# Standards and Practices

# Over Head Electric Equipments

**by**

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# ELECTRIFICATION SCENARIO AT A GLANCE

- 1st Electric Train started on 3rd February, 1925 on ex-Great Indian Peninsula **Railway** (**GIP Railway**), (now Central Railway ) from Bombay VT(now CSTM) to Kurla via Harbor line, about 15.00 Km long.
- Now, as on 31-03-05, the electrified route is 17,280 Km which is about 27% of Indian Railways route of about 63,000 Km.

# ELECTRIFICATION SCENARIO AT A GLANCE

- Passenger Traffic carried out on Electrified route is about 50%.

- Goods Traffic carried out on Electrified route is 67%.

# TRACTION VOLTAGE SYSTEM

- Electric Traction introduced in Mumbai area on 1500 volt DC traction in 1925.
- 25 KV AC Traction introduced in 1960 which is now universally adopted in Indian Railways.
- 1500 volt DC – 400 route Km.(which is also under conversion to 25 KV AC).
- 25 KV AC, single phase 50 Hz – 16,880 route Km

# Traction Distribution (TRD)

- Power Supply Installation (PSI)
- Overhead Equipment (OHE)
- Remote Control equipment
  - RCC [Remote Control Center]
  - SCADA- [Supervisory Control and Data Acquisition system]


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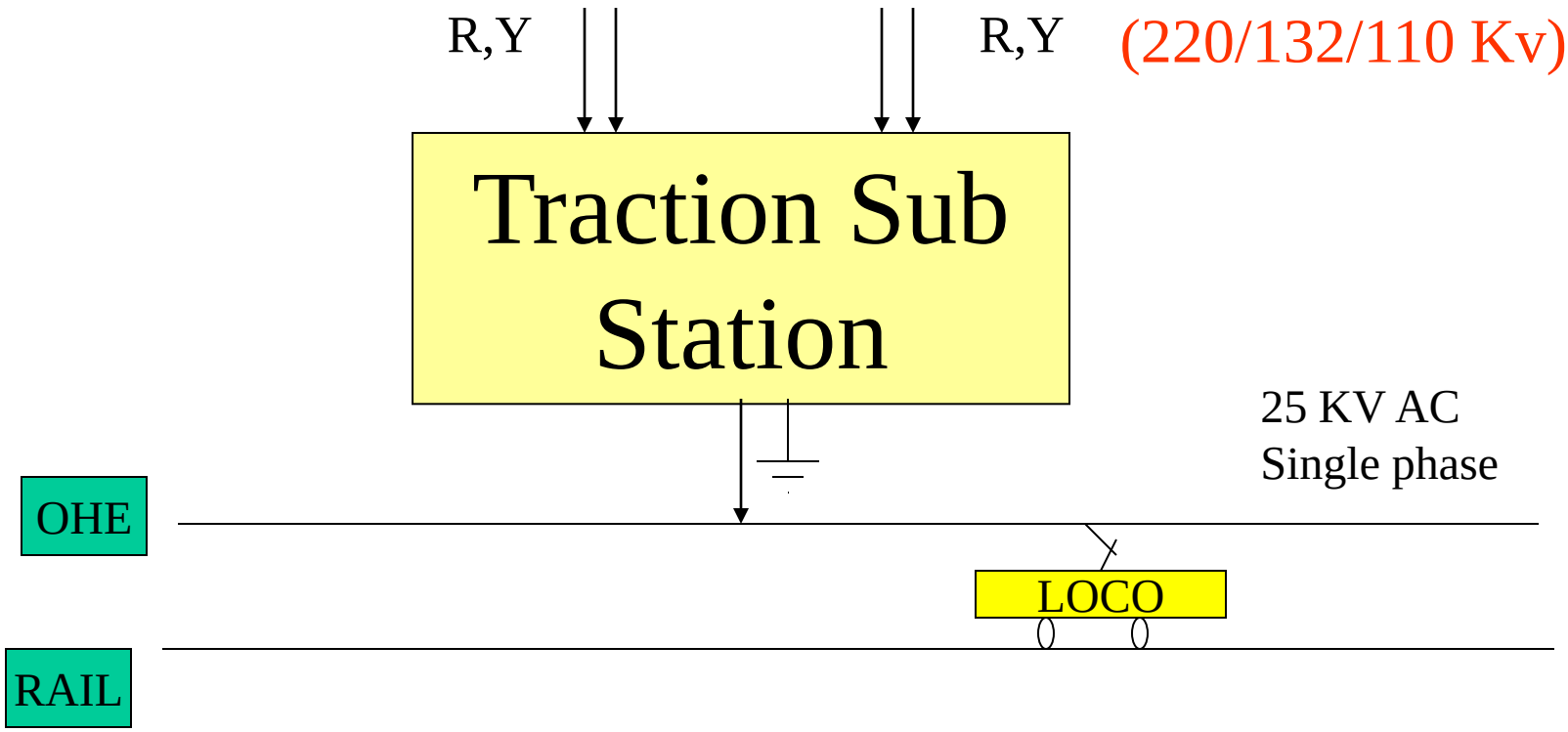
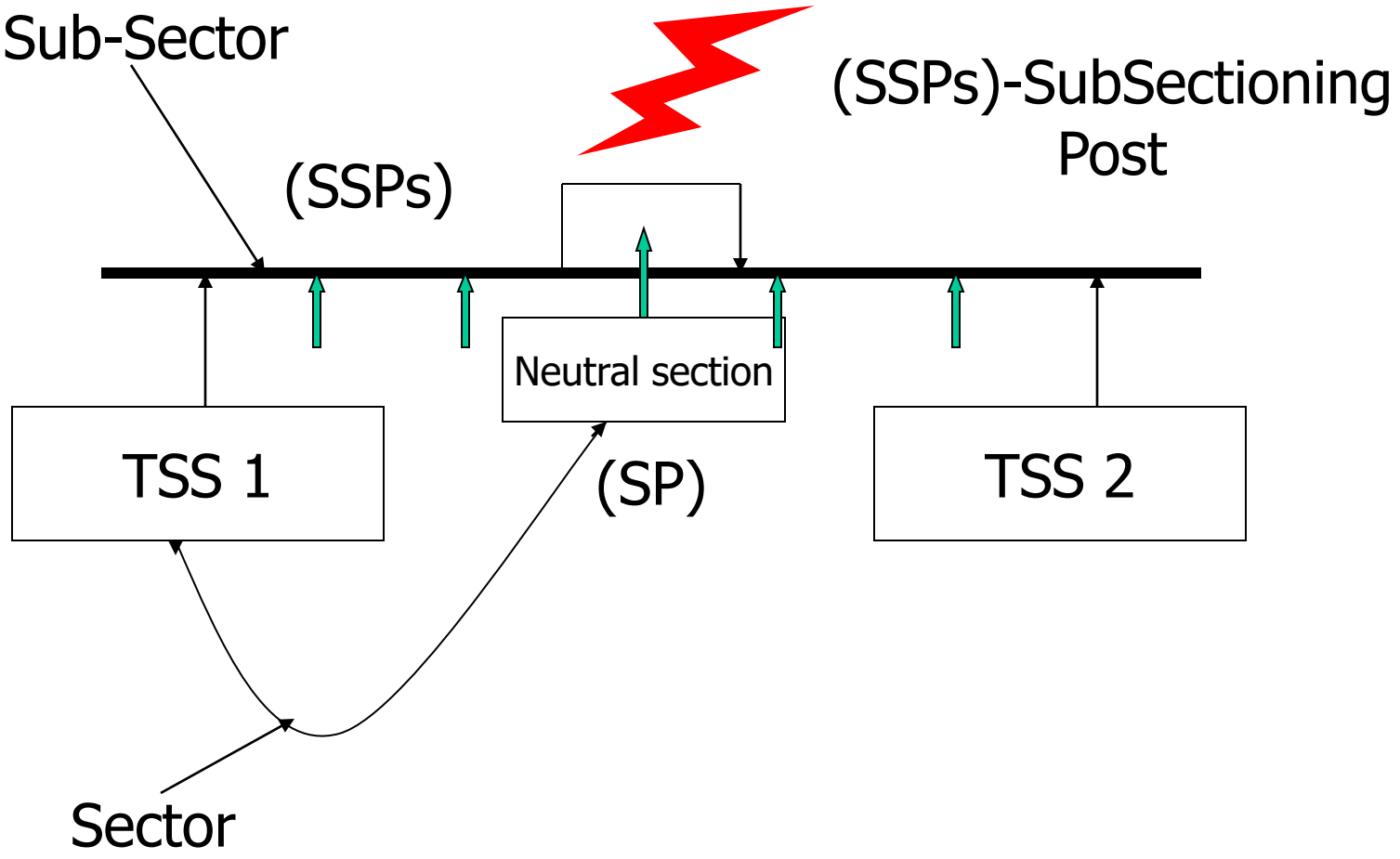
# SCHEMATIC DIAGRAM OF TRACTION SUB STATION



# SCHEMATIC DIAGRAM



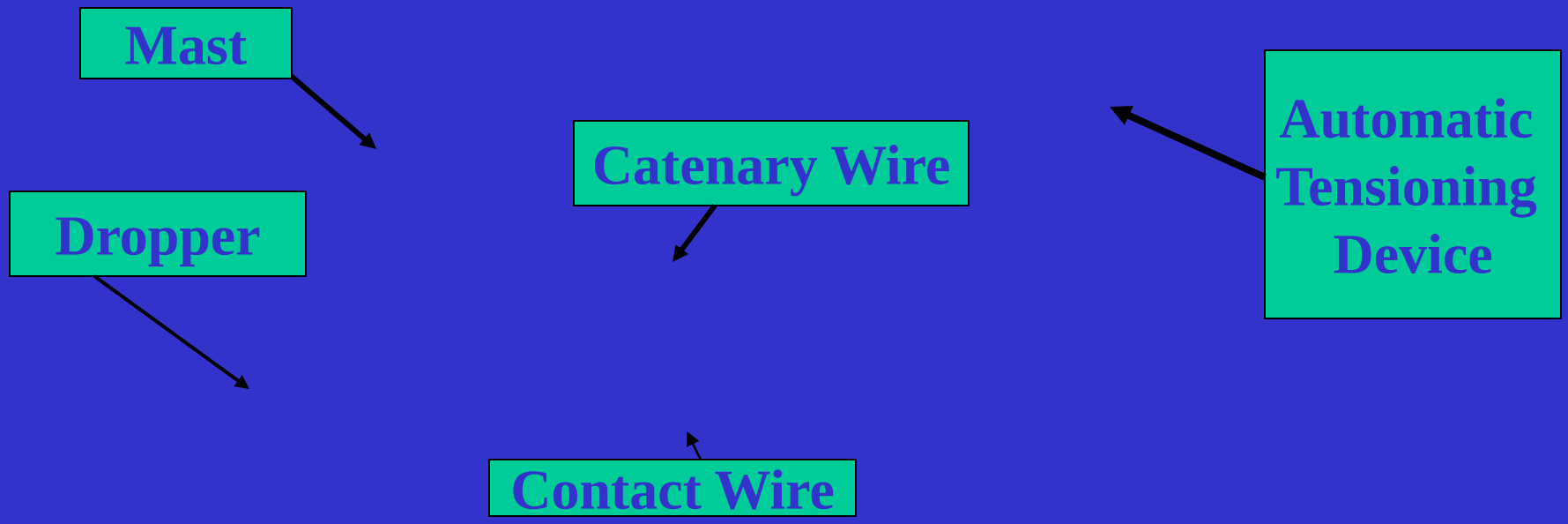
# PTFE SHORT NEUTRAL SECTION

# Neutral Section

A short section of insulated dead over-head equipment which separates the sectors fed by two adjacent substations which are normally connected to different phases.

- Warning Boards for Driver

# OHE Arrangement



# OVERHEAD EQUIPMENT

Site Photograph

- Masts and portals
- Cantilever Assembly
- Contact and Catenary Wire
- Dropper
- Auto tensioning device (ATD)

# CANTILEVER ASSEMBLY

Sketch

Main parts

- Stay tube
- Bracket tube
- Steady arm
- Bracket Insulator
- Stay arm Insulator
- Register arm
- Suspension clamp

# DROPPERS & BONDS

- DROPPERS
  - A fitting used in overhead equipment construction for supporting contact wire from catenary
- BONDS
  - An electrical connection across a joint in or between adjacent lengths of rail

  (structure bond, continuity bond, cross bond etc.)

# Auto Tensioning Device (ATD)

- Auto tensioning device
  - A device for maintaining the tension of OHE conductors constant under all ambient temperature conditions.
  - Such OHE is called regulated OHE.

# CONTACT & CATENARY WIRE

- Contact wire –
  - cross sectional area - 107 sq.mm.
  - diameter - 12.24 mm
  - normal tension – 1000 kg
  - breaking load – 3905 kg

- Catenary wire –
  - cross sectional area - 65 sq.mm.
  - diameter – 10.50 mm
  - Normal tension – 1000 kg
  - breaking load – 3920 kg

# Electrical Clearance

- The minimum distance in air between live equipment and the nearest earthed part.
- Vertical

  i) long durations 320 mm

  ii) short durations 270 mm
- Lateral

  i) long duration 320 mm

  ii) short duration 220 mm

# Working Clearance

- Minimum clearance between live conductor/equipments and such earthed structure/live parts of different elementary sections where men are required to work shall be 2 m.
- Where the clearance is not obtained the structure shall be protected by earthed metallic screens or prescribed warning boards.

# IMPLANTATION

- The horizontal distance from the nearest face of traction mast to the centre line of track
- The nominal IMPLANTATION of mast is 2.5 m.
- Can be lowered to 2.36 m (with the approval of EIG)

# Height of the Contact Wire

- Minimum 4.80m (above rail level)
- maximum 5.80m
- On level crossing 5.50m. (Provision of Height Guage at LC Gates)

# OHE Inspection Car (Tower Wagon)

- Used for maintenance of OHE and for attending to break downs.
- Carries necessary tools for maintenance and break downs such as tackles, straining screws, clamps, ropes, ladders, adequate stock of insulators, length of contact and catenary wires and other OHE fittings.
- Types of Tower wagon –
  - Four Wheeler (speed potential upto 75 KMPH)
  - Eight Wheeler (speed potential upto 110 KMPH)

# Environmental Effect on OHE

- Pollution causes large number of insulator – flash over.
- Pollutants provide creepage path resulting into flash over of insulators and consequent creeping of circuit brakers.
- Types of pollution
  - Saline pollution – caused by salt deposits in coastal areas.
  - Chemical and industrial pollution - caused by waste from industries like hydrochloric acid, Sulphuric acid, particles of urea, cement etc.

# Maintenance Schedules for OHE

- Foot Patrolling – For visual inspection of every part of OHE.
- Trolley Inspection – To observe closely the OHE during day time.
- Current Collection Tests – To detect points at which contact between the contact wire and pentograph is unsatisfactory resulting in sparking. These tests are performed at night.
- Special Checks – More frequent attentions on items such as Insulators , section insulators, Isolating switches, earth connections, Bird nest etc.

# Maintenance Schedules for OHE – contd.

- Annual Maintenance and OHE Inspection Car Check – Replacement of defective fittings, checking and correction of clearances, heights, staggers, Checking of Masts, portels, contact wire and catenary wire, insulators, neutral sections, regulating equipments, clamps etc.
- Periodical Overhaul – At the interval of four years.
- Re-tensioning of Unregulated OHE – At every six months.

# Power Supply Installations

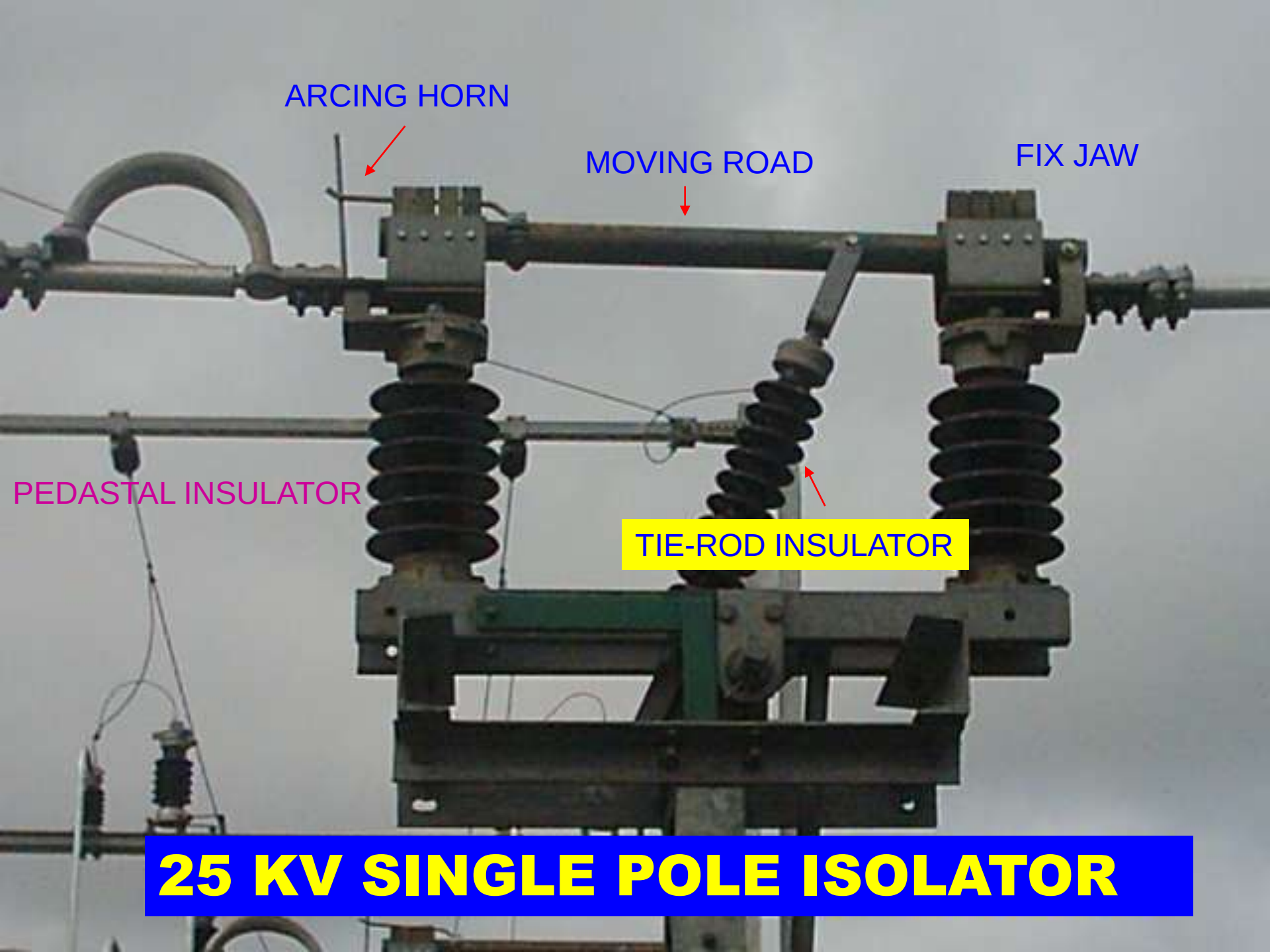
- Traction Substation ( TSS)
- Switching Stations

# 132 KV DOUBLE POLE ISOLATOR


132 KV SF 6 CIRCUIT BREAKER
LA
2004/06/26


HV BUSHING
BUCHHLOZ RELAY
RADIATORS
TAP CHANGER
MARSHALLING BOX
132/25 KV TRANSFORMER
EMCO
20
2004/06/26

# CURRENT TRANSFORMER




# 25 KV SINGLE POLE ISOLATOR

# SUB SECTIONONG AND PARRALING POST DC SECTION

# Maintenance Schedules of Tractions sub-stations

- Fortnightly maintenance -
  - Going around the whole area of sub stations,
  - inspect for general cleanliness, proper drainage, road and rail axis.
  - Checking of batteries.
- Monthly maintenance –
  - Bonding and earthing
  - Oil level in transformers, circuit breakers etc.
  - Insulators
  - Traction transformer
  - Operating mechanism of circuit breakers and interrupters.

# Maintenance Schedules of Tractions sub-stations-- Contd

- Quarterly maintenance
  - Inspection of batteries and battery charges.
  - PTs and CTs.
  - Auxillary transformers.
- Half yearly maintenance
  - Traction transformers – Testing of oil sample for accidity and BDV.
  - Control and Relay panel
  - Traction transformers.

# Maintenance Schedules of Tractions sub-stations-- Contd

- Yearly maintenance
  - Inspection of fence all around the sub station and bonding between metal fencing panels and to earth.
  - Lighting arresters.
  - Bonding and Earthing
  - Traction transformers.
  - Control and Relay panel
  - Batteries and battery charges.

# THANK YOU

# ELECTRIC LOCOMOTIVES

# Nomenclature

Electric Locos and EMUs are classified by means of a three letter code, followed by version number in numeric

| First Letter- | Gauge |
| --- | --- |
| W | Broad Gauge |
| Y | Meter Gauge |
| Z | Narrow Gauge |

# Nomenclature

| Second Letter- | Type of Traction (current) |
|---|---|
| C | Continuous Current (DC) |
| A | Alternating Current |
| CA | Dual Current AC/DC |
| (D | Diesel) |

| Third Letter – | | Type of Service | |
|---|---|---|---|
| M | Mixed Service | P | Passenger Service |
| G | Goods Service | S | Shunting |
| U | Multiple Units | | |

# Examples of Nomenclature

- WAP 4
  - BG, AC, Passenger service,Version 4
- WCAM1
  - BG, Dual Current, Mixed service, Version 1
- YCS 1
  - Meter Gauge, DC, Shunting service, Version 1
- WCG 5
  - BG, DC, Goods service,Version 5

# Bogie Arrangements

- B ---Two axle bogie with one Traction Motor for both the axles.
- BO--- Two axle bogie with one Traction Motor for each axle.
- CO--- Three axle bogie with one Traction Motor for each axle.
- B-B Loco with two 'B' bogies
- CO-CO Loco with two 'CO' bogies

# Types of Electric Locos

AC Locos

- **B-B** WAG1, WAG2, -WAG3, WAG4,
- **BO - BO** WAM1, WAM2, WAM3,
- **CO-CO** WAM4, WCAM1, WAP1, WAG5, WAG6,WAG7,WAP3,WAP4, WAG9

DC Locos

- **CO-CO** WCM1, WCM2, WCM3, WCM4, WCM5, WCG2

# Comparison Of Pass & Goods

| *Loco for Passenger* | *Loco for Goods* |
| --- | --- |
| Less Tractive Effort | *More Tractive Effort* |
| More speed | *Less speed* |
| Lower gear ratio | *Higher gear ratio* |

# ELECTRIC LOCOMOTIVE

## LOCO TYPES

- WAG 5 — 3900 KVA
- WAM 4 — 3900 KVA
- WAG 7 — 5400 KVA
- WAP 1 — 5400 KVA
- WAG 9 — 6000 hp 3 phase
- WAP 5 — 6000 hp 3 phase
- WCAM1 — 5400 KVA AC/DC

# CIRCUIT DIAGRAM OF LOCO

A TYPICAL CIRCUIT DIAGRAM OF CONVENTIONAL ELECTRIC LOCOMOTIVE IS SHOWN HEREWITH

# Main Equipments of Electric Locomotive

- Roof Equipments –
  - Pantograph – for current collection
  - Circuit Breaker – for making on/off electric supply from panto to power equipments
- On Board power equipments
  - Traction Transformer – for stepping down voltage from 25 KV to 750/1500 volts.
  - Rectifier – for converting 750 AC to 750 volt DC for feeding supply to traction motors.
  - Arno Converter – for converting single phase 750 volt AC to 3 phase 415 volt for feeding supply to auxiliary machines like compressor/exhausters.

# Main Equipments of Electric Locomotive

- Under slung Equipments –
  - Traction motor – for producing tractive effort required to move train.
  - Suspension arrangement – system for transmitting tractive effort from traction motor to bogie.
  - Brake System – for braking of electric loco and train
  - Batteries – for feeding supplies to control system

    -baby compressor for initial raising of pantograph.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# Specific Energy Consumption (SEC)

- SEC for Goods Train= 10 Kwh per 1000 GTKM
- SEC for Passenger Train= 19 Kwh per 1000 GTKM

# MAINTENANCE COST OF LOCOS

- About Rs. 20 lacs per loco per year

# THANK YOU