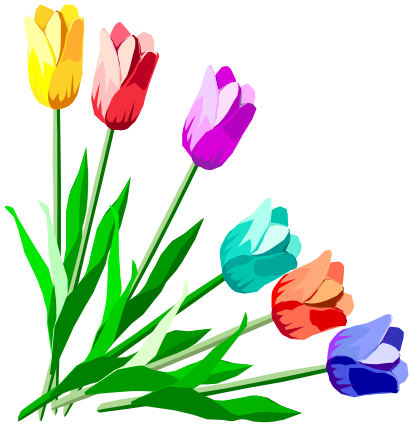
# Bharat Heavy Electricals Limited
# Jhansi

## Locomotive Engineering Division

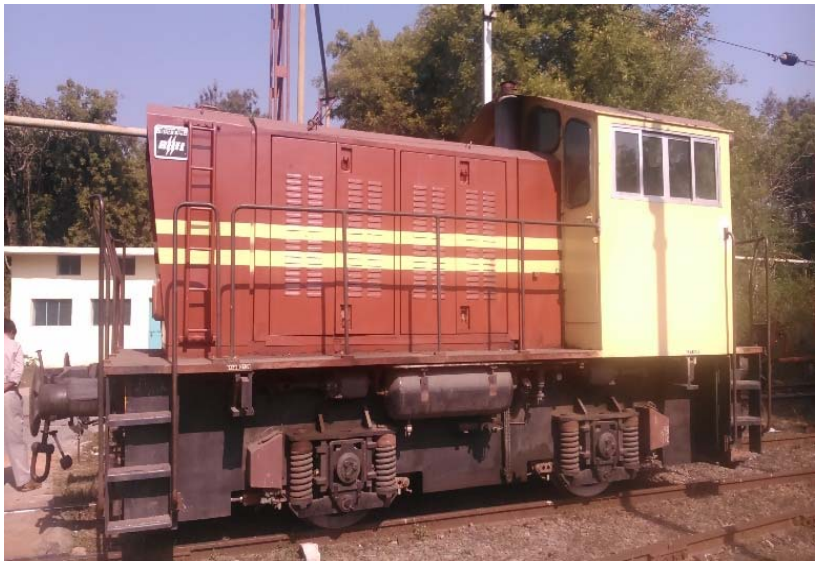
# Welcomes
# Esteemed Customers



Monday, November 09, 2015

# Locomotive Product Profile

# 350 HP DIESEL ELECTRIC SHUNTING LOCO



- **Gauge**: Broad Gauge (1676mm).
- 2-Axle Locomotive.
- **Bogie Configuration** : O-B-O
- **Wt. of loco**: 45 Ton.
- **Diesel Engine**:

  NTA 855L(Cummins Make) /CAT3406 (Caterpillar Make)

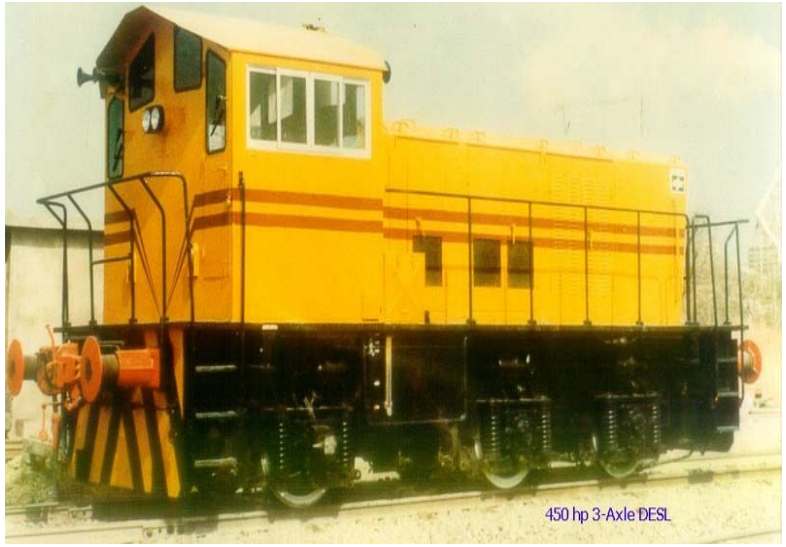
- **Haulage Capacity**: 1500 -2000Ton**

  (** On level tangent ,depends on track condition, Wagon bearing type, climatic condition etc)

# Special Features

- No separate starter motor; cranking through TG having start field winding.
- Compact single bearing traction generator, Self aligning.
- Best suitable for light shunting duties.
- Provision of MU operation for increased haulage requirement as standard feature.
- Dual control station, convenient for driving in both forward and reverse direction.

# 450 HP DIESEL ELECTRIC SHUNTING LOCO



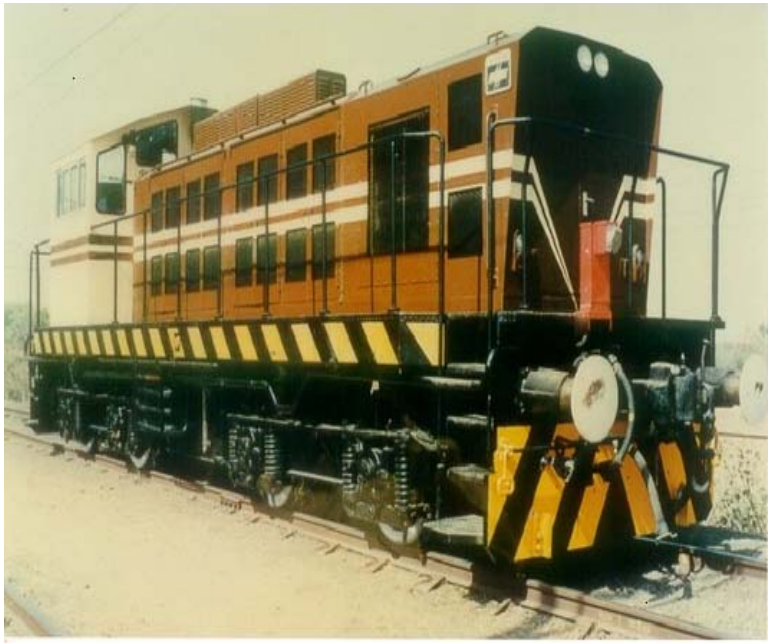

- **Gauge**: BG (1676mm)
- 3-Axle Locomotive.
- **Bogie Config**: C'
- **Wt. of loco**: 45 Ton.
- **Diesel Engine**: KTA 1150L (Cummins Make)
- **Traction generator**: TG 4903 CW
- **Traction motor**: 1 no. TM4906 AY
- **Haulage Capacity**: 2200 -2800 Ton**

  (** On level tangent, depends on track condition, Wagon bearing type, climatic condition etc)

# Special Features

- Single traction motor drives all three axles using cardan shaft and final drive gear boxes.
- Since axles are mechanically coupled adhesion is more, resulting into higher tractive effort.
- Provision of MU operation for increased haulage requirement as standard feature.

# 700 HP (SPP) DIESEL ELECTRIC SHUNTING LOCO



700 hp Single Power-Pack DESL

- **Gauge**: BG(1676mm).
- 4-Axle Locomotive.
- **Bogie Configuration**: Bo-Bo
- **Wt. of loco**: 90 Ton.
- **Diesel Engine**:

  VTA1710L / KTA 28L (Cummins Make)

- **Haulage Capacity**: 3000 - 3500

  Ton** (** On level tangent ,depends on track, trailing load bearing condition, climatic condition etc)

# Special Features

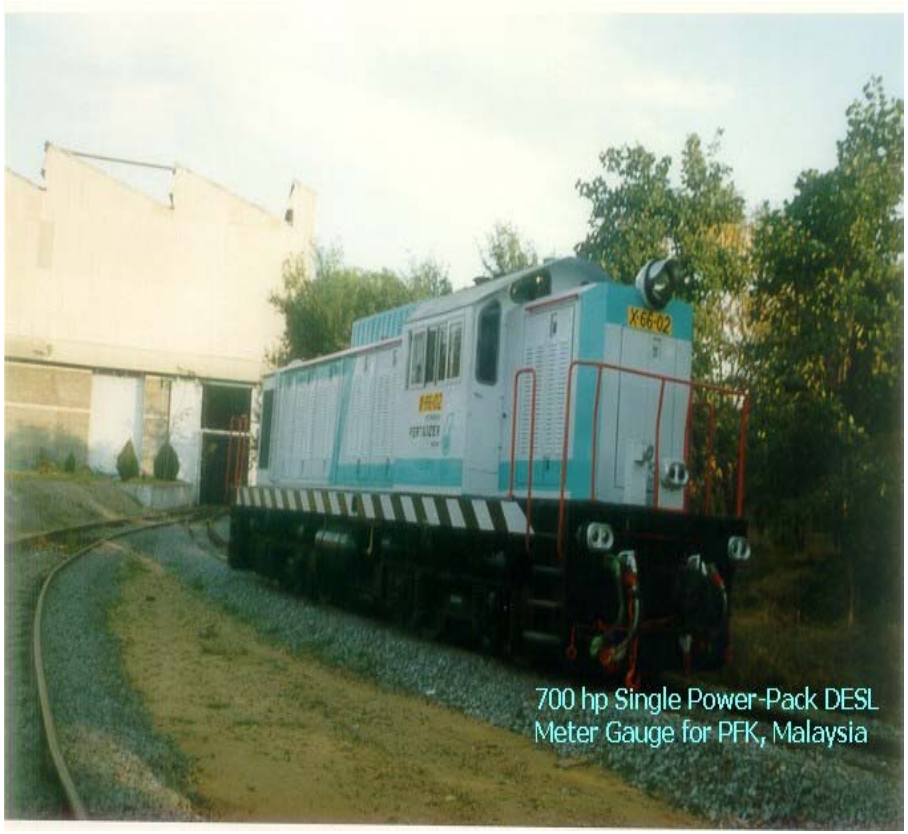
- Traction alternator with brushless excitation.
- 64 V electric starter motor for engine cranking.
- Microprocessor controlled excitation and load controller (LCC) from GAC, USA.
- Provision of MU operation for increased haulage requirement as standard feature.
- Dual control station, convenient for driving in both forward and reverse direction.

# 700 HP (SPP) DIESEL ELECTRIC SHUNTING LOCO

**Advantages of using LCC**:

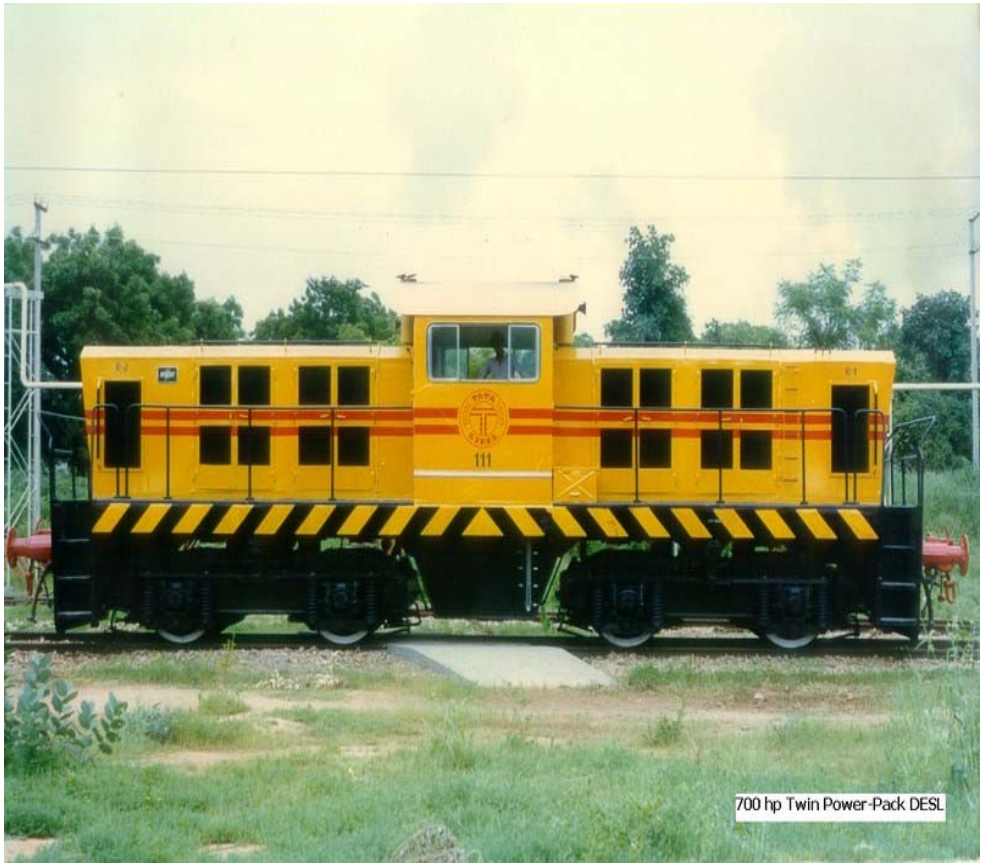
- Precise control of RPM by adjusting gain, droop, stability, speed ramp acceleration / deceleration etc at each notch.
- No load voltage control at each notch.
- Maximum Current limit control at each notch.
- Precise control of Power / load control by adjusting Load gain, droop, stability and derivative at each notch.

# 700 HP (SPP) DIESEL ELECTRIC SHUNTING LOCO (Exported to M/s Petronas Fertilizers , Malaysia)




- Gauge: MG(1000mm).
- 4-Axle Locomotive.
- Bo-Bo
- Wt. of loco: 68 Ton.
- Diesel Engine:
  KTA 28L(Cummins Make)

# 700 HP (TPP) DIESEL ELECTRIC SHUNTING LOCO




- **Gauge**: BG(1676mm).
- 4-Axle Locomotive.
- **Bogie Config**: Bo-Bo
- **Wt. of loco**: 90 Ton.
- **Diesel Engine**:

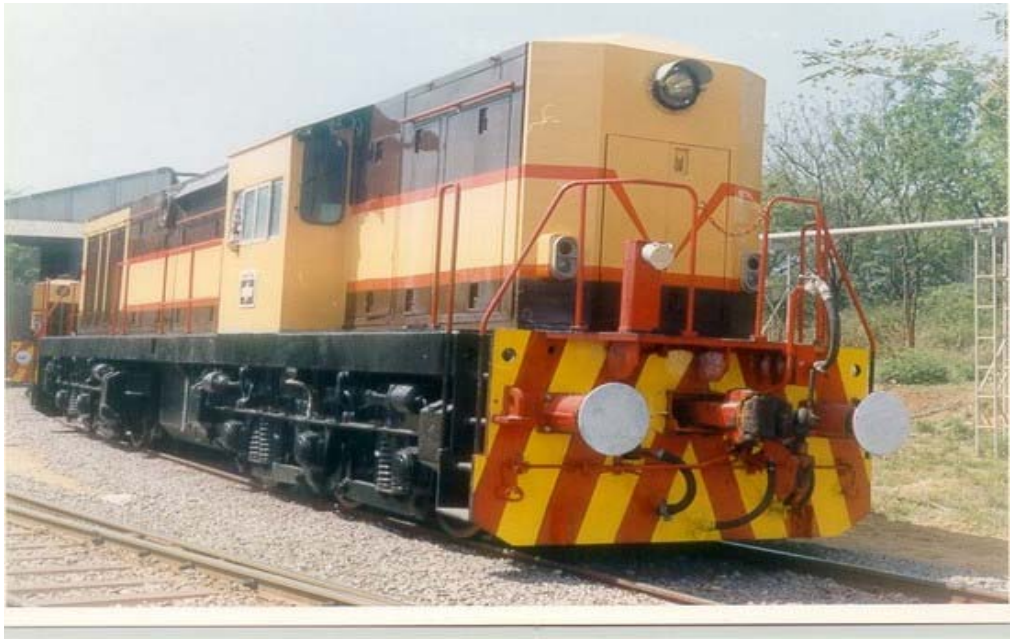
  2 nos. NTA 855L(Cummins Make)
- **Haulage Capacity**: 3000 - 3500 Ton**

(** On level tangent ,depends on track, trailing load bearing condition, climatic condition etc)

# Special Features

- Freedom of running with single power pack in case of empty wagon hauling.
- No separate starter motor; cranking through TG having start field winding.
- Compact single bearing traction generator, Self aligning.
- Conventional Hydra-Mechanical governing system easy to maintain.
- Provision of MU operation for increased haulage requirement as standard feature.
- Dual control station, convenient for driving in both forward and reverse direction.

# 1400 HP DIESEL ELECTRIC SHUNTING LOCO



- **Gauge**: BG(1676mm).
- 6-Axle Locomotive.
- **Bogie Config**: Co-Co
- **Wt. of loco**: 126 Ton.
- **Diesel Engine**: KTA 50L(Cummins Make)
- **Haulage Capacity**: Full rake (58 wagons @ 81.3 ton)

(** On level tangent ,depends on track, trailing load bearing condition, climatic condition etc)

# Special Features

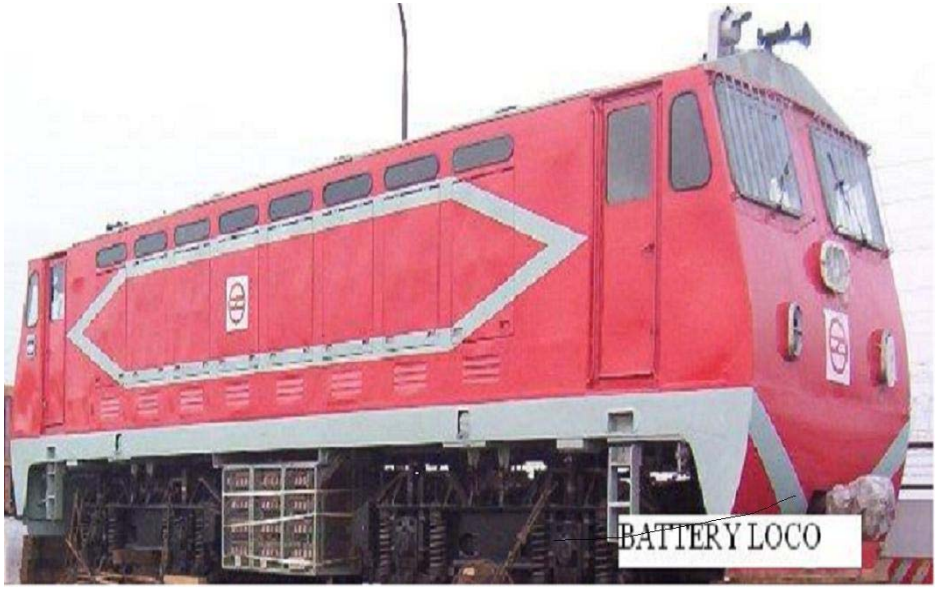
- Microprocessor controlled excitation and load controller (LCC) from GAC, USA.
- Two level Air filtration and dust collection system.
- Air conditioned Cabin
- High adhesion unidirectional bogie
- Suitable for MGR operation
- Provision of MU operation for increased haulage requirement as standard feature.
- Dual control station, convenient for driving in both forward and reverse direction.

# 1400 HP DIESEL ELECTRIC SHUNTING LOCO

## **Advantages of using LCC**:

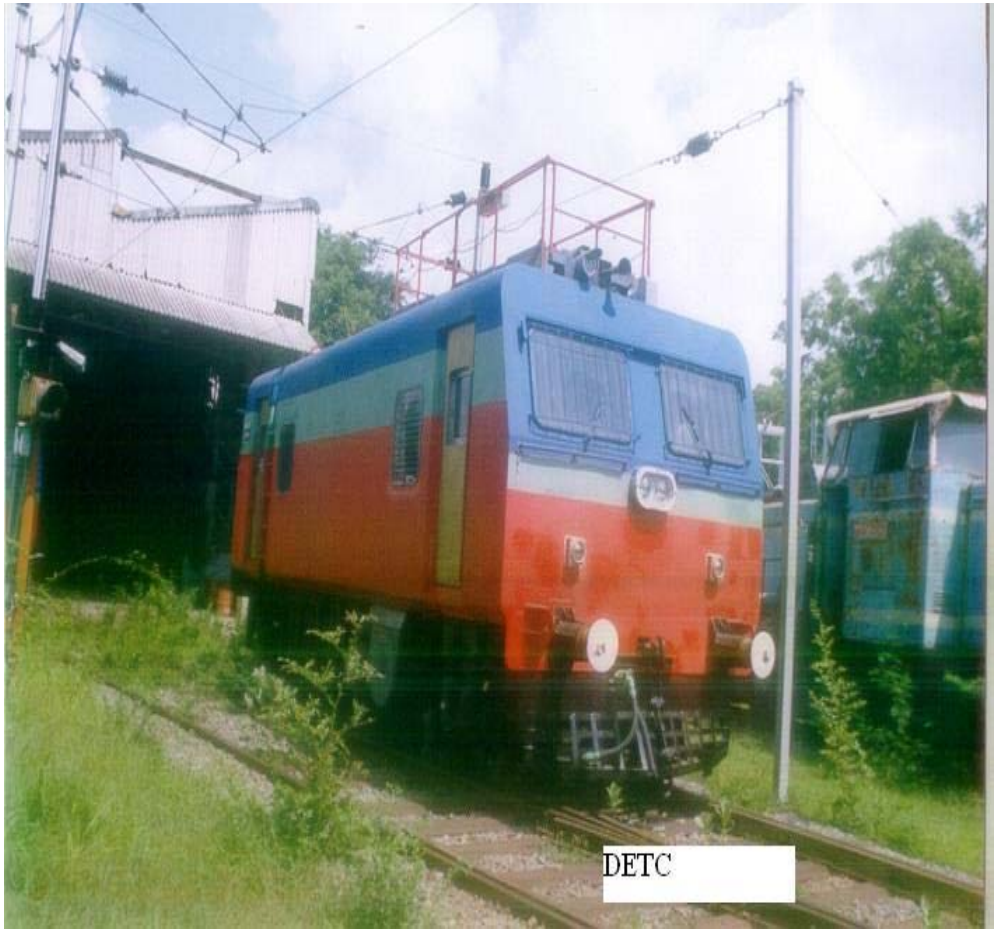
- Precise control of RPM by adjusting gain, droop, stability, speed ramp acceleration / deceleration etc at each notch.
- No load voltage control at each notch.
- Maximum Current limit control at each notch.
- Precise control of Power / load control by adjusting Load gain, droop, stability and derivative at each notch.

# 700 HP BATTERY OPERATED SHUNTING LOCO




- Gauge: BG(1676mm).
- 4-Axle Locomotive.
- Bo-Bo
- Wt. of loco: 68 Ton.
- Ni-Cd battery operated

# 4-WHEELER DIESEL ELECTRIC TOWER CAR




- Gauge: BG(1676mm).
- 2-Axle Locomotive.
- Under-slung power pack
- Wt. of loco: 32 Ton.
- Diesel Engine: NTA 855R (265HP)

# Dynamic Track Stabilizer

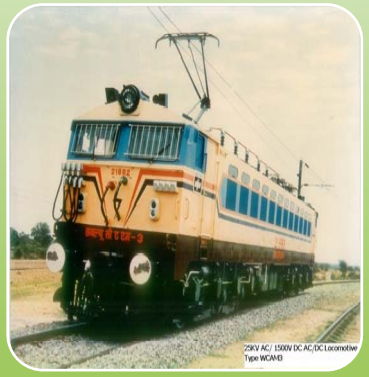

- Gauge: BG(1676mm).
- 4-Axle Locomotive.
- Bo-Bo
- Wt. of loco: 64 Ton.
- Diesel Engine: NTA 855 L6 (Cummins Make)

# Electric Locomotives


WCAM2:

25KV, 1500V DC , AC / DC , Mainline Broad Gauge Electric Locomotive

Power: 4720 HP AC / 3800 HP DC




WCAM3:

25KV, 1500V DC , AC / DC , Mainline Broad Gauge Electric Locomotive

Power: 5000 HP AC / 4600 HP DC

# Electric Locomotives

## WAG7:

Continuous rated power :5000 hp

Maximum speed: 100 kmph

No. of axles: 6 axle, Co-Co

Power: 5000 HP

Crew friendly Air Conditioned Cabin

180KVA static inverter

Vigilance control device

# FIELD APPLICATION OF SHUNTING LOCO

- MOVEMENT OF PART RAKE WITHIN PREMISES
- RAKE FORMATION FOR OUTWARD TRAIN
- TIPPLER OPERATION
- MERRY-GO-ROUND APPLICATION

**BHEL DIESEL ELCTRIC SHUNTING LOCOS CAN MEET ALL THE ABOVE DUTIES**

# Advantages of Electric over Hydraulic transmission

# Advantages of Electric over Hydraulic transmission

**DE Transmission**

- Uses Brushless Alternator hence:
  - No Carbon Brush.
  - No Commutator.
  - No wear and tear of parts.
- No commutator / brush gear cleaning required.

Nil maintenance requirement

**DH Transmission**

- Final drive gear box and torque converter has gear train.
- Damage of Gear box requires extensive maintenance
- Requires frequent change of oil in Torque Converter.

Higher Downtime, Higher Maintenance

# Advantages of Electric over Hydraulic transmission

**DE Transmission**

- Motorized axle drive with single reduction gear.
- Service life of traction motor approx 25 years.

**DH Transmission**

- Axle drive with two stage helical/ spur gear arrangement. Hence, Less efficient & more Maintenance.
- Prone to lubricant leakage from seals.
- Service life of axle drive 8-10 years

# Comparison of Savings / advantage (DE V/s DH)

| Parameter | DE Loco | DH Loco |
|---|---|---|
| Over all transmission efficiency | Approx 81% | Approx 78 % |
| Rolling resistance | 9 kg / ton | 12 kg / ton |
| Fuel Consumption per day for same duty cycle Avg. 16 hrs | 473 lit. | 518 lit.<br>(Approx 9% more fuel) |
| Maintenance cost per year | Rs. 1.65 – 2.2 lakhs | Rs. 7.5 – 8.5 lakhs |

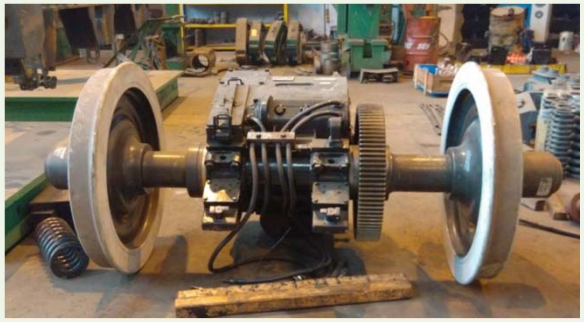
# Improved features introduced in Locomotives over the years

| 1400 HP Diesel Electric Loco | | |
|---|---|---|
| **Standard Feature** | **Improved Feature** | |
| Analog type speedometer | Reliable and precise microprocessor based electronic speedometer cum milometer being used. It has data recording facility. |  |
| Analog type Load ammeter | More reliable LED Bar Graph type Load Ammeter. Alternatively, Digital load ammeter also available. |  |
| Non air conditioned cabin | Roof mounted 1.5 t @ 50 deg C air conditioned cabin with heating feature and separate Inverter unit. |   |

| 1400 HP Diesel Electric Loco | | |
|---|---|---|
| **Standard Feature** | **Improved Feature** | |
| Bulb type conventional Marker Light | Highly reliable LED type marker light with higher illumination. | |
| Elastomeric control cable | Electron beam type control cable with 1800 V insulation grade being used. | |
| Single beam head light | 72 / 24 VDC Twin beam head light along with DC-DC converter with redundancy feature. Feature for beam adjustment. |  |
| ESBI tyre coupling for blower drive | Fenner Tyre coupling being used. ESBI coupling used to have very less metal left in the hub after key way slot. | |

| 1400 HP Diesel Electric Loco | | |
|---|---|---|
| **Standard Feature** | **Improved Feature** | |
| Grab rail on side wall in the walk way | Hand rails being provided for more support and safety. |  |
| Asbestos rope were used for heat shielding on the engine exhaust line. | Asbestos being hazardous in nature, heat shielding outer wrap having heat insulating fibre. | |
| Tube light in cabin | Energy efficient CFL (2 X 9 Watt) having long life being used in cabin. |  |

# 1400 HP Diesel Electric Loco

| Standard Feature | Improved Feature |
|---|---|
| Fabricated driver desk | Improved finish, Powder coated fabricated driver desk using die and punch. |
| Engine cranking through starter motor | Improved circuit using time delay for over / repetitive engine cranking protection feature. |
| TM 4906 with Sleeve bearing  | *Proposed* TM 4907 with Roller suspension bearing (with Suspension tube).<br>Advantages:<br>1. No axle lubricator required .<br>2. Life of roller bearing is more.<br>3. Higher KW motor with improved loco performance like improved continuous tractive effort / speed 30000 kg @ 8kph Vs 29100 kg @ 8.4 kph.<br>  |

| 700 HP (SPP) Diesel Electric Loco | |
|---|---|
| **Standard Feature** | **Improved Feature** |
| Analog type Load ammeter | More reliable LED Bar Graph type Load Ammeter. Alternatively, Digital load ammeter also available. |
| LCC 112 for Engine RPM control and VCL panel for excitation control | LCC 108B with combined control of excitation and RPM control.<br>Advantages:<br>1. Compact unit<br>2. More reliable<br>3. Precise control of RPM and excitation. |
| Analog type speedometer | Reliable and precise microprocessor based electronic speedometer cum milometer being used. It has data recording facility. |
| Bulb type conventional Marker Light | Highly reliable LED type marker light with higher illumination. |
| Tube light in cabin | Energy efficient CFL (2 X 9 Watt) having long life being used in cabin. |

| 700 HP (SPP) Diesel Electric Loco | |
|---|---|
| **Standard Feature** | **Improved Feature** |
| Air brake on loco only with TRC1000B / IR2545 Compressor (1000 lpm) | Feature of air brake for trailing stock (on requirement). For air brake on trailing stock 2000 lpm compressor being used to maintain charging time. |
| Asbestos rope were used for heat shielding on the engine exhaust line. | Asbestos being hazardous in nature, heat shielding outer wrap having heat insulating fibre. |
| Electro-Mechanical type Overload relay | Microprocessor based electronic overload relay for more reliability and program based current setting. |
| Conventional bulb type indications | LED type modular indication panel |
| Absence of Over / repetitive engine cranking protection feature | Over / repetitive engine cranking protection feature added to avoid failure of starter motor by providing additional TDR. |
| Elastomeric control cable | Electron beam type control cable with 1800 V insulation grade being used. |

| 700 HP (TPP) Diesel Electric Loco | |
|---|---|
| **Standard Feature** | **Improved Feature** |
| Analog type Load ammeter | More reliable electronic Load Ammeter (as per latest IR practices). |
| Analog type speedometer | More simple, reliable and precise microprocessor based electronic speedometer being used. It has data recording facility as well. |
| Transition Relay panel were used for speed transition of locomotive | Transition is being carried out with potential free contact of speedometer. This system does not requires the transition relay panel. |
| Conventional cam type master controller | Micro-processor based electronic master controller having the following feature :-<br>1. Digital notch indication<br>2. It is combined unit having the feature of overload relay, speedometer & load ammeter |

| 700 HP (TPP) Diesel Electric Loco | |
|---|---|
| **Standard Feature** | **Improved Feature** |
| Asbestos rope were used for heat shielding on the engine exhaust line. | Much more effective heat shielding outer warp being used.<br>These wraps are not harmful like asbestos rope. |
| Electro-Mechanical type Overload relay | Microprocessor based electronic overload relay for more reliability and variable current setting. |
| Conventional bulb type indications | More reliable LED type indications in a single panel |
| Elastomeric control cable | Electron beam type control cable with better insulation being used. |
| Tube light/bulb in cabin | LED Type cab light for better illumination. |
| Bulb type conventional Marker Light | LED type marker light with more illumination |

| 350 HP Diesel Electric Loco | |
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| Tube light/bulb in cabin | LED Type cab light for better illumination. |
| Bulb type conventional Marker Light | LED type marker light with more illumination |

# Standard Practices / Safety / Environmental aspects

- Anti-fall arrangement for suspension springs .
- Safety strap for brake pull rods.
- Asbestos free ferrodo brake shoe on demand.
- High Quality Painting with Epoxy Paint.
- Painting Scheme to suit customer requirement.
- Use of asbestos rope stopped. Instead heat shielding wrap with insulating fibres being used.
- Use of couplers in electronic consoles for reliable connectivity.
- Pre-testing of electrical and Pneumatic equipment before fitment.
- Light run test of loco and subsequent inspection before dispatch of loco to customers.
- Sound level within 90db at a distance of 10m from centerline of loco.
- Smoke emission level less than 2 on BOSCH scale.

# BHEL Venturing into Higher HP Loco

- BHEL is manufacturing Locomotives up to 1400 hp as a regular product.
- To cater to higher load and higher speed requirement, Specially for MGR application and for export requirement BHEL plans to enter into the segment of high horse power locomotives.
- BHEL is already in talk with M/s GE, MTU, Caterpillar etc for this development. They have already shown willingness and have submitted their proposal.
- Joint presentation by BHEL and engine supplier already given to Major customer like NTPC and private power plant operators.

# Proposed BHEL make 3000 HP Diesel Electric Locomotive Particulars

| | |
|---|---|
| **Wheel Arrangement** | Co-Co |
| **Rail Gauge** | 1676 mm (Broad Gauge) |
| **Weight Per Axle (Max.)** | 21t ± 3% |
| **Fuel Tank Capacity** | 5 cu. meter (approx) |
| **Wheel Diameter (New)** | 1092 mm |
| **Wheel Diameter (full Worn)** | 1016 mm |
| | 1095 mm + 10 mm |
| **Height of Coupler above rail level (in empty condit** | – 5 mm |
| **Traction Motor Gear Ratio** | 18/65 |
| | Curve - 175 mtr. (10 Degree) |
| **Negotiability** | Turnout- 1 in 8½ |
| **Diesel Engine** | M/s GE / MTU / Caterpillar make diesel engine |
| **Traction Alternator** | 1 no. BHEL make alternator |
| **Traction Motor** | 6 nos. BHEL make motors Type TM5002BY or l |
| **Haulage Capacity** | Similar to WDG3A locomotive of DLW |
| **Speed** | Approx upto 100 Kph |

# Accolades

BUREAU VERITAS
Certification

*Certification*

*Awarded to*

## BHARAT HEAVY ELECTRICALS LIMITED

TRANSFORMER PLANT, P.O. BHEL,
JHANSI – 284 129, U. P., INDIA.

*Bureau Veritas Certification (India) Private Limited certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the standard detailed below*

*STANDARD*

**ISO 9001:2008**

*SCOPE OF SUPPLY*

**DESIGN, MANUFACTURE, SERVICING AND COMMISSIONING OF POWER AND SPECIAL TRANSFORMERS; SERIES AND SHUNT REACTORS; DRY TYPE TRANSFORMERS AND REACTORS; CURRENT AND VOLTAGE TRANSFORMERS; AND ELECTRIC & DIESEL LOCOMOTIVES.**

**MANUFACTURE OF ACEMU COACHES.**

*Certification Cycle Start Date:* **08 May 2012**
*Next Recertification Due Before:* **09 February 2015**

*Subject to the continued satisfactory operation of the organisation's Management System, this certificate expires on:* **10 May 2015**

*Original Certification Date:* **12 January 1994**

*Certificate Number:* **IND12.9316U**

R. K. SHARMA
Director

*Bureau Veritas Certification using the accreditation certificate number 008*

008

*Certification Body Address: Brandon House, 180 Borough high Street, London SE1 1 LH, United Kingdom.*
*Local Office Address: "Marwah Centre" 6th Floor, Krishanlal Marwah Marg,Opp. Anna Industrial Estate, Off Saki Vihar Road, Andheri (East), Mumbai – 400 072, India.*
*Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.*
*To check this certificate validity please call : +91 22 6695 6300*

NABL

## National Accreditation Board for Testing and Calibration Laboratories

Department of Science & Technology, India

### CERTIFICATE OF ACCREDITATION

## MATERIAL TESTING LABORATORY, BHARAT HEAVY ELECTRICALS LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

Jhansi

in the field of

ELECTRO-TECHNICAL CALIBRATION

(You may also visit NABL website www.nabl-india.org to view the scope of accreditation)

**Certificate Number** C-0626
**Issue Date** 23/04/2012
**Valid Until** 22/04/2014

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

Mallika Gope
Convenor

Anil Relia
Director

Dr. T. Ramasami
Chairman

# Steps being taken for better customer satisfaction

- Close interaction with customers to understand the requirement and early supply of spares.
- Educate the loco drivers and maintenance staff for better utilization of locomotive.
- Undertake the POH / Repowering of locomotives.
- Repowering of bogies.
- Supply of wheel axle sets.
- Reconditioning / overhauling of Electrics.
- Necessity based visit of BHEL experts on paid basis for advice on better performance of loco and maintenance.

# (FUEL ECONOMY DUE TO TRNSMISSION EFFICIENCY)

| SL. NO. | PARAMETERS | DE LOCO | DH LOCO |
|---|---|---|---|
| 1 | Transmission efficiency | Generator eff. = 92%<br>Traction motor eff.= 87.5%<br>Total = 80.5% | Torque convertor eff. = 82%<br>Gear Box eff. = 96%<br>Total 78.7% |
| 2 | Power loss | 750 x (1-0.805)<br>= 146 hp Due to inefficiency | 750 x (1-0.787)<br>= 160 hp Due to inefficiency |
| 3 | Fuel Consumption due to transmission efficiency | Considering<br>SFC = 0.162 kg/hp/hr<br>Hours per day = 16<br>146*.162*16 = 378 kg<br>= 473 liters per day | 160*.162*16 = 415 kg per day<br>= 518 liters per day |
| 4 | Fuel saving per annum | 45 lit per day * 250 day<br>11250 lit per annum | |



# Comparison of DE Loco Vs DH Loco

| Railways | Avg. No. under repair (%) | | Repair cost per equated Kms in Rs. | |
|---|---|---|---|---|
| | DE | DH | DE | DH |
| Central | 1.98 | 2.35 | 3.43 | 7.61 |
| Eastern | 2.82 | 5.2 | 3.51 | 5.4 |
| Northern | 2.1 | 2.17 | 4.27 | 3.06 |
| Southern | 2.09 | 1.33 | 4.26 | 5.76 |
| Average | 2.11 | 2.75 | 3.86 | 5.2 |

**The above data is based on Indian Railways Annual Statistical Statements 1995-96.**

# Upcoming developments

- Development of mobile charger for all types of DESL
- Development of single battery voltmeter for all types of DESL
- Implementation of Wago terminal board assembly in 7oo HP TPP on developmental basis. After success, it shall be implemented in all types of DESL.

# *Thank*
# YOU