Hand Book
On
Dual Cab (WDP4D) Locomotives
(Siemens Make Traction System)
The Handbook of Dual Cab (Siemens make traction system) has been prepared by CAMTECH for loco running as well as Diesel shed maintenance staff.

The failure of Dual cab locomotive has a great impact on the reliability of the diesel locomotives. Due to various modifications and alterations, in existing WDP4 Locomotive there is only one driver cabin has now being upgraded to Dual cab (WDP4D) Locomotive with some additional features.

I hope that this Handbook will definitely enhance the knowledge of concerned staff to do faster restoration of troubles pertaining to Dual cab (WDP4D) Locomotive while working on line.

February-2019

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Executive Director
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PREFACE

Dual cab (WDP4D) Siemens Locomotive is the vital part of diesel electric locomotives. Existing WDP4 Locomotive has now been upgraded to Dual cab (WDP4D) Locomotive with additional features. Knowledge of new Dual cab (WDP4D) Locomotive is necessary to running/maintenance staff to ensure reliability and availability of locomotives in sheds as well as on line.

The purpose of this book is to enhance knowledge and competence of loco pilots in dealing with the problems of Dual cab (WDP4D) Locomotive.

This book will be useful to the maintenance staff and loco inspectors also for counseling running staff about Dual cab (WDP4D) Locomotive.

It is clarified that this Hand book does not supersede any existing procedures and practices laid down in the maintenance instructions issued by manufacturers or by RDSO/LKO.

We welcome any suggestions from our readers for further improvement.

FEB, 2019

Place: CAMTECH/GWL

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GENERAL

The WDP4D dual cab locomotive is equipped with a turbocharged 16-cylinder 2-stroke 710 G3B diesel engine. This engine has high fuel efficiency and requires low maintenance. The fuel efficiency of this locomotive is better than the existing locomotives. This engine has many modern features like, laser hardened cylinder liners, unit fuel injectors which eliminate the problematic HP tube, Inconel valves, hydraulic valve adjuster, durable crankcase and piston structure. The diesel engine drives the main alternator.

Feature of dual cab has sufficiently improved the visibility for crew. The length of locomotive is 23002 mm over buffer to buffer whereas, length of both cab is not same. The CAB-1 & CAB-2 length are 2377 and 2232 mm respectively. This locomotive has been designed to run up to maximum operating speed of 140 Km/h on BG routes of Indian Railways for passenger service. The tractive effort limiting switch has been provided in the driver cab of the locomotive & may be operated by the crew at the time of requirement.

- **Traction & Companion Alternator (TA 17):** The main alternator TA17 is a 3-phase, 10 pole, 90 slots machine equipped with two independent and interwoven sets of stator winding. The main alternator construction is such that there are basically two alternators in one - two sets of stator windings, permanently connected in series, work with a rotating field common to both the windings in order to provide higher alternator output voltage, which is a basic requirement of a low current high voltage alternator used on AC-AC locomotives. The main alternator converts the mechanical power of diesel engine into 3-Phase Electrical Power alternating current. The internal rectifier bank of the main alternator converts 3 Phase AC Power into DC Power (alternating current into direct current) there by providing a DC power output. The DC voltage output from the main alternator is called the DC link voltage and is applied to the traction inverters. DC link voltage varies with the throttle position from 600 V DC at Throttle - 1 to 2600 V DC at Throttle - 8. The inverter changes DC power into variable frequency variable voltage 3 phase AC power for traction requirement as per the feedback control signals received from LCC & TCC. WDG4D locomotive is provided with self load test feature, capable of testing full output of the engine. There are three variants of traction alternator in this locomotive i.e M/s EMD, M/s BHEL and M/s Yongji at present.

- **Companion alternator (CA 6B):** This is a three phase AC steady state alternator of 250 kVA rating, which is physically connected but electrically independent of the main alternator. The companion alternator rotorfield is excited directly by auxiliary supply of the locomotive (74+ 4 V DC). It receives the excitation current from the auxiliary alternator through a pair of slip rings which are located adjacent to the slip rings of the main alternator. The companion alternator develops power whenever the diesel engine is running. The output voltage is directly proportional to the speed of rotation but varies to some extent with change in alternator temperature and load. It is used for excitation of the main alternator as well as for supply to Inertial (dustbin) blower, TCC1 and TCC2 blower motor, TCC electronic blower, 55-220V AC for radiator fans and various control circuits. An AC auxiliary alternator of 18 kW rating is used for meeting the auxiliary and control system load.
- **Traction Alternator Blower:** The Main Alternator Blower and traction motor blower share a common housing mounted on the front side of the auxiliary generator. Although both the blowers are mounted on the auxiliary generator shaft an internal partition separates the two blower portions. Air is drawn from the central air compartment into the alternator blower close to the auxiliary generator and passes through a duct to the main alternator air box. Air from alternator blower first cools the main alternator rectifier banks then passes internally through the alternator and companion alternator to the engine room. This creates a slight positive pressure to keep the dirt from entering the engine room.

- **Traction Motor.** The traction motor is a three phase, asynchronous type 4 poles force cooled electrical machine. Its stator winding is star connected. The motor converts electrical power into mechanical power to the shaft. It has very simple & extremely rugged, almost unbreakable construction i.e. squirrel cage rotor. Use of AC traction motor in AC-AC transmission has the advantage of high adhesion and high tractive effort, maintenance free, high reliability & availability and higher energy efficiency. In dynamic braking mode, the three-phase motors act as generators and power is fed back to the DC link via the two inverters and gets dissipated in BDR grids. There are five variants of traction motor in this locomotive i.e M/s Siemens, M/s EMD, M/s Yongji, M/s Medha & M/s BHEL at present. The technical details are incorporated in RDSO specification no. MP.0.2400.52 (Rev.02) July’2013.

- **Traction Motor Blower** It mounted on the auxiliary generator, supplies air for traction motor cooling, generator pit aspirator operation, main electrical cabinet pressurization and traction computer cooling. Air is drawn through a movable inlet guide vane through the blower, and delivered into a duct to the traction motors. A portion of this air is diverted through a set of filters for delivery to the computer module portion of traction inverter cabinets for module cooling. Another set of filters cleans the air used to pressurize the main electrical cabinet.

- **Dynamic Brake Grid Blower:** Each unit of the Dynamic Brake Grid Blower Assembly consists of fan assembly powered by a 36 HP series wound DC motor. During dynamic braking, a portion of the current (rectified DC) from the traction motors is shunted around one of the resistor grids and used to power the grid blower motor. Air driven by the grid blower drives grid heat to atmosphere.

- **Inertial / Dustbin Blower** Outside air is cleaned by Inertial (dustbin) blower, before it enters central air cabinet. In the Inertial blower there are two inertial filter panels, one mounted on either side of the locomotive. Outside air is drawn rapidly through the tubes which contains specially designed vanes that induce a spinning motion to the contaminated incoming air. Dirt and dust particles, because they are heavier than air are thrown to the outer wall of the tube and carried to the bleed duct where it is removed by the scavenging action of the Inertial blower and expelled through the roof of the locomotive. The resulting clean air continues on through the smaller diameter portion of the tube where the air is again caused to swirl by internal vanes. The particles are carried to the bleed duct and the resulting clean air enters the central air compartment.

- **Radiator Cooling Fan Motors** Radiator Cooling Fan Motors are of the inverted squirrel cage induction motor type and are integral part of the cooling fan assembly. Each cooling fan (total two per locomotive) is driven by a two-speed AC motor, which in turn is powered by the companion alternator. Cooling fans are powered through contactors, which are controlled by the locomotive control system. Each fan motor circuit consists of one slow-speed and two fast-speed contactors that are located in the AC cabinet.
AC –AC TRANSMISSION SYSTEM M: Siemens AC-AC traction/transmission systems, the locomotive has two traction inverters TCC1 and TCC2 (one inverter per 3 traction motors of a bogie) traction motor. The output of inverters (pulse width modulated PWM output voltage) is responsible for providing the variable frequency and the variable terminal voltage for the three phase motors. The main alternator feeds electrical power to the DC link via two series connected diode rectifiers. The TCC blowers diffuse heat produced by losses generated in TCCs. The WDP4D locomotive is equipped with a microprocessor based computer control system. It provides fault detection of components and systems, it contains 'self tests' to aid in trouble shooting locomotive faults. It has basic features like, significant reduction in number of control modules, better fault detection of components, memory archive and data snap shot. This system is equipped with a diagnostic display system in the cab to provide an interface between the maintenance personnel and the computer. The computer is programmed to monitor and control locomotive traction power, record and indicate faults that have been incorporated in control system. One of the special features of the locomotive is that, it is provided with event recorder, which downloads various parameters in control system for later use.

2. Major Assemblies of Dual Cab (WDP4D) Locomotive (Siemens)

2.1 Electrical Control Cabinet -1:-
Function of Electrical Control Cabinet (ECC1):

- To equip power and control switchgear for various Locomotive functions.
- To monitor the function of all Locomotive components.
- To provide feedback and reference signal for various Loco function.
- To provide crew message to each fault for corrective action.
- To provide warning signals and directions for loco functioning.
- To store fault archive for fault analysis and corrective action.

2.1.1 Components of ECC 1:

2.1.1 (A) Circuit Breaker Panel: It is located at the rear Top Leftmost Door Cover of ECC1 (upper portion). The circuit breaker panel consists of circuit breakers and switches used in the control and protection of diesel engine and electrical systems. The circuit breakers can be operated as switches but will trip open when an overload or short circuit occurs.
The circuit breaker portion of the panel is divided into sections. Breakers in the shaded section must be CLOSED (lever up) during locomotive operation. Breakers in the unshaded section can be used as and when required.

- **Lights Circuit Breaker**: The double pole 30A circuit breaker provides power and protection to the switch controlled lights, including the maintenance lights, cab lights, exterior lights, flashers, classification lights and gauge lights.
- **Circuit Breaker - Head Lights**: The 35A circuit breaker provides power and protection to the front and rear headlight circuits.
- **Circuit Breaker – Radio**: The 15A circuit breaker is installed between the radio base and the locomotive battery. It protects the radio communication equipment.
- **Circuit Breaker – Event recorder**: The 15A circuit breaker provides power and protection to the event recorder circuit.
- **Circuit Breaker – Cab Fans**: The 15A circuit breaker provides power and protection to the cab fans and its control circuit.
- **Circuit Breaker – Air Dryer**: The 15A circuit breaker provides protection for the Air Dryer System.
- **Circuit Breaker – Governor Booster Pump**: The 30A circuit breaker provides power and protection for the Governor Booster Pump.
- **Circuit Breaker – Control**: The 40A circuit breaker sets up the fuel pump and control circuits used for engine starting. The control circuits are fed from battery through the battery knife switch, before an engine start. Once the engine is running, the auxiliary generator supplies power through this breaker to maintain operating control. A set of auxiliary contacts of the breaker is connected to DI-1 input channel 2 (CNTL CB) of the SIBAS KLIP module.
- **Circuit Breaker – Local Control**: The 30A circuit breaker establishes “local” control with power from the locomotive battery to operate heavy duty switchgear, magnetic valves, contactors, governor solenoids and wheel flange lube system. A set of contacts belonging to the local control circuit breaker is connected to DI-6 input channel 5 (LCBAT) of the SIBAS KLIP module.
- **Circuit Breaker – SCR Module**: The 10A circuit breaker provides power and protection to Main Generator Field Excitation Controller (GRAU SCR assembly).
- **Circuit Breaker – Filter Blower Motor**: The 30A circuit breaker protects the inertial filter blower motor circuit. The blower is used to evacuate dirt laden air from the central air compartment of inertial filters. Auxiliary contacts of this circuit breaker is connected to DI - input channel 3 (FLBWC) of the SIBAS Klip input module. If this breaker trips open or is inadvertently left in the OFF position, then a “FILTER BLOWER MOTOR CB OPEN” message will appear on the display.
- **Circuit Breaker – Aux. Generator Field This 10A circuit breaker feed power and protects the auxiliary generator field regulator ERG 02 module. A trip coil, part of CB assembly may be energized by OVR –over voltage relay, if an over voltage condition is detected. If the breaker is tripped, then auxiliary generator field is de-energized. A set of contacts belonging to the Aux.Gen field circuit breaker is connected to DI-5 input channel 9 (AGENTON) of the SIBAS KLIP module which indicates the circuit breaker is closed and Aux.gen is delivering the required output voltage.
- **Circuit Breaker – Fuel Pump**: This 30A circuit breaker protects the fuel pump motor circuit.
- **Circuit Breaker – TCC PS**: This 30A circuit breaker provides power (74VDC) and protection to traction control computer and associated circuits. This circuit breaker has
a contact which gives power to the contact of the TCC1 Blower CB. A protection cover is used over this circuit breaker to avoid inadvertent actuation.

- **Circuit Breaker – Micro Air Brake**: This 15A breaker provides in series with the Micro Air Brake Circuit Breaker in CAB 1 i.e. on ECC1 provides power from the locomotive battery to the Knorr Air Brake computer relay unit/voltage conditioning unit. A set of contacts belonging to the Micro air brake circuit breaker is connected to DI-6 input channel 6 (MAB) of the SIBAS KLIP module.

- **Circuit Breaker – Turbo**: This 30A circuit breaker provides power and protection to the turbo lube pump motor. It must be in ON position (lever up) before diesel engine start for pre-lube and after diesel engine shutdown (to remove residual heat from the turbo bearings). If the diesel engine is running and this circuit breaker is OFF (lever down), then a “TURBO CIRCUIT BREAKER OPEN” message will appear on the display. A protection cover is used over this circuit breaker to avoid inadvertent tripping.

- **Circuit Breaker – Computer Control**: This 65A circuit breaker in series with the Computer Control CB in Cab 1 is in series to the Computer Control Circuit Breaker in Cab 2 which provides power and protection to Power Regulator PRG 01 and MCB relay coil.

- **Circuit Breaker – DISP**: This 6A circuit breaker provides power and protection to Display Unit.

- **Circuit Breaker – PS 05**: This 6A circuit breaker provides power and protection to PRG 05 responsible for providing +24V DC power supply to SIBAS Klips.

- **Circuit Breaker – PS 04**: This 10A circuit breaker provides power and protection to PRG 04, which supplies +/-15V DC to RADAR system through TB RA.

### 2.1.1(B) Test Panel & Circuit Breaker Panel of ECC1:

Located at the rear of Top Leftmost Door Cover of ECC1 (lower portion) this panel consists of Circuit Breakers as well as the test points for service personnel during Loco operation and maintenance.

**Test Panel**

1. Main Generator Field voltage (DC)
2. Companion alternator voltage (Max 230VAC)
3. Load regulator voltage (DC)
4. Battery voltage (DC)

**Circuit Breaker Panel:** It consists of circuit breakers used in the control and protection of Gen. field supply and TCC blower motor supply systems. The circuit breakers operate as switches but trip open when an overload or short circuit occurs in the system. It consists of the following components:

- **Circuit Breaker - Generator Field**: The companion alternator provides the excitation current to the main generator field winding through the GRAU assembly (MG field
excitation controller). This 90A circuit Breaker is in parallel to the GF CB in the ECC1 panel. When the both GF CB are in ON condition the locomotive is in No Load condition.

- **Circuit Breaker – TCC #1 Blower** This circuit breaker is used to protect the Traction Control Converter (TCC) Cabinet #1 blower motor. The circuit breaker has an auxiliary contact giving feedback about the state of the CB to SIBAS through DI 1 input channel 4 (TC1BKR) of the SIBAS Klip module.

- **Circuit Breaker – TCC #2 Blower** This circuit breaker is used to protect the Traction Control Converter (TCC) Cabinet #2 blower motor. A set of contacts belonging to the TCC blower2 circuit breaker is connected to DI-1 input channel 5 (TCC2BKR) of the SIBAS KLIP module.

- **GRNTOC Switch** This double pole toggle switch disconnects the ground protection from the locomotive high voltage electrical circuits for maintenance inspections or troubleshooting. When the switch in ECC1 and ECC4 are in ON position then only LCC receives an ON command. This switch is normally locked in the closed (lever up) position by a pin which is safety wired to a switch guard bracket. In this position, the Ground Fault Protection System is armed.

2. **1.2 Engine Control Panel of ECC1: - On Front Top Right Door of ECC1.** ECP panel consists of various switches and indicating meters related to various critical Loco functions.
- **Isolation Switch SW:** The rotary type switch can be used to isolate the locomotive from other units in formation and has two operating positions - RUN and START/STOP/ISOLATE.

- **RUN Position:** This position puts the locomotive on line after an engine start- the unit will load and respond to throttle control in a normal manner. RUN is in series i.e. for RUN command both the switch has to be in RUN.

- **START/STOP/ISOLATE Position:** The isolation switch must be in this position to start the diesel engine. The engine starting switch (FP/ES) is cut out unless the isolation switch is in START/STOP/ISOLATE. This position also isolates the locomotive, therefore, the unit will not develop power – the diesel engine runs at idle speed in all throttle positions. Isolate position is in parallel to the switch in ECC1 i.e the locomotive can be isolated from either cab.

- **Fuel Prime/Engine Start Switch:** This spring loaded switch has three positions; OFF (switch not activated, centre position), PRIME (switch turned to the left) and START (switch turned to the right).
  - **OFF Position:** No fuel priming or engine starting is requested. Normal position with the engine running or not.
  - **PRIME Position:** When the switch is held in the PRIME position, it turns on DI-2 input channel 7 (PRIME). If conditions for priming are satisfied, the computer picks up the fuel pump relay FPR (fuel pump motor starts to run) and the turbo lube pump relay TLPR (turbo lube pump will run for 35 minutes).
  - **START Position:** When the switch is held in the start position, it turns on the DI-1 input channel 1(START) and the DI2 input channel 7 (PRIME). Another switch contact closes also to prepare the path for the STA contactor pick up. In reaction to the starting request, the computer energizes STA contactor coil (which engages the starting process) and the governor booster pump relay GBC (GB pump turns ON and adjusts the fuel injector racks for adequate supply of fuel and air). The Locomotive can be Started from either Cab.

- **Switch SW EFCO/STOP:** This switch is used to stop the diesel engine when pressed. When the push button is pressed for approx 1 sec, the computer recognizes the activation of the switch and stops the diesel engine. It is not necessary to press the button continuously for engine stop. The push button has the facility of locking so that Engine cranking is restricted in case of any maintenance work in process. The locomotive can be put to shutdown from any cab.
- **BL KEY**: It consists of 10 contacts, open in “OFF” position and closed simultaneously by the operation of the BL key to “ON” Position.

- **Switch Classification Lights SW CLASS LTS**: This switch is used for turning on the classification lights of the Loco. It has 3 positions, Long Hood Forward, Cab End Forward and OFF. The functions are:
  - **Long Hood Forward**: Illuminates the classification lights of the Long Hood End (White LEDs at Long Hood end and Red LEDs at Cab end).
  - **Cab End Forward**: Illuminates the classification lights of the Cab End (White LEDs at Cab end and Red LEDs at Long Hood end).
  - **OFF**: Turns off the classification lights.

- **Switch DBCO (Dynamic Braking Cut off Switch)**: This switch when put in CUT OUT position will not enable the Loco to operate in dynamic braking mode. The Loco shall operate with normal air brake and power mode. This switch can also be used to limit the number of Locos in consist for Dynamic Braking or to isolate the Loco with defective dynamic braking while enabling it to work in power mode. This switch is usually sealed with safety wire to avoid inadvertent dynamic braking to be CUT IN.
- **Blended Brake (SW BLND BRK):** This switch when put in CUT IN position will enable the Loco to perform blended braking. The blended brake uses both dynamic brake and Pneumatic brake and the extent of braking is decided according the Automatic brake handle position. This switch is usually sealed with safety wire to avoid inadvertent dynamic braking to be CUT IN.

- **VCD BYPASS SWITCH:** This switch when put in CUT OUT position will disable the Vigilance Control Device operation. This switch is usually sealed with safety wire to avoid inadvertent isolation of VCD function.

- **Switch Exterior Lights (SW EXT LTS):** This slide switch is used to have ON/OFF control of the lights in long hood and the fuelling areas on the left and right side of the Loco. When the switch is in ON position, all these lights are turned on. However, for this to happen the battery knife switch should be closed and the LIGHTS CB should be turned ON.
- **Switch Maintenance Lights (SW MAINT LTS):** This slide switch is used to have ON/OFF control of the lights in the engine room, behind ECC 1 and the inertial filter compartment of the Loco. When the switch is in ON position, all these lights are turned on. However, for this to happen the battery knife switch should be closed and the LIGHTS CB should be turned ON.

- **Ammeter Battery Charger AMM BC:** This Battery charger Ammeter indicates the battery charging current and also indicates the battery load current when battery charger was not in operation commonly known as discharging current.

- **Alerter Alarm AR:** This alarm is used as an audio aid to alert the Loco operator as part of alerter function. The alerter alarm sounds simultaneously in both the cabs.

- **Tractive Effort Limit Switch & RAPB Switch:** These switches are used to select the Tractive Effort Limit and Repatriation Brake (Auto Emergency Brake) functions.
2.1.3 Main Control Panel of ECC1
This panel controls the critical Loco operations. It consists of various components viz relays, rectifiers, resistors, connectors etc required for various locomotive operation. These components are located on the back wall of the ECC1. The detailed functions of these components are described below:
- **Resistor Asm – RE GNL**: This resistance assembly consists of 3 resistors- REGNLA, REGNLB, and REGNLC. These resistors are connected to each phase of the output of main generator left half and CR GNL (1, 2 &3). These resistors are required to limit the current to the phase imbalance detection circuit.

- **Resistor Asm – RE GNR**: This resistance assembly consists of 3 resistors, RE GNR A, RE GNR B, RE GNR C. These resistors are connected to each of the output phases of main generator right half and the CR GNR (1, 2 &3). These resistors are required to limit the current to the phase imbalance detection circuit.

- **Rectifier CR GNR1, GNR2, GNR3, GNL1, GNL2, GNL3**
  - **GNR1, GNR2, GNR3**: These are used in the generator imbalance detection circuit for right half side facing M.G. These rectifiers are used to prevent the AC voltage from the main generator from being fed to the positive DC generator output bus bar.
  - **GNL 1, 2, 3**: These are used in the generator imbalance detection circuit for left half side facing M.G. These rectifiers are used to prevent the AC voltage from the main generator from being fed to the negative DC generator output bus bar.
Current Transducer IG1 & IG2: These transducers measure the current through them from the generator halves. The PRG 06 provides the ±15 V DC for the transducer operation. These transducers are connected to the Analog input module L135 at SIBAS through X-plug. The SIBAS uses this information for phase imbalance detection.

Generator Field Decay relay GFDR: The GFDR relay controls the making and breaking of GFD contactor. Under normal operating condition GFDR will be in pick up state making GFD contactor closed. When SIBAS detects a fault, it de-energizes the GFDR relay coil causing the GFD contactor to open. Resistor RE2 is in series with the generator field discharge circuit, thereby increasing the field decay rate.

Dryer Control Relay DCR: The DCR relay controls the air filter/dryer to regenerate the air only when the Loco is in motoring/dynamic mode or when the Loco at consist formation and air compressor is pumping. This relay is controlled by SIBAS through DO-2 channel 10.

Radar Test Relay RDRTST: If RADAR receives less than 14.5V DC from PRG 04 power supply, the unit encounters a fault message “Radar is moving or Radar is vibrating”. So to perform self test for detecting the PRG 04 failure, this RADAR Self Test relay RDRTST is used. During self test the relay coil receives signal from DO-4, channel 24 from SIBAS Klips, and +15V will be supplied to the RADAR.

Radiator Fan 1 Fast Relay FCF1R: This relay controls the making and breaking of FCF1A contactor. When the DO 6, channel 41 signal from SIBAS Klips is given to the relay coil, FCF1R relay picks up, making the FCF1A contactor to close by energizing its coil.

Radiator Fan 2 Fast Relay FCF2R: This relay controls the making and breaking of FCF2A contactor. When the DO 6, channel 42 signal from SIBAS Klips is given to the relay coil, FCF2R relay picks up which makes the FCF2A contactor to close by energizing its coil.

Radiator Fan 1 Slow Relay FCS1R: This relay controls the making and breaking of FCS1 contactor. When the relay coil gets signal from DO 6 channel 43 of SIBAS Klips, FCS1R relay picks up which makes the FCS1 contactor to close by energizing PU and hold coil.

Radiator Fan 2 Slow Relay FCS2R: This relay controls the making and breaking of FCS2A contactor. When the relay coil gets DO 6, channel 44 signal from SIBAS Klips, FCS2R relay picks up. This makes the FCS2 contactor to close by energizing PU and hold coil the contactor.

Compressor Synchronization Relay CMPSYN: This relay is picked up by SIBAS based on the compressor loading routine software. The relay is picked up through DO 2, channel 12 by SIBAS computer. When this relay picks up, compressor load synchronization request
signal is sent to train line 25T to activate any train line compressor by making MV-CC to drop out. When pressure inside Main Reservoir detected by MRPT reaches its limit, SIBAS shuts off the DO signal making the CMPSYN to de-energize making MV-CC to pick up preventing loading of the compressor.

- **Governor Booster Pump Relay GBC:** This relay picks up when the Governor Booster Pump Circuit Breaker is closed and a digital output of DO-3, channel 23 is applied to the relay coil. GBC relay operates to give supply to the Governor Booster Pump to develop fuel pressure. This pressure developed is used to move the injector’s rack linkage to a fuel delivery position in order to speed up the engine starting. Once the engine is started, SIBAS de-energizes the Governor Booster Pump Relay (GBC).

- **Flasher Relay FLSHR:** Flasher relay is used for turning ON and OFF of the flasher lights of the Locomotive by two toggle switches provided at the control console.

- **TCC1 Blower Motor Slow Speed Relay TCC1SR:** This TCC1SR relay gets energized when it receives DO 6, channel 46 signal from SIBAS Klips for slow speed operation of the TCC1 blower motor making the TCC1SS contactor to close.

- **Alarm Relay AR:** This relay is picked up in normal operation. When the attendant call push button is pressed or the SIBAS computer detects, an abnormal condition during loco functioning, the AR relay is de-energized and alerter alarm starts ringing. The SIBAS computer de-energizes the relay coil through DO 4, OUTPUT channel 31 and the contacts close the 74V DC to the alarm.

- **SIBAS Computer Control relay MCB:** MCB picks up when the COMPUTER CONTROL breaker closes, provided that either the battery knife switch is closed or the turbo lube pump relay (TLPR) is picked up. MCB drops out if the COMPUTER CONTROL Breaker opens. When MCB drops out by Computer Control CB, #1 NC contact closes to keep the fuel pump relay FPR energized (Bypassing the FPRLY output channel), provided that all four following conditions are met:
  - Battery knife switch is closed.
  - LOCAL CONTROL breaker is closed.
  - No emergency fuel cutoff (EFCO) switch is operated.
  - Shutdown relay SDR is not picked up.
  - #2 closes to give indication regarding the Tractive Effort Reduction by SIBAS through DO-5, channel 36.
  - #3 closes to discharge PRG 01 when Computer Control CB is switched off.

- **Fuel Pump Relay FPR:** FPR relay provide a facility to switch off the fuel pump through a switch provided on the left side of control console #2. FPR relay is normally ON through the SIBAS Klips DO 3, channel 18. When the emergency fuel cutoff switch is pressed, the relay drops out to cut off the fuel supply to shut down the engine.

- **TCC2 Blower Motor Slow Speed Relay TCC2SR:** This TCC2SR relay gets energized when it receives DO 6, channel 47 signal from SIBAS for slow speed operation of the TCC2 blower motor causing TCC2SS contactor to close.

- **Brake Warning Relay BWR:** This relay is picked up when DYNAMIC BRAKE GRID over current (IB-braking current) is sensed by SIBAS. As a result, the dynamic brake operation is cut out and the Brake Warning indicator lights turn ON at the control console. BWR relay coil picks up through DO-1, channel 8 from SIBAS Klips. Upon energizing BWR, one NO contact provides feedback regarding coil pickup to SIBAS through DI-1 channel 6, while another NO contact provides the signal to the 20T train line by energizing the DI-2 channel 22 (BW 20T) and the brake warning indicator lights on the control consoles.
- **Pneumatic Control Relay PCR**: This relay in normally picked up by CRU (Computer Relay Unit) when the throttle is in idle position, making PCS (Pneumatic Control Switch) closed. The Knorr air brake system de-energizes Pneumatic Control Relay PCR whenever it encounters a safety control or an emergency air brake application. When PCR trips, it switches on the PCS OPEN light and SIBAS turns off the excitation, interrupting locomotive power/dynamic brake operation.

- **Ttractive Effort Limit Relay TEL**: When the Ttractive Effort of the Locomotive reaches a predefined limit SIBAS 32 computer detects it and gives a Digital Output signal to the TEL relay coil. TEL coil on energizing closes the relay contacts, causing an alert indicator light provided at each of the control stands to glow.

- **Shut Down Relay SDR**: This relay is used to shut down engine of the Locomotive immediately (includes locos in consists also). When the MU engine stop switch at control console #2 is pressed, the SDR relay picks up to shut down the engine, by dropping out EFCO relay, GFC contactor and train line communication.

- **Engine Fuel Cutoff and Engine Stop Relay EFCO**: This relay is energized in the normal condition, when no emergency shut off is requested. When the EFCO switch at the control panel or EFCO2/EFCO3 switch at the Loco under frame are pressed, the EFCO relay is de-energized. This causes the D valve of the Woodward governor to move to no fuel position and causing the engine to shut down due to lack of fuel.

- **Turbo charger Lube Pump Relay**: This relay is picked up by SIBAS through DO 4, channel 22. This relay energizes the turbo charger auxiliary lube pump during engine start. Engine start is prevented until TLPR is picked up.

- **Wheel Slip Relay WL**: This relay is picked up when there is wheel slip, wheel over speed, or wheel locking condition. As a result, the wheel slip indicator on the control console light up indicating the wheel slip condition. The relay is picked by SIBAS through the DO 4, Channel 31.

- **START Relay**: When Engine Prime/Fuel Start switch is placed in start position and when all the condition for cranking are satisfied, then SIBAS delivers an output signal DO 5 channel 4 to the coils of the relay. This energizes the relay coil making the relay contacts to close, which in turn starts energizing the STA contactor coil.

- **Terminal Board RADAR TB RA**: The terminal board is used to provide interface between the RADAR and SIBAS computer through the L135 card. This TB also provides the +15V DC and COM to the RADAR from the PRG 04 power supply.

- **Resistor Headlights RE HDLT DIM A & DIM B -1G**: This resistor is required to provide proper supply voltage when the lights are in Dim position. They are located on the top right corner of the panel.

- **Diode Resistor Capacitor Assembly DRC**: This resistor, capacitor, diode assembly is used to suppress the coils of the relays from the transients during relay pickup viz GFD etc. This assembly suppresses the voltage transients for the coils which are connected parallel to the suppressor assembly.
- **Resistor RE PRG:** The resistor is used to discharge the PRG 01 when the circuit breaker of computer control is turned off.

- **Resistor - RE FL 1, 2, 3, 4:** This resistor is required to provide proper supply voltage when the headlights are in bright position. They are located on the top right corner of the panel.

- **Rectifier CRST:** The rectifier assembly is used to prevent current flowing from the battery into the starting circuit and the Loco positive string when the battery knife switch is open and the TLPR relay is picked up.

- **Rectifier CRBRK1, 2, 3, 4:** The rectifier prevents the feedback of the braking contactors B1, B2, B3, and B4 from the negative string to the ISOLATION Switch.
- **Power Distribution Connectors PD1, 2, 3, 4:** These are 36 pins common connected socket connectors used to provide low voltage power viz ±74V DC from the Circuit breakers to the analog input/output channels which are mounted at the right middle corner of the mounting plate.

- **Barometer:** The Barometer measures the pressure in the ECC1 cabinet and provides feedback as analog signal to SIBAS Klips through the Analog input module. The maximum barometric pressure measured corresponds to the +24V DC input.

- **Terminal Board Barometer TB Bar:** The terminal board is used to provide interface between the Barometer and the SIBAS KLIPS analog module through PDP-power distribution panel. This TB also provides the +24V DC to the Barometer from PRG 05 power supply. It also interfaces ERG 02 load regulator control signals.
- **Harting Connectors Y1, Y2 and Y3**: These connectors are used to interface all inputs and outputs from/to SIBAS Klips module. These connectors should be removed while welding/meggering or any high voltage operation is carried out, so that the I/O modules, sensors, transducers and other systems connected to Klips are isolated.

2.1.4 **DIAGNOSTIC PANEL**: This panel contains ports for Uploading/Downloading of data from/to SIBAS TCC, EVENT RECORDER & KNORR AIR BRAKE system, by connecting these ports with a laptop.

  - TCC SIBAS ➔ upload/download port
  - AIR BRAKE ➔ upload/download port
2.1.5 SIBAS KLIPS: The peripheral signals in the vehicle like feedback and control signals are hereby connected to the I/O module of the SIBAS-KLIP substation (SKS) by means of front connectors. These I/O modules are connected to the vehicle control (SIBAS) through the AS 318 MVB interface via the Multifunction Vehicle Bus (MVB). The signal transfer between AS318 and each I/O module in SKS is by BUS MODULE’s mounted on a rail.

- SIBAS KLIP STATION 1: The first module in this SKS 1 is the interface module AS 318 interfacing 5 Digital input modules, 6 digital output modules and 1 analog input module through BM700 Bus Module on the mounting rail. The interface module (AS318 MVB) communicates with other stations including SIBAS 32, KLIPS Station 2 and DISPLAY system through MVB cable.
 **SIBAS KLIP STATION 2:** The SKS 2 contains the interface module AS 318 interfacing 2 Digital input modules, 2 digital output modules, 2 analog input modules and 2 analog output modules through BM700 Bus Module mounted on DIN rail. The interface module (AS318 MVB) communicates with other stations including SIBAS 32, KLIPS Station 1 and DISPLAY system through MVB cable.

 **INTERFACE MODULE AS318:** The AS318 MVB interface module enables data exchange between the MVB and the I/O module of the SIBAS-KLIP substation by means of an internal serial bus. The AS318 provides monitor and control of I/O modules, communication b/w modules and service interface for loading Firmware and NSDBs.

 **Digital Input Module:** This module interfaces 16 input signals with the AS318, through BM700. The module detects the input signal low when the input voltage is b/w 0-22V DC → bit 0 and high when the input voltage is 38-101V DC → bit 1, thereby transfers the input signal to MVB interface module in 0’s and 1’s
➢ **Digital Output Module:** This module interfaces 8 normally open output channel with the AS318, through BM700. This module delivers output voltage of 72 V to the output peripherals, based on the control signal from SIBAS computer interfaced with it through AS318 module via BM700 bus.

➢ **Analog Input Module:** This module interfaces 1, 2 or 4 selectable analog input channels with the AS318, through BM700 bus. This module detects the analog value between a range of ± 20mA.
- **Analog Input Module**: This module interfaces 1, 2 or 4 selectable analog input channels with the AS318, through BM700 bus. This module detects the analog value between a range of ± 10V.

- **Analog Output Module**: This module interfaces 2 selectable analog output channels (2x±20mA / 2x±10V) with the AS318, through BM700 bus. This module detects the analog value between the range of ± 20mA / ±10V.

- **Bus Module**: All the modules in the SIBAS Klip Station are connected to this BUS BM700 module mounted on the DIN rail. This module interfaces the entire I/O modules in station with the AS318 through the module connector, providing communication and signal transfer between them.
2.1.6 Dynamic Braking Contactors B1, B2, B3, B4: These contactors come into picture when the dynamic braking is set up. During dynamic braking the energy of the Traction motors is feed back to the Dynamic Brake Grids RE GRID 1-8 through the DC Link. The contactors B1 & B2 connect grids 1-4 and contactors B3 & B4 connect grids 5-8 to the DC Link. These contactors operate together to connect the three 1.251 Ω and one 1.222 Ω which is tapped at 0.687 Ω for providing supply to the Grid blowers. These four resistances in series help in high dissipation of power during dynamic braking. These grid resistors are cooled by the radiator fans whose speed depends on the amount of current carried by the resistance grids. The pickup of the contactors B1 is controlled by SIBAS DO1, channel 6 and B3 by DO1, channel 7 and the contactors B2 and B4 are operated by the B1& B3 relay logic.

2.1.7 POWER REGULATOR PRG 01: This PRG 01 regulates the power from the battery to a constant 74V DC supply and feeds it to all other regulators PRG04, PRG05, PRG06 and Display unit.

2.1.8 LOAD REGULATOR ERG 02: Load regulator SYKO 2 regulates the Aux. Gen field voltage, which makes the Aux. Gen. To generate 3Ø AC supplied to Battery Charging Assembly for Battery charging. This ERG delivers required field supply to the Aux. Gen. making the Batteries to be charged and maintain the battery voltage level at 74V DC.
2.1.9 MG Excitation Controller: This device (GRAU Assembly) converts the 3Ø AC power from the Companion Alternator to DC and provides required DC voltage to the Main Generator field winding for excitation. The DC output of the Grau Asm. is controlled by the SIBAS computer depending upon the Throttle position at the Control console.

2.1.10 PRG 04 Power Supply: This PRG is a DC-DC converter, converting 74V DC to 15V DC giving regulated power supply to RADAR.

2.1.11 Generator Field Contactor (GFC): The AC supply from the Companion Alternator is routed through this 2 pole contactor to the GRAU Asm. for feeding the MG field winding. The GFC is controlled by SIBAS. When the power circuit is complete and all the other control circuit equipment conditions are met, SIBAS provides output through DO 3 channel 20, enabling the GFC contactor to pickup.

2.1.12 Generator Field Decay Contactor GFD: This contactor is used to decrease the discharge time of the generator field circuit. On occurrence of fault the SIBAS opens the GFDR relay making
the pickup coil of the GFD contactor to drop. As a result, the main contacts of the GFD contactor open up to insert a resistor in the main generator field discharge circuit and hence increasing the field decay rate.

**2.1.13 FREE WHEELING DIODE FWD-1:** This FWD is connected across SYKO 2 module and Aux. Gen field for protection of the ERG 02/SYKO 2. This freewheeling diode protects the ERG 02 module by preventing the reverse current flowing from the Aux. Gen field when Aux. Gen. Fld CB is switched off.

**2.1.14 Grid Blower Motor Current Transducers IBKBL 1, IBKBL 2:** These transducers measure the Grid Blower motor current. The PDP panels provide the ±15V DC for the transducer operation. These transducers are connected to SIBAS through X02-plug. The SIBAS32 uses this information to detect the shorted, open grid motor or failure due to bearing seizure.

**2.1.15 Grid Path Current Transducer IB1, IB 2:** These transducers measure the current through both the Grids. The PDP panels provide the ±15V DC for the transducer operation. These transducers are connected to the ADA module through the PDP panels. The SIBAS uses this information to control the dynamic braking effort and current.
2.1.16 Engine Filter Switch (EFS): This switch measures the pressure drop across the inertial filters and the engine air filters. When the combined pressure of these filters drop to 24 inch of water column, the EFS switch trips. The DI 2 channel 30 provides signal to the SIBAS computer that EFS has blocked the air supply, and message will be displayed “EFS: Plugged Engine Filters”. As a result, the engine will reduce the speed and load.

2.1.17 Filter Vacuum Switch (FVS): This switch measures the pressure drop across the inertial plus the engine air filters. When the combined pressure of these filters drop to 14 inch of water column, the FVS switch closes. The DI2 channel 31 provides a signal to the SIBAS computer and message will be displayed “ENGINE AIR FILTER DIRTY”, that there is excessive resistance to air supply.

2.1.18 Capacitor CA MG: This capacitor connected in series with RE MG2, acts as a spike suppression circuit for the Main Generator field windings.

2.1.19 Generator Field Decay Resistor RE MG1: This resistor is connected in series with the MG field windings, parallel to GFD contacts. This resistor is used to reduce the decay time of the field circuit. When GFC contactor opens, GFD cuts out making the RE MG1 resistor series with Gen. field to increase field decay rate.

2.1.20 Generator Field Decay Resistor RE MG2: This resistor is connected in series with capacitor CA MG and acts as a spike suppression circuit for the main generator field windings.
2.1.21 SCM SIGNAL CONVERTER: SCM converts current signal into voltage signal. These are used to convert the Voltage sensors output signals (which are 0-25mA for input voltage of 0-100V) into voltage form (0-7.5V)

2.1.22 QPSW VOLTAGE TRANSDUCER: This voltage transducer operating at ±15V DC detects the voltage across the primary side and delivers corresponding current signal at the secondary side. This transducer is used for measurement of voltage across Load regulator, control signal from Dynamic Braking handle provided at control console and Aux. Generator

2.1.23 OVER VOLTAGE RELAY (OVR): This OVR is a battery voltage monitoring relay, which monitors overvoltage and protects by tripping the Aux. Gen. field CB there by terminating the supply to SYKO 02 module.
2.1.24 TEPERTURE CONVERTER: This converter converts the change in resistance (for thermistor) into a 4 - 20 mA output signal, i.e.; it converts the PT1000’s varying resistance value into a 4 to 20mA signal.

2.1.25 TCC Blower Slow Speed Contactors TCC 1SS, 2SS: The power from the Companion alternator to the Blowers of the TCCs is routed through these contactors. The contactors’ aux. contacts are connected to SIBAS Klips to get the feedback signals from them. The SIBAS Klips controls these contactors through DO-6 channel 46 for TCC 1SS and DO-6 channel 47 for TCC 2SS based on the request signal from the TCC computers.

2.1.26 PRG 06 Power Supply: This PRG is a DC-DC converter, converting 74V DC to 15 V DC giving power supply to Voltage sensors.

2.1.27 PRG 05 Power Supply: This PRG is a DC-DC converter, converting 74V DC to 24 V DC giving power supply to SIBAS Klip modules.
2.1.28 Power Distribution Panel PDP1: These distribution panels are used to distribute power to the various sensing devices like the voltage and current transducers, and radar trans receiver. The signals are exchanged between the components and the ADA (Analog–Digital–Analog) module through the PDP panels, for necessary processing by SIBAS Klips.

2.1.29 Traction Motor Air Temp. Sensor TMA: This is basically a thermal resistor, Thermistor. This measures the temperature of the filtered cooling air for Traction Motors. The PDP panels provide the ±15V DC for the transducer operation. These transducers are connected to the ADA module through the PDP panels.

2.1.30 Terminal Board X6 TB X6: The terminal board is used to provide interface between the IG1, IG2 and SIBAS computer through the L1035 card. This TB also provides the +15V DC and COM to the transducers from the PRG 06 power supply.

3.0 Electrical Control Cabinet -2:

3.1 Main component of ECC2:
- **AUX GEN Circuit Breaker:** The circuit breaker is provided at the input side of the battery charger unit in ECC2 for charging the battery bank for the Locomotive. This circuit breaker is used for switching on/ off the input supply to the battery charger from Aux. Generator.

- **Contactor STA:** When the engine prime switch is placed at ENGINE START position, the contactor STA closes to apply full battery power to the solenoids which are part of starting motors. The solenoids drive the starting motors with the pinion assembly. After the motors
are engaged, the starting solenoids close to energise the contactor ST to apply full battery power to the starting motors.

- **Starting Contactor ST**: The cranking motor assembly is equipped with heavy duty contact tips that make contact when the starting solenoid has operated to engage the cranking pinion motor with the starting gear. Such contacts are normally used to carry current to the cranking motors. Use of solenoid contacts ensures engagement of starting motors before applying power to the starting motors.

- **Rectifier & Resistor Asm (Battery Charger) BC**: The battery charger is used for converting the AC output into DC input for the battery bank of the Locomotive. It consists of Resistors, RE-BC, which protects the auxiliary generator and battery charger unit from heavy current when the battery has lower charge. The charger ASM consists of a pair of heat sink mounted diodes for power conversion in parallel with selenium diode which protects the diodes from high voltage spikes. The selenium diode also prevents reverse leakage of current from battery to the auxiliary generator circuit when the diesel engine is stopped.

- **Resistors RE ST1, RE ST2**: These are 0.16 ohm resistors which are connected across the starting solenoids SM1 & SM2 to increase the current through the starting motors during engagement. This increase in current is sufficient for engagement of pinion gear with the ring gear in the locomotive.

- **Element filter**: The element filter is enclosed in the box enclosure at the bottom right corner of ECC2. Since, the ECC2 cabinet is forced air cooled pressurized air chamber with clean air brought from Locomotive air cooling system, the element filter is put in the input supply of clean air to ward off any entry of dust particles etc into the cabinet.
Terminal Boards 61A, 62A: These terminal boards 61A, 62A are mounted on the front right wall of the ECC2 cabinet. These terminal boards are required for making connections between the various components of ECC2 and with the Locomotive wires coming outside the ECC2 cabinet.

4.0 Electrical Control Cabinet -3:

4.1 Main components of ECC3:

- AC Breaker -3P, VL400: This Breaker is designated as CB RBL 1 and 2. This Breaker
Makes and breaks the connection across the Companion Alternator and radiator fan contactors. This CB will trip to protect against following:

- Locked motor rotor due to bearing seizure or jammed fan blades blade.
- Single phased motor winding.
- Faulty fan contactors.
- Phase faults and SC faults.

➢ **AC Contactor -3P, 325 FCF1B, FCF2B**: The contactor is designated as FCF1B. This contactor in conjunction with contactor FCF1A results in faster speed for radiator fan. FCF1B when connected with computer create parallel WYE connection across the AC power from the companion alternator. As a result, this causes radiator fan to rotate at faster speed.

➢ **AC Contactor- 2 Pole FCF1A, FCF2A**: The contactor is designated as FCF1A. This contactor in conjunction with contactor FCF1B results in faster speed for radiator fan. FCF1A when connected with computer create parallel WYE connection across the AC power from the companion alternator. As a result, this causes radiator fan to rotate at faster speed.

➢ **AC Contactor- 3 Pole FCS1, FCS2**: The contactor is designated as FCS1A. This contactor results in slower speed for radiator fan. FCS1A when connected with computer create serial WYE connection across the AC power from the companion alternator. As a result, this causes radiator fan to rotate at slower speed.

➢ **Transducer Pressure MRPT**: The compressor control system uses MRPT to monitor main reservoir pressure. However, this pressure transducer does not control directly the operation of the unloaded Magnet Valve. (MV-CC), but acts as an input to the control computer (through ADA module). Operation of MV-CC is controlled by EM2000 DIO-1 output channel 14 (MV-CC) based on feedback from MRPT and train lined units requests.

➢ **Terminal Boards 83A, 83B, 83C, 83D, 83E**: The terminal boards 83A, 83B, 83C are used to connect the locomotive electrical systems to the devices in the AC Cabinet.
5.0 Electrical Control Cabinet -4:

Function of Electrical Control Cabinet (ECC 4):
- To equip power and control switchgear for various Locomotive functions.
- To monitor the function of all Locomotive components.
- To provide feedback and reference signal for various Loco function.
- To provide crew message to each fault for corrective action.
- To provide warning signals and directions for Loco functioning.
- To store fault archive for fault analysis and corrective action.

5.1 Main components of ECC 4:
5.1.1 Circuit Breaker Panel: It is located at the rear Top Leftmost Door Cover of ECC4 (upper portion). The circuit breaker panel consists of circuit breakers and switches used in the control and protection of diesel engine and electrical systems. The circuit breakers can be operated as switches but will trip open when an overload or short circuit occurs. The circuit breaker portion of the panel is divided into sections. Breakers in the shaded section must be CLOSED (lever up) during locomotive operation. Breakers in the unshaded section can be used as and when required.
- **Circuit Breaker – Cab Fans and Light**: The 15A circuit breaker provides power and protection to the cab fans and lights in CAB 2 and its control circuit.

- **Circuit Breaker – Micro Air Brake**: This 15A breaker provides in series with the Micro Air Brake Circuit Breaker in CAB 1 i.e. on ECC1 provides power from the locomotive battery to the Knorr Air Brake computer relay unit/voltage conditioning unit. A set of contacts belonging to the Micro air brake circuit breaker is connected to DI-6 input channel 6 (MAB) of the SIBAS KLIP module.

- **Circuit Breaker – Computer Control**: This 65A circuit breaker in series with the Computer Control CB in Cab 2 is in series to the Computer Control Circuit Breaker in Cab 1 which provides power and protection to Power Regulator PRG 01 and MCB relay coil.

- **Circuit Breaker - Generator Field**: The companion alternator provides the excitation current to the main generator field winding through the GRAU assembly (MG field excitation controller). This 90A circuit Breaker is in parallel to the GF CB in the ECC1 panel. When the both GF CB are in ON condition the locomotive is in No Load condition.

- **GRNTCO Switch**: This double pole toggle switch disconnects the ground protection from the locomotive high voltage electrical circuits for maintenance inspections or troubleshooting. When the switch in ECC1 and ECC4 are in ON position then only LCC receives an ON command. This switch is normally locked in the closed (lever up) position by a pin which is safety wired to a switch guard bracket. In this position, the Ground Fault Protection System is armed.

### 5.1.2 Engine Control Panel of ECC4
- It is located on Front Top Right Door of ECC4. This panel consists of various switches and indicating meters related to various critical Loco functions.

- **Isolation Switch (SW IS)**: The rotary type switch can be used to isolate the locomotive from other units in formation and has two operating positions – RUN and START/STOP/ISOLATE.
• **START/STOP/ISOLATE Position**: The isolation switch must be in this position to start the diesel engine. The engine starting switch (FP/ES) is cut out unless the isolation switch is in START/STOP/ISOLATE. This position also isolates the locomotive, therefore, the unit will not develop power – the diesel engine runs at idle speed in all throttle positions. Isolate position is in parallel to the switch in ECC1 i.e the locomotive can be isolated from either cab.

• **RUN Position**: This position puts the locomotive on line after an engine start - the unit will load and respond to throttle control in a normal manner. RUN is in series i.e. for RUN command both the switch has to be in RUN.

  ➢ **Fuel Prime/Engine Start Switch**: This spring loaded switch has three positions; OFF (switch not activated, center position), PRIME (switch turned to the left) and START (switch turned to the right).
    - **OFF Position**: No fuel priming or engine starting is requested. Normal position with the engine running or not.
    - **PRIME Position**: When the switch is held in the PRIME position, it turns on DI-2 input channel 7 (PRIME). If conditions for priming are satisfied, the computer picks up the fuel pump relay FPR (fuel pump motor starts to run) and the turbo lube pump relay TLPR (turbo lube pump will run for 35 minutes). The locomotive can be Primed from either cab.
    - **START Position**: When the switch is held in the start position, it turns on the DI-1 input channel 1 (START) and the DI2 input channel 7 (PRIME). Another switch contact closes also to prepare the path for the STA contactor pick up. In reaction to the starting request, the computer energizes STA contactor coil (which engages the starting process) and the governor booster pump relay GBC (GB pump turns ON and adjusts the fuel injector racks for adequate supply of fuel and air). The Locomotive can be Started from either Cab.

  ➢ **Switch SW EFCO/ STOP**: This switch is used to stop the diesel engine when pressed. When the push button is pressed for approx 1 sec, the computer recognizes the activation of the switch and stops the diesel engine. It is not necessary to press the button continuously for engine stop. The push button has the facility of locking so that Engine cranking is restricted in case of any maintenance work in process. The locomotive can be put to shutdown from any cab.

  ➢ **BL KEY**: It consist of 10 contacts, open in “OFF” position and closed simultaneously by the operation of the BL key to “ON” Position.

  ➢ **Switch Classification Lights SW CLASS LTS**: This switch is used for turning on the classification lights of the Loco. It has 3 positions, Long Hood Forward, Cab End Forward and OFF. The functions are:
    - **Long Hood Forward**: Illuminates the classification lights of the Long Hood End (White LEDs at Long Hood end and Red LEDs at Cab end).
    - **Cab End Forward**: Illuminates the classification lights of the Cab End (White LEDs at Cab end and Red LEDs at Long Hood end).
    - **OFF**: Turns off the classification lights

  ➢ **Alerter Alarm AR**: This alarm is used as an audio aid to alert the Loco operator as part of alerter function. The alerter alarm sounds simultaneously in both the cabs.

  ➢ **Tractive Effort Limit Switch & RAPB Switch**: These switches are used to select the Tractive Effort Limit and Repatriation Brake (Auto Emergency Brake) functions. It is in series with the corresponding BL key.
- **MEMORY FREEZE SWITCH:** This switch when put in ON position will enable the memory freeze operation. This switch is usually sealed with safety wire to avoid inadvertent isolation of memory freeze function. Memory of the event recorder can be freezed from any cab.

**5.1.3 TB & Connectors:** This zone contains terminal board’s receptacle connectors 743E and 733A and also contains TB77A, TB77B, TB77C and TB77F at inner side of ECC4 back panel.

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**6.0 Description of DIALS with 6U Rack.** DIALS combines all Driver Information Dispaly and Analogue Indications (Speedometer, Tractive Effort Meter and Pressure Guages)

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**Schematic view of DIALS Front Panel**
Schematic View of DIALS Back Panel.

6.1 DIALS Front Panel equipment:
- DIALS computer system
- Alerter indicators and reset switch
- Speaker with integrated amplifier and mounting arrangement
- Front panel connectors
- Cables with connectors
- Ethernet connector.
- USB for Communication with the Display

6.1.1. DIALS computer system: The DIALS computer system consist of the LCD Screen, various Hard Keys on top and sideways and LED indications

LCD Screen: The main component of the DIALS is LCD Screen and is designed to be used in the driver's cab of a rail vehicle. It is based on an industrial PC with a backlit flat panel display and an environment controller for temperature management as well as various special functions.
Pictorial representation explanation:

**ER: Equalizing Reservoir:** The equalizing reservoir pressure is displayed as a digital number, with least count of 0.1, and a horizontal bar graph. The units for display is in kg/sq-cm. Having value 5.6 kg/cm² which is shown in mathematical and in graphical way.

**BP: Brake Pipe:** The brake-pipe pressure is displayed as a digital number, with least count of 0.1, and horizontal bar graph. The units for display are in kg/sq-cm. Having value 3.3 kg/cm² also available in mathematical and graphical way:

**BC: Brake Cylinder:** It is Brake Cylinder Pressure with value of 4.7 kg/sm² which is also available in mathematical as well as in graphical value.

**MR: Main Reservoir:** The Main Reservoir Pressure is displayed as a digital number, with least count of 0.1. The units for display is in kg/sq-cm. Only Mathematical value is shown for this pressure.

**AIR Flow:** The air flow in the locomotive brake pipe is displayed as a digital number, with least count of 10 kg/min, and horizontal bar graph. The units for display is kg/ sq-cm.

**Hard keys (Keys on TOP):**

- Language change over
- Description of the selected message
- Remedy at velocity > 0 not used
- Day/Night presentation
- Step back one screen
- Message overview
- Remedy at velocity = 0
- Brightness adjustment
- Switch between Drivers Display and Diagnostics Display
Events are caused by malfunction or faults of subsystems or gadgets of the locomotive. They are derived from the appropriate diagnostic messages. Events appear in the message line on the screen and are stored in the memory of the display. They are displayed until they are acknowledged. Events are tailored to inform the driver and give him hints to solve the problem. Independently of the actually displayed screen the events can be visualized by keys described below.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![File Icon]</td>
<td>Displays all events from memory. All present, already gone and acknowledged events are displayed in the form of a list. Each event contains a short text, date and time of appearance and date and time of disappearance (if no more present).</td>
</tr>
<tr>
<td>![Information Icon]</td>
<td>Information screen for the displayed event. This screen contains a description of the actual event to help the driver to understand what happened. Hints to solve the problem are shown by pressing the keys “v&gt;0” or “v=0”.</td>
</tr>
<tr>
<td>![Arrow Down Icon]</td>
<td>Remedy at v&gt;0 according to the actually displayed event. This is a help for the driver if the problem can be solved while the locomotive is running or what else the driver should do.</td>
</tr>
<tr>
<td>![Arrow Up Icon]</td>
<td>Remedy at v=0 according to the actually displayed event. This is a help for the driver if the problem can be solved while the locomotive is at standstill or what else the driver should do…</td>
</tr>
</tbody>
</table>

### Indicator LEDs:

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Lightning Bolt Icon]</td>
<td>Application (H1)</td>
</tr>
<tr>
<td>![Light Bulb Icon]</td>
<td>On/Off, temperature (H2)</td>
</tr>
<tr>
<td>![Arrow Up Icon]</td>
<td>Key acknowledgement (H3)</td>
</tr>
</tbody>
</table>

Three LED pairs (each comprising one red and one yellow LED) are used to indicate the various operating states. They are driven by the environment controller and the controller for the membrane keyboard. Each of the three LED pairs can also be controlled by the user software via the API.

LED3 (yellow) lights up briefly each time a key is pressed on the membrane keyboard. It lights up continuously (also yellow) if the environment controller is switched on and the PC is switched off. This is the case during the power-up phase (delayed connection of the PC), if the maximum or minimum temperature limit is exceeded (to protect the PC and the hard drive), or briefly if the watchdog is activated (power off and power on reset).

H1 is only used by the application.
H2 is only used by the EVC (on/off, temperature).
H3 is only used by the EVC (yellow: key acknowledgment, red: not assigned).
Hard keys (Keys on RIGHT):

- **Cancel**
- **Right**
- **Left**
- **Up**
- **Down**
- **Enter**

Hard Keys (Bottom):

- Not used
- Data meter
- Locked Wheel
- DPC in S2 LOCOS
- Diagnostics Display
- Driver Input
- Cut Out
- Not Used
- Not Used
- Not Used

Pictograms:

- Pictograms only are shown when a system is in transition from one state to another, eg. <Engine Starting> or when a limitation occurs or when the system is not available.

- Pictograms are not shown when the appropriate system is working without problems, eg. no pictogram for <Engine off>.

**Different Pictograms are given below:**

<table>
<thead>
<tr>
<th>For Diesel Engine:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Start</td>
<td>Engine Stop</td>
<td>Engine Off</td>
<td></td>
</tr>
<tr>
<td>Engine</td>
<td>Engine TH6</td>
<td>Engine TH2</td>
<td></td>
</tr>
</tbody>
</table>

These are the pictograms for diesel engine
For Trawctions: These are the pictograms for Traction.

For Brake: This is the pictogram for Brake.

For Head End Power: This is the pictogram for Head End Power.

For VCD Bypass This is the pictogram for VCD Bypass. This is used to Alerter Control Circuit Breaker Input.

- For some systems it's better to show the actual state, eg. when HEP is on or not available or when vigilance device is cut out.

- The pictogram <Self test> reminds the loco pilot of a still running self test.

**Indicator Lamps:** There are four types of indicator lamps of different three colors which are white, yellow, black and red. Every colored lamp have its own work.

<table>
<thead>
<tr>
<th>IL1</th>
<th>IL2</th>
<th>IL3</th>
<th>IL4</th>
<th>IL5</th>
<th>IL6</th>
<th>IL7</th>
<th>IL8</th>
<th>IL9</th>
<th>IL10</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS Open</td>
<td>Sand</td>
<td>Auto Flasher</td>
<td>Wheel Slip</td>
<td>Power Ground</td>
<td>ALI Fault</td>
<td>Brake Warn</td>
<td>AEB</td>
<td>Blending</td>
<td>DPC</td>
</tr>
</tbody>
</table>

**Black lamps:** When indicator lamps are not switched on only their black background is visible.

<table>
<thead>
<tr>
<th>IL1</th>
<th>IL2</th>
<th>IL3</th>
<th>IL4</th>
<th>IL5</th>
<th>IL6</th>
<th>IL7</th>
<th>IL8</th>
<th>IL9</th>
<th>IL10</th>
</tr>
</thead>
</table>

**Yellow lamps:** Yellow indicates a minor failure which may reduce the capabilities of the locomotive. Yellow lamps are given as below.

| PCS Open | Sand | Brake Warn | Power Ground |
Red lamps: Red indicates a serious fault which sets the locomotive out of service.

White lamps: These are the white lamps which indicates an information.

6.1.2 Alerter Indicators and Reset Switch: the photograph of the working DIALS with Alerter Indications and Reset Switch.

6.1.3 Speaker with Integrated Amplifier and Mounting Arrangement:

Front view of Speaker, back side of Amplifier and Maintainers position for controlling and connecting the Audio source.

6.1.4. Ethernet Connector.: Connector type: M12, 4-pole, female, D-coding

- The 6U Rack has a 10 Base-T Ethernet connection. The baud rate is 10 or 100 Mbit/s. This is provided at the bottom right of the Rack and not accessible to the Loco Pilots and only used by the train maintainers.

6.1.5. USB for Communication with the Display. :

Connector type: M8, 4-pole, female
This USB connection on the 6U Rack is used to communicate with the Display SITET for Uploading and downloading the software. This is provided at the bottom right of the Rack and not accessible to the Locomotive operator and only used by the train maintainers.
6.2 DIALS SCREENS: DIALS is divided into 2 parts namely:

1. DRIVER DISPLAY: Contains DIALs Screens and driver related input
2. DIAGNOSTIC DISPLAY: This part contains

   Data meters, Totals, Power Meter, SW-Version, Self Test, I/O signals, Fault Archive, Environment Data, Driver ID

6.2.1 TRACTION Screen: This is the traction display Screen.
On the left side of the screen there are some abbreviations which are as follows:

ER: Equalizing Reservoir,  BP: Brake power  BC: Brake cylinder,  MR: Main Reservoir
These are given in mathematical as well as in graphical form. Now on the right side some abbreviations are also used:
TE: Traction input/output.

6.2.2 DYNAMIC BRAKE Screen: This screen is for dynamic brakes.

![Dynamic Brake Screen](image)

BE: Brake input/output.

All abbreviations are shown in mathematical as well as in graphical form.

6.2.3 CREW MESSAGE Screen:

![Crew Message Screen](image)

CREW MESSAGE Screen has been come after pressing the MESSAGE OVERVIEW key as given below:

This is the Crew message key
After pressing this key a screen will be displayed in the middle of the display in which a message will come out about the locomotive that it works or not, there may be some problems to start the locomotive by some faults which will be displayed on the screen after pressing this key.

For eg: A0225 fuse starter motor failed. This type of messages are shown by this key.

6.2.4 MESSAGE DESCRIPTION Screen:

This is the message description key.

After pressing this key, a message will come on the screen. In this message, a region will be given that why the locomotive is not starting. The screen will be like as:
6.2.5 BRIGHTNESS Screen:

This is the brightness key by which we can change either increase or decrease the brightness of Screen display. After pressing this key the following type of screen will be displayed:

![Brightness Screen](image)

We can edit the brightness by the use of following key to min. or max. this key is for enter or yes.

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>←</td>
<td>For Minimum</td>
</tr>
<tr>
<td>→</td>
<td>For Maximum</td>
</tr>
<tr>
<td>E</td>
<td>For Enter or Save</td>
</tr>
</tbody>
</table>

6.2.6 DRIVER ID Screen:

![Driver ID Screen](image)

For this Driver ID a hard key at the bottom at 3rd position will be used here which is given below

3
After pressing this key we will get to edit the Driver ID. For providing a name to the driver the hard keys will be changed in another form like a mobile phone pad. This is given as below:

The driver information can be saved for a given section and Load.

**6.2.7 DATA METER Screen:** After pressing the 4 we will get the term DATA METERS.

This is the key after pressing that we will get the information about DATA METERS. This key will show a message about parameters.

About hundred signals comes which will be visible on the screen and we can edit or change the parameters from there.

The parameters will be on the screen like as shown below:

There are nine Data Meters.

Each data meter will show about the parameters one by one. The above screen is for DATA METER 1. We can edit or change the parameters by using the key given in right side on the screen. This is user programmable as per the different requirements the signals could be saved on the Meter pages one by one. A total of 20 parameters can be viewed on any one such Meter.
The changing keys are given below:

By using these keys we can edit the parameters for Data Meter.

6.2.8 CUT OUTS Screen:

Cutouts is the 5th key on the DIALS Display as given above. After pressing the 5th key from the Display we will get the information about the cutouts. After that it will show a message about trucks. It will tell us that the trucks are working or not.

As shown in fig. there is a Truck 1 enabled and Truck 2 enabled. We can change this by using the keys which are given on the right side of the screen and can change the truck disable or enable.

The changing keys are shown below:

By using these keys we can change or edit this mode. By using enter key the position of the Truck can be changed and saved.
6.2.9 Locked Wheel Detection Screen:

This is the 6th key after pressing that we will get the information about Locked Wheel Detection.

There are six traction Motors in a Freight Locomotive and six in a Passenger Locomotive. This 6th key will show the message about the locked wheel. The screen will be comes during this process is given below.

Like Cutouts we can edit or change the reactions mode by using the following keys:

To Scroll up and down and enter Key to change the position.
6.2.10 Running Totals Screen:

From Base Screen >> Press 1 (Diagnostic Display) for Running Total 1

From Base Screen >> Press 1 (Diagnostic Display) >> Press 5 (Running Total 2)

Running Total1

This Screen shows running totals of the Locomotive viz. Distance Travelled, operating hours of Traction, dynamic etc.
It will describe about the total time taken by the Throttle Governor and Dynamic brake. After pressing the 5th key we will come on this stage i.e running totals 2.

6.2.11 Power Meter Screen: From Base Screen >> Press 1 (Diagnostic Display) >> Press 7 (Power Meter)
After pressing the 6th key from display we will get the information about the Power meter. This is a useful screen during the Load test and when the Locomotive is in running condition.

6.2.12 SW Versions Screen: From Base Screen >> Press 1 (Diagnostic Display) >> Press 1 (System)

6.2.13 Self Test Screen: From Base Screen >> Press 1 (Diagnostic Display) >> Press 7 (Power Meter)

The screen for the self test is given below:
The screen gets divided in two parts. On left side a list contains all available tests, and on the right side are two text fields. Two soft keys at the bottom of the screen make possible to start or stop a test. The way to operate a test is:

Select a test from the list on the left side. The list can be moved using the arrow keys to display covered items. When a test is selected the upper field on the right side contains the preconditions which are necessary to run this test. The test only can be started when all conditions are fulfilled.

The lower field on right side displays some information about the progress or failure of the test or inform the operator what to do next (e.g. if the test is split in several steps which have to be processed consecutively.)
The above photograph gives the contents for self test. As shown in the left side photograph cooling fan 1 self test is selected, the conditions is displayed on the screen. A state also come up if the conditions meet or does not meet.

We can change the components from screen for self test by using the following keys:
6.2.14 I/O Signal Screen:

From Base Screen >> Press 1 (Diagnostic Display) >> Press 1 (System) >> Press 4
This shows overview about input/output signals.
The detailed I/O Signal photograph is shown below:
This is the signal details. There are total 12 signals on the screen. We can get the detail about each signal by changing the position of the signal by using the following keys:
6.2.15 **Fault Archive Screen:** From Base Screen >> Press 7 >> Press 8 This is the information about the fault overview. In this sub menu detailed history of faults can be accessed including the Environment data during the fault.

In this we can see that what is the problem in the locomotive or what fault has been come.

6.2.16 **Environment Data Screen:** The gives details of the data archived as a fault. This helps in the trouble shooting of the Locomotive as it captures the data at the time of Fault.
7. Operating Instructions of DIALS

7.1. How to Cutout Truck

**Step 1:** Go to the main screen (Press 0), **Step 2:** Press No.5
Then you get the screen shown bellow

Now select the truck which you want to DISABLE by pressing Arrow Keys at the side of the LCD Screen. Then press ENTER, it will get DISABLED. Press 0 for main screen.

7.2. How to cut out the Speed Sensor?

**Step 1:** Go to the Main screen, **Step 2:** Press No.6
Then you get the screen shown bellow

Now select the speed sensor of motor which you want to DISABLE by pressing Arrow .Then press ENTER, it will get DISABLED. Press “0”for main screen.

7.3 How to do Self Test?

Step1 Reverser and Throttle should be in IDLE position.
Step 2 GF circuit breaker on Circuit Breaker panel and GF SW of control stand should be ON.
Step 3 IS (Isolation switch) should be in RUN position
Step 4 Then Go for Self Test from display (From Base Screen >> Press 1 (Diagnostic Display) >> Press 1 (System) >> Press 3 (Self Test))
Step 5 Select the option which you want to test, by pressing arrow down and up arrow keys.
Step 6 Then press Enter Key, then press the button No.8 (Start Button) to start the test.
Step 7 After completion of the test press No. 9 (Cancel) button to exit test followed by Cont.
Step 8 Go to main screen by pressing “0”

7.4 How to read the fault data on display screen?

Step 1 Go to the main screen
Step 2 Press No.1 (Disgn. Display), Again press No.1 (System) then press No.5 (Fault archive), You will get the screen given below.
Step 3 Then press No.1 (Read Memory). Now you can see All fault messages on the Display.
Step 4 Press “0” for main screen.

7.5. How to see power meter screen on the display?

Step 1 Go to the main screen by pressing “0”, Now press 1 (for Diagn. Display) and then press 6 for power meter.
This shows 32 parameter of the Locomotive.
8.0 Traction Control Converter (TCC):
The locomotive has two traction inverters TCC1 and TCC2 (one inverter per 3 traction motors of a bogie) The output of inverters (pulse width modulated PWM output voltage) is responsible for providing the variable frequency and the variable terminal voltage for the three phase motors. The main alternator feeds electrical power to the DC link via two series connected diode rectifiers. The TCC blowers diffuse heat produced by losses generated in TCCs.

Traction Control Converter (TCC):
Front side:

Rear side:
General Technical Information:

Type Number: SIBAC G 2800 D 2190 810 M 5 R F D Q

Each TCC has two inverters with independent outputs.

**Input** Voltage: 620 V DC to 2800V DC  
**Input** Current: max. 1510A DC

**Output** Voltage: 0V AC 2190V AC 3-Phase  
**Output** Current: max. 810A AC  
Frequency: 0 Hz ... 125 Hz

9.0 Engine Starting Procedure of Dual Cab Locomotive (Siemens make):

Precautions before Starting the Engine

- Ensure that Throttle Handle of both cabs in IDLE, Reverser handle in center position, ISOLATE Switch in ISOLATE position.
- Switch “OFF” all the circuit breakers in ECC1 & ECC2.
- Ensure that the MUSD is in RUN position in both CABs
- Ensure sufficient oil level of Compressor oil, Engine Lube Oil and Governor Oil.
- Ensure sufficient coolant water level in the water tank (Engine dead – Full).
- Ensure that no one is working on the Engine, Generator Room, Compressor Room etc and all doors are closed.
- Ensure that the engine over speed trip mechanism (OST) is in normal condition.
- Ensure that the Governor Low Lube Oil shutdown plunger is in reset condition.
- Ensure that the positive Crankcase pressure and Low water pressure detector reset buttons are reset. If low water button found ejected, press and hold it for 15 seconds.
- Ensure that loco is properly secured - apply Hand brake & wooden wedges.

Steps to Start the Engine:

i. Secure control console of working Cab  

ii. Ensure that the starting fuse is installed in good condition and is rated correct as 800 Amps for WDP4D locomotives.  

iii. Close the battery knife switch  

iv. Switch ON all the circuit breakers of ECC1 & ECC2 in a sequence (Black, White & Yellow label) except GFCB  

v. Switch ON the CONTROL & FP slide switch in active cab control console. This allows fuel pump to RUN when FP/ES switch is in Fuel prime or engine start position  

vi. 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.
vii. 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).

viii. After holding the engine RPM above 200, release the FP / ES switch.

ix. Check Low water pressure detector reset button on EPD after Engine start:

x. If the detector trips, press continuously for 15 seconds.

xi. If the detector is not reset, the engine shuts down after a short time delay.

xii. To prevent over heating of starting motors, which may damage them, system will restrict cranking if time exceeded more than 20 seconds.

xiii. If engine fails to start after cranking for 20 seconds, system will allow cranking after 2 minutes only, to cool starting motors before cranking engine again.

10.0 Cab Changing Procedure from One Cab to another Cab:

<table>
<thead>
<tr>
<th>Active cab</th>
<th>BL Key ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>InActive cab</td>
<td>BL Key OFF</td>
</tr>
</tbody>
</table>

### Locomotive Cracking

<table>
<thead>
<tr>
<th>Switch/Circuit Breaker</th>
<th>Location</th>
<th>Active cab</th>
<th>In active</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP/ES Switch</td>
<td>ECC</td>
<td>Locomotive can be started from any cab</td>
<td></td>
</tr>
<tr>
<td>Computer Control CB</td>
<td>ECC</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>MUSD</td>
<td>Control console</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>CNTRL &amp; FP SW</td>
<td>Control console</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>EFCO/STOP SW</td>
<td>ECC</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>IS SW</td>
<td>ECC</td>
<td>ISOLATE</td>
<td>Any position</td>
</tr>
<tr>
<td>FP CB</td>
<td>ECC</td>
<td>ON</td>
<td>NA</td>
</tr>
<tr>
<td>TURBO CB</td>
<td>ECC</td>
<td>ON</td>
<td>NA</td>
</tr>
</tbody>
</table>

### Locomotive Running

<table>
<thead>
<tr>
<th>Switch/CB</th>
<th>Location</th>
<th>Active cab</th>
<th>In active</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP CONTROL CB</td>
<td>ECC</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>MICRO AIR BREAK CB</td>
<td>ECC</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>IS SW</td>
<td>ECC</td>
<td>RUN</td>
<td>RUN</td>
</tr>
<tr>
<td>EFCO/STOP SW</td>
<td>ECC</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>GEN FLD CB</td>
<td>ECC</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>GEN FLD SW</td>
<td>Control console</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>ENG RUN SW</td>
<td>Control console</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>CNTRL &amp; FP SW</td>
<td>Control console</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>MU ENG STOP</td>
<td>Control console</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>LEAD/TRAIL SW</td>
<td>Control console</td>
<td>LEAD</td>
<td>TRAIL</td>
</tr>
</tbody>
</table>
### 11.0 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECC 1</td>
<td>Electrical Control Cabinet – 1</td>
</tr>
<tr>
<td>ECC 2</td>
<td>Electrical Control Cabinet - 2</td>
</tr>
<tr>
<td>CB AUX GEN</td>
<td>Circuit Breaker Auxiliary Generator</td>
</tr>
<tr>
<td>ST</td>
<td>Starting Contactor</td>
</tr>
<tr>
<td>STA</td>
<td>Starting Contactor Auxiliary</td>
</tr>
<tr>
<td>RE</td>
<td>Resistor</td>
</tr>
<tr>
<td>TB</td>
<td>Terminal Board</td>
</tr>
<tr>
<td>BCP</td>
<td>Battery Charger Positive</td>
</tr>
<tr>
<td>SIBAS</td>
<td>Computer</td>
</tr>
<tr>
<td>TCC</td>
<td>Traction Control Cabinet</td>
</tr>
<tr>
<td>ECC 3</td>
<td>Electrical Control Cabinet - 3</td>
</tr>
<tr>
<td>CB</td>
<td>Circuit Breaker</td>
</tr>
<tr>
<td>FCF</td>
<td>AC Contactor Fast Speed</td>
</tr>
<tr>
<td>FCS</td>
<td>AC Contactor Slow Speed</td>
</tr>
<tr>
<td>MRPT</td>
<td>Main Reservoir Pressure Transducer</td>
</tr>
<tr>
<td>AL 11, 12, 13</td>
<td>Companion Alternator Supply to the contactor</td>
</tr>
<tr>
<td>A11, 11A, 12, 12A, 13, 13A</td>
<td>Wire tags for supply to fast speed contactor # 1</td>
</tr>
<tr>
<td>A21, 21A, 22, 22A, 23, 23A</td>
<td>Wire tags for supply to fast speed contactor # 2</td>
</tr>
<tr>
<td>DCL</td>
<td>DC Link</td>
</tr>
<tr>
<td>AC CNTL</td>
<td>AC Control</td>
</tr>
<tr>
<td>Dual Cab</td>
<td>Nomenclature of Locomotive manufactured by Indian Railways.</td>
</tr>
<tr>
<td>ASG</td>
<td>TCC Computer</td>
</tr>
</tbody>
</table>
OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and man power which inter-alia would cover reliability, availability, utilization and efficiency?

If you have any suggestions and any specific comments, please write to us.

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                Maintenance Technology,
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