الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

United Arab Emirates

Air Accident Investigation Sector

Accident

- Final Report -

AAIS Case Nº: AIFN/0013/2015

Gyrocopter Loss of Control-Inflight

Owner/Operator:	Nad Al Sheba Private Club
Make and Model:	AUTOGYRO / MTOSport
Nationality and Registration:	United Arab Emirates, A6-GY0
Place of Occurrence:	Skydive Drop Zone, Palm Jumeirah, Dubai
State of Occurrence:	The United Arab Emirates
Date of Occurrence:	9 December 2015

Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

Accident Brief

Operator	:	Nad Al Sheba Private Club
Aircraft Manufacturer	:	AUTOGYRO GMBH Germany
Aircraft Model	:	MTOSport
Nationality	:	The United Arab Emirates
Registration	:	A6-GY0
Place of Occurrence	:	Skydive Drop Zone, Palm Jumeirah, Dubai
State of Occurrence	:	The United Arab Emirates
Date and time	:	9 December 2015, 1424 LT
Injuries	:	Fatal injury to the Pilot

Investigation Objective

This Investigation is performed pursuant to the United Arab Emirates (UAE) *Federal Act No. 20 of 1991*, promulgating the *Civil Aviation Law*, Chapter VII – *Aircraft Accidents,* Article 48*.* It is in compliance with Part VI, chapter 3 of the *Civil Aviation Regulations*, and in conformity with *Annex 13* to the *Convention on International Civil Aviation*.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. Thus, it is inappropriate that this Report should be used to assign fault or blame or determine liability, since neither the Investigation nor the Report process has been undertaken for that purpose and may lead to erroneous interpretations and conclusions.

Investigation Process

The Air Accident Investigation Sector (AAIS) of the United Arab Emirates was informed about an Accident, involving a gyrocopter, which occurred during the Fédération Aéronautique Internationale (FAI) World Air Games (WAG), held at Skydive, Dubai Palm Jumeirah. The occurrence was notified to the AAIS Duty Investigator (DI) hotline number +971506414667.

The AAIS appointed an investigator-in-charge (IIC) together with an investigation team. Notifications and participation entitlement letters were sent to Germany as the State of the Aircraft Design and Manufacture, and to the Dutch Safety Board as the Netherlands is the State of the Pilot. The General Civil Aviation Authority, the Dubai Civil Aviation Authority, the Flying Club and the FAI also assisted with providing evidence. The AAIS led the Investigation and issued this Final Report.

The information contained in this Final Report is derived from the factual information gathered during the Investigation. Comments received by the stakeholders was reviewed and, amendments made before the Report was finalized.

The AAIS Reports are made publicly available at:

http://www.gcaa.gov.ae/en/epublication/pages/investigationReport.aspx

Notes:

1. Whenever the following words are mentioned in this Report with first Capital letter, they shall mean the following:
   - (Accident) – this investigated accident
   - (Aircraft) – the MTOsport gyrocopter involved in this accident
   - (Investigation) – the investigation into the circumstances of this accident
   - (Pilot) – the pilot involved in this accident
   - (Federation) – the Emirates Aerosports Federation
   - (Report) – this accident investigation Final Report.
2. Unless otherwise mentioned, all times in this Report are local time (Local time in UAE was UTC + 4 hours).
3. Photos and figures used in this Report are taken from different sources and are adjusted from the original for the sole purpose to improve the clarity of the Report. Modifications to images used in this Report are limited to cropping, magnification, file compression, or enhancement of color, brightness, contrast, or addition of text boxes, arrows or lines.

Abbreviations

AAIS	The Air Accident Investigation Sector of the United Arab Emirates
AoA	Angle of Attack
ASC	Air Sport Commission of the FAI
ASI	Air speed indicator
BCAR	*British Civil Airworthiness Requirements*
CAA	Civil Aviation Authority – the United Kingdom
CAR	*Civil Aviation Regulations* of the United Arab Emirates
CAAP	*Civil Aviation Advisory Publication* issued by the General Civil Aviation Authority of the United Arab Emirates
CAP	*Civil Aviation Publication* issued by the Civil Aviation Authority of the United Kingdom
CIMA	The International Microlight and Paramotor Commission of the FAI
CPR	Cardiopulmonary resuscitation
DCA	The applicable Emirate Department of Civil Aviation, which is the Appropriate Authority under the UAE *Civil Aviation Law*
DCAA	Dubai Civil Aviation Authority
DULV	Deutscher Ultraleichtflugverband e.V.
EAF	Emirates Aerosports Federation
FAI	Fédération Aéronautique Internationale
ft	feet
GCAA	The General Civil Aviation Authority of the United Arab Emirates, which is the Competent Authority under the *Civil Aviation Law*
kg	kilogram
LSA	Light sports aviation
LT	UAE local time
MLH	Micro Light Helicopter
NAC	National Air Sport Control
NFL	Nachrichten für Luftfahrer”
POH	*Pilot operating handbook*
RNAA	Royal Netherlands Aeronautical Association
rpm	Revolutions per minute
UAE	The United Arab Emirates
UK	The United Kingdom
WAG	World Air Games

Synopsis

On 9 December 2015, at approximately 1424 UAE time, an MTOsport gyrocopter, registration A6-GYO, flown by a Dutch citizen Pilot participating in an air race held as part of the Fédération Aéronautique Internationale (FAI) 2015 World Air Games (WAG), Dubai, suffered loss of control and impacted the sea upon passing the final race course pylon. The Pilot was submerged in the water for a period of approximately ten minutes before being rescued in an unconscious condition by Search and Rescue divers. The Pilot did not regain consciousness and succumbed to his injuries ten days after the Accident.

The gyrocopter, known as an AutoGyro MTOSport was owned by Nad Al Sheba Private Club and was being flown in the gyrocopter air race competition. The air race was cancelled after the Accident.

The race was held at the two Dubai Skydive facilities, located at Palm Jumeirah and Skydive Desert Campus. The Accident occurred over the water at Palm Jumeirah.

The Air Accident Investigation Sector determines that the most probable cause of the Accident was due to the pilot losing control of the Aircraft as he attempted a high speed unbalanced left hand turn and becoming distracted, at the same time, due to loss of his helmet. Thereafter, the sudden control stick input to the left and against the stops, caused the Aircraft to lose lift from the rotors, enter a negative g-load and loose engine power that caused the Aircraft to roll and dive, impacting the water at high speed.

The Investigation lists a number of factors that could have contributed to the Accident:

- The Pilot was most likely not sufficiently experienced to fly the gyrocopter in an air race as he had just over 20 hours of pilot-in-command time for the gyrocopter;
- The Pilot selection process lacked robust qualification procedures as all pilots nominated were allowed to compete by the FAI;
- The Pilot was allowed to take part in the race even though he had less than the 45 hours of pilot-in-command on the gyrocopter as stipulated in GCAA CAAP 15;
- The race course did not have a safe height established and most of the flight was performed at an average of 100 feet above the water.
- Most of the flight was flown at speeds in the yellow precautionary range in excess of 120 km per hour.

Several safety recommendations are mentioned in this Final Report, addressed to the Fédération Aéronautique Internationale and the General Civil Aviation Authority.

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1. Factual Information

1.1 History of the Flight[1]

On 9 December 2015, at approximately 1424 LT, the Pilot of Autogyro MTOsport gyrocopter, registration A6-GYO, lost control of the Aircraft whilst participating in the Fédération Aéronautique Internationale (FAI) World Air Games (WAG) held at Dubai, the United Arb Emirates. Upon passing the final race course pylon, the Aircraft steeply dived towards the sea and impacted the water surface with high kinetic energy. The Pilot sustained fatal injury.

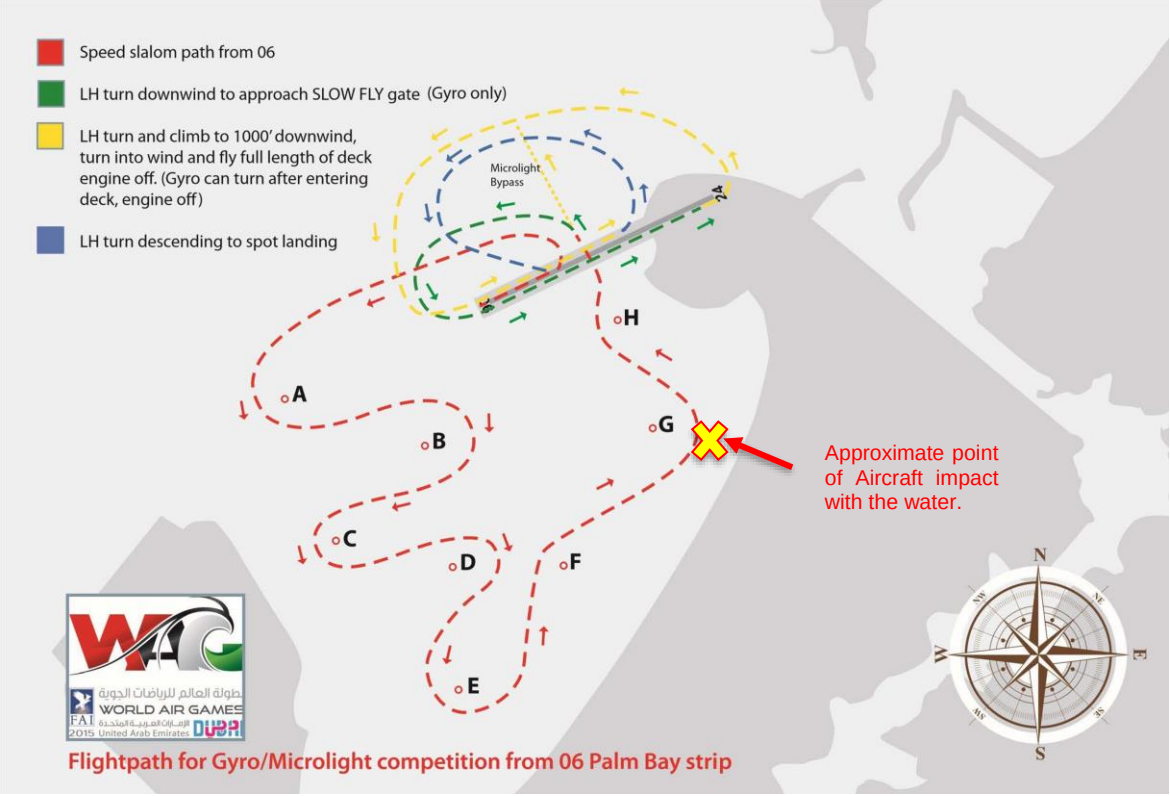

Figure 1. Autogyro race flightpath and approximate position of Aircraft impact

During the flight preparation, the Pilot was composed and prepared for the flight. He was wearing normal clothes, a life jacket, and a safety helmet. The open face helmet had a two-pieces chinstrap and was connected to the Aircraft communication system via a plug-in electrical cable.

The Aircraft was refuelled with auto gas up to third of its tank capacity. Before engine start, the Pilot donned his helmet and was observed by his team members checking the helmet intercom. A video captured by the Pilot's GoPro camera, and an observer's photo, showed that the straps of his helmet were not fastened and it remained unfastened for the entire duration of the flight.

[1] The history of flight was based on video footage which was retrieved from the WAG and the Pilot's GoPro body camera. Timings mentioned is the time stamps from the WAG video camera. The Aircraft speed and altitudes were recorded by the Pilot's GoPro body camera which had captured the indications from the Aircraft instrumentation with acceptable level of clarity

The Pilot team members assisted him prior to the taxi out, in addition to a WAG steward who was keeping track of the sequence of the starts.

After taxiing the Aircraft to the holding point, the Pilot was cleared to enter the runway for takeoff by the race steward. Thereafter, the Pilot performed the magneto checks, and in accordance with the *standard operating procedure (SOP)*, pre-rotated the rotor to WAG limit of 200 rpm, trimmed fully forward, and, with the control stick fully aft, opened the engine throttle to achieve the required propeller speed. The Pilot released the brakes and commenced the takeoff. The Pilot's left hand was kept on the throttle after the takeoff.

At 1423:43, the Aircraft was Airborne. The Pilot flew the pylon race course making three left hand turns without any problem at pylons A, C and E. From pylon F to G, the Aircraft was in a right hand turn then a sharp bank into a left hand turn at pylon G.

At 1424:19, the Aircraft was in an approximate 30 degrees coordinated left turn with a speed of 165 km per hour at an altitude of 150 feet. At 1424:20, the Aircraft was in an almost 45 degree left bank angle with a left rudder deflection and speed of 151 km per hour. Then the Pilot made a control stick input to roll out, which caused severe flexing of the windscreen due to the wind coming from the right. As the altitude started to increase towards 200 feet, the Pilot then pushed the control stick to the left, with 400 rpm rotor speed.

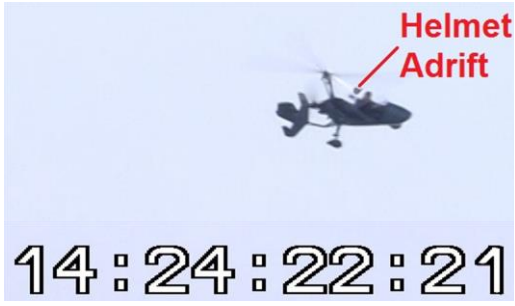

Figure 4. Pilot helmet comes off

At 1424:22 (figure 2), the helmet was seen coming off the Pilot's head and simultaneously his left hand released the throttle. The Aircraft entered into a right roll and the stick was moved to full left and forward to the mechanical stop in order to recover from the roll. Another photo shows that the helmet remained attached to the Aircraft by the communications cable and trailed around the left side of the Aircraft where the helmet was being blown by the wind.

Figure 4. Aircraft starts to roll

At 1424:24, the Aircraft was on a nose-high attitude. The Pilot's left hand momentarily grabbed the throttle. The control stick was fully forward, and the Aircraft entered into zero or negative load factor (g), with the rotor speed at approximately 400 rpm, and 180 feet altitude.

At 1424:26 (figure 3), the Aircraft rolled to the right at almost 90 degrees after reaching 250 feet altitude. The Pilot pulled the control stick back and to the left. The airspeed slowed down to about zero, and the rotor speed decelerated in a significant rate.

At 1424:28 (figure 4), the Aircraft impacted the water at approximately 90 km per hour in a nose down attitude. Four seconds later, the Aircraft started to sink and submerged within six seconds after the impact. The Pilot was not seen until the search and rescue team recovered him.

Figure 4. Aircraft impacts the water

During the left hand turns, the Aircraft was flown out of balance as observed by the yaw indicator and verified by the life jacket inflator lanyard which was blown across the camera. In right hand turns, the Aircraft was generally in balance. After takeoff, the Aircraft engine speed was at full power of 5,800 rpm, and the rotor speed was between 400 and 420 rpm for the duration of the air race flight.

The approach to pylon G, as noted by the GoPro camera, the Aircraft airspeed was in the yellow band with a speed between 160 to 170 km per hour. The normal range, green arc speed, as per the *POH*, is between 30 to 120 km per hour. The WAG event director for the gyrocopter air race had stated that the Pilot had performed satisfactorily during the competition, and was ranked number 11 out of 21 competitors at the start of the Accident flight.

Figure 5. Aircraft approach to pylon G

1.2 Injuries to Persons

The search and rescue divers recovered the Pilot from a depth of about 20 feet below the surface. The Pilot was unconscious and sustained a broken jaw. It is estimated that the Pilot was submerged in the water for approximately ten minutes.

The Pilot did not regain consciousness and succumbed to his injuries ten days after the Accident.

1.3 Damage to Aircraft

The Aircraft was severely damaged because of the impact.

1.4 Other Damage

There was no report of damage to any ground equipment, or the environment.

1.5 Personnel Information

The 49-year Pilot possessed a valid flight crew licence for microlight helicopter (MLH)–gyroplanes, issued by the Civil Aviation Authority of the Netherlands including a valid Class 2 medical certificate. He was also a glider pilot.

As a requirement to enter the FAI WAG, the Pilot also possessed a valid FAI sporting license to compete in the gyrocopter air race.

The Pilot's flying logbook for gyrocopter indicated that he had flown a total of 52:38 flight hours which consisted of 31:20 dual hours, and 21:18 pilot-in-command solo hours. These hours included the flights that he did in Dubai for the WAG activities. Prior to the WAG, the Pilot had logged total of 30:20 dual hours and 20:23 pilot-in-command.

During the Dubai WAG 2015, the Pilot flew a total of 20 minutes as part of the practice flights and a total air race time of 35 minutes. A one-hour dual flight was also flown during repositioning of a gyrocopter. All flights were accomplished using a UAE-registered Autogyro aircraft provided by the Flying Club.

1.6 Aircraft Information

1.6.1 General data

The Aircraft was built by AutoGyro GMBH in Germany and was assembled at Nad al Sheba Private Club. The Aircraft was registered in the Civil Aircraft Register of the United Arab Emirates on 30 November 2015 with the registration mark A6-GY0, and was issued its first *permit to fly* by the Club. The *permit to fly* was issued according to the *Civil Aviation Regulation* (*CAR*) Part IV, subpart D, allowing the Aircraft to fly within the UAE airspace only without a certificate of airworthiness being in force.

A review of the Aircraft assembly and the maintenance records by the Investigation did not reveal any findings.

The *pilot operating handbook* (*POH*)[2] stated that:

> "The MTOsport is designed, tested and certified according to the German design specifications for microlight gyroplanes ("Bauvorschriften für Ultraleichte Tragschrauber", BUT 2001) including its latest amendment published in "Nachrichten für Luftfahrer" NFL II 13/09 issued 12.02.2009, as well as the British Civil Airworthiness Requirements (BCAR) Section T."

The Aircraft was equipped with two seats open to air. The maximum take-off mass was 450 kg. The Aircraft was powered by 115-horse power turbo-charged Rotax engine.

The Pilot's helmet contained provisions for headphone and boom mike connected to the Aircraft communication control panel by a wire that extends from the boom mike on the right side of the helmet to a connector positioned next to the Pilot's left leg.

Table 1. Aircraft data

Aircraft Type	AUTOGYRO MTOSport
Manufacturer	AUTOGYRO GMBH, Germany
MSN	M01230
Time since new (hours)	18:16
Engine type	Rotax 914UL. 4-cylinder, 4-stroke, opposed cylinder arrangement and turbo-charger
Rotor type	Two bladed, fixed pitch, free to teeter
Propeller type	Two bladed, fixed pitch, free to teeter
Empty weight	240.8 to 247.0 kg
Payload	209.2 to 203.0 kg
Fuel tank capacity	68 litres
Dimensions (meters): Length: 5.08 width: 1.88 Height: 2.71	

[2] *AutoGyro_POH_MTOsport Revision 6.0*, issue date 16 June 2014

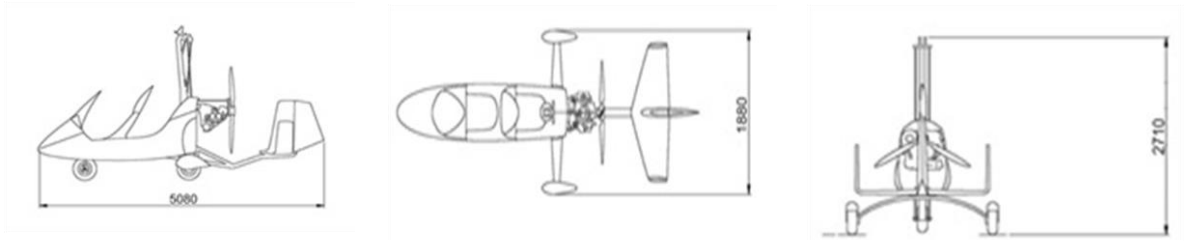

Figure 6. Gyrocopter dimensions

1.6.2 Principle of operation

The MTOsport is designed, tested, and certified according to *the German design specifications for microlight gyroplanes*[3], and the *British Civil Airworthiness Requirements (BCAR),* Section T*.*

An Autogyro is characterized by a free-spinning rotor which rotates because of the passage of air through the rotor from below. The vertical (downward) component of the total aerodynamic reaction of the rotor provides lift for the vehicle, and sustains the Autogyro in the air. A separate propeller, which is placed with the engine at the rear of the fuselage provides forward thrust.

There are three primary flight controls: control stick, rudder pedals, and throttle. Typically, the control stick is termed the cyclic and tilts the rotor in the desired direction to provide pitch and roll control. The rudder pedals provide yaw control, and the throttle controls engine power.

1.6.3 Throttle and brake

The throttle and brake quadrant with choke (figure 7) is located on the left side of the pilot station.

The throttle control (No. 1 in figure 7) is conventional with idle speed in the aft (or pulled) position and full throttle in the most forward position. With the ROTAX 914 UL engine, the boost range is entered by overcoming a small resistance to the front. The throttle lever is linked by cable controls to the carburettors. A mechanical spring applies tension to the control cables and brings the carburettors to full throttle in case of cable break. The throttle lever has a pre-set friction brake which holds the throttle in the selected position. Choke (No. 3 in figure 7) is used to start a cold engine.

The hydraulic wheel brake is actuated by pulling the brake lever (No. 2 in figure 7). A locking pawl mechanism allows setting for use as a parking brake. The parking brake is released by pulling the brake lever to let the spring-loaded locking pawl disengage.

The throttle and brake quadrant also supports the brake fluid reservoir (No. 4 in figure 7) with screw cap and fluid level minimum and maximum markings, as well as the primary brake cylinder (No. 5 in figure 7).

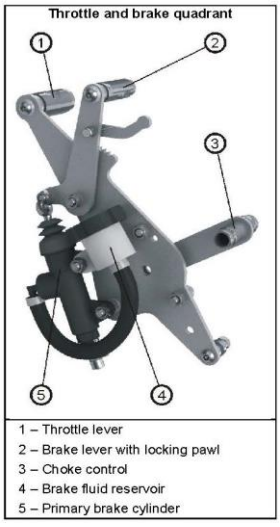

Figure 7. Throttle and brake quadrant

[3] ("Bauvorschriften für Ultraleichte Tragschrauber", BUT 2001), including its latest amendment published in "Nachrichten für Luftfahrer" NfL II 13/09 issued on 12 February 2009

1.6.4 Control stick

Pitch and roll of the gyroplane are controlled by tilting the rotor by means of control stick (figure 8). Control input is transferred via torsion tube and linkage running from underneath the seats to the base link and from there to the rotor head via two split control rods with ball ends.

The control stick head is ergonomically shaped to fit the pilot's right hand and features control buttons for radio transmission (No. 1 in figure 8), a four-way trim function (No. 2 in figure 8), and activation of the pre-rotator (No. 3 in figure 8). The trim control works as a classical 4-way beep switch. Pulling the beep switch back increases aft trim or nose-up tendency, while pushing the switch forward reduces back trim pressure, leading to a nose-down tendency.

Figure 8. Control stick

Lateral trim input is not active on MTOsport models. Because of a safety circuit, activation of the pre-rotor is only possible when the pneumatic mode selector on FLIGHT position and the control stick is fully forward. This prevents inadvertent activation of the pre-rotator during flight or in BRAKE mode.

1.6.5 Rudder and front wheel control

The rudder is connected to the foot pedals by steel cables which are routed horizontally along the main frame. Both pedals are interconnected by a linkage. The nose wheel steering is directly linked to the pedal/rudder control input by control rods.

1.6.6 Aircraft limitations

Section 1.5 of the *POH* instructs the pilots to avoid abrupt manoeuvres or flight in heavy turbulence as "This could lead to rotor speed variations associated with high stress, possible damage to the aircraft, or uncontrollable attitudes."

The structural load limitations mentioned in the *POH* are for positive load factor (500 kg) maximum of +3 g and for negative load (500 kg) factor of -1 g.

Several warnings, which are boxed in red, and limitations are mentioned in the *POH* pertaining to operating procedures. It is mentioned that whenever the word "WARNING" is used it means that neglecting the appropriate procedure or condition could result in personal injury, or loss of life.

A general "WARNING" is mentioned in the *POH* stating:

> "The operation of a gyroplane demands professional pilot instruction and dedicated training on gyroplanes. Without a valid license the gyroplane must not be operated.
>
> During the entire flight adequate rotor loading must be maintained. Do not perform any manoeuvres resulting in the sensation of feeling light or near weightless."

Indicators on the instrument panel of the Gyrocopter has colour codes as stated in section 2.3 of the *POH.* The three colour codes used are:

- Red: Operating limits. Instrument pointer should not enter red colour during normal operation
- Yellow: Precautionary or special operating procedure range

- Green: Normal operating range.

Airspeed limitations are mentioned in section 2.4 of the *POH.* The never exceed speed is 185 km per hour which is the red area of the airspeed indicator. There are two yellow arcs on the airspeed indicator; from 120 to 185 km per hour and; from 0 to 30 km per hour. The green arc is stated as from 30 to 120 km per hour.

In section 2.9 of the *POH*, under the heading *Kinds of Operation*, it was mentioned that aerobatic flight is prohibited and that manoeuvers involving bank angles of more than 60 degrees are considered aerobatic flight. In addition, the following warnings in the *POH* stated:

> "Any manoeuvre resulting in a low-G (near weightless) condition can result in a catastrophic loss of lateral/roll control in conjunction with rapid main rotor RPM decrease. Always maintain adequate load on the rotor and avoid aggressive forward control input performed from level flight or following a pull-up.
>
> Excessive sideslip is prohibited! Sideslip may be performed only with proper training and within safe boundaries. Use gentle pedal input for initiation and stabilization. Do not rely on airspeed indication in sideslip. Never perform abrupt control stick input into the direction of motion. Be aware that excessive side slip may result in an uncontrollable and unrecoverable (low-G) attitude."

1.6.7 Weight and balance

The maximum take-off mass of the Aircraft was 450 kg as mentioned in the *POH*.

According to the *POH,* the front seat pilot weight shall be between 60 to 125 kg, and the rear seat pilot weight shall not exceed 129 kg. The maximum load in the storage compartment located in the nose section of the Aircraft is 10 kg.

With the Pilot's weight of 88 kg, and the one-third filled tank, it is estimated that the take-off weight of the Aircraft was 375 kg.

1.7 Meteorological Information

The prevailing weather conditions at the time of the Accident flight were:

Temperature:	24 ºC
Cloud condition:	Clear sky, with few passing clouds
Wind speed:	9 km per hour from southeast
Visibility:	More than 10 km
Humidity:	27%
QNH[4]:	1019 mbar

The weather and visibility conditions was not a factor in the Accident.

1.8 Aids to Navigation

Not a factor in this Accident.

[4] QNH: Atmospheric pressure adjusted to sea level

1.9 Communications

Not a factor in this Accident.

1.10 Aerodrome Information

The runway at Skydive Palm Jumeirah was used for the final two days of the gyrocopter air race competition. Runway 24 (figure 9) was the departure runway for the Accident flight. Eight floating pylons were placed at set coordinates adjacent to the runway to form the racecourse.

The aerodrome, known as Marina Dubai, did not have a GCAA approval at the time of the Accident. It was approved by the GCAA in March 2016 as Landing Area Acceptance (LAA) with the aerodrome operator being Skydive Dubai LLC. The approval was based on *CAR* Part IX – *Aerodromes*, with guidance given in *CAAP 72* issued in June 2014.

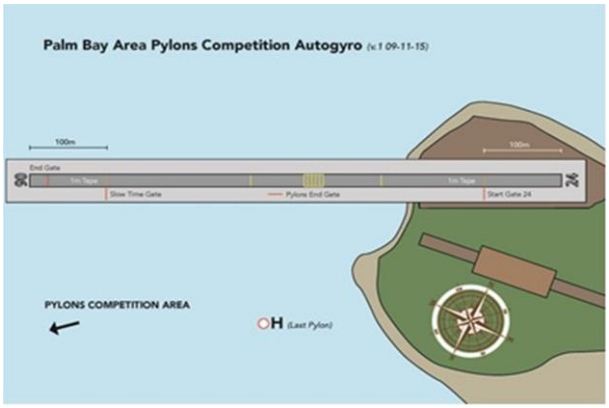

Figure 9. Runway 24

1.11 Flight Recorders

The Aircraft was not equipped, nor was it required to be equipped with recording devices by the *Civil Aviation Regulations.*

The Pilot and the Aircraft had GoPro cameras fitted. In addition, video footage of the flight was retrieved from the WAG organizers. The video recorded by the Pilot's GoPro was of good quality whereas the video recorded by the Aircraft GoPro was non-readable because the camera case was opened by the impact force which adversely affected the recording media.

1.12 Wreckage and Impact Information

There was extensive damage to the Aircraft as follows:

- The majority of the glass fiber monocoque at the front of the Aircraft damaged and a large area was absent
- The instrument panel was loosely attached to the Aircraft by the cables and tubes
- The nose wheel assembly broke up and the push rods attached to the pedals broke
- The rudder cables were in good condition, while the control rods were bent and distorted due to impact forces
- The main cyclic control and all of its associated control rods were bent and distorted due to the impact, but the cyclic control was still intact
- The main fuel tanks were ruptured and contaminated by sea water. A fuel sample was therefore not obtainable
- The exterior of the Rotax engine and the propeller showed no signs of damage

- The main rotor: One rotor blade had sheared off and the other was bent and distorted.

1.13 Medical and Pathological Information

The sample blood test results did not indicate any psychoactive material that may have degraded the Pilot's performance.

1.14 Fire

There were no signs of fire.

1.15 Survival Aspects

1.15.1 The Pilot

The Pilot was wearing an open face helmet without a visor and he had donned a life jacket prior to the departure of the Accident flight. He was strapped into the front seat of the Aircraft with the built in seat restraint harness.

The Flying Club had supplied the life jacket worn by the Pilot, as it was a requirement of the Club, but not a requirement of the WAG, to wear a life jacket when flying over water. The jacket was manufactured by Lalizas and was a Manual Sigma 150N built to *ISO 12402-3* specifications. For inflation, the life jacket requires manual activation by pulling a toggle.

Securing of the helmet is the responsibility of the Pilot and this is mentioned as part of the pre-flight preparation in the Autogyro *POH*. Whether the pilot's helmet was correctly secured was not noticed either by the Dutch Team members who were assisting the Pilot prior to the taxi out, nor WAG steward keeping track of the sequence of the starts nor the race steward giving the clearance to proceed to the runway for the takeoff.

Six seconds before the impact with the water, the Pilot's helmet was blown off his head

The nose of the Aircraft was severely damaged due to the impact force, but the damage did not reach the Pilot's seat or the restraint harness. The Investigation could not exactly determine the magnitude of the g-force that was transferred to the body of the Pilot and whether the impact had brought the Pilot into an immediate state of unconsciousness.

The Investigation could not determine whether the Pilot had undergone water survival training, which includes underwater rollover training.

1.15.2 Search and rescue

Based on the WAG videos, the Search and Rescue team arrived at the Accident site within 40 seconds, and the first diver was in the water at 1425:44 which was 72 seconds after the impact. The team stated that they faced difficulties due to limited underwater visibility. The Pilot was recovered approximately 10 minutes after the impact. The medical team carried out cardiopulmonary resuscitation (CPR) two minutes after he was placed in the rescue boat.

Figure 10. Diver in the water 72 seconds after impact

During the WAG competition, the Investigation was informed by the appointed WAG flying display event director that search and rescue was provided by trained operators from

two organizations, one of which provides regular day to day search and rescue services for the skydive operations at Skydive Palm Jumeirah. It was stated that relevant safety briefings were done as part of the preparation for the WAG.

The Investigation interviewed the person responsible for the Search and Rescue team who recovered the Pilot and it was stated that in preparation for the WAG there was no specific training and mock exercises provided by the organizers and they were not made aware of the seating arrangement or restraint harness operation for the Autogyros used during the WAG air race competition.

1.16 Tests and Research

For the purpose of determining the engine performance before the impact, the Investigation shipped the engine's turbo control unit (TCU)[5] to the manufacturer for data download and analysis. The data revealed that the engine was performing normally during the flight.

1.17 Organizational and Management Information

1.17.1 The Fédération Aéronautique Internationale (FAI)

The FAI is the world governing body for air sports, and for certifying world aviation and space records. The FAI was founded in 1905 and is a non-governmental and non-profitmaking organisation. Its head office is located in Lausanne, Switzerland.

FAI activities include the establishment of rules for the control and certification of world aeronautical and astronautical records. FAI promotes skill, proficiency and safety in aeronautics. FAI establishes regulations for air sporting events, including the World Air Games, which are organised by member countries throughout the world. The Emirate of Dubai became a member of FAI through the Emirates Aerosport Federation.

The air sport disciplines that the FAI oversees include balloons and airships, power flying, gliding, helicopter flight, parachuting, aeromodelling, aerobatics, hang gliding, microlight and paramotor, amateur-built aircraft, manpowered flying, paragliding, and other aeronautic and astronautic sporting activities.

The rules for the gyrocopter air race are referenced under the FAI *Sporting Code*, section 10 subject matter Microlights and Paramotors, also known as CIMA. The FAI defines a microlight or paramotor aircraft as a one or two seat-powered aircraft whose minimum speed at maximum take-off mass (MTOM) is less than 65 km per hour.

The normal takeoff speed of a gyrocopter at MTOM is approximately 30 km per hour, and gyrocopters are classified by the FAI under the category of microlight. The FAI considers the gyrocopter as an Autogyro that is a powered aircraft which, in flight, derives most of its lift from an autorotating rotor system not provided with any form of direct power drive.

1.17.1.1 WAG, Dubai 2015

WAG is considered the premier international multi-discipline air sports event fielding the world's top air sports competitors. The 2015 WAG was awarded to the EAF by the FAI and was held in Dubai, during the period 1 to 12 December. This required the EAF to manage the WAG according to the relevant provisions in the FAI statutes and by-laws, the FAI *Sporting Code*, event competition rules, and local regulations applied by the FAI. It was noted by the

[5] The TCU is designed to sense and decipher data from the engine in order to achieve the optimum level of boost (source Rotax Owner Manual)

Investigation that for the Dubai WAG, there were no FAI references regarding an emergency response plan or safety management and reporting system.

The EAF is an independent non-profit organization, established in 2012, with the purpose of coordinating aerosport within the United Arab Emirates. It was not affiliated to any flying club in the United Arab Emirates and did not possess a GCAA approval to conduct civil aviation activities. As a result, there was a signed leasing agreement between the EAF and the Flying Club to provide two MTOsport Autogyros for the WAG.

During the first quarter of 2015, the GCAA was informed about the WAG by the EAF and was invited to be part of the organizing committee.

With reference to the published GCAA requirements, a flying display event director was appointed for the WAG by the EAF. In accordance with GCAA *CAAP 15*, Dubai Civil Aviation Authority (DCAA) was involved in the WAG as the appropriate authority of the Emirate of Dubai. The DCAA was the coordinator for WAG requirements between the EAF and the GCAA. The DCAA had also issued a no-objection letter to the EAF, which stated that they recognized the organization management oversight of the appointed flying display event director for the Dubai 2015 WAG.

The number of participants during the Dubai WAG was 875 competitors representing 55 countries. The competitions were categorised[6] as: Aerobatics, aeromodelling, aerostats, general aviation, ballooning, gliding, microlights (weight shift, paramotor, gyrocopter), parachuting and paragliding.

Previous WAG were held in Turkey (1997), Spain (2001), and Italy (2009).

1.17.1.2 Pilot selection for the WAG gyrocopter air race

Within the framework of the FAI, each air sport has an FAI Air Sport Commission (ASC) responsible for making the rules for competitions, functioning oversights on the championships, record setting activities of their particular air sport, and selection of competitors.

As stated by the FAI, for the 2015 Dubai WAG, a list of qualified competitors, possessing an FAI sporting licence, was provided to the FAI microlight and paramotor commission (CIMA) by the national air sport control (NAC) of each participating State. The WAG selection process is normally based on world ranking lists, and when a selected competitor cannot attend, his NAC is not allowed to choose a replacement. The replacement is chosen by the ASC based on the next best competitor from the reserve list provided by each ASC.

However, for the CIMA, which is responsible for the WAG gyrocopter air race, there was no world-ranking list prior to the 2015 Dubai WAG. As the CIMA was not able to run a qualifying competition before the WAG, the CIMA informed the NACs for their nomination for all three disciplines including paramotor, microlight trikes, and microlight gyrocopter. Each NAC, was responsible for providing the CIMA with the criteria of pilots' selection. This was used by the CIMA in selecting the final list of competitors for the Dubai WAG.

The Dutch NAC informed the Investigation that the selection criteria for the Autogyro pilots was done by the CIMA and that the NAC was not involved. After the pilots were selected, the Dutch pilots were invited by the FAI to take part in the World Air Games. The three Dutch pilots completed the registration process for the WAG themselves, and thereafter, the Dutch NAC was asked to confirm their participation on behalf of the Netherlands. After becoming members, the NAC issued a no objection for the three Dutch pilots to participate in the WAG.

[6] Reference: The general bulletin number *WAG2015_GB-20150615_v0*, issued by the FAI on 15 June 2015

In the microlight gyrocopter class, as the CIMA had received fewer nominations than the available places, it was decided to accept all the competitors provided by the NACs including the Accident Pilot.

1.17.1.3 The gyrocopter air race discipline

For the 2015 Dubai WAG, it was the first time that the FAI had approved the gyrocopter air race. As per the FAI CIMA policy, an event director was appointed for the air race together with stewards to assist the event director. Duties and responsibilities for the event director and stewards are mentioned in the FAI *Sporting Code,* general section, chapter 4, paragraphs 4.3.4.1 and 4.3.4.2.

Before the WAG, the event director carried out a risk assessment which was presented to the FAI and the DCAA. The assessment included overwater engine failure. It was also stated in the risk assessment, that for a hazard of the aircraft landing in the water, a consequence can be drowning of the pilot and the mitigation was determined by making available multiple rescue boats to be strategically located, having an emergency plan in place, and the training of rescue staff, divers and life jackets. The Investigation was not provided with a risk assessment that included loss of aircraft control and impact with the water including underwater recovery of an incapacitated pilot.

The verification of the event director of the flight competency of the participating pilots was limited to inspection of the pilot's licence and medical records. As part of his pre-race briefing, the event director provided safety guidelines about the operation of the gyrocopters used in the WAG, including flying within the envelope as mentioned in the *POH*. Therefore, all pilots were required to be aware of the gyrocopter limitations before commencing flight.

All of the competing pilots for the gyrocopter air race selected by the CIMA commission, were in possession of a FAI sporting license and their respective national foreign light sport aircraft license.

Two locations were used for the gyrocopter air race: racing over the water which was conducted at Dubai Skydive facility located at Palm Jumeirah, and racing over land which was conducted at the Skydive Desert Campus. The Accident occurred over the water at Palm Jumeirah.

According to the WAG program, two days were reserved before the competition as practice flights at the Desert Campus, and four days (between 4 and 9 December 2015) for the air race competition.

The full sequence of the air race required the gyrocopter pilots to fly all stages consecutively. Initially, the pilots lined up the gyrocopter behind a one-meter tape and then took off passing through the start gate above the one-meter tape where the pilots timing started. The pilots then flew round the 8-pylon course passing through the finish gate at 90 degrees to the runway.

Thereafter, the gyrocopter was turned for 270 degrees and decelerated to over fly along the runway. The pilots were then required to pass along the runway through the finish gate at minimum speed. At this stage, the gyrocopter should climb to 1,000 feet, turn 360 degrees, and then fly towards the specific landing area on the runway with the engine turned off. The final stage requires the pilot to pass through the start of runway, turn 360 degrees to land back on runway. Each pilot's final placing in the race was based on the time taken to complete the course in addition to time given in case of incurred penalties. (Figure 1 shows the course used for the air race pattern, pylons A to H, over the water).

The event director[7] stated that the Pilot flew five uneventful flights before the Accident flight: two practice flights over land, two competitive flights over land and one competitive flight over water. Each flight was one takeoff and landing and the average elapsed time of the practice flights was 10 minutes and approximately three minutes for the competitive flights.

1.17.2 The Flying Club – gyrocopter operation

For the gyrocopter air race during the WAG, the Flying Club provided two UAE-registered gyrocopters, A6-GY0 and A6-GY9. The Club issued a temporary authorization to the Pilot stating that he was authorized to fly the UAE-registered gyrocopter. The Club made a reference to *CAR* Part II, subpart D[8], in the temporary authorization.

Paragraph 2.2.2 of the Club's GCAA-accepted *Operational Manual (*revision 2, dated 4 April 2015) stated that one of the responsibilities of the technical manager is the authorization of the appropriate pilot permit. Part 17 of the *Operational Manual – Light Sports Aircraft (LSA) Pilot Permit*, provides details for the Club on how to issue the LSA permit.

The GCAA approval certificate, issued 14 July 2015 which was current during the WAG, under *Operational Specifications*, did not mention that the Club was an approved training facility authorized to issue light sport aircraft licenses and permits. The GCAA informed the Investigation that, as the Flying Club was not approved as a training institute, the Club could not issue an LSA license/permit as mentioned in *CAR* Part II, chapter 10[9]. At the time of the Accident, the GCAA stated that there was only one flying club in the UAE that was allowed by the GCAA to issue an LSA permit for UAE pilots.

1.17.3 GCAA and DCAA oversight

The EAF had informed the GCAA about the 2015 Dubai WAG championship and listed the expected activities as well as the aircraft types. The EAF listed the gyrocopter event under the light aircraft activity.

Thereafter, a no-objection letter was issued by the DCAA to the EAF endorsing the WAG, and providing the EAF with details about the DCAA responsibilities during the WAG with reference to GCAA *CAAP 15*. The DCAA also stated to the EAF that the UAE *Civil Aviation Law* requires aerobatic aircraft operation authorization from the DCAA in accordance with the terms prescribed by the GCAA.

The DCAA authorisation also stated that:

> "For any Flying Display, the compliance with these GCAA terms shall be the responsibility of the DCA. The DCA must satisfy itself that the organizer of a Flying Display and the participating pilots, are competent and conduct their aerial activities in accordance with DCA instructions and these terms. The DCA is required to ensure the UAE GHQ is notified and has issued any necessary permission and the applicable ATS has been notified and approval granted for flight above 250 knots below 10,000 ft if appropriate."

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7 During the WAG the FAI assigns an event director for each category of air race to supervise the competition

8 The Investigation could not find a UAE regulation referring to *CAR* Part II, subpart D, and believes that this may have been a typographical error

9 *CAR* Part II, chapter 10 Arabic version was issued on 7 June 2015 with an effective date of one year after the official publication. The English version for *CAR* Part II, chapter 10 was issued April 2016 and revised September 2016 with an effective date of 1 January 2017. *CAR* PART II, chapter 10, English version, states that *CAR* Part II, chapter 10 supersedes *CAR* Part IV – *Special Purpose*, section D – *Ultralight and Microlight Operations*

A list of all the competing gyrocopter pilots, including information about their license and medical records, was presented by the EAF to the DCAA for validation. After reviewing the pilots' competencies, and eight days before the start of the practice flights, the DCAA issued a no-objection for the gyrocopter discipline and for the competing pilots. The DCAA informed the Investigation that as they were not competent to determine the pilots' skill level, they relied on the selection process performed by the CIMA, together with feedback and observations from the discipline event director. The Investigation was unable to determine whether the pilots flying experience had been reviewed against the requirements of *CAAP 15*.

Four days before the start of the WAG, the DCAA applied for a no-objection to the GCAA under the title *CAAP 15 – Flying Displays*. The application contained information about the Dubai WAG 2015, and stated that the DCAA would be accepting the responsibility to ensure that safety assessments were carried out for each discipline[10] and that risks would be mitigated. A waiver was also requested by the DCAA for *CAR* Part III, chapter 2, paragraphs 2.3 – *Minimum Heights*, 2.5 – *Dropping or Spraying*, 2.8 – *Aerobatic Flights*, and 2.9 – *Formation Flights*. Another application for waiver from the requirements of these paragraphs was presented by the DCAA to the GCAA for dispensation in the navigation discipline event for general aviation[11] pilots to allow foreign pilots to participate in the WAG.

1.17.3.1 GCAA no-objection

The GCAA issued a no-objection letter on 30 November 2015, addressed to the DCAA, under the subject *World Air Games 2015*. In this no-objection, the GCAA stated that the event was to be conducted in accordance with the specific provisions of the *CAR* Part III relevant guidelines as promulgated by *CAAP 15* and *CAR* Part III, chapter 6 – *Foreign Civil Aircraft Operations in the UAE*.

In addition, the DCAA was responsible for ensuring that:

- All participating display pilots to be authorized by the DCAA;
- All microlight operations shall be conducted in accordance with *CAR* Part III –*Special Purpose Operations*, section D[12];
- All A6 registered microlight operations responsibility shall remain with Emirates Aerosport Federation;
- All aerobatic flights shall be conducted in accordance with *CAR* Part III, paragraph 2.8, with the exception of a waiver[13];
- Any pilot who is required to obtain a validation to fly a UAE registered aircraft shall not operate without a specific GCAA approval.

A list of participating general aviation foreign licenced pilots was submitted by the DCAA to the GCAA for validation. Based on this list, the GCAA granted to the DCAA a temporary authorization for a list of foreign licensed pilots applicable to operate Cessna C-172 only.

[10] Each discipline event director had submitted its own event details and risk/safety assessment

[11] *CAR* Part I defines general aviation as an aircraft operation other than a commercial air transportation or an aerial work operation

[12] The Investigation could not find *CAR* Part III, section D, and this was probably a typographical error. The reference should have been *CAR* Part IV, section D

[13] A waiver was issued by the GCAA to the DCAA allowing aerobatic overwater flight with a minimum height of 300 feet, within the proposed area of the WAG aerobatic box for Palm Jumeirah Corniche, in visual meteorological, day flight only

As two UAE-registered gyrocopters, including the Accident Aircraft, were participating in the WAG gyrocopter air race, the Investigation did not find evidence that there was a request for a GCAA approval from the DCAA to allow the foreign gyrocopter pilots to fly UAE-registered aircraft. The DCAA stated that at the time of the event, no specific pilot was delegated to the Autogyro as supplied by the Flying Club and the two aircraft were due to be on standby for competitors who may need to use them.

'Microlight' is not defined in the *CAR* or in *CAAP 15*. However, it is stated in paragraph 1.1.2 (c)(5) of *CAR* Part IV, section D[14], that the key definition of a microlight is an aircraft that is not capable of exceeding 75 knots (139 km per hour) calibrated airspeed, at full power, in level flight. The Accident Aircraft was certified by the manufacturer with a maximum never exceed speed (V_{NE}) of 100 knots (185 km per hour).

1.17.3.2 *CAAP 15 – Flying Display*[15]

Article 24 of the *Civil Aviation Law* of the United Arab Emirates requires that aerobatic, flight formations or displays be authorized by the DCA in accordance with the terms prescribed by the GCAA.

As per the UAE *Civil Aviation Law*, the Appropriate Authority is the concerned authority for civil aviation in the respective Emirate. For the Emirate of Dubai, the Appropriate Authority is the Dubai Civil Aviation Authority.

Guidance on flying displays can be found in *CAAP 15* and was the referenced document used by the DCAA to request a no-objection from the GCAA for the WAG. The GCAA does not have a specific regulation nor advisory publication related to air racing.

It is stated in *CAAP 15* that:

> "This *CAAP* applies to all flying displays, where aircraft are flown in proximity to the public or spectators and may include low flying, aerobatics, formation, or special activities unique to that aircraft. It would normally include air shows, open days (normally, but not necessarily at aerodromes) and promotional events but need not include stand-alone individual demonstration flights of an aircraft's capabilities. The conduct of low flying, aerobatics, formation, or special activities unique to that aircraft, where there is no public involvement (including practice for Flying Displays), still requires DCA authorization and conduct in accordance with GCAA terms."

Flying display is defined in *CAAP 15* as "Any flying activity deliberately performed for the purpose of providing an exhibition or entertainment at an event open to the public. This definition also applies to specific practice prior to the event."

For flying displays, *CAAP 15* gives guidance for the safety and administrative procedures to be followed by both the Appropriate Authority and the event organiser, known as the Flying Display Director, and participants in such events.

[14] *CAR* Part IV, section D, was issued in January 2004 and was withdrawn from the UAE regulations in April 2016

[15] *CAAP 15* available at the time of the Accident on 9 December 2015 was issued on 1 November 2003. This is the referenced CAAP 15 used by the DCAA. In February 2017, *CAAP 15* was revised and published on the GCAA website as 'issue 02'

Information in *CAAP 15* is based on the *Civil Aviation Publication (CAP) 403*[16] issued by the United Kingdom Civil Aviation Authority, and also gives reference to the Joint Aviation Authorities (JAA) *Temporary Guidance Leaflet (TGL) No. 5*[17].

Concerning the conduct of Flying Displays, the following is stated in *CAAP 15*:

> "Note 1: All Flying Displays are authorised by the Appropriate Authority. However, a condition of the authorisation is notification to the GCAA by the Appropriate Authority and a Letter of No Objection to the Appropriate Authority from the GCAA.
>
> Note 2: Waivers and authorisations from the GCAA in respect to specific Flying Display participants and manoeuvres are required and application must be made by the Appropriate Authority on behalf of the participant."

In addition to the specifics for flying displays, it is mentioned in *CAAP 15* that the skill levels required by the pilots are those defined by the Commission Internationale de Voltige Aerienne (CIVA) of the FAI. Without giving a specific CIVA reference, there are no other guidelines in the *CAAP* to assist the local DCA on how to determine the skill level required for air racing.

CAAP 15, Section 16 – *Recreational Aircraft Events*, states in paragraph 16.1 – *General*:

> "For the purpose of this Section, recreational aircraft events include microlight aircraft, ultralight aircraft, gyrocopters and home built aircraft, which may or may not be registered aircraft. The terms included in this Section are applicable for a Flying Display in which recreational aircraft participate or as a standalone event. Notification of a recreational aircraft event, whether including a Flying Display element or not, must be made to the appropriate DCA."

Paragraph 16.2.7 in *CAAP 15* states that the DCA shall ensure that each pilot participating in an air race, contest, or display shall have at least 45 hours as pilot-in-command of aeroplanes or microlight aeroplanes, out of which five hours have been flown on the type of microlight aeroplane to be flown at the event.

Before to the Dubai WAG 2015, the Pilot had accumulated 20:23 flight hours as pilot-in-command including five hours in the MTOsport gyrocopter.

During the gyrocopter air race, after takeoff, the course was flown at an altitude just above 100 feet. Paragraph 14.6.2 of *CAAP 15 – Setting of Minimum Heights,* states that for flying displays that are held away from the aerodrome, the DCA shall impose minimum heights of 200 feet above ground level over land and 100 feet above surface level water. The Investigation could not verify if this was referred to by the GCAA or the DCAA during the WAG.

There are no minimum heights mentioned in *CAAP 15* for air racing. In paragraph 3.6 in *CAR* Part III, chapter 3 – *Visual Flight Rules*, minimum safe heights, it is stated that except for takeoff or landing, or when/as authorized by the GCAA, no person shall operate an aircraft under visual flight rule below the following heights:

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[16] UK CAA *CAP 403* that is referenced in the revised *CAAP 15*, was issue 02, dated May 2016. Subsequently, there was another revision to *CAP 403* in February 2017

[17] Reference in *CAAP 15* is also made to *TGL No. 5*. The Investigation noted that this reference could not be found.

> "(a) Anywhere: A height allowing, if an engine fails, an emergency landing without hazard to persons or property on the surface.
>
> (b) Over Congested Areas: Over any congested area of a city, town, or settlement, or over any open air assembly of persons, a height of 1000 feet above the highest obstacle within a horizontal radius of 600 metres (2000 feet) of the aircraft.
>
> (c) Over Other Than Congested Areas: A height of 500 feet above the surface."

Section 7.4.3 in *CAAP 15* mentions that the GCAA involvement with the event requires that the DCA allow the GCAA to attend the final briefing to ensure that all the terms of *CAAP 15* are complied with. In addition, the *CAAP* states that GCAA representative(s) shall be able to attend the displays and have access to the flying display event director and DCA coordinators. The Investigation could not verify whether GCAA inspectors performed an oversight function during the Dubai WAG.

1.18 Additional Information

An independent investigation into this Accident was carried out by the Royal Netherlands Aeronautical Association (RNAA), and a report (titled *Accident Autogyro A6-GY0 at the FAI – World Air Games 9 December 2015*) was issued on 1 February 2016 and made available to the AAIS Investigation. The RNAA based their investigation on interviews and available multimedia material.

Similar to this Annex 13 Investigation, the RNAA intention in their investigation was to formulate neutral recommendations for the FAI safety expert group with the objective of limiting accidents from reoccurring and to enhance safety for the World Air Games. The content of the RNAA investigation report is not reproduced in this Final Report except for the recommendations which can be found in Appendix 1.

1.19 Useful or Effective Investigation Techniques

The Investigation was conducted in accordance with the Legislation and *Civil Aviation Regulations* of the United Arab Emirates using the AAIS-approved policies and procedures, and in accordance with the Standards and Recommended practices of *Annex 13 to the Chicago Convention*.

2. Analysis

2.1 General

Flying displays and air racing require a high level of professionalism and dedication. Sporting event flying is performed to a level where competitors employ beyond normal flying techniques and operate the aircraft near to its flight envelope limits.

Air races involving different aircraft categories including microlights, ultralights, and balloons, are attractive events which many States like to host. The United Arab Emirates has been the venue for many of these events, including the Red Bull Air Race. Preparation for such activities requires competent organizational management together with a robust emergency response plan.

Mitigation of the hazards associated with flying displays and air racing requires the support of the General Civil Aviation Authority (GCAA), the local Department of Civil Aviation (DCA), and other essential support services.

This section of the Report discusses the operational aspects of the Accident flight, human factors, survival aspects, and air racing policy by the FAI and within the United Arab Emirates.

2.2 Operational aspects of the Accident Flight

According to eyewitnesses, including the event discipline director, the Pilot was in a normal condition prior to the Accident flight. His previous flights during the practice sessions and the air race were achieved uneventfully.

The Aircraft was airworthy and had accumulated 18:16 total hours since new.

Weather limitations for visual flight rules operation were met and the weather was not a factor in the Accident.

From the videos and photographs for the Accident flight which were made available to the Investigation, the Pilot's helmet chin strap was seen to be unsecured by the chin straps and it remained unsecured for the duration of the flight. The Pilot was probably preoccupied mentally with preparations for the air race and, as no preflight checklist was used, he most likely overlooked securing his helmet straps.

There were three opportunities where the unsecured helmet was not noticed prior to take off. The first was when the pilot interacted with his accompanying team members after getting into the Aircraft; the second was when he received clearance to taxi from a WAG steward; and the third opportunity was when he proceeded to the air race steward before getting clearance to enter the runway. After the Accident, the helmet was retrieved and the straps were observed to be intact with no evidence of fraying. The locking mechanism of the buckle was tested and found to functioning normally.

The takeoff and the initial maneuvers following the race course until the fourth pylon were performed without any apparent difficulties except for instability in the left hand turns. As the Aircraft approached the fourth pylon (pylon G), the airspeed was close to 170 km per hour. The Aircraft entered the left turn in an out of balance condition, with an airspeed close to 151 km per hour, and with full engine power applied. This exposed the right side of the Aircraft fuselage to a substantial amount of airflow, which increased the yaw and caused the fuselage to move away from the vertical axis of the rotor blades. Left rudder was either applied by the Pilot or the rudder was pushed out by the resultant airflow and the Aircraft rolled to the right. At this stage of the flight, the Aircraft was effectively travelling sideways and the rotor disc was no longer receiving airflow, hence there was a reduction in rotor rpm.

Simultaneously, the Pilot's helmet slipped off his head which distracted his attention. He immediately removed his left hand from the throttle control as he tried to get hold of the helmet and the Aircraft is seen in a pitch-up attitude. The Pilot applied left control stick input which returned the rotors to adopt a flat attitude, thus causing unloading of the rotors. The Aircraft forward airspeed dropped to zero with the engine at full power.

The Pilot then pushed the stick rapidly forward and to the left, maybe with the intention to increase airspeed, which effectively caused unloading of the rotors again. This would have created a zero or negative g-force and once more the rotor disc was flat. The Aircraft suddenly climbed by approximately 80 feet and with no loading, the rotor rpm decayed rapidly.

The initial significant yaw was recovered by the Pilot, however, the subsequent action of pushing the stick fully and rapidly forward to the control limits, was inappropriate and resulted in a low g-force situation, loss of rotor rpm, loss of engine power, and loss of control at an altitude from which recovery was not possible.

Because the stick was already to the left and against the stick stops, the rotor disk could not be returned to a level attitude, and the aerodynamic loading on the side of the Aircraft was much higher than that on the rotor, so the rollover continued. The negative g-force caused an engine power loss, and a sudden loss of torque roll had adversely added to the problem.

The Aircraft rolled right, descended and inverted. The Pilot correctly pulled the stick back to force air into the rotor disk and in order to accelerate the rotor. This action would have allowed the Aircraft to recover from the induced loop. As the Aircraft approached the sea, the rotor rpm and airspeed were observed increasing as an indication of an attempt to recover the Aircraft attitude but the height remaining was insufficient for recovery. The Pilot was unable to regain control and the Aircraft impacted the water at a speed of approximately 90 km per hour.

A review of the actions taken by the Pilot, after losing his helmet, was analyzed by the manufacturer and based on an estimated take-off weight of 375 kg, the calculated main rotor rpm for this weight and the weather conditions was 360 rpm. As the engine was at maximum power, it was generating 170 kg of static thrust which would have sustained the Aircraft in a high nose-up attitude, thus reducing the rotor loading and rotor speed.

Normally, the rotor speed will decrease to match the air loading and descent rate of the Aircraft. As per the manufacturer, this drop is approximately 10 percent. However, when the airspeed suddenly reduced from above 140 km per hour to zero, the initial rotor speed which was just above 400 rpm, resulted in the Aircraft climbing followed by a drop in the rotor speed to correct for the loading condition.

The appropriate Pilot reaction should have been to move the control stick slightly forward allowing the airspeed to gradually increase. Instead, the Pilot rapidly moved the control stick forward to the limit stop. As the Aircraft had zero forward airspeed, this deprived the rotor of necessary airflow. Accordingly, the rotor speed slowed and the Pilot was unable to recover control.

The Investigation could not determine whether the Pilot was adequately aware of the *pilot operating handbook (POH)* warnings and limitations in avoiding abrupt manoeuvres. He was probably startled by the sudden loss of the helmet and his reactions thereafter for upset recovery adversely affected the continued safe operation of the Aircraft.

2.3 Human Factors

2.3.1 Selection of pilots

The Dubai World Air Games (WAG) 2015 was the first competition experience for the Pilot. It is possible that his limited experience as a pilot-in-command (approximately 20

hours), the demands of the race, his desire to perform up to the team expectations and to impress the audience, had influenced his performance. The Pilot was aware that his final ranking would be determined by completing the course within the shortest time with the minimum penalties.

From the Pilot's flight log, most of his hours as a single pilot were accumulated from August 2015 until the end of November 2015, including flights on MTOsport aircraft. Two months before the WAG, the Pilot flew seven days for a total of eight hours in his home country. Considering that his experience as a single pilot was 20 hours, it is possible that his level of preparedness was insufficient for the demands of the gyrocopter air race.

The Pilot was selected as one of three pilots from the Netherlands for the gyrocopter air race. The FAI sporting commission accepted his recommendation even though there had been no qualifying competition prior to the WAG by the FAI.

Air racing involves flying aircraft at low altitudes, and close to their flight envelope limitations, therefore, pilots and aircraft participating in air racing are prone to more risk than the normal operations. It is possible that the performance of a pilot will be affected by factors including training, pilot-in-command hours and race course practice time.

Other factors can be peer pressure caused by the national loyalty level, the club expectation, the sponsor demands, or the psychological pressure of performing to an audience. Although the Investigation could not determine the contribution level of each of these factors on the Pilot's performance, the Investigation believes that pilot selection criteria should be enhanced to ensure that appropriately skilled and competent pilots are selected in order to minimize the risk associated with air racing.

The AAIS recommends that the FAI review the process of mitigating the risk involved with competitive gyrocopter air racing and establish an enhanced procedure for pilot selection by the State national sport body as well as the responsible FAI air sport commission.

2.4 Survival Aspects

2.4.1 Emergency response plan

The Aircraft sank within six seconds of impact. The effect of the impact on the Pilot was not determined. There was no deployment of the life jacket and the Pilot's seat belt strap was still in place, which may indicate that the Pilot did not attempt to liberate himself, most probably, as a result of losing consciousness due to the impact.

The Search and Rescue team arrived at the Accident site within 40 seconds, and the first diver was in the water 72 seconds after the impact. The Rescue team stated that they had faced difficulties in locating the Aircraft due to limited underwater visibility. The Pilot was recovered after 10 minutes, and cardiopulmonary resuscitation (CPR) was applied approximately two minutes after he was placed in the rescue boat.

As the Dubai WAG 2015, was held at an aerodrome without a GCAA accepted landing area, there was no regulatory requirement to operate an emergency response plan.

Before the WAG, the gyrocopter air race event director carried out a risk assessment which concluded that an appropriate search and rescue team, including divers, to be available during the event in case of an aircraft landing in the water, a consequence of which can be drowning of the pilot. Training was also mentioned as part of the risk mitigation. However, the divers who recovered the Pilot had no knowledge of the Aircraft nor of the Aircraft seat belt restraint mechanism. Recovery of an unconscious pilot from beneath the surface was not addressed in the risk assessment. Consequently, no specific need to train the rescue team for such conditions was identified, and no mock exercises were performed prior to the start of the WAG.

For the WAG, it is an international competitive air-sporting event involving calculated risk, the organization of such games requires a well-prepared search and rescue team. This is even more critical when flights are conducted over water. Thus, it is essential that the FAI as well as the WAG delegated organizers engage the necessary experts with the objective of having set emergency standards and procedures as guidelines. This should include critical review of the risk assessments and risk mitigation as well as having established safety guidelines for the search and rescue team members.

The AAIS recommends that the FAI develop and publish an emergency response plan (ERP) for sporting events and ensure that roles and duties are defined.

The AAIS also recommends that the FAI review the policy of accepting Federations to organize any World Air Games. These Federations should fulfil the condition of being registered in a State national civil aviation authority and demonstrate that they have the ability to perform the necessary safety oversight during the WAG.

2.4.2 Safety enhancements for the WAG

The competitive nature of an air race, requires detailed safety procedures to ascertain safety of the pilots, the aircraft, as well as the audience and public within the vicinity of the flying area. The FAI has recognized that safety enhancements are required, thus, has accordingly established a committee responsible for achieving a reduction in the number and seriousness of accidents and incidents for future air sport activities. However, for the Dubai WAG 2015, the involvement of the FAI with safety enhancements was not verified by the Investigation.

From the collected evidence, the Pilot had entered the Aircraft and after performing, the cockpit checks started the engine. At some point before taxi out, he should have confirmed that this helmet was secured. The Aircraft *POH*, which is not used as part of the pre-flight check, contained a reminder for pilots to ensure that the helmet was secured. However, video footage did show that the before-taxi checks were memory based and no hard copy checklist was used. Another opportunity was missed for the Pilot's helmet security when he taxied the Aircraft and reported to the race course steward prior to the take-off clearance. There was no safety checks performed at this time, and shortly after, the Pilot taxied the Aircraft to the runway.

In addition, as the WAG flying display event director was mainly focused on the operational aspect of the games, there should have been an independent safety officer and team members responsible for ensuring that the safety standards are maintained throughout the competition. As noted by the commitment made for safety during the Dubai WAG 2015, the DCAA had assumed this responsibility.

During his safety briefing to the pilots, the gyrocopter air race event director stressed the importance of pilots being aware of the aircraft limitations. However, the responsibility rested with each pilot to ensure that they reviewed this information. The Investigation could not confirm if the Pilot had reviewed the *POH* and was aware of the limitations of the Accident Aircraft.

For the various categories of aircraft participating in the WAG, and for pilot safety, the FAI should ensure that pilots are made aware of the limitations of each aircraft. The Investigation highlights this point especially as the WAG is held approximately every four years, in different States, using local and foreign registered aircraft.

The AAIS recommends that the FAI establish and operate a safety management system which should include a reporting mechanism accessible to all competitors and supporting staff at the sporting events. In addition, the FAI should establish safety policies and

procedures, including a pre-flight checklist, to be followed by the pilots as well as the race course stewards before an aircraft is allowed to take off.

2.4.3 Pilot safety during gyrocopter air race

The different aircraft operating manuals warn the pilots against exceeding the gyrocopter flight envelope or published limitations, but the possibility still exists that pilots can make inputs that may take the aircraft beyond the envelope or limitations.

The Accident Pilot had continuously flown the Aircraft in the yellow arc area and during the approach to the final pylon the speed was close to 170 km per hour. As per the Aircraft *POH*, the yellow arc extends from 120 to 185 km per hour, whereas the green arc extends from 30 to 120 km per hour. Even if the Pilot had kept the Aircraft airspeed in the green arc, in case of an impact, the chances of survivability would have been doubtful especially as the Pilot personal protection was minimal, except for the seat restraint harness.

The Aircraft had impacted the water during its recovery from the vertical nose dive, at a speed of 90 km per hour. Even at this speed, with the open design of the gyrocopter and without any enhanced safety features for air racing, the possibility of fatal injury to the pilot is significant.

The various kinds of safety equipment used including helmets, life jackets, seat restraint harness, there should be some commonality with the equipment used, without compromising safety of the pilot. This will make it easier for training of the pilots as well as for the search and rescue team.

As some gyrocopters were open to air and without a canopy, the helmet should offer the pilot a means for head and face protection. The helmet of the Accident Pilot helmet was an open face helmet, without a visor, and may not have given the necessary protection to his head and face in case of an accident

When flights are overwater, the FAI sporting commission should ensure that the appropriate life jackets are worn.

The AAIS recommends that the FAI consider if gyrocopters with a canopy offer increased protection for pilots and until there are specific gyrocopters designed for air racing, should review and possibly limit the airspeed and minimum height at which pilots are allowed to fly.

The AAIS recommends that the FAI review the pilots' personal safety and consider the appropriate kinds of helmets. The FAI is also recommended to carry out a safety study for the need of gloves and if a g-force resistant suit will offer additional protection for the pilots. Similar to the red bull air racing under the FAI, the pilots taking part in any air racing should be appropriately equipped.

The AAIS recommends that the FAI review the requirements for the pilots to wear an appropriate life jacket for flights over water and require that all pilots involved in displays and competition flying undergo water survival training, which includes underwater rollover training.

2.5 Air Racing Policy in the United Arab Emirates

2.5.1 The GCAA involvement and publications

2.5.1.1 Regulations and publications

The GCAA had published *CAAP 15* as a guidance material for local DCAs for flying displays. The GCAA did not promulgate specific regulations for air racing. The definition of flying display in *CAAP 15* did not indicate that the intent of the *CAAP* was for air racing as it is

mentioned that the flying activity, including practise flights, is performed for the purpose of providing an exhibition or entertainment at an event open to the public. Thus, the details found in the *CAAP* did not have additional guidelines for air events involving competitions in general and light sport aircraft category.

The FAI sporting commission classified the gyrocopter under the category of microlight. The GCAA definition of microlight as stated in the cancelled *CAR* Part IV, section D, was an aircraft not capable of exceeding 139 km per hour. Therefore, according to this definition, the Accident gyrocopter should not have been classified as a microlight as it was capable of exceeding 139 km per hour. As *CAR* Part IV, section D, has been withdrawn, the only other reference that could be used to classify a gyrocopter was stated in *CAR* Part II, chapter 10 which described a gyrocopter as a light sport aircraft, rotor wing category.

In the general introduction of section 16, *CAAP 15* stated that the flying of gyrocopters is included under recreational aircraft events. Paragraph 16.2.7 of the *CAAP*, required that a pilot taking part in an air race shall have a minimum of 45 hours experience as pilot-in-command of aeroplanes, or microlight aeroplanes, of which five hours must be on the type to be flown at the event. However, *CAAP 15* did not clearly state the intent of this paragraph, as there was no definition of microlight aeroplanes.

In issuing the GCAA's no-objection letter for the Dubai WAG 2015 to the DCAA, reference was made to several *CARs* and GCAA publications including *CAR* Parts III and IV, and *CAAP 15*. The Investigation also referred to *CAR* Part IX and *CAAP 72* for aerodromes, and *CAR* Part II, chapter 10 for light sports aircraft. In addition, for the WAG, the GCAA issued a waiver for general aviation aerobatic flights specifying a minimum height of 300 feet. The Investigation noted that the GCAA no-objection letter contained a reference to *CAR* Part III – *Special Purpose Operations*, section D, which did not exist. The Flying Club had also made a similar mistake when they issued the temporary authorization for the Pilot license quoting a non-existing regulation, *CAR* Part II, subpart D. These were most probably typographical mistakes.

A requirement was also contained in the GCAA's no-objection letter to include all UAE-registered microlight operations under the responsibility of the EAF. As the EAF was not a GCAA-approved agency, nor was it a flying club, the intent in assigning this responsibility was not made clear to the Investigation, nor what was meant by microlight operations.

CAAP 15 contained details about liaison with emergency services during a flying display. However, in issuing the GCAA no-objection letter the safety enforcement statement was not mentioned because, probably, the DCAA, in its request for the no-objection, had implied that appropriate risk assessments had been performed and that safety would not be compromised. The Investigation recommends that for flying displays and air sporting events, especially as these events can be held at aerodromes without an emergency response plan, the appropriate DCA should provide an acceptable emergency response plan to the GCAA.

The revised *CAAP 15* (issued in February 2017) as well as the *CAAP* that was effective on the day of the Accident, make reference to the United Kingdom Civil Aviation Authority *CAP 403* and to a non-existing *temporary guidance leaflet No. 5* issued by the former European Joint Aviation Authority. In addition, the revised *CAAP 15* refers to *CAR* Part IV, section D, which was withdrawn from the regulations library in April 2016. The withdrawal of section D is also mentioned in the current *CAR* Part II, chapter 10. The Investigation noted that there were other ambiguities within *CAAP 15* which could create confusion and possibly lead to errors being committed by the local Department of Civil Aviation.

The AAIS recommends that the GCAA review and standardize the process of issuing no-objection letters for flying displays and air race events so that the local DCA can be guided appropriately. This should include the requirement to have in place an emergency response plan which includes evidence of training, staffing, agreements, and exercises.

The AAIS recommends that the GCAA review and enhance the regulations and publications for flying displays and air racing events within the UAE for light sports aircraft and general aviation and standardize the definitions used in the regulations and publications.

2.5.1.2 Licensing

The GCAA does not have a specific regulatory unit responsible for licensing of pilots involved in light sports aircraft flying. This responsibility has been delegated to the certificated GCAA flying club based on the requirements established by the GCAA licensing department. As such, the approved flying club is required to have an established training department as per *CAR* Part II, chapter 10.

However, air sporting and flying display pilots who possess flying licenses issued by States, other than the State of aircraft registry, required validation of their foreign license. The acceptable means of compliance with the GCAA requirements were not clearly defined, except for what is mentioned in *CAAP 15* for flying display pilots. The *CAAP* requires the participating display pilots to be authorized by the local DCA. In conformity with the *CAAP*, the DCAA issued a no-objection letter for the Dubai WAG 2015 gyrocopter pilots.

The only information mentioned in the regulations regarding flying a foreign light sports aircraft in the UAE was in CAR Part II Chapter 10 - *Light Sports Aircraft*, and it stated that a no-objection is required from the GCAA to operate a foreign-registered light sport aircraft in the UAE. No guidance material was provided by the GCAA on the requirements for a foreign licensed light sports aircraft pilot to fly a UAE-registered aircraft. However, one day before the start of the WAG, the GCAA did inform the DCAA that any pilot who was required to obtain a validation to fly a UAE-registered aircraft shall not operate without a specific GCAA approval. Had this information been published for light sports aircraft foreign pilots, similar to the waivers requested by the DCAA prior to the start of the WAG, it is most likely that the DCAA would have also requested GCAA approval for the foreign gyrocopter pilots to fly UAE-registered aircraft. The failure by the DCAA in not requesting a no-objection for the gyrocopter pilots from the GCAA could have been due to a lack of understanding of the requirements involving light sport aircraft activities and the no-objection delegated to the DCAA by the GCAA under *CAAP 15*.

This misunderstanding of light sports aircraft pilot licensing was also exhibited by the Flying Club as they had issued a temporary authorization stating that the Accident Pilot was permitted to fly a UAE-registered light sport aircraft. Even though the Flying Club's *Operational Specifications,* which were approved by the GCAA, did not include the issuance of light sport aircraft permits or licenses, the Club probably assumed that they had the authority to issue the temporary authorization for the Pilot as the GCAA-accepted Club *operations manual* contained details related to issuing a light sport aircraft permit.

The GCAA should clarify the requirements for foreign licensed light sports aircraft pilots to enable them to fly UAE-registered aircraft.

The AAIS recommends that the GCAA review the process of flying club application in order to ensure that the GCAA-accepted *operations manual* does not contradict the approval granted to clubs by the GCAA.

2.5.1.3 Minimum heights

A request was made by the DCAA to the GCAA for a waiver of *CAR* Part II, chapter 2, paragraph 2.3 – *Minimum Heights*, and paragraph 2.8 – *Aerobatic Flights*, for flights during the WAG including general aviation flights. The waiver granted by the GCAA specifically mentions that the waiver was to require aerobatic flights being flown over water to maintain a minimum height of 300 feet within the proposed area of the WAG aerobatic box for the Palm Jumeirah Corniche in visual meteorological daylight flight only.

For the Dubai WAG 2015 gyrocopter air race, there was no restriction on the minimum height to be flown during the race. After takeoff, and based on the video footage, the course was flown at an average of 100 feet height over water. As the air race is not considered an aerobatics activity, nor was it a general aviation activity, the waiver granted by the GCAA was not applicable. This means that the gyrocopter air race was flown without a GCAA waiver. The minimum heights mentioned in *CAAP 15*, paragraph 14.6.2. was not relevant for the gyrocopter air race as this was applicable only during flying displays.

An additional reference of minimum heights is mentioned in *CAR* Part III, chapter 3 –*Visual Flight Rules*, which states that for UAE-registered aircraft, and except for takeoff and landing, the aircraft shall maintain a minimum height of 500 feet. If the course was flown at this height, it may have allowed the Pilot to recover the Aircraft as it appeared that the Accident Aircraft was recovering towards a safe flight attitude just before impact.

Although the gyrocopter racing event was not a flying display, based on the GCAA definition of flying display, there should have been a request to the GCAA to hold the gyrocopter air race, in addition to a request for a waiver of the minimum height requirement.

The AAIS recommends that the GCAA review the current process of waiver granting and the provision of guidelines for the DCAs related to minimum heights for aerobatics, flying displays and air racing events.

2.5.1.4 Control of light sports aircraft activities

Within the United Arab Emirates, light sports aircraft activities are the responsibility of the GCAA approved flying clubs. The GCAA had delegated to a specific club the right to issue light aerosport licences and permits to pilots. Regarding flying displays and air racing, as per *CAAP 15*, the organization of such activities is delegated to the respective Emirate Department of Civil Aviation.

The number of Light aerosport flying by the public and aero sporting events has increased in the UAE over the last five years. In addition, other aero sporting events have been held in the UAE including the FAI Red Bull air race, the 2015 FAI World Air Games and international parachuting competitions.

There is no established aerosport federation within the UAE. Internationally, there are examples whereby the responsible Civil Aviation Competent Authority delegating the responsibility for control, oversight and establishment of relevant rules and guidelines to a single and united federation. Together with the relevant State regulations, the establishment of a GCAA approved and accepted UAE federation responsible for all aero sporting events and light sport activities will offer significant safety benefits.

The AAIS recommends that the GCAA study the benefits and establishment of a united federation within the UAE to monitor and control all light sports aircraft activities, including flying displays and air racing.

2.5.1.5 Responsibilities of the local DCAs

In requesting for the no-objection to host the WAG, the DCAA, being the responsible appropriate authority, made reference to *CAAP 15* and assured the GCAA that a safety assessment for each WAG discipline was carried out and necessary mitigations put in place. However, the risk assessment for the gyrocopter air race did not examine appropriate mitigations in case of an overwater accident. The Investigation could not determine the level of involvement of the DCAA in harmonizing communications and expected safety requirements based on the risk mitigation identified as part of the risk assessment performed for the gyrocopter air race.

The DCAA, similar to other departments of civil aviation in the UAE, does not have the necessary expertise to perform the requirements contained in *CAAP 15*, which require that the DCA is to ensure that the participating pilots are competent to conduct the aerial activities in accordance with the DCA's instructions. Thus, they depend on other professional persons or entities to assist in making such decisions. In issuing the no-objection letter for the participating gyrocopter pilots, the DCAA based this decision on the selection process followed by the FAI CIMA including advice from the event discipline director. However, as *CAAP 15* was the referenced document being used by the DCAA, a GCAA waiver should have been requested against the 45 flight hours' pilot-in-command requirement from the GCAA to allow the accident Pilot to take part in the air race as he had accumulated only 20.23 hours. As mentioned previously, this oversight by the DCAA could have been due to a misunderstanding for pilots involved in light sports aircraft activities which included the gyrocopter pilots.

As *CAAP 15* does not provide specific guidelines on how to determine the skill level of a flying display or air race pilot, the authority delegated to the DCA by the GCAA requires clarity so that there are enhanced guidelines. This will enable the DCA to have a structured approach in assessing the competency of pilots especially as the DCAs lack subject matter experts.

The AAIS recommends that the GCAA review the responsibilities, including the issuance of no-objections, delegated to the local Departments of Civil Aviation regarding air sporting and flying display events.

The AAIS recommends that the GCAA enhance the guidelines for air sporting and flying display events regarding the determination of pilot flying skill level and competency.

3. Conclusions

3.1 General

From the evidence available, the following findings, causes and contributing factors were made with respect to this Accident. These shall not be read as apportioning blame or liability to any particular organization or individual.

To serve the objective of this Investigation, the following sections are included in the conclusions heading:

- **Findings.** Statements of all significant conditions, events or circumstances in this Accident. The findings are significant steps in this Accident sequence but they are not always causal or indicate deficiencies.
- **Causes.** Actions, omissions, events, conditions, or a combination thereof, which led to this Accident.
- **Contributing factors.** Actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the Accident, or mitigated the severity of the consequences of the Accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 The Aircraft

a) The Aircraft was registered, certificated, equipped, and maintained in accordance with the current requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

b) The Aircraft was airworthy for the flight.

c) The Aircraft was leased to the Emirates Sports Federation by the Flying Club for the duration of the World Air Games.

d) The Aircraft was registered on 30 November 2015 and had accumulated 18:16 flight hours before the Accident.

e) The manufacturer *pilot operating handbook (POH)* contained several warnings advising the pilot to maintain adequate rotor loading during the entire flight.

f) There was a warning in the *POH* to avoid any maneuver which would result in a low g-force near weightlessness.

g) Aerobatic flights are prohibited according to the *POH.*

h) The Aircraft suffered damage beyond repair because of impact and prolonged underwater time.

3.2.2 The Pilot

a) The Pilot was qualified to fly an MTOsport gyrocopter.

b) The Pilot possessed a microlight helicopter license issued by the Civil Aviation Authority of the Netherlands including a valid class 2 medical certificate.

c) The Pilot possessed a sporting license issued by the Fédération Aéronautique Internationale.

d) The Pilot's logbook recorded a total of 52:38 flight hours, which consisted of 31:20 dual hours and 21:18 solo hours.

e) The Pilot had completed five flights (two practise and three air races) on UAE-registered MTOsport gyrocopters.

f) The Pilot had been issued a temporary authorization by the Flying Club permitting him to fly UAE-registered MTOsport gyrocopters.

g) The Pilot license and medical records were validated by the DCAA.

h) The Pilot foreign license was not presented to the GCAA for validation.

3.2.3 Flight Operations – Air Race

a) The weather and visibility conditions were met for visual flight and were not a factor in the accident.

b) The aerodrome selected by the EAF to be used during the World Air Games did not have a GCAA landing area acceptance, nor was it certified.

c) There was no requirement to have a pre-flight checklist to be completed by the Pilot, nor by the steward who released the Aircraft for takeoff.

d) The Pilot's helmet was not secured prior to the takeoff.

e) The engine was kept at maximum speed for the duration of the flight until the Accident.

f) The Aircraft was flown at an average height of 100 feet above sea level for the duration of the race.

g) The Aircraft was flown out of balance during the left hand turns.

h) The Aircraft speed was in the yellow band area of 151 km per hour as it entered the final left turn of the race.

i) The helmet flew off the Pilot's head as the Aircraft entered a high-speed maneuver during the air race.

j) The Aircraft suffered negative g-force after the pilot lost his helmet.

k) The Pilot's control inputs caused unloading of the rotors and the rotor speed to drop.

l) The Aircraft impacted the water at approximately 90 km per hour and sank within 6 seconds.

3.2.4 The Flying Club

a) The Flying Club was the owner of the Accident Aircraft which was leased to the EAF for the World Air Games.

b) A *Permit to Fly* was issued for the Aircraft by the Flying Club.

c) The maintenance of the Aircraft during the World Air Games was performed by the Club.

d) The Club was approved by the GCAA for light sports aircraft operations.

e) The Club's GCAA-accepted *operational manual*, contained details on how to issue a pilot light sport aircraft permit.

f) The Club did not have a training department approved by the GCAA.

g) The Club had issued the Pilot a *temporary authorization* permitting him to fly a UAE-registered aircraft.

h) The club made reference to a nonexistent *CAR* Part II, subpart D, for the Pilot's temporary authorization.

3.2.5 The Emirates Aerosport Federation (EAF)

a) The EAF was established in 2012 as a non-profit organization to coordinate aerosport in the United Arab Emirates.

b) The EAF was not approved by the GCAA.

c) The FAI awarded the Dubai World Air Games 2015 to the EAF.

d) The EAF had provided information about the World Air Games to the GCAA including the expected air sport activities.

e) The EAF did not have an emergency response plan in place for the World Air Games.

3.2.6 The Fédération Aéronautique Internationale (FAI)

a) The responsibility of the World Air Games comes under the rules and regulations established by the FAI sporting commission.

b) The FAI classifies the gyrocopter under microlights.

c) The FAI sporting commission responsible for microlights and paramotors is known as CIMA.

d) The CIMA is responsible for selecting the competitors for the World Air Games.

e) The CIMA did not have a world ranking list of competitors for the gyrocopter air race discipline.

f) For the gyrocopter air race, all nominated pilots were accepted by the CIMA.

g) There was no qualifying gyrocopter air race performed prior to the 2015 Dubai World Air Games.

h) The FAI did not have an emergency response plan, safety management system or reporting system for the World Air Games.

3.2.7 The Dubai Civil Aviation Authority (DCAA)

a) The DCAA issued a no-objection letter to EAF recognizing the organization management oversight of the appointed flying display event director for the Dubai World Air Games 2015.

b) The DCAA referred to *CAAP 15 – Flying Display*, indicating the DCAA responsibilities to the EAF during the World Air Games.

c) The DCAA issued a no-objection letter for the gyrocopter pilots.

d) As per *CAAP 15*, the DCAA was required to ensure that each pilot taking part in a race, contest, or display, had gained at least 45 hours as pilot-in-command of aeroplanes or microlight aeroplanes.

e) The risk assessment performed by the event discipline director for the gyrocopter air race was reviewed by the DCAA.

f) The DCAA requested a dispensation from the GCAA for the list of general aviation foreign licenced pilots taking part in the World Air Games.

g) Four days before the start of the World Air Games, the DCAA made a request for a no-objection to the GCAA with the subject – *CAAP 15 Flying Displays*.

h) The DCAA informed the GCAA that they accepted responsibility of the World Air Games ensuring that safety assessments for each discipline had been carried out.

i) The DCAA requested GCAA waivers from the requirements of paragraphs 2.3 – *Minimum Heights*, 2.5 – *Dropping or Spraying*, 2.8 – *Aerobatic Flights*, and 2.9 – *Formation Flights* of *CAR* Part III, chapter 2.

j) The DCAA was granted the no-objection letter for the 2015 World Air Games by the GCAA one day before the start of the Games.

k) The DCAA was granted a waiver by the GCAA for *CAR* Part III, paragraph 2.8, allowing aerobatic flights to operate at a minimum of 300 feet over water.

l) Except for general aviation navigation flights, the Investigation did not find evidence that the DCAA requested the GCAA to validate and authorize foreign licensed pilots flying the UAE-registered AutoGyro aircraft.

3.2.8 The General Civil Aviation Authority of the United Arab Emirates (GCAA)

a) The GCAA was made aware of the World Air Games by the EAF and the DCAA.

b) The reference material published by the GCAA for flying displays was *CAAP 15*.

c) *CAAP 15* refers to the *CAP 403* issued by the Civil Aviation Authority of the United Kingdom and to a non-existent Joint Aviation Authorities *Temporary Guidance Leaflet (TGL) No.5.*

d) The GCAA did not promulgate any separate publication for air racing.

e) The GCAA had issued a no-objection letter for the World Air Games at the request of the DCAA.

f) The GCAA issued a temporary authorization for the foreign licensed pilots flying general aviation on Cessna C-172 participating during the World Air Games.

g) There was no explicit definition of microlight in the no-objection letter issued by the GCAA to the DCAA.

h) As per *CAR* Part IV, section D, a gyrocopter was not considered a microlight as its maximum speed was more than 139 km per hour.

i) *CAAP 15* permitted flying below the published minimum heights mentioned in *CAR* Part III, chapter 3 – *Visual Flight Rules*, for off-aerodrome flying displays. This allowed a minimum height of 100 feet above water.

j) *CAR* Part III, chapter 3 – *Visual Flight Rules*, allowed a flight at, other than over congested areas, a minimum height of 500 feet.

k) *CAAP 15* did not give specifics on how to determine the skill level of a flying display or air race pilot.

l) The GCAA does not issue licenses or permits for pilots of light sports aircraft.

m) The GCAA did not have guidance on the requirements for a foreign pilot in the light sport aircraft category to fly a UAE-registered aircraft.

n) The Flying Club GCAA-accepted *operational manual*, contained details on how to issue a light sport aircraft pilot permit.

3.2.9 Survivability

a) The risk assessment for the gyrocopter air race did not have any risk mitigation in case of an accident on water and retrieval of an unconscious Pilot from under the water.

b) No training exercises were carried out by the search and rescue team that rescued the Pilot.

c) The search and rescue team were not familiar with the gyrocopter restraint harness mechanism, nor how to release the Pilot from the harness.

d) The Pilot was not wearing any survival equipment except for a helmet and life jacket of 150N value, both of which were supplied by the Flying Club.

e) The first rescue diver entered the water 72 seconds after the impact.

f) Poor visibility under the surface of the 20-foot depth of water delayed retrieval of the Pilot.

g) The Pilot was found strapped in his seat by the restraint harness.

h) The Pilot was unconscious when he was removed from the water.

i) The Pilot was submerged for approximately 10 minutes.

j) Medical tests performed on the Pilot did not reveal any abnormalities.

3.3 Causes

The Air Accident Investigation Sector determines that the most probable cause of the Accident was due to the pilot losing control of the Aircraft as he attempted a high speed unbalanced left hand turn and becoming distracted, at the same time, due to the loss of his helmet. Subsequently, the sudden control stick input to the left and against the stops caused the Aircraft to lose lift from the rotors, enter negative g-loading and suffer a loss of engine power causing the Aircraft to roll and dive, impacting the water at high speed.

3.4 Contributory Factors

The Air Accident Investigation Sector determines that the following factors contributed to the Accident or the severity of its consequences:

- The Pilot was most likely not sufficiently experienced to fly the gyrocopter in an air race as he had just over 20 hours of pilot-in-command time for the gyrocopter;
- The Pilot selection process was lacking robust procedures as all pilots who had been nominated, irrespective of experience, were allowed to compete by the FAI;
- The Pilot was allowed to fly even though he had less than the 45 hours of pilot-in-command experience flying a gyrocopter as stipulated in GCAA *CAAP 15*;
- The race course did not have a safe height established and most of the flight was performed at an average of 100 feet above the water.
- Most of the flight was flown at speeds in the yellow precautionary range in excess of 120 km per hour.

4. Safety Recommendations

4.1 General

The safety recommendations listed in this Report are proposed according to paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation*, and are based on the Analysis and Conclusions mentioned in this Report; the GCAA expects that all safety issues identified by the Investigation are addressed by the receiving States and organizations.

4.2 Final Report Safety Recommendations

The Air Accident Investigation Sector recommends that:

4.2.1 The Fédération Aéronautique Internationale:

SR39/2017

Review the process of mitigating the risks involved in competitive gyrocopter air racing and establish an enhanced procedure for pilot selection by the State national sporting body as well as the responsible FAI air sport commission.

SR40/2017

Develop and publish for all sporting events; an emergency response plan; safety management system; and reporting system.

SR41/2017

Review the policy of accepting federations as organizers of the World Air Games, to ensure that the federations fulfil the condition of being registered with a State national civil aviation authority under a well-established certification, approval, and oversight system.

SR42/2017

Establish safety guidelines which include pre-flight checklists to be completed by the pilots, as well as the race course stewards, before an aircraft is cleared for takeoff.

SR43/2017

Consider whether gyrocopters with a canopy offer increased protection for pilots and, until there are specific gyrocopters designed for air racing, review and limit the maximum airspeed and minimum height at which pilots are allowed to fly.

SR44/2017

Review the pilot's personal safety equipment and training which should include; the use of life jackets for flights overwater; water survival training; use of appropriate helmets; and whether flying gloves and g-force suits will offer additional protection for the pilots.

4.2.2 The General Civil Aviation Authority of the United Arab Emirates (GCAA):

SR45/2017

Review and enhance the regulations and publications for flying displays and air racing events within the UAE for light sports aircraft and general aviation; including the waiver and no-objection process; minimum heights; determination of pilot flying skill level and competency; and standardize the definitions used in the regulations and publications.

SR46/2017

Review and standardize the process of issuing no-objection letters for a flying display and air race events so that the local Department of Civil Aviation can be guided accordingly. This should include the requirement to have an emergency response plan with evidence of training, staffing, agreements and exercises.

SR47/2017

Publish requirements enabling foreign licensed pilots to fly UAE-registered light sports aircraft.

SR48/2017

Review the process of flying club application in order to ensure that the GCAA-accepted *operations manual* does not contradict the clubs' approval granted by the GCAA.

SR49/2017

Establish a national federation within the UAE to monitor and control all light aero sporting activities including flying displays and air racing.

SR50/2017

Review the authority delegated by the GCAA to the local UAE departments of civil aviation under *CAAP 15* in order to maintain an acceptable level of competency in regulating flying displays and air racing across the United Arab Emirates.

This Report is issued by:

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General Civil Aviation Authority
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Appendix 1. RNAA Recommendations

The following seven recommendations were included in the investigation report issued by Royal Netherlands Aeronautical Association (RNAA) on 1 February 2016.

4. RECOMMENDATIONS

4.1. FAI-ERP
It is recommended that the FAI develops an Emergency Response Plan (ERP) including all scenario's, different parties, disciplines, nationalities and their roles once involved in a competition- or WAG- incident or accident.

4.2. Evaluation of FAI-ERP
Before each contest or WAG the actual FAI ERP shall be examined, tested and evaluated at the applicable location together with local authorities.

4.3. Sharing FAI-ERP
FAI ERP conditions were applicable shall be shared with all competitors before the start of the competition / games.

4.4. FAI – Safety Management System
It is recommended that the FAI Safety Expert Group (SEG), in line with the FAI's mission and objectives (see par 1.5 and 1.6, this report) and the FAI – Safety Management Policy and Goals (see par 1.7, this report),
- adopts a Safety Management System (SMS) as defined by ICAO SARP doc 9859; SMS requirements as applicable for General Aviation and Sport Flying (art 3.3.1) issued 2013 and
- to make this FAI-SMS globally available and accessible to all FAI members.

4.5. Incident Reporting System
In order to install a solid FAI - Safety Management System the FAI is recommended to adopt an Incident Reporting System which is easy accessible to all competitors and attendees at an FAI competition, WAG event.

4.6. Accessibility Incident Reporting System
It is recommended to make this FAI-Incident Reporting System available to all members of the FAI in order to;
- timely recognize trends which as such may contribute to the overall safety of General Aviation in all disciplines and the overall safety of possible competitions such as the WAG.
- allow FAI members to get used to this FAI-Incident Reporting System what will stimulate a more active usage of the reporting system during competitions such as the WAG.

4.7. Safety Dispatch.
It is recommended to appoint (discipline related) Safety Dispatch Team(s), to;
- evaluate per discipline, per race, including reported incidents and actual situation(s), the planned safety precautions versus the actual required safety precautions
- complete and record a final control of these actual defined precautions before each race in the competition
- check each competitor's safety equipment and the correct usage thereof, before competitors are given clearance, to start and take part in the race.