SECTION – 8B

TECHNICAL SPECIFICATION

PART -(I)
TECHNICAL SPECIFICATIONS (GENERAL)

1. GENERAL:

The Indoor & Outdoor works include supply and execution of items as well as work in the relay/equipment room and in the field. It will be the responsibility of the Tenderer to commission the complete interlocking with outside gears i.e., points, signals and other field signaling equipment, installation, testing and commissioning of system including transportation of all the equipment to site of installation. Testing and commissioning will be done in association with Bi-RIDE Engineer and staff. The work shall be carried out according to the drawings approved by the Bi-RIDE and shall conform to the provision of Signal Engineering Manual and schedule of dimensions. The contractor shall be solely responsible for the proper execution of the work as per specification. Description of Outdoor work is given in the respective item of Schedule of work, however, Broad guidelines for various activities in connection with outdoor works are as follows. In case of any conflict with the description in Schedule of Work and these guidelines, the details in the Schedule of work shall prevail.

2. CABLE LAYING

Guidelines on the Cable Laying (Document No. RDSO/SI/G/2010, Version 1.1 or latest) issued by RDSO dated 04.02.2014, which shall be followed while laying the signaling, power, Telecomm and OFC in the station section and block section.

1) All main cable shall be laid in RCC duct/ Split RCC pipes/Poly olefin ducts.
2) Tail cable shall be laid through DWC/HDPE/RCC split pipes of suitable sizes with non-flame and anti-rodent properties, proper coupling and cable be laid at depth not less than 1000mm from ground level.
3) For laying of signaling cables in the station yards from Home to Home Signal Manual trenching is recommended.
4) From Home to distant signal and beyond into block/automatic section - mechanized trenching is recommended.
5) Under road/platforms/railway tracks/difficult terrain etc., trench less horizontal directional drilling (HDD) method may be adopted under the supervision of competent staff for laying of GI/DWC-HDPE pipe.
6) Trenches shall be straight as far as possible and steep angles shall be avoided, clearing roots of trees, rocks etc., in all types of soils.
7) The bottom of the trench shall be levelled and got rid of any sharp materials like stone chips, iron pieces etc.
8) It is desirable that the trenches do not remain uncovered for long period; instead cables are laid and refilling done on the same day.
9) Before commencement of the laying, inspection of the trench and inspection of protection works shall be carried out.
10) Backfilling of the trenches shall be done properly. The earth excavated shall be put back on the trench, rammed and consolidated.
11) During excavation, the earth of the trenches shall not be thrown on the ballast. The earth shall be thrown by the side of the trenches away from the track.

3. Cable laying in underground

i. In AC electrified areas cables shall be laid underground only.

ii. Cables may be laid underground, either in the trench, in ducts, in cement troughs, in pipes or in any other approved manner.

iii. Cable is generally laid parallel to the track beyond Home signal with minimum deviations and on one side of the yard.

iv. As far as possible, cable shall be crossed only at two locations, i.e. one crossing on each side of the yard.

v. The cable laid parallel to the track shall be buried at a depth of minimum 1.0 meter (top most cable) from ground level. Those laid across the track must be minimum 1.0 meter below the rail flanges.

vi. However, in case of rocky soil, the depth may be reduced suitably.

vii. For laying of tail cables the depth shall not be less than 0.50 meters.

viii. In theft prone areas the cables may be laid at a depth of 1.2 meters with anchoring at every 10 meters.

ix. The minimum width of manually made cable trenches shall be kept as 0.3 meters.

x. The cable shall be covered with a layer of sand or sifted earth of 0.10 meter thickness and thereafter a protective cover of trough or a layer of bricks shall be placed.

xi. Normally, not more than 12 cable are to be laid in one trench.

xii. It is recommended that cables are laid in RCC duct up to home signal on both side of the station and may be extended up to distant, if required. This will also help later for laying of additional cable later without carrying out trenching.

xiii. For the safety of the track: (i) Outside the station limits, the cables shall generally be laid at not less than 5.5 metre from the centre of the nearest track. (ii) Within the station limits, the trenches shall preferably be dug at a distance of not less than 3 metre from the centre of the track, width of the trench being outside the 3 metre distance. (iii)At each end of the main cable an extra loop length of 6 to 8 metre shall be kept burried at same depth as that of cable in the same trench to ensure that cable is free from theft/outside interference.

xiv. Before starting cabling work location boxes shall first be erected so that cable after laying is directly taken inside location box.

4. Track Crossing

a) As far as possible, cable shall be crossed only at two locations, i.e. one crossing on each side of the yard.

b) When a cable has to cross the track, is shall be ensured that

i) The cable crosses the track at right angles

ii) The cable does not cross the track under points and crossings

iii) The cable is laid in concrete/GI/CI/PVC/DWC-HDPE pipes or suitable ducts or in any other approved manner while crossing the track.

iv) Cable laid across the track must be 1.0 meter (minimum) below the rail flanges.

v) No digging shall be done below the sleepers. Digging work while crossing a track shall be done between sleepers in the presence of a Railways representative.

5. Road Crossing

i. The cable is laid in concrete/GI/CI/PVC/DWC-HDPE pipes, suitable ducts or in any other approved manner while crossing the road at the depth of 1 meter from the ground level. It shall extend 1 meter (minimum) on each side of the road keeping in view the future increase of width of the road.

ii. Suitable precautions may be observed while laying of pipes and refilling the trench depending upon the type of road (e.g. heavy or light traffic, broad or thin) so as not to block the road traffic for a longer period.

iii. Whenever a cable is laid across an important road, particularly one with a special surface, a spare pipe may be laid, through which a cable can be drawn when required. It will be advantageous to leave a lead wire of G.I. wire in the pipe for drawing the cable in future.

6. Cable laying on bridges/culverts

i. Wherever practical, the cable may be taken underground across the drain bed at a suitable depth for crossing small culverts with low flood level.

ii. Where cable may not be taken underground across the drain bed, cable shall be taken on the culvert through GI/DWC-HDPE pipe of suitable sizes.

iii. When cables have to cross a metallic bridge, they shall be placed inside a metallic trough which may be filled, as an anti-theft measure, with sealing compound. The cable shall be supported across the bridge in a manner which would involve minimum vibrations to the cable and which will facilitate maintenance work.

iv. In case of arch bridges, cable shall be taken through GI/DWC-HDPE pipes on top of the arch adjoining the parapet wall. The pipe shall be covered with ballast.

7. Laying near to sleeper

In places where cables are to be laid within 1 meter from sleeper end, digging beyond 0.50 meter shall be done in the presence of an official from Engineering Department, and the laying of the cable and refilling of trench shall be done with least delay. Laying may be undertaken under block protection as needed.

8. Jumper cable for track circuits

i. Jumper cable should be tied with the nearest sleeper, on wooden sleepers using iron clamps/hook and on PSC sleepers using clamps. Laying of Signaling cables

ii. Cable shall be buried underground in the line of sleeper and taken to TLJB, where sleeper ends.

iii. Wherever required, cable may be laid in DWC-HDPE pipe.

iv. Jumper cable shall be laid at least 0.5 meter below ground level excluding ballast depth.

v. Jumper cable shall be laid neatly in squared manner and shall not be kept in loose coils above the ground near TLJB.

vi. Top surface of TLJB shall not be 1 feet above rail level.

9. Cable Marker

Cable markers wherever provided shall be placed at 25 meter interval in station section and 50m interval in block section and at diversion points.

10. Storing and transportation of cable

i. Cable drums shall not be stacked on flat side. Suitable stoppers or wooden wedges shall be placed for stability.

ii. Cable drums shall have easy access for lifting and moving.

iii. While unloading from a vehicle the drum shall not be dropped on the ground directly to avoid damage due to impact. Fork lifter or ramp shall be used.

iv. When rolling the cable drum either for unloading or transportation, the drum shall always be rotated in the direction of the 'arrow' which is marked on the drum. Wooden drums frequently have an arrow marked on their flanges to indicate both the directions that cable to be wound on to them and also the direction in which the drum is to be rolled.

v. During storage, the ends of the cable should be effectively sealed by end cap or in any other approved manner to avoid water entry into the cable.

vi. Storage in covered shed is desirable to protect against direct exposure to sun.

11. Paying out the Cable

i. For paying out cables, the cable drums shall be mounted on cable wheels or on axle whichever is available. It shall be ensured that no kink is formed while paying out the cable.

ii. The cable drum shall be brought as close to the cable trench if possible, with a clearance to the ground by 5 to 10 cm. and the cable shall be laid along the trench.

iii. A party of laborers shall move along the trench carrying cable at suitable intervals so that cable is not damaged due to dragging along the ground or bent unduly.

iv. In no case, shall the drum be rolled off on to the road for laying the cable and the cable dragged on the ground for laying purposes.

v. Where the cable drum is in damaged condition the cable may be placed on a horizontal revolving platform and the cable paid out in the same manner as given above.

vi. Paying out of cable shall be done by rotating the cable drum and not by pulling the cable with excessive force.

12. Testing of Cable

Before the cable is laid in the trench, a visual inspection of cable shall be made to see that there is no damage to the cable. It shall be tested for insulation and continuity of the cores. Thereafter, the cable shall be laid into the trench. Record of insulation and loop resistant must be maintained.

13. Special requirements in 25kV AC electrified area

i. Only unscreened cable shall be used.

ii. Screened signaling cable may be used on signaling installations where screened cable is already in use and site condition demand its further use.

iii. PVC insulated PVC sheathed and armored unscreened cable to an approved specification (IRS-63) shall be used for carrying signaling circuits. Only approved type (IS-1554) power cable shall be used for signaling purposes.

iv. The screened cable, if used, shall be PVC insulated, armored and to an approved specification IRS S-35.

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

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

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

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

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

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Letter No: STS/Cable-Laying Practices Vol.- IV Date: 09/05/18

मुख्य संकेत एवं दूरसंचार अभियन्ता,	Chief Signal & Telecom Engineer,
मध्य रेलवे, मुम्बई सी.एस.टी.– .400001	Central Rly, Mumbai CST- 400 001
पश्चिम रेलवे, चर्च गेट, मुम्बई – 400020	Western Rly, Churchgate, Mumbai – 400 020
पूर्व रेलवे, फेयरली प्लेस, कोलकाता – 001	Eastern Rly, Fairlie Place, Kolkata – 700 001
दक्षिण पूर्व रेलवे, गार्डन रीच, कोलकाता – 43	South Eastern Rly., Garden Reach, Kolkata - 43
उत्तर रेलवे, बड़ौदा हाउस, नई दिल्ली – 01	Northern Rly., Baroda House, New Delhi- 01
पूर्वोत्तर रेलवे, गोरखपुर – 273012	Northeastern Rly., Gorakhpur - 273 012
पूर्वोत्तर सीमान्त रेलवे, मालीगांव, गुवाहाटी 11	North Frontier Rly., Maligaon, Guwahati- 011
दक्षिण रेलवे, पार्क टाउन, चेन्नई – 600 003	Southern Rly., Park Town, Chennai -600 003
दक्षिण मध्य रेलवे, सिकन्द्राबाद –500 371	South Central Rly, Rail Nilayam, Secunderabad-71
पूर्व मध्य रेलवे, हाजीपुर दृ 841 101	East Central Railway, Hazipur - 841 101
उत्तर पश्चिम रेलवे, जयपुर–300206	North Western Railway, Jaipur-300206
पूर्व तटीय रेलवे, ग्राउन्ड तल, उत्तरी ब्लाक, समन्त विहार, भुवनेश्वर–17	East Coast Railway, Rail Vihar, Ground floor, North Block, Samant Vihar, Bhubneshwar -17
उत्तर मध्य रेलवे, गंगा काम्पलेक्स, सूबेदारगंज, इलाहाबाद।	North Central Railway, Ganga Complex, Subedarganj, Allahabad.
दक्षिण पश्चिम रेलवे, क्लब रोड, केशवपुर, हुबली– 580023	South Western Railway, Club Road, Keshavpur, Hubli - 23
पश्चिम मध्य रेलवे, जबलपुर दृ 482 001	West Central Railway, II floor, DRM Office, Jabalpur – 01
दक्षिण पूर्व मध्य रेलवे, आर0ई0 ऑफिस काम्पलेक्स, बिलासपुर– 495004	South East Central Railway, R. E. Office Complex, Bilaspur-495004
मैट्रो रेलवे,33/1, जवाहर लाल नेहरू रोड, कोलकाता–71	Metro Railway, 33/1, Jawaharlal Nehru Road, Kolkata –71
कोर , नवाब युसुफ रोड सिविल लाइन्स इलाहाबाद –01	CORE, Nawab Yusuf Road, Civil Lines, Allahabad- 01

Sub: Plastic Cable Ducts / Tray.

Ref: This office letter No. STS/Cable-Laying Practices Vol.- IV Dated 09.11.17 in reference to Railway Board's Letter no. 2006, 2012, 2014 and 2014/Sig/SGF/3(CABLE) dated 09/08/12, 13/05/14, 10/07/14 and 29/08/16.

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In continuation of above as referred, Railway board was enclosed technical and other details of plastic ducts/tray .These cable ducts being developed for laying of all types of cables e.g. Signalling, Telecommunication and Power etc.

Railway Board had further informed vide above referred letter that these cable ducts may be very useful for application in suburban sections where cable trenching and digging is a severe problem due to space constraints, proximity of other cables and utilities, traction bonds and cables etc.

To comply above mentioned Railway Board letters, all the railways are once again advised to send their performance feedback/Remarks, specification being followed with testing details, installation practices etc.to RDSO.

RDSO has already issued guidelines vide RDSO/SI/G/2010 version 1.1 dated 04/02/2014 as a policy for laying of signalling cable. To ensure quality of plastic cables duct/tray, technical specification and testing procedures as attached with above referred Railway board letter is summarized and enclosed herewith for comments on the performance.

9.5.18
(A.K.Singh)
Director/Signal-VIII
for Director General /Signal

DA : As above enclosed by Railway Board as Annexure- I

RDSO - Ref No: STS/Cable-Laying Practices Vol- IV/ Dated: 09/05/2018

Annexure- I

I. **Technical Specification of – Injection Moulded – Plastic Cable Duct / Trays**

1. Basic/ Minimum Technical specifications /Testing procedures & Check list

Properties	Type – I (2434)	Type- II (1020)
Width (Internal / External)	240mm/340mm	100mm/200mm
Height (Internal / External)	155mm/ 230mm	155mm/230mm
Weights per Mt/ PC (Including Bottom and top cover)	8.00 kg (Minimum)	5.00 kg(Minimum)
Length per pc / per mtr -	1000mm (appx)	
Material	Polyolefin / polymers/Engineering plastics	
Fire Behavior	Fire Protection Class K 1 in accordance and referenced with DIN 53438 part-2	
Breaking Load (Minimum)	≥ 12 KN,at room Temperature, over the specified surface area of: 250mm x 150mm for Type I (2434) 250mm x 75mm for Type 1I (1020)	
Thermal Characteristics (Type Test– Frequency 6 months)	Thermal stability from -10 degree to + 70 degree As per IS 9000- part- 2 & part- 3 :1977	
Electrical Characteristics (Type Test– Frequency 6 months)	Dielectric Strength: 48 kV (Min breakdown voltage) as per IEC-60243-1-2013	
Tolerance in Dimensions	(+/-) 10mm	

2. The cable ducts should be horizontally attachable to each other with male/female swallow tail connections with suitable detachable/ push fit cover.

3. Required accessories/ earth pins etc. for fixing of cable ducts should be supplied, if required at the time of installation.

4. The cable duct should have predetermined breaking points/ perforated opening/ outlet on the sides for taking cables inside/outside the duct.

II. **Tests Procedures:**

1. Load Bearing Capacity (at Room temperature of 27^0C):

1.1 Sample - Complete cable channel with cover.

1.2 Conditioning for room temperature test - $27^0C \pm 2^0C$ for 2 hours.

1.3 Sampling size of each test = Complete cable channel with cover.

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1.4 Test Procedure:-

1.4.1 The test specimen to be tested should be in locked position and to be kept on the surface in such a way that bottom surface of the box will get total support. The force shall be applied in the Centre of the cover. A rubber or wooden pad should be introduced in between the plate and box to avoid direct rupture due to sharp edges of the plate. The load test equipment should have at least load capacity of 12 KN.

1.4.2 The force measurement should be carried out with a load cell with an accuracy of 1N. Using hydraulic test cylinder, the force should be continually increased.

1.4.3 This load to be increased up to the 12 KN. Then the test may be discontinued once the sample survives the minimum breaking load criteria.

1.4.4 Size of steel plate shall be as under:
Type 1 (2434)- 250mm x 150 mm
Type 2 (1020)- 250mm x 75 mm

1.5 Acceptance criteria: Breaking load $\geq$12KN

2. **Determination of Burning Behaviour (Edge combustion):**

2.1 Sample - 190mm X 90mm (to be cut from the cable tray).

2.2 Sampling – One sample should be tested.

2.3 The Test Apparatus for this test shall comply the standard DIN: 53438 Part-2.

2.4 Test Procedure:-

2.4.1 A specimen of 190mm X 90mm should be mounted in a vertical position.

2.4.2 A measuring mark is to be made at a distance of 150mm from the bottom edge.

2.4.3 The height of flame is to be adjusted to 20mm.

2.4.4 The angle of burner should be inclined to 45° to the surface of the test specimen.

2.4.5 The flame is to be applied to the edge of sample for 15 second.

2.5 Acceptance Criteria:-

2.5.1 The test shall satisfy the requirements of classification K1. (Classification K1: If the tip of the flame of the burning specimen does not reach the measuring mark or if the flame has extinguished.)

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III. **Check lists for Testing of The cable Ducts:**

1. Size of Sample: For Acceptance Test- As per standard sampling from lot and for Type Test - One sample.

2. Following Acceptance Tests & Type Test shall be conducted.

SN	Tests Parameters	Requirements	Observations	Remarks
	Acceptance Tests			
2.1	Visual	No sharp edges, burrs, or surface projection which is likely to damage conductor or cable.	No sharp edges, burrs or surface projection should be found.	
2.2	Dimensions / Min. weights per mtr/pc (cover and bottom) Length- 1000mm both the types Tolerances +/- 10mm	For Type – I (2434) Width = 240mm (int.) / 340mm (ext.) Height = 155mm (int.)/ 230mm (ext.) Weight : 8.00Kg (min) per meter For type – II (1020) Width = Int. -100mm / Ext -200mm Height = Int.-155mm / Ext.-230mm Weight : Per Mtr 5.00 Kg (min)	Dimensions should be within limit.	
2.3	Load bearing capacity at room temperature	Conditioning for room temperature test = $27^0C \pm 2^0C$ for 2 hours Min. breaking load $\geq$ 12 KN	No crack or failure of the cable channel should observed	
2.4	Burning Behavior	The test shall satisfy the requirements of class - K1/ with DIN 53438 part-2.	It should confirm to Fire Protection Class K -1	
2.5	Outlet for taking cables inside/outside of duct.	Cable Ducts/ Tray should have predetermined breaking points/ perforated opening / outlet on the sides for taking cables inside/outside.	Plastic cable duct should confirm the requirement.	
	Type Tests			
2.6	Thermal Characteristics	Thermal stability from -10 degree Celsius to + 70 degree Celsius as per IS 9000- part- 2 & part- 3 :1977	Test reports shall be submitted from approved laboratory.	
2.7	Electrical Characteristics	Dielectric Strength: 48 kV (Min breakdown voltage) as per IEC-60243-1-2013.	Test reports shall be submitted from approved laboratory.	

11. FOUNDATION & ERECTION OF APPARATUS CASES:

a. The work consists of pit excavation, casting foundation with bolts of adequate size having cement concrete of ratio 1:3:6 as per: -

i. Drg. No. SG/SWR/055 (Apparatus case full size)

ii. Drg. No. SG/SWR/056 (Apparatus case Half sizes)

The location of apparatus case will be indicated by Bi-RIDE/Railways.

b. Two `E" types locks on the doors of full size apparatus case and one `E' type lock on the front door for half size apparatus cases shall be firmly fixed and tested with `E' type key. Locking and unlocking shall be smooth with least force. Suitable fixing arrangements for `E' type lock on the door of apparatus case shall be fabricated by the contractor, if such arrangements do not exist. One hard wood shelf plank 37mm thick, planed and varnished shall be firmly fixed for all types apparatus cases/ battery boxes. Also latching arrangement for the back door shall be provided, if required.

c. All the apparatus cases (Full/Half/Quarter) are to be painted with Aluminum paint on the outsides surface and the location numbers are to be painted in 'Bold' letters. Inside of location box shall be painted with white/Aluminum enamel paint.

d. SHIFTING OF APPARATUS CASES/ CT BOXES:

The work consists of excavation of pit around the existing apparatus cases full/ half size and CT boxes, shifting of the location box along with foundation clear of infringement from the track. The pit shall be excavated with maximum care to avoid any possibility of damage to the existing cables.

The location box shall then be shifted carefully along with the foundation and cable termination, equipment etc., without disturbing the wiring. While shifting apparatus cases of full size, the brick wall covering the cables shall be broken before shifting the location box. After the location box is shifted, brick masonry walls shall be constructed on the front and back sides of the location box foundation. River/M-sand sand shall be filled up to the floor of the location and the bottom shall be sealed with sealing compound.

e. CABLE TERMINATION IN APPARATUS CASES/CTB's:

11.e.1 At each apparatus case/CTB, the work consists of fixing all cables, fixing of Phynolic synthetic industrial fiber base fine weave cotton fiber sheet - 6mm thick to IS specification 2036 - 1995 - Type board along with terminal blocks and termination of cables/cores (conductors) using PVC/ Nylon sleeves as per details of termination in approved location diagrams. The contractor shall prepare cable termination and wiring details of apparatus cases and C.T. boxes and obtain the approval of the BI-RIDE/ Railway Engineer before execution as per the approved cable plan.

11.e.2 The underground signaling cable-main, tail and power shall be properly secured by wooden clamps of 50mm x 50mm teak wood inside apparatus case on 25mm x 100mm base plank. The cables shall be neatly skinned duly mending and taping of cable ends for termination bunched and terminated on the terminal board at the required place in order as per approved apparatus case circuit diagram. All the aluminum power cables of size 10 Sq.mm and above shall be provided with Aluminum lugs using crimping tool of appropriate size.

11.e.3 BI-RIDE will indicate approximate total number of cable core, terminations to be made in the apparatus cases/cable termination boxes. The contractor shall fix Phynolic synthetic industrial fiber base fine weave cotton fiber sheet - 6mm thick to IS specification 2036 - 1995 - Type F5 sheet as required by Railway. Terminal blocks with links, fuse blocks with fuse shall be fixed on the terminal board pertaining to each apparatus case and cable termination box using proper size of wood screws. Two suitable holes shall be made on either side of terminal block and fuse block for bringing cable for termination. Termination of main cables, tail cables, power cables, core/cores shall be made at the proper terminal as per approved wiring diagram pertaining to each apparatus case and C.T. Boxes. Before final termination, each cable shall be tested for continuity, insulation etc. and readings recorded and jointly tested and signed.

11.e.4 As per site conditions, the termination of new cables may be required on the existing terminal blocks or by fixing new terminal/fuse blocks in old apparatus cases which shall be done as per approved circuit diagram wherever required. The terminal particulars are to be re-painted or corrected on the doors of apparatus cases as instructed by BI-RIDE. Suitable clamping arrangements have to be made for the new cables and also the bottom the opening of the apparatus cases shall be closed with masonry brick work and sealed with cable compound.

11.e.5 After fixing all the signaling cables inside the apparatus case, the side opening shall be closed with masonry work and plastered. The inner side is filled with Sand and finally the bottom is sealed with sealing compound.

11.e.6 All the underground cables shall be provided with punched name plates showing total no. of cores, cross section of each core, Aluminum or copper conductor and from and to details etc. and also painted inside each apparatus case.

f. WIRING OF SIGNALS/ LC GATE CONTROL/ TRACK CIRCUIT/ POINT CONTROL RELAYS IN LOCATIONS:

11.f.1 Relays, transformers, heavy duty contact relays and other gadgets controlling the above functions shall be firmly fixed on suitable relay frames using MS Angles of size 25mm x 25mm x 6mm and MS Flats of size 25mm x 6mm inside respective apparatus cases. The MS relay frame shall be painted before fixing. Hylam sheet of 25mm thick of requisite size shall be fixed inside the apparatus case for fixing Resistance and Electrolytic condensers. In case of shelf type relays, the relays shall be mounted on shelf planks with suitable anti- tilting arrangement. If plug in type relays are used, 16/0.2mm flexible copper wire shall be used for wiring. For shelf type relay and point motor circuit, 3/0.75mm copper wire shall be used. There shall be no joint in the wire. For soldering the wire to relay clips of Plug-in-type relays in relay racks, best quality rosin core solder and temperature-controlled soldering irons shall be used. The complete wiring shall be tested jointly and linked to tail cable.

11.f.2 The description of all relays, fixed in each apparatus case shall be painted inside apparatus case doors. PVC/ Nylon sleeves shall be provided on each wire before termination on terminal block. The name of the circuit and wire where connected shall also painted on the sleeves.

11.f.3 Wire should be soldered to relay clips and suitable copper eyelets crimped with crimping tools shall be adopted before the termination. The wiring and termination shall be carried out as per the approved circuit diagram. The relays details shall be painted. PVC/Nylon sleeves shall be provided for each wire before termination and the details of circuit and where the wires connected etc., shall be painted on the sleeves. The complete wiring shall be tested.

g. ALTERATIONS TO PAINTING PARTICULARS AT LOCATION BOXES:

Consequent to introduction of new circuits or alterations to existing circuits in apparatus cases/ CTB's, new nomenclature should be painted on the cable sleeve. And also the new particulars should be painted on the inner side of the doors at apparatus cases/ CTB's.

h. FILLING OF EARTH AROUND LOCATIONS:

The work consists of filling of earth around the foundations of signals and apparatus cases for a width of 0.5m on all sides from 150mm below the foundation top to ground level. The earth shall be consolidated after filling.

12. MAIN SIGNALS:

a. CASTING OF COLOUR LIGHT SIGNAL FOUNDATION:

12.a.1 The work includes excavation of pit and casting of color light signal foundations with M.S foundation bolts as per Drg. No. SG/CN/02/9. The position of signals will be indicated by Bi-RIDE.

12.a.2 The Signal should be casted using Hylam sheet/ Waterproof Plywood/ MS sheet Form work to ensure smooth exterior finish and avoid the additional plastering. Necessary earth work, shall be made around the signal foundation and sufficient earth work shall be made up to the required level in the normal terrain and the cable entries shall be closed as per the instructions of Bi RIDE/ Railway Representative at Site.

b. ERECTION AND WIRING OF SIGNALS:

13.b.1 Signal pole shall be securely fixed to surface base and erected on signal foundation and plumbed. The gap between the signal pole and surface base shall be filled with suitable putty to avoid tilting. Soon after installation, the pole shall be painted with two coats of Aluminum paint/Yellow & Black strips of Enamel paint for second distant signal after a coat of primer. Signal unit shall be provided with two coats of black enamel paint.

13.b.2 Multi-unit color light signals up to 4 aspects shall be properly mounted on the top of signal pole where there is no route indicator. If required, LED type signal aspect shall be fixed for signals. If there is route indicator a large off set bracket shall be fixed firmly with 2 nos. of `U' bolts 3/4" thick on the signal pole for mounting multi-unit color light signals. One 22mm through hole shall be drilled on signal pole just below the off-set bracket and a 20mm through bolt shall be the provided to prevent offset bracket from sliding down.

13.b.3 Signal ladders with platform complete fittings, cast iron shoe and adequate number of support to suit signal pole 3.6/4.6m, shall be firmly fixed clear of infringement with suitable bolts and nuts and painted in black. The ladder shoes shall be concreted. This work also includes fixing of marker boards, enameled number plates with suitable clamps at the required place. Speed board if any, shall be fixed on the pole with proper clamp clear of infringement as required by Bi-RIDE.

13.b.4 Signal tail cable shall be taken through the signal pole without damaging insulation and armor, skinned and terminated on signal units. If the signal units are mounted on large offset brackets a vertical slotted hole of 50mmx50mm in size shall be made on signal pole for taking signal tail cable. Suitable protection shall be provided on the slotted hole to avoid damage to insulation of cable.

13.b.5 This work includes fixing of LED Unit along with Current Regulator. Wiring to be done according to approved circuit diagram. The unwanted aspects shall be blanked using MS sheets of 3mm thick.

13.b.6 All the multi-unit color light signals shall be wired with 3/0.75mm copper wire and terminated. For each aspect 2 separate wires shall be used from the terminals and the wiring shall be tested jointly.

c. BLANKING ARRANGEMENTS FOR SIGNALS:

In case of signals with a horizontal clearance between 2.21m and 2.36m (in B.G) from the nearest track centre, blanking arrangement shall be provided. If a Ladder of signal erected at a distance within 2360 mm from C/L of adjacent track then it should be blanked off (strap around by a sheet around ladder) to a height of 300mm between 2060mm and 2360mm above rail level using MS plate not less than 8mm thick. The end portions of the plates should be folded and made smooth so that it will not harm the person climbing the ladder. This plate shall be painted with black.

d. All signals shall be properly earthed in RE area.

e. Necessary wooden cross shall be fixed on the newly erected signals before being brought into use.

f. ROUTE INDICATORS:

12.f.1 All types of Route Indicators shall be mounted on the top of signal pole firmly. The tail cables for route indicators shall be taken through signal pole without any damage to the insulation and armor, skinned and terminated on route indicators. Route indicators shall be wired with Wire PVC 3/0.75mm copper as per the approved circuit diagram. Hoods shall be fixed properly and examined during day time and if required extension of hoods shall be made to have proper visibility. The route indicators shall be painted as required by Railways.

12.f.2 Universal AC/DC LED Numeric Route indicator

12.f.2.1 Universal AC/DC LED Numeric Route indicator should be capable of displaying 1 to 19 route with right & left arms with optical sensing and complete housing for use with LED ECR.

12.f.2.2 The unit should mount at the top of signal post safely and securely. Necessary fixing arrangements shall be supplied by Contractor.

12.f.2.3 The circuit should be so designed that it draws the required current to ensure the pickup of ECR whenever the digit is lit.

12.f.2.4 RDSO approved Route LED's should be used for left and right arms. It should work on 110V +/- 20% AC.

12.f.2.5 Color of LED‟s of white color of reputed make should be used for Numeric Route indicator seven segment display. Fusing of an LED should neither blank the whole segment nor deteriorate the visibility of indication. Uniform intensity over entire operating range Components used in numeric route indicator unit should be industrial grade.

g. CALLING - ON SIGNALS/'A' MARKER LIGHTS:

Calling on signals/"A" marker shall be fitted on the signal posts at required height using off-set bracket. Suitable hole shall be drilled on the signal poles to bring the cable/jumper wires. The cable/jumper wires shall be taken to calling on signal/ "A" marker through suitable steel hose pipes and wired by using 3/0.75mm copper wire. The calling on signals shall be provided with 'C' marker and "A" for "A" marker. Number plates to be fixed and painted as per the standard practice in this Railways.

h. REPLACING THE TAIL CABLES IN SIGNALS:

Wherever necessary the existing tail cables shall be released from the existing signals and new tail cables shall be drawn to the aspects and terminated. The termination particulars shall be painted.

i. SHIFTING OF SIGNALS:

wherever required the existing Colour Light Signals shall be shifted to clear any infringement from the tracks as instructed by Bi-RIDE/ Railway representative at site. The earth surrounding the foundation shall be excavated and the cable coils shall be loosened very carefully without causing any damage to the cables. The Signal shall be moved along with the foundation slowly to the new position and earthwork shall be done around the foundation. The loosened cables shall be buried at 1m depth.

j. REPLACEMENT OF SIGNAL UNITS:

The existing CLS units shall be removed from the signal post duly disconnecting the cables and new signal units (required as per signaling plan) shall be mounted on the existing signal pole. The tail cable is to be terminated and the signal aspect shall be wired by providing LED unit with Current regulator. If there are any blank aspect, the same shall be covered with round MS plate.

k. SCREENING ARRANGEMENTS:

For the Colour Light signals in RE area which are coming in the infringing zone, screening arrangement as per standard RE drawing shall be provided as required by Railways. The screen made of MS wire-mesh will be fixed on MS angles of size 25x25x6mm with suitable fixing clamps, bolts and nuts and finally painted with black.

13. SHUNT SIGNALS:

a. POSITION LIGHT GROUND TYPE SHUNT SIGNAL:

13.1.1 The work involves excavation of pits and casting of shunt signal foundations as per Drg, No.SG/SWR/053. The position of shunt signals will be indicated by the BI-RIDE. Foundation for shunt signals shall be casted with cement concrete in the ratio 1:3:6 using stone jelly of size 20/25mm. The foundations are to be plastered on all sides. Necessary earthwork shall be made for each position light shunt signals as required by the BI-RIDE.

13.1.2 The position light shunt signal shall be properly mounted and plumbed.

13.1.3 The cables are to be taken through the unit, skinned and terminated. The post type/Ground type shunt signals shall be wired and terminated and the wiring shall be tested jointly.

13.1.4 This work includes fixing of number plates and direction Arrow plates. The post shall be painted with Aluminum while the signal unit and surface base with black enamel paint.

13.1.5 The CLS units, Route Indicators, Calling-on signals, position light shunt signals post type and ground type shall be provided with EWS locks.

b. POST TYPE SHUNT SIGNAL:

Small off-set bracket shall be firmly fixed with `U' bolts of suitable size on signal pole for mounting Post type shunt signals. One 22mm through hole shall be drilled on signal pole just below the off-set bracket and a 20mm through bolt shall be the provided to prevent offset bracket from sliding down. A vertical slotted hole of 50x50mm in size shall be made on signal pole for taking the signal tail cable. Suitable protection shall be provided on the slotted hole to avoid damage to insulation of cable. The cables are to be taken through the unit, skinned and terminated. The post type/Ground type shunt signals shall be wired and terminated and the wiring shall be tested jointly. This work includes fixing of number plates and direction Arrow plates. The post and signal unit shall be painted with Aluminium and enamel black respectively. One EWS lock shall be provided for the signal.

14. CABLE TERMINATION RACK:

a. Cable termination racks shall be erected in the relay room at the required location as per the approved Relay room floor plan and shown by the BI-RIDE with suitable foundation bolts and cement concreted. The cable termination racks shall be painted soon after installation but before cable termination work is taken up. Suitable cable ducts wherever required shall be provided to bring all outside cables to the termination rack.

b. All the cables are to be neatly skinned, fixed on the cable bracket and terminate in order. Bending of cables to less than 120 degrees shall be avoided. The cable armors and the rack should be earthed. Internal wiring and termination particulars are to be written with paint. 6 way/1 way terminal blocks are to be fixed on Hylum sheet and held rigidly by mechanical screws.

c. TERMINATION OF CABLES:

14.c.1 The PBT terminal and fuse blocks shall be fixed firmly on the cable termination racks and serially numbered with paint for easy identification. Tags shall be provided for each terminals and painted, giving description of the circuit. Suitable rubber grommet shall be provided on the holes of termination racks. Copper tape of width 25mm x 1.5mm shall be used for providing bus bars. Suitable holes shall be drilled in copper tape for this purpose.

14.c.2 All the cables shall be identified by a punched label, tied on to each cable. Printed cable termination index and pasted on Perplex sheet of thickness 10mm as per instructions of site in- charge shall be fixed in the relay room showing the terminal numbers circuit-wise. In case sufficient space is not available for fixing the board in one piece, it may be provided in parts retaining the overall size as per instructions of site in-charge. `As made' terminal particulars shall be prepared in tracing Film duly signed and handed over to the Bi-RIDE at the time of commissioning.

15. RELAY ROOM:

a. ERECTION OF RELAY RACK:

i. Relay rack shall be erected as per the SWR standard practice.

ii. The relay rack shall be painted including Relay nomenclature as per relay disposition chart soon after the installation and before plugging of relays.

b. WIRING OF RELAYS (NEW/ ADDITIONAL/ ALTERATION):

i. Based on the circuit diagram, contact analysis chart shall be prepared by the contractor. The

required number of 50-way terminal boards, plug boards and plug in type relays shall be fixed on the new/ existing rack in the nominated places as instructed by Bi-RIDE representative. The configuration of plug boards should be checked with the contact analysis chart. The nomenclature both on the rear and the front side of the plug board and on front side of the relays in the relay frame shall be painted.

ii. Suitable arrangements shall be made in the relay rack for fixing condenser and resistance unit, required for slow to pick up or slow to release feature. Letter painting shall be made against each unit to identify the circuit for which it is used. Suitable wire supporting Tray made of PVC shall be provided for each row in relay rack to accommodate the complete bunch, wherever the new wiring is carried out.

iii. The wiring shall be carried out as per approved circuit diagram. The wiring shall be done on connectors and terminated on terminal clips by soldering process neatly, using high grade solder and Temperature controlled soldering iron. PVC flexible wire 650V grade 16/0.20mm copper conductor shall be used. Potential free contacts of various relays required to be monitored by the Data logger should also be wired on the tag block of the data logger using distinct colour wire. In case of alteration to existing wiring, the wires and relays not required shall be removed. After completing the alteration work, the new wires have to be bunched neatly and brought to original condition. The relay rack wiring shall be tested initially by the contractor and then jointly with Bi-RIDE Representative. Any addition/alteration to wiring in the course of testing shall be carried out free of cost by the contractor. Different colours of wire shall be used for identify the power supply circuit wiring. In case of alteration, a different colour of wire from the existing one shall be used for easy identification.

iv. Before plugging, the relays shall be checked visually and defective ones noticed shall be replaced duly reporting the same to the BI-RIDE/Railways.

v. The printed Relay Index and pasted on Perpex sheet of thickness 10mm as per instructions of site in-charge shall be fixed in the relay room in the relay room giving the details of the relays and their position in the relay rack. In case of alteration/ additional relay wiring, the relay particulars shall be incorporated in the existing relay index board available in the relay room. If sufficient space is not available for fixing the board in one piece, it may be provided in parts retaining the overall size as per instructions of site incharge.

vi. Rubber mat having sufficient width should be placed in front and rear of all the relay rack and FTOT. The mat should not be less than 6mm thick and it should withstand 650V AC.

c. Relay rack to relay rack wiring shall be done with 16/0.2mm PVC copper conductor by soldering process.

d. The inter-connection between the relay rack and power room, power room and FTOT, Block Instruments and FTOT shall be carried out with underground, armoured, sheathed, power/ signaling cables of adequate length. The termination shall be carried out using suitable size of copper eyelets/sockets. Inter-connection between power rack and battery room, shall be carried out by using suitable underground cables.

e. All the interconnecting wires shall be supported by means of Aluminium ladder. Ladder of suitable capacity shall be manufactured using Aluminium angles of size 50mmx50mmx6mm and Aluminium flats of size 25mmx6mm. The inter spacing between two rods of the ladder shall not be more than 125mm. The corners of the ladders as well as the inner path of the ladders shall be of curved shape and shall not damage the insulation of the inter-connection

wire. The bends also shall not be steep. The bottom of the ladders shall be provided with Hylam sheet of 3mm thickness. The ladder shall be fixed firmly with proper Aluminium flats.

f. The inter connection arrangement includes laying of signaling cables in ducts, wherever necessary as indicated by BI-RIDE/Railways. Wherever cables are taken through cable ducts inside relay room/ battery room etc., the ducts shall be filled with River/ M-Sand sand up to the floor level and covered with RCC slabs covered with suitable tiles.

g. All connections/ terminations shall be tested by the contractor and after satisfying himself jointly with Bi-RIDE Representative. Any alterations required shall be carried out by the contractor free of cost.

h. Cable details, functions allotted to each core and terminal numbers shall be prepared in standard size tracing film and handed over to BI-RIDE.

16. POWER SUPPLY ARRANGEMENT:

a. INSTALLATION IN POWER ROOM:

b. The contractor shall manufacture a power supply panel using 1200x1200mm Hylam sheet not less than 10mm thick for mounting meters, switches/fuses, etc. as required by BI-RIDE/Railways. It shall be installed on a frame made of MS angles of size 25x25x6mm, MS flat of size 50x6mm and grouted to the wall after leaving sufficient space from the wall for testing and replacement. The cable shall be fixed on TW base plank of size 25x150mm using TW cable clamps of size 50x50mm and terminated on PBT Terminal blocks.

c. The power supply arrangements wiring shall be carried out using 7/1.4 mm PVC Copper wire as per the approved circuit diagram.

d. Ammeter and Stabilizer by-pass arrangements shall be provided on the panel to prevent ammeter being always in the circuit. After wiring, the power rack shall be tested jointly. The power rack shall be energized to its rated capacity and kept in that condition for not less than a week before commencement and any defect notice shall be rectified by the contractor. The Guarantee Certificates and Technical Pamphlets for the power supply equipment's shall be handed over to Bi-RIDE. Any addition/alteration to power supply arrangement shall be carried out during Testing and Commissioning.

e. The power rack and power supply equipment shall be painted suitably and uniformly before installation as required by Bi-RIDE/Railways. Schematic diagram of power supply arrangement and distribution details shall be printed and pasted on 10mm thick perplex sheet as per instructions of site in-charge and fixed in the power room. As made power diagram shall be submitted in tracing film duly indicating the power supply details and position of the equipment's.

f. The power panel and power rack should be suitably earthed.

17. INTERLOCKING OF LEVEL CROSSING GATES WITH LIFTING BARRIERS:

a. Excavation of pit, concrete foundation as per Drg.No.SG/CN/ 11 and erection of ground lever frame using suitable bolts and nuts. Casting of A type foundations for mounting the cranks is included in the scope of this work. All the foundations will be plastered on the top.

b. Making rod connection from the Ground lever frame to the boom locking mechanism through cranks, adjusting and testing the boom locking from ground lever frame. The rod run shall be at rail level and gap of not less than 40mm shall be maintained while crossing the

track. All the joints of rod connecting cranks and levers shall be smithy welded. The rod run between the track shall be insulated while crossing the track circuited portion The Lengthy rodding's shall be run on roller stands fixed on trestle located not more than 2.2 Meters between adjacent supports.

c. The gate interlocking arrangement shall be carried out as per the standard practice of S.W. Rly and as per the instructions of the Bi-RIDE representative at site.

d. The lifting Barrier will be painted with two coats of enamel paint of approved quality as given below:

i. Stands: Black

ii. Boom with fringes: Black and Yellow- Retro-Reflective stripe 300 mm wide alternatively

iii. Stop Disc on the boom: Red- Retro-Reflective

e. Florescent paper strips should be pasted on both the lifting barrier boom.

f. INSTALLATION OF ELECTRONIC GATE WARNING EQUIPMENT:

The work includes fixing of Gate warning equipment on suitable fixtures as per Railway standard for LC gates - 2 Nos. one on each side of the track, fixing of amplifier in apparatus case and hooter at Road warning signal post, wiring as per approved circuit diagram and painting.

g. In RE area wire rope and Roding shall be insulated with proper insulating material and all metallic parts shall be connected to earth. Insulation required for wire rope and Roding insulation shall be supplied by the contractor.

In RE area wire rope and Roding shall be insulated with proper insulating material and all metallic parts shall be connected to earth. Insulation required for wire rope and Roding insulation shall be supplied by the contractor.

** **This specification is issued with the fixed** Specification No. RDSO/SPN/208/2012 followed by the year ofadoption as standard or in case of revision, the year of latest revision.

** The rated voltage and normal operating current / maximum rated current of themotor of lifting barrier shall be as AC110V voltage, operating current 2.5 Amps & rated current 4 Amps for each barrier for boom length up to 9.76mts.

18. ELECTRIC KEY TRANSMITER AT LC Gate/ STATION HOUSE:

a. Electric key transmitter with/ without crank handle fixed to the key shall be installed firmly on suitable angle supports and Hylam sheet boards in the place indicated by BI-RIDE/Railways, with economizer push switch and wired. The cables shall be terminated on a terminal box made using 25mm thick T.W. planks and locking facilities. Required number of terminal blocks shall be fixed inside the terminal box for termination of cables and jumper wires. The wiring shall not be exposed. The cables shall be taken to the terminal box using Powder coated MS Box of suitable size. Interlock the EKT key with Crank handle by Nickel coated Dog chain/ welded. The EKT should be painted and the circuit particulars and ward nos. are to be painted in bold letters.

b. INSTALLATION OF EMERGENCY KEY PROVING CONTACT:

EKT shall be kept in a glass fronted wooden box and wired. The box shall have the locking and sealing facility using 6 levers NAVTAL LOCK with duplicate keys.

The contacts shall be made when the key is `IN' and contacts shall break when the key is disturbed or taken `OUT' using a limit switch.

NOTE: In case of Crank Handle Interlocking using Key-Lock Checking Relays, Provision for KLCR/Crank Handle Box, Termination of Cables on Wago Terminals and Installation to be carried out as per the Item Description in the Tender Schedule and Drawing enclosed here.

19. INTERLOCKING OF SIDING POINTS/ TRAP POINTS:

a. For siding points with succession key lock arrangements and trap points, hand plunger lock fitted with "E" type locks shall be provided on gauge tie plates with suitable bolts and nuts. This work includes fixing of switch extension pieces and split stretcher bars. Notches on split stretcher bars shall be cut at site.

b. It shall be ensured that, it is not possible to lock the points with an obstruction of 5mm test piece placed between switch and stock rail at 150mm from the toe of the switch.

c. `E' type lock shall be fitted to the hand plunger locks with proper bolts and nuts. After ensuring the free as well as the full movement of the plunger, marking shall be done and notches cut on the plunger.

d. Proper lubrication shall be done for the smooth operation of points, HP locks and `E' type locks.

20. TELEPHONES:

a. DESK TYPE PHONES AT STATION HOUSE/APPARATUS CASES/LCs:

Desk Type magneto telephone shall be supplied and fixed at station house/ apparatus case/ LCs/ apparatus cases near top points/siding points and securely fixed on shelf planks. It shall be ensured that no other gadgets is kept in that apparatus case and separate door lock arrangement made to protect the Telephone battery.

Nickel-Cadmium power pack 4V - 2.2AH, with battery charger 110V AC/4V DC shall be supplied and provided for telephone.

21. PROVISION OF TEAK WOOD KEY BOX & TOOL BOX:

a. This work involves manufacture, supply and installation of Glass fronted Teakwood Key box of size 300mmx600mmx75mm with built in lock arrangement. Plastic tags duly engraved giving the particulars of various keys are to be provided along with the keys.

b. A teak wood tool box of size 1000mm x750mm x100mm (inner dimensions) made of 25mm thick teak wood, perplex sheet fronted 6mm (Color-less) shall be manufactured and fixed on the wall at a convenient location as instructed by Bi-RIDE representative at site. The box should have provision of padlock for locking arrangements.

22. ERECTION OF BOARDS WITH LEGENDS/ GOODS WARNING BOARDS:

a. Retro reflective Boards with Calling on Legends/ Goods Warning boards shall be fitted on to the Rails/L-Angles, erected with suitable foundation at location as indicated by Bi-RIDE representative and as per approved signaling plan, clear of infringements.

b. Necessary legends such as "DRAW CLOSE IF SIGNAL IS AT ON" shall be computer printed on retro reflective sheet as per standard practice of this Railways and as per Signal Engineering Manual.

c. Rail posts and other fittings shall be painted as prescribed in Signal Engineering Manual and as directed by BI-RIDE/Railways Engineer.

23. EARTHING:

a. All apparatus cases, battery boxes, CT boxes, armors of cables, battery chargers, transformers, power panels, Control panel, Block Instruments/Control test panel/Cable Termination Rack/Relay Racks, etc., shall be earthed. If number of apparatus cases are grouped at a place, one earth shall be provided up to 2 Full Locations and 1 Half Location. Over and above this, additional earth to be provided at the other end and both the earth need to be connected to all the locations in ring path. Otherwise, separate earth is to be provided for each apparatus case. The earth resistance shall not be more than 10 Ohms.

b. GI PIPE EARTHING SYSTEM shall be provided as per the drawing of GI Pipe Earthing system available at BI-RIDE and as directed by Railways Engineer.

24. PROVISION OF LOCKS:

Universal locks (EWS Locks)/ GI locks/Navtal Locks shall be provided for CLS units, Route Indicators, point machines, apparatus cases, battery boxes and C.T. boxes, wherever necessary. Two Navtal locks (Godrej make) 75mm with 2 keys shall be provided for Relay Rooms at all stations.

25. PAINTING:

a. Block instruments, Block counters, control panel, EKT‟s and all signaling gears installed shall be painted in accordance with the standard practice of South Western Railway and as per Signal Engineering Manual.

b. While painting, initially one coat of primer and afterwards 2 coats of enamel/aluminium paint shall be applied.

c. The details of paints to be used on the signaling gears are shown below.

S. No.	Signaling Gadgets	Colour to be painted (outside)
I	Signal (Colour Light Signal) & Shunt Signal: i) Surface base ii) Post iii) Aspect unit complete	Black, Aluminium (except for Distant Signal in Double Distant Territory) Black Note: Post of Distant Signal in Double Distant Territory to be painted in black & yellow stripes at 300 mm interval.
II	All types of apparatus cases and cable termination box	Aluminium
III	Track Lead Disconnection Box	Black
IV	SM‟s Control Frame Instrument	Green Enamel
V	Point machines	Black
VI	Electrical Detectors	Black
VII	Electrical Lever locks & Circuit Controller	Black
VIII	Key Transmitters	Red or Black
IX	(i) Double line SGE Block Instrument (ii) Single Line Token Instrument (iii)Single Line Token less Instrument	Green Enamel Grey Enamel Green Enamel

X	(i) Interlocking frame supports, quadrants, lever below quadrants, locking trough, catch handle connection & Indication plates (ii) Down rods between Lever tail and crank (iii) All types of cranks, compensators, Facing point Locks, lock bars & Detectors. (iv) Roddings & Rod Rollers	Black Black Red Oxide Paint
XI	(i)Point Lever (ii)Lock Lever (iii)LC Gate Control Lever (iv)Spare Lever (v)Signal Lever	Black Blue Chocolate White Red
XII	Rails	Black

26. NON-INTERLOCKED SIGNALLING ARRANGEMENT:

a. Non-Interlocked Signaling Arrangement as explained below shall be made by the Contractor at his own Cost during all the phases of Commissioning of Stations as per the directions of Bi-RIDE representative. No extra payment will be made on this account.

b. Erection and wiring of temporary relay rack, SM's slide instrument, wiring alteration in the FTOT, apparatus cases, signals, Control panel etc. as per the instructions of Bi-RIDE representative at site for operating signals and points during non-interlocked working. The work also includes provision of Magneto Telephone communication between Top points/ location goomties and SM's Room.

c. The SM‟s control instrument shall be wired as required by BI-RIDE/Railways and as per the circuit diagram prepared in connection with NI. working. Necessary wooden crosses shall be fixed for the signals out of use as indicated by BI-RIDE/Railways. Special warning boards/stop/speed boards may be fixed temporarily as per the NI plan.

27. RELEASING OF S & T GEARS:

a. An inventory of all the S&T gears to be released in the yard should be taken up jointly with BI-RIDE/Railways representative duly indicating as serviceable or unserviceable before NI working commences. The same should be submitted and approved by the Engineering in-charge.

b. The S&T gears as mentioned in the schedule should be released carefully without damage and stacked at a place indicated by the Bi-RIDE representative.

c. All the concrete foundation of the released gears like signals, location boxes, „A‟ type bases, etc. should be broken completely. The resultant pit shall be refilled with earth, rammed and re-surfaced. In case of releasing, the stands grouted on the walls/ floor should be restored to original condition and neatly plastered.

d. All the unserviceable released materials shall be guarded by the contractor till they are returned back to stores/ depot as directed by Bi-RIDE representatives.

28. TRANSPORTATION OF SERVICEABLE MATERIALS:

The released serviceable materials shall be transported from the work spot to the Stores

Depot. Loading and Unloading of materials shall be done by the contractor. The released material shall be stacked neatly by the contractor in the Railway Stores.

29. PROCUREMENT OF CEMENT:

a. Cement for use in the works shall be procured by the contractor from the main producers/their authorized dealers/ authorized stock yards which shall conform to BIS Specifications.

b. Cement bags packing should bear the following information in legible marking:

i. Manufacturer's name
ii. Registered Trade Mark of manufacturer, if any
iii. Type of cement
iv. Weight of each bag in kgs. or No. of bags/ton.
v. Date of manufacturer, generally marked as week of the year/year of manufacturer, e.g., 30/93 which means of 30th week of 1993.

c. To ensure quality control, test certificates from the manufacturer should be produced by the contractors, which should confirm to the relevant specifications [latest may be incorporated].

d. BI-RIDE/Railways may also take samples during the course of the work and get the cement tested to ascertain their conformity to specifications.

e. When such sampling is done, it shall be as per IS Specifications.

f. Test on the cement as per IS:4301 shall be carried out in the field level. Some of the tests

Which may be carried out are:

(i) Compressive strength
(ii) Initial and final setting time
(iii) Consistency
(iv) Soundness

30. WIRES TO BE USED IN S&T INSTALLATION:

The size of various wires/ cables to be used for the wiring of signaling and telecommunication gadget is indicated below:

Size of wire	Circuits/ Equipment's
16/0.2 mm Copper	Relay rack wiring Panel wiring Plug-in type relay wiring at location
7/1.4mm Copper	Power equipment's
3/0.75mm Copper	Power equipment's in locations Relays other than plug-in type Block instrument • Rotary key transmitter • All Signals • Electrical detector • SM"s control instrument Point machine • Loop wire at locations

31. TESTING & COMMISSIONING INCLUDING AS MADE:

a. The entire installation shall be tested by the contractor as per the approved plan and design according to the provisions in Signal Engineering Manual (SEM), OEM guidelines and

established practice of the railways and after satisfying himself, the Bi-RIDE / Railway shall jointly test along with the contractor. Any alteration during testing shall be carried out at free of cost as required by Bi-RIDE/Railways before commissioning. Each installation shall be tested in the presence of the supervisory officials deputed by the Bi-RIDE/Railways as soon as the particular installation/ equipment is installed and unless the working of the equipment is actually ensured, it will not mean that the work has been completed to the satisfaction of the BI-RIDE / Railway. This work involves testing and commissioning of the entire installation. Two copies of the approved plans and designs incorporating all construction details and stamped as "TESTING COPY" shall be submitted to Bi-RIDE before taking up the joint testing with Railways.

b. In order to ensure that equipment's are properly installed and commissioned by adhering to pre- commissioning check list and procedure as defined by OEM in its installation manual, it is necessary that Electronic Signaling systems i.e. EI, SSDAC, IPS, Datalogger are installed, tested and commissioned by RDSO approved manufacturer and a certificate shall be issued to BI-RIDE/Railways.

c. "**AS MADE" DETAILS:**

After joint testing of the installation with the BI-RIDE/Railways engineers and incorporating all alterations suggested in the approved plan and design, the contractor shall update all the records, plans and design. Required copies of final `As Made' details as hereunder shall have to be supplied duly incorporating all particulars for the station before commissioning of the entire installation. All "Asmade" shall be prepared by the contractor in AutoCAD 2000 or latest and submitted in compact discs in duplicate. All `As Made' documents/ plans shall be made by the contractor on Polyester Films to RAILWAY STANDARD only as laid down in the Special Condition of Contract and shall be handed over to the Railways, duly signed.

i. As made Circuit Diagram
ii. As made Cable Core Plan
iii. As made Cable Route Plan
iv. As made Track Bonding Plans
v. As made Power Supply Layout Diagram
vi. As made Contact Analysis Chart
vii. As made Relay Disposition Chart
viii. As made Termination Particulars of Locations & FTOT.

Contractor shall hand over along with the negatives, required copies of plans and designs in the neatly bound booklet marked as `FINAL as Made'. Two sets of these documents shall be kept in thick plastic cover (2 sheets back to back in one plastic cover) duly filled in plastic folder and handed over to Railways.

The contractor is required to supply the following bound registers in 100 pages printed on good quality papers. (75 GSM)

i. Cable Meggering Register,
ii. Relay Register,
iii. Relay Room Key Register,
iv. Route Cancellation Register
v. Earth Resistance Register.

vi. Track Circuit Register
vii. Points Machine Parameter Register
viii. IPS Parameter Register
ix. Battery Register,
x. Axle Counter/MSDAC/ BPAC Parameter Register and any other Registers/Bounded Books as indicated by the Bi-RIDE Representative.

32. PROCEDURE FOR INITIAL CHARGING OF SECONDARY CELLS:

a. All the cells in the battery set shall be same type and capacity.
b. Electrolyte shall be prepared by mixing battery grade Sulphuric Acid and distilled water in the ratio 1:5 in a glass/ Porcelain container by adding Acid to water and not vice-versa
i. The new cells shall be cleaned with distilled water and filled with this electrolyte up to 12-15mm above the plates
c. Allow the plates of cells to soak in the electrolyte for 12 hours
d. Charge shall be applied at the rate of 4% of AH value of the cells to the correct terminals of the battery set duly interconnected.
e. Specific Gravity and voltage of each cell shall be measured and recorded once in 8 hours.
f. Charging shall be stopped when specific gravity becomes 1210 +/ -5
g. If the specific gravity does not attain this value, little quantity of electrolyte shall be taken out and with electrolyte of higher value (1400 – obtained by adding acid and added water in the ratio 7:11) and charging shall be started afresh.
h. On charge, the cells shall be discharged with lamp load up to the limit when the specific gravity becomes 1190 and voltage 1.85 volts.
i. Charge and discharge cycle shall be repeated once again.
j. Final charge shall be given before wiring the cells to use.

33. PROCUREMENT OF STORES:

a. For the execution of the works, the contractor shall procure items of materials inclusive of miscellaneous and consumable items of Stores.

b. The specification for each material to be procured and used by the tenderer shall be as indicated against each item of material. All the materials and equipment's to be supplied and used for execution of work shall be to IRS specification wherever available, or to IS, if IRS is not available. In case of materials for which neither IRS nor IS specification is

c. Available, detailed specifications with drawing have to be supplied by the contractor for approval of the Bi-RIDE/ Railways.

d. Materials not covered in RDSO's approved list of items and to be supplied by the contractor shall be of the best quality and from manufacturers of reputed establishments. The contractor shall produce Quality test, Warranty certificates from the manufacturers and the pamphlets in four copies to the Bi-RIDE Materials covered under RDSO's approved list of items should be procured from those firms approved by RDSO only.

e. The contractor, will however have to procure all the tools and plants required for executing the labour portion of the work and before the actual commencement of the work, the contractor will satisfy the Bi-RIDE engineer that he has procured all the necessary tools and plant required of good quality. The contractor shall engage his own labour and supervisor for the execution for work covered in the contract.

34. USE OF TECHNICAL TERMS AND CONDITIONS, DRAWINGS AND SPECIFICATIONS:

Definition of technical terms and symbols used in circuits shall be as per Indian Standard Specifications and where such specifications are not available, they should be of British Standard Specification.

35. SPARES:

The Tenderer shall supply the essential spares as per the quantities indicated in respective Schedule of works.

36. DISCREPANCIES IN DRAWINGS AND OTHER DOCUMENTS:

The tenderer shall carry out at his expense any alteration of the work due to any discrepancies, errors or omissions in the drawings or other particulars submitted by him.

Any approval given by the BI-RIDE/Railway for this purpose shall in no way absolve the contractor from any or all responsibilities for the correct function of the equipment. In this regard, the sole responsibility rests with the contractor in all respect. Any fittings or accessories which may not be specifically mentioned in the specification of tender documents or the letter of acceptance of the tender or the agreement executed thereof but which are usual or necessary as per normal Signal Engineering practice are to be provided by the contractor without extra charge so that the plant is complete in all respects.

37. ISSUE OF MATERIALS:

a. Extra care should be taken in the transportation of sophisticated Electrical and Electronic equipment's like relays, power equipment's, etc. to prevent from damage during transit. Further, these equipment's should be stored in a covered place to protect from heat, dust, water, etc. These equipment's should be installed and brought in use before the expiry of the shelf life

b. Material at Site statement shall be prepared and submitted as per the provisions contained in GCC by the Bi-RIDE Engineer. The contractor must promptly submit the monthly return of the issued stores to Bi-RIDE Engineer in the first week of every month without fail.

c. If at any time, any material which the contractor would normally have to arrange for himself for executing the works, is supplied by the Bi-RIDE/Railways, either at the contractor's request or suo-moto in order to prevent possible delay in the execution of the work due to contractor's inability to make adequate arrangements for the supply thereof or otherwise such materials will be made available to the contractor in the Railways Stores. All handling thereof will be the contractor's responsibility. Recovery of the cost of such supply materials will be made from the contractor's bills as per extant rules of the BI-RIDE

38. RETURN OF SURPLUS/ RELEASED MATERIALS:

a. The contractor has to return any cut pieces of cables, wires, etc., that may be left out and surplus materials from the drums and other packing materials that might have been handed over to him. No extra payment will be made for this and the unit price quoted against the various items should include this work also. The surplus materials have to be handed over to the Railway Stores as per the instructions of the Engineer- in-Charge of the work

b. The contractor shall take proper written acknowledgement from the Engineers Representative for all the materials returned by him.

c. All tools that are required by the contractor for the purpose of transportation of the materials, digging, concreting and erection, wiring and painting works shall be brought by the contractor himself. This shall include spare parts, fuel and consumable and miscellaneous stores. The rates quoted by the contractor shall be deemed to be inclusive of all charges for such items and inclusive of labour required to ensure efficient and methodical execution of work.

39. RECEIPT OF MATERIALS FROM CONTRACTOR:

a. As soon as the materials are accepted by the Bi-RIDE from the contractor, DMTR entries are to be made immediately. While taking materials from the contractor, delivery challan issued by the firm, who has sold the materials to the contractor/trader and inspection certificate shall be insisted upon.

b. Fabricated items which are to be supplied by the contractor are to be checked thoroughly with the drawings regarding quality of the materials, gauge dimensions, etc. as per the schedule. Wherever any material is received from field/contractor, the detailed nomenclature shall be entered in the DMTR. In case of equipment, the details of manufacturer's name, year of manufacture, RDSO Test Certificate No., Serial No., Contractor's name and Agreement No. and place of installation shall be mentioned both in the DMTR and the ledgers.

c. Materials are normally to be delivered at designated Stores by the contractor. If they are delivered at site due to logistics/exigencies, the supervisor/officer receiving such materials (after verification of due inspection) shall arrange for necessary entries in the Site Inspection Register and ensure the entry in designated Stores DMTR within a week.

40. INSPECTION OF WORKS:

a. The Engineer or his representative shall inspect and test the various portions of the work at all stages and shall have full power to reject all or any portion of the work that he may consider to be defective or inferior in quality of materials workmanship or design in comparison to what is called for in the specification. In the event of rejection of any work already executed and not in accordance with specification as in this tender and/or as determined by the Engineer or which the Contractor has been apprised, the contractor shall carry out alterations/ replacements to such works to the satisfaction of the Engineer for which no additional expenses will be borne by the Bi-RIDE.

b. The contractor shall submit detailed test procedure for each equipment, sub-system and system as a whole to the Bi-RIDE. The Bi-RIDE shall discuss with the contractor and modify the test procedure as may be required to ensure that the requirement of tender specifications is complied. The finalized test procedure shall, only, act as a broad guideline and K-Ride shall be free to carry out any other tests that may be considered essential. The test procedure shall give details of all equipment, test and measuring instruments required to perform the tests which shall be provided by the contractor free of cost.

41. ATTENDING TO DEFECTS:

The contractor shall rectify defects that may arise in the work executed during Maintenance period after completion of work, such defects being due to bad workmanship on the part of the contractor or otherwise. Should any dispute arise so as to correctness of the defect pointed out, the Engineer's decision in this regard is final and binding.

42. INSPECTION OF MATERIALS:

a. Materials to be supplied by Contractor shall be of best quality and shall conform to the relevant specifications, Designs and Drawings. The materials shall be procured by the Contractor/s from manufacturers of repute or their authorized dealers as approved by the Engineer-in-Charge.

b. The contractor should procure signaling/telecom items which appear in the RDSO approved list of suppliers. The contractor shall take prior approval of the BI-RIDE/Railways before placing orders on the firms.

c. The items which are included in the list of RDSO approved suppliers (Electrical Signaling items) shall be inspected by RDSO and Mechanical Signaling items shall be inspected by RITES except petty items which shall be inspected by representative of the Engineer-in-Charge. The RCC products, GI Pipes, FRP type TLD Boxes, Apparatus Case, HDPE Pipe, Polyolefin Cable channel and Earth Electrodes, shall be inspected by RITES. In case the value of Electrical signaling items is less than Rs. Five Lakh, the inspection shall be carried out by Consignee. In exceptional cases, the consignee inspection shall be carried out by an Official nominated for the purpose. Even in these cases, the materials shall be procured from RDSO approved sources.

d. The following critical items will continue to be inspected by RDSO irrespective of its value:

i. All Types of Signaling Relays
ii. Block Instruments
iii. Axle Counter Equipment's
iv. All Power Supply Equipment's
v. Electric Key Transmitter
vi. Terminal Blocks (PBT type)
vii. Electric Point and Lock Detector
viii. Electronic Interlocking system.
ix. Data Loggers
x. LED Signals
xi. PVC Wire Copper for signaling
xii. Maintenance Free Earth.

e. All materials that are not covered under specification, designs and drawings of RDSO, Railway Board, etc., will be procured by the Contractor from the manufacturers of repute/their authorized dealers, after the approval of the Contract Signing Authority

f. Materials to be supplied by the contractor shall be put up for inspection of Engineer or his representative for checking its quality/ suitability before they are finally used/ installed by the Contractor and necessary inspection certificate to be obtained. The Contractor shall therefore arrange to get the material inspected in advance, preferably in bulk and not in piece-meal. The Contractor shall give the Bi-RIDE 10 (Ten) days' notice, when the materials are ready for inspection.

g. All materials to be supplied by contractor should be offered by him/them for RDSO's/RITES inspection, well in time, so as not to delay the progress of work at any stage at any of the stations in any way on this account.

h. If required, the Contractor shall provide at point of production, apparatus and labour for making required tests under the supervision of the Bi-RIDE. Tests may be made either at point of production, on samples submitted or at the destination.

43. FACILITIES FOR TEST & EXAMINATION:

The contractor shall provide, without any extra charges, all materials, equipment's, tools and labour of every kind which the RDSO/RITES or their nominee may consider necessary for any tests and examinations which they or their nominee shall require to be made on the contractor's premises and shall pay all cost attendant there upon. The contractor shall also provide and deliver free of charge at such places as the RDSO/RITES or their nominee may nominate such materials as they or their nominee may require for the independent testing organization. The cost of any such tests will be defrayed by the K-RIDE unless it is stated in the specification that it is to be paid

by the Contractor.

44. CERTIFICATE OF INSPECTION AND APPROVAL:

a. No stores will be considered ready for delivery until RDSO/RITES/BI-RIDE/Railway inspecting officer nominated by them have certified in writing that the material has been inspected and approved by them for dispatch.

b. Facilities must be provided by the contractor to the BI-RIDE or their nominee for inspection of the stores, equipment's and structures at all stages of their assembly, manufacture and fabrication.

45. INSURANCE:

a. The contractor shall take out and keep in force a policy or policies of insurance against all liabilities of the Contractor or the BI-RIDE at common law or under any statute in respect of accidents to persons who shall be employed by the Contractor in or about the site or the Contractor's Office for the purpose of carrying out the contract works on the site. The contractor shall take about and keep in force a policy or policies of Insurance against all recognized risks to their office accommodation and storage for which he is liable. Such insurance shall in all respects be subject to the approval of the BI-RIDE.

b. The Contractor shall take out and keep in force a policy or policies or insurance for all materials handed over to him irrespective of whether used up in the portion of work already done or kept for use for the balance portion of the work until such works are handed over to the Railway.

c. For this purpose, the works are deemed to have been handed over when final acceptance certificate is issued by the Engineer after the completion of the entire acceptance test to be conducted on the works. The contractor shall not be liable for losses/damages to the materials either used up in the portion of work done or the materials kept for use at site, in consequence of mutiny or other similar causes over which the contractor has no control and which cannot be insured. Such losses or damages shall be the liability of the De.

d. The Contractor should, however, insure the stores brought to site, against risks in consequence of war and invasion, as required under the Emergency Risk (Good) Insurance Act in force.

e. The Contractor shall take out all insurance covers in connection with this contract with the General Insurance Corporation of India.

46. AVOIDING INFRINGEMENT OF INDIAN RAILWAY ACT:

a. The works must be carried out most carefully without any infringement of the Indian Railway Act or the General and subsidiary rules in force on the Railway, in such a way that they do not hinder Railway operation nor affect the proper functioning of or damage any Railway equipment, structure or rolling stock except as agreed to by the Railway, provided that all damage and disfiguration caused by the contractor to any Railway or Public properly must be made good by the contractor at his own expenses failing which cost of such repairs shall be recovered from the contractor.

b. No work on the points, track circuits, equipment's involving working signaling gears, internal wiring, cable termination, etc., should be done unless and until contractor's technical supervisors are present at site.

47. CONTRACTOR's DRAWINGS:

a. Any work done by the contractor prior to the approval of the contractor's drawings will be done at the risk of the contractor unless previously authorized in writing by the BI-RIDE.

b. The tenderer shall be responsible for the correctness of the drawings furnished by him. The contractor shall carryout any alterations of the works due to any discrepancies, errors or omissions in the drawings or other particulars, submitted by him. Any approval given by the BI-RIDE/Railways for this purpose shall in no way absolve the tenderer from full responsibility for the execution of the contract in all respects.

c. After the contract is awarded, the contractor shall furnish to the BI-RIDE required, prints of contractor's drawings that form an essential part thereof. No change shall be made in any approved drawings without the written consent of the Bi-RIDE/Railways.

d. After completion of the execution of the contracts, the contractor shall submit to the Bi-RIDE/Railway all corrected tracing film/cloth tracings of drawings furnished by him and prescribed sets of copies of final drawings.

e. Notwithstanding the fact the Bi-RIDE/Railway might have approved or the contractor's design, drawings and specifications the contractor is responsible for the correctness of the entire scheme as a whole and its satisfactory performance to the specifications as laid down by the Railway. The Bi-RIDE/Railway's responsibility is only for the correctness of the signaling plans.

f. In the event of any breach of the aforesaid conditions, the contractor shall in addition to throwing himself open to action for contravention of terms of the agreement and or for original breach of trust, be liable to account to Government for all moneys, advances or profits resulting or which in the usual course would have resulted by reason of such breach.

PART-(III)

TECHNICAL REQUIREMENTS OF AS MADE DIAGRAMS

1. The following as made Design and documents shall be prepared by the contractor after completion of the work and submit the same for approval through BI-RIDE by Railways. After receiving the approval, Soft copy in two sets and Hard Copy One set on tracing film and 6 Sets of the bounded Blue Prints of the following design and documents shall be handed over to the Bi-RIDE / Railway.
   (a) Equipment Layout diagram
   (b) Application Logic and associated Circuit diagrams
   (c) Interface circuits
   (d) Wiring diagram of All EI equipment's including Object Controllers
   (e) Panel Termination particulars
   (f) Relay Contact particulars
   (g) Terminal Analysis diagram
   (h) Fuse Particulars
   (i) Inspectors Completion Certificate
   (j) Relay Index and disposition particulars
   (k) Power distribution diagram etc.,

2. The sizes of different signaling documents are standardized as follows. However, contractor shall take the confirmation about the sizes and media etc., before undertaking preparation of as Made drawings and designs.
   (a) Circuit diagram: A3 Size.
   (b) Panel termination particulars, FTOT particulars, location particulars: A3 Size.
   (c) Font name: Times New Roman – Auto CAD.
   (d) Font size: 10- 2.5 mm
   (e). The above drawings to be made as per SEM/ CSTE Circular (copy may be collected from BI-RIDE office).
   (f). Two draft copies of above drawings to be submitted for approval. One copy will be returned either duly approved for making a fair copy or for resubmission for approval after incorporating the changes as required by Railways.
   (g). After completion of each phase work, the Application logic and Interface circuits has to be updated as per bell test copy / SAT copy and submit 2 sets of corrected Application logic and Interface circuits in plain paper.
   (h). After preliminary approval, required 2 number of prints are to be submitted for Administrative approval. After the Administrative approval negatives of the above drawings have to be made in tracing films for signature in token of approval. After signature on the tracings, 6 sets of these drawings in ammonia/ blue prints kept in standard plastic covers back to back and bounded neatly shall be handed over to the office of GM/Bi-RIDE.
   (i). One set of the above drawings shall be submitted in Reproduction Tracing Film with 2 sets of soft copy in CD‟s/Pen Drive.

K-RIDE