MEDHA™

Operator's Manual

AC-AC TRACTION SYSTEM

TYPE MAS 696

MEDHA SERVO DRIVES PVT. LTD.

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Chapter 1

SYSTEM OVERVIEW

1.1 Introduction

WDG4 and WDP4 series Diesel Electric Locomotive of Indian Railways are driven by 3-phase AC Traction Motors, employing AC-DC-AC Power Transmission system. Medha Servo Drives Pvt. Ltd. has designed and developed indigenously the AC-AC Traction System type MAS 696 suitable to the above said series of locomotives delivering up to 4500 HP.

MAS 696 is a comprehensive solution encompassing complete locomotive control and fault diagnostic features along with 3 MW traction converter. MAS 696 AC AC Traction system comprises of four cabinets:

- Electrical Control Cabinet 1 (ECC#1)
- Electrical Control Cabinet 2 (ECC#2)
- Electrical Control Cabinet 3 (ECC#3)
- Traction Control Cabinet (TCC)

The Diesel Electric Locomotive is equipped with Turbo charger, 16 cylinders, two stroke Diesel Engine. The Main Generator Assembly is directly coupled with the Main Crank shaft of the Diesel Engine. The Main Generator is 3 phase Alternator consisting of two independent and Interwoven sets of stator winding and rotor field common to both

Fig. 1.1 Cabinets of AC AC Traction System

windings. Overview block diagram is given in Fig. 1.2.

The Diesel Engine drives the main Generator Assembly. The Main Generator assembly has two Alternators which are MAIN ALTERNATOR and COMPANION ALTERNATOR. The Traction Alternator converts the Diesel Engine mechanical power into 3 phase AC electrical power. The Alternator's two windings' (left bank and right bank) outputs are connected to two air cooled Rectifier Assemblies consisting of high voltage, high current silicon Diodes with Fuses in the 3 phase Full Wave Rectifier circuit. The two Rectifiers output are connected in series across the DC LINK. The AC 3-phase power is converted into DC power by Rectifier Assembly. These are the internal parts of TA-17-CA-6B Main Generator Assembly.

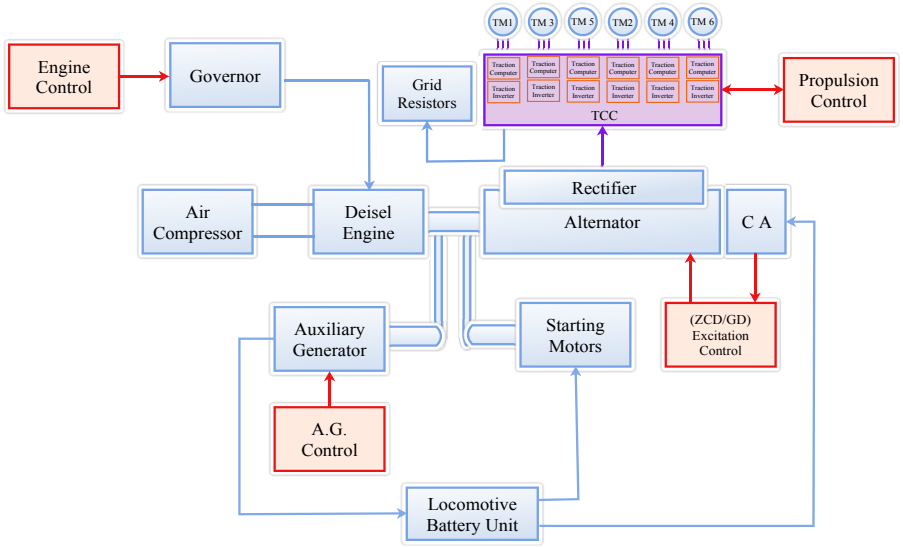


Fig. 1.2 Block Diagram of Locomotive Control System

Rectified DC power supply is applied to DC LINK. When all DCL switch gears are closed, DC voltage is applied to IGBT based Traction Inverters. Each Traction Inverter has separate control module in the form of Traction Computer. The Traction Computer receives Traction Motors' speed, temperature, Voltage and Current values for controlling the IGBTs to maintain required torques according to Notch selection.

The Traction inverters have main role in controlling the 3 phase induction motors. The Traction Inverters converts the DC power into 3 phase AC power for variable frequency using IGBT based technology. Six DC LINK switch gears passes the DC power to the six Traction Inverters through its closing

contacts with the help of DC Motor controlled by Locomotive Control Computer (LCC) which is housed in Electrical Control Cabinet 1 (ECC#1). Traction Control Cabinet (TCC) consists of six Traction Computers, 6 DCL switch gears, 6 IGBT based Inverters, DC link Capacitors and Crow bar circuit. Based on the Inputs received from Locomotive Computer and analogue feedbacks from Traction motors, Traction computer converts the DC power into 3 phase AC power required to the traction motors. LCC receives the operator request as digital inputs and analog signal from different sensors and sends request to the traction computer for converting required amount of Power during Motoring and Dynamic Braking modes. The term TCC refers to an Electrical System that converts DC power into 3 phase AC power during motoring and 3 phase AC power into DC power during dynamic brake. The terms Invert and Convert are interchangeable in this locomotive during Power Mode and Dynamic Brake Mode.

The Traction Motors are 3 phase AC Induction Motors. The 3 phase AC power from Inverters are fed to the Traction Motors mounted on the Trucks, Each Traction Motor is geared with a pair of Wheels with the gear ratio 17:90 (MAC loco) for Goods Service and 17:77 (PAC loco) for Passenger service. The Traction Motors once again convert the Electrical power into Mechanical power to provide high starting Torque required for Locomotive service. These are explained in detail in later chapters.

1.1.1 Auxiliary Generator

The Auxiliary Generator (Aux. Gen.) Is driven by the Engine gear train at three times of engine speed. Its field is controlled by LCC through AG PWM. AC power from Aux.Gen. is supplied to an external 3 phase Full wave rectifier in the Battery Charging Assembly. There it is converted to 74 volts DC power for Companion Alternator excitation, control system operation and Locomotive Battery charging. The Aux. Gen. also supplies 74 volts DC power for Fuel Pump Motor, Turbo lube oil Pump circuits, Locomotive lighting and other miscellaneous equipments.

1.1.2 Companion Alternator

The Companion Alternator (CA) is coupled directly to the Traction Alternator within the Main Generator housing. The Companion Alternator is physically connected to the Main Gen. assembly but electrically independent to the Traction Alternator. Companion Alternator has 16 field poles on the same rotor back of Main Gen. field poles. The rotating CA field poles receiving low voltage current from Aux. Gen. through a pair of slip rings are adjacent to the

Main Alternator slip rings. CA produces 3 phase 45-230 V AC supply to excite Main Alternator field through SCR Assembly and Power fed to the Radiator Fans 1 & 2, Inertial Blower motor and Traction Inverter Blowers.

1.2 Major Features of MAS 696 System

Major Features of the System in operation point of view are explained hereafter.

1.2.1 DYNAMIC BRAKE

Dynamic Brake is an electrical braking method used to regulate the speed of the Locomotive by translating the Kinetic Energy in the Traction Motors into Electric Energy. This Mechanical rotating energy is converted to Electrical Power by using Traction Motors as electrical Generators. The power generated by these Traction Motors are applied to the Grid Resistors, which dissipate the generated power in the form of heat into the atmosphere, there by reducing the speed of the train.

Re-generation operation of AC Induction Machine is not so easy to explain. To examine the entire Braking process, consider first a DC Machine in a Generating mode. In this case a stationary magnetic field is established in the stator of the Motor. The momentum of the Train causes the Motor to Turn. As the motor turns, the Armature cuts through the stationary magnetic field in the stator. This cutting generates a current flow in the Armature which is dissipated through Grid resistors.

On the DC Machines four power cables are run to the Motor, two are connected to the field and two to the Armature. The cabling that runs to the Grid Resistors makes a connection with the Armature. For Motoring operation, armature cables and field cables are connected in series and across the generator. During Dynamic Brake, Filed cables are connected across the generator and armature cables are connected to the grid resistors to dissipate the generated energy in the form of heat to the atmosphere.

In the AC Machines only three cables are connected to the Motor. These cables supply 3 phase AC source needed by Motors both in Power and Dynamic Brake mode. For more braking effort the Inverters supply more power to the field. So power must always flow into the Motor to excite the field (regardless of operation mode).

Power is multiplied by two components, Voltage and Current. The direction of power flow depends on the relationship between Voltage and Current with

respect to the time or phase relationship. The phase relationship depends on the speed of the Rotating Field with respect to the Rotating speed of the Rotor. If Rotor speed lags Field speed, Voltage and Currents are nearly in phase and Power flows into the Motor most of the time. If Rotor Speed exceeds Fields speed, Voltage and Current are out of phase by nearly 180 degree and Power flows out of the Motor most of the time.

1.2.2 Alerter/VCD System

The Alerter indicator light is mounted on the control consol, below the indicator light panel. The Alerter reset push button mounts on the control consol desktop surface. The Audible Alarm is mounted on the ECC#1 Engine control panel. ALERTER SYSTEM can be ENABLED through Display Unit by selecting proper option. When Locomotive Brakes are released, the Alerter system requests an Acknowledgement from the operator from time to time, once in 60 seconds. If the Acknowledgement request is not answered within 60 seconds, the Locomotive control Computer drives a Digital Output to flash the Alerter light for 17 sec. After 17 sec drive, one more Digital Output provides an audible sound for 17 sec. If the Alerter request is not acknowledged, while the Aleter light is flashing or alerter alarm is sounding, the alarm stops sounding and a penalty Brake is applied for 34 seconds or until Locomotives speed drops to zero, whichever occurs first. Then the penalty brake application must be reset before normal operation of train to continue. One must follow Railway rules and operating practices regarding use of Alerter Equipment.

Pressing either alerter reset button while the Alerter light is flashing or the Alerter Alarm is sounding, resets the acknowledgement request timing cycle. Using the Automatic Brake handle to moderately reduce the brake pipe pressure also resets the timing cycle. Automatic Brake handle operation also resets the timing cycle. In addition, movement of the Throttle Handle, Independent Brake handle or Dy. Brake handle also reset the timing cycle, as well as pressing the HORN or SAND button.

1.2.3 A E B : Auto Emergency Brake System

While traveling through a terrain with a considerable large Down-Gradient, speed of the Train needs to be kept under control, so that the AEB system does not allow to enter in uncontrollable speed zone. Indian Railways has studied and defined optimum speeds for every section. There is popular saying that human can do mistakes. There is always chance that a manually controlled Loco may exceed the section speed limit. Which in turn may cause major accidents/loss/damage. To avoid this, Indian Railways incorporated a

system called "Auto Emergency Brake System", which by default initiates Braking in the event of Train/Loco crossing the permissible set speed. The microprocessor based inbuilt AEB system, developed by M/S Medha Servo Drives Pvt. Ltd., is implemented on WDG4 and WDP4 Locomotives.

1.2.4 Blended Brake System

The MAS 696 system Locomotives are equipped with blended brake system. It is simultaneously applying Dynamic Brake and Air Brake, when the driver operates the Automatic Air brake handle in the service zone. The KNORR CCB Air Brake system controls the Airbrake on the Locomotives and cars coupled in train, and requests some amount of Dynamic Braking from LCC for blended brake operation.

1.2.5 Manual TE Limiting

To avoid putting stresses on weak bridges when Locomotive is traversing them, the Manual TE Limiting option was developed to enable the operator to limit the Tractive Effort through (lighted) switch mounted on Engine control panel. The position of the switch indicates the loco pilot that the feature has been turned ON, indicating that the switch is active. The tractive effort limit may be imposed by train line Input from another locomotive equipped with this feature via TEL relay.

1.2.6 Auto Flasher

To switch ON of Flasher Lights automatically during Train parting, RDSO has suggested modification in the existing Brake and Electrical control circuit of Locomotives, to link switching ON of Flasher Light switch drop in Brake pipe pressure on Locomotive. The flasher lights are applied automatically whenever Emergency/penalty brake application takes place, as indicated by the 'Loss of PCS'. The flasher can still be turned ON manually so that if the operator have an Emergency that did not drop PCS, the Flashers can still be activated.

Chapter 2

GENERAL SAFETY PRECAUTIONS

This manual provides guidelines and cautions for Locomotive operating personnel. Though enough care is taken while designing MAS 696 system developed by M/S MEDHA SERVO DRIVES PVT. LTD, which is implemented on WDG4/WDP4 Locomotive, the Microprocessor based system to keep as similar as existing WDG4 and WDP4 Locomotives in operational point of view, due to advanced features, some modifications have taken place. This manual includes information compiled for a typical WDG4/WDP4 Locomotive with basic equipment and its functions explained in short notes. These instructions do not cover all details or variations in equipment, nor provide for every contingency. If any further information is required, or if problems arise which are not covered sufficiently, M/S MEDHA's representatives can be contacted.

Information about adjustment, testing and maintaining Locomotive equipment is provided in other Locomotive service manual and various maintenance instructions.

2.1 WDG4/WDP4 Locomotive Safety Precautions

WDG4/WDP4 Locomotive has an AC Electrical Transmission system and therefore includes special equipment not found on Locomotive having the usual DC/DC or AC/DC Transmissions. For safety sake, it is necessary to fallow certain unique precautions before inspecting the equipment or operating the Locomotive.

The Locomotive operator shall not access any devices within the ECC#1 due to residual high voltage. Access within ECC#1 is limited to maintenance individuals that are knowledgeable of the WDG4/WDP4 DC LINK discharge procedure. The output of the Main Generator is the DC LINK VOLTAGE. Large capacitors are located within each of Traction Inverter to filter Main

Gen. Voltage. These capacitors operate at the DC LINK Voltage between 600 to 3400 V DC. When the Locomotive shutdowns, these capacitors could remain high Voltage causing severe injury or death to the operating and maintenance personnel.

A procedure has been developed to discharge this high voltage into Dynamic Brake Grids to prevent the possibility of Injury.

1. Before shutdown of the Locomotive, keep RUN/ISOLATE switch in ISOLATE position and then shutdown the Locomotive. All 'BRAKING CONTACTORS' picks up and discharge the DC LINK capacitors through Grid resistors in one second. After 20 seconds all DC LINK switch geares are driven to shorting position.
2. After shutdown, the Locomotive remains the COMP. CONTROL and TURBO LUBE PUMP Circuit Breakers in ON position. These two CB's are required to perform POST LUBRICATION for TURBO SUPER CHARGER for 35 minutes.
3. If any disturbance for Post lubrication occurs within 35 minutes, while cranking, Computer does not allow for cranking unless PRE-LUBRICATION is successfully completed for 15 minutes.

2.2 Automatic Discharge

The DCL Voltage is discharged automatically, when the Locomotive operator takes manual action to shutdown the Locomotive. There are 3 general ways to discharge the DC LINK capacitors and other components prior to servicing, plus a fourth method to maintain the short.

1. **Reverser in Centre Position (Through Bleeder Resistors)**
   Each Traction Inverter has Bleeder Resistors (400 k ohms/200 W) across the DC LINK. When the Reverser is moved from Forward or Reverse to Centre, main Generator Excitation stops. If no further action is taken, the Bleeder Resistors discharges the DC LINK voltage to less than 50 Volts in approximately 50 minutes. Although very reliable, the Bleeder Resistors do not guarantee the discharge since the resistor could be interrupted internally or externally.

2. **Run/Isolation Switch (Through Dynamic Brake Grids)**
   The normal way to discharge the DC LINK capacitors is through two Dynamic Brake Grids in parallel. When Locomotive operator turns Isolation switch from RUN to ISOLATE (or the LCC loses the

RUN digital Input signal), the parallel Brake Grid path is connected to the DC LINK by four Braking contactors (B1, B2, B3, B4). This method discharges the DC LINK capacitors in less than ONE second.

3. Brake Chopper and Hard Crow Bar

Whenever the DCL V >= 2800V Brake Chopper fires to bring the DCL V to <= 2600 V, if the DCL V >= 3000 V TCC Lockout the operation of Inverters, and the DCL V >= 3400 V Locomotive Control Computer fires Hard Crowbar, at DCL V >= 3600 V HW Fires Hard Crowbar. Automatically recycling of DCL switch gears when DCL Voltage decoys, if there was no other Crowbar event in last 10 minutes.

- After the DC LINK has been discharged by braking grids or the brake chopper or crow bar, the DC LINK Contactors moves to the open position. Moving all the DC LINK switch gears to the open position causing all Traction Inverters to be shorted and grounded with busbar connected to connectors of the DCL contactors.

  a. When the Engine is shutdown (regardless of the Isolation switch position) the control computer picks up all the Braking contacotrs, the DC link Voltage dissipate through grid resistors. Once the DC LINK capacitors are discharged, DCL contactor moves to open position.
  b. Whenever the Battery Knife switch or Local control circuit breaker is opened, the LCC detects the loss of Local control or Knife switch and moves all DCL contactors to shorted position. Indian Railways Electrical Control Cabinet 1 comprises of all electrical controls of the locomotive along with Locomotive Control Computer.

Chapter 3

STARTING THE ENGINE

The WDG4/WDP4 Locomotive is equipped with dual STARTOR MOTORS for cranking the Diesel Engine, at left side near the Engine Ring gear. Diesel Engine fuel oil must be circulated through fuel system before the Engine starts. When the FP/ES switch is held in PRIME (left), the Locomotive computer starts the fuel Pump motor. After ensuring the return fuel sight glass clear without bubbles (approximately 20 seconds), turn the FP/ES switch to START (right) position. These STARTOR MOTORS run with Battery supply available on Locomotive to start the Diesel Engine.

While cranking the Diesel Engine, ensure the following:

1. Ensure that Throttle Handle of both control console is in IDLE, Reverser handle at center and RUN/ISOLATE Switch is in ISOLATE position.
2. Ensure there is sufficient oil level of Compressor Oil, Engine Lube Oil and Governor Oil.
3. Ensure there is sufficient Coolant Water level in the water tank (Engine dead – Full).
4. Ensure that no one is working on the Engine, Generator Room, Compressor Room etc. and all doors are closed.
5. Ensure that the MU Engine Stop button is in RUN position (For RUN press Green portion inside).
6. Ensure that the engine Over Speed Mechanism (OST) is reset.
7. Ensure that the Governor Low Lube Oil Button (LLOB) is reset.
8. Ensure that the Crankcase (oil pan) pressure and Low water pressure detector reset buttons are reset (pressed inside). If any button is found ejected, press and hold it for 15 seconds immediately after Engine starts.

Check Time and Date of Loco shutdown from the Engine logbook. If the Loco has been shutdown for more than 48 hours, don't start the Engine and contact home shed for advice.

Engine should be Pre-Lubricated, if it has been shutdown for more than 48 hours. See Engine Maintenance Manual for Pre-Lubrication procedure.

To Start The Engine, follow the below procedure:

1. Close the Battery knife Switch. Ensure that the Starting Fuse is installed in good condition and it is at correct rating. (800 Amps for WDG4/WDP4).
2. Switch ON Control and Local Control circuit Breakers on Breaker panel.
3. Switch "ON" TURBO lube pump Circuit Breaker to pick up "TLPR" when Turbo lubrication is required.
4. Switch 'ON' DCL 1 CB, DCL 2 CB, DCL 3 CB, DCL 4 CB, DCL 5 CB and DCL 6 CB on Circuit Breaker panel to control DCL switch gear motor for closing and opening the DCL switch gear.
5. Switch ON all Traction Computer circuit breakers TC-1 CB, TC-2 CB, TC-3 CB, TC-4 CB, TC-5 CB and TC-6 CB. All Traction Computers Initializes and power ON self check is done.
6. Switch ON COMP. CONTROL Circuit Breaker. The MAS 696 System Initializes and Power ON self check is done. If any abnormality is found, the same message is informed through Display Unit for correction, otherwise the MAIN MENU is displayed.
7. Switch ON all Traction Computer Blower circuit breakers TCC BLWR 1 CB, TCC BLWR 2 CB, TCC BLWR 3 CB, TCC BLWR 4 CB, TCC BLWR 5 CB and TCC BLWR 6 CB to control and protect TC Blower motors.
8. Switch ON the CONTROL & FP slide switch on control console No. 2. This allows fuel pump to RUN, when FP/ES switch is in Fuel prime or Engine Start position.
9. Switch ON the FUEL PUMP Circuit Breaker.
10. Switch ON the AC CONTROL Circuit Beaker.
11. Switch ON the Governor Booster Pump CB, if it is available on locomotive.

- If the Governor Booster pump is not provided on Locomotive, Advance the Governor linkage Lay shaft gently while cranking, till the Engine is running.
- Verify that the Ground Relay CUTOUT Switch is closed (lever up) and sealed properly. It is located on the Circuit Breaker Panel.
- Never discharge Batteries excessively by repeated cranking. If first two or three attempts are failed, identify the fault or check and reset safety devices like OSTA/LLOB etc. If any one is tripped, recheck cranking procedure.
- Ensure that MU Engine Stop button is not operated in the consist Locomotives.
- Follow the correct Cranking and Shutdown procedure to enhance Engine and Turbo life.

12. Turn the FP/ES switch lever to PRIME and hold it there (normally 10 - 20 sec, then release it) until the fuel flows clear and free from bubbles in the return fuel sight glass.
13. Turn the FP/ES switch lever to ENGINE START and hold it there until the Engine Starts and speed increases to Low Idle RPM 200. Do not crank for more than 20 seconds.

To prevent over heating of starting Motors, which may damage them, do not allow Engine cranking for more than 20 seconds. If Engine fails to start after cranking for 20 seconds, wait for 2 minutes to cool starting Motors before cranking Engine again.

14. After holding the engine RPM above 200 rpm, release the FP/ES button.
15. Check Low water pressure detector reset button on EPD after Engine starts. If the detector is not reset, the Engine shuts down after a short time delay. If the detector trips, press continuously for 15 seconds.

- Keep the Engine at Low Idle for 6 minutes. Don't shift the ISOLATION switch to RUN position immediately to avoid automatic shutdown due to low water and low LUBE OIL Pressure. After six minutes automatically Engine speed increases for Air compressor operation or Low water temperature.
- Ensure that the Batteries are charging and Battery Ammeter is showing charging side (Green zone).
- Do not apply load before Engine water inlet temperature has been reached 49º C.

16. Follow specified standard Railroad precautions in setting of LEAD/TRAIL switch for safe operation.
17. Follow correct Air Brake equipment setup procedure to avoid delay and incorrect operation.
18. To perform Air Brake System normal working, keep LEAD/TRAIL switch in LEAD position on required control console, in other control console it must be in TRAIL only.
19. Check the Display for CREW MESSAGES one by one and clear as per the Computer advice.
20. Keep Auto Brake Handle in Full Service on working control console and observe the following message after 10 seconds.

Message: To restore normal Air Brake operation, keep Auto Brake Handle in RUN position.

Chapter 4

STOPPING PROCEDURE FOR WDG4/WDP4 DIESEL ENGINE

4.1 Engine Stopping System

The normal way to shutdown a Diesel Engine is to cause the Engine Governor to bring the fuel injector to the NO FUEL position. There are several ways to cause the Governor to bring the fuel injectors to NO FUEL position including operating the following switches:

1. EFCO/STOP: The Emergency Fuel Cutoff & Engine Stop push Button switch mounted on the high voltage cabinet Engine control panel in the cab.
2. EFCO 2: The emergency fuel cutoff push Button switch mounted on the left side of the locomotive just above the fuel tank filler.
3. EFCO 3: The emergency fuel cutoff push button switch mounted on the right side of the Locomotive just above the fuel tank filler.
4. MU ENG.STOP: The multiple Engine Stop/Run switch mounted on the control console#2 pressing the STOP portion of this switch stops all Engines in the consists. This is the result of the pickup of SDR relay, when SDR is picked up, Governor DV solenoid energizes and Fuel Rack comes to No Fuel position.
5. The Governor also brings the fuel injectors to the NO FUEL position, if any of the following conditions is occurred:

    - Engine lube oil pressure is too low.
    - Engine lube oil is too Hot.
    - Engine coolant water pressure is too low.
    - Engine crank case pressure is too high.

Fig. 4.1 EFCO Engine Stop

Fig. 4.2 MU Engine Stop

6. After shutdown of the Locomotive let the COMP. CONTROL and TURBOLUBE PUMP Circuit Breakers remain in ON position. These two CB's are required to perform POST LUBRICATION for TURBO SUPER CHARGER for (maximum) 35 minutes.

Chapter 5

ELECTRICAL CONTROL CABINETS

As mentioned in Chapter 1, MAS 696 AC AC Traction System comprises of four Cabinets, viz. ECC#1, ECC#2, ECC#3 and TCC. The three Electrical Control Cabinets are explained in detail in the following sections:

5.1 ECC#1

High voltage and current are present within this cabinet. Do NOT open a cabinet door except to access the Circuit Breaker panels.

The Electrical Control Cabinet, as shown in Fig. 5.1, is located in the drivers cab. It houses equipments that controls and supplies power to the Locomotive.

Fig. 5.1 Electrical Control Cabinet#1

The various internal equipments (not driver accessible) included in ECC#1 are:

1. Main Control Panel (Relays, Resistors etc.)
2. Locomotive Control Computer MLC 691
3. ADB 1, 2, 3, 4 and FDB
4. Four Braking contactors (B1, B2, B3, B4)
5. Silicon Control Rectifier (SCR) Assembly

ECC#1 is modified for MAS 696 system. The following changes are made in the MAS 696 system:

1. Locomotive Control Computer (LCC) called MLC 691 is shifted to top portion of ECC#1.
2. Display Unit MDS 737 is located on the middle door of the ECC#1.
3. Circuit Breakers numbers are increased to 33. These are located on the same panel.
4. DC LINK switch gear is modified as 6 DCL switch gear and is shifted to TCC cabinet.
5. The DCL switch gear Control circuits are provided with individual Circuit Breakers on the Breaker panel.
6. Individual Traction Computer Control circuit Breakers are provided on the Breaker panel.
7. Individual Traction Inverter Blower Motor Circuit Breakers are provided on the Breaker panel.
8. Radio Circuit Breaker is replaced with DPC Circuit Breaker.
9. Auxiliary Generator FB Circuit Breaker is removed.
10. Ground Relay is replaced with Ground Leakage detection current sensors.
11. There is no separate Event recorder, it is part of LCC. There are no panel Mounted Modules i.e. DVR, TLF, ASC, FCF, FCD. These all are part of the LCC Unit.
12. Power supply modules i.e. PSM300, PSM310, PSM320 are replaced with Power Supply modules located on the LCC Unit.
13. DC LINK current sensors are modified as DCL 1A – DCL 6A and are shifted to TCC cabinet.
14. ADB1, ADB2, ADB3, ADB4 and FDB are added in the ECC#1 Cabinet to provide Power to various Sensors.
15. Communication between LCC to TCC is through Optical Fiber cables.

5.2 ECC#2

This Electrical Control Cabinet#2, as shown in Fig. 5.2, mounts on the right side of the locomotive, under the locomotive under frame, between the No.1 bogie and the fuel tank.

The various internal equipments (not driver accessible) included in ECC#2 are:

1. BCA : Battery Charging Assembly
2. ST & STA Contactors

3. TB 61A & TB 62 A

Fig. 5.2 Electrical Control Cabinet#2

ECC#2 consists of two interfaces. One is for battery charging and another one is for starting motors circuit.

Battery Charger Assembly:

It receives auxiliary generator output, three phase AC, and converts it to Direct Current, supply to Batteries for charging and to auxiliary machines used in the locomotive. The AGAV and AGAI sensors are provided in the Battery Charger output, as shown in Fig. 5.3, to control auxiliary generator within safe operating limits by LCC. The AUX. GEN. Breaker is provided to supply auxiliary generator power to locomotive low voltage DC circuits. It protects against excessive current demands. Since the low voltage DC system provides companion alternator excitation, if the breaker is OFF, the locomotive computer displays the appropriate message and sounds the alarm to alert the operator.

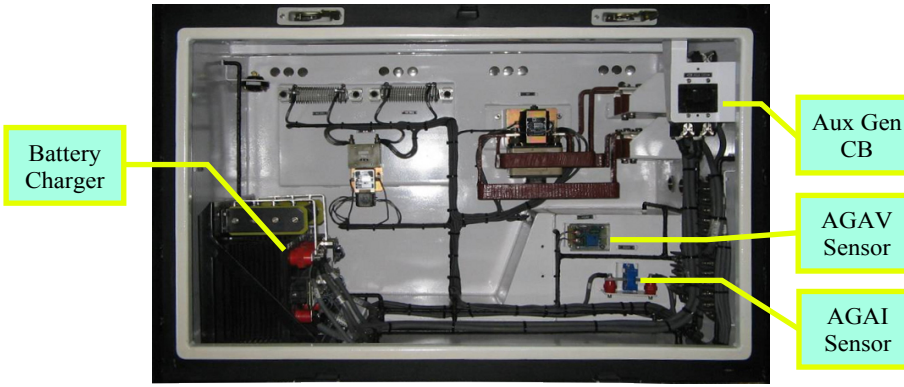


Fig. 5.3 Internal View of ECC#2

Staring Circuit:

Two starting contactors (ST and STA) with resistors (RE ST1 & RE ST2) have been provided in this cabinet, as shown in Fig. 5.4, for the following function:

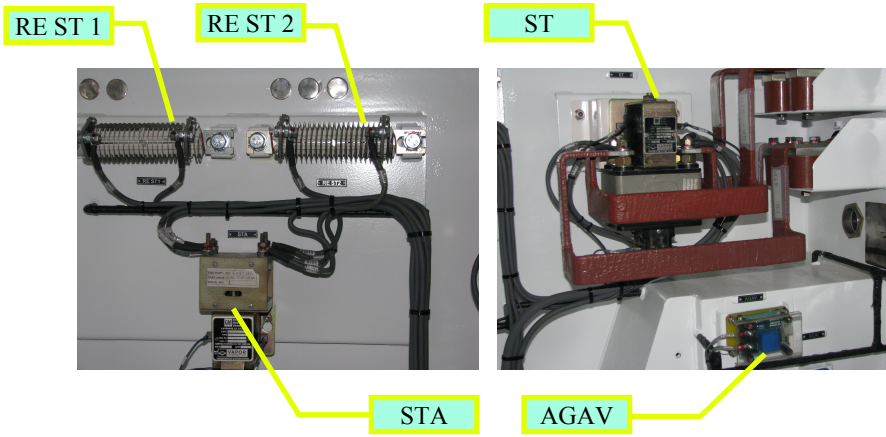


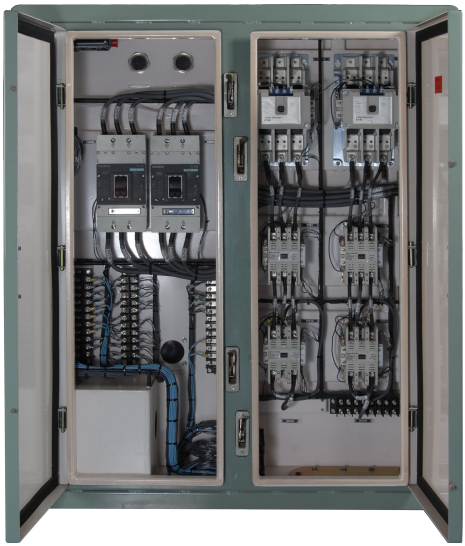
Fig. 5.4 ST Contactors and Resistors in ECC#2

Holding the FUEL PRIME/ENGINE START switch in START provides a START signal input to the locomotive computer. The locomotive computer initiates engine cranking by two starting motors by energizing ST (STarting) contactor through STA (Auxiliary STarting) contactor. Storage batteries provide energy to the starting motors through ST contactor. Two starting motor solenoids are mounted at the lower rear right hand side of the engine. The solenoids engage the starting motor pinions with the engine ring gear. When both pinions are engaged, full battery power is applied to the starting

motors to crank the diesel engine. Starting motor torque increases and the diesel engine cranking speed increases until the engine starts.

5.3 ECC#3

The Electrical Control Cabinet#3 mainly consists of Two Circuit Breakers and 6 contactors, as shown in Fig. 5.5, to run the radiator Fan Blower Motors either Slow speed or Fast speed for cooling engine water temperature.



The various internal equipments (not driver accessible) included in ECC#3 are:

1. Fan contactors FCS 1, FCS 2, FCF 1A, FCF 1B, FCF 2A and FCF 2B
2. TB's 83A, 83B, 83C
3. MRPT (Main Reservoir Pressure Transducer)
4. Connectors 823A, 823B, 823C, 823D, 833A, 833B, 833C and 833D

Fig. 5.5 Electrical Control Cabinet#3

The LCC performs the following function for COOLING FANS TWO SPEED A.C.MOTORS CONTROL. Each fan motor circuit consists of one slow speed and two full speed contactors. FAN MOTOR 1 with associated slow speed contactor FCS 1 and fast speed contactors FCF1A and FCF1B. The circuit for FAN MOTOR 2 operation is in a similar manner. The cooling system designed to normally maintain operating temperature of 79°C to 85°C. Both fans will be picked up in sequence, starting with the slow speed mode. There is a 20 seconds interval between FAN 1 & FAN 2 energiation. When the Engine temperature crosses 85°C then both FANs will be picked up at fast speed as required. There will still be a 20 seconds interval between picks up, in the same order as slow speed. Once the fan is turned ON, it must remain ON for at least Two minutes before it will be stopped down from FAST to SLOW, and SLOW to OFF. If circuit breakers trips due to any reason, an appropriate message will be displayed on display screen for information to

operator for necessary corrective action. The Radiator Blower CB's is shown in Fig. 5.6.

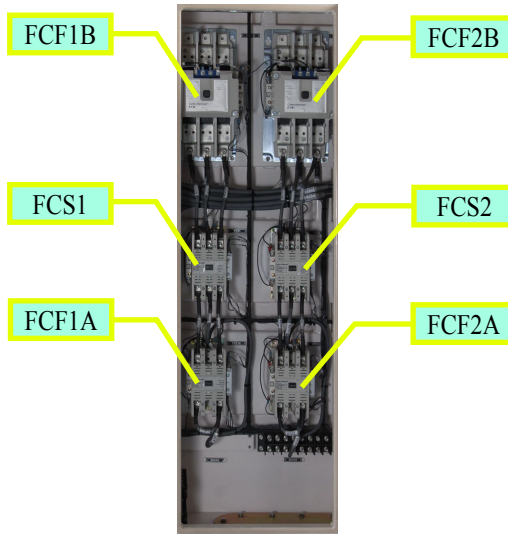


Fig. 5.6 Radiator Blower CB's in ECC#3

It also consists of MRPR sensor to measure MR pressure and accordingly to control compressor loading and unloading control by LCC to maintain required MR pressure. The MRPR sensor and Fan Contactors are shown in Fig. 5.7.

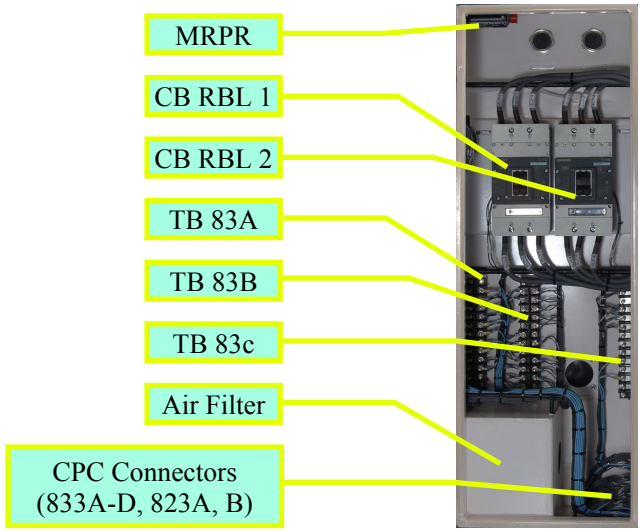


Fig. 5.7 Fan Contactors in ECC#3

5.4 Driver Accessible Panels

These are the various Driver Accessible Panels:

1. Circuit Breaker Panel
2. Engine Control Panel
3. Ground Relay Cutout switch and Test panel
4. MDS 737 Display Unit for TM Cutout, viewing of Crew messages and Fault Archive and to Enter Driver ID, Train no. Section name, Train Load, etc.
5. Auxiliary Generator (250 A) CB in the ECC#2
6. Auxiliary Generator (250 A) CB in the ECC#2

5.5 Circuit Breaker Panel

ECC#1 cabinet Circuit Breaker panel has approximately 33 Circuit Breakers that are used in the control and protection of Diesel Engine and Electrical systems. These Breakers can operate as switches but get trip open when an overload occurs.

1. **LIGHTS Circuit Breaker:** This 30A Circuit Breaker must be switched ON (liver up) to power the locomotive lights switches.
2. **HDLTS Breaker:** This 35A Circuit Breaker provides power and protection to the cab end and hood end Head Light circuits.
3. **CAB FANS Circuit Breaker:** This 30A Circuit Breaker provides power and protection for Cab Air Circulating Fan motors and their control circuits.
4. **AIR DRYER Circuit Breaker:** This 15A Circuit Breaker provides power and protection to the main Reservoir Air Filter Dryer and associated circuit.
5. **AC CONTROL Circuit Breaker:** This 15A Circuit Breaker Provides CA Power supply to ZCD circuit, to detect zero crossing and control Excitation for Main Alternator.
6. **CONTROL Circuit Breaker:** This 40A Circuit Breaker sets up the Fuel Pump and control circuits for engine starting. It supplies Battery Power through Battery Knife switch before an Engine starts. Once the Engine is running, the Auxiliary Generator Supplies Power through this breaker to main operating control.
7. **LOCAL CONTROL Circuit Breaker:** This 30A Circuit Breaker establishes Local control with power from the Locomotive Battery or Auxiliary Generator to operate heavy duty switch gear, Magnetic valves, contactors, Blowers and Relays etc.

8. **FILTER BWR MTR Circuit Breaker:** This 30A circuit Breaker protects the Inertial Filter Blower Motor circuit.

> **NOTE** If the Filter Blower Motor breaker trips, continue Locomotive operation to the nearest maintenance point.

9. **AUX GEN FIELD Circuit Breaker:** This 10A circuit Breaker protects the Auxiliary Generator Field circuit and it is equipped with auxiliary contact sets. One set is double pole switch that protects the AG PWM circuit.
10. **FUEL PUMP Circuit Breaker:** This 30A circuit Breaker protects the Fuel Pump Motor Circuit.

Fig. 5.8 Circuit Breaker Panel

11. **TURBO Circuit Breaker:** This 30A circuit breaker provides power and protection to the Turbo Lube pump Motor. It must be switched ON before Engine start for pre lube and after Engine shutdown to remove residual heat from the Turbo bearings. If the Engine is running and this breaker is OFF, the TURBO CIRCUIT BREAKR IS NOT CLOSED message appears on the Display.
12. **COMPTR CONTROL Circuit Breaker:** This 15A Circuit Breaker protects the Locomotive Control Computer operating power supply.
13. **MICRO AIR BRAKE Circuit Breaker:** This 15A Circuit Breaker provides operating power to the KNORR Air Brake system and the Air Brake system cooling Fans.

14. **DCL 1 to 6 Circuit Breakers:** This 10A circuit Breaker protects the DC LINK contactor Motor and control circuits.
15. A safety guard over the Breaker lever helps to prevent accidental operation. 6 Nos of DCL Circuit Breakers are provided for individual DCL Motor control.
16. **TC 1 COMPTR TO TC 6 COMPTR Circuit Breakers:** This 10A Circuit Breaker provides power and protection to Traction Computer#1 to #6 and associated circuits. A safety guard over these Breakers are provided to prevent accidental breaker operation.
17. **GEN FIELD. Circuit Breaker:** This 90A Circuit Breaker protects the Traction Alternator Field circuit. The Companion Alternator supplies Traction Alternator Field Excitation current through Silicon Controlled Rectifiers (SCR's). The GEN. FLD. Breaker protects the SCR's, Traction Alternator, Companion Alternator and other associated circuitry. If the TA field current overload occurs, the Breaker trips and the Locomotive Computer Displays the Message: **"Main Gen. Field Circuit Breaker is tripped under load"**
18. **TCC BLOWER 1 to TCC BLOWER 6 Circuit Breakers:** This 30A Circuit Breaker protects the Traction Inverter Blower Motor and associated circuit.
19. **GROUND CUTOUT Switch:** This Toggle switch, when open, disconnects ground protection sensors (Ground leakage current sensors PGND MG, PGNDPI+VE, PGNDPI-VE, PGNDG1, PGNDG2, PGNDTI1-6) from Locomotive electrical circuits for maintenance inspection or troubleshooting. When switch is open, the LCC prevents TA excitation. This switch is normally locked in the closed position by a pin that is safety-wired to bracket. This setting arms the ground fault protection.

5.6 Test Panel

Test panel jacks provided on the Circuit Breaker panel, enable Maintenance personnel to conveniently check the following voltages:

1. Main Generator (Traction Alternator) Field voltage
2. Companion Alternator Output voltage
3. Load Regulator voltage
4. Loco Battery voltage (Battery Positive-Battery Negative)

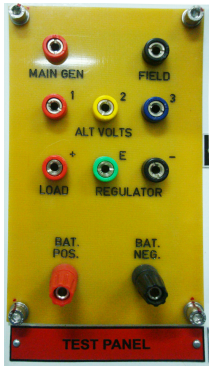


Fig. 5.9 Test Panel

5.7 Engine Control Panel on ECC#1

The Engine Control panel has the following control Equipments for setting up Locomotive operation:

1. **ISOLATION Switch:** This Rotary switch has two settings.
   START/STOP/ISOLATE are in ONE position. RUN is in SECOND position.
   START/STOP/ISOLATE: This position enables Diesel Engine for PRIMING and STARTING. Unit does not develop Power or respond to control, Engine runs at IDLE speed regardless of Throttle Handle setting except for Engine speed that increases for compressor operation, Low Engine Temperature and Turbo cool down cycle.
   RUN: In this position Locomotive responds to (Throttle handle setting changes) Digital Inputs from operator local or train lined and develops POWER in normal operation.

Fig. 5.10 Engine Control Panel

2. **DYN BRAKE CUTIN/CUTOUT Switch:** This switch has two positions CUT IN and CUT OUT. If this slide switch is set in CUT OUT (slider down), the Locomotive does not operate in Dynamic Brake mode. The Locomotive operates in Power with normal Air Braking and no other Loco's in tandem gets effected. Cutting out Dynamic Braking on selected Loco's in a tandem limits total Dynamic Brake effort. Cutting out Dynamic Brake does not effect normal Power

operation and does not effect the Air Brake system. This lever of this switch is normally safety wired in the CUT IN (lever up) setting to prevent accidental Dynamic Brake CUTOUT.

3. **BLENDED BRAKE CUTIN/CUTOUT Switch:** When this slider switch is set in CUT OUT (slider down) position, Locomotive does not operate in Blended Brake mode when the operator moves the Automatic Brake Handle into the service application zone. Normal Air Brake applies on the Locomotive, dynamic braking is still available when the controller/dynamic braking handle is moved in the Dynamic Braking Zone or Default State.
4. **EXTERIOR LIGHTS Switch:** This slide switch provides ON/OFF control of the platform light at the rear end of the Locomotive and the fuel filler lights on both sides of the Locomotive. With the slider in the ON position, Power is supplied to these lights, provided that the Battery knife switch is closed and LIGHTS Breaker is ON.
5. **MAINT. ROOM LIGHTS Switch:** This slide switch provides ON/OFF control of the Engine Room maintenance lights. With the slider in the ON setting, power is supplied to these lights, provided that the Battery knife switch is closed and the Maintenance Lights switch is ON.
6. **EMERGENCY FUEL CUTOFF & ENGINE STOP Switch:** When this switch is pressed for approximately 0.5 seconds, this red push button switch requests the Locomotive Computer to stop the Diesel Engine. The push button need not to be held in, until the Engine stops. However, Pushing button in for 0.5 second ensures that the Computer recognizes the switch actuation as a proper shutdown request.
7. **BATTERY AMMETER:** This Analog Meter indicates the Locomotive Batteries Charging/Discharging rate. It does not indicate Auxiliary Generator Output or Engine cranking current during start-up.
8. **CLASSIFICATION LIGHTS Switch:** This Rotary switch has three settings LONG HOOD FORWARD, OFF and CAB END FORWARD.
   CAB END FORWARD setting: White Class Lights ON at Cab End and Red class lights ON at Long hood side.
   OFF setting: Turns OFF classification Lights at both ends of the Locomotive.
   LONG HOOD FORWARD setting: White Class Lights ON at Long Hood End and Red class lights ON at Cab End side.
9. **ALERTER ALARM:** The Alerter Alarm sounds, if the driver has not acknowledged the flashing of the console alerter indicate lights for 17

seconds. When the Alerter sounds, the driver must acknowledge it within the next 17 seconds to avoid a penalty Brake application.

10. **RAPB:** Restricted Air Penalty Brake switch is provided on Engine Control Panel to enable the AEB system.
11. **TELM SW:** Tractive Effort Limit switch is provided on Engine Control Panel to enable the Tractive Effort Limit while working on Weak/Lengthy Bridges.

5.8 Control and Operating Switch Panel

Control and Operating switches, Engine Run, Control & Fuel Pump, Generator Field slide switches and Dynamic Brake Control Circuit Breaker are located on a panel mounted on the right side of the No. 2 Control console just below the MU Engine Stop switch.

1. **ENGINE RUN SWITCH:** Set this switch ON if the Locomotive is to LEAD in tandem. Set this switch OFF if the Locomotive is TRAIL in tandem or if it is to be hauled dead in tandem. This switch is ON when its slider is up. When the Engine Run switch is ON, the Locomotive control system controls the Diesel Engine speed according to Throttle Position. When the Engine Run switch is OFF (slider down) Engine speed is not effected by Throttle Handle position, except during Load Test Mode.
2. **GEN. FLD. SWITCH:** Set this switch ON if the Locomotive is to LEAD in tandem. Set this switch OFF if the Locomotive is to TRAIL in tandem or if it is to be hauled dead in tandem. This switch is ON when its slider is up.

   WDG4/WDP4 Traction power setup is different from conventional DC Locomotives set up. In the conventional Locomotives, Generator power is directly power to Traction Motors, and setting the GEN FLD switch OFF it prevents Main Generator Excitation.

   On WDG4/WDP4 Locomotives, Main Generator output powers to Traction Inverters, which power the Traction Motors. The LEAD Loco Gen. Field switch must be ON to enable Traction Inverters to power the Traction Motors. If Gen. Field switch is OFF, Traction Alternator Excitation still continue to produce output. But the Traction Inverters stop the operation of power to the Traction Motors. This switch is train lined.
3. **CONTROL & FP SWITCH:** Set this switch ON if the Locomotive is to LEAD in tandem. Set this switch OFF if the Locomotive is to TRAIL in tandem or if it is to be hauled dead in tandem. This switch is ON when its slider is up. When CONT&FP switch is ON, it provides

power to key Low Voltage control circuit and it enables the Loco computer to pickup Fuel Pump Control Relay FPR and it enables Diesel Engine starting.

4. **DYNAMIC BRAKE CONTROL CB:** Circuit Breaker protects against a faulty operating or test setup. The circuit should be in the ON (up) position for normal operation. A tripped circuit breaker generally indicates that, during dynamic brake testing, more than one dynamic brake handle in a consist was out of OFF position. The safety Guard covering for this breaker lever prevents accidental switching the Breaker in ON or OFF.

Chapter 6

SPEEDOMETER

An analog Speedometer is mounted on both the control console Instrument panel. The Analog Speedometer receives analog signals from LCC, these resultant signals are based on TM speed sensors speed signals. The speedometer scale is 0 to 120 kilometers per hour (km/h)

6.1 Speedometer

Chapter 7

TRACTIVE EFFORT/DYNAMIC BRAKE EFFORT METER

The TE/BE meters are mounted on both control console instrument panel just at the right of the Speedometer. This meter indicates sum of all active Traction Motors Torque. When Locomotive is not in Power mode or in Dynamic Brake mode, meter pointer is centered (indicates zero). When the Locomotive is on Power mode, the Pointer moves Clockwise for Tractive Effort and When the Locomotive is on Dynamic Brake mode, the Pointer moves Counter Clockwise for Dynamic Braking Effort. The Tractive Effort meter scale is 0 to 550 KN (Kilo Newtons). The Dynamic Brake effort scale is 0 to 300 KN.

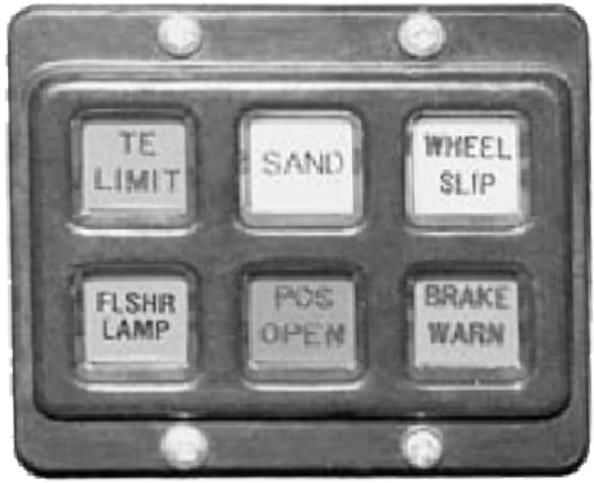
This meter also includes a High Motor Tractive Effort indicator (yellow) LED that lights when Tractive Effort is high. When TE > 400 KN, the yellow LED lights up with all Traction Motors being active. If any Traction Motor is cutout, the LED lights up and the range is proportionate to the Active Traction Motors.

7.1 Tractive Effort/Dynamic Brake Effort Meter

Chapter 8

INDICATING LIGHTS PANEL

These panels are mounted on both Control console just at the right of the instrument panel. It has six indicating lights that indicates operation of various Locomotive system.



8.1 Indicating Lights Panel

NOTE

Each of the following indicator lights has the Push-to-test feature, which allows testing the light circuit alone. This test determines if the light circuit isworking properly. Pressing the lens cap, applies supply voltage to the light circuit. After one second delay the light should switch ON.

1. **TE LIMIT LIGHT:** It indicates that Tractive Effort Limiting has been Enabled through TE LIMIT SW. This switch status is given as digital input to the Locomotive Control Computer and other Locomotives in tandem through Train lined with this Input signal.

2. **SAND LIGHT:** It indicates that a sanding request has been made to the Locomotive Computer by means of a MANUAL SAND switch actuation on this Locomotive or any Train lined to this Locomotive. Other Sanding requests are made by the Automatic function (to help wheel creep or wheel slip control) and the Emergency Air Brake application on run.
3. **WHEEL SLIP LIGHT:** Four conditions cause the wheel slip light to switch ON:
   - Locked wheel due to Mechanically Locked Pinion
   - Wheel Slipping momentarily due to Rail conditions being exceptionally poor
   - Wheel Slip Light by Train lined from consist Locomotives
   - Wheel Over speed due to wheel diameter mismatch

LOCKED WHEEL CONDITION: Locked wheel is dangerous and requires immediate action by crew.

Refer to, and follow Rail road rules and regulations concerning Locked wheel faults.

Locomotive computer immediately lights WHEEL SLIP indicator and drops power when the Traction Computer detects Locked Wheel. After 10 seconds delay (20 if Air Brakes are applied) Locomotive Computer sets fault, Sounds alarm Bell, continues wheel slip light and displays following Message:

" # n LOCKED WHEEL - OR SPEED SENSOR FAULT-STOP TRAIN AND VERIFY THAT AXLE ROTATES"

Fault Indications above continue until Driver uses Locomotive computer Display Unit to reset fault.

- Stop train and set throttle handle in IDLE.

Locked Wheel on moving Locomotives are very dangerous. If locked wheel is indicated, perform the following steps.

- Find the Locomotive with Locked wheel Indication.
- Slowly run the Unit with indication duly observing for sliding wheels and listening for unusual noises from Traction Motors and Gear cases. Are there any wheel sliding and/or Traction Motors or Gear cases making unusual noises?

- Yes - go to 4th point
- No - go to 5th point
- Take appropriate action specified by Railways rules and regulations concerned Locked Wheel fault.

Do not, under any circumstances, tow a Locomotive having sliding/Locked Wheels or move such a Locomotive in tandem.

- Reset fault by pressing RESET key on Locomotive Computer Display (Locked wheel fault message screen).
- On the Locomotive Computer display, Disable Locked wheel detection for faulty axle (If false Locked wheel detection has been diagnosed).
- Continue monitoring for locked wheel fault recurrences. Report or Stop Locomotive at next maintenance point for locked wheel system problem.

WHEEL SLIP CONDITION: While starting train, when rail conditions are exceptionally poor, any occasional flash of the light indicates normal wheel slip control. Automatic sanding may also occur. Do not reduce throttle setting unless severe lurching threatens to break train.

WHEEL SLIP CONDITION ON OTHER LOCOMOTIVE: If another Locomotive is in tandem, connected by MU jumper to this Locomotive, detects any condition that causes it to light its WHEEL SLIP indicator, it energizes the train line that lights the WHEEL SLIP indicator on this Locomotive.

WHEEL OVER SPEED CONDITION: The indicator light flashes ON and OFF to indicate wheel (Traction Motor) over speed, which can be caused by excessive track speed or by simultaneous slipping of all Locomotive wheels.

4. **FLASHER LAMP LIGHT:** This indicator flashes ON/OFF when either outside Flasher light (at cab end or long hood end) is flashing or the outside Flasher lamps are connected through Lights Circuit Breaker. So the Lights CB is necessary to switch ON for Flasher Lights operation.
5. **PCS OPEN LIGHT:** The Air Brake system trips Locomotive control system Pneumatic Control Relay (PCR), whenever it initiates a safety control or Emergency Air Brake application. When PCR trips, it switches ON the PCS OPEN light and Locomotive control system

stops Traction Alternator excitation, interrupting Locomotive Power/Dynamic Brake operation.

To restore Locomotive Power after safety control or Emergency Brake conditions end and to reset PCR, set throttle handle in IDLE, then set Automatic Brake handle in Emergency for 60 seconds, then move it to Release position.

6. **BRAKE WARN LIGHT:** The Brake Warn indicator lights, whenever this Locomotive and/or another Locomotive in tandem with jumper cable is connected, generates excessive Dynamic Braking current, regardless of tractive effort meter reading. If the light switch is ON, make sure that it does not remain ON longer than few seconds.

Chapter 9

STARTING FUSE AND BATTERY SWITCH BOX

Starting Fuse and Battery knife switch box is located on the left side of the Locomotive.

The Box includes the equipment described in the following paragraphs:

1. **BATT SWITCH (Battery Knife Switch):** When this switch is closed, it connects the Locomotive Batteries to the Locomotive low voltage electrical system. The Battery switch must be closed at all times during Locomotive operation.
2. **STARTING FUSE:** The 800 Amps starting fuse is in use only during Diesel Engine starting. Battery current flows through fuse and the starting contactor to the starting Motors. The starting fuse protects the Motors from current overload.

A defective starting fuse can be detected when attempting to start the Engine. If the Engine start switch does not crank the Engine, then check the fuse.

Chapter 10

OPERATION SELECTION

This section includes recommended procedure for setup, service operations and General Locomotive operation. The procedures are brief and do not contain detailed descriptions of equipment location or function. See the Locomotive service manual for more specific descriptions.
Always comply with Railway rules and instructions regarding Locomotive operation or Inspection.

This section is arranged as follows:

1. **Preparation for service**
   Ground Inspections
   Engine Room Inspection
   Starting Fuse & Battery Knife Switch Box Inspection
   Lead Locomotive cab Inspection
   Trailing Locomotive cab Inspection
2. **Starting Lead Locomotive Engine**
   Engine Inspection
   Engine Starting
3. **Starting Trailing Locomotive Diesel Engines**
4. **Various other operating procedures**
5. **Stopping Engines**
6. **Towing Locomotive**
7. **Leaving Locomotive Unattended**

10.1 Preparation for Service

GROUND INSPECTION: Check for the following and correct them when necessary:

Leakage of Fuel Oil, Lube Oil, Water or Air

1. Loose or dragging parts

2. Proper Installation of Electrical cables and Air Brake house connections in multiple Unit tandem and to train.
3. Proper setting of angle cocks and shutoff valves
4. Air cut into boogie brake cylinder
5. Satisfactory of Brake shoes
6. Adequate Fuel supply
7. In No.2 Electrical Control Cabinet, Verify that AUX. GEN. Circuit Breaker is closed in ECC#2.

ENGINE ROOM INSPECTION:

Engine room can be inspected and operated by opening access doors along the sides of the long hood. Check for the following and correct them when necessary:

1. Check Lube Oil level
2. Check Air compressor Oil level
3. Check governor Oil level
4. Check Water level in water tank sight glass. It should be nearer to FULL (Engine running) mark.

Recheck water level when Engine is running. It should be nearer to FULL (Engine running) mark.

1. Check Head lights, Flasher Lights, Classification lights etc.
2. Check all Valves for proper setting
3. Check for leakage of Fuel oil, Water, Lube oil or Air.

A Proper filled Engine lube oil system coats the oil gauge above the FULL mark when the Engine is stopped. To obtain an accurate check, recheck the level when the Engine is Idling and at normal operating temperature.

STARTING FUSE AND BATTERY BOX INSPECTION:

1. Verify that main Battery Knife switch is closed.
2. Verify that Staring Fuse is installed in good condition and is of correct rating.

LEAD LOCOMOTIVE CAB INSPECTION:

On the Lead Locomotive Control Unit, check the Control locations described in operation section. Set the equipment for operation as follows:

1. CIRCUIT BREAKER PANELS
   a. The following Circuit Breakers must be ON for Locomotive running:
      - AC CONTROL
      - CONTROL
      - LOCAL CONTROL
      - AUX.GEN.FLD
      - FUEL PUMP
      - COMP.CONTROL
      - MICRO AIR BRAKE
      - DCL 1 TO DCL 6 (ALL SIX BREAKERS)
      - TC 1 COMPTR to TC 6 COMPTR (ALL SIX BREAKERS)
      - GEN. FIELD
      - TCC BLW 1 to TCC BLW 6 (ALL SIX BREAKERS)

   b. The other Circuit Breaker should be ON as required:
      - LIGHTS
      - HEAD LIGHTS
      - CAB FANS
      - AIR DRYER
      - FILTER BLOWER MTR

   c. At Circuit Breaker Panel verify that GROUND RELAY CUTOUT switch is closed (lever up) and sealed.

ENGINE CONTROL PANEL:

1. ISOLATION switch in START/STOP/ISOLATE position.
2. Miscellaneous switches set as required.

Electrical control cabinet must be securely closed during Locomotive operation for proper cooling.

CONTROL CONSOLES:

Set control console devices as follows:

1. Set CONTROL & FP switch ON (slider up). This always Fuel Pump to start and Run when FP/ES switch is in Fuel Prime or Engine start.
2. Set Engine Run switch and the Gen. Field switch OFF (slider down during cranking)
3. Set Light switches and other switches as desired.
4. Set Throttle Handle in IDLE. Center Reverser (neutral) and remove it.

AIR BRAKE EQUIPMENT:

1. Set Air Brake controller Automatic Brake Handle in FS (full service). This nullifies any safety control brake application.
2. Set Air Brake controller Independent Brake valve Handle in FULL (full application)
3. Set Air Brake controller setup (LEAD/TRAIL SWITCH) in LEAD position.

TRAILING LOCOMOTIVE CAB INSPECTION:

Check the following trailing Locomotive cab device settings, correct them as required:

STARTING FUSE AND BATTERY BOX:

1. Verify that main Battery Knife is closed.
2. Verify that Staring Fuse is installed in good condition and is of correct rating.

10.2 Starting Lead Locomotive Engine

The Diesel Engine may be started after the following inspection have been completed:

ENGINE INSPECTION:

1. Ensure Throttle Handle of both control console is in IDLE, Reverser handle is at center and RUN/ISOLATE Switch is in ISOLATE position.
2. Ensure there is sufficient oil level in Compressor oil, Engine sump Lube Oil and Governor Oil.
3. Ensure there is sufficient Coolant Water level in the water tank (Engine dead – Full).
4. Ensure no one is working on the Engine, Generator Room, Compressor Room etc. and all the doors are closed.
5. Ensure the MU Engine Stop button is in RUN position (For reset press Green portion inside)
6. Ensure the engine over speed mechanism is reset.
7. Ensure the Governor Low Lube Oil Button (LLOB) is reset.
8. Ensure that the Crankcase (oil pan) pressure and Low water pressure detector reset buttons are reset (pressed in side). If the button is ejected, press and hold it for 5 seconds immediately after Engine starts.

ENGINE STARTING PROCEDURE:

After the preceding inspections have been completed, the Diesel Engine may be started.

Engine should be Pre-Lubricated, if it has been shut down for more than 48 hrs. See Engine Maintenance Manual for Pre-Lubrication procedure.

1. Make sure that starting fuse is installed, is in good condition and correctly rated. Verify that main Battery Knife Switch is closed.
2. At the Circuit Breaker panel, make sure that the following Breakers are 'ON' and GROUND RELAY CUTOUT switch is closed and sealed:

   - AC CONTROL
   - CONTROL
   - LOCAL CONTROL
   - AUX.GEN.FLD
   - FUEL PUMP
   - COMP. CONTROL
   - MICRO AIR BRAKE
   - DCL 1 TO DCL 6 (ALL SIX BREAKERS)
   - TC 1 COMP to TC 6 COMP (ALL SIX BREAKERS)
   - GEN FIELD
   - TCC BLW 1 to TCC BLW 6 (ALL SIX BREAKERS)

3. At the No.2 Control Console, make sure that the GEN. FLD and ENG. RUN switches are OFF (DOWN). Verify that the CONTROL & FP switch is ON.

While starting Trailing Locomotive Diesel Engine, if its jumper cable is connected between the Locomotive, leave the CONTROL & FP switch OFF. At the Engine control panel, verify that the ISOLATION switch is set in Isolate Position.

4. Turn the FP/ES switch lever to PRIME and hold (Normally 10-20 sec) it there until the fuel flows clear and free of bubbles in the return fuel sight glass and then release it.
5. Turn the FP/ES switch lever to ENGINE START and hold it there until the Engine Starts and speed increases to Low Idle RPM 200. Do not crank for more than 20 seconds.

6. In case the Low Lube Oil shutdown is noticed immediately after cranking, check Low water Pressure detector (EPD) for trip. If the water pressure is less, the Engine shuts down after a short time delay.
7. If the detector trips, press continuously for 15 seconds to reset, after ensuring the water level and water pump working.
8. Check the following with the Engine running and at a normal operating temperature (49ºC) and correct if necessary:

    a. Coolant Water level is near to the FULL (Engine running) mark limits on Water level Inspection plate.
    b. Engine Lube oil level is near FULL mark on oil level gauge (Lube oil Dipstick).
    c. Governor oil level is near to the upper mark on sight glass.
    d. Compressor Lube oil is within the normal range.
    e. After Engine has been started and is operating normally, check and ensure that all Engine room access doors are securely closed.

Do not apply load before Engine water inlet temperature has reached 49ºC.

10.3 Starting Training Locomotive Diesel Engines

Start trailing locomotive Engines in the same manner as the Engine in the lead unit. Refer to Starting lead Locomotive.

If MU jumper cables are already connected between Locomotive, make sure that these trailing Locomotive switches are OFF (slider down) Control & FP, GEN. FLD and ENG. RUN, these switches are controlled from the Lead Unit.

10.4 Setting Locomotives On Line

Verify that the throttle handle is in IDLE on all Locomotives in tandem before setting a Locomotive on line.

After the Diesel Engine is started and inspected, set the Locomotive on line by setting the ISOLATION switch in RUN. When a Locomotive is on line, it can respond to operator controls and develop tractive effort/Braking effort. When on line, a trailing Locomotive follows train lined Throttle/Dynamic

Brake commands from the LEAD Locomotive. The Locomotive Computer changes Diesel Engine speed in response to certain operating conditions, such as low Main Reservoir pressure, causes PCS OPEN by Air Brake Computer or Hot Engine-extended time and TH limit to 6 notch. In these circumstances, Diesel Engine speed is not precisely related to throttle setting.

10.5 Precautions Before Moving Locomotive

Before attempting to move the Locomotive under its own power, carefully follow these precautions:

1. Make sure that main Reservoir Air pressure is normal.
2. Make sure that the Brake system is set up as LEAD on a single or lead Locomotive and TRAIL on trailing Locomotive.
3. Check for proper Air Brakes application and release. Observe Brake cylinder and Brake rigging.
4. Release Hand Brake and remove any wheel blocking.

Engine water temperature should be 49ºC or high before full load is applied to Engine.

10.6 Handling Light Locomotive

After starting the Engine, placing the Locomotive on line and completing the preceding inspections and precautions, the Locomotive is handled as follows:

1. Set the ENG. RUN and GEN. FIELD switches "ON" on Control & operating switch panel.
2. Set the Air Brake system on single or leading Unit for LEAD position.
3. Insert the Reverser Handle (Direction Handle) and set in the direction of travel, Forward or Reverse. (Engine speed increases from low Idle to Throttle 1 speed, as soon as the Reverser handle is thrown)
4. Release the Air Brakes.
5. Advance the Throttle handle as needed to move Locomotive at desired speed.
6. Switch Headlights and other lights ON as needed.

Locomotive response to Throttle movements is almost immediate. There is little delay in power build up. Do not operate Reverser Handle, Reverse to Forward or Forward to Reverse when the Locomotive is moving.

10.7 Coupling Locomotive Together

Use the following procedure when coupling Locomotives together for Multiple Unit operation:

1. Couple and stretch Locomotive to ensure the couplers are locked properly.
2. Install 27 conductor electrical control cable between Locomotives.
3. Perform ground, Engine room and Engine inspections outlined in preceding pages.
4. Set cab controls for trailing Unit operation. Remove Reverser from all controllers to Lock controls.
5. Connect Air Brake hoses between Locomotives.
6. Open required Air hose cutout cocks on each Locomotive.
7. Using Lead Locomotive Air Brake Cab Control Unit (CCU), make an Automatic brake application to determine if brakes are applied on each Locomotive. Release the Automatic application, then make sure the brakes on each locomotive are released.
8. Follow the same procedure to check an independent brake application. Also, release an Automatic brake service application by pulling up the independent brake handle bail-release ring. Inspect all brakes in the tandem to verify they are released.

10.8 Dynamic Braking For Locomotive in Tandem

The Dynamic Brake Handle operates the Dynamic Brake Rheostat. The Locomotive Computer uses the Voltage level signal produced by the Rheostat to control Dynamic Braking effort. The Rheostat Voltage level appears on a train lined wire that controls the dynamic braking effort of all Locomotives in a tandem that are equipped with dynamic braking. The total Braking effort of a multi-unit tandem can become quite high. Observe Railway Rules Regarding Multiple Unit Dynamic Braking.

10.9 Engine on Train (Coupling Locomotive to Train)

Be careful when coupling Locomotive to a Train as taken when coupling Locomotives together.

After coupling, perform the following checks:

1. Make sure that couplers are locked by stretching the connection.
2. Connect the Air Brake hoses.

3. Slowly open Air valves on the Locomotive and the train to cut in brakes.
4. Pump up Air using the procedure given in the next section.

10.10 Pumping Up Air

After cutting in Air brakes on train, note the reaction on the control console MAIN RESERVOIR pressure gauge. If pressure falls too low, the Locomotive Computer automatically increase Engine speed to Notch 2 and displays the Message: "Engine speed Increases – Air compressor operation". After getting sufficient MR pressure, Engine speed comes back to Idle. If the MR pressure falls < 8 kg cm^2, the LCC automatically increases Engine speed to Notch 4. After getting sufficient MR pressure Engine speed comes to Idle.

10.11 Double Heading Service

In double heading service, an extra Locomotive is temporarily coupled to the lead end of the Lead Locomotive, Air Brake pipes are connected between them, but MU jumper electrical cable are not provided. There is a Driver in each Locomotive.
Prior to Double Heading behind another Locomotive, make a full service brake pipe reduction with the Automatic Brake valve and set the brake system in the Lead-out mode.

The operation in the throttle is normal, but the Brakes are controlled from the lead Locomotive. An Emergency Air Brake application may be made however, from the Automatic Brake Valve of the second Unit. Also, the Automatic Brake on this Locomotive may be released by pulling up Bail-off release ring on the Independent Brake Handle, while Automatic and Independent Brake handles are set in REL (release).

10.12 Helper Service

In HELPER service, an extra Locomotive is temporarily coupled to the rear of the Train.

HELPER Air Brake system set-up is the same as for double heading Locomotives. There is no basic difference in the instructions for operating the Locomotive as a helper or with a helper. In most instances it is desirable to get over a gradient in the shortest possible time. Refer to Rail Road operating Rules And Instructions.

10.13 Changing Operating Ends

Use the following procedures to change the Lead from the Locomotive on one end of a tandem to the Locomotive on the opposite end:

ON END BEING CUTOUT

1. Set Independent Brake in FULL (Full application).
2. Set Automatic Brake handle in service zone and make a 1.4 kg/cm^2 (20 psi) reduction.
3. After Brake pipe exhaust sound stops, set Control console Brake system CCU set up Valve in TRL (TRAIL).
4. Set Independent Brake handle in REL (release).
5. Set Automatic Brake handle in RUN (running).
6. Set Throttle/Dynamic Brake handle in IDLE and Set Reverser in CENTER, then remove it to lock the controls.
7. Set all off, make sure that the Gen. Field switch and Eng. Run switch are OFF.
8. At the Engine Control Panel, set switches on as needed.
9. All the Circuit Breakers on No.1 and No.2 ECC cabinet Circuit Breakers are to be remained ON.
10. After completing the preceding steps, move to the cab of the new LEAD UNIT.

ON END BEING CUTIN

1. At the No. 2 Control Console, make sure that the Gen. Field switch is OFF (slider down).
2. Insert Reverser (direction handle) and leave it in CENTERED.
3. Set Automatic Brake Handle in FS (full service) for at least 10 seconds to clear any power-up penalty.
4. Set Independent Brake in FULL (full application).
5. To avoid an Emergency Brake application :
   (a) Set Control Console Brake system CCU set up valve in LEAD-OUT.
   (b) Set Automatic Brake handle in REL (release), then wait for equalizing reservoir Air pressure to raise to 5.17 kg/cm^2 (73.5 psi)
   (c) Set Brake system CCU set up valve in LEAD-IN.
6. All the Circuit Breakers on No.1 and No.2 ECC cabinet Circuit Breakers are to be remained ON.
7. At the Engine Control Panel, set switches as needed.
8. Set ENG. RUN, CONTROL & FP and GEN. FIELD switches ON and other switches as needed.

10.14 Stopping Engines

There are six ways to Stop the Engine:

1. On the Engine Control Panel, set the Isolation switch in START/STOP/ISOLATE, then press the EMERGENCY FUEL CUT OFF & ENGINE STOP push button switch (this switch is also known by its electrical reference designator, EFCO/STOP). Since Control system reaction time after pressing the EFCO/STOP push button is very quick, the push button need not be held in until the Engine stops.
2. Press one of the Emergency Fuel Cut Off (EFCO) push buttons. One is located near each Fuel filler, on the side of the Locomotive Under frame. These push buttons operate in the same manner as the Engine Control panel EFCO/STOP push button and need not be held in nor reset.
3. Pull the Lay shaft (injector rack manual control lever) outward, towards the right side of the Locomotive and hold it there until the Engine stops completely. The lay shaft overrides the engine governor, forcing the fuel injector racks into the "No Fuel" setting.
4. Close the Low water detector test cock (lever horizontal). After some Engine coolant leaks down, the low water detector trips, oil dumps from the Governor low oil shutdown device and the Governor stops the Engine.
5. To simultaneously stop all On-line Engines in a multiple-unit tandem from the cab of the lead unit, press the Red STOP section of the MU STOP switch on the right side of the No.2 Control Console. (The switch remains in stop until the green RUN switch section is pressed).
6. Pull out Low Oil shutdown plunger on the side of the Engine Governor.

Chapter 11

DISPLAY UNIT AND NAVIGATION THROUGH MENU

The Display unit is the main interface between the user and the Control System. It has an alphanumerical Keyboard and a VFD through which it interacts with the user. It gets the information requested by the user from the Control system (Locomotive Control Computer) through the Serial Communication Interface and Displays it on the VFD. It has a MENU driven operation that makes it User friendly. Normally a group of parameters are displayed in real time on the Display unit. Different groups of such parameters are available for selection. The parameters are grouped functionally e.g. Excitation related parameters, Aux. Gen. Related parameters, wheel RPM's and Traction Motor currents etc. User can select any one of the groups for display and record the required Loco parameters while testing the Locomotive. By default the display Unit is in "Status Display" mode. In addition to Loco parameters, warning messages are also displayed during fault occurrence with or without Audio based on the severity of the fault. The Main Menu, Sub Menus and Display mode are illustrated below for quick reference. To select a Menu/Sub Menu, operator has to simply press either Menu option Number or down arrow key till the required option is highlighted and then press "Enter" key.

11.1 Locomotive Control Computer Display Panel Details

Fig. 11.1 Display Panel Keypad

The Locomotive control computer is equipped with Alphanumeric keyboard containing 29 keys. They are defined below:

F1, F2, F3, F4 keys are called function (Soft) keys. These keys perform the operations as displayed on the screen in the space directly above them at any particular moment. If an option does not appear above that key in a particular screen, it serves no purpose. In the example shown above, the MAIN MENU the SELECT option executes with to the F3 key, EXIT with F4, NEXT with F2 and F1 serves no purpose.

ON/OFF key is used to turn the Display ON or OFF. This can be done from any screen. The screen may turn ON by itself, if the computer has a crew message to announce.

MAIN MENU key is used to force the display back to the MAIN MENU screen from any other screen.

CREW key displays the Active crew messages if any. Only one crew message at a time is displayed.

BRIGHT/DIM key is used to vary brightness of the Display. Every pressing changes the level to the next.

HOTEL LOAD Key is required for Hotel Load Feature and is presently unused.

DRIVER ID key is used to enter driver name or identification.

TRAIN NO. Key is used to enter Train number.

CURSOR KEY/ARROW KEYS are used to move the CURSOR to different locations on the Display.

1, 2, 3, 4, 5, 6, 7, 8, 9 and 0 Alphanumeric keys are used to enter into the concerned screen, password, data entry by operator and selection etc.

ENTER key is used to enter into modes, select screens, etc.

HELP key is not in use at present.

11.2 Menu Screens, Sequential Flow and Key Actions for Display

The Locomotive computer display is available for both locomotive operation and locomotive service functions.

1. Operation – Locomotive crew members use only crew message screens to monitor unusual operating or fault conditions and cutout motors or reset faults.
2. Service – Maintenance persons use two types of screens:

    - Crew message screen to examine fault condition.
    - Main menu screens to load test the locomotive, test modes, meter screens and other troubleshooting data.

The main menu has two pages containing seven sub menus. These are Data Meter, Self Test, Fault Archive and TM cutout in the first page and Cumulative Data, Settings and System Information in the second page.

11.3 How to Select SELF TESTS

Press No. 2 key or keep cursor on SELF TEST and press F3 key. The screen appears as shown in Fig. 11.2.

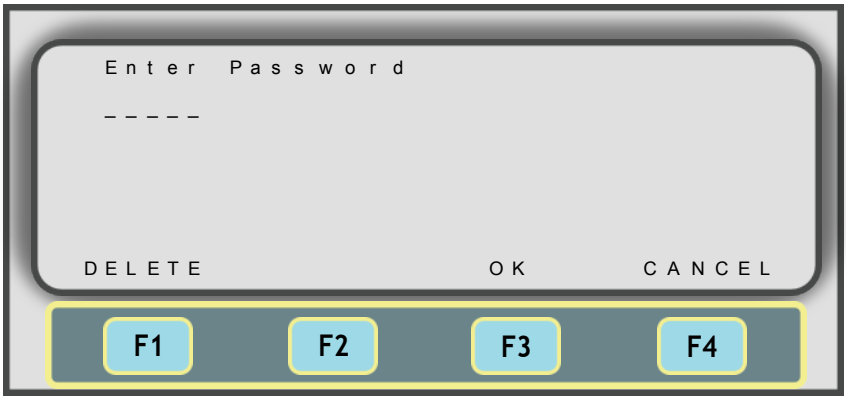


Fig. 11.2

Enter the correct password and press **F3 key** to get SELF TEST MENU. SELF TEST is selected from Main Menu.

Self Test Page:1

The Self Test screen is displayed in Fig. 11.3.

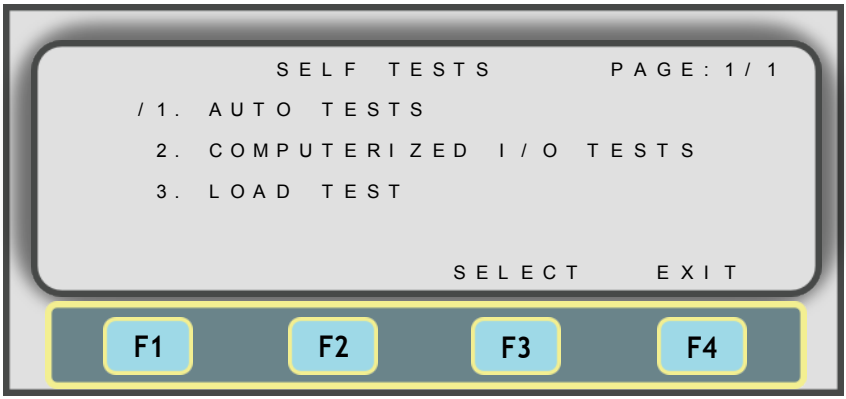


Fig. 11.3

Press No. 1 key or Keep cursor on AUTO TESTS and press F3 key for Auto tests list.

Auto Test Page:1

The Auto Test has three screens. The first screen for Auto Test is shown in Fig. 11.4.

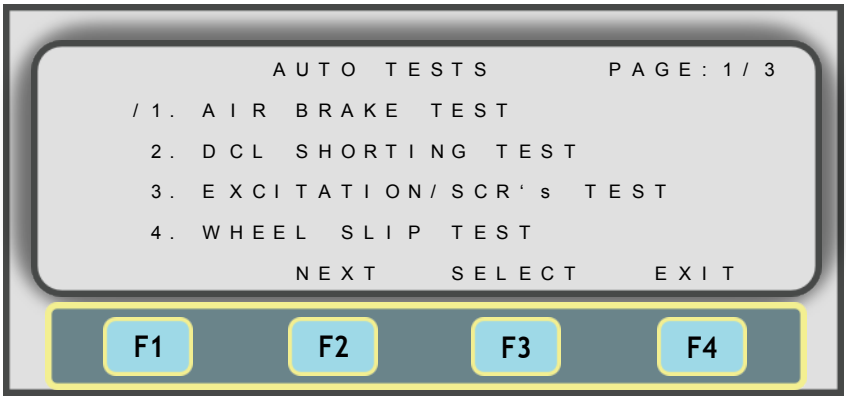


Fig. 11.4

Auto Test Page:2

The second screen for Auto Test is shown in Fig. 11.5.

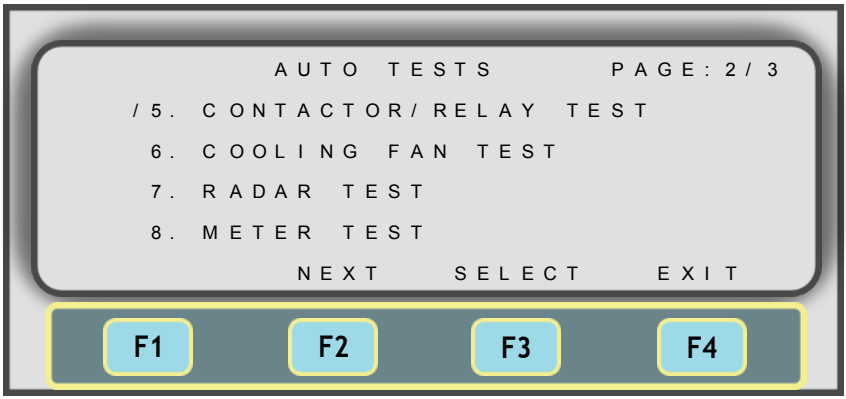


Fig. 11.5

Auto Test Page:3

The third screen for Auto Test is shown in Fig. 11.6.

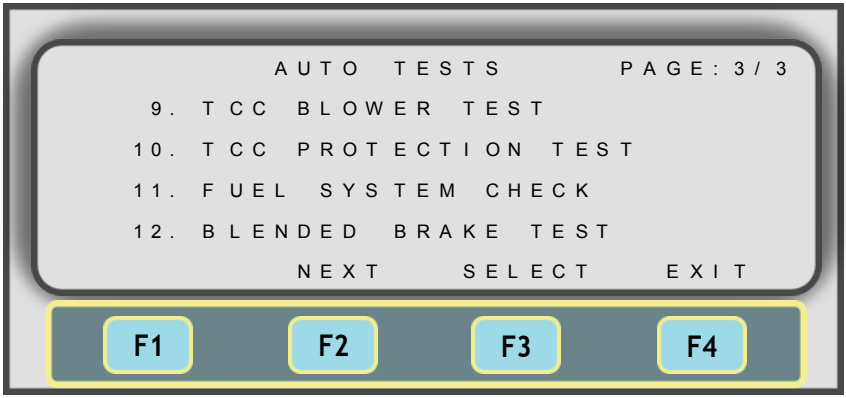


Fig. 11.6

11.4 TM CUTOUT

The TM's CUTOUT Function in the MAS 696 system through Display Unit replaces the Traction Inverter #n CUTOUT system in the WDG4 & WDP4 Locomotives. The existing system in WDG4 & WDP4 can be able to Disable/Enable all Traction Motors on the TRUCK # 1 or TRUCK # 2 and the associated Blower Motor, but not be possible to CUTOUT any one of the Traction Motors. Any one TM or upto Five TM's are possible to CUTOUT in the MAS 696 system since Independent Traction Inverter and its controlling Computers are provided for Individual Traction Motors. The Traction Motor CUTOUT/CUTIN function can be performed from the Traction Status Display Screen.

The Locomotive must be UNLOADED while attempting to CUTOUT/CUTIN a Traction Motor.

Access the Traction Status Screen selection either two ways:

1. Press Main Menu and press No. 4 key to select TRACTION STATUS on the screen.
2. Press Main Menu and bring cursor on TM CUTOUT then press F3 key to select TRACTION STATUS.

TM CUTOUT on MAIN MENU

The screen for TM CUTOUT on Main Menu screen is shown in Fig. 11.7.

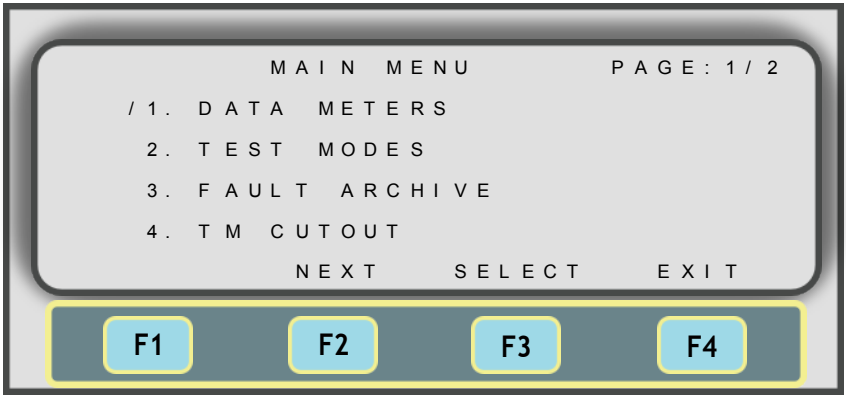


Fig. 11.7

On selecting TM CUTOUT, the screen appears as shown in Fig. 11.8.

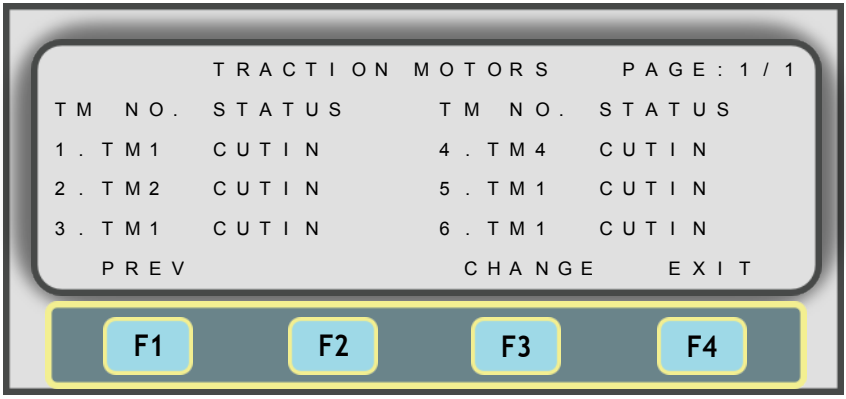


Fig. 11.8

The **TM STATUS** of the various Traction Motors are displayed in Fig. 11.9.

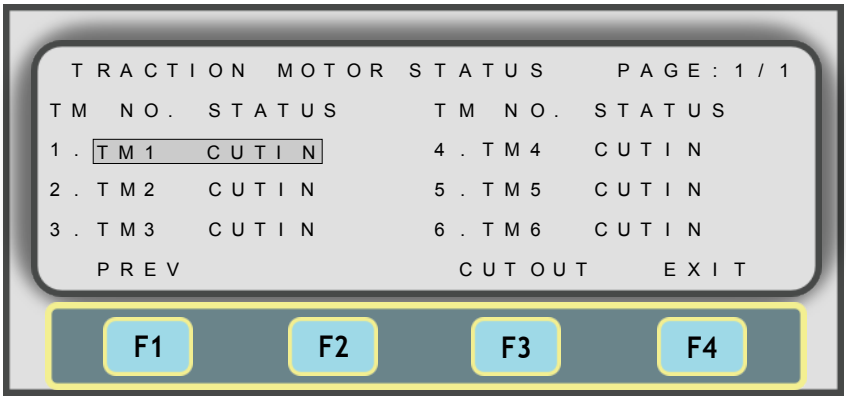


Fig. 11.9

Press F3 key for change the Traction Motors status.
Keep cursor on the defective TM and press F3 key to select TM cut out.
Exp:- If you want to select TM No.3 Brining the Cursor on TM 3 CUTIN (Item No.3) and press F3 to CUTOUT TM3.

Fig. 11.10 displays a screen where the status of TM#3 is CUTOUT.

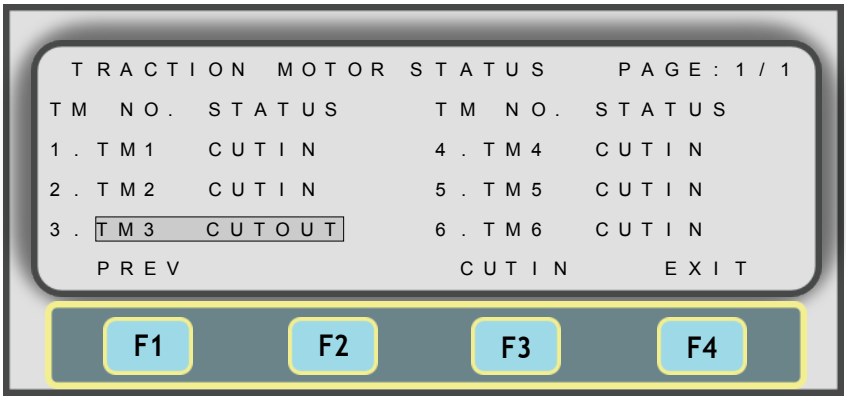


Fig. 11.10

There are some Entry Conditions for TM CUTOUT, as shown in Fig. 11.11.

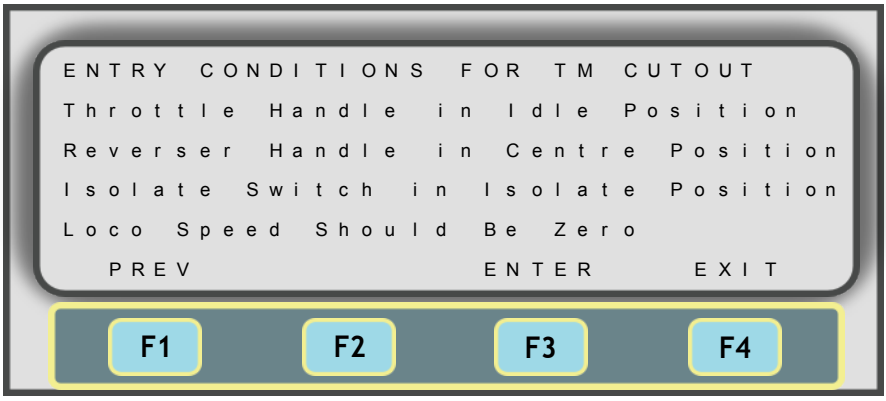


Fig. 11.11

After fulfilling of all the entry conditions, Press F3 key to enter for password.
The screen for entering the password is displayed in Fig. 11.12.

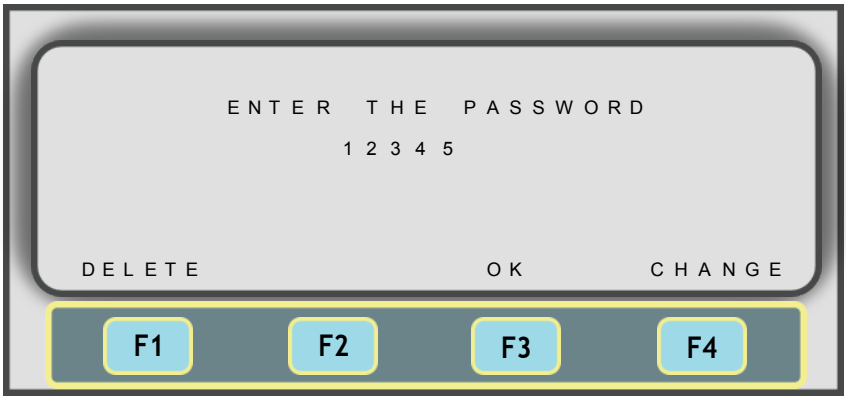


Fig. 11.12

After Entering the correct password press F3 key for OK.

11.5 Crew Messages List

Message Code	Message Text
2420	Air Brake circuit Breaker is not closed.
2975	Air Brake failure – Use Locomotive in TRAIL only.
2976	Air Brake Cutoff failure – Use Locomotive in LEAD-IN only.
2978	Air Brake Controller No.1 failure-switch to Air Brake Controller No.2.
2979	Air Brake Controller No.2 failure-switch to Air Brake Controller No.1.
2980	Air Brake failure – Check for proper LEAD/TRAIL set up.
2983	Air Brake power interruption penalty-place handle in FS for 10 seconds.
2985	Air Bake Emergency – place handle in Emergency for 60 seconds.
2986	Air Brake penalty – place handle in Full Service for 10 seconds.
2987	To restore normal Air Brake operation place Automatic handle in running.
2493	Alerter or Vigilance system has made a penalty Brake application.
5037	AEB applied Brake – move MCH to Idle – press AEBRST switch to release Brake.
5090	ADB Power supply 1 failure.
5091	ADB Power supply 2 failure.
5092	ADB Power supply 3 failure.
5093	ADB Power supply 4 failure.

Message Code	Message Text
5094	FDB Power supply failure.
2060	B1 contactor failed to pickup.
2062	B2 contactor failed to pickup.
2051	B3 contactor failed to pickup.
2049	B4 contactor failed to pickup.
5109	Blended Brake Cutout.
2671	Coupled Locomotive detected-Tractive Effort limited.
3320	Cold Engine Throttle 2 limit.
794	DCL 1 Control Circuit Breaker is not closed.
794	DCL 2 Control Circuit Breaker is not closed.
794	DCL 3 Control Circuit Breaker is not closed.
794	DCL 4 Control Circuit Breaker is not closed.
794	DCL 5 Control Circuit Breaker is not closed.
794	DCL 6 Control Circuit Breaker is not closed.
5095	Dynamic Brake Cutout.
14	Engine Air Filters are Dirty – Change out request power may limit to TH6.
66	Engine Dead – Locomotive is not Isolated.
67	Emergency Fuel Cutoff activated.
76	Engine speed Increases – Turbo Cool down cycle.
77	Engine speed Increases – Air Compressor operation.
341	Engine Speed increases – Traction Motor over Temperature.
716	Engine Dead while Loading.
937	Engine Dead with cold water.
994	Engine shutdown – Engine oil pressure.
1104	Engine speed Increases – High Aux. Generator Load.
1227	Engine will not start – Low Engine water level detected.
1056	Engine shutdown – Engine over speed.
3319	Engine shutdown – low water level.
5065	Engine speed Increases – Hot Engine.
93	Filter Blower Circuit Breaker is not closed.
96	Forced minimum Engine speed – Engine Run switch is down.
136	Forced minimum Engine speed – Locomotive is Isolated.
221	FP Relay failed to pickup.
296	Fuel Pump is not running-check FP Relay and Circuit Breaker.
352	FP Relay failed to drop out.

Message Code	Message Text
1672	Fuel Pump Circuit Breaker is not closed.
5001	Filter Vacuum switch tripped.
5002	Fire Engine shutdown.
61	Ground Fault – Grid path 1
359	Ground Fault – Main Generator.
5040	Ground Fault – Grid Path 2.
5043	Ground Fault – Main Gen. Positive half side phase imbalance.
5045	Ground Fault – Main Gen. Negative half side phase imbalance.
1960	GFD Failed to pickup.
1961	GFD Failed to drop out.
1962	GFC Failed to pickup.
1963	GFC Failed to drop out.
53	Hot Engine Throttle 6 Limit.
319	Hot Engine Throttle 6 Limit – Extended time.
1031	Improper Train line Throttle request in Dynamic Brake.
15	# 1 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
16	# 2 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
17	# 3 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
18	# 4 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
19	# 5 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
20	# 6 Locked Wheel or Speed Sensor Fault – Stop Train & Verify that Axle rotate.
792	Local control circuit Breaker is not closed/Battery Knife switch is open.
5047	Lead Unit Tractive Effort Limit.
1069	MRPT Failed – Forced Air Compressor operation Loading.
1673	No Start – Fuel Pump is not running.
223	No Start – Control Circuit Breaker or Control/Fuel pump switch is down.
135	No Start – Locomotive is not Isolated.
5003	No Start – Fire shutdown.
5066	No Start – Low Lube Oil pressure.
5117	No Start – Starter Motors are abutment.

Message Code	Message Text
1081	No Engine Start – Turbo pump not running Run pump for 15 minutes.
125	No Load – Locomotive is Isolated.
179	No Load – Improper GFC contactor status – Cycle Computer Control CB.
192	No Load – Improper B3 contactor status – Cycle Computer Control CB.
193	No Load – Improper B1 contactor status – Cycle Computer Control CB.
1815	No Load – Improper B2 contactor status – Cycle Computer Control CB.
616	No Load – Improper B4 contactor status - Cycle Computer Control CB.
200	No Load – Improper GFD contactor status – Cycle Computer Control CB.
220	No Load – Fuel pump is not running.
602	Reduced Load – TCC 1 Blower Circuit Breaker is not closed.
602	Reduced Load – TCC 2 Blower Circuit Breaker is not closed.
602	Reduced Load – TCC 3 Blower Circuit Breaker is not closed.
603	Reduced Load – TCC 4 Blower Circuit Breaker is not closed.
603	Reduced Load – TCC 5 Blower Circuit Breaker is not closed.
603	Reduced Load – TCC 6 Blower Circuit Breaker is not closed.
617	No Load – Improper DCL 1 Status – Cycle Computer Control CB.
617	No Load – Improper DCL 2 Status – Cycle Computer Control CB.
617	No Load – Improper DCL 3 Status – Cycle Computer Control CB.
617	No Load – Improper DCL 4 Status – Cycle Computer Control CB.
617	No Load – Improper DCL 5 Status – Cycle Computer Control CB.
617	No Load – Improper DCL 6 Status – Cycle Computer Control CB.
637	No Load – No CA output Check Aux.Gen.Field Circuit Breaker.
986	No Governor Boost – Improper Relay Status.
996	No Aux.Gen. Output - Check Aux.Gen. Field circuit breaker.
2616	No Aux Power – Control Circuit Breaker is not closed.
2354	No Lubrication allowed Turbo Lube Pump Circuit Breaker is not closed.
2495	No Power – Locomotive speed too high bring MCH to Idle.
3315	No Dynamic Brake – DB Circuit Breaker is not closed.
2654	Reduced Dynamic Brake/Load Test – No Grid Blower 1 current imbalance.

Message Code	Message Text
2655	Reduced Dynamic Brake/Load Test – No Grid Blower 2 current imbalance.
2656	Reduced Dynamic Brake/Load Test – High Grid Blower 1 current imbalance.
2657	Reduced Dynamic Brake/Load Test – High Grid Blower 2 current imbalance.
2660	Reduced Dynamic Brake/Load Test – Grid Blower 1 current imbalance.
2661	Reduced Dynamic Brake/Load Test – Grid Blower 2 current imbalance.
5120	Radiator Fan # 1 Fault – Limited Cooling available.
5121	Radiator Fan # 2 Fault – Limited Cooling available.
7000	TC # 1 Torque Limit – DCL capacitor Temperature sensor faulty.
7001	TC # 1 Torque Limit – UTOP HS
7002	TC # 1 Torque Limit – UBOT HS
7003	TC # 1 Torque Limit – VTOP HS
7004	TC # 1 Torque Limit – VBOT HS
7005	TC # 1 Torque Limit – WTOP HS
7006	TC # 1 Torque Limit – WBOT HS
7007	TC # 1 HL Voltage
7008	TC # 1 HL Current
7009	TC # 1 GND Leakage Current
7010	TC # 1 Blower Motor Current
7010	TC # 1 DC Link Current

Chapter 12

DOS & DON'TS

No.	Dos	Don'ts
1	Keep LEAD/TRAIL switch in LEAD position on working control console.	Do not Keep LEAD/TRAIL switch in LEAD position on non working control console.
2	Always keep TELM and RAPB toggle switches in Normal position Unless and Until required.	Do not keep TELM and RAPB toggle switches in ENABLE position Unless and Until required.
3	Make a habit to check the TM CUTOUT status on Computer Display Unit, while taking over charge.	Do not start Locomotive without ensuring the TM CUTOUT status on Computer Display Unit as per previous Driver Log Book entry.
4	Put OFF the ENG.RUN and GEN. Field switches in rear Locomotives, while working on MU operation.	Do not put ON the ENG. RUN and GEN. Field switches ON in rear Locomotive, while working on MU operation.
5	Apply Loco Brakes through Independent Brake Handle and ensure Brake Cylinder pressure 5kg/cm^2 to avoid Alerter Penalty Brake application while the Train is stabled condition.	Do not release Loco Brakes, while Loco is in stable condition to avoid Alerter penalty Brake application
6	While Cranking the Locomotive, advance the Governor Lay shaft gently to avoid Discharge of Batteries due to late cranking. If the Loco is not fitted with Governor Booster Pump Motor.	Do not Discharge Batteries excessively by repeated Cranking, if two or three attempts failed. Identify the fault or check and reset safety devices like OSTA/LLOB etc. if any of those is tripped or recheck the cranking procedure.
7	When the Engine speed increases for Compressor operation, Ensure the No Air leakages on Engine and Formation.	Do not Notch up beyond 5^{th} for MR pressure build up without load. Automatically Engine speed increases to TH 5 when MR pressure drops < 8 kg/B3cm^2.

No.	Dos	Don'ts
8	Press Alerter Reset button when the Alerter light is flashing or Audio bell is sounding to avoid penalty Brake application.	Do not Disable the Alerter system unless and until the system is malfunctioning.
9	While Re-cycling Computer Control Circuit Breaker, keep Reverser Handle at center, TH in Idle and Isolation switch in Isolate position.	Do not Re-cycle Computer Control Circuit Breaker when the Reverser is in a Direction, Isolation switch is in Run position and TH is in Notch 1-8 or DB mode.

DISPLAY MENU SCREENS AND PARAMETERS

MAIN MENU

MEDHA LOCO'S
DATA METERS
SELF TESTS
FAULT ARCHIVES
TM CUTOUT
RUNNING TOTALS
SETTINGS for functional modes
UNIT INFORMATION

METER MENU
Meter Menu is having 26 screens:

1. MOTORING
2. USER PROGRAMMABLE SCREENS-8 NO.
3. DYNAMIC BRAKE
4. DRIVER DATA
5. AUX. GEN.
6. STARTING SYSTEM
7. COOLING SYSTEM
8. TORQUE
9. TM VOLTAGES
10. TM SPEEDS
11. TM CURRENTS
12. TM TEMPERATURES
13. TM1 PARAMETERS
14. TM2 PARAMETERS
15. TM3 PARAMETERS

16. TM4 PARAMETERS
17. TM5 PARAMETERS
18. TM6 PARAMETERS
19. DIGITAL INPUTS
20. DIGITAL OUTPUTS
21. CREEP CONTROL
22. TI STATUS
23. DC LINK PARAMETERS
24. CCB 1 STATUS
25. CCB 2 STATUS
26. LOAD TEST SCREENS

SETTINGS

LOCK WHEEL DETECTION
AUTO CREEP CONTROL
BLENDED BRAKE
VCD MODE
DATE & TIME
LOCOMOTIVE NUMBER
LOCOMOTIVE TYPE
SHED NAME

TM CUTOUT

Individual TM CUTOUT is possible to cutout up to 5 Traction Motors.

BLENDED BRAKE

Blended brake provided on WDP4 Loco's only.

SELF TESTS

Self Tests Menu has AUTO TESTS and MANUAL TESTS. It can be performed only after entering a valid PASSWORD.

METER TEST

Meter Tests can be conducted for selected speed, selected Tractive effort and Braking Effort

Operator's Manual

AC-AC Traction System

Type MAS 696

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