AIRCRAFT ACCIDENT REPORT

SEIL/2011/05/24/F

Accident Investigation Bureau

Report on the accident involving a Beechcraft C90 with nationality and registration marks N364UZ operated by Shoreline Energy International Limited which occurred at Barakallahu village near Old Kaduna (Military) Airport, Kaduna State, Nigeria on 24th May, 2011.

This report was produced by the Accident Investigation Bureau (AIB), Murtala Muhammed Airport Ikeja, Lagos. The report was based upon the investigation carried out by AIB, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Civil Aviation Act 2006 and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019. In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

Readers are advised that AIB investigates for the sole purpose of enhancing aviation safety. Consequently, AIB reports are confined to matters of safety significance and should not be used for any other purpose.

The AIB believes that safety information is of great value if it is passed on for the use of others. Hence, readers are encouraged to copy or reprint reports for further distribution, acknowledging the AIB as the source.

Safety Recommendations in this report are addressed to the Regulatory Authority of the State, as well as other stakeholders, as appropriate. The Regulatory Authority is the authority that ensures implementation and enforcement.

Printed in Nigeria for the Accident Investigation Bureau (AIB)

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AIB	Accident Investigation Bureau
ABUTH	Ahmadu Bello University Teaching Hospital
AMO	Approved Maintenance Organisation
ATC	Air Traffic Control
DANA	Dornier Aviation Nigerian AIEP
DATCO	Duty Air Traffic Controller
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FOCC	Flight Operations Clearance Certificate
IITA	International Institute for Tropical Agriculture
MCC	Maintenance Clearance Certificate
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
NAF	Nigerian Air Force
NCAA	Nigerian Civil Aviation Authority
SEIL	Shoreline Energy International Limited
VFR	Visual Flight Rules
VMC	Visual Meteorological Condition

Aircraft accident report number:	SEIL/2011/05/24/F
Registered owner and operator:	Shoreline Energy International Ltd
Manufacturer:	Beech Aircraft Corporation
Aircraft type and model:	Beechcraft (King Air) C90
Date of manufacture:	1979
Serial number:	LJ-805
Nationality and registration marks:	N364UZ
Location:	Barakallahu village near Old Kaduna (Military) airport, Kaduna State, Nigeria 10°36′45″N 07°27′49″E
Date and Time:	24th May, 2011 at 12:00hrs *(All Times in this report are local time, equivalent to UTC+1, unless otherwise stated)*

SYNOPSIS

Accident Investigations Bureau (AIB) received notification about the accident on 24 May, 2011 at about 12:30 h; investigators were mobilized.

On 24 May, 2011 at 11:54 h, a Beechcraft C90 aircraft with nationality and registration marks N364UZ, operated by Shoreline Energy International Limited (SEIL), departed

Old Kaduna (Military) airport on a test flight with a pilot and another person onboard, with three hours endurance on a visual flight rules (VFR) flight plan.

At 11:59 h, the aircraft crashed on a farm-land 878 meters short of RWY 23 (military) and engulfed into flames. The two occupants were fatally injured.

Dornier Aviation Nigeria AIEP (DANA) and Nigerian Air Force (NAF) fire-fighting personnel were dispatched immediately. There was no direct access between the runway and the accident site, which delayed the fire trucks from reaching the accident site on time.

The accident occurred in day light in visual meteorological conditions (VMC).

The investigation identified the following causal and contributory factors:

Causal factor

Inability of the pilot to control the aircraft to landing due to inadequate power to enable the pilot maintain the appropriate approach profile (height, speed and glide path) to cover the required distance to threshold.

Contributory factors

1. Non-adherence to approved storage procedure
2. Non-adherence to approved return from storage procedure
3. Inadequate regulatory oversight by the authority on flight operation and maintenance of foreign registered aircraft in Nigeria

Four Safety Recommendations were made.

1.0 FACTUAL INFORMATION

1.1 History of the flight

On 24th May, 2011 at 11:54 h, a Beechcraft C90 aircraft with nationality and registration marks N364UZ, operated by Shoreline Energy International Limited (SEIL), departed Old Kaduna (Military) airport on a test flight with a pilot and another person onboard with three hours fuel endurance. The test flight was on a visual flight rules (VFR) flight plan.

According to an eye witness, the aircraft sound was unusual and the aircraft seemed not to be gaining altitude after takeoff.

Another eye witness (a local farmer), stated that he saw the aircraft moving up and down with increasing and decreasing engine sound. Thereafter, the aircraft impacted a mango tree, turned and crashed. The local farmer further stated that he and some military personnel tried all they could to rescue the occupants inside the aircraft but their efforts were not successful.

At 11:59 h, the aircraft crashed on a farm-land 878 meters short of RWY 23 (military) and engulfed into flames. The two occupants were fatally injured.

Dornier Aviation Nigeria AIEP (DANA) and Nigerian Air Force (NAF) fire-fighting personnel were dispatched immediately. There was no direct access between the runway and the accident site, which delayed the fire trucks from reaching the aircraft at accident site on time.

The accident occurred in day light, in visual meteorological conditions (VMC).

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft
Fatal	2	Nil	2
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	Nil	Nil	Nil
Total	2	Nil	2

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

Farm-land and economic crops were destroyed.

1.5 Personnel information

1.5.1 Pilot

Nationality:	British
Age:	67 years
License:	Airline Transport Pilot Licence (FAA)
Aircraft rating:	Beech 1900D/Airplane Multi engine Land CE500
Instrument rating:	Not Available
Proficiency/Recurrent check:	27th April, 2011
Medical:	Not available

Total flying experience:	Not available
On type:	Not available
Last 90 days:	1 h
Last 28 days:	0.10 h
Last 24 hours:	Nil

The pilot is reported to have flown the aircraft for many years dating from the 1980s. The services of the pilot were retained upon the purchase of the aircraft from International Institute for Tropical Agriculture (IITA) by Shoreline Energy International Limited (SEIL) in November 2009. It was also reported that SEIL hired another pilot to fly as co-pilot on the aircraft due to the advancing age of the pilot.

The pilot's correspondences indicated that his employment ceased to be enforced by SEIL in June, 2010. However, the services of the pilot was still rendered to SEIL with regards to coordinating maintenance of the aircraft and renewal of certificate of insurance.

The services of the pilot were requested to move the aircraft to Farnborough, UK for maintenance (Wing Bolt Inspection/Structural Inspection). This prompted the pilot to go for King Air Pilot Recurrent training in April 2011, after which he proceeded to Kaduna in May, 2011.

Prior to the pilot's arrival at Kaduna, he had expressed his concerns about the aircraft's pitot probe being left uncovered.

Upon arrival at Kaduna on the 17th May, 2011; the pilot described the condition of the aircraft as "is a bit of a mess, but recoverable… returning to UK with a suitcase of avionics and instruments for fixing" and that "All the fuel lines have contaminated and we are cleaning them"

The Bureau has no records of any significant medical history associated with the pilot.

1.6 Aircraft information

1.6.1 General information

Manufacturer:	Beech Aircraft Corporation, USA
Type:	Beechcraft, (King Air) C90
Serial number:	LJ 805
Year of manufacture:	1979
Total airframe time:	9665.39 h
Total landing cycle:	8342
Certificate of insurance:	Not Available
Certificate of Airworthiness Issued (FAA):	3rd April, 2009

The aircraft was acquired from International Institute of Tropical Agriculture (IITA), Ibadan.

The aircraft completed "Phase IV" inspection at DANA facilities in June 2010 and was parked at DANA ramp after few flights. On 7th February, 2011, 200hrs inspection/lubrication was carried out on the request of the Pilot to return the aircraft to service.

On 20th May, 2011, the first test flight was carried out to prepare the aircraft for a ferry flight to the facilities of GAMA Support Services in the United Kingdom to accomplish a "Service Letter" requirement. The flight lasted for 6 minutes. The pilot recorded some snags during the first test flight on a sheet of paper and after the test flight, gave it to the engineers to rectify. See Appendix A: List of Snags

According to report, the Pilot carried out inspections and released the aircraft for flight.

1.6.2 Engines

Engine	Number 1	Number 2
Manufacturer	Pratt & Whitney, Canada	Pratt & Whitney, Canada
Type/Model	PT6A-21	PT6A-21
Serial number	PC-E 24581	PC-E 24586
Time since new	9665.33 h	9665.33 h
Cycle since new	8341	8341

1.6.3 Propellers

Propellers	Number 1	Number 2
Type	Hartzell HC-D4N-3C/D9290K	Hartzell HC-D4N-3C/D9290K
Serial number	FY 3032	FY 3038
Time since new	9665.33 h	9665.33 h
Time since overhaul	158.06	158.06
Number of blades	4	4

1.7 Meteorological information

The meteorological information for Old Kaduna (Military) Airport for the day of the accident was given as:

Time:	**11:00 h**
Wind:	230°/08kt
Visibility:	18km
Weather:	Nil
Cloud :	BKN 330m
Temp/dew point:	29°/21^{0}C
QNH:	1016 hPa

Time:	**12:00 h**
Wind:	220/06kt
Visibility:	18km
Weather:	Nil
Cloud :	BKN 390m
Temp/dew point:	30/22^{0}C
QNH:	1015 hPa

1.8 Aids to navigation

There were no available records to indicate the condition of the navigational aids at the time of the occurrence.

1.9 Communications

Tower frequency was reported serviceable and there was good communication between the aircraft and Air Traffic Control (ATC). The ATC recording facility of the Old Kaduna (Military) airport was reported unserviceable on the day of the accident.

1.10 Aerodrome information

Old Kaduna (Military) airport has a single runway with designation 05/23, coordinates 10°35′55″ N and 07°26′55″ E. The runway has a dimension of 2700 m by 31 m with asphalt surface. It serves mostly the Nigerian Air Force and is home for DANA operations.

Operation of the airport is restricted to daylight only, confined to altitudes below 4000 ft on QNH and coordinated with civil Duty Air Traffic Control (DATCO).

The Western Line of Nigeria's Railway network passes adjacent the aerodrome with a part of it crossing the extended runway center line at about 800 m from the threshold.

1.11 Flight recorders

The aircraft was not equipped with a Flight Data Recorder or a Cockpit Voice Recorder. Neither recorder was required by the regulations.

1.12 Wreckage and impact information

The aircraft crashed on a farmland which was occupied with crops and economic trees.

The aircraft struck a mango tree at about 854 meters to RWY 23 threshold. The propeller of the right engine was detached and the propeller blades of the left engine were bent backwards.

After striking the mango tree, the aircraft turned west and travelled 35 ft before impacting the ground. The aircraft came to rest at about 843 m to RWY 23 threshold. The wreckage was largely in one piece.

The aircraft was completely burnt except the tail section.

Figure 1: Burnt fuselage of the aircraft

Figure 2: Tail section of the aircraft

Figure 3: Aircraft wreckage in relation to mango tree

Figure 4: The Mango tree impacted by the aircraft before the crash

Figure 5: Detached right propeller blade assembly

Figure 6: Left engine propeller blades bent backward

1.13 Medical and pathological information

The autopsy for the crew was conducted by the Pathology Department of Ahmadu Bello University Teaching Hospital (ABUTH), Zaria on the 27 May, 2011. Examination of the cardiovascular system for the pilot revealed *the heart appear grossly normal… the left coronary artery is patent and devoid of atherosclerotic plaque or occluding thrombus. The remaining major blood vessels show no abnormality.* It showed that both the pilot and the other occupant died of severe burns.

Toxicological examination revealed no alcohol and/or drugs abuse.

The remains of the pilot and the other occupant were positively identified using forensic dental identification on the 2 June, 2011 at the Nigerian Airforce Hospital, Kaduna.

On 8 July, 2011 another autopsy was performed on the pilot at Bedford Hospital, United Kingdom. The following was observed by the examiner *A number of fractures which I believe to be ante-mortem in nature; these particularly include a fracture of the base of the skull, a fracture of the thoracic spine and some posterior rib fractures on both sides. If these injuries are indeed genuine, I believe is likely, they would be consistent with having been caused when the aircraft struck the ground. The basal skull fracture is indicative of a severe impact to the head, and it is my opinion that it is likely that it would have rendered him at least unconscious from the moment of impact, if not actually proving fatal.*

It goes on to state *the autopsy examination revealed no other evidence of pre-existing pathology which could have incapacitated the pilot or contributed to the accident in any other way, although the degree of fire damage and decomposition severely hindered the autopsy examination.*

It then states that the cause of death was *head and chest injuries and the effects of fire.*

1.14 Fire

The aircraft was engulfed in flames on impact. DANA and NAF Fire Services were unable to access the crash site in good time due to an unfavorable terrain and a rail line that prevented quick access to the site from the airside. Eye witness account said it took more than 20 minutes before the arrival of the first fire truck by which time the aircraft had been burnt.

1.15 Survival aspects

The crash was not survivable. The aircraft impacted a tree, crashed and immediately went into flames. DANA and NAF firefighting personnel were dispatched immediately but could not access the site after 20 minutes.

The occupants were fatally injured.

1.16 Test and research

No engine investigation was performed.

1.17 Organizational and management information

1.17.1 Shoreline Energy International Limited

Shoreline Energy International Ltd. (SEIL), the owner of the aircraft, is involved in oil exploration across the West and Central African regions. The company uses the aircraft to transport its personnel on official assignments within and outside Nigeria.

SEIL contracted maintenance of the aircraft in Nigeria to DANA, Kaduna for routine maintenance for a period of twelve months effective from 1 January 2010.

SEIL also designated the pilot as the "Attorney" and he had responsibility of liaison with both DANA and GAMA Support Services for all maintenance obligations on the aircraft in addition to his responsibility for all the aircraft operational requirements.

1.17.2 Dornier Aviation Nigeria AIEP Limited (DANA)

Dornier Aviation Nigeria AIEP (DANA) Ltd is a private limited liability company owned by foreign and Nigeria Investors. The company formerly known as AIEP started its aviation business in 1979 at the Old Kaduna (Military) Airport where the company administrative and maintenance base is located.

DANA holds an Air Operator's Certificate issued by the Nigerian Civil Aviation Authority (NCAA), as well as an Approved Maintenance Organisation (AMO), certification No. AMO/5N/DANA valid till 30 March, 2012 for specific aircraft which included line maintenance and 100/200hrs/annual inspections capability on Beechcraft C90 aircraft.

The maintenance of the aircraft was contracted out to DANA to conduct the following:

- All schedule inspection
- All out of phase inspection
- Rectification of faults
- Oxygen/nitrogen services
- Deep cycle of battery
- Interior and exterior cleaning
- Storage of spare parts
- C of A renewal (paperwork, compass swing, etc.) excluding any fees to NCAA/FAA

1.17.2.1 Extract from DANA Maintenance Procedure Manual (MPM) 2.19.5 Test Flights

Section 2.19.5.1 CONDITIONS FOR REQUIRING A TEST FLIGHT

A test flight will be conducted after maintenance has been performed that could affect flight characteristics. Test flight is also required to verify defect that cannot otherwise be confirmed by ground test. Other conditions requiring a test flight are:

(a) When two engines/propellers are changed.
(b) When extreme roughness is reported on an engine and no definite cause can be found.
(c) Outer wing removal or replacement.
(d) Wing tip change (check applicable maintenance manual for requirement).
(e) Wing major repairs.
(f) Fuselage major repairs.
(g) Horizontal and vertical stabilizer-major repairs.
(h) Aileron, rudder, or elevator change.
(i) Airplane buffeting, vibration or flutter reported.
(j) Flight control surface major repair.
(k) Any other condition specified by NCAA, competent Authority or the manufacturer.

Section 2.19.6 TEST FLIGHT PROCEDURE

a) Prior to proceeding with a test flight, the following must be ensured;
  - *i) A certificate of release to service on the job performed had been duly signed by authorised personnel.*
  - *ii) A certificate for fitness for flight has been issued for the test flight.*
  - *iii) A valid insurance cover is in place.*

iv) The relevant checklist for the particular test flight is made available to the test flight crew.

b) *During the flight test, congested population area must be avoided while circuits close to the airport is recommended before extending the test flight to other airports/cities. Flight of this nature should not be extended longer than necessary once the required checklist has been completed. All data/parameters must be recorded as they become available in-flight and not to be memorized for recording after landing.*

1.17.3 Nigerian Civil Aviation Authority (NCAA)

In Nigeria, NCAA is the regulatory body overseeing the activities of all airlines/operators, crew, engineers, navigation aids, all service providers including airport authorities and air traffic services.

1.17.3.1 Extract from Nig.CARs 1.1.1.2 Applicability

(a) These Regulations shall apply to all persons operating or maintaining the following—

(1) Nigeria registered aircraft;

(2) Aircraft registered in another Contracting State that are operated by a person licensed by Nigeria, and must be maintained in accordance with the standards of the aircraft State of Registry, wherever that maintenance is performed;

(3) Aircraft of other Contracting States operating in Nigeria.

6.5.1.7.—(a) A certification of release to service shall be issued by appropriately authorised certifying staff when satisfied that all required maintenance of the aircraft has been properly carried out by the AMO in accordance with the approved data and the AMO Maintenance Procedures Manual.

(b) A certification of release is required at the completion of any maintenance on an aircraft part, component or assembly when off the aircraft.

(c) The release to service to be used for release of an aircraft or aeronautical part, component or assembly shall adhere to the following items—

(1) The certification of release to service shall contain the following statement: Certifies that the work specified was carried out in accordance with current regulations and in respect to that work the aircraft/aircraft component is considered approved for release to service.

(2) The certification of release to service shall reference the data specified in the manufacturer's maintenance instructions or instructions for continued airworthiness.

(3) Where instructions include a requirement to insure that a dimension or test figure is within a specific tolerance as opposed to a general tolerance, the dimension or test figure shall be recorded unless the instruction permits the use of GO/NO gauges. It is not normally sufficient to state that the dimension or the test figure is within tolerance.

(4) The date such maintenance was carried out shall include when the maintenance took place relative to any life or overhaul limitation in terms of date/flying hours/cycles/landings, etc., as appropriate.

(5) When extensive maintenance has been carried out, it is acceptable for the certification of release to service to summarise the maintenance as long as there is a cross-reference to the work package containing full details of maintenance carried out. Dimensional information shall be retained in the work package record.

(6) The person issuing the release to service shall use a full signature and preferably a certification stamp except in the case where a computer release to service system is

used. In this latter case, the Authority will need to be satisfied that only the particular person can electronically issue the release to service.

(7) One such method of compliance with item (c)(6) is the use of a magnetic or optical personal card in conjunction with a personal identity number (PIN) which is keyed into the computer and known only to the individual.

(d) An aeronautical product which has been maintained off the aircraft requires the issue of a certificate of release to service (NCAA Form One) for such maintenance and another certificate of release to service of the aircraft in regard to maintenance being properly accomplished on the aircraft. The release to service of the aircraft shall be made by the AMO in the aircraft technical log maintenance records section.

(e) When a part of component is released to service, the AMO shall complete NCAA Form One as contained in IS: 6.5.1.7.

…

1.17.3.2 Extract from Nig. CARs 8.2.1.9 Operations of Foreign-Registered General Aviation Aircraft.

(a) No person shall operate a foreign-registered aircraft in general aviation in Nigeria except in accordance with the terms and conditions of the Flight Operations Clearance Certificate (FOCC) and the Maintenance Clearance Certificate (MCC) issued by the Authority and in force in respect of that aircraft.

(b) The FOCC and MCC shall be issued for a period not exceeding six (6) months.

(c) The FOCC and MCC will be renewed only once for a maximum period of six (6) months.

….

1.17.3.3 Extract from Nig. CARs 6.5.1.8 Maintenance Records.

(a) The AMO shall record, in a form acceptable to the Authority, all details for maintenance work performed.

(b) The AMO shall provide a copy of each certificate of release to service to the aircraft operator, together with a copy of any specific airworthiness data used for repairs/alterations performed.

(c) The AMO shall retain a copy of all detailed maintenance records and any associated airworthiness data for two years from the date the aircraft or aeronautical product to which the work relates was released from the AMO.

(d) Each person who maintains, performs preventive maintenance, rebuilds, or alters an aircraft/aeronautical product shall make an entry in the maintenance record of that equipment:

(1) A description and reference to data acceptable to the Authority of work performed.

(2) The date of completion of the work performed.

(3) The name of the person performing the work if other than the person specified in this subsection.

(4) If the work performed on the aircraft/aeronautical product has been performed satisfactorily, the signature, certificate number, and kind of certificate held by the person approving the work.

(5) The authorised signature, the AMO certificate number, and kind of licence held by the person approving or disapproving for return to service the aircraft, airframe, aircraft engine, propeller, appliance, component part, or portions thereof.

(6) The signature constitutes the approval for return to service only for the work performed.

(7) In addition to the entry required by this paragraph, major repairs and major alterations shall be entered on a form, and the form disposed of by the person performing the work, in the manner prescribed by the Authority in Part 5:5.7.1.1.

…

1.17.3.4 Extract from Nig. CARs 8.5.1.19 Reporting Mechanical Irregularities.

(a) The PIC shall ensure that all mechanical irregularities occurring during flight time are-

(b) For general aviation operations, entered in the aircraft logbook and disposed of in accordance with the MEL or other approved or prescribed procedure.

...

1.17.3.5 Extract from Nig. CARs Part 12 Sub-paragraph 12.6.15.2

(a) In an emergency plan, the aerodrome operator shall, at a minimum:

(1) identify the potential emergencies, including:

(i) an aircraft accident or incident:

(a) within the aerodrome boundaries, and

(b) within a critical rescue and fire-fighting access area that extends 1000m beyond the ends of a runway and 150m at 90° outwards from the centerline of the runway including any part of that area outside the aerodrome boundaries.

(ii) an aircraft emergency declared by either air traffic services or a pilot,

…

1.17.4 Federal Aviation Administration (FAA)

The aircraft was registered in the United State of America (USA) and an airworthiness certificate was issued with a provision that maintenance and alterations are done under 14CFR parts 21, 43 and 91.

1.17.4.1 Extract from FAR 43.16 Airworthiness Limitations.

Each person performing an inspection or other maintenance specified in an Airworthiness Limitations section of a manufacturer's maintenance manual or Instructions for Continued Airworthiness shall perform the inspection or other maintenance in accordance with that section, or in accordance with operations specifications approved by the Administrator under part 121 or 135, or an inspection program approved under §91.409(e).

…

1.17.4.2 Extract from FAR 91.7 Civil Aircraft Airworthiness.

(a) No person may operate a civil aircraft unless it is in an airworthy condition.

(b) The pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. The pilot in command shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.

…

1.17.4.3 Extract from FAR 91.703 Operations of Civil Aircraft of U.S. Registry outside of the United States.

(a) Each person operating a civil aircraft of U.S. registry outside of the United States shall—

(1) When over the high seas, comply with Annex 2 (Rules of the Air) to the Convention on International Civil Aviation and with §§91.117(c), 91.127, 91.129, and 91.131;

(2) When within a foreign country, comply with the regulations relating to the flight and maneuver of aircraft there in force;

(3) Except for §91.117(a), 91.307(b), 91.309, 91.323, and 91.711, comply with this part so far as it is not inconsistent with applicable regulations of the foreign country where the aircraft is operated or Annex 2 of the Convention on International Civil Aviation;

…

1.17.4.4 Extract from FAR 91.207 Emergency Locator Transmitters.

(a) Except as provided in paragraphs (e) and (f) of this section, no person may operate a U.S.-registered civil airplane unless—

(1) There is attached to the airplane an approved automatic type emergency locator transmitter that is in operable condition for the following operations, except that after June 21, 1995, an emergency locator transmitter that meets the requirements of TSO-C91 may not be used for new installations:

(i) Those operations governed by the supplemental air carrier and commercial operator rules of parts 121 and 125;

(ii) Charter flights governed by the domestic and flag air carrier rules of part 121 of this chapter; and

(iii) Operations governed by part 135 of this chapter; or

(2) For operations other than those specified in paragraph (a)(1) of this section, there must be attached to the airplane an approved personal type or an approved automatic type emergency locator transmitter that is in operable condition, except that after June 21, 1995, an emergency locator transmitter that meets the requirements of TSO-C91 may not be used for new installations.

1.18 Additional Information

1.18.1 Excerpt from KING AIR 90 SERIES MAINTENANCE MANUAL Chapter 10 section 10-00

STORAGE

ENGINE

The engine preservation procedure to be followed depends upon the period of inactivity, the type of preservation used, and whether or not the engines may be rotated during the period of inactivity. To establish the procedure, refer to the preservation records (tags) secured to the engine and the engine service records (logbooks). The anticipated period of inactivity should also be established. Record the type of preservation used on the tags and in the logbook.

CAUTION: Under no circumstances should preservative oil be sprayed into the compressor or turbine sections of the engine. Dirt and other foreign particles adhered by the preservative oil will alter the airfoil shape of the turbine blades and vanes to adversely affect compressor efficiency during engine operation.

LONG-TERM STORAGE (91 DAYS AND LONGER)

Preserve engines inactive longer than 90 days as instructed in INTERMEDIATE-TERM STORAGE. In addition, drain the engine oil and spray the unused accessory drive-ends as follows:

CAUTION: Do not exceed the starter operating time of 30 seconds ON, 5 minutes OFF, 30 seconds ON, 5 minutes OFF, 30 seconds ON, then 30 minutes OFF.

a. Close the fuel shutoff valve and motor the engine until oil pressure and compressor speed (N1) are indicated.

b. Drain the engine oil as instructed in the oil changing procedure (Ref. Chapter 12-10-00).

c. Allow the oil filter element to drain to a slow drip (approximately one-half hour), then install the filter, all drain plugs, and chip detector.

d. Remove the cover plates from the pads of the accessory drives.

e. Spray the exposed surfaces and gear shafts with engine oil (15, Chart 2, 10-00-00) and install the accessory drive cover plates.

f. Tag the oil filter cap with the date of preservation. Enter the date and type of preservation in the engine log book.

g. Install all shipping plugs, caps, and covers to prevent the entry of foreign materials and accumulation of moisture.

h. If the engines are to remain in the airplane, install desiccant bags, humidity indicators, and moisture barriers as instructed in SHORT-TERM STORAGE.

NOTE: Inspect the preserved unit every two weeks if the airplane is stored outside, or every thirty days if the airplane is stored inside. If the relative humidity indicated is less *than 40%, no further action is required. If the humidity indicated is 40% or greater, replace the desiccant bags with freshly activated bags.*

i. If the engines are to be removed, preserve the engines as instructed in the supplier maintenance manual.

AIRPLANE

CAUTION: It is imperative that the storage areas of nickel-cadmium batteries be separated tin different buildings if possible) from lead-acid batteries so that no contamination, even from fumes, is possible.

BATTERY COMPARTMENT

a. Disconnect and remove the nickel-cadmium battery, then place it in a suitable storage area.

b. Clean the battery compartment, quick disconnect plug, cables, and vent hoses with a solution of 5 ounces of boric acid (5, Chart 2, 10-00-00) dissolved in one gallon of water, then rinse with clean water and allow to dry.

c. Seal the battery vent tubes and cover the quick-disconnect plug with barrier material (3, Chart 2, 10-00-00).

FUEL CELLS

a. If the airplane is to be in storage 90 days or less fill the fuel cells to capacity with fuel (6, Chart 2, 10-00-00) to minimize fuel vapor and protect the cell inner liners.

b. If the airplane is to be in storage longer than 90 days, drain the fuel cells, then flush, spray or rub a thin coating of light engine oil (7, Chart 2, 10-00-00) on the inner liners of all fuel cells.

PROPELLERS

a. Remove dirt, oil, and bug accumulation from the propellers with cleaning solvent (8, Chart 2, 10-00-00), then coat the blades with corrosion preventative compound (9, Chart 2, 10-00-00). Wrap the propeller blades with barrier material (3, Chart 2, 10-00-

00) and secure with tape. touch up the propeller spinners with paint as necessary, then secure blades with propeller sling (2, Chart 1, 10-00-00) to prevent rotation.

AVIONICS

Clean and cover with barrier material (3, Chart 2, 10-00-00) any equipment sensitive to dust or moisture. Take any additional precautions recommended by the manufacturer of such equipment.

INSTRUMENTS

If the airplane is to be in storage for more than 90 days, cover the instrument panel with barrier material (3, Chart 2, 10-00-00) and secure with tape.

SEATS

Clean the seats and install protective covers.

STALL WARNING UNIT

If the airplane is to be in storage for 90 days or more, cover the stall warning unit with barrier material (3, Chart 2, 10-00-00) to prevent collection of dust, debris and moisture on the transducer.

LANDING, STROBE AND TAXI LIGHTS

If the airplane is to be in storage for 90 days or longer, cover the landing, strobe, and taxi lights with barrier material (3, Chart 2, 10-00-00) and secure with tape.

FLIGHT CONTROL SURFACES

a. If the airplane is to be in storage up to 90 days, install the control surface locks as instructed in CONTROL LOCKS.

b. If the airplane is to be in storage longer than 90 days, lubricate all hinges, bearings, bell cranks, chains, and quadrants (Ref. Chapter 12-20-00) and apply corrosion preventive compound (9, Chart 2, 10-00-00). Place the flaps in the retracted position.

WING FLAP TRACKS AND ROLLERS

If the airplane is to be in storage over 90 days, apply corrosion preventive compound (9, Chart 2, 10-00-00) to the flaps tracks and rollers. place the flaps in the retracted position.

LANDING GEAR

a. Clean the brakes and apply a coating of primer (10, Chart 2, 10-00-00) to the brake discs.

b. Cover the wheels with barrier material (3, Chart 2, 10-00-00) and secure with tape.

c. Check the air pressure in the tires periodically. It is recommended that unserviceable tires be used for prolonged storage.

CAUTION: Do not apply corrosion preventive compound to the exposed surfaces of the landing gear strut piston or to the extended polished surfaces of the hydraulic cylinders.

d. Coat the exposed surfaces of the shock strut pistons and the nose gear shimmy dampener piston with preservative hydraulic fluid (11, Chart 2, 10-00-00). Cover the surfaces with barrier material and secure with tape.

e. Fabricate a hardwood shock strut collar (4, Chart 1, 10-00-00) for each strut position to prevent bottoming of the strut when deflated. Install the collars over the barrier material. Slowly deflate the struts until they rest on the wooden collars.

HYDRAULIC SYSTEM

Fill the hydraulic reservoir with MIL-H-5606 hydraulic fluid (12, Chart 2, 10-00-00) as instructed (Ref. Chapter 3231-00) and inspect the system for leaks.

LOOSE TOOLS AND EQUIPMENT

If the airplane is to be in storage over 90 days, remove the loose tools and equipment and store them in a room of low humidity.

AIRFRAME

a. Install the air inlet covers (5, Chart 1, 10-00-00).

b. Install the pitot tube covers (6, Chart 1, 10-00-00). Cover the static ports with barrier material (3, Chart 2, 10-0000) and secure with tape.

c. Install the bleed air intake scoop plugs (3, Chart 1, 10-00-00).

d. Clean all exposed antennas and connections.

e. Remove the windshield wipers, wrap with barrier material (3, Chart 2, 10-00-00), and secure with tape. Store the wipers in the cockpit or with the loose tools and equipment.

f. Cover the windows and windshield with strippable coating (13 Chart 2, 10-00-00), or the preferred adhesive paper (14, Chart 2, 10-00-00)

1.18.2 Excerpts from ICAO Doc 9756 "Manual of Aircraft Accident and Incident Investigation, Part III- Investigation First edition – 2011

12.3 PISTON AND TURBINE/PROPELLER ENGINES
12.3.1 A different technique is required to determine if a piston or turbine/propeller engine was under power at the time of impact. Here again a lack of power may appear to be obvious at first inspection (see Figures III-12-29 to III-12-33) and the propeller may even be feathered but this is not conclusive evidence of lack of power available at the engine. Accidents have been caused by crew mistakenly feathering the "good" engine instead of the defective one, so propeller examination must also go along with engine examination. Again it is very unwise to try and conclude power output of a piston, or turbine/propeller engine at the scene of an accident. Engines and propellers should be taken to a capable workshop or laboratory for expert examination or, at the

minimum, a technician with experience in maintaining that engine type should assist in the examination of the engine.

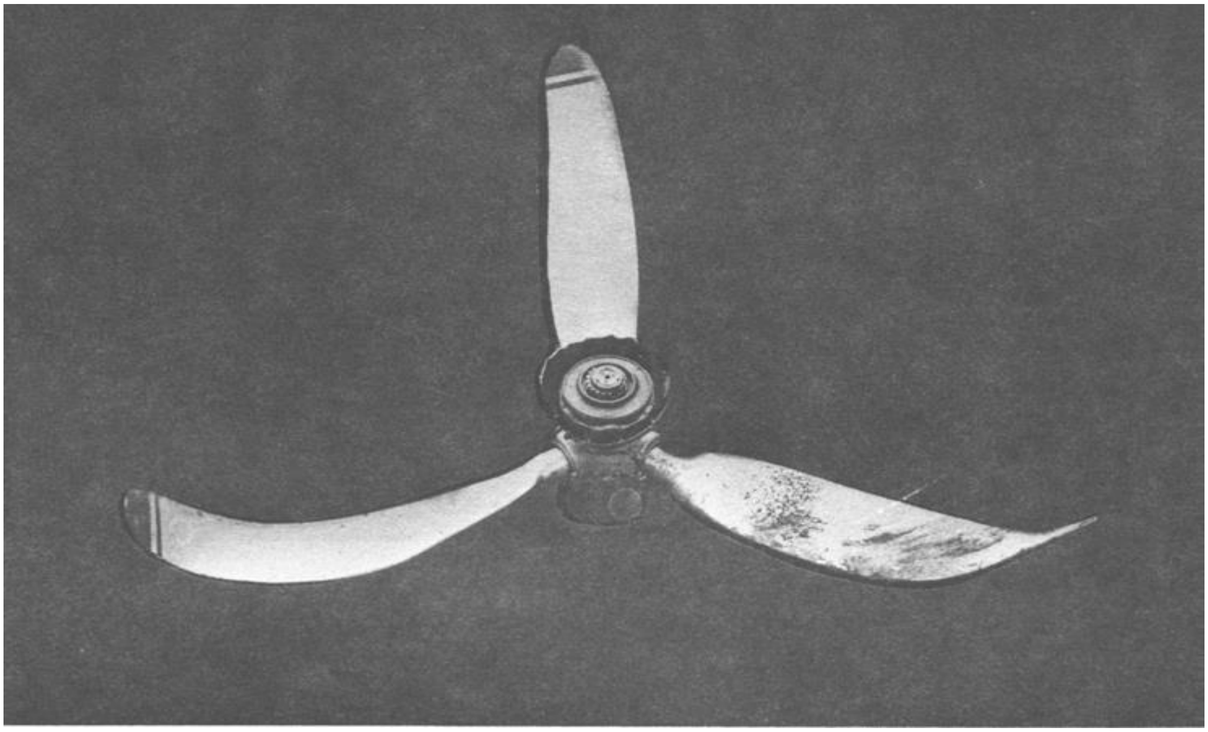

Figure III-12-29. Metal propeller wind milling at impact

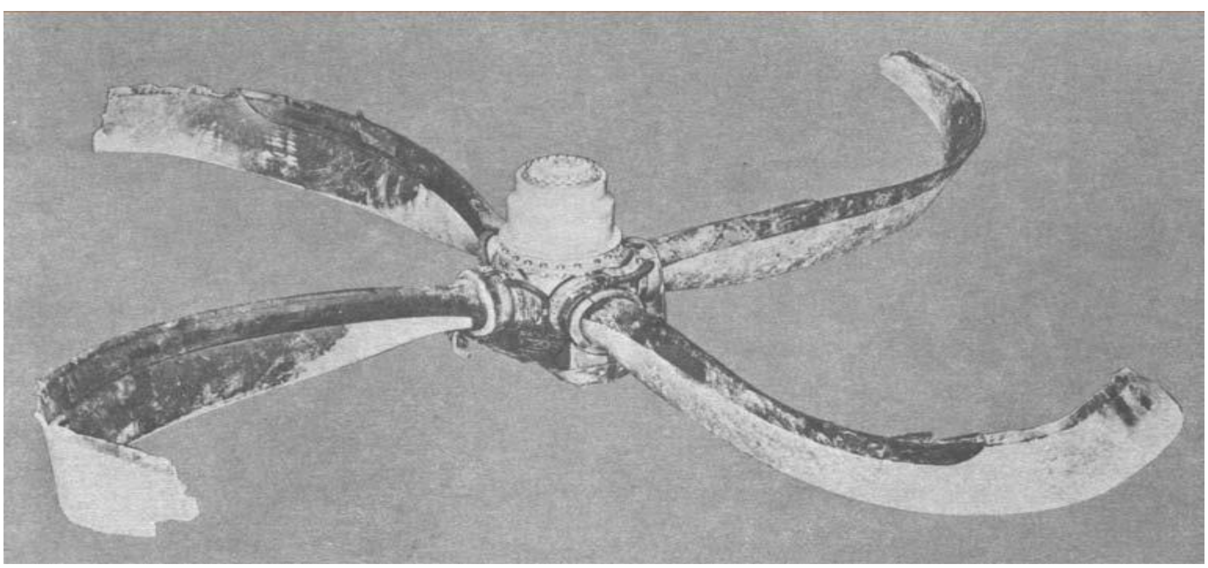

Figure III-12-30. Metal propeller under power at impact

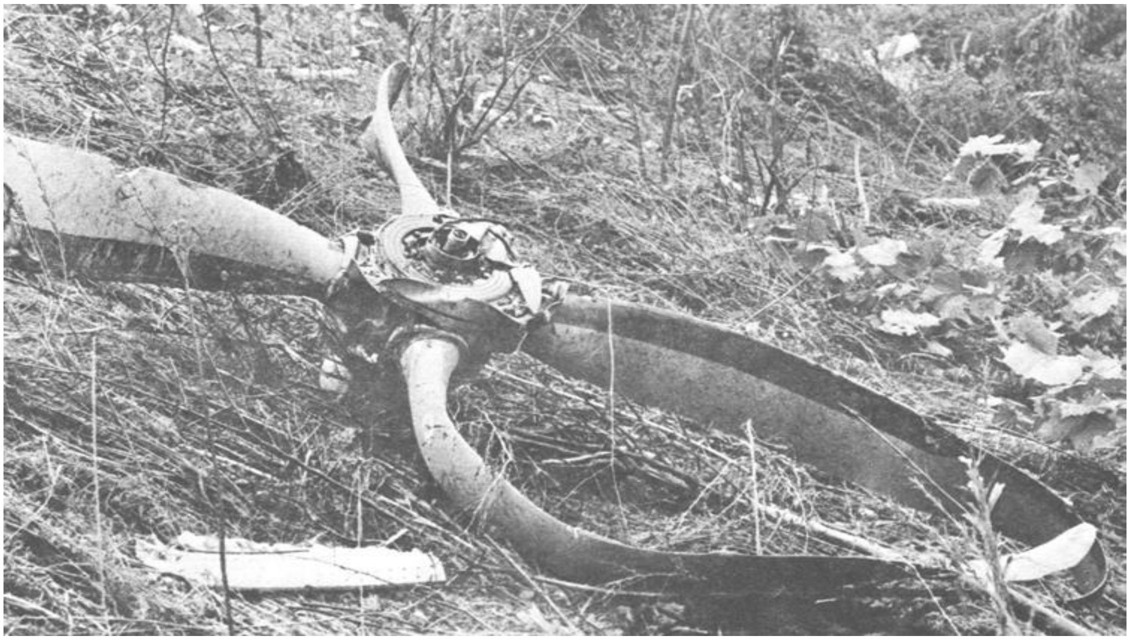

Figure III-12-31. Metal propeller under power at impact

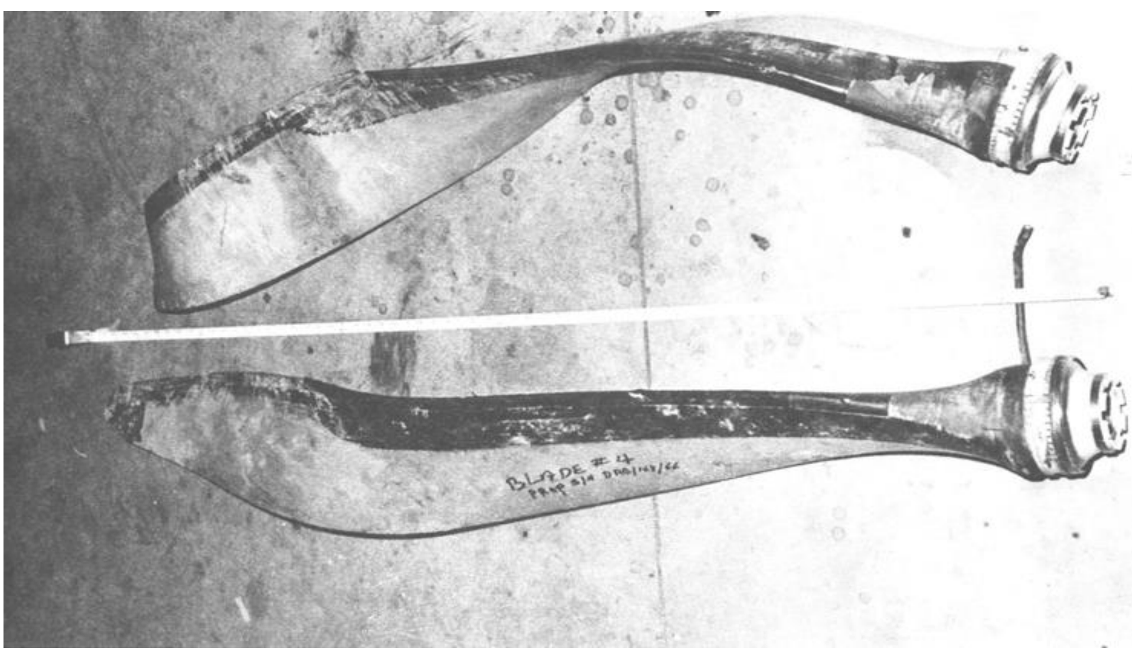

Figure III-12-32. Metal blades 3 and 4 of the previous propeller

12.4 EVIDENCE OBTAINABLE FROM PROPELLER EXAMINATION

12.4.1 When properly correlated with evidence obtained from the engine, examination of the propeller can produce valuable evidence such as:

a) revealing whether power was being produced at time of impact;

b) rpm of the engine (in some cases);

c) propeller blade angle; and

d) ground speed of the aircraft (in some cases).

Examination of blades

12.4.2 The first step in propeller examination is to account for all the blades, particularly the integrity of the tips. If any portion of the blade is missing, the fractures on the recovered portion should be examined with a magnifying glass to determine whether the break occurred in flight or at impact. Evidence of fatigue or tension breaks should be carefully noted.

Determination of rotation at impact

12.4.3 The next step should be an examination to determine whether the propeller was rotating at the time of impact. The most typical indications are as follows:

a) blades bent opposite to the direction of rotation;

b) cord wise scratches on the front side of the blades. It is almost impossible to produce a scratch that is exactly perpendicular to the edges of the blade unless the blade was turning at the time;

c) similar curling or bending at the tips of all blades. (See Figure III-12-35.) It is almost impossible to damage the tips of all blades in a similar manner unless the propeller was turning at the time;

d) dings and dents to the leading edge of the blades; and

e) torsional damage to the prop shaft or attachment fitting;

12.4.4 It must be remembered that the propeller in all probability was turning at impact. Even if the engine failed or was shut down, the propeller will windmill at an rpm high enough to produce these indications of rotation. The exceptions to this are:

a) the propeller was feathered. If this occurred, the propeller will, of course, show no signs of rotation;

b) The propeller was not feathered, but was completely stopped due to either internal failure (seizure) of the engine or aerodynamic stall of the propeller. If the engine seized internally there will be clear evidence of that. The aerodynamic stall theory involves shutting down the engine and then slowing the aircraft down to the point where the propeller stops wind milling. This is difficult to do. It is generally necessary to hold the plane near a full stall while waiting for the propeller to stop.

Figure III-12-35. Propeller tip bent forward as a result of high rpm during a low-angle impact

12.4.5 When a non-feathering propeller is involved it should be expected to have been rotating at impact. Finding evidence of rotation does not say much. Finding absolutely no evidence of rotation should however lead the investigator to suspect massive internal engine failure.

12.4.6 However, a word of warning — the investigator in the field must treat with great reserve the damage and distortion seen in propeller blades after they have struck the ground. It is all too easy to reach a hasty conclusion that an engine had been under power when the accident occurred because the propeller is greatly bent or damaged. Evidence adduced from examination of the propeller blades will normally be correlated with other evidence before it is possible to form a proper conclusion.

12.4.7 What can the propeller damage tell us about engine power output? Not much unless there are propeller strike marks that will allow the investigator to calculate rpm. Many investigation texts will suggest that if the propeller tips are bent backward, the rpm was low. If they are bent forward, the rpm was high. This is very misleading.

12.4.8 What actually happens is that the tips of the blades as they strike the ground may bend either forward or backward depending on the relationship between rpm and forward velocity. This is a simple exercise in forces. The prop blade is not straight, but is twisted forward at the blade pitch angle. If the rpm is high compared to the forward velocity, then the dominant force tending to bend the blade is the blade pitch angle and it tends to curl the end of the blade forward. On the other hand, if the rpm is low compared to the forward velocity, then the dominant force on the blade comes from the forward velocity. This tends to curl the end of the blade backward. Therefore, the curling of the blade end is not a direct measurement of rpm. The rpm might be high, but if forward velocity is also high, the blade tips are likely to curl backwards. If the tips are curled forward, it is clear that the prop rpm was not only high in relation to the forward velocity, but the propeller was being driven under positive power from the engine. Other issues need to be kept in mind regarding this phenomenon. First, it *occurs only at the blade tips and it appears as a curling starting with the leading edge corner of the tip. A blade bent at mid-span, either forward or backward, is not an indication of high or low rpm. Second, it occurs on all blades. If only one blade is bent, it was caused by something else; not rotation. Third, this only occurs at relatively low angles of impact: five degrees or less. This phenomenon is most commonly interpreted following gear-up landings. If the pilot had no idea that the gear was up until the screeching sound was heard, then the blade tips will be bent back; the engine was near idle power. If, on the other hand, the pilot realized at the last moment that the gear was up and shoved the throttle full forward to go around, the blade tips will be bent forward.*

12.4.9 As a precaution against the loss of important evidence, it is a good practice to mark the position of the blade shank with respect to the propeller hub, but where the drive between the blade and the pitch change mechanism is severed as a result of impact, the significance of these marks will have to be assessed during detailed inspection. Many factors must be taken into consideration, and each accident assessed accordingly. The angle of impact, the nature of the ground, speed of impact, the material of the propeller be it aluminium alloy, steel or wood, all influence the assessment. In short, it is not sufficient to examine a propeller by itself and then assess whether or not the engine was under power. The propeller blades form only one link in the chain of evidence, which, when coupled with other features such as pitch angle of the blades in relation to the known phase of operation at the time of the accident, the twisting, if any, in the propeller shaft and the condition of the engine and fuel valves, etc. may lead to sounder conclusions regarding the degree of engine power being developed at the time of impact. Determination of the pitch setting may be ascertained by stripping the propeller governor head and checking the position of the pitch change mechanism in conjunction with impact markings or impressions often made across the *base of the blade on the soft copper shims or packing plates. The markings or impressions can give valuable and reliable clues as to the pitch angle of the blades at the time the blade strikes the ground. This work must be done with care in conjunction with an expert from the propeller.*

….

1.19 Useful or effective investigation techniques

Not Applicable.

2.0 ANALYSIS

2.1 General

The wind was calm at the time of the occurrence and visibility was in more than of 10 km, therefore weather was not a factor in this occurrence.

The pilot had the requisite qualification to conduct the flight; pathology examination did not suggest pilot incapacitation prior to the crash.

The accident occurred two days prior to the aircraft losing its airworthiness status as it would be due for Wing Bolt Inspection/Structural Inspection.

2.2 Conduct of the flight

N364UZ departed Old Kaduna (Military) airport on a test flight with a pilot and another person onboard.

Investigations reveal that the co-pilot hired on the aircraft was not available for the flight, therefore the pilot decided to fly without a co-pilot. This was not in line with the SEIL policy as stated by the co-pilot that was assigned due to the pilot's advanced age. In addition, the inputs of a co-pilot in the planning and flight phases have proven invaluable.

On finals the aircraft impacted a mango tree at a distance of about 878 m from the runway threshold. The right propeller assembly separated from the engine and was found partially embedded in the ground, while the left propeller remained attached to the engine. For the aircraft to be at a very low altitude to strike a mango tree at a distance of about 800 m to the runway threshold; it was an indication that either the aircraft was gliding or the engines were operating at very low rpm (revolution per minute) and producing inadequate power to enable the pilot maintain the appropriate approach profile (height, speed and glide path) to cover the required distance to threshold.

Examination of the left hand propeller blades revealed that the propeller blades were bent backwards at about one third from the tip and there was no significant twist on all the four blades. This type of damage is consistent with the propeller coming to a stop with significant low power upon impact with the ground, which suggested that the propeller was either wind milling[1] at the time of impact as per paragraph 12.3.1 of ICAO Doc 9756 Part III or that the propeller rpm was low compared to the forward velocity of the aircraft as per paragraph 12.3.4 of the ICAO Doc 9756 Part III. This was corroborated by the eye witness (a local farmer) who stated that he saw the aircraft moving up and down with increasing and decreasing engine sound. The pilot did not declare emergency in any phase of the flight.

The pilot had earlier expressed his concerns about the aircraft's pitot probe being left uncovered and no leak test was reported to have been carried out thereafter. This could lead to blockages in the system and erroneous airspeed readings. However, considering the pilot's experience it was unlikely to have misled him to fly at a low altitude thus colliding with an obstacle (mango tree).

The lack of operational oversight on the aircraft by no one other than the pilot constituted a serious safety issue. This is due to the fact that the pilot was the sole person coordinating the maintenance activities with the AMO and flight operations activities of the aircraft. This arrangement does not allow for alternative vetting of the pilot's activities and his judgments especially as the pilot had not been around for 11 months to have supervised the maintenance being carried out.

[1] Wind milling refers to a situation when the propellers are rotated by air flow over the blades rather than the engine power

2.3 Maintenance

According to the records available, the aircraft had been parked for a period of 11 months from June 2010 to May, 2011. The aircraft logbooks did not show any record of compliance with preservation procedures in line with Kings Air C90 Maintenance Manual, chapter 10.

Upon inspection of the aircraft the pilot determined that the aircraft could not be ferried to the UK as initially planned as it was "a bit of a mess".

The duration of which the aircraft was stored and the harshness of the environment in which it was stored entail that the Return to Service Procedures of the aircraft and engine manufacturers be diligently adhered to. This could have addressed in a systemic way the possible degeneration of the power plants and controls that could have initiated during the storage period.

The pilot's correspondence prior to the first test flight mentioned that the fuel system was contaminated and that it was being flushed. The Kings Air C90 Maintenance manual, chapter 10 gives a detailed guidance on how to resolve this contamination. If not properly addressed this could lead to a reduced engine performance or even a fuel starvation.

From the record available the pilot had entered a number of snags on a piece of paper after the previous test flight which could not be traced on the technical log. However, Nig. CARs 8.5.1.19 clearly stated that *(a) The PIC shall ensure that all mechanical irregularities occurring during flight time are-(b) For general aviation operations, entered in the aircraft logbook and disposed of in accordance with the MEL or other approved or prescribed procedure*.

This investigation revealed that the maintenance contract agreement between DANA and Shoreline Energy International Ltd had expired on 10 January 2011 and there was no record of its renewal.

2.4 Regulatory oversight

The aircraft was a United State of America registered. It operated largely from Nigeria making its operations subject to Nigerian regulations as stated in Nig. CARs 1.1.1.2 and FAR91.703. However, the aircraft's maintenance was to be done according to the provisions of FARs and the manufacturer's maintenance manuals so long as they did not go against the Nig. CARs. As such, the operator was required to adhere to the provisions of the Flight Operations Clearance Certificate (FOCC) and the Maintenance Clearance Certificate (MCC) in respect of the aircraft. The investigation could not determine either FOCC or MCC were initially obtained or they were renewed according to provisions of Nig. CARs 8.2.1.9.

2.5 Rescue and fire fighting

The aircraft crashed about 843 m from the threshold of RWY23 of the Old Kaduna (Military) airport; DANA and NAF Fire Fighting personnel were dispatched immediately.

The aircraft was engulfed in flames after the crash which raged on for several minutes before the arrival of the rescue team thus consuming most of the aircraft as there was an existing rail track that obstruct the fire trucks from reaching the aircraft on time. However, Nig. CARs 12.6.15.2 stipulates that rescue and fire-fighting personnel should have access to areas that extend to 1000m beyond the ends of the runway and outside the aerodrome boundary.

Figure 7: Location of the accident site in relation to runway

3.0 CONCLUSION

3.1 Findings

1. The pilot and another person were onboard the aircraft.
2. The pilot had a valid licence with relevant ratings and recurrence training.
3. The pilot was to fly the aircraft to the United Kingdom for Wing Bolt Inspection/Structural Inspection.
4. Autopsy report did not suggest pilot incapacitation prior to the crash.
5. Toxicology examination showed no evidence of substance abuse.
6. The pilot had expressed concerns on the state of the aircraft.
7. The aircraft was not flown for 11 months prior to May, 2011.
8. The pilot coordinated the maintenance activities of the aircraft.
9. Both occupants were fatally injured.
10. The aircraft was United States of America registered.
11. The aircraft had been parked for eleven months prior to the accident without the recommended preservation procedure.
12. Emergency Locator Transmitter was not installed on the aircraft at the time of the accident.
13. The aircraft would have been due for Wing Bolt Inspection/Structural Inspection Checks on 26 May, 2011.
14. The aircraft struck a mango tree at about 854 meters to RWY 23 threshold.
15. The aircraft was destroyed by impact forces and fire.
16. The maintenance contract between DANA and SEIL had expired as at the time of the accident.
17. Maintenance work carried out was not properly documented.
18. The terrain beyond RWY 23 (military) threshold was inaccessible to fire trucks.

19. DANA and NAF Rescue teams were dispatched immediately after the accident but arrived the accident scene 20 minutes after.

3.2 Causal Factor

Inability of the pilot to control the aircraft to landing due to inadequate power to enable the pilot maintain the appropriate approach profile (height, speed and glide path) to cover the required distance to threshold.

3.3 Contributory factors

1. Non-adherence to approved storage procedure
2. Non-adherence to approved return from storage procedure
3. Inadequate regulatory oversight by the authority on flight operation and maintenance of foreign registered aircraft in Nigeria

4.0 SAFETY RECOMMENDATIONS

4.1 Safety Recommendation 2020-017

Nigeria Civil Aviation Authority NCAA should increase safety oversight on foreign registered general aviation aircraft operating in Nigerian airspace.

4.2 Safety Recommendation 2020-018

Nigeria Civil Aviation Authority NCAA should promulgate detailed regulations/requirements on private category aircraft operations.

4.3 Safety Recommendation 2020-019

Nigeria Civil Aviation Authority NCAA should liaise with the Old Kaduna (Military) Airport authorities to ensure that 1000 m beyond RWY 23 should be easily accessible in accordance with internationally accepted standard stipulated in ICAO Annex 14.

4.4 Safety Recommendation 2020-020

Nigeria Civil Aviation Authority NCAA should liaise with the Old Kaduna (Military) Airport authorities to ensure that an Airport Emergency Plan (AEP) is developed and maintained in line with Nig.CARs Part 12 (Aerodrome Regulations).

APPENDIX A: LIST OF SNAGS

N364UZ 24/5/2011

(1) ✓Brake Bleed

(2) ✓Pilot Vertical Seat Adj.

(3) ✓Taxi Light CB Switch Trips ✓

(4) /Com Box No 1 – Not Clear ATC Comment

(5) ? MFD No GPS Signals Received

(6) FD Bar Up/Down P/✓

(7) Door Threshold Light Switch ✓

(8) Toilet Roof Light Switch . Stuck

(9) Cabin Roof Light Switches – "

(10) ? Sandel EHSI Heading Bug U/S

(11) Noise in Roof – above/behind pilots ?