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]
SCHEMATIC DIAGRAM OF TRACTION SUB STATION

Traction Sub Station

R,Y → R,Y (220/132/110 Kv)

OHE

25 KV AC Single phase

RAIL

LOCO
Neutral Section

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

• Warning Boards for Driver
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 breakers.
- 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
132/25 KV TRANSFORMER

HV BUSHING

BUCHHLOZ RELAY

RADIATORS

TAP CHANGER

MARSHALLING BOX

2004/06/26
CURRENT TRANSFORMER
SUB SECTION ONG AND PARRALING POST DC SECTION

LA

BUS BAR

CT

PT

CB

2004/06/29
• **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 Ttractions 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 acidity 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

<table>
<thead>
<tr>
<th>First Letter</th>
<th>Gauge</th>
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<tbody>
<tr>
<td>W</td>
<td>Broad Gauge</td>
</tr>
<tr>
<td>Y</td>
<td>Meter Gauge</td>
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<tr>
<td>Z</td>
<td>Narrow Gauge</td>
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# Nomenclature

<table>
<thead>
<tr>
<th>Second Letter-</th>
<th>Type of Traction (current)</th>
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<tbody>
<tr>
<td>C</td>
<td>Continuous Current (DC)</td>
</tr>
<tr>
<td>A</td>
<td>Alternating Current</td>
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<tr>
<td>CA</td>
<td>Dual Current AC/DC (Diesel)</td>
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<table>
<thead>
<tr>
<th>Third Letter</th>
<th>Type of Service</th>
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<tbody>
<tr>
<td>M</td>
<td>Mixed Service</td>
</tr>
<tr>
<td>G</td>
<td>Goods Service</td>
</tr>
<tr>
<td>U</td>
<td>Multiple Units</td>
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<tr>
<td>P</td>
<td>Passenger Service</td>
</tr>
<tr>
<td>S</td>
<td>Shunting</td>
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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

<table>
<thead>
<tr>
<th>Loco for Passenger</th>
<th>Loco for Goods</th>
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</thead>
<tbody>
<tr>
<td>Less Tractive Effort</td>
<td>More Tractive Effort</td>
</tr>
<tr>
<td>More speed</td>
<td>Less speed</td>
</tr>
<tr>
<td>Lower gear ratio</td>
<td>Higher gear ratio</td>
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</table>
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.
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