Podcast 20 – Ryan Air flight 9503

Hello everyone and welcome to this week's talk. Having thrown a couple of fairly heavy technical podcasts at you over the last few weeks we thought we do something a bit different here this time. Today we will look at an event that was categorised as a serious incident involving a Ryanair 737-800 out in Sodermanland county at Skavsta Airport. It was investigated by the Swedish Accident Investigation Authority and we'll put a link to the full report on social media and attached to the podcast.

Thanks Ian for taking care of the pronunciation and I will try and avoid those names from here on. The description of the incident in the report is largely based on the interviews with the pilots. As you would expect, there are some differences between the descriptions.

Both crew members were very experienced on type with almost identical total flying hours and time on type. Both the captain and FO had over 6000 hours on the 737 with plenty of recent experience.

The flight, on the 25th April 2011, was a regular line flight between Stockholm Skavsta and Paris Beauvais with 173 passengers and 6 crew on board with the callsign RYR 9503.

At around 110kts on the takeoff roll a warning light illuminated. PM extinguished the light and the commander, who was PF, completed the takeoff. At 400ft the pilots began their diagnosis and discovered the light from the right-side Source Off and Master Caution had illuminated.

As a refresher from our electrics podcast the source off light indicates that the power source that was connected, in this case the right IDG to the main transfer bus 2, has been disconnected. It doesn't mean the Transfer bus is not powered as the Bus Power Control Unit, or BPCU, should close the Bus Tie Breakers to allow IDG 1 to power both Transfer Busses automatically. This then keeps to the 737 electrical rules of no paralleling of AC power sources.

The pilots concluded here that no memory items were necessary and followed company procedures to delay the NNC until passing 1000ft and the normal after takeoff checklist was complete.

Here PF then asked for the associated NNC for Source Off. The QRH guides the crew to try to switch the generator switch on the affected side to ON, in the case where only one source off light is illuminated.

Unfortunately, this action caused a fault that illuminated the Transfer Bus off light indicating Transfer Bus 2 was now not receiving power from any of the generators. Here, unknown to the pilots the Generator Control Unit 2 had received an erratic signal that IDG 2 was connected to the transfer bus 2 when indeed, it wasn't. This signal is then passed to the BPCU which would now not even dream of closing the Bus Tie Breakers as it would believe that would cause paralleling of AC power sources.

The difference in opinion of the pilots is to when the following indications occurred.

“A number of warning lights illuminated, all displays on the first officers side went out and the autopilot disengaged. Altitude reporting on the transponder disappeared, which meant ATC could no longer see the aircraft’s altitude.”

Those indications either occurred when the pilots tried to switch the Gen 2 back on, or, when on the continuation of the QRH, the APU was started.

Either way when the crew tried to connect the APU generator to Transfer bus 2 the erratic signal Mark previously mentioned stopped this connection taking place.

One of the warning lights that illuminated was the Battery discharge light. We’d normally interpret this as the battery supplying power to the system instead of being charged. According to the pilot’s description, this light illuminated for between a few and 25 minutes.

What was actually happening here is that the main battery charger is powered from transfer bus 2 so is inop in this situation. The battery would be powering the hot battery bus and the switched hot battery bus in this situation so would show a discharge. If this situation continued for long enough, and we’re talking up to 2 hours you could see a loss of power to those battery busses.

According to the pilots the following systems went off-line. Autopilot A + B as a result of automatic pitch trim ceasing to function, Electrical trim, PFD and ND on the first officers side, both transponder 1 and 2 altitude reporting, nose wheel pedal steering and the indicator for trailing edge flap.

The same report also lists the illuminated lights which we’ll mention just to give you an idea of the picture the crew were looking at. Battery discharge, Master Caution, RH Source off, RH Transfer bus off, Mach trim fail, Auto slat fail, Fuel pump 2 fwd, Fuel pump 1 aft, A elec pump 2 Hyd, Probe heat B (4 lights), Both engine EEC Altn and 3 Zone temp lights.

As an aside the standby EMDP is also powered by transfer bus 2 so would not have been available either as well as no engine vibration monitoring.

The pilots also read the NNC for transfer bus off but as the actions were the same as for source off they chose to take no further measures and return to Skavsta.

After the autopilot had disengaged and was unable to be reinstated the commander flew manually. Radar vectoring back was requested with that request repeated after ATC initially cleared the crew for the NDB arrival. The pilots had to explain they had problems with the on-board instruments.

Latterly, during the approach the pilots added a Pan call to indicate their request for priority but implicating it was not an immediate emergency situation.

After vectors for the ILS 26 the first approach was aborted as the pilots were still carrying on discussions with the maintenance organisation used by Ryan air at the airport. The commander also wanted the FO to visually inspect the trailing edge flap position as the indicator in this failure is inoperative.

As a bit of background here the trailing edge flaps remain available with asymmetry protection and flaps manoeuvring indications on the speed tape remain valid. The bottom of the upper red bar is equal to the placard speed of the actual flap setting so can be used as a trailing edge flap indicator in a way.

Another radar vectored ILS to runway 26 was flown and the landing executed with no problems. After landing the pilots pulled the circuit breaker to the CVR in accordance with the operators' procedures and the entire crew was relieved of duty for the rest of the day.

Aircraft technicians commenced fault isolation immediately after the airplane landed and parked and ground power had been connected. At this point the fault has ceased and it was not possible to recreate it. GCU 2 presented the fault "BTB fault" and as a safety measure BTB2 and GCU2 were replaced with new units.

Six days before this incident the Source off light for AC system 2 had illuminated with GCU2 presenting that same "BTB fault". Also on that occasion BTB 2 was replaced.

Several similar incidents had occurred before this flight in which the source off for AC system 2 had illuminated and one of the power sources could not be connected to transfer bus 2. In several of the cases the fault disappeared once the control units, BCPU and GCU2, and other components, including cabling and breakers, had been inspected or replaced and a BITE test carried out. On one of the occasions an emergency landing was necessary.

After several extensive fault isolation tests Ryanair technicians could finally trace the primary cause of the fault to a short circuit between the phases in the feeder cabling from IDG2. The reason for the Transfer buses not being interconnected during the present incident was never found.

The SHK investigation looked into the number of aircraft delivered with the same electrical system, 3,622 in April 2011. Incidents of the same type became apparent both before and after the incident we are discussing.

There were attempts to verify their result analysis of system logic through tests in the 737-800 simulator. However, it wasn't possible to introduce these faults as the simulators were quite simply not built with a view to these faults being able to arise.

The suspicion that an erroneous status signal was the cause became stronger after the SHK received information on an incident in which the cause of the transfer buses not being interconnected was shown to be a loose connection in the auxiliary contact in the GCB.

The findings of the report included among others that the logic of the GCU and BCPU makes it possible for an erroneous status signal from the GCB to place Transfer bus 2 in an

unpowered state and that the prescribed procedure in the QRH for reconnecting the IDG differs from the prescribed procedure for aircraft with similar electrical systems and from the understanding of the procedure by pilots on the type.

This latter point refers to procedures on the Boeing 777 which is a similarly designed electrical system. Here you put the generator switch on the effected side to OFF before putting it to the ON position. This is on order to force the GCB to open and then after to attempt to reconnect.

We've mentioned it a couple of times but just to reenforce the cause. The incident was caused by the system logic for the Generator Control Unit and the Bus Power Control Unit enabling erroneous status signals from the Generator Control Breaker to lead to a transfer bus losing power.

The recommendations of the report were to ensure that Boeing introduces measures so that logic in the electrical system prevents a transfer bus losing power as a result of an erroneous status signal from the GCB and to ensure Boeing investigates whether a revision of the procedure in the QRH for reconnecting the IDG can rectify these erroneous status signals.

Out of interest Mark and I have recreated as best we can in the simulator this failure by failing Gen 2, and also simultaneously a "bus transfer switch mechanical failure" to stop the opposite generator taking over. If you head over to B737training.org we have a presentation before hand followed by the simulator video. We also have numerous other simulator videos and virtual briefs available there so please head over there too if you want to continue the 737 experience with us.

That one gives real food for thought over potential unforeseen failures and the need for us as pilots to have the necessary competencies to deal with them effectively. It would certainly be one where the lessons of the startle and surprise podcast would come in handy.

So, that's it for this week and thanks for joining us again and we'll look forward to seeing you in a couple of weeks to share more 737 information with you. Please do join us over on social media and sign up for our newsletter over on www.B737Talk.com for more information on what we're up to.