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Swiss Transportation Safety Investigation Board STSB

Summary Report

A summary investigation, in accordance with Art. 45 of the Ordinance on the Safety Investigation of Transport Incidents from 17th December 2014 (OSITI), as of 1st February 2015 (SR *742.161*) was carried out with regards to the serious incident. This report was prepared to ensure that lessons can be learned from the incident in question.

The definitive version of this report is the original report in German and therefore binding.

Aircraft	AVRO 146-RJ100			HB-IYU
Operator	Swiss Global Air Lines AG, Malzgasse 15, 4052 Basel			
Owner	Triangle Regional Aircraft Leasing Limited, St Albans Rd W, Hatfield, AL10 9NE, United Kingdom			
Pilot	Swiss citizen, born 1974			
Licence	European Aviation Safety Agency (EASA) airline transport pilot licence aeroplane (ATPL (A)), issued by the Federal Office of Civil Aviation (FOCA)			
Flying hours	**Total**	9525 h	**During the last 90 days**	132 h
	On the incident type	5878 h	**During the last 90 days**	132 h
Co-pilot	German citizen, born 1992			
Licence	EASA commercial pilot licence aeroplane (CPL(A)), issued by FOCA			
Flying hours	**Total**	796:40 h	**During the last 90 days**	136:55 h
	On the incident type	475:15 h	**During the last 90 days**	136:55 h
Location	Approx. 8 NM west of waypoint DOPIL			
Coordinates	---		**Altitude**	Flight level (FL) 140
Date and time	3rd September 2016, 14:17 UTC (LT[1] = UTC[2] + 2 h)			
Type of operation	Scheduled flight			
Flight rules	Instrument flight rules (IFR)			
Point of departure	Geneva (LSGG)			
Destination	Zurich (LSZH)			
Flight phase	Cruise flight			
Type of serious incident	Fume smell in the cockpit, use of oxygen masks			

Injuries to persons	**Crew**	**Passengers**	**Third parties**
Minor	0	0	0
None	4	88	-

Damage to aircraft	Not damaged	-
Third-party damage	None	

[1] LT: Local Time

[2] UTC: Universal Time Coordinated

Swiss Transportation Safety Investigation Board STSB
3003 Bern
Tel. +41 58 466 33 00, Fax +41 58 466 33 01
info@sust.admin.ch
www.sust.admin.ch

Factual information

Course of events

The AVRO 146-RJ100 aircraft, registered as HB-IYU, took off from Geneva with the radio call sign SWR48TP at 13:58 UTC on 3rd September 2016 for the scheduled flight LX 2813 to Zurich. There were 2 pilots, 2 cabin crew members and 88 passengers on board. The pilot was the pilot monitoring (PM) and the co-pilot was the pilot flying (PF).

Whilst on the ground, bleed air from the auxiliary power unit (APU) had been activated to cool down the cabin air.

After take-off, at 1,500 ft above ground level (AGL), the engines were set to climb power and clean up was initiated. As per the relevant checklist, engine bleed air was now activated for the air conditioning system and the APU was switched off. Shortly afterwards, the crew noticed a fume smell. They therefore wanted to return to the initial configuration using APU bleed air. As the APU had already been switched off, it was restarted; this start-up was unsuccessful and the APU only started at the second attempt. In the meantime, the crew had switched off the engine bleed air as they wanted to prevent further air contamination. Shortly after switching off the engine bleed air, the co-pilot already noticed a slight improvement in the air quality. This view was not shared by the pilot.

After the successful start-up of the APU, the APU bleed air was reactivated and the flight crew immediately judged the air quality to be significantly better. Subsequently, at 14:06:00 UTC, the pilot requested the senior cabin crew member – the 'maître de cabine' (MC) – to come to the cockpit. The MC reported that the cabin air was fine and that he could not smell anything abnormal in the cockpit.

At 14:06:46 UTC, the flight crew requested a cruise altitude at flight level (FL) 140 from air traffic control, as – because of the APU use – procedural rules meant they were limited to a maximum of FL 140.

At 14:08:47 UTC, the co-pilot asked the pilot if he could once again smell something. The pilot responded in the negative. The flight crew discussed the situation and decided to call the MC back to the cockpit once more, as they might not smell anything anymore, because they could have become used to the contaminated air.

At 14:13:47, the MC was called to the cockpit and stated that he could not necessarily smell anything. However, upon further questioning, he confirmed that he could now detect a perfume-like odour.

According to their statements, both pilots subsequently felt a certain pressure in their heads and had dry throats. After that, they decided to put on their oxygen masks for safety reasons and did so at 14:17:16 UTC. Furthermore, they decided to request priority for the approach to and landing in Zurich.

As a precaution, the second cabin crew member was also called to the cockpit a little later on who confirmed the abnormal smell but was unable to attribute it to a specific source.

In the meantime, the flight crew had switched to the Zurich Arrival (West) frequency (ZAW). After registering on the frequency at 14:17:55 UTC, the crew received the following instructions from the air traffic controller (ATC), *"Swiss four eight Tango Papa, Arrival, 'guete Namittag', Information Kilo current, continue on present heading, vector ILS one four."* The flight crew responded as follows at 14:18:02 UTC, *"Present heading, runway one four, Swiss four eight Tango Papa, and uh we do have a situation, we have a suspicious uh smell in the flight deck area, we're using oxygen masks, request priority."* After a repeated question for reasons of comprehension, the ATC responded at 14:18:36 UTC as follows, "*Swiss four eight Tango Papa roger that, you can expect no delay, descend to flight level one one zero."*

Thirty seconds later, the pilot notified the MC and the MC confirmed once more that the cabin air seemed fine.

The flight crew subsequently received various heading and flight level clearances and was guided to the approach using radar vectoring. To make the flight crew's job even easier, the ATC informed them of the following at 14:22:28 UTC, "*And Swiss four eight Papa Tango, to get you on an isolated frequency contact now one two five decimal three two five."*

On this frequency, the flight crew was guided to the approach using radar vectoring and was also informed that the fire service was standing by. At 14:25:33 UTC, the flight crew received clearance to land on runway 14 and the landing took place at 14:28:50 UTC.

After landing, the two pilots opened the cockpit windows and following a brief assessment of the situation, they decided to taxi directly to the stand and to let the passengers disembark in the normal way.

After the passengers had left the aircraft, fire service experts boarded. Using their thermal-imaging camera and detecting devices they were unable to detect anything abnormal.

Medical findings

As stated earlier in the report, the pilots had noted a fume smell shortly after take-off which was clearly not normal. In order to improve the air supply, several changes were made to it and approx. 2-3 minutes passed during which contaminated air was inhaled. It is not clear if the changes definitely improved the air quality. However, to begin with, the pilots felt that they experienced an improved situation. But after another 6 minutes or so, the first symptoms appeared. The pilot felt an unpleasant pressure in his head. The co-pilot experienced a headache and sore throat. Therefore, the decision to put on their masks with 100% oxygen was safety-conscious. This made the situation tolerable and the flight crew was able to complete the flight without experiencing any additional symptoms.

After the flight, the two pilots went to the Airport Medical Centre (AMC) for a medical check-up. The main reason for this was that the co-pilot was experiencing a severe headache and an extremely sore throat.

Both pilots were examined at the AMC. These examinations did not produce any causal findings that could definitively have pointed towards an exogenous intoxication as described by the pilots.

Over the course of the following days, both pilots reported to their Aviation Medical Examiners (AME). The pilot was signed off as healthy within a short period of time and was certified as fit to fly on 4th September 2016. The co-pilot had a somewhat longer recovery period and did not return to flying activities until 14th September 2016.

The pilots mentioned that they considered the medical care following the serious incident to have been suboptimal.

Technical findings

Maintenance documentation shows that the aircraft registered as HB-IYU had previous history with regards to smell.

During flight LX 1613 from Milan Malpensa to Zurich on 11th July 2016, the flight crew already complained about an odour reminiscent of dirty socks. The air conditioning packs and the APU were examined and no abnormalities were found.

During flight LX 2813 from Geneva to Zurich on 26th August 2016, the flight crew reported a strong fume smell after they had switched the supply for the air conditioning packs from APU bleed air to engine bleed air. The following work was subsequently carried out:

- the torque values of the air cycle machines were checked;
- the APU was checked for faults;
- all four engines were examined for potential leaks;
- all four engines underwent a test run;
- as a preventative measure, the cockpit and cabin air filters were replaced.

In this case, too, the maintenance company could not determine the source of the fume smell that had been detected.

As in both instances the maintenance company did not produce any findings and the flight crew neither put on their oxygen masks nor sent an urgency message to air traffic control, the STSB had no reason to investigate these two cases.

After the serious incident on 3rd September 2016, additional experts from the MCC[3] trouble-shooting department and from the power plant and system engineering division were consulted for the investigation. As a result, the measures taken included inspections of all four engines and the APU using a borescope to find a potential oil leak. No such leak was found.

The extensive checks showed smaller discrepancies that could possibly have led to a fume smell. Most notable, however, was a leak in engine 1's IDG[4] oil system. The IDG oil system works independently of the engine oil system and its components are arranged around the engine compressor. The temperature control valve is situated exactly in the twelve-o'clock position directly above the engine compressor. It was found that the oil pipe connections for this temperature control valve had not been tightened using sufficient torque. Oil was therefore able to drip onto the engine compressor and get through the bleed band openings into the engine compressor, therefore also reaching the engine bleed air and the air conditioning circuit (see Figure 1).

Another possible contributory factor was recorded: instead of flowing overboard, the contaminated air was able to get into the air conditioning circuit because the APU breather and the engine oil cooler ventilation pipes had not been correctly aligned.

On completion of all of these checks, a test flight was carried out during which all possible air and air conditioning configurations were tested. All of these tests showed no abnormalities.

[3] MCC: Maintenance Control Centre

[4] IDG: integrated drive generator; an engine-driven generator

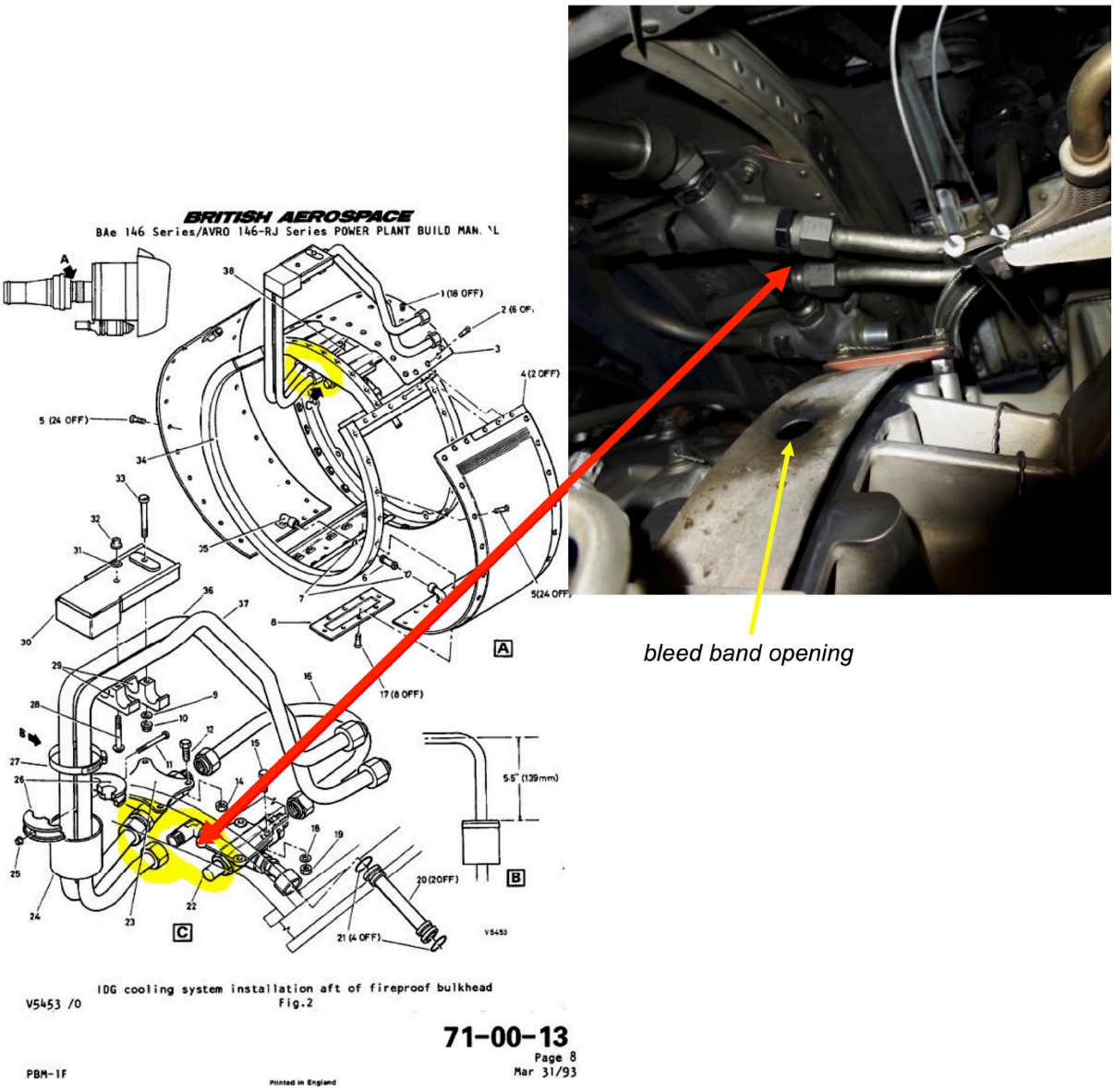

Figure 1: Oil leak in the connection (red arrow) for the IDG oil cooler's temperature control valve

Analysis and conclusions

After take-off, a fume smell became noticeable when the air supply was switched to engine bleed air. The flight crew immediately turned off the engine bleed air and, after the APU had been restarted, again supplied the air conditioning packs with its bleed air. These actions were appropriate for the situation and both logical and justified, as the APU bleed air had conditioned the cabin's air on the ground without any problems. It was not foreseeable that the fume smell would return after a certain period of time.

When the fume smell again became noticeable and also had physical effects on the flight crew, they immediately put on their oxygen masks. This behaviour was safety-conscious. Involving the cabin crew in the assessment of the situation and repeatedly enquiring about the air quality in the cabin was prudent.

However, the serious incident has once again demonstrated that it is virtually impossible to either identify the source of the contaminated air or to predict its further development. Therefore, flight crews would be well-advised to classify any occurrence of contaminated air that requires oxygen masks to be put on as an emergency and to act accordingly.

Measures taken by the aviation company

On 20th September 2016, the aviation company published a 'Smoke/Fumes/Smell Kit' which was distributed to all cockpit and cabin crew members in electronic form. With this, it also met a long-standing demand made by cabin crew and cockpit associations, who subsequently contributed to this kit.

In the introduction, the aviation company writes amongst other things, "*We have all become increasingly sensitized to the risks and dangers associated with smoke, fumes and smells in the cabin and the cockpit through various incidents that have occurred and studies that have been conducted over the past few years."*

The aviation company states its intention and the kit's contents as follows, *"[...] is intended to guide you through what to do in a concrete case of smoke, fumes or smell, and to provide you with all the necessary documentation. The Kit consists of:*

- *a checklist to lead you point by point through the procedure to be applied*
- *a Smoke & Fumes Event Report form*
- *our Medical Guidelines and Report form, which should help you ensure that you are subjected to all the tests required if your symptoms need to be examined following such an event."*

A flowchart is intended to help crews carry out a certain degree of self-assessment in incidents involving smoke/fumes/smells. To this end, symptoms such as headaches, impairment of consciousness, dizziness, impaired vision, nausea, vomiting, tingling, hand trembling, numbness, irritated eyes/nose/throat, breathing difficulties and coughing are listed. Another resource for crews is a corresponding medical sheet which needs to be completed if a visit to a doctor is deemed to be necessary. It is also emphasised that this medical sheet is to be handed in to the examining doctor. It also stated that the doctor's examination should include the following:

- *"a clinical history*
- *a physical examination*
- *laboratory tests: hemogram, creatinine, GGT, AST (GOT), ALT (GPT), blood glucose, urinalysis and oximetry*
- *in severe cases: plasma cholinesterase, methemoglobin, CO hemoglobin."*

The final component of the kit is an information letter for the attention of the attending doctor. Among other things, this states that,

"As part of the examination, the crew member will give you a 'Medical Sheet Fume Event' with information about potential medical conditions. Whilst respecting your diagnostic and therapeutic freedom, we would like to request that you clinically examine the crew member in addition to taking the medical history and to run several blood and urine tests as stated on the form."

In view of these results, the Swiss Transportation Safety Investigation Board concludes that no further findings are to be expected with regard to the serious incident being investigated here that would be useful for the prevention of such an incident. Therefore, based on Art. 45 OSITI, the STSB refrains from further investigative activities and closes the investigation with the present summary report.

Bern, 8 February 2023 Swiss Transportation Investigation Safety Board