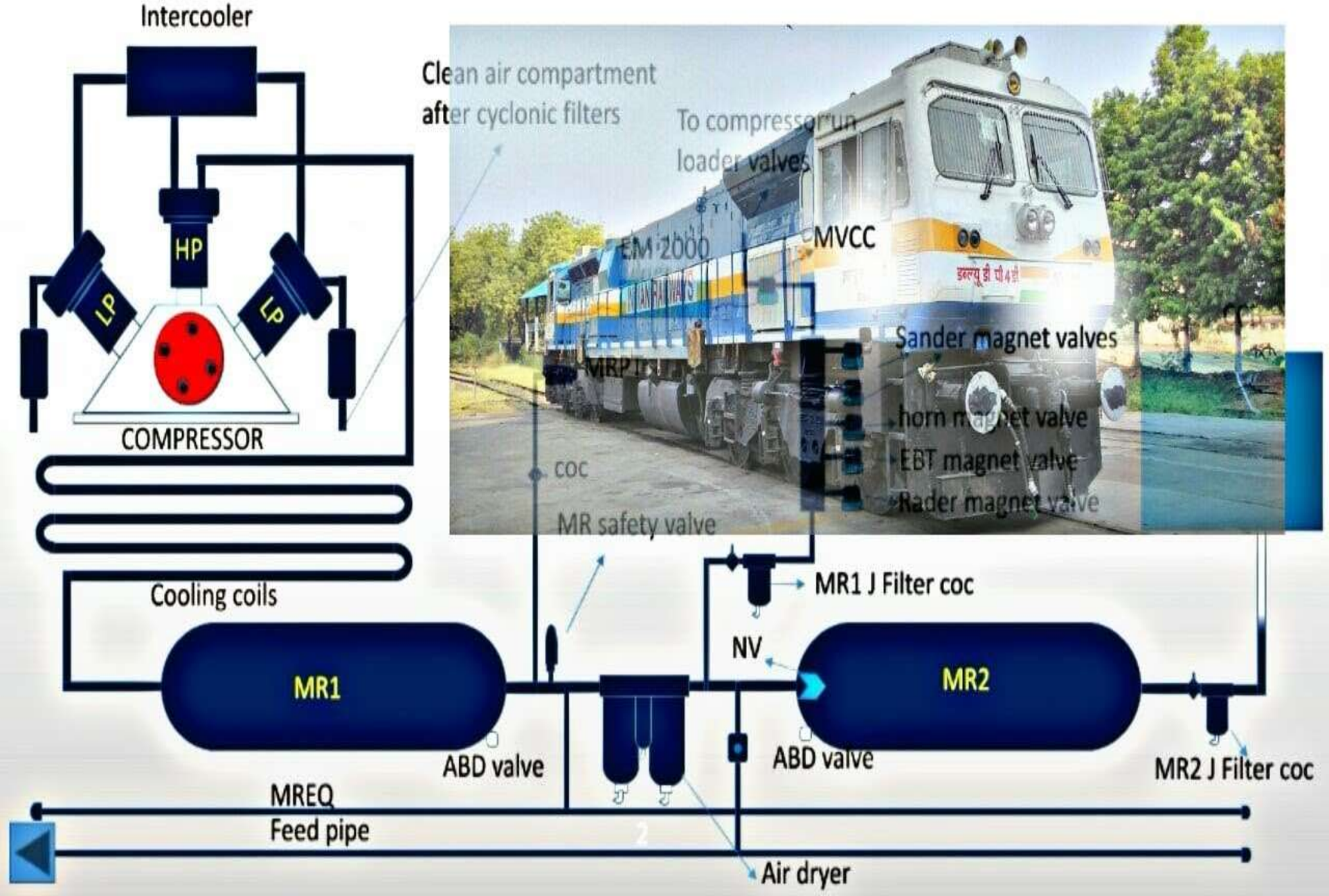
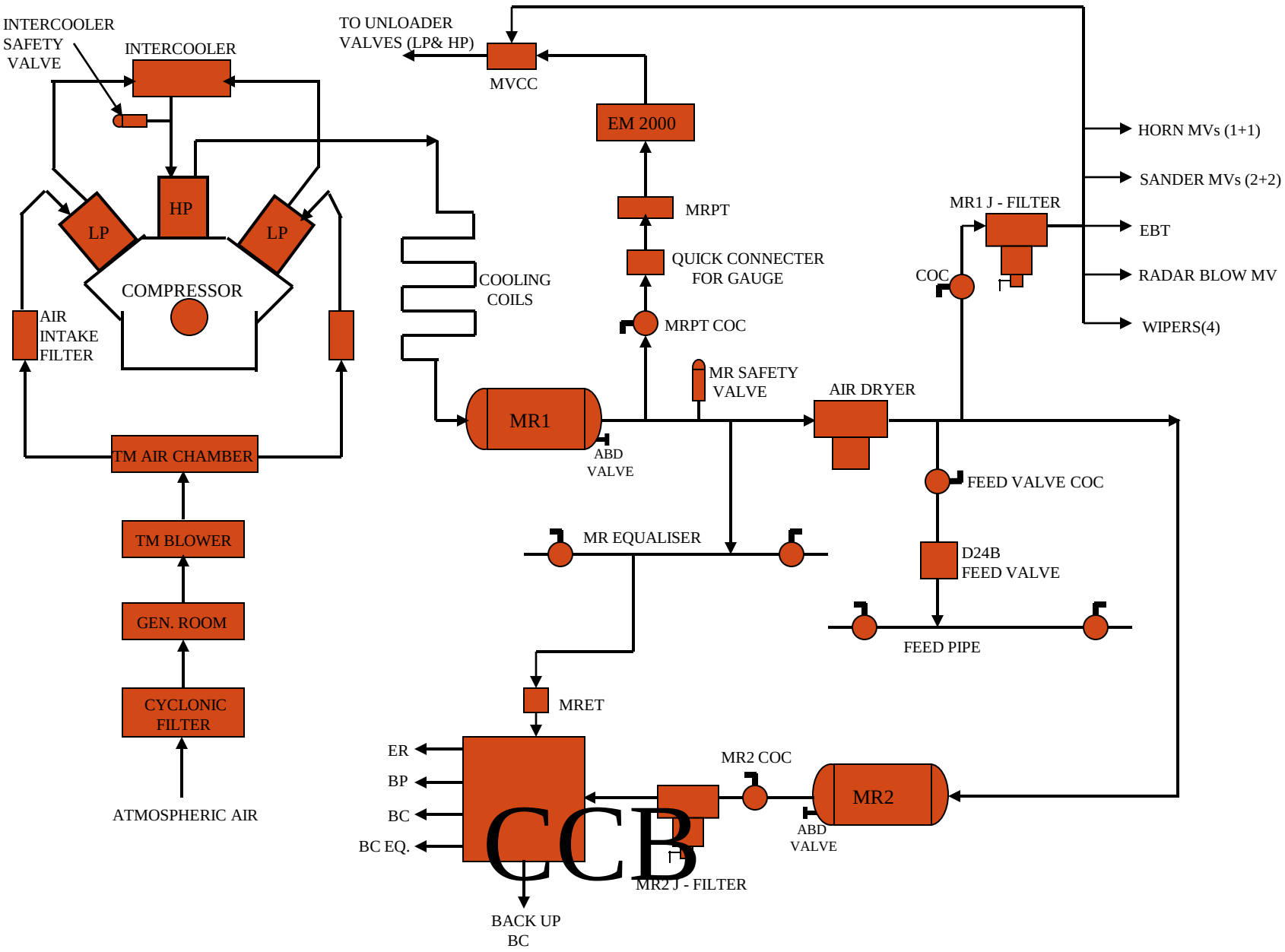
Compressed Air system in HHP Locomotive

- Compressed air in GM locomotive is used for the locomotive brake system as well as for auxiliary systems such as sanders, bell, horn, windshield wipers, rail lube systems, and radar head air cleaner.
- **GM locomotive Vs Alco locomotive**
- 1. In GM locomotive the compressor and compressed air is water-cooled but in Alco loco the compressor and air is cooled by air.
- 2. Both compressors have its own lubrication system.
- 3. Both compressors have an intercooler between low-pressure cylinder and high-pressure cylinder.
- 4. Both locos have an after cooler cooling coil between the compressor and reservoir.
- 5. Both locos have a loading –unloading arrangement.

COMPRESSED AIR SYSETM





COMPRESSED AIR SYST

INTRODUCTION

- A complete microprocessor Control Air Brake System for main line locomotives.
- Fully compatible with locomotives having conventional AAR brake system
- All logic is computer controlled.
- Emergency applications are initiated pneumatically in parallel with computer initiated emergency applications.

- Commands are through the CCB **brake valve controller**
- **BVC** is an electronic component and generates frequency signal according to the position of the handle.
- Computer interprets the signal and commands the electro-pneumatic valves, accordingly, while applying and releasing brakes.
- Lead/ Trail /Test/HLPR modes are set up through the LT switch.
- The feed valve setting is factory set by the computer software.

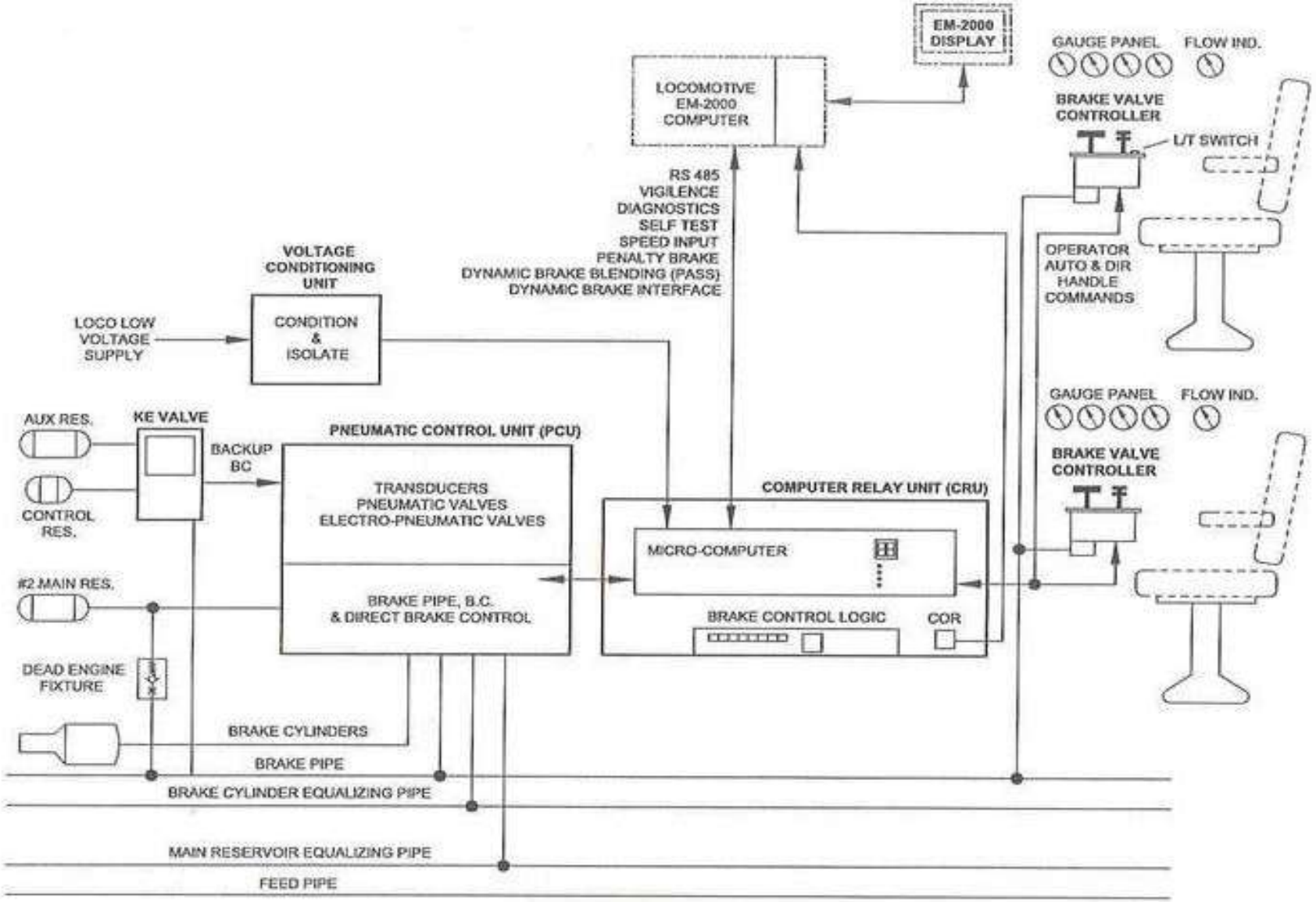
- The only pneumatic valve contained in the brake valve is the mechanically actuated emergency vent valve which is open in emergency position.
- All control pressures are developed in this manner (brake pipe, brake cylinder equalizing pipe and brake cylinder).
- The computer also controls the locomotive power knock down cut-off relay.
- The voltage conditioning (VCU) circuitry isolates the locomotive battery supply from the CCB system as well as providing 24V DC to operate the CCB equipment.

- The KE Valve provides control volume pressure to the BC relay control that operates to provide 'Service' automatic brake in loco.
- Handle positions, locomotive set up and pressure development flow rates remain almost the same.
- The changes from conventional AAR systems occur in how the air pressure is controlled and the type of equipment used to control the brakes.
- The major enhancement is the ability to diagnose problems.

COMPUTER CONTROLLED BRAKE (CCB)

- State of art electronically controlled microprocessor air brake system.
- Panel mounted modular design.
- Communication from driver brake valve is through fiber optic cable.

CCB EQUIPMENT OVERVIEW



SYSTEM OVERVIEW

- In the CCB System, the Air Brake Computer (KNOR) interacts with the Locomotive main computer (EM 2000) to interchange the information, so that, engine running condition and Air Brake application will be matching each other for normal and emergency brake application.
- Requisite display is made as crew message on EM 2000 display screen.
- ADZ (Analog to digital to Analog) module used for converting information from Analog to Digital and vice versa while interacting between two computers or giving command to any electro-pneumatic valve.
- In the self-test mode also the two computers interact with each other and display test results and diagnostic information on the display screen of main computer.
- Transducers are used to sense pressure at various circuits, in terms of electrical signal and to provide feedback information through computer for operating solenoid valves.
- Like mechanically controlled pneumatic valves, solenoid valves are used for charging and venting of air in pneumatic circuits for application & release of brakes.

MAIN UNITS / SYSTEMS

- Electronic Brake Valve Controller
- Voltage Condition Unit (VCU)
- Pneumatic Control Unit (PCU)
- Computer Relay Unit (CRU)
- Back up
- Diagnostics

MAJOR ASSEMBLIES

CCB RACK (COMPLETE UNIT)

Brake Valve Controller (BVC)

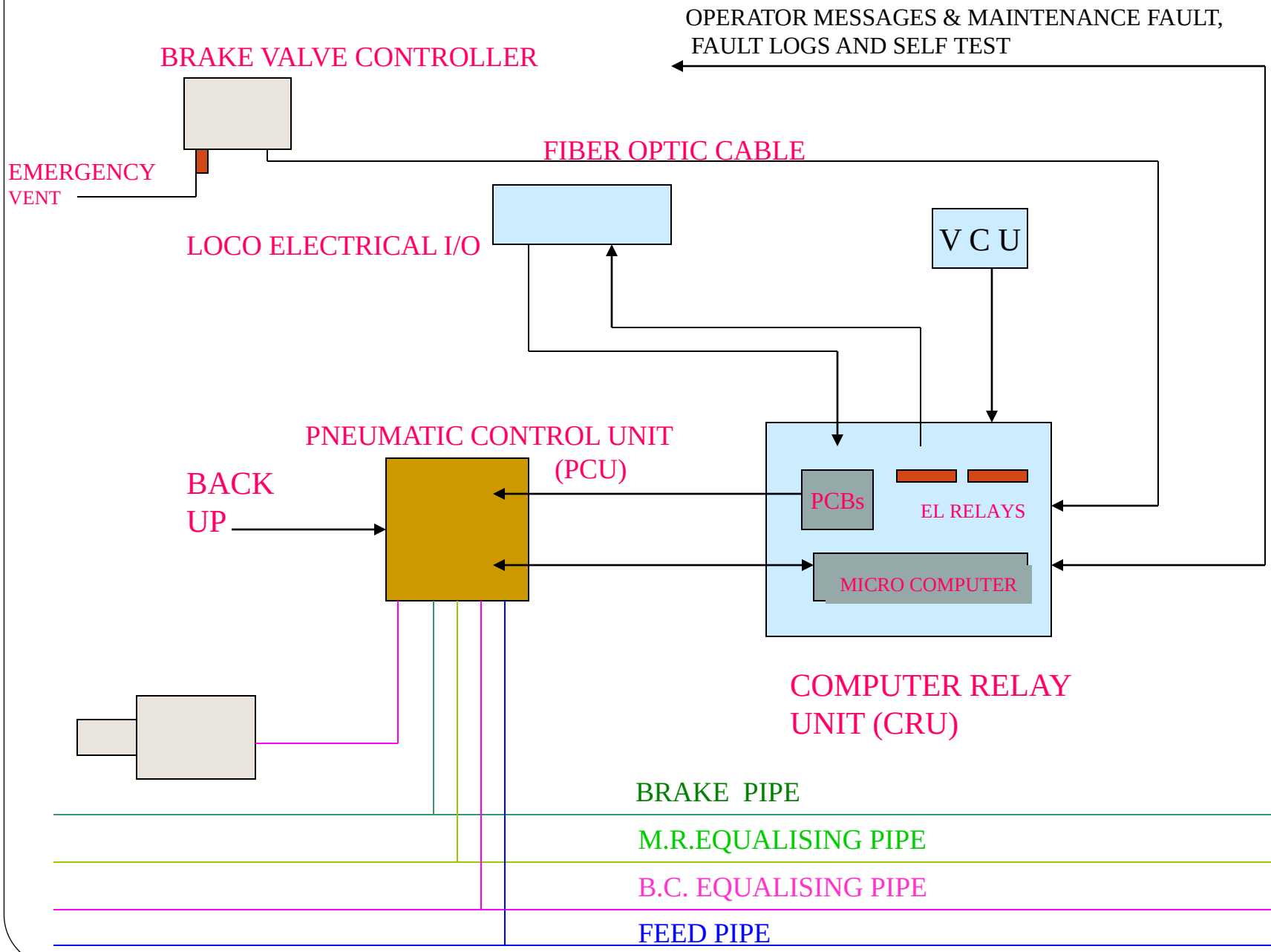
Voltage Conditioning Unit (VCU)

Computer Relay Unit (CRU)

Pneumatic Back-Up Distributor Valve

Pneumatic Control Unit (PCU)

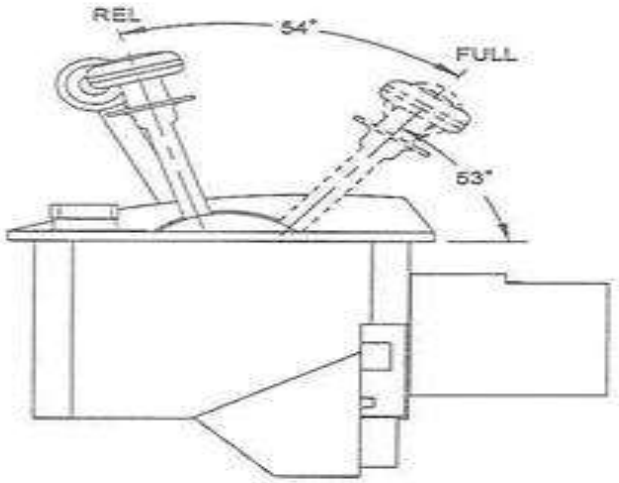
COMPUTER CONTROLLED BRAKE SYSTEM

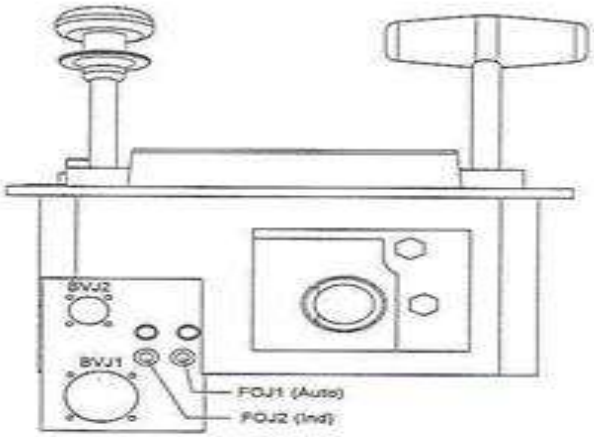


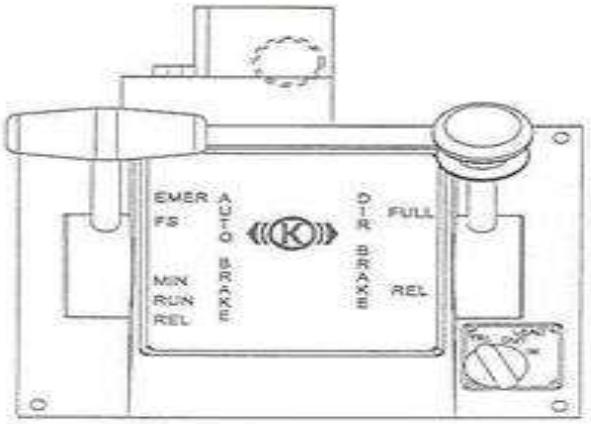
ELECTRONIC BRAKE VALVE CONTROLLER

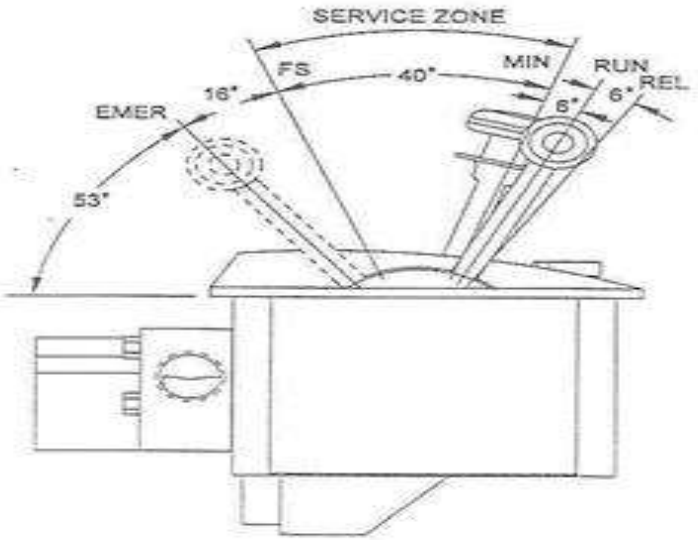
- Desk Top Model
- Push to brake configuration
- House emergency vent valve
- Contains following controls
  - Automatic Brake Handle
  - Independent Brake Handle
  - Lead / trail switch Handle
- Handles are attached to a variable resistor which provides input signal to the CCB computer

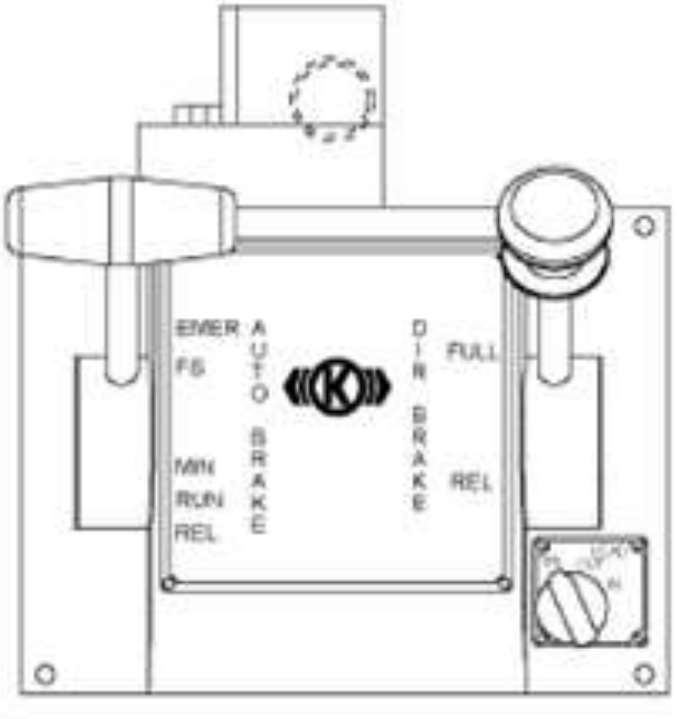
BRAKE VALVE CONTROLLER







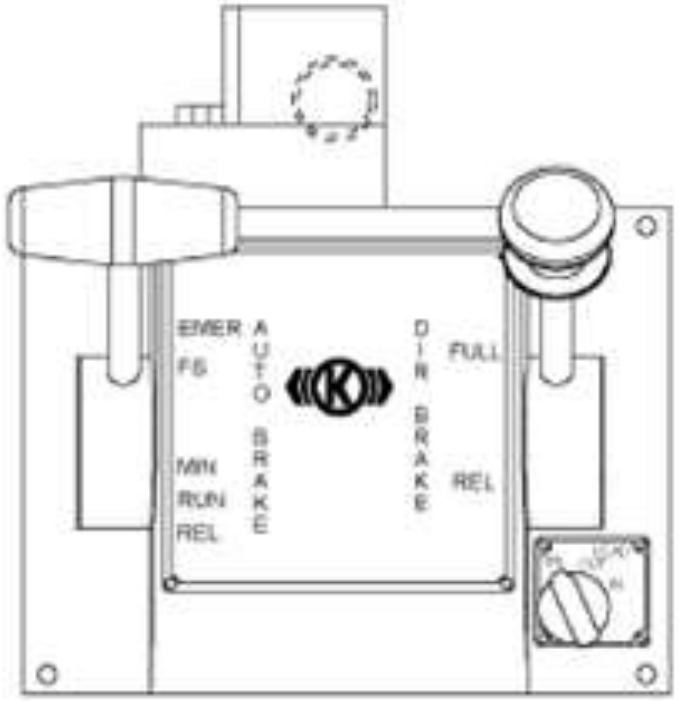




Independent (Direct) Brake system

Handle Positions	BC (kg/cm^2)	BCEP (kg/cm^2)
Release (REL)	**0**	**0**
Full Application (FULL)	**5.2 Max. (EMD), 3.5(ALCO)**	**5.2 Max.(EMD), 3.5(ALCO)**

Brake valve controller (BVC) handle positions



Automatic Brake system

Handle Positions	BP/ER (kg/cm^2)	BC (kg/cm^2)
Release (REL)	**5.7 Max. (EMD), 5.5(ALCO)**	**0**
Running (RUN)	**5.2 Max. (EMD), 5.0(ALCO)**	**0**
Minimum (MIN)	**Reduced to 4.7**	**0.3 to 0.4**
Full Service (FS)	**Reduced to 3.4**	**1.82**
Emergency (EMER)	**ER reduce to 0** **BP reduces less then 1**	**1.82**

Automatic Brake Valve (T-Red Handle)

- Control the application & release of both Locomotive & Train Brakes
- Pressure maintaining type which hold Brake pipe pressure constant as the selected pressure value
- Contains following positions
  - REL- overcharging (Extreme position towards Driver side)
  - RUN- normal release
  - MIN- minimum brake application
  - FS- full service application
  - EMER- emergency service:mechanical exhaust & for resetting after any emergency brake application

Independent Brake Valve(Round-Black Handle)

- Provide independent control of locomotive brake
- Contains following positions
  - REL- loco brake release (Extreme position towards driver)
  - FULL- full application of loco brake
  - BAIL OFF RING- Bailing off of loco brake

Lead /Trail Switch

- Contains following positions
  - LEAD IN - brake controller levers are active
  - TEST - to check BP leakage
  - TRAIL - Controller levers are inactive except for emergency application
  - HLPR – When in a Banker Loco

VOLTAGE CONDITIONING UNIT

- Connected to CRU through cables
- Supply all power for operation of the brake valve and computer
- Receives 75 V dc from Loco & gives output of 24 V dc
- Maintains a constant output voltage over a input voltage range of 20 -100 Vdc

COMPUTER RELAY UNIT (CRU)

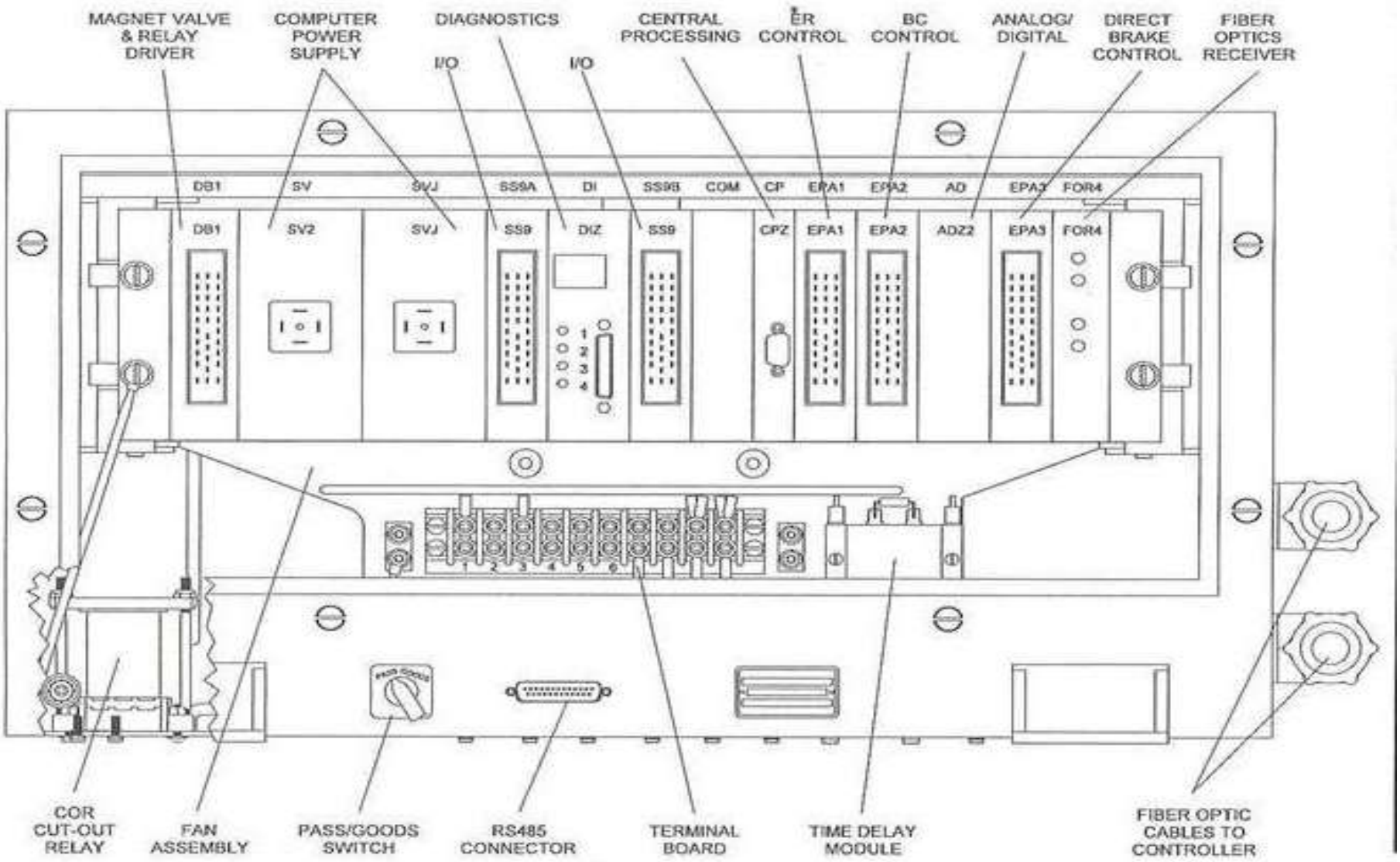
- Electronic control for brake system comprising of a computer and an input/output unit.
- Receives brake commands from driver and control PCU to develop pressure as logic dictates.
- Monitors the train line pipes and commands development of brake cylinder pressure.
- Provides vigilance system interface by responding to signals from locomotive control system and initiate penalty application at service rate.

COMPUTER RELAY UNIT (CRU)

CRU consists of 12 nos. Cards/Modules:

CPZ: Main microprocessor card.
SS9A: Receives signal command from Brake Valve conroller 1
SS9B: Receives signal command from Brake Valve conroller 2
EPA1: For ER & BP
EPA2 : For 16 & BC
EPA3 : For 20 & BCEP
DB1 : Driver Board card gives supply of 24V to all Magnet valves & Transducers.
ADZ : Analog to Digital & vice versa converter card.
SV2 : Power supply card for all MVs and rest of the cards through DB1
SVJ : Power supply card for power supply to Solenoid valves one each for Supply & Exhaust.
FOR: Fibre Optic Receiver decoding frequency of BVC into Electrical signal.
DIZ : Display card.

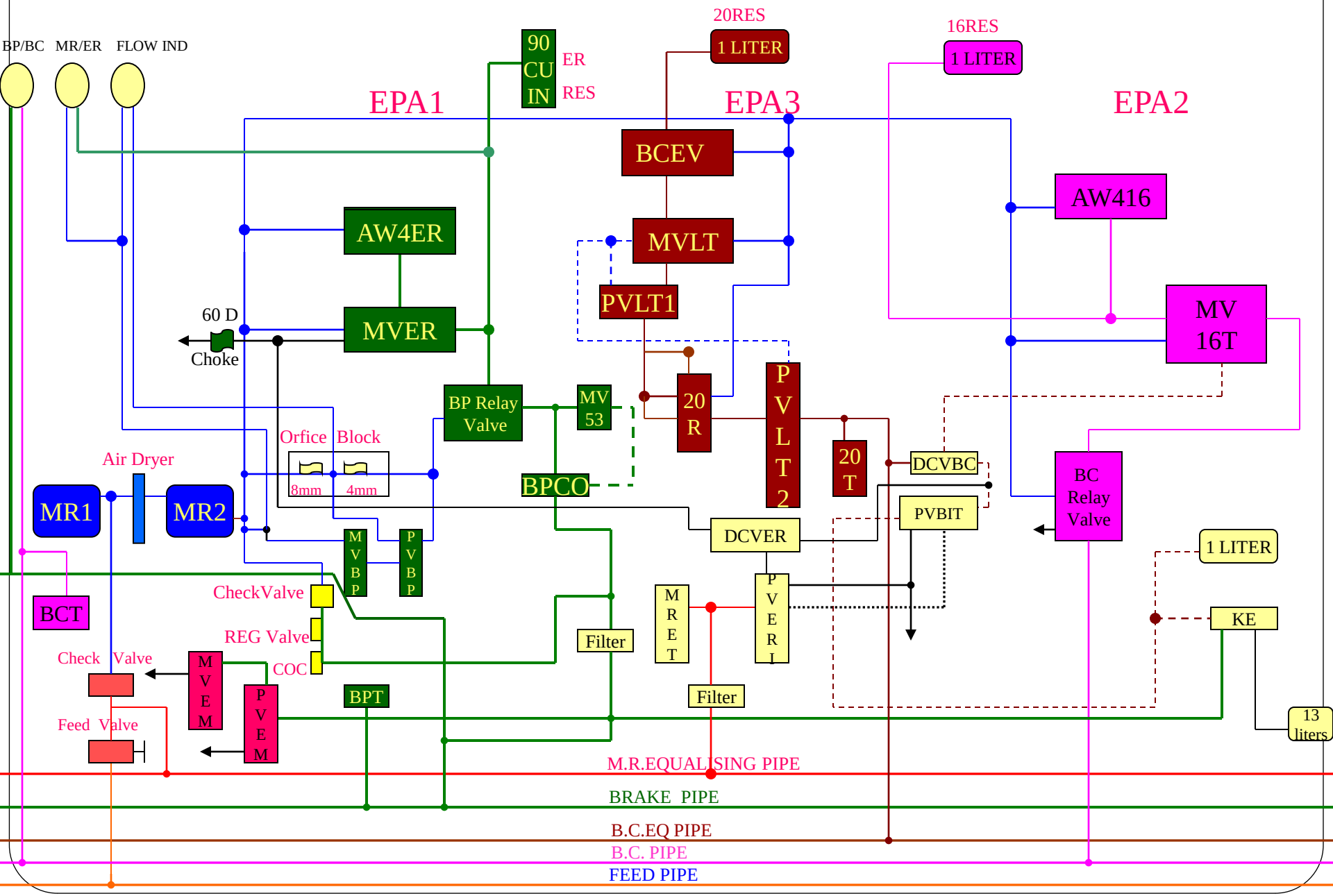
COMPUTER RELAY UNIT



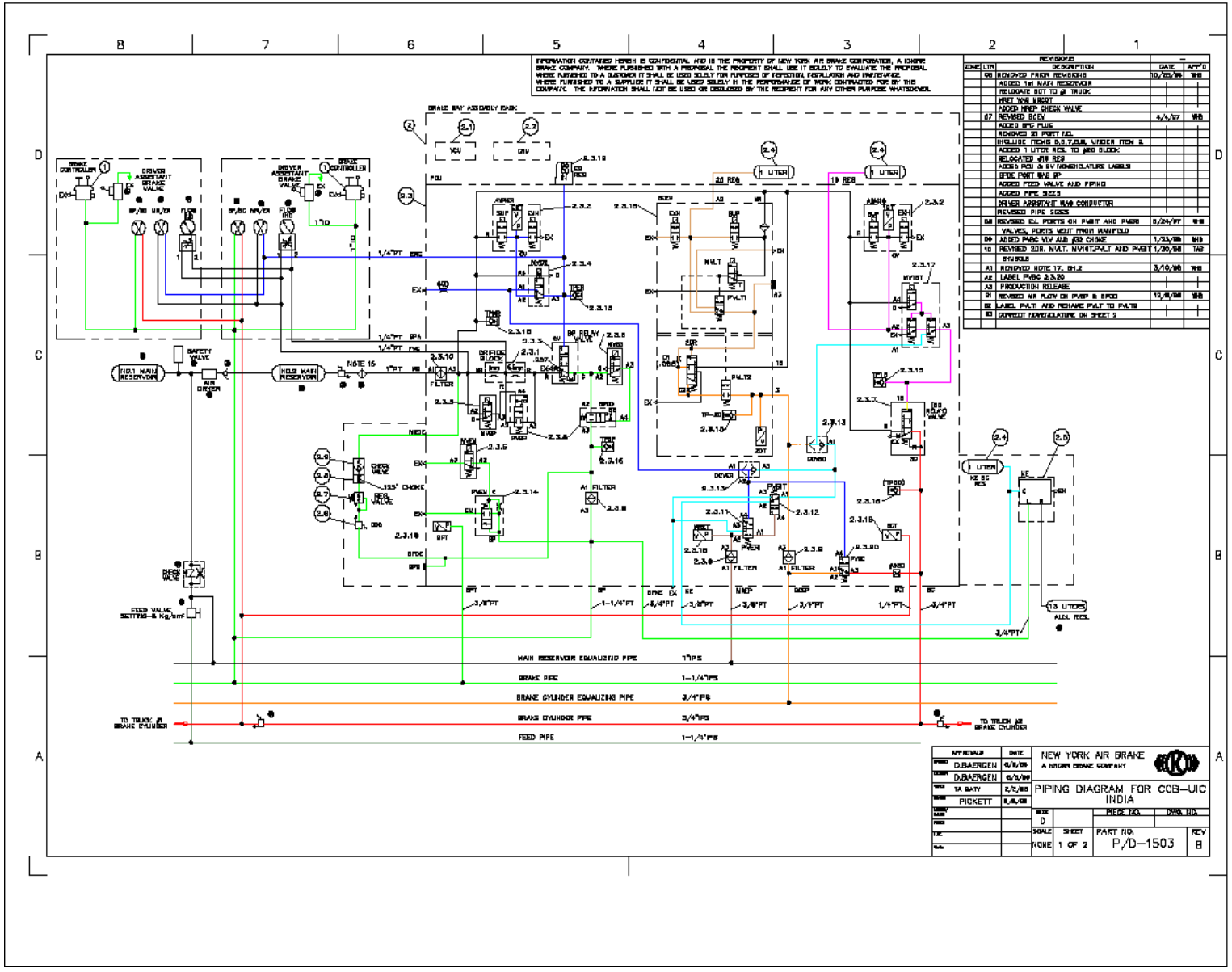
PNEUMATIC CONTROL UNIT(PCU)

- An electro-pneumatic device that responds to the CCB COMPUTER to develop pressure in
  - brake cylinder
  - brake pipe
  - b.c.equalising pipe
- Most of Brake pneumatic & electro- pneumatic valves are mounted on a laminated, aluminum panel
- In the event of power loss or as the result of critical diagnostic detection PCU arranges
  - Exhaust of brake pipe at service rate
  - Automatically lap of BP and BC equalising pipe for trail operation
  - Turn electronic control of brake cylinder to pneumatic control
  - Emergency brake initiation and brake cylinder development in purely mechanical nature.

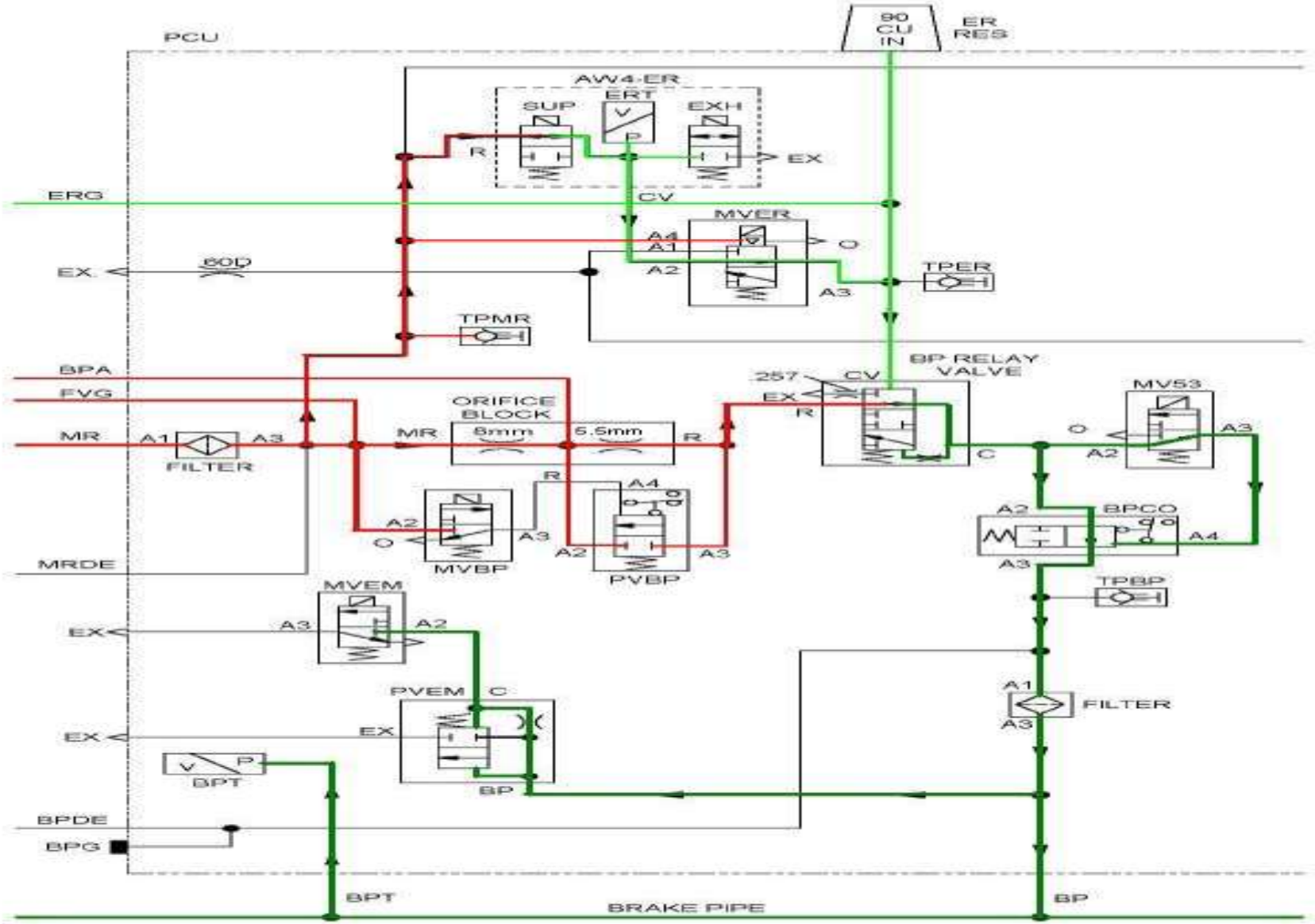
COMPUTER CONTROLLED BRAKE SYSTEM(PCU)



PIPING DIAGRAM CCB 1.5 SYSTEM



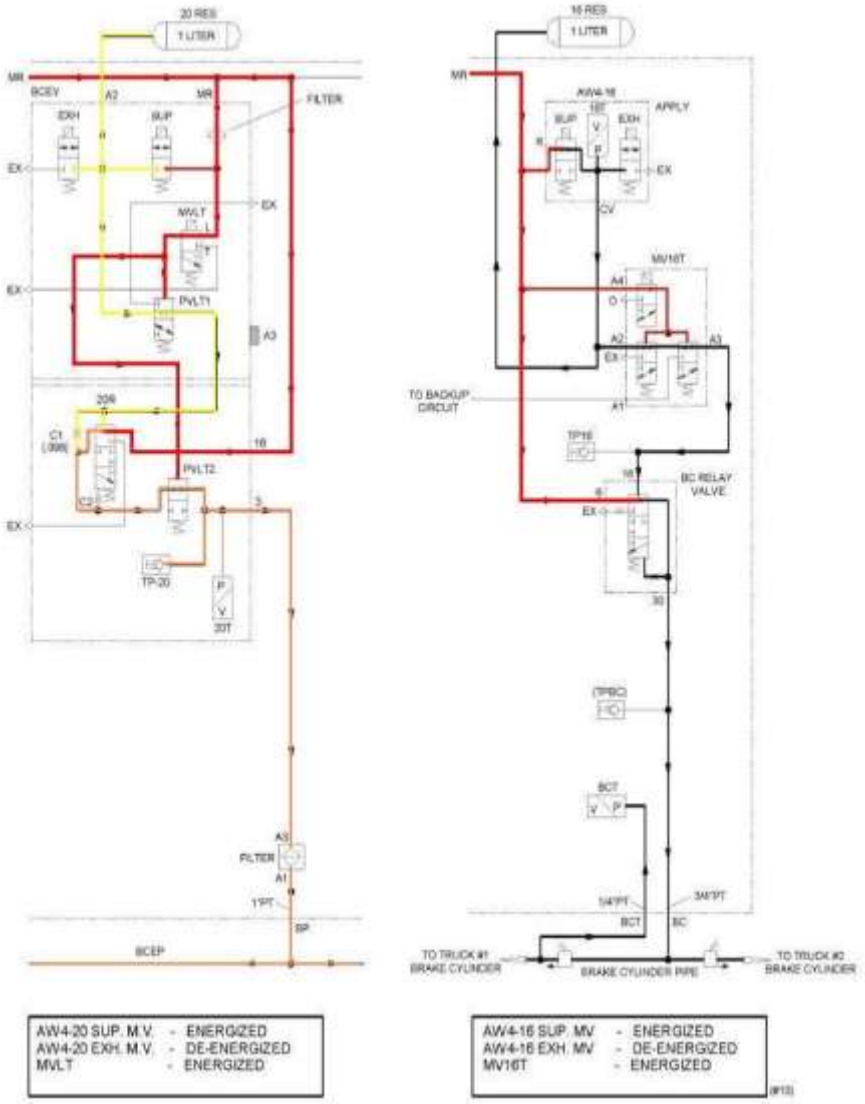
Brake Pipe Pressure Charging



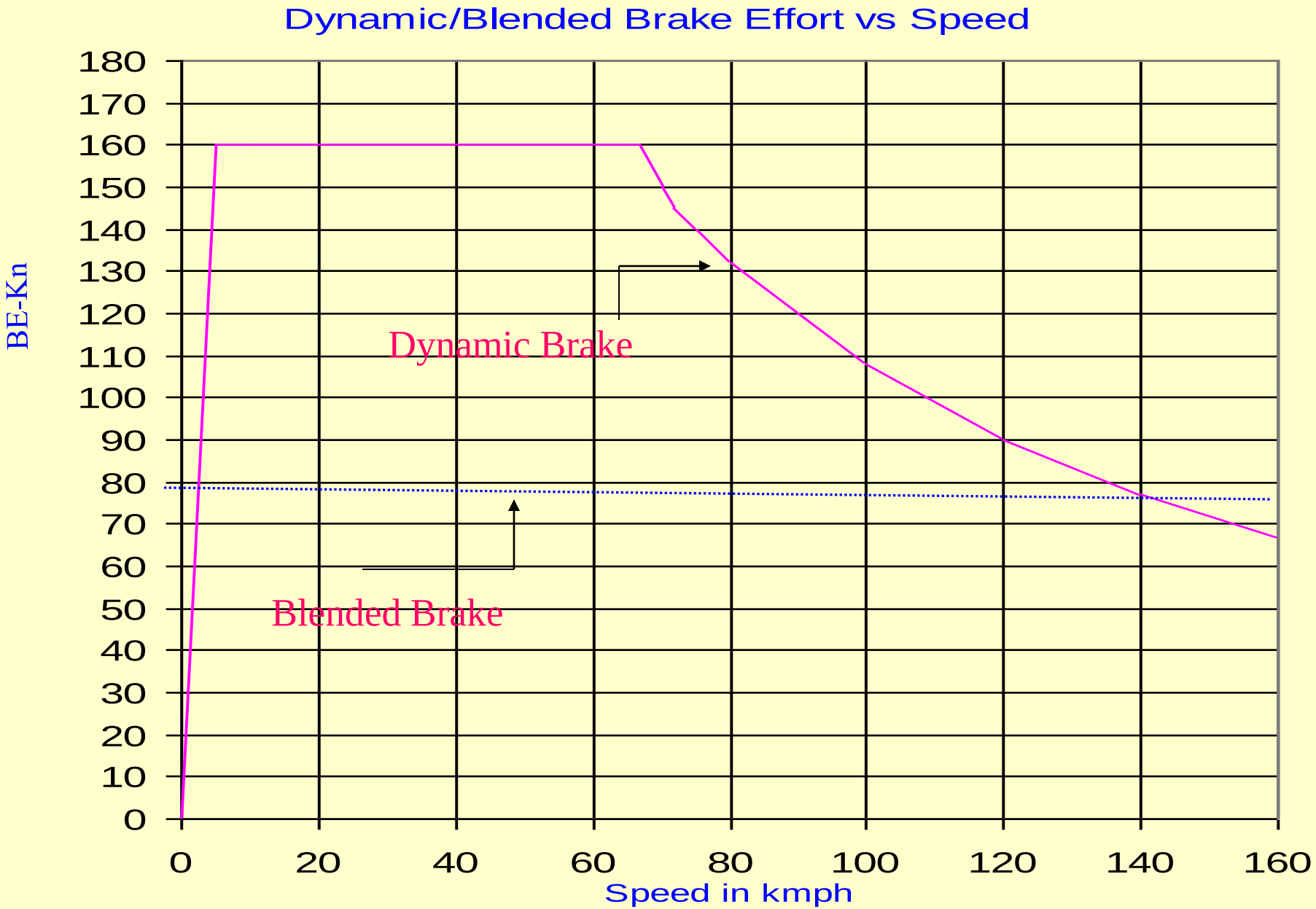
AW4-ER SUP. M.V.	-	ENERGIZED
AW4-ER EXH. M.V.	-	DE-ENERGIZED
MVER	-	ENERGIZED
MV53	-	DE-ENERGIZED

WORKING OF CCB SYSTEM

BC & BCEP Control



Blending of Brake



Total Braking = Dynamic Brake + Air Brake

CCB – Features Compared with IRAB1 System

CCB	IRAB 1
Microprocessor/Computer Controlled, Fibre Optic interface between Brake controller & Computer and further Electronic	All pneumatic interface (No electrical/OF interface)
All the pressures are pre set & are TAMPER PROOF	All the critical pressures can be tampered
Very accurate, Consistent pressures	Less accuracy & repeatability levels are poor
Precise control due to feedback through electronic signals	No feed backs available
Protection from charging of BP from both control stands same time	No protection –Unsafe
Blending feature available through software hence no need of Additional hardware	No Blended Brakes available
Quick Charging & Overcharging feature (with assimilation) available thru spring loaded position in Auto Brake Handle.	Thru foot peddle (pneumatic control) which is an additional equipment for Quick Release.
Inbuilt system diagnostics available	No such facility available
Self test on whole CCB system is available	No such facility available
Extended Overhauling Schedule every 6 year	24 months overhauling periodicity
Down load evaluation/preventive action is possible	No such facility
Remote operation/DPC/Locotrol is possible	No such facility

CCB – Features Compared with IRAB1 System

CCB	IRAB 1
ACD can be fitted thru computer interface	No such facility
Further upgradation is possible	No such facility
Interfacing available for Vigilance device (Alerter) thru serial interfacing (w/o any additional hardware) and is 100% functional and safe.	No such facility
BP leakage for Loco and for full train can be tested by just selecting Lead/Trail switch in "Test".	No such facility
Applies penalty brakes for safety, ensures acknowledgement by driver (10sec Penalty in case of communication failure, LCC/CCB Breaker tripping or re-cycling, 60 sec penalty in emergency application, parting etc). Without driver's acknowledgement BP will not re-charge automatically, which is unsafe.	No such facility
Graduated brake application & Quick release is computer controlled and is precise	No such facility
Provision for switching mode to operate Freight and Passenger service	No such facility

DIAGNOSTIC

- Self test
  - –A routine comprehensive health test
- Fault
  - –Monitor braking system defects.
  - –Penalty brake application if critical brake fault is detected.
  - –Otherwise, information is displayed to the operator and send to main loco computer
  - – Identify the probable device which caused the fault
- Portable test unit
  - –A connection provided for portable test unit (Laptop computer)
  - –Allows detailed circuit and component tests for maintenance

PROCEDURE FOR AIR BRAKE SELF TEST

Before running the self test verify the following safety points.

Locomotive speed is zero.

Apply hand brakes and place the skids in position.

Verify one controller is in lead and the other controller is in trail. Neither of the Automatic brake (A9) handle of the controllers should be in EMERGENCY position.

Reverser to be CENTERED and throttle to be in IDLE position.

Main reservoir (MR2) pressure is above 8 Kg/sq cm.

No controller faults(20-2D & 30-3D), Passenger Goods Switch Failure faults(4A,4B) and transducer fault(50) are active.

Do not use BAIL OFF during the self test.

Conduct the self test.

Verify self test passes. If fails consult the Diesel shed and follow the instructions.

ADVANTAGES OF CCB

- Fault Diagnostic:
  - An excellent trouble shooting tool which reduces down time of locomotive
  - Reduces technical skill required for trouble shooting
- Self test - Reduces brake system checking time
- Vigilance control trough software with no additional valve
- Precise control of brake pipe and brake cylinder pressure by electronic logic replacing pneumatic logic
- Provides flexibility for future system upgrades
- Enhanced safety through constant monitoring of critical safety functions
- Elimination of air pipes

Main Reservoir =	8-10 kg/cm^2
Release- BP =	5.6 kg/cm^2
Running- ER & B.P =	5.2 kg/cm^2, B.C=0
Minimum Service-	ER/BP reduces to 4.7kg/cm^2 ,B.C=1.1kg/cm^2
Full Service-	ER/BP reduces to 3.4kg/cm^2 , B.C=4.35kg/cm^2
Emergency-	ER reduces to 0 , B.C=4.35kg/cm^2
	BP reduces to less than 1 kg/cm^2
BCEP=	3.57kg/cm^2

THANKS