The original of the Final Report was issued in the Slovak language.
In case of inconsistency original version in Slovak language is applicable.

MINISTRY OF TRANSPORT, CONSTRUCTION AND REGIONAL DEVELOPMENT OF THE SLOVAK REPUBLIC

Aviation and Maritime Investigation Authority
Námestie slobody 6, P.O.BOX 100, 810 05 Bratislava 15

Reg. No. : SKA2013004

FINAL REPORT

on investigation of accident of

helicopter type **Dynali H2S**

Registration No. **OM-M959**

Date: 21.04.2013

Place: Landing and take-off area “Trnava – Kopánka” / VPP TK

The investigation of occurrence has been conducted pursuant to Art. 18 of the Act No. 143/1998 on Civil Aviation (Civil Aviation Act) and on Amendment of Certain Acts and in accordance with the Regulation (EU) No. 996/2010 of the European Parliament and of the Council on investigation and prevention of civil aviation accidents and incidents, governing the investigation of civil aviation accidents and incidents.

The final report is issued in accordance with the Regulation L 13 that is the application of the provisions of ANNEX 13 Aircraft Accident and Incident Investigation to the Convention on International Civil Aviation.

The exclusive aim of investigation is to establish causes of accident, incident and to prevent their occurrence, but not to refer to any fault or liability of persons.

This final report, its individual parts or other documents related to the investigation of occurrence in question have an informative character and can only be used as recommendation for the implementation of measures to prevent occurrence of other accidents and incidents with similar causes.

A. INTRODUCTION

Type of operation:	general aviation / sport and recreational flying
Type of helicopter:	Dynali H2S, characterized by the authorized organization Slovak Ultra Light Aviation Federation (hereinafter "organization SFUL") as flying sport vehicle ("FSV")
Registration No:	OM-M959

Operator / owner:	Arpád Albert
Take-off site:	VPP TK
Planned landing site:	VPP TK
Flight phase:	circling flight
Place of accident:	385 m of the threshold of VPP TK 31
Geographic coordinates of the place of accident (WGS84):	N 48° 23′ 44′′ E 17° 37′ 10′′
Date and time of accident:	21.04.2013, 08:37

Note: All time data in this report are stated in the UTC time.

B. INFORMATIVE SUMMARY

During the flight near VPP TK in an altitude of 270 m above ground level with speed of 120 km/h the engine cut off and FSV in auto-rotation hit the ground with high vertical speed.

The passenger was seriously injured and the pilot was killed in this accident.

The commission composed of the following members was appointed for investigation of the accident:

Ing. Igor BENEK
Ing. Juraj GYENES

The report is issued by:
Aviation and Maritime Investigation Authority
of the Ministry of Transport, Construction and Regional Development
of the Slovak Republic

C. MAIN PART OF REPORT

1. FACTUAL INFORMATION

1.1 History of the flight

On 21 April 2013 at 08:37 the pilot of FSV, registration No. OM-M959, was conducting an exhibition circling flight in the proximity of VPP TK. During the flight in an altitude of 270 m above the ground level with speed of 120 km/h the engine cut off. The pilot switched FSV over to the autorotation mode. At high vertical descent speed during autorotation FSV came into contact with the ground. The pilot sitting on the right seat got stuck under the wreckage of FSV. Passenger sitting on the left seat fell out of FSV when it hit the ground and the lock of the safety belt got broken.

The emergency call operator reported the accident by phone to the Aviation and Maritime Investigation Authority of MTCRD SR on 21 April 2013.

Daytime: day
Flight rules: VFR

1.2 Injuries to persons

Injury	Crew	Passengers	Other persons
Fatal	1	-	-
Serious	-	1	-
Minor	-	-	-
None	-	-	

1.3 Damage to FSV

FSV was destroyed in the accident.

1.4 **Other damage**

No circumstances with potential claims for compensation of other damage toward a third party were notified to the Aviation and Maritime Investigation Authority.

1.5 **Personnel information**

Pilot:

National of the Slovak Republic, male, aged of 56 years

- Holder of the PPL(A) private pilot licence No. SK02020140 issued by the Civil Aviation Authority of the Slovak Republic on 27.06.2002, with marked validity until 16.04.2017

  Qualifications:
  SEP(L) with marked validity until 30.11.2014

- Holder of the FSV pilot licence No. 08S1008 issued by the organization SFUL

  Qualifications:

Pilot of FSV helicopter	with marked validity until 30.04.2013
Instructor of FSV helicopter	with marked validity until 30.04.2013
Pilot of FSV autogyro	with marked validity until 31.05.2013
Instructor of FSV autogyro	with marked validity until 31.05.2013

- Holder of the PPL(H) helicopter private pilot licence No. SK06120057 issued by the Civil Aviation Authority of the Slovak Republic on 10.05.2012, with marked validity until 10.05.2017

  Qualifications:
  R22 with marked validity until 31.03.2014

Medical certificate of 2nd class with marked validity until 28.05.2013.

Passenger:

National of the Slovak Republic, male, aged of 54 years.

1.6 **Information about FSV**

Airframe:	Type:	Dynali H2S
	Building kit serial No.:	H2S 1223-035
	Year of manufacture FSV:	2012
	Manufacturer of building kit for amateur builders:	Dynali Helicopter Company
	Builder of the building kit:	Arpád Albert
Engine:	Type:	Subaru DS EJ25
	Serial No.:	1A 12047
	Year of manufacture:	2012
	Manufacturer:	Subaru

Total operating hours since manufacture: 48h 55min

The certificate of airworthiness of FSV No. RS243, issued by the organization SFUL, with marked validity until 05.10.2013.

Third-party insurance: Allianz Slovenská poisťovňa No. 411015101.

History of operation of FSV

- 26.04.2012 The owner notified the organization SFUL of his intention to build FSV
- 18.05.2012 Introduction of assembly log
- 11.08.2012 Termination of assembly works
- 10.09.2012 Test flight of FSV

- 17.10.2012 Implementation of bulletin SB No 13 and SB No14
- 31.10.2012 Change of oil and oil filter in engine
- 13.12.2012 Change of oil in main and back gearbox
- 28.01.2013 Implementation of bulletin SB No. 15.

Calculation of weight of FSV at the time of accident according to the flight manual

Calculation of centre of gravity: 2 passengers, 25 l of fuel, attached doors		**Weight [kg]**	**Distance from datum plane [mm]**	**Moment [kg * mm]**
Empty weight		392	-115	-45080
Attached doors (2*3kg)		6	575	3450
Passenger on the left side		94	575	54050
Passenger on the right side		85	575	48875
Disposable fuel (0.7 kg/l) (fuel max. 85 l = 60 kg)	25L	17,5	175	3062,5
Baggage (max.26kg)		0	0	0
TOTAL		**594,5 kg**	////////////	**64357,5**
CG *(Centre of gravity)* **For this configuration**		**64357,5 / 594,5**		**108,25 mm**

- Maximum take-off weight 560 kg (indicated in the flight manual) was exceeded by **34.5kg.**
- The c.g. position of 108.25 mm was within tolerance limits according to the flight manual (forward centre of gravity “122 mm”, aft centre of gravity “-34 mm” of the datum plane),
- The requirement of roll trim was fulfilled – heavier person occupied the left seat.

1.7 Meteorological situation

N/A.

1.8 Aids to navigation

FSV was equipped for VFR flights.

1.9 Communication

FSV was equipped by radiocommunication equipment enabling two-way radio communication with all air stations at every moment of flight.

1.10 Information about airport

VPP TK 13/31 with dimensions 600 x 15 m, grass, situated 2 km away from the city of Trnava, is intended for take-offs and landings of FSV.

1.11 Flight recorders

N/A.

1.12 Wreckage and impact information

The place of impact of FSV is determined by geographic coordinates:

N 48°23´44´´
E 017°37´10´´


SKA2013004
Trnava


OM-M959

1.13 **Medical and pathological information**

From the forensic aspect the pilot died of violent death, which occurred in direct causative connection with the accident of FSV when it hit the ground.

On the basis of changes that occurred due to the accident in the area of upper and lower extremities and were detected by autopsy, including implemented laboratory biochemical examinations and investigated circumstances, it can be assumed that at the time of impact the left upper limb and the lower limbs of the pilot were in the active position on the controls, which means that the pilot with the highest probability navigated FSV.

The external and internal inspection and supplementary laboratory examinations of biological materials sampled during autopsy did not detect any acute or chronic pathological changes which could negatively influence the attention and activity of the pilot at the time of accident or cause his death.

At the time of accident the pilot was not under the influence of alcohol, common drugs, narcotics or foreign substances which could decrease his attention during flight and negatively influence the flight and the occurrence of the accident.

1.14 **Fire**

No fire broke out.

1.15 **Aspects of survival**

The rescue operations were implemented by local population and members of HAZZ, RLP and LZS.

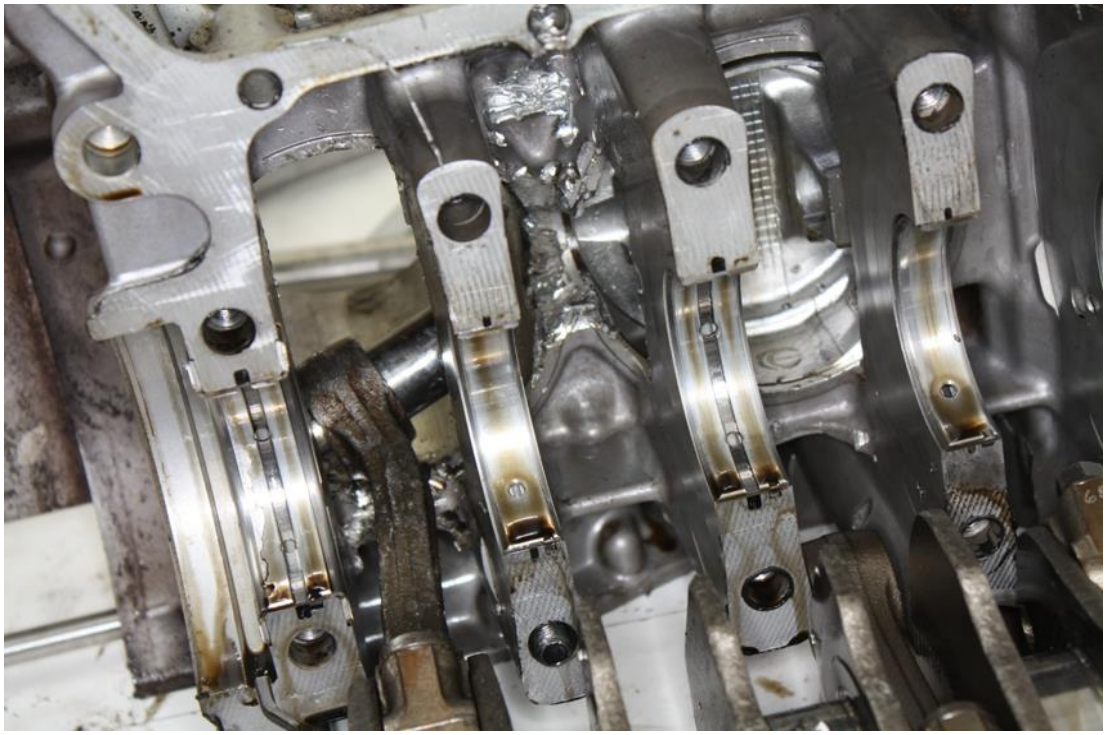
1.16 **Tests and research**

- The **wreckage of FSV was weighed** after the accident using the certified device Dynamometer with evaluation electronics XK3100-B1 from company Ing. Peter Trančík – INSPECT. The weight of the wreckage of FSV with all separated parts was fixed at **381.15 kg,**
- The **gasoline** sample was sent for analysis to EUROFINS BEL/NOVAMANN s.r.o – accredited testing laboratory in Bratislava. The analysis of fuel detected that distillation test and octane number did not fulfil the requirements of standard STN EN 228,
- The **oil** sample taken from **engine** was tested in the company for productiOn, distribution and service of lubricants MOL-LUB, s.r.o. - laboratory WEARCHECK.

The analysis demonstrated high occurrence of abrasion metal content in oil and the experts recommended to quickly change the oil which was contaminated by the fuel and coolant, judging by the content of sodium and natrium,

- The **oil** sample taken from the **reductor** confirmed the occurrence of solid particles in oil, visible by naked eye,
- The engine and main reductor were dismantled at the manufacturer of the building kit Dynali Helicopter Company in the presence of a commission member, which proved that during operation the bolt of connecting rod of piston No. 3 gradually became loose, as proved by the visible fatigue rupture on the connecting rod.

The loose connecting rod bumped into piston No. 4 until it completely destroyed it and pierced the engine block, thus making it unfunctional.



The main rotor transmission gearing did not show any excessive wear, in spite of the collected data on the quality of oil used during operation and metal particles detected in oil. The metal parts found in the detector were within tolerance limits.

1.17 **Organizational and management information**

- On 26.04.2012 the company HELIKOMPRESS, s.r.o. announced its intention to build FSV Dynali H2S from the building kit for amateur builders with supplied engine Subaru under supervision of inspector – technician of the organization SFUL. 51% of the building work should have been implemented by Arpád Albert and 49 % came from the building kit for amateur builders Dynali,

- FSV was built by the builder on the basis of authorization No. 3/2009-P issued by the Civil Aviation Authority of SR on 1 January 2009 and according to SFUL Regulation No. 4/2000 (requirements for construction and demonstration of airworthiness of flying sport vehicles of micro-light aircraft type) a**nd its Addendum D/2006** (requirements for construction and demonstration of airworthiness of flying sport vehicles of helicopter and autogyro type),

- FSV was allocated the registration number on the basis of the SFUL Regulation No. 3/2000 (allocation of registration numbers to flying sport vehicles of category micro-light aircraft, ultra-light glider and autogyro),

- In the approval process for building of helicopter Dynali the authorized organization SFUL followed the extended authorization No. 3/2006-P issued by the Civil Aviation Authority of SR on 9 February 2007, extending this authorization to the verification of professional competence and supervision of building of FSV by micro-light helicopter,

- On 1 September 2009 the Civil Aviation Authority of SR issued the new Authorization No. 3/2009-P, indicating the authorizations referred to above for selected types of FSV, which however were nowhere defined,

- The individual types of FSV are named in SM-12 issued by the Civil Aviation Authority of SR, but helicopter does not appear in this list,

- On the basis of aforesaid it can be stated that SFUL approving the putting into operation of helicopter Dynali incorrectly relied on invalid extended Authorization No. 3/2006-P, which was replaced by new Authorization No. 3/2009-P at that time.

1.18 Additional information

FSV did not carry documents and other documentation requested by Article 14 of the Act No. 143/1998 Coll. on civil aviation. The following documentation was later submitted to the Commission: certificate of registration of FSV, certificate of airworthiness of FSV, aircraft log, approval of aircraft station, insurance certificate.

1.19 Useful or effective investigation techniques

Standard investigation techniques were used.

2. ANALYSIS

2.1. Description of flight

After refuelling, pre-flight briefing and engine heating the pilot FSV conducted the demonstration of FSV hovering in ground level altitude above VPP TK 13/31 for the passenger.

After a short break the pilot conducted another take-off with the passenger from VPP TK 31 to demonstrate a circling flight. Based on the statement of the passenger, during demonstration after the 4th circular turn the engine cut off, which was confirmed by the engine testing. The passenger indicated that he had had his hand and feet on the controls during the flight and after the engine cut-off full control of FSV was taken over by the pilot who had decided to land in the autorotation regime and used unusually large cyclic control deflections.

The sudden and immediate failure of engine probably surprised the pilot so much that he did not manage to timely switch FSV over to the normal autorotation mode. Consequently the speed of primary rotor dropped below the critical values required for autorotation, which the pilot did not succeed to restore, and all this ended in an uncontrolled fall of FSV under steep angle, followed by hard ground collision.

2.2. Results of examination of engine

After dismantling of the engine the experts detected that the bolt of the connecting rod of piston No. 3 had gradually became loose during operation, which caused the formation of fatigue rupture on this connecting rode, its bending, bump into piston No. 4 and piercing of the engine block. The cause of the bolt becoming loose was most probably its improper tightening by prescribed moment during assembly of the engine in production plant.

3. C O N C L U S I O N S / CAUSE OF ACCIDENT

3.1 Findings

- The Civil Aviation Authority of SR issued the authorization to the organization SFUL without determination of special conditions for allocation of registration numbers and their records,

- Allocation of the registration number OM-M959 by the organization SFUL for FSV of helicopter type was not compliant with SM12 and Regulation No. 3/2000,
- FSV was built according to the authorization No. 3/2009-P which does not specify FSV of helicopter type and SFUL approved the building of this helicopter on the basis of extended authorization No. 3/2006-P, which was not valid at that time,
- The aircraft did not carry documents and other documentation requested by Article 14 of the Act No. 143/1998 Coll. on civil aviation,
- FSV did not show any faults before the accident,
- The maximum take-off weight of FSV was exceeded during the flight.

3.2 **Cause of incident**

- Gradual loosening of the bolt of the connecting rod of piston No. 3 with formation of fatigue rupture on the connecting rod, leading to its bending, bump into piston No. 4, piercing of the engine block and its cutting off,
- Late reaction of the pilot to sudden loss of engine power and poor mastering of the flying technique in non-standard flight regime,
- High vertical speed at the moment of impact on the ground.

4. SAFETY RECOMMENDATIONS

On the basis of investigation of causes of accident of FSV

Registration No. **OM- M959**
Date of accident: **21.04.2013**

We recommend the **organization SFUL and the Transportation Office of SR – the Civil Aviation Division** to implement the following measure**:**

- To mutually harmonize the authorization of the Civil Aviation Authority of SR for SFUL and its prescription basis,
- To increase the supervision of the fulfilment of conditions issued in the decision of **CAA SR of** 19.06.2013, authorizing the organization SFUL for performance of specified activities.

We recommend the **organization SFUL** to implement the following measure**:**

- To draw up a procedure according to which a technician of SFUL designated by the supervisor of the fulfilment of conditions for construction will professionally assess the percentage of works carried out for a particular individual construction of FSV from the point of view of amateur builder and manufacturer of the building kit.

We recommend the company **Dynali Helicopter Company** to implement the following measure**:**

- To issue a service bulletin with requirement to check the tightening of bolts on cylinder heads and connecting rods of this series of engines with use of prescribed moment.

Bratislava, 10.03.2014