



TECHSAVIATION *Training Center*

Este material em hipótese alguma substituirá os manuais do fabricante para qualquer ação de manutenção. Consulte os manuais correspondentes. **EDUCATIONAL PURPOSE ONLY**

Electrical Power

Introduction

The 787 electrical power system is made up of these subsystems:

- Electrical Power Generation and Start System (EPGSS)
- Power Conversion System (PCS)
- Primary Power Distribution System (PPDS)
- Secondary Power Distribution System (SPDS).

Because the 787 is made of mostly composite materials, the current return network provides:

- Return path for component power
- Fault current returns
- High intensity radiated field protection.

The EPGSS generates variable frequency 235V AC power. This was selected because higher voltage means less current, which in turn means less line wiring weight.

The power conversion system converts primary power (235V AC) to:

- +/-130V DC
- 115V AC
- 28V DC.

The primary power distribution system distributes and protects the 235V AC, 115V AC, and 28V DC power.

The secondary power distribution system distributes and protects the distribution of 115V AC and 28V DC power through electrical load control units, solid state power controllers, secondary power distribution units, and remote power distribution units.

The circuit breaker indication and control function is a hosted software application in the Common Core System (CCS). It provides the interface for:

- Electronic circuit breakers
- Electrical load control functions
- Thermal circuit breakers (indication only).

The electrical system indication and control provides the user interface for control of electrical power system contactors that are not available using flight deck switches.

These additional systems use electrical power on the 787:

- Main engine start
- Air conditioning
- Wing anti-ice protection
- Horizontal stabilizer trim
- Wheel brake systems.

24-00 *Electrical Power*



Electrical Power System Components

The electrical power system supplies these voltages to the airplane:

- 235V AC
- 115V AC
- 28V DC.

These are the power sources:

- Four Variable Frequency Starter
- Generators (VFSG)
- Two APU Starter Generators (ASG)
- Ram Air Turbine (RAT) generator
- Main and APU batteries
- External power.

There are two VFSGs on each engine. They are the primary source of AC power in flight. Additional sources of AC power are the ASGs.

Each VFSG supplies a maximum of 250 kVA. The ASGs supplies a maximum of 225 kVA.

A RAT generator is a source of backup AC power. It supplies 230V AC power up to 10 kVA.

For ground operations, there are three external power receptacles.

There are two external power receptacles on the forward left side of the fuselage and one aft of the left wing-to-body fairing. These receptacles are rated at 90 kVA.

There are two lithium ion batteries on the airplane. The main battery and Battery Charger Unit (BCU) are in the forward electronic equipment bay.

The APU battery and BCU are in the aft electronic equipment bay.

These electrical system components are in the forward equipment bay:

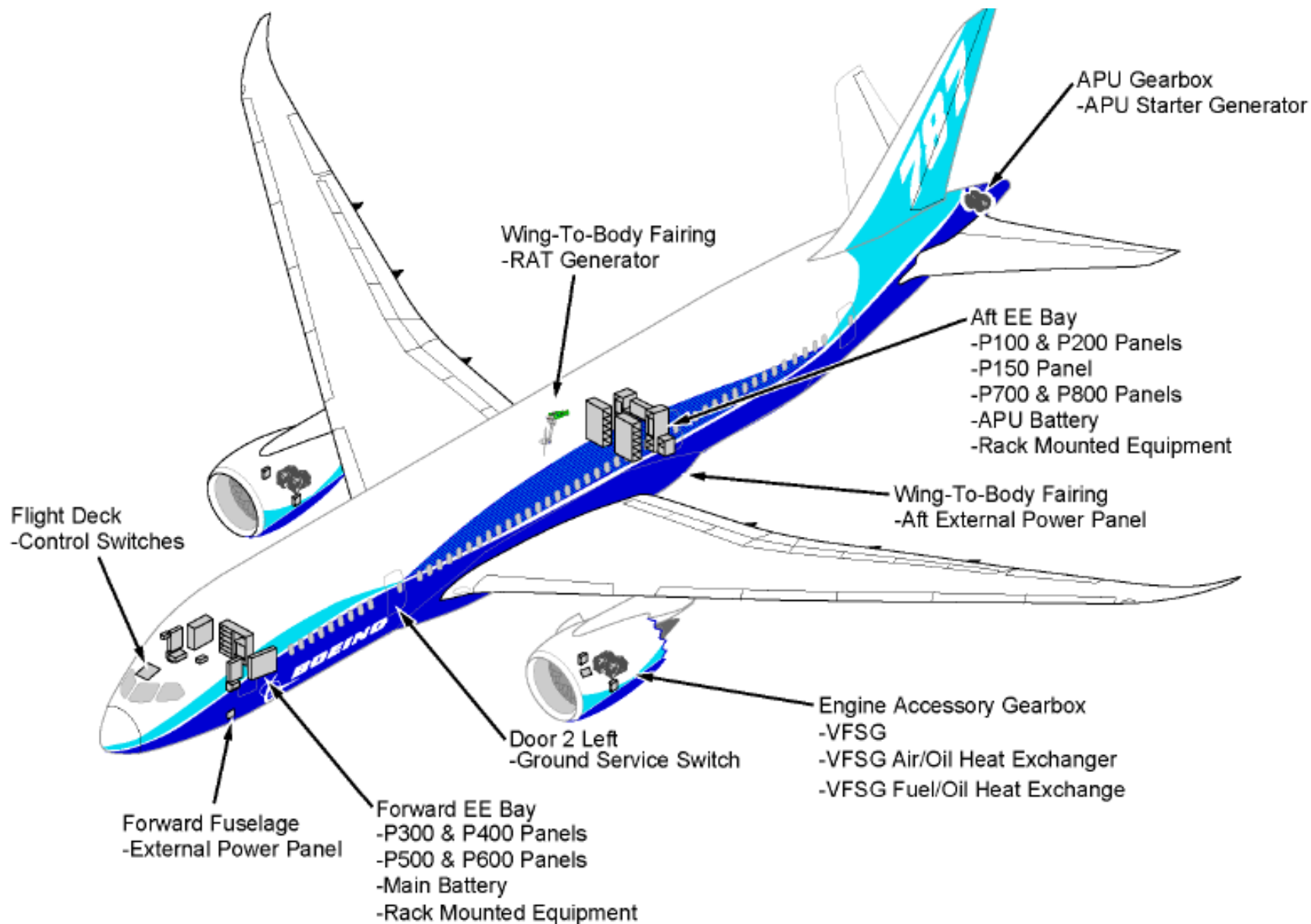
- P300 power distribution panel
- P400 power distribution panel
- P500 power conversion panel
- P600 power conversion panel
- Main BCU.

These electrical system components are in the aft electronic equipment bay:

- P100 power distribution panel
- P200 power distribution panel
- P150 auxiliary power panel
- P700 High Voltage DC (HVDC) panel
- P800 HVDC panel
- APU BCU
- Start power unit.

The P700 and P800 HVDC panels are liquid cooled by the Power Electronics Cooling System (covered in ATA 21).

There are Remote Power Distribution Units (RPDU) throughout the fuselage.



Electrical Power System Controls

The electrical panel is on the P5 overhead panel. There is also a towing switch and battery state of charge indicator on the upper part of the P5 panel.

ELECTRICAL CONTROL PANEL

The electrical panel has these controls and indications:

- Main battery
- In-Flight Entertainment (IFE)/ passenger seats
- Cabin/utility
- Left and right APU Starter Generator (ASG) control
- Left and right forward external Power
- Aft external power
- Left and right Variable Frequency Starter Generator (VFSG) control
- Left and right VFSG drive disconnect.

The main battery switch is used to apply battery power to the instrument buses when there are no other power sources available and the airplane is on the ground.

The IFE/passenger seats and utility switches are used to control IFE, passenger seat power, and galley power, respectively.

The APU generator control switches are used to control ASG excitation.

The external power switches are used to connect up to three external power sources to the airplane if available.

The generator control switches are used to control VFSG excitation.

The drive disconnect switches are used to disconnect the VFSG in the event of low oil pressure or bearing failure.

The panel also has the APU start selector.

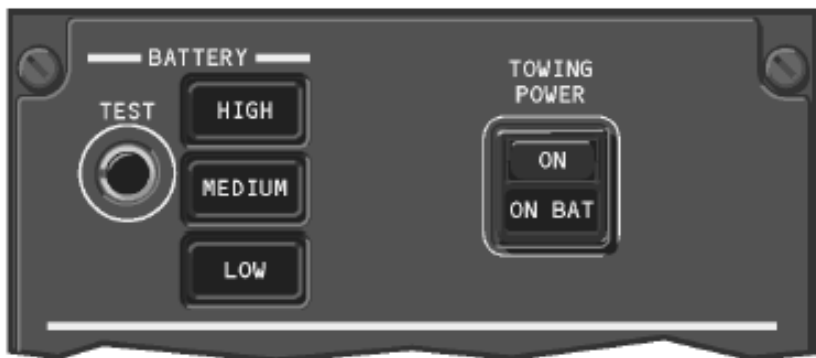
TOWING POWER PANEL

The towing power switch is used when towing the airplane using only the main battery. When selected on, it provides:

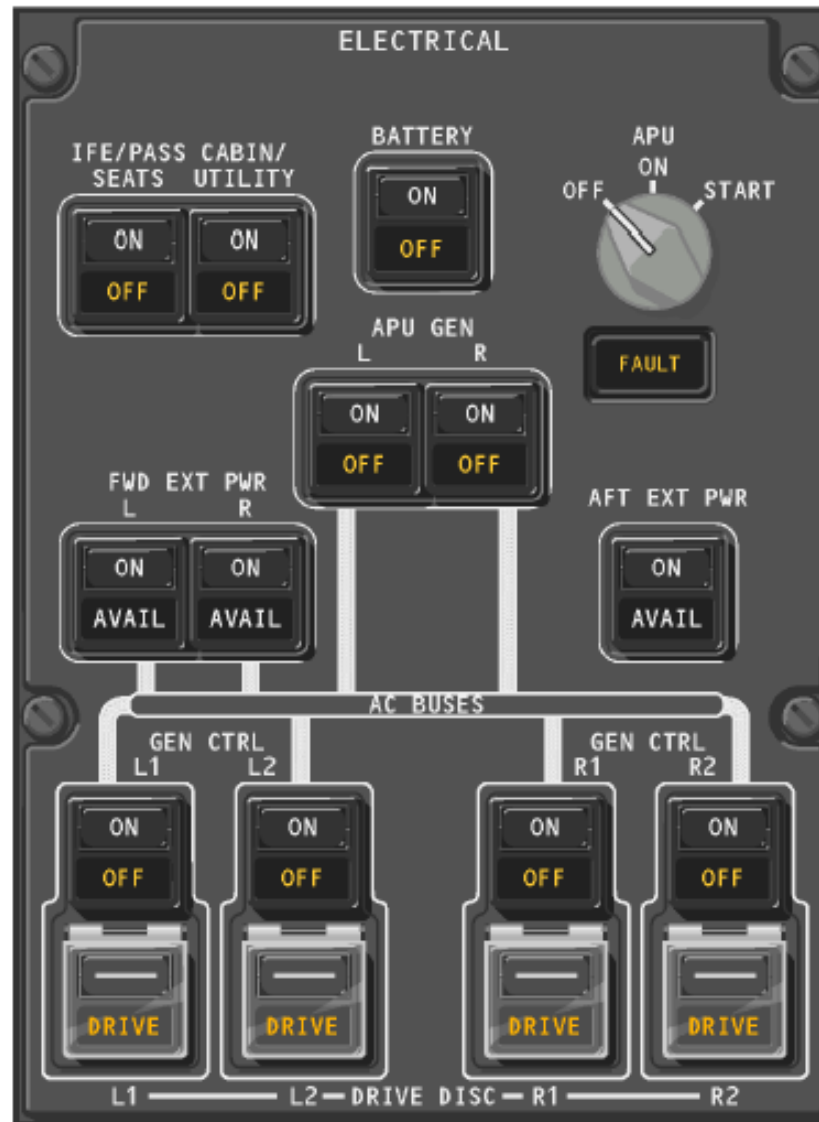
- Captain flight interphone
- Flight deck dome lights
- Aisle stand floodlights
- Wing and tail position lights.

The battery state of charge indicator and test switch are used to verify battery status. These are the three indications:

- HIGH – 1 hour of battery power is available
- MEDIUM – 30 minutes of battery power is available
- LOW – 15 minutes of battery power is available.



P5 Towing Power Panel



P5 Electrical Panel

Current Return Network

Because the structure on the 787 is made up of mostly composite materials, the structure cannot be used as a current return medium as on other airplanes.

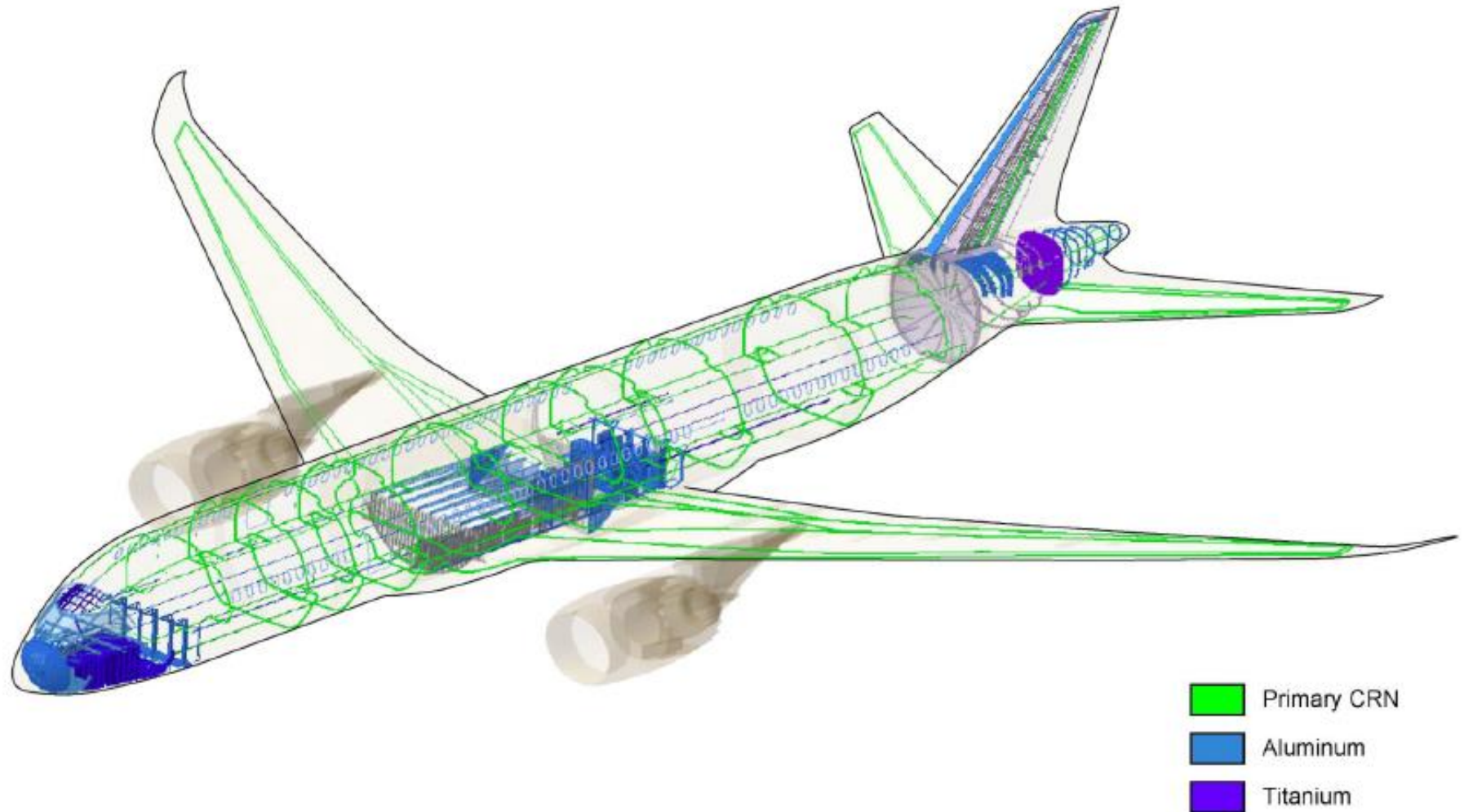
The Current Return Network (CRN) is used to provide:

- Return path for component power returns
- Return path for AC and DC fault currents
- High Intensity Radiation Frequency (HIRF) protection.

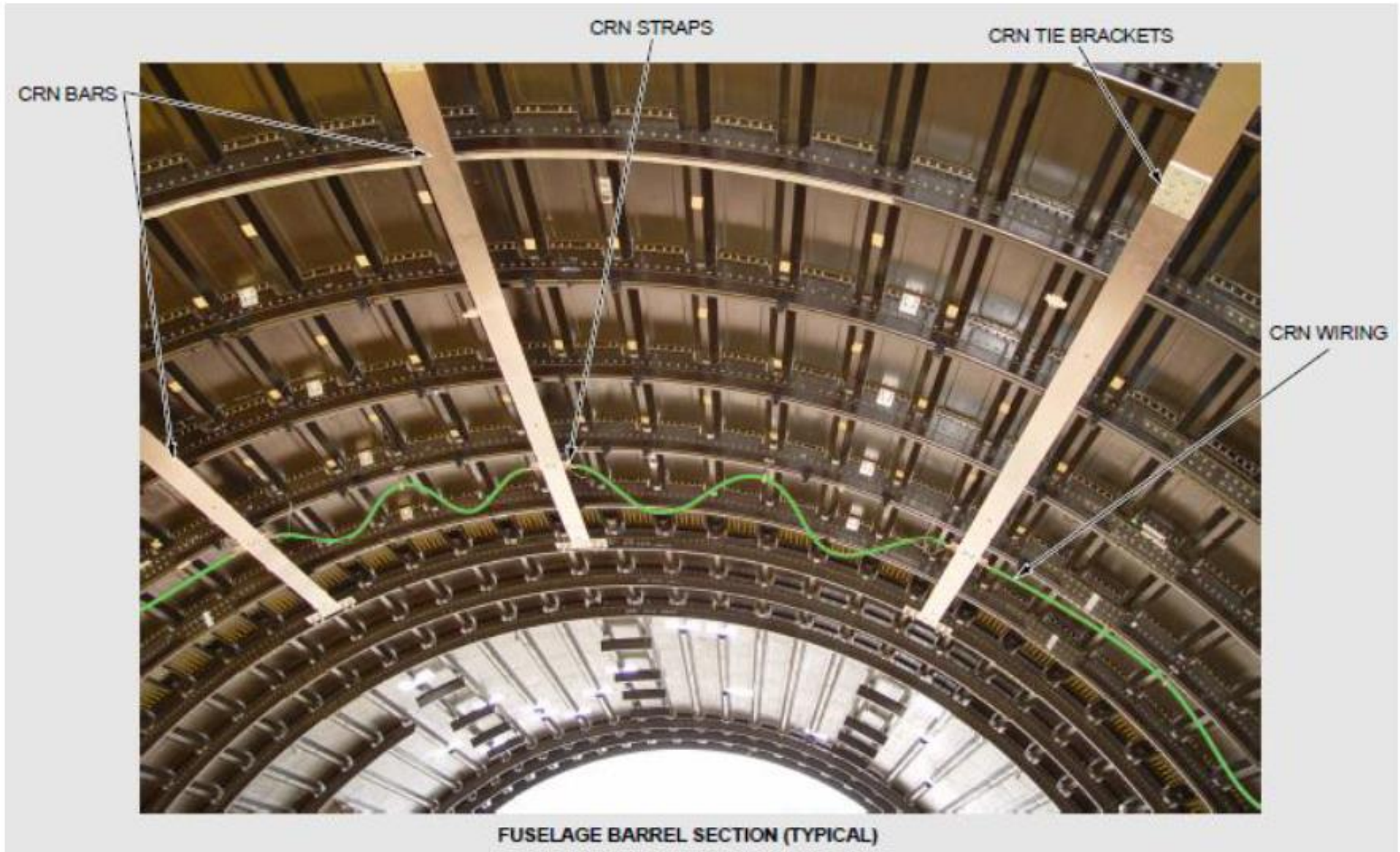
In the fuselage, the CRN is made of longitudinal bars that are connected by cables. This provides redundant current paths.

In the wings, the CRN has two cable paths that provide redundant current paths. The CRN in the wing is connected to the fuselage CRN.

The CRN in the wings and empennage areas is used exclusively for fault currents and lightning protection. The AC and DC grounds from individual components are connected by wires back to the CRN inside the fuselage.



Current Return Network



Power Distribution System

The electrical power distribution system controls and protects the distribution of:

- 235V AC power
- 115V AC power
- 28V DC power.

Four main 235V AC buses distribute power to:

- Autotransformer Rectifier Units (ATRU)
- Electrical Load Control Units (ELCU)
- Autotransformer Units (ATU)
- Transformer Rectifier Units (TRU)
- Backup bus.

The ATRUs supply +/- 270V DC power to the Common Motor Starter Controllers (CMSC), which convert it to variable frequency 235V AC power.

The ELCUs supply 235V AC power to large loads.

The ATUs supply 115V AC power to the left and right 115V AC buses.

The two 115V AC buses send power to:

- Loads through ELCUs
- Loads through Thermal Circuit Breakers (TCB)
- Onside Secondary Power Distribution Unit (SPDU)
- Remote Power Distribution Units (RPDU) through ELCUs.

The TRUs supply 28V DC power to:

- Left 28V DC bus
- Captain instrument bus
- First officer instrument bus
- Right 28V DC bus.

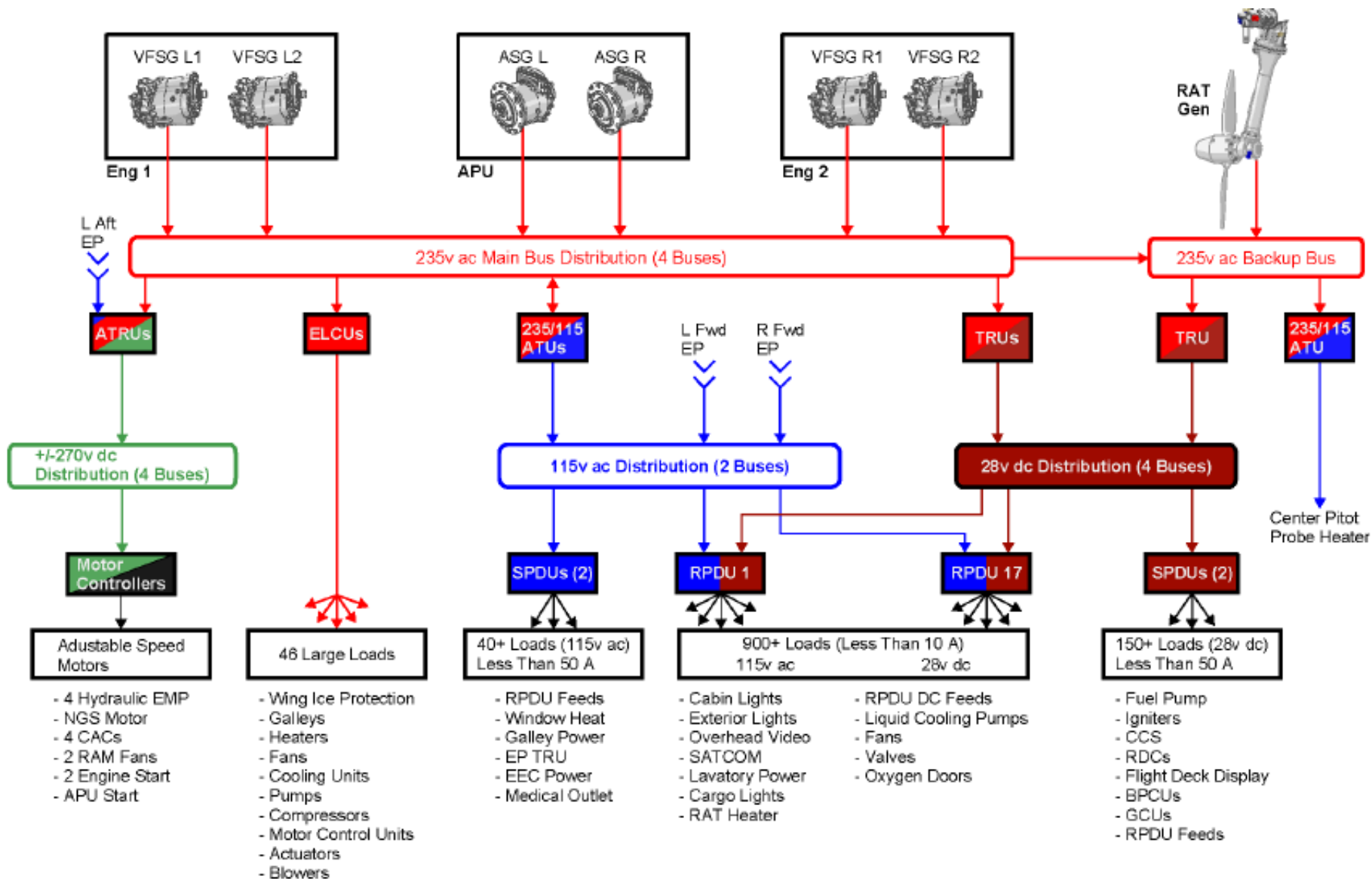
These four DC buses supply some loads directly through TCBs. They also supply power to their onside SPDU.

The SPDUs supply 28V DC power directly to some loads and also to the RPDUs.

The SPDUs supply loads of less than 50 amperes.

The RPDUs supply loads of less than 10 amperes.

In the event of a loss of airplane power, the Ram Air Turbine (RAT) generator will supply the backup bus, which will supply two TRUs to maintain 28V DC power on the captain and first officer instrument buses.



Remote Power Distribution System

The Remote Power Distribution System (RPDS) has 17 Remote Power Distribution Units (RPDU) throughout the airplane.

There are four gateway RPDUs and 13 standard RPDUs. The electrical power system hosted applications in the Common Core System (CCS) communicate with the gateway RPDUs through the Common Data Network (CDN).

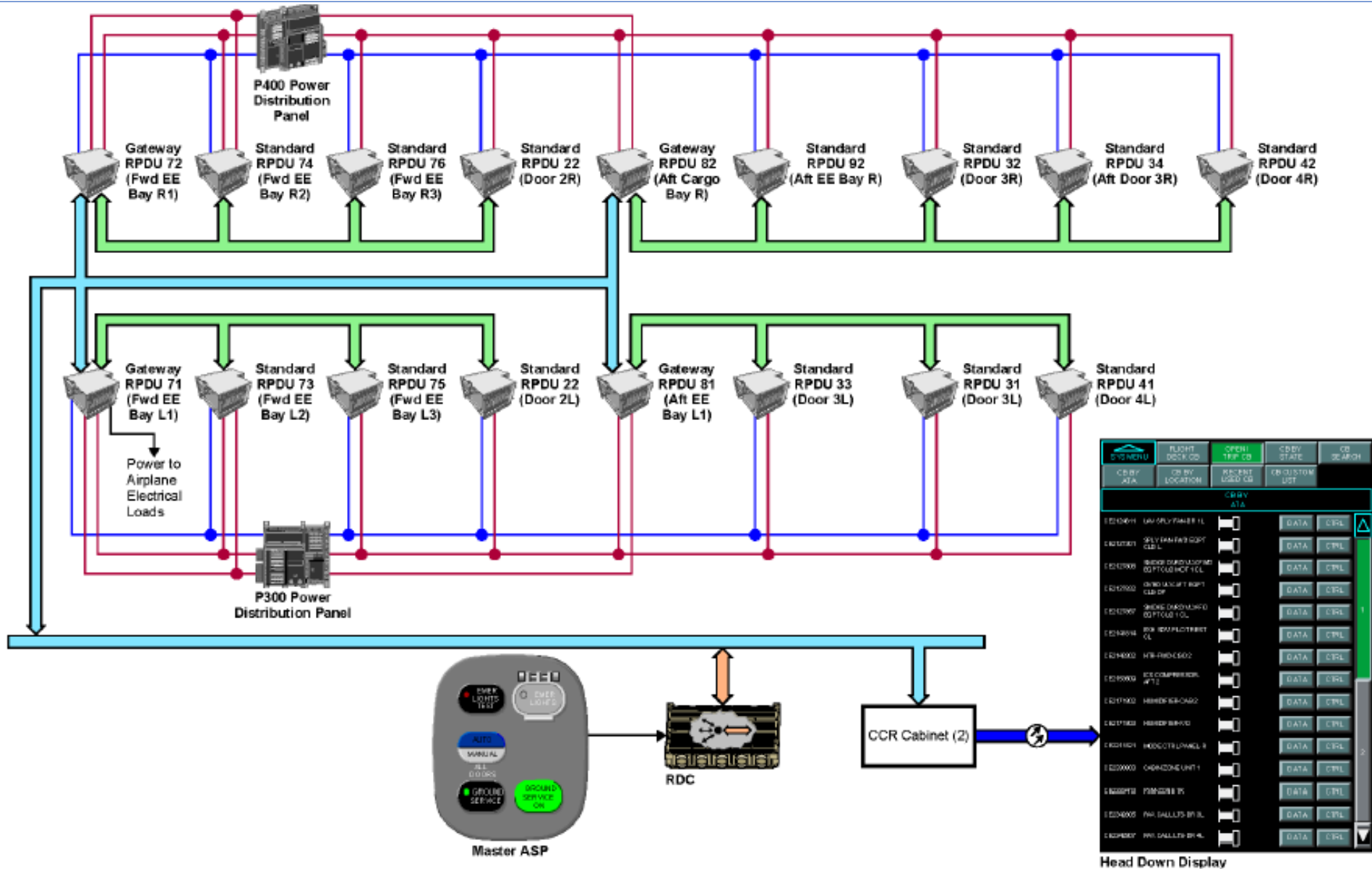
The standard RPDUs communicate with the gateway RPDUs over a Time Triggered Protocol/Critical (TTP/C) bus.

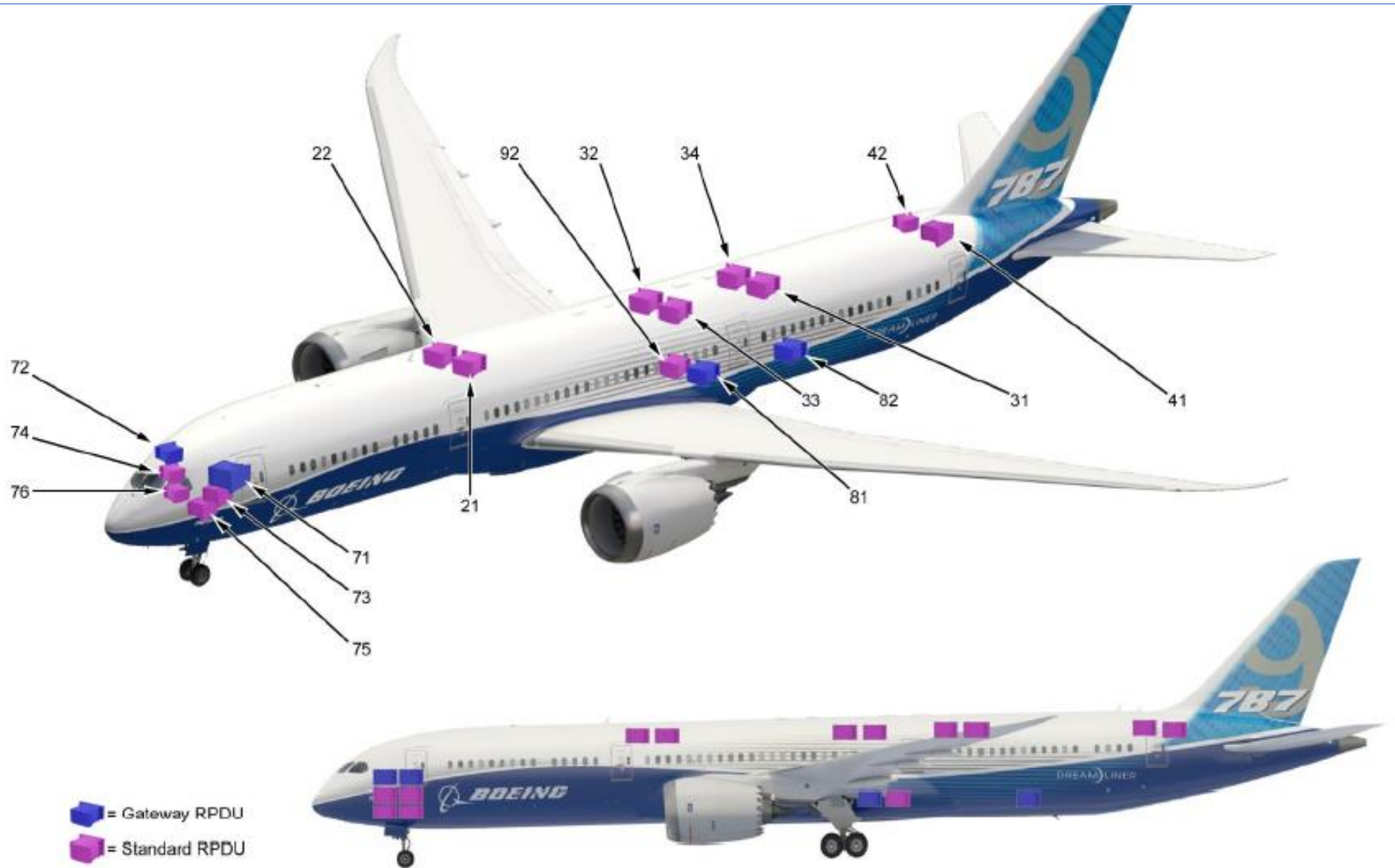
The RPDUs receive 28V DC power from Secondary Power Distribution Units (SPDU) in the P300 and P400 power distribution panels.

The RPDUs receive 115V AC power from Electrical Load Control Units (ELCU) in the P300 and P400 power distribution panels.

The RPDUs supply 115V AC power and 28V DC power to loads of less than 10 amperes using Solid State Power Controllers (SSPC).

The SSPCs are controlled through the Circuit Breaker Indication and Control (CBIC) system. They are also controlled from the ground service switch on the master Attendant Switch Panel (ASP).





Batteries

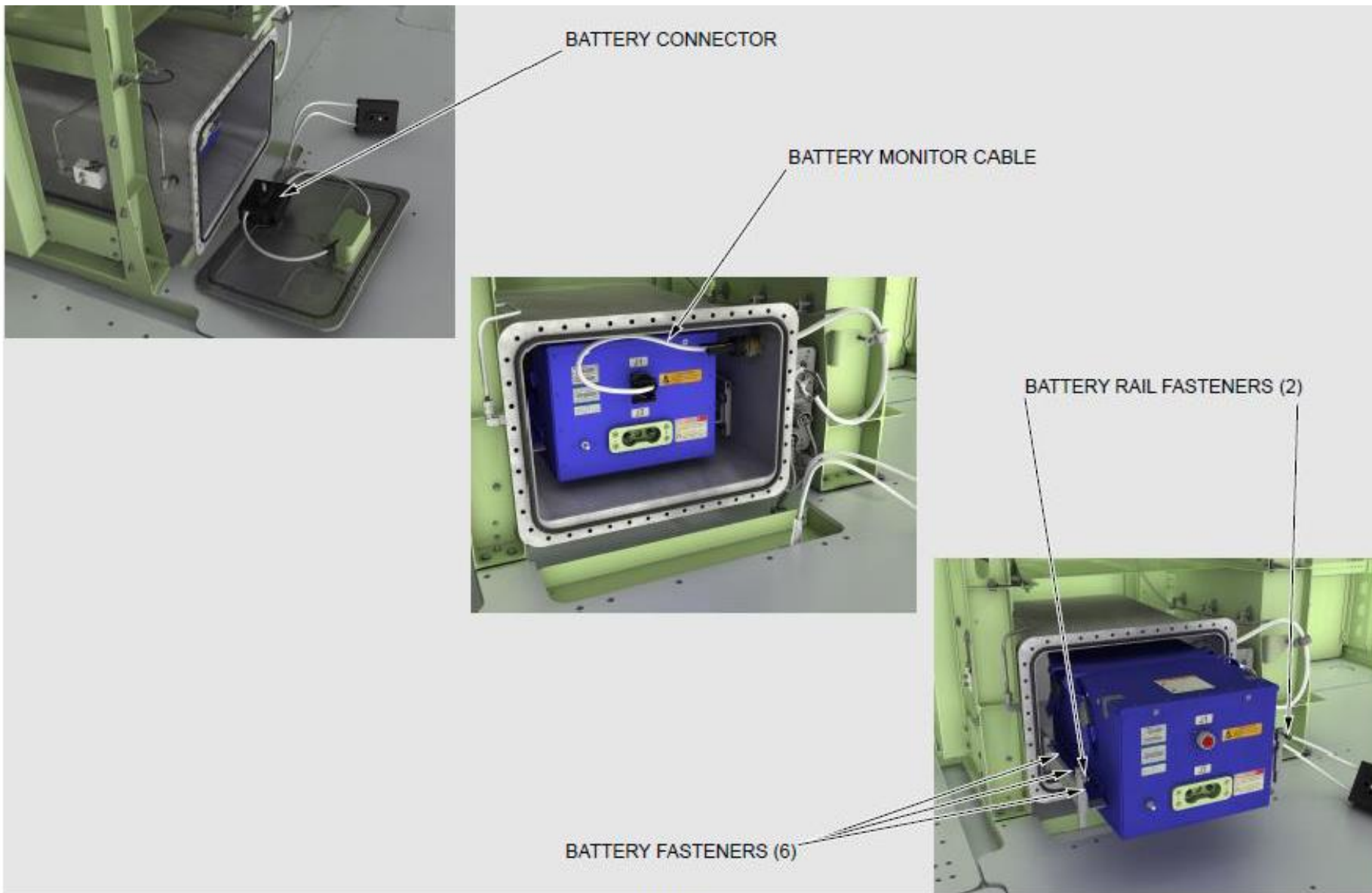
The main and APU batteries are 32-volt DC, lithium ion batteries rated at 65 ampere-hours.

The main battery provides:

- Power to essential loads during Ram Air Turbine (RAT) deployment
- Power for emergency braking
- Refuel power
- Initial power up of the airplane.

The APU battery provides power for APU start. It also provides power for the airplane navigation lights during towing operations using the airplane battery only.

The batteries are encased in 1/8-inch stainless steel enclosures. The enclosures limit the amount of oxygen around the battery and protect the airplane structure if there is a battery event.



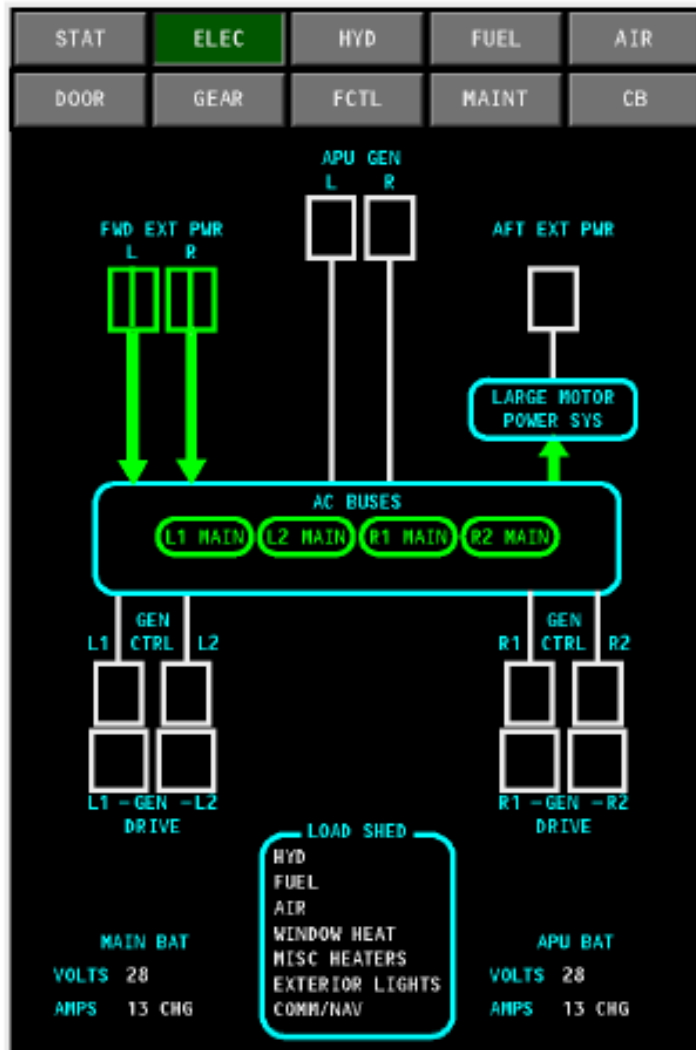
Batteries

Electrical Synoptic Pages

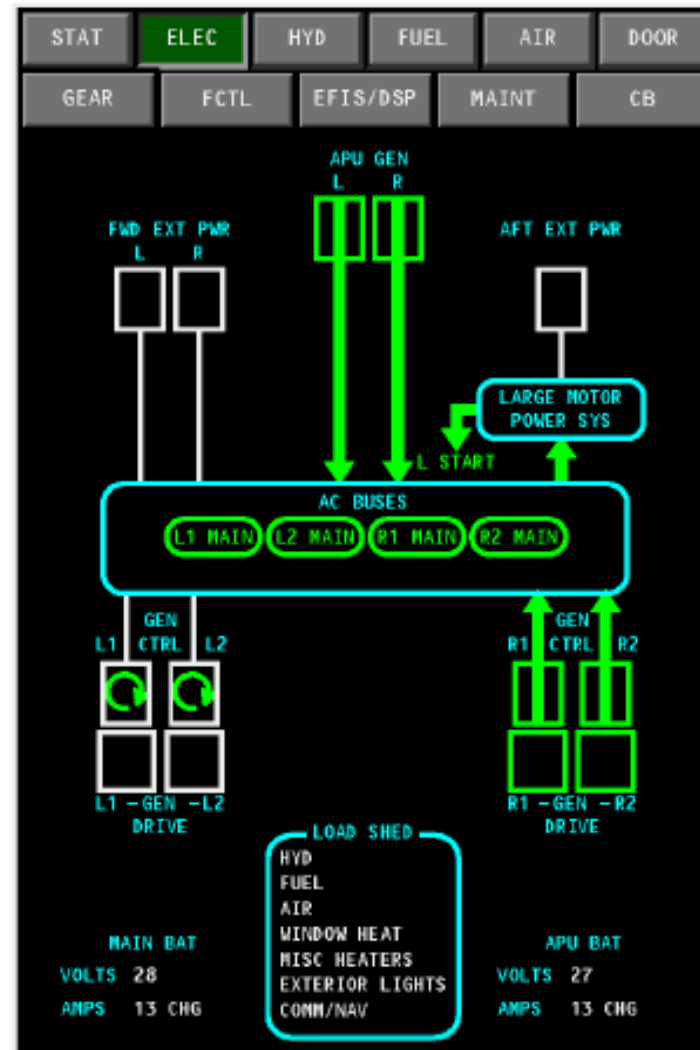
The electrical synoptic display is a simplified schematic of the main electrical system.

It shows this information:

- External power status
- APU Starter Generator (ASG) status
- Variable Frequency Starter Generator (VFSG) status
- Main 235V AC bus status Main and APU battery status
- Load shed data.



External Power Connected



Engine Start using APU Power

Circuit Breaker Indication and Control Pages

The Circuit Breaker Indication and Control (CBIC) pages provide control and indication for these components:

- Electronic Circuit Breakers (ECB)
- Flight Control (FC) ECBs
- Electrical Load Control Contactors (ELCC).

It also provides indication for most of the Thermal Circuit Breakers (TCB) on the airplane.

CBIC is a hosted application in the Common Computing Resource (CCR) cabinets.

CBIC is accessed through the Multi-Function Displays (MFD) in the air or on the ground. Maintenance personnel can also access CBIC using the maintenance laptop on the ground.

CBIC uses different icons to show the state of the CBs. These are the indications:

- Closed
- Open
- Locked - DO NOT CLOSE
- Locked - INOP
- Tripped
- Unknown.

The CTRL selection allows the crew to change the state of the ECB.

The image displays three screenshots of an aircraft maintenance system interface, likely for Boeing aircraft, showing circuit breaker (CB) status and details.

Left Screenshot: Shows the 'CB CUSTOM LIST' menu. The 'OUTPUT STATUS' is highlighted in pink and set to 'OFF'. The 'ADD TO RECENT USED CB' button is visible at the bottom.

Middle Screenshot: Shows the 'UPDATE LIST' menu. The 'OPEN / TRIP CB' column is highlighted in green. The 'DO NOT CLOSE' warning is visible for several CBs.

Right Screenshot: Shows the 'UPDATE LIST' menu. The 'DO NOT CLOSE' warning is visible for several CBs. A dialog box is shown with 'CLOSE', 'LOCK', and 'CANCEL' options.

CB ID	Component	Status	Warning	DATA	CTRL
CE2127811	FAN-MISC CLG MC	Open	DO NOT CLOSE	DATA	CTRL
CE2127811	SPLY FAN-F/D EQPT CLG MC	Open		DATA	CTRL
CE2127811	LOW FLOW DET-FWD EQPT CLG 1-3	Open		DATA	CTRL
CE2127811	SPLY FAN-FWD EQPT CLG L MC	Open		DATA	CTRL
CE2127811	VENT FAN-FWD EQPT CLG MC	Open		DATA	CTRL
CE2127811	VENT FAN-FWD EQPT CLG MC	Open		DATA	CTRL
CE2127811	SMOKE OVRD VLV-F/D EQPT CLG 1 DP	Open	INOP	DATA	CTRL
CE2127811	SMOKE OVRD VLV-F/D EQPT CLG 1 CL	Open		DATA	CTRL
CE2127811	SMOKE DET-FWD EQPT CLG 2 DP	Open	DO NOT CLOSE	DATA	CTRL
CE2127811	SMOKE DET-FWD EQPT CLG 1	Open		DATA	CTRL
CE2127811	SMOKE DET-FWD EQPT CLG 1	Open		DATA	CTRL
CE2127811	DYBD VLV-FWD EQPT CLG DP	Open		DATA	CTRL
CE2127811	DYBD VLV-FWD EQPT CLG CL	Tripped		DATA	CTRL
CE2127811	DYBD VLV-FWD EQPT CLG DP	Unknown		DATA	CTRL
CE2127811	DYBD VLV-FWD EQPT CLG CL	Open		DATA	CTRL