FINAL REPORT

on
investigation of an aviation occurrence with An-26 aircraft, registered LZ-MNH, operated by Air Scorpio Ltd air operator, occurred on 07.11.2005 during a flight from Sofia to Budapest

2005

The materials on the aviation occurrence have been classified under state file number 8/07.11.2005.

Air operator (AO) is Air Scorpio Sole Owner Ltd. with main office in Sofia, 19A Lyubotran Str.

Aircraft manufacturer: Antonov Design Bureau in Ukraine.
Aircraft national and registration marks: LZ-MNH, in accordance with Certificate for Registration No 1972, issued on 08.04.2005 by Civil Aviation Administration (CAA) of the Ministry of Transport.
Place and date of the aviation occurrence: flight SCU 551, phase of climb.
Notified: Aircraft Accident Investigation Unit, CAA, International Civil Aviation Organization (ICAO).

For investigation of the aviation occurrence a Commission was appointed by the Order RD-08-502/17.11.2005 of the Minister of Transport.

Type of flight: cargo flight No SCU 551.

An-26 aircraft, reg. No LZ-MNH took-off for transportation of goods on Sofia – Budapest destination at 16:45 UTC on 07.11.2005. At an altitude of 400 m when engaging the air conditioning system in the cockpit appeared a smell of oil and smoke. At an altitude of 8000ft "Emergency Remaining Oil" light came on. By commander's instruction the first officer disengaged the air conditioning system and depressurized the cockpit. The reading of oil quantity of the left engine was 20 liters in a process of fast decreasing. The commander ordered for feathering of the engine No1 (left-hand). The execution of the turn was stopped and the crew was vectored by the ATC for ILS approach and landed at Sofia Airport with one engine operative.

The landing was uneventful for the crew, aircraft and the cargo.

In accordance with Para.3 of Additional Provisions of Regulation No 13 of MT of 27.01.1999 for aircraft accident investigation and taking into account, that:

- this was a second occurrence of the kind with this air operator in five (5) months;
- the flight was aborted and the aircraft performed landing approach with one engine operative and with a dangerous goods on board,

Aircraft Accident Investigation Unit, in order to assure safe level of flights, classified the occurrence as a serious incident.

1. Factual Information

1.1 History of the Flight

The flight assignment was given by the airline operator to a crew consisting of: commander, first officer, navigator and flight engineer.

1.1.1 Flight Number: SCU 551/SOF – BUD.

1.1.2 Flight Preparation and Description

Preflight briefing for the flight from Sofia to Budapest was done. The slot for flight Sofia – Budapest was set for 16:45 UTC (18:45 local time). The crew arrived at Sofa Airport at 14:30 UTC (16:30 local time). The first officer was appointed as a flying pilot for the Sofia – Budapest segment. After the preflight briefing the crew performed preflight check of the aircraft without any remarks. The first officer performed cabin systems preflight check without remarks. The loading of 436 kg cargo for transportation was done under first officer supervision. The commander determined take-off parameters and after a clearance from Sofia Tower started engines, taxied for RWY 09 and after reporting ready for take-off and clearance from ATC took-off from Sofia Airport at 16:45 UTC on 07.11.2005. During the take-off, after standard procedures execution and landing gear retraction at an altitude of 400 m the first officer engaged the air conditioning system. He set both engines air bleeding at 2 units and controlled by the cabin pressure indicator the pressurization process. A slight smoke and oil smell appeared in the aircraft cockpit. The temperature gauge in the conditioner line read 40 degrees, what was within normal limits. The air bleeding was increased to 2.5 units, but the smoke and smell persisted. Under commander's instruction the first officer disengaged the air bleeding and depressurized the cockpit by circuit breaker "Emergency Pressure Drop". At an altitude of 8000ft "Emergency Remaining Oil" light of the left-hand engine came on. The commander ordered to feather the left-hand engine and after confirmation the flight engineer feathered the left-hand engine. The commander decided to abort the flight, returning and landing at Sofia Airport. Sofia Approach was informed for left-engine feathering and for landing with one engine operative. The commander decided to land on RWY 27. The aircraft was vectored for ILS approach on RWY 27. The landing was uneventful for the aircraft, crew and cargo.

After landing the aircraft was stopped at the apron. At arrival of AAIU representative and Sofia Airport on-duty security officer was established, that the covers of the left-hand engine nacelle were opened, the propeller spinner was removed and the on-duty engineer was refilling the left-hand engine oil container with oil. The technical group activities were stopped by an order of AAIU representative and the hatches of the engine and aircraft doors were sealed by the on-duty security officer.

1.1.3 Location of the Occurrence

The serious incident emerged at 16:50 UTC on 07.11.2005 at nighttime, in flight, during the climb at an altitude of 8000ft.

1.2 Injures to Persons

No injures to the crew.

1.3 Damage to Aircraft

No damages to the aircraft.

1.4 Other Damages

No other damages.

1.5 Personnel Information

1.5.1 Commander – male, aged 35, with valid ATPL license and medical certificate.

1.5.2 First Officer – male, aged 30, with valid CPL License and medical certificate.

1.5.3 Navigator - mail, aged 28, with valid FNL License and medical certificate.

1.5.4 Flight Engineer – male, aged 52, with valid license and medical certificate.

1.6. Aircraft information

1.6.1. Airworthiness information

An-26 aircraft manufacturer serial number 6407 registered LZ-MNH, manufactured on 27.04.1978 by Ministry of Aircraft Industry – USSR, Certificate of Airworthiness No 1972, issued on 08.04.2005, reissued on 28.10.2005 and valid till 27.09.2006 and Aircraft Registration Certificate was issued under No 1972 on 08.04.2005.The aircraft is owned by AO Scorpion Air EOOD and was wet leased by Air Scorpio EOOD.

Under a decision of ANTK Antonov from 12.10.2005 for the aircraft was determined:
- design life of 31000 flying hours, 16800 cycles and calendar time of 28 years and 5 months;
- time between overhaul 9800 flying hours, 5400 cycles and calendar time of 14 years 4 months (till 10.10.2006).

The last overhaul of the aircraft was attested on 10.06.1992 at No 410 factory of Civil Aviation of Russia.

As to 30.10.2005 the following flying time was recorded in the aircraft technical logbook:
- 29320:46 hrs total flying hours since new and 8362:09 hrs since the last overhaul;
- 14659 cycles since new and 4601 cycles since the last overhaul.

At the moment of the aviation occurrence the aircraft had the necessary total operating life and overhaul life.

Two main engines AI-24 VT were installed on the aircraft and an auxiliary power unit RU19A-300.

The failed left-hand engine AI-24 VT, manufacturer serial number N464VT031 was manufactured on 02.11.1976 and the last overhaul was attested on 31.01.1989. The design life of the engine is 9000 hrs. The time between overhaul of the engine was extended by a technical deed of GP ZMKB Progress named after A.G. Ivchenko on 12.02.2005 as follows: till 2500 flying hours and calendar time till 09.02.2006. As on 31.10.2005 the engine had 3144:19hrs since new and 2216:10 since the last overhaul and it had enough operating time for execution of flights before and at the moment of the aviation occurrence.

The aircraft has been operated according the Maintenance Program approved by CAA.

The regular form of scheduled maintenance F-28 was attested on 27.10.2005. On the same date was attested airframe lifetime extension, auxiliary power unit lifetime extension, replacement of No2 (right-hand) engine and tasks for autumn and winter operation.

On the 07.11.2005 line maintenance check Form A2 was performed, what was recorded in the technical logbook No 0000002297. The end of the works was recorded at 16:00 local time. The same date was written in the technical logbook No 0000002296. In the Remarks column it was written:

"1. Unsuccessful left-hand engine start".

In the Actions column it was written:
"Adjustment of the fuel pressure at BNK-10I according TK No 31 25, Part 1."
In the "Released to service by" column there was no date, time and signature.

In the technical logbook No 0000002288 from 02.11.2005 in the Remarks column there was a following record: "1. Left-hand engine doesn't start or starts with a delay", in the Actions column it was written "Sparking plugs on the left-hand engine replaced with new ones – I category".

The abovementioned shows a presence of a problem in left-hand engine operation.

1.6.2. Airplane performance
An-26 aircraft with manufacturer serial number No 6407 has a maximum take-off weight of 24000 kg. The take-off weight (TOW) of the aircraft for the flight No SCU 551 was 20986 kg.

Operating ceiling with one engine operative AI-24 VT at take-off regime (RU19A-300 not operative) in standard conditions:

- with TOW 24000 kg = 1450m;
- with TOW 22000 kg = 2450m;
- with TOW 21000 kg = 2850 m.

The landing approach and landing with a feathered propeller of an inoperative engine on An-26 should be performed with operative engine RU19A-300 and steady necessary regime of the operative engine. The speeds of descend on glide slope with 15 degrees flaps depend on aircraft weight, respectively for 24000kg indicated airspeed is V=270 km/h, for 23000 kg V=265 km/h, for 22000kg V= 260 km/h, for 21000kg V=259 km/h.

1.6.3. Fuel
The aircraft was refueled with 4800kg of fuel JET A1. The on-board fuel was enough for the flight execution.

1.7. Meteorological information
CAVOK, visibility more than 10 km, wind 4 m/s from Southwest, temperature 10°C, atmospheric pressure QNH 1027.

1.8. Aids to navigation
Standard aids for An-26 aircraft.

1.9. Communications
Standard communication equipment for An-26 aircraft.

1.10. Airport
The aviation occurrence occurred in-flight at an altitude of 8000ft.
The aircraft took-off and landed at Sofia Airport.
The reference point of Sofia Airport is with coordinates 42^0 41,7 N, 023^0 24,5 E.

Airport elevation is 531 m.
The airport is equipped with ILS Instrumental Landing System, Cat. II.

1.11. Flight data recorders
A read-out of MSRP-12 aircraft data recorder was performed. The next is a reference about the read-out made and the graphics from the read-out are given in Enclosure 1.

The record started after engine start at a magnetic heading (MH)=217°. After about 2 minutes the taxi started. During the taxi a check of the controls was made at MH=290°. After line-up at MH=92° for take-off from RWY 09 the engines were successively set according the throttle at 18-20° and the propellers were set at propeller pitch lock, at 35 - 40°, at 60 - 62°, where the oil pressure P_{IKM} for left- and right-hand engines increased up to more than 25 kg/cm^2 and the engines were set to take-off mode with oil pressure P_{left} = 89kg/cm^2, P_{right} = 83 kg/cm^2.

The aircraft took-off at V=196 km/h. At height H=200m and V=255 km/h a command for flaps retraction was registered.

At an altitude H=450m the engines were set to Throttle Left Engine = 74° and Throttle Right Engine = 78° according UPRT (fuel regulator position), and the oil pressure P_{left} = 79kg/cm^2, P_{right} = 76 kg/cm^2 , the aircraft continued to climb, at $H_{barometric}$=1330m the autopilot was engaged for bank and pitch stabilization in MH=305°.

At $H_{barometric}$=2640m a command “Feathering Pump activation” was registered at the following parameters: oil pressure P_{left} = 72kg/cm^2, P_{right} = 74 kg/cm^2 for 9 seconds. The readings of the left-hand engine increased to 108kg/cm^2 and dropt to 0 kg/cm^2. A little bit before the pressure increase the discrete parameter “outer radiocommunication” was registered. On the basis of the the recorded parameters it could be concluded that the engine was feathered by KFL-37. After the engine shut-off the heading was changed and a descent for returning to Sofia Airport was started.

After engine shut-off a negative thrust was registered for the left-hand engine. The left-engine throttle was at 55° for about 3 minutes and after that it was put to 0.

At an altitude of H=520 m a flap extension was registered and taking landing heading for RWY27 at Sofia Airport. An indication for landing gear extension was registered at H=350m after what discrete parameter for outer communication was registered.
At H=120 m discrete parameter for flaps extension was registered.
The aircraft landed with N_y= 1.33g, V_i=199 km/h on RWY 27 SOF.
After landing a discrete parameter for removing propeller pitch lock and discrete parameter for negative thrust of the right-hand engine were registered.

Notes: 1. Rudder situation gauge was not installed according the TU (technical conditions) – the neutral position was moved.
2. The oil pressure at take-off regime was not according the technical requirements (92 +2/-1 kg/cm$_2$).

1.12. Wreckage and impact information
The aviation occurrence emerged in flight and as a result brought to a landing with single engine operative. The landing was without any complications and consequences for the crew and aircraft.

1.13. Medical and pathological information
It was not necessary to perform medical and pathological researches.

1.14. Fire
No fire appeared.

1.15. Survival aspects
No emergency equipment was used for aircraft evacuation.

1.16. Tests and research
For the purpose of the technical investigation the following tests and research have been conducted:

- Visual inspection of aircraft condition and the left-hand engine;
- Engine test at ground idle regime and at working regimes;
- Aircraft documentation about the flight;
- Aircraft continuing airworthiness documentation;
- Engine continuing airworthiness documentation;
- An interview with the crew was carried out and written explanations were taken;
- Read-out and analysis of the flight data records;
- A listening of the air-ground communications was performed;
- A logical and probabilistic analysis of the possible reasons for the air occurrence was performed.

2. Analysis
Because the flight abortion was a result from the left engine shut-off, for the clarifying of the occurrence the commission has tried to establish the causes for this shut-off. From the crew explanations it was cleared up, that the cause for engine feathering was oil quantity decreasing under the minimal allowable value. Before this to be ascertained, the crew has sensed a smell of oil and small smoke in the cockpit. During the inspection on the ground it was established an oiling from the engine at the area of the propeller hub in the intake area and on the outer surfaces in the compressor area, including on the surfaces of the installed in this area components and pipelines. See Fig.1 and Fig.2 of Enclosure 1. Obviously such an oiling may be caused by oil leakage. During the inspection no pipelines intactness was established nor a leak from the pipelines. The most probable cause for oil leak should be searched in the propeller hub gaskets, reducer fore bearing gaskets, fore mount gasket of the compressor rotor. The reason for decreasing of the oil in the oil container might be not oil leaking outside the engine, but also accumulation of excessive oil quantity in the inner engine cavities (housing) because of failure of the normal work of return oil manifold or some malfunctions, emerged in the engine feathering system. In order to assess the engine technical condition the following program was proposed to the air operator and approved by the commission:

1. Familiarization with the crew activities after malfunction occurrence;
2. Sampling oil for examination.
3. Visual inspection of the engine (oil system), the aircraft and propeller rotation by hand.
4. Washing and cleaning of the engine and engine nacelle.
5. Uninstall and inspection of oil filter, magnetic plug of the engine front casing and oil filter of RO.
6. Propeller group inspection.
7. Check the accuracy of reading of the system for oil quantity measuring.

8. Removal of the TCC-23 and the oil filter of the middle and aft mount.
9. Engine un-feathering.
10. Engine cold starting with un-feathering, feathering and un-feathering – engine inspection.
11. Engine start and test according TK.
12. Hydraulic (emergency) feathering with a next un-feathering.
13. Engine systems, components and propeller group inspection.

After fulfillment of all items of the program for assessment of engine technical condition according to the current normative documents and taking into account the operational technical documentation of An-26 aircraft and AI-24 VT engine and additional measures in accordance with the procedures of Catalog of Charts for Defect Finding and Repair, book 1, SU, page 13/14.04.2000 and page 20/14.04.2000 the following was established:

1. The oil consumption from the oil container during the engine operation is over the limits;
2. The presence of smoke in the cockpit after engagement of air bleeding is a result of faulty sealing of labyrinth packing of the compressor fore bearing.

Having in view the above mentioned findings, an Air Operator commission, consisting of the heads of OOTO, BTO, OPLGVS, was made the following conclusion:

AI-24VT engine, manufacturer serial No H464VT031, installed on An-26 aircraft, reg. No LZ-MNH, first SU, is improper for operation and should be removed from the aircraft".

Afterwards AI-24 VT was removed from the aircraft and its operation was ceased.

From the aforesaid is evident, that the left-hand engine shut-off was provoked by technical condition worsening, related with increased oil consumption from the oil container during engine operation and faulty sealing of labyrinth packing of the compressor fore bearing.

In the described situation the crew actions were regulated by An-26 Aircraft Operation Manual, Section 7, Aircraft Systems Operation, point 7.2.2 Oil System, where the following was said:

"Oil System control of AI-24 VT engine and monitoring of its work should be done from the cockpit."

During the climb at an altitude = 8000ft the commander, first officer and flight engineer established reduced oil quantity and Emergency Oil Reminder indication came on. This was confirmed by control gauge reading of 20 liters oil level in the left-hand oil container.

In the cited point 7.2.2 is written, that in case of Emergency Oil Reminder indication flashing and oil gauge reading of 20 liters, the engine operation is permitted for 1 hour with the following important warning:

"In case of flight with emergency oil reminder the oil quantity gauge and oil pressure gauge readings to be monitored. If the oil pressure drops under 3.5 kg/cm^2, the propeller should be feathered and the engine should be shut-off."

In the crew explanations, taken after the flight, no crew member mentioned about monitoring of the oil pressure, what leaded the commission to conclusion, that maybe it was more expedient to perform the approach and landing without feathering and shutting off the engine.

During the investigation it was also established:

- Improper actions of the technical staff after placing the aircraft on the tarmac, related with works on the faulty engine and refilling with oil in the assumption of an occurrence emerged in connection with oil system operation and the reason for it was not established, what was a violation of Regulation No 13 from 27.01.1999 of the Ministry of Transport.
- Poor choice of aircraft parking place in view on the assumption the aircraft was involved in aviation occurrence with forced landing and dangerous goods on-board.
- Poor choice of approach with one operative engine, with dangerous goods on-board over the city of Sofia.

3. Conclusions

On the grounds of the investigation of the serious incident the following **Main cause** for its emerging was established:

Impairment of the technical condition of the left-hand engine, which has caused increased consumption of oil from the oil container during the engine operation, and faulty sealing of labyrinth packing of compressor fore bearing.

During investigation the following deficiencies were also established:

- Unconsidered proposal for landing approach by the approach controller in the situation created – one operative engine and presence of dangerous goods on-board;
- Non-rational choice of parking place for an aircraft, which has been involved in an aviation occurrence;
- Crew activities weren't in full compliance with the requirements of Section 7, p. 7.2.2 of An-26 Aircraft Operation Manual in the situation created;
- Improper actions of the technical staff after placing the aircraft on the tarmac;
- The engine number was not written in the aircraft technical logbook when installed;
- According the data of MSRP-12 flight data recorder at take-off regime the right-hand engine oil pressure P_{IKM} was not compliant with the technical requirements;
- The sensor of the rudder position was not installed according the TU (technical requirements);
- the column "Released to service by" of the technical logbook No 0000002296 from 07.11.2005 was not fulfilled.

Safety recommendations:

The commission proposes the following safety measures to be undertaken in connection with the occurrence investigated:

1. The Air Operator to organize an exam for the crew of flight No SCU 551 for knowing of An-26 Aircraft Operation Manual and a copy of the results to be submitted to AAIU at the Ministry of Transport.

Time: 1 month after the day of handing in of the report. Person responsible: Director Flight Operations of the AO.

2. The Air Operator to establish in its Maintenance Control Manual the provisions about the responsibility for technical documentation keeping control and for implementation the requirements of Regulation 13 of 27.01.1999 for Air Accidents Investigation of the Ministry of Transport.

Time: 1 month after the day of handing in of the report. Person responsible: Operation Director of AO.

3. The Air Operator to conduct an inspection and to bring to conformity with the technical requirements the sensors of MSRP-12 on-board of operated An-26.

Time: 15 days after the day of handing in of the report. Person responsible: Operation Director of AO.

4. The Air Operator to bring to conformity with the technical requirements the values of oil pressure P_{IKM} at take-off regime of AI-24VT engine, manufacturer serial No N441VT052, installed as a right-hand power plant of An-26 aircraft, reg. No LZ-MNH.

Time: 15 days after the day of handing in of the report. Person responsible: Operation Director of AO.

5. ATC State Enterprise to establish an approach chart for Sofia Airport for two-engine airplanes with one engine inoperative, taking into account the risk of flight over the city of Sofia.

Time: 1 month after the day of handing in of the report. Person responsible: Director General of ATC SE.

6. Sofia Airport to designate an emergency parking stand for landed emergency aircraft, emergency landed aircraft with dangerous goods on-board and aircraft suffered unlawful interference act.

Time: 1 month after the day of handing in of the report. Person responsible: Executive Director of Sofia Airport.