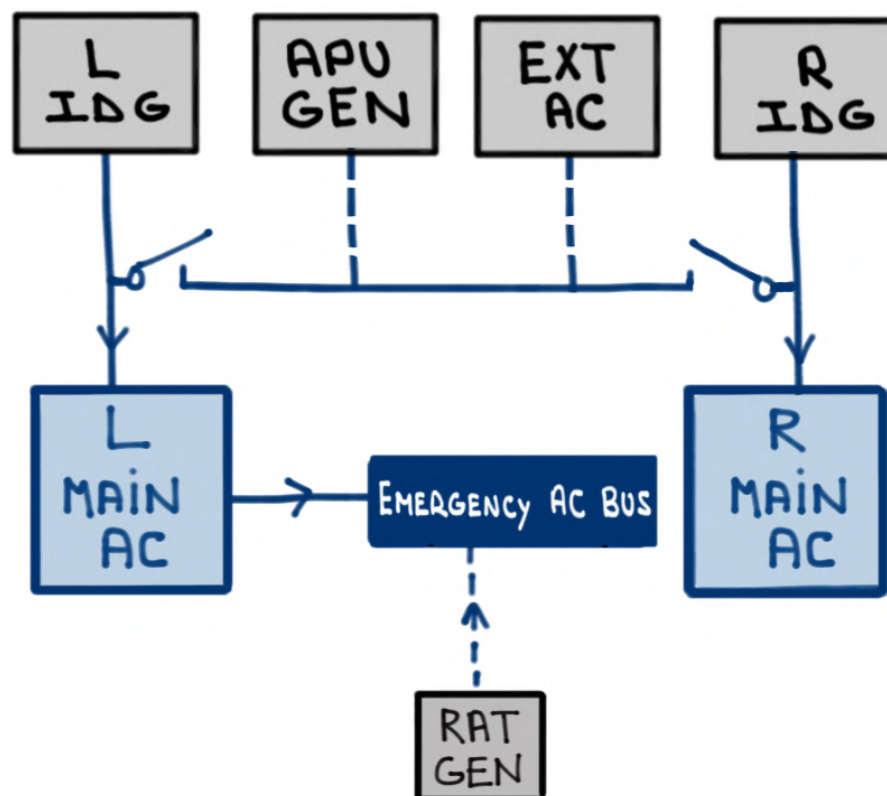


G650 ELECTRICAL System

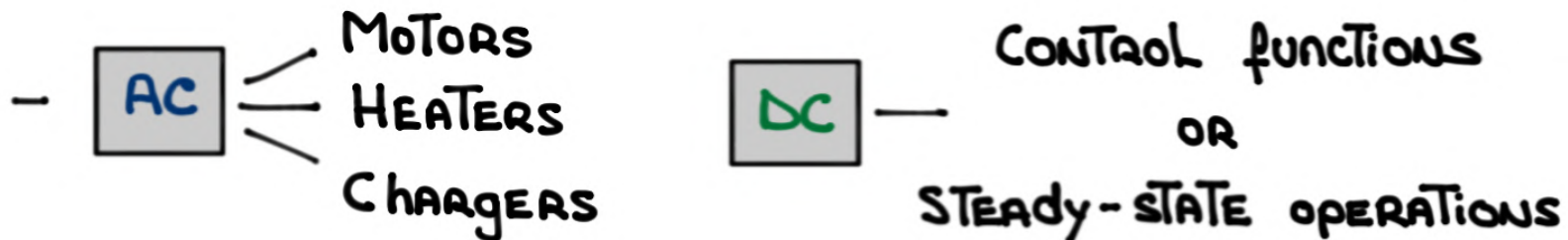


For study purposes only

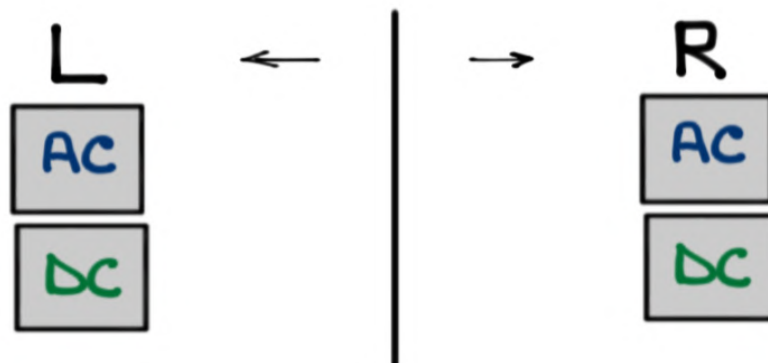
- The ELECTRICAL Power System produces:



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

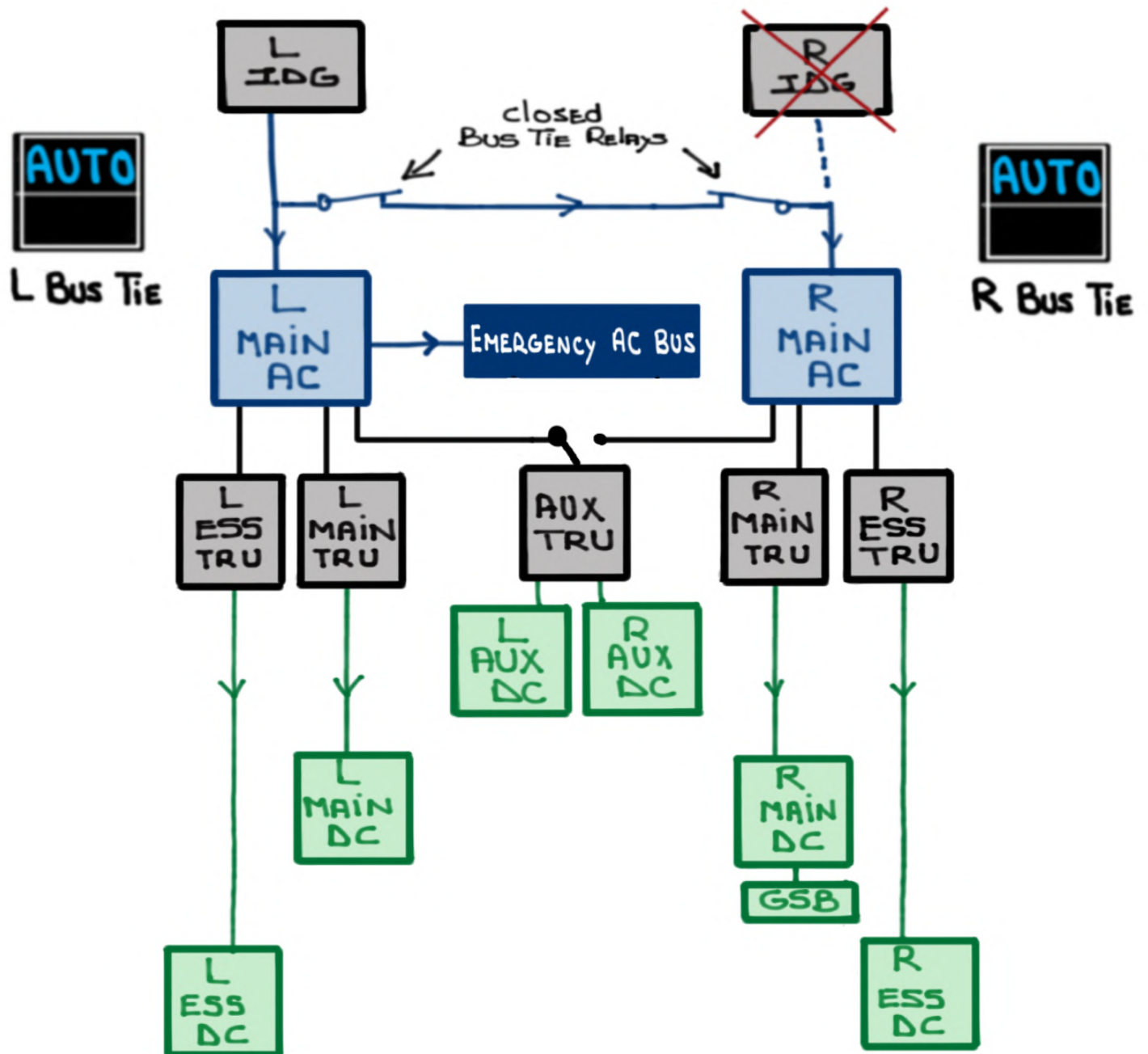


- Two (2) SEPARATE SYSTEMS/NETWORKS



- A split bus system prevents a short on one side from affecting the other side

- Operative side can power the inoperative side

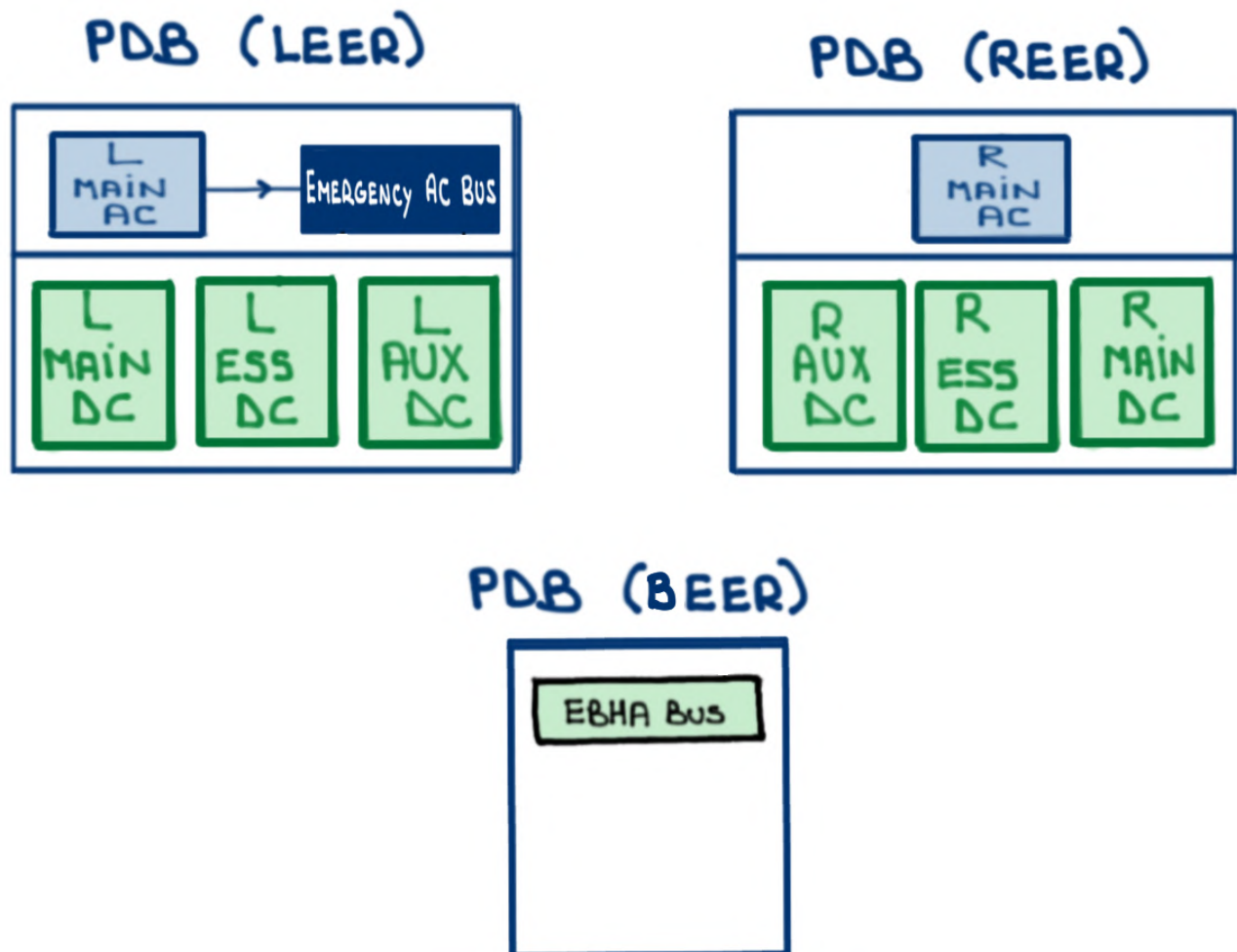


- PRIMARY Power Distribution BOXES (PDBs)

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:

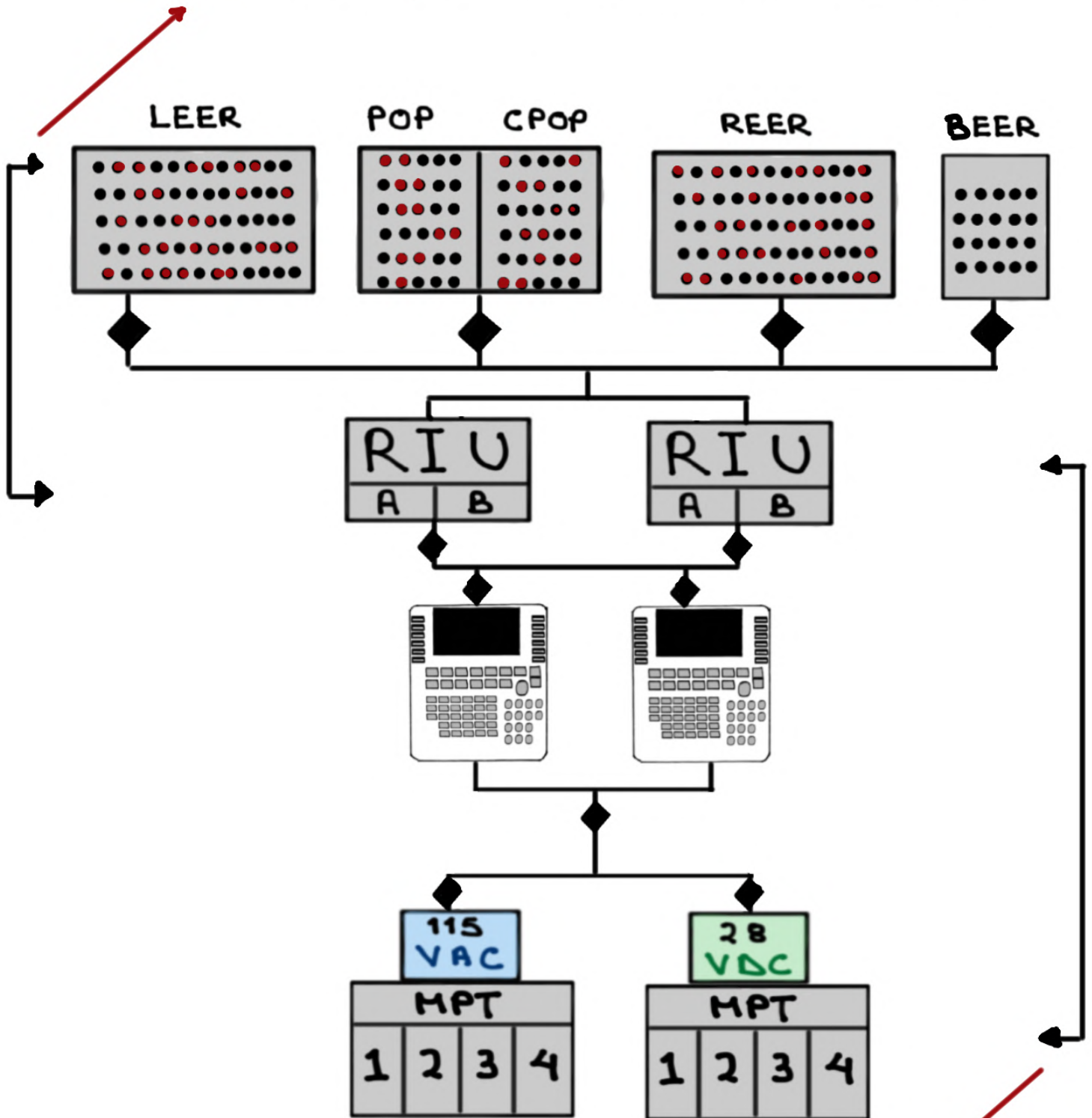
(2) Remote Interface Units (RIU):

- BRAINS of the SPDS
- DUAL channels
- PERFORM system control functions and interface with other aircraft systems

(8) Modular Power Tiles (MPT):

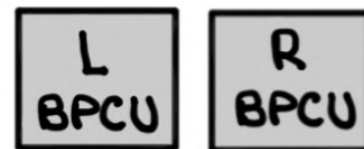
- MPTs perform power routing and circuit protection functions using AC and DC Solid State Power Controllers (SSPC)
- FOUR (4) 115
VAC AND FOUR (4) 28
VDC

ELECTROMECHANICAL CIRCUIT BREAKERS

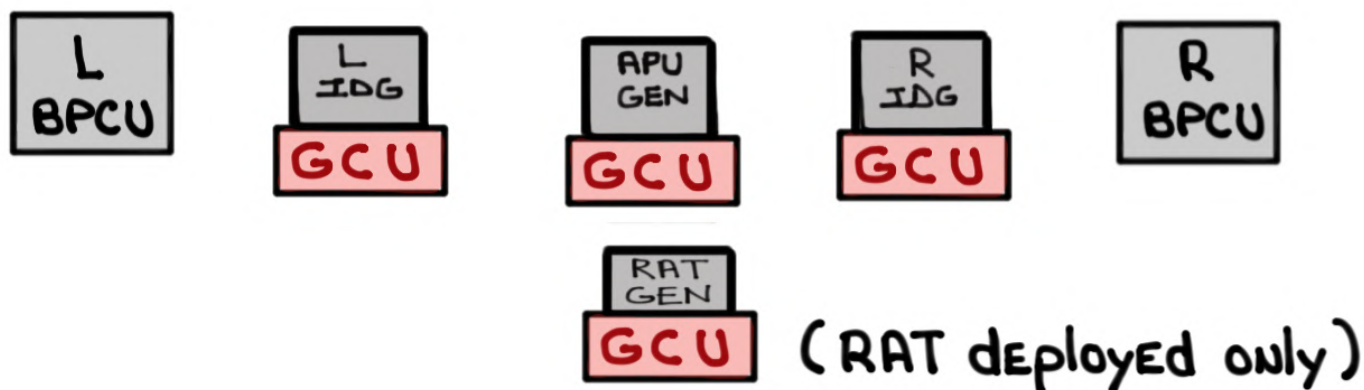


Solid STATE POWER CONTROLLERS (SSPC) (VIRTUAL CBs)

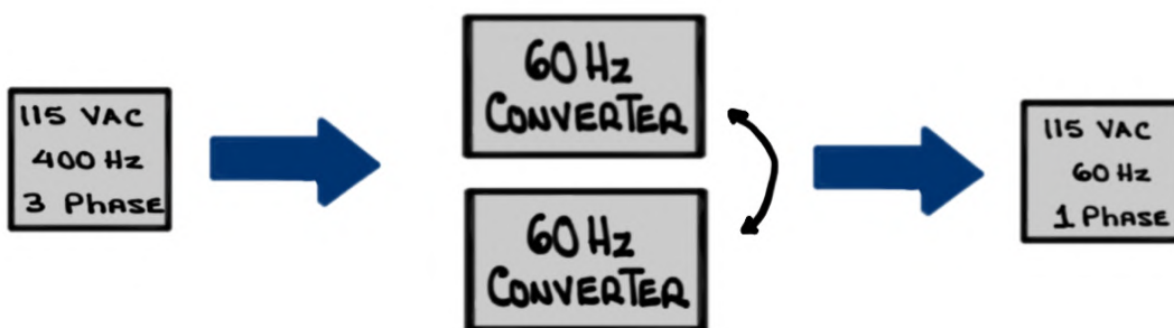
- The ELECTRICAL Power System is controlled by Two (2) BUS POWER CONTROL UNITS (BPCU)



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



- There ARE TWO (2) 60 Hz CONVERTERS located in The Tail COMPARTMENT

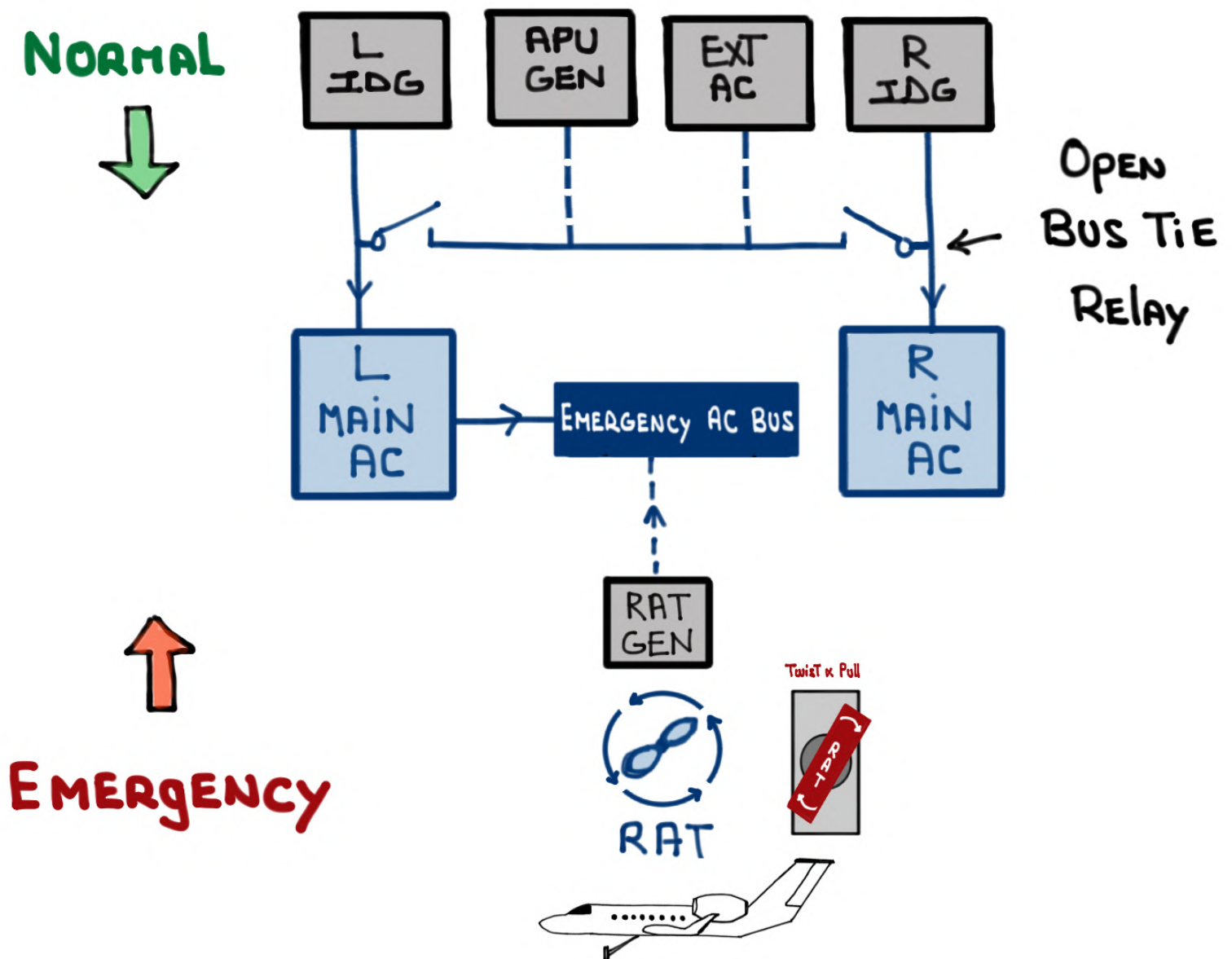


- ONE (1) 60 Hz CONVERTER ACTIVE AND THE OTHER ON STANDBY

- 115 VAC 60 Hz 1 Phase = COMMON household power

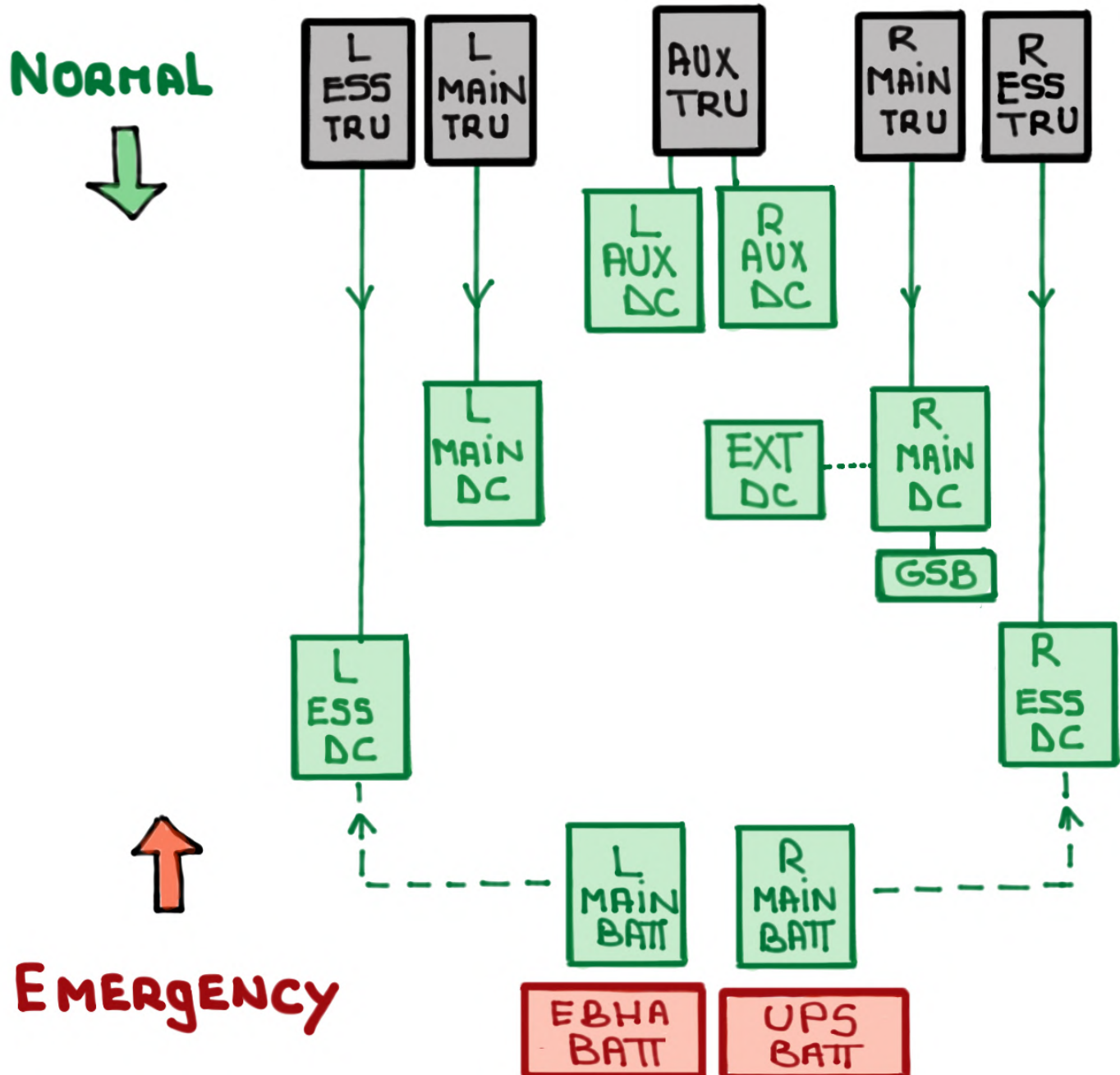
- AC SYSTEM:

115 VAC is GENERATED by:




- DC SYSTEM:






28 VDC is PRODUCED by:



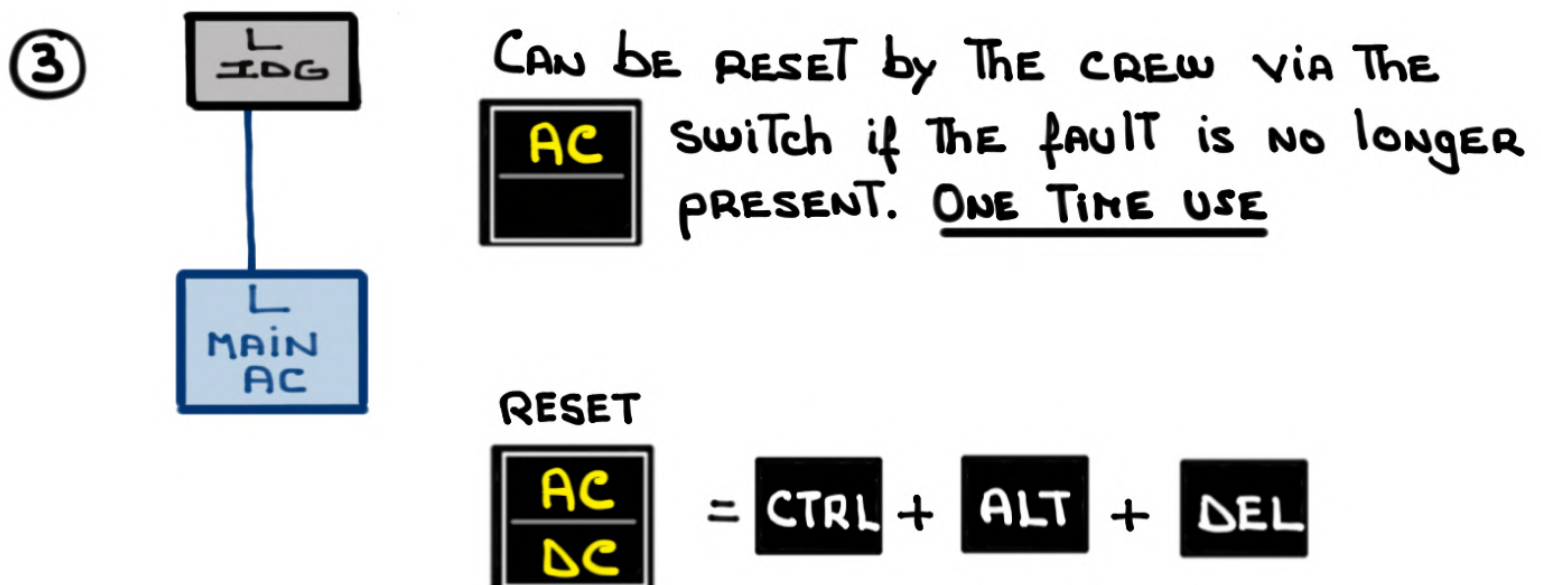
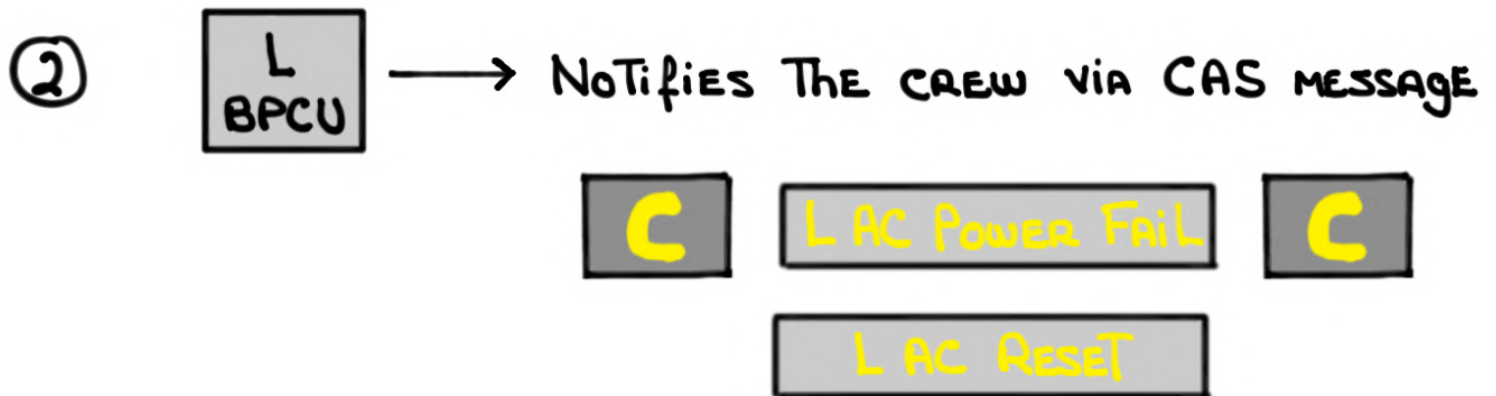
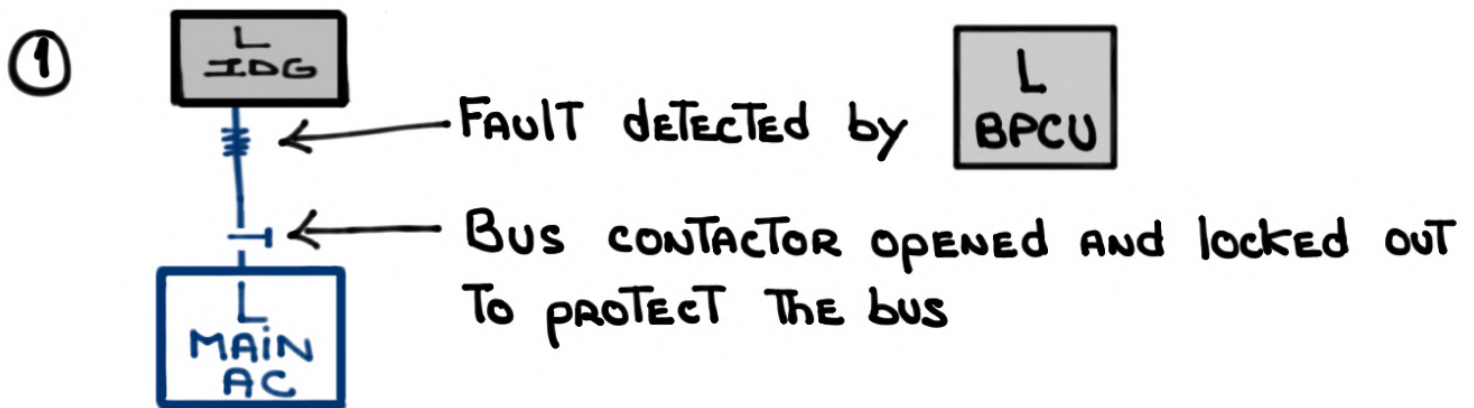
BUS POWER CONTROL UNITS (BPCU)

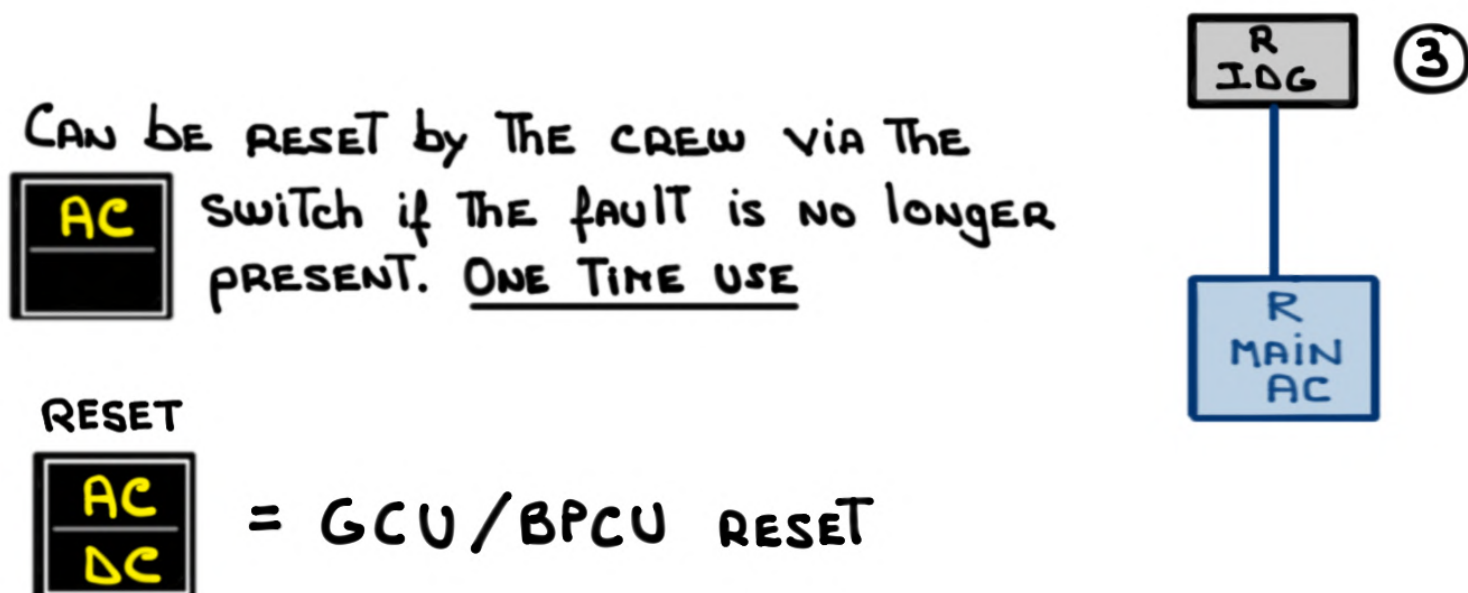
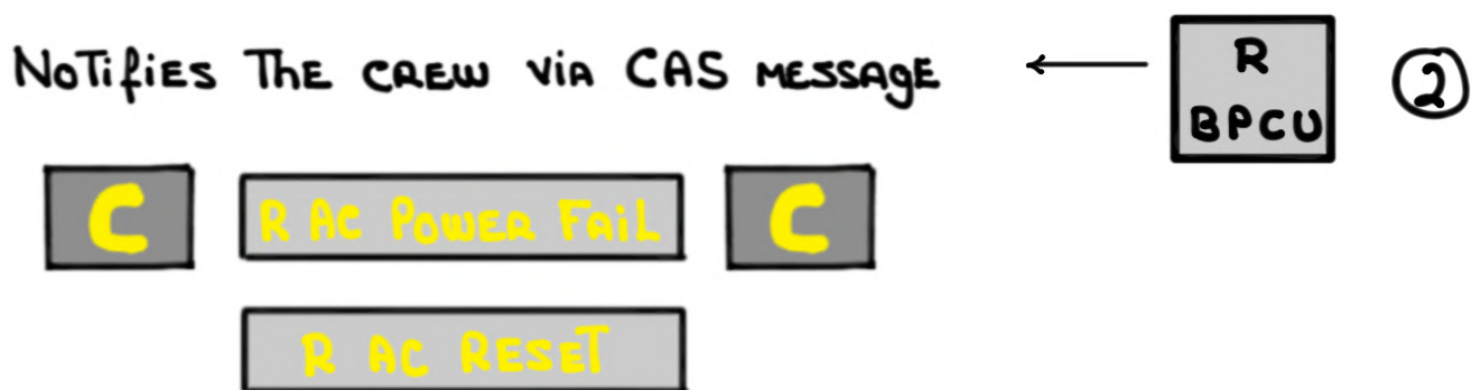
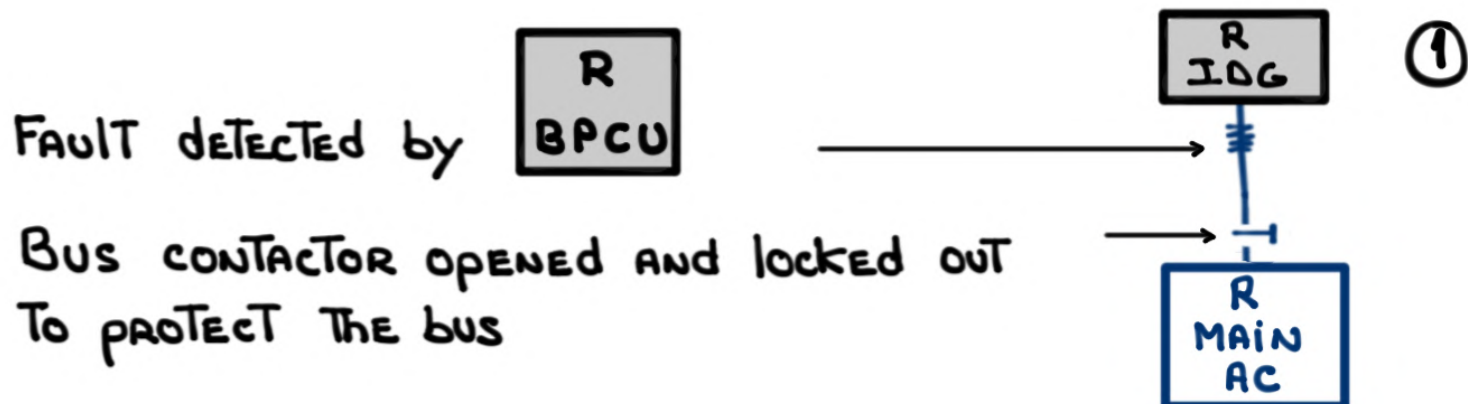
THE ELECTRICAL POWER SYSTEM IS CONTROLLED BY TWO (2) IDENTICAL AND INTERCHANGEABLE MICROPROCESSORS CALLED BPCUs

 = THE BRAINS

- THE   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  RESET SWITCH
- MONITOR EXTERNAL   POWER
- CONTROL THE NO BREAK POWER TRANSFER (NBPT)

- FAULT DETECTION, PROTECTION AND NOTIFICATION:



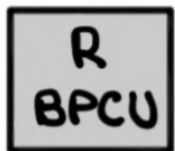


- BPCU logic: **ESS** before **MAIN** / **L** before **R**

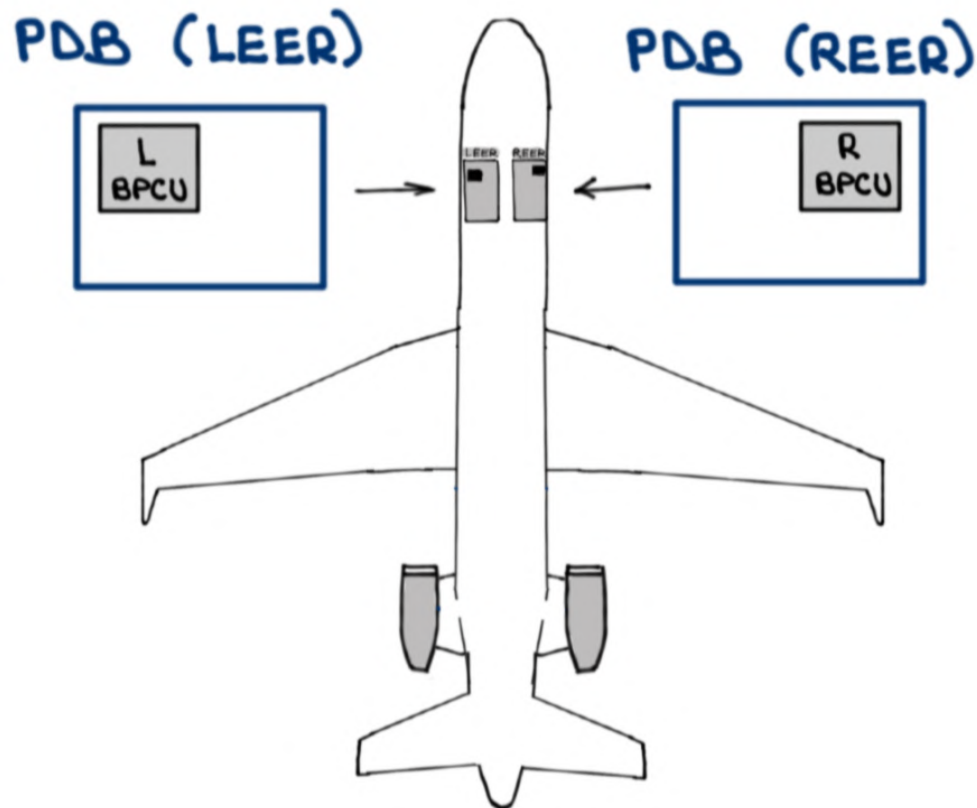
- LOCATED in:



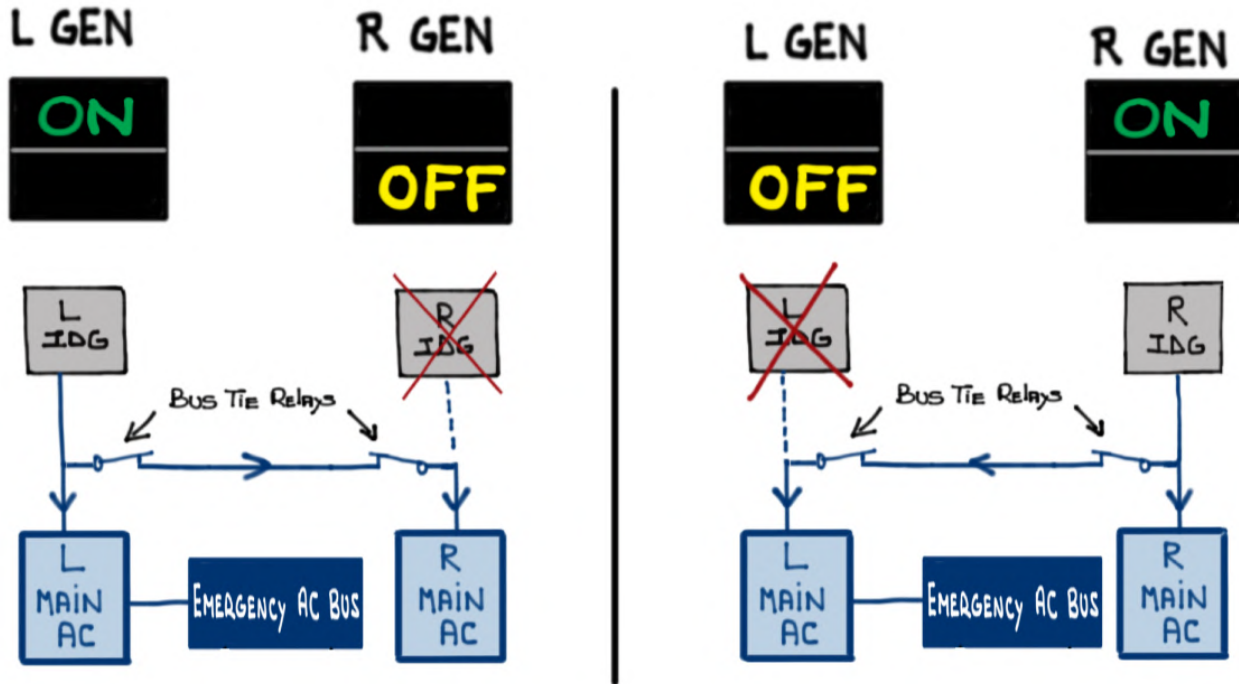
LEFT ELECTRONIC EQUIPMENT RACK (LEER)



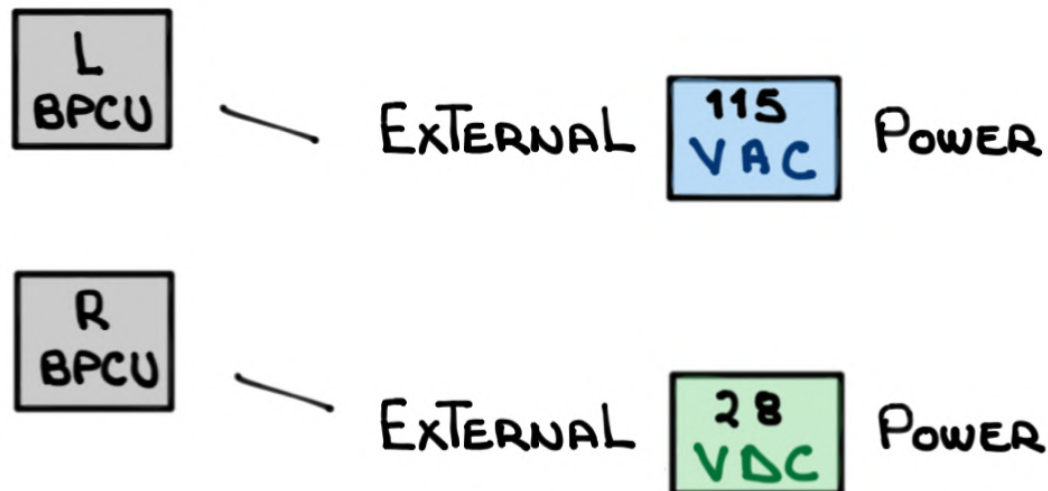
RIGHT ELECTRONIC EQUIPMENT RACK (REER)



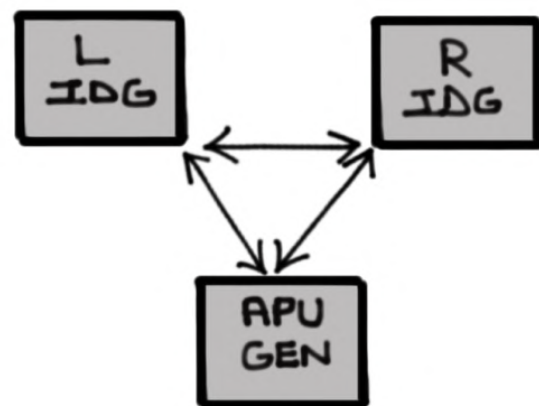
- CONTROL THE BUS TIE RELAYS which allow OPERATIVE side TO POWER THE INOPERATIVE side in THE EVENT of A SHORT/FAULT ON ONE side



- CONTROL AND MONITOR:

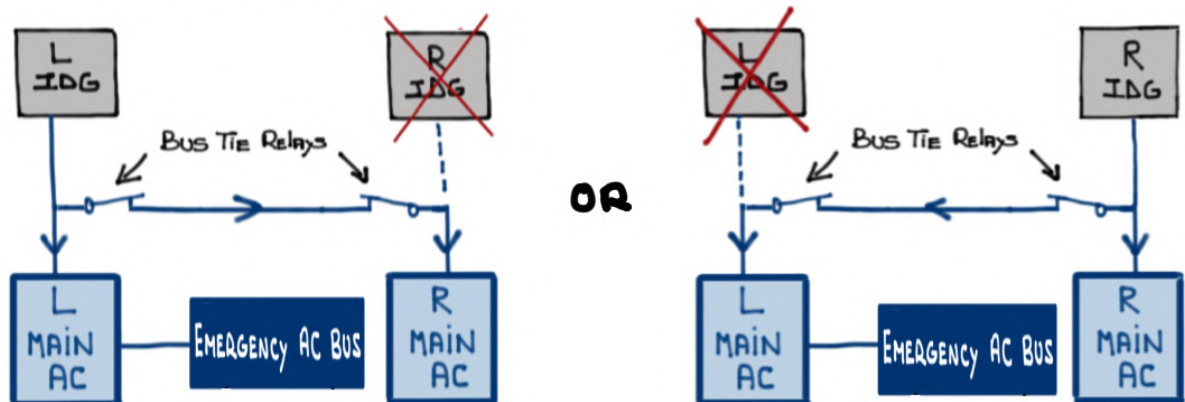


- NO BREAK POWER TRANSFER (NBPT)
 - CONTROLLED BY BPCU
 - POWER TRANSFER WITHOUT A MOMENTARY INTERRUPTION
 - USES THE **GCU** SPEED CONTROL TO SYNCHRONIZE THE FREQUENCY AND PHASE OF THE IDGs TO THE PREVIOUS OR NEXT AC SOURCE
 - IDG AVAILABLE AND NO FAILURE
 - TWO (2) SOURCES CONNECTED AT THE SAME TIME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

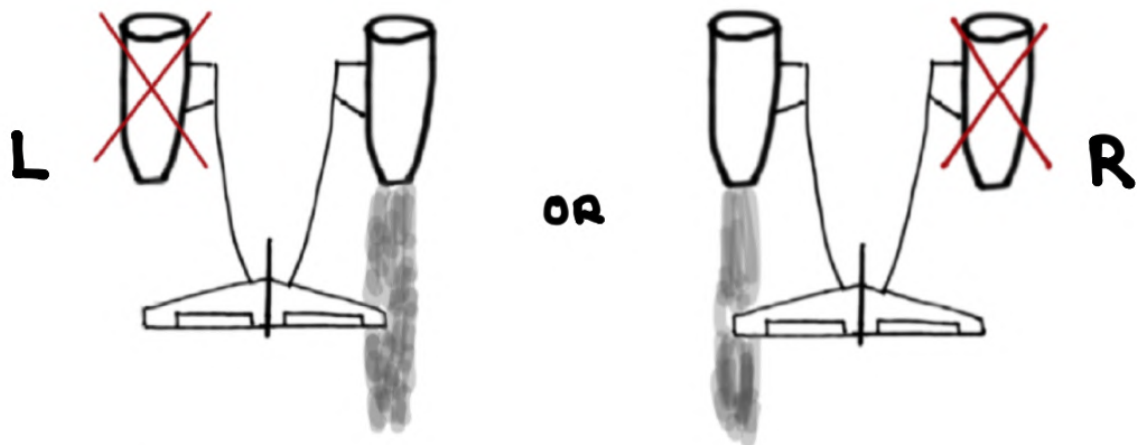


- BREAK POWER TRANSFER (BPT)

AN IDG FAILURE



AN ENGINE FAILURE



A FIRE handle pulled

L ENGINE FIRE

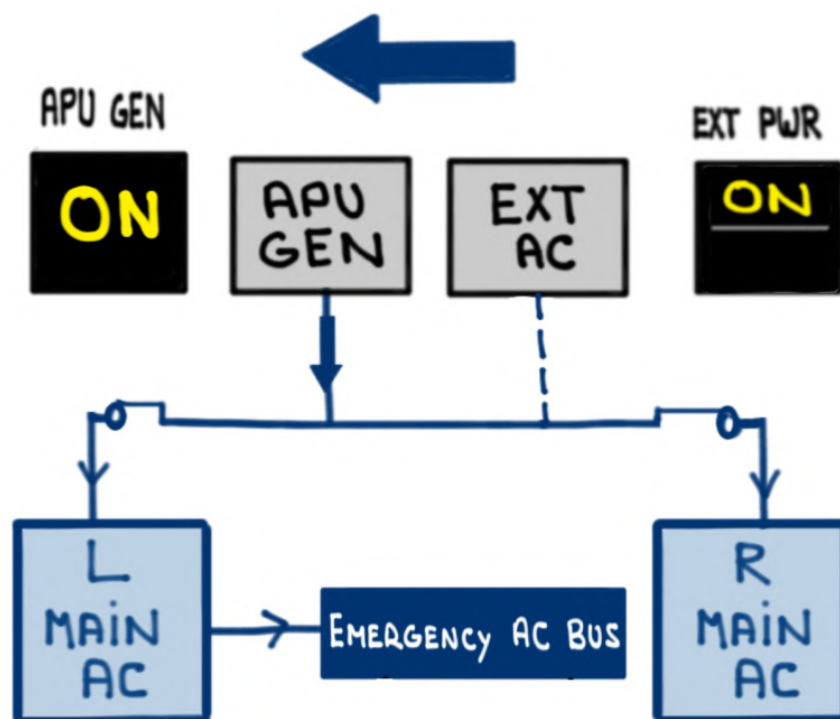
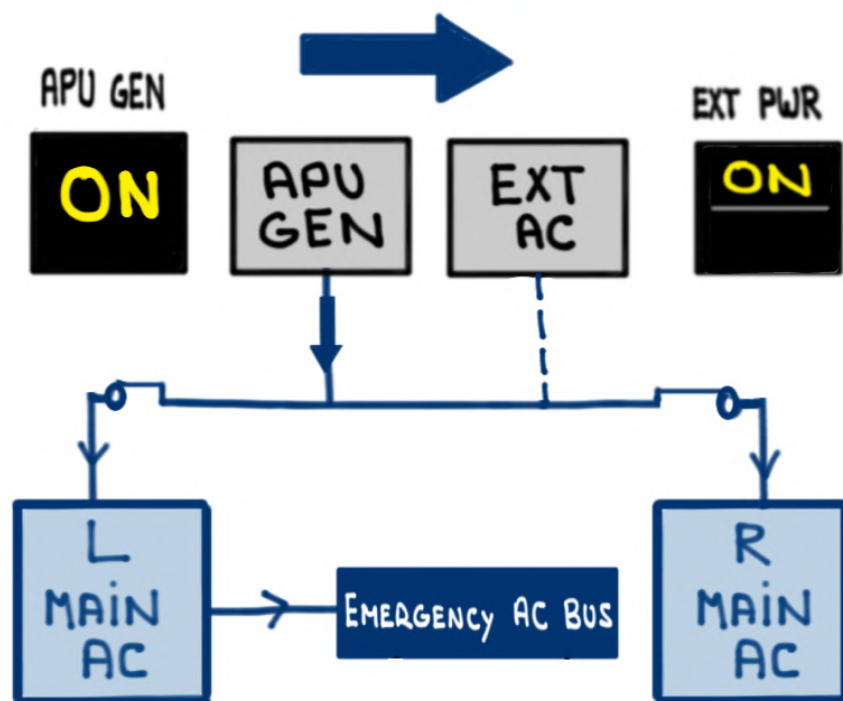
R ENGINE FIRE



OR



AN IDG NOT AVAILABLE

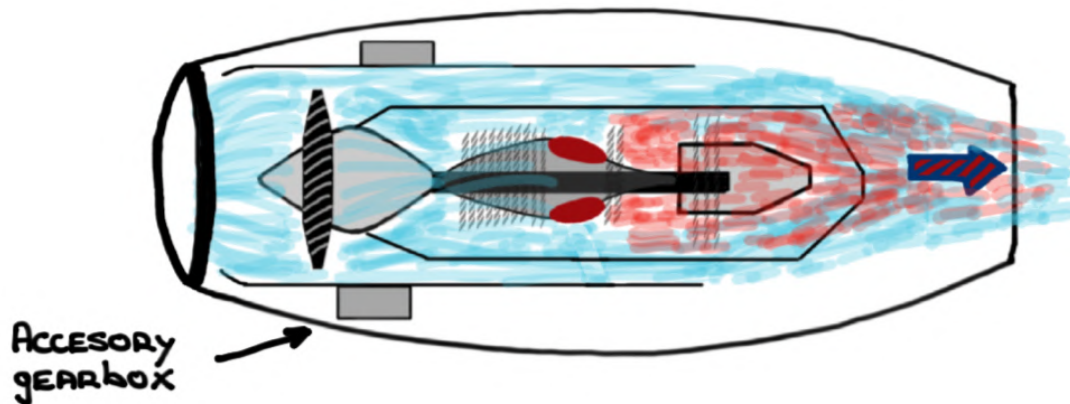


INTEGRATED DRIVE GENERATORS (IDG)

- Two (2) ENGINE-DRIVEN IDGs



- LOCATED ON THE ENGINE'S ACCESSORY GEARBOX

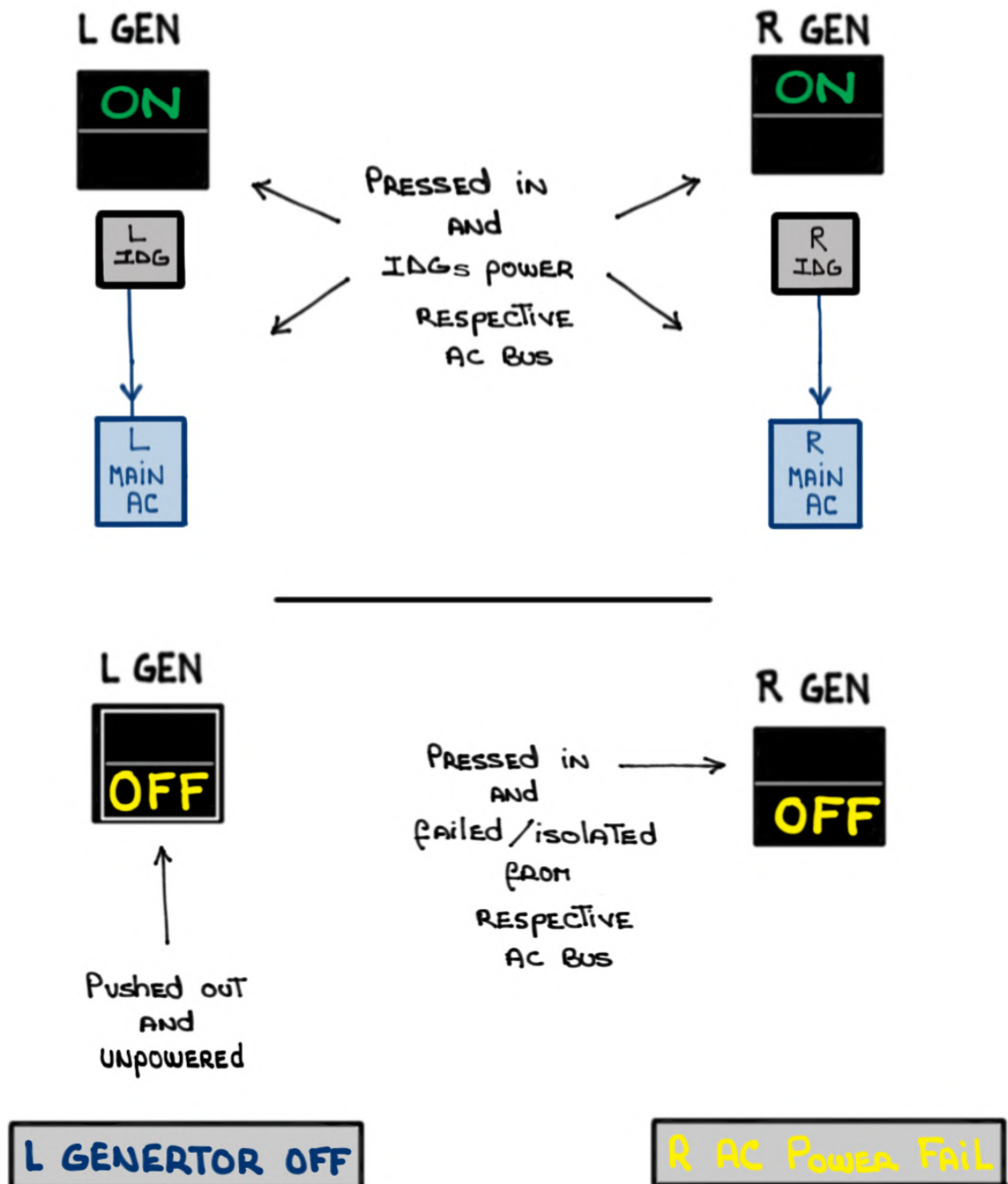


- IDG < CONSTANT SPEED DRIVE (CSD)
Oil-cooled GENERATOR (oil is cooled by fan air)

- IDG < RATED AT 40 KVA
PRODUCES: 115 VAC
400 HERTZ
3-phase

- 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:

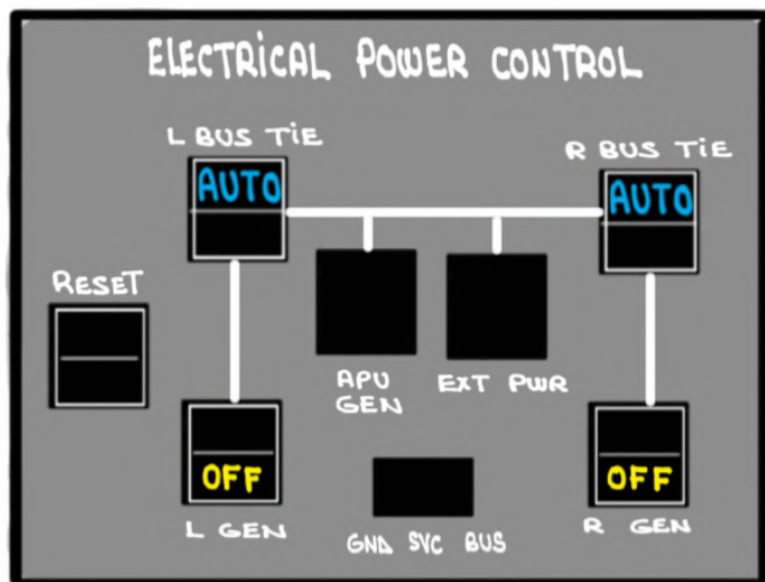
All AC AND DC BUSES

- 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

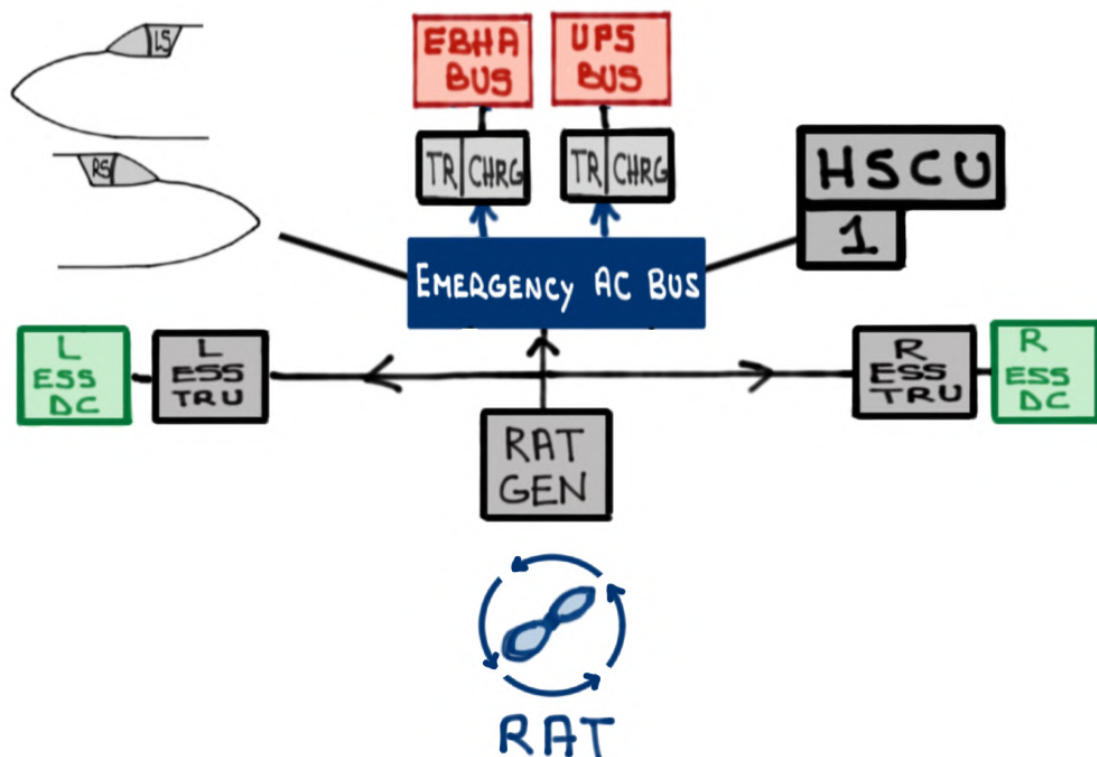


L-R AC POWER FAIL

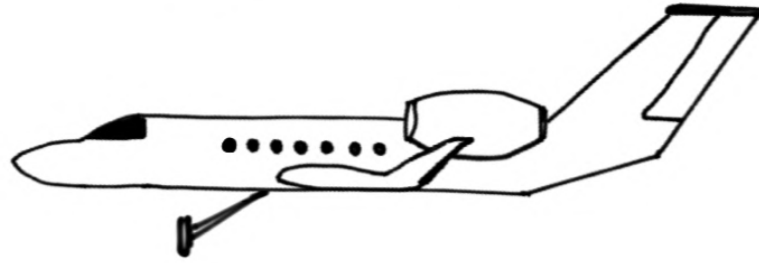
L-R AC POWER FAULT

APU POWER FAIL

RAT GENERATOR ON

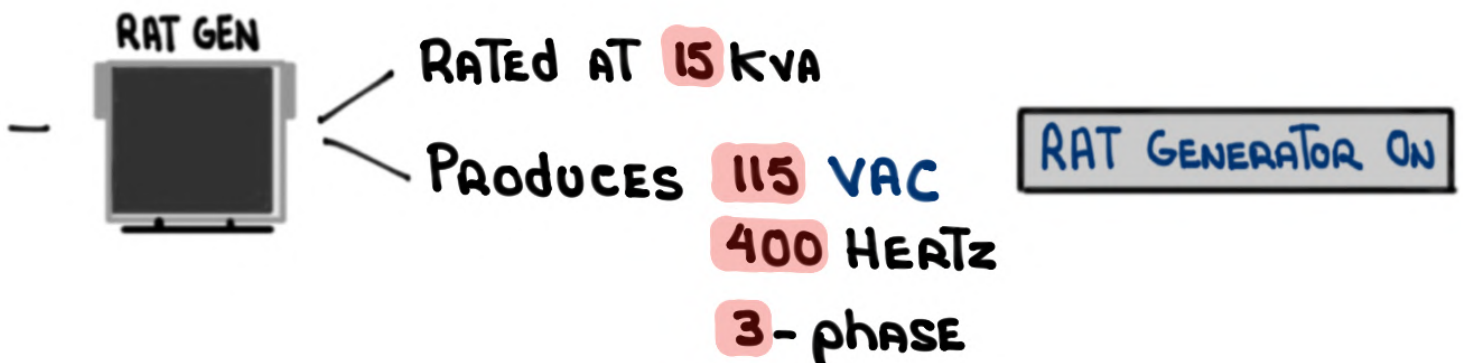
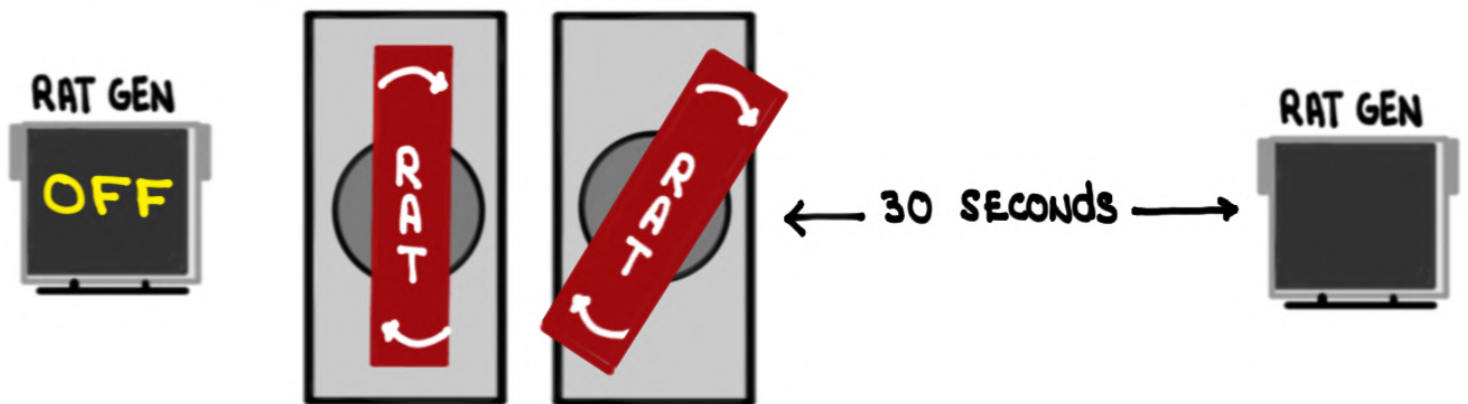


- The RAT, once deployed by The CREW, CONVERTS AIRSTREAM ENERGY TO ELECTRICAL ENERGY



- 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  drops offline AND The   power The   buses




-  ROTATES COUNTER clockwise

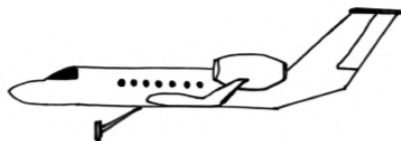
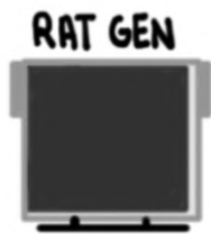
- Six (6) PERCENT fuel penalty

- RAT TEST = MAINTENANCE function only



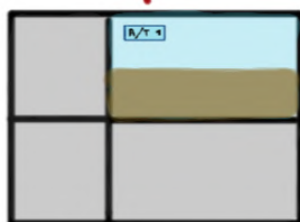
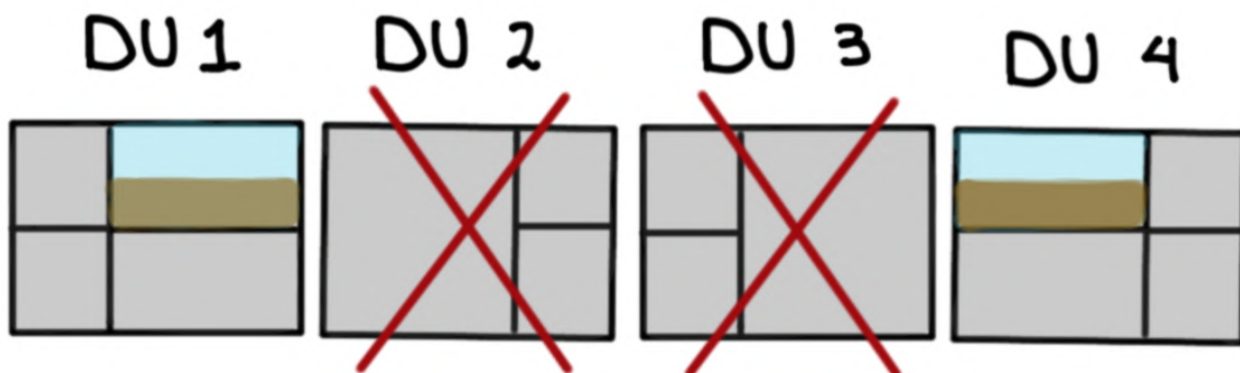
- ONCE deployed The RAT CAN'T BE STOWED in flight

- LAND with flaps **20°** (AS PER THE QRH) SO THAT
IN THE EVENT of a GO-AROUND THE   ARE
NOT USED TO power The  pump TO RETRACT
The flaps from **39°** TO **20°** (SAVE THE BATTERIES)

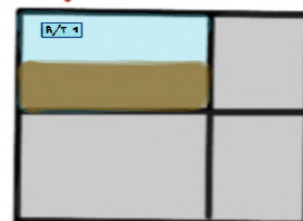


RAT GEN ON = ADS # 4 (STBY) only

- No VERTICAL Speed OR ALTitude Hold MODES
- Only FPA AVAILABLE



No
Auto Throttles

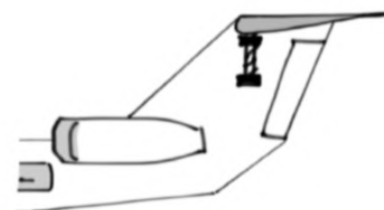
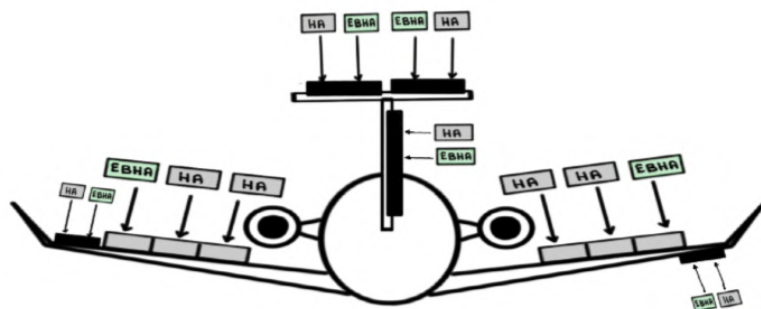
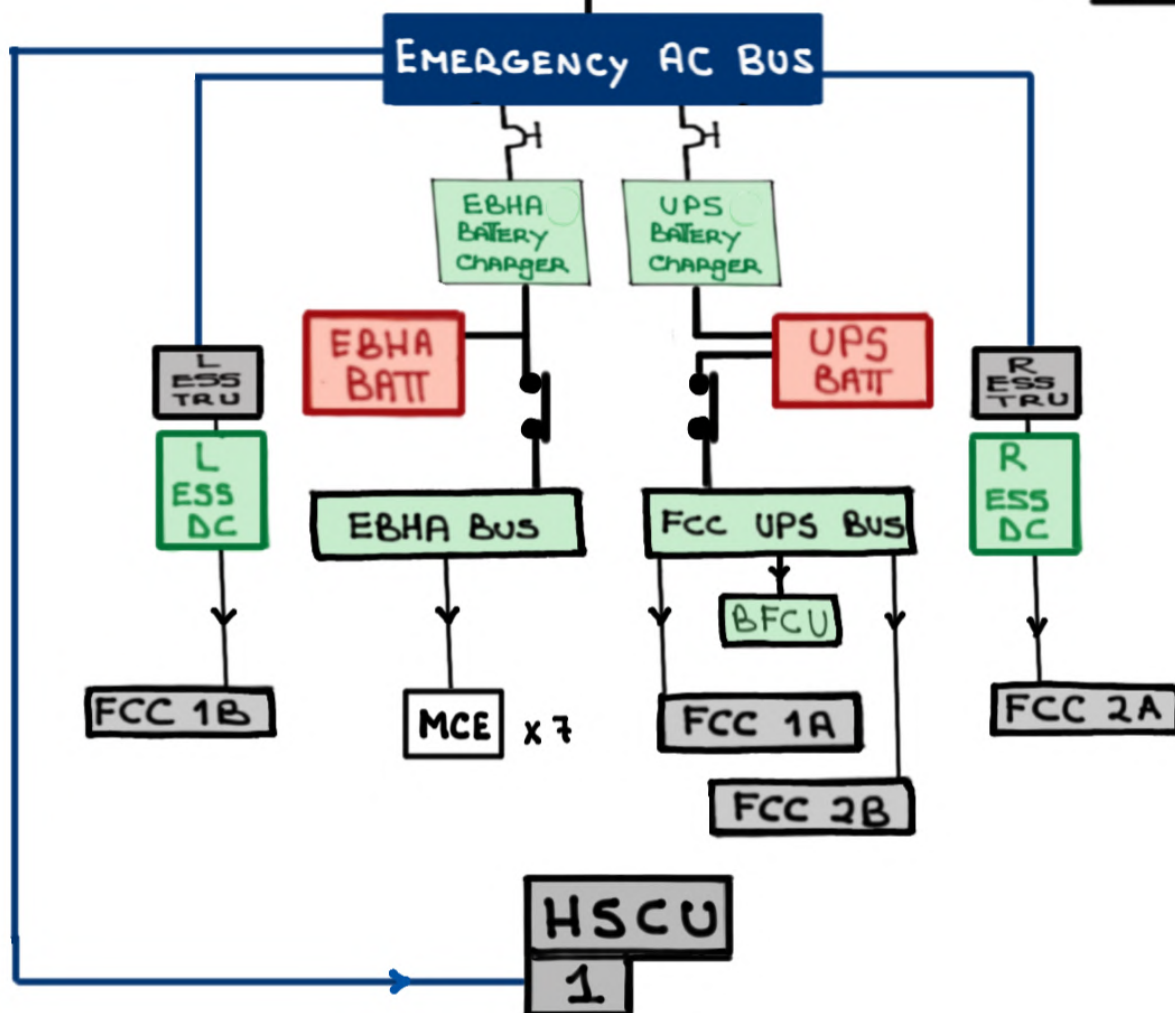


RAT GENERATOR ON

RAT GEN

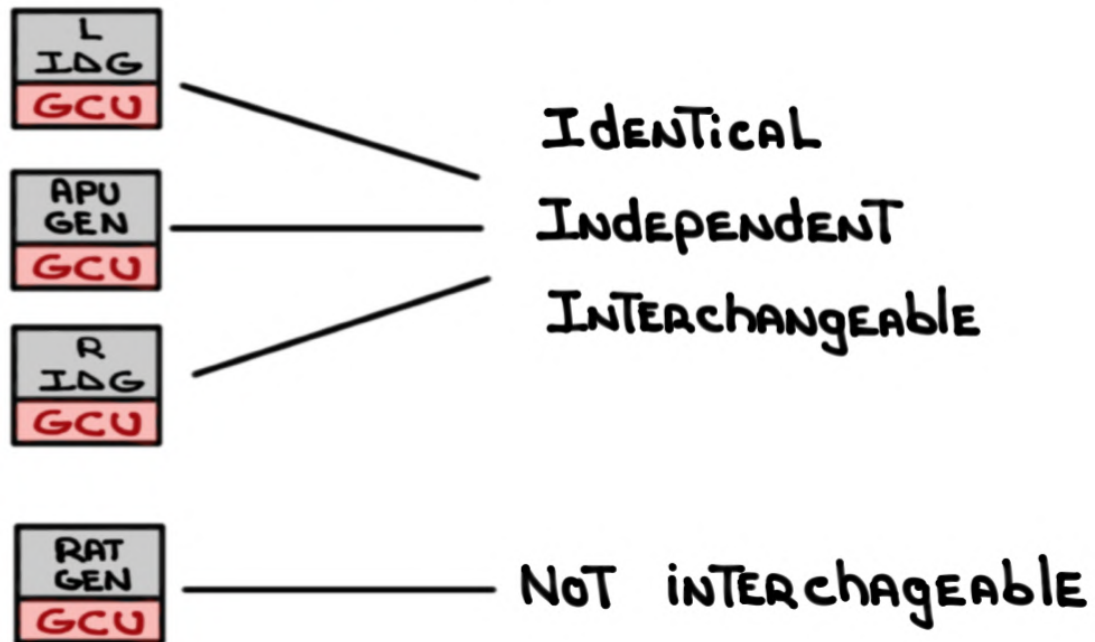
(> 180 kts)

RAT GEN

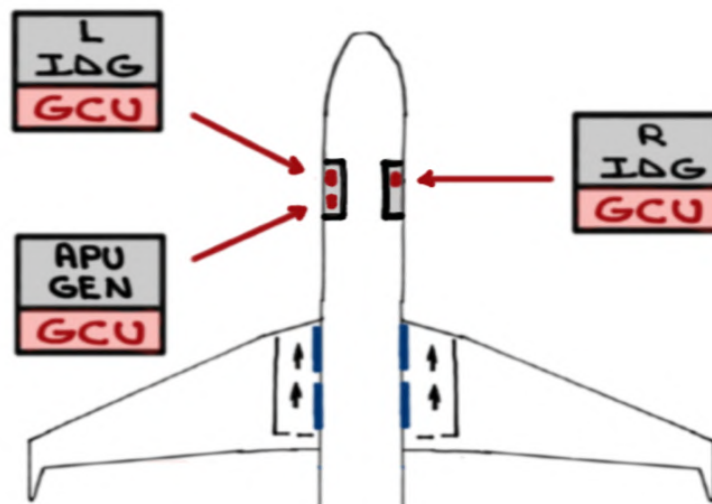


GENERATOR CONTROL UNITS (GCU)

- 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



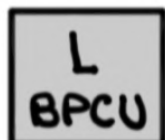
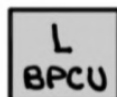
outside
PARAMETERS =

GCU

TAKES GEN offline



NOTifies



NOTifies CREW via CAS:

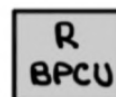
L AC POWER FAIL

L GENERATOR FAIL

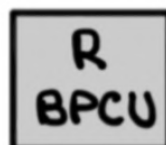
TAKES GEN offline



NOTifies



NOTifies CREW via CAS:



R AC POWER FAIL

R GENERATOR FAIL

GCU

CAN BE RESET by cycling The



Switch

EXTERNAL AC/DC POWER

EXT PWR

— EXTERNAL  POWER 

- RECEPTABLE 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

EXT PWR

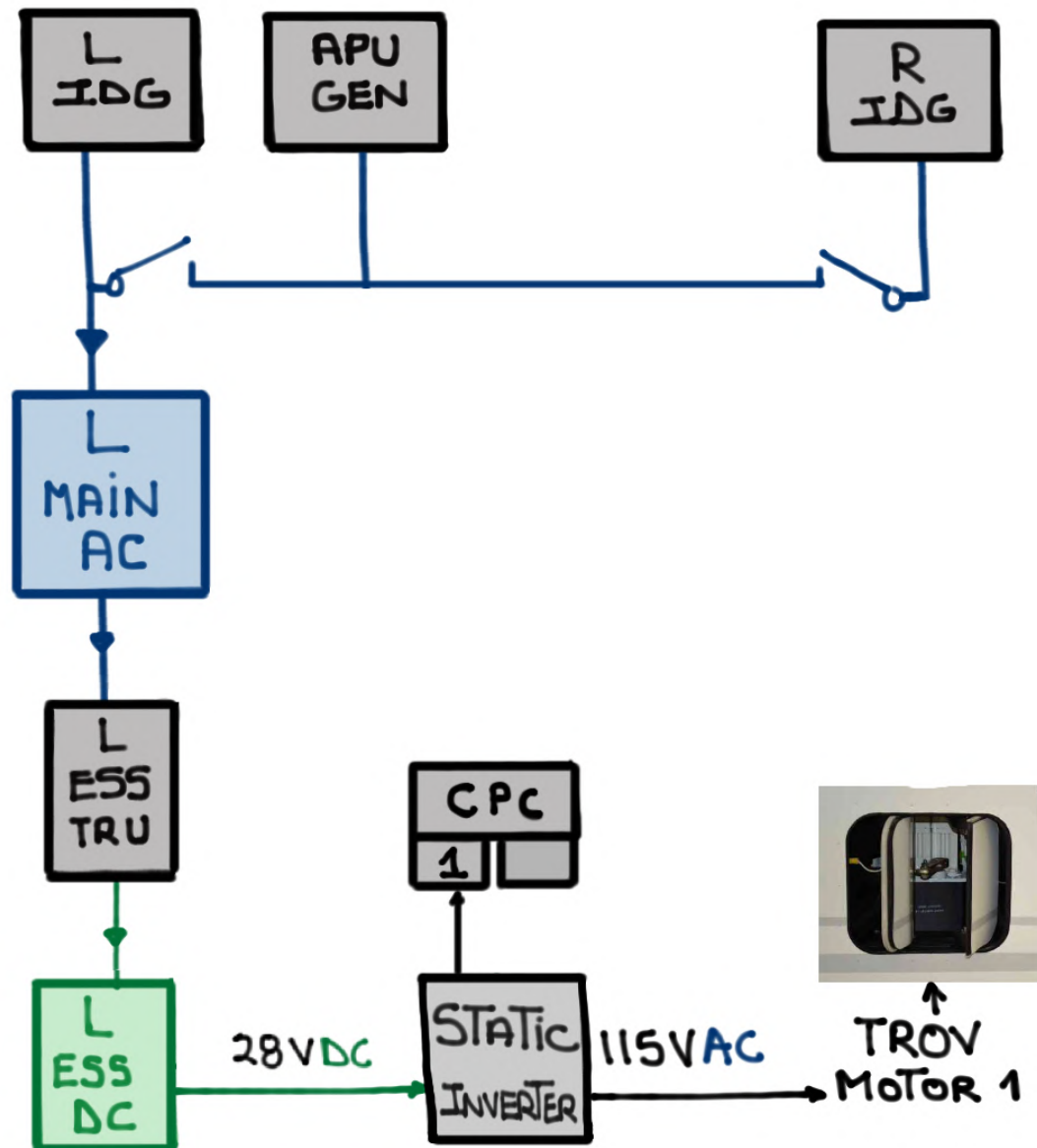
— EXTERNAL  POWER 

- RECEPTABLE 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

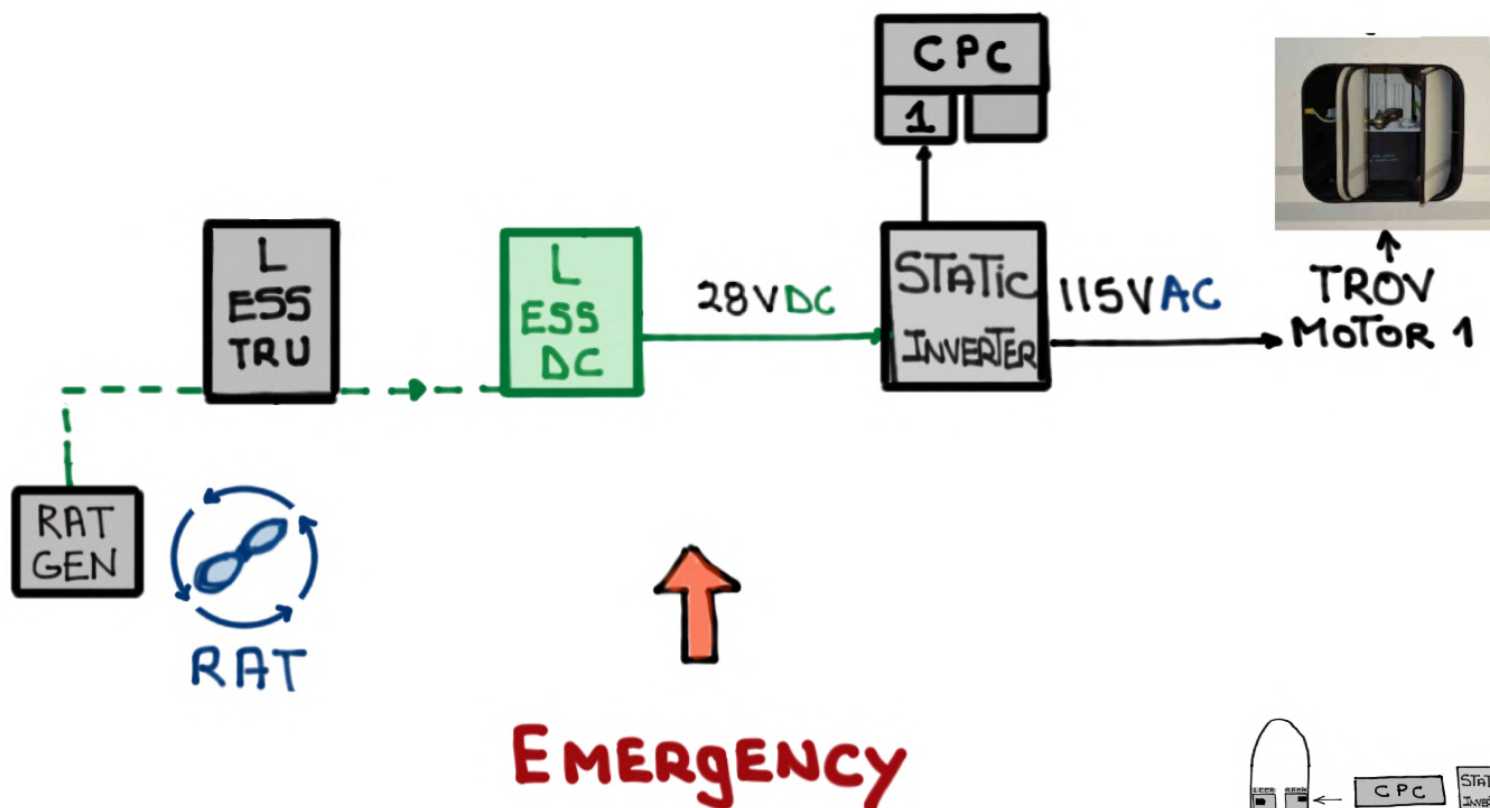
STATIC INVERTER

- A STATIC INVERTER CONVERTS **DC** To **AC** power in ORDER To power CHANNEL **1** of The CABIN PRESSURE CONTROLLER (CPC)

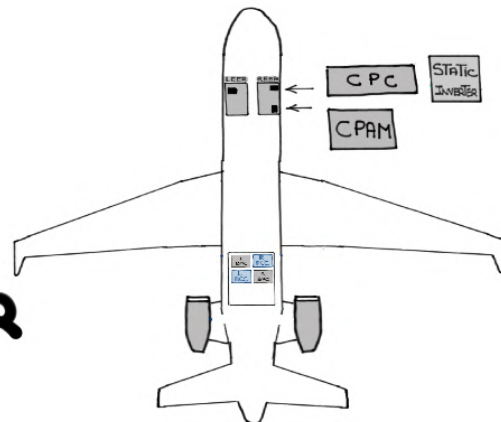
NORMAL



- 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**



- 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

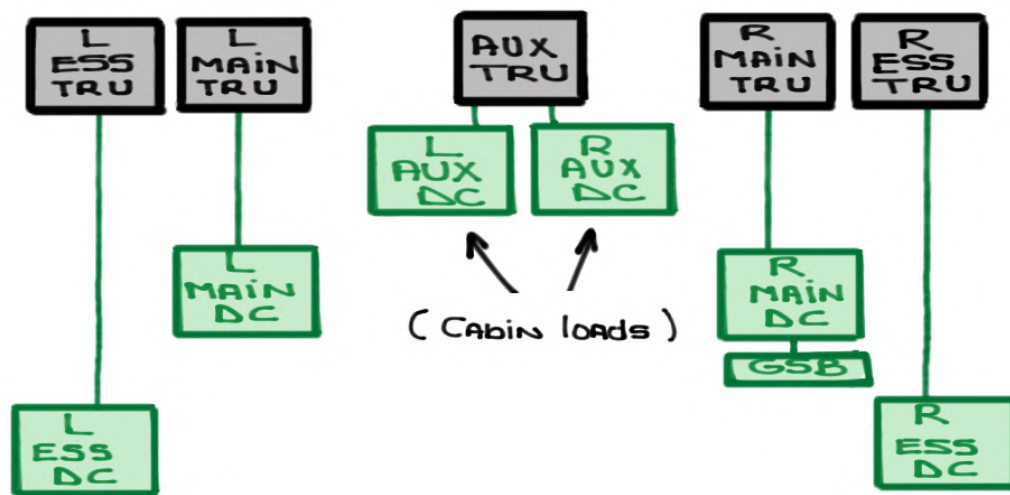
TRU

 CONVERTS

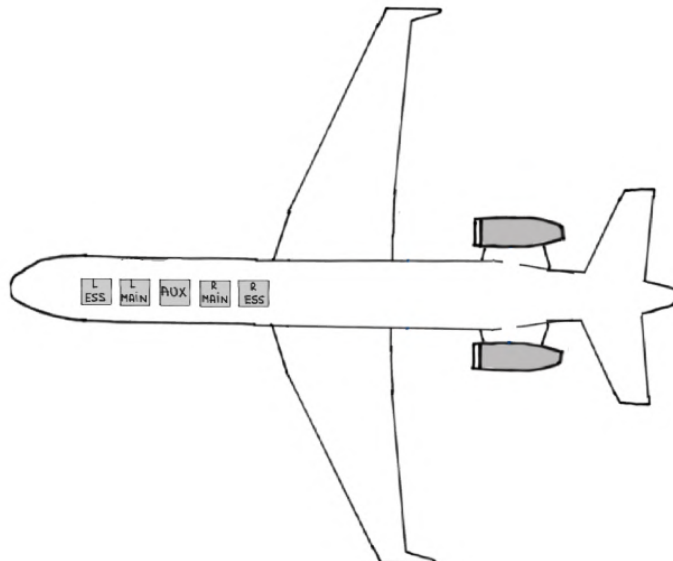
115
VAC

 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

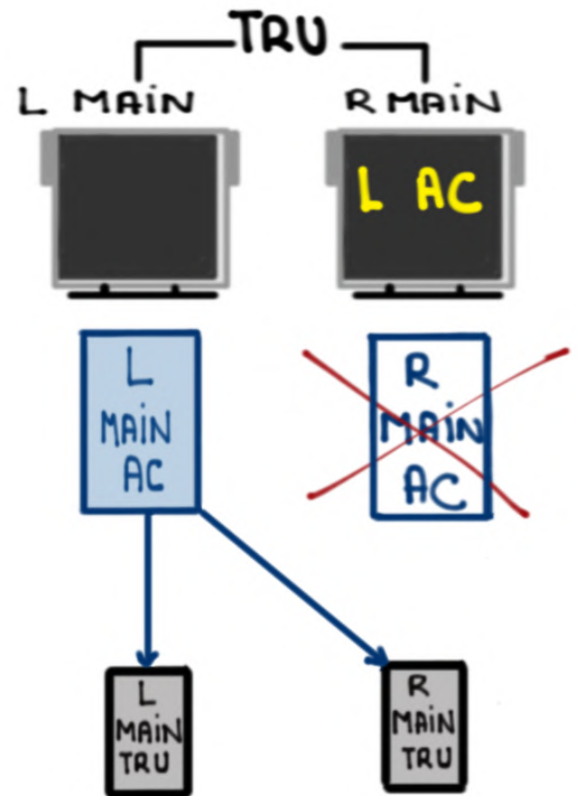
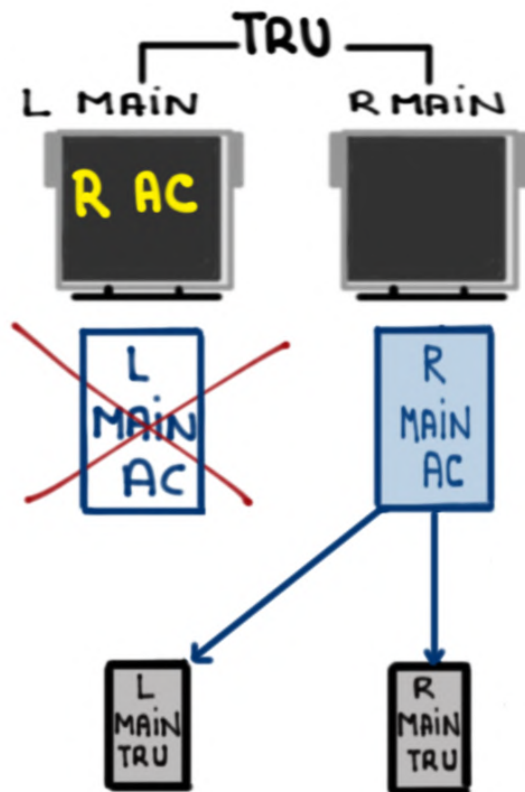
② 

③ 

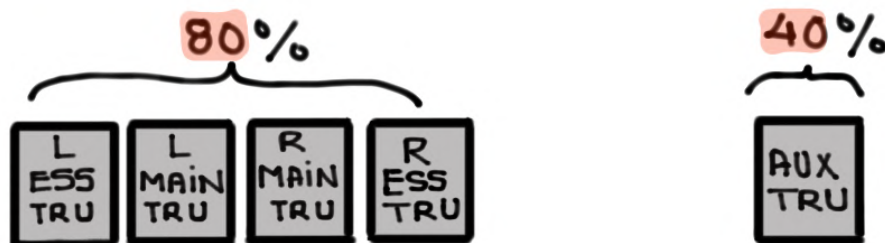
④ 

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

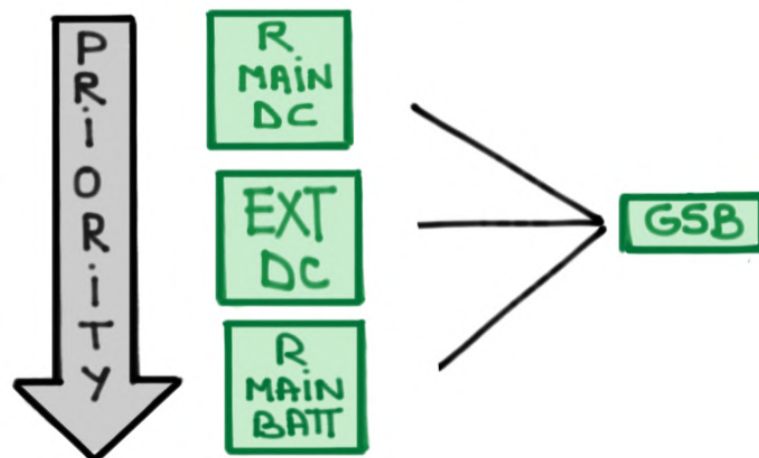
ON

GND SVC BUS

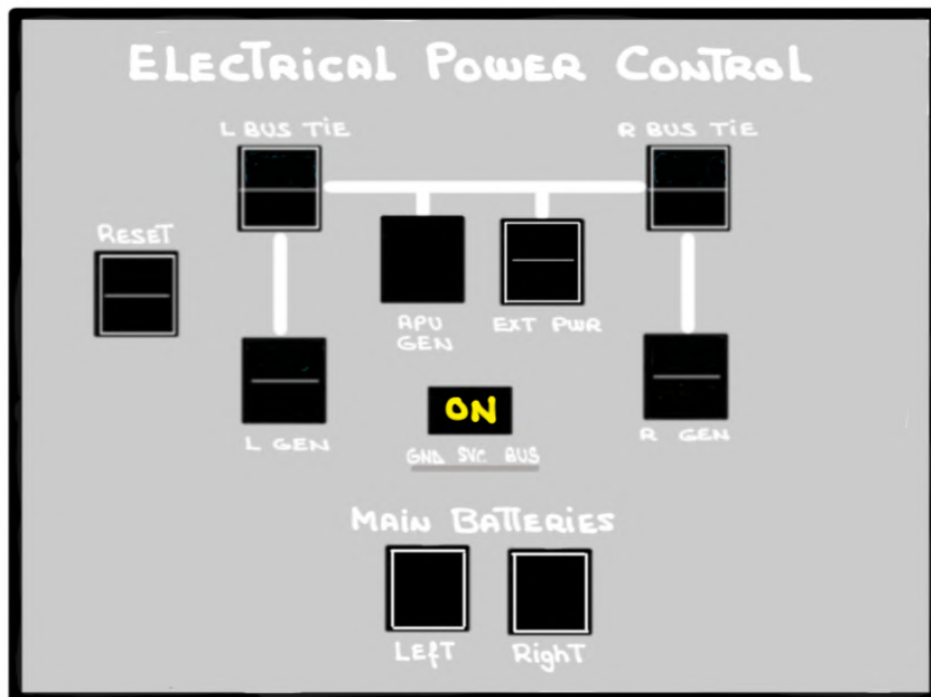
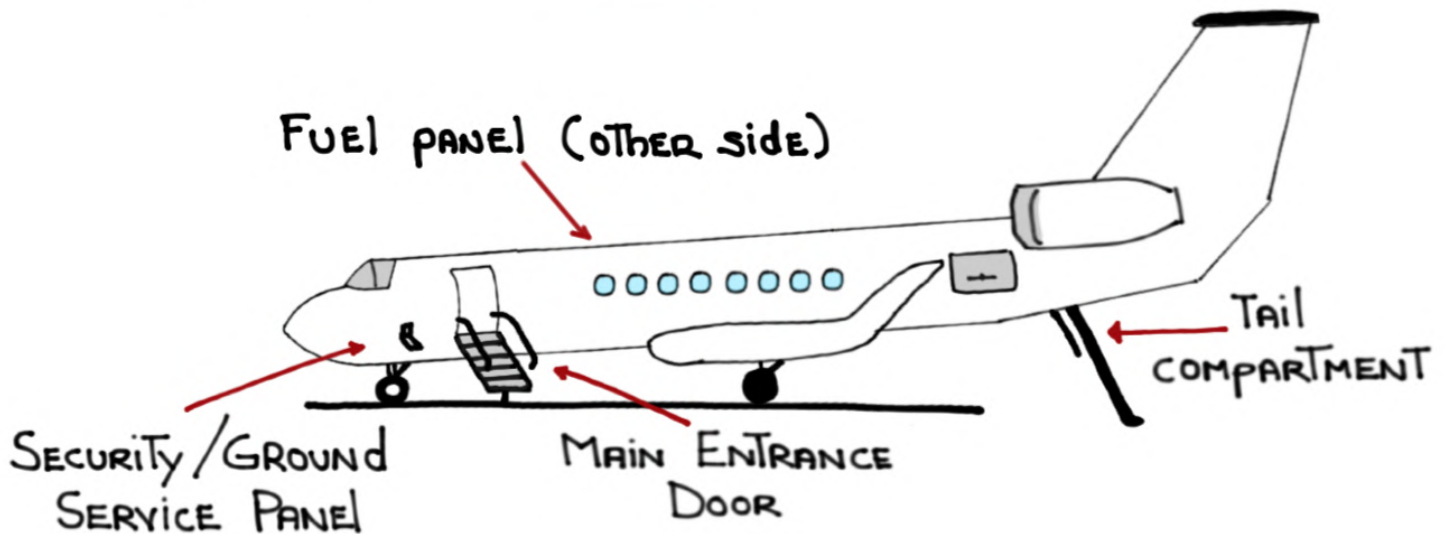
- FOUR (4) GSB switches:

- 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

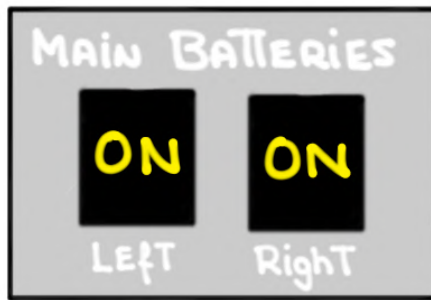


SWITCHES MUST BE SELECTED ON

NOTE: MINIMUM 22 VOLTS REQUIRED TO START APU

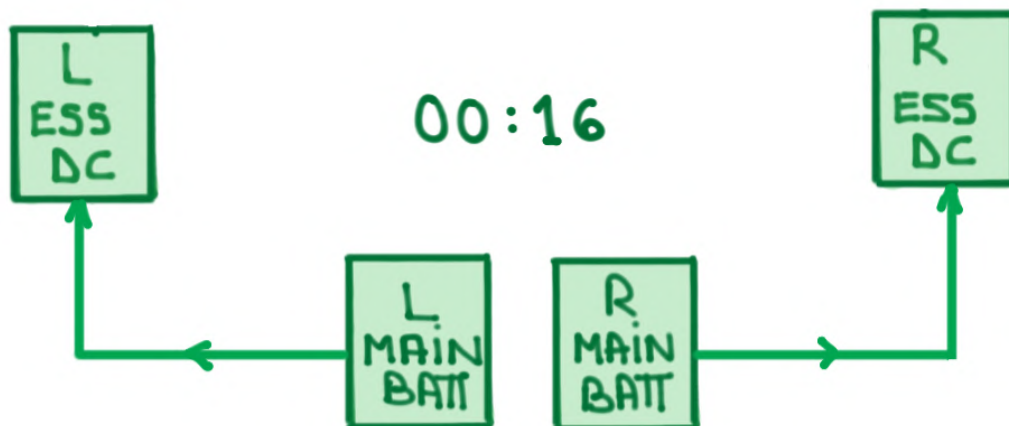
② OPERATE  AUX HYDRAULIC PUMP - BOTH  

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



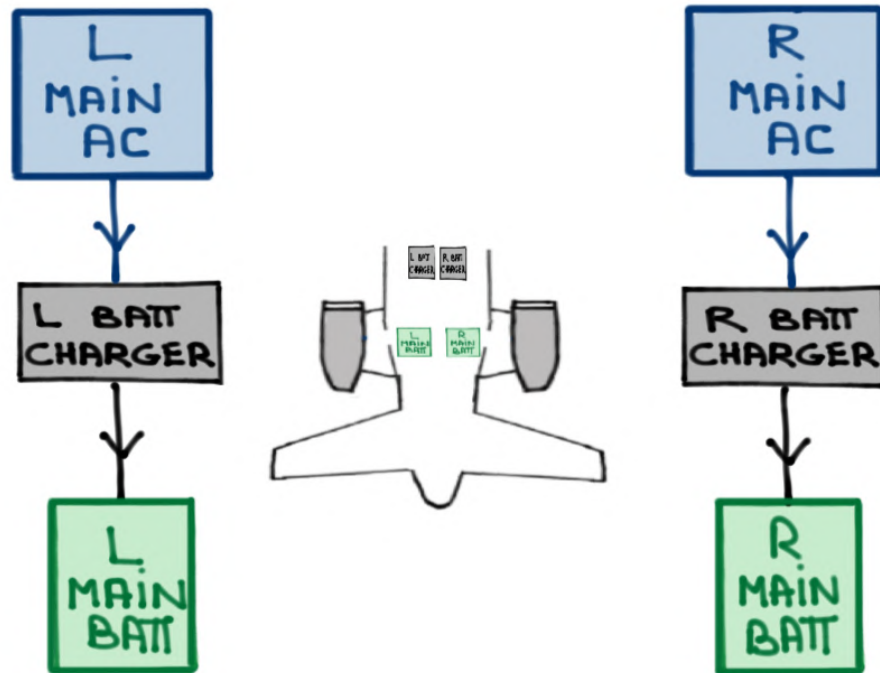
Switchlights illuminate to indicate that the batteries are discharging

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



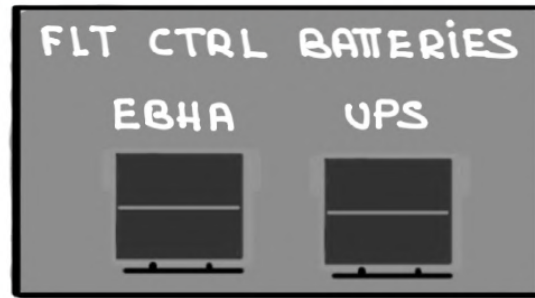
- MUST BE REMOVED FROM THE AIRCRAFT IN COLD SOAKED CONDITIONS ($\leq 20^{\circ}\text{C}$) AND STORED IN A LOCATION WARMER THAN -20°C AND COOLER THAN $+40^{\circ}\text{C}$
- If ≤ 22 VOLTS DC REFER TO GVI MAINTENANCE MANUAL

- 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

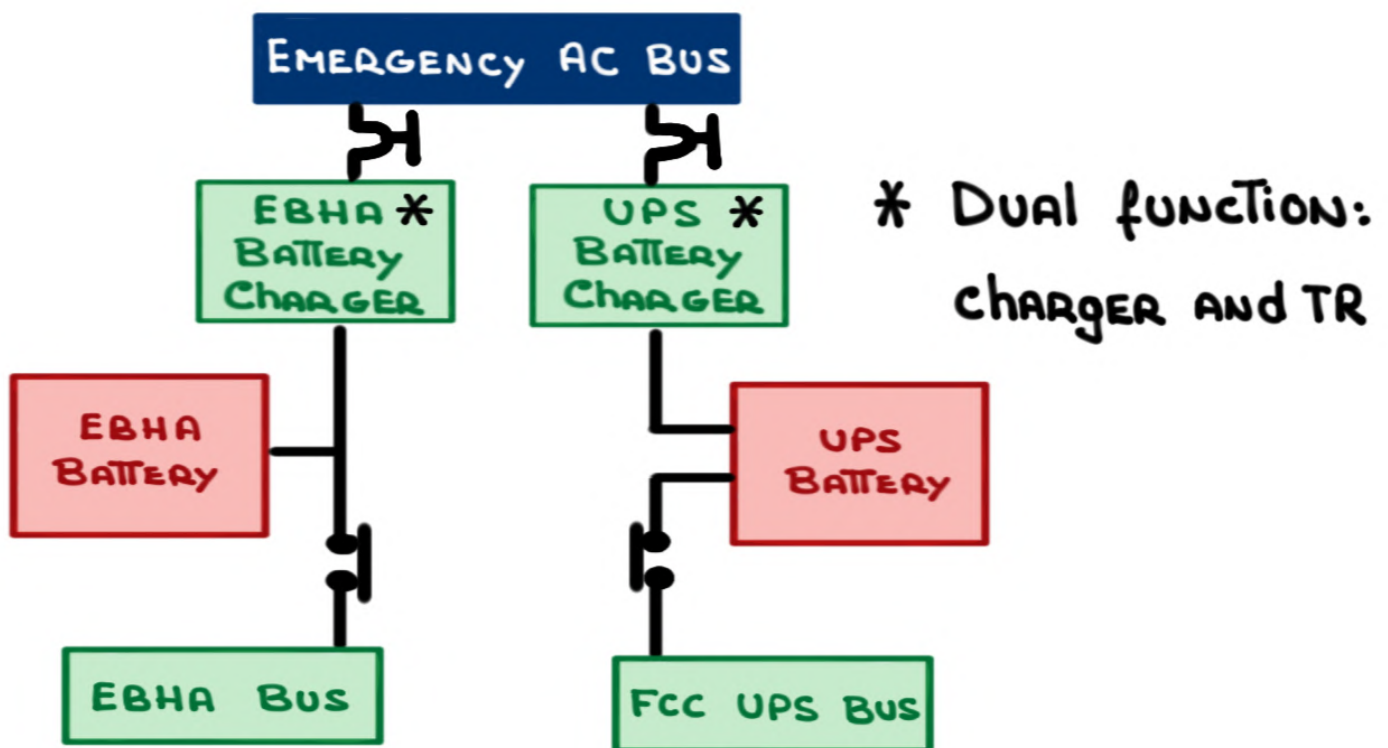
- ILLUMINATED   if NO  POWER IS BEING PRODUCED AND THEY POWER THEIR OWN BUSES (DISCHARGING)



- SYSTEM POWER ON SELF TEST (SPOST)

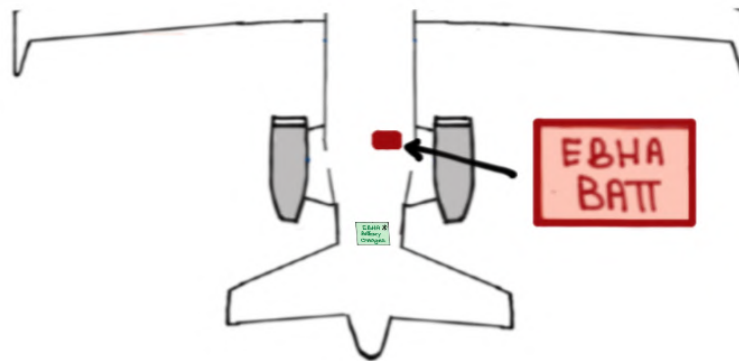
-  SELECTED ON FIRST THEN  SELECTED ON
- FORTY FIVE (45) SECOND TEST
- NO ELECTRICAL INTERRUPTIONS DURING SPOST OR A COMPLETE POWER DOWN IS REQUIRED

- FCS BATTERIES - CHARGER/TRANSFORMER RECTIFIER

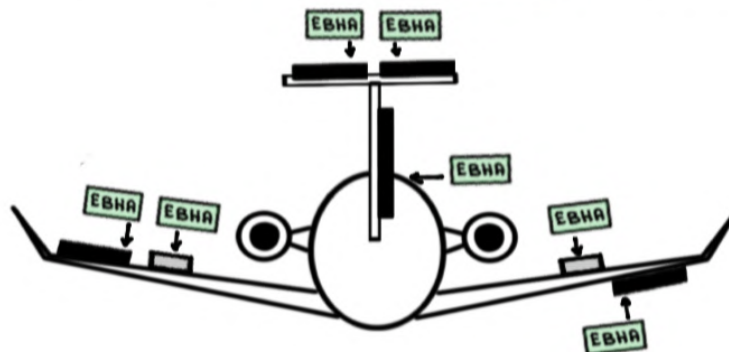


- **EBHA BATT** ELECTRICAL Backup Hydraulic Actuator

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



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



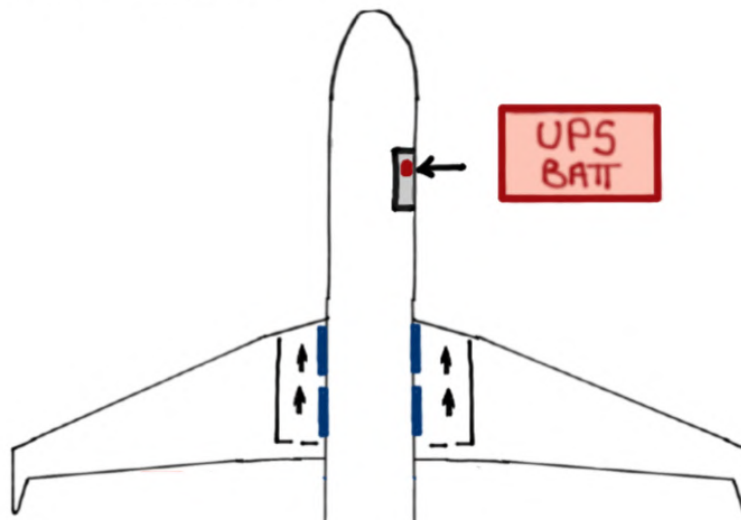
- CAN BE CHARGED BY **RAT GEN**  VIA THE **EMERGENCY AC BUS**

RAT

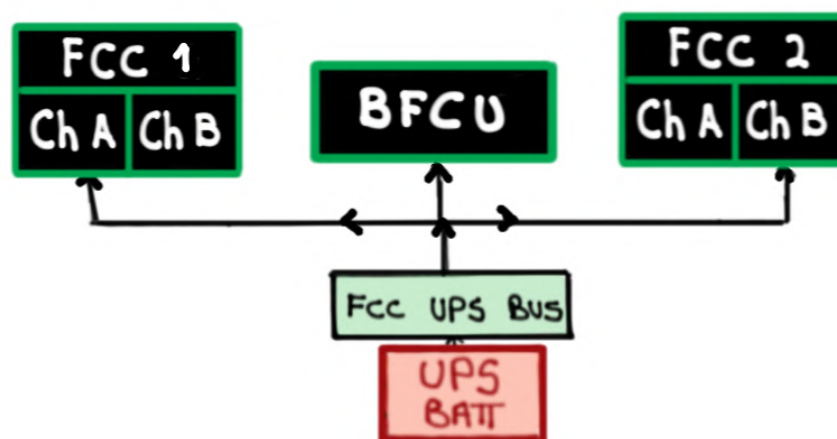
- MUST BE REMOVED FROM THE AIRCRAFT IN COLD SOAKED CONDITIONS (\leq **20°C**) AND STORED IN A LOCATION WARMER THAN **-20°C** AND COOLER THAN **+40°C**

- **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 - 28V DC



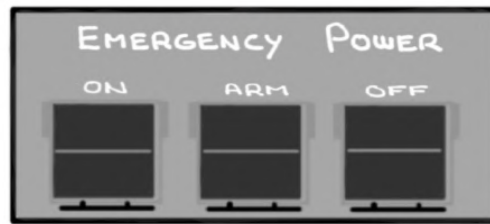
If voltage 22-24V DC, charge EBHA BATT for fifteen (15) MINUTES while operating on EXTERNAL AC power, APU GENERATOR, OR ENGINE GENERATOR. If voltage is < 22V DC REFER TO GVI MAINTENANCE MANUAL

UPS
BATT > 23 - 27V DC



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

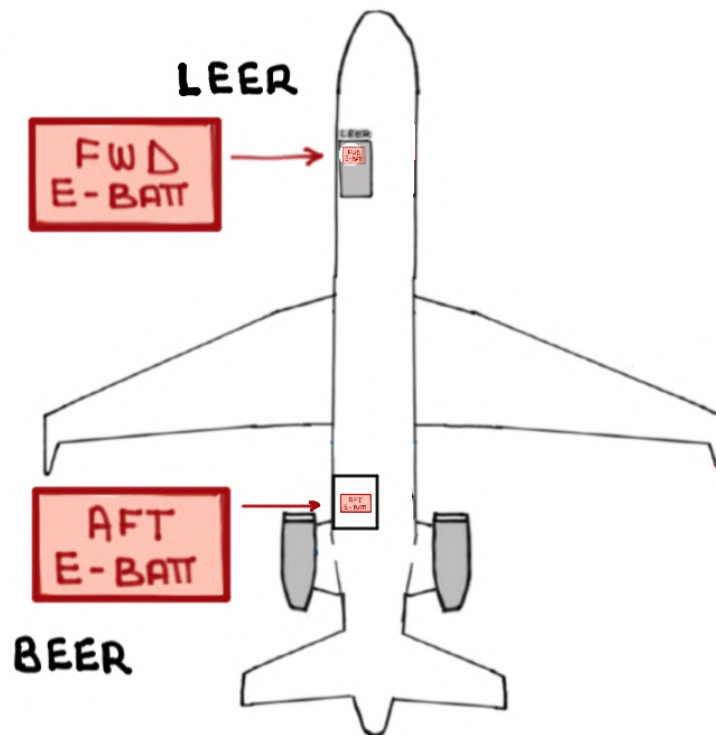
EMERGENCY BATTERIES



- THERE ARE TWO (2) E-BATTs

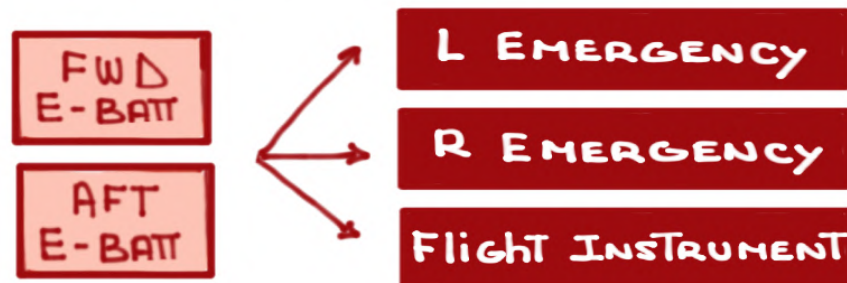
A FORWARD AND AN AFT E-BATT

- LOCATED in:

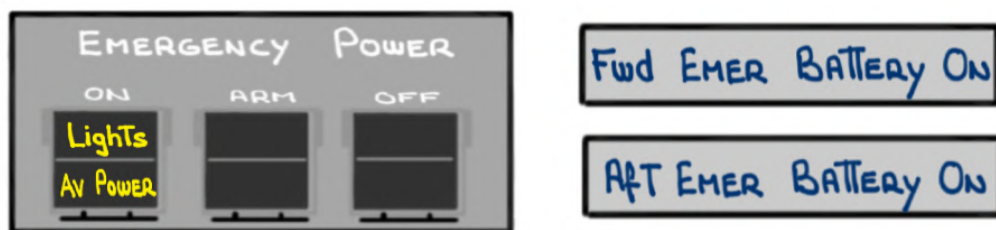


- SEALED, LEAD ACID with its own INTERNAL charger
- 24 Volts, 10.5 amp/hour
- Forty Five (45) MINUTES duration, approximately

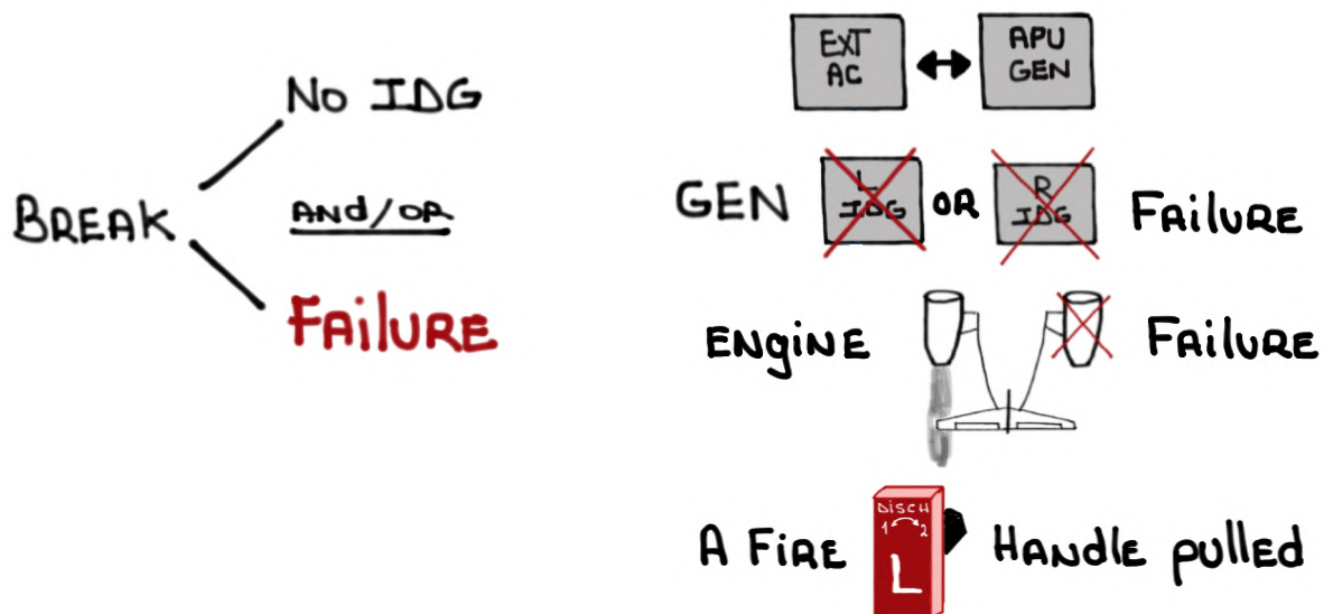
- POWER The following buses:



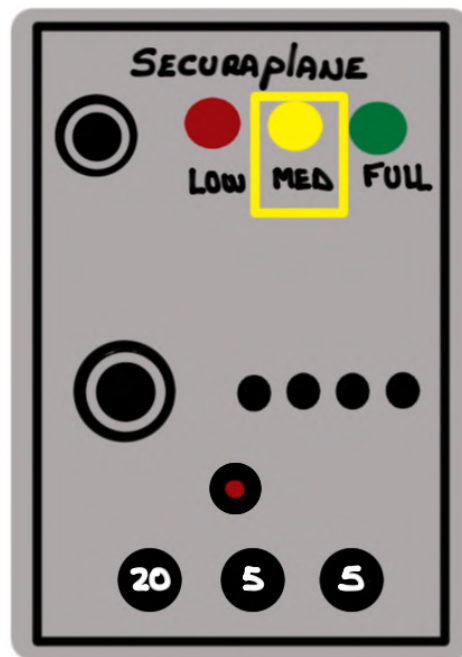
- When "ARMED" The E-BATTs come ON automatically when power to the L ESS DC AND/OR R ESS DC drops below 20 Volts, EVEN MOMENTARILY



- AFTER A BREAK POWER TRANSFER The E-BATTs will come ON



- MINIMUM CHARGE LEVEL REQUIRED FOR DISPATCH : 72%

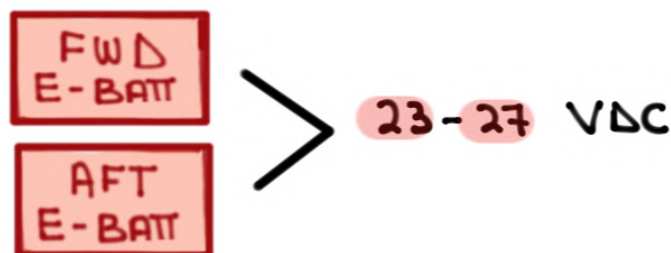


● : 0-50%

● : 50-75%

● : 75-100%

- MINIMUM BATTERY VOLTAGE:

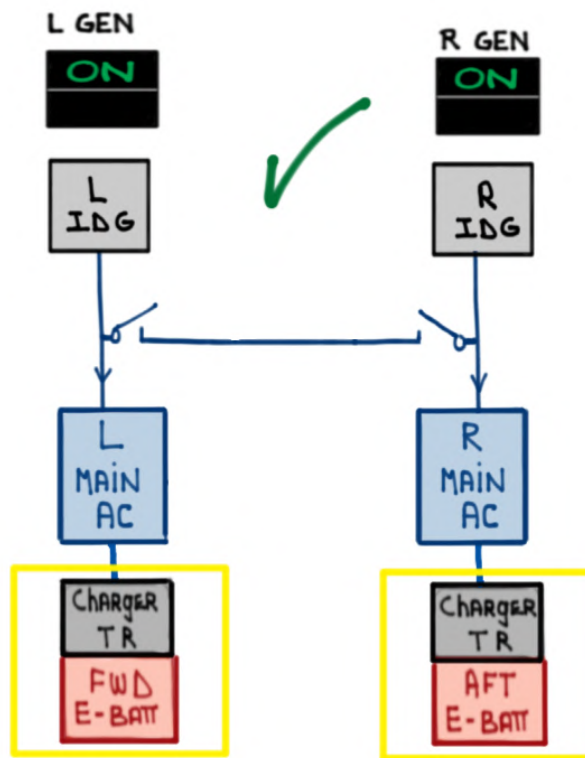


If voltage 22-23V DC, charge E-BATTs for fifteen (15) MINUTES while operating on EXTERNAL AC power, APU GENERATOR, OR ENGINE GENERATOR. If voltage is < 22V DC REFER TO GVI MAINTENANCE MANUAL

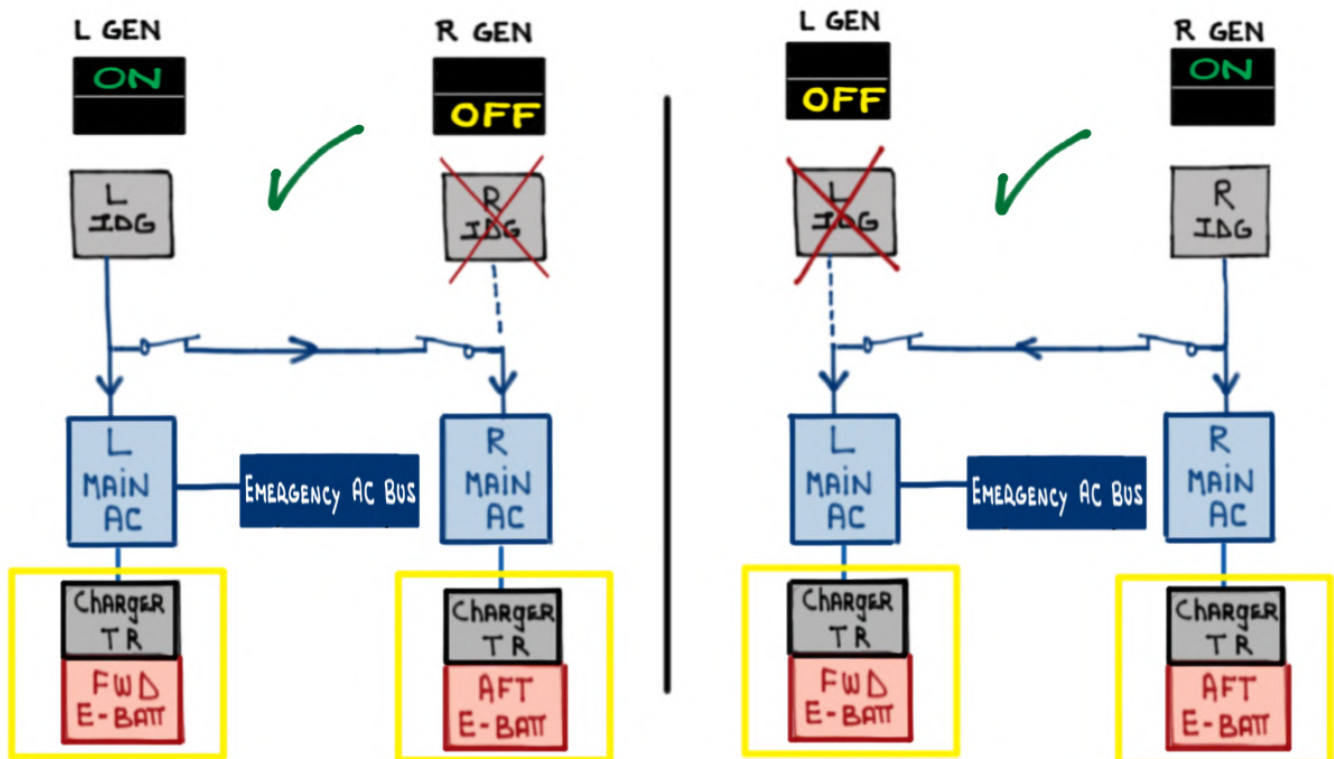
- E-BATTs power the following equipment:
 - EMERGENCY Lighting
 - Cabin EMERGENCY Lights
 - EXTERIOR EMERGENCY Lights
 - STANDBY FLIGHT Displays (2)
 - INERTIAL REFERENCE UNITS (3)
 - THREE (3) Audio CONTROL PANELS (ACPs)
 - MCDU 1 - STBY ENGINE INSTRUMENTS
 - MCDU 3 - Backup RADIOS (VHF 1/NAV1)
 - Two (2) clocks
- AN INTEGRATED CHARGER/TRANSFORMER RECTIFIER RECHARGES THE E-BATTs



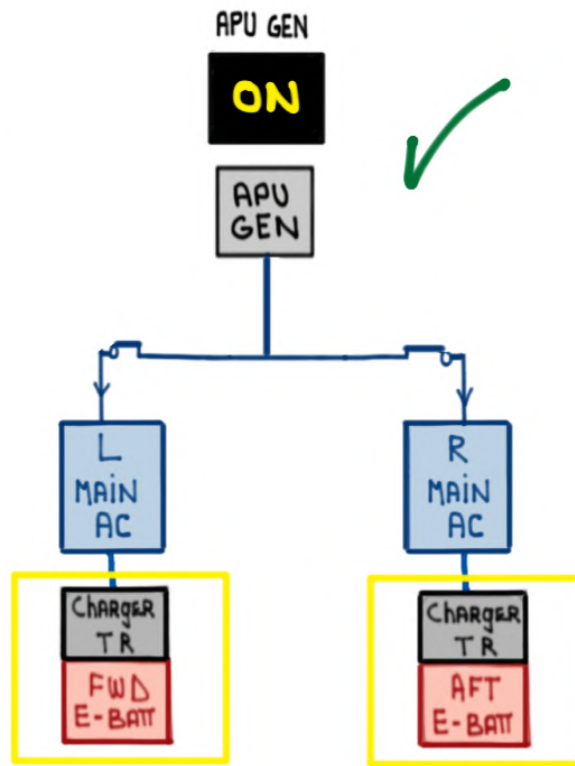
① Both IDGs



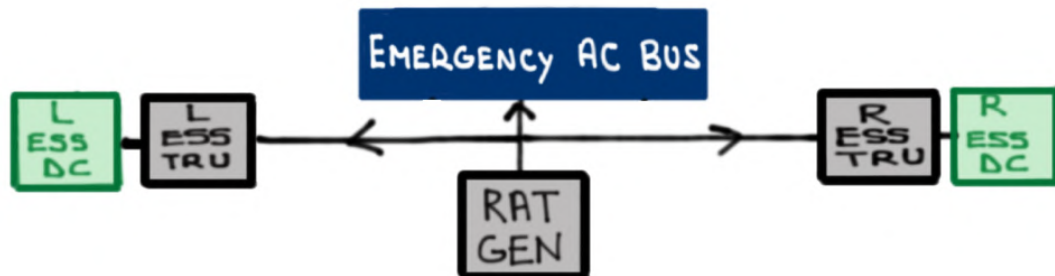
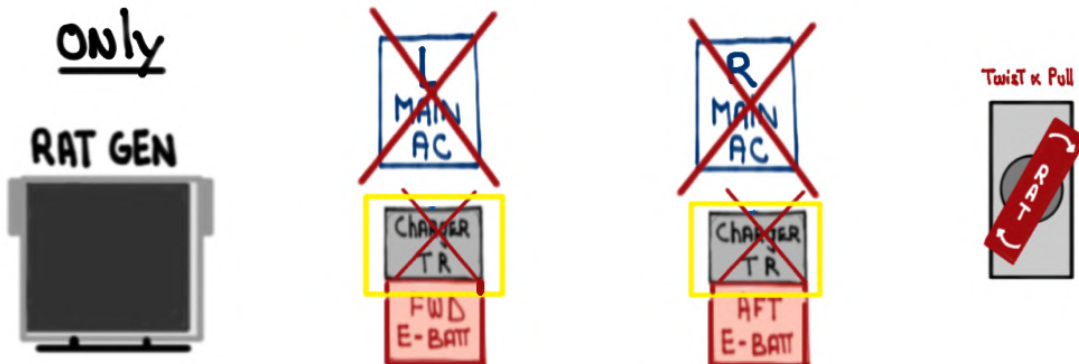
② ONE IDG only



③ APU GEN
only

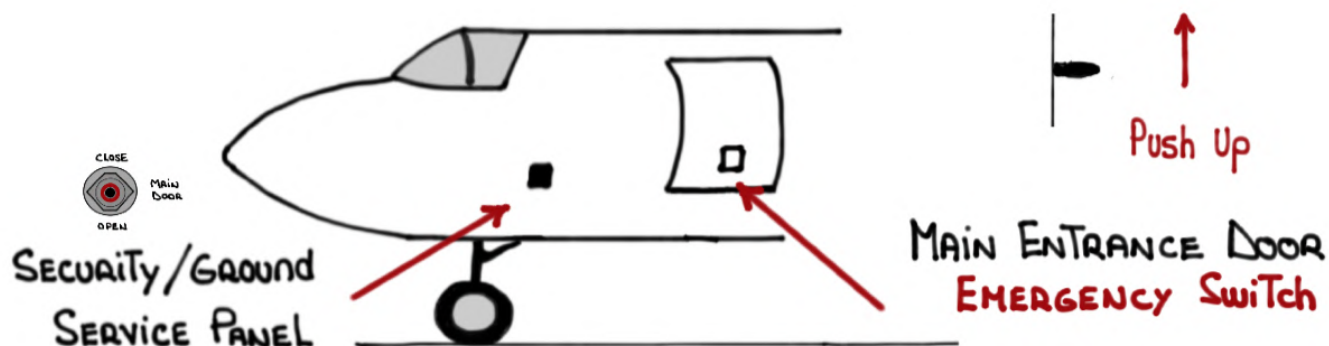


④ RAT GEN
only



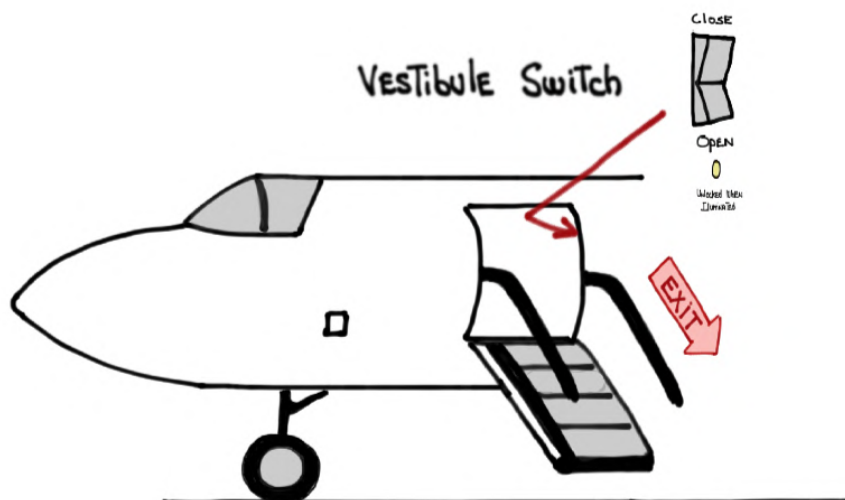
- The **FWD E-BATT** CAN BE USED IN AN EMERGENCY TO OPEN THE ELECTRIC MAIN ENTRANCE DOOR (EMED) VIA THREE (3) SWITCHES. TWO (2) EXTERNAL AND ONE (1) INTERNAL

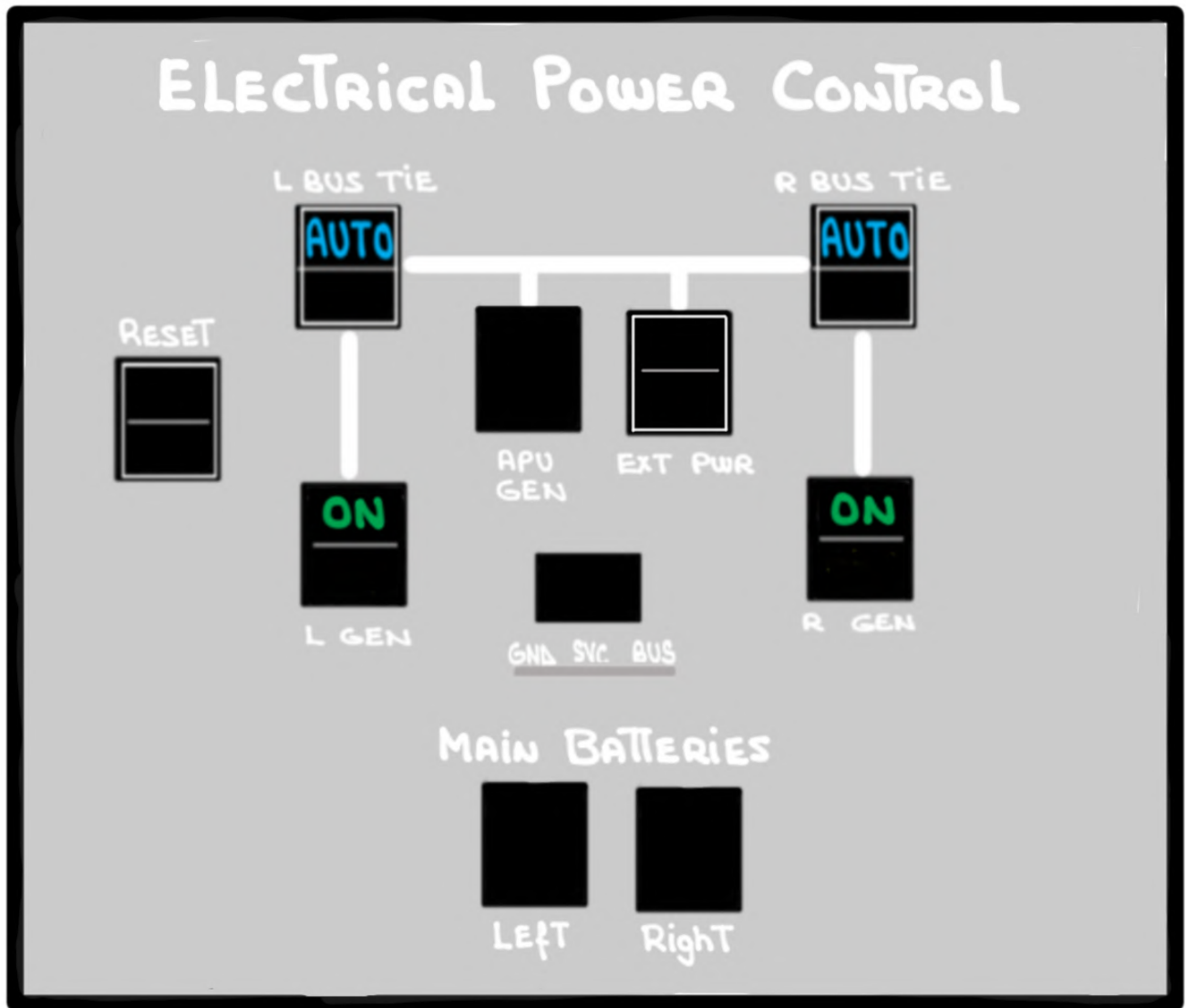
EXTERNAL switches:



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

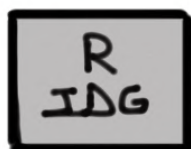


NORMAL - EMERGENCY

NORMAL



AND



- All AC AND DC buses



OR



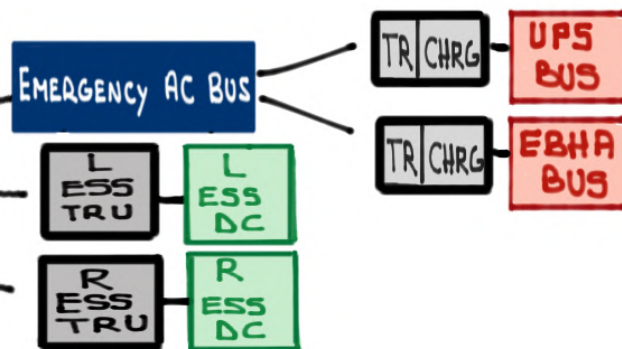
- All AC AND DC buses



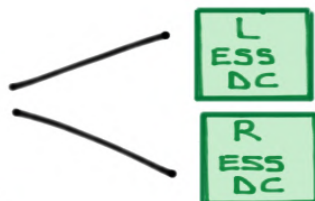
- All AC AND DC buses



(≥ 180 KTs)



(2 APU START ATTEMPTS)

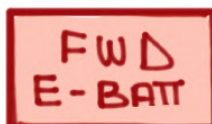


00:16 MINUTES



(< 180 KTs)

00:30 MINUTES



(ESS DC buses < 20 Volts)

L EMERGENCY

R EMERGENCY

FLIGHT INSTRUMENT

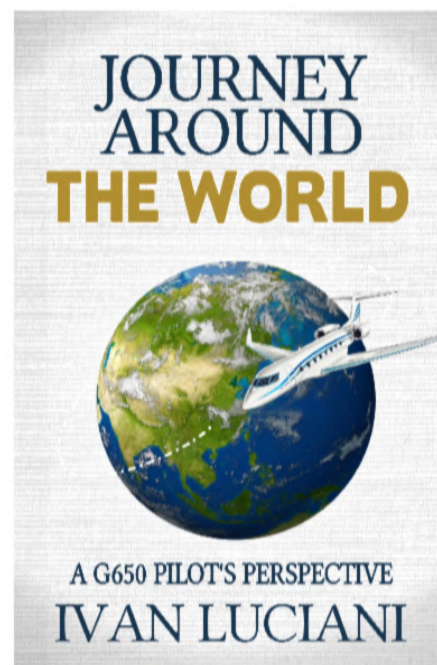
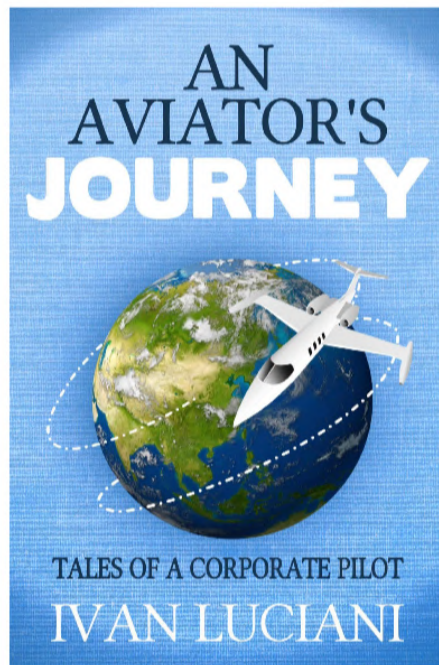
00:45 MINUTES
(APPROXIMATELY)

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!