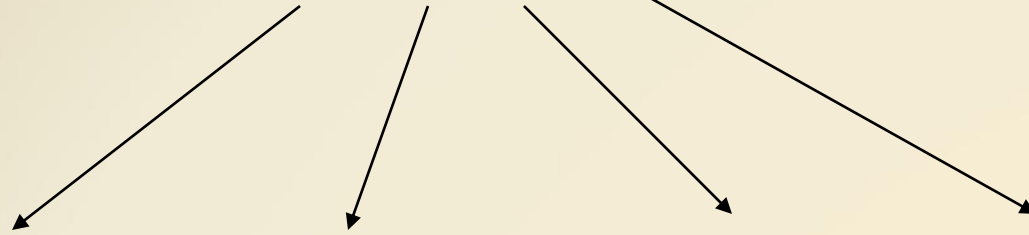


DEMU



DEMU



Diesel Electric Multiple Unit

Diesel Multiple Unit

Diesel Multiple Unit

DEMU

DMMU

AC-DC

AC-AC

DHMMU

DEMU AC-AC TRACTION

- *The Power transmission in conventional DEMU is AC-DC-DC.*
 - *Engine + Alternator + Rectifier + DC TMs.*
- *In the new DEMU the power transmission is AC-DC-AC*
 - *Engine + Alternator + Rectifier + Traction Converter + AC Traction Motors.*

DEMU Advantages

- Scalability
- Quicker Acceleration and Braking
- Quick reversal – no shunting required at endpoints
- Low system Construction Costs
- Less maintenance
- More Fuel Efficient



700 hp DEMU – 1994

6-car formation **DPC+TC+TC+TC+TC+DPC**

700 HP DEMU

Salient Features

- Composition – DPC + TC + TC
- Maximum speed – 100 KMPH
- Bogie mounted graduated release air brake system
- Schaku type semi permanent coupler
- Fully vestibuled unit for inter coach passenger movement

High Horse Power DEMU 1400 HP



1999



2004



1400hp DEMU – 2000

8 car formation



- FRP Nosecone from 2004
- Steel Nosecone from 2013



1400 HP DEMU

Salient Features

- Composition – DPC + TC + TC +TC
- Maximum speed – 100 KM
- Air Spring secondary suspension
- Bogie mounted graduated release air brake / EP brake system
- Schaku type semi permanent coupler
- Fully vestibuled unit for inter coach passenger movement

1400 HP DEMU

Propulsion System

- A 1400 HP 1800 rpm water cooled diesel engine drives a 1150kVA 3 phase brushless alternator
- The three phase output of the alternator is rectified using a full wave silicon bridge rectifier
- The DC output of the rectifier is fed to 4 Nos. of Axle hung nose suspended DC series traction motors of 208 KW rating
- The alternator excitation, engine rpm and power output is regulated by an Electronic Governor

TECHNICAL DETAILS OF MOTIVE POWER EQUIPMENT – 1400 HP DEMU

(i) Engine

	CIL	CATERPILLAR
Model	KTA 50 L	3508B
Type	16 cylinder 60 deg. V	8 cylinder Inline
HP	1400	1400
Rated RPM	1800	1800
Weight (Kg)	4858	4975
SFC at rpm (gm/bhp/hour)	215.93	197.6

1400 hp DEMU - 2006



- 8 car rake with two power cars at ends
- Power cars equipped with 1400hp Diesel power pack
- All coaches fitted with Roof Mounted Heating Units (RMHU) to keep interiors warm
- Two trailer cars fitted with underslung diesel alternator sets to power the RMHUs
- Switch over to 1600hp AC-AC DEMU from 2016-17.

1600 HP IGBT AC DEMU



1600 hp AC-AC DEMU -2013



10 car formation

DPC+TCV+TCG+TCG+TCG+TCG+TCG+TCG+TCV+DPC



- First of its kind stainless steel DEMU in IR
- First DEMU with 3 phase AC-AC transmission
- First DEMU turned out in Oct. 2013 to SCR



1600 HP IGBT AC DEMU

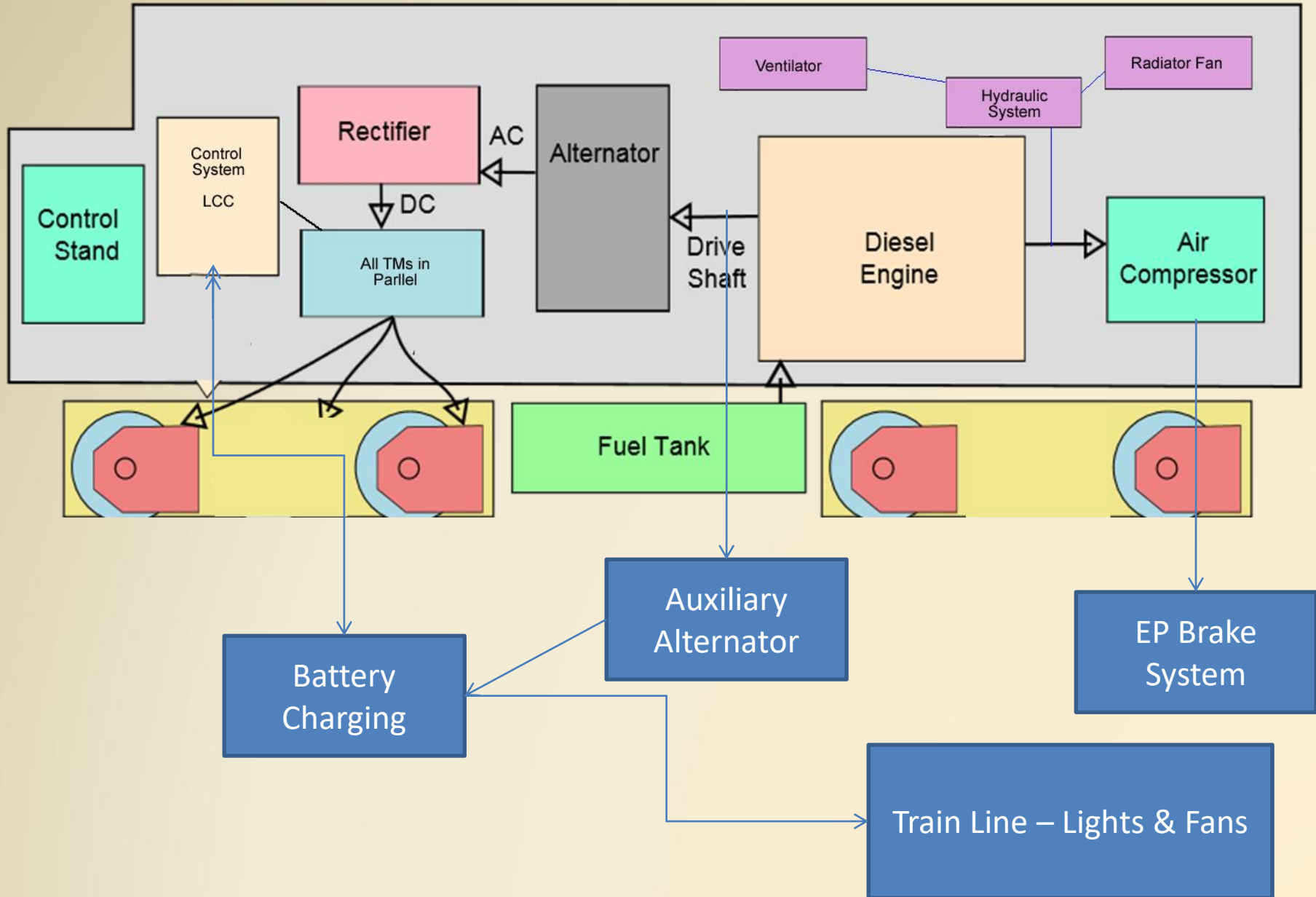
- First rake Manufactured in 2013
- Rake formation – 1DPC+1TC/V + 6 TC + 1TC/V + 1 DPC
- Each rake has 10 coaches against 8 coaches on 1400 hp DEMU
- Stainless steel Shells of Linke Hoffman Bosch (LHB) design
- Sidewall, endwall of SS-409 M grade, roof SS-304 and underframe of corten steel.
- IGBT (Insulated gate bipolar transistor) – latest switching device)
Based 3 phase technology
- Wider vestibule openings in ends for easy movement of passengers.
- Aluminium windows with polycarbonate fixed louvers on top and bottom half movable
- FRP Panelling with concealed fasteners
- Improved design cushion seats
- Trailer coaches provided with toilets.

1600 HP Diesel Engine

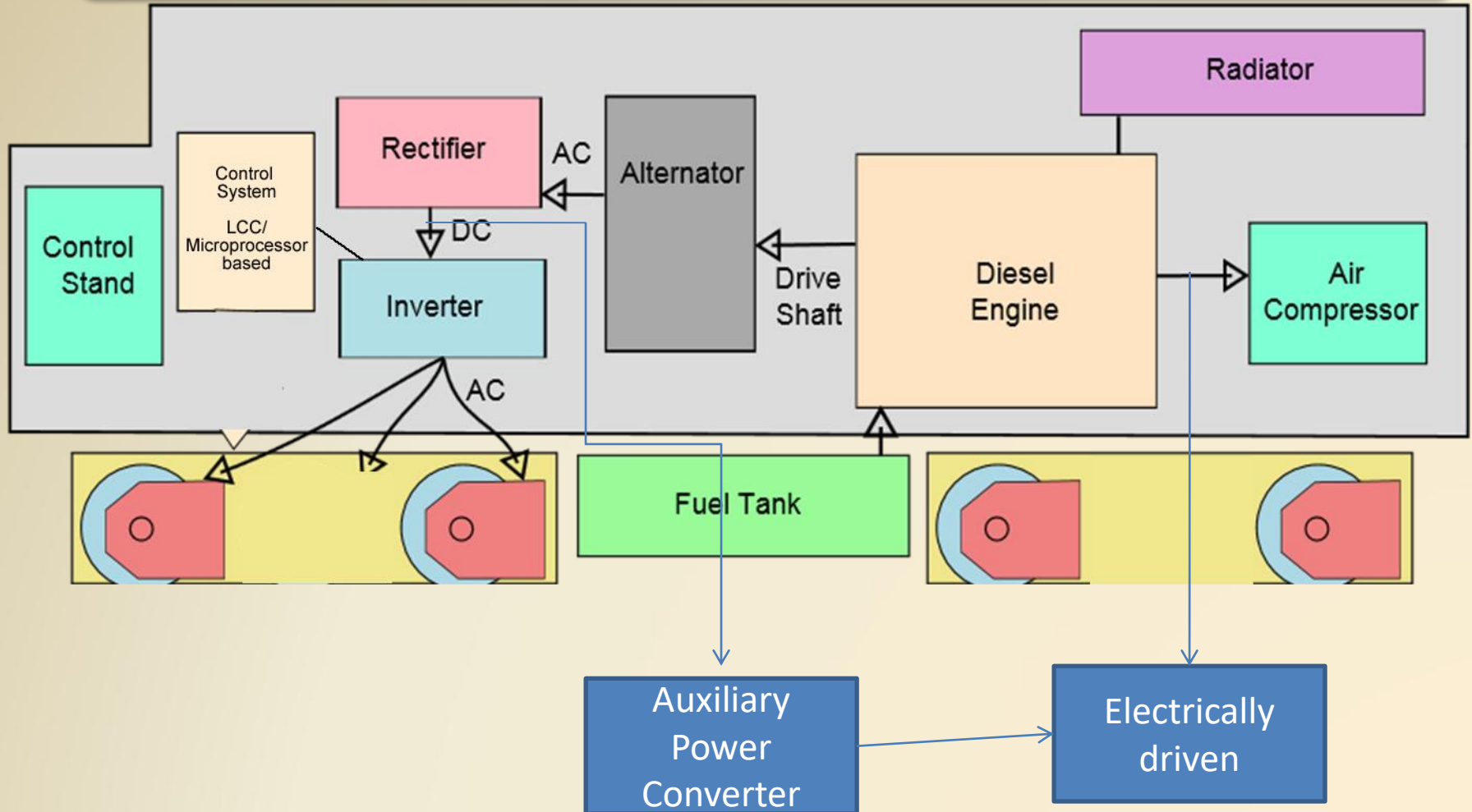
- ◆ New generation Diesel Engine with Electronic fuel Injection (EFI) system. 1600 HP @ 1800 RPM
- ◆ Emission compliant and fuel efficient engine
- ◆ Engine Control Unit (ECU) for engine control and functions and protection
- ◆ Compact Hydraulic cooling system with microprocessor based control.
- ◆ Starting system uses separate battery bank with starter motor. After cranking small alternator charges this battery
- ◆ Hydraulically operated ventilation and radiator fans
- ◆ Common base rail for mounting Engine and Traction Alternator with a coupling between them.

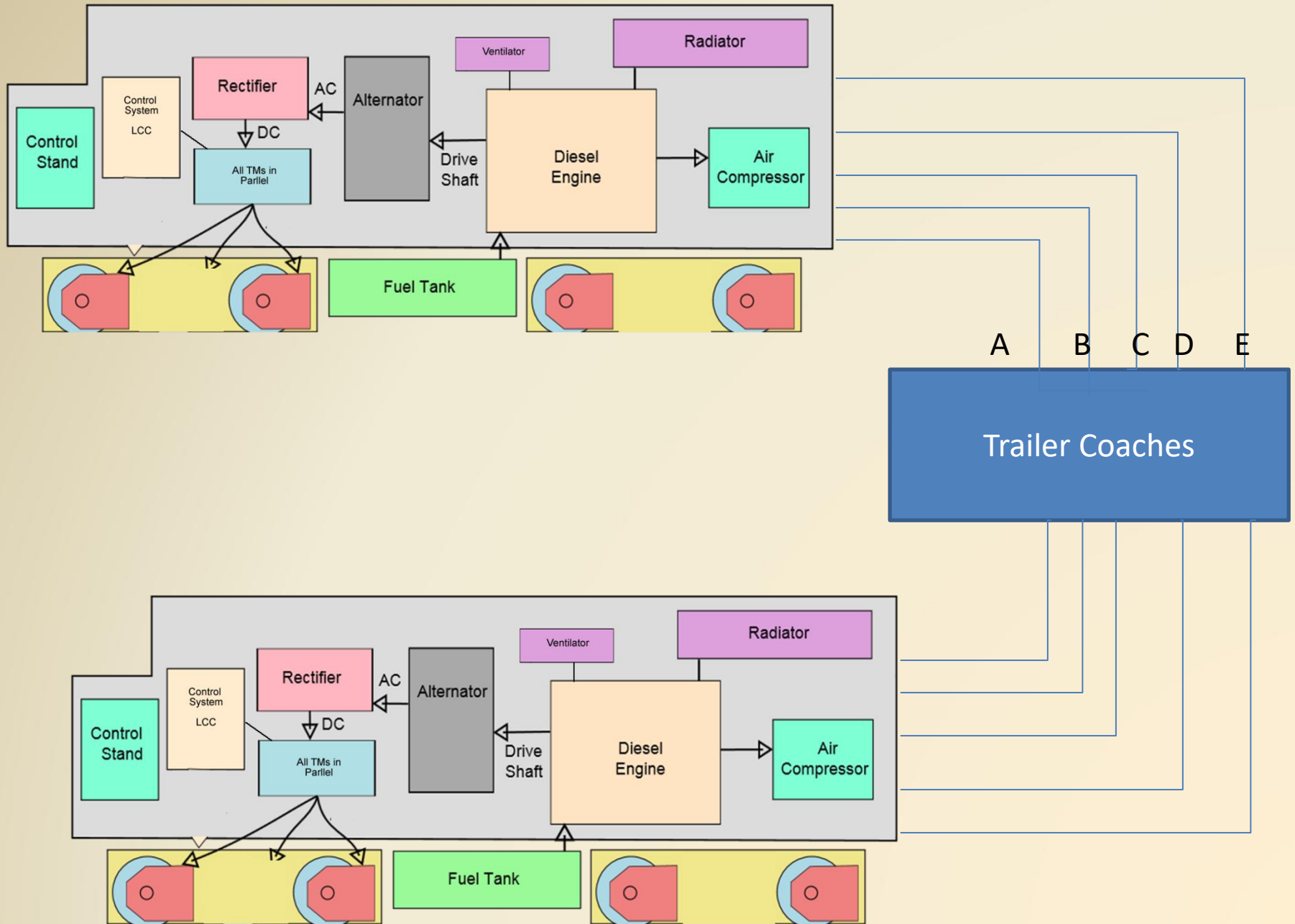
Seating Capacity

	700 HP		1400 HP		1600 HP	
	Sitting	Standing	Sitting	Standing	Sitting	Standing
DPC	72	72	52	34	29	86
TC	108	216	96	218	84	247
TC /V	-	-	97	246	89	246
Rake Formation	DPC+ 4TC+DPC		DPC+TC/V+ 4TC+TC/V+DPC		DPC+TC/V+ 6TC+TC/V+DPC	
Total Capacity	1584		2084		2886	

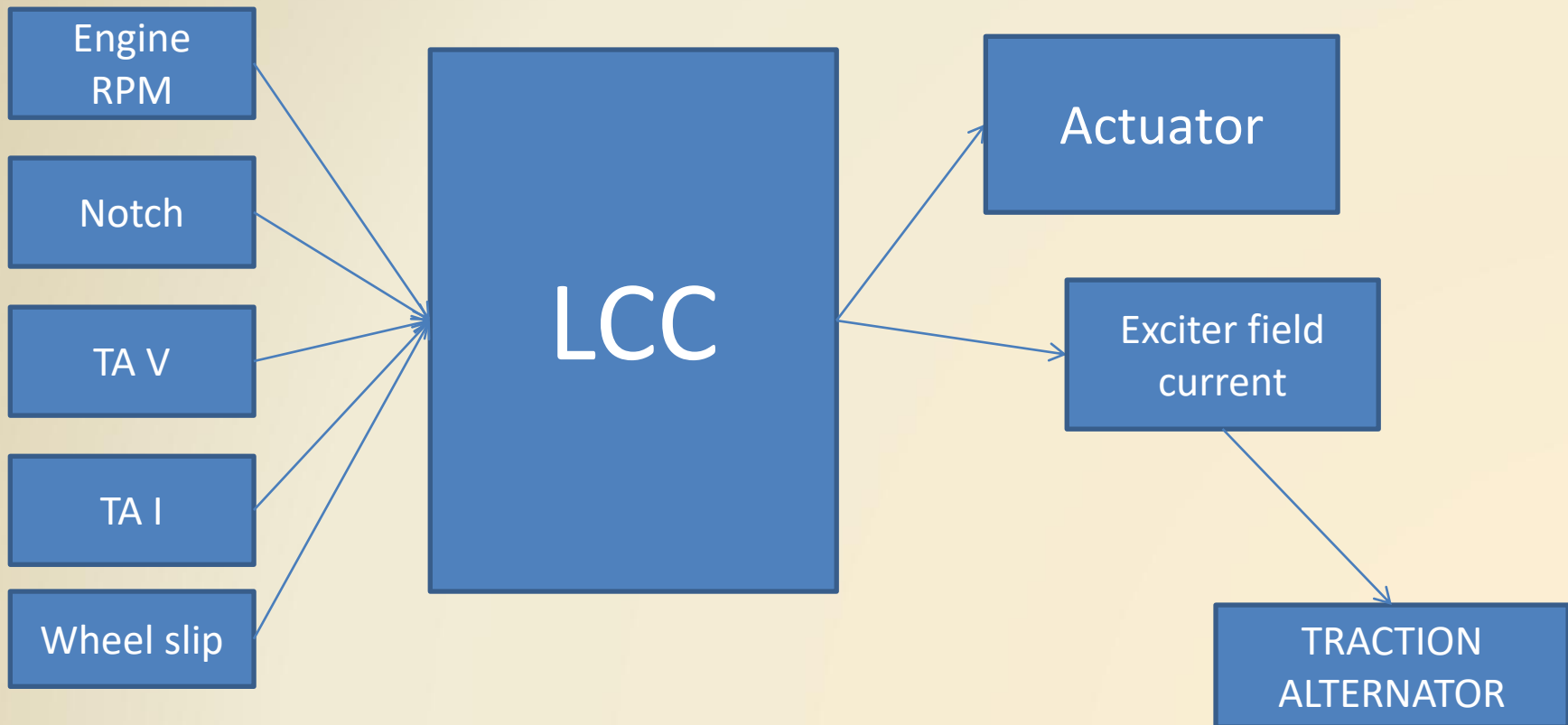


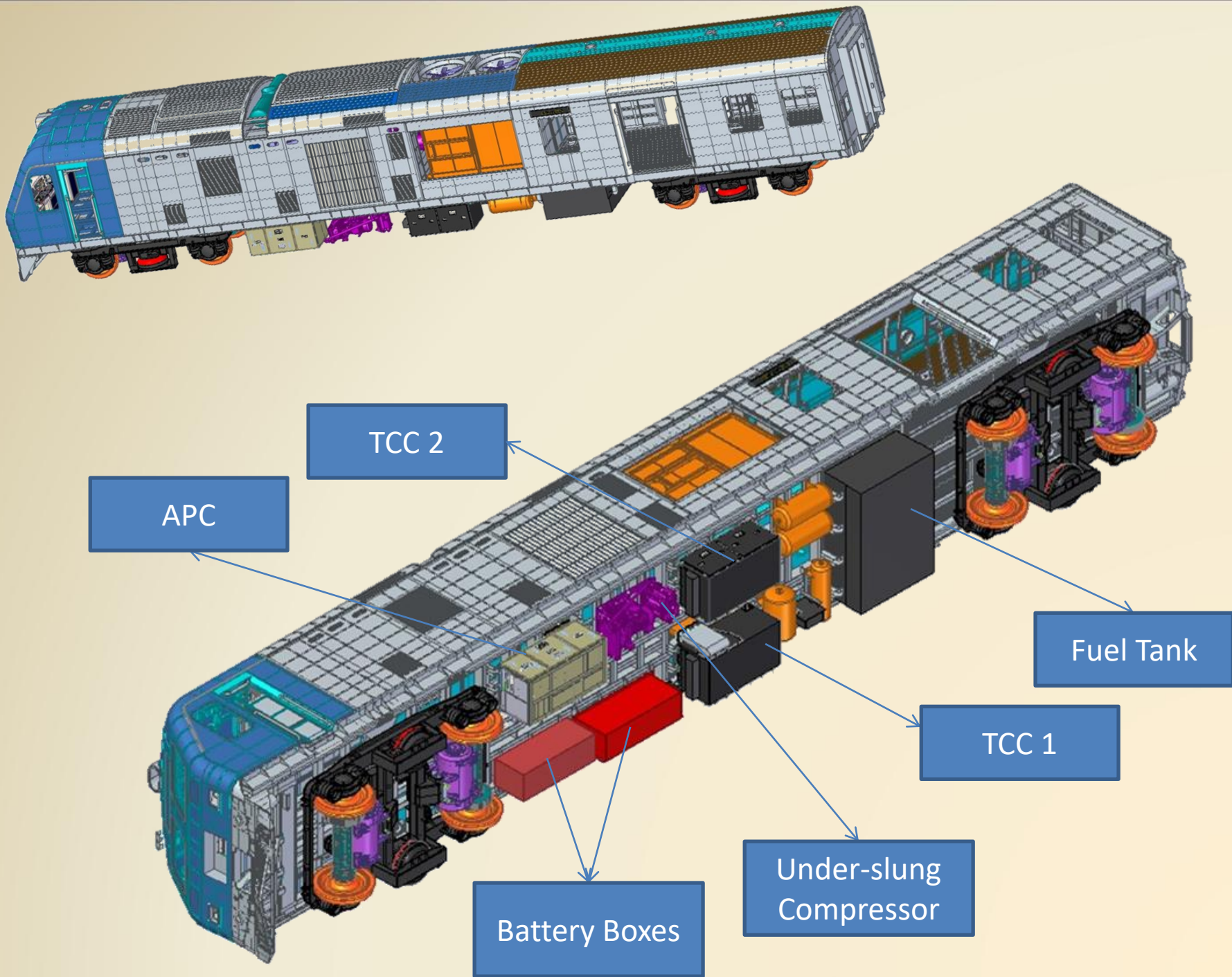
AC-AC Transmission

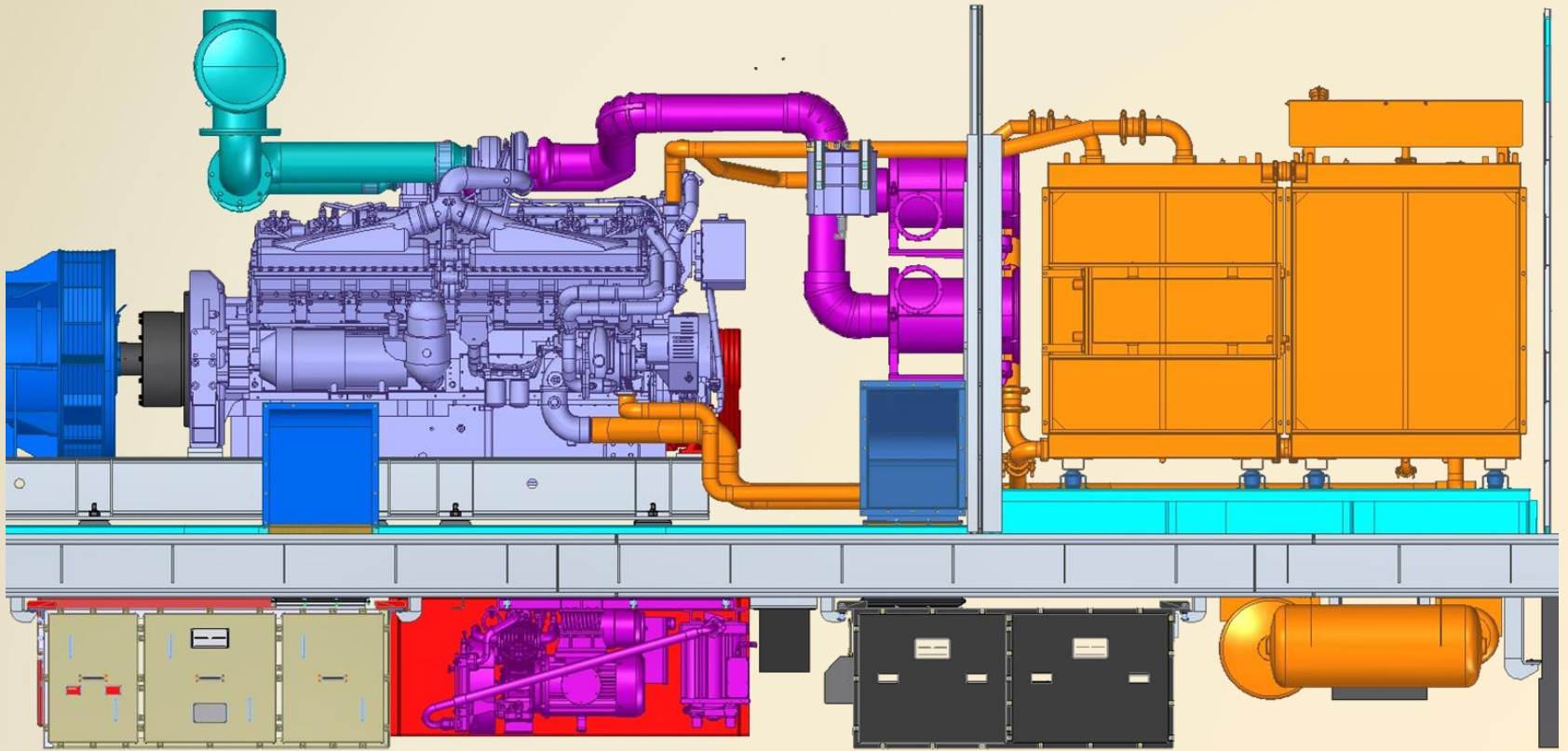




- On Diesel power cars -Governing of the engine speed as well as alternator excitation and load control is achieved through the Locomotive Control Console (LCC).







AC-AC DEMU – FUNCTIONS

CONSTANT HP CONTROL

8th Notch working with Full Auxiliary Power

- | | |
|--|---------|
| ➤ Engine HP at Site conditions | 1617 HP |
| ➤ Mechanical Auxiliary Power (Radiator, compressor) | 120 HP |
| ➤ Input to Traction Alternator (Traction +APC I/p) | 1497 HP |
| ➤ Traction Alternator Output (Alt. Efficiency 95%) | 1422 HP |
| ➤ Rectifier Output (Rect. Effi. 99.5%) | 1415 HP |
| ➤ Tr. Converter Input (Rect. O/P - APC power) | 1371 HP |
| ➤ Power input to Tr.Motors (TI Effi. - 99%) | 1357 HP |
| ➤ Power Available at wheels (Motor & Gear Effi.-91%) | 1237 HP |
| ➤ Power available per wheel (309 HP) | 227 kW |

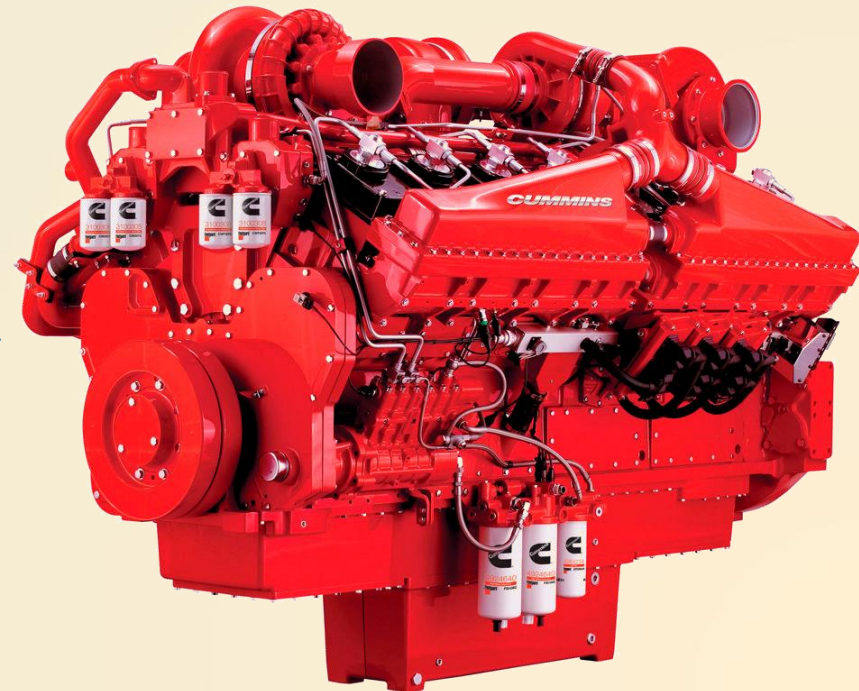
EU III A Compliant Diesel Engine

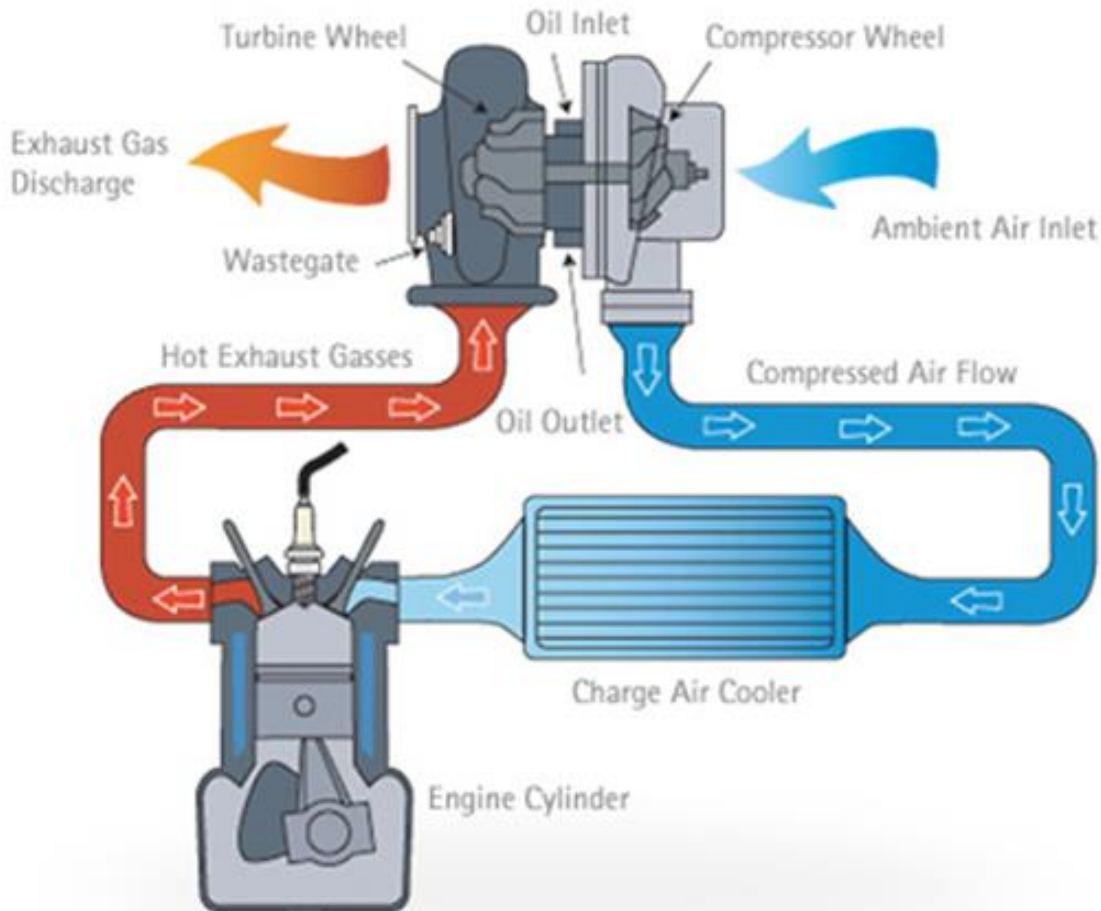


CAT 3512 C

1800 RPM 2200 HP
Approx Weight 7 Tons

Cummins QSK 50



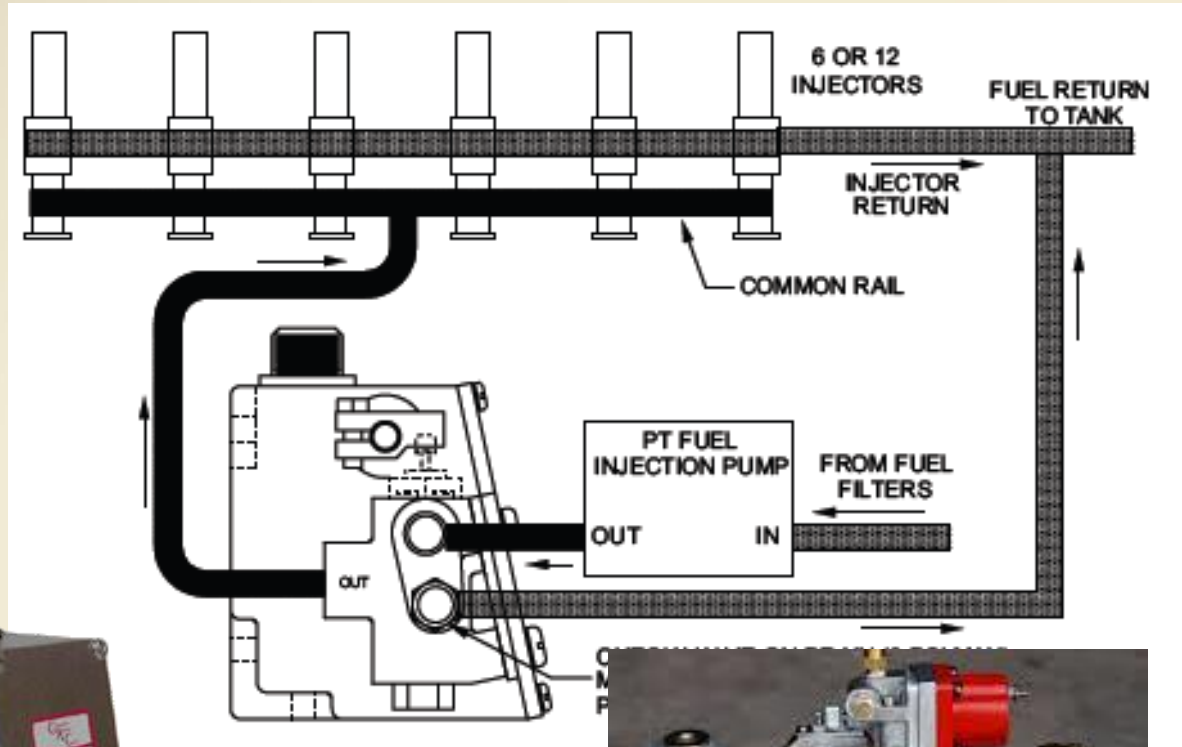


- ✓ Air Intake system (Turbocharging)
- ✓ Fuel oil System
- ✓ Lube oil system
- ✓ Cooling system
- ✓ Governing/ actuation
- ✓ Over speed/ Temperature protection

Notch Position

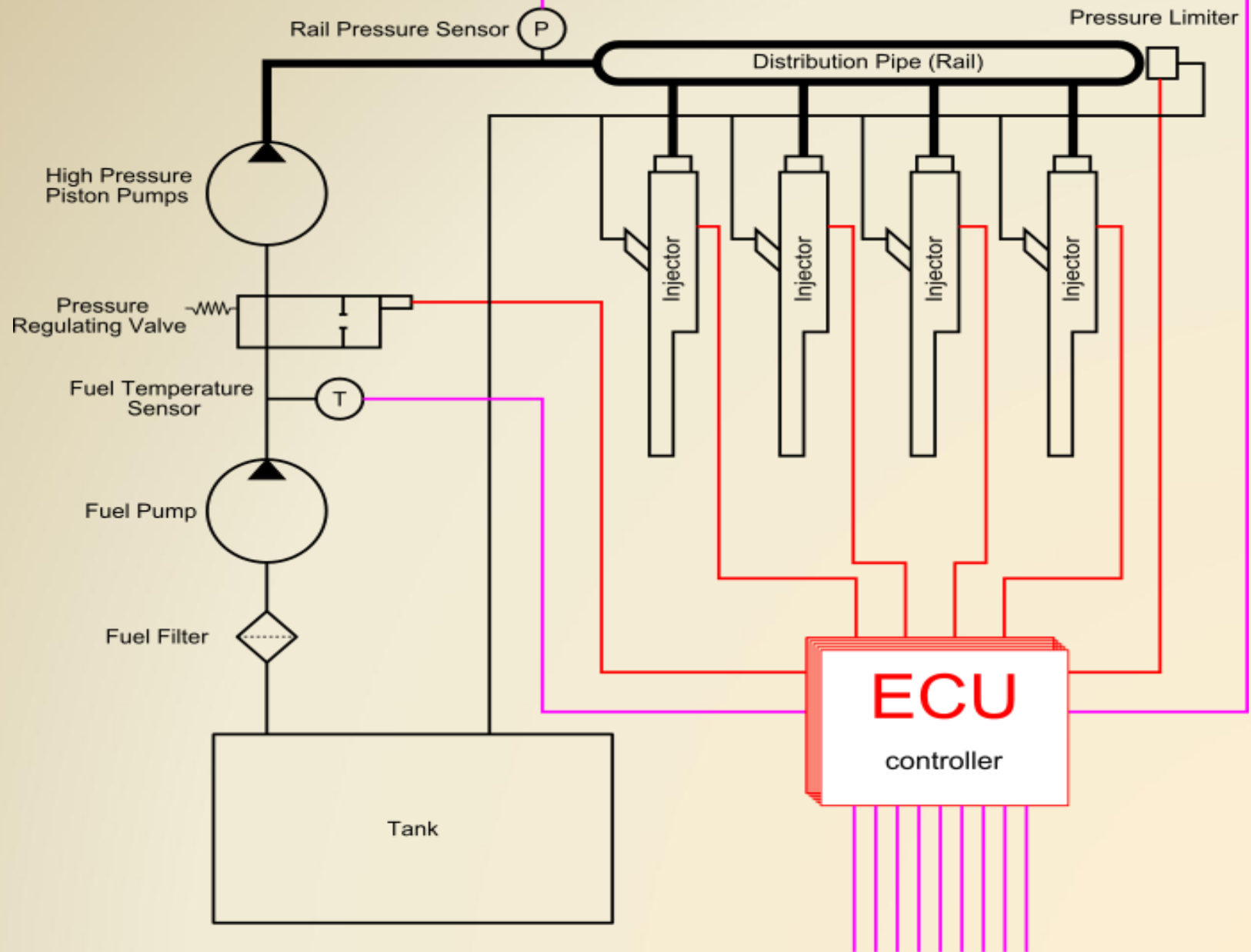
Engine RPM

FUEL SCHEMATIC



LCC





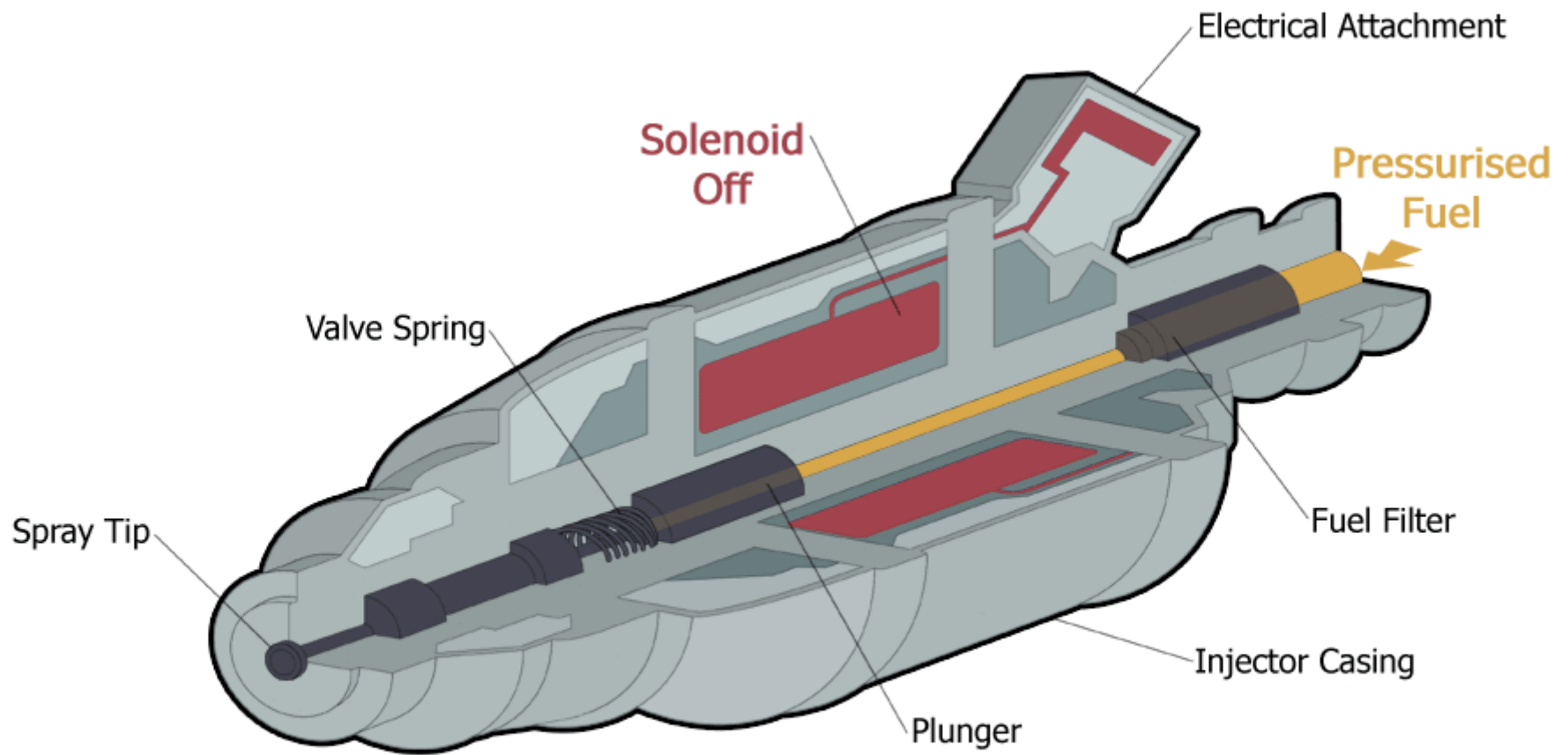
ECU
controller

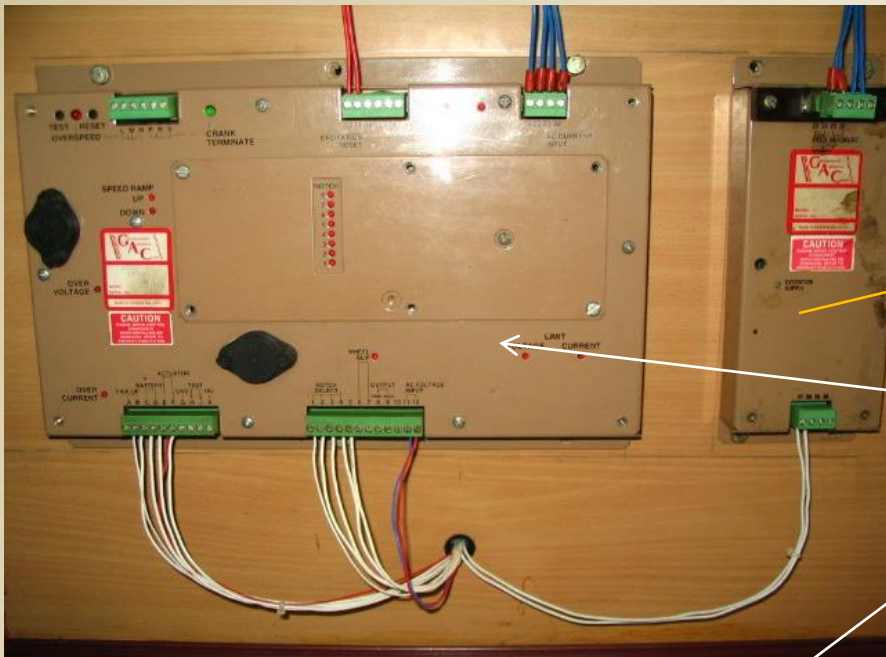
Other Sensors

- Reference Mark, Engine Speed
- Accelerator Pedal Position, Load Pressure
- Radiator and Air Temperature Sensor

Electronic Fuel Injection

- High-pressure injection system and electronic controls ensure clean, powerful and efficient operation every time.
- The ECM continuously monitors data from strategically placed sensors within the engine, optimizing the fuel-to-air mixture for maximum combustion. Fuel is injected at pressures exceeding 25,000 psi.
- This results in better utilization of fuel with fewer emissions. Getting more energy out of every drop of diesel fuel also results in greater power.
- Multiple injection events during each power stroke yield smoother, more consistent power at every rpm.

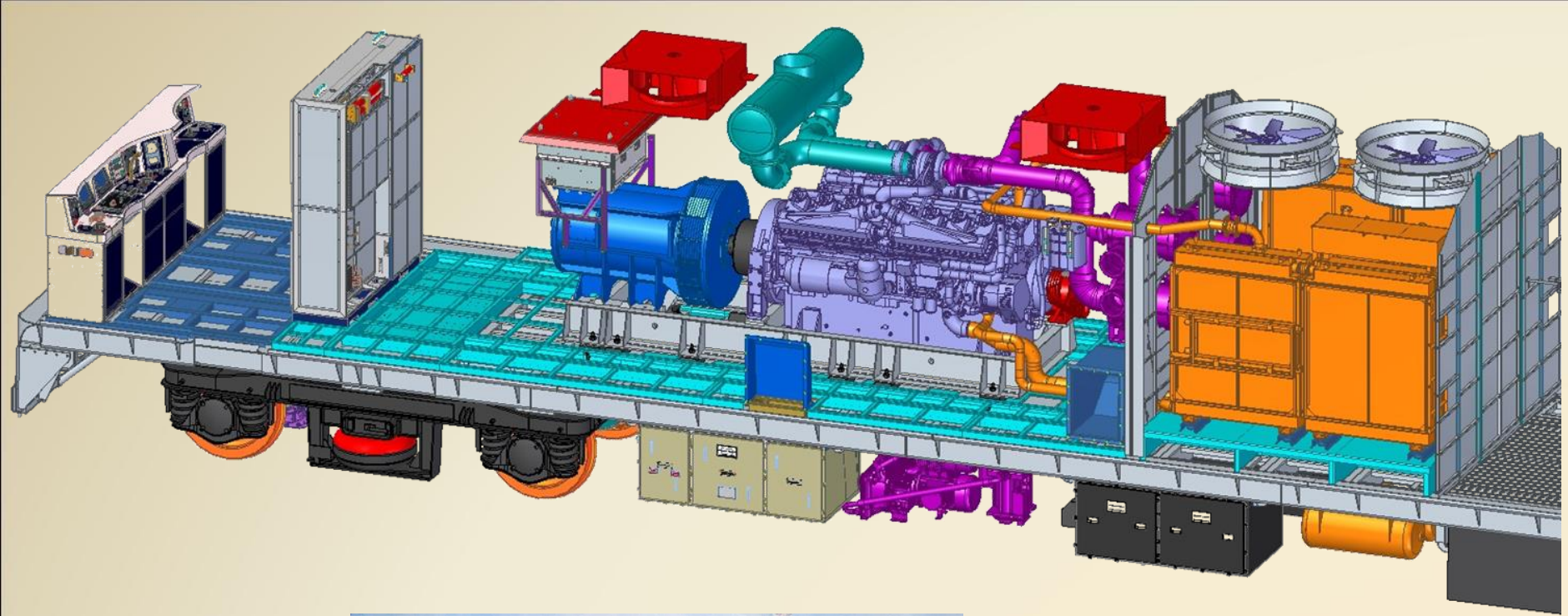




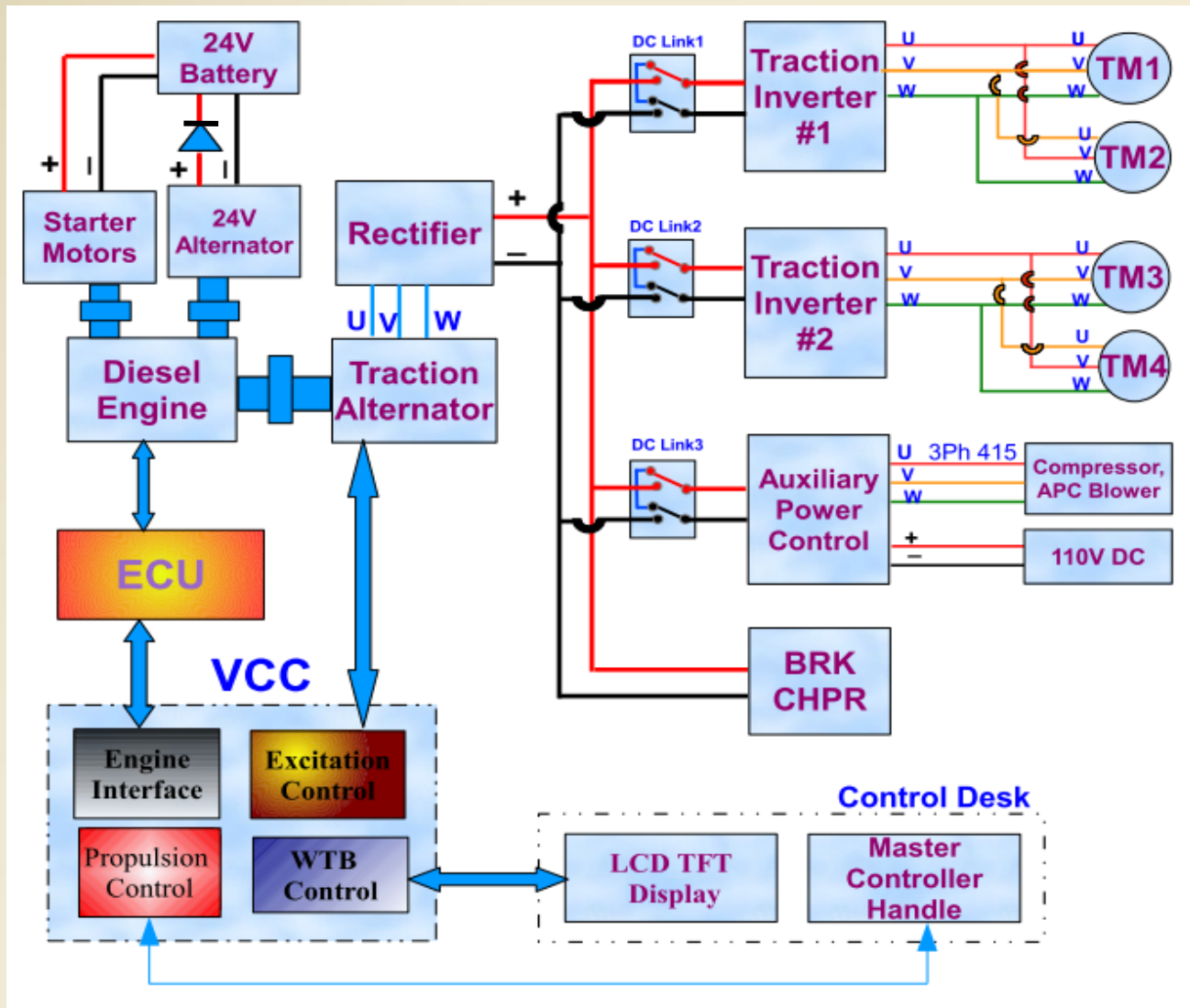
SPEED MODULE

POWER MODULE





SYSTEM LEVEL BLOCK DIAGRAM



Traction Motors

- ◆ These motors are 3phase AC induction motor suitable for VVVF (Variable Voltage and Variable Frequency) control.
- ◆ Four AC Traction Motors two in each truck to drive individual wheels.
- ◆ Traction motor includes pinion, bull gear and gear case assembly.
- ◆ Two Traction motors are driven by a single Traction Converter.
- ◆ Traction Motors are self ventilated. Separate blowers are not required.

Traction Motors

- ◆ Advantages of AC Traction Motors:
 - Have more pulling power
 - Avoid stall burns in the traction motors
 - Have correspondingly lower maintenance requirements
 - One of the miracles of the AC motor is that in the AC induction motor, the rotor has no visible electrical contacts to the outside world. Instead, it has an electrical field *induced* into it by the electrical field of the stator -- no commutator, no brushes
 - The induction of the electrical field into the rotor happens because of the characteristic pulsing flow of current in AC.

Improvements

Driver's Desk



Earlier driver desk



Improved driver desk

- Joystick Controls and twin Digital Displays.
- Improved ergonomics.
- Improved user-friendly



THANK YOU