

# CHAPTER VIII

## LINE PLANT SYSTEM –COMMUNICATION THROUGH ‘RE CABLE’

### 8.1 SYSTEM

8.1.1 Armoured, screened underground cables are used for control communication in electrified areas to limit induction effect.

### 8.2 SPECIFICATION AND PERFORMANCE PARAMETERS:

8.2.1 (a) Types of cables with construction as below are used in RE area

$(0 + m + n)$

0 = no. of carrier frequency quads (1.2 mm dia copper conductor paper insulated)

m = no. of Voice frequency quads Paper insulated 0.9 mm conductor dia

n = no. of Voice frequency quads Polythene insulated 0.9mm conductor dia .

(b) Main telecom quad cable aluminium sheathed to specification IRS: TC-14.

(c) Derivation quad cable lead sheathed to specification IRS:TC-27.

(d) Now these specifications are obsolete and presently steel armoured aluminium screened 4/6 quad cable to spec IRS: TC 30 and steel armoured PIJF cable to spec IRS: TC 41 are used. However since such old installations are still in use, such cable system is dealt in this chapter.

8.2.2 Paper insulated quads are used for speech circuits like Section Control, Remote Control, etc., and polythene quads are used for Block Circuits, fault identification and test speaker local.

8.2.3 The cable route survey shall be carried out as per RDSO Technical Instructions No.STS/RE/C-TI-1.

8.2.4 System design of Telecom. Circuits in 25KV AC Electrified areas shall be as per RDSO Technical Instructions No.STS/RE/C-45 which lays down the procedure for location of cable huts and repeater stations to limit the longitudinal induced voltage to safe values.

8.2.4.1 The cable huts are provided at every station for :

- (i) Isolation
- (ii) Tapping/deriving circuits
- (iii) Testing of circuits.

8.2.4.2 (a) VF Repeaters are provided at every 50 to 55 km. along the cable route to compensate the attenuation in the cable.

- (a) Notice Board prohibiting the entry of unauthorised persons in the repeater station shall be displayed at a prominent place of the repeater premise

## 8.2.5. INSTRUCTIONS FOR INSTALLATION OF CABLES.

8.2.5.1 The pairs of paper insulated VF quads are loaded with 88 mH coils spaced at 1.83 km. (+/- 50 mtrs.) which results in:

Characteristic Impedance : 1120 ohms at 800 Hz.

Attenuation : 0.25 db/km at 800 Hz.

## 8.2.6 CABLE JOINTING

All joints in main cable shall be underground and properly sealed to prevent moisture ingress.

### 8.2.6.1. TYPES

#### 8.2.6.1.1 Straight Through Joints

These are used for jointing of two consecutive lengths of cables. Poling at these joints may be done to reduce earth capacitance unbalances.

Refer to RDSO Instructions No. STS/RE/C-33 for conventional joints and STT/RE/C/CJ-1 for heat shrinkable joints.

#### 8.2.6.1.2 Transformer Joints :

The circuits on the main cable are derived/tapped through tapping transformers and extended on derivation cable to the utilisation points. Depending on the requirement 5T or 10T or 20T joints are used.

T denotes Transformer.  
(Refer RDSO's Instruction No.STS/RE/C-36)

#### 8.2.6.1.3 Loading Coil Joints:

These are used for connecting the loading coils of 88 mH in the cable.  
(Refer RDSO Instruction No.STS/RE/C-35).

#### 8.2.6.1.4 Condenser Joints:

These are provided in the middle of loading section for adding condensers to

reduce capacitance unbalances in the cable.

Balancing of the VF quad of the Main Telecom cable is carried out as per RDSO /Technical Instruction No.STS/RE/C-30 to minimize cross-talk and noise caused by capacitance unbalances.

Max. Capacitance unbalance shall be 40 pF for full loading section and 20 pF for half loading section.

Poling at these joints may be done to reduce earth capacitance unbalance.

Refer RDSO Technical Instructions                      for conventional joints.  
No.STS/RE/C-31 & 34

No.STT/RE/C/CJ-1    for heat shrinkable joints.

8.2.6.1.5 Building out Net work joints:- These are provided to make the cable length between two repeater stations an exact multiple of loading section length. (Refer RDSO Technical Instructions No.STS/RE/C-37).

#### 8.2.7 Main Cable Termination:

At repeater stations/cable huts the main cable shall be terminated on a terminating Joint with switchboard cable of approved type. (Refer RDSO Technical Instructions No.STS/RE/C-9)

#### 8.2.8 Earthing:

It is provided on metallic screen/armor of cables and equipments in VF repeater Stations/cable huts to afford safety to personnel against shock and protect equipment against surges & high voltages and to limit the induced voltages to safe value.

##### 8.2.8.1 Limits of Earth Resistances for :

- |      |   |                       |
|------|---|-----------------------|
| i)   | Surge arrestors/lightning dischargers of Telecom. equipment.          | Not more than 10 ohms |
| ii)  | Screen/Armour of Aluminium sheathed Telecom. Cable.                   | Not more than 1 ohm.  |
| iii) | Equipment earth in VF repeater stations, Cable huts and way stations. | Not more than 5 ohms. |

(Refer RDSO Instructions S&T/Earth)

### 8.3 SYSTEM REQUIREMENT

### 8.3.1. INSTRUCTIONS FOR LAYING OF CABLES.

8.3.1.1 The cable will be generally buried underground in a trench of 0.3 metre width and depth of 0.8 metres.(As per drawing no.RDSO/TC:35007) If more than one cable is to be laid in the same trench the width can be increased up to 0.5 metre.

8.3.1.2 In exceptional cases, such as in yards and when the depth of the cable trench is limited to 0.5 m. Due to local conditions a minimum distance of one metre shall be maintained between the cable and the OHE mast supporting the catenary or any other structure likely to come in contact with the high tension conductors. When the observance of this rule creates difficulty, the cable shall be laid in concrete pipes and in that case the distance to be maintained as specified above can be brought down to 0.5m.

8.3.1.3 When the depth of the cable trench exceeds 0.5 m. near the OHE masts, it shall be ensured that the nearest edge of the cable trench is at least 3m away from the OHE mast.

8.3.1.4 Position of cable joints shall be marked on the nearest OHE mast by painting of an approved legend.

8.3.1.5 Laying of cables in the vicinity of traction sub-stations, OHE switching stations and their associated earthing system shall be governed by the following principles:

- (i) In the vicinity of traction sub-stations, the cable shall be laid at least one metre away from any metallic body of the sub-stations, which is fixed in the ground, and at least one metre away from the sub-station earthing. The cables shall, further, be laid in concrete pipes or enclosed brick channels for a length of 300 m. on either side of the sub-station. As far as possible, the cable should be laid on the side of the track opposite the sub-station side.
- (ii) In the vicinity of the OHE switching stations (feeding posts, sectioning and sub-stationing posts), the cable shall be laid at least one metre away from any metallic body of the station which is fixed in the ground and at least 5 m. Away from station earthing. The distance of 5 m. from station earthing can be reduced to one metre, provided the cables are laid in concrete piles
- (iii) Where an independent earth is provided for an OHE structure, the cables shall be laid at least one metre away from such earthing.

8.3.1.6 Outside station limits, the cable shall generally be laid at a standard distance from 10m. from the centre of the nearest track.

8.3.1.7 When signalling and telecommunication cables are laid in the same trench, a distance of about 100 mm. is to be maintained between them by placing bricks between them, at intervals of two metres.

8.3.1.8 HT and LT power cables and telecommunication cables shall not be laid in the same trench.

8.3.1.9 The cable laid parallel to the track shall normally be buried at the depth of 0.8 m. While those laid across the track must be one metre below the rail flanges.

8.3.1.10 The trench for the telecommunication cable shall be kept as far away as possible from the trench for the power cables.

8.3.1.11 When cables are to be laid along the girder bridges, over the culverts, through the bed of culverts, over the rocky terrain and the like, they shall be laid as per the approved methods for each such location.

8.3.1.12 While laying, the cables shall not be subjected to sharp bends. The bending radius for the cable shall in no case be less than 20 times the diameter of the cable in case of lead sheathed armoured cables and 40 times the diameter of the cable in case of aluminium sheathed armoured cables.

## **8.4 MAINTENANCE SCHEDULE**

### **8.4.1 INSTRUCTIONS FOR MAINTENANCE.**

Following instructions shall be followed:

8.4.1.1 All cable termination devices, cable heads shall be kept clean and dry.

8.4.1.2 All cables shall be tested as per following section of this chapter.

8.4.1.3 Notice shall be given to the SE/JE(Telecom) prior to digging along the cable route .

8.4.1.4 (a) Earths shall be watered regularly.

β (b) Earths and earth connections shall be examined once in a month.

(c) Earth resistance shall be measured every year and entered in a register.

8.4.1.5 Maintenance staff of repeater stations and test room shall regularly monitor the performance of circuits every day.

8.4.1.6 Each Emergency socket shall be inspected once in 10 days by the maintainer for its performance and good shape and the markings on OHE masts shall be well painted. No two consecutive sockets along the route shall remain faulty.

8.4.1.7 Protective works for cables track crossings, culverts, bridges shall be inspected once in a month and particular attention is to be given after the monsoon.

### **8.4.2 TESTING OF CABLES**

8.4.2.1 Following parameters shall be tested:

- i) Attenuation as measured at 800 Hz. by Transmission Measuring set

Loaded Cable (RE) 0.25 dB/Km.

Unloaded cable (RE) 0.8 dB/Km.

Section/ Quad	Pair	Attenuation dB
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I

II

- ii) Insulation Resistance shall be measured at ambient temperature with a 500V DC megger and shall be better than 10,000 mega ohm/km.

Section/Quad

Pair I	Conductor 1 to Earth	Conductor 2 to earth	Conductor 1 & 2
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Pair II

- iii) Max. Average Loop Resistance of conductor pair measured with a multimeter shall be 56 ohms/km at 20 degrees C. Nominal loop resistance shall be 55.2 ohms per km.

- iv) Cross Talk level between two VF pairs of a quad shall be measured with cross talk measuring set as per IRS:TC:45 and limits are as under:

Near End Cross Talk : Better than 61 dB.

Far End Cross Talk : Better than 65 dB.

- v) Psophometric Noise

The Psophometric noise shall be measured by psophometer and it shall not exceed 2 mV.

8.4.2.2 Schedule of measurements:

All measurements shall be carried out from Repeater to Repeater.

- |                              |           |
|------------------------------|-----------|
| 1. Checking Attenuation      | Monthly   |
| 2. Checking Cross Talk Level | Quarterly |
| 3. Checking Noise Level      | Quarterly |
| 4. Loop Resistance Test      | Monthly   |

5. Insulation Resistance Test                      Yearly

8.4.2.3 Repeater Station Measurements:

8.4.2.3.1 Following parameters shall be measured

(i) Gain of Amplifiers

Repeater Amplifier              (VFR)              24 db.

Repeater Amplifier with leak      (VFL)      20 db

(ii) Cross talk level of VFR shall be better than 80 db.

(iii) Frequency response in 300-3400 Hz. range shall be within +/- 0.75 db for VFL.

(iv) Phantom voltage of SRR (wherever provided)

Incoming : Not less than 10 volts.

Outgoing : 50 +/- 2 volts.

(v) Buffer Amplifier

Gain : 24 db.

Shunting loss: shall be better than 1.5 db in frequency range 300 Hz. to 3.4 KHz.

8.4.2.3.2 Tools and Equipment for underground cables:

- (i) Multimeter - 1
- (ii) T.M.S. Kit - 2 Sets
- (iii) Cross talk measurement Set - 1 (-70 dB range shall be available)
- (iv) Capacitance unbalance measuring Set - 1
- (v) Earth tester - 1
- (vi) Million Megohm meter (100 Volts) - 1
- (vii) Hydrometer - 1 in each repeater and test room
- (viii) Emergency control telephone - 1 with each Inspector
- (ix) Frequency counter for DTMF Signalling - 1 in Headquarters
- (x) Cable fault locator (Digital) - One in repeater
- (xi) Pick axe - 2 Nos.
- (xii) Crow Bars - 2 Nos.
- (xiii) Shovels - 2 Nos.
- (xiv) PSOPHOMETER - 1 No.

8.4.2.3.3 Schedule of measurements

- (a) Gain of Amplifiers                      Monthly
- (b) Phantom voltage                      Monthly

- |                        |           |
|------------------------|-----------|
| (c) Frequency response | Quarterly |
| (d) Shunting loss      | Quarterly |

### 8.4.3. LOCATION OF FAULTS

#### 8.4.3.1. TYPES

Cable faults may be divided into two groups

- (i) Faults in end or termination portion
- (ii) Faults in buried portion.

8.4.3.1.1 (a) When the fault is suspected at end, affected conductors should be disconnected, and retested for continuity and insulation.

(b) The terminals and leading wires should be separately tested to ensure that fault is not in the terminal or leading wires.

© When cable is terminated with Switch Board cable, the end should be cut off and re-made, in case low insulation is detected.

#### 8.4.3.1.2 BURIED CABLE

(a) The faulty section is traced out first.

VARLEY Loop Test using a bridge megger is used for fault localisation  
By using a pair of polyethylene quad terminated in each cable hut/repeater station for fault checking purpose.

(b) The surface of the earth near the point of localisation shall be inspected to see whether the damage has been caused by excavation or subsidence.

(c) Ground should then be opened and cable exposed for careful examination.

(d) The faulty section of main cable is temporarily restored by using a switch Board cable of required length.

### 8.4.4. TESTING AND MEASURING INSTRUMENTS.

#### 8.4.4.1 Measuring Instrument for Maintenance of cable

- |  |                            |
|--|----------------------------|
| i) Transmission Measuring Set<br>(IRS-TC-43) | : One per Repeater Station |
| ii) Psophometer<br>(STS/RE/C/SPN/MI-73)      | : One per Division         |
| iii) Cross Talk Measuring Set<br>(IRS-TC-45) | : One per Repeater Station |

iv) Megger 500V DC : One per Repeater Station

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- v) Capacitance Unbalance Measuring Set (IRS/TC:48) : One per Division
  - vi) Impedance Bridge (STS/RE/C/SPN/MI-73) : One per Division
  - vii) Cable fault locator : One per Division

8.4.5. INSPECTION, RECORDS AND REPORTS.

- (a) Monthly schedule shall be carried out by Telecom. Inspector.
- (b) Quarterly and Yearly schedules of maintenance shall be carried out Under the supervision of Telecom. Inspector Incharge.
- (c) The records of tests and maintenance schedules shall be maintained in Relevant proforma given at the end of the chapter.
- (d) ASTE/DSTE/Sr.DSTE during their annual inspection shall check the Records of test and maintenance schedules.

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-----RAILWAY

ATTENUATION

- SECTION \_\_\_\_\_
- SUB – SECTION \_\_\_\_\_
- CABLE ROUTE DISTANCE \_\_\_\_\_
- SIZE OFCABLE \_\_\_\_\_
- STATION \_\_\_\_\_
- MEASURED BY \_\_\_\_\_
- DATE \_\_\_\_\_

Name of Circuit	Quad No.	Pair	Attenuation of Cable in dB

-----RAILWAY

INSULATION RESISTANCE

- SECTION \_\_\_\_\_
- SUB – SECTION \_\_\_\_\_
- CABLE ROUTE DISTANCE \_\_\_\_\_
- SIZE OF CABLE \_\_\_\_\_
- STATION \_\_\_\_\_
- MEASURED BY \_\_\_\_\_
- DATE \_\_\_\_\_

Name of Circuits	Quad No.	Pair	Insulation Resistance (M. Ohms)		
			L1 to E	L2 to E	L1 to L2

-----RAILWAY

**CROSS TALK LEVEL**

- SECTION \_\_\_\_\_
- SUB – SECTION \_\_\_\_\_
- CABLE ROUTE DISTANCE \_\_\_\_\_
- SIZE OF CABLE \_\_\_\_\_
- STATION \_\_\_\_\_
- MEASURED BY \_\_\_\_\_
- DATE \_\_\_\_\_

Name of Circuits	Quad No.	Pair	Cross Talk Level in dB	
			With in same quad	Between Adjacent quads.

-----RAILWAY

**NOISE LEVEL**

- SECTION \_\_\_\_\_
- SUB – SECTION \_\_\_\_\_
- CABLE ROUTE DISTANCE \_\_\_\_\_
- SIZE OF CABLE \_\_\_\_\_
- STATION \_\_\_\_\_
- MEASURED BY \_\_\_\_\_
- DATE \_\_\_\_\_

Name of Circuits	Quad No.	Pair	Noise Level in mV

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-----RAILWAY

<b>LOOP RESISTANCE</b>
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- SECTION \_\_\_\_\_
- SUB – SECTION \_\_\_\_\_
- CABLE ROUTE DISTANCE \_\_\_\_\_
- SIZE OFCABLE \_\_\_\_\_
- STATION \_\_\_\_\_
- MEASURED BY \_\_\_\_\_
- DATE \_\_\_\_\_

Name of Circuits	Quad No.	Pair	Loop Resistance in ohms