sp.gravity becomes 1210 + 5 .		
	e. If the Sp.gravity of a cell after charging does not improve to 1210 + 5, then a small quantity of the electrolyte is taken out and is replaced with higher (1400) sp. gravity of electrolyte. After this, a fresh charging cycle must be given for 2 Hrs to ensure mixing of electrolyte.		
	f. Discharge the battery through suitable load (lamps) till the Sp.gravity reduces to 1180 to 1190 and voltage of cells to 1.8 V		
	g. Repeat the cycle of charge and discharge once again and then charge it finally for use.		
	3.1.4. Equalizing Charging:		
	a. After initial charging, batteries are not connected to load (not put in use) for 15 days then equalizing charge must be given.		
	b. If the batteries are continuously used in "FLOAT charging" then equalizing charge must be		

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	given once in 3 months (or) whenever required (after restoration of power supply failure)	
	c. Equalizing charging current must given at the rate of C/10 amp, till the voltage & Sp. Gravity of the all the cells have remains constant for 3 consecutive ½ hourly readings. (C=AH capacity of the cell) i.e. Equalizing charge (Boost mode) brings the sp. Gravity of the cells to 1210±5 and voltage to 2.2 V.	
	d. Apply a coat of petroleum jelly or non-oxidizing grease on the battery connections to avoid corrosion.	
	e. Close all the Vent caps and ensures that float indicators, indicates the electrolyte level, are in proper position.	
Float mode	2.15 V/Cell	f. Charger o/p voltage shall normally be adjusted to the
Boost mode Equalizing charging	2.4 V/Cell	
Initial charging mode	2.7 V/Cell.	
	following values in case of constant voltage type charging.	
	Note : Specific gravity mentioned in this notes is Hydrometer reading for easy reference. In fact, if the hydrometer reading is 1210 then the Sp.gravity of the electrolyte = 1210.	
	3.1.5. Battery Connections and arrangements: Cells are to be connected with suitable links sufficient to carry full load. Immediately, after connection, petroleum jelly shall be applied on battery terminals. The wiring shall be carried out by 10 sq.mm multi strand copper wire. The details of batteries and the capacity, circuit, date of installation etc., should be painted. The specific gravity and voltage reading shall be recorded for each cell in a separate register, along with the guarantee certificate of the supplier and handed over to Railway duly signed. A wooden stand for keeping hydrometer shall be fixed in each battery room.	
	3.2 DG Set: Supply of factory assembled and performance tested DG set Air cooled self start 10 KVA/15KVA single phase with required BHP diesel engine with facility to start and stop operation. Engine/alternator of Kirloskar make or equivalent mounted on a fabricated iron base channel vibration free with acoustic enclosure with 75dB(A) insertion loss along with battery for self start of TATA/AMRON/EXIDE make or better. All mounting type panel with push button assembly. The DG set shall comply with CPCB norms notified vide GSR 371(E) dtd 17/2/05 and its amendments (at serial No.94 paras 1&3) as amended by GSR 448(E) dtd. 12/7/04 and GSR 520(E) dtd.12/8/04. Facility to charge the DG battery in DG ideal condition through 230V external local supply to be made available in the DG set.	
	3.3 Solar Panel: Solar panel of RDSO approved make (as applicable)/ recommended source shall be supplied as per the Following Specification:	
	a. Solar modules - 12V 80W or higher capacity as per RDSO specification IRS S84/92 amend 3 or latest.	
	b. Solar charge controller - 110V, 40 Amp to RDSO/SPN/187/2004 or latest suitable for LMLA batteries wall mountable should be supplied with spares as mentioned in the IRS specification 187/2004 or latest.	
	c. N module mounting structures as per site requirement. Structures to be powder coated with facility to change the angle of inclination.	
	d. Array junction box	
	e. Copper cable,2cX10sq.mm,1cX25sq.mm	
	f. Super earthing kit	
	g. Installation kit	
	Note: All nuts and bolts to be galvanized. Should be supplied with required manuals.	
	3.4 IPS: General Requirements: a. IPS shall be procured and installed as per RDSO specification no. RDSO/SPN/165/2012 Version 3.0 or latest. The SMPS based Integrated Power Supply (IPS) system is meant to give continuous supply to both AC & DC signalling circuits for wayside and medium size signalling installations without AFTC (upto 15KVA signalling load) in RE & Non-RE areas. The SMPS based IPS system	

consists of the following:

- b. SMPS based Float cum Boost Charger (FRBC) Panel This panel consists of FRBC (float rectifier cum boost charger) module, Distribution/ Supervisory control / Alarm (DSA) unit and metering section.
- c. AC Distribution Panel- This cabinet consists of Inverters, Ferro-Resonant based Automatic Voltage Regulator (AVR), Transformers and metering section.
- d. DC Distribution Panel -This panel consists of all DC-DC converters and common Digital voltmeter for measurement.
- e. Status Monitoring Panel for ASM's Room -This panel consists of status indications and critical alarms of IPS to be provided in ASM room. The monitoring panel shall be of wall mounting type. OEM shall supply 12 core, 1.5 sq.mm signalling cable as per IRS:S 63/2007 for connecting IPS to Status Monitoring Panel in Station Master's room (distance to be given by Railways at the time of indenting).
- f. Battery Bank IPS system is suitable for charging 110V battery bank of Low Maintenance cells as per IRS:S 88/2004 or VRLA Maintenance free cells as per IRS:S 93/96(A). Battery bank is part of this specification and the same shall be supplied and commissioned along with IPS. Manufacturers shall give an undertaking regarding use of battery grade acid as per IS 266:1993 and demineralised / distilled water as per IS 1069:1993 for initial charging.
- g. Battery racks (MS) for VRLA batteries / wooden rack for low maintenance batteries, along with its accessories duly approved by purchaser, shall also be supplied with battery bank.
- h. The battery is to be installed in a separate room. Low maintenance batteries are to be charged at the site by OEM for which power supply shall be arranged by Railways. A test certificate of initial charging/capacity testing shall be submitted by OEM to Railways.
- i. OEM shall supply copper cable of suitable dia as per IS: 694 and grade 1100V for connecting IPS to Battery bank (distance to be given by Railways at the time of indenting) as given below
 - a) For 120AH battery – 10Sq.mm
 - b) For 200AH battery – 16 Sq.mm
 - c) For 300AH battery – 25 sq.mm.
- j. A tool kit containing tools as detailed in Annexure-I required for maintenance of IPS shall be supplied along with IPS and shall be placed inside the IPS rack in a suitable bag.
- k. An exhaust fan of 12" size (minimum) shall be supplied for the IPS room by the OEM. The exhaust fan shall run with commercial AC supply. Railways shall ensure installation & commissioning of the exhaust fan.

3.4.1 Technical Requirements of IPS :

- a. The IPS shall be suitable for operation for a nominal input voltage of 230V AC, 50Hz single phase power supply derived from Electricity Board or Railway Traction supply or 7.5/10/15 KVA diesel generator set with AMF control of appropriate quality. The system shall work satisfactorily with input voltage variation from 150 to 275V AC and frequency variation from 48Hz to 52 Hz.
- b. It shall be ensured by Railway that the capacity of AC input feeder installed at the station is adequate as per the signalling load catered by IPS. All the switchgear and cables shall be adequately rated and shall be of approved makes.
- c. The DG Set used for feeding IPS shall be capable of taking 10% overload for period of one hour during any 12-hour period. It should be ensured that waveform of DG set is near sine wave.
- d. The accidental short circuit at input feeder shall not cause any interruption to the IPS sub system. The accidental over voltage shall not cause any damage to IPS system.
- e. There shall be an automatic arrangement for disconnecting the mains within 500 ms to the rack whenever the input voltage is beyond the specified operating limits with suitable alarm indication. The IPS shall resume normal working automatically when the input is restored within the working limits. A self storing type static switch should be provided at the input.

3.4.2 Construction of IPS :

- a. The individual cabinets shall be within the overall dimensions of 2000- mm max. Height, 750 mm. max. Depth and 750 mm max. Width. In case all DC-DC Converter modules cannot be accommodated in one DC distribution panel, then a second DC distribution panel shall be provided instead of making oversized panel. The height and depth of all cabinets shall be of equal size. Each cabinet will have min 10-mm thick anti vibrating pad and 75 mm x 5mm bottom channel as per sketch no. SDO/IPS/Layout/007 at Annexure V.
- b. The spares (other than modules used for redundancy) may be placed at bottom of any rack as per the availability of space.
- c. The rack structure and the module frame shall be made up of rigid framework of steel profiles.


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	<p>The front door, if used, shall be of hinged type. The rear panel shall be provided with proper ventilation arrangement. DC fan shall be provided at rack level for forced cooling. The operation of such fan shall be continuous.</p> <ul style="list-style-type: none"> d. The racks and module cabinets shall be of robust construction. They shall be housed in self-supporting cubicles made of cold rolled closed annealed mild steel sheet of thickness not less than 1.6mm. The rack shall be adequately ventilated. The ventilating opening shall be less than 3mm size for protection against entry of lizard's etc. The rack shall conform to IP31 type of Protection as specified in table 1 of specification no. IS 2147-1962. e. The racks and the modules shall be treated with zinc chromate primer followed by electrostatic epoxy powder coating paint finished, passivation shall be done through seven stage process/sand blasting. Small metal parts such as nuts, bolts and washers shall be chrome plated. All other metal parts of the rack shall be plated for protection against corrosion. f. The racks and the module cabinets shall be free from sharp edges & sharp corners. g. Provision of doors are optional, the cabinet sides shall have 3mm louvers covered with wire mesh. However, if the doors are not provided, the sub system shall have proper enclosures so that any reptile/ insect shall not enter in the IPS cabinet. The magnetic latches/handle shall be provided on the doors. h. The racks and the modules shall be designed for easy maintenance and installation. i. Facility shall be provided at the top of the rack to connect external AC power and lightning arrestors (if provided inside the rack). Where cables pass through metal panels, suitable rubber grommets shall be provided to protect cable from damage. j. The modules shall be of modular type. The module shall be easily mounted or removed from the front side of the rack. The module shall be designed to slide into the rack on a suitable mechanical arrangement. Suitable arrangement shall be made for pulling out each module separately. The associated AC input, DC output connection, control/alarm & interface cable connecting the module shall be disconnected/installed easily without causing any interruption/damage to supply & working module. <p>3.4.3 Installation & Commissioning of IPS :</p> <p>Installation shall be done by OEM if specified by the purchaser. However, commissioning of IPS shall be done by the OEM only. OEM shall issue a certificate of fitness of installation before commissioning. For this, Zonal Railways and OEM shall ensure the compliance to Pre-commissioning checklist issued by RDSO.</p>
	<p>3.5 Power Supply Requirements For EI:</p> <ul style="list-style-type: none"> a. 230V AC 50Hz mains, 110V AC 50Hz & 110V DC supplies from IPS shall be provided by Railways for EI functioning to the vendor/manufactures and rest all subsequent power supply requirements for EI, MT, VDU, OC etc. Including backup of at least four hours (to prevent shutting down of system due to fluctuations in main supply) for EI system shall be arranged by the vendor. The system shall work satisfactorily with input voltage variation from 150 V to 275 V AC and frequency variation from 48 Hz to 52 Hz. This shall also include provision of power supply change over panel for selection of power supply from available multiple sources. The details of power supply shall be specified by the purchaser. b. Two different voltages shall be used, one to drive EI equipment and the other for receiving the inputs from the field gears. c. All the DC-DC converters used to provide the different supply to the EI Shall be provided for main and standby EI system separately. d. DC-DC converters shall be capable for working in non-air conditional environment and ambient temperature range between -10⁰ C to 70⁰ C and relative humidity up to 95% at 40⁰ C. e. The short circuit & over voltage protection of self restoring type shall be provided. f. The required protection shall be provided to protect from any malfunctioning due to spurious feed. g. Suitable surge protection and proper earthing arrangement shall be provided in the power supply system to protect against transient voltages, lightning & spikes etc as per IEC normative. h. Tenderer shall provide a document capturing the installation/maintenance methods/work instruction prior to installation. i. A detailed power supply arrangement diagram/circuit shall be provided. Power supply arrangement for individual processor should be such that, in case of fault in

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	<p>power supply of one processor, all processors should not cease to function simultaneously. It should be possible to switch off and take out faulty processor for repairing/replacement without affecting working of the balance system.</p> <p>Other power supply requirement as per Technical Advisory Note vide It no: No: STS/E/TAN/DS-III/Vol-I Dated 22.08.2016 shall be complied.</p>
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4.0	RELAY INTERLOCKING:
	4.1 Nomination of relays: Relays shall be nominated as per the approved circuit diagram and contact analysis. All the works / circuit diagrams shall comply to RE standards.
	4.2 Type of Relays: Generally the following type of relays are used in relay room as per site requirement : <ul style="list-style-type: none"> a. QN1 /QNA1 - 8F/8B, b. Universal LED ECR's 4F/4B, c. QBCA1- 2F/4B, d. QNA1K(1000Ω)- 6F/6B, e. QSPA1- 8F/4B, f. QTA2- 2F/2B, g. QS3 (1000 Ω) 12v-4F/4B h. QL1- 11F/4B, i. QBAT- 2F/2B. j. Timer relay 60/120sec. <p>Code pin configuration/holes on the relay bases should not be tampered.</p>
	4.3 Cable Termination Rack:
	a. Cable termination racks shall be erected in the relay room at the required location as shown by the Railway with suitable foundation bolts and cement concreted. The cable termination racks shall be painted soon after installation before cable termination work is taken up. Suitable cable ducts wherever required shall be provided to bring all outside cables to the termination rack. All the cables are to be neatly skinned, fixed on the cable bracket and terminated in order. The cable armours and the rack should be earthed. Internal wiring and termination particulars are to be written with paint.
	b. Relay/Cable Termination rack shall be powder coated.
	c. 6 way terminal blocks/polyamide DIN-rail mounted terminals as the case may be are to be fixed on Hylum sheet of 10mm size and held rigidly by mechanical screws at CTR. The number of 6 way terminals is to be painted serially on the C.T. Rack and details of termination are painted on hylum sheet and fixed in the relay room. 6-way blocks/ polyamide DIN-rail mounted terminals are covered as a supply item or supplied by Railway.
	d. As made terminal particulars shall be prepared in linen/polyester tracing signed and handed over to the Railways. Printed ferrules shall be provided for easy identification of incoming/outgoing wires.
	4.4 Relay Racks:
	a. The provisions of 21.15/ 21.16 of SEM Part-II shall be broadly followed in relay erection and wiring. The quality of relay racks as similar to racks supplied by reputed EI firms M/s Medha, M/s Ansaldo-Signal, M/s TSTS and M/s Siemens to be provided. (check concerned item in tender schedule)
	

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	b. Relay rack frame 1 way, fabricated out of 2 Nos. Vertical supporting U angles of 70mm x 60mm of 2103mm x 1220mm.
	c. The frame is held rigidly by the base assembly and electrically isolated by insulator. Angle plates of 65mm x 130mm x 6mm size are welded to the vertical frame angle at the top to facilitate fixing of 'I' bracket and is electrically isolated by insulator. Ladder is fixed to the ladder supporting angle by 12mm x 20mm bolts and nuts with washers and spring washer. The base assembly is anchored to the ground by means of 'J' type foundation bolts 12mm x 100mm with washer and spring washer. For further details for fabrication, the drawing may be referred to. The exact requirements of wall angles and cable ladder are to be arrived at taking the disposition of the relay racks in the relay room. The cable ladder brackets are to be provided with plastic sleeves to avoid damage to the wires and multi core cables run on the ladder. Alternative ladder arrangement for carrying the wires as per the instructions or approval of inspector in charge of the work can be fixed.
	d. Relay racks erected in the relay room shall accommodate 'Q' style relays in different racks is indicated in the sketch showing the disposition of rack (9 rows of 6 relays grouped in pairs such that the one relay gap between such pairs for enabling examination by technician). While working out the relay requirements it must be ensured that at least one front and one back contact is left as spare.
	e. The disposition of relays in the relay rack shall have to be carried out as per the directions of the site inspector. A typical circuit diagram with contacts numbered will be given for guidance and the contact numbering is to be planned accordingly taking into the account of the contact configuration of the relays supplied by the Railways. For example contact no: relay no & rack no. A2(45.03)A1
	f. Important points to be kept in mind while numbering the circuit diagram. <ul style="list-style-type: none"> i. Maintaining uniformity. ii. Maintain same contact for stick path in stick circuit. (A1/A2 in case of QN1 relays). iii. The principle of similar relays at one location shall be normally adhered to. iv. As far as possible, allot same contact for vital circuits. For example: <ul style="list-style-type: none"> • RR front contact used in UCR, HR circuit shall be same. • UCR front contact used in HR circuit shall be same. • HR front contact shall be same for lighting circuits. • ASR/ASPR back contact proved in HR circuit shall be same. • UCR, RR back contact used in ASR circuit shall be same. • The cross protection contact used in UCR, HR circuit shall be same i.e., RR back contact in UCR circuit, UCR back contact in the HR circuit.
	g. For inter rack cables/wiring ladder to be used instead of duct in relay room.
	4.5 Wiring in General: Standard colors codes i.e. Red for +ve, Black for –ve , (for all the circuits) and green for Earthing shall be used. The following types of wires shall be used. <ul style="list-style-type: none"> • 16/0.2 for internal relay wiring. • 3/20 for Track battery chargers , batteries, signal unit & point machine wiring. • 1 or 0.9 sq mm for data logger wiring • 0.64 sq mm from Telecom CTB to B/I for line circuit. • 7/20 ,16 sq mm multi strand copper cables for power supply wiring • 10 strand, 16 strand, & 35 sq mm multi strand copper cable for earthing. Eyelets must be used whenever multi strand wires are used.

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	<p>a. The provisions of 21.15/ 21.16 of SEM Part-II shall be broadly followed in relay erection and wiring. Each wire shall be given a distinctive ferrules for easy identification as shown in picture.</p>
	<p>b. The equipments are to be wired in relay room, SMs office, power room, Location box, CT box, battery box and in other locations as per the approved circuit diagrams.</p>
	<p>c. Contact numbering for the relays shall be made as per the approved circuit diagram issued by the Railway and type of relay proposed to be used on the installation.</p>
	<p>d. Relays pertaining to a signal route may be wired on one rack as far as possible, to reduce the MTTR during failures.</p>
	<p>e. Relay rack wiring housing plug in type relays conforming to BRS-930 and BRS-931 shall be done with "PVC insulated unsheathed flame retarding type single core flexible wire 1100 V grade having 16/0.2mm annealed copper conductor. Wiring of these relays shall be terminated on eyelets/lugs of standard design.</p>
	<p>f. For all external circuits PPTC fuses shall be provided.</p>
	<p>g. The sequence of wiring and testing :</p> <ol style="list-style-type: none"> i. Erection of relay racks ii. Fixing of relay bases as per disposition chart prepared and ensured for proper tightness. iii. Fixing of fuses and terminals and ensure proper tightness. iv. Drawing of wires from contact to contact. v. Wire to wire testing including wire count w.r.t. wiring diagram by supervisor (JE/ SSE) vi. Soldering after due corrections and testing. vii. Wire to wire testing including wire count w.r.t. wiring diagram by supervisor (JE/SSE) of soldered wires. viii. Testing of wire to wire by officer (ADSTE/ DSTE) ix. Plug in Relays in their base duly matching them. Code pins must not be tampered. x. Ensuring the proper locking of all the relay clips. xi. Visual inspection, testing of individual relays for its contacts resistance with proper operation. xii. Plugging of relays after confirming as per nomination. xiii. Connection of simulation panel, operating panel and block instruments. xiv. Simulation testing and square sheets check by in-charge supervisor as per approved TOC. xv. Simulation testing and square sheets check by in-charge Officer (ADSTE/DSTE) as per approved TOC. xvi. Functional testing including correspondence with field gears by in-charge supervisor and officer. (Done during Non interlocking for working stations).
	<p>4.6 Checking of wiring :</p>

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	a. After testing, the loose wires on the cable ladder shall be neatly bunched and laced with twine black. A suitable colour code for wiring shall be adopted as required by Railways.
	b. Various supplies associated with signaling viz., 110V AC, 110V DC, 24V DC and 12/24V DC are to be brought out from the IPS distribution panel. Necessary measuring instruments are to be mounted on the Hylum sheet on the distribution panel.
	c. The incoming cables to the relay room are to be neatly arranged and fixed to the cable supporting and guiding rack and all holes to be plugged to avoid rodents entry.
	d. After the complete testing by the Railways supervisor and officer and before commissioning the installation proper sealing arrangements to be done for relevant gears.
	e. The nomenclature of each relay shall be painted both in front and rear side of each relay with contact configuration. The CT rack, fuse chart and relay index plan duly printed(in black) with relevant details on white flex sheet affixed over plywood sheet of 6mm thickness of standard size in the relay room. All the relays to be plugged shall be checked visually and defect if any, noticed shall be replaced duly reporting the same to the Railways. As made relay rack wiring and contact chart of all relays shall be prepared in linen/polyester sheets, duly signed and handed over to Railways for preparation of handing over documents to maintenance organization.
	f. Suitable fixing arrangements shall be made in the relay rack for fixing condenser and resistance unit wherever required. Letter painting shall be made against each unit to identify circuit to which it is used.
	g. All circuits shall be carefully protected by individual fuses in the relay room and locations grouped preferably to facilitate easy fault location. Fuses shall be so arranged that they can easily be placed without causing interference to other circuits. Fuses for all signalling circuits shall be of the non-deteriorating type as per RDSO specification. For all circuits in relay room, indicative type of fuses shall be provided, which are normally blank and when fuse is blown off concerned RED LED of 5mm indication shall lit at respective racks. Push button switch for confirming the healthiness of all LEDs shall be provided in respective racks.
	h. Fixing of EKT/HKT with micro switches 2 NO/2NC at gate lodge, S.M's office on Teakwood board, providing telephone at site/gate lodge/SM's office, carrying out wiring of EKT/HKT, telephone using 16/0.2mm wire and testing as per approved circuit diagram and commissioning the same wiring has to be neatly clipped wherever necessary.
	<p>4.7 Testing :</p> <p>Signalling: The contractor shall make such tests as may be necessary to demonstrate to the satisfaction of the Railway that the apparatus and the system as installed are in accordance with the specification and contract. The contractor shall provide such instruments and apparatus as may be necessary for conducting the following tests:</p> <p>a Test to determine that all circuits confirm to approved circuit, plan by individually, electrically checking each contact selection.</p> <p>b Test of all electrically operated devices to determine that electrically operating characteristics are in accordance with specification designated by the Railway.</p> <p>c The insulation resistance shall not be less than values specified in the signal engineering manual.</p> <p>d The responsibility of fault localization in the defective or inoperative installation during the execution and testing and restoration thereof shall be that of the contractor.</p> <p>e The contractor shall co-operate in conducting tests and trials and wherever the special conditions of the contract, contained herein shall prevail.</p> <p>f IPS cabinets, invertors, transformers, spare modules/cards and accessories are to be protected.</p> <p>Pre-commissioning joint check list of IPS, EI, HASSDAC/BPAC, UFSBI/SSBPAC, MSDAC,DATALOGGER, ELD and DG shall be adhered as per RDSO standard formats.</p>

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g. The various field gears shall be tested and ensured for its satisfactory working before declaring work ready and the readings shall be recorded and submitted to controlling office before applying for NI:

Name of station:

1. Points:

Point No	Point sleeper assembly done or not	Fittings			Opening in mm		Housing		Packing
		Leading stretcher Bar	Following stretcher bar	Gauge Tie plate	LH	RH	LH	RH	

2. Signals:

Sl. No	Signal No	Aspects				Testing from Apparatus case		Testing from Relay room		ECR operation
		DG	HG	HHG	RG	Voltage (V)	Current (mA)	Voltage (V)	Current (mA)	

3. Block Instruments:

Type of Block Instrument	Make	Year of manufacture	Supply of Block Counter	Fixing of Block counter	Instrument Installation of Block	Fixing of Filter unit	Transformer Fixing of derivation	Instrument to filter unit	Instrument Energisation of Block	Testing of instrument	Connecting of earth to the	Painting of particulars	Remarks

4. Track Circuits:

Track circuit No	Track circuit length	Charger		Battery cell		Feed end	Relay end	Relay
		Voltage (V)	Current (A)	Voltage (V)	Specific gravity (1180-1220)	Voltage (V)	Voltage (V)	Current (mA)

4.8 Testing and commissioning of relay interlocking:

4.8.1. Indoor testing

- Testing of Electrical Signaling Circuits shall be broadly as per Para 13.30 to 13.41 of SEM Part-II.
- Testing of relay interlocking consists of energisation of relays by connecting the simulation panel. Clearing of signals on the simulation panel and carrying out the following tests (As per table of control):
- Field correspondence test. (This is done during Non-Interlocking for existing station).
- Negative tests.
- Dead/Approach locking tests.
- Route/Back locking tests.
- Testing of conflicting signals.
- All other circuits viz., SM's key, CHLR, LXPR, KLCPR are provided correctly in the

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	respective signaling circuits.
	<p>4.8.2. Testing of outdoor gears:</p> <p>Testing of outdoor gears consist of:</p> <ul style="list-style-type: none"> a. Signals b. Motor operated points c. Track circuits / track detection d. LC gates (interlocking) e. Sidings f. Slots. g. BPAC etc,
	<p>4.8.3. Testing and commissioning of outdoor equipments:</p> <ul style="list-style-type: none"> a. Cable meggering and pairing up of conductors shall be done. b. All the power cables shall be made through and power supply shall be extended to all locations. c. After the power cables are energized, check up each limb of the power cable whether any earth fault exists using multimeter. This will indicate whether any cable conductor is faulty (i.e., earthed). d. Testing of signals: <ul style="list-style-type: none"> i. Signals shall be initially tested from the Location box to attend to minor troubles wiring and connections etc., ii. All the aspects shall be checked by giving 110V AC feed from Location box to signals and repeat the same by giving the feed from relay room CT rack. This test shall be done for each aspect, route and pilot lamp of shunt signals. iii. Care shall be taken that no testing is done when train is approaching to avoid misleading information to drivers. iv. Ensure that signal number plate is provided and unit back door is fastened and locked properly. v. Focus the signal, record the voltages & current for all aspects and ensure that readings are within the permissible limits.
	<p>4.8.4. Check up the interlocking of LC gates, siding points:</p> <ul style="list-style-type: none"> a. Check up for the proper functioning of electrical transmission of key transmitters and ensure the completion of scheduled maintenance as per SEM part-II Annexure 30. (para 19.148) b. Check up and ensure all the panel indications are lit properly as per approved panel diagram. c. Test magneto telephone communication between SM and LC gate/siding/top points. d. Ensure that respective signals cannot be taken OFF if LC/siding controls are not available with SM (i.e. on panel). e. Ensure that when the signals are taken off, respective LC gate/siding keys are locked and cannot be extracted from the EKT.

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5.0

Sl. No	Type of station	Avg no of routes	Type of interlocking to be provided
1. C class station 2. Mid section interlocked LC gates 3. IBS/IBH 4. Station on double line section without loop and with one emergency X-over and/or siding 5. Station on single line section with one loop 6. Automatic block signalling with/without Mid-section interlocked LC gate		Upto 10	Electronic interlocking
2	Way side station & small junction station	10-50 routes	Electronic interlocking linked to signal control centre if required
3	Big station and Major junction station	50-500 routes	Electronic interlocking with Distributed architecture and/or object controller
4	Very large station/Junction station	More than 500 routes	Route relay interlocking with metal to metal type relays OR Electronic interlocking with Distributed architecture and object controller

ELECTRONIC INTERLOCKING: Ref: RB Lr.No.2003/Sig/G/5 dtd 28.4.16

5.1 Installation and testing:-

- i. All stations EI with Hot standby shall be provided with Dual VDUs of 55 inches size each. Array of monitors may be provided for major yards (PCSTE/SWR letter **No.SG/SWR/Policy/EI/Vol I dtd 07.01.19**).
- ii. Class 'A' Protection shall be provided at all stations and its earthing shall be separate from the ring earth of the equipment (PCSTE/SWR letter No. SG/SWR/Action plan dtd. 18.10.17).
 - a. The whole interlocking of a yard shall be controlled either by Central operation or Distributed operation as per approved plans. stage wise/phase wise commissioning to be catered as per need.
 - b. The system shall have facility of monitoring of internal variables as well as status of I/O through the maintenance terminal and data logger network of the Railway.
 - c. External data logger shall be connected in such a way both for logging of analog/digital inputs of external functions and for EI modules inherent diagnostics. It shall be possible to connect EI with central monitoring unit kept at HQ control unit.
 - d. MT shall be used to diagnose problems/events related to hardware and software of EI. MT shall have facility for automatic serial data transfer to a central monitoring unit. The common protocol for this communication shall be as per data logger specification no. IRS: S-99 latest version for interface only. MT shall be installed in Maintainers room.
 - e. The system shall be capable for working in non air-conditioned environment and ambient temperature range between -10° c to 70 ° c and relative humidity upto 95% at 40° c.
 - f. EI shall have user-friendly graphic based design tool to generate station specific application software to carry out future yard modifications. It shall be possible for Railway to carryout minor yard modifications without the help of firm and the training to this extent shall be imparted to Railway maintenance staff as per agreement with the Railways. The same may be incorporated by Railway in the agreement with the firm.

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- g. For all vital inputs/outputs going out of EI room's double cutting arrangement shall be provided.
- h. The RTC of EI system(s) should be updated/synchronized with the external data logger and it shall be possible to log the events in chronological order in case of use of either single/multiple EI with data logger through CMU (Central Monitoring Unit) if provided in network otherwise through protocol converter.
- i. In case any peripheral equipment (such as VDU, MT, Data Logger etc.) needs to be connected to the EI through serial ports and then EI system shall be isolated from the peripheral systems. Suitable isolators shall be used for connecting the peripheral devices.
- j. Earthing and lightening protection shall be done as per latest version of **RDSO/SPN/197/16** and **RDSO EI TAN No.STS/E/TAN/3006 dt 02.11.2012.**
- k. The terminals, through which common positive or negative supply is provided to EI, must be duplicated. This shall also require duplicated power supply cables from power supply source to EI in redundant paths.
- l. The system shall have log of all the counters like emergency route cancellation, calling on signal, overlap release operation etc and that will be logged in Maintenance Terminal. It shall be possible to read all counters as and when required. If Railway required, it shall also be possible to provide a counter box having non-resettable counters.
- m. The next level signal control circuits like cascading of signal aspects, red lamp protection etc., shall be achievable through software only.
- n. The audio-visual alarm shall be available for signal blanking, TFBC failure, EI communication link failure and button stuck up command held for more than a specified duration etc in EI as specified by the user Railway.
- o. The central interlocking unit shall have back up information on log of all counters provided on VDU like emergency route cancellation, calling on signal, overlap release operations etc.
- p. Cycle time and response time to read and process the input shall be fast enough to ensure safety and avoid any apparent delay. Cycle time and response time of the system shall be clearly indicated. The longest route for which all points are in favour shall not take more than 5 seconds from initiation of Command to display of lowered signal aspect on control panel.
- q. The medium of communication between CIU and OCs shall be OFC provided on a ring basis. In case of communication failure between CIU & OC, all the outputs shall be brought to safe state whenever two consecutive telegrams are not received in stipulated time period.
- r. All the inputs and outputs of OCs shall be isolated.
- s. OC shall carry out the supervisory function to check the proper level of system voltages at critical points to ensure proper working of the system and shall also check the health of the complete system. OCs when placed at multiple locations shall be connected through diversified/duplicated OFC ring and the protocol shall comply to EN-50159-1 for closed loop transmission, additionally vital radio link as per the Indian telecom standards to connect between object controllers and CIU may also be used which should comply with EN-50159-2 for open loop transmissions. LED/LCD display shall be provided on all the modules of EIs to indicate status/ errors of the module.
- t. The EI system including its equipment and subsystems shall be under warranty for minimum **One year** from the date of commissioning system of working in the specified section.
- u. i. Additional software work due to change in scope of signal Interlocking plan shall be carried out by the contractor without any extra cost up to 10% increase in routes and 15% increase Input/output functions. The tenderer shall submit the clause by clause compliance to the RDSO specification RDSO/SPN/192/2005 with latest amendment including any deviation if any, to the specification along with tender document. Tenderer shall submit clause by clause compliance to Technical Advisory Notes/improvements suggested by RDSO from time to time.
ii. EI system shall comply with instructions issued by RDSO from time to time in terms of Technical Advisory Notes and improvements.

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- iii. The EI equipment shall be installed, tested and commissioned by OEM only. The EI shall comply with all items specified in the pre commissioning check list for EI's issued by RDSO from time to time and items specified in technical system approval by Railway for routes upto 100 and by RDSO for routes more than 100. OEM shall certify the installation as specified by RDSO.
- iv. It shall be possible to connect EI's in a network fashion with central monitoring unit kept at divisional/zonal HQ control unit.
- v. Supply, installation, wiring, testing and commissioning of dual operator VDU with 55" LED monitor. This shall be fanless embedded industrial grade personal computer as per approval /spec and their connectivity to EI shall be either on ethernet or through an optical fiber cable. Optical fiber cable is preferred medium. It shall display yard and Automatic signals on either side in one screen. Yard to be displayed in bigger size at the top and Automatic signals in smaller size at the bottom of the monitor. Display of yard and Automatic signals shall be shown as per instructions of the site in-charge.
- vi. Supply, installation, wiring, testing and commissioning of VDU of 55" LED to display Automatic section in one screen. This shall be industrial grade as per approved spec and their connectivity to EI and Maintainer Terminal shall be either on Ethernet or through an optical fiber cable. Optical fiber cable is preferred medium.
- vii. Supply, installation, wiring, testing and commissioning of Maintainer VDU with 42" monitor. This shall be industrial Grade fanless embedded personal computers as per approval spec.
- viii. VDU shall be provided with hard SM key along soft controlled touch to prevent unauthorized operation in addition to password protection.
- ix. Non resettable counters with necessary wiring and fixing arrangements as per instructions of engineer shall be provided in the Dy.SS room.
- x. Blocking of functions individually (points, signals, track circuits etc) shall be possible through VDU.
- xi. Input/output functions of Object controller shall be selected in such a way that failure of one object controller shall not paralyze the entire yard.
- xii. 110V DC power supply from IPS will be provided by Railways. Supply will be made available in the equipment room. Further for extension to EI, required DC-DC converters in redundant mode with SPDs shall be provided by the contractor. The maximum load current required shall be catered by the contractor. The DC-DC converters used for EI shall be provided in N+1 configuration with a safety factor of 1.5. Segregation between the DC-DC converters for system A & B shall be made so that if any DC-DC converter fails whole system should not get affected. The DC-DC converters shall be of approved make as recommended in RDSO Specification/Technical Advisory Notes. The power cable and the terminals bringing from IPS/battery charger shall be duplicated with minimum 16 sq.mm copper cable so as to provide redundancy. Availability of pure DC supply (harmonics and ripples free) for working of different modules/cards shall be the responsibility of the contractor.
- xiii. Input and output interface relays (QECR, QN1, QNN1, QNA1, QNA1K, QTA2 & QBCA1 working on 24 V except track relays) are known to the Railways. Any other special relays required for systems shall be supplied and installed by the Contractor only.
- xiv. The System shall be supplied with properly interfaced Data logger with protocol converter and adequate capacity of digital and analog inputs, which meets the latest specification of Data logger specification no.IRS.S.99/2006 or latest. The data logger PC shall be provided separately and it shall not be combined with maintenance VDU as per approved Spec.
- xv. Maintenance free ring earthing arrangements along with the protection against Electromagnetic and Electrostatic interference for the equipment and to the S&T Rooms respectively shall be provided by the tenderer. The requirements laid down in clause 6.3 of RDSO/SPN/192/2005 with latest amendment shall be complied. The earthing shall be as per Railway board letter no.2010/SIG/SGF/EI (Ansaldo) dated 22.6.2011. As per RDSO letter no.STS/L/SSI dated 28.3.2012 (Para-24), all the EI vendors were advised to use the same drawing. If the earth resistance prescribed by the RDSO is not achieved, additional earth pits shall be provided. No additional payment will be made by Railways.
- xvi. All the accessories like communication equipment, relay racks, wiring materials, wire coils Aluminum Ladder, fuses (indicative), indoor signaling cables, Tag blocks etc., required for EI shall be provided by the Contractor. Outdoor signaling cables required will be provided by the Railways.

5.2 Operator and Maintenance VDU Display Requirements:

- a. The software of VDU shall be supplied by OEM or authorized by OEM.
- b. Shall have Ethernet/OFC communication with the CIU either on OFC, with suitable isolators.
- c. Shall have required level of security features & access control for the operator/maintainer.
- d. Shall have key board/mouse operation.
- e. It shall synchronize the counters/clocks all the time and particularly when resuming from a failure.
- f. Shall support buzzers/alarms as in CCIP.
- g. It is desired that it shall be possible to analyse the operation and run the play back of the yard for the events of last 30 days.
- h. Embedded industrial grade fanless PC with latest PC configuration shall be provided and suitable compact flash

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disc memory space shall be catered for the backup requirements.

- i. Shall have required no. of serial ports and Ethernet ports. The serial ports shall have inbuilt isolation, else external isolation shall be provided.
- j. A flashing indication shall be provided on the VDU to indicate healthy condition of the main system, communication channel. Three dot markers in red, blue & green colours respectively shall also be displayed prominently at conspicuous location on the VDU terminal to indicate that the colour monitor is healthy and all the three colours (red, blue & green) are present in right proportion
- k. It shall be possible to display the status of the yard by distinguishing with two differ colours (i.e., system active and system inactive).
- l. It shall be possible to display the complete yard layout including the section on the monitor. It shall also have facility for displaying a portion of the yard or section in an enlarged mode or with scrolling arrangement, if required
- m. The current position/ status of various field equipments and track circuits shall be displayed on the VDU using different colors/ symbols, as desired by the purchaser.
- n. Availability of communication channel shall be indicated by a constantly flashing indication. Whenever the communication channel goes faulty, a suitable error message shall be displayed on the terminal.
- o. Blocking of functions (points, signals, track circuits etc) shall be possible through VDU. The blocking operations shall be achieved in fail-safe manner.
- p. If VDU and CIU are in separate building, then they shall be interfaced using FOM (fiber optic modem) to protect against lightning and surges.
- q. Operation of signaling gears shall not be possible simultaneously through both VDUs. In case of VDUs used in hot standby, VDU switch over is required as per Railway requirements.

5.3 Maintenance and Diagnostic aids:

MT consisting of an Industrial grade embedded fan less PC with printer from a reputed manufacturer shall be provided for following operations: -

- a. Display of the current status of points, signals, controls etc. of the yard.
- b. Storage of minimum one month data or 10, 00,000 events.
- c. Display of recorded events and
- d. Data transfer to floppy, CD, flash memory or any other storage media.
- e. Transfer of recorded events to external data logger.
- f. Generation of exceptional reports shall be possible on MT for analysis purpose and past events simulation on yard layouts etc.
- g. The soft copy of signalling circuits/manuals provided at the station shall also be loaded on MT for ready reckoner of ESM in simple/local language.
- h. MT shall be preferably connected to EI through OFC. If copper cable is used for connectivity the MT port shall be isolated from the port of EI. At both ends RS232 isolator/industrial grade opto-isolator shall be used.
- i. Result of the failure of any card/module in the system should be clearly indicated. The supplier should also indicate process of replacing such defective cards / modules.
- j. MT shall be user friendly and the displays on MT shall be self guiding type for identifications of faults as well as for maintenance of system.
- k. In case of any module/ card becoming faulty, this fact should be displayed on MT with diagnostic facility to identify faulty module/ card.
- l. Miniature pre wired NI panel shall be kept in the maintainer room at all the EI installations. NI wiring shall be made and kept ready In the relay room for immediate change over.

5.4 Miscellaneous (EI):

- a. OEM's checklist to be signed by OEM's Engineer and Railway Engineer jointly.
- b. Compliance to RDSO/PCSTE's remarks for giving Technical System Approval to be adhered.
- c. Signal and interlocking fittings: All signal and interlocking fittings should be in accordance with I.R.S. Specification no. IRS S-10 unless otherwise specified.
- d. All relay interlocking principles contained in IRS S-36 shall be applicable for all relay interlocking works.
- e. All Electronic interlocking systems shall comply to RDSO/SPN/192/2005 version.1 and/or No. RDSO/SPN/203/2011 as applicable for all EI works.


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6.0	OTHER INDOOR EQUIPMENTS:
	<p>6.1 Data Logger:</p>
	<p>6.1.1.General Requirements:</p> <ol style="list-style-type: none"> The system shall chronologically monitor and record the status of various field functions like track circuits, points, signals, operator's push buttons/switches (digital Inputs) and level of various analog signals like DC and AC supply voltages, Axle counter signals etc. The equipment shall also have the capability of statistical analysis, predict the faults and generate failure reports. It shall be possible for the user to define fault logics taking digital/analog inputs into consideration and generate reports for such faults. The equipment shall be capable of generating audio-visual alarm under defined conditions. In addition, it shall be able to deliver non-vital relay outputs on receipt of command from CMU. At least 8 non-vital relay outputs shall be provided. The non vital relay output shall be in the form of potential free contacts capable of driving 24V 'Q' series relays. These outputs may be used for non-vital functions like radio patching of control circuits etc. For digital inputs, potential free contacts shall be used. Analog signals shall be scaled to a suitable limit using signal conditioner before converting to digital signal. While tapping analog input, it shall not load the analog channel/ field gear by more than 1% of rated load The system shall be suitable for working on non electrified, AC electrified and DC electrified areas and where passenger/freight trains hauled by single phase thyristor controlled or three phase induction motor controlled AC locomotives or chopper controlled EMU stock are operated. The system shall be capable of working in conjunction with conventional relay interlocking, multi- aspect colour light signalling installations operated by lever frames/ slides & Electronic Interlocking systems. It shall have facility to log data received from Electronic Interlocking through a serial port. The system (except commercial PC used for CMU) shall be capable of working in an ambient temperature range of -100 C to +700 C and relative humidity up to 95% at ambient temperature of 400° C. Special protection against ingress of dust, moisture etc. shall be provided. The data logger shall be capable of being connected to a printer for obtaining a hard copy of the function recorded. It shall be possible to print the following on the connected printer by selecting from user friendly menu (i) on line events as they are generated. (ii) to print the exceptional report (iii)to print the status of user specified inputs for user definable time period.

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	<p>i. The data logger shall record various field functions as indicated in para 3.10 below chronologically in the following format with name of the location at top of every page: Date, time, channel no., field function, status / value.</p> <p>j. The system shall be easily re-configurable to any changes required by user, whenever modifications are carried out in the yard.</p> <p>k. Provision for networking and remote monitoring of several data loggers from the central place shall be provided.</p> <p>l. Implementation of version control and change of software shall be as per RDSO/SPN/144.</p> <p>6.1.2. Technical requirements:</p> <p>a. Data logger equipment which is provided near the signalling gears to be monitored has following modules: (i) Processor module. (ii) Input module (digital/ analog) (iii) Signal conditioning module (iv) Communication module (v) Printer 80 Col. Dot matrix (Optional) (vi) Modem(s)</p> <p>b. Central monitoring unit (if provided) with communication facility to retrieve data from data logger(s) provided at station(s). The central monitoring unit shall run the diagnostic software to generate alarm and exception reports.</p> <p>c. Special Requirement: The power supply to the data logger shall be maintained uninterrupted by providing a separate battery bank and charger. This source shall be kept in the IPS/Equipment room.</p>
	<p>6.2 OEM's Site Installation Certificate: OEM certification for the installation before commissioning to be issued for each of the equipment meticulously: (a) EI (b) SSDAC / MSDAC (c) UFSBI / BPAC (d) AFTC (e) IPS (f) DATA LOGGER OEM is required to issue "Site Installation Certificate" addressed to CSTE of the Railway, as per format given at annexure .</p>
	<p>6.3 Station Equipment :</p> <p>a. Orientation of the Dual VDU or VDU with CCIP shall be in such a way that SM should face the track and with clear view of yard through window/door.</p> <p>b. Dual VDUs should be installed as per the customized drawing ref SG/SWR/068.</p> <p>c. Where ever Dual VDUs are installed a complete yard diagram in flex print affixed over plywood of 6mm, shall be fixed on the wall in front of the SM with clear view.</p> <p>d. Miniature KLCR relay type crank handles shall be used at SM room.</p>
	<p>6.4 Crank Handle Interlocking: (in panel room/ goomty/ apparatus cases):</p> <p>a. The crank handles shall be installed on the opposite wall to the main door in panel room.</p> <p>b. Miniature KLCR Relays shall be used for crank handle interlocking for elegant look in the panel room.</p> <p>c. For location other than panel room, Electric key transmitter with crank handle fixed to the key shall be installed on Acrylic sheet/Glass fronted T.W. box firmly on suitably angle supports, in panel room/goomty/apparatus cases as indicated by Railways. The wiring shall not be exposed, EKT when fixed with crank handle, shall be ensured that proper supports, have been given to the crank handle to avoid undue strain to the mechanism of the EKT. A push button with 2 NO/2 NC contacts of reputed make viz., L&T/Crompton make. 3 Nos. of LEDs Red, yellow and green shall be provided inside the box to give crank handle "Out", crank handle "IN", crank handle "FREE " indications. Providing nickel coated welded chain handle and key, locking and sealing arrangements. 37mm brass locks good quality should be provided. carrying out wiring as per approved circuit diagram. (This includes necessary mounting of the box to the wall using TW plugs and cement mortar.</p>
	<p>6.5 Block Instruments:</p> <p>a. Block instruments are to be installed on places as indicated by Railways. Separate signalling cables between Relay room/IPS room and respective block instruments shall be laid through cable ducts. The cables shall be fixed properly inside the Block counters/Block Instruments and terminated.</p> <p>b. Gradually UFSBI/SSBPAC(D) shall be provided in place of conventional Block instruments and similar type of block instruments are to be provided in a stretch of stations, to have operational and maintenance familiarity with the adjacent sections as per PCSTE/SWR policy No.<u>SG/SWR/Signal Policy/Vol. V dt.08.01.2019.</u></p>

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	<p>6.6 Fire Alarm and Suppression:</p> <p>a. As per RB letter no. 2013/Sig/Specifications dtd 25.02.13. Automatic Fire Detection and suppression system to be installed as per RDSO specification no. RDSO/SPN/218/2016. Ver. 1</p> <p>b. Fire detection and alarm system shall be provided at all installation as per the recommendation at page no 48 of 84th SSC:</p> <p>i. ‘Automatic Fire Detection and Alarm System’ shall be provided at all the stations irrespective of number of routes.</p> <p>ii. ‘Automatic Fire Suppression System’ along with ‘Automatic Fire Detection and Alarm System’ shall be provided at stations with more than 400 routes.</p> <p>iii. Latest RDSO Specifications to be followed (when ever issued).</p>
	

<p>7.0</p>	<p>EARTHING & LIGHTENING PROTECTION:</p>
	<p>7.1 Earthing With GI Pipe Electrode:</p> <p>The work includes excavation of a pit at a given location as per Drg. No. <u>SG/SWR/057</u> on natural soil, fixing earth pipe covering the same with a mixture of 30 kg of charcoal, 30 kg. of common salt and earth. This includes brick masonry around the earth. GI pipe of size 50mm x 2000 x 3.5 mm thick with 12mm dia holes on the sides at intervals of 300mm. The equipments to be earthed shall be connected to the earth pipe by using 2C/2.5 Sq.mm cables for Signals/ Location Boxes by neatly soldering at equipment end and earth pipe end. Earth resistance shall be measured and painted on the earth pipe with date. The earth resistance shall be always less than 10 ohms. The provisions of para 19.88 19.103 of SEM part-II shall be broadly followed.</p>
	<p>7.2 Class `A` Protection:</p> <p>Supply of Active lightening arrestors of class A for building protection as per standard NFC 17-102 it shall work on Early Streamer Emission principle and shall be made of stain less steel with a T of 60 micro Sec. The dimension of device shall be 599 mm x120mm. Provision shall be there to test this device if necessary by external tester. A non resettable type counter shall also be supplied to count the number of lightning occurrences. This includes supply of 20 Nos of Electrolytic copper tape of 25mm x 2mm or better for connecting Class A device to earth pit. Installation of Class A device on the top of the building. The device shall be installed at a height of about 3mtrs from the roof of the building using a GI mast. The device shall be connected to the earth pit using the copper tape of 25mm x 2mm or better. This copper tape shall be run firmly along the side of the mast with the help of the spacers. It shall down conductor shall be connected to the earth electrode using exothermic welding. A counter shall be installed at an appropriate place to count the number of occurrences. All the accessories like spacers, welding material etc required for the installation shall be arranged by the contractor.</p>

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7.3 Class 'B' Protection:

- The first stage of protection provided before the equipment at mains distribution panel is called class 'B' type.
- This type of protection shall be provided against Lightning Electromagnetic Pulse (LEMP) and other high surges at the power distribution panel.
- The modules shall have an indication function to indicate the life and failure mode to facilitate the replacement of failed SPDs
- The device is a Spark gap type and operate on arc chopping principle and designed to handle lightning current pulses of 10/350 μ s.

Sl. No.	Parameter	Value/Limit	
		Line & Neutral	Neutral & Earth
1.	Nominal voltage (U0)	230 V	230 V
2.	Maximum operating voltage (Uc)	>255 V	>255 V
3.	Lightning impulse current between R/Y/B & N (Imp)	>50 kA, 10/350 micro sec. for each Phase	--
4.	Lightning impulse current between N & E (Imp)	--	> 100 kA, 10/350 micro sec.
5.	Response time (Tr)	< 200 n sec.	< 200 n sec
6.	Voltage protection level (Up) between L & N	< 1.3 kV	---
7.	Voltage protection level (Up) N & PE	--	< 1.5 kV
8.	Short circuit withstand and follow up current extinguishing capacity without back-up fuse (Isc)	> 10 kA	
9.	Operating temperature / RH	70 ° C / 95%	70 ° C / 95%
10.	Mounted on	DIN rail	DIN rail

7.4 Class-'C' Protection:

This type of protection is provided against low voltage surges at the equipment input level connected between line and neutral. The device is a single compact varistor (MOV) which have following additional features: Indication (shows red) when device failed.

Thermal disconnection of device when it starts having heavy leakage current due to ageing / handling several surges. Potential free contact for remote monitoring. A number of MOVs shall in no case be provided in parallel.

Sl No	Parameter	Value / Limit
1.	Nominal voltage (U0)	230 V
2.	Maximum continuous operating voltage (Uc)	> 300 V
3.	Nominal discharge current between R/Y/B & N (In)	> 10 kA, 8/20 micro sec. for each phase
4.	Maximum discharge current between L & N (Imax)	> 40 kA, 8/20 micro sec
5.	Response time (Tr)	< 25 n sec.
6.	Voltage protection level (Up)	< 1.6 kV
7.	Operating temperature / RH	70° C / 95% RH
8.	Mounted on	DIN rail

7.5 Class `D` Protection:

Arrester between Zone 1 and 3 for Power supply Line 110VDc/24V DC/60V DC/110VAC.

Detailed Specification:

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SI No	Parameter	Specification
1	Type	Combination of GD tube, MOV and Diode. Indicative type
2	Protected wires	2 Wires (Suitable for Multi wire system)
3	Max Line Current	16 amps
4	Nominal Voltage	110V DC/24VDC/60VDC/110V AC
5	Maximum continuous Operating Voltage	150V/75V
6	Voltage Protection Level	< 200
7	Maximum Discharge Current(8/20US)	2 KA
8	Mounting	DIN rail

9.0	DOCUMENTATION AND TOOLS:
	9.1 Drawings and Specification:
	<ul style="list-style-type: none"> a. Signal and interlocking fittings: All signal and interlocking fittings should be in accordance with I.R.S. Specification no. IRS S-10 unless otherwise specified. b. All relay interlocking principles contained in IRS S-36 shall be applicable for all relay interlocking works. c. All Electronic interlocking systems shall comply to RDSO/SPN/192/2005 version.1 and/or No. RDSO/SPN/203/2011 as applicable for all EI works.

	9.2 As Made Documents:
	<p>After commissioning of the entire installation, as made tracings of relevant documents/plans shall be made on tracing film to Railway in standard size, also 04 copies of booklets and its soft documents in 4 DVDs consisting of the following documents shall be made and submitted:</p> <ul style="list-style-type: none"> a. Signaling plan. b. As made track bonding diagram c. As made cable distribution plan d. As made cable route plan e. As made apparatus case wiring diagram, termination and cable particulars. f. As made cable termination rack particulars. i. Power distribution ii. Circuit diagrams iii. Panel diagram. iv. Panel termination particulars v. Table of control. g. Cable meggering readings. h. Copies of CRS sanction, safety certificate. i. Relays and other equipments details (field equipments). j. Sighting committee report. k. Relay contact particulars. l. Equipment arrangement plan (Floor Diagram) of Panel room, relay room, OFC room, IPS room, battery room, maintainer room and store room as applicable. m. Earthing arrangement diagram. n. Infringement particulars. o. Pre-commission check lists of electronic equipments. p. OEMs warranty certificates/AMC.

	9.3 The Following Registers Shall be Handed over to operating Staff:
	<ul style="list-style-type: none"> a. Relay room key register b. Route cancellation/Calling on register c. Calling On Cancellation register d. Block Line Clear Cancellation register e. Crank Handle register f. Signal Failure Register g. Signal History book. h. Block Instt Key Register i. Joint Insp of Points and Crossings register. j. Joint Insp of Track Circuits register k. BPAC Reset Register l. PB-1 and PB-2 Counter registers (if applicable) m. HASSDAC/MSDAC Ayle counter reset register

	9.6 The following specialized measuring instruments are to be procured in the new works:
	a. True RMS Digital Clamp –ON meter (fluke 376 type or better)- 01No
	b. Digital clamp on Earth Tester (fluke 1630 type or better) -01No.
	c. Digital insulation tester- (fluke 1507)-1 No
	d. Cable fault locator-01 no
	e. Cable route tracer (spec TEC.SPEC-G/TIE-01/02)-01 no.
	f. TMS kit(Anuvidyut make or better as per spec IRS/TC-43/87 or latest) -01 no
	g. Psophometer-01 no
	h. Cross talk meter(Anuvidyut or better as per spec IRS/TC-45/88 or latest) -01 no

	<ul style="list-style-type: none"> i. Cable Insulation register j. Consent memo register k. Earth resistance register l. Failure memo register m. Point Track circuit bond connections register n. Work cum inspection register
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10.0	TELECOM EQUIPMENTS:
	10.1 Laying of HDPE duct in Special Cases:
	<p>a. Near Power Cable: When the contractor comes across any other cable already laid, suspecting a power cable (LT or HT), he shall first report the finding to the Engineer. And the trench shall be dug as far away from the route. If unavoidable, at the area of cables crossing, HDPE duct in RCC Pipe of suitable size supported on Masonry shall be provided.</p>
	<p>i. Crossing of Optical Fibre Cable Duct with another cable: Crossing of the Optical Fibre Cable /HDPE Duct with another cable shall be avoided wherever possible. Where, however, this is not possible, the Optical Fibre Cable/HDPE duct shall be laid in cement or asbestos cement pipes. The length of the pipe to be provided on either side of the crossing shall be at least one meter.</p>
	<p>ii. Laying of cable other than Optical Fibre Cable / HDPE ducts in the same trench: No cable other than quad cable shall be laid in the trench for the Optical Fibre Cable /HDPE duct. Even in such cases, both the cables are to be laid as per approved drawing. Where, however, exceptional circumstances exist, the Optical Fibre Cable/HDPE duct may be laid along with another cable in the same trench provided a specific permission of each such case is obtained in writing from the Engineer. When Optical Fibre Cable/ HDPE duct and LT power cable have to be laid in the same trench they shall be separated by placing a layer of brick between them vertically (approx. 16 bricks /meter) or laid in RCC pipe.</p>
	b. Laying of HDPE duct through pipes:
	<p>i. The HDPE duct shall be laid through RCC pipes at the locations marked on the route plan and as advised by the Engineer or his representative.</p>
	<p>ii. For laying the HDPE duct through pipes galvanized steel wires of a cross section not less than 10 SWG shall be used as a lead wire. Two such lengths of wires shall be laid through the pipes, so that after the HDPE duct is threaded through the pipe, one lead wire is permanently left in the pipe with a suitable overlay at two ends, to enable the HDPE duct to be pulled out at a later stage if required to do so.</p>
	<p>iii. On arch bridges and culvert bridges the HDPE ducts will be threaded through GI pipes etc. While threading the HDPE duct through these pipes the contractor shall do the trenching to the required depth wherever necessary.</p>
	<p>c. Laying of HDPE duct near feeding post: In the vicinity of feeding posts, as far as possible the HDPE duct shall be laid on the side of the track opposite to the feeding post. Further the Optical Fibre Cable /HDPE duct shall be at least one meter away from any metallic part of other equipment at the substation which is fixed on the ground and at least one meter away from the substation earthing. In addition, the HDPE duct shall be laid in RCC pipes of minimum 150 mm dia (standard 2 meters length) complete or capable of being split into two half as per Spec. No. ISS-458 latest for a length of 300 meters on either side of the feeding point.</p>
	<p>d. Running of HDPE ducts at foundations other than OHE masts and from pipe outlets: Damage to HDPE duct is likely to occur if care is not taken in laying HDPE duct where the bed changes from solid support such as a foundation pipe or bridge to soft support such as soft soil. The HDPE duct must not press against the edge of the solid support. The soft soil near the edge must be tamed and HDPE duct raised slightly.</p>
	<p>e. Laying near oily surface: If during the excavation of trenches for laying HDPE ducts, the contractor or his representative notices the presence of oil or oily substance or any other chemical which is likely to cause deterioration of the HDPE Duct protective material. He shall bring the matter to the notice of the engineer or his representative and on the latter's decision he shall choose an alternative HDPE duct route or he shall protect the HDPE Duct in such places in such manner as advised in writing by the Engineer or his representative. No additional charges are payable.</p>
	<p>f. Special soil surface: HDPE duct should not be run through abnormally high acidic or alkaline soil or through sewage. If this is unavoidable, special measures should be taken against corrosion as advised by the Engineer in charge.</p>
	g. Precaution for damage due to sharp edges:

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	When HDPE Duct are laid in trunking, care should be taken to see that no ballast or stones have been dropped inside the trunking and it should be cleared of all ballast and stones before the cover is secured. When the ends of covers are joined together with cement plaster, a piece of paper or wood should be placed under the joint to prevent the cement plaster from falling on the HDPE Ducts. Where rocky soil is found after trench the closing of HDPE duct's trench to be closed manually to avoid damage/pressing of HDPE DUCT
	h. Handling of HDPE duct drums & laying of HDPE ducts:
	i. The drums shall be unloaded by the side of the Railway track from either a crane or any other suitable means very carefully so as not to cause any damage to the HDPE duct. The drums at site shall be protected until they are laid.
	ii. On each drum there are two ends, A & B. The 'B' end of the one HDPE duct length shall meet "A" end of the next HDPE duct at a joint. The 'A' end shall be normally on the top unless indicated otherwise on a drum.
	iii. The drums shall always be kept upright, i.e. Axle in parallel position to the base. The drums shall not be set by jerks but shall be handled slowly and with care. The walls of the drums should not be damaged while moving the drums if required for unrolling.
	iv. The drums shall normally be unrolled at the same place and the HDPE duct carried by workmen near the trench. The drums, shall not be dragged in any case. But where drums of HDPE duct have to be moved, would always be rolled in the direction of the arrow, otherwise the coils tend to unwind and the HDPE duct may get battered. In case no direction arrow is marked on the drum, remove several battens and determine the direction in which the HDPE duct is coiled. The arrow should then be painted on the drum pointing in the opposite direction in which the upper HDPE duct end is coiled so that future handling of the HDPE duct drum is facilitated and then replace the battens carefully.
	v. The drum should be properly mounted on jacks (or on a HDPE duct wheels) making sure that the spindle is large enough to carry the weight without bending and that it is laying horizontally in the side so as to prevent the drum creeping to one side or the other while it is rotating. Before attempting to pull off the HDPE duct, remove the end protection box attached to the flange of the drum and cut the security ropes so as to leave the HDPE duct free to move.
	vi. If a portion of HDPE duct only is taken out from the HDPE duct drum, the battens should be immediately replaced to prevent damage to the balance of the HDPE duct. This is important.
	vii. The use of steel bars between the bolt heads to 'jump' or turn the drum around is dangerous to staff and likely to damage the drums. A better method is to use two steel plates with grease between them. By standing the drum on these greased plates, it can be easily elevated round to the desired position.
	viii. All care should be taken in handling HDPE duct drums with a view to ensure safety not only of the HDPE ducts but also of the working party handling them. The man should not be allowed to break the HDPE duct drum by standing in front but only from side.
	i. Rewinding and Re-drumming of HDPE ducts: If for any reason it is found necessary to rewind a HDPE Duct on a drum, HDPE Duct drum with a proper barrel diameter not less than of the original drum should be chosen. The drums should be mounted on HDPE Duct jacks during rewinding operations using proper size of spindles passed through flange holes, which will not buckle under the lead. The HDPE duct should not be bent opposite to the set it is having already. In the re-drumming operations, drums should be to turned that the HDPE Duct passes from the bottom of the original set with as little gap as possible. Replace all the lagging on the HDPE Duct drum.
	j. HDPE duct laying: It is advisable to employ the same people at the same place or job while HDPE Duct is being laid. Before commencement of the laying, inspection of the trench and inspection of protection works should be carried out so as to ensure their conformity with the specification. The trench bottom should be clean, smooth and free of small stone. When the soil contains stone or pieces of rock and therefore cannot be raddled, sieved earth about 10 cm. Thick should be used both for the bedding on which the HDPE Duct is laid and for covering the HDPE Ducts. The HDPE Duct drum should be brought as close to the cable trench as possible. It should be lifted with the aid of HDPE Duct jacks firmly mounted on a support of stone or wood. The spindle should be minimum of 55mm diameter and having a clearance from

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	<p>ground by 5 to 10 cm.</p> <p>Where necessary the HDPE duct drum may be placed at such a point so that 2/3 of the HDPE duct is laid directly in one direction and the balance in other direction. Care should be taken in such a case to see that there are no kinks or loops in the HDPE duct. The wooden battens on the drum should be carefully removed shortly prior to laying and before the drum is mounted on the jack should be carefully removed. While rolling a HDPE duct drum for laying, the drum shall be supported on an axle running through its center, the height of the axle being such that the end frames are free to rotate and do not touch the ground at any point. The HDPE duct shall be carefully uncoiled by gently pulling the HDPE duct s assisted as necessary by carefully turning the drums. The quick pulling of the HDPE duct or turning the drums shall be avoided at all costs. Each HDPE duct drum shall be braked while laying is in progress to prevent sharp bending or buckling, particularly when the HDPE duct coils are sticking together. The method of mounting the brakes is shown in the drawing no.RE/42/164. When drums are turned for change of direction, wooden blocks shall be carefully put under the drum bolts, which stand out from the drum discs. It is customary for the mate to stand in a commanding position where he can view the entire route, and should evenly timed calls to his men to pull. If there is proper synchronization between the mate's calls and the pulling by the men, the HDPE duct will leave the drum without difficulty. It is important that the HDPE duct should be pulled with steady and even pulls and not be unnecessarily jerked or strained. On no account should a HDPE duct be allowed to twist or kink, as this is likely to spring the armour and fracture the outer serving of the HDPE duct. When pulling HDPE duct around bends, one or two men should be stationed to given the HDPE duct the correct bend when it passes. While laying the HDPE duct, employ adequate number of men such that the HDPE duct can be conveniently carried by them in both hands without such that the maximum sag of the HDPE duct between any two persons is stretched arms. The distance between any two persons carrying the HDPE duct shall be from 2 to 10 Mtrs depending upon weight of HDPE duct not more than 0.5 Mtrs. The HDPE duct shall be gently drawn by pulling the HDPE duct, which may be assisted as required, by smoothly and slowly turning the winch. The HDPE duct shall not be twisted on any account. Before laying is commenced, the HDPE Ducts shall be uncoiled first in a straight line supported by men and then carried to the trench and laid gently & carefully ensuring that HDPE duct is not stretched while putting in the trench. While laying work is in progress one man must continuously observe the HDPE Duct along its length in order to determine whether any indentations, holes or other damaged parts are apparent. Such damaged parts have to be protected immediately by the HDPE Duct jointer provided with the laying party. When two or three turns of HDPE Duct are left on the drum, the pulling should be stopped and the inner end of the HDPE Duct removed from the slot in the drum. Pulling should then be continued. If this is not done the HDPE Duct end is likely to be stretched and damaged. The ends of the Optical Fibre HDPE Duct should have an overlap of 1 Mtr at the end of each drum for jointing purpose. The conditions of the HDPE Duct shall be visually inspected though out its length and in case any damage or defect is noticed, the trench shall not be filled up until the engineer's representative is notified to examine and authorize filling of the trench.</p>
	<p>k. Minimum bending radius:</p> <p>HDPE ducts should always be bent (or straightened) slowly; they should never be bent to small radius while handling. The minimum safe bending radius for Optical Fibre HDPE ducts should be 30 times the diameter of the HDPE duct but wherever possible larger radius should be used.</p>
	<p>i. Wherever HDPE duct has to be coiled/looped the diameter of the coil/loop shall be greater than 30 times the diameter of HDPE duct.</p>
	<p>ii. The pit to be constructed should be as per the specification given in the Drg. No.Core/S&T/AId/Sk/435/95 and HDPE Duct joint enclosure to be fixed inside the pit wall.</p>
	<p>10.2 Cable Markers for OFC:</p> <p>The cable markers shall normally be provided at the distance of every 50 meters on the HDPE Duct route and also at places or corners wherever the route of the HDPE Duct changes. The joint indicators shall be provided at all types of cable joints. The cable markers and joint markers provided shall be of standard concrete type as per approved drawing, letters engraved, suitably painted, fixed over standard trench as per site conditions. The design of route indicator shall be got approved from Railway in advance.</p>

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	In addition electronic cable markers of proven design shall also be provided.		
	TOOLS REQUIRED FOR TRENCHING, HDPE DUCT LAYING AND FILLING:		
	TOOL'S NAME:		
	1. HDPE duct jack,	2. Reopening device	3. Free hood hook
	4. Shackle free head hook	5. Growling hook,	6. Pulling bolt,
	7. Tension meter,	8. Pulley	9. Anti twist device (swivel)
	10. Roller	11. Flexible HDPE duct	12. Pulling rope
	13. Brush	14. Chain	15. Measuring cord for strain gauge
	16. Slip winch,	17. Wire rope,	18. Portable VHF set,
	19. Measuring tape,	20. Powrah,	21. Iron plate,
	22. Loader backhoe for drilling,	23. Warning tape,	24. Caterpillar tractor
	25. Fork lifter,	26. Vehicle van type	27. Tachometer,
	28. Road measurer.		
	10.3 Laying of OFC and Installation of OFC Equipment:		
	a. Blowing of OFC in HDPE duct: Blowing of OFC shall be accomplished using blowing machines as per Standard TECH practice and keeping in view the specifications of the duct manufacturer.		
	10.4 Jointing and Termination of OFC:		
	a. Preparation of OFC Cable For Jointing:		
	i. During the installation, a minimum of 10 meter of cable of each end is coiled in the jointing pit to provide for jointing to be carried out at convenient location as well as spare length to be available for future use in case of failures.		
	ii. The pit size must be chosen carefully to ensure that length of the wall on which joint is mounted is greater than closure length plus twice the minimum bending radius of the cable. A pit length of 1 meter is sufficient for most of the cable and joint closures. Bracket to support the cable coil are also fixed on the wall of the pit.		
	iii. The cable is then coiled on to the pit wall in the same position as required after the joint is complete. The marking is done on all the loops so that it will be easier to install it later.		
	iv. The distance from the latest center to the end of the cable must be at least 1.8 meter. This is being the minimum to be standard for preparation of the joint.		
	v. Sufficient cable at each end up to the jointing vehicle/enclosure is then uncoiled from the pit for jointing.		
	b. Stripping/Cutting of the OFC:		
	i. The cables are stripped of their outer and inner sheath with each sheath staggered approximately 10mm from the one above it.		
	ii. Proper care must be taken when removing the inner sheath to ensure the fibers are not scratched or cut with the stripping knife or too. To prevent this, it is best to only score the inner sheath twice on opposite sides of the cable, rather than cut completely through it. The two scores marking on either side of the cable are then stripped of the inner sheath by hand quite easily.		
	c. Preparation of OFC joint closure for splicing: The type of preparation work performed on the cable prior to splicing differs on the type of joint closure and fibre organizer used. However, the following steps are usually common:		
	i. The strength members of each cable are joined to each other and/or to the central frame of the joint closure.		
	ii. The joint closure is assembled around the cable.		
	iii. The sealing compound or heat shrink sleeve is applied to the cables and closure, or prepared for application after splicing is complete.		
	iv. The fibers are protected (usually with plastic tubing) in their run from the cable core to the fibre organizer trays (Particularly if cable construction is slotted core type).		

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	v. Tags, which identify the fibers no. are attached at suitable location on the fibres.
	vi. Splice protectors are slipped over each fibre in readiness for placing over the bare fibre after splicing.
	d. Stripping and cleaving of fibre:
	i. Prior to splicing each fibre must have approximately 50mm of its primary protective U.V. Cured coating removed, using fibre stripper which are manufactured to fine tolerances and only score the coating without contacting the glass fibre.
	ii. The bare fibre is then wiped with a lint free tissue doused with ethyl alcohol.
	iii. Cleaving of the fibre is then performed to obtain as close as possible to a perfect 90 face on the fibre.
	e. Splicing of the fibres: The fusion splicing shall be used for fibre splicing. Some of the basic steps for fusion splicing are as given in para 2.6.8.
	f. Fusion splicing of fibre: Some of the general steps with full automatic microprocessor control splicing machine are as under.
	i. Wash hands thoroughly prior to commencing this procedure.
	ii. Dip the clean bare fibre in the beaker of ethyl alcohol of the ultrasonic cleaver. Switch on ultrasonic cleaver for 5-10 seconds (some of the manufacturers do not prescribe the above cleaning).
	iii. Place the bare fibre inside 'V' groove of the splicing machine by opening clamp handle such that the end of fibre is app. 1 mm. Over the end of the "V" groove towards the electrodes.
	iv. Repeat the same procedure for other fibre, however, first insert heat shrink splice protector.
	v. Press the start button on the splice controller.
	vi. The machine will pre fuse, set align both in 'X' and 'Y' direction and then finally fuse the fibre.
	vii. Inspect the splice on monitor if provided on the fusion splicing machine and assure no nicking, bulging is there and cores appear to be adequately aligned. If the splice does not visually look good repeat the above procedure.
	viii. Slide the heat shrink protector over the splice and place in tube heater. Heat is complete when soft inner layer is seen to be "oozing" out of the ends of the outer layer of the protector.
	ix. Repeat for other fibres.
	g. Fusion splicer and OTDR: The fusion splicer and Optical Time Domain Reflectometer (OTDR), to be used for splicing and measurements of parameters respectively, shall be of approved design and quality. The contractor shall submit:
	i. Specification of fusion splicer and OTDR.
	ii. Certificate from the user, who have used the splicer and OTDR of the make, the contractor intends to use, regarding their satisfactory performance.
	iii. Railways reserves the right to direct the contractor to use the same or any other proven design of fusion splicer and OTDR if in the opinion of Railways the specification of fusion splicer and OTDR are not suitable.
	h. Organizing fibre & finishing joints:
	i. After each fibre is spliced, the heat shrink protection sleeve must be slipped over the bare fibre before any handling of fibre takes place, as uncoated fibres are very brittle and cannot withstand small radius bends without breaking.
	ii. The fibre is then organized into its tray by coiling the fibres on each side of the protection sleeve using the full tray side to ensure the maximum radius possible for fibre coils.
	iii. The tray is placed in the position.
	iv. OTDR reading taken for all splices in this organized state and recorded on the test sheet to confirm that all fibres attenuation is within specification. This OTDR test confirms fibres were not subjected to excessive stress during the organizing process.
	v. After this the joint can be closed with necessary sealing etc and ready for placement in the pit.
	i. Placing of completed joints in pit:
	i. Joint is to be placed on the tarpaulin provided near the pit.

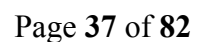
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	ii. The cable is laid on the ground; loop the cable such that the pen mark previously placed on the cable line up. Tape these loops together at the top of the coil.
	iii. The joint can now be permanently closed and sealed by heating heat shrinkable sleeve etc. However, before closing, silica gets to be kept inside for moisture protection.
	iv. Now the joint closure is fixed to the bracket on the pit wall and pit is closed. Refer annexure 6.1 (Drg. No. CORE/S&T/ALD/SK/435/95).
	j. Re-opening of joint: If required for attending to faults etc., manufacturers supply special kits for opening of the joint and the steps to be followed. However, the general steps are as under:
	i. Using suitable knife cut heat shrink sleeve longitudinally along its entire length.
	ii. Do not damage the smaller heat shrunk sleeve on the ends of the joint.
	iii. Apply heat to the cut sleeve until it begins to separate.
	iv. Gently remove the cut sleeve from the joint. Now the joint can be opened.
	v. Protective sleeve/cover can be removed for attending to faults etc.
	k. Termination joint for OFC:
	i. This joint is provided in the cable hut for terminating the outdoor fibre optic cable of both the sides, splicing through fibres, connecting fibres to pigtails for connection to optical lines terminal equipment etc.
	ii. The OFC shall be dressed upon teak wood plank/aluminum ladder inside cable hut. The armour of the OFC shall be cut before taking the cable in the equipment rack. The cables shall be terminated on OFC termination joint closures.
	iii. The optic fibre termination joint closure as per specification NO. TREC TV-210-J-93 (latest) or a proven design approved by Railways shall be provided in each cable hut to terminate both optical fibre cables and deriving required pigtails. If the contractor intends to supply joint enclosure, which is not as per TEC specification, before starting the supply, contractor shall submit.
	iv. The specification of the joint enclosure.
	v. Users certificate regarding its satisfactory performance.
	At the discretion of the Railways, contractor will have to demonstrate the working of the joint enclosure. Based on specification, user certificate and demonstration, Railways, if Railways finds the design suitable, will grant specific approval to use the joint enclosure. The supply of the joint enclosures, which is not of TEC design, shall start only after the approval is received from Railways.
	vi. The procedure for installation of termination joint box depends upon the type of joint enclosure. The installation manual supplied gives the step-by-step procedure for installation. However, the general steps are as under. Making the cable, Stripping / cutting the cable, Gripping cable in sheath / clamp, Treatment of tension member, Fibre splicing, Enclosing fibre, Fixing strength member, closing the cover, Fixing termination box & Fixing the cable.
	l. Marking the OFC:
	i. Determine the cable length up to the proposed location of termination box. It is also to be ensured that at least 10 meters of cable is coiled in the cable pit.
	ii. Determine the cutting point and mark the cable.
	iii. Determine the sheath peeling point and mark the cable.
	m. Cutting / stripping the OFC:
	i. Cut the cable as per the marking.
	ii. Remove the sheath from cable ends. During sheath stripping care should be taken not to damage the fibres.
	iii. The length and the steps for various sheath cutting shall be as per instructions given in the manual.
	n. Gripping the OFC:
	i. Wind PFC tape around the cable core just beside edge of the sheath.
	ii. Insert the bushing inside sheath by cutting the cable sheath for about 25mm.
	iii. Place the sheath grip (lower half and upper half) and tighten it with the help of torque wrench.
	o. Fixing of tension member:
	i. Mark the tension member for the specified length and cut it.
	ii. Clean the tension member thoroughly by alcohol and cotton cloth.

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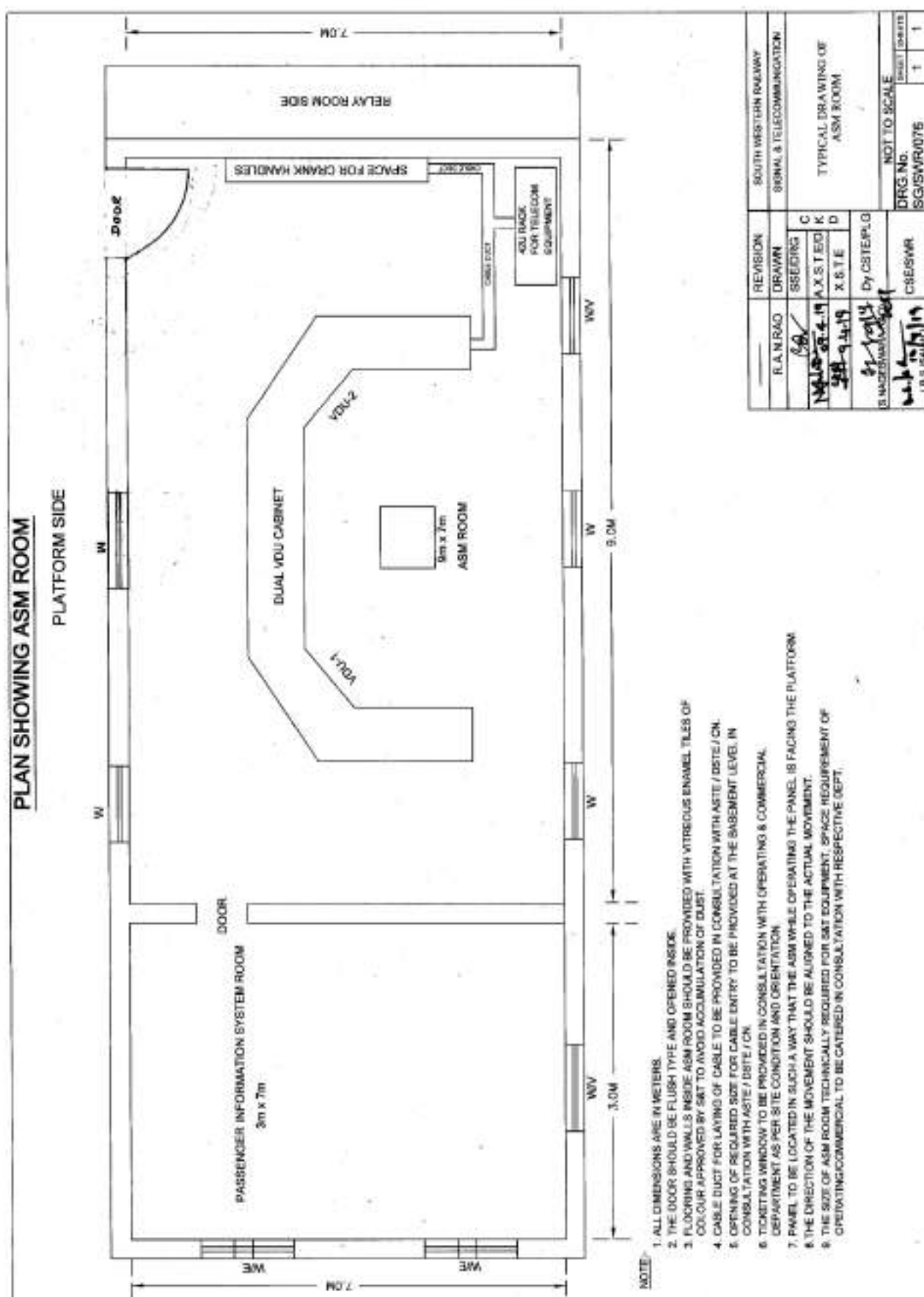
	iii. Fix tension member holder with the help of instant adhesive at the end of tension member.			
	p. Fibre splicing: The procedure for splicing is same as described for the straight joint closure in clause 6.6 above.			
	q. Enclosing fibres:			
	i. Set the fibre cassette on the base.			
	ii. Arrange excess length of fibre to make double figure of eight.			
	iii. Enclose the splice fibre and its excess length carefully.			
	iv. Repeat the procedure for other fibres.			
	v. After this, the box can be closed. However, a packet of silica gel may be placed inside for Protection from entry of moisture.			
	r. Mounting of termination box: Termination box can be fixed either on wall or on equipment rack. At way side stations it shall be mounted inside the equipment rack in order to prevent pigtails from rodent attacks.			
	i. Mark the fixing holes on the walls/rackets/frame.			
	ii. Place the termination box and tightened the nuts inside the base box.			
	iii. Put the covers.			
	s. Fixing the cable: Secure the cable on wall/frame at two places within one meter from termination box keeping in view straight entry of cable in termination box.			
	10.5 Acceptance test for OFC: The procedure for testing Fibre Optic Cable shall be jointly finalized by Railways. The parameters in the concerned specification shall be taken as reference. The test shall be conducted from cable hut to cable hut, after the splicing & termination joints are completed. The length of the cable (as per marking in cable & as measured by OTDR) loss in cable, average loss per KM, No of splices, splice loss, etc shall be recorded and jointly signed as per pro-forma given in para .2.6.23 below.			
	10.6 System test protocol for OFC field test Route: _____ Date: _____ Station _____ No of midsection splices: _____ Section: _____ Measured by: _____ Length (by OTDR): _____ Length as per meter marking on cable Sheath: _____			
	10.7 Tools and Equipment, required for jointing and termination of OFC:			
	TOOL's Names:			
	Branch joint closure	Termination Box	Rubber End Block	Sheath Clamp
	Bushing	Strength member holder	Heat Shrinkage tube	power cord AC/DC
	Arc fusion splicer Machine	Walkie-Talkie 12 V DC source	Tuber heater	Precision cleaver
	Cable Sheath Stripper	Fibre stripper	knife for HDPE cutting	hexa for strength membrane
	isopropyl alcohol or methanol of high specific gravity	Johnson buds	Tweezers	Gun heater blower type.
	Sleeve for splice protection,	OTDR	Stickers for numbering of splicer's	Portable k. Oil generator
	Umbrella's 2 Nos.	Dust protection for splicing machine.		
	10.8 Communication to be provided at new stations: Control telephone in controlled sections. a. Selective calling Phone communication to all manned level crossing gates controlled from the station. a. 25W VHF sets with 12 Volt Charger & 100 AH battery.			

10.10 Telecom Equipments	
	a. E1 Convertors:
	i. Features: Support 10 FXS ports per module able to be accommodated in the PCM integrated access TDM multiplexer The module should be hot swappable so that service is not disturbed.
	ii. Technical Specifications: Support FXS voice interfaces, hot line feature between two FXS interfaces over E1, support 8khz channel sampling rate, support operating frequency of 300 to 3400 Hz, support impedance of 600 ohms balanced, support ring current voltage of ac 75v \pm 15v , 25 \pm 3hz Should support RJ45 type connectors for FXS interface module.
	iii. Others:
	<ul style="list-style-type: none"> The module to be capable of receiving the voice from the remote station to the central side and terminate in the central unit,or in a ring or chain topology when connected over SDH; fiber or standard copper conductor.
	<ul style="list-style-type: none"> The module in the existing unit should be capable of interoperating with the central 1U height TDM multiplexer MAPLE 4 /MRO TEK/FXS module interface to support HOTLINE feature if required, it should be configurable i.e. some might be hotline and the others used to carry PABX extensions from the remote end.
	<ul style="list-style-type: none"> The product should have been procured earlier by Indian Railways.
	b.FXO Module for integrated access device supporting 124 DSO level cross connect.
	i. Features: Support 10 FXO ports per module, should be able to be accommodated in the PCM integrated access TDM multiplexer of height 1u and 19" rack mountable, the module should be hot swappable so that service is not disturbed.
	ii. Technical specifications: Support FXO voice interfaces, support operating frequency of 300 to 3400hz, support ring current voltage of AC 75v \pm 15 V , 25 \pm 3 Hz, support RJ45 type connectors for FXO interface module.
	iii. Others:
	<ul style="list-style-type: none"> The module to be capable of carry voice from the remote station over E1 to the central location or on copper or fiber when connected.
	<ul style="list-style-type: none"> The module in the existing unit should be capable of interoperating with the central or remote 1U height TDM Integrated Access multiplexer MAPLE 4C.
	<ul style="list-style-type: none"> The module should have been procured by Indian Railway earlier and to provide Caller Line.
	<ul style="list-style-type: none"> Transparency to the extensions which are being extended over SDH Network.
	c. Optical Redundancy Fiber Multiplexer:
	i. Features: <ul style="list-style-type: none"> Support 4 E1 channels and 1 Ethernet over 100 base FX (Auto MDI / MDX) Confirm to ITU G.703, G.823, G.824, GR-499 core jitter requirements and IEEE Ethernet standards. Provide alarm monitoring indication. Support link and port status of local and remote units Support loop back for diagnostics Support built in auto ranging AC/DC power supply 100base FX port should support sc connector – two ports (main & redundant link) Support single mode, multimode or single fiber option Support sc connector for the fiber interface Support single mode fiber option up to 15kms or 40km Support 1550nm wavelength at 40km or the appropriate wave length Support long haul transmission up to 100km if required LED indicators – power, Fx1/Fx2 link status (main & redundant link) ,LOS, AIS, TEST,10/100
	ii. Interfaces: <ul style="list-style-type: none"> Support minimum 4 E1 ports Each E1 port should support data rate of 2048 Kbps Support G.703 Framing

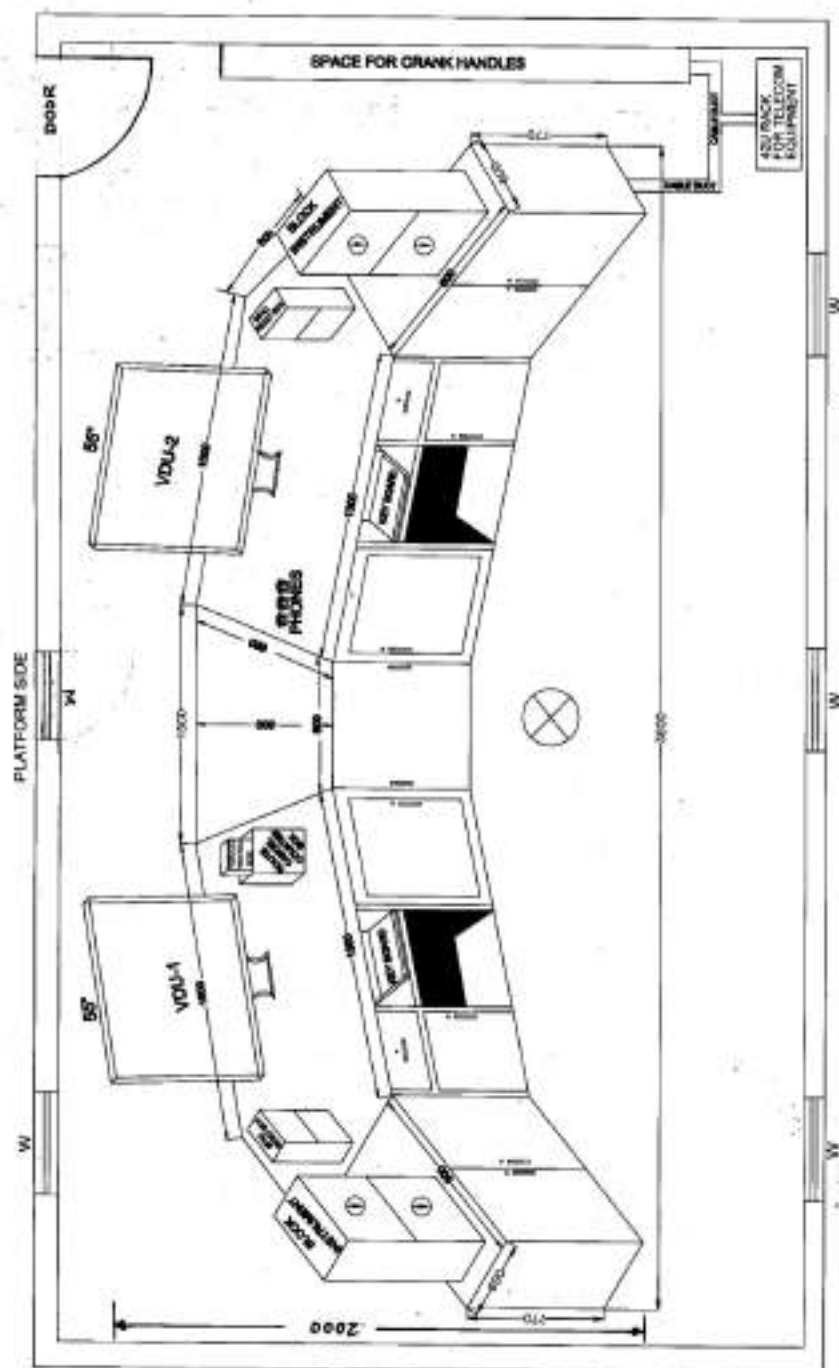








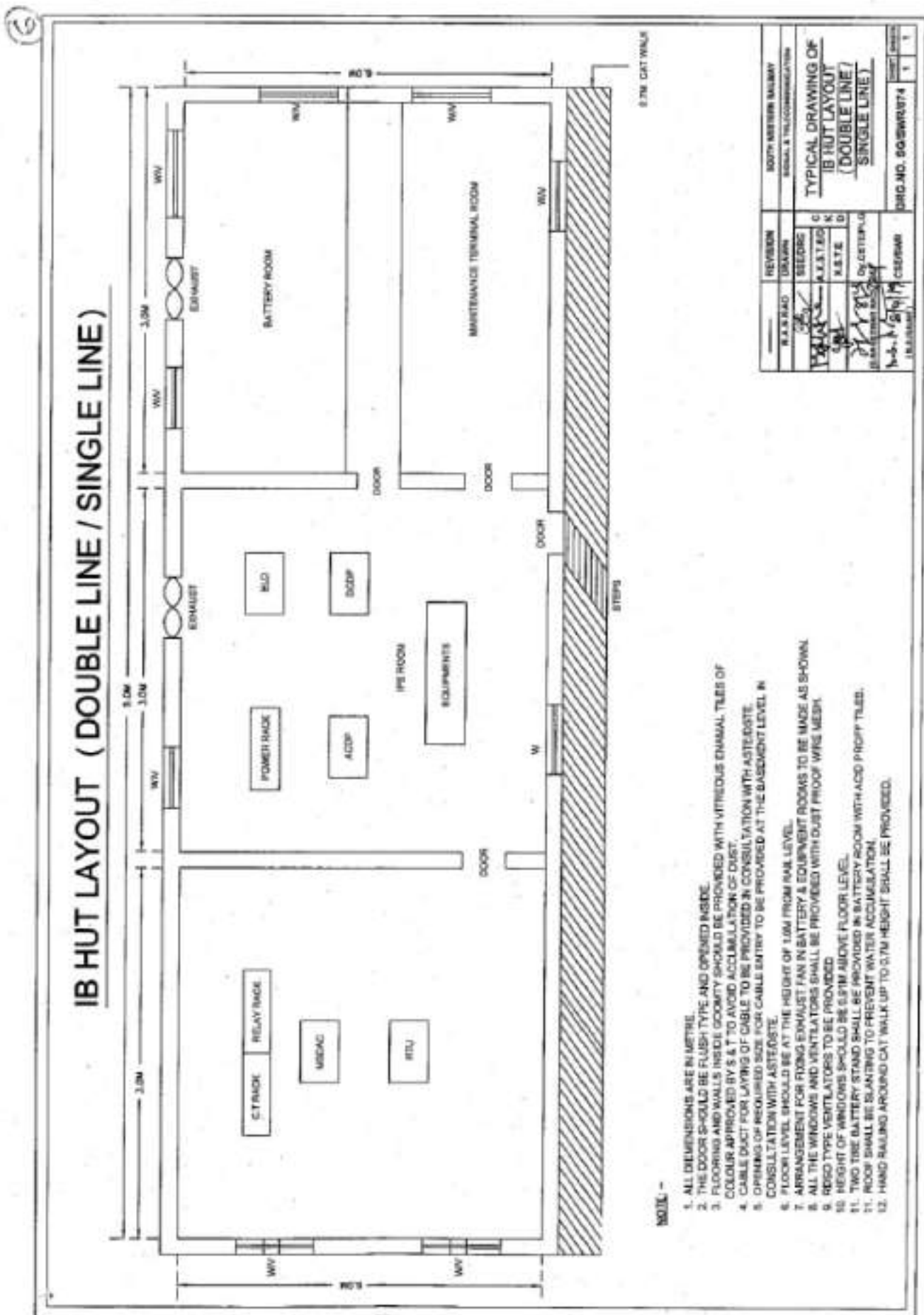
TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS (MAY-2019)

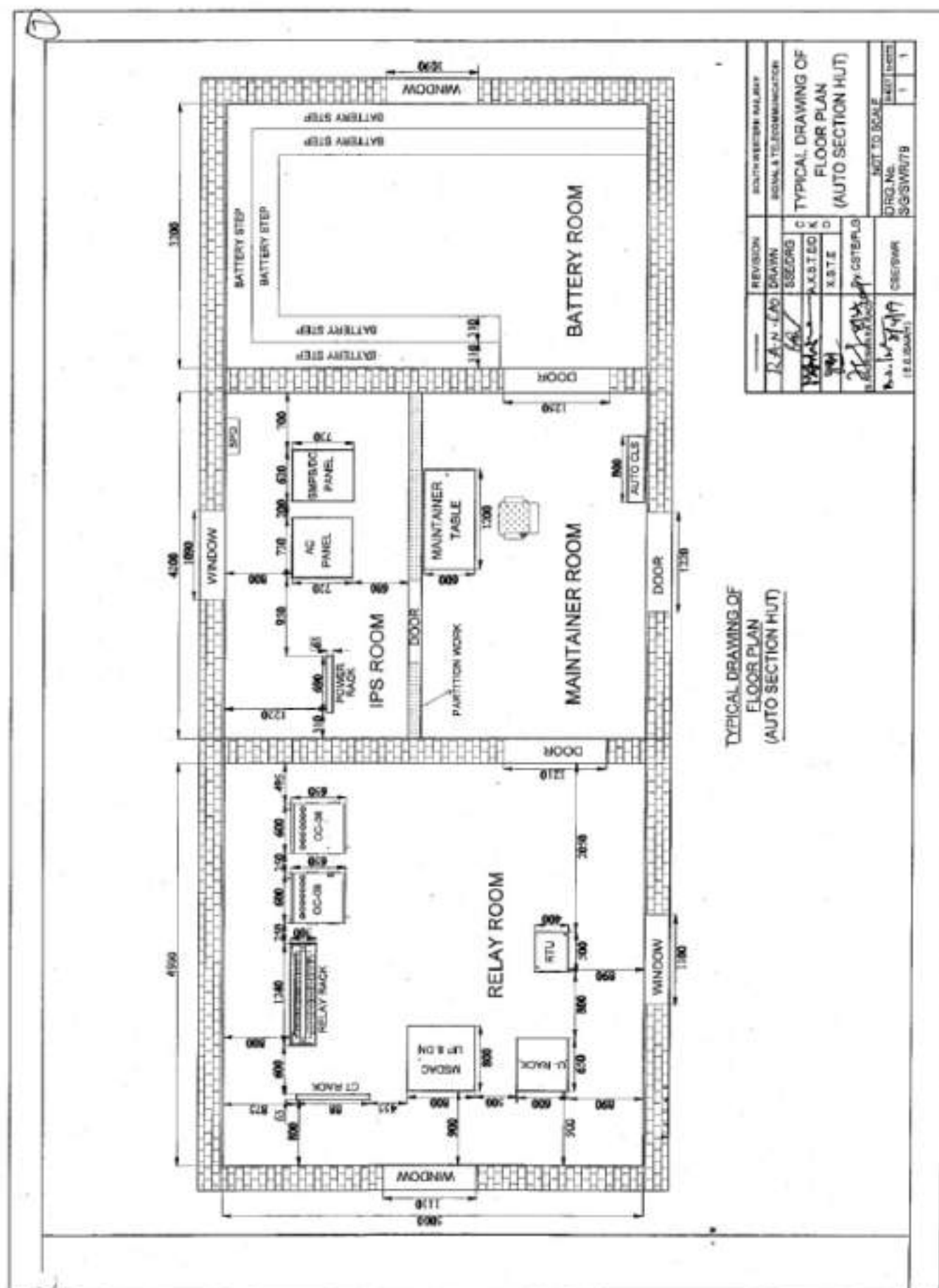


7070

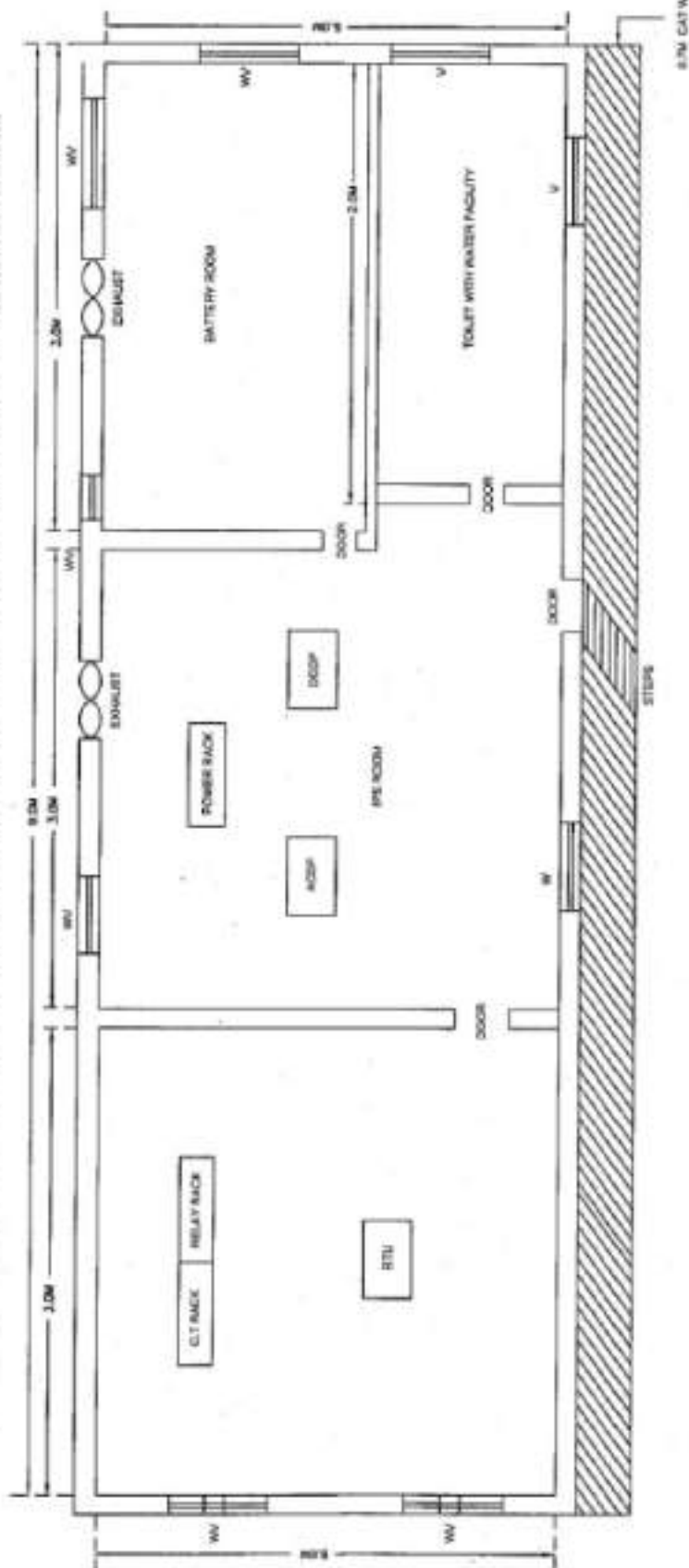
1. FOR BIGGER WAREDS, NUMBER OF VENTS MAY BE INCREASED.
2. FOR JUNCTION STATIONS, NUMBER OF BLOCK TREATMENTS MAY BE MORE THAN TWO.
3. YOU TABLE SIZE TO BE MODIFIED TO SUIT ABOVE.
4. ALL DIMENSIONS ARE IN mm.

[illegible]





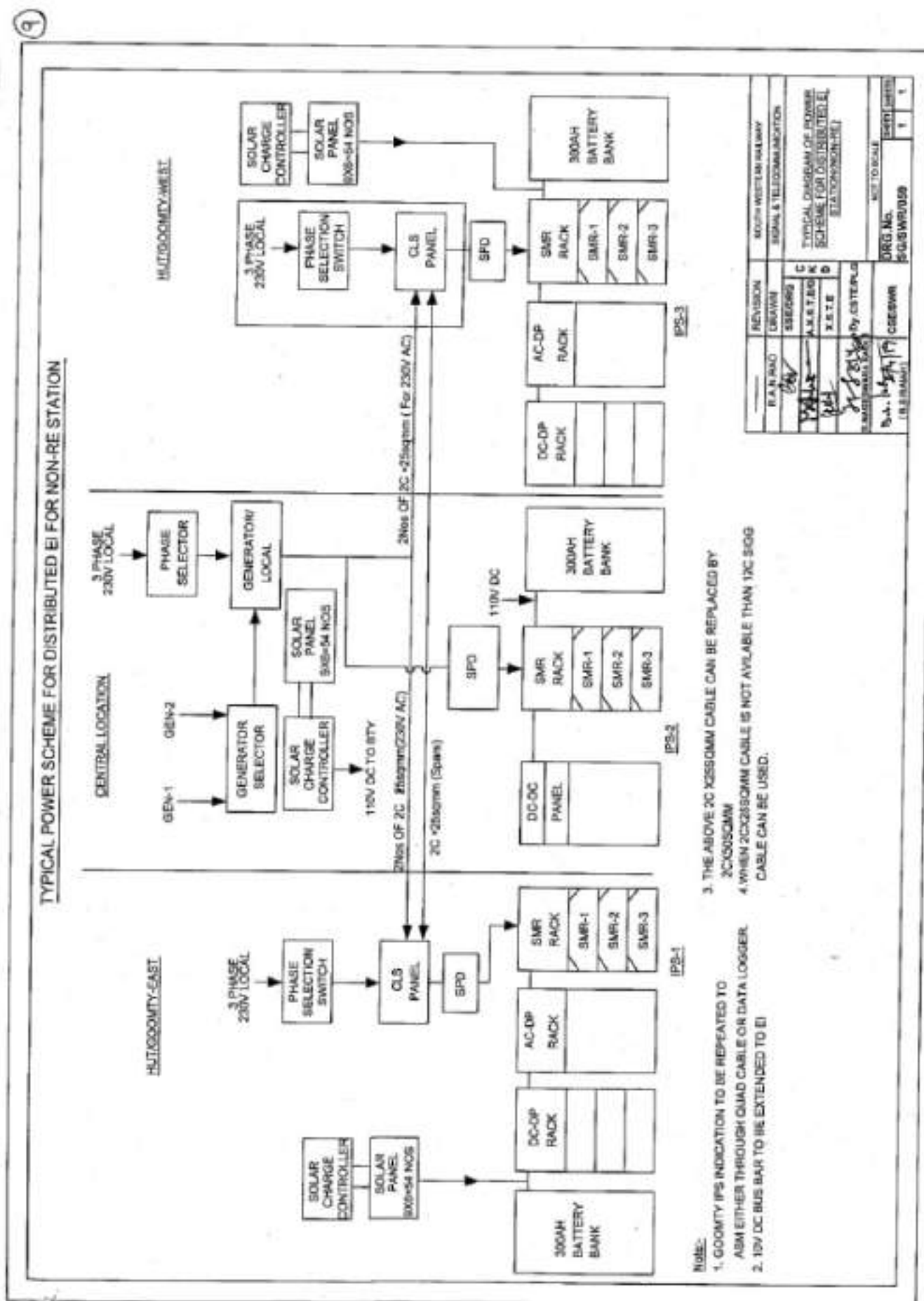
TYPICAL DRAWING OF S&T BUILDING PLAN FOR MID SECTION INTERLOCKED LC GATE



NOTE:-

1. ALL DIMENSIONS ARE IN METRE.
2. THE DOOR SHOULD BE FLUSH TYPE AND OPENED INSIDE.
3. FLOORING AND WALLS INSIDE GROUND SHOULD BE PROVIDED WITH VITREOUS ENAMEL TILES OF COLOUR APPROVED BY S & T TO AVOID ACCUMULATION OF DUST.
4. CABLE DUCT FOR LAYING OF CABLE TO BE PROVIDED IN CONSULTATION WITH ASTE/DSTE.
5. OPENING OF REQUIRED SIZE FOR CABLE ENTRY TO BE PROVIDED AT THE BASEMENT LEVEL IN CONSULTATION WITH ASTE/DSTE.
6. FLOOR LEVEL SHOULD BE AT THE HEIGHT OF 1.0M FROM RAIL LEVEL.
7. ARRANGEMENT FOR FIXING EXHAUST FAN IN BATTERY & EQUIPMENT ROOMS TO BE MADE AS SHOWN.
8. ALL THE WINDOWS AND VENTILATORS SHALL BE PROVIDED WITH DUST PROOF WIRE MESH.
9. REDSO TYPE VENTILATORS TO BE PROVIDED.
10. HEIGHT OF WINDOWS SHOULD BE 0.91M ABOVE FLOOR LEVEL.
11. ROOF SHALL BE SLANTING TO PREVENT WATER ACCUMULATION.
12. HAND RAILING AROUND CAT WALK UP TO 0.7M HEIGHT SHALL BE PROVIDED.

REVISION	DESIGN	DATE	BY	CHKD	APPD
1	R.A.N.BAO	01/01/2019	01/01/2019	01/01/2019	01/01/2019
2	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
3	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
4	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
5	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
6	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
7	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
8	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
9	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
10	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
11	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019
12	01/01/2019	01/01/2019	01/01/2019	01/01/2019	01/01/2019

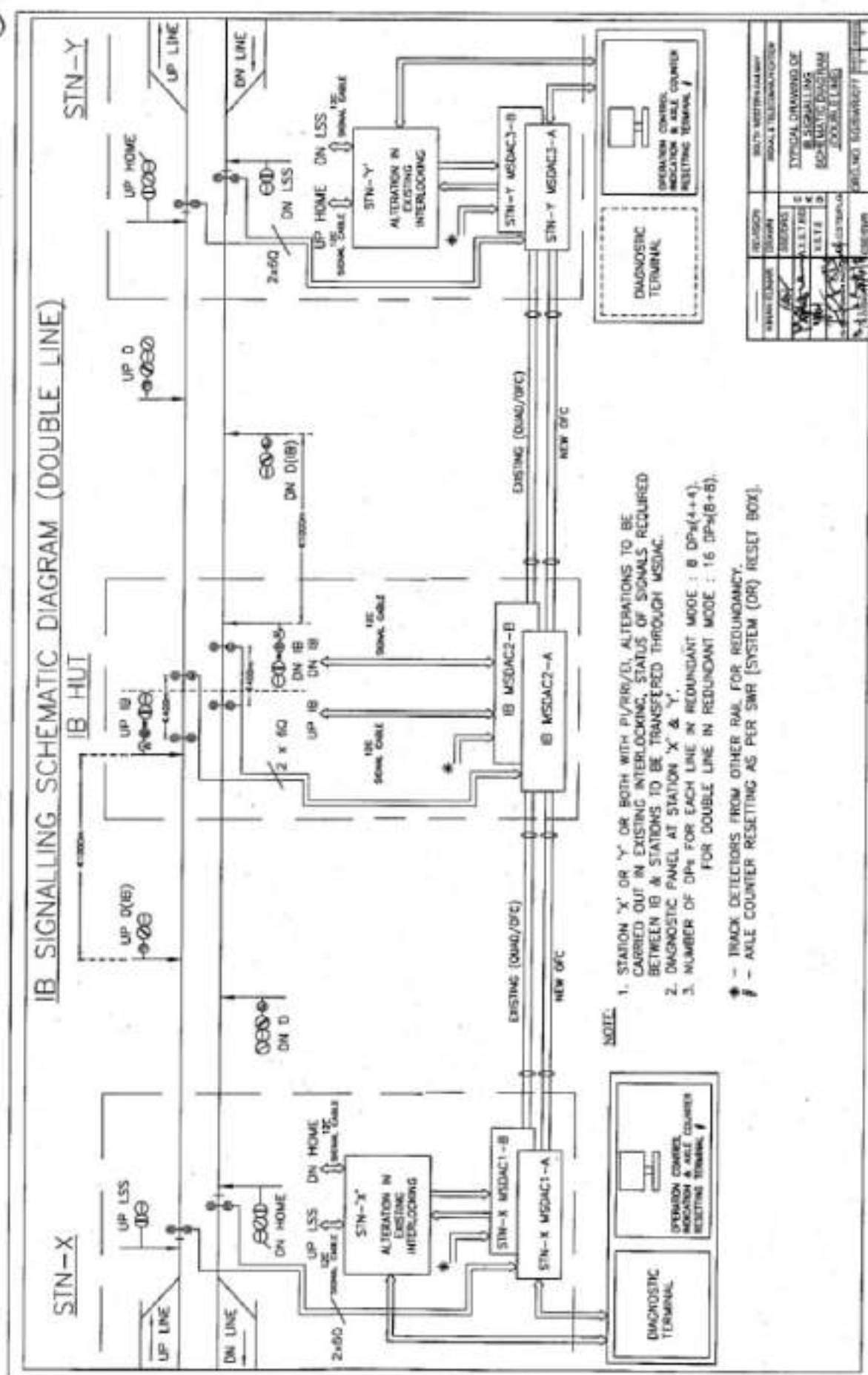


1. AT TRANSFORMER ARE PLACING AT THE END OF PLATFORM OF THE STATION'S
2. LOCAL POWER SUPPLY TO BE EXTENDED FOR STATION TROUGH CABLES.
3. STATION REQUIRED 230VA AT SINCE SAT, PA SYSTEM, OFC LOADS etc.

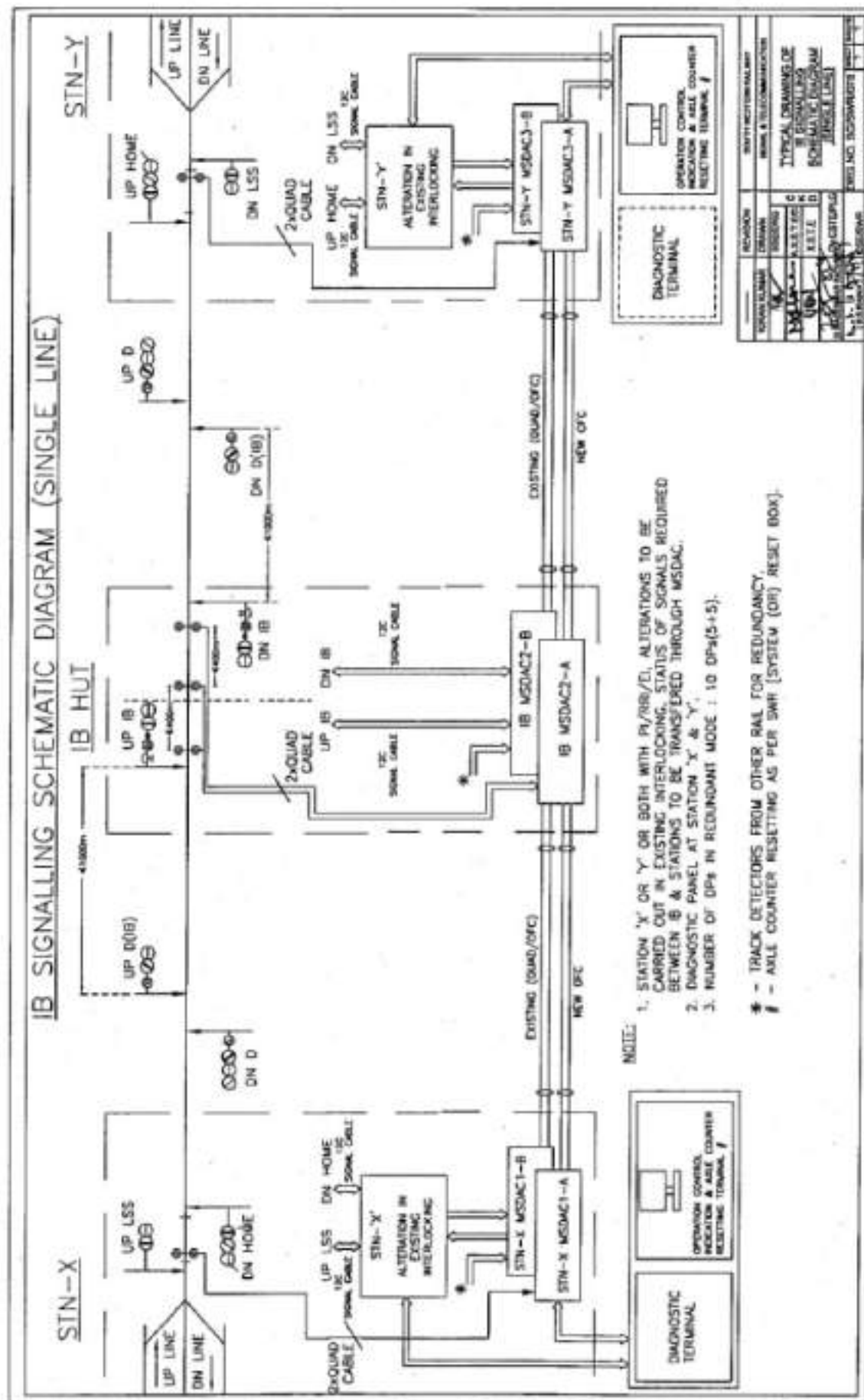
2000 Denotes Conventional aetiology.

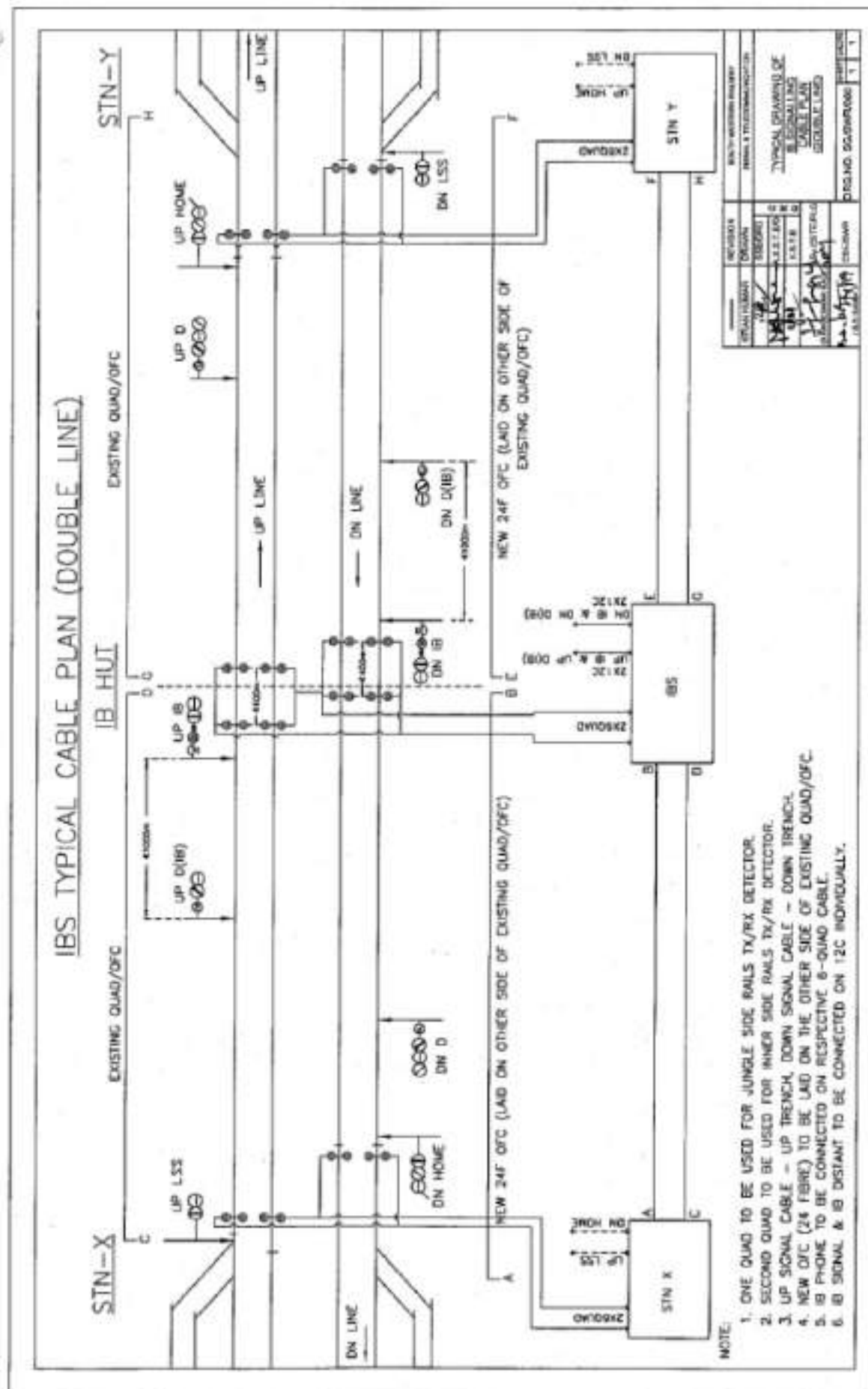
Only Bundles Cable Wire to meet these Scorpion Power Cable.

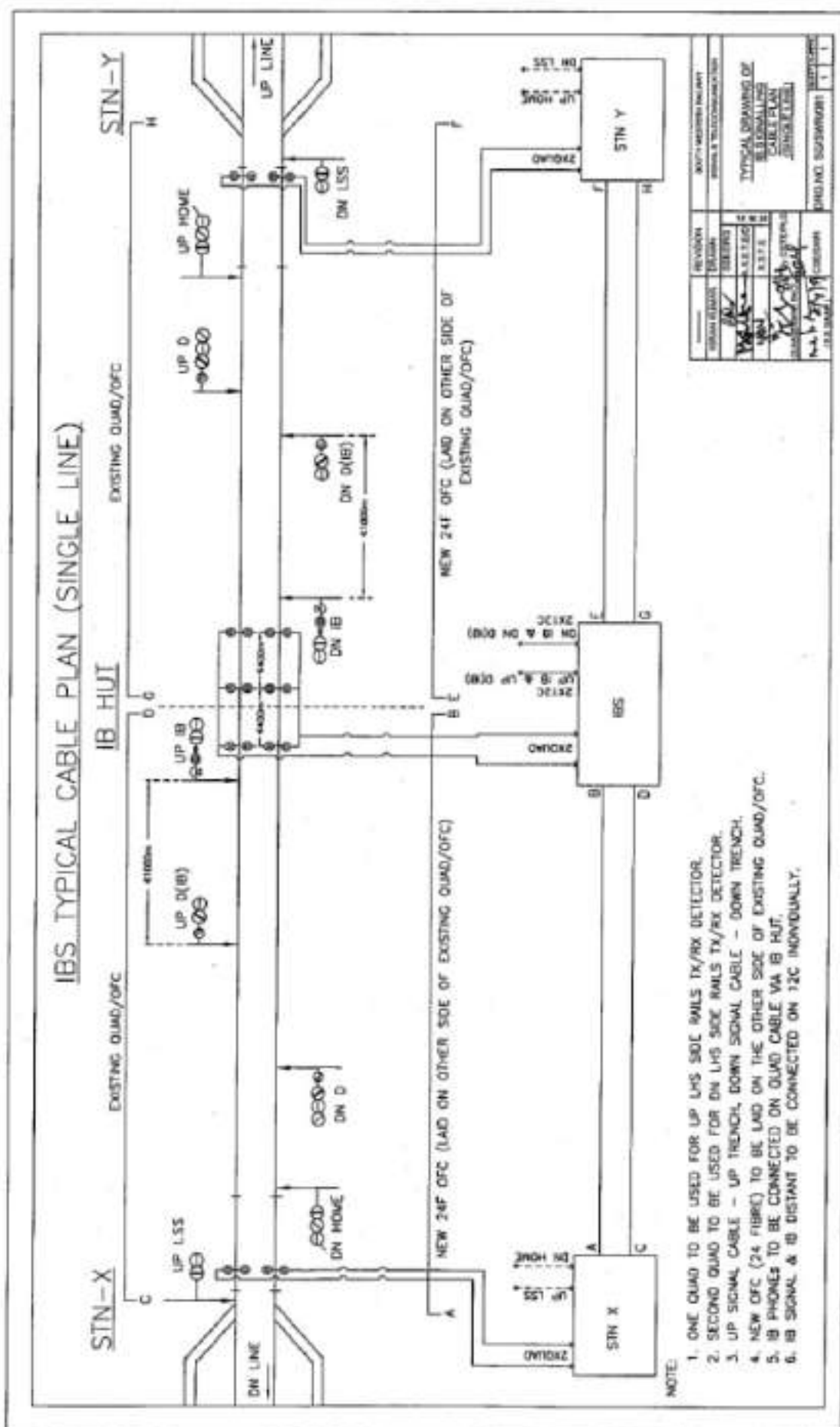
REVISION	SOUTH WESTERN RAILWAY
R.A. READ	SIGNAL & TELECOMMUNICATION
552089	TYPICAL DIAGRAM FOR SCHEME
A X 5 T B C	OF AT POWER SUPPLY
E	ARRANGEMENT BE DISTRIBUTED
D	AT STATIONS WITH TWO END
E	GOINETS
552089	NOT TO SCALE
552089	DRG. No.
552089	SC-5100-010
552089	CREATOR
552089	ISSUANCE

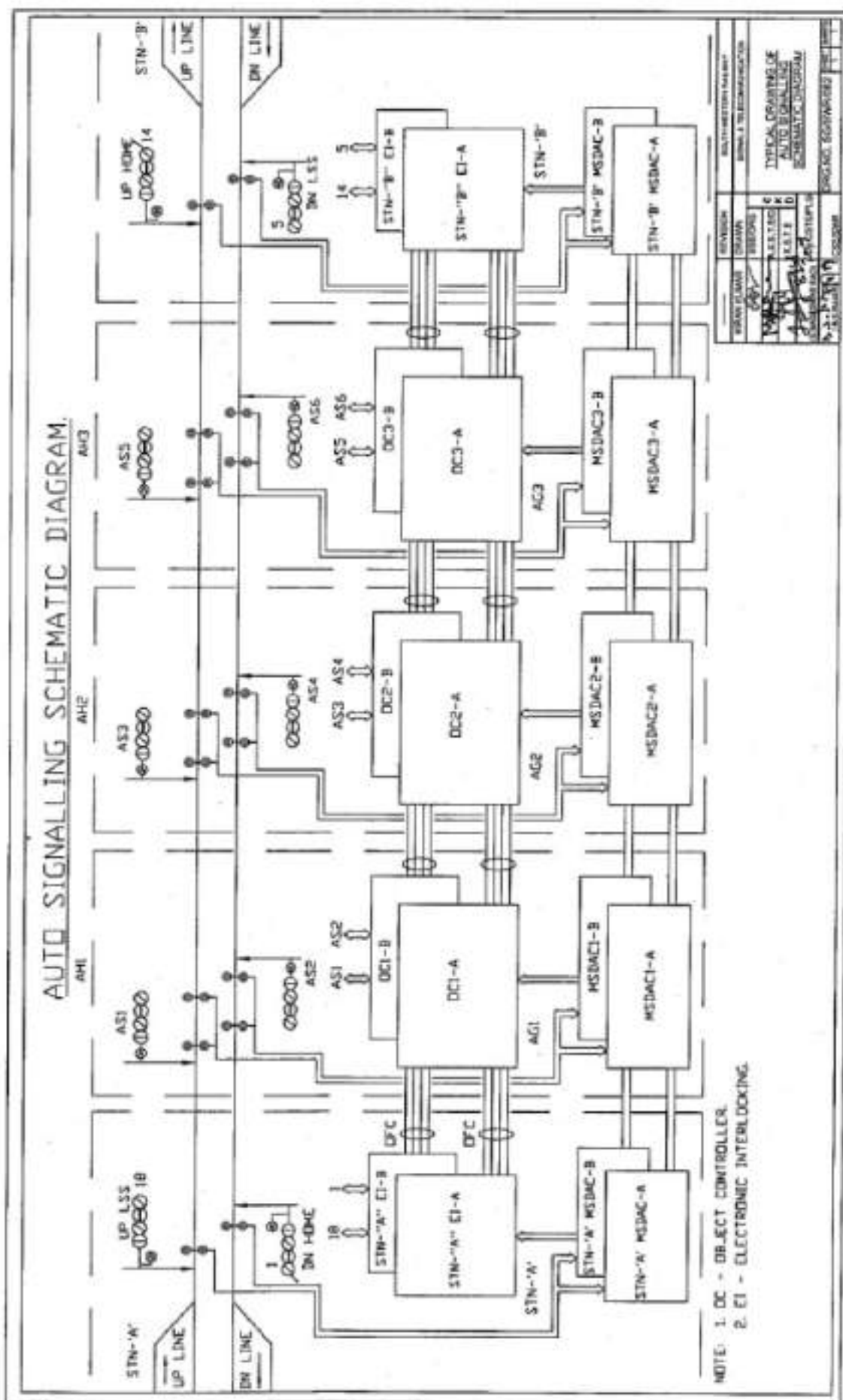


12

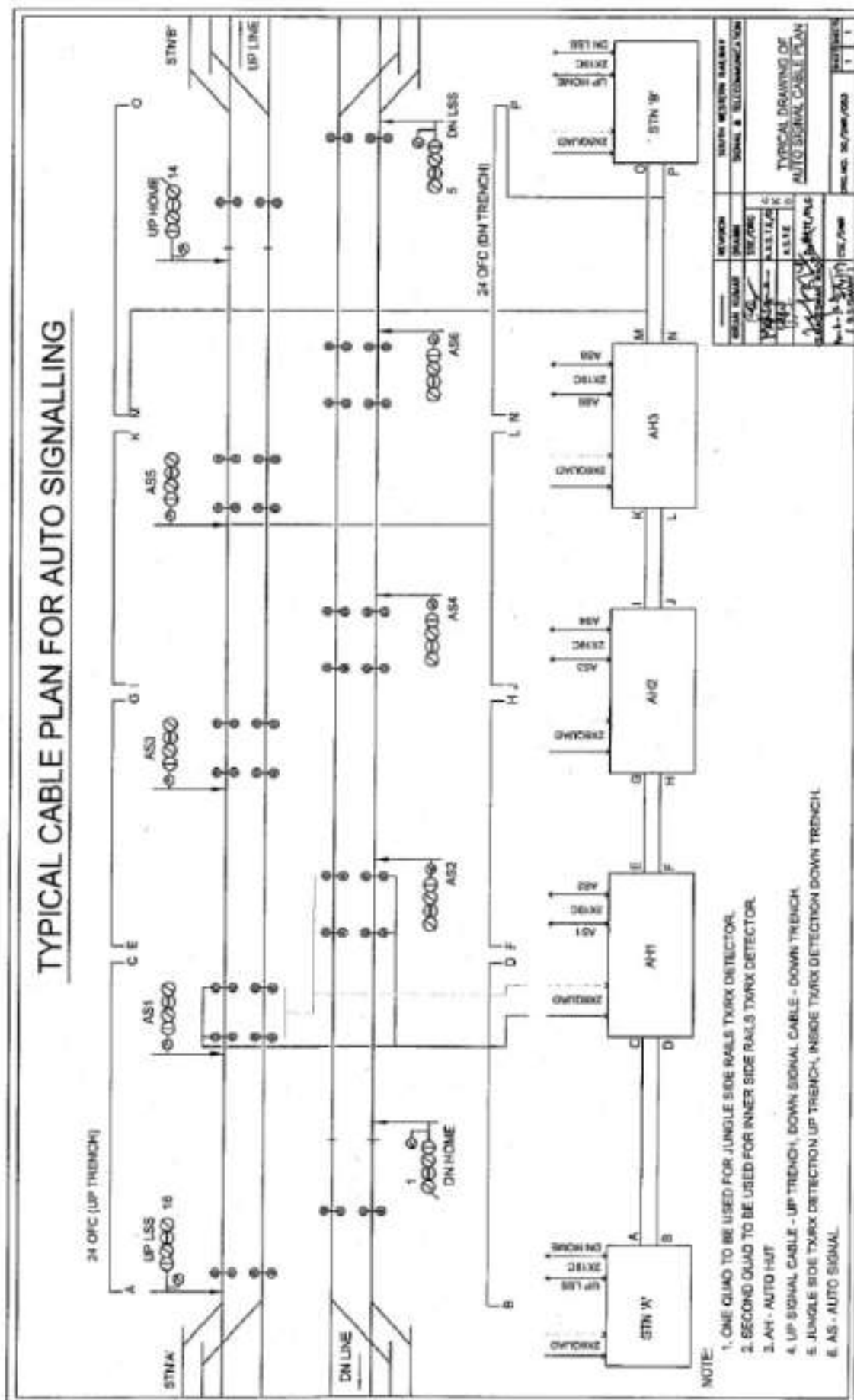


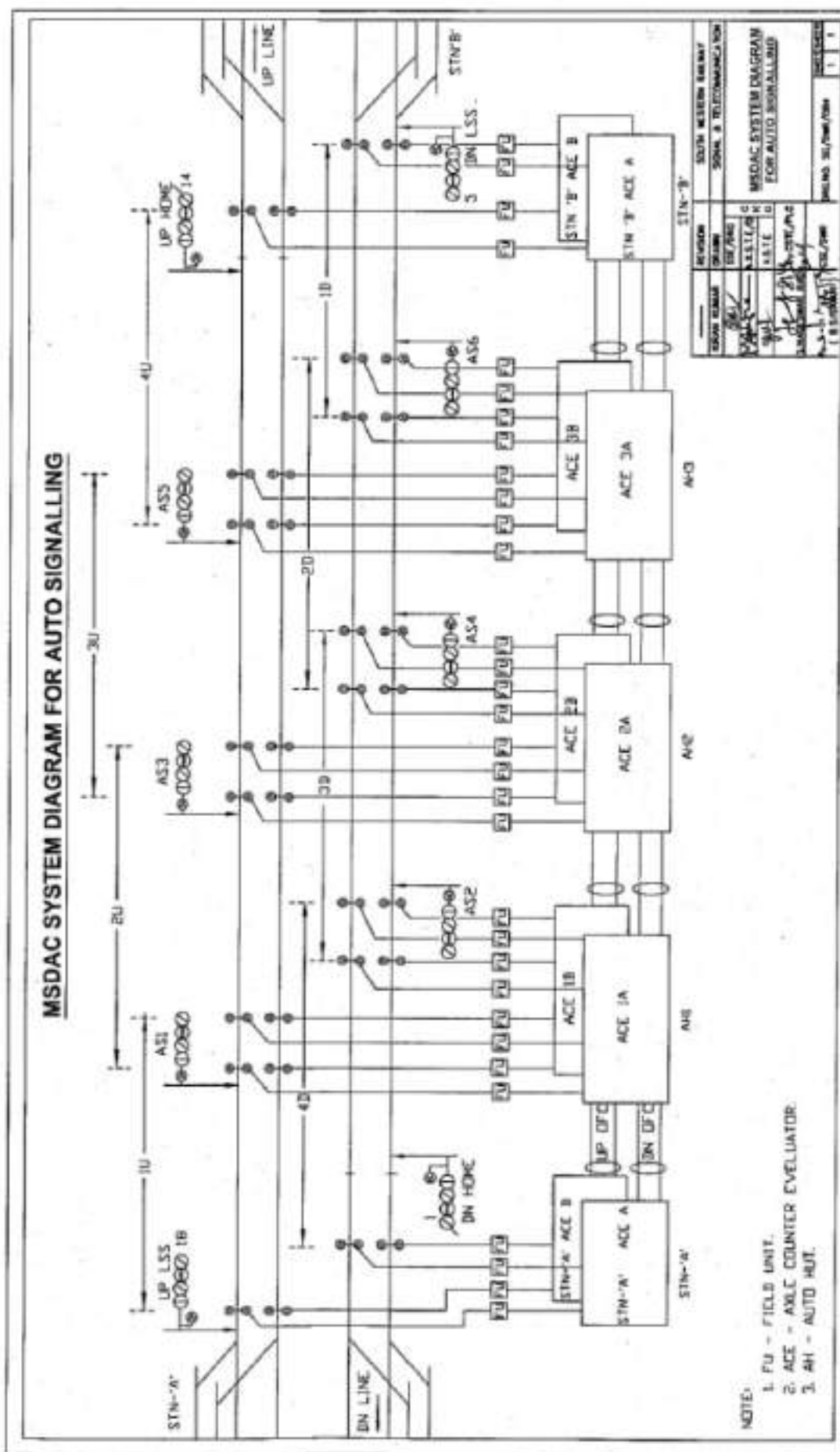




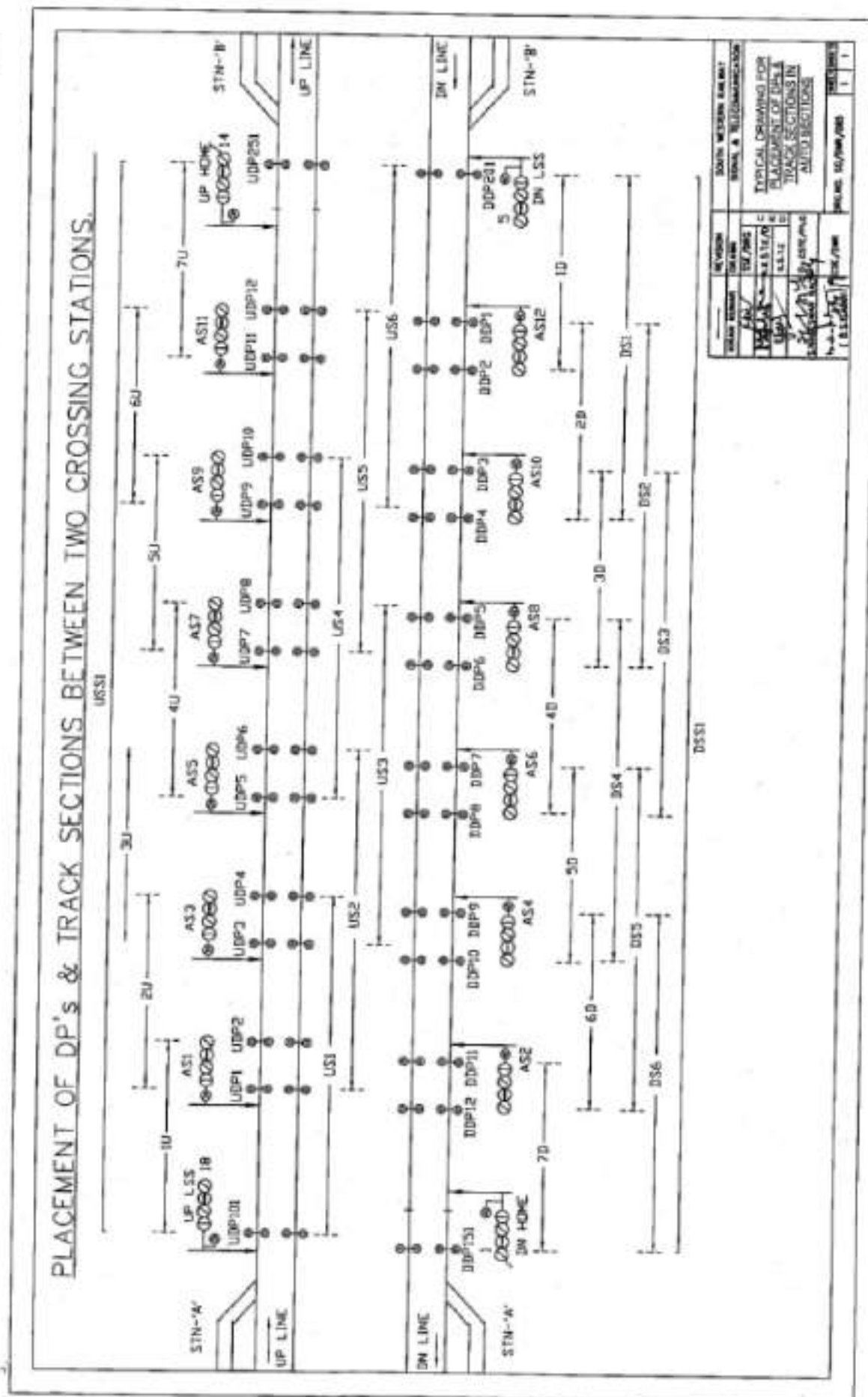


16

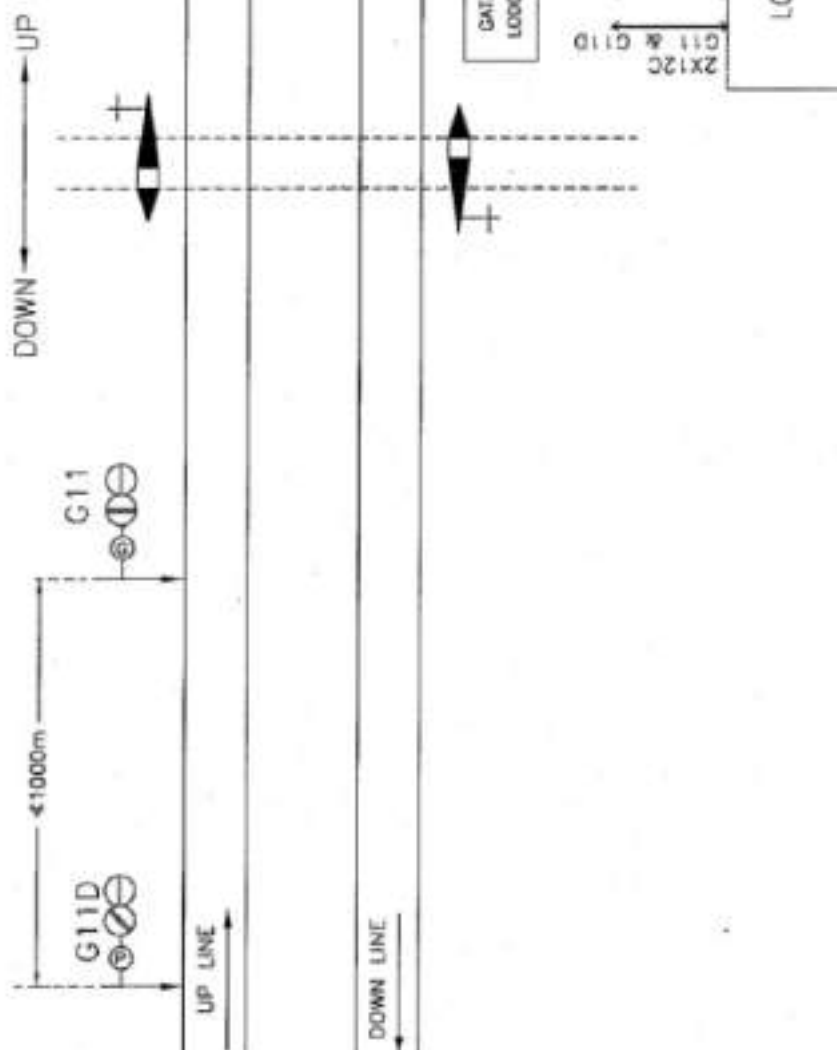




18



TYPICAL CABLE PLAN FOR MID SECTION INTERLOCKED LC GATE



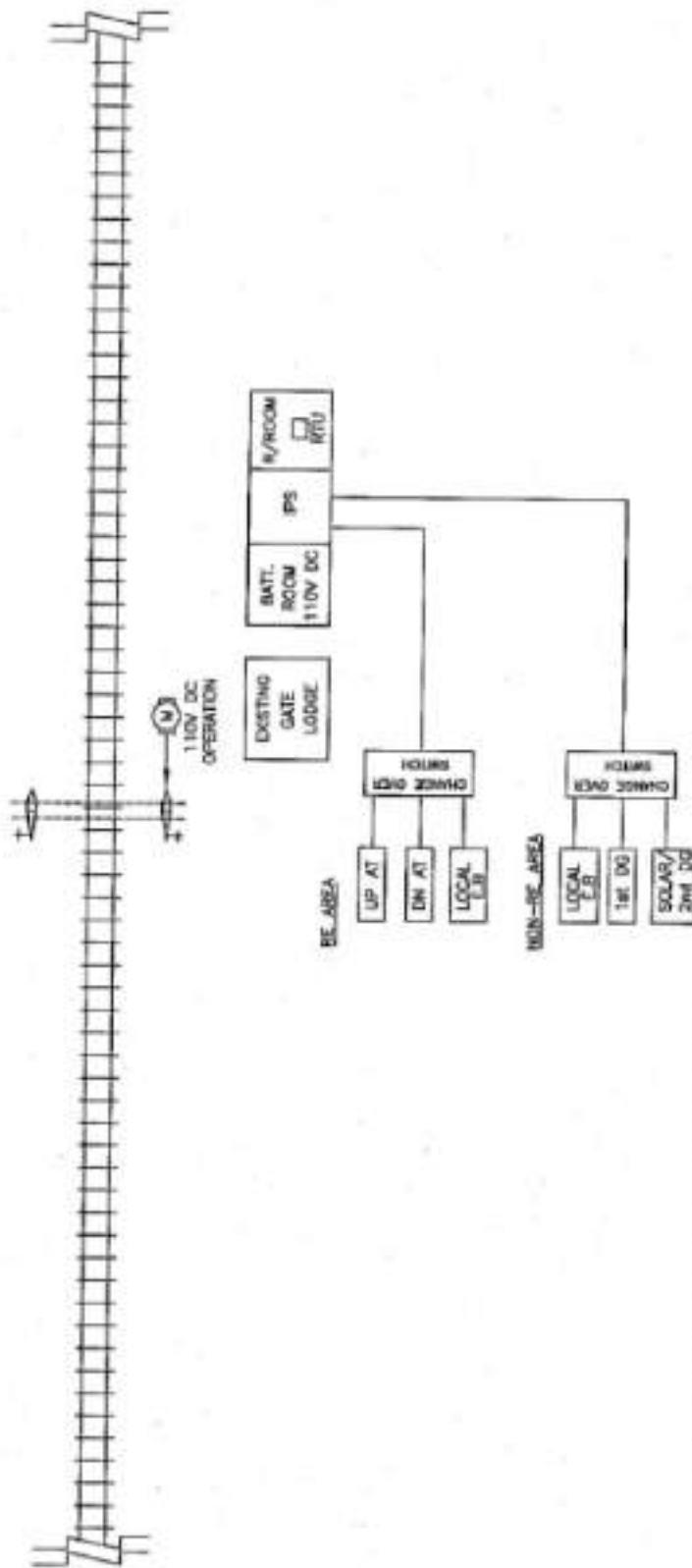
NOTE:

1. GATE SIGNAL & GATE DISTANT SHALL BE CONNECTED THROUGH 12C INDIVIDUALLY.
2. ELECTRONIC LC GATE TELEPHONE SHALL BE CONNECTED THROUGH QUAD CABLE FROM CONTROLLING STATION.
3. RTU AT MID-SECTION LC GATES SHALL BE CONNECTED THROUGH QUAD CABLE FROM NEAREST STATION.
4. ROAD WARNING SIGNALS SHALL BE SO POSITIONED, TO HAVE CLEAR VISIBILITY FOR ROAD USERS & NOT TO LOOZ PLOTS.

REVISION	DATE	BY	CHKD	APPD
1	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
2	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
3	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
4	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
5	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
6	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
7	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
8	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
9	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
10	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
11	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
12	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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18	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
19	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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21	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
22	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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25	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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35	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
36	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
37	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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60	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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74	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
75	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
76	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
77	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
78	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
79	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
80	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
81	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
82	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
83	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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87	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
88	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC
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100	10/11/17	SSC/SSC	SSC/SSC	SSC/SSC

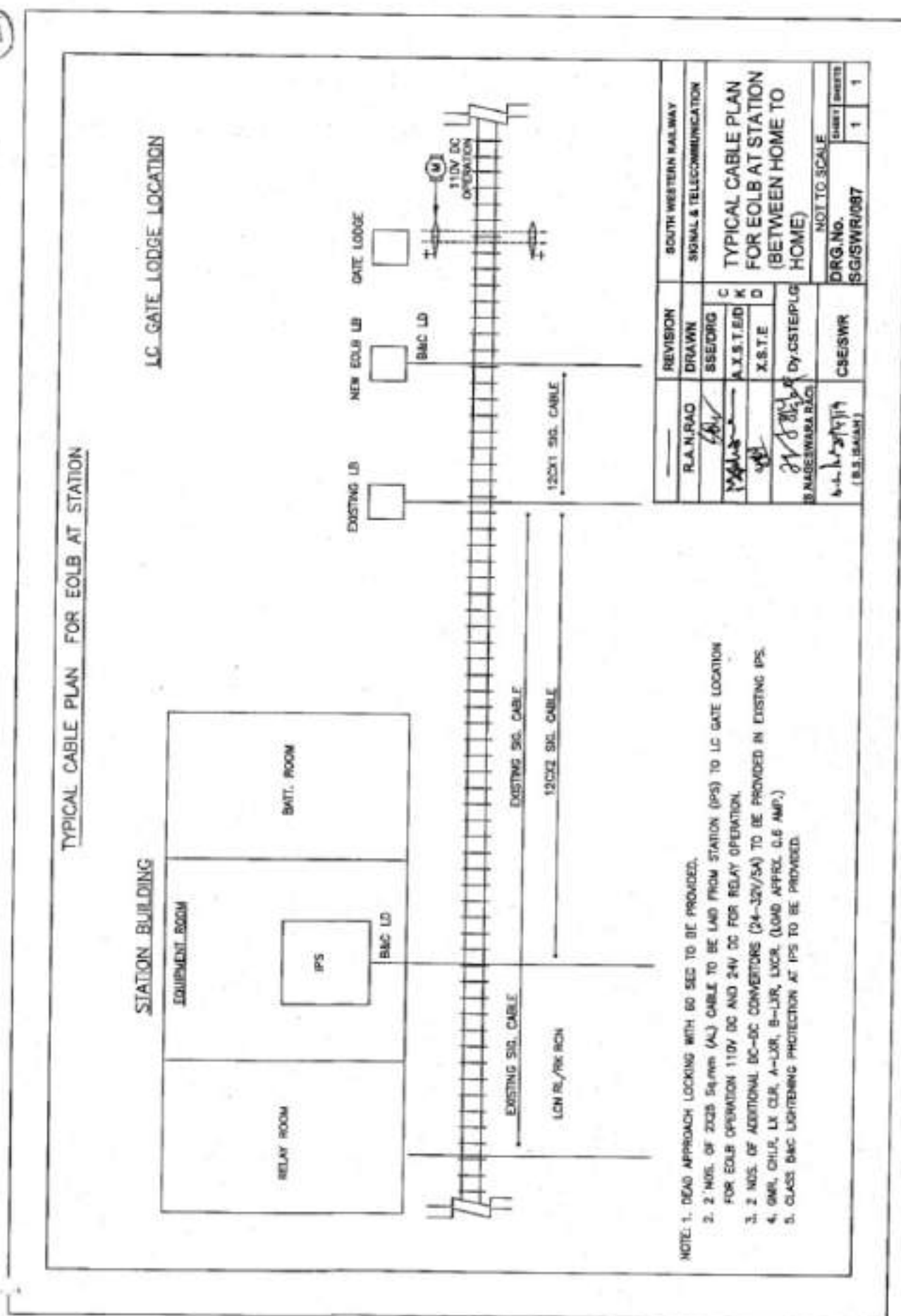
20

TYPICAL POWER SCHEME FOR EOLB AT MID SECTION INTERLOCKED LC GATE

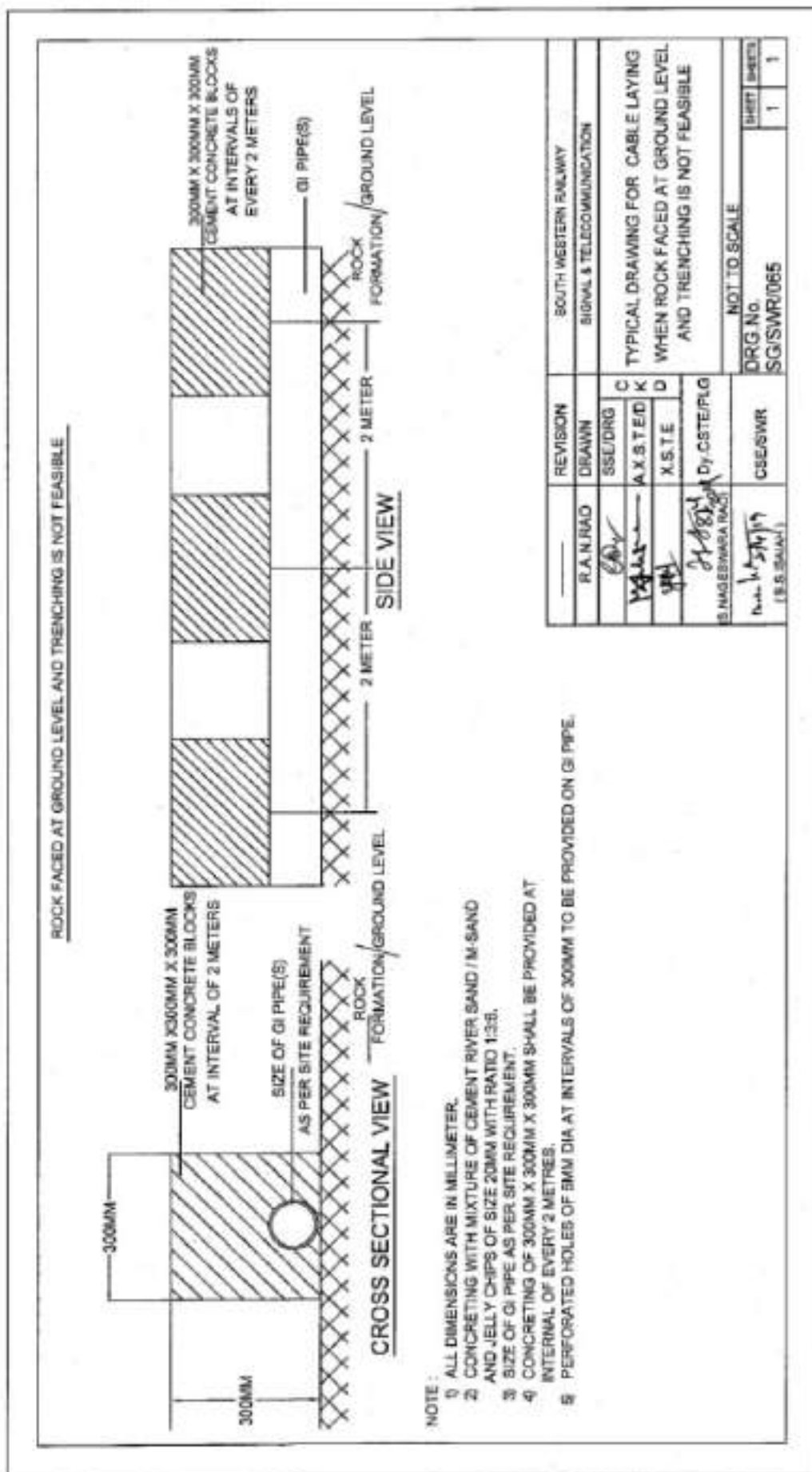


NOTE: Along with EOLB 60 Sec. Dead Approach locking to be provided.

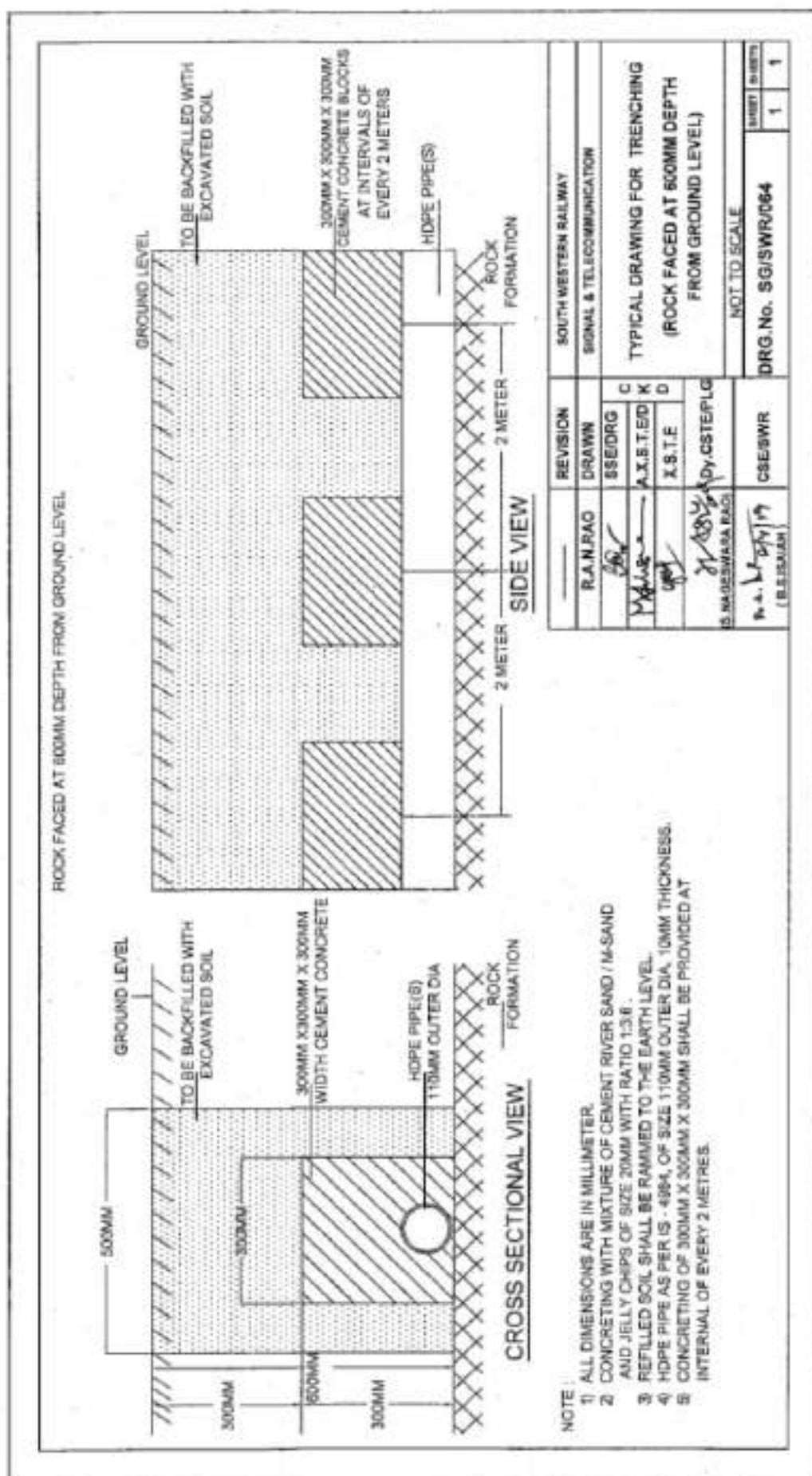
REVISION		SOUTH WESTERN RAILWAY	
PLAN/RAO	DRAWN	SIGNAL & TELECOMMUNICATION	
	SSE/ORG	C	TYPICAL POWER SCHEME FOR EOLB AT MID SECTION INTERLOCKED LG GATE
	A.X.S.T.E.D	K	
	X.S.T.E	D	
	Py.C.S.T.E.P.L.G		
S. MADHAWA RAO		NOT TO SCALE	
	CSE/SWR	DRG.No.	SHEET SHEETS
		SG/SWR/0086	1 1
(S.S. RAO)			



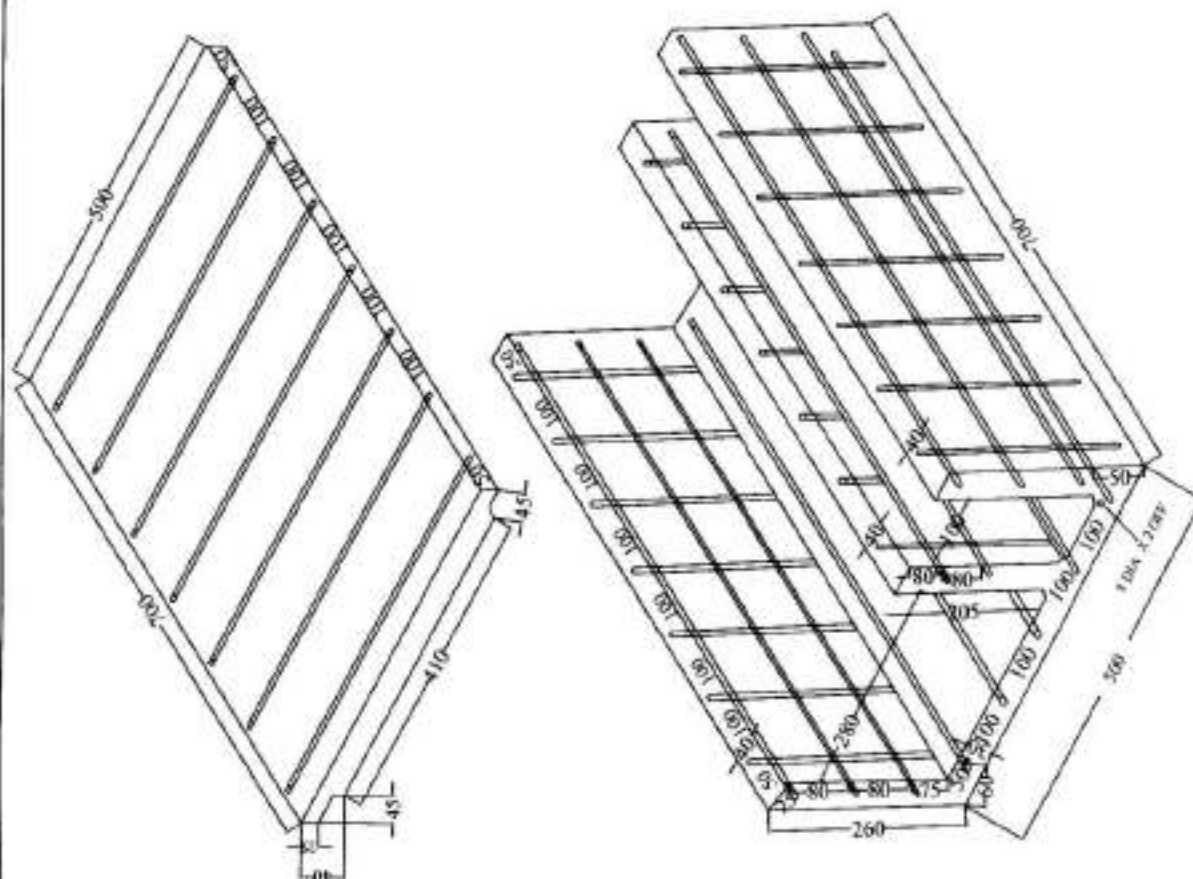
22



TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS (MAY-2019)

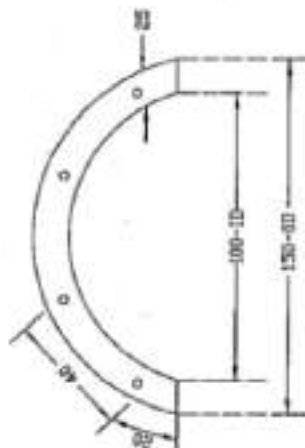
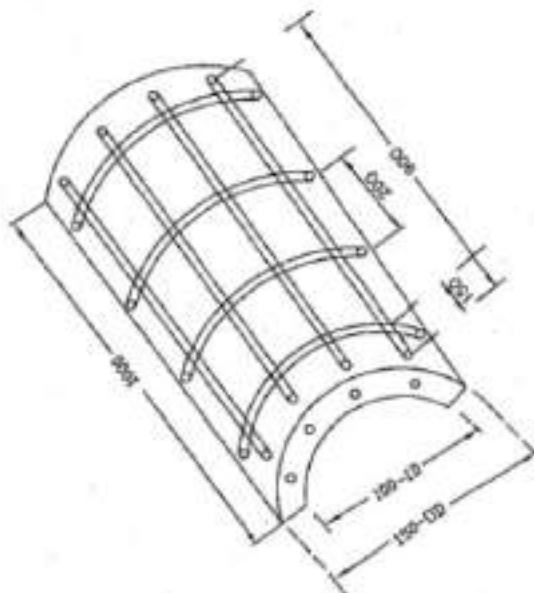


TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS (MAY-2019)



- Note :-
1. TRUNKING AND CAPPING ARE SUITABLE FOR BURYING ADJACENT TO THE TRACKS IN TRENCHES WITH MINIMUM DEPTH OF 600 mm.
 2. THE TRUNKING TO BE ALIGNED BY PUTTING AN MS ROD OF 8 mm DIA. X 100mm LONG AS PER IS:432 PART (1)-1982 IN THE TWO HOLES PROVIDED.
 3. 6.0 mm DIA HIGH STRENGTH DEFORMED STEEL BARS CONFORMING TO IS:11786 TO BE USED FOR REINFORCEMENT
 4. M - 25 GRADE OF CONCRETE TO BE USED CONFORMING TO IS: 10262 - 1982 AND IS:456 - 2000
 5. - 10 mm SIZE COURSE AGGREGATE TO BE USED. OPC OF 43 GRADE TO BE USED CONFORMING TO IS:8112 - 1989.
 6. THE ACCEPTANCE TEST SHALL BE CONDUCTED IN A RECOGNISED LABORATORY AND THE COST OF THE TEST AS CHARGED BY THE LABORATORY SHALL BE BORNE BY THE CONTRACTOR.
 7. CURING SHALL BE DONE AS PER THE IS: 456:2000.
 8. DUCT MAY BE IN-SITU OR FACTORY MADE
 9. ALL DIMENSIONS ARE IN MILLIMETER

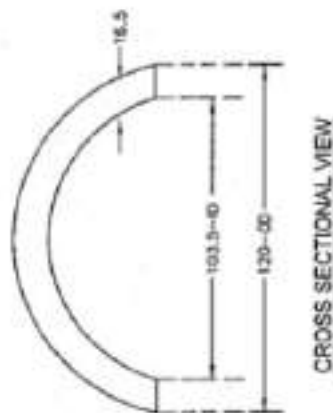
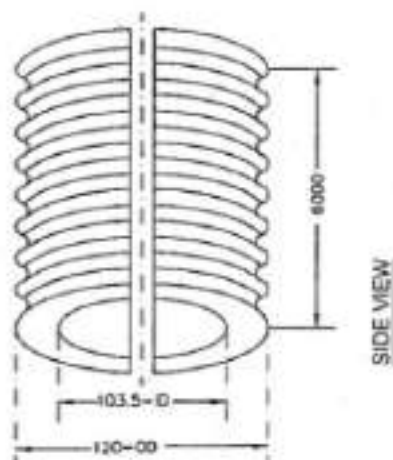
CHECKED BY	JE/SE/SEE	RCC DUCT 500 MM.	SDO/CABLE LAYING/007
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			



1. RCC SPLIT PIPE SIMILAR TO HP2 PIPES CONSISTING REINFORCED CONCRETE AND ARE SUITABLE FOR BURYING ADJACENT TO THE TRACKS IN TRENCHES WITH MINIMUM DEPTH OF 600mm.
2. 8 SWG 0 MILD STEEL WIRE CONFORMING TO IS:280-3006 TO BE USED FOR REINFORCEMENT.
3. M-25 GRADE OF CONCRETE TO BE USED CONFORMING TO IS:10262-1982 AND IS:456-2000 WITH MAXIMUM 8mm SIZE COURSE AGGREGATE.
4. OPC OF 43 GRADE TO BE USED CONFORMING TO IS:8112-1969.
5. THE CURB TEST SHALL BE CONDUCTED IN A RECOGNISED LABORATORY AND THE COST OF THE TEST AS CHARGED BY THE LABORATORY SHALL BE BORNE BY THE CONTRACTOR.
6. CURING SHALL BE DONE AS PER THE IS:456-2000.
7. PIPE SHALL BE FACTORY MADE.
8. ALL DIMENSION ARE IN MILLIMETER.

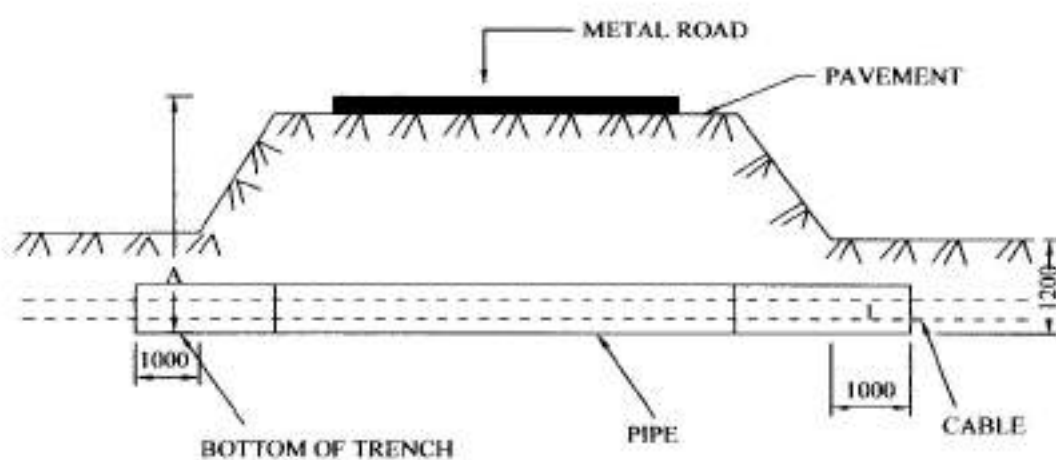
REVISION	SOUTH WESTERN RAILWAY
DRAWN	SERIAL & TELECOMMUNICATIONS
DESIGNED	C
CHECKED	AXS/EDK
APPROVED	R.S.T.E
DATE	27/03/2019
BY	CS/ENR
FOR	CS/ENR
NOT TO SCALE	
DRG. No.	BQSWR0061
SHEET	1
TOTAL SHEETS	1

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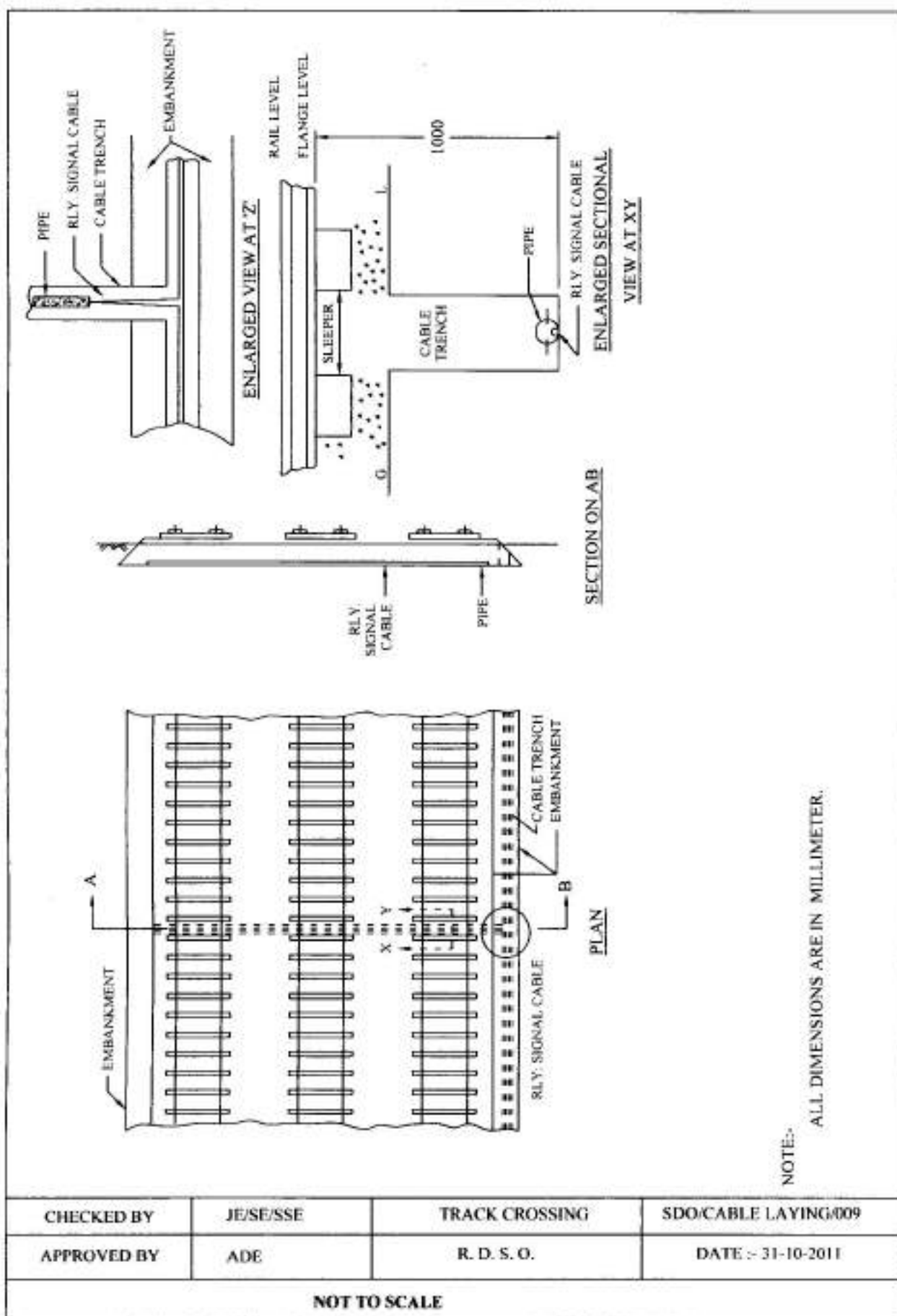
1. DWG SPLIT PIPE OF ID 103.5mm DIA AND OD 120mm DIA. OF STANDARD LENGTH OF 6mms WITH COUPLING SHALL BE PROVIDED SUITABLE FOR BURYING ADJACENT TO THE TRACKS.
2. PIPE SHALL BE FACTORY MADE AS PER IS SPEC No. 1485(PART-2), 2001
3. ALL DIMENSION ARE IN MILLIMETER.

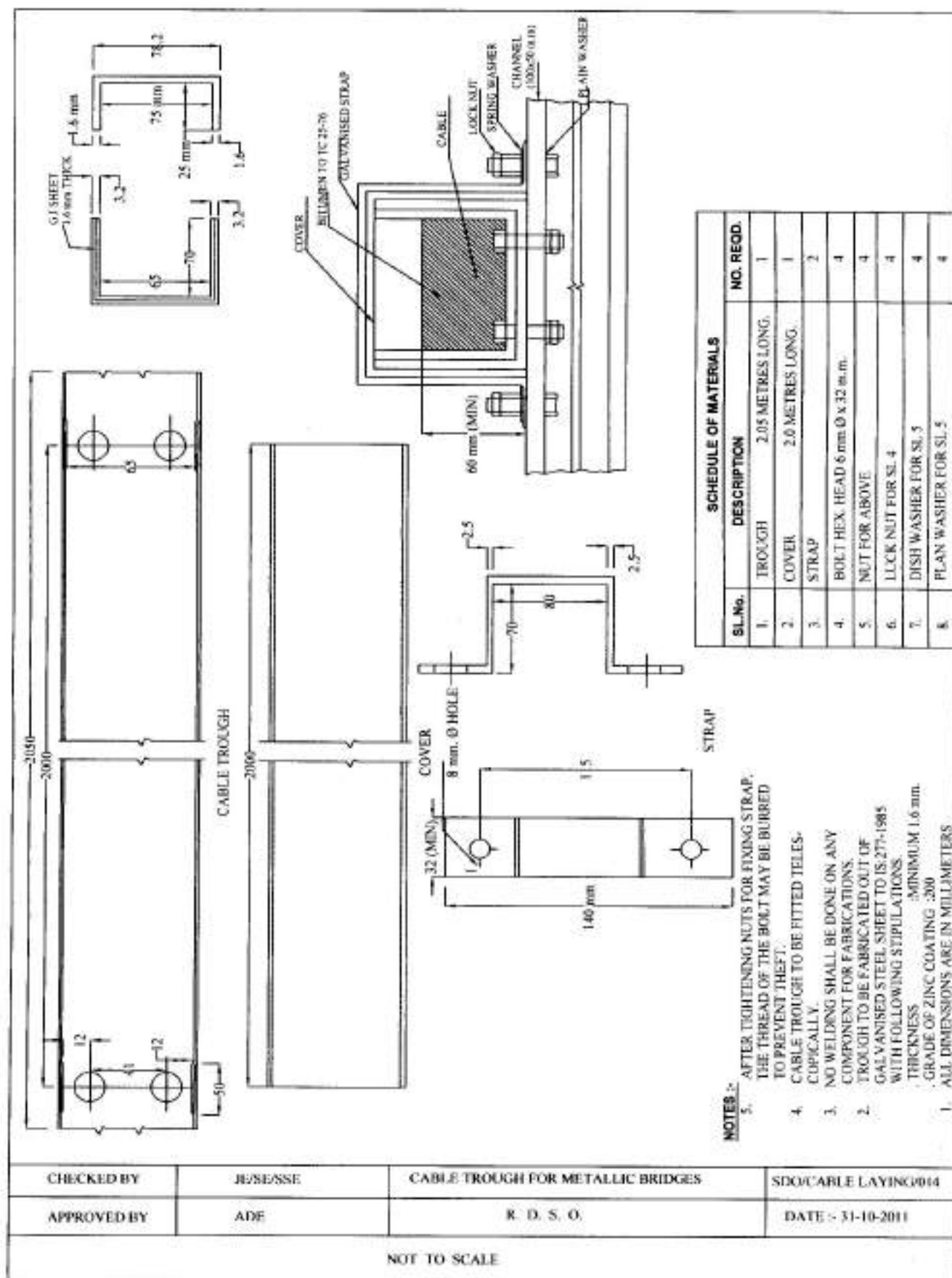
REVISION	SOUTH WESTERN RAILWAY
DRAWN	SIGNAL & TELECOMMUNICATION
CHECKED	TYPICAL DRAWING OF
APPROVED	DWG SPLIT PIPE
DATE	(120mm DIA)
BY	NOT TO SCALE
DATE	DRG No.
BY	SQL/SWR/009
DATE	SHEET NO.
BY	1
DATE	1



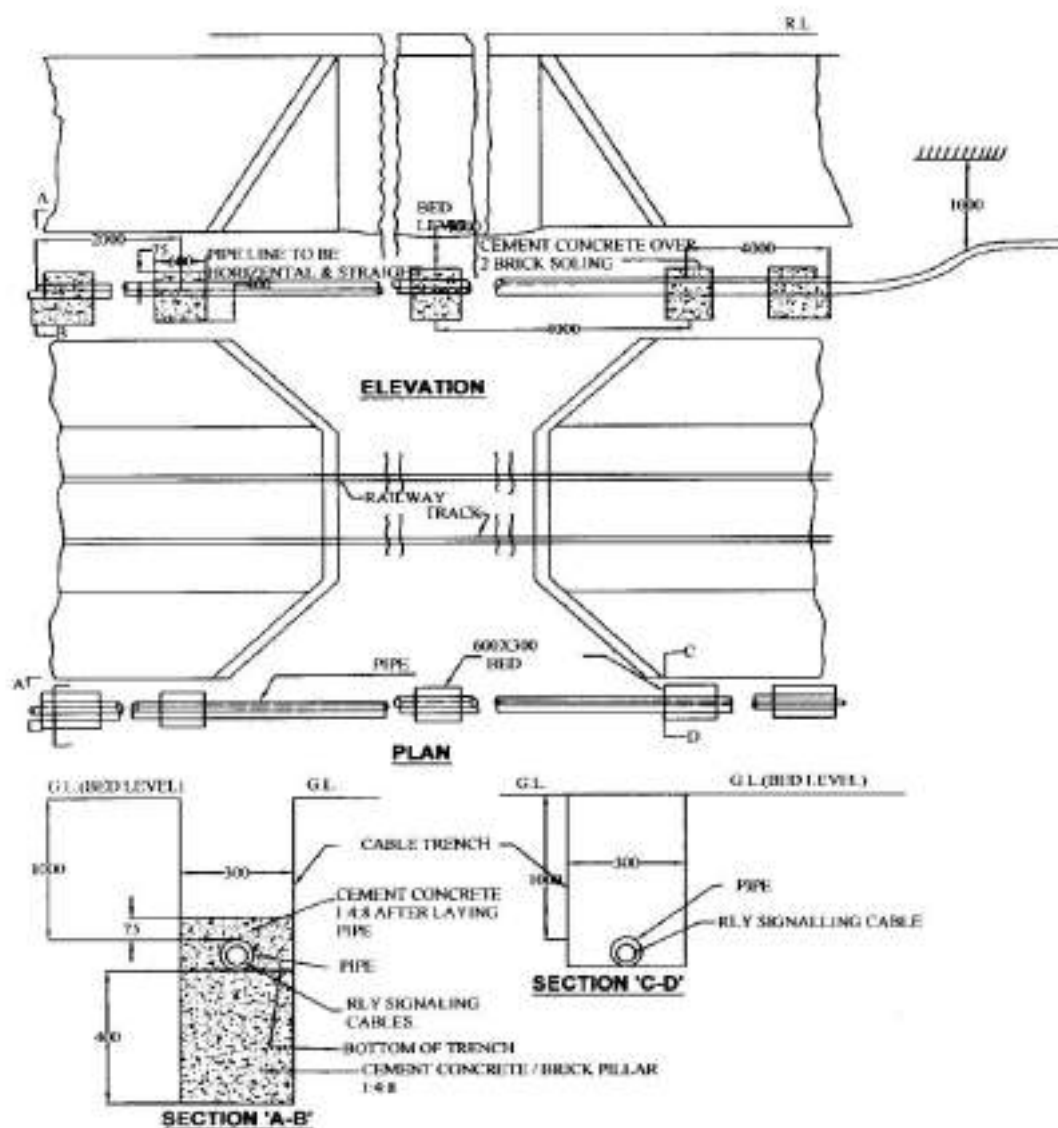
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	ROAD CROSSINGS	SDO/CABLE LAYING/010
APPROVED BY	ADE	R. D. S. O.	DATE :- 31-10-2011
NOT TO SCALE			





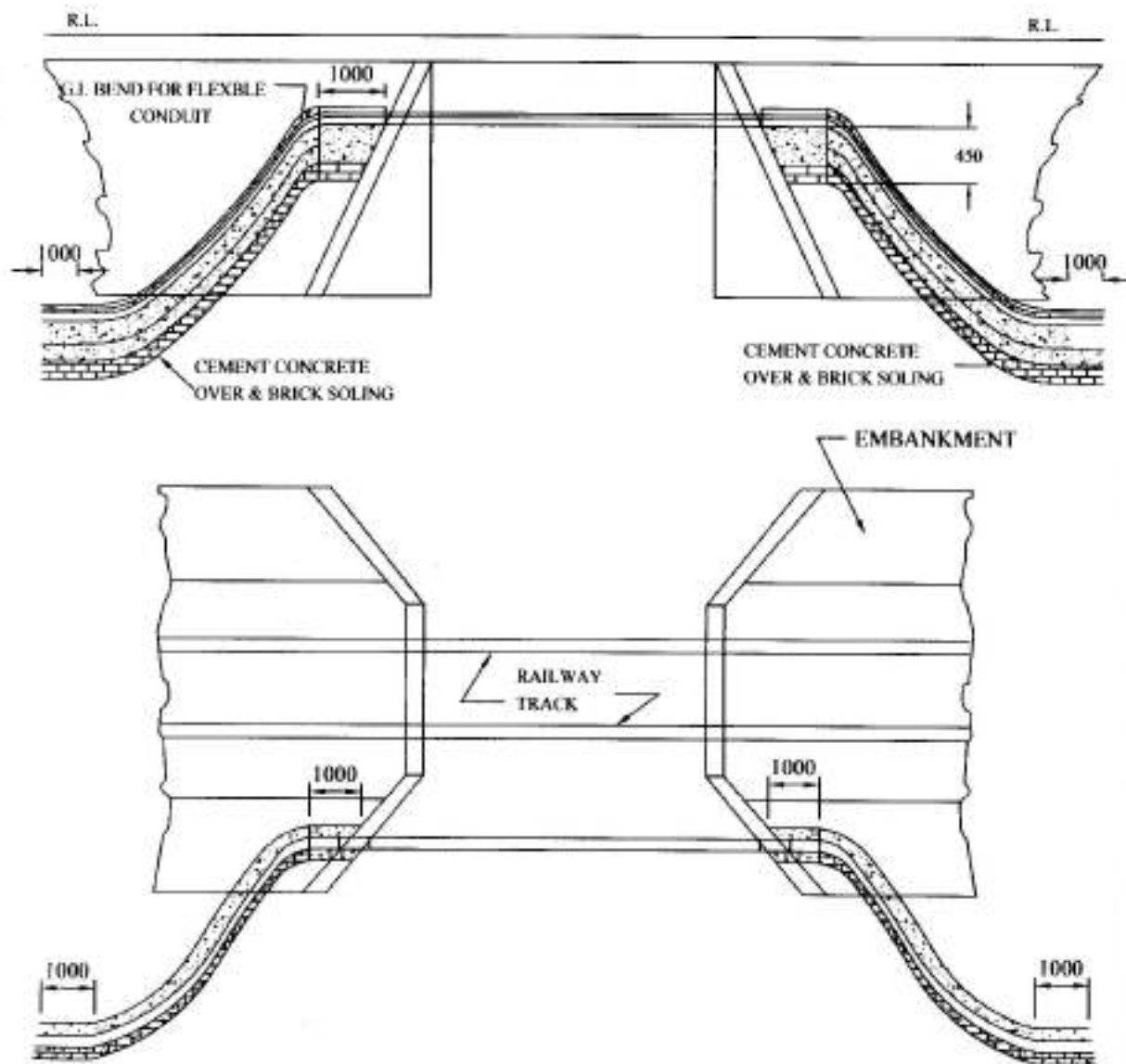
TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS (MAY-2019)



NOTE:-

ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH LOW FLOOD LEVEL	SDO/CABLE LAYING/011
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

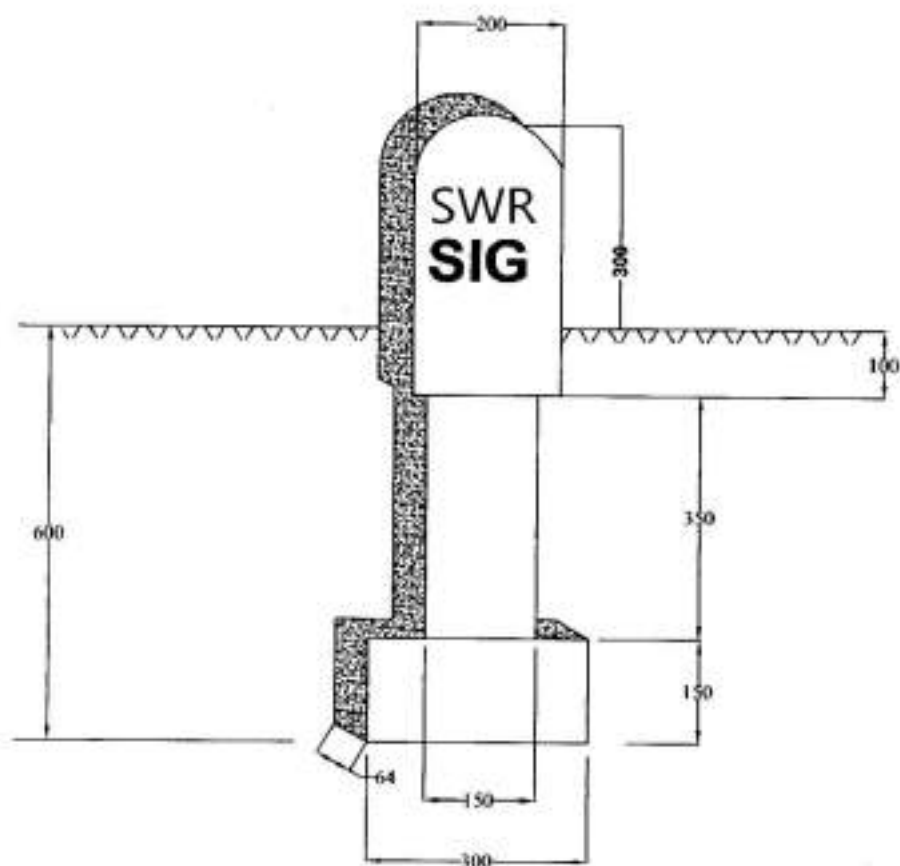


NOTE:-
ALL DIMENSIONS ARE IN MILLIMETER.

CHECKED BY	JE/SE/SSE	CABLE LAYING ON CULVERTS WITH HIGH FLOOD LEVEL	SDO/CABLE LAYING/012
APPROVED BY	ADE	R.D.S.O	DATE :- 31-10-2011
NOT TO SCALE			

REINFORCEMENT DETAILS FOR RCC CABLE MANNER

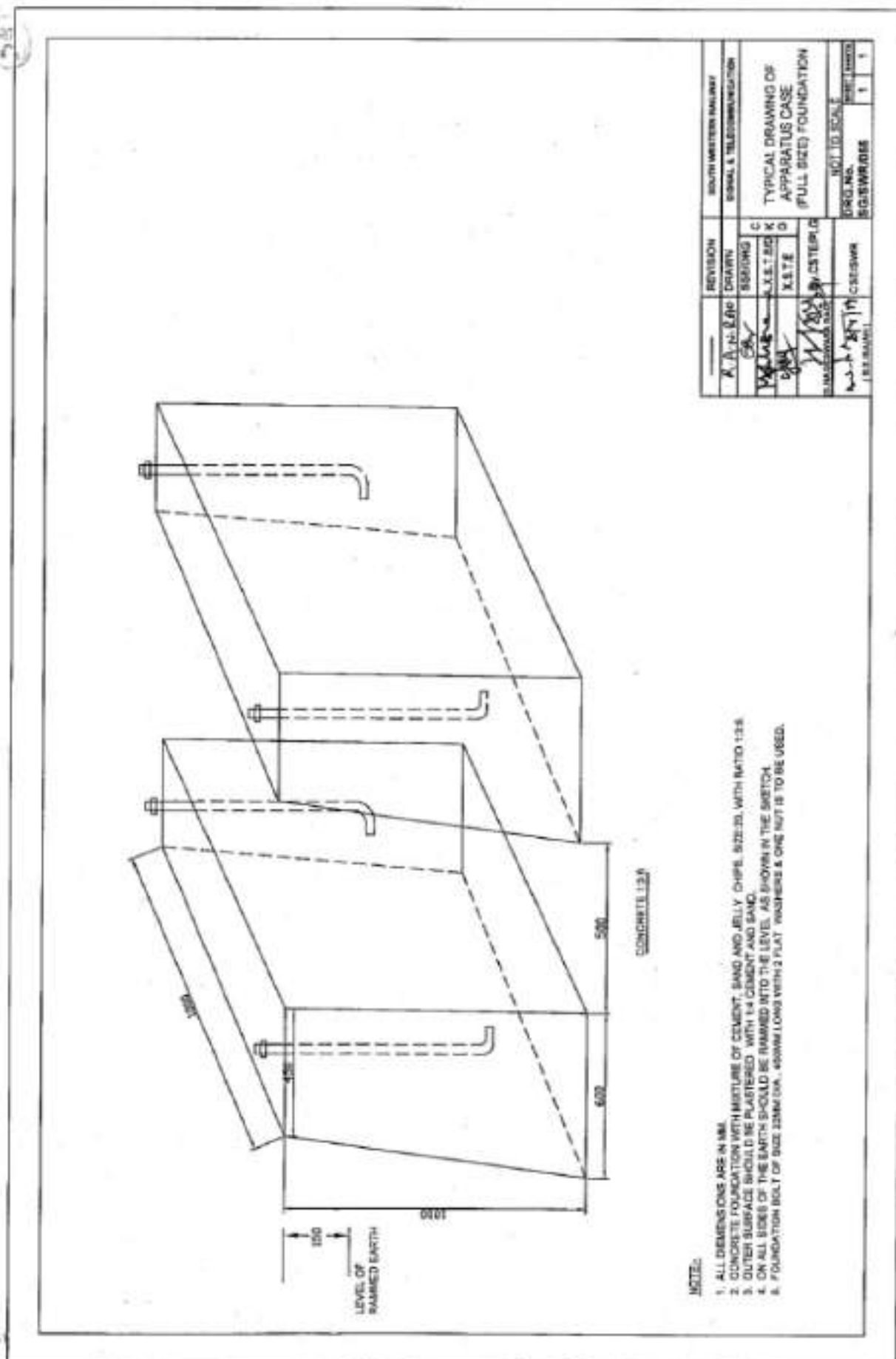
[illegible]



NOTE:-

1. ALL DIMENTIONS ARE IN MILLIMETER
2. PAINTED WHITE LETTERS ON RED BACKGROUND.
3. FOUNDATION CONCRETE OF 300 mm FROM THE BASE OF THE MARKER SHALL BE DONE AT SITE AT ALL PLACES WITH MIX 1:3:5.
4. COMPONENT CONCRETE SHALL BE OF M25 MIX AND WIRE MESH OF 1.5MM THICKMESS SHALL BE USED.
5. THE ENGRAVING OF "RLY" & "SIG" SHALL BE DONE ON BOTH SIDES OF THE MARKER.

CHECKED BY	JE/SE/SSE	CONCRETE CABLE MARKER	SDO/CABLE LAYING/020
APPROVED BY	ADE	R.D.S.O.	DATE :- 31-10-2011
NOT TO SCALE			





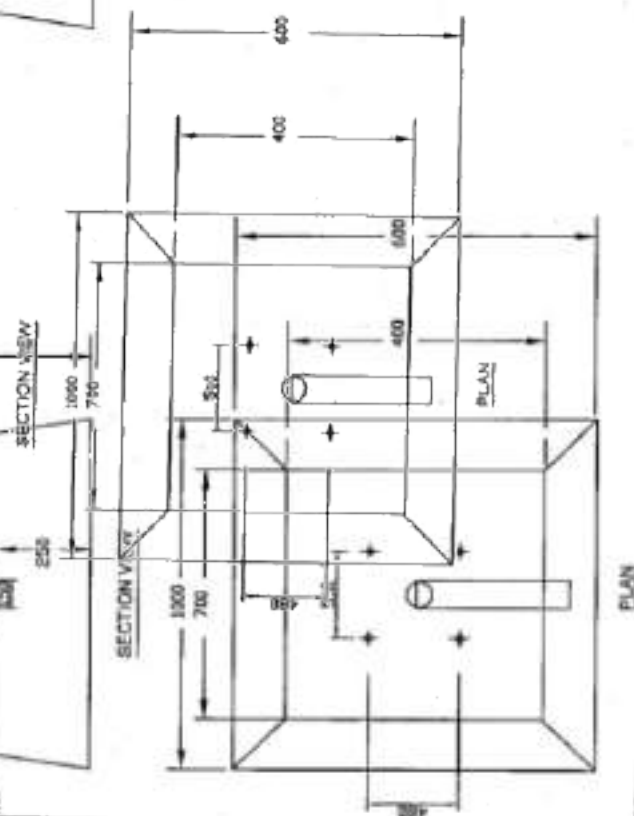
salmon

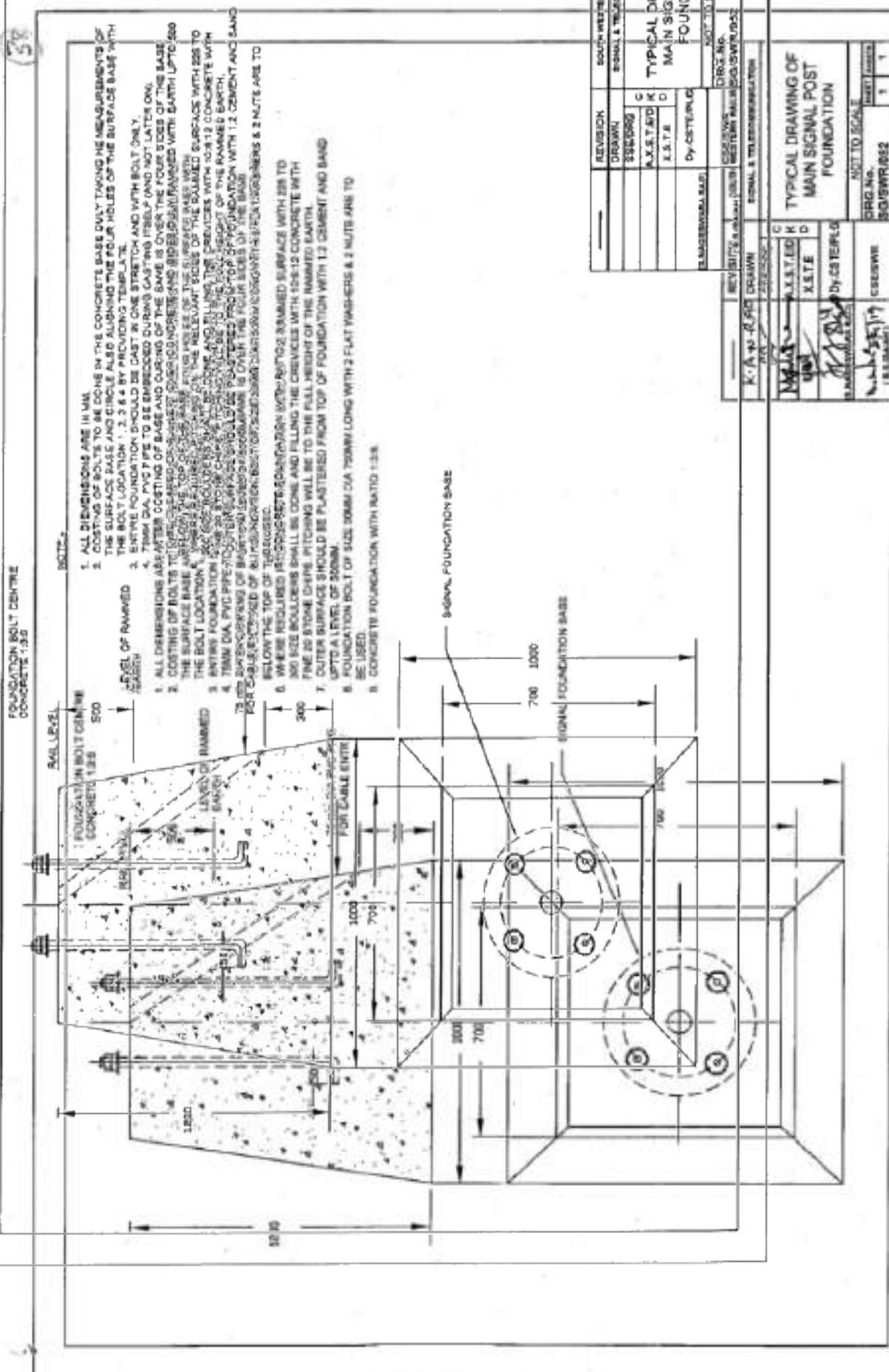
MAIN SCORES

salmon

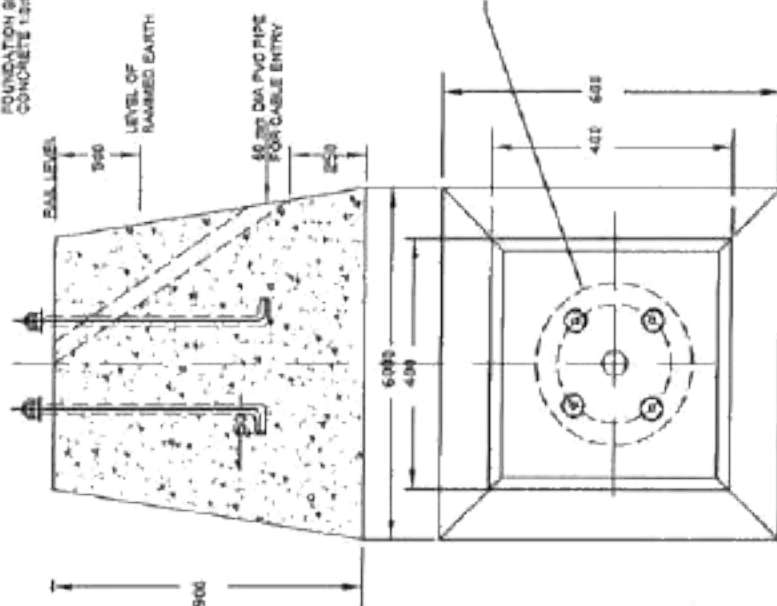
- NOTE:
1. ALL DIMENSIONS ARE IN MM.
 2. CONCRETE FOUNDATION WITH MIXTURE OF CEMENT, SAND AND JELLY CHIPS. S.RATIO WITH RATIO 1:3:6.
 3. OUTER SURFACE SHOULD BE PLASTERED WITH 1:4 CEMENT AND SAND.
 4. ON ALL SIDES OF THE EARTH SHOULD BE MARKED INTO THE LEVEL.
 5. ALL DIMENSIONS ARE IN MM. SHOWN IN THE SKETCH.
 6. CONCRETE FOUNDATION WITH RATIO 1:3:6 (S.RATIO) WITH 2 PLAT CHIPS. MIXED WITH RATIO 1:3:6 & ONE NUT IS TO BE USED.
 7. OUTER SURFACE SHOULD BE PLASTERED WITH 1:4 CEMENT AND SAND.

3. ON ALL SIDES OF THE EARTH SHOULD BE RAISED INTO THE LEVEL AS SHOWN IN THE SKETCH.

[illegible]



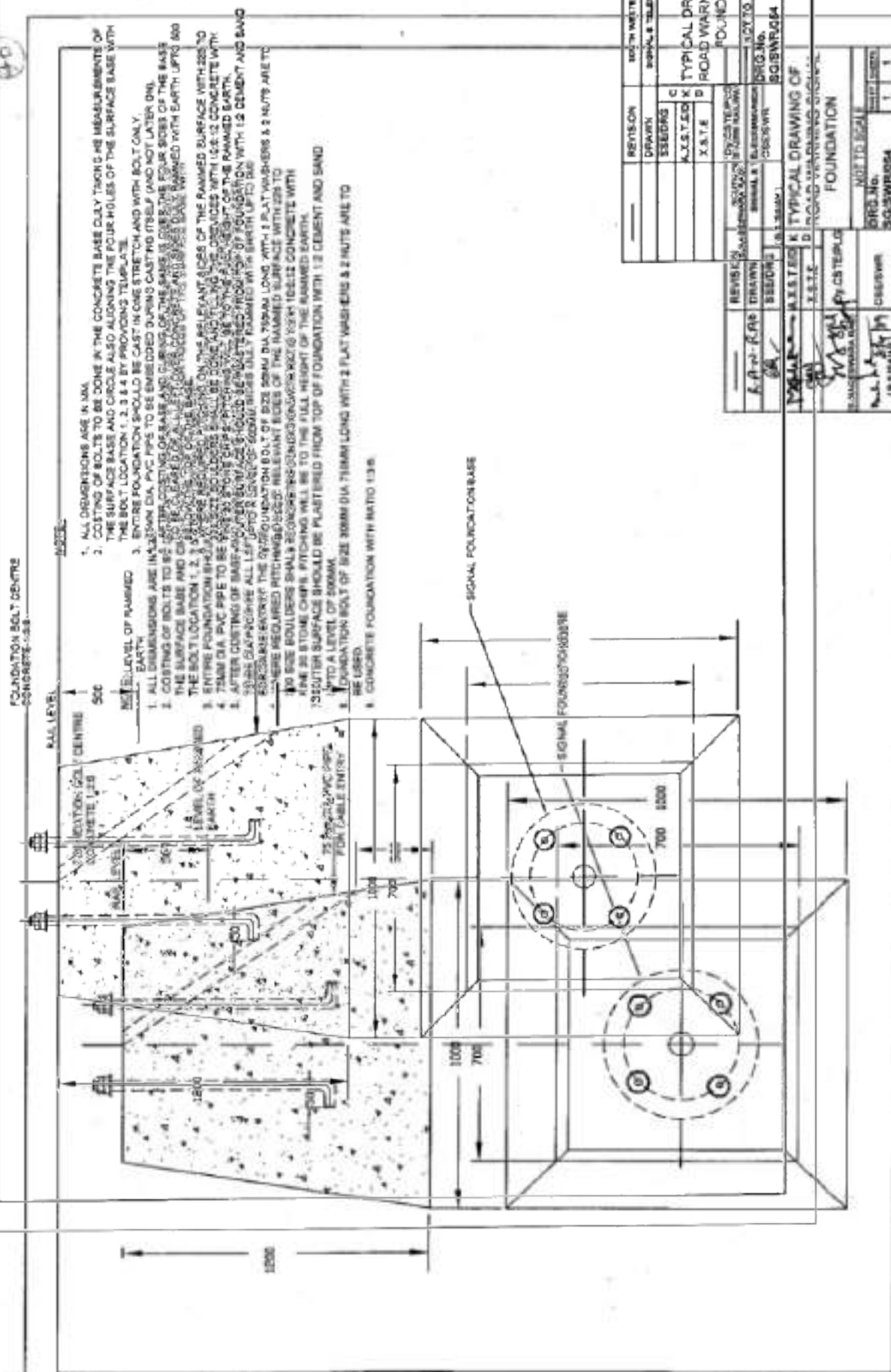
FOUNDATION SOLT CENTRE
CONCRETE 1:2:4

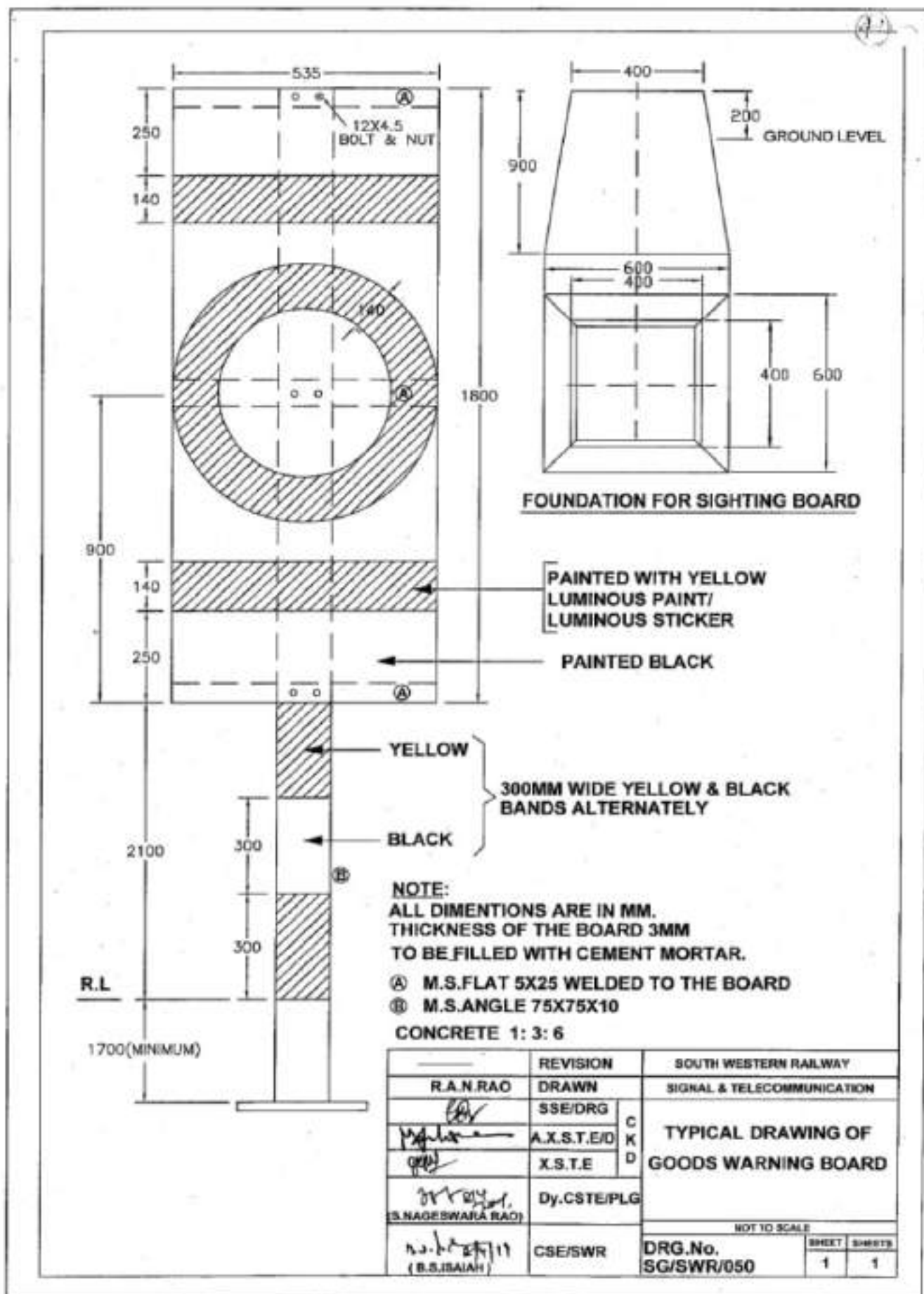


NOTE:

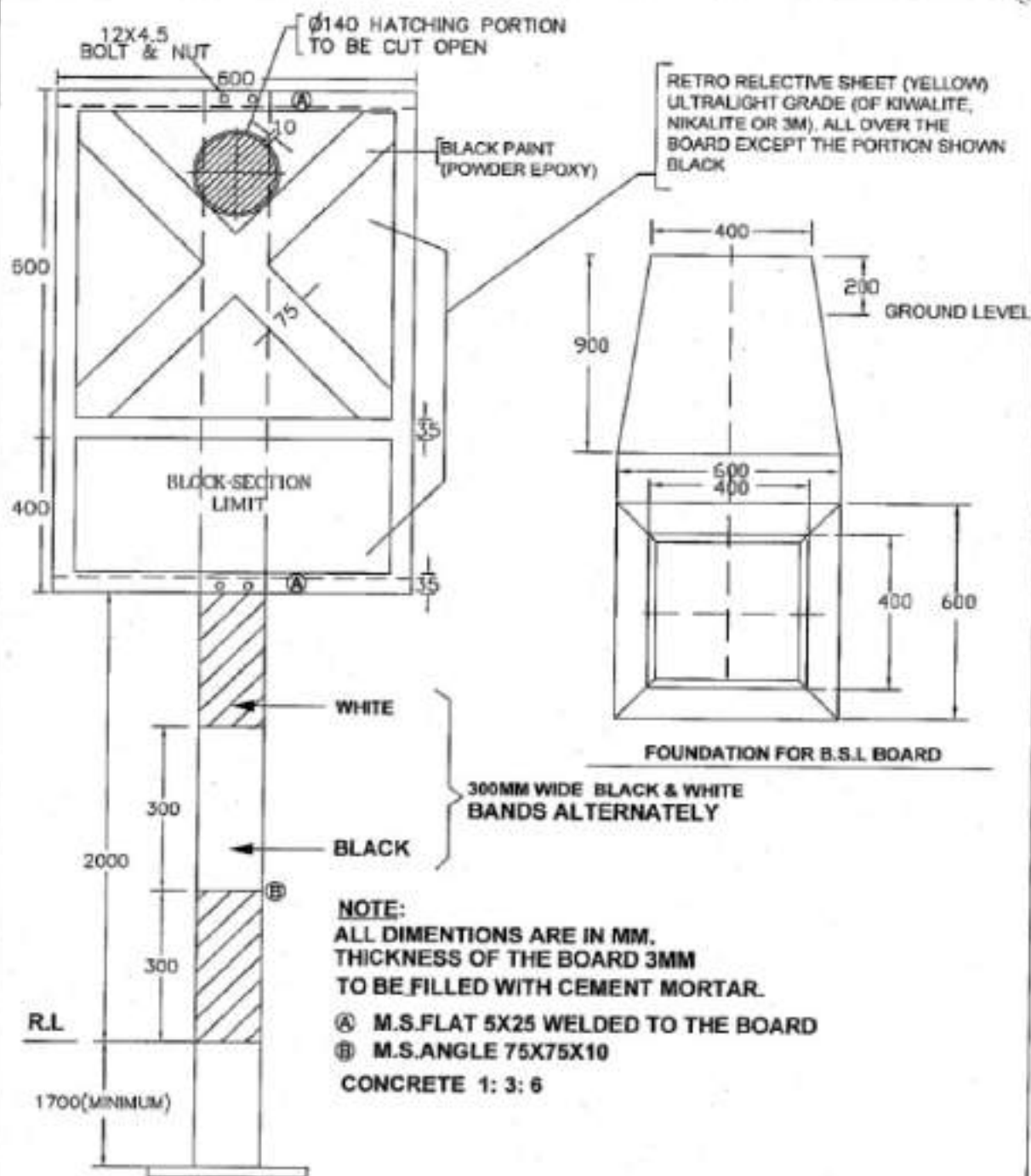
1. ALL DIMENSIONS ARE IN MM.
2. CASTING OF BOLTS TO BE DONE IN THE CONCRETE BASE DUE TO THE MEASUREMENTS OF THE SURFACE BASE AND CIRCLE ALSO ALONG THE FOUR SIDES OF THE SURFACE BASE WITH THE BOLT LOCATION 1, 2, 3 & 4 BY PROVIDING TEMPLATE.
3. ENTIRE FOUNDATION SHOULD BE CAST IN ONE STRETCH AND WITH BOLT ONLY.
4. 50MM DIA. PVC PIPE TO BE BURIED DURING CASTING ITSELF AND NOT LATER ON.
5. AFTER CASTING OF BASE AND CURING OF THE SAME IS OVER THE FOUR SIDES OF THE BASE TO BE CURED OF ALL LEFT OVER CONCRETE AND SIDES DULY RAISED WITH EARTH UP TO 500 BELOW THE TOP OF THE BASE.
6. WHERE REQUIRED PITCHING ON THE RELEVANT SIDES OF THE RAISED SURFACE WITH 225 TO 300 SIZE ROLLERS SHALL BE DONE AND FILLING THE CREVICES WITH 1:2:4 CONCRETE WITH FINE 30 STONE CHIPS. PITCHING WILL BE TO THE FULL HEIGHT OF THE RAISED EARTH.
7. OUTER SURFACE SHOULD BE PLASTERED FROM TOP OF FOUNDATION WITH 1:3 CEMENT AND SAND UP TO A LEVEL OF 500MM.
8. FOUNDATION BOLT OF SIZE 20MM DIA 450MM LONG WITH 2 FLAT WASHERS & 2 NUTS ARE TO BE USED.
9. CONCRETE FOUNDATION WITH RATIO 1:2:4.
10. SAME DRAWING CAN BE ADOPTED FOR GYR. BSL. CALLING-ON LEGEND BOARD OR ANY OTHER SOUNDS OF SPECIFIED IN R.P.






REVISION	SOUTH WESTERN RAILWAY
CHART	SIGNAL & TELECOMMUNICATION
SECTION	C
AXIS & NO. K	D
LIST	D
DATE	20/05/2019
DESIGNER	DR. C. S. S. S. S.
CHECKER	DR. C. S. S. S. S.
APPROVED	DR. C. S. S. S. S.
DATE	20/05/2019
SCALE	1:1
PROJECT	FOUNDATION
DRG. NO.	SO/SMR/653
REVISION	1





TECHNICAL GUIDELINES FOR S&T CONTRACTUAL WORKS (MAY-2019)



	REVISION	SOUTH WESTERN RAILWAY		
R.A.N.RAO	DRAWN	SIGNAL & TELECOMMUNICATION		
	SSE/DRG	C K D	TYPICAL DRAWING OF BLOCK SECTION LIMIT BOARD	
	A.X.S.T.E/D			
	X.S.T.E			
 (S.NAGESWARA RAO)	Dy.CSTE/PLG	NOT TO SCALE		
 (S.S.ISAIAH)	CSE/SWR	DRG.No.SG/SWR/051		
		SHEET	SHEETS	
		1	1	

