



**AIRCRAFT ACCIDENT REPORT  
01/2008 (BH/2007/08/03/F)**

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**Accident Investigation Bureau**

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**Report on Bristow Helicopters  
Accident Bell 412 EP Registration 5N - BIQ  
at Qua Iboe Terminal Akwa Ibom State, Nigeria  
on 3rd August 2007**

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This report was produced by the Accident Investigation Bureau (AIB), Murtala Muhammed Airport, Ikeja, Lagos.

The report is based upon the investigation carried out by Accident Investigation Bureau, 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.

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 Accident Investigation Bureau investigates for the sole purpose of enhancing aviation safety. Consequently, Accident Investigation Bureau reports are confined to matters of safety significance and should not be used for any other purpose.

As the Bureau believes that safety information is of great value if it is passed on for the use of others, readers are encouraged to copy or reprint for further distribution, acknowledging Accident Investigation Bureau as the source.

Recommendations in this report are addressed to the regulatory Authorities of the state (NCAA). It is for this authority to decide what action is taken.

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## GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

ADA	Abu Dhabi Aviation
AFCU	Automatic Fuel Control Unit
AIB	Accident Investigation Bureau
ATPL	Air Transport Pilot's Licence
Company	Bristow Group and/ or its Subsidiaries and Joint Ventures (as appropriate)
CVR	Cockpit Voice Recorder
CRM	Crew Resource Management
DVD	Digital Versatile Disc
EGPWS	Enhanced Ground Proximity Warning System
ELT	Emergency Locator Transmitter
FDR	Flight Data Recorder
FOD	Foreign Object Damage
ft	Feet - (unit of measurement) length
HR	Human Resources
ICAO	International Civil Aviation Organisation
LAE	Licensed Aircraft Engineer
LLC	Limited Liability Company
MGH	Mobil Guest House
MHz	Mega Hertz - (unit of measurement) frequency
ml	Milliliter - (unit of measurement) liquid (volume)
mm	Millimeter - (unit of measurement) distance
MPN	Mobil Producing Nigeria
MSN	Manufacturer's Serial Number
NASA	National Aerospace & Aeronautics Administration (a US Agency)
NCAA	Nigerian Civil Aviation Authority
NCAR	Nigerian Civil Aviation Regulation
NTSB	National Transportation Safety Board (a US Agency)
nm	Nautical Miles - (unit of measurement) distance
OPC	Operational Proficiency Check
Q&S	Quality and Safety
QIT	Qua Iboe Terminal (a facility of Mobil Producing Nigeria)
Tech log	Technical Logbook
USA	United States of America
UTC	Universal Time Co-ordinate
VIP	Very Important Person



BELL 412 EP Helicopter Type



**Aircraft Accident Report No:** (BH/2007/08/03/F)

**Registered Owner and Operator:** Bristow Helicopters (Nig) Ltd

**Aircraft Type and Model:** BELL - 412 EP

**Registration:** 5N -BIQ

**Manufacturer's Serial No.:** 35385

**Location:** In a field at Qua Iboe Terminal (QIT) heliport, Eket, Akwa Ibom State, Nigeria

**Date and Time:** 3<sup>rd</sup> August 2007 at 07:39

*All times in this report are local time (equivalent to UTC +1) unless otherwise stated*

## **SYNOPSIS**

The Accident Investigation Bureau (AIB) was notified of the accident on the 3<sup>rd</sup> of August, 2007 at about 07:55hrs. The investigation began at about 15:00hrs the same day, in company of the Bristow Helicopters' Lagos based Operations Manager.

Bristow Helicopters (Nigeria) Ltd provides flight logistics and support to Mobil Producing (Nig.) Unlimited (MPN) in its oil explorations both on-shore and off - shore at Akwa Ibom State. The contract mandates the operator (Bristow) to provide helicopter air support while Mobil (MPN) dictates the revenue tasking for crew and aircraft as required daily.

The Bristow line training captain boarded the aircraft 5N - BIQ Bell 412EP at 07:30hrs without the co-pilot. He started the aircraft engines rapidly, made a radio call at 07:32.16hrs for a "local flight", and lifted rapidly at 07:35hrs.



It was revealed that no such flight was scheduled or requested.

He made two fast fly passes over the airfield and on the third fly pass the aircraft descended steeply over the west of the airfield at a high speed impacting the ground at 07:39hrs.

The Pilot died of injuries shortly after being rescued from the wreckage.

The Acting Managing Pilot reported and made a statement to the Divisional police headquarters of Nigerian Police in Ibeno, Akwa Ibom State, regarding the accident. The pathological report confirmed death due to hemorrhage and traumatic shock consequent upon multiple soft tissue and skeletal injuries. The nature of injuries was consistent with that of air accident. However, toxicological examination did not detect any evidence of alcohol or other substances of abuse in the system.

Analysis of the flight recorder parameters showed that the engines and flight controls were serviceable and functioning normally until the aircraft made final impact with the ground.

Cockpit Voice Recorder (CVR) readout was analysed and it was consistent with Flight Data Recorder (FDR) and equally suggestive.

The Bureau conducted interviews abroad with the next of kins of the victim for relevant information pertinent to this accident.

The investigation determined the following causal and contributory factors.

**Causal factor:**

- The pilot flew aggressively and vigorously during which the aircraft impacted the ground.

### Contributory factors:

- The organizational safety management system did not identify, intervene and mitigate stress and crisis that developed in the circumstances of the pilot, days before the accident.
- The pilot did not follow the company's normal procedures, before proceeding to the flight line. He flew the aircraft without pre-flight and a co-pilot.
- The pilot did not respond to the EGPWS warnings as indicated in the FDR/CVR readout.

Nine safety recommendations have been made and Operators response is in the Appendix F.

## 1.0 FACTUAL INFORMATION

### 1.1 History of Flight

On the day of the accident, the pilot of 5N - BIQ was allocated as captain of Crew 3 on the company's roster. The co-pilot was another Eket based captain. The captain travelled from Mobil Guest House (MGH) where he left in convoy with the Managing Pilot. Upon arrival at QIT, the Managing Pilot had a brief conversation with the captain in the hangar, regarding an under-slung aerial spraying task that was proposed for the day.

The captain continued downstairs to the line office without contacting his co-pilot who was waiting in the crew room. In the line office, he met the maintenance engineers and demanded the status of the aircraft which he must have identified on the aircraft rostering board. The completion of paper work for citing the cargo hook in the role change section of the Tech log was still in progress. The captain did not take the Tech log which was mandatorily required on board for any flight. He did not alert any engineer as was the procedure for engine start up, rather he asked another engineer outside the hanger to accompany him to the aircraft. The pilot got into the right hand seat of the aircraft without performing his pre-flight walk around check.

The accompanying engineer was surprised as he knew the captain for thoroughness in flight safety procedures and again as a training captain. He did, however, perform a walk around inspection removing the float pins. The pilot signalled to start engine No.1. The engineer sought the help of the ramp assistant to connect the ground power unit (GPU) when the captain waved him away and commenced a battery start contrary to the normal starting procedure of the company.

The battery is kept fully charged and in full capacity in case of a shut down away from base. APPENDIX A details Engine Start Procedures.

The pilot commenced starting No.2 engine while the engineer repositioned himself to give a fire cover with the fire extinguisher. The company’s operation manual for Bell 412, details system checks for ground run. Normally this takes several minutes, rather the captain accelerated both engines without final clearance from the engineer.

The radio room received a departing call for a ‘local flight’ from the captain at 07:32:16hrs. The captain flew vigorously and performed extreme maneuvers as reported by eye witnesses. The aircraft climbed rapidly and made a right turn at high speed descending to a low altitude. The captain made two high speed passes over the airfield, during which the cockpit voice recorder (CVR) recorded multiple EGPWS warnings. The CVR recorded a significant statement ‘all right’ at 07:33:59hrs. His breathing was audible (sound similar to grunting). At this point no distress calls were made.

On the third fly pass, the aircraft descended south towards an open field in QIT between two lamp posts on the southern perimeter of the ‘ABUJA’ building impacting the ground at a steep angle approximately 135ft south of the fence.

The accident occurred in a field at Qua Iboe Terminal (QIT) heliport, Eket, Akwa Ibom State, Nigeria with one fatality.

## 1.2 Injuries to Persons

<b>INJURIES</b>	<b>CREW</b>	<b>PASSENGERS</b>	<b>OTHERS</b>
FATAL	1	0	0
SERIOUS	0	0	0
MINOR	0	0	0

## 1.3 Damage to the Aircraft

The aircraft was destroyed.

## 1.4 Other Damage

There was impact and fuel/oil contamination on the field along the debris trail.

## 1.5 Personnel Information

### 1.5.1 Captain

Age:	47 years
Gender:	Male
Nationality:	Australian/British citizenship
Licence:	Air Transport Pilot's Licence. Nigerian validation (14 February, 2007) Australian ATPL (187942) (Issued 17 <sup>th</sup> July, 1991)
Aircraft Rating:	Bell 212, BELL 412 and Sikorsky S76
Instrument Rating:	02 March, 2007
Licence Proficiency Check:	02 March, 2007
Operational Proficiency Check:	27 July, 2007
Medical Certificate:	10 July, 2007 (Nigeria) 15 <sup>th</sup> February, 2007 (Australia)
Flying Experience:	Total Hours      9659.1 hours
On type:	1588.9 hours
Last 90 days	-      162 hours 30 minutes
Last 28 days	-      82 hours 30 minutes
Last 7 days	-      34 hours

Last 24 hours - 6 hours and 35minutes

The captain prior to his flying career served the Australian Army Cavalry unit as an armoured personnel carrier driver. He flew for Lloyd Helicopter in Australia after gaining Australian private pilot licence in 1985 and obtained USA Air Transport Pilot Licence (ATPL) in 1999.

While flying for Lloyd, he was demoted to co-pilot following a wrong deck landing. He later flew Bell 412S for Abu Dhabi Aviation (ADA), with commendable employment records.

The captain subsequently married his second wife, a Spanish native for which he converted to Islamic faith even though he did not practice the religion.

He later joined Bristow Helicopters in October, 2002 and progressed to become a line training captain in Eket.

In Bristow he was regarded as a dedicated, hardworking, highly professional and meticulous pilot, who constantly craved for excellence. Many believed he knew more about emergency procedures than any other pilot in the fleet.

### **1.5.2 Licenced Aircraft Engineer I**

Age: 59 years

Gender: Male

Location/Shift: QIT Eket

Licence: Bell 212 with P & W PT6 Engines series

Relevant Approvals: Level 6 maintenance authorized on Bell 412 with P & W PT6 Engine series

Experience: 35 years as LAE with Bristow (Management Staff) 37 years experience on Bell & other aircraft types

Duty Pattern: 0700 - 1700 hours daily, 8 weeks on 4 weeks off, 1 day off per week.

The licensed engineer was appropriately trained and qualified in accordance with NCAR 145 approved AMO/5N/BHL.

He certified the aircraft serviceable.

### **1.5.3 Licenced Aircraft Engineer II:**

Age: 61 years

Gender: Male

Location/Shift: QIT Eket

Licence: BELL 212, 205A, B727, Allison 250 C20/C20B Engines

Relevant Approvals: Level 6 maintenance Authorization on Bell 412 with P & W PT6 Engine series

Experience: 17 years with Bristow as LAE

Duty Pattern: 0700 - 1700 hours daily, 8 weeks on 4 weeks off.

The engineer was appropriately trained and qualified in accordance with NCAR 145 approved AMO/5N/BHL. He was

authorised to perform certain task on Bell 412 up to level 6 maintenance.

He certified Cargo suspension hook installation, (Configuration change).

## 1.6 Aircraft Information

### 1.6.1 General Information

Registration:	5N-BIQ	
Type:	BELL 412 EP	
Serial Number:	35385	
Year of Manufacture:	September 2005	
Airframe hours:	1249.30hrs.	
<b>Engines:</b>	2 PT6T - 30 Pratt & Whitney engines	
	<b>No. 1</b>	<b>No. 2</b>
Serial Numbers:	0703	0702
Hours:	1521	1521
Cycles:	4891	4891
Type of fuel used:	Jet A1	

The aircraft had a valid Certificate of Airworthiness issued on 17<sup>th</sup> May, 2007. It had no deferred defects and weight and balance was within limits.

The last major inspection, B-Check and Phases 3 & 4 of



C-Check were carried out at 1185.7hrs on the 15<sup>th</sup> of July, 2007.

#### **1.6.2 Maintenance Inspection Performed Prior to Flight**

The accident flight was the first flight following the completion of the daily check performed on the 2<sup>nd</sup> of August, 2007. For operational reason the daily check is always carried out during lunch break. Therefore the aircraft was released for service at midday on the 2<sup>nd</sup> of August, 2007.

#### **1.6.3 Maintenance Inspection and Logbook Entries**

In the Organisation's Quality Engineering Procedures, "Technical log forms are in accordance with company exposition part 6 chapter 1 with the appropriate wording to satisfy compliance in accordance with NCAR 145". Therefore all time related entries in the Technical logbook must be expressed in local time or UTC.

#### **1.6.4 Pre-Flight Inspection and Certification**

"The pre-flight inspection is a brief visual inspection to ensure that the aircraft is not obviously non-airworthy and is carried out by commencing at the aircraft nose and checking the relevant items in an anti-clock wise direction around the aircraft, ending on the cabin roof". It is an essential task.

However, the holders of maintenance authorisation may only certify for work provided they were personally involved in performing the completed task. By inference, the discrepancies in time recorded by the certifying LAE for the pre-flight turnaround column of the technical log suggested non involvement in the certified task.

The convoy departed Eket at 0645hrs while the task was certified first at 0520hrs and later at 0715hrs when observation was raised by the AIB investigators. It is pertinent to note that any person(s) completing and certifying any work activity is therefore accountable by legislation for the adequacy of tasks performed against defined standards.

### **1.7 Meteorological Information**

The actual weather condition was good.

### **1.8 Aids to Navigation**

None available.

### **1.9 Communications**

The radio room is equipped with VHF radio on 131.65Mhz for communication between radio room and pilots, and a telephone link with Eket which was hardly used for communication.

A complete set of Radio Transmission (RT) recordings were listened to in order to analyse the pilot's communication. A brief radio transmission was received in the company radio room from the captain that 5N-BIQ was departing on a local flight" CVR Readout 0732:16hrs. "bravo India quebec lifting at four for a local flight, one on board, Zero one three zero engines" 0732:32hrs. (TWR) "India".

### **1.10 Aerodrome Information**

QIT heliport has no air traffic control services. There is a grass strip with the security perimeter fence. Available are fire engines that can be called up from the complex, but a Rapid Intervention Vehicle (RIV) is stationed at the heliport. The heliport is unlicensed and operated by Mobil Producing Nigeria (MPN).

## 1.11 Flight Recorders

The aircraft was equipped with a Smiths Flight Data Recorder (P/N 177045-01-01 Model 325701 and a L-3 Cockpit Voice Recorder (P/N 2100-1010-00). Both 'flight recorders' were sent to NTSB (USA) to obtain readouts/analysis.

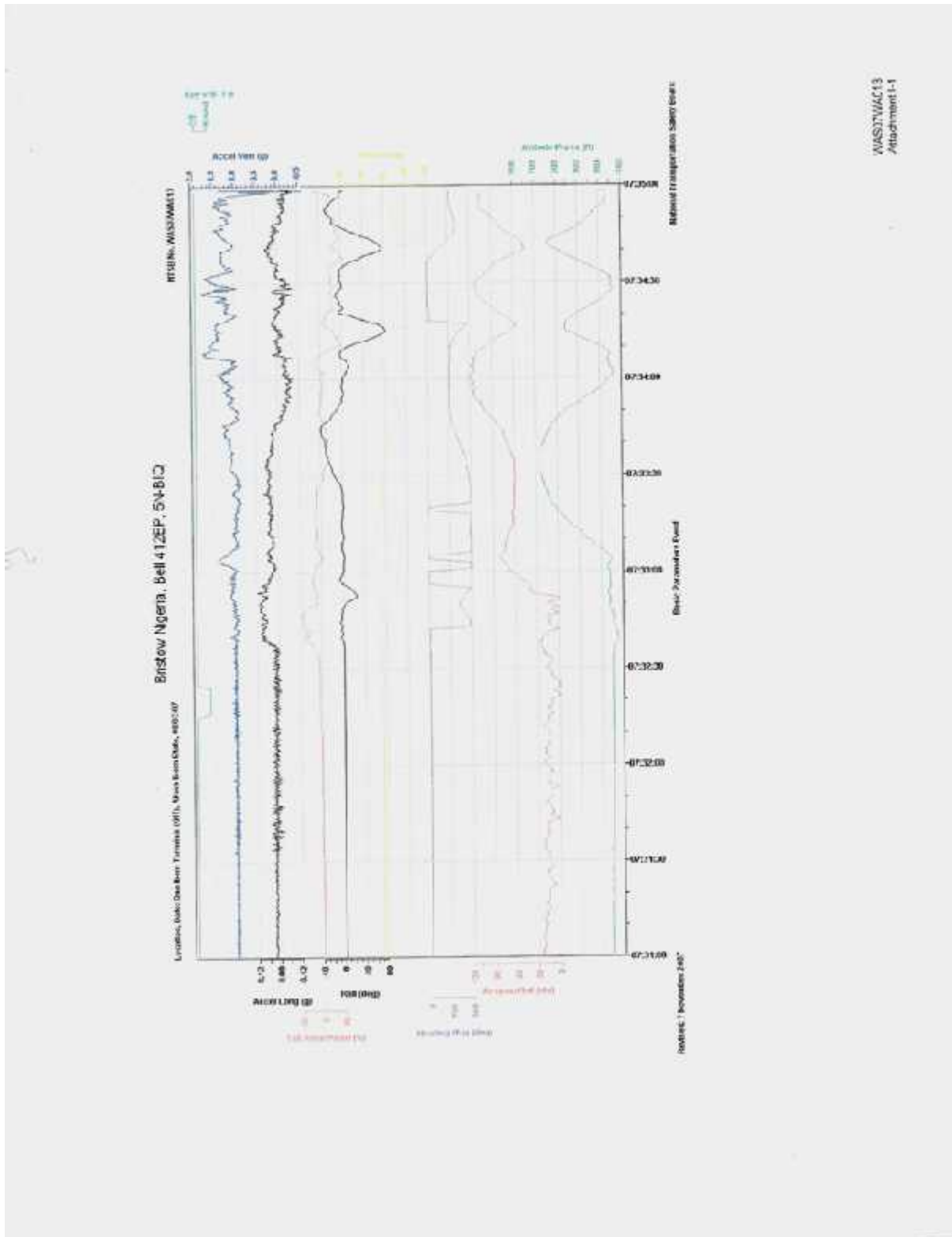
The recorder(FDR) exhibited impact damage and the data could not be extracted from the unit in the normal manner. The crash protected memory was removed from the damaged accident box and transferred to a surrogate unit in order to download the data.

The FDR recording contained over 600 hours of recorded data. The event flight was the last data and the recording duration was 5 minutes. The four (4) plots in this report contain data which illustrated the event flight.

Analysis of the flight recorders parameters revealed that flight control inputs, gearbox, transmission and engines were functioning normally up till the moment the aircraft impacted the ground. The CVR never revealed any distress call, except for a significant statement, "*all right*" at 0733:59hrs by the captain.

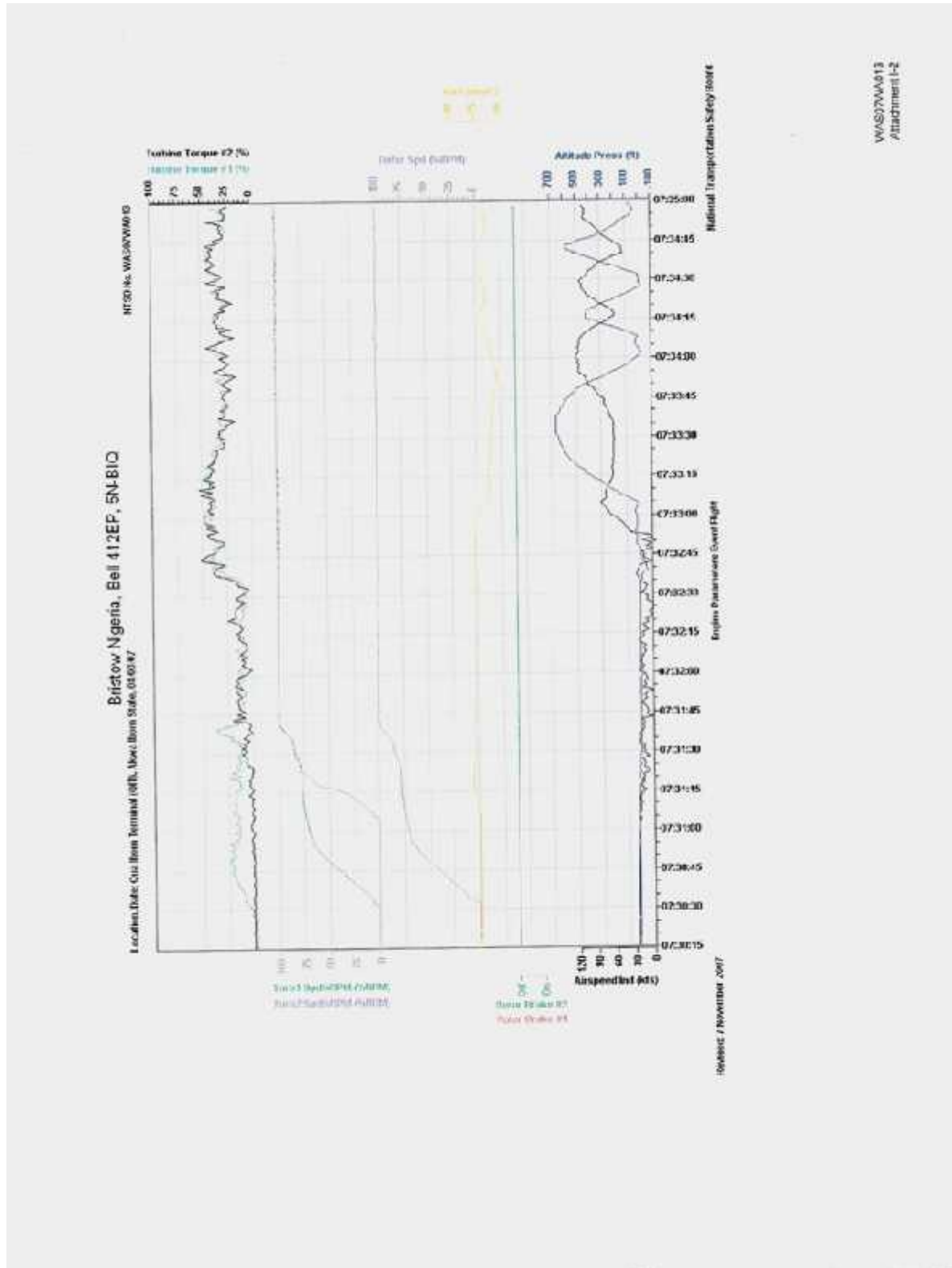


Fig. 1.11 Flight Data Recorder



WAS07VAC13  
Attachment 1-1

FDR Plot 1



WAS0700013  
Attachment 1-2

FDR Plot 2









Fig. 1.11.1 Cockpit Voice Recorder

## 1.12 Wreckage and Impact Information

Wreckage examination by the investigating team took place on the 3<sup>rd</sup> of August, 2007 and the 7<sup>th</sup> of August, 2007 respectively. The wreckage however remained under the constant guard by the Nigerian Mobile Police Force with the main piece covered with tarpaulins. The MPN Loss Prevention Manager made a 5-minute video recording while walking down the debris trail on the 3<sup>rd</sup> of August, 2007. The right hand skid contacted the ground first followed by the left hand skid.

Both were ripped off alongside with both pitot tubes. The tail boom separated at the production joint. The main wreckage came to rest 150ft from point of impact. The wreckage was released to the Company on the 15<sup>th</sup> of August, 2007 and was later transported to Lagos.

The main transmission was free to rotate and the chip detectors and oil filters were checked, no debris found.

The main rotor blades were all shattered with root ends intact.

The No. 2 Engine Fuel Control Unit (FCU) lever was found in flight setting while No. 1 Engine (FCU) lever was fractured, distorted and unable to determine its setting at impact.

All damages occurred as aircraft impacted the ground.



Photograph showing point of impact



Photograph showing main wreckage



Photograph showing Debris trail



Photograph showing final resting place after impact



Photograph showing rotor assembly and transmission damage



Photograph showing separation of tail boom

### **1.13 Medical and Pathological Information**

An autopsy was carried out on the pilot in Lagos on the 4<sup>th</sup> of August, 2007 at the request of Accident Investigation Bureau. It was performed by two Pathologists led by an Associate Professor/Consultant Pathologist. Report was issued on the 22<sup>nd</sup> of August, 2007. The cause of death was due to hemorrhagic and traumatic shock as a consequence of multiple soft tissue and skeletal injuries. There were multiple laceration and bruises on the scalp and all over the body. There were a number of fractures including nasal bone, left maxilla, the left zygomatic bone, both sternoclavicular joints, all the ribs on the right, left wrist bone and left fibula and both tibia were also fractured. There was approximately 500mls of clotted blood within the right thoracic cavity.

Toxicological examination carried out in South Africa did not detect any evidence of alcohol and other substances of abuse in the system.

### **1.14 Fire**

A small post-impact fire in the jet pipe area was quickly put out by arriving firemen with a handheld extinguisher. Crash site was not accessible to fire and rescue vehicles as the entry gate near the main gate house was not opened immediately.

### **1.15 Survival Aspect**

The accident was not survivable as there was no livable volume available to the pilot. The injured pilot was met by the nearby villagers still breathing, with his hands by his sides away from the main wreckage. His shirt was open and had only one shoe on. The firemen and police arrived about five (5) minutes after the impact followed by the medics who administered oxygen to the injured pilot. The pilot was pronounced dead after being taken to the medical centre within the complex.

The aircraft was equipped with a Techttest/HR Smith 503-1 Emergency Locator Transmitter (ELT). In a typical accident like this, it was activated by 'G' Switch enabling the unit to broadcast on 121.5, 243.0 and 406 Mhz frequencies, via the external mounted aerial on the cockpit roof.

Unfortunately, the ELT antenna mounted on the forward cabin roof was completely destroyed in the crash, therefore transmission was not possible.

### 1.16 Test and Research

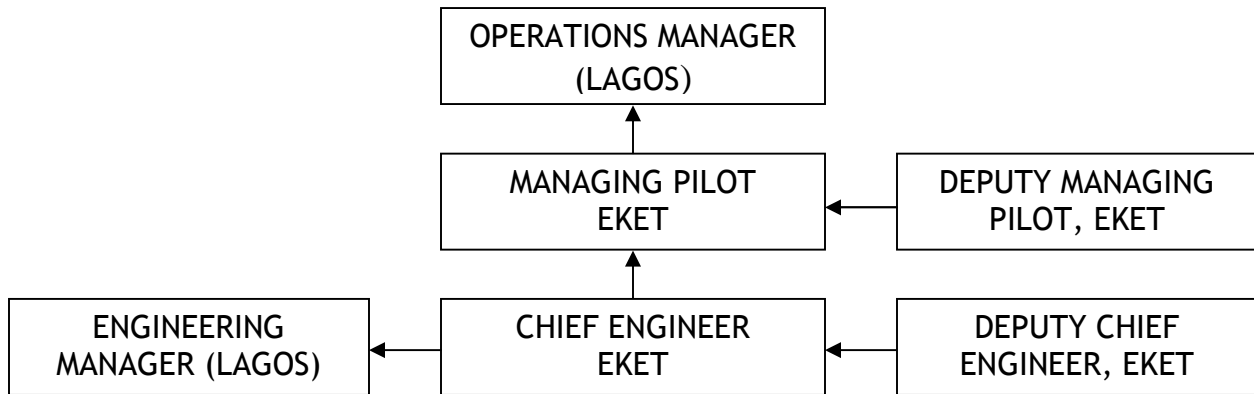
Medicaments that were found and not identified from packaging and markings in the pilot's apartment were sent out by the company for specialist examination at Aberdeen University in the U.K. Report received confirmed pills as antispasmodic used for the treatment of stomach cramp.

During investigation fuel samples were collected and tested. They were found uncontaminated.

Furthermore, the memory files of the lap top computer of the pilot were analysed, no significant information was obtained. Attempt to obtain his hotmail password to review his mails was unsuccessful.

## 1.17 Organisational and Management Information

### 1.17.1 Management Structure of the Company



The Senior Company Manager at Eket is the Managing Pilot who reports to Operations Manager in Lagos.

The Chief Engineer reports to the Managing Pilot on local administrative issues and day to day matters, but reports essentially to the Engineering Manager in Lagos on technical and engineering management issues.

At the time of the accident, the Managing Pilot was overseas for training, while a Senior Pilot was appointed as Acting Managing Pilot. Likewise the Deputy Chief Engineer was acting for the Chief Engineer who was away on training.

### 1.17.2 Safety Management System

All airworthiness requirements demand that the operator has in place accident prevention and flight safety programme.

The implementation of a Safety Management System (SMS) is intended to promote safety and quality performance by enhancing the best practice and moving beyond mere compliance with legislative and regulatory requirements. The Safety Management



System is both proactive and reactive, providing a means to anticipate and prevent or reduce the effects of risks.

The Eket emergency response plan contains detailed guidance on stress counseling for those who have been in or witnesses of accident. It could be useful as a management tool to detect stress and crisis especially when the physical and mental sensation was obvious. The “Target Zero” campaign emphasises that employees should report any safety concerns. “Target Zero” was launched in February, 2007.

On the 1st of August, 2007, the pilot admitted before the Acting Managing Pilot that he had “a big problem”. He was offered an early return home, which he rejected. The Safety Management System in place did not recognise a crisis that was developing many weeks before the event. On the same day he was noticed to be depressed, withdrawn and mentioned to an engineer that he had ‘a bad leave’, again “Target Zero” campaign did not report and intervene. An early recognition of the onset of significant abnormal behaviour was tragically missed.

Reportedly, the organisation had a well established safety management system but regrettably in this particular case, the system expected Eket management to inform the Lagos management while the pilot was excused from flying duties.

### 1.17.3 Security

Mobil heightened security procedures during the later part of 2007 after a significant security incident in October, 2006 at the residential site of the company. The regimented life style and restriction have consequential psychological stress.

The workforce travel in armed convoy to and from QIT, owing to the threat of Niger Delta militant insurgency. Investigation revealed the pilot's fear and anxiety and subsequent directives to his wife on security and safety of the family. The pilot was constantly disturbed and worried about the possibility of being kidnapped by the Niger Delta militants. While in Nigeria he repeatedly advised the wife not to accept calls from anyone from Nigeria or indulge in any ransom negotiation in case he was kidnapped. As a result, he never flew with his wedding ring to avoid heightening the stake for excessive ransom demand in case he was kidnapped, as ransom demand from married victims are usually high.

The pilot enjoyed his job, liked his company but entertained great security concerns about being kidnapped in his living and work environment. As stated by the next of kin, *"the worst time during his leave was always the last week prior to his return to work in Nigeria". "He demonstrated unhappiness, irritability and unwillingness to travel back to the country"* on expiration of his last leave.

In effect he was unable to cope with stress caused by both personal and work related problems.

#### **1.17.4 Flight Scheduling and Authorisation**

Logistical requirements are collated by a Mobil office. These are passed to the controller in the passenger terminal; the controller co-ordinates Mobil activities at the heliport and liaises with the company. He identifies which aircraft are allocated to which crew, calls out company crew with local information on respective flight. The Managing Pilot can authorise non-revenue flight while the Training Captain can authorise training flights.

Air tests and maintenance flights are requested by engineering through the carry forward section of the Technical logbook.

#### **1.17.5 QIT Radio Room**

The Company has a radio room at QIT. It is situated at the upper floor of the hangar with very limited views of the heliport. A radio room supervisor, who reports to the Managing Pilot controls the radio operators. They are not trained to license standard. Their main function is to provide flight information services and to trigger and assist Search and Rescue; The flight information service was carried out with uncalibrated instruments. The deficiencies in all these operations are of concern to the Eket Air Traffic Control and require to be redressed urgently.

### **1.18 Additional information**

#### **1.18.1 AIB interview with next of kin**

Accident Investigation Bureau's interview with the next of kin revealed the following:

- i. The Australian court divorce settlement which gave the ex-wife of the pilot the right to possess the land and the property, as well as the custody of the seven-year old son was a very stressful and disturbing event which the pilot found difficult to come to terms with.
- ii. The ill feeling was further exacerbated during the last leave, when the ex-wife returned the consent document for legal possession of the land in Australia because it was witnessed by the current wife. The pilot saw this as renewal of an old wound.

- iii. He demonstrated significant frustration owing to his inability to have unfettered access to the son whenever he wanted to see him. For this he was to seek a legal redress by his next leave to Spain.

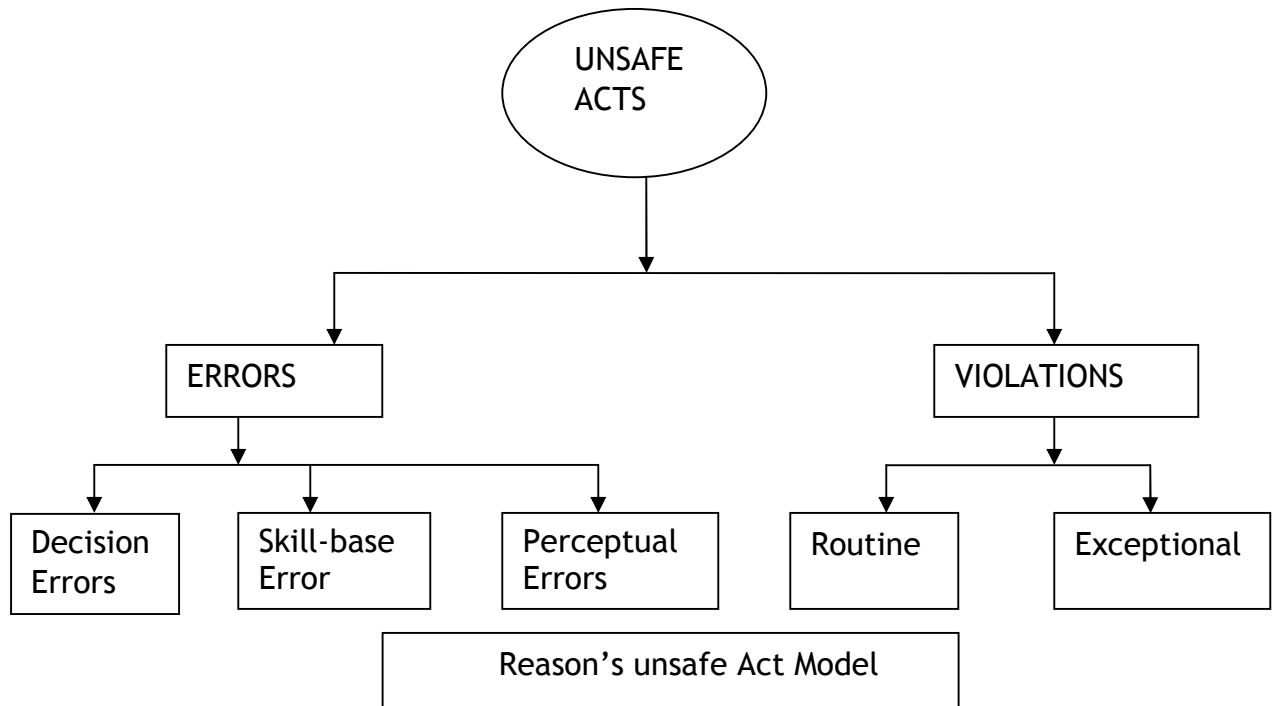
Consequently, all these contributed to the '*bad leave*' he reportedly had.

### **1.19 Useful or Effective Investigation Techniques**

James Reason / Jens Rasmussen models were used.

## 2.0 ANALYSIS

### 2.1 Human Factor Element in the Analysis



One of the most influential human error models was developed by James Reason, a professor of psychology at Manchester University England. However, the model was first developed by a Danish Professor Jens Rasmussen. The model classified unsafe acts as either errors or violation (Reason 1990). As Professor Reason suggested in his research, 'errors and violations involve different cognitive phases' as demonstrated above.

In general, errors represent the mental or physical activities of individuals that fail to achieve their intended outcome.

*Slips* typical during the execution phase of task performance involve errors of commission.

*Lapses* also occur during execution phase of task performance but involve errors of omission. Hence slips and

lapses are errors that result in failure of execution whereas *mistakes* are deficiencies or failures in judgment. (Reason 1990).

Violations on the other hand refer to willful disregard for rules and regulations that govern the safety of flight. Therefore, the categories of errors and violations were expanded as illustrated (Reason 1990, Rasmussen 1982) to include three basic types (Skill based, Decision and Perceptual) and two forms of violations (Routine and Exceptional).

Routine violation tends to be habitual by nature and often tolerated by governing authority (Reason 1990).

Exceptional violations appear as isolated departure from authority not necessarily indicative of an individual typical behavior pattern nor condoned by management (Reason 1990).

Human Performance under this category are intentional commission of unsafe act or violations of regulations/procedures. Some of these factors may be personality driven, exhibitions of stress reactions that result in demonstration of hostility and aggression or over estimation of flying ability and anti-authority attitude and disregard for regulations.

## 2.2 James Reasons Swiss Cheese Model Of Human Error

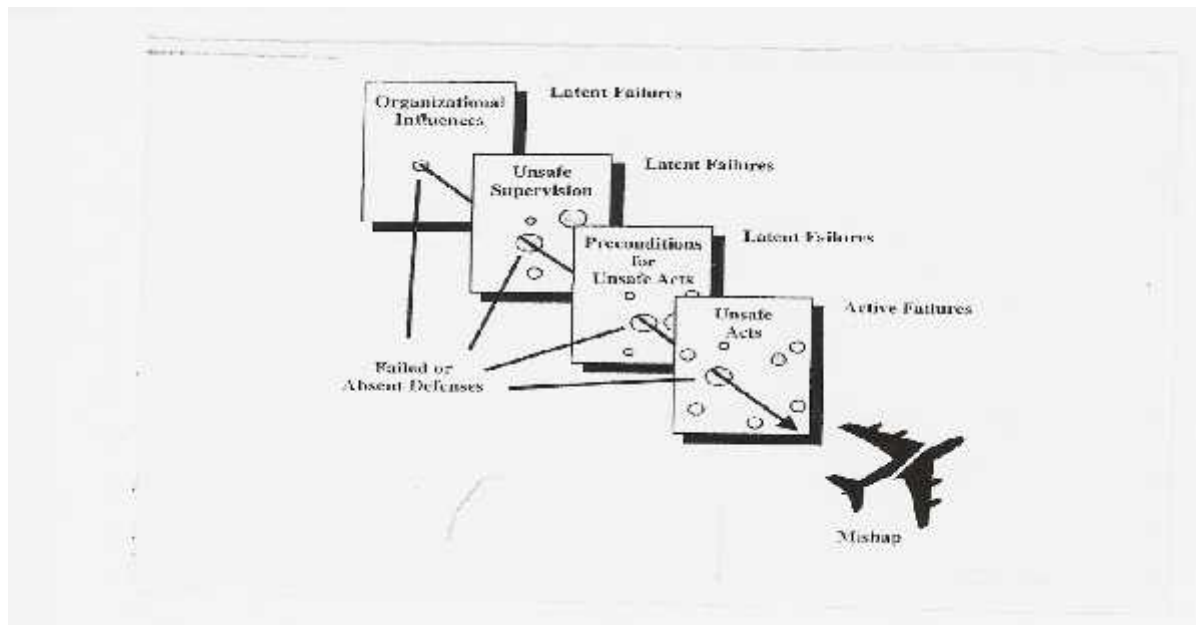


Fig 2. Source: US Federal Aviation Administration (FAA)

The Swiss Cheese model of human error as described by Reason in Fig. 2 above, identify four levels of human failures each influencing the next. Working backwards in time from the accident, the first level depicts those unsafe acts of operators that ultimately led to the accident. Swiss Cheese model is particularly useful in that it enables Investigators to address latent failures within the causal sequence of events. Latent failures unlike their active counterpart may be dormant or undetected for hours, days, weeks or even longer until they adversely affect the unsuspecting pilot/operator.

### 2.2.1 Pilot's General Demeanour

The pilot has been consistently described as meticulous and has a detailed knowledge of procedures which makes him useful and suitable as a line training captain. He had also expected others to display high procedural and competence knowledge; hence there were two recorded Crew Resources Management (CRM) events during his training captainship.

Unlike their engineering counterparts who are subjected to a scheme of annual appraisal, pilots are only subjected to a rigorous competence assessment.

### **2.2.2 Pilot Conduct During the Tour of Duty**

By the 1<sup>st</sup> of August, 2007, the pilot had spent half of the tour of duty. He successfully completed Operational Proficiency Check (OPC) on the 27<sup>th</sup> of July, 2007. His request to work two (2) weeks longer in November had been approved. This was to raise additional funds to move from an apartment to a house and purchase his dream car in Spain. Certainly he had plans for the future, and displayed the spirit of a responsible family man.

But 48 hours before the accident there were indications of some kind of unspecified problems in his mind. He became quiet, withdrawn and subdued. He made specific statements to few colleagues and to the Managing Pilot about having a problem, even on the day of the accident when both travelled in the same convoy to the terminal.

Perhaps the concentration of study for the Operational Proficiency Check (OPC) on the 27<sup>th</sup> of July, 2007 may have diverted his attention from a developing problem.

### **2.2.3 Latent Failures - Company Control and Procedure**

The Eket management at the time of the accident denied any knowledge of the emergency response plan of the company which had useful elements in stress counseling. Failure to adopt the above and safety culture and reporting procedures in “Target Zero” initiative, created defenses failure against an unsafe act.



The ability to recognise the signals that people are operating under excessive stress and that a problem either already exist or will shortly arise is a key to management of stress.

The absence of formal appraisal system vis-à-vis non-competence issue for pilot makes it possible for useful warnings not to be collated by line manager; this again indicate a latent failure which preconditioned an unsafe act.

### **2.3 Operation of Flight and Purpose**

There were certain elements in the operation of the flight that must be considered:

1. The pilot left the line office without the technical logbook and requested an engineer to accompany him.
2. The pilot did not collect a life jacket perhaps as he planned to make an overland flight he never needed one.
3. He did not make contact with his co-pilot who was waiting in the crew briefing room.
4. He boarded the aircraft and commenced start without pre-flighting the aircraft.

In an attempt to classify these actions, it is necessary to recall that the flight was not requested or scheduled. Even though the training captain can authorise a training flight, but there was no training need; the technical logbook never called for any maintenance air test. Given the manner the engines were started and conduct of the flight, it was an exceptional violation.

## 2.4 Conduct of Flight

The pilot flew aggressive and vigorous manoeuvres contrary to Company Operations Manual Part A Section 2.5, described as “Indiscipline Flying”. This is another element of exceptional violation which includes departure of the aircraft without the technical logbook, a requirement for the flight.

The CVR recorded statement “*all right*” captured the pilot’s determination to a definite intention in relation to continuation of the flight. Flight Data Recorder readout revealed that engines, flight controls, gearbox parameters were functioning normally prior to ground impact at 07:35:00hrs. The emergency response was prompt.

## 2.5 The Accident Fly Pass (Third Pass)

The pilot made two fly passes over the airfield. The aircraft was maneuvered to the west outside the airfield perimeter for the third fly pass.

The (CVR) readout at 0733:59hrs local time, “all right” callout by the captain could either express frustration from continuous warnings from the EGPWS or pilot’s intentions to the final outcome.

The Flight Data Recorder (FDR) corroborated the vigorous and extreme maneuvers flown by the pilot. The analysis, however, revealed no mechanical failure from flight control inputs, gearbox, transmission or engines, up till the moment the aircraft impacted the ground.

The pilot was not disabled during this fly pass. The Cockpit Voice Recorder (CVR) continued to record breathing until impact, he was still alive after impact, and autopsy never suggested any pre-existing conditions. More especially the

maneuvering of the aircraft over the field indicated that the aircraft was under control.

The numerous exceptional violations associated with the flight were suggestive of pilot's intentions. If the pilot intended the third flight pass to be similar to the previous two but misjudged, the FDR and CVR analysis did not reveal.

The analysis of FDR and CVR readout did not reveal any attempt made by the pilot to avert ground impact at steep angle of descent. Conversely, no evidence that indicated pilot intentions has been found so far.

## **2.6 Sequence of Impact**

The aircraft impacted the ground in a nose low attitude. On impact, the nose mounted pitot tubes and the skin ripped off breaking open the underfloor fuel bays. The eye witness accounts revealed series of bangs and aircraft tumbling two to three times before coming to rest.

The main rotor blades struck the ground followed by the upper fuselage. The tail boom separated at the production joint earlier in the break up sequence.

## **2.7 Survivability Factor**

The accident was not survivable as there was no livable volume available to the pilot.

The villagers first attended to the unconscious but breathing pilot's body. Cracks on the pilot's seat were consistent with a failure in tension with mass on the seat. There was greater compression on the strut of the pilot seat compared to the unoccupied co-pilot seat. The pilot was thrown out of the wreckage with both hands by the side of the body. With reference to autopsy report and photographs, there were considerable upper body impact

injuries which suggested that the pilot was not wearing his shoulder harness. It is very likely the lap belt was worn.

The ELT did not transmit emergency signal essentially due to impact damage. The design of the system (antenna/transmitter) makes it susceptible to damage.

## 2.8 Security

It would be recalled that October 2006 saw a major Niger Delta militancy incident which led to significant changes in security procedures for the entire workforce of Mobil Producing Nigeria (MPN) and Bristow Helicopters (Nig) Ltd in Eket.

Amongst other measures, included movement in armed convoys to and from Qua Iboe Terminal (QIT). Restriction to movement and confinement to hotel environment resembled wartime military style arrangement.

Managing stress in today's work environment is a significant challenge. The nation, individual and the oil and gas producing companies must take steps to address matters which cause unacceptable level of stress. It is however, the responsibility of all stakeholders to ensure that business operations do not constitute hazard to health, safety and security of the operators as well as the nation.

Irrespective of the recreational facilities provided within such "stronghold", the living condition are capable of causing psychological stress and exacerbating existing stress caused by personal problems.

As Daroru (AAPW 2006.4) research stated, "In Niger Delta, the disrespect for local governance rules and lack of transparency, lack of consideration of local businesses in the award of contract and employment, failure to honour and implement Memorandum of Understanding between the oil and gas companies and the host communities contribute to youth restiveness and conflict".

Therefore, all stakeholders must amend their corporate social responsibility statements to correct the above and manage successfully the delivery of local mitigation measures and poverty reduction initiatives.

This will in turn reduce youth restiveness, enable the oil and gas producing companies to be seen by their host communities as being committed to their welfare, progress and development, while the companies will enjoy the peace, tranquility and support required for their operations.

## 3.0 CONCLUSION

### (a) Findings

1. The aircraft was serviceable and airworthy.
2. There was no evidence of any pre-impact failure or damage.
3. The pilot was scheduled to fly on the 3<sup>rd</sup> of August, 2007, as captain of 5N-BIQ. He had been assigned another captain as co-pilot.
4. The pilot was licensed and current to fly Bell 412 EP.
5. The starting procedure was not observed.
6. The pilot operated alone in a two-man crew aircraft contrary to company policy.
7. LAE certified tasks based on the assumption that they were correctly performed.
8. The pilot departed hastily without conducting any checks.
9. The pilot's behaviour on the day of the accident was unusual.
10. The pilot flew vigorous and unusual manoeuvres making two passes over the airfield and impacted the ground on the third pass.
11. The pilot had been distressed during the preceding 48 hours and had commented he had a problem and had "a bad leave" to some people.

12. The Eket Bristow Managing Pilot was aware of the pilot's personal problems and offered him an early return home which he turned down.
13. The company safety system did not identify stress and crisis that perhaps developed weeks before the event took place.
14. The aircraft impacted the ground at a steep angle of descent with excessive sink rate.
15. The aircraft broke up on impact and tumbled several times before it came to final rest.
16. The ELT did not send any emergency signal.
17. Rescue services arrived the crash site promptly.
18. Crash site was not accessible to fire service vehicles as the entry gate near the main-gate-house was not opened immediately.
19. The captain suffered multiple injuries from which he died shortly after being stretchered from the crash site.
20. The radio room was manned by staff who were not trained to license standard and not in regular contact with Eket Control Tower.
21. QIT heliport was not licensed.
22. The regimented life style and restriction to movement of the expatriate workforce of Bristow/MPN in Eket is capable of causing or exacerbating psychological stress.
23. The pilot was stressed due to personal problems relating to the divorce settlements in his previous marriage and work related security

concerns posed by possibility of being kidnapped by the militants. This precipitated his crisis.

The investigation determined the following causal and contributory factors.

**Causal factor:**

- The pilot flew aggressively and vigorously during which the aircraft impacted the ground.

**Contributory factors:**

- The organizational safety management system did not identify, intervene and mitigate stress and crisis that developed in the circumstances of the pilot, days before the accident.
- The pilot did not follow the company's normal procedures, before proceeding to the flight line. He flew the aircraft without pre-flight and a co-pilot.
- The pilot did not respond to the EGPWS warnings as indicated in the FDR/CVR readout.



## **4.0 SAFETY RECOMMENDATIONS**

As a result of the investigation, the following safety recommendations were made:

### **4.1 Safety Recommendations 2010 - 025**

Bristow Helicopters (Nig) Ltd should take suitable action to provide additional training for supervisors and managers to enable them render psychological/counseling support to their direct subordinates. To ensure that there is adequate level of confidential advice to all employees whenever they have a problem, “Target Zero” initiative should be emphasized to all management/senior staff making them aware of their responsibility to their subordinates whenever signs of stress or disordered behaviour are noticed.

### **4.2 Safety Recommendation 2010 - 026**

Bristow Helicopters should take suitable action to remind all maintenance staff of their professional responsibilities, the limit of their authorisation and that approval from appropriate authority is required when it becomes necessary to deviate from approved instructions and procedures. The use of “hour meter” format for time entries in the technical logbook does not conform to NCAR 145. All time related entries should be in local time or UTC.

### **4.3 Safety Recommendation 2010 - 027**

Bristow Helicopters should take suitable action to ensure that the engineering quality services department has a better oversight and understanding of the day to day practices of maintenance carried out.

Licensed Engineers who carry out certifications must be fully involved in the performance of the task or have sufficient oversight of the task. Certification must not be based purely on the assumption that the task had been performed correctly.

#### **4.4 Safety Recommendation 2010 - 028**

Bristow Helicopters should take suitable action to increase and centralize control of both revenue and non-revenue tasking flights. The proposed position of an “Operations Controller” will be of advantage, if introduced. Based in the radio room, the controller will be the focal point of contacts with customers, relaying the necessary information from engineering and operational air crew. The “Operation Controller” should also co-ordinate all maintenance ground runs and test flights as may be necessary.

#### **4.5 Safety Recommendation 2010 - 029**

Bristow Helicopters should consider the introduction of annual appraisal for all safety critical employees so that relevant behavioral history will be recorded and evaluated.

#### **4.6 Safety Recommendation 2010 - 030**

Bristow Helicopters should take suitable action to review both Company and MPN emergency procedures at QIT. This should include the relocation of the radio room which has only about 25% view of the heliport and review of the control of access gates off site locations.

#### **4.7 Safety Recommendation 2010 - 031**

Bristow Helicopters should ensure that the radio room is appropriately staffed and managed by adequately trained, competent and licensed professionals with emergency exercise experience. The radio room should always be in contact with Eket control tower for all flights into and out of QIT. All instruments/equipment for weather advisory services should be recalibrated and tagged at regular intervals.

#### **4.8 Safety Recommendation 2010 - 032**

Bristow Helicopters Engineering Quality Services Department should take suitable action to review the current installation of Emergency Locator Transmitter (ELT). The FAA approved field modification is designed to enable the unit transmit via a remote externally mounted whip aerial on the cockpit roof. There is need to co-locate transmitter and aerial in location that will increase survivability in the event of a high energy impact.

#### **4.9 Safety Recommendation 2010 -033**

Nigerian Civil Aviation Authority (NCAA) should take necessary action to include Psychological Appraisal as an element in Flight Crew Medical Requirement.

### **SAFETY ACTIONS**

1. In the Organisation's Quality Engineering Procedures, "Technical log forms are in accordance with company exposition part 6 chapter 1 with the appropriate wording to satisfy compliance in accordance with NCAR 145". Therefore all time related entries in the Technical logbook must be expressed in local time or UTC.

The use of "hour meter" format does not conform to NCAR 145.

In response to this recommendation, Bristow has reverted to the normal time recording format.

## **APPENDIX F**

### **RESPONSE TO SAFETY RECOMMENDATIONS**

#### **Safety Recommendations 2010 - 025**

Bristow Helicopters (Nig) Ltd should take suitable action to provide additional training for supervisors and managers to enable them render psychological/counseling support to their direct subordinates. To ensure that there is adequate level of confidential advice to all employees whenever they have a problem, “Target Zero” initiative should be emphasized to all management/senior staff making them aware of their responsibility to their reports whenever signs of stress or disordered behaviour are noticed.

#### **Response to Safety Recommendations 2010 - 025**

*The Company accepts this recommendation. Under the Target Zero programme, the Company doctor in Nigeria is being asked to provide a list of critical psychological symptoms and provide an element of training of supervisory staff so that when visiting operations, they will be better equipped to recognize any early symptoms of psychological problems.*

#### **Safety Recommendation 2010 - 026**

Bristow Helicopters should take suitable action to remind all maintenance staff of their professional responsibilities, the limit of their authorization and that approval from appropriate authority is required when it becomes necessary to deviate from approved instructions and procedures. The use of “hour meter” format for time entries in the technical logbook does not conform to NCAR 145. All time related entries should be in local time or UTC.

## Response to Safety Recommendations 2010 - 026

*The Company accepts this recommendation. The Company Maintenance Organisation has reverted to normal time related entries in the technical log-book in accordance with NCAR 145.*

## Safety Recommendation 2010 - 027

Bristow Helicopters should take suitable action to ensure that the engineering quality services department has a better oversight and understanding of the day to day practices where maintenance is carried out.

Licensed engineers who carry out certifications must be fully involved in the performance of the task or have sufficient oversight of the task. Certification must not be based purely on the assumption that the task had been performed correctly.

## Response to Safety Recommendations 2010 - 027

*The Company accepts this recommendation. Chief Engineers will be requested to include this topic in their regular 'tool box' meetings and all bases will be formally reminded of the NCAA regulations regarding the responsibilities of certifying staff. Additionally, a formal programme of 'Focus on Maintenance Improvement' has been introduced, which provides a direct reporting link from certifying staff to the Quality & Safety department.*

## Safety Recommendation 2010 - 028

Bristow Helicopters should take suitable action to increase and centralize control of both revenue and non-revenue tasking flights. The proposed position of an "Operations Controller" will be of advantage, if introduced. Based in the radio room, the controller will be the focal point of contacts with customers, relaying the necessary information from engineering and operational air crew. The "Operation Controller" should also co-

ordinate all maintenance ground runs and test flights as may be necessary.

### **Response to Safety Recommendations 2010 - 028**

*The Company accepts this recommendation. The position of 'Operations Co-ordinator has been introduced to centralize control from the Radio Room.*

### **Safety Recommendation 2010 - 029**

Bristow helicopters should consider the introduction of annual appraisal for all safety critical employees so that relevant behavioral history will be recorded and evaluated.

### **Response to Safety Recommendations 2010 - 029**

*The Company accepts this recommendation. As annual appraisal for all staff is being introduced by the Human Resources department.*

### **Safety Recommendation 2010 - 030**

Bristow helicopters should take suitable action to review both company and MPN emergency procedures at QIT. This should include the relocation of the radio room which has only about 25% view of the heliport and review of the control of access gates off site locations.

### **Response to Safety Recommendations 2010 - 030**

*The Company partially accepts this recommendation. A review of Company emergency procedures is in hand but whilst the Company accepts the spirit of the remaining elements of the recommendation, it does not own the facilities to which this recommendation refers. Nevertheless, the heliport/facility owner has been asked to consider a change to the location of the Radio Room.*

## **Safety Recommendation 2010 - 031**

Bristow Helicopters should ensure that the radio room is appropriately staffed and managed by adequately trained, competent and licensed professionals with emergency exercise experience. The radio room should always be in contact with Eket control tower for all flights into and out of QIT. All instruments/equipment for weather advisory services should be recalibrated and tagged at regular intervals.

## **Response to Safety Recommendations 2010 - 031**

*The Company partially accepts this recommendation. A review is presently underway to establish the means by which communications with Eket control can be effected and the procedures which would be required. The review includes the review of the accuracy of the radio room equipment. Actions taken will be as a result of that review.*

## **Safety Recommendation 2010 - 032**

Bristow Helicopters Engineering Quality Services Department should take suitable action to review the current installation of Emergency Locator Transmitter (ELT). The FAA approved Field Modification is designed to enable the unit transmit via a remote externally mounted whip aerial on the cockpit roof. Unfortunately transmission was not possible as antenna was completely destroyed during impact. There is need to co-locate transmitter and aerial in location that will increase survivability in event of a high energy impact.

## **Response to Safety Recommendations 2010 - 032**

*The Company partially accepts this recommendation. The spirit of this recommendation is accepted but is considered that wherever a remote aerial is located on a helicopter, the fuselage disruption in a 'high energy' accident may render the aerial, or its feeder, ineffective - as in this case.*

*A review has been initiated with the Type Engineering department to attempt to improve the chances of ELT effectiveness/survivability in a crash, this review will include, but not be limited to, the FAA modification in the recommendation.*

### **Safety Recommendation 2010 -033**

Nigerian Civil Aviation Authority (NCAA) should take suitable action to include Psychological Appraisal as an element in Flight Crew Medical Requirement.

### **Response to Safety Recommendations 2010 - 033**

*The recommendation is implemented as psychological appraisal is already part of NCAA flight crew medical requirements.*





BELL 412 EP Helicopter Type on Landing

## Appendix A Engine Start Procedures

Operational Manual Part A, Section 8.2.3.1c requires that local Ramp Procedures are followed during engine starts.

The following is from the Eket Ramp Procedures:

### 3.3 Start Procedures

3.3.1 Place fire extinguisher into position - hose uncoiled.

3.3.2 Plug in external power and switch on at pilots command.

3.3.3 Pilot will request clearance for start-up by indicating which engine by holding up one or two fingers with the hand held in the vertical position close to the windscreen.

NOTE: No.1 Engine starts first on odd dates,  
No.2 Engine on even dates.

3.3.4 Ground crew will check area around aircraft is clear of debris and personnel. If clear will give the signal to start by holding up one or two fingers as applicable.

3.3.5 On completion of the start cycle the Pilot will request external power to be removed by making a breaking action with both hands.

3.3.6 Ground crew acknowledges with a "thumbs up", then removes the external power supply and secures it at a safe distance.

3.3.7 After necessary checks have been completed the Pilot will request clearance to start the other engine, if area is still clear, the ground crew will give the signal to start in the same manner as the first engine.

3.3.8 Ground crew will remove the fire extinguisher to a safe distance after second engine start.

3.3.9 Pilot will give thumbs up indication that all system checks have been completed and the aircraft is ready to lift.

3.3.10 The ground crew may depart to a safe distance, providing the Pilot with a final "Thumbs Up" indicating the aircraft is clear to lift. If any of the procedures become unsafe for any reason, the Pilot should be advised to shut down by making a signal of a cutting action across the throat.

3.3.11 Night Start Up: Procedures are the same as daytime. (Handler will acknowledge the Pilots signals by means of illuminated wands or torch if required).

## APPENDIX B






Notice to Engineers

APPENDIX D

15/8/07

**Gentlemen**

During the on going investigation into the accident of 5N-BIQ the Nigerian AIPB have raised the point that the daily inspections do not have a completion time entered in the tech logs. In view of this effective immediately the engineer who signs for the daily inspection should also record the time the inspection was completed next to the date.

Jimmy Peebles   
Acting Chief Engineer

BASE INSTRUCTIONS - Eket  
QIT OPERATIONS CONTROL

