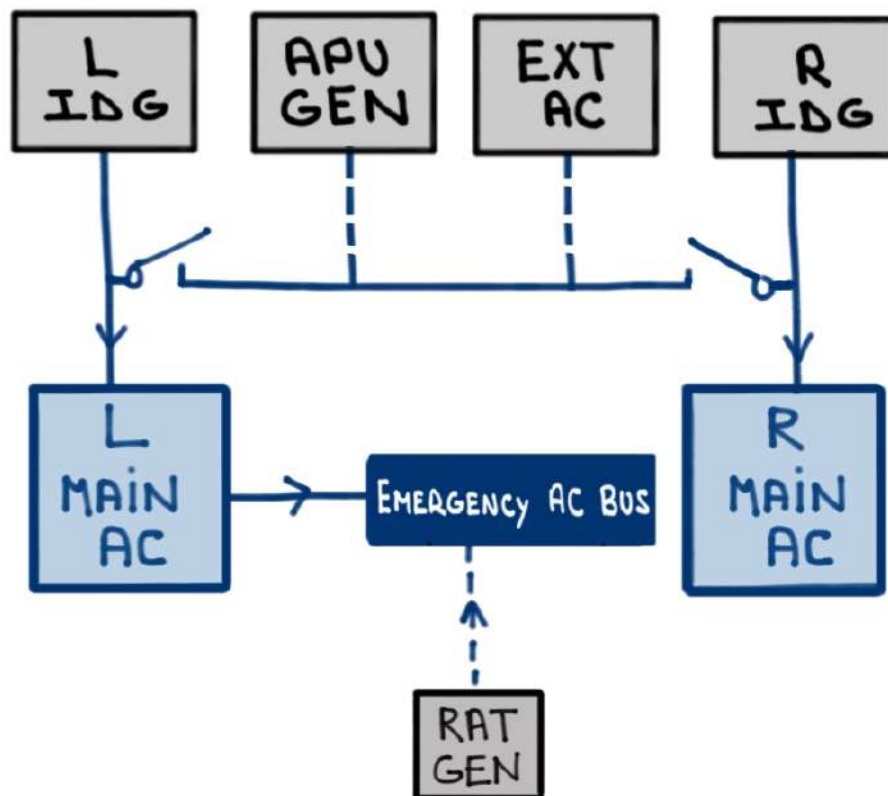


G650 ELECTRICAL SYSTEM



For study purposes only

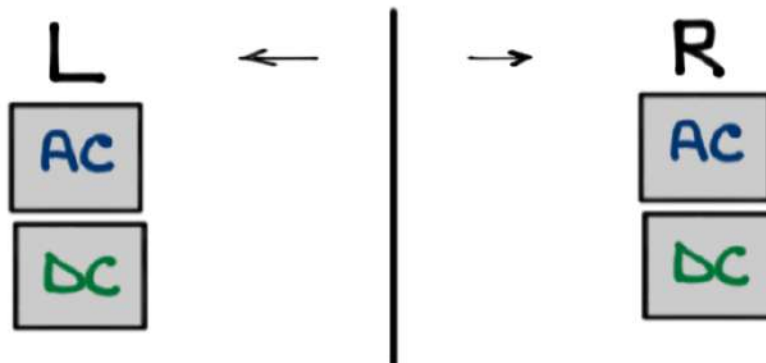
- The ELECTRICAL POWER SYSTEM produces:



- 115 Volts AC is GENERATED in order to PRODUCE 28 Volts DC via TRANSFORMER RECTIFIER UNITS (TRU)

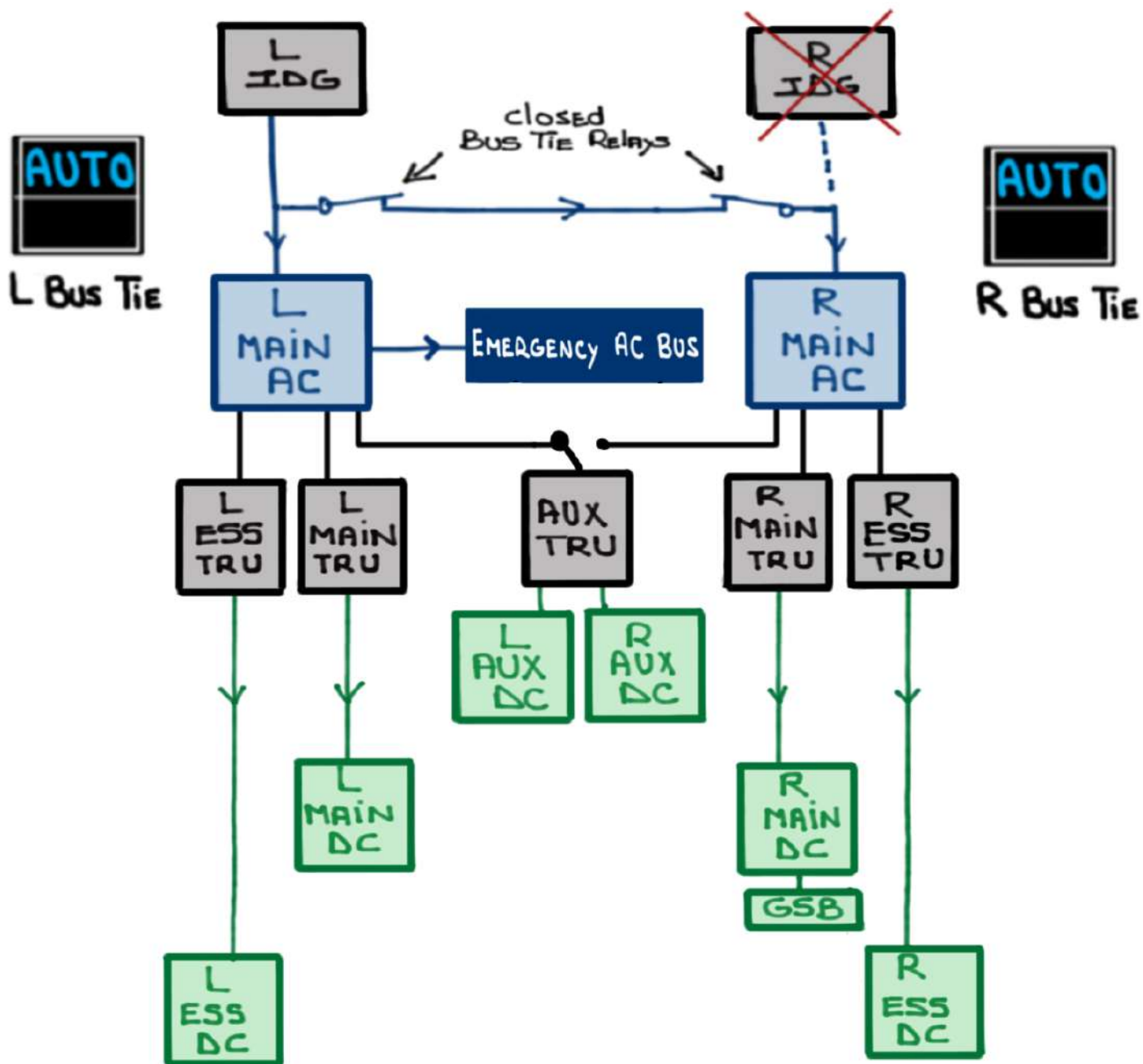


- Two (2) SEPARATE SYSTEMS/NETWORKS



- A split bus system PREVENTS A SHORT ON ONE SIDE FROM AFFECTING THE OTHER SIDE

- OPERATIVE SIDE CAN POWER THE INOPERATIVE SIDE

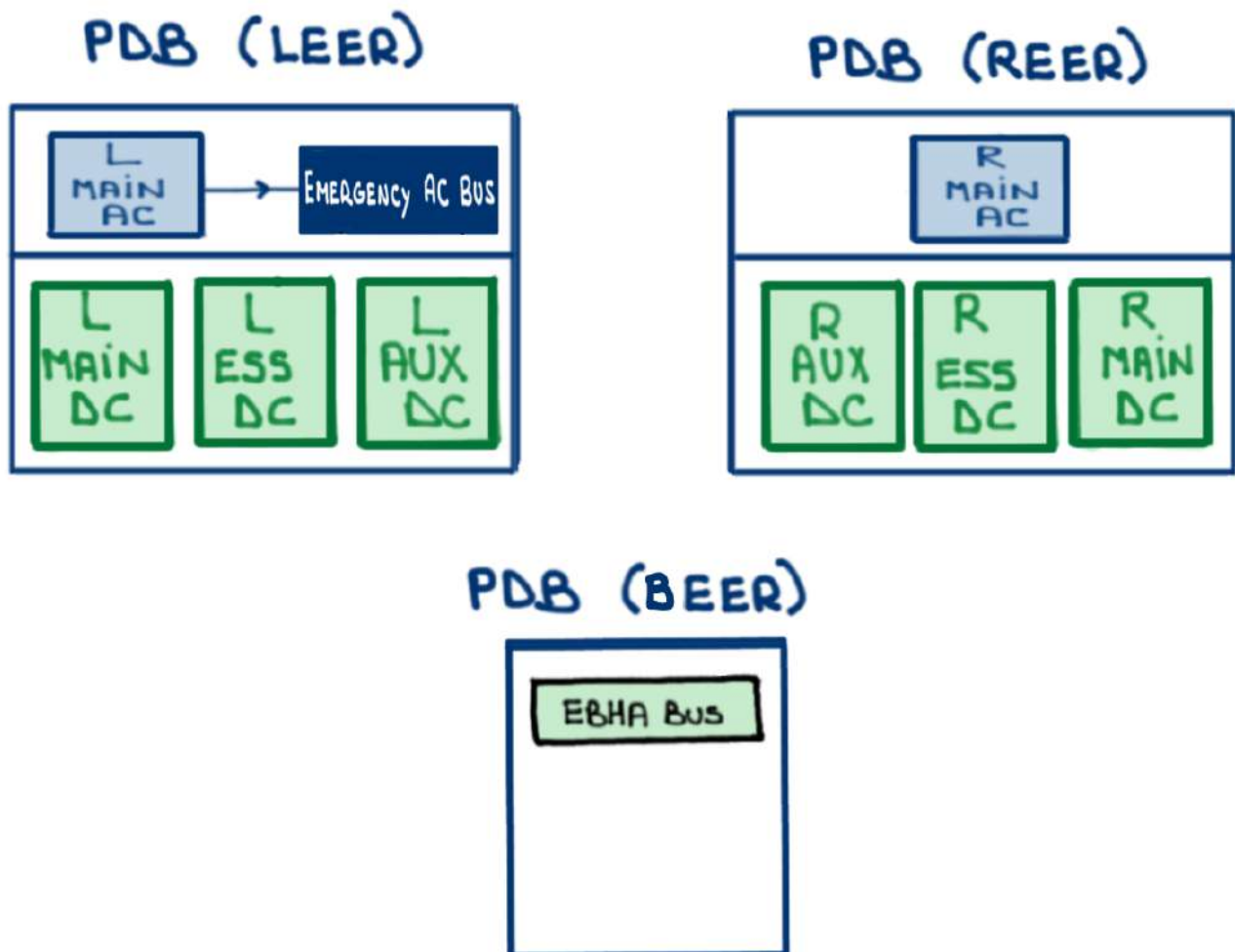


- PRIMARY POWER DISTRIBUTION BOXES (PDBs)

AC AND **DC** POWER CONTACTORS AND BUSES ARE LOCATED IN PDBs

ON THE PDBs THERE ARE CIRCUIT BREAKERS (CB) TO PROTECT THE INDIVIDUAL BUSES

FROM THE PDBs POWER IS DISTRIBUTED TO THE SECONDARY POWER DISTRIBUTION SYSTEM (SPDS)



- SECONDARY POWER DISTRIBUTION SYSTEM (SPDS)

The purpose of the SPDS is to take 115 VAC and 28 VDC power from the primary power system and distribute it to the various aircraft loads.

SPDS is comprised of:

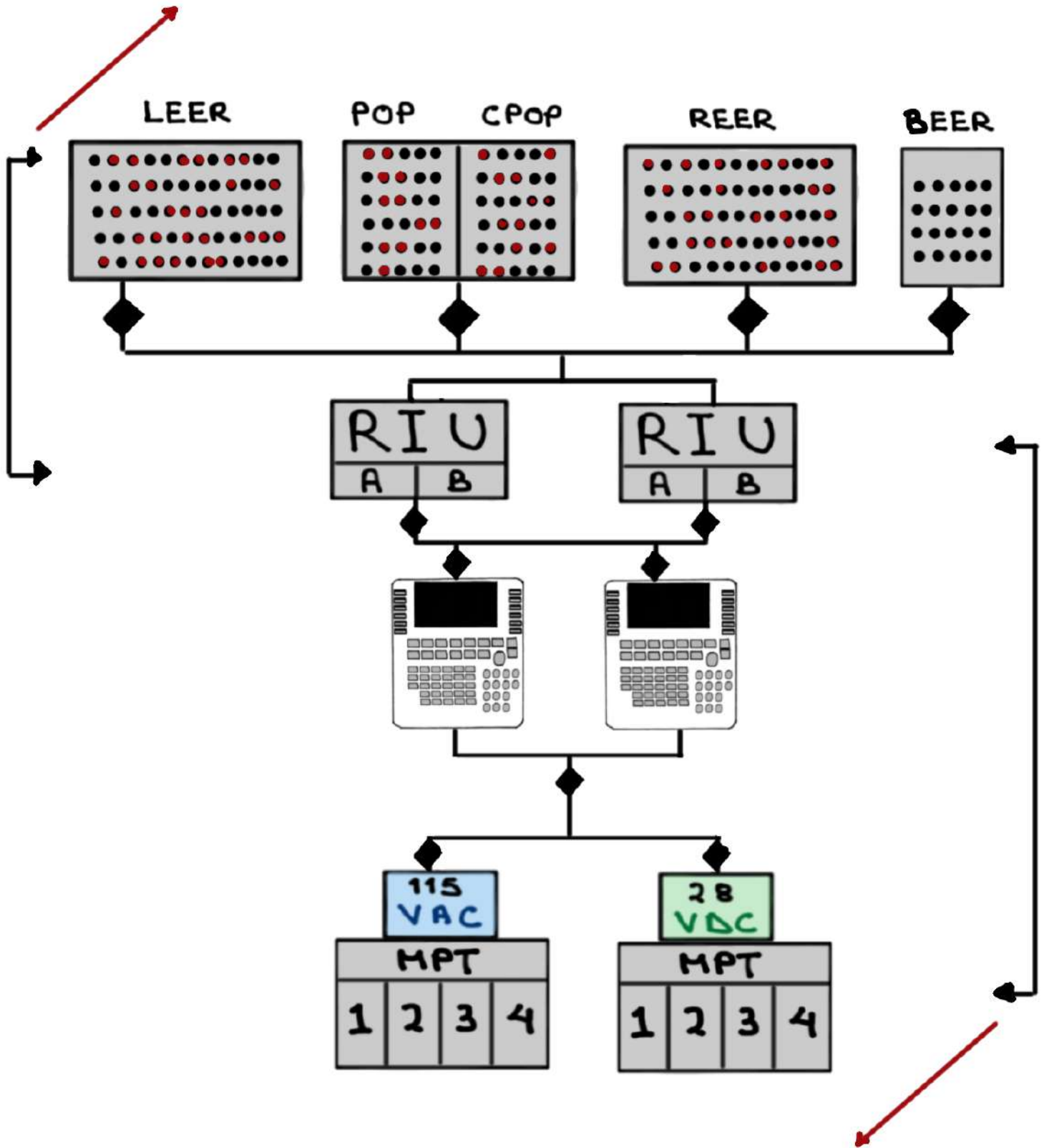
(1) REMOTE INTERFACE UNITS (RIU):

- BRAINS of the SPDS
- DUAL channels
- PERFORM SYSTEM CONTROL FUNCTIONS AND INTERFACE WITH OTHER AIRCRAFT SYSTEMS

(8) MODULAR POWER TILES (MPT):

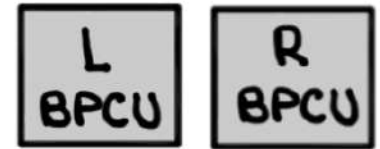
- MPTs perform power routing and circuit protection functions using AC and DC Solid STATE POWER CONTROLLERS (SSPC)
- FOUR (4) 115 VAC AND FOUR (4) 28 VDC

ELECTROMECHANICAL CIRCUIT BREAKERS

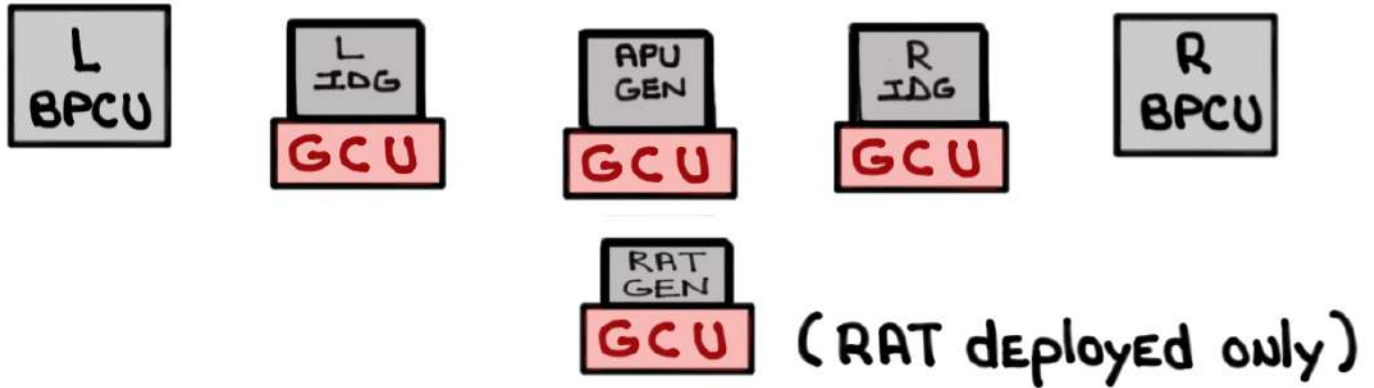


Solid STATE POWER CONTROLLERS (SSPC)
(VIRTUAL CBs)

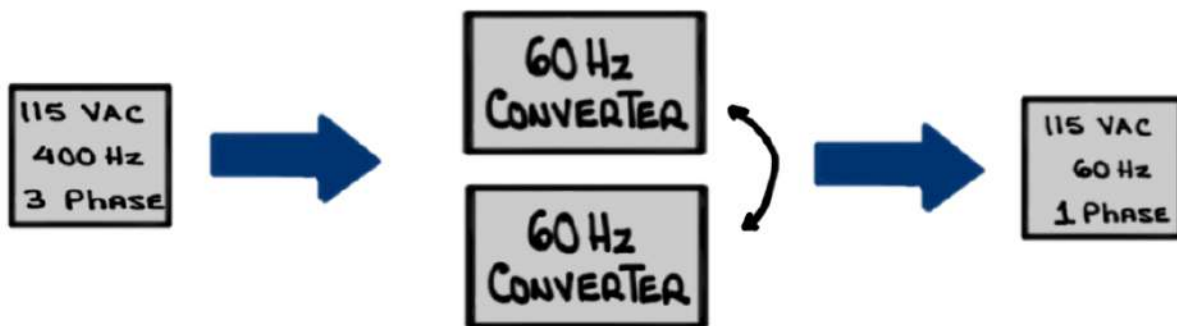
- THE ELECTRICAL POWER SYSTEM IS CONTROLLED BY TWO (2) BUS POWER CONTROL UNITS (BPCU)



- THERE ARE SIX (6) MICROPROCESSORS (BPCUs AND GCUs):



- THERE ARE TWO (2) 60 Hz CONVERTERS LOCATED IN THE TAIL COMPARTMENT

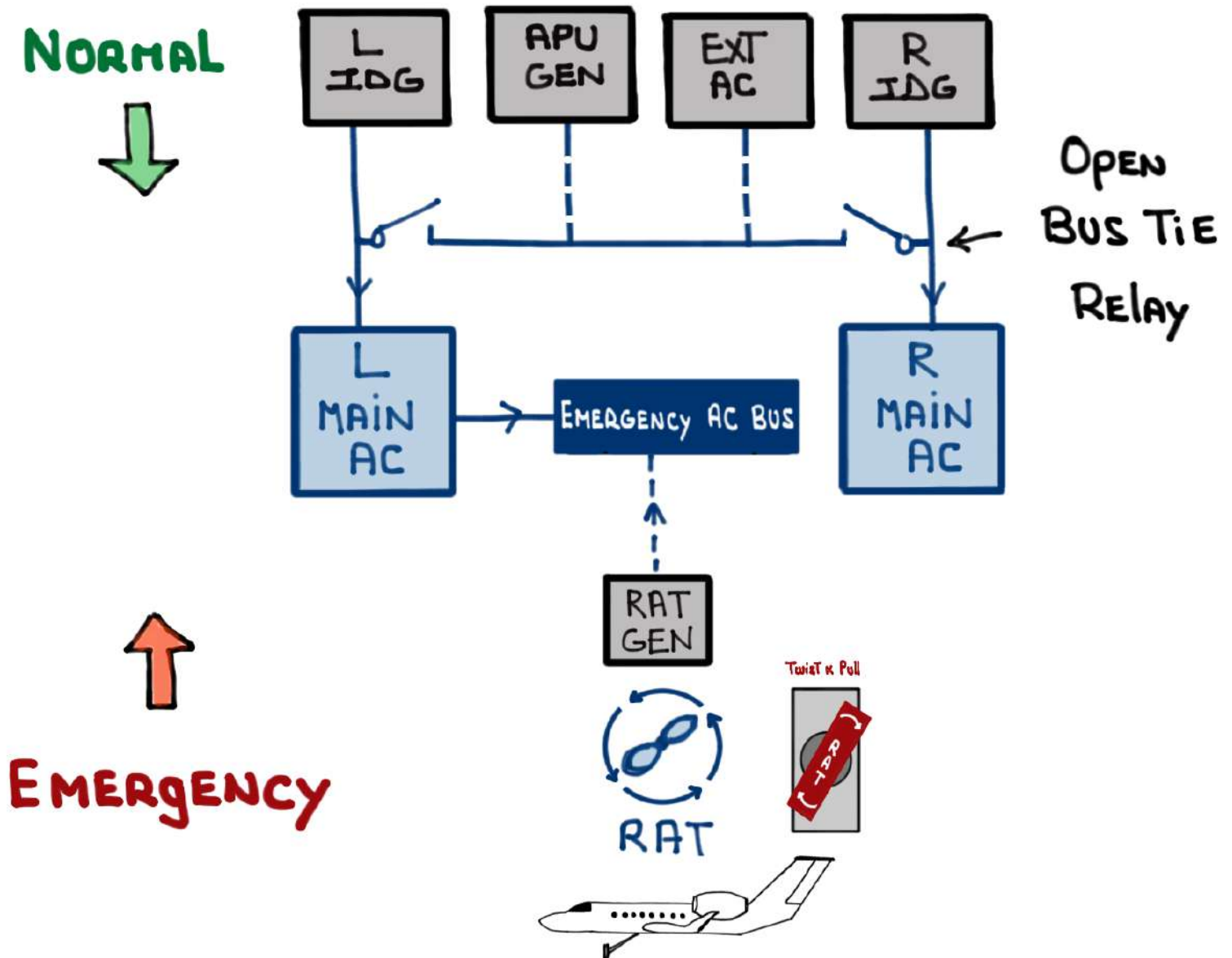


• ONE (1) 60 Hz CONVERTER ACTIVE AND THE OTHER ON STANDBY

• 115 VAC 60 Hz 1 Phase = COMMON HOUSEHOLD POWER

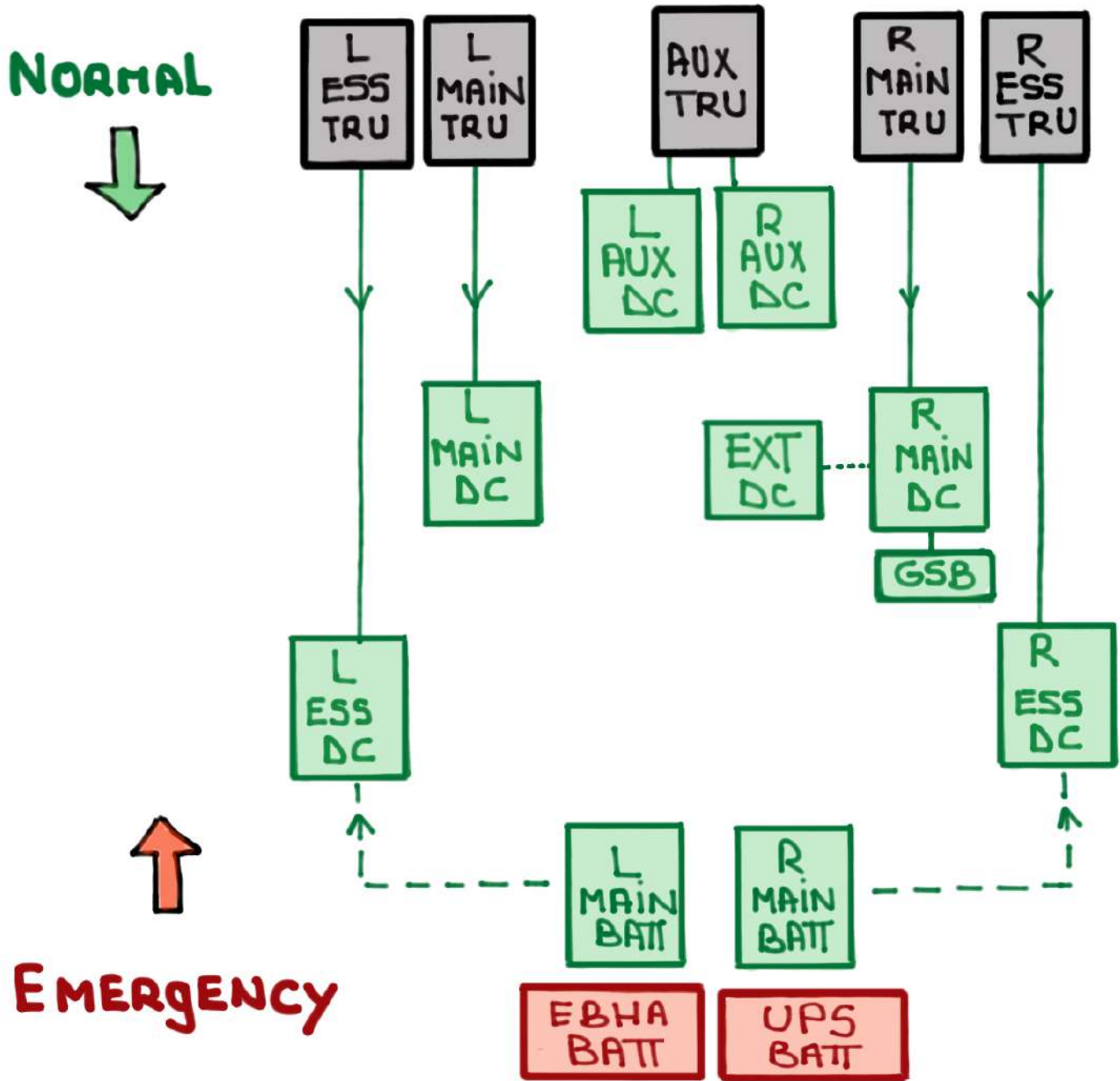
- AC SYSTEM:

115 VAC is GENERATED by:



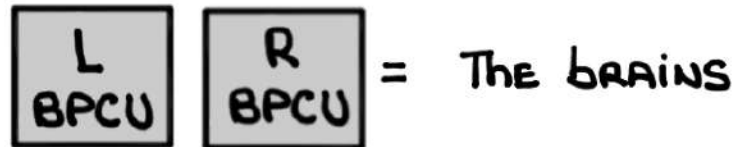
- DC SYSTEM:

28 VDC is PRODUCED by:



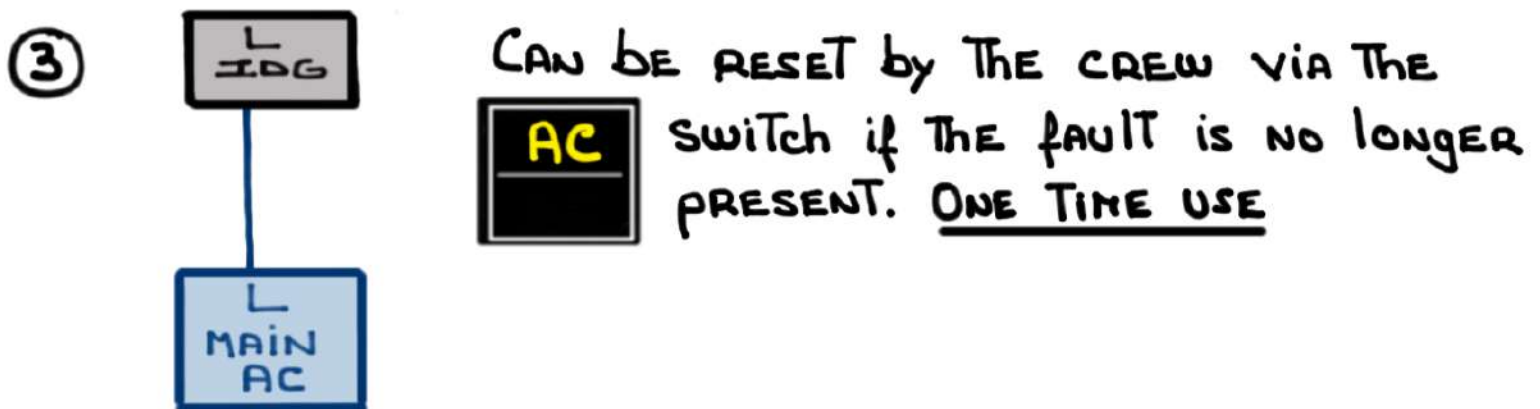
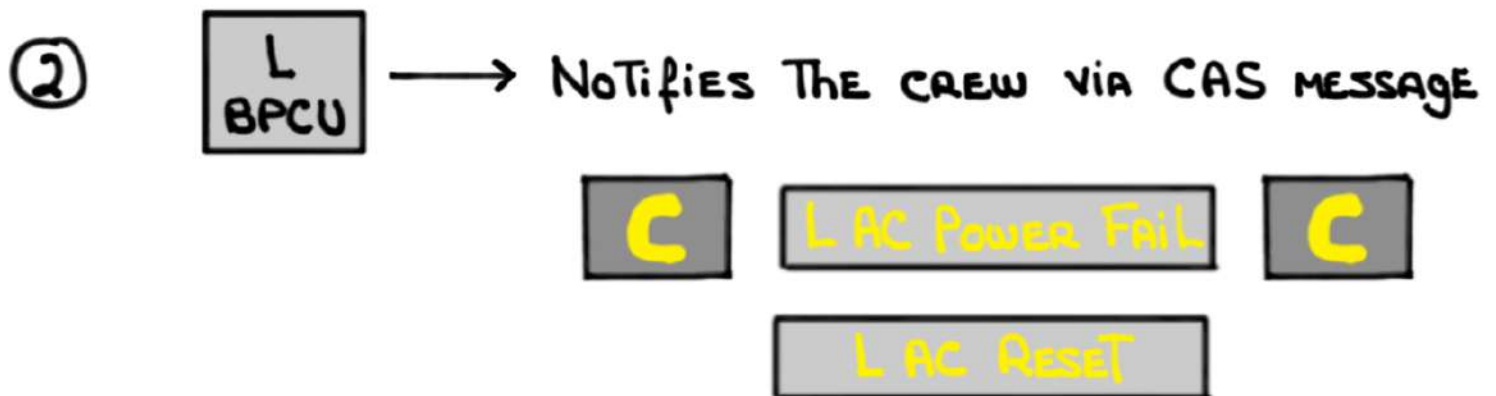
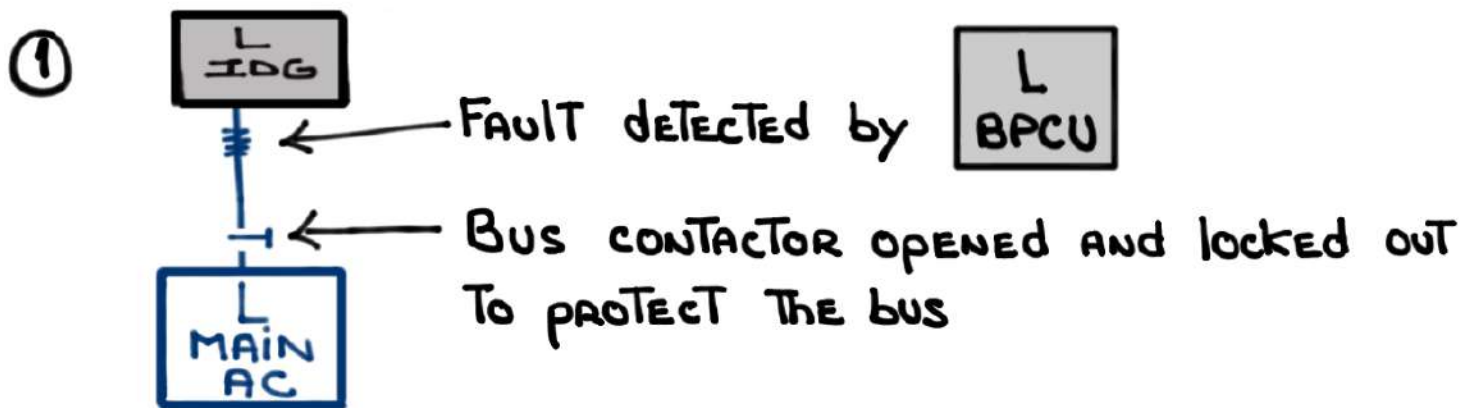
BUS POWER CONTROL UNITS (BPCU)

THE ELECTRICAL POWER SYSTEM IS CONTROLLED BY TWO (2) IDENTICAL AND INTERCHANGEABLE MICROPROCESSORS CALLED BPCUs



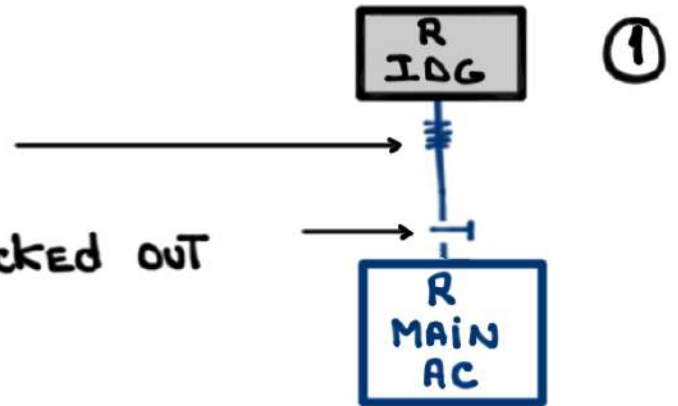
- THE L
BPCU R
BPCU CONTROL AND MAKE ALL LOGICAL DECISIONS FOR ELECTRICAL DISTRIBUTION AND PROTECTION
- TRAFFIC COPS - PROTECTORS OF THE BUSES
- CLOSE AND OPEN CONTACTORS AND/OR RELAYS TO:
 - EFFICIENTLY SUPPLY POWER TO THE BUSES
 - PROTECT AND ISOLATE THE ELECTRICAL SYSTEM FROM FAULTS
- OUTPUT CRITICAL FINDINGS TO THE CAS
- PROVIDE PROTECTION, POWER AND LOGIC TO AC
DC RESET SWITCH
- MONITOR EXTERNAL AC DC POWER
- CONTROL THE NO BREAK POWER TRANSFER (NBPT)

- FAULT DETECTION, PROTECTION AND NOTIFICATION:



FAULT DETECTED by **R BPCU**

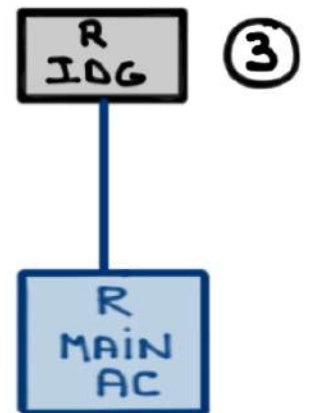
BUS CONTACTOR OPENED AND LOCKED OUT TO PROTECT THE BUS



NOTIFIES THE CREW VIA CAS MESSAGE



CAN BE RESET BY THE CREW VIA THE **AC** SWITCH IF THE FAULT IS NO LONGER PRESENT. ONE TIME USE



- BPCU logic: **ESS** before **MAIN** / **L** before **R**

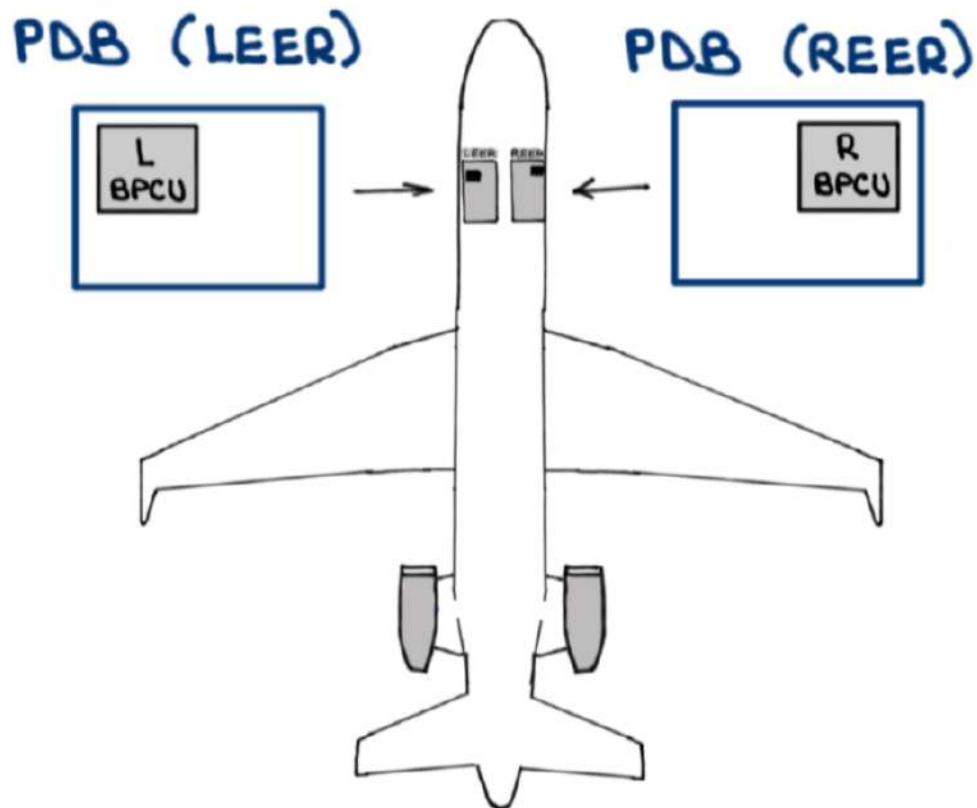
- LOCATED in:

L
BPCU

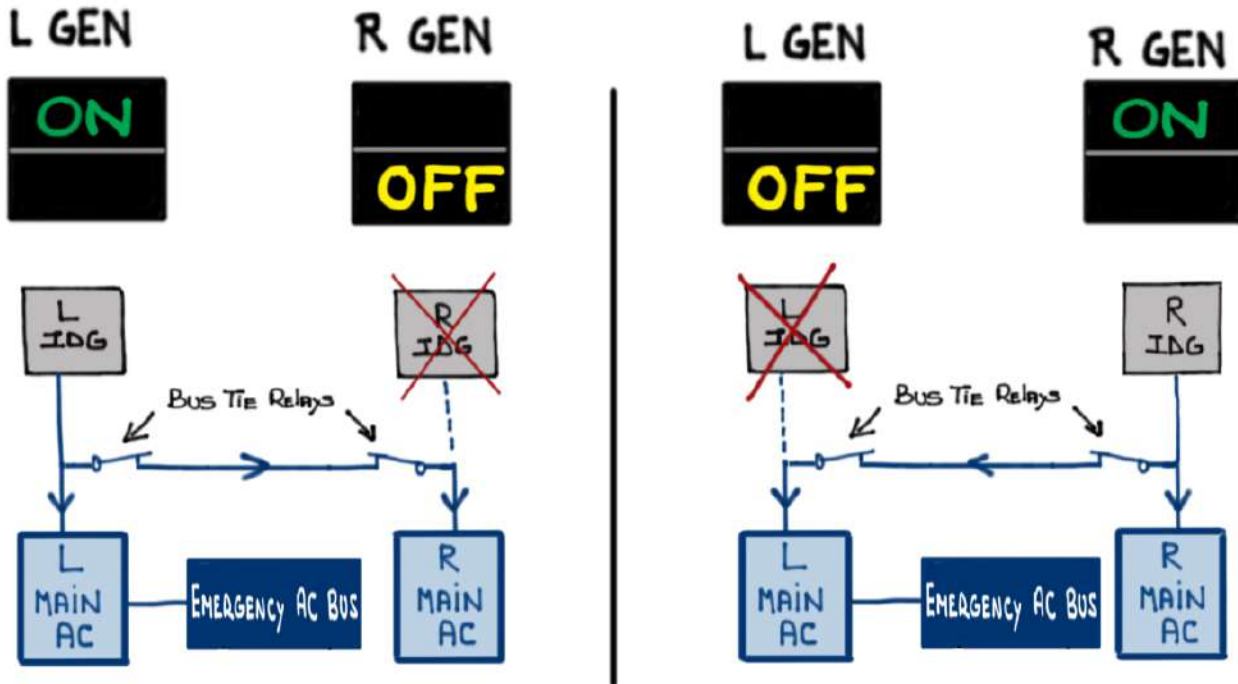
LEFT ELECTRONIC EQUIPMENT RACK (LEER)

R
BPCU

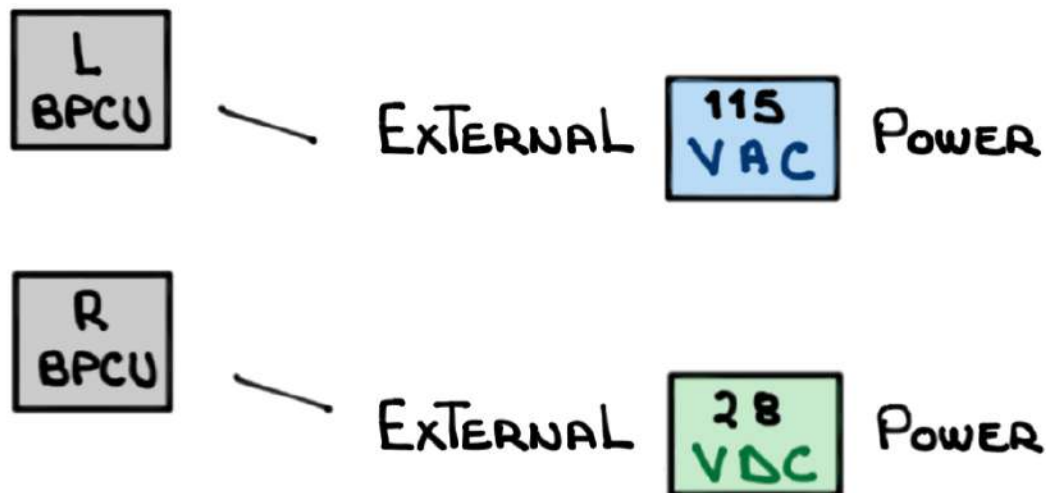
RIGHT ELECTRONIC EQUIPMENT RACK (REER)



- CONTROL THE BUS TIE RELAYS which allow operative side to power the inoperative side in the event of a short/fault on one side

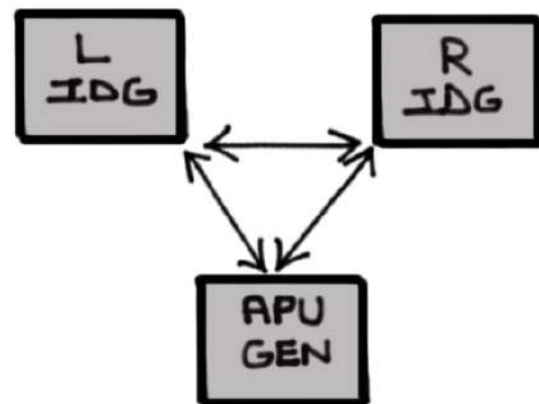


- CONTROL AND MONITOR:



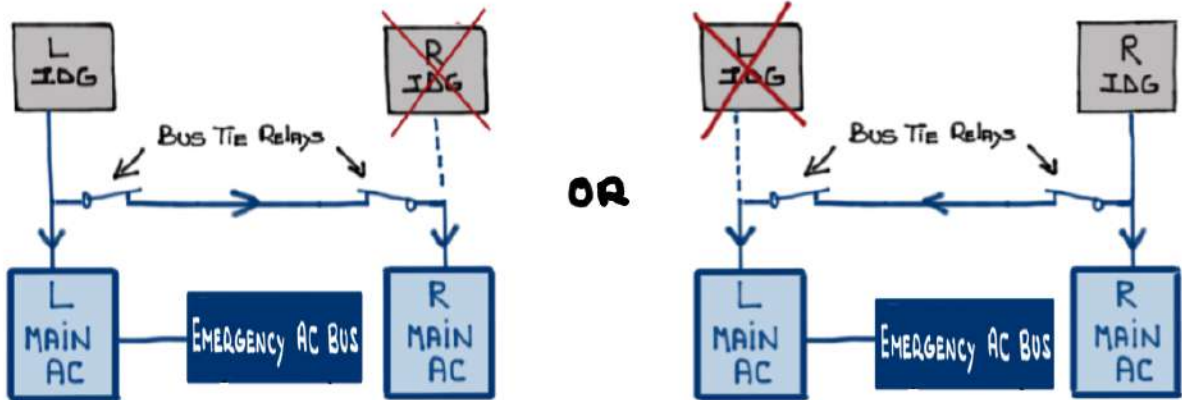
- NO BREAK POWER TRANSFER (NBPT)

- CONTROLLED BY BPCU
- POWER TRANSFER WITHOUT A MOMENTARY INTERRUPTION
- USES THE **GCU** SPEED CONTROL TO SYNCHRONIZE THE FREQUENCY AND PHASE OF THE IDGs TO THE PREVIOUS OR NEXT AC SOURCE
- IDG AVAILABLE AND NO FAILURE
 - TWO (2) SOURCES CONNECTED AT THE SAME TIME
 - NEW SOURCE IS CONNECTED FIRST BEFORE PREVIOUS SOURCE IS DISCONNECTED
 - TO AND FROM AN IDG ONLY SINCE ITS **GCU** HAS SPEED CONTROL

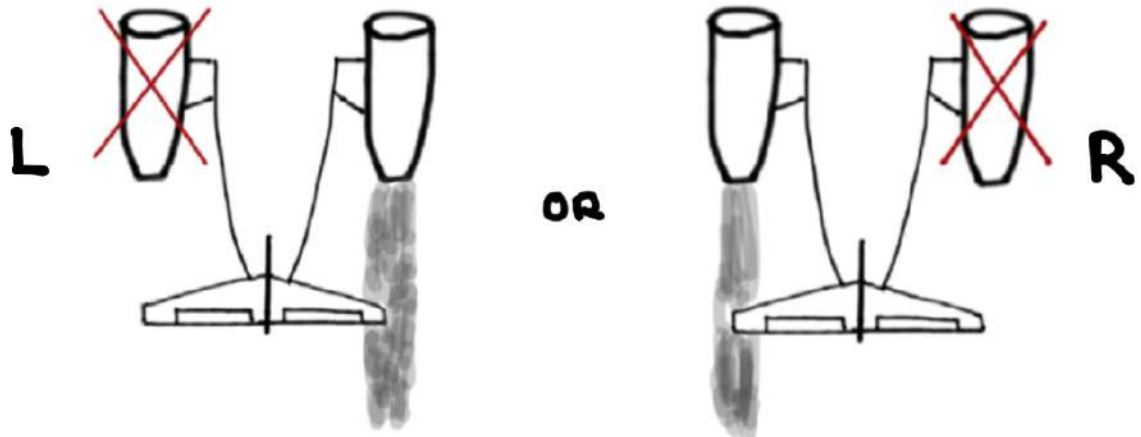


- BREAK POWER TRANSFER (BPT)

AN IDG FAILURE



AN ENGINE FAILURE



A FIRE handle pulled

L ENGINE FIRE

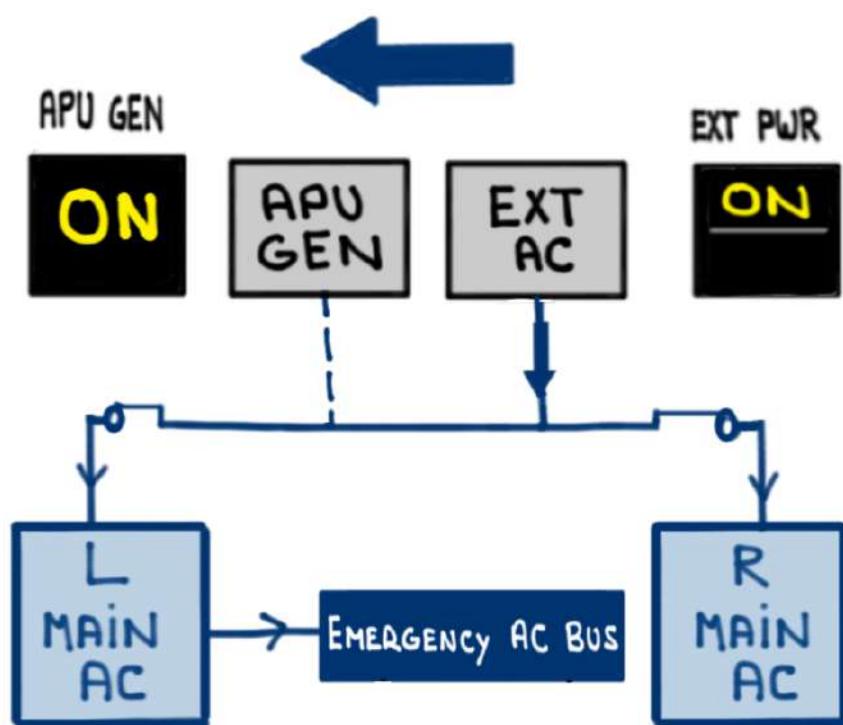
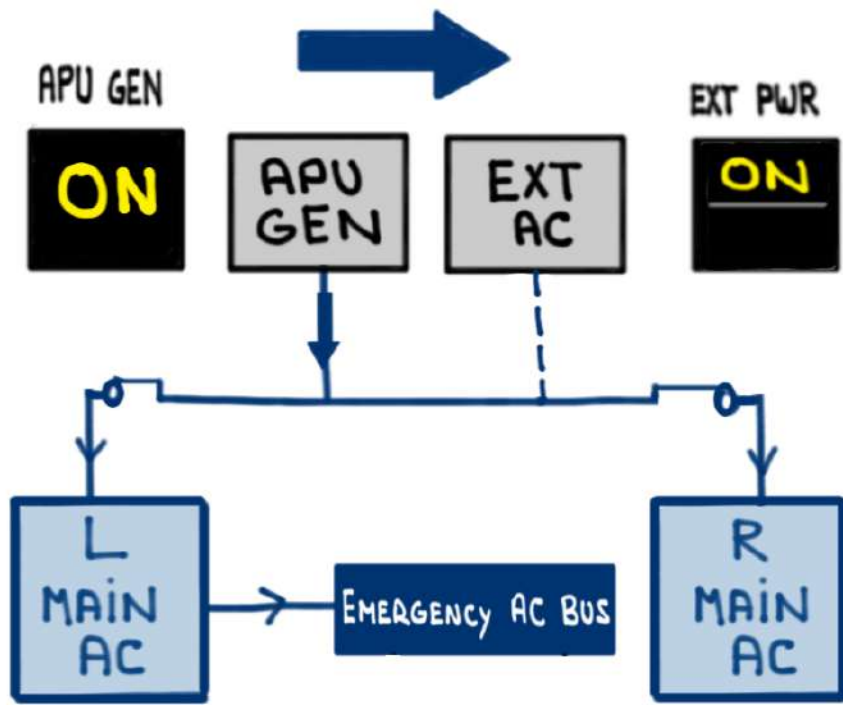
R ENGINE FIRE



OR

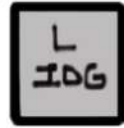


AN IDG NOT AVAILABLE

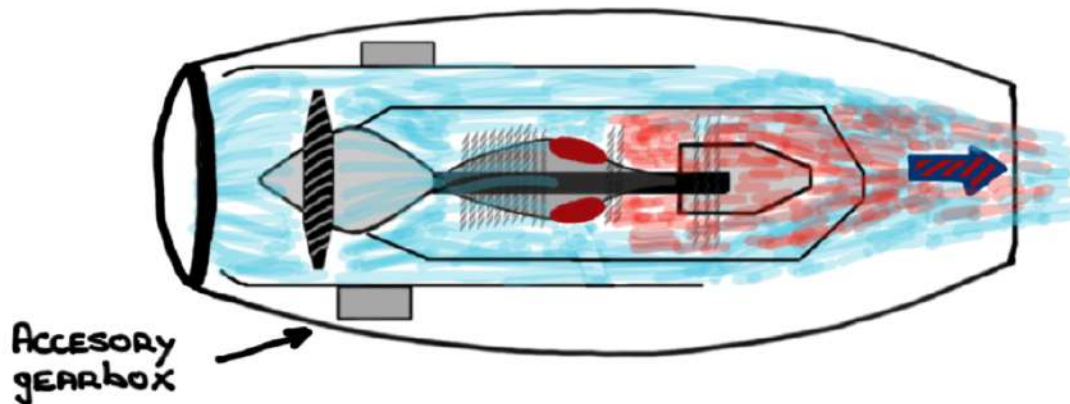


INTEGRATED DRIVE GENERATORS (IDG)

- Two (2) ENGINE-DRIVEN IDGs



- LOCATED ON THE ENGINE'S ACCESSORY GEARBOX



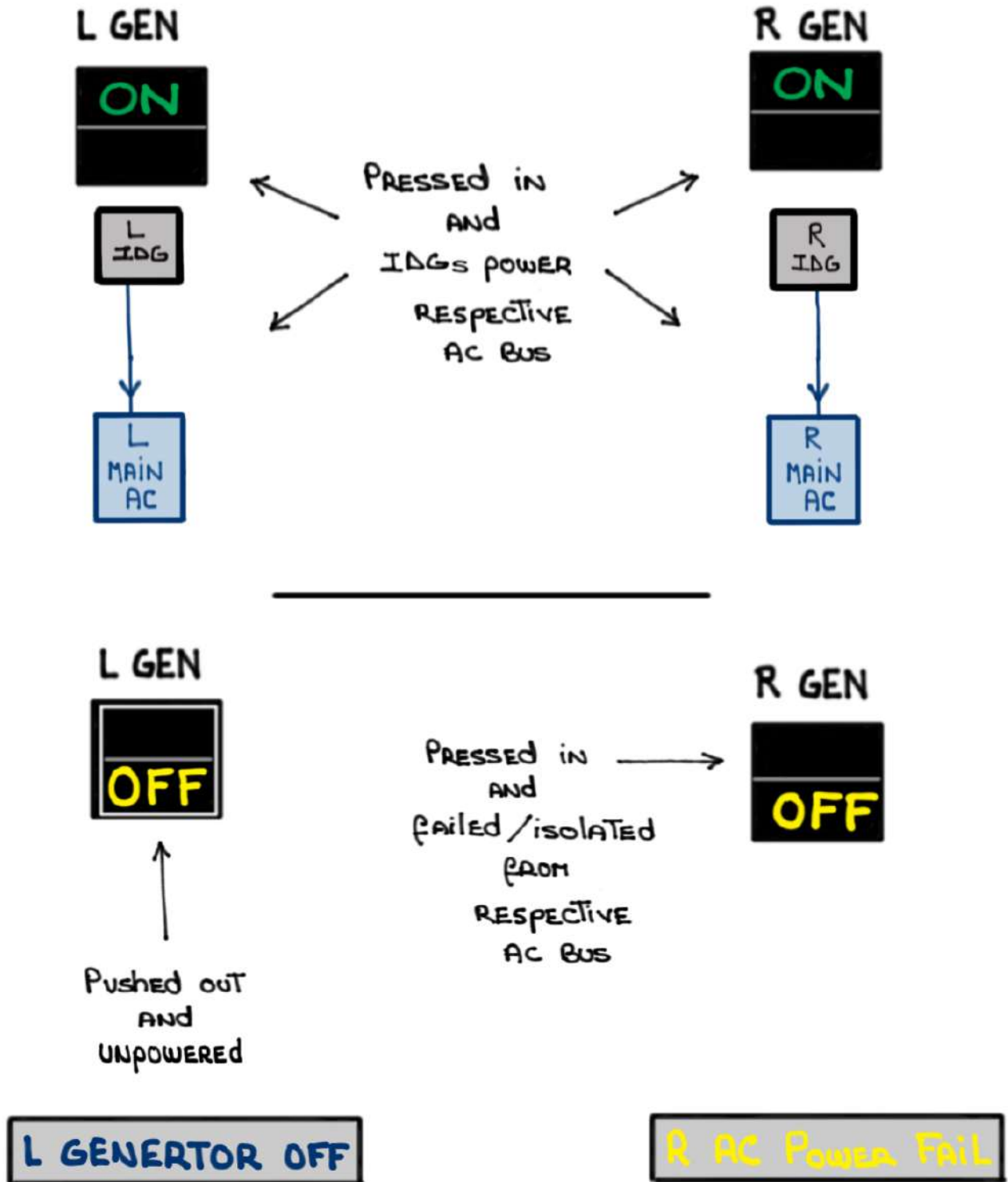
- IDG $\left\{ \begin{array}{l} \text{CONSTANT SPEED DRIVE (CSD)} \\ \text{Oil-cooled GENERATOR (oil is cooled} \\ \text{by fan air)} \end{array} \right.$

• IDG $\left\{ \begin{array}{l} \text{RATED AT } 40 \text{ KVA} \\ \text{PRODUCES: } 115 \text{ VAC} \\ 400 \text{ HERTZ} \\ 3\text{-phase} \end{array} \right.$

• CSD CONVERTS VARIABLE ENGINE SPEED TO A CONSTANT SPEED AT THE GENERATOR (12,000 RPM)

- Dispatch with AN IDG inop is NOT PERMITTED AS PER AFM ois **G650ER-2016-03** APU SEALANT (if applicable)

- GENERATOR Switches:



Auxiliary Power Unit (APU) GENERATOR

- The APU provides an auxiliary source of:

① ELECTRICAL **AC** power - **GROUND**

② Backup electrical **AC** power - **Air**

- The APU can be started with **L MAIN BATT** **R MAIN BATT** power

- AT **99%** RPM plus two (**2**) seconds the APU GEN comes online and can power:

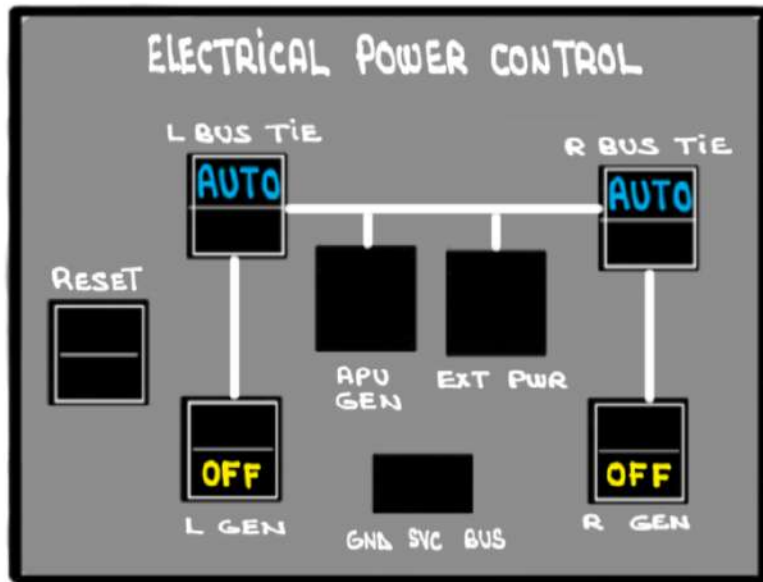
All **AC** and **DC** buses

- **APU GEN** **RATED AT 40 kVA** **45,000 FEET**
PRODUCES: 115 VOLTS **↑ 100%**
400 HERTZ **GROUND**
3-PHASE

- REFER TO AFM OIS **G650ER-2016-03** APU SEALANT
FOR APU **in flight** OPERATION LIMITATIONS

RAM AIR TURBINE (RAT)

- Backup **AC** GENERATOR

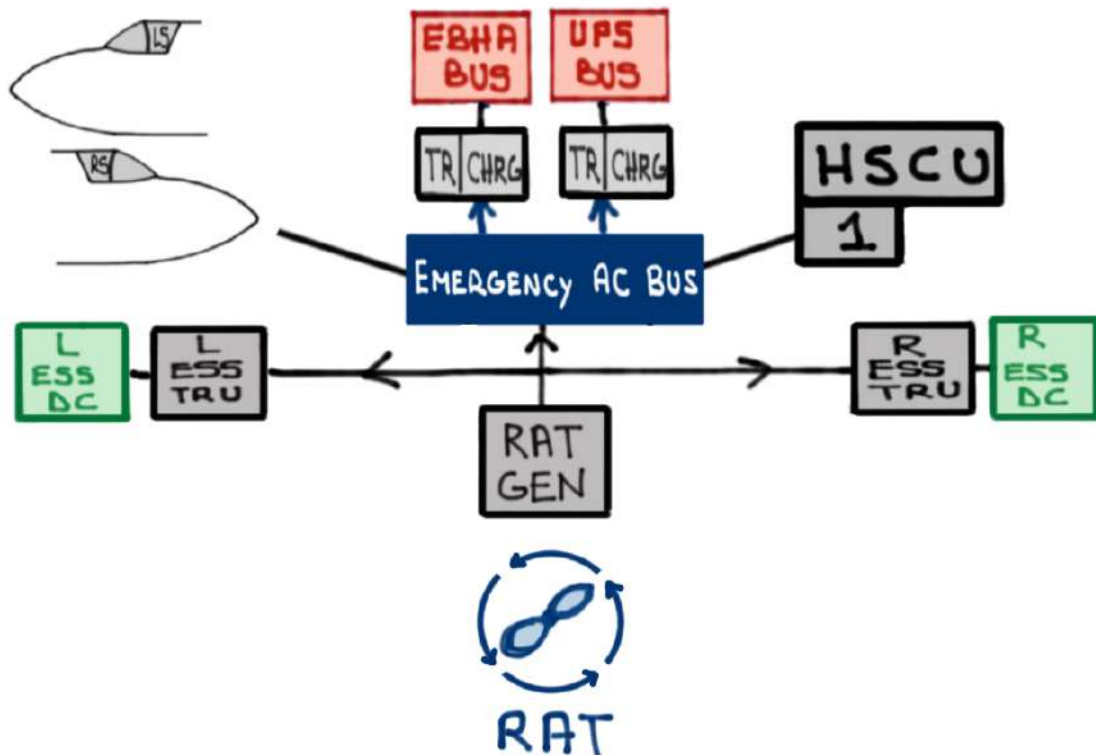


L-R AC POWER FAIL

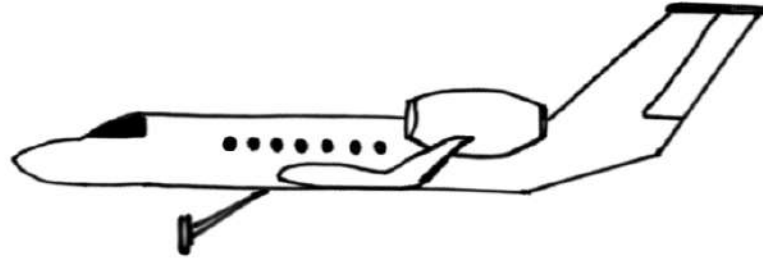
L-R AC POWER FAULT

APU POWER FAIL

RAT GENERATOR ON

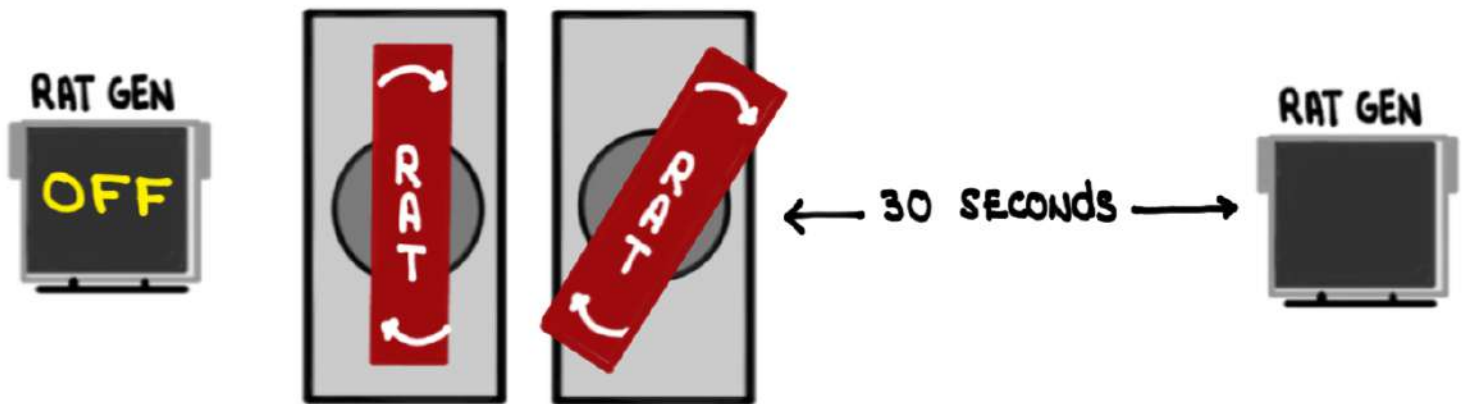


- The RAT, once deployed by the crew, CONVERTS AIRSTREAM ENERGY TO ELECTRICAL ENERGY



- RAT GEN MUST BE switched OFF PRIOR TO deploying THE RAT. THEN, WAIT **30** SECONDS FOR RAT SPEED TO STABILIZE PRIOR TO switching its GEN ON

Twist & Pull



- RAT GEN switch is KEPT ON TO PROVIDE HEAT TO THE RAT

- OPERATING ENVELOPE:

- ≥ 180 KTS - $\leq M0.925$ (Mmo)

- SEA LEVEL \rightarrow FL510

- < 180 KTS The RAT GEN drops offline AND THE POWER THE L MAIN BATT R MAIN BATT L ESS DC R ESS DC BUSES

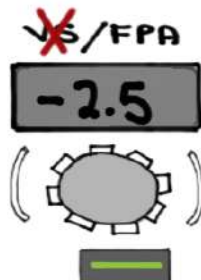
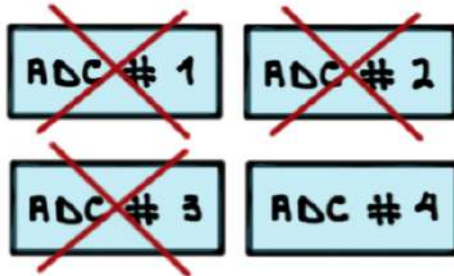
-  ROTATES COUNTER CLOCKWISE

- Six (6) PERCENT FUEL PENALTY

- RAT TEST = MAINTENANCE FUNCTION only

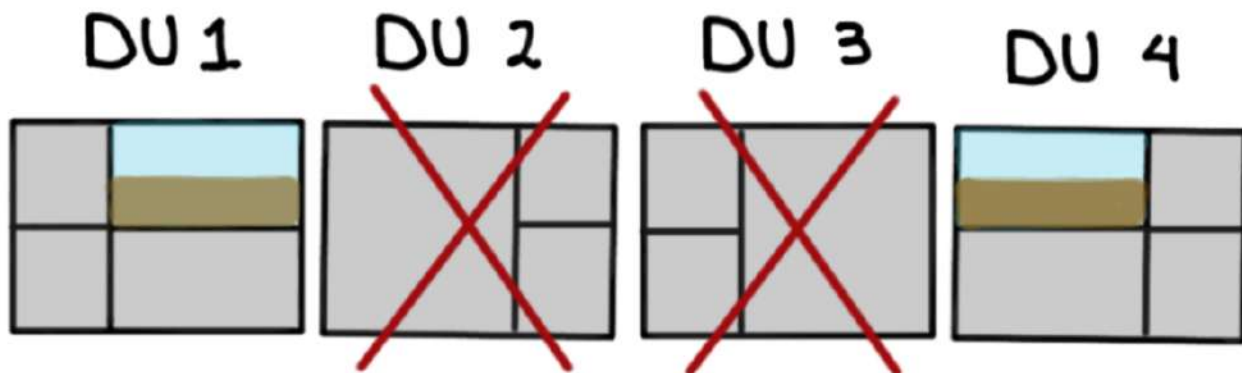


- ONCE DEPLOYED THE RAT CAN'T BE STOWED IN FLIGHT

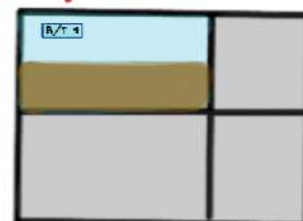
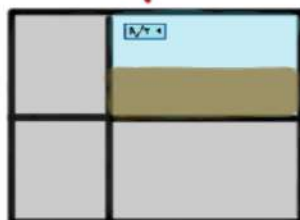


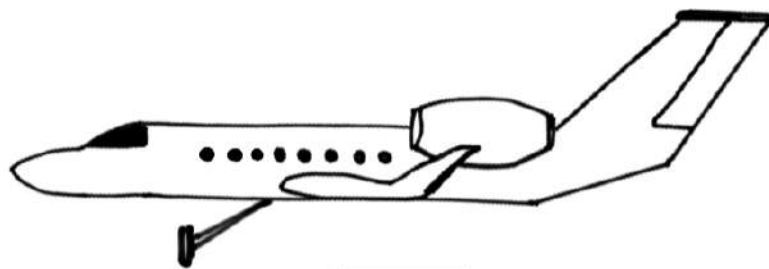
RAT GEN ON = ADS # 4 (STBY) only

- No VERTICAL SPEED OR ALTITUDE Hold MODES
- Only FPA AVAILABLE



No
AUTO THROTTLES

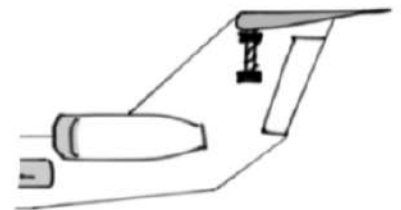
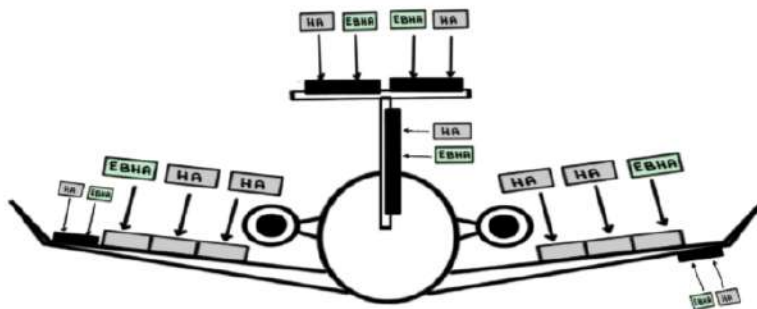
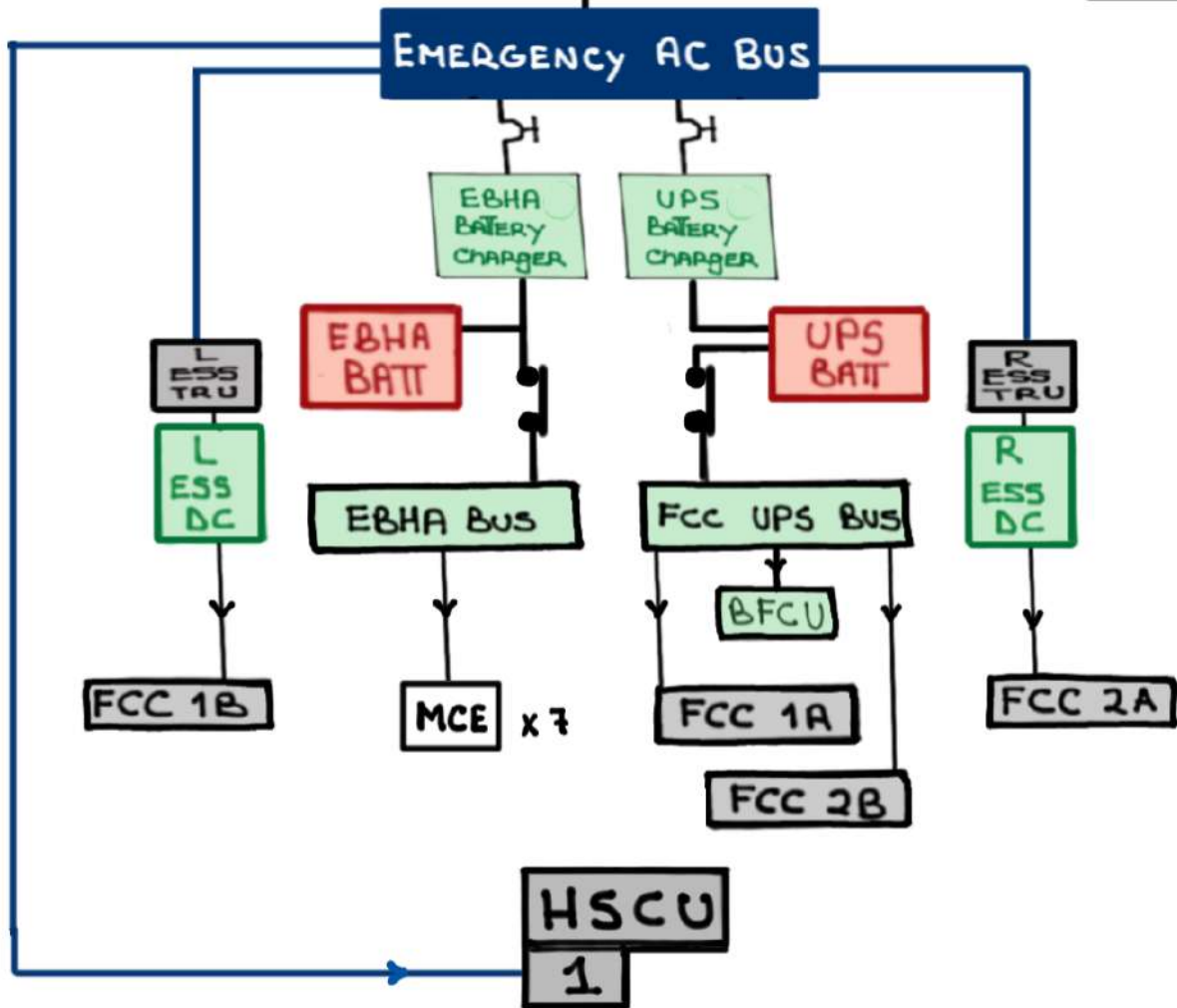
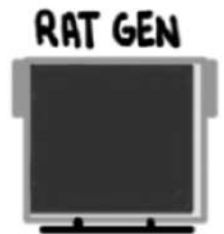




RAT GENERATOR ON

RAT GEN

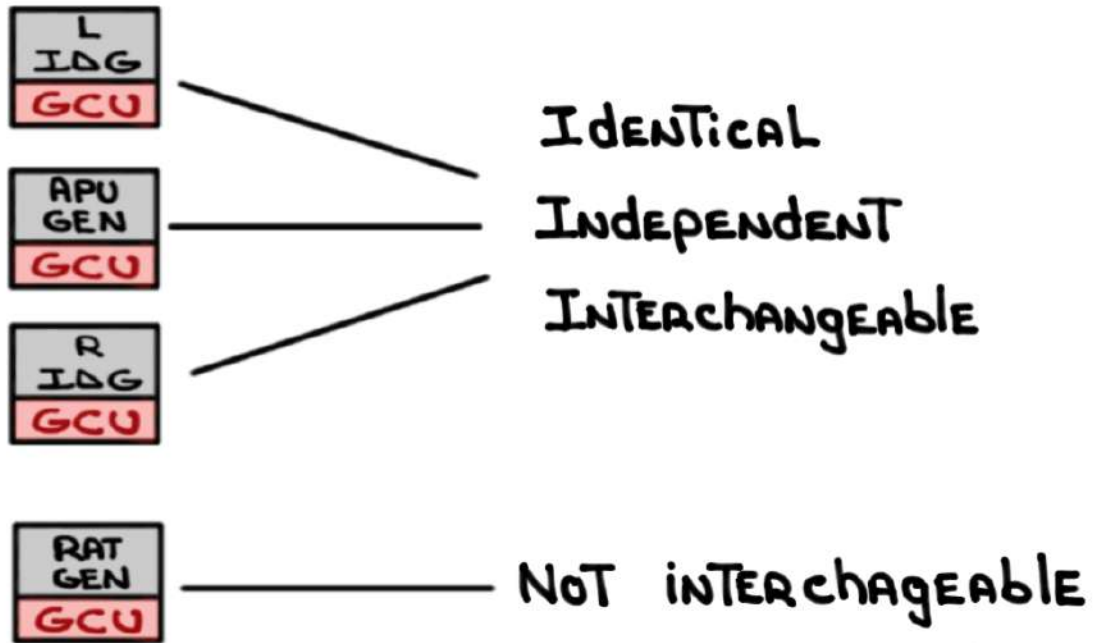
(> 180 kTs)



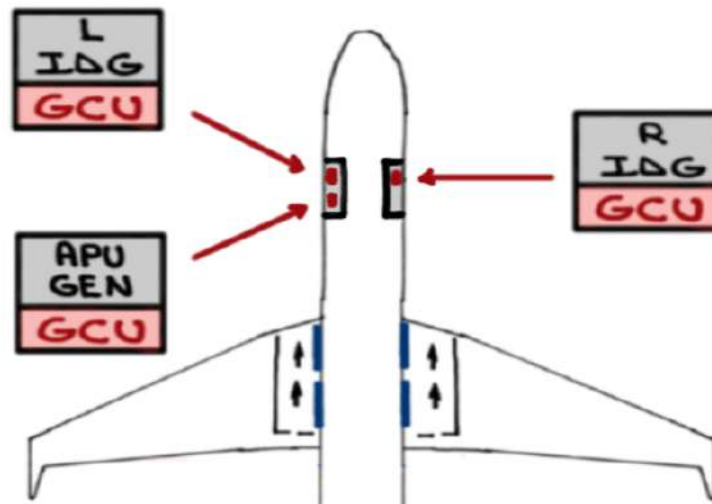
GENERATOR CONTROL UNITS (GCU)

- GCUs ARE MICROPROCESSORS THAT CONTROL GENERATOR OUTPUT (QUALITY ASSURANCE) AND PROVIDE FAULT PROTECTION

- THERE ARE **FOUR (4)** GCUs:



- GCUs ARE LOCATED IN THE LEER AND REER



- If GEN

VOLTAGE
FREQUENCY
AMPERAGE



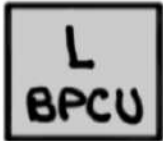
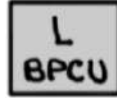
OUTSIDE PARAMETERS =

GCU

TAKES GEN OFFLINE



NOTIFIES



NOTIFIES CREW VIA CAS:

L AC POWER FAIL

L GENERATOR FAIL

TAKES GEN OFFLINE

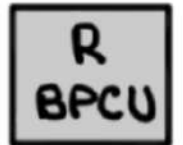


NOTIFIES



GCU

NOTIFIES CREW VIA CAS:



R AC POWER FAIL

R GENERATOR FAIL

GCU

CAN BE RESET BY CYCLING THE



SWITCH

EXTERNAL AC/DC POWER

- EXTERNAL AC POWER  

- RECEPTACLE IS LOCATED ON THE RIGHT SIDE OF THE FUSELAGE
- 40 KVA, 115 VAC, 400 Hz, 3 PHASE
- CAN POWER ALL AC BUSES AND THROUGH THE TRUS ALL DC BUSES ARE POWERED
- BPCU CHECKS QUALITY OF POWER BEFORE ALLOWING ONTO AIRCRAFT

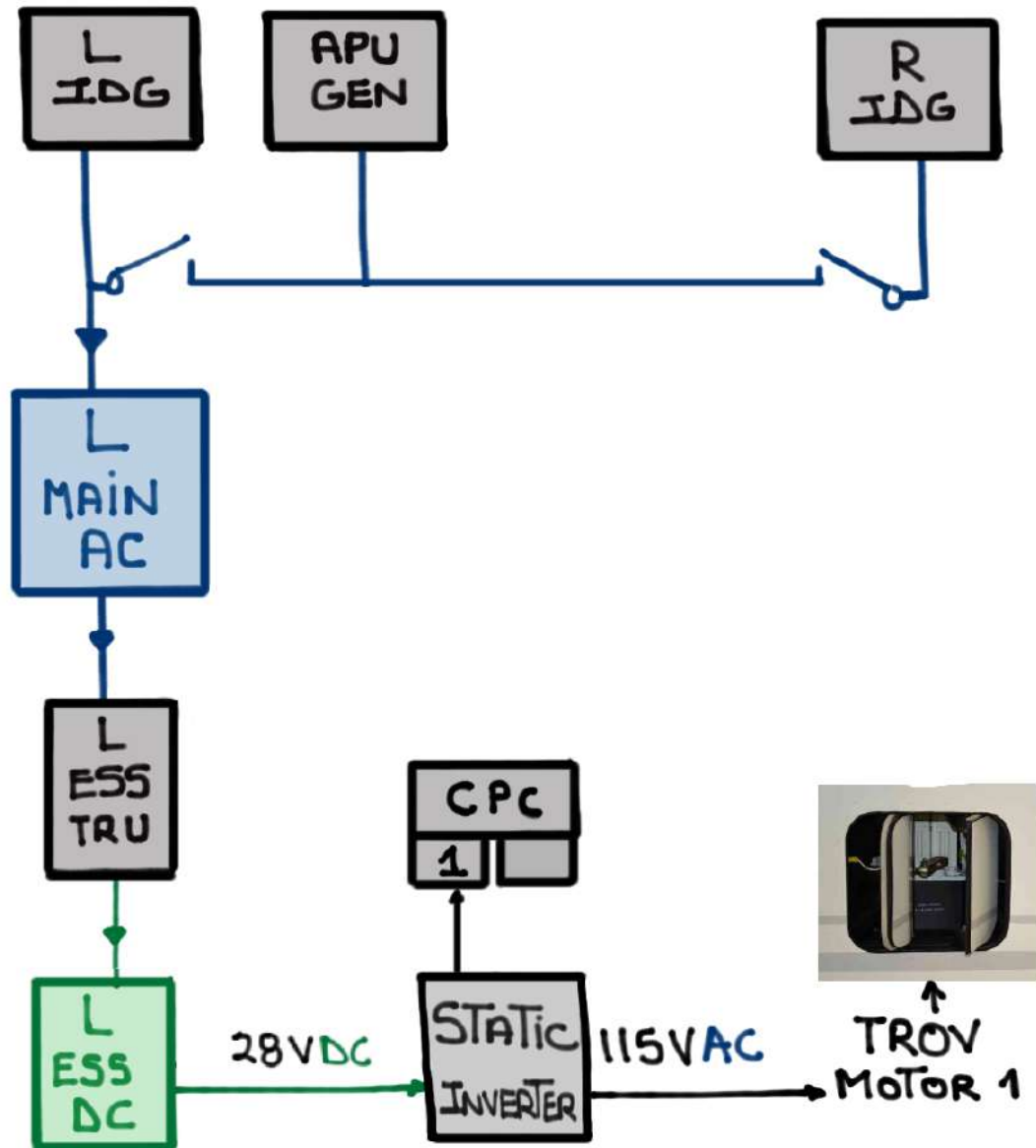
- EXTERNAL DC POWER  

- RECEPTACLE IS LOCATED ON THE RIGHT SIDE OF THE FUSELAGE
- POWERS ALL DC BUSES
- CAN BE USED TO POWER THE GSB
- USE OF EXTERNAL DC POWER TO START THE APU IS PROHIBITED

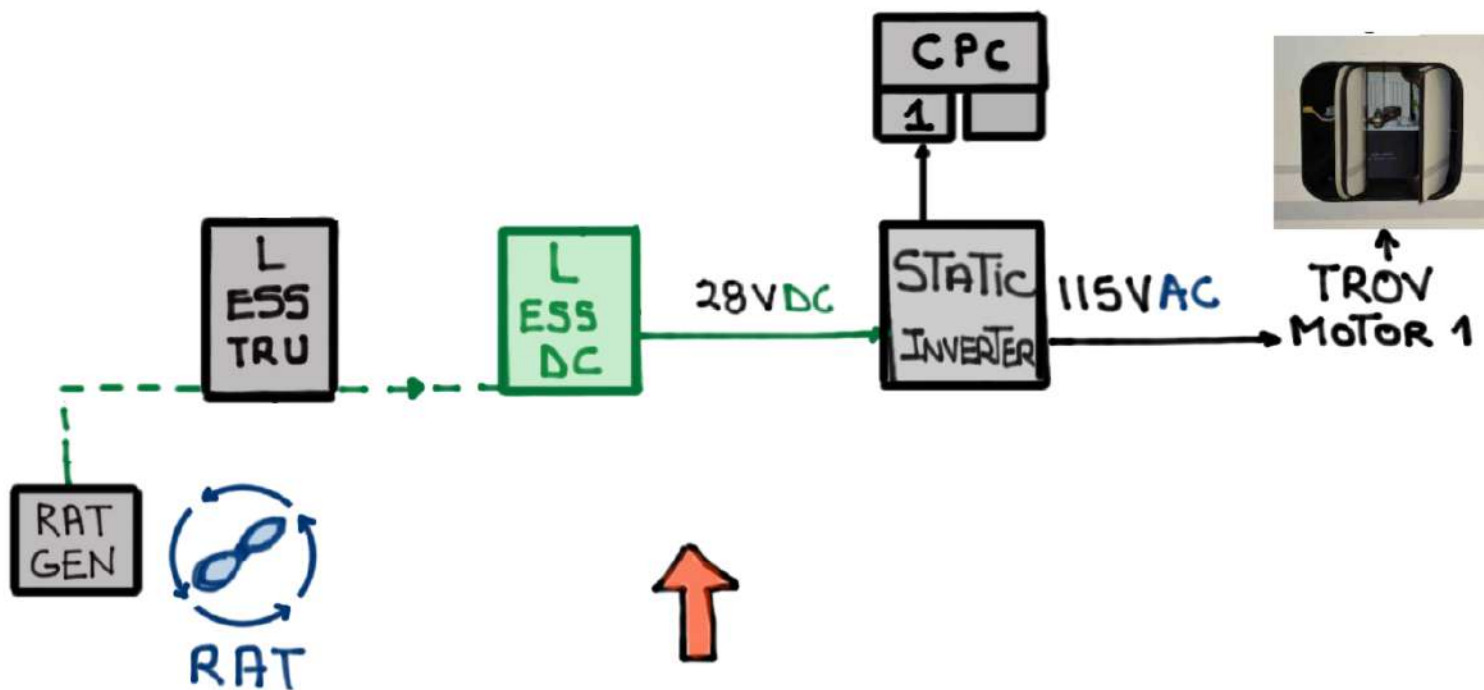
STATIC INVERTER

- A STATIC INVERTER CONVERTS DC To AC POWER IN ORDER TO POWER CHANNEL 1 of THE CABIN PRESSURE CONTROLLER (CPC)

NORMAL

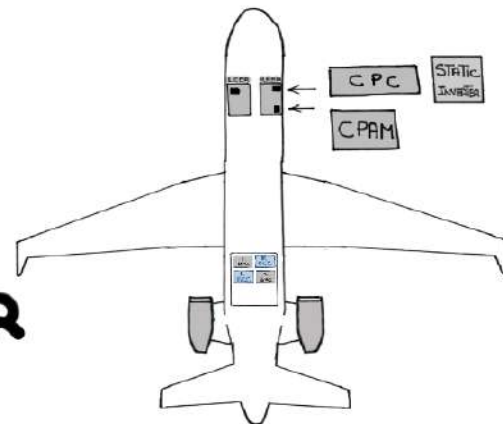


- In the unlikely event that normal (IDG) or backup AC power (APU GEN) are not available the **RAT GEN** can continue to power **CPC 1**



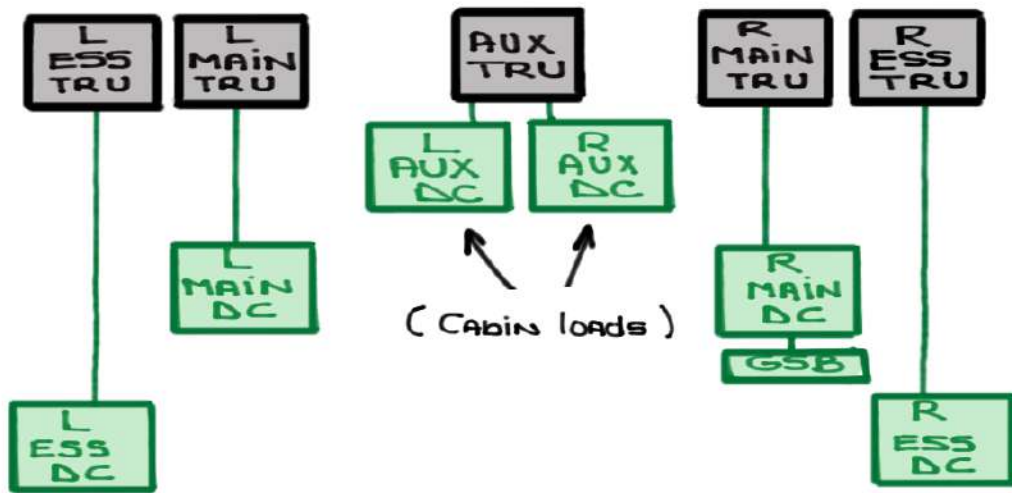
EMERGENCY

- The **STATIC INVERTER** is located in the REER

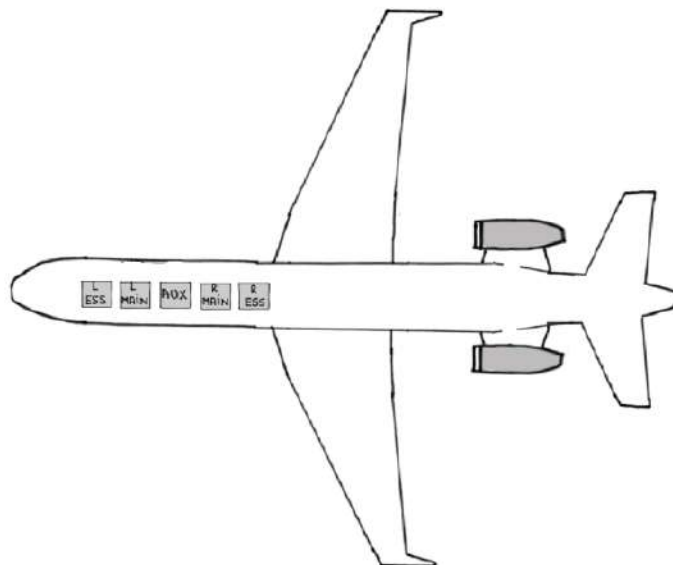


TRANSFORMER RECTIFIER UNITS (TRU)






- TRUs ARE POWERED BY THE **L MAIN AC** **R MAIN AC** BUSES
- A **TRU** CONVERTS **115 VAC** TO **28 VDC**





- TRUs ARE LOCATED UNDERNEATH THE FLOOR

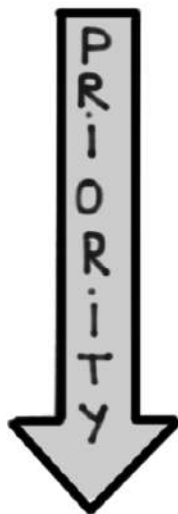


-     POWER THEIR OWN BUSES

-  POWERS THE   BUSES AND WILL TAKE OVER THE DUTIES OF A FAILED ~~~~ OR ~~~~ TRU USING THE FOLLOWING PRIORITY PROCESS:

 BEFORE 

 BEFORE 



① Sheds   BUSES

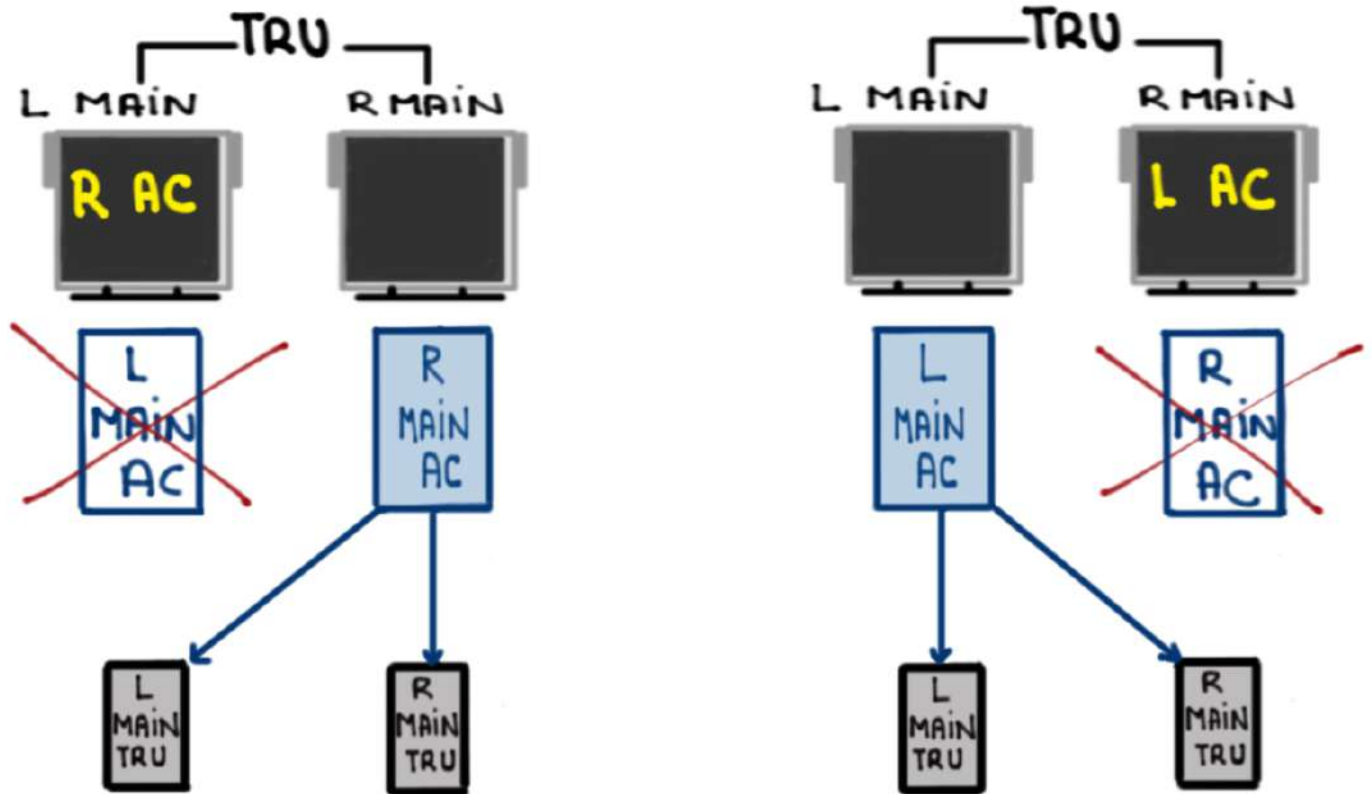
② 

③ 

④ 

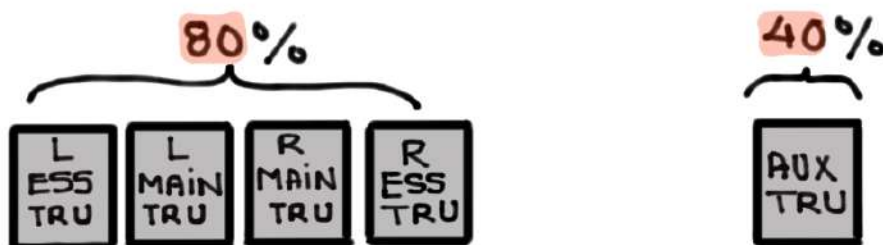
⑤ 

- TRU switches allow opposite **MAIN AC** bus to power a **MAIN TRU** that lost power due to the failure of its own ~~MAIN AC~~ bus



- TRUS ARE RATED AT **250** AMPS

- **GROUND** ops - TRU LOAD LIMITS:



GROUND SERVICE BUS

- "When you don't want to wake up the beast"

- **GROUND OPERATIONS** (APU shutdown)

- REFUELING OPERATIONS
- ENGINE OIL SERVICING
- POTABLE WATER SERVICING
- HYDRAULIC FLUID SERVICING
- OPERATION OF WHEEL WELL LIGHTS

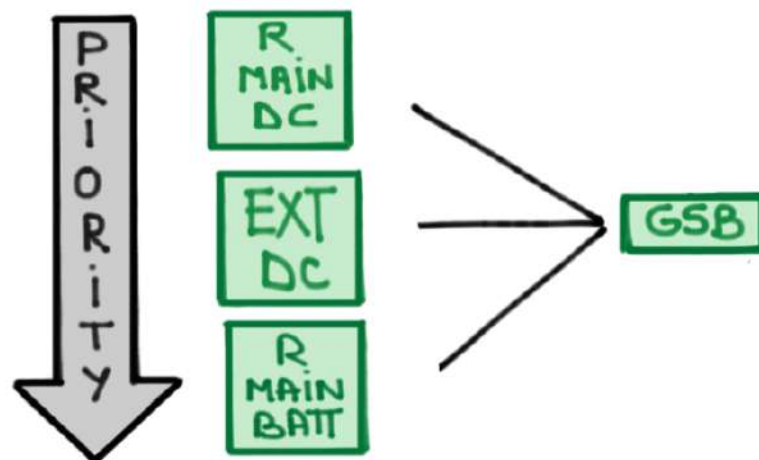
ON

GND SVC BUS

- FOUR (4) GSB SWITCHES:

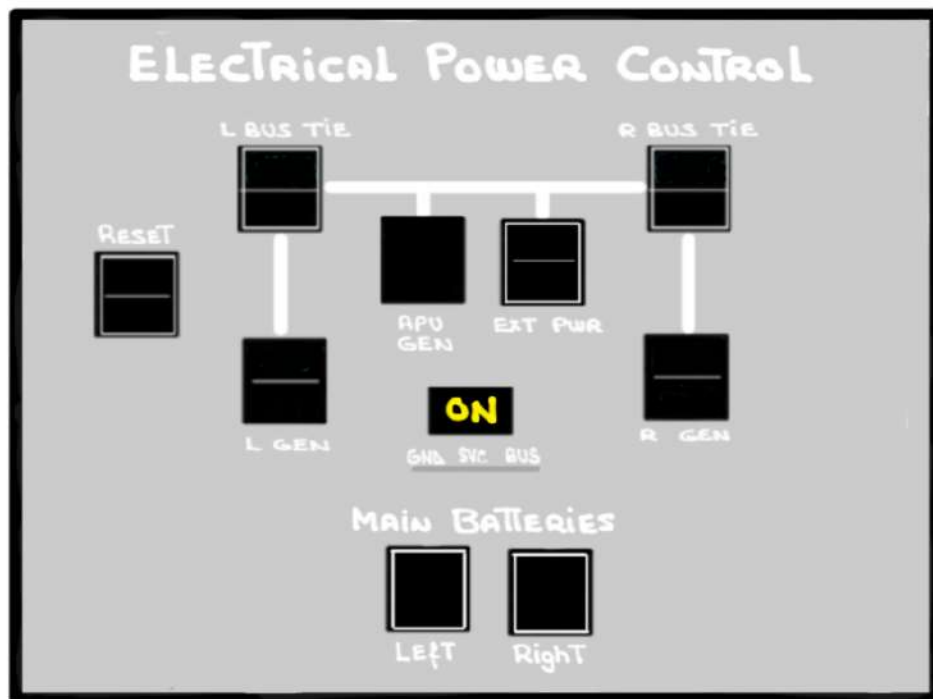
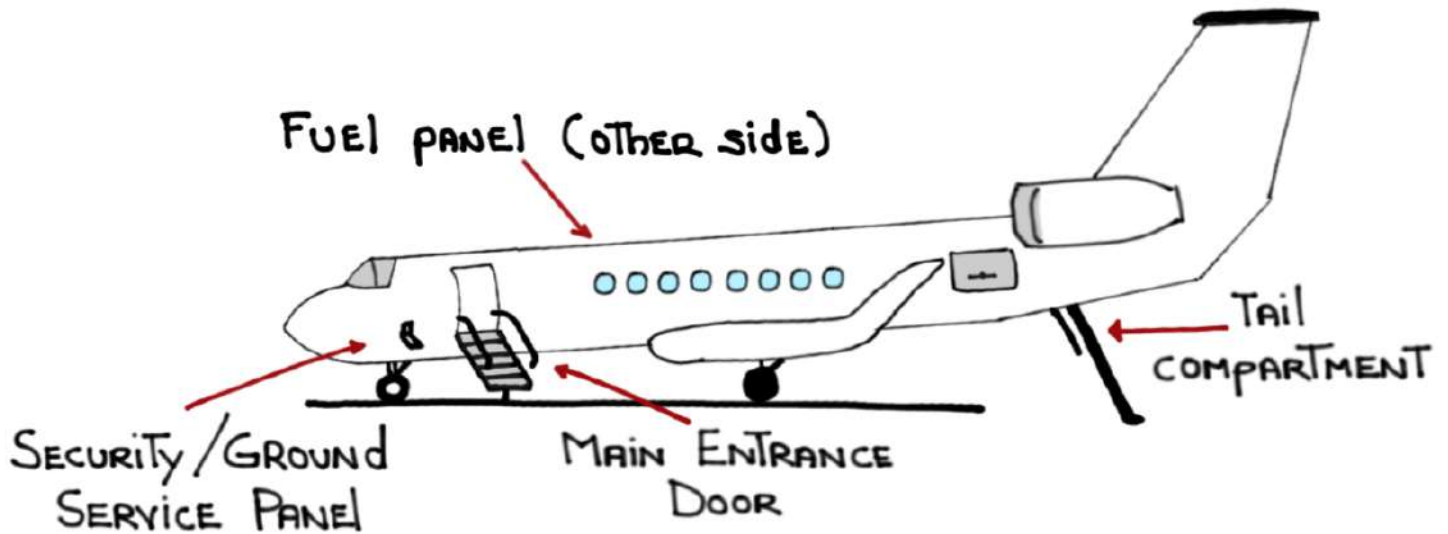
- SECURITY/GROUND SERVICE PANEL
- REER MAINTENANCE PANEL
- TAIL COMPARTMENT
- FUEL PANEL

- POWER SOURCES (PRIORITY):



- ROTATING BEACON light is powered by the **GSB** when the **R MAIN BATT** is the source of power

- AT LEAST ONE OF THE following MUST BE OPEN when using ONE of the **GSB** switches:



MAIN BATTERIES

- Two (2) MAIN BATTERIES






- LOCATED IN THE TAIL COMPARTMENT
- Nicad, 21 cells, 95 pounds EACH
- 28 VDC, 53 AMP/HOUR
- PURPOSE:





① START THE APU - USES  ONLY BUT BOTH

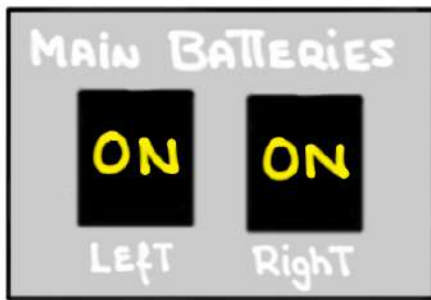


SWITCHES MUST BE SELECTED ON

NOTE: MINIMUM 22 VOLTS REQUIRED TO START APU

② OPERATE  HYDRAULIC PUMP - BOTH  

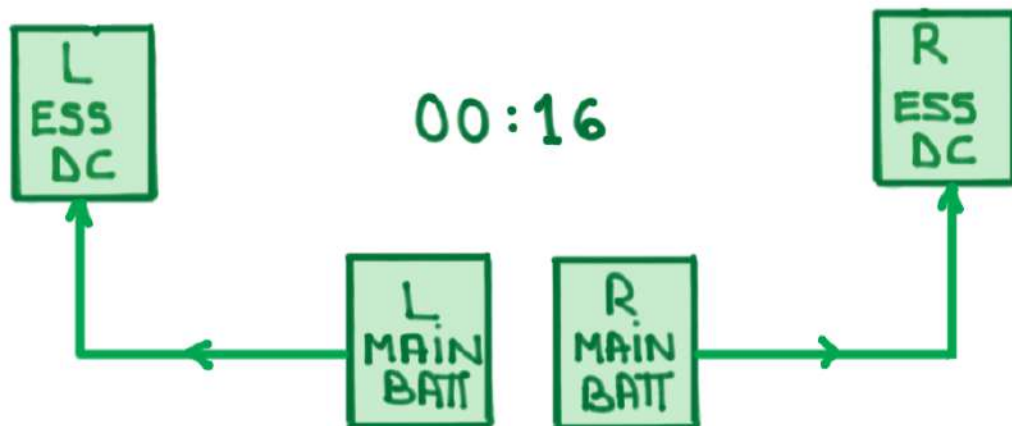
③ POWER   BUSES - BOTH   IF NO OTHER SOURCE OF DC POWER IS AVAILABLE



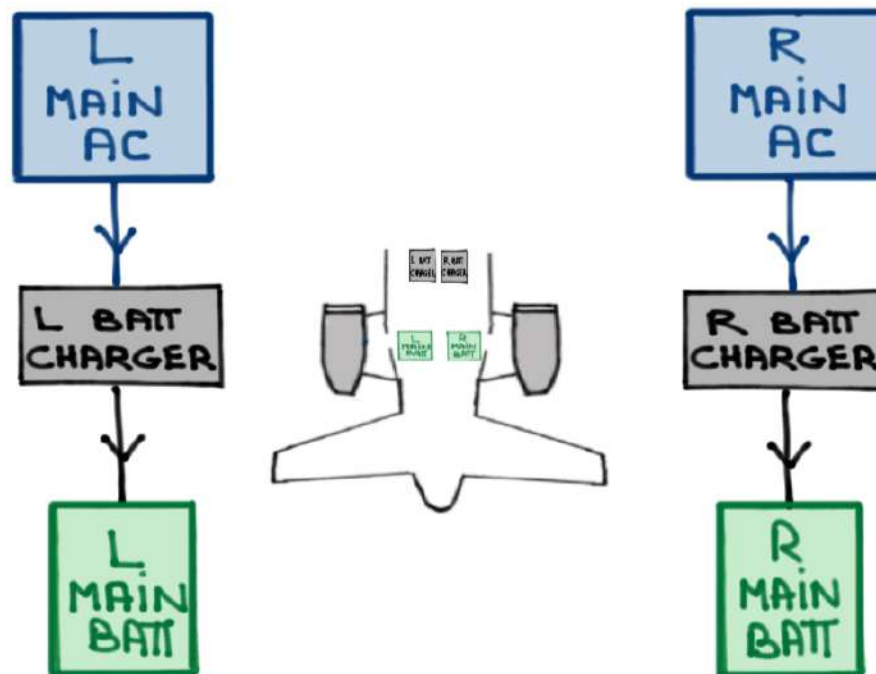
Switchlights illuminate to indicate that the batteries are:

- ① Powering the ESS DC buses (discharging)
- ② When starting the APU
- ③ When the AUX pump is activated

- MAIN BATTERIES CAN POWER THE ESS DC BUSES FOR SIXTEEN (16) MINUTES AFTER TWO (2) FAILED APU START ATTEMPTS

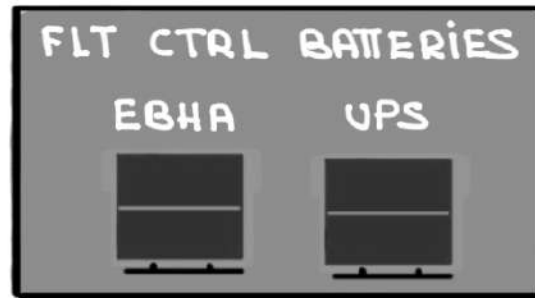


- MUST BE REMOVED FROM THE AIRCRAFT IN COLD SOAKED CONDITIONS ($\leq -20^{\circ}\text{C}$) AND STORED IN A LOCATION WARMER THAN -20°C AND COOLER THAN $+40^{\circ}\text{C}$
- If ≤ 22 VOLTS DC REFER TO GVI MAINTENANCE MANUAL
- The L
MAIN
BATT R
MAIN
BATT ARE NORMALLY RECHARGED BY THE MAIN
AC BUSES



- THE MAIN BATTERY CHARGERS ARE LOCATED IN THE TAIL COMPARTMENT

FLIGHT CONTROL BATTERIES



THERE ARE TWO (2) Flight Control System (FCS) BATTERIES:


① ELECTRICAL Backup Hydraulic Actuator (EBHA) BATTERY



② UNINTERRUPTIBLE Power Supply (UPS) BATTERY





THE FCS BATTERIES CAN POWER THE FLIGHT CONTROLS FOR THIRTY (30) MINUTES

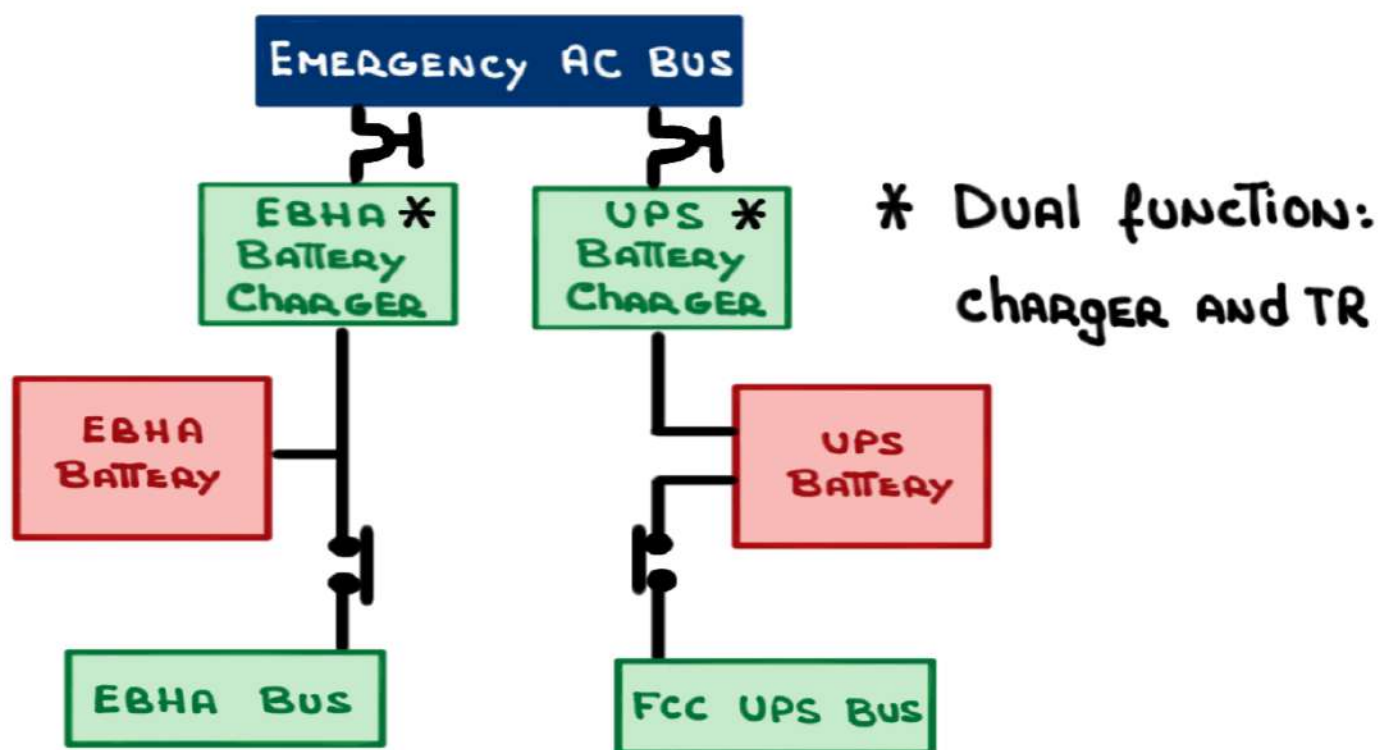
- ILLUMINATED   if NO  POWER IS BEING PRODUCED AND THEY POWER THEIR OWN BUSES (DISCHARGING)



- SYSTEM POWER ON SELF TEST (SPOST)

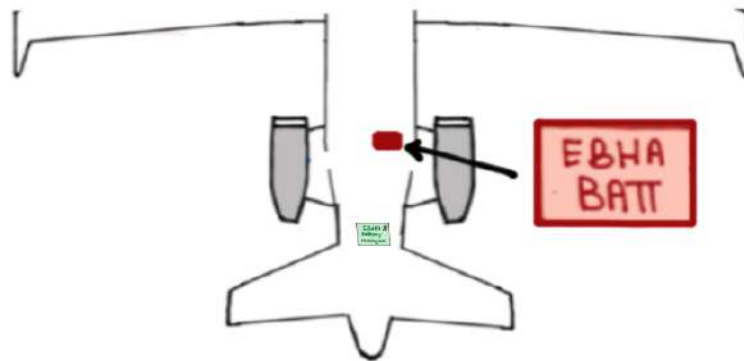
-  SELECTED ON first THEN  SELECTED ON
- FORTY five (45) SECOND TEST
- NO ELECTRICAL INTERRUPTIONS DURING SPOST OR A COMPLETE POWER DOWN IS REQUIRED

- FCS BATTERIES - CHARGER/TRANSFORMER RECTIFIER

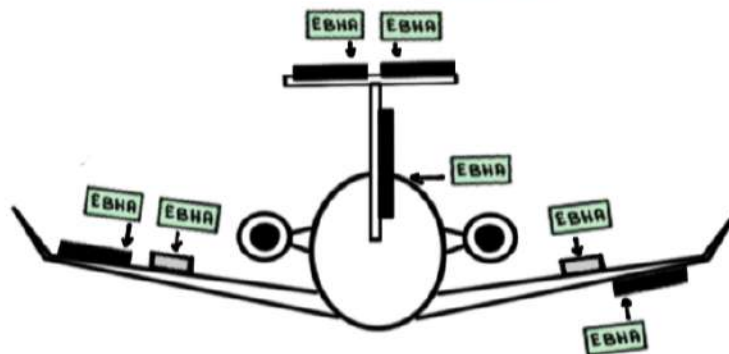


- **EBHA BATT** ELECTRICAL BACKUP HYDRAULIC ACTUATOR

- Nicad, 28 Volts, 53 amp/hour
- LOCATED IN THE TAIL COMPARTMENT



- POWERS SEVEN (7) **EBHA** ACTUATORS

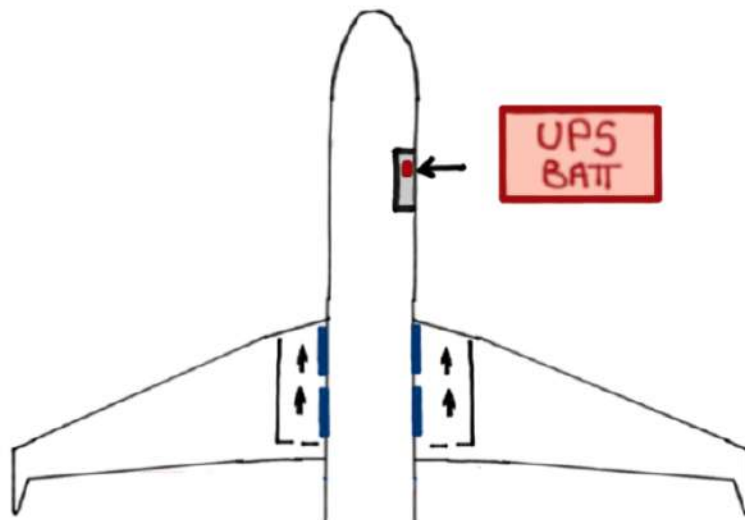


- CAN BE CHARGED BY **RAT GEN**  VIA THE **EMERGENCY AC BUS**

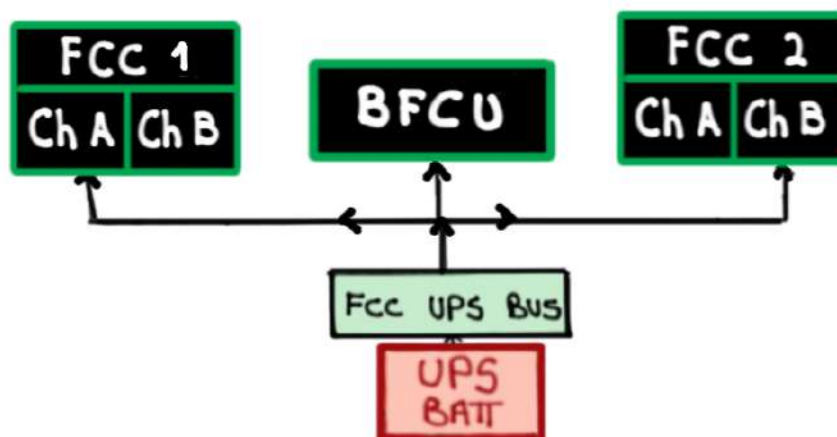
- MUST BE REMOVED FROM THE AIRCRAFT IN COLD SOAKED CONDITIONS ($\leq -20^{\circ}\text{C}$) AND STORED IN A LOCATION WARMER THAN -20°C AND COOLER THAN $+40^{\circ}\text{C}$


• **UPS BATT** UNINTERRUPTIBLE POWER SUPPLY (UPS)

- LEAD ACID, **24** Volts, **10.5** Amp/hour
- LOCATED IN THE REER



- POWERS FLIGHT CONTROL COMPUTER CHANNELS 1A AND 2B



- CAN BE CHARGED BY **RAT GEN**  VIA THE **EMERGENCY AC BUS**

• MINIMUM BATTERY VOLTAGE:

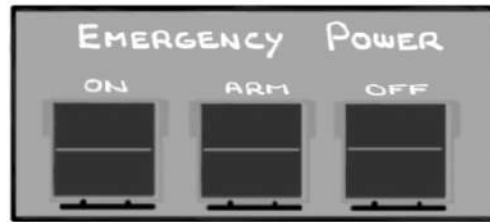
EBHA BATT > 24 V DC MINIMUM 

If voltage 22-24V DC, charge **EBHA BATT** for fifteen (15) MINUTES while OPERATING ON EXTERNAL AC POWER, APU GENERATOR, OR ENGINE GENERATOR. If voltage is < 22V DC REFER TO GVI MAINTENANCE MANUAL

UPS BATT > 23 V DC MINIMUM 

If voltage 22-23V DC, charge **UPS BATT** for fifteen (15) MINUTES while OPERATING ON EXTERNAL AC POWER, APU GENERATOR, OR ENGINE GENERATOR. If voltage is < 22V DC REFER TO GVI MAINTENANCE MANUAL

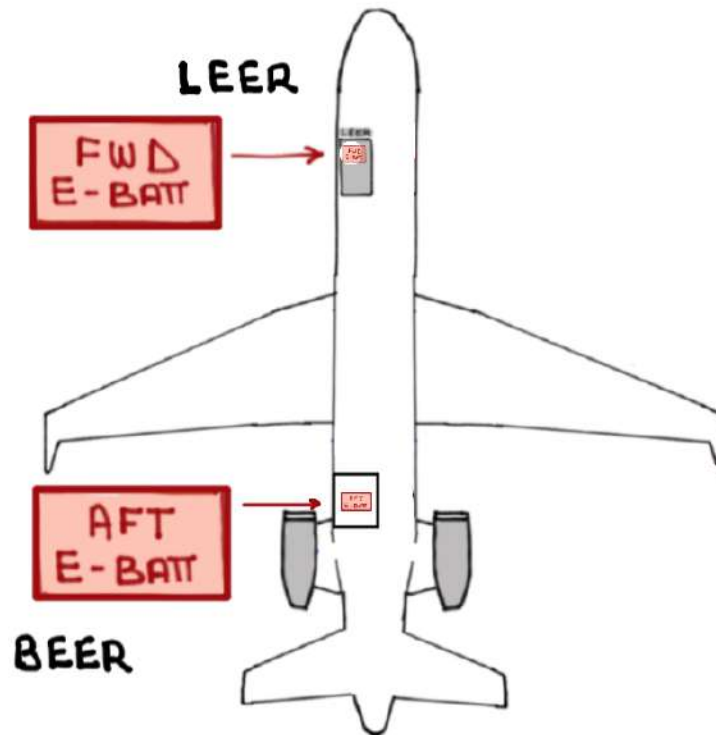
EMERGENCY BATTERIES



- THERE ARE TWO (2) E-BATTs

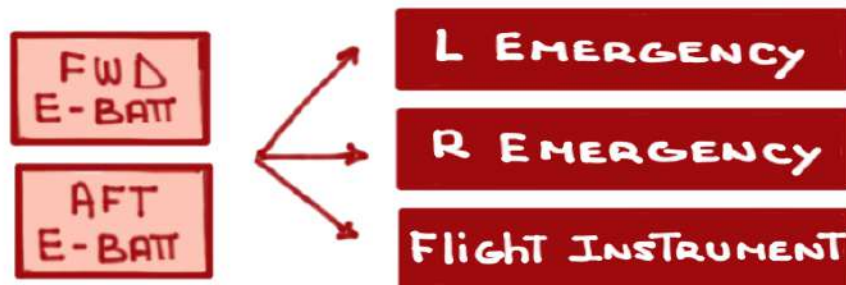
A FORWARD AND AN AFT E-BATT

- LOCATED in:

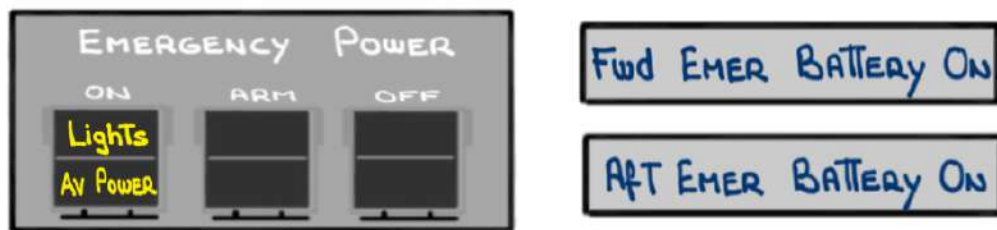


- SEALED, LEAD ACID WITH ITS OWN INTERNAL CHARGER
- 24 Volts, 10.5 AMP/HOUR
- FORTY FIVE (45) MINUTES DURATION, APPROXIMATELY

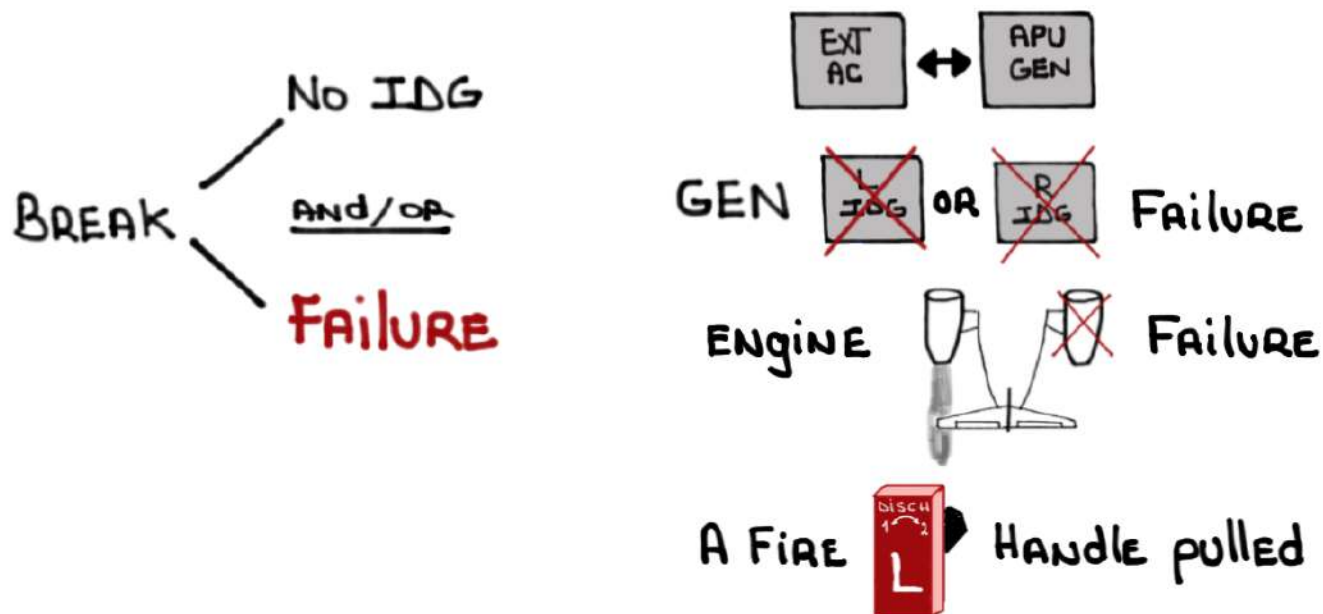
- POWER THE following buses:



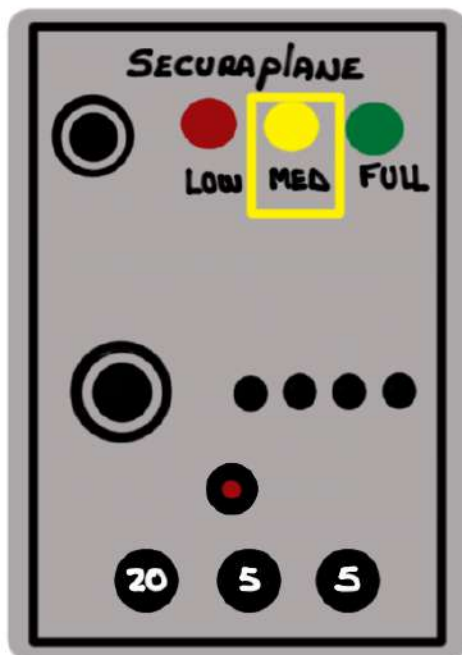
- When "ARMED" The E-BATTs COME ON automatically when power to the **L ESS DC** AND/OR **R ESS DC** drops below **20** Volts, EVEN MOMENTARILY



- AFTER A BREAK POWER TRANSFER THE E-BATTs will COME ON

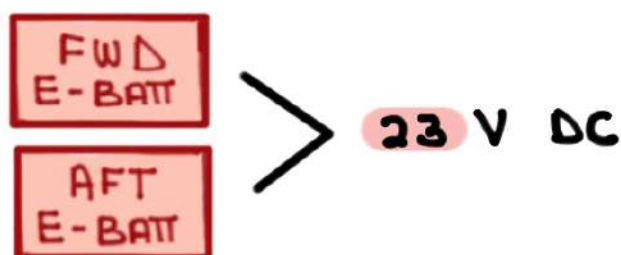


- MINIMUM CHARGE LEVEL REQUIRED FOR DISPATCH : 72%



- Red : 0-50%
- Yellow : 50-75%
- Green : 75-100%

- MINIMUM BATTERY VOLTAGE:



If voltage 22-23V DC, charge E-BATTs for fifteen (15) minutes while operating on external AC power, APU generator, or engine generator. If voltage is < 22V DC refer to GVI MAINTENANCE MANUAL

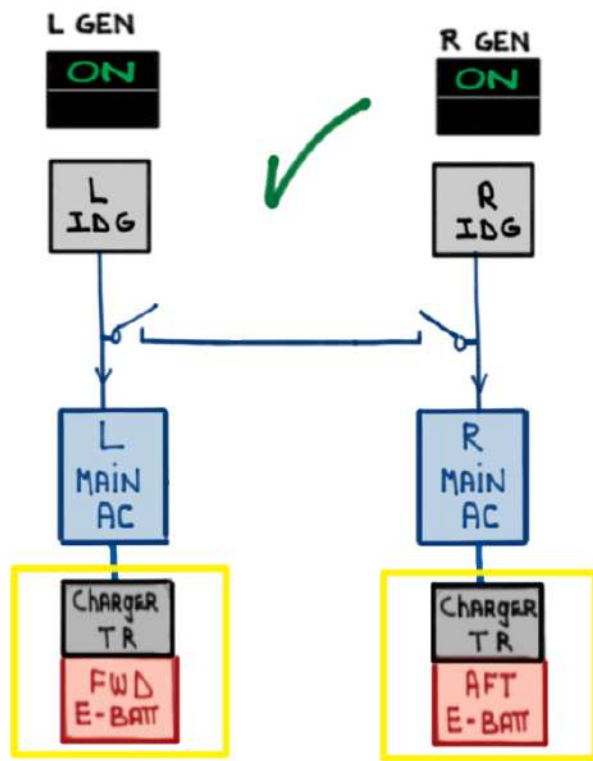
- E-BATTs POWER THE following EQUIPMENT:

- EMERGENCY Lighting
 - ↳ CABIN EMERGENCY LIGHTS
 - ↳ EXTERIOR EMERGENCY LIGHTS
- STANDBY FLIGHT DISPLAYS (2)
- INERTIAL REFERENCE UNITS (3)
- THREE (3) AUDIO CONTROL PANELS (ACPs)
- MCDU 1 - STBY ENGINE INSTRUMENTS
- MCDU 3 - BACKUP RADIOS (VHF 1/NAV 1)
- Two (2) clocks

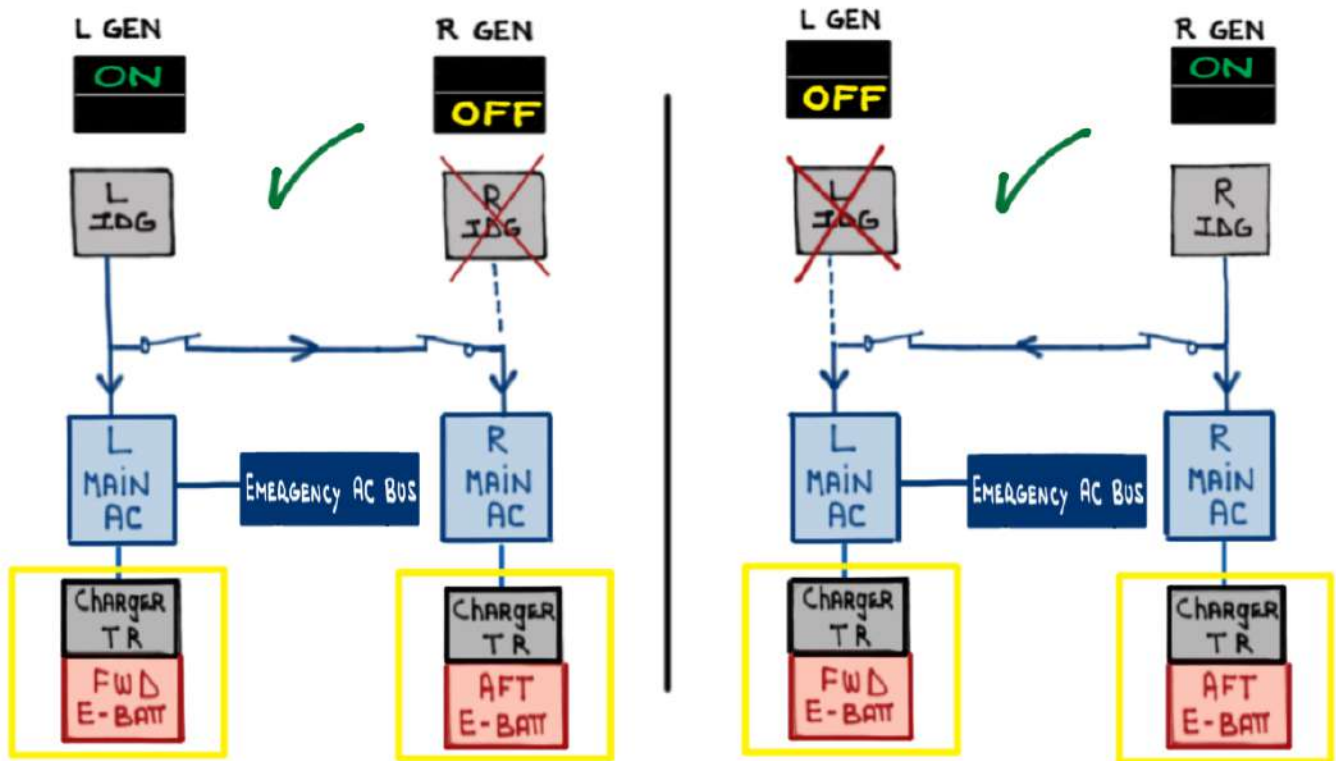
- AN INTEGRATED CHARGER/TRANSFORMER RECTIFIER RECHARGES THE E-BATTs



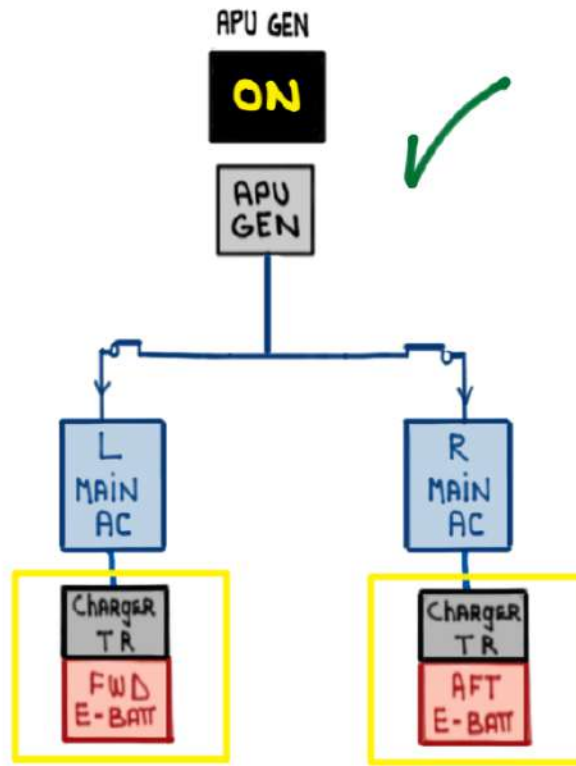
① Both IDGs



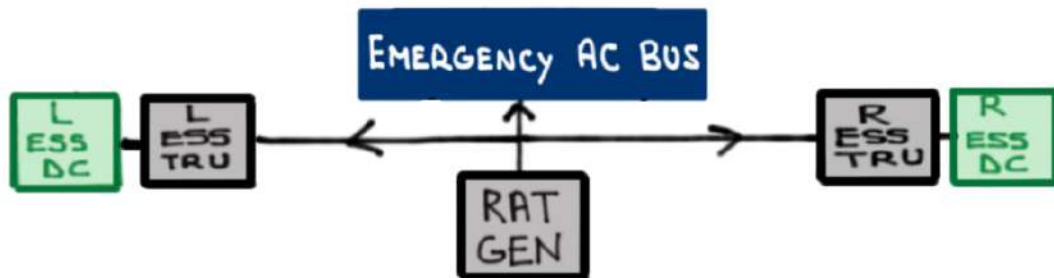
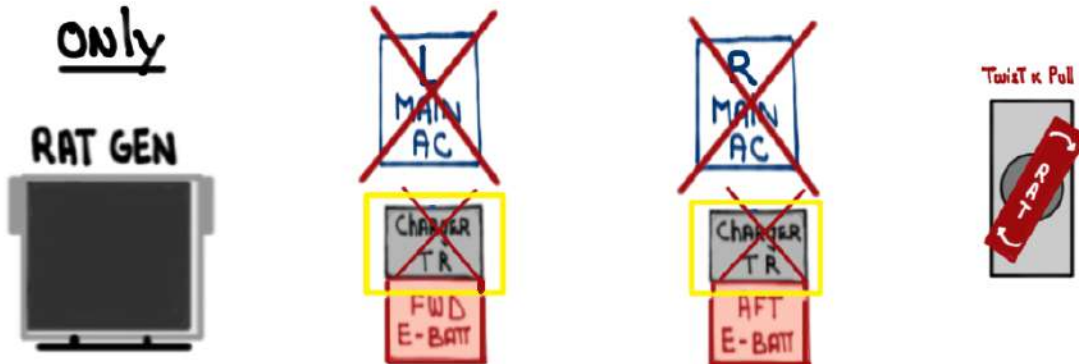
② ONE IDG only



③ APU GEN
only

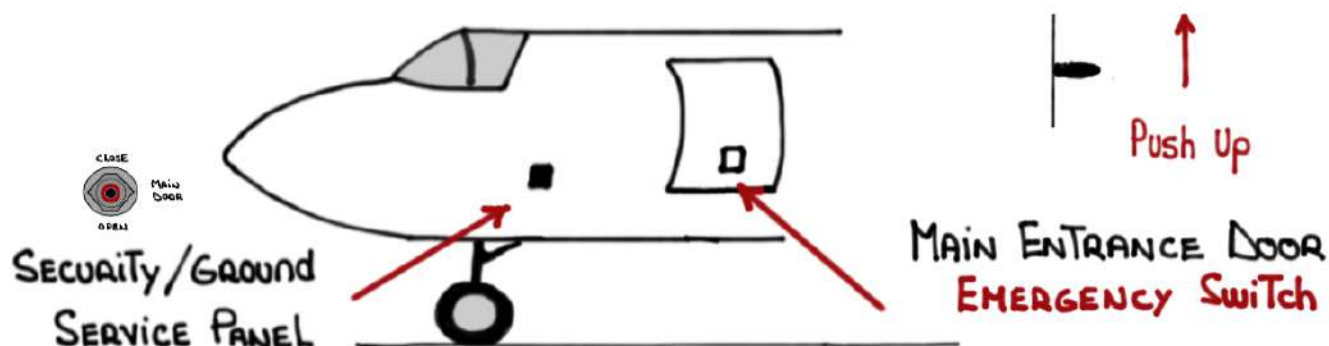


④ RAT GEN
only



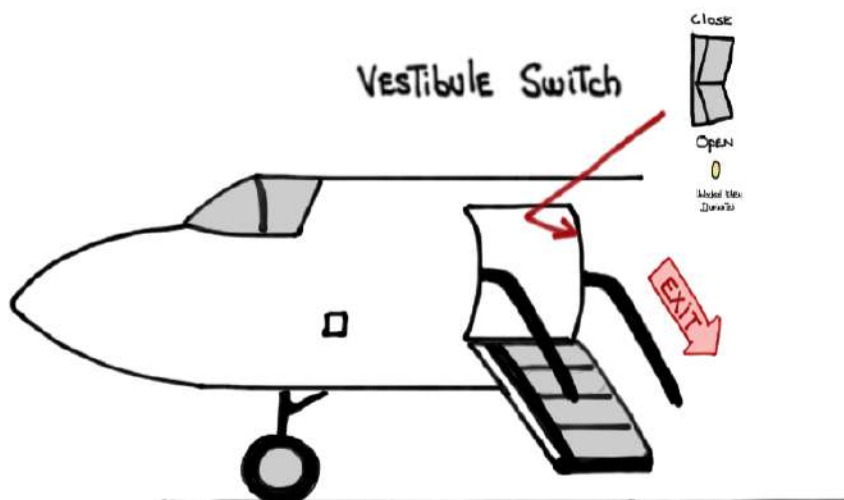
- The **FWD E-BATT** CAN BE USED IN AN EMERGENCY TO OPEN THE ELECTRIC MAIN ENTRANCE DOOR (EMED) VIA THREE (3) SWITCHES. TWO (2) EXTERNAL AND ONE (1) INTERNAL

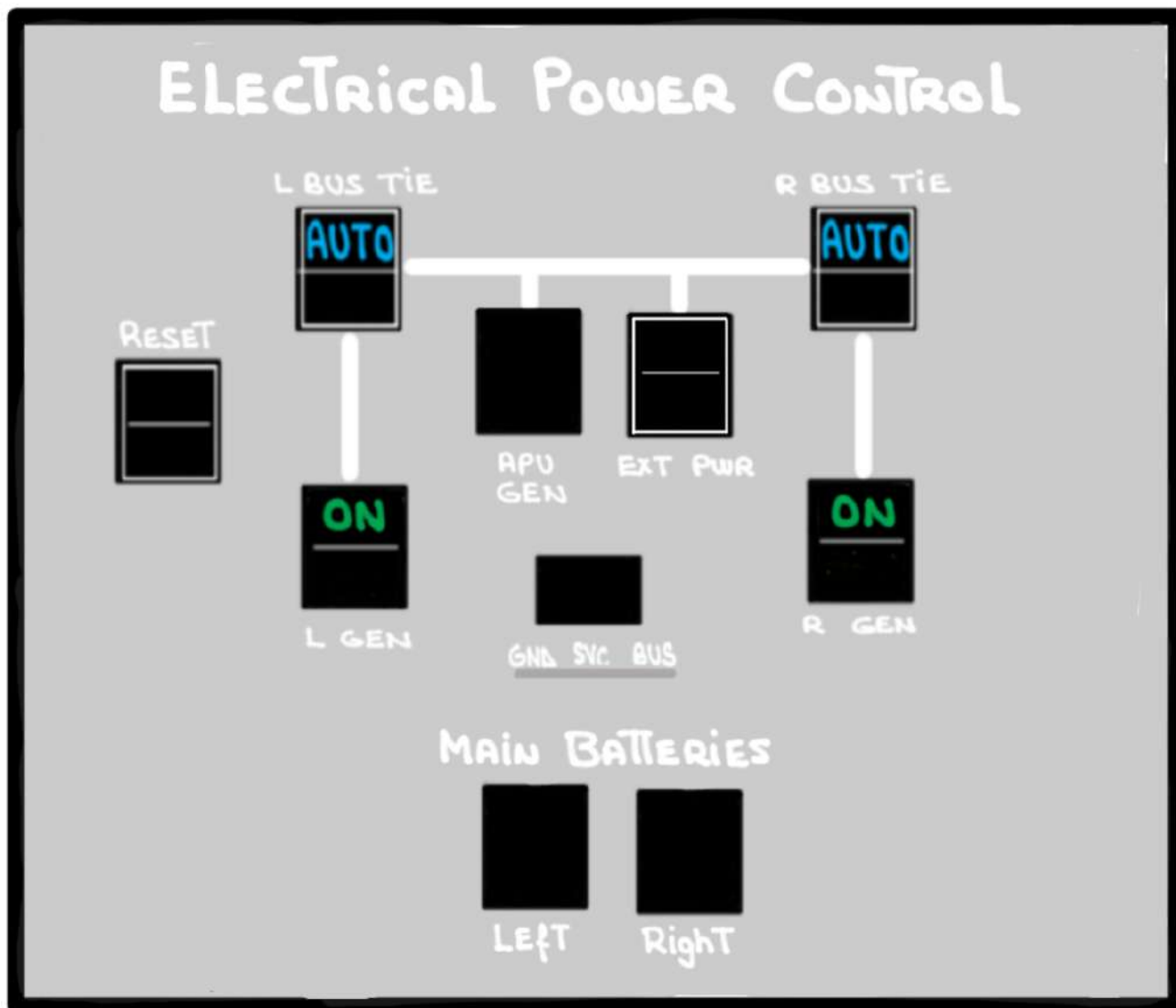
EXTERNAL SWITCHES:



THE EMED IS OPENED VIA **EMERGENCY SWITCH** ON THE FIRST flight of the day TO CONFIRM THAT THE **FWD E-BATT** HAS SUFFICIENT BATTERY CHARGE

INTERNAL SWITCH:





Two (2) BLUE

Two (2) GREEN

Six (6) Black

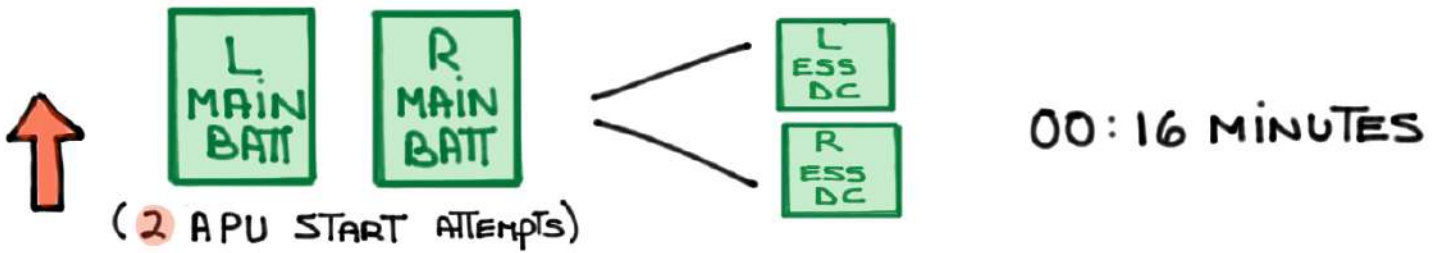
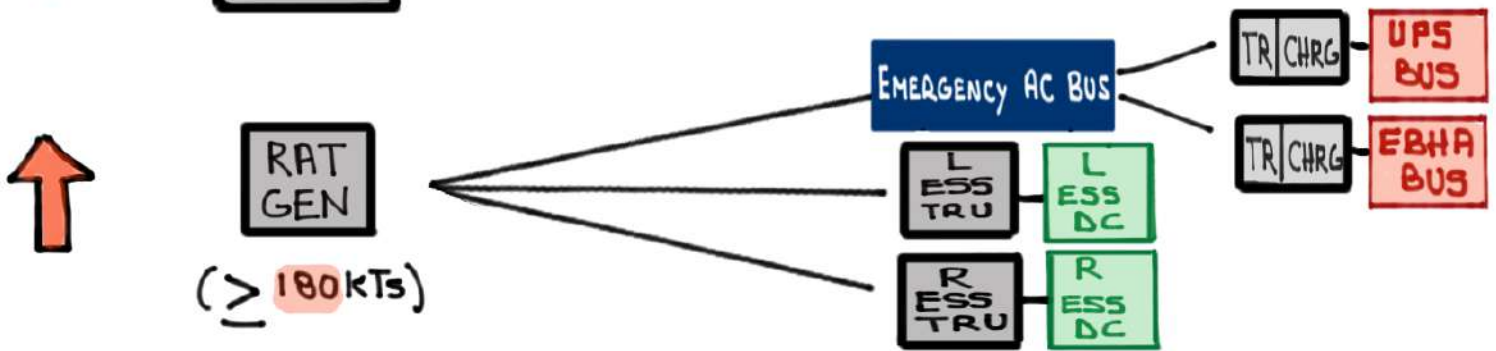
FIVE (5) switchlights PRESSED IN



FOUR (4) switchlights PUSHED OUT



NORMAL - EMERGENCY

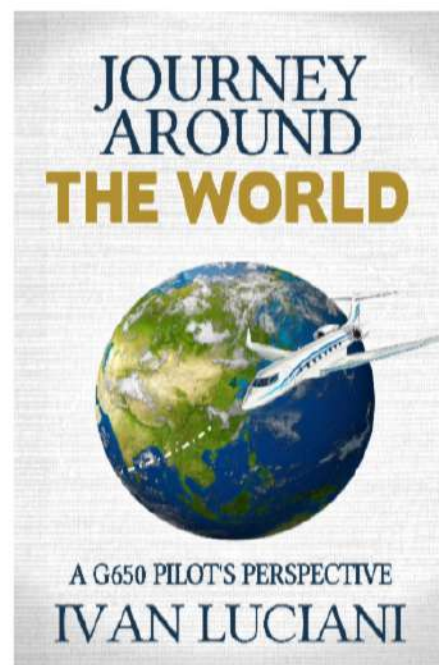
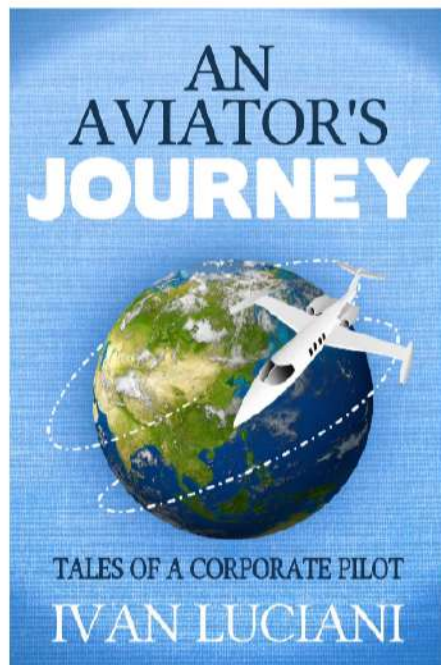


EMERGENCY

REMINDER: these system notes are intended for study purposes only. Always refer to official Gulfstream manuals and other approved references when operating your aircraft.

NOTE: these system notes are updated from time to time and what is posted on Code450.com will always be the most recent version.

Questions, comments or errors...please do send me an email:
ivan@code7700.com



Thank you!