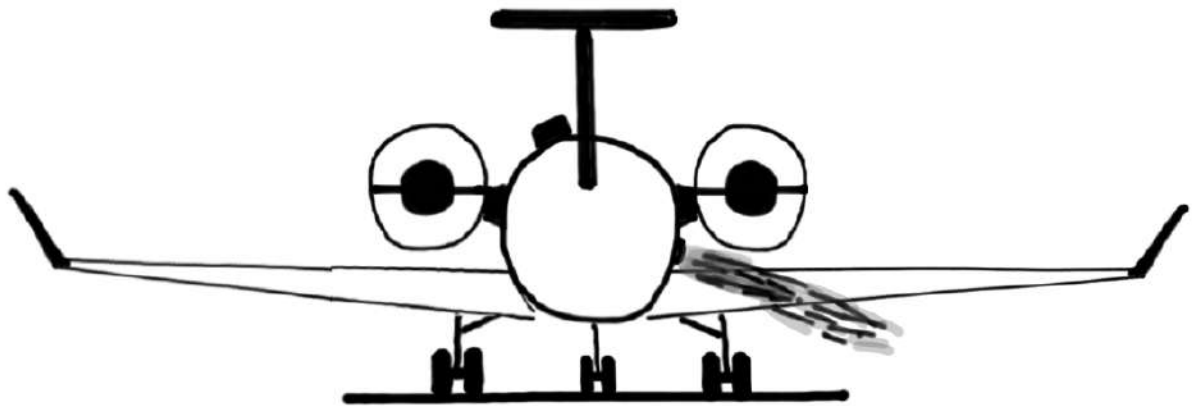


G500 Auxiliary Power Unit



For study purposes only

HONEYWELL HGT 400G

The purpose of The APU is To supply AN AUXILIARY SOURCE of:

① ELECTRICAL AC POWER > ON GROUND
② PNEUMATIC BLEED AIR

① BACKUP ELECTRICAL AC POWER > In flight
② PNEUMATIC BLEED AIR FOR ENGINE AIR START

- APU IS POWERED BY A DEDICATED SINGLE SHAFT, CONSTANT SPEED GAS TURBINE
- APU IS CONTROLLED BY AN ELECTRONIC CONTROL UNIT (ECU)
- APU IS SELF MONITORING AND WILL PROTECT ITSELF AGAINST FAULTS WITH AN AUTOMATIC SHUTDOWN
- APU CANNOT BE USED FOR PRESSURIZATION
- MAXIMUM OPERATING ALTITUDE IS 45,000'
- APU FUEL BURN IS 260 POUNDS/HOUR (ON THE GROUND)


- MINIMUM AMBIENT TEMPERATURE FOR GROUND START is -40°C (-40°F)

- APU HAS A FULLY AUTOMATIC START SEQUENCE

- THE APU CAN BE STARTED WITH   POWER

- APU STARTER LIMITS:

- THREE (3) CONSECUTIVE START ATTEMPTS WITH A ONE (1) MINUTE COOL DOWN PERIOD BETWEEN ATTEMPTS. AFTER THREE (3) START ATTEMPTS, FOLLOW A ONE (1) HOUR COOLING PERIOD

- USE OF  TO START THE APU IS PROHIBITED

- APU EGT LIMITS:

- START = 1050°C

- RUNNING = 732°C

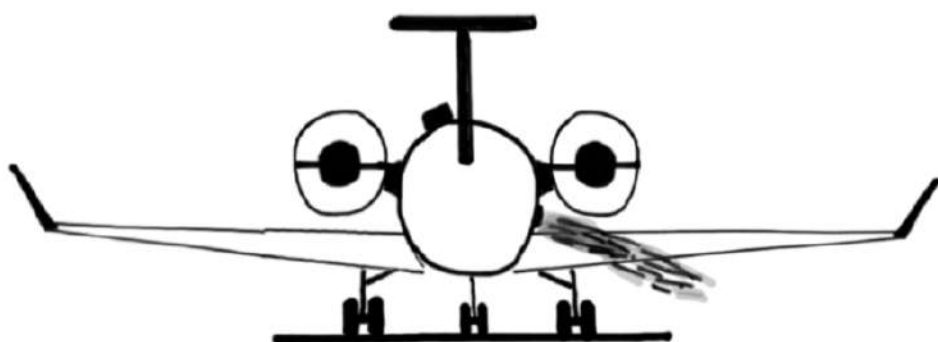
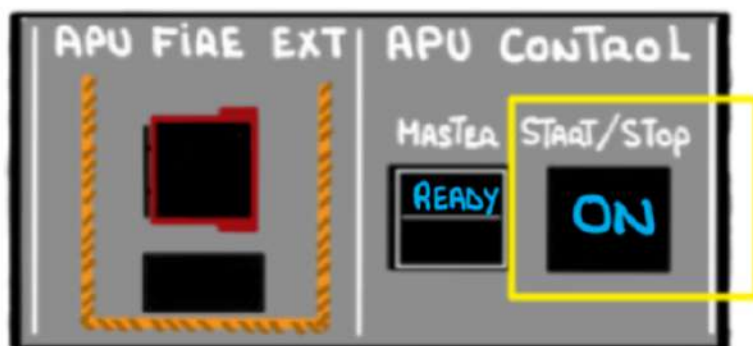
- MAXIMUM APU RPM (ROTOR SPEED): 106%

- APU OIL CHECK: $10-30$ MINUTES AFTER SHUTDOWN

- MAXIMUM TAT for **inflight** operation: **47°C**
- TAKEOFF with THE APU OPERATING is PROHIBITED with OAT ABOVE **45°C**
- MAXIMUM ALTITUDE for APU START:

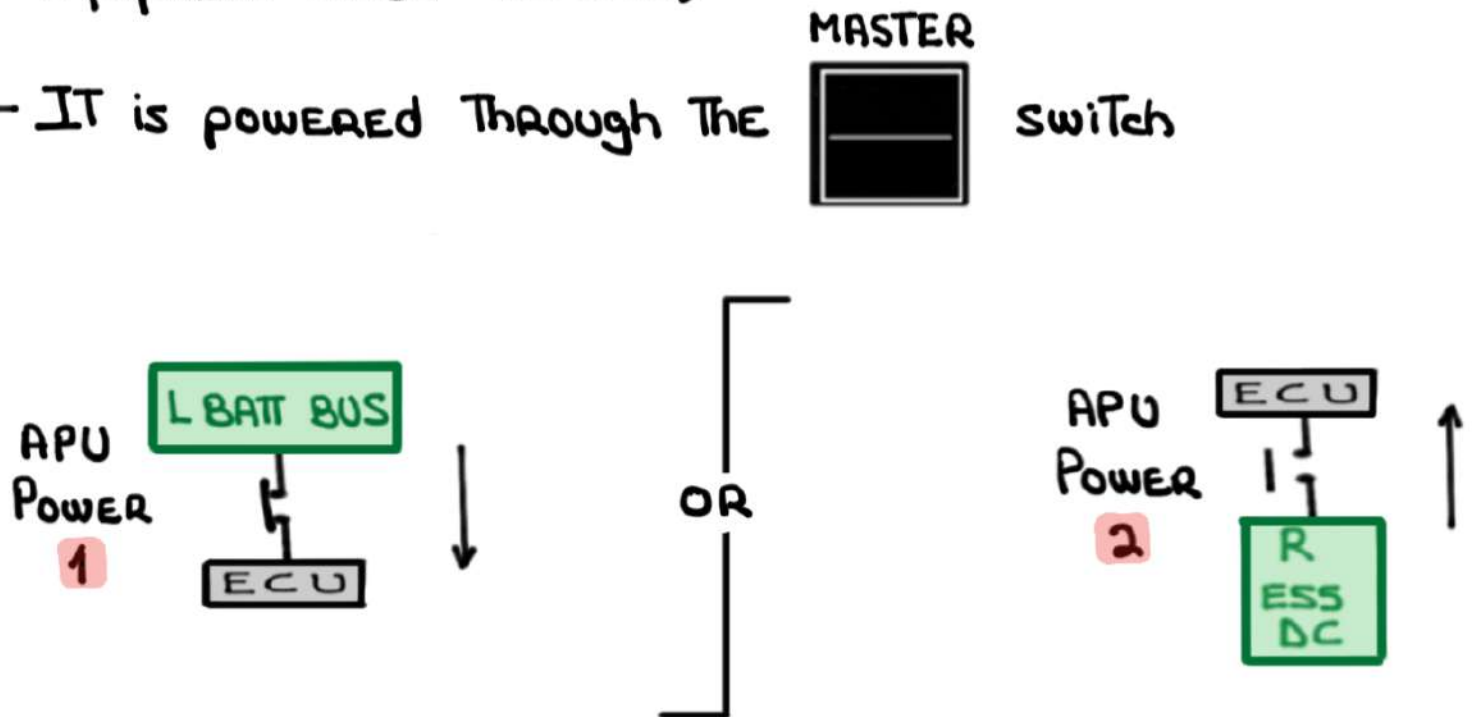


GUARANTEED AT OR BELOW **37,000'**



ELECTRONIC CONTROL UNIT (ECU)

- The **ECU**, THE BRAINS OF THE APU, IS A MICROPROCESSOR WITH EMBEDDED SOFTWARE
- IT AUTOMATICALLY CONTROLS THE APU AND INTERFACES WITH SUBSYSTEMS
- IT IS LOCATED IN THE FORWARD BAGGAGE ELECTRONIC EQUIPMENT RACK (BEER)
- IT IS POWERED THROUGH THE **MASTER** switch



THE **ECU** SELECTS ONE OF THE TWO POWER SOURCES IF BOTH ARE AVAILABLE

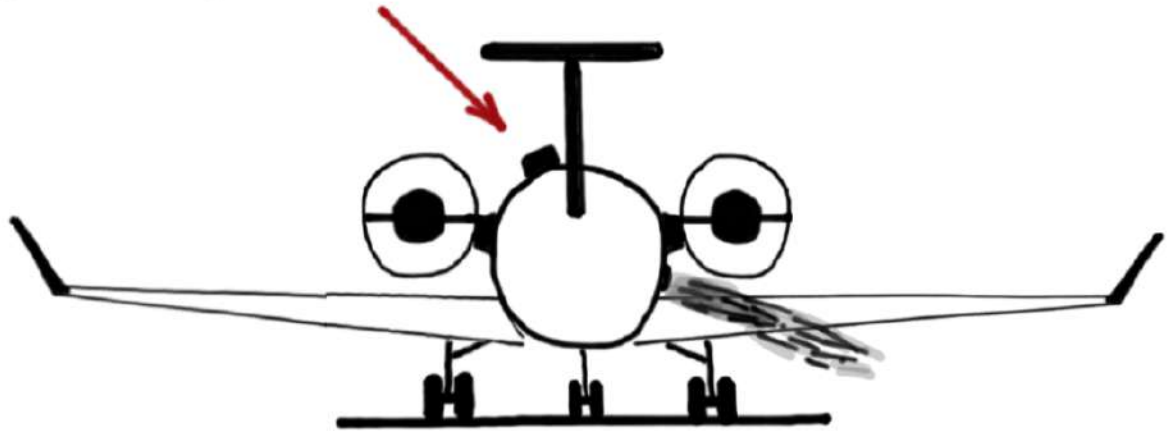
- The **ECU**

① MAINTAINS REQUIRED RPM AND SAFE EGT DURING:

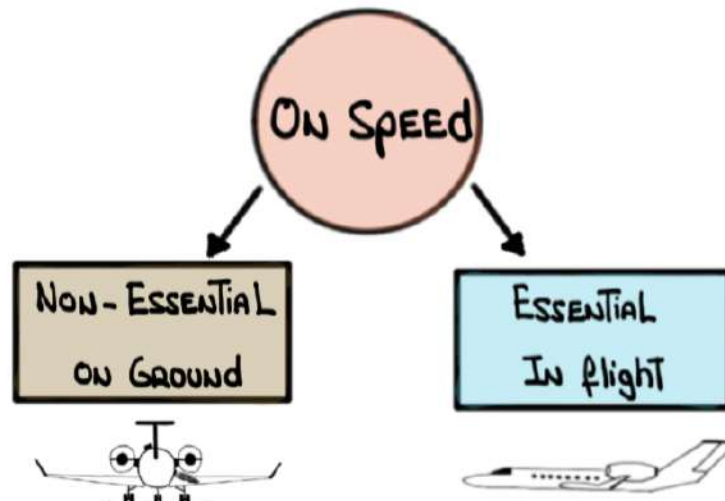
- START
- ACCELERATION
- Idle
- Full load OPERATION

② MONITORS OPERATIONAL limits

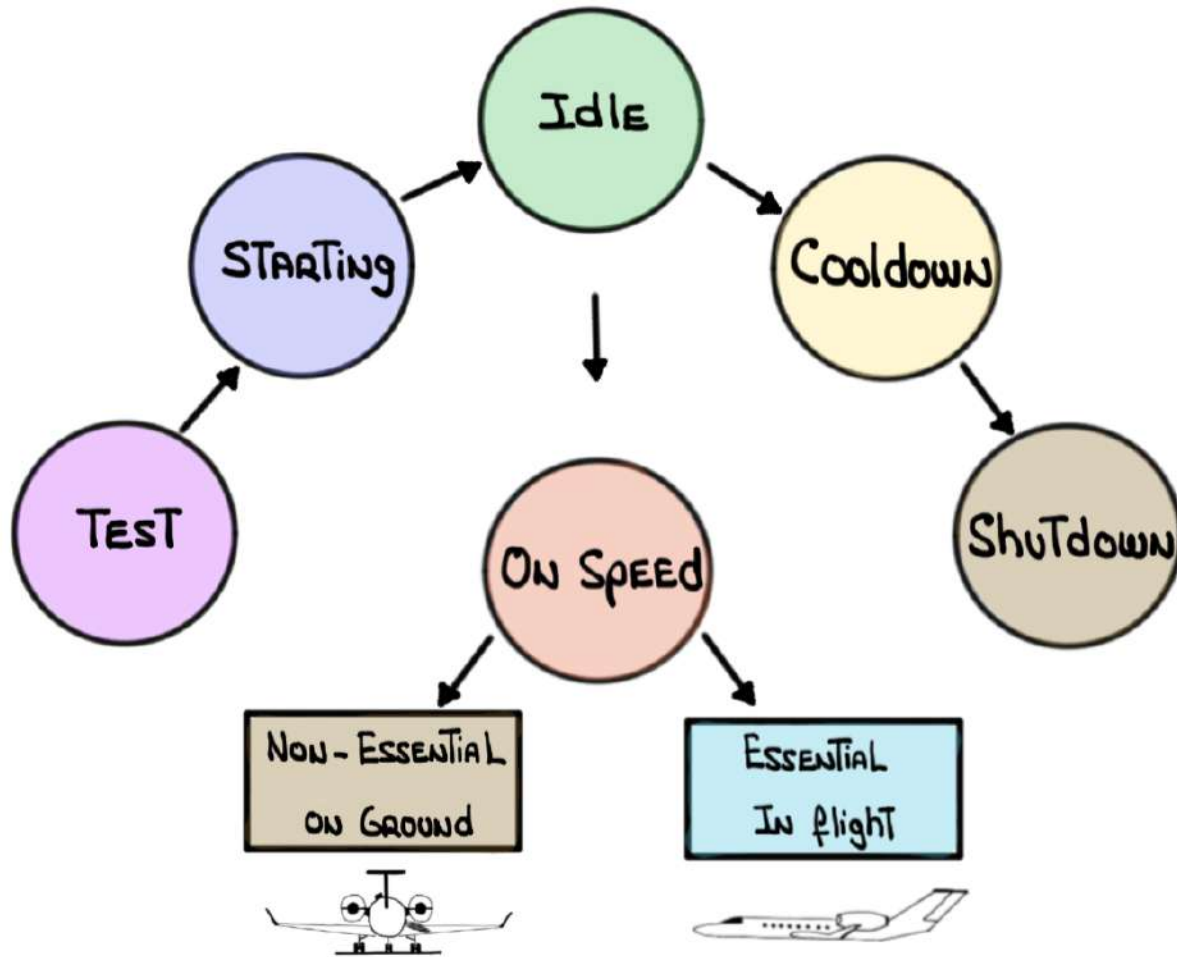
③ CONTROLS AIR INLET door



④ CONTROLS PROTECTIVE SHUTDOWNS



- Six (6) OPERATIONAL MODES:



- Auto PROTECTIVE SHUTDOWNS:

The **ECU** PROVIDES OPERATIONAL PROTECTION FOR THE APU by shutting it down if OPERATING PARAMETERS ARE EXCEEDED OR if a FIRE IS DETECTED WITHIN THE APU housing

The **ECU** USES TWO (2) SETS OF OPERATING LIMITS:

NON-ESSENTIAL
ON GROUND



ESSENTIAL
IN FLIGHT



① NON-ESSENTIAL (ON GROUND):


THE APU WILL AUTOMATICALLY SHUTDOWN IN ORDER TO PROTECT ITSELF IN THE EVENT OF SIXTEEN (16) SAFETY-RELATED FAULTS

- COOL-DOWN MODE IS BYPASSED
- APU'S FUEL SHUTOFF VALVE IS CLOSED
- APU SHUTS DOWN

② ESSENTIAL (IN FLIGHT):



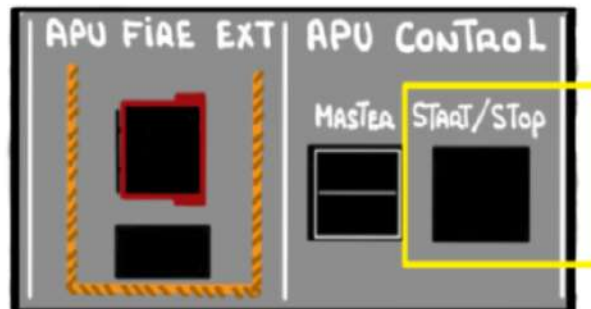
IN ESSENTIAL MODE THE APU WILL NOT AUTOMATICALLY SHUTDOWN FOR CERTAIN FAILURES. THE SAFE CONDITION OF THE AIRCRAFT TAKES PRECEDENCE OVER ANY POSSIBLE DAMAGE TO THE APU

- APU operating **In flight** 
- FAULT DETECTED
- CREW NOTIFIED VIA CAS MESSAGE



If THE APU is NOT NEEDED:

- SHUT IT DOWN WITH THE START/STOP SWITCH

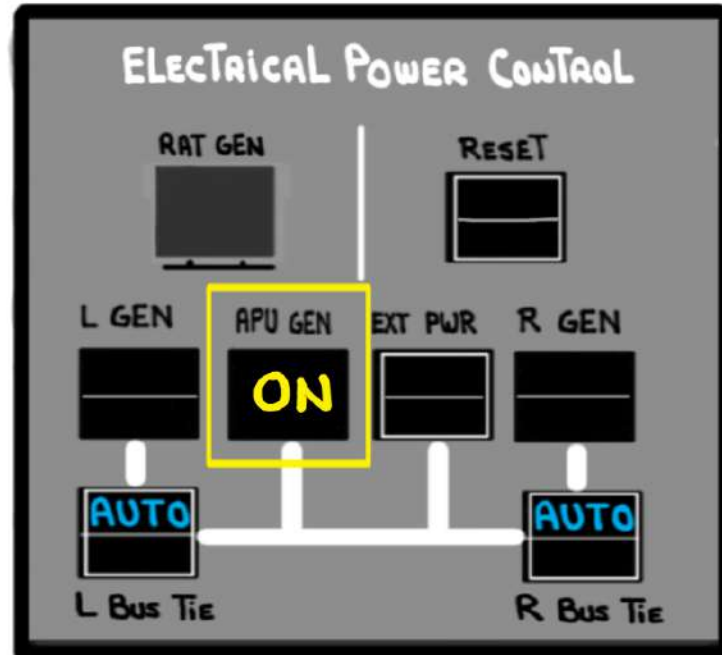


- RESTART IS POSSIBLE IF STILL AIRBORNE

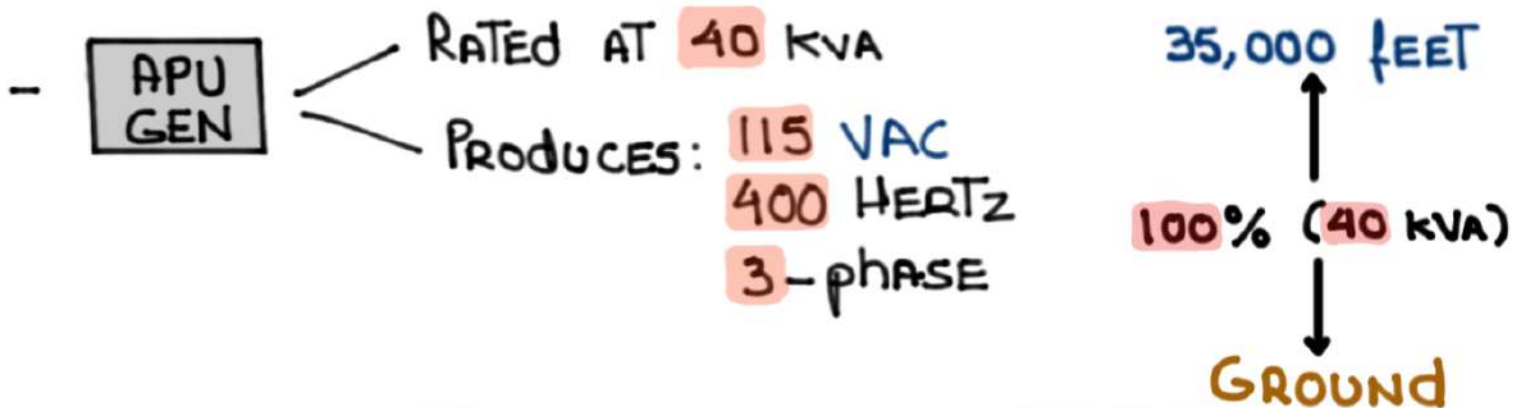
If THE APU is NEEDED:

- ALLOW APU TO CONTINUE RUNNING
- AFTER LANDING THE APU REMAINS IN ESSENTIAL MODE FOR FIFTEEN (15) MINUTES BEFORE THE **ECU** SHUTS IT DOWN. IF NOT NEEDED SHUT IT DOWN

APU GENERATOR

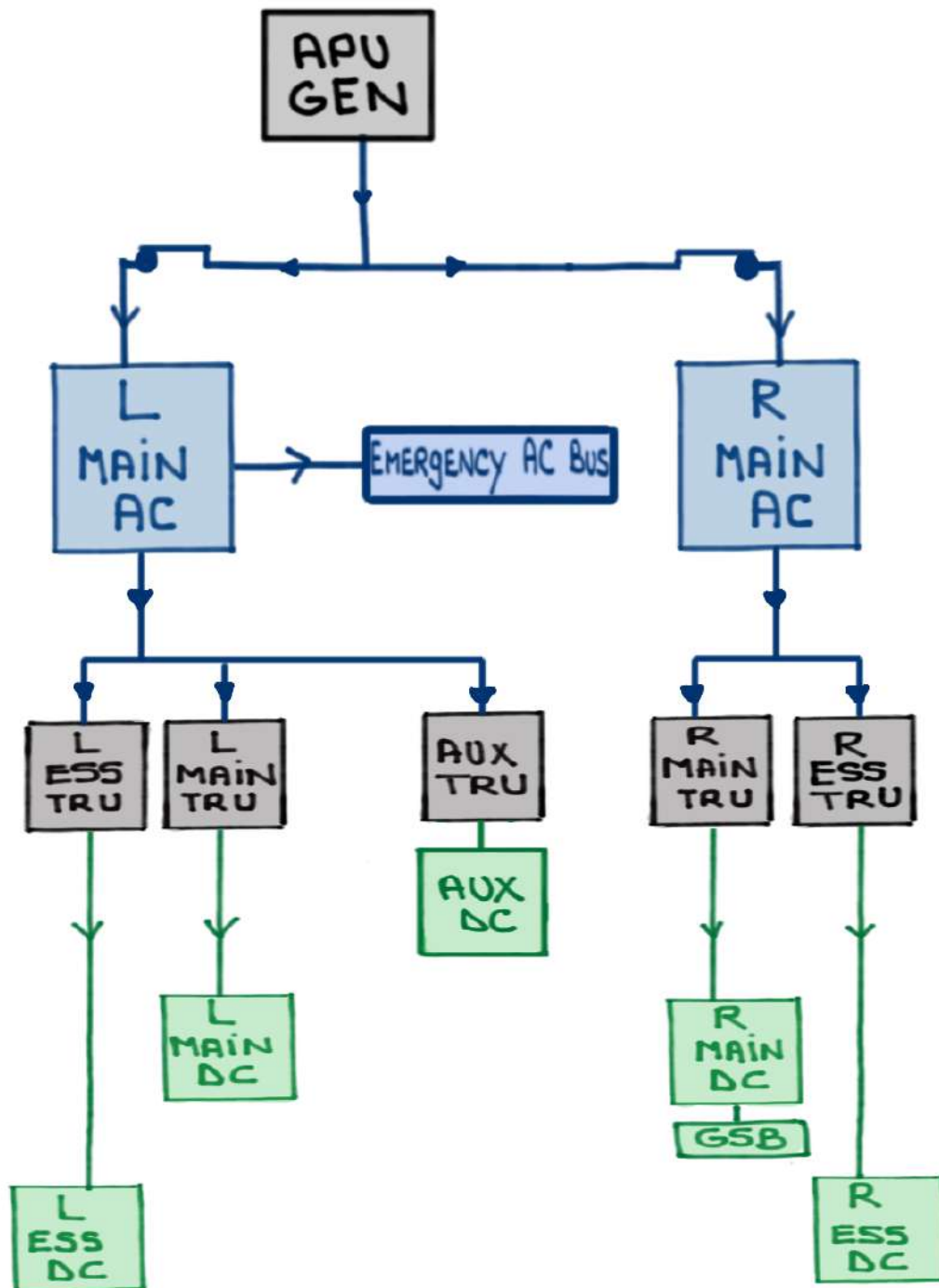


- The APU provides an auxiliary source of:
 - ① Electrical **AC** power - **On Ground**
 - ② Backup Electrical **AC** power - **In flight**
- The APU GEN runs at a constant speed

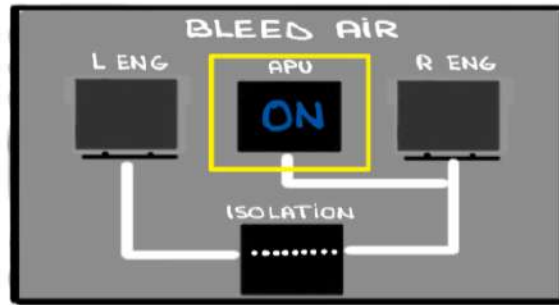


If load > 55% → DESCEND ≤ FL350

- When The APU REACHES 99% RPM + Two (2) SECONDS
THE APU GENERATOR COMES ONLINE AND CAN POWER
All AC AND DC BUSES



APU BLEED AIR

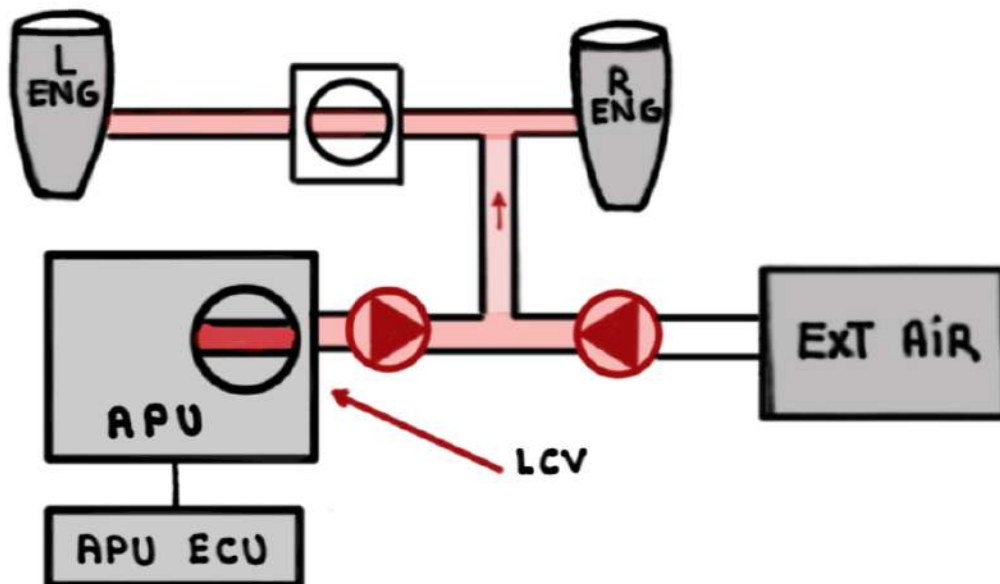


- The APU provides:

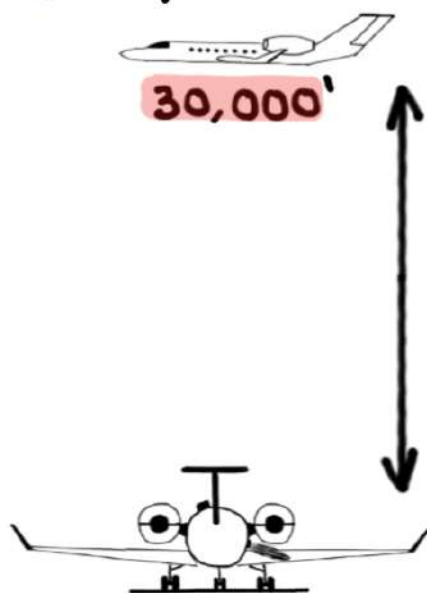
- **On ground:** bleed air for air conditioning and engine start
- **In flight:** bleed air for assisted air starts

- The APU's Load Control Valve (LCV) allows

High pressure/temperature air into the left and right pneumatic manifolds



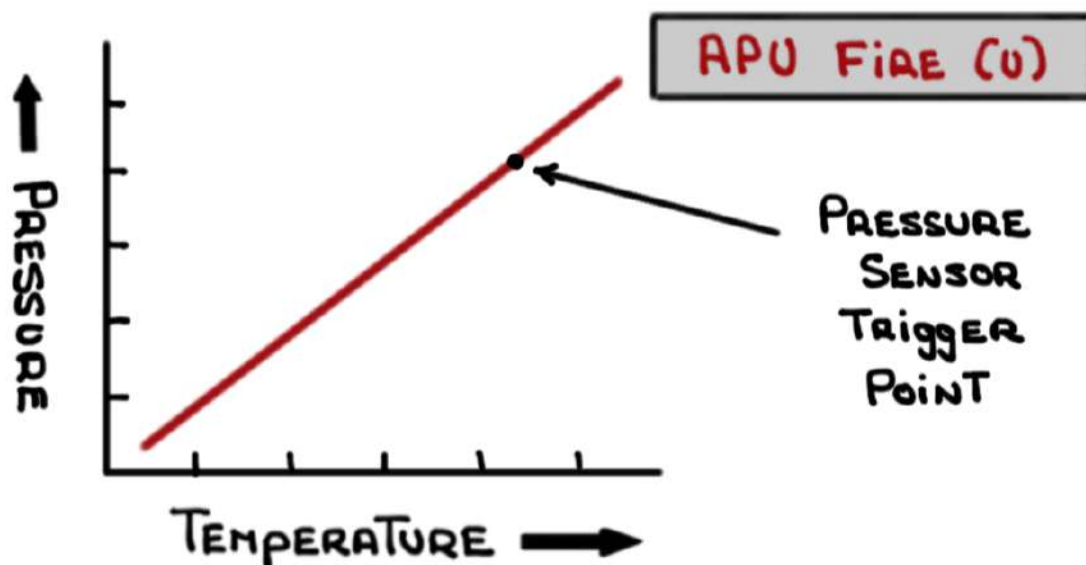
- After the APU is started on the ground the LCV will NOT open for sixty (60) seconds to allow the APU to operate in a lightly loaded condition (low EGT)
- If the EGT is warm ($> 149^{\circ}\text{C}$) the sixty (60) second time delay is removed and APU pneumatic air will be available immediately
- APU bleed air is available immediately to restart an engine in flight
- APU bleed air is available to start the engines on the ground or in flight up to:



- APU bleed air plumbing connects directly to the **R** manifold

APU FIRE DETECTION SYSTEM

- The APU is ENCLOSED in a TITANIUM CASE capable of CONTAINING a fire for FIFTEEN (15) MINUTES. Beyond this PERIOD damage to OTHER SYSTEMS will OCCUR
- The APU OVERHEAT/FIRE DETECTION SYSTEM consists of a HERMETICALLY SEALED HELIUM-FILLED TUBE SECURED TO THE TOP OF THE APU ENCLOSURE
- As the TEMPERATURE inside the ENCLOSURE INCREASES the GAS in the TUBE EXPANDS AND the PRESSURE INCREASES

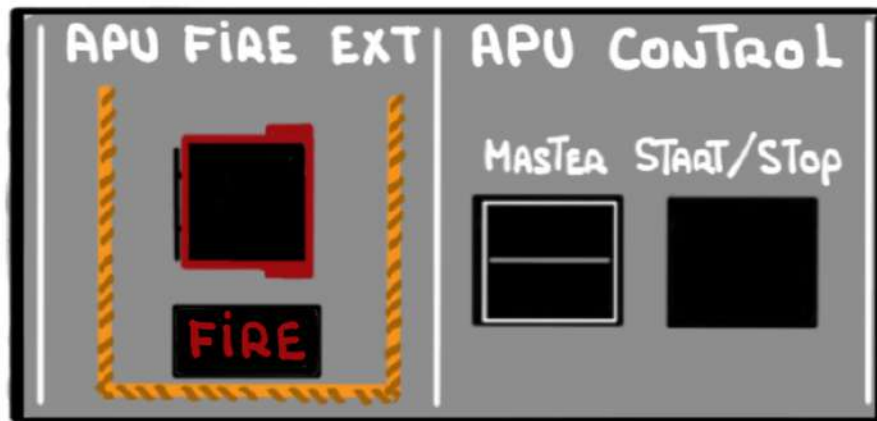


- The DCN DETERMINES WHEN AN APU OVERHEAT/FIRE CONDITION EXISTS BASED ON INPUT FROM PRESSURE SWITCHES

- AN AVERAGE INCREASE IN TEMPERATURE OVER ENTIRE TUBE INDICATES AN **OVERHEAT**



- A LARGE TEMPERATURE INCREASE ON A SMALL LENGTH OF TUBE INDICATES A **FIRE**



▲ FIRE BELL (ON GROUND ONLY)

- ▲ APU ECU
 - CLOSES APU FUEL SUPPLY VALVE
 - CLOSES LOAD CONTROL VALVE
 - SHUTS OFF APU GENERATOR
 - CLOSES APU INLET DOOR

APU FIRE EXTINGUISHING SYSTEM

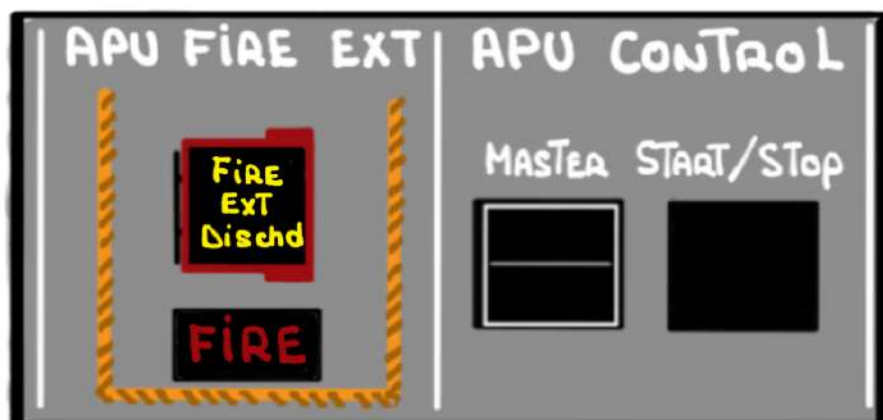
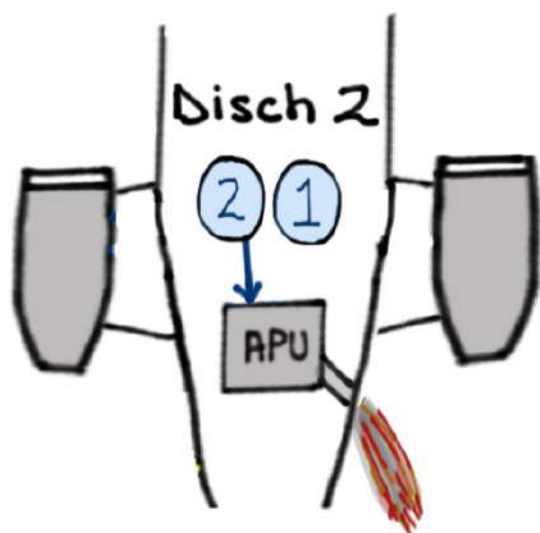
- The APU FIRE EXTINGUISHING SYSTEM is powered by the



bus (down to MAIN BATTERIES)

- FIRE EXTINGUISHING discharge switch (GUARDED) is located ON THE APU CONTROL PANEL

APU FIRE (U)



- Discharges LEFT fire bottle HALON INTO APU COMPARTMENT. Only ONE SHOT is AVAILABLE
- Discharge GENERATES THE following CAS MESSAGE:

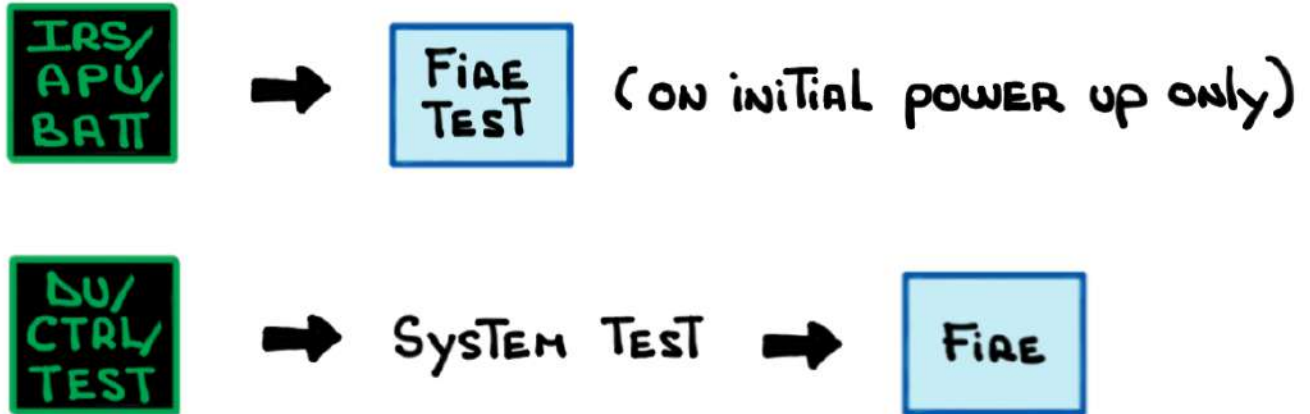


L/APU Fire Bottle Dischd

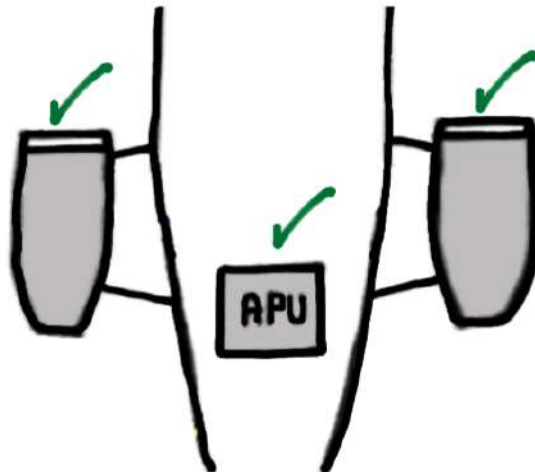


APU FIRE TEST

- FIRE TEST switch is located in two (2) locations on ANY OVER HEAD PANEL TOUCH SCREEN (OHPTS)

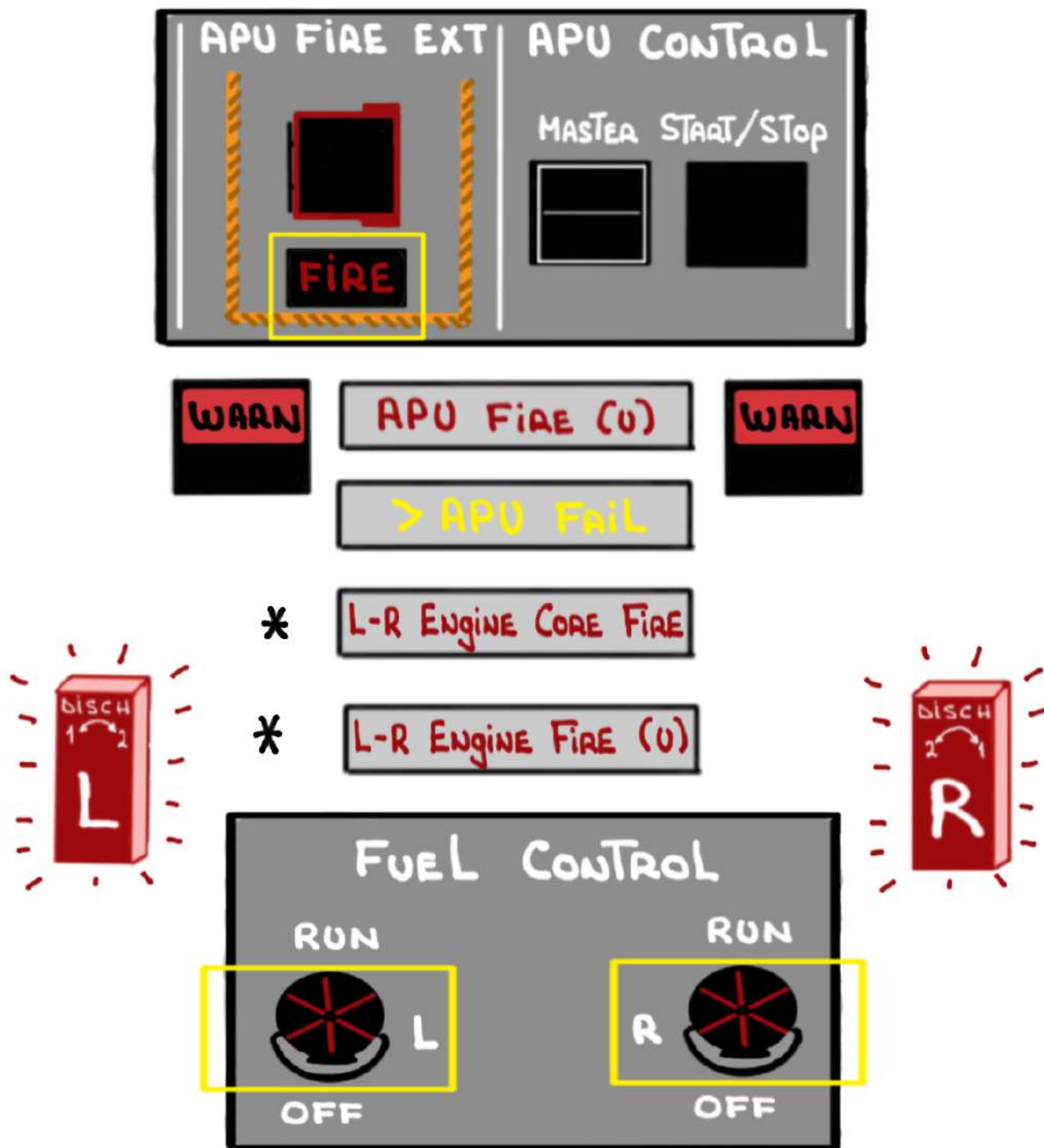


- A single switch accomplishes TEST for APU AND ENGINES



- Checks fire detection only

- PROPER TEST - THIRTEEN (13) INDICATIONS

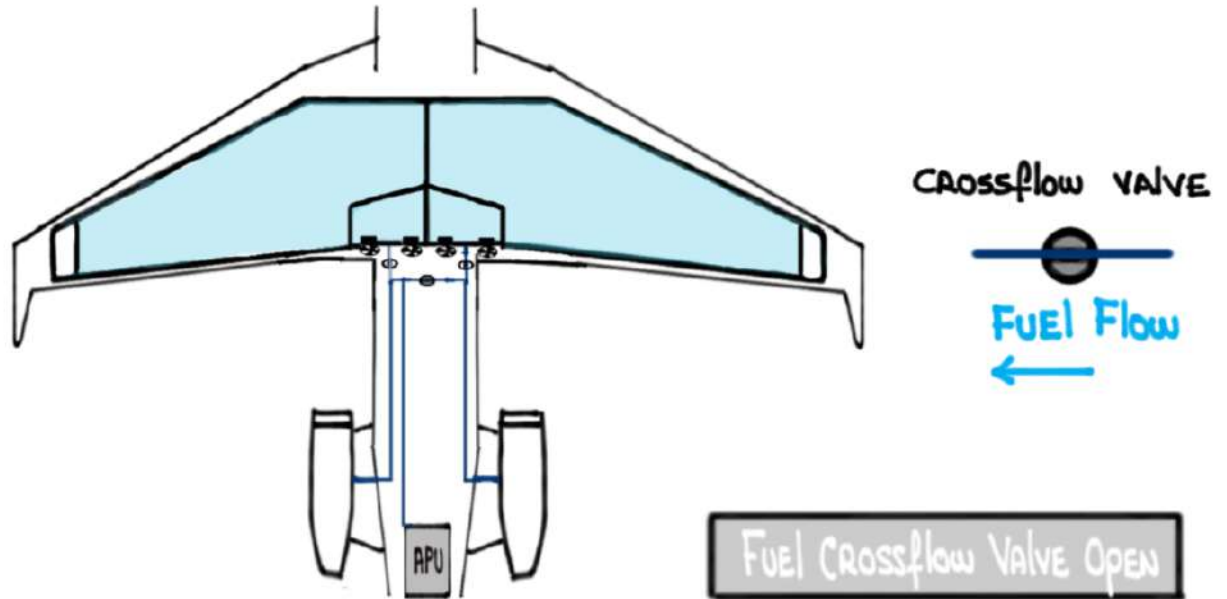


If on the **ground** a **FIRE BELL** (LOCATED IN THE NOSE WHEEL WELL) will sound

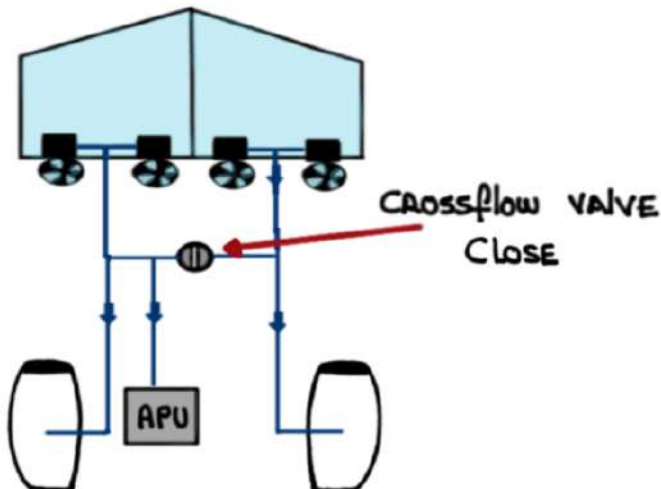
* L-R COUNT AS TWO (2)

APU FUEL Supply

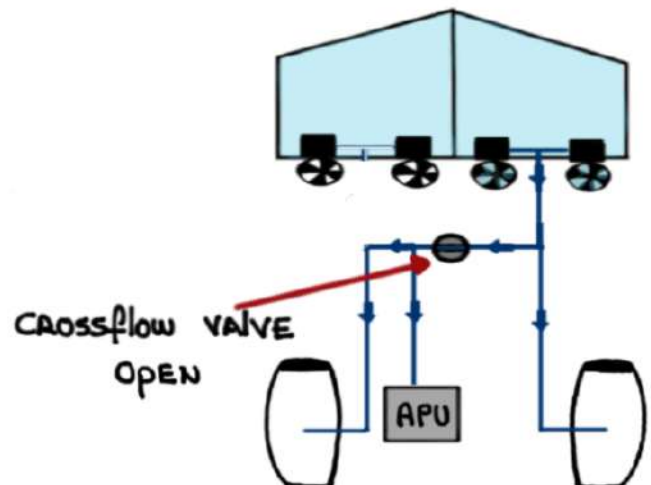
FUEL is NORMALLY supplied FROM THE LEFT FUEL MANIFOLD BUT IT CAN ALSO BE SUPPLIED FROM THE RIGHT MANIFOLD by TEMPORARILY OPENING THE CROSSFLOW VALVE



L MANifold
To
APU

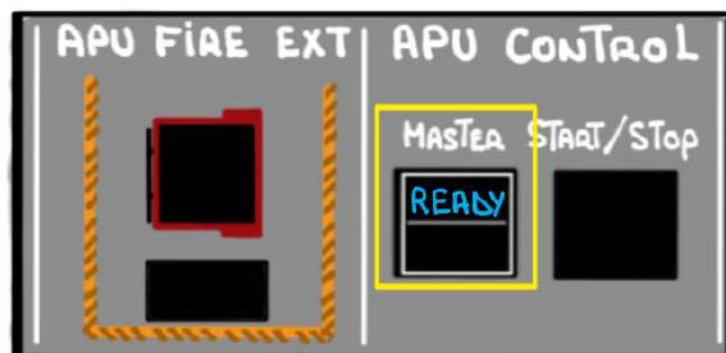


R MANifold
To
APU



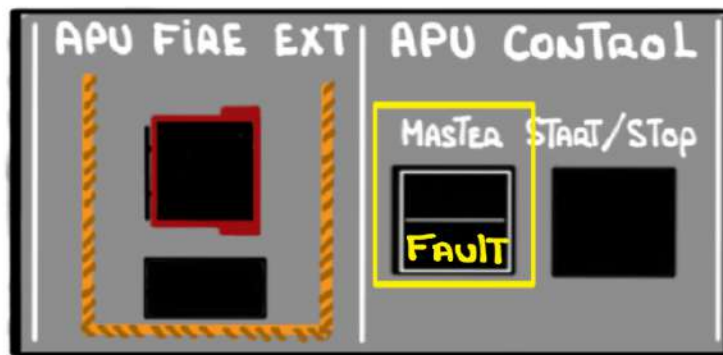
APU CONTROL PANEL - MASTER SWITCH

- When selected ON THE ECU:
 - PERFORMS POWER-UP BUILD-IN TEST (PBIT)
 - COMMANDS APU INLET DOOR TO OPEN IMMEDIATELY ON THE GROUND. If **inflight** inlet door opens AFTER APU RPMs INCREASE
 - COMMANDS APU FUEL SHUTOFF VALVE TO OPEN
- THE DATA CONCENTRATION NETWORK (DCN) AUTO SELECTS:
 - THE NAV LIGHTS ON
 - LEFT MAIN FUEL PUMP TO ON
 - THE TROV OPEN
- CYAN "**READY**" light ILLUMINATES WHEN ALL PRESTART CONDITIONS HAVE BEEN MET AND THE APU IS READY TO START



- If a failure is detected during the PBIT:

- ECU inhibits APU START (EXCEPT for LOW OIL TEMP)
- THE CREW IS NOTIFIED VIA CAS MESSAGE
- REPORTS FAULT TO CMC
- DISPLAYS AMBER "FAULT" IN MASTER SWITCH




THE MASTER SWITCH CAN BE CYCLED OFF AND ON IN AN ATTEMPT TO CLEAR THE FAULT

- WHEN SELECTED OFF THE ECU:

- SWITCH LEGEND EXTINGUISHES
- APU FUEL SHUTOFF VALVE CLOSES
- APU INLET DOOR CLOSES TO TEN (10) PERCENT BELOW 63% RPM AND FULLY CLOSES < 40% RPM

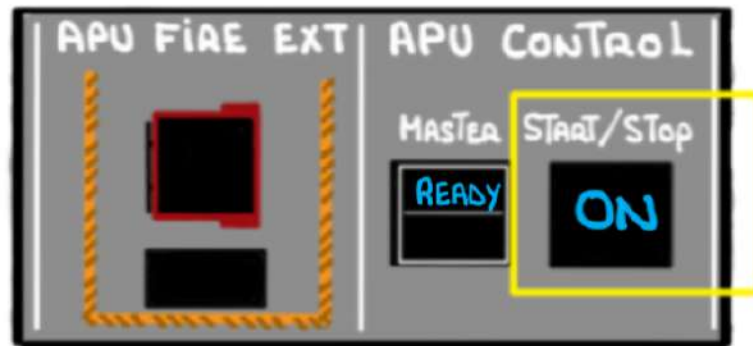
MASTER



If THE APU IS OPERATING PRESSING THE  WILL SHUTDOWN THE APU IMMEDIATELY. THIS IS STRONGLY DISCOURAGED BECAUSE THE COOL-DOWN PERIOD IS BYPASSED AND COMPONENT DAMAGE IS LIKELY

APU CONTROL PANEL - START SWITCH STOP

- When pressed in the **ON** legend illuminates and the START SEQUENCE COMMENCES
- If the **READY** light is illuminated the **ECU** TRANSITIONS TO START MODE



- STARTER ENGAGEMENT
- **5%**
 - OPENS FUEL CONTROL UNIT
 - ENERGIZES IGNITION SYSTEM
 - BEGINS TO CONTROL FUEL FLOW
- **46%** STARTER CUTS OUT (**60%** in flight)
- **50%** IGNITION COMMANDED OFF (**98%** in flight)

ON LEGEND REMAINS ILLUMINATED TO INDICATE APU IS ON

- When the switch is pushed out the **ON** legend extinguishes and the shutdown sequence commences



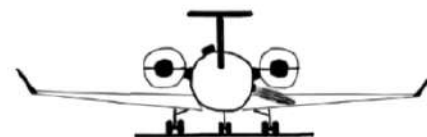
45,000'

- A. Unloads electrics and bleed air
- B. APU enters cool-down mode
 - RPM remains at **100%** for **60** seconds
- C. After cool-down the ECU signals an overspeed condition to shut down the APU
- D. Any faults detected - CMC and/or CAS
- E. APU air inlet door closes

> 20,000'

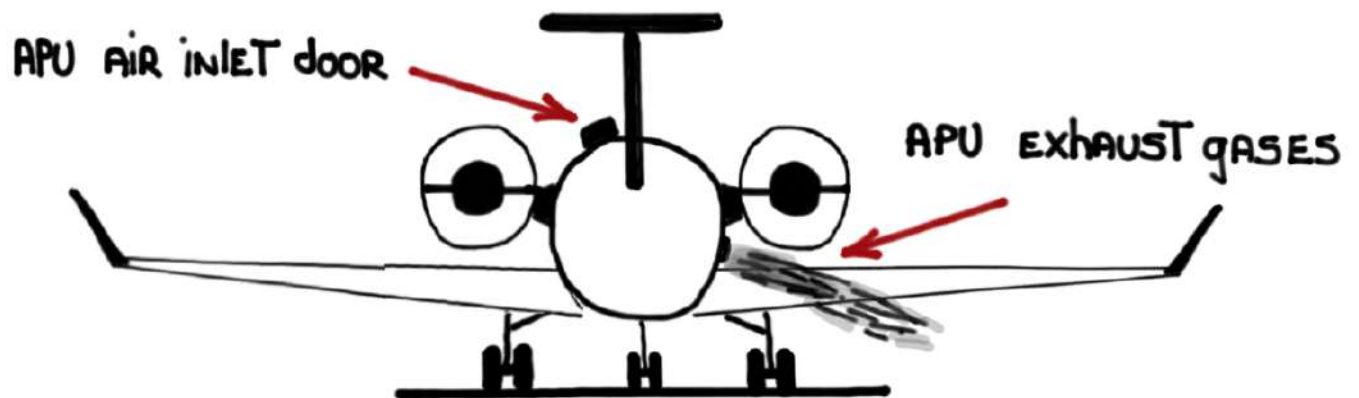
≤ 20,000'

- A. Unloads electrics and bleed air
- B. APU enters cool-down mode
 - RPM decreases **1/2%** for **60** seconds (**70% RPM**)
- C. After cool-down the ECU signals an overspeed condition to shut down the APU
- D. Any faults detected - CMC and/or CAS
- E. APU air inlet door closes

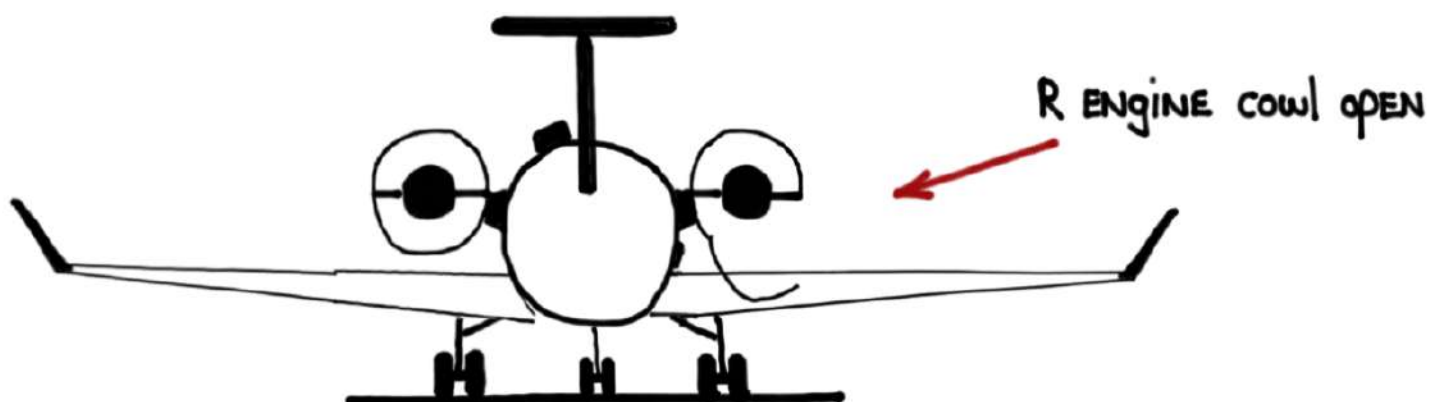


APU AIR INLET DOOR

APU EXHAUST IS EXHAUSTED OVERBOARD ON THE AFT LOWER RIGHT SIDE OF THE FUSELAGE UNDER THE ENGINE PYLON



TO PREVENT DAMAGE TO THE ENGINE COWL WHEN OPENED DURING GROUND MAINTENANCE THE APU STARTER IS INHIBITED

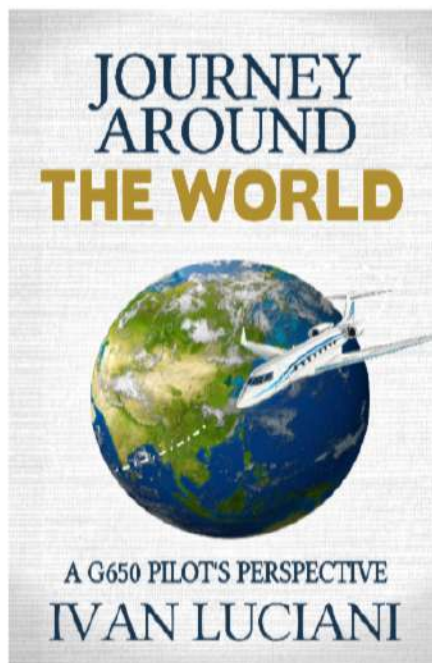
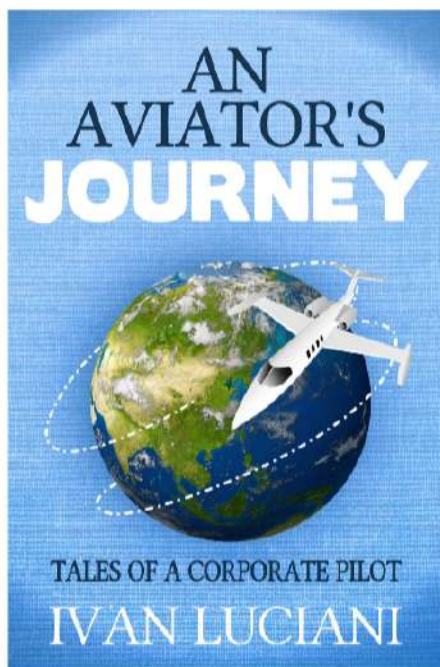


STARTER IS NOT INHIBITED INFLIGHT

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.luciani@gmail.com



Thank you!