Podcast 009 – Electrical 2

Hello everyone and welcome back to what will be part 2 of our journey around the 737NG electrical system. This week we will look at the main AC electrical system covering how the 737 generates its AC power including discussions on the Integrated Drive Generators, the Bus Power Control Unit and Ground power as well as system associated lights and their various meanings.

The AC generating part consists of the Engine Generators, the APU generator, as we discussed previously, and an External power source. We'll quickly run through the External power system and then go through the main IDG's or integrated Drive Generators. As with the last electrical podcast I would recommend that, if possible, you have a system schematic Infront of you while you listen.

The external power receptacle is located near the nose gear wheel well on the first officer's side. There are status lights on the panel which indicate to the ground crew if external power is being used. This panel also contains headset inputs and a pilot call button. When connected and the quality criteria are met the GRD POWER AVAILABLE light will illuminate and when placed to ON by the flight crew the external power can supply both transfer busses.

Part of the ground electrical system that is often confusing to people is the ground service switch. This is on the forward attendants panel and through a ground service relay provides ground power directly to the AC ground service busses for utility outlets, cabin lighting, equipment cooling fans and the battery charger. It basically allows cabin servicing without the need to power up the flight deck. This is more than likely the case when we find the aircraft cold and dark. The ground service relay will open if you place the ground service switch to off disconnecting the ground power from the service busses and will also automatically open should you place the ground power switch in the flight deck to ON thus preventing paralleling of AC power.

Before we move on to the IDG's let's have a look at what the AC power system consists of. Each side has a transfer bus, a main bus, two main galley busses and a ground service bus. Transfer bus 1 also powers the AC standby bus. If the AC power source of either transfer bus fails or is disconnected, that transfer bus can be powered by any available source through the tie bus with the bus tie Breakers or BTB's.

On the ground, without engines running, selecting the GRD PWR switch ON connects external power to both transfer busses. Selecting either APU GEN switch to ON will connect the APU generator to both transfer busses. Whichever source is selected last will power both busses. It is not possible to power one transfer bus with external power and one with APU power.

With engines running the momentary selection of the related Gen switch to ON will power its transfer bus. The APU or ground power will continue to power the other side until that engine generator is too selected. For example, if we have the APU running once we've started the engines and we select first Gen 1 what will physically happen is that the Generator Circuit Breaker 1 will close connecting IDG 1 to Transfer Bus 1 while at the same time BTB 1 will open allowing the APU to continue to power transfer Bus 2 without the paralleling of AC sources.

In-flight each IDG will power its respective transfer bus but if one IDG loses power then the BTB's automatically close to allow the other IDG to supply both transfer busses. The APU can power either or both transfer busses through the BTB's.

The automatic transfer of power under failure conditions is achieved when the BUS TRANS switch is in AUTO. This allows the source powering the opposite transfer Bus to pick up the failed or disconnected sides load. The AUTO position of this switch also allows the DC cross tie relay operation for isolating the DC Buses on glideslope capture. If you were to put this switch to OFF, you would isolate Transfer bus 1 from Transfer Bus 2 if one IDG was supplying them both and also open the DC cross tie relay isolating DC bus 1 from DC bus 2.

Before I hand back to Ian for a discussion on the IDG's a quick tip here about the power outlets in the flight deck. There is a tamper safety device in these outlets which means that if you don't insert the prongs of the plug simultaneously the device will activate, and power won't be received. Also, if you insert the plug before power up you will need to remove it and reinsert to achieve power.

Thanks for that Mark. To the IDG's now which are mounted on the accessory gear box beneath the starter motor. The IDG's contain the generator and drive in a common housing hence they are integrated! They are lubricated and cooled by a self-contained oil system with two heat exchangers, air/oil and fuel/oil.

The IDG's convert variable engine speed to a constant 24,000RPM using a constant speed drive. We have an amber DRIVE light associated with each IDG that will illuminate when low oil pressure is sensed below 165PSI. This low oil pressure could be caused by either IDG failure, engine shutdown, IDG auto disconnect due to high oil temperature of 182 celsius which is 363F OR the IDG is disconnected through the red guarded drive DISCONNECT switch.

This switch is Red guarded as the action is irreversible in-flight and needs to be held in position momentarily when used in order to prevent generator drive damage. You can only use this switch when the associated engine start lever is in IDLE and electric power is available.

Monitoring and Controlling the AC power system is the Bus Power Control Unit or BPCU for our acronym collection. It ensures there is no paralleling of AC sources, controls load shed function, monitors the external power contactor and controls the Generator Control Units, APU Generator control unit and the external power contactor relay.

Each IDG has an associated Generator Control Unit or GCU which controls and protects generator operation. Each GCU controls the onside Generator Control Breaker GCB and the Bus Tie Breaker BTB. The GCU will trip the GCB to protect the electrical system against things such as under or over frequency or voltage and overcurrent. The GCU controls the excitation of the IDG and is the source of the amber lights SOURCE OFF and TRANSFER BUS OFF.

You may or may not remember from previous sims, or even if you've been unlucky an inflight occurrence, that you can end up with multiple lights when it comes to an electric system malfunction. A tip again is that priority should be given to that last one Ian mentioned being

the TRANSFER BUS OFF light. Also remember that you must go through all NNC's for each amber light on the flight deck to have the aircraft correctly configured for the given malfunctions. I admit there may be times when this is not be possible due to the priority being getting on the ground, but this is the general ethos for 737 malfunction handling.

We haven't stated this but the obvious is true here in that if you get the TRANSFER BUS OFF light it means that the related Transfer Bus is not powered. Say what you see in this case!

Ian also mentioned the GCU giving us the SOURCE OFF light. The reason behind this one isn't quite so straightforward, and people often muddle themselves up over it. So here is what I hope to be a straightforward explanation.

SOURCE OFF means that no source has been manually selected to power the related transfer bus, or the manually selected source has disconnected. Remember this doesn't mean it's unpowered as if the other Transfer bus has power automatic switching will occur. This can be quite the trainer favourite as no doubt he or she has failed the side which is operating your autopilot and then when you start the APU and select its generator ON you'll kick out said autopilot and he or she will feel smug and have something to write down as you scramble to reconnect it again!

Let's wrap up here on electrics with a very quick look at the AC and DC Metering panel. It is little used other than the battery switch but has some useful information for us should we so wish. We discussed it a little last time so let's look at the AC side. You can read AC voltage and frequency for standby power, ground power APU and engine generators and also the static inverter. You'll only get frequency though when the generator is electrically excited. Current readings are also available for the two IDGs and APU generators from the ammeter. The TEST position is used by maintenance for fault finding using a power system test module.

And that is that. I hope you found these electrical podcasts useful to brush up on the system knowledge and maybe even cleared this murky subject up a little. We'll get back to a more operational style podcast next time we promise. Until then head over to our social media pages to continue the talk.