OPERATION MANUAL FOR DRIVERS

MICROPROCESSOR BASED
AC – AC TRACTION SYSTEM
MAS 696

For WDG4/WDP4
Diesel Electric Locomotives

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1. INTRODUCTION

The Diesel Electric Locomotives of Indian Railways are implementing MAS 696 system, Designed and Developed by MEDHA SERVO DRIVES PVT LTD. These Locomotives are driven by AC Traction Motors, employ AC-DC-AC Power Transmission system. 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 consists of two independent and Interwoven sets of stator winding and rotor field common to both windings.

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

Rectified DC power supply is applied to DC LINK. When DCL switch gears close, the DC voltage applied to IGBT based Traction Inverters. Each Traction Inverter is having separate control module in the Traction Computer. The Traction Computer monitors Traction Motor speed, temperature, Voltage and Current feedbacks for controlling the IGBTs to maintain required Torques according to command received from the Locomotive Control Computer.

The Traction inverters are having main role to control the 3 phase induction motors. The Traction Inverters converts the DC power into 3 phase AC power of variable frequency using IGBT based technology. Six DC Link switch gears pass the DC power to the six Traction Inverters through its closing contacts with the help of DC Motor, controlled by Locomotive Control Computer (LCC).

The Traction Control cabinet consists of six Traction Computers, six DCL switch gears, six IGBT based Inverters, DC link Capacitors and Crow bar circuit. Based on
the Inputs received from Locomotive Computer and analogue feedbacks from Traction motors, the Traction computer converts the DC power into 3 phase AC power required to the traction motors. The 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 device that converts DC power into 3 phase AC power during motoring and 3 phase AC power in to 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 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 convert the Electrical power into Mechanical power to move Locomotive.

1.1. AUXILIARY GENERATOR:
The Auxiliary Generator is driven by the Diesel Engine gear train at three times of engine speed. Its field winding current is controlled by LCC through AG PWM module. AC power from Auxiliary Generator 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 Auxiliary Generator also supplies 74 volts DC power for Fuel Pump Motor, Turbo lube oil Pump circuits, Locomotive lighting and other miscellaneous equipments.

1.2. COMPANION ALTERNATOR:
The Companion Alternator is coupled directly to the Traction Alternator with in the Main Generator housing. The Companion Alternator physically connected to but Electrically independent of the Traction Alternator. Companion Alternator is having 16 field poles on the same rotor back of Main Generator Field poles. The rotating CA field poles receiving low voltage current from Auxiliary Generator through a pair of slip rings adjacent to the Main Alternator slip rings. CA produces 3 phase 45V - 230
VAC supplies to excite Main Alternator field through SCR Assembly and Power fed to the Radiator Fans 1&2, Inertial Blower motor, Traction Inverter Blowers.

1.3. ALERTER / VCD SYSTEM:
The Alerter indicator light mounts on the control console, below the indicator light panel. The Alerter reset push button mounts on the control console desktop surface. The Audible Alarm mounts on the ECC# 1 Engine control panel. ALERTER SYSTEM can be enabled/disabled through Display Unit menu selection. When Locomotive Brakes released the Alerter system requests an Acknowledgment from the operator time to time. If no Acknowledgment received within 60 seconds, the Locomotive control Computer drives a Digital Output DOP 43 ALT LT to flash the Alerter light for 17 seconds. After lapse of 17 seconds, it drives one more Digital Output DOP 44 ALT BEL to provide a Audio sound for 17 seconds. If still the Alerter request is not acknowledged, while the Alerter light is flashing or alerter alarm sounding, the alarm stops sounding and a penalty Brake is applied for 34 seconds or until Locomotives speed drops to zero which ever occurs later. Then the penalty brake application must be reset before normal operation of train can continue.

You 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 acknowledgment request timing cycle. Use Automatic Brake handle to moderately reduce the brake pipe pressure it also resets the timing cycle. In addition, movement of the Throttle Handle, Independent Brake handle or Dynamic Brake handle also will reset the timing cycle, as well as pressing the HORN or SAND button.

1.4. 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. 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 Locomotive may exceed the section speed limit. This in turn may cause for major accidents / loss / damage. To avoid this, Indian Railways incorporated a system is called "**Auto Emergency Brake System**" Which by default initiates Braking in the event of Train / Loco crossing the permissible set speed. The system developed by M/S Medha Servo Drives pvt Ltd. has the AEB feature implemented on WDG4 and WDP4 Locomotives. This feature can be enabled and disabled through switch on the ECC#1 ECP panel.

1.5. **BLENDED BRAKE SYSTEM:**
The MAS 696 system Locomotives are equipped with a blended brake system. It will simultaneously apply Dynamic Braking and Air Braking, when the driver operates the Automatic Air brake handle in the service zone. The KNORR CCB Air Brake system controls the Air brake on the Locomotives and cars coupled in train, and request some amount of Dynamic Braking from LCC for blended brake operation.

1.6. **MANUAL TE LIMITING:**
To avoid putting stresses on weak bridges when Locomotive is traversing them, a Manual TE Limiting option is developed to enable, the operator to limit the Tractive effort through switch mounted on Engine control panel. The position of the switch will indicate to Railroad personnel that the feature has been turned ON the switch will indicate that it is active. The tractive effort limit may be imposed by train line Input from another locomotive equipped with this feature via the TEL relay.

1.7. **AUTO FLASHER:**
The flasher lights will be applied automatically whenever Emergency / Penalty brake application taken place, as indicated by the 'Loss of PCS' through the PCR relay dropping by Computer Controlled Brake(CCB) system. The flasher can still be turned ON manually so that if the operator have an Emergency, that did not drop PCS.
2. GENERAL SAFETY PRECAUTIONS:

This manual provides guide lines 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, to keep control and operation 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 which are explained in short notes. This 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, contact M/S MEDHA's representative. 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 follow 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 the 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. A large capacitors located within each of Traction Inverter to filter Main Generator Voltage. These capacitors operate at the DC LINK Voltage between 600 to 3400 VDC. When the Locomotive shutdown, these capacitors could retain 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 or by other means to prevent the possibility of Injury.

1. Before shutdown the Locomotive, keep RUN/ ISOLATE switch in ISOLATE position and then shutdown the Locomotive. All 'BRAKING CONTACTORS'
will pickup and discharge the DC LINK capacitors through Grid resistors in one second. After 20 seconds all DC LINK switch gears driven to shorting position.

2. After shutdown of the Locomotive let the COMP. CONTROL and TURBO LUBE PUMP Circuit Breakers remain 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 within 35 minutes, Computer will not allow for cranking unless PRE-LUBRICATION 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 4th method to maintain the short.

1. REVERSER IN CENTER POSITION (BLEEDER RESISTORS):
   Each Traction Inverter has Bleeder Resistors (400 k ohms / 200W) across the DC LINK. When the locomotive operator moves the Reverser from Forward or Reverse to Centered, Main Generator Excitation stops. If no further action is taken, the Bleeder Resistors will discharge the DC LINK < 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 the external connection to the Capacitors could be interrupted.

2. ISOLATION SWITCH IN ISOLATE (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 loss 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.
Note: If the Braking Grids were shorted or grounded, or any one grid path open circuited, the grids would still discharge the DC LINK. Only if both grid paths were failed the DC link will not discharge by this method.

3. BRAKE CHOPPER AND HARD CROW BAR: When ever 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 MCC fires Hard Crowbar, at DCL V ≥ 3600 V Hardware Fires Hard Crowbar. Automatically recycling of DCL switch gear when DCL Voltage decays,

4. 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. Moves all the DC LINK switch gears to the open position causes all Traction Inverters to be shorted and grounded.

- When the Engine is shutdown (regardless of the Isolation switch position) the control computer will pickup all the Braking contactors, the DC link Voltage dissipate through grid resistors. Once the DC LINK capacitors are discharged, DCL contactor moves to open position.

3. STARTING THE ENGINE:-

The WDG 4 / WDP 4 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 will start. When the FP / ES switch is held in PRIME(left), The Locomotive computer will start 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 in IDLE, Reverser handle center, RUN/ ISOLATE Switch in ISOLATE position.
2. Ensure sufficient oil level of Compressor oil, Engine Lube Oil and Governor Oil.
3. Ensure 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 found ejected, press and hold it for 15 seconds immediately after Engine starts.

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

Engine should be Pre-Lubricated, If it has been shut down 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 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 1CB, 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 contactors.
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 other wise the MAIN MENU will be 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.

Note:

- 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 CUT OUT 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 or recheck cranking procedure.
- Ensure that MU Engine Stop button 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 Start and speed increases to Low Idle RPM 200. Do not crank more than 20 seconds.
**CAUTION**: To prevent over heating of starting Motors, which may damage them, do not allow Engine cranking 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 start, If the detector is not reset, The Engine will shuts down after a short time delay. If the detector trips press continuously for 15 seconds.

**Note:**
- 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 49° 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.
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 picked up, Governor DV solenoid energize and Fuel Rack comes to No Fuel position.
5. The Governor will also bring the fuel injectors to the NO FUEL position, if any of the following conditions 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.
6. After shutdown 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.

5. **ELECTRICAL CONTROL CABINET# 1,2,3:**

ECC# 1 located in the drivers cab. It houses equipments that controls and power to the Locomotive. 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 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 modified as 6 DCL contactors and shifted to TCC cabinet.
5. The DCL Contactors 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 provide 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 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 replaced with Power Supply modules located on the LCC Unit.
13. DC LINK current sensors modified as DCL 1A – DCL 6A and shifted to TCC cabinet.
14. ADB1, ADB2, ADB3, ADB4 and FDB added in the ECC# 1 cabinet to provide power to various sensors.

15. Communication between LCC to TCC is through Optical Fiber cables.

5.1. **DRIVER ACCESSIBLE PANELS**
1. Circuit Breaker Panel
2. Engine Control Panel
3. Ground Relay Cut out 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. Radiator Fan Motor Circuit Breakers in the ECC# 3

5.2. **ECC#1 Internal Equipment (Not Driver Accessible)**
1. Main Control Panel (Relays, Resistors etc.)
2. Locomotive Control Computer MLC 691.
3. ADB 1, 2, 3, 4 and FDB.
4. 4 Brake contactors (B1, B2, B3, B4)
5. Silicon Control Rectifier (SCR)

5.3. **ECC# 2 INTERNAL EQUIPMENT (Not Driver Accessible)**
1. BCA: Battery Charging Assembly.
2. ST & STA contactors.
3. TB 61A & TB 62 A.

5.4. **ECC# 3 INTERNAL EQUIPMENT (Not Driver Accessible)**
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)
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 will trip open when an over load occurs.

1. **LIGHTS Circuit Breaker:** This 30 A Circuit Breaker must be switched ON (live up) to power the switches that control Locomotive lights.

2. **HDLTS Breaker:** This 35 A Circuit Breaker provides power and protection to the cab end and hood end Head Light circuits.

3. **CAB FANS Circuit Breaker:** This 30 A Circuit Breaker provides power and Protection for Cab Air Circulating Fan motors and their control circuits.

4. **AIR DRYER Circuit Breaker:** This 15 A Circuit Breaker provides power and protection to the main Reservoir Air Filter Dryer and associated circuit.

5. **AC CONTROL Circuit Breaker:** This 15 A Circuit Breaker Provide CA Power supply to ZCD circuit, to detect zero crossing and control Excitation for Main Alternator.

6. **CONTROL Circuit Breaker:** This 40 A Circuit Breaker sets up the Fuel Pump and control circuits for engine starting. It supplies Battery Power through Battery Knife switch before an Engine start. Once the Engine is running the Auxiliary Generator Supplies Power through this breaker to main operating control.

7. **LOCAL CONTROL Circuit Breaker:** This 30 A 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 30 A 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 10 A 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 30 A circuit Breaker protects the Fuel Pump Motor Circuit.
11. **TURBO Circuit Breaker**: This 30 A 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. **TURBO Circuit Breaker**: This 30 A 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.

13. **COMPTR CONTROL Circuit Breaker**: This 15 A Circuit Breaker protects the Locomotive Control Computer operating power supply.

14. **MICRO AIR BRAKE Circuit Breaker**: This 15 A circuit breaker provides operating power to the KNORR Air Brake system and the Air Brake system cooling Fans.

15. **DCL 1 to 6 Circuit Breakers**: This 10 A circuit Breaker protects the DC LINK contactor Motor and control circuits.

16. A safety guard over the Breaker lever helps to prevent accidental operation. 6 Nos DCL Circuit Breakers are provided for individual DCL Motor control.

17. **TC 1 COMPTR TO TC 6 COMPTR Circuit Breakers**: This 10 A 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.

18. **GEN FIELD. Circuit Breaker**: This 90 A 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, The Traction Alternator, The Companion Alternator and other associated circuitry. If the TA field current over load occurs, the Breaker trips and the Locomotive Computer Displays the Message: “Main Gen. Field Circuit Breaker is tripped under load”
19. **TCC BLOWER1 to TCC BLOWER 6 Circuit Breakers:** This 30A Circuit Breaker protects the Traction Inverter Blower Motor and associated circuit.

20. **GROUND CUTOUT Switch:** This Toggle switch, When open, disconnect ground protection sensors (Ground leakage current sensors PGND MG, PGNDPI+VE, PGNDPI-VE, PGND G1, PGND G2, PGNDTI 1 to 6) from Locomotive electrical circuits for maintenance inspection or trouble shooting. When switch is open the LCC prevents TA excitation. This switch 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 personnels 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 (BP-BN)
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:** In 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 increases for compressor operation, Low Engine Temperature, Turbo cool down cycle.

   **RUN:** In this position Locomotive will respond to (Throttle handle setting changes) Digital Inputs from operator local or train lined and will develop POWER in normal operation.

2. **DYN BRAKE CUT IN / CUT OUT Switch:** This switch is having two positions CUT IN and CUT OUT. If this slide switch is set in cut out (slider down) the Locomotive will not operate in Dynamic Brake mode. The Locomotive will operate in Power with normal Air Braking and no other Loco's in tandem will not effect. 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 CUT OUT.

3. **BLENDEN BRAKE CUT IN / CUT OUT Switch:** When this slider switch is set in CUT OUT (slider down) position, Locomotive will not operate in Blended Brake mode when the operator moves the Automatic Brake Handle in to the service application zone. normal Air Brake applies on the Locomotive. However, dynamic braking is still available when the controller throttle/dynamic braking handle is moved in the Dynamic Braking Zone.

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 recognize the switch actuation as a proper shutdown request.

7. **BATTERY AMMETER:** This Analog Meter indicate 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 provided on Engine Control Panel to enable the AEB system.

11. **TELM SW:** Tractive Effort Limit switch 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.

3. 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.

4. **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.
5. **DYNAMIC BRAKE CONTROL CB:** This circuit breaker protects against a faulty operating or test setup. The circuit breaker 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 is ON or OFF.

6. **SPEEDOMETER:**
An analog Speedometer mounted on the Both control console Instrument panel. The Analog Speedometer receives analog signals from LCC, these resultant signal based on TM speed sensors speed signals. The speedometer scale is 0 to 120 kilometers per hour(km/h)
7. TRACTIVE EFFERT / DYNAMIC BRAKE EFFORT METER:
The TE/ BE meters Mounted on both control console instrument panel just right of Speedometer. This meter indicates sum of all active Traction Motors Torque. When Locomotive is not on Power mode or 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 the TE > 400 KN the yellow LED lights up with all Traction Motors are active. If any Traction Motor is cutout the LED light up range will be proportionate to the Active Traction Motors.
8. INDICATING LIGHTS PANEL:
These panels are mounted on both Control console just right of the instrument panel. It has six indicating lights that indicates operation of various Locomotive system.

![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 is working 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 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 are 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.

   **Note**: 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 Display 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.

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

   - Stop train and set throttle handle in IDLE.
   - 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 4 th point
     - No - go to 5 th point
   - Take appropriate action specified by Railways rules and regulations concerned Locked Wheel fault.
• WARNING: 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 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, outside Flasher lamps are connected through Lights Circuit Breaker. So that 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, 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 connected, is generating excessive Dynamic Braking current, regardless of tractive effort meter reading. If the light switch ON, act to make sure that it does not remain ON longer than few seconds.

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 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.

10. OPERATION SECTION:
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. PREPERATION 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 in to 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 ECC2
• 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.

Note: 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.

Note: 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 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 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.

  *Note*: 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.

• 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 COMP to TC 6 COMP. (ALL SIX BREAKERS)
     GEN. FIELD
     TCC BLW 1 to TCC BLW 6 (ALL SIX BREAKERS)

  b. The other Circuit Breaker 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.

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

• CONTROL CONSOLES: Set control console device as follows :
  1. CONTROL & FP switch, GEN.FLD. Switch, and ENG. RUN switch must be OFF (slider down)
     Note : This step presumes that electrical MU cables are previously installed.
  2. Set throttle in IDLE, center Reverser (neutral setting) and remove it to lock throttle handle in IDLE.
  3. Set light switches and other switches as required

• CONSOLE AIR BRAKE EQUIPMENT:
  1. Set Automatic Brake handle in RUN (Running)
  2. Set Independent Brake handle in REL (Release)
  3. Set Brake Controller LEAD / TRAIL cutout switch in TRAIL

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 in IDLE, Reverser handle center, RUN/ ISOLATE Switch in ISOLATE position .
  2. Ensure the sufficient oil level in Compressor oil, Engine sump Lube Oil and Governor Oil .
  3. Ensure the 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 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 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.

**Note:** Engine should be Pre-Lubricated, If it has been shut down 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 CUT OUT 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.
   **Note:** When starting Trailing Locomotive Diesel Engine, If its have jumper cable 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

6. Start and speed increases to Low Idle RPM 200. Do not crank more than 20 seconds.

7. In case the Low Lube Oil shutdown noticed immediately after cranking, check Low water Pressure detector (EPD) for trip. If the water pressure is less, the Engine will shuts down after a short time delay.

8. If the detector trips press continuously for 15 seconds to reset, after ensuring the water level and water pump working.

9. Check the following with the Engine running and at a normal operating temperature (49ºC) and correct if necessary.

10. Coolant Water level is near to the FULL (Engine running) mark limits on Water level Inspection plate.

11. Engine Lube oil level is near FULL mark on oil level gauge (Lube oil Dipstick)

12. Governor oil level near upper mark on sight glass.

13. Compressor Lube oil is within normal range.

14. After Engine has been started and is operating normally, check and ensure that all Engine room access doors are securely closed.

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

10.3. STARTING TRAILING LOCOMOTIVE DIESEL ENGINES:

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

Note: 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 will be controlled from the Lead Unit.
10.4. SETTING LOCOMOTIVES ON LINE:

**WARNING:** 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, 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.

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

10.6. HANDLING LIGHT LOCOMOTIVE:
After starting the Engine, Placed Locomotive on line, and preceding inspections and precautions completed 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.

Note: 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 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 apply 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 following procedure.

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 display the Message: "Engine speed Increases – Air compressor operation ". After getting sufficient MR pressure Engine speed come back to Idle. If the MR pressure falls < 8 kg cm2 , 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 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 CUT OUT**
  1. Set Independent Brake in FULL (Full application)
  2. Set Automatic Brake handle in service zone, and make a 1.4 kg/cm2 (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. 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 remain ON.

10. After completing the preceding steps, move to the cab of the new LEAD UNIT.

**ON END BEING CUT IN**

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 5.17kg/cm² (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 remain 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 to be held in until the Engine stops.
2. Press one of the Emergency Fuel Cut Off (EFCO) push button. One is located near each Fuel filler, on the side of the Locomotive Under frame. These push button operates 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, toward 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.

11. DISPLAY UNIT AND NAVIGATION THROUGH MENUS:
The Display unit is the main interface between the user and the Control System. It has an alphanumerical Key Board and a VFD through which it will interact with the user. It will get the information requested by the user from the Control system (Locomotive Control Computer) through the Serial Communication Interface and Display 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 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 high lighted and then "Enter" key.
11.1. LOCOMOTIVE CONTROL COMPUTER DISPLAY PANEL DETAILS

DISPLAY PANEL KEYPAD

The Locomotive control computer is equipped with Alphanumeric key board 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** display the Active crew messages if any. Only one crew message at a time will be displayed.
- **BRIGHT/DIM key** can 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** to enter driver name or identification.
- **TRAIN NO. Key** 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 to enter into the concerned screen, pass word, data entry by operator and selection etc.
- **ENTER key** to enter into modes, select screens, etc.
- **HELP key** 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 trouble shooting data.

The main menu is having two pages containing seven sub menus. These are Data Meter, Self Test, Fault Archive and TM cutout in the first page, 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. Then following screen will appear.

Enter Password

DELETE OK CANCEL

F1 F2 F3 F4

Enter the correct password and press F3 key to get SELF TEST MENU.
SELF TEST selected from Main Menu.
Self Test Page: 1

<table>
<thead>
<tr>
<th>SELF TESTS</th>
<th>Page : 1 / 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 1. Auto Tests</td>
<td></td>
</tr>
<tr>
<td>2. Computerized I/O Tests</td>
<td></td>
</tr>
<tr>
<td>3. Load Test</td>
<td></td>
</tr>
</tbody>
</table>

SELECT EXIT

F1 F2 F3 F4

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

AutoTest Page: 1

<table>
<thead>
<tr>
<th>AUTO TESTS</th>
<th>Page : 1 / 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 1. Air Brake Test</td>
<td></td>
</tr>
<tr>
<td>2. DCL Shorting test</td>
<td></td>
</tr>
<tr>
<td>3. Excitation/SCR’s Test</td>
<td></td>
</tr>
<tr>
<td>4. Wheel Slip Test</td>
<td></td>
</tr>
</tbody>
</table>

NEXT SELECT EXIT

F1 F2 F3 F4
### AUTO TESTS

<table>
<thead>
<tr>
<th>Page: 2 / 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 5. Contactor / Relay Test</td>
</tr>
<tr>
<td>6. Cooling Fan Test</td>
</tr>
<tr>
<td>7. Radar Test</td>
</tr>
<tr>
<td>8. Meter Test</td>
</tr>
</tbody>
</table>

- NEXT
- SELECT
- EXIT

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
</table>

### AUTO TESTS

<table>
<thead>
<tr>
<th>Page: 3 / 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. TCC Blower Test</td>
</tr>
</tbody>
</table>

- NEXT
- SELECT
- EXIT

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
</table>

### 11.4. TM CUT OUT:

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

**Note**: The Locomotive must be UNLOADED while attempting to CUT OUT / CUT IN 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 CUT OUT then press F3 key to select TRACTION STATUS.
TM CUT OUT on MAIN MENU

MAIN MENU
1. Data meters
2. Self Tests
3. Fault Archive
* 4. TM Cutout

NEXT SELECT EXIT
F1 F2 F3 F4

TM CUT OUT page No:1

TM CUT OUT
1. TM 1 CUT OUT
2. TM 2 CUT OUT
3. TM 3 CUT OUT

PREV NEXT SELECT EXIT
F1 F2 F3 F4

TM CUT OUT page No:2

TM CUT OUT
4. TM 1 CUT OUT
5. TM 2 CUT OUT
6. TM 3 CUT OUT

PREV SELECT EXIT
F1 F2 F3 F4

Keep cursor on the defective TM CUT OUT and press F3 key to select TM cut out status.
TM CUT OUT STATUS

CUT OUT designation is above F3 key, Press F3 key to cut out the defective TM. The following entry condition will Displayed on the screen.

TM CUT OUT test conditions
- Throttle Handle in IDLE position.
- Reverser Handle in centered
- Isolation switch to ISOLATE position.

After full fill all the entry conditions, Press F3 key to enter for password.

ENTER THE PASSWORD

1 2 3 4 5

TM # n status is CUT OUT
## 11.5. CREW MESSAGES LIST

<table>
<thead>
<tr>
<th>Code</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>2420</td>
<td>Air Brake circuit Breaker is not closed.</td>
</tr>
<tr>
<td>2975</td>
<td>Air Brake failure – Use Locomotive in TRAIL only.</td>
</tr>
<tr>
<td>2976</td>
<td>Air Brake Cutoff failure – Use Locomotive in LEAD-IN only.</td>
</tr>
<tr>
<td>2978</td>
<td>Air Brake Controller No.1 failure-switch to Air Brake Controller No.2.</td>
</tr>
<tr>
<td>2979</td>
<td>Air Brake Controller No.2 failure-switch to Air Brake Controller No.1.</td>
</tr>
<tr>
<td>2980</td>
<td>Air Brake failure-Check for proper LEAD/ TRAIL set up.</td>
</tr>
<tr>
<td>2983</td>
<td>Air Brake power interruption penalty-place handle in FS for 10 seconds.</td>
</tr>
<tr>
<td>2985</td>
<td>Air Bake Emergency – place handle in Emergency for 60 seconds.</td>
</tr>
<tr>
<td>2986</td>
<td>Air Brake penalty – place handle in Full Service for 10 seconds.</td>
</tr>
<tr>
<td>2987</td>
<td>To restore normal Air Brake operation place Automatic handle in running.</td>
</tr>
<tr>
<td>2493</td>
<td>Alerter or Vigilance system has made a penalty Brake application.</td>
</tr>
<tr>
<td>5037</td>
<td>AEB applied Brake–move MCH to Idle–press AEBRST switch to release Brake.</td>
</tr>
<tr>
<td>5090</td>
<td>ADB Power supply 1 failure.</td>
</tr>
<tr>
<td>5091</td>
<td>ADB Power supply 2 failure.</td>
</tr>
<tr>
<td>5092</td>
<td>ADB Power supply 3 failure.</td>
</tr>
<tr>
<td>5093</td>
<td>ADB Power supply 4 failure.</td>
</tr>
<tr>
<td>5094</td>
<td>FDB Power supply failure.</td>
</tr>
<tr>
<td>2060</td>
<td>B1 contactor failed to pickup.</td>
</tr>
<tr>
<td>2062</td>
<td>B2 contactor failed to pickup.</td>
</tr>
<tr>
<td>2051</td>
<td>B3 contactor failed to pickup.</td>
</tr>
<tr>
<td>2049</td>
<td>B4 contactor failed to pickup.</td>
</tr>
<tr>
<td>5109</td>
<td>Blended Brake Cutout.</td>
</tr>
<tr>
<td>2671</td>
<td>Coupled Locomotive detected-Tractive Effort limited.</td>
</tr>
<tr>
<td>3320</td>
<td>Cold Engine Throttle 2 limit.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 1 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 2 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 3 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 4 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 5 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>794</td>
<td>DCL 6 Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>Code</td>
<td>Message Text</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5095</td>
<td>Dynamic Brake Cutout.</td>
</tr>
<tr>
<td>14</td>
<td>Engine Air Filters are Dirty – Change out request power may limit to TH6.</td>
</tr>
<tr>
<td>66</td>
<td>Engine Dead – Locomotive is not Isolated.</td>
</tr>
<tr>
<td>67</td>
<td>Emergency Fuel Cutoff activated.</td>
</tr>
<tr>
<td>76</td>
<td>Engine speed Increases-Turbo Cool down cycle.</td>
</tr>
<tr>
<td>77</td>
<td>Engine speed Increases-Air Compressor operation.</td>
</tr>
<tr>
<td>341</td>
<td>Engine Speed increases – Traction Motor over Temperature.</td>
</tr>
<tr>
<td>716</td>
<td>Engine Dead while Loading.</td>
</tr>
<tr>
<td>937</td>
<td>Engine Dead with cold water.</td>
</tr>
<tr>
<td>994</td>
<td>Engine shutdown - Engine oil pressure.</td>
</tr>
<tr>
<td>1104</td>
<td>Engine speed Increases-High Aux. Generator Load.</td>
</tr>
<tr>
<td>1227</td>
<td>Engine will not start – Low Engine water level detected.</td>
</tr>
<tr>
<td>1056</td>
<td>Engine shutdown – Engine over speed.</td>
</tr>
<tr>
<td>3319</td>
<td>Engine shutdown – low water level.</td>
</tr>
<tr>
<td>5065</td>
<td>Engine speed Increases-Hot Engine.</td>
</tr>
<tr>
<td>93</td>
<td>Filter Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>96</td>
<td>Forced minimum Engine speed -Engine Run switch is down.</td>
</tr>
<tr>
<td>136</td>
<td>Forced minimum Engine speed -Locomotive is Isolated.</td>
</tr>
<tr>
<td>221</td>
<td>FP Relay failed to pickup.</td>
</tr>
<tr>
<td>296</td>
<td>Fuel Pump is not running-check FP Relay and Circuit Breaker.</td>
</tr>
<tr>
<td>352</td>
<td>FP Relay failed to drop out.</td>
</tr>
<tr>
<td>1672</td>
<td>Fuel Pump Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>5001</td>
<td>Filter Vacuum switch tripped.</td>
</tr>
<tr>
<td>5002</td>
<td>Fire Engine shutdown.</td>
</tr>
<tr>
<td>61</td>
<td>Ground Fault-Grid path 1</td>
</tr>
<tr>
<td>359</td>
<td>Ground Fault – Main Generator.</td>
</tr>
<tr>
<td>5040</td>
<td>Ground Fault- Grid Path 2.</td>
</tr>
<tr>
<td>5043</td>
<td>Ground Fault-Main Gen. Positive half side phase imbalance.</td>
</tr>
<tr>
<td>5045</td>
<td>Ground Fault-Main Gen. Negative half side phase imbalance.</td>
</tr>
<tr>
<td>1960</td>
<td>GFD Failed to pickup.</td>
</tr>
<tr>
<td>1961</td>
<td>GFD Failed to drop out.</td>
</tr>
<tr>
<td>1962</td>
<td>GFC Failed to pickup.</td>
</tr>
<tr>
<td>Code</td>
<td>Message Text</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1963</td>
<td>GFC Failed to drop out</td>
</tr>
<tr>
<td>53</td>
<td>Hot Engine Throttle 6 Limit</td>
</tr>
<tr>
<td>319</td>
<td>Hot Engine Throttle 6 Limit – Extended time</td>
</tr>
<tr>
<td>1031</td>
<td>Improper Train line Throttle request in Dynamic Brake.</td>
</tr>
<tr>
<td>15</td>
<td># 1 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>16</td>
<td># 2 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>17</td>
<td># 3 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>18</td>
<td># 4 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>19</td>
<td># 5 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>20</td>
<td># 6 Locked Wheel or Speed Sensor Fault – Stop Train &amp; Verify that Axle rotate.</td>
</tr>
<tr>
<td>792</td>
<td>Local control circuit Breaker is not closed / Battery Knife switch is open.</td>
</tr>
<tr>
<td>5047</td>
<td>Lead Unit Tractive Effort Limit</td>
</tr>
<tr>
<td>1069</td>
<td>MRPT Failed – Forced Air Compressor operation Loading.</td>
</tr>
<tr>
<td>1673</td>
<td>No Start – Fuel Pump is not running.</td>
</tr>
<tr>
<td>223</td>
<td>No Start -Control Circuit Breaker or Control/ Fuel pump switch is down.</td>
</tr>
<tr>
<td>135</td>
<td>No Start-Locomotive is not Isolated.</td>
</tr>
<tr>
<td>5003</td>
<td>No Start-Fire shutdown.</td>
</tr>
<tr>
<td>5066</td>
<td>No Start – Low Lube Oil pressure.</td>
</tr>
<tr>
<td>5117</td>
<td>No Start – Starter Motors are abutment</td>
</tr>
<tr>
<td>1081</td>
<td>No Engine Start-Turbo pump not running Run pump for 15 minutes.</td>
</tr>
<tr>
<td>125</td>
<td>No Load – Locomotive is Isolated</td>
</tr>
<tr>
<td>179</td>
<td>No Load – Improper GFC contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>192</td>
<td>No Load – Improper B 3 contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>193</td>
<td>No Load – Improper B 1 contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>1815</td>
<td>No Load – Improper B 2 contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>616</td>
<td>No Load – Improper B 4 contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>Code</td>
<td>Message Text</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>200</td>
<td>No Load – Improper GFD contactor status -Cycle Computer Control CB.</td>
</tr>
<tr>
<td>220</td>
<td>No Load – Fuel pump is not running.</td>
</tr>
<tr>
<td>602</td>
<td>Reduced Load – TCC 1 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>602</td>
<td>Reduced Load – TCC 2 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>602</td>
<td>Reduced Load – TCC 3 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>603</td>
<td>Reduced Load – TCC 4 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>603</td>
<td>Reduced Load – TCC 5 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>603</td>
<td>Reduced Load – TCC 6 Blower Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 1 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 2 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 3 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 4 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 5 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>617</td>
<td>No Load – Improper DCL 6 Status-Cycle Computer Control CB.</td>
</tr>
<tr>
<td>986</td>
<td>No Governor Boost – Improper Relay Status.</td>
</tr>
<tr>
<td>2616</td>
<td>No Aux Power – Control Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>2354</td>
<td>No Lubrication allowed Turbo Lube Pump Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>2495</td>
<td>No Power – Locomotive speed too high bring MCH to Idle.</td>
</tr>
<tr>
<td>3315</td>
<td>No Dynamic Brake – DB Circuit Breaker is not closed.</td>
</tr>
<tr>
<td>2654</td>
<td>Reduced Dynamic Brake / Load Test – No Grid Blower 1 current imbalance.</td>
</tr>
<tr>
<td>2655</td>
<td>Reduced Dynamic Brake / Load Test – No Grid Blower 2 current imbalance.</td>
</tr>
<tr>
<td>2656</td>
<td>Reduced Dynamic Brake / Load Test – High Grid Blower 1 current imbalance.</td>
</tr>
<tr>
<td>2657</td>
<td>Reduced Dynamic Brake / Load Test – High Grid Blower 2 current imbalance.</td>
</tr>
<tr>
<td>2660</td>
<td>Reduced Dynamic Brake / Load Test – Grid Blower 1 current imbalance.</td>
</tr>
<tr>
<td>2661</td>
<td>Reduced Dynamic Brake / Load Test – Grid Blower 2 current imbalance.</td>
</tr>
<tr>
<td>5120</td>
<td>Radiator Fan # 1 Fault – Limited Cooling available.</td>
</tr>
<tr>
<td>Code</td>
<td>Message Text</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>5121</td>
<td>Radiator Fan # 2 Fault – Limited Cooling available.</td>
</tr>
<tr>
<td>7000</td>
<td>TC # 1 Torque Limit – DCL capacitor Temperature sensor faulty.</td>
</tr>
<tr>
<td>7001</td>
<td>TC # 1 Torque Limit – UTOP HS</td>
</tr>
<tr>
<td>7002</td>
<td>TC # 1 Torque Limit – UBOT HS</td>
</tr>
<tr>
<td>7003</td>
<td>TC # 1 Torque Limit – VTOP HS</td>
</tr>
<tr>
<td>7004</td>
<td>TC # 1 Torque Limit – VBOT HS</td>
</tr>
<tr>
<td>7005</td>
<td>TC # 1 Torque Limit – WTOP HS</td>
</tr>
<tr>
<td>7006</td>
<td>TC # 1 Torque Limit – WBOT HS</td>
</tr>
<tr>
<td>7007</td>
<td>TC # 1 HL Voltage</td>
</tr>
<tr>
<td>7008</td>
<td>TC # 1 HL Current</td>
</tr>
<tr>
<td>7009</td>
<td>TC # 1 GND Leakage Current</td>
</tr>
<tr>
<td>7010</td>
<td>TC # 1 Blower Motor Current</td>
</tr>
<tr>
<td>7011</td>
<td>TC # 1 DC Link Current</td>
</tr>
</tbody>
</table>
## 12. DO'S and DONT'S

<table>
<thead>
<tr>
<th>No</th>
<th>DO's</th>
<th>DONT's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Keep LEAD / TRAIL switch in LEAD position on working control console.</td>
<td>Do not Keep LEAD / TRAIL switch in LEAD position on non working control console</td>
</tr>
<tr>
<td>2.</td>
<td>Keep always TELM and RAPB toggle switches in Normal position Unless and until required.</td>
<td>Do not keep TELM and RAPB toggle switches in ENABLE position Unless and until required.</td>
</tr>
<tr>
<td>3.</td>
<td>Make a habit to check the TM CUTOUT status on Computer Display Unit, while taking over charge.</td>
<td>Do not start Locomotive without ensuring the TM CUTOUT status on Computer Display Unit as per previous Driver Log Book entry.</td>
</tr>
<tr>
<td>4.</td>
<td>Put OFF the ENG.RUN and GEN. Field switches in rear Locomotives, while working on MU operation.</td>
<td>Do not put ON the ENG. RUN and GEN. Field switches ON in rear Locomotive, while working on MU operation.</td>
</tr>
<tr>
<td>5.</td>
<td>Apply Loco Brakes through Independent Brake Handle and ensure Brake Cylinder pressure 5kg/cm² to avoid Alerter Penalty Brake application while the Train is stabled condition.</td>
<td>Do not release Loco Brakes, while Loco is stabled condition to avoid Alerter penalty Brake application</td>
</tr>
<tr>
<td>6.</td>
<td>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.</td>
<td>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 tripped or recheck cranking procedure.</td>
</tr>
<tr>
<td>7.</td>
<td>When the Engine speed increases for Compressor operation, Ensure the No Air leakages on Engine and Formation.</td>
<td>Do not Notch up beyond 5th for MR pressure build up without load. Automatically Engine speed increase to TH 5 when MR pressure drops &lt; 8 kg/cm².</td>
</tr>
<tr>
<td>No</td>
<td>DO's</td>
<td>DONT's</td>
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<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
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<tr>
<td>8.</td>
<td>Press Alerter Reset button when the Alerter light is flashing or</td>
<td>Do not Disable the Alerter system unless and until the system is</td>
</tr>
<tr>
<td></td>
<td>Audio bell is sounding to avoid penalty Brake application.</td>
<td>malfunctioning.</td>
</tr>
<tr>
<td>9.</td>
<td>While Re-cycling Computer Control Circuit Breaker keep Reverser</td>
<td>Do not Re-cycle Computer Control Circuit Breaker When the Reverser in a</td>
</tr>
<tr>
<td></td>
<td>Handle center, TH Idle, Isolation switch in Isolate position</td>
<td>Direction, Isolation switch in Run position and TH in Notch 1-8 or DB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mode.</td>
</tr>
</tbody>
</table>

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