AIRCRAFT ACCIDENT REPORT

SAL/2018/09/12/F

Accident Investigation Bureau

Report on the serious incident involving Gulfstream G-IV Aircraft operated by Skybird Air Limited with nationality and registration marks 5N-BOD which occurred during landing at Nnamdi Azikiwe International Airport Abuja On 12th September, 2018.

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.

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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

ABV	Abuja
AD	Aerodrome
AIB	Accident Investigation Bureau
ATIS	Automatic Terminal Information Service
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATS	Air Traffic Services
ABS	Aircraft Braking Systems
AMA	Aircraft Management Agreement
ARFFS	Aerodrome Rescue and Fire Fighting Services
ATL	Aircraft Technical Log
AEP	Airport Emergency Plan
AC	Alternating Current
BITE	Built-in Test Equipment
C/A	Cabin Attendant
C of A	Certificate of Airworthiness
CVR	Cockpit Voice Recorder
CPO	Co-pilot Overhead
CAS	Crew Alerting System
DAUs	Data Acquisition Units

DATCO	Duty Air Traffic Controller
Brake-by-Wire	Electronic braking system
ECU	Electronic Control Unit
EICAS	Engine Indicating and Crew Alerting System
FFV	Fire Fighting Vehicle
FDR	Flight Data Recorder
FL350	Flight Level 350
FOM	Flight Operating Manuals
FOOs	Flight Operations Officers
FXE	Fort Lauderdale Executive
G-IV	Gulfstream IV
HBCM	Hydraulic Brake Control Module
HMAB	Hydro-Mechanical Analog Braking system
IFR	Instrument Flight Rules
KIAS	knots Indicated Air Speed
LDR	Landing Distance Required
LCC	Lead Cabin Crew
LVDTs	Linear Variable Differential Transducers
LOC	Localizer
MOU	Memorandum of Understanding
METAR	Meteorological Aerodrome Report

DNMM	Murtala Mohammed International Airport Lagos
NAMA	Nigerian Airspace Management Agency
NCAA	Nigerian Civil Aviation Authority
Nig. CARs	Nigerian Civil Aviation Regulations
NiMeT	Nigerian Meteorological Agency
DNAA	Nnamdi Azikiwe International Airport Abuja
OE	Operating Experience
OpsSpecs	Operations Specifications
PF	Pilot Flying
PM	Pilot Monitoring
PIC	Pilot-In-Command
PIREP	Pilot Report
PMI	Principal Maintenance Inspector
ROTORS	Rotating Discs
SMA	Santa Maria
SEP	Safety Equipment & Procedures
SPECI	Special Weather Observation
SOPs	Specific Operating Provisions or
STATORS	Stationary Discs
TGM	Technical Guidance Materials
TAF	Terminal Aerodrome Forecast

TR	Thrust Reversers
TCC	Trainee Cabin Crew
WOW	Weight-On-Wheels
WSSs	Wheel Speed Sensors
WS	Wind Shear
WDM	Wiring Diagram Manual

Aircraft accident report number:	SAL/2018/09/12/F
Registered owner and operator:	SkyBird Air Limited
Aircraft type:	Gulfstream IV (G-IV)
Manufacturer:	Gulfstream Aerospace, USA
Year of manufacture:	1990
Registration marks:	5N-BOD
Serial number:	1126
Location:	Runway 22, Nnamdi Azikiwe Int'l Airport Abuja 9°00'24"N 7°15'47"E
Date/Time:	12 September, 2018 at 21:14 h (*All times in this report are local time (UTC +1 h) unless otherwise stated*)

SYNOPSIS

Accident Investigation Bureau (AIB) was notified of the serious incident by FAAN through a phone call. Safety Investigators were dispatched immediately to the site and commenced preliminary investigation.

On 12 September, 2018 at about 20:20 h, a Gulfstream IV (G-IV) aircraft with registration mark 5N-BOD operated by SkyBird Air Ltd, on an Instrument Flight Rules (IFR) Flight Plan, departed Murtala Mohammed International Airport (DNMM) Lagos for Nnamdi Azikiwe International Airport (DNAA), Abuja on a post-charter return to base flight with One (1) person and Five (5) crew on board, with an endurance of

four hours. The Captain was the Pilot Flying (PF) while the First Officer was the Pilot Monitoring (PM).

The aircraft departed Lagos at 20:20 h and climbed to Flight Level 350 (FL350) as cleared. The en-route weather was stormy almost all the way. Following an uneventful flight, the aircraft was in contact with the DNAA Approach Radar and was given a clearance for Radar Vectors for an ILS approach Runway (RWY) 22.

At 20:11 h UTC, 5N-BOD established initial contact with Abuja Control Tower and reported 9 NM final and fully established on ILS RWY 22. The controller advised the crew to exercise caution as runway surface was wet, and thereafter cleared the aircraft to land. 5N-BOD acknowledged and continued approach normally.

Upon touchdown, the captain noticed the aircraft was not decelerating as it should and that the Thrust Reversers (TR) were not deploying, even though he could see physically that the aircraft was properly configured. He pulled the speed brake handle to possibly force the Nutcracker, (Weight on Wheel Switches), into the "Ground Mode" and get the TR to deploy.

The aircraft exited the end of the runway, travelled over a grassy area before it came to a stop in mud at approximately 71m from the end of RWY 22.

After the aircraft finally came to a complete stop, the flight crew shut down the engines, the lead cabin attendant opened the forward main entry door and all occupants exited the aircraft unhurt.

The Aerodrome Rescue and Fire Fighting Services (ARFFS) arrived the scene and provided fire cover and lighting support for the area.

The accident occurred at 21:14 h at night.

Causal factor

Delayed response by the crew to recognize that the ground spoilers and thrust reversers were locked out led to the runway overrun.

Contributory factor

The delayed deployment of ground spoilers led to the flight crew's problems in stopping the airplane within the remaining available runway length.

Nine safety recommendations were made

1.0 FACTUAL INFORMATION

1.1 History of the flight

The Flight Data Recorder (FDR) and the Cockpit Voice Recorder (CVR) did not record any data on this flight. Therefore, only information derived from Air Traffic Control (ATC) recordings, Aircrew interviews, aircraft inspection were used to compile the history of flight.

On 12 September, 2018 at about 20:20h, a Gulfstream IV (G-IV) aircraft with registration mark 5N-BOD operated by Skybird Air Limited on an Instrument Flight Rules (IFR) Flight Plan, departed Murtala Mohammed International Airport (DNMM) Lagos for Nnamdi Azikiwe International Airport (DNAA), Abuja on a post-charter return to base flight with One (1) person and Five (5) crew on board; with an endurance of four hours. The Captain was the Pilot Flying (PF) while the First Officer was the Pilot Monitoring (PM).

Earlier in the day at about 14:30 h, the Captain was attending a meeting at the company's headquarters when he received notification for a charter flight to Lagos, departing Abuja at 16:30 h. The aircraft departed Abuja at about 18:10 h and landed in Lagos at about 19:05. The incident flight was the second and last flight to be operated by the crew for that day.

According to the crew, the aircraft departed Lagos at 20:20 h and climbed to Flight Level 350 (FL350) as cleared. The en-route weather was stormy almost all the way. Following an uneventful flight en-route, the aircraft was in contact with the DNAA Approach Radar and was given a clearance for Radar Vectors for an ILS approach RWY 22.

Radar instructed 5N-BOD to keep up to speed of 240 knots Indicated Air Speed (KCAS), being number one in the landing sequence for RWY 22. The aircraft intercepted Localizer (LOC) RWY 22 at about 15 NM to touchdown and slowed down to configure.

At 20:11 h UTC, 5N-BOD established initial contact with Abuja Tower and reported 9 NM final and fully established on ILS RWY 22. The controller advised the crew to exercise caution; runway surface was wet, and thereafter cleared the aircraft to land. 5N-BOD acknowledged and continued approach normally.

The captain also stated that "the rain was heavier than advised". He further stated that upon touchdown, he suddenly noticed the aircraft was not decelerating as it should and that the Thrust Reversers (TR) were not deploying, even though he could see physically that the aircraft was properly configured. He pulled the speed brake handle to possibly force the Nutcracker, (Weight on Wheel Switches), into the "Ground Mode" and get the TR to deploy. The captain reported that he did not recall any cockpit advisory message [incorrect spoiler operation] from the Engine Indicating and Crew Alerting System (EICAS).

The first officer indicated in a post incident interview that he noticed the aircraft approach speed was relatively faster (about 150kts) than normal (144kts), while the target landing was 140kts IAS upon landing (these speeds were confirmed by the captain but he believes that they were within 5kts of these speeds as indicated). He added that the captain called "No ground Spoilers", he then deployed the speed brakes and applied braking. He asserted that "Reverse thrust came in very late".

In addition to the above, the two cabin attendants stated that they experienced a long landing that was different from the usual landing they were used to.

At 21:14 h, Tower observed that 5N-BOD while on landing RWY 22 with reported wind calm could not exit the RWY via normal exit points (A4-A6).

The aircraft exited the end of the runway, and travelled over a grassy area before it came to a stop in mud at approximately 71m from the end of RWY 22.

After the aircraft finally came to a complete stop, the flight crew shut down the engines, the lead cabin attendant opened the forward main entry door and all occupants exited the aircraft unhurt.

At 21:15 h, the Tower informed the Fire Watch Room that an aircraft overshot the runway. The Aerodrome Rescue and Fire Fighting Services (ARFFS) arrived the scene and provided fire cover and lighting support of the area.

The Air Traffic Controller on Duty also re-emphasized during the post incident interview, that he observed the approach and landing of 5N-BOD was normal and also other aircraft that landed before 5N-BOD did not report any adverse weather encounter during approaches and landings.

The accident occurred at 20:14 h at night.

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	5	1	6
TOTAL	5	1	6

1.3 Damage to aircraft

The aircraft was slightly damaged.

1.4 Other damages

Two approach lights were damaged

1.5 Personnel information

1.5.1 Pilot (Pilot in command)

Nationality: Nigerian

Age:	61 years
License type:	Airline Transport Pilot Licence (A)
License validity:	16th September, 2019
Medical validity:	9th January, 2019
Ratings:	Hawker Siddeley HS-125, British Aerospace BAE-125-1000, Gulfstream IV (G-IV), Gulfstream V, Boeing B737-NG
Simulator validity:	2nd July, 2019
Instrument rating validity:	2nd July, 2019
Total flight time:	8,436 h
Hours on Type:	1,418 h
Last 90 days:	42:50 h
Last 28 days:	17:10 h
Last 24 Hours:	03:30 h

1.5.2 Co-pilot

Nationality:	Namibian
Age:	31 years
Licence type:	Airline Transport Pilot Licence
License validity:	23rd September, 2018
Medical validity:	31st March, 2019
Ratings:	Gulfstream G-IV, Aero Commander AC90
Simulator validity:	25th June, 2019

Instrument rating validity:	26th June, 2019
Total Flight time:	4,607:1 h
Hours on type:	42:05 h
Last 90 days:	Nil
Last 28 days:	Nil
Last 24 hours:	01:50 h

1.5.3 Flight dispatcher (observer)

Nationality:	Nigerian
Age:	30 years
License type:	Flight Dispatcher Licence
License validity:	17th March, 2020

1.5.4 Lead cabin crew (LCC)

Nationality:	Nigerian
Age:	34 years
License type:	Cabin Crew Licence
License validity:	28th October, 2019
Medical validity:	27th October, 2018
Ratings:	Hawker Siddeley HS-125, Boeing B737-300/500

The Lead Cabin Crew informed the investigation team during post incident interview, that she performed the functions of a Cabin Crew on board the aircraft and also conducted training for the Trainee Cabin Crew (TCC).

1.5.5 Trainee cabin crew (TCC)

Nationality:	Nigerian
Age:	34 years
License:	Cabin Crew Licence
License validity:	28th October, 2019
Medical validity:	27th October, 2018
Ratings:	Hawker Siddeley HS-125, Boeing B737-300/500

This TCC stated that she was on board the aircraft for training purposes. The training was conducted by the LCC. According to the records made available to the investigation, the TCC was neither trained nor type rated on G-IV.

1.6 Aircraft information

1.6.1 General information

Manufacturer:	Gulfstream Aerospace Corporation, USA.
Type/Model:	Gulfstream G IV
Serial number:	1126
Year of manufacture:	1990
Total airframe time:	7,803:58 h
Total landing cycle:	5,512
Certificate of Insurance validity:	22nd October, 2018

Certificate of Airworthiness validity: 27th September, 2018

Certificate of Registration: Issued on 29th October, 2014

The Gulfstream IV (or G-IV or GIV) is a twin-jet aircraft, mainly for private or business use. The aircraft was designed and built by Gulfstream Aerospace Corporation, a General Dynamics company based in Savannah, Georgia, United States. It is powered by two Rolls Royce TAY 611-8 engines.

This aircraft (5N-BOD) is a 13-passenger VIP configuration. It is owned by Merrola Nigeria Ltd - a non-Air Operator Certificate (AOC) holder. Merrola Nigeria Ltd and Skybird Air Ltd signed an aircraft management agreement to enable Skybird Air Ltd use the aircraft for commercial charter operations. According to the agreement, the aircraft would use Skybird's Call Sign for all its flight operations and Merrola Nigeria Ltd would be responsible for paying crew, engineers, fuel and maintenance.

1.6.2 Engines

Engines	**Number 1**	**Number 2**
Manufacturer	Rolls Royce	Rolls Royce
Type/Model	Turbo fan/TAY611-8	Turbo fan/TAY611-8
Serial Number	16355	16354
Time since new	6729:18 h	6729:18 h
Cycles since new	5212	5212

1.6.3 Wheels and brakes system

The GIV aircraft is equipped with main landing gear wheels and brakes manufactured by Aircraft Braking Systems (ABS) and tyres manufactured by Goodyear, speed rated at 182 knots. Beginning with S/N 1214, aircraft were equipped with main landing gear wheels/brakes manufactured by Dunlop, and Goodyear tyres.

1.6.3.1 Nose landing gear wheels and tyres

The nose landing gear has dual wheels. Each wheel is 22 x 6.6 inches and made of two forged aluminum halves. The two-wheel halves are mated together by eight

bolts, with the inner joint fitted with an O-ring seal, forming an airtight structure for mounting tubeless tyres.

1.6.3.2 Main landing gear wheels and tyres

Each main landing gear has dual wheels. The wheels are forged aluminum with a removable flange to facilitate tyre servicing. The flange is mated to the wheel with an O-ring that provides an airtight seal for the tubeless tyres. Each wheel is mounted to the landing gear axle with two tapered roller bearings. A brake assembly is integrated into the wheel, fitting into the space between the bearing housing and inside wheel rim.

1.6.3.3 Brake assemblies

Brakes manufactured by ABS have four rotating discs (rotors) three stationary discs (stators) an end plate and a pressure plate. All of these elements are composed of carbon-metallic alloy and are referred to as a whole as the disc stack or heat pack. The stators are attached to the torque tube that in turn is bolted to the aircraft gear assembly and holds the wheel bearings. The rotors are attached to the wheel, with notches in the rotors fitting keys on the interior of the wheel hub. The wheel with attached rotors turns on the wheel bearing, with the rotors spinning between the brake stators. Brake bolts attached at the brake housing and fastened to the outside of the end plate maintain sufficient clearance between the rotors and the stators to permit the wheels to turn freely. Five hydraulic actuating pistons are built in the brake housing. When the brakes are applied, hydraulic pressure is applied to the pistons that then move outward from the housing squeezing the pressure plate and reducing the clearance between the rotors and stators. The surfaces of the rotors and stators are pressed against each other, producing the friction that slows the spinning wheel.

Dunlop brakes have three rotors, two inner stators of double thickness, and a stator of single thickness at the pressure plate and the end plate. Operation of the Dunlop brakes is similar to that of the ABS brakes, but because of the greater energy

absorbing mass afforded by the increased diameter of the wheel and resulting larger surface area of the rotors and stators, a higher braking efficiency is attained.

Both brake types have provisions for brake temperature monitoring, anti-skid protection, and application of hydraulic pressure at a reduced level (400 ± 50 psi) to stop wheel spin as the landing gear are retracted into the wheel well.

1.6.4 Nutcracker system (refer to G-IV Maintenance Manual 32-07-00 and Operating Manual 2A-32-00)

The nutcracker (squat) switch system provides AIR or GROUND sensing to aircraft systems and components. A nutcracker switch is installed on each landing gear. The nutcracker switch contacts are depressed when the landing gear oleo-pneumatic struts are compressed by the weight of the aircraft on the ground. When the aircraft is in flight, the struts extend, releasing pressure on the nutcracker switches and opening the switch contacts.

Circuits may be opened or closed corresponding to AIR or GROUND states of operation by wiring systems and components through the nutcracker switch relays.

The left and right main landing gear nutcracker switch relays are powered by the Essential DC bus. The nose gear nutcracker switch relay is powered by the Emergency DC bus. Each nutcracker switch has a dedicated circuit breaker. If a nutcracker switch fails in the ground (closed) position, pulling the respective circuit breaker will change the switch input to relays to the air position. Nutcracker switch inputs from the main landing gear control the landing

Gear lever safety lock solenoid and the nose landing gear nutcracker switch weight-on-wheels signal is necessary for nose wheel steering.

Of those systems which depend on the nutcracker system for operation, some are required in one mode of operation on the ground and a different mode in flight. Other systems require that they be operative in flight and not on the ground. Still other systems may require operation on the ground only. The nutcracker relay

contacts are selected accordingly to meet the particular needs of the system involved.

2. Component locations

The following comprises the major components of the nutcracker system:

Unit	*No.PerAircraft*	*Location*
Circuit Breakers	*4*	*Co-pilotsCircuitBreakerPanel5Amp*
	1	*2Amp*
	1	*2Amp*
Nutcracker	*1*	
LNutcracker		
RNutcracker		*2AmpPedestal*
NutcrackerBattPwr(AircrafthavingASC242)	*1*	*MainJunctionRelayBox/Pnl (324/*
NutcrackerTestSw&IndicatorRelays		*325)*
NutcrackerNo.1		*MainJunctionRelayBox/Pnl (324/325)*
	1	*MainJunctionRelayBox/Pnl (324/325)*
NutcrackerNo.2	*12*	*MainJunctionRelayBox/Pnl (324/325)*
	1	*MainJunctionRelayBox/Pnl (324/325)*
NutcrackerNo.3		*MainJunctionRelayBox/Pnl (324/325)*
	1	*MainJunctionRelayBox/Pnl (324/325)*
NutcrackerNo.4		*MainJunctionRelayBox/Pnl (324/325)*
	1	*MainJunctionRelayBox/Pnl (324/325)*
NutcrackerNo.5	*1*	*Cockpit-LJunctionPnl (305A1) Cockpit-RJunctionPnl(306A1) Cockpit-RJunctionPnl(306A1)*
NutcrackerNo.6	*1*	
NutcrackerNo.7		*Mounted on Nose Gear Shock Strut*
	1	*Mounted on Structural Post (L & R*

NutcrackerNo.8	*1*	*Gear)*
NutcrackerNo.9	*1*	
NutcrackerNo.10		
NutcrackerNo.13	*1*	
NutcrackerNo.14		
Switches	*1*	
• *Nose Wheel Nutcracker*	*1*	
• *Main Gear Nutcracker*	*1*	
	3	
	1	
	2	

1.6.4.1 Operation

1.6.4.1.1 Ground position

The nutcracker switches on the main gear struts are series connected and control the twelve nutcracker relays, which are connected in parallel and act simultaneously. Power from the essential dc bus is fed through the NUTCRACKER circuit breaker to the left main gear nutcracker switch. When the switch is in the GROUND position, it feeds the nutcracker switch on the right main gear. If that switch is also in the GROUND position, power is provided to energize all twelve relays into their GROUND configuration. With the relays energized, electrical continuity is provided for the following system circuits of the aircraft (see Wiring Diagram Manual (WDM) for landing gear nutcracker system - wiring diagram):

- *Thrust Reverser*
- *Gnd Spoiler*

- *APU Control*
- *Air Flow Control*
- *CKPT Clock*
- *FMCS*
- *EDS*
- *Autopilot*
- *CKPT Voice Recorder*
- *ILS*
- *Engine Start*
- *Speed brake Flap Alarm*
- *Cabin Pressure Control*
- *L Nutcracker SW Input (EICAS DAU #1)*
- *L Nutcracker SW Input (EICAS FWC #1)*
- *R Nutcracker SW Input (EICAS DAU #2)*
- *R Nutcracker SW Input (EICAS FWC #2)*
- *G-meter*
- *Stall barrier*

1.6.4.1.2 Airborne position

When the main gear nutcracker switches are in the AIRBORNE position, all seven relays are de-energized and electrical continuity is provided for the following circuits of the aircraft:

- *Thrust reverser (REVERSE ALERT light circuit)*

- *Angle-of-attack (Computer)*
- *Landing gear handle downlock solenoid (ground safety lock)*
- *Pitot heat*
- *VHF Nav*
- *Angle-of-attack*
- *Brake-by-wire*
- *Flight data recorder system*

With both main gear nutcracker switches in the AIRBORNE position, power through the nutcracker No. 3 relay energizes the safety solenoid located in the landing gear handle. The solenoid is a continuous duty type. When energized, it retracts a spring-loaded locking tab which allows movement of the landing gear handle from the DOWN to the UP position.

***NOTE:** The locking tab can be manually retracted in case of a solenoid or electrical malfunction. This is done by depressing the manual release button on the landing gear handle panel which allows the handle to be selected from the down to up position (i.e., aircraft airborne or on jacks). At no time does the locking tab inhibit movement of the landing gear handle from the up to down position.*

1.6.4.2 Nutcracker test switch

An indicator / switch labeled NUTCRACKER TEST SW, located on the center pedestal, is used for testing the main landing gear nutcracker switches while the aircraft is in the air. When this indicator / switch is pressed, the L and R lights of the indicator switch come on, verifying that the nutcracker switches are in the air mode.

***NOTE:** Pressing the NUTCRACKER TEST SW while the aircraft is on the ground will put the nutcracker system in a flight mode, removing the downlock solenoid pin from the landing gear lever. The nose landing gear nutcracker switch is used to*

disable the nose wheel steering circuit when the aircraft is in the air and enable it on the ground.

1.6.5 Spoiler system (Reference: G-IV Operating Manual 2A-27-70)

The spoiler system for the Gulfstream IV assists the flight crew in maintaining roll control of the aircraft, functioning as flight spoilers. Additionally, while in flight, the spoilers extend to decrease airspeed and increase descent rate, functioning as speed brakes. On the ground after landing, they function as ground spoilers, extending to help dump any remaining lift and increase braking effectiveness.

The aircraft has three spoilers on the upper trailing edge of each wing (from inboard to outboard): a ground spoiler, an inboard flight spoiler and an outboard flight spoiler. The spoilers are manually and electrically controlled, hydraulically powered, and mechanically actuated. They are hinged to open forward when extended and close aft when retracted. Four hydraulic actuators convert hydraulic pressure to a linear mechanical force to position the spoilers.

Spoiler panel function and position depends upon the control input. Moving the SPEED BRAKE handle to the extend position extends all six spoiler panels simultaneously to function as speed brakes. Rotating the control wheel from the neutral position extends the inboard and outboard spoiler panels on the same wing as the raised aileron, functioning as flight spoilers to assist with roll control.

When armed, all six spoiler panels extend automatically on touchdown to dump lift and increase braking effectiveness, functioning as ground spoilers. Panel function and position is summarized in the following table:

INPUT CONDITION	*PANEL POSITION*
Maximum Aileron, No Speed Brakes	*Two Down-Wing Flight Spoilers Extended 23°, All Other Panels Retracted*
Maximum Speed Brakes, No Aileron	*All Six Panels Extended 26°*
Maximum Speed Brakes, Maximum Aileron	*Two Down-Wing Flight Spoilers Extended 55°, Two Ground Spoilers Extended 26°, Two Up-Wing Flight Spoilers Extended 26°,*
Automatic Ground Spoilers	*All Panels Extended 55°*

The spoiler system is composed of the following subsystems, units and components:

- *Flight Spoiler System*
- *Speed Brake System*
- *Ground Spoiler System*
- *Flight Power Shutoff System*

1*.6.5.1 Description of subsystems, units and components:*

1.6.5.1.1 Flight spoiler system:

Flight spoilers are incorporated into the roll flight control system to improve aircraft roll response. Spoiler travel varies in proportion to the degree of roll input. The flight spoiler system is solely a hydraulically powered system, thus reversion to manual control is not possible.

As the aileron control system commands an aileron to deflect upward, a mixing linkage between the aileron and flight spoiler control systems transmits an extend command to the flight spoiler actuator servo control valve. The servo control valve then shifts to direct pressure to the flight spoiler actuator. This allows the two outboard spoiler panels on the same side as the raised aileron to extend commensurate with the amount of roll input, up to a maximum of 23 ±2°. The opposite spoilers remain flush to the wing as that aileron travels downward. If the speed brakes are extended, the flight spoilers may extend up to a maximum of 55 +41-3°.

The opposite spoilers remain in the position commanded as speed brakes.

1.6.5.1.2 Speed brake system:

The speed brake system provides a method for manual symmetrical deployment of all six spoiler panels in flight to decrease airspeed and increase descent rate.

They may also be manually extended on the ground to increase braking effectiveness, should the ground spoilers not automatically extend upon landing or an aborted takeoff. This is accomplished by mechanical control of the left and right flight spoiler actuators through the use of the SPEED BRAKE handle located on the cockpit center pedestal. The speed brake system is solely a hydraulically powered system, thus reversion to manual control is not possible. Moving the SPEED BRAKE handle out of the RETRACT detent provides simultaneous mechanical input to the left and right flight spoiler mixing linkages. Each mixing linkage then shifts the associated flight spoiler actuator servo control valve to the extend position. The servo control valve then directs Combined and Flight hydraulic system pressure to the actuator piston. The pistons extend and the attached mechanical linkage drives all six spoiler panels to a position commensurate with SPEED BRAKE handle position. Speed brake position is infinitely variable between fully retracted (0°) and fully extended (26 ±2°), depending on handle position. With speed brakes extended, rotation of the control wheel repositions the mechanical linkage between the aileron and flight spoiler control mechanisms. Movement in either direction will further extend the outboard two (inboard and outboard flight spoiler) panels on the side of the raised aileron, up to a maximum of 55 +41-3°. These panels will return to their original speed-brakes-extended position when the control wheel is returned to neutral. When speed brakes are extended, a blue SPD BRAKE EXTNDED advisory message is displayed on the Crew Alerting System (CAS). In addition, the SPEED BRAKE handle will illuminate blue. On airplanes SN 1000 through 1472 having ASC 415B and SN 1473 and subs, an amber SPD BRAKE EXTNDED caution message is displayed on CAS any time the speed brakes (flight spoilers) are extended with one or both power levers above idle. Should this message be displayed, the flight crew normally would either retract the speed brakes or reduce engine thrust to extinguish the message. Should the fault warning computer and flight guidance computer disagree on the position of the speed brakes, a blue SPD BRAKE SWITCH advisory message is displayed on CAS. A red ACFT CONFIGURATION warning message will be

displayed on CAS, along with the associated warning tone, whenever the SPEED BRAKE handle is not in the RETRACT detent and the following conditions occur:

■ *Advancing either power lever above 80% HP RPM on the ground •*

Extending the flaps to DOWN (39°) or extending the landing gear in flight

For aircraft having a Standby Warning Lights Panel (SWLP) installed, a red

ACFT CONFIG light will be illuminated whenever the SPEED BRAKE handle is not in the RETRACT detent and the following conditions occur: •

Advancing either power lever above the takeoff power range on the ground

■ *Extending the flaps past 22° or extending the landing gear in flight*

1.6.5.1.3 Ground spoiler system:

The ground spoiler system provides the capability for full and automatic deployment of all six spoiler panels upon aircraft touchdown in order to dump any remaining lift and increase braking effectiveness. Also, if takeoff is aborted, the system provides for automatic deployment of all spoiler panels. The inboard spoilers on each wing are used as ground spoilers and, through electrical control, are powered by the Combined or Flight hydraulic system. Ground spoiler operation is dependent on control signal pressure being available from the Combined, Utility or Auxiliary hydraulic system. When the system is armed (GND SPLR switch selected to ARMED), the ground spoilers extend to 55 +4/-3° upon touchdown as the power levers are retarded to the ground idle setting. Movement of the two ground spoiler actuators provides an input to the two flight spoiler actuators, causing flight spoiler extension to 55 +4/-3°. These two actions result in all six panels extending. After rollout is completed, all six spoiler panels are retracted by selection of the GND SPLR switch to OFF. Switch selection to OFF also causes a blue GND SPOILER UNARM advisory message to be displayed on CAS.

NOTE:

The GND SPLR switch is normally selected to ARMED on line up before takeoff. If either power lever is advanced above idle after the spoilers are armed, the electrical circuit to the primary and secondary solenoid operated hydraulic control valves is broken. The spoilers will remain stowed even though the GND SPLR switch is selected to ARMED. If the aircraft is operating on Essential DC bus power only, the ground spoilers are inoperative, as power for the system is required from the Main DC bus.

If Main DC bus power is not available and the GND SPLR switch is selected to ARMED, a red NO GND SPOILERS warning light (windshield center post) illuminates when the power levers are retarded to ground idle after landing. Since the ground spoilers are inoperative, no input is made to the flight spoilers, thus they also do not extend. In this case, the speed brakes would be extended at the discretion of the flight crew. The ground spoiler system incorporates two distinct warning functions. The first warning function occurs only on the ground, and is activated if the ground/flight spoilers do not automatically extend upon touchdown. This is annunciated by illumination of the red NO GND SPOILERS warning light on the windshield center post. The second warning function can occur both on the ground and in flight, and is activated if there is a failure within the ground spoiler system which might result in inadvertent spoiler extension. This is annunciated by a red GND SPOILER warning message displayed on CAS and, if installed, the SWLP.

(2) Hydraulic Operation: The ground spoiler system requires both control pressure and operating pressure. Control pressure, also known as servo pressure, is normally supplied by the combined hydraulic system, but can be supplied by either the Utility or Auxiliary hydraulic systems. Operating pressure is supplied by the Combined and Flight hydraulic systems. The ground spoiler system is solely a hydraulically powered system, thus reversion to manual control is not possible. The ground spoiler hydraulic system contains primary and secondary solenoid-operated hydraulic control valves located in the main wheel well. Two ground spoiler actuators (one per side) are located at the inboard ends of the left and right wing rear beam. During normal operation, Combined and Flight hydraulic system pressure is supplied through the

open flight power shutoff valve to the retract side of the ground spoiler actuators. The ground spoiler automatic deployment feature is accomplished by a common hydraulic signal that overrides any input to the servo valve through the SPEED BRAKE handle. The override signal is supplied by Combined (or Utility or Auxiliary) hydraulic pressure to both actuators through normally-closed solenoid valves. Since the override signal is common to both the left and right actuators, the possibility of asymmetrical extension is virtually eliminated. In the unlikely event that the ground spoilers inadvertently extend during low-speed flight, the ground spoiler control system will extend all six spoiler panels in unison to 55 +4/-3°. Should this occur at higher airspeeds, the panels will "blow back" to an angle that balances the aerodynamic load against the panels with the force applied by the actuators. If both Combined and Flight hydraulic system pressure is lost, a bypass feature in the actuators allows the spoiler panels to "blow down" to a trail position. Operational Logic: The ground spoiler control system will automatically extend all six spoiler panels in unison to 55 +4/-3° when the following parameters are satisfied:

- *Combined (or Utility or Auxiliary) hydraulic pressure is available to provide servo pressure for spoiler control*
- *Combined or Flight hydraulic pressure is available to provide operational pressure to extend the spoilers*
- *GND SPLR switch is selected to ARMED*
- *Both power levers are retarded to ground idle*
- *Main landing gear Weight-On-Wheels (WOW) is sensed by the nutcracker system*
- *At wheel spin up greater than 57 knots (48 knots for aircraft with ASC 307 incorporated) when:*
  - *Flaps position is greater than 22° OR:*
  - *Flaps position is less than 22° and the GND SPLR FLAP OVRD switch is selected to ON*

1.6.5.1.3 Ground spoiler warning system:

The ground spoiler system is monitored by a warning circuit that will detect certain in-flight and on ground malfunctions within the ground spoiler system. (a) A red GND SPOILER warning message will be displayed on CAS and, if installed, the

SWLP, should any of the following events occur while in flight:

• One or both ground spoilers not fully retracted with SPEED BRAKE handle in RETRACT detent

• Primary solenoid-operated hydraulic control valve failure with secondary solenoid-operated hydraulic control valve pressurized

• Secondary solenoid-operated hydraulic control valve electrically energized

• Failure of the primary solenoid-operated hydraulic control valve nutcracker relay No. 6

• Failure of the secondary solenoid operated hydraulic control valve nutcracker relay No. 1 Additionally, the red GND SPOILER warning message will be displayed should any of the following events occur while on the ground:

• Primary solenoid-operated hydraulic control valve failure with the power levers not in ground idle

• Unlocked ground spoiler with power levers at takeoff power.

(b) A red NO GND SPOILERS warning light, located adjacent to the pilot's AOA indexer on the windshield center post, will illuminate if the ground spoilers do not automatically extend upon touchdown.

Ground Spoiler System Check: The following ground spoiler system check should be performed during the After Starting Engines checklist prior to the first departure of each day. It provides a complete functional check of the automatic ground spoiler system and ground spoiler warning system.

(a) Verify the GND SPLR switch is selected to OFF.

(b) Verify left and right power levers are positioned to idle. Verify the following indications:

• Ground spoilers are stowed (visually check)

• NO GND SPOILERS light is extinguished

• GND SPOILER warning message is not displayed on CAS

• GND SPOILER UNARM advisory message is displayed on CAS Select the GND SPLR switch to ARMED. Verify the following indications: ■ Ground spoilers are extended (visually check)

• NO GND SPOILERS light is extinguished (may flash momentarily) • GND SPOILER warning message is not displayed on CAS

• GND SPOILER UNARM advisory message is not displayed on CAS

(d) Advance the left power lever out of idle. Verify the following indications:

• Ground spoilers are stowed (visually check)

• NO GND SPOILERS light is extinguished

• GND SPOILER warning message is not displayed on CAS (may appear momentarily) Advance the right power lever out of idle. Retard the left power lever to idle. Verify the following indications:

• Ground spoilers remain stowed (visually check)

• NO GND SPOILERS light is extinguished

• GND SPOILER warning message is not displayed on CAS Select the GND SPLR switch to OFF. Verify the following indications:

■ GND SPOILER UNARM advisory message is displayed on CAS (h) Press and hold the GND SPLR TEST switch. (See Notes 2 and 3.)

Verify the following indications:

• Ground spoilers remain stowed (visually check)

• NO GND SPOILERS light is illuminated

• GND SPOILER warning message is displayed on CAS • Both MASTER WARN lights illuminate • GND SPOILER UNARM advisory message is displayed on CAS

■ *GND SPOILER light on SWLP (if installed) is illuminated. Release the GND SPLR TEST switch. Verify the following indications:*

■ *Ground spoilers remain stowed (visually check)*

• NO GND SPOILERS light is extinguished

■ *GND SPOILER warning message is not displayed on CAS*

• Both MASTER WARN lights are extinguished

• GND SPOILER UNARM advisory message is displayed on CAS

■ *GND SPOILER light on SWLP (if installed) is extinguished Retard the right power lever to idle. Verify the following indications:*

■ *NO GND SPOILERS light is extinguished*

• GND SPOILER warning message is not displayed on CAS

• GND SPOILER UNARM advisory message is displayed on CAS

NOTE:

(1) When the power lever is advanced, the red GND SPOILER warning message may be displayed momentarily and then extinguish. If the message remains extinguished, continue the test.

(2) The absence of either the NO GND SPOILERS light or the GND SPOILER message during Step 6 of the ground spoiler system check, or any incorrect indication, constitutes an unsuccessful ground spoiler system check.

(3) The ground spoilers cannot always be observed from the cockpit. The correct GND SPOILER message and NO GND SPOILERS light indications are sufficient for satisfactory pre-flight functional verification.

1.6.5.1.4 Flight power shutoff system:

The flight power shutoff valve is a mechanically operated shutoff valve located between the Combined and Flight hydraulic system pressure sources and the flight and ground spoiler actuator pressure lines. The valve consists of two mechanically connected but hydraulically isolated sections. A control ex cable connects the valve to a FLIGHT POWER SHUT OFF handle located on the left aft side of the cockpit center pedestal.

Moving the FLIGHT POWER SHUT OFF handle up from its stowed (horizontal) position to the vertical position mechanically closes the flight power shutoff valve. With the valve closed, operating pressure is removed from the spoiler actuators and use of the system is not possible. In accordance with limitations established in the GIV Airplane Flight Manual, pulling the FLIGHT POWER SHUTOFF handle with speed brakes extended is prohibited. The resultant advantage of the flight power shutoff provision is the ability to bypass a malfunctioning actuator (such as would be the need in the unlikely event of an actuator jam) and manually fly the aircraft. Although control column effort and response time to inputs are increased while in manual reversion, the aircraft remains capable of positive and harmonious control.

1.6.6 Thrust reversers system

The engine exhaust (aft cowl) system directs the exhaust gases from the engine turbine section aft and into the atmosphere. The T/Rev exhaust unit for the Gulfstream IV is an airframe furnished component and is therefore not considered a portion of the engine. It is intended for ground use only and provides a means of

decelerating the aircraft during landing roll. When the reverser assembly is in the stowed position, it forms the engine exhaust nozzle and the aft most portion of the nacelle fairing.

The T/Rev (aft cowl) assembly consists of a forward barrel assembly, two doors, acoustic tailpipe, two stang beam assemblies, mechanical operating linkage, aft portion of mechanical feedback control system and electrical control / indication circuitry. The tailpipe assembly provides supports for the following items:

- *T/Rev doors*
- *T/Rev fairings*
- *T/Rev actuating mechanism*

The forward end of the tailpipe is flanged and is bolted to W struts on engine turbine section.

The airframe portion of the T/Rev system consists of a hydraulic selector control valve, throttle mounted reverse thrust lever, forward portion of mechanical feedback control system and electrical control / indication circuitry.

The doors are operated by means of a hydraulic actuator and beli crank mounted in the outboard stang beam of each T/Rev. Hydraulic power to right T/Rev is provided by the flight hydraulic system. Hydraulic power to left T/Rev is provided by the combined hydraulic system. Control is provided by the left and right T/Rev selector control valves located in tail compartment. Each valve contains two solenoids, one to port hydraulic fluid to stow portion of actuator and one to port hydraulic fluid to deploy portion of actuator. Selection of stow or deploy is made with reverse thrust lever in cockpit.

1.6.6.1 T/Rev system safety devices

During normal T/Rev system operation, the following safety devices are utilized to protect against inadvertent operation of reverser, a jammed condition, and improper operation of system:

(1) Primary lock

The hydraulic actuator includes a built-in locking device which is engaged by spring force when actuator is fully extended to reverser stowed position. The lock disengages hydraulically when deploy pressure is applied to actuator.

(2) Secondary lock

A secondary latch located in outboard stang beam locks both doors in stowed position. It is spring-loaded to the locked position and is unlocked by a solenoid actuator which is energized via a deploy command. On aircraft having ASC 18 (CAA requirements), Aircraft 1000 thru Aircraft 1143 excluding 1034 having ASC 166 and Aircraft 1034, 1144 and subsequent, the solenoid actuator is de-energized when doors deploy by a 5-second time delay relay.

(3) Mechanical feedback system

1.6.6.2 Arming system

When the power lever mounted in cockpit control pedestal is in idle position (L Power Lever electrical switch also in idle position), the reverse thrust lever can be moved in its upward / aft direction for deployment. With L Power Lever switch in idle position, left fire handle in normal position, T/REV EMER STOW switch not depressed and on Aircraft 1000 thru Aircraft 1143 excluding 1034 not having ASC 166 Nutcracker No. 3 relay energized (on ground configuration) or on Aircraft 1000 thru Aircraft 1143 excluding 1034 having ASC 166 and Aircraft 1034, 1144 and subsequent either Nutcracker No. 3 relay energized (on ground configuration) or - I/Rev Wheel Speed relay energized (wheel speed above 65 mph), 28 V_{DC} essential

bus power is transmitted via L TYREV CONT circuit breaker to L T/Rev arm indicator causing REV ARM light on pilot instrument panel to come on.

1.6.6.3 Deployment

When reverse thrust lever is moved in its upward / aft direction, a sector wheel and push-pull rod in pedestal is caused to move forward to activate L T/Rev Lever switch to deploy position. Power coming from the same source is also routed to energize the L Secondary Lock relay. When this relay is energized, a circuit is completed from essential 28 V_{DC} bus via L SEC LOCK circuit breaker and the closed contacts of L Secondary Lock relay to energize the secondary lock actuator. With secondary lock actuator energized, the circuit described in Arming System above (coming through L TYREV CONT circuit breaker) is also completed to energize solenoid No. 1 of L T/Rev selector control valve to admit hydraulic pressure to deploy side of T/Rev actuator. This results in hydraulic pressure unlocking T/Rev actuator primary lock and deploying doors. On Aircraft 1000 thru Aircraft 1143 excluding 1034 having ASC 166 and Aircraft 1034, 1144 and subsequent, after 5 seconds the L Secondary Lock Time Delay relay is energized. Power is no longer routed to L Secondary Lock relay and to secondary lock actuator, but is routed directly to solenoid No. 1 of LRev selector control valve to maintain hydraulic pressure to deploy side of actuator.

The left T/Rev REV UNLK light will come on when secondary lock actuator retracts (unlocks), either upper or lower door limit switch is activated or primary lock switch (part of T/Rev actuator) is closed to unlocked position. When any or all four of these conditions are present, power is transmitted from warning lights power system to energize L T/Rev Interlock relay. When activated, this relay completes a circuit through its contacts to L T/Rev unlock indicator causing REV UNLK light to come on.

Also, when any of the four conditions for REV UNLK light illumination occurs, Engine Instrument and Crew Alerting System (EICAS) and standby warning light indications are also activated if either Nutcracker No. 1 relay is not energized (air configuration) or Power Lever 2 -1/0 relay is energized.

The L T/Rev REV DPLY light on pilot instrument panel will come on when T/Rev doors are fully deployed. In this condition, power is transmitted from warning lights power system through closed contacts of deploy limit switch to left T/Rev deploy indicator causing REV DPLY light to come on.

1.6.7 Weight and balance

According to the flight dispatcher during the post incident interview, due to the delayed flight out of NAIA to DNMM and considering the nature of the return flight to be a quick turn around, he called and requested his colleague in Lagos to assist him to file and submit it upon arrival of 5N-BOD. He also stated that there was no time on ground to prepare any trip paper work for the return flight. There was no any document available to the Bureau regarding the dispatch release folder which include the following; load sheet, trim sheet or weight and balance, ATC briefs and NOTAMS, Forecast Weather information and any company message and other related information. It is pertinent for this investigation to mention that neither the flight dispatcher nor any of SkyBird's representative received weather forecast information from any of the NiMeT's offices at Abuja or Lagos in order to brief or update the crew.

During the post incident interview, the Bureau requested for the actual takeoff and landing weights of the incident flight of which 58,600 lbs and 51,020 lbs were given respectively. Few days after the interview, the Bureau requested for the same information amongst other pertinent load sheet information, SkyBird provided different information that was not consistent with the first actual take-off and landing weights of (58,500 lbs and 54,500 lbs respectively). See appendices 1 and 2

Using the information in Appendix 3 the result of the calculation indicated that the center of gravity for 5N-BOD was 37.2 and 449.60 percent of mean aerodynamic chord, which was within the approved limits of the airplane. The information also included the following: basic operating weight 45,176 pounds, passenger weight, 184 pounds; baggage weight 40 pounds; zero fuel weight 45,400 pounds, takeoff fuel 13,500 pounds, ramp weight 58,900 pounds; taxi fuel burn 400 pounds, takeoff

weight 58,500 pounds, estimated fuel burn 4000 pounds, and estimated landing weight 54,500 pounds. The zero fuel, ramp, takeoff, and landing weight maximums were 46,500; 73,600 and 58,500 respectively.

1.6.8 5N-BOD's previous flights on the day of the accident

On the day of the accident, 5N-BOD flew from Abuja to Lagos and back to Abuja as the incident flight. The captain reported, in a post incident interview, that the spoilers were armed and deployed normally during landing in Lagos. The maintenance engineer also stated, in a post incident interview, that the spoilers, thrust reversers, and manual brakes worked normally in the previous flights and there was no recorded snag to indicate any malfunction before the incident.

1.6.9 Gulfstream IV demonstrated landing distance

As part of an airplane's certification, a manufacturer must demonstrate the distance to land from a 50-foot height to a complete stop (14 CFR 25.125). The Bureau requested the manufacturer (Gulfstream Aircraft Company) to provide the Demonstrated Landing Distance with computer plots or diagrams as follows:

I. With Braking, Thrust Reversers and Spoilers operating

II. With Braking and Thrust Reversers without Spoilers operating

III. With Braking without Thrust Reversers and Spoilers operating

The conditions under which the computations were made have been based on the following:

Aircraft:	GIV SN 1126
Airport Elevation:	1123 ft
Runway:	04/22, Length = 3610 m (11844 ft), Width = 60 m (197 ft), Smooth (not grooved)
Environmental:	Rain, Temperature 21/18, Wind Variable at 02kts

(approximately = 0)

Weights:	Initially 51020 lbs., Updated to 54500 lbs. on 9/25/2018
Approach Speed	150 kts
Landing Speed	140 kts

JAA method for Air segment from 50 ft threshold crossing to touchdown (7 seconds)

VTD / V50' = 0.93

Thrust reversers:

Full reverse thrust from deployment to 70 kts

Thrust reverse spool down to 50 kts

Thrust reverse off below 50 kts

Spoilers deployed to 26 degrees (manual deflection).

Results summary

- Standing Water time histories provided in the following table

Rwy Condition	TR Status	Spoilers	Weight	Delta Approach Speed	V land	Time to Full Brakes (From TD)	Spoiler Deflection	Time to Spoilers Deployed (From TD)	Time to Thrust Reverse (From TD)	Thrust Reverse Stow Speed	LFL
wet	in_op	inop	54500	15	140	1	0	N/A	N/A	N/A	7863
wet	op	man	54500	15	140	1	26	2	8.4	70	5576
wet	op	inop	54500	15	140	1	0	N/A	8.4	70	6304
5mm	in_op	inop	54500	15	140	1	0	N/A	N/A	N/A	10281
5mm	op	man	54500	15	140	1	26	2	8.4	70	6867
5mm	op	inop	54500	15	140	1	0	N/A	8.4	70	7292

Table 1

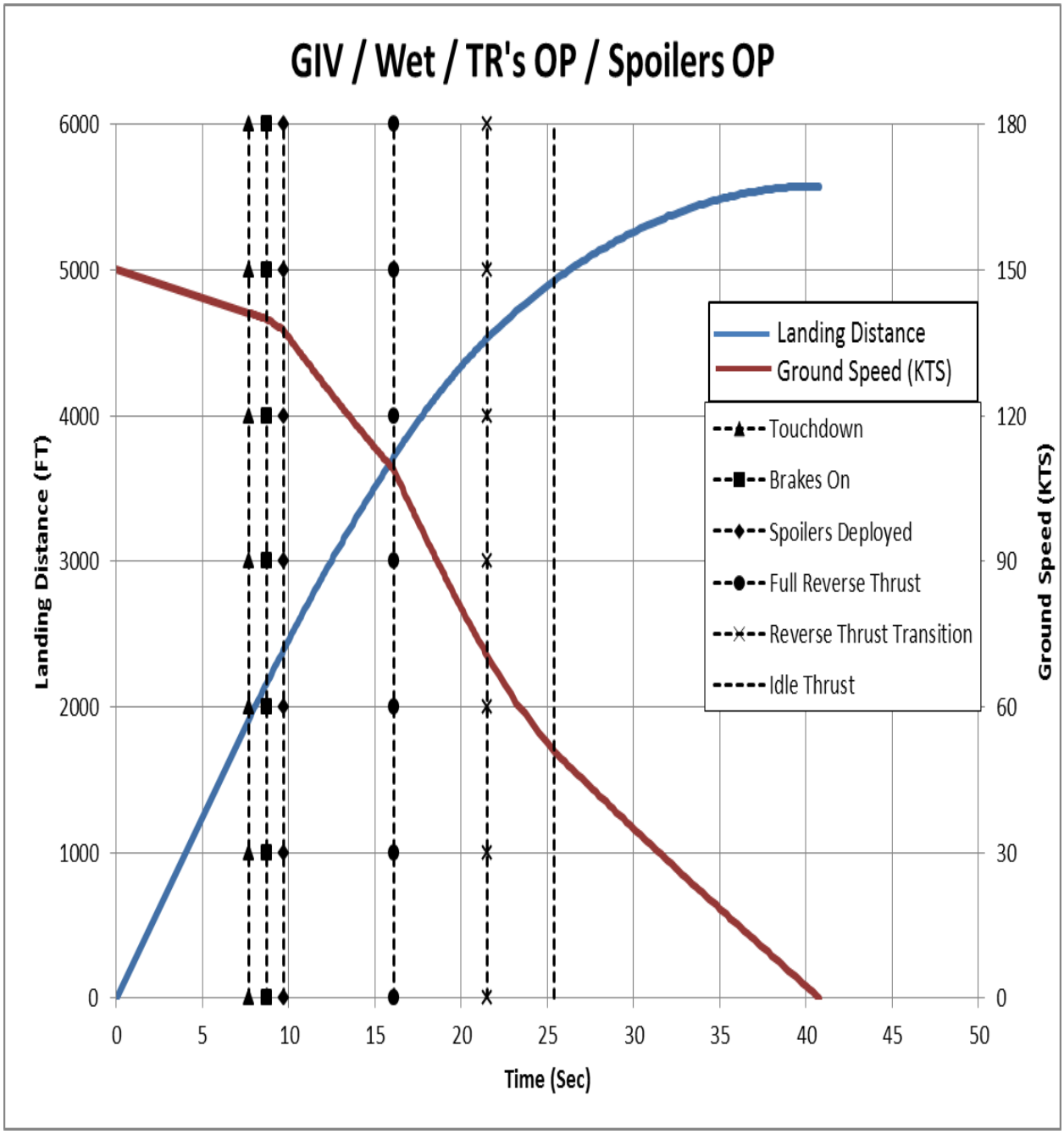


Figure 1: Wet runway/thrust reverser's and spoilers operating

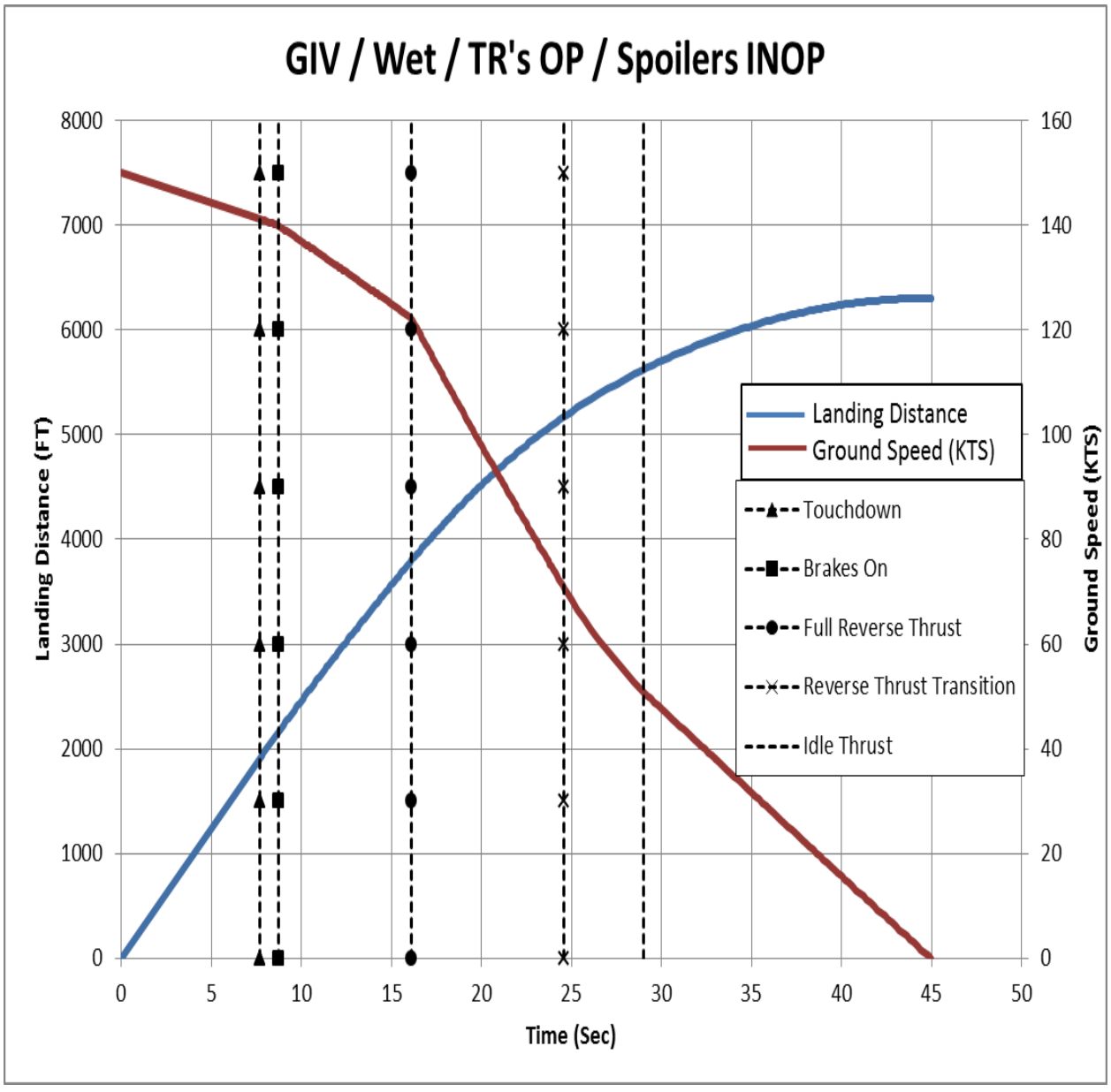


Figure 2: Wet runway/thrust reverser's operating and spoilers inoperating

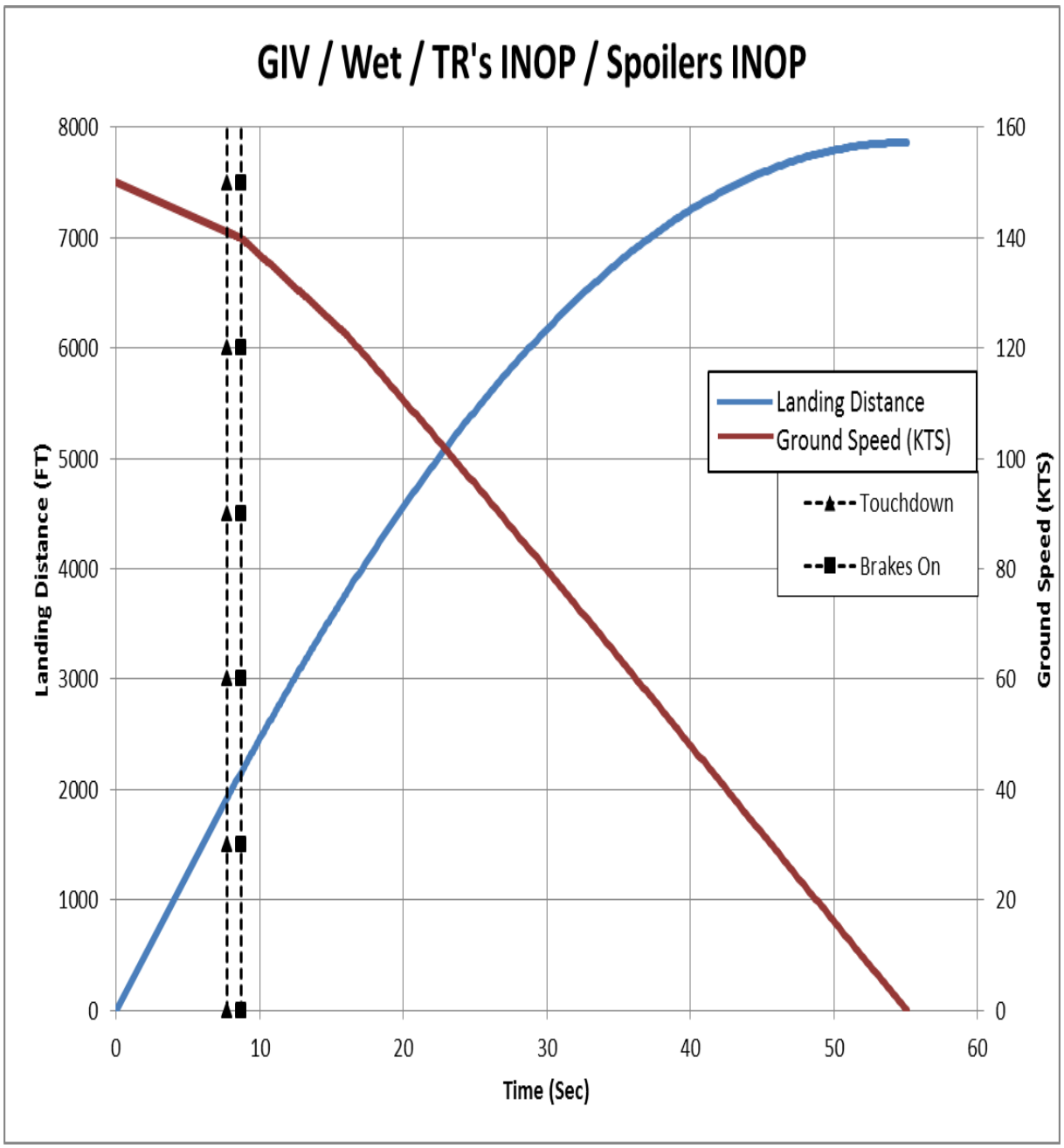


Figure 3: Wet runway/thrust reverser's and spoilers inoperating

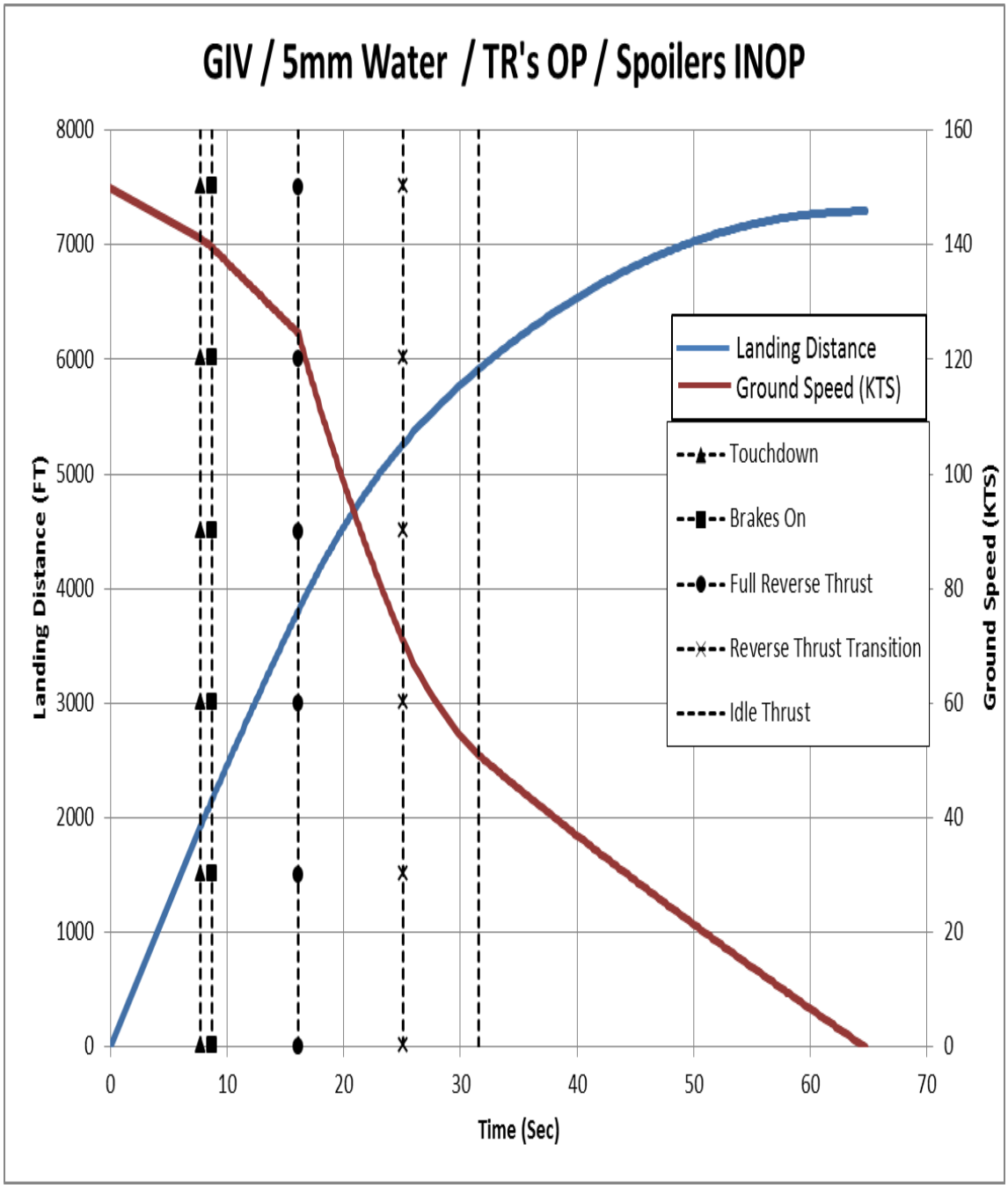


Figure 5: Standing Water / thrust reverser's Operating / spoilers inoperative

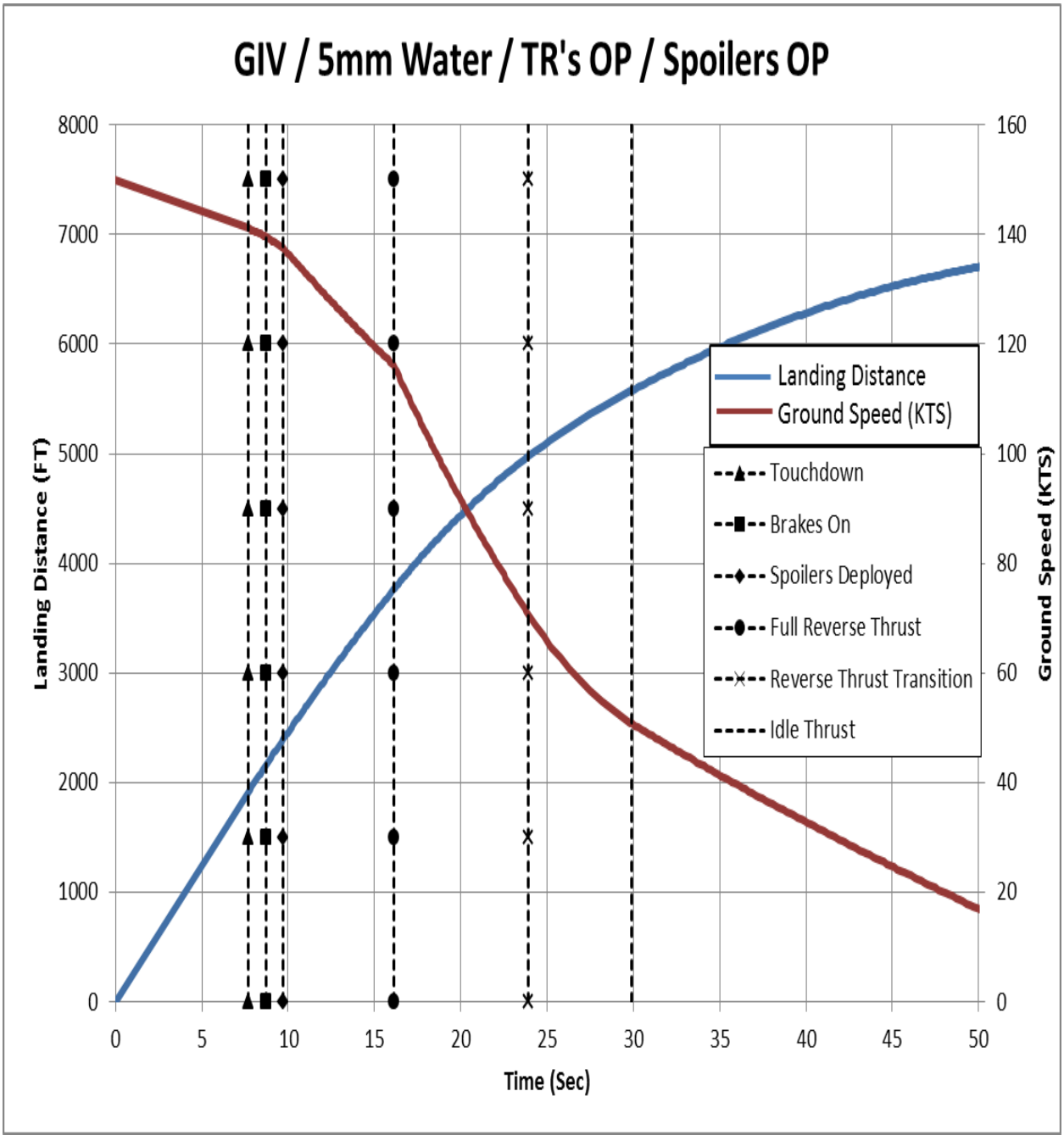


Figure 6: Standing water / thrust reverser's and spoilers operating

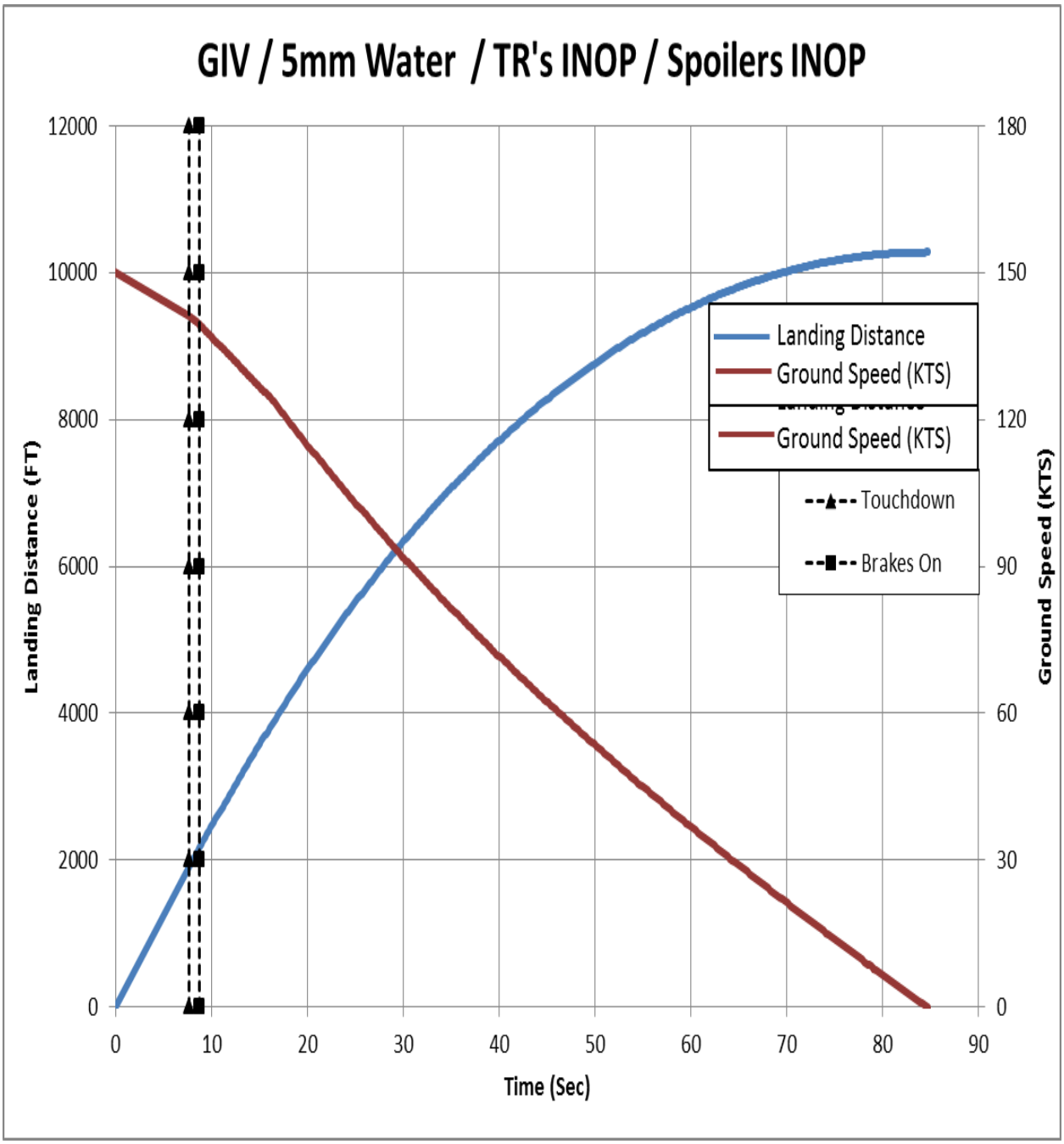


Figure 7: Standing water / thrust reverser's and spoilers inoperative

1.7 Meteorological information

1.7.1 Airport weather information

Weather observations and Forecasts at DNAA are made by the Nigerian Meteorological Agency (NiMeT), which is then passed to crew as flight briefing or transmitted to pilots through Automatic Terminal Information Service (ATIS). ATIS gives pilots firsthand information for wind speed and direction, cloud cover, temperature, precipitation, visibility etc.

ATIS transmits an official Meteorological Aerodrome Report (METAR) at an interval of 30 minutes and Special weather observation (SPECI) as conditions warrant or when there is significant change such as wind shift, change in visibility, and change in ceiling (cloud cover or height). Another important weather information issued by NiMeT is the Terminal Aerodrome Forecast (TAF) which is updated every 6 hours and it is valid for 30 hours.

The ATIS transmitted by NiMeT through Nigerian Airspace Management Agency (NAMA) for 2000 UTC, 2030 UTC and 2100 UTC of the day of incident were as follows:

Information Papa 2000 UTC

Main landing runway 22, wind 130 at 08kts, visibility 10km, light thunderstorm to rain, scattered 800ft, few 1900ft cumulonimbus, temperature 21, dew point 17, QNH 1014, no significant change. End of information Papa.

Information Quebec 2030 UTC

Main landing runway 22, wind variable at 02kts, visibility 10km, light thunderstorm to rain, scattered 800ft, few 1900ft cumulonimbus, temperature 21, dew point 18, QNH 1015, no significant change. End of information Quebec.

Information Romeo 2100 UTC

Main landing runway 22, wind variable at 01kt, visibility 10km, light thunderstorm to rain, scattered 800ft, few 1900ft cumulonimbus, temperature 21, dew point 18, QNH 1015, no significant change. End of information Romeo.

The SPECI observation issued by NiMeT for 1930 UTC was as follows:

Wind from 110 at 07 knots, visibility 10000 meters, thunderstorms, a few clouds at 570 meters in cumulonimbus clouds (North – West), ceiling broken at 240 meters, temperature 20º C, dew point temperature 18º C, altimeter 1014 hPa and No Significant change.

The SPECI observation for 2000 UTC indicated that the wind was from 130º at 08 knots, visibility was 10km in thunderstorms with slight train, a few clouds at 570 meters in cumulonimbus clouds (North – West), ceiling broken at 240 meters, temperature 21ºC, dew point temperature 17ºC, altimeter 1014hPa and No Significant change.

The SPECI observation for 2030 UTC indicated that the wind was Variable at 02 knots, visibility was 10km in thunderstorms with slight rain, a few clouds at 570 meters in cumulonimbus clouds (North – West), ceiling broken at 240 meters, temperature 20º C, dew point temperature 18º C, altimeter 1015hPa and No Significant change.

The Terminal Aerodrome Forecast for 1540 UTC indicated that the wind was from 250º at 08 knots, visibility was 9999 meters, scattered at 1400 meters, tempo 1218/1223 thunderstorms, a few clouds at 200 meters in cumulonimbus clouds, prob 30, tempo 1222/1302 06015 knots, visibility 5000 meters in thunderstorm with rain, ceiling broken at 800 meters, a few clouds at 1800 meters in cumulonimbus cloud, becoming 1302/1304 15005 knots, few at 1000 meters. In addition to the above weather information, NiMeT has also issued four warnings including three Aerodrome (AD) warnings and one Wind shear (WS) warning at NAIA same day of the occurrence. See Appendix 4

1.8 Aids to navigation

The condition of the navigational aids at the Nnamdi Azikiwe International Airport Abuja on the day of the occurrence were as follows:

VHF 127.05 MHz ATIS Frequency	Serviceable
ABC VOR/DME 116.3MHz	Serviceable
IAB; ILS/DME RWY 22 109.3 MHz	Serviceable
IAC; ILS/DME RWY 04 111.9 MHz	Serviceable
LLWAS	Unserviceable
Radar Monitor	Serviceable

1.9 Communication

There was effective two-way communication between the aircraft and the Air Traffic Services (ATS) throughout the duration of the flight.

1.10 Aerodrome information

Nnamdi Azikiwe International Airport Abuja (DNAA) has Aerodrome Reference Point $09^{0}00'15"N$ $07^{0}15'30"E$ and an elevation of 1123ft (342m). The aerodrome has a runway with orientation of 04/22. The length and width of the runway are 3610m and 60m respectively, with an asphalt/concrete surface and blast pads of 65m at both ends.

1.10.1 Runway surface information

There are mainly three types of friction loss that can occur on a wet runway surface. They are viscous hydroplaning, dynamic hydroplaning and reverted rubber skidding (or locked tyres). Their main contributing factors are briefly described as follows:

A. The contributing factors for viscous hydroplaning are a damp or wet pavement, medium to high speed, poor pavement texture, and worn tyre tread. If a runway has good micro-texture and grooving and the aircraft tyre have a good tread design, viscous hydroplaning could be alleviated.

B. The contributing factors for dynamic hydroplaning are a flooded pavement, high speed, low tyre pressure, and worn tyre tread. If a runway has good macro-texture and grooving and the aircraft tyre have high pressure and good tread design, dynamic hydroplaning could be alleviated.

NASA Langley Research Center, presented runway wetness classifications as follows:

- Damp—moisture present on the surface to a depth of less than 0.01 inch
- Wet—standing water on the surface to a depth between 0.01 and 0.1 inch
- Flooded—standing water on the surface to a depth that exceeds 0.1 inch.

The presentation also indicated that a pavement's capability to alleviate slipperiness improves as its micro-texture and macro-texture increase. The potential to alleviate slipperiness on smooth pavement surface that is damp or flooded is poor, whereas the potential to alleviate slipperiness on a porous pavement surface that is damp or flooded is excellent.

According to the article, "Landing on Slippery Runways," in Boeing's October to December 1992 *Airliner* magazine, "*viscous hydroplaning occurs on all wet runways and is a technical term used to describe the normal slipperiness or lubricating action of the water*." The article also stated that viscous hydroplaning reduces friction but not to the level that would prevent an airplane's wheel from spinning up shortly after touchdown. Macro-texture is the large roughness in the surface that is visible.

According to the article, "Landing on Slippery Runways," in Boeing's October to December 1992 *Airliner* magazine, dynamic hydroplaning "*lifts the tyre completely*

off the runway and causes such a substantial loss of tyre friction that wheel spin up may not occur."

c. *The contributing factors for reverted rubber skidding are a wet or flooded pavement, high speed, poor pavement texture, and a deficient brake system. To alleviate reverted rubber skidding, a good pavement structure and grooving and improved anti-skid control devices are necessary.*

1.10.2 Runway friction information

The following assessments of runway 04/22 were made upon arrival of the Bureau investigation team about an hour after the incident:

• A visual inspection revealed several clear smooth surface pavements with no holes on both approach ends of runway 22/04. There was no evidence of light, medium and large rubber deposits on the runway surface. No evidence of structural pavement failure was present.

• Friction survey tests, using an Airport Surface Friction Tester, were conducted at 65 to 95 kmph in both runway directions. RY22/04 170418 080300 and RY22/04 170418 084239, "Runway 22/04 Surface Friction Measurements" (dated 17 April, 2017). The NCAA guidelines for establishing the design objective, maintenance planning level and minimum friction levels of runways states that the maintenance planning friction levels at 65 and 95 kmph are 0.60 and 0.54, respectively. The average friction readings for runway 22/04 were 0.83 at 65 kmph and 0.53 at 95 kmph See Appendix 5.

• The runway surface was not grooved

In addition, the de-rubberization exercise was satisfactorily conducted quarterly on runway 04/22 in as prescribed in the appropriate FAAN manual as follows:

First quarter: - FFAN/300/BS/V.VIII/056, completed 14th on March, 2018

Second Quarter: - FFAN/300/BS/V.VIII/056, completed on 21st June, 2018

Third Quarter: - FFAN/300/BS/V.VIII/056, completed on 13th September, 2018.

1.11 Flight recorders

The aircraft was equipped with a Flight Data Recorder (FDR), a Cockpit Voice Recorder (CVR) and both were recovered from the aircraft in good physical condition.

1.11.1 Flight Data Recorder (FDR)

Model	FA2100
Part No.	2100-4043-00
Serial No.	000000124
Manufacturer	L-3 Aviation Recorders 100 Cattle Road, Sarasita, Florida

The airplane was equipped with an L3-Communications (Fairchild) Model FA2100 Flight Data Recorder (FDR). The FDR was delivered to the AIB Flight Safety Laboratory, Abuja on 14th September, 2018, and a download was performed.

The FDR recorded data in a digital format using a solid-state Flash Memory as the recording medium. The FDR was not damaged as a result of the incident; however, it was determined that of the 45 parameters recorded for the last 21 hours pertinent to the incident flight were not working except the Pressure Altitude, Airspeed and Time.

The last flight found recorded by the FDR was Abuja (ABV) – Santa Maria (SMA) – Fort Lauderdale Executive (FXE).

NCAA requested for submission of the last FDR readout and FDR Sensor Analysis required by Nigerian Civil Aviation Regulations (Nig. CARs) 7.8.1.4 as part of deficiencies found during the last Certificate of Airworthiness (C of A) renewal inspection conducted on the aircraft at Toledo maintenance facility in Fort Lauderdale, Florida (USA) via a letter referenced NCAA/DAWS/AD.1148/Vol.2/14 dated 17 August 2017.

In another letter referenced NCAA/DAWS/AD.1148/Vol.2/15 dated 8 December 2017, NCAA also reminded SkyBird Air Ltd about the outstanding FDR readout. In their response to the above referenced letter, SkyBird Air Ltd informed NCAA that Nig. CARs 7.8.1.4 could not be complied with via letter referenced SBA/NCAA/Q. S/2017/081 dated 13th December 2017. SkyBird applied for extension of FDR Readout submission to NCAA via letter Referenced SBA/NCAA/Q. S/2018/025 dated 5th March 2018.

NCAA granted Skybird's request for extension of the FDR readout submission until 27 September 2018 when the C of A would have expired via letter NCAA/DAWS/AD.1148/Vol.2/19 dated 12 March See Appendix 7

1.11.2 Cockpit Voice Recorder (CVR)

Model	A100A
Part No.	93-A100
Serial No.	S-55474
Manufacturer	Fairchild Aviation Recorders

The airplane was equipped with a Fairchild model A-100 Cockpit Voice Recorder (CVR). The CVR was delivered to the AIB Flight Safety Laboratory, Abuja on 14 September, 2018.

CVR specialists convened the same day to download the audio. However, after the teardown of the CVR, it was discovered that the Bulk Erase Coil had melted on top of the plastic tape reel. This resulted in the tape sticking together and some part of it got folded.

The Bureau is of the belief that it is likely:

I. The CVR might not be serviceable as at the time of the incident.

II. At some time in the past, a bulk erase was used on the CVR which caused the bulk erase coil to melt. See Figure below

III. It might also likely be that the bulk erase function was faulty.

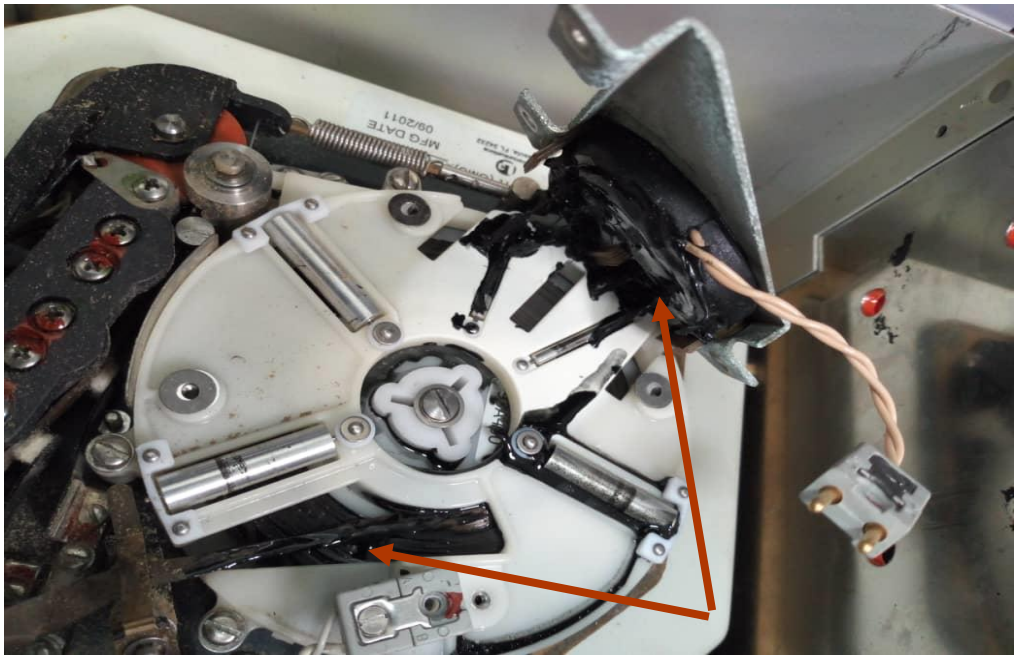


Figure 8: Melted bulk erase coil of the CVR

1.12 Wreckage and impact information

The aircraft maintained runway heading until it came to a stop in mud about 71m from the paved end of RWY22.

The aircraft remained in one piece. The following were found during post-incident inspection of the aircraft:

- Damage caused by debris on the right-hand flap lower surface with a puncture on the upper surface. The damage is approximately three inches in diameter located approximately one inch from the inboard end and eight inches from the trailing edge.
- The main wheel tyres were found in good condition (threads and inflation – NORMAL, No cut and No Flat Spots);
- There was no hydraulic leakage

- All the four brake wear indication Tubes were found missing on both main landing gears.
- G-IV Maintenance Manual (32-43-01 pages 601/602 and 605/606) Alternate Procedure was used to measure Brake Wear (Wear Indicator Tubes missing) and the result of the measurement of the clearance between Brake Housing and Pressure Plate was as follows:
- No.1 Main Landing Gear = 1.6”
- No.2 Main Landing Gear = 1.35”
- No.3 Main Landing Gear = 1.4”
- No.4 Main Landing Gear = 1.25”

NOTE: all the four Brake Assemblies were found within limits.

Figure 9: The aircraft 5N-BOD after the incident

Figure 10: The Nose Wheel bogged in mud.

Figure 11: One of the Main Wheel showing the aircraft bogged in mud.

Figure 12: The aircraft after the incident

1.13 Medical and pathological information

The toxicological examination for alcohol and substance abuse was not carried out on the crew.

1.14 Fire

There was no fire outbreak in-flight or after the occurrence. The Aerodrome Rescue and Fire Fighting Services (ARFFS) responded promptly.

1.15 Survival aspect

The crew and passenger survived the incident without injuries. There was no damage to the aircraft. The occupants had disembarked before the arrival of the ARFFS.

1.15.1 Emergency response and aircraft recovery

During the post incident interview, the air traffic controller on duty indicated that he called the ARFFS units on the radio at about 20:15 h. According to ARFFS personnel, "the fire main station watch room copied a conversation between the pilot and the control tower through the monitoring radio frequency 118.6, that an aircraft overshot the threshold of runway 04 after landing via runway 22.

The ARFFS station responded with available resources: a fire-fighting vehicle (Titan E-20). The driver of the fire fighting vehicle (FFV) reported that the FFV had departed the station within 2 minutes of the controller's radio conversation.

ARFFS personnel reported that the FFV proceeded to the scene and provided support with lighting because of the darkness at the scene.

1.15.1.1 Aircraft removal and recovery

After the incident, the ARFFS assessed the situation, after which the airport authorities coordinated the removal of the aircraft from the mud, which took one and a half days.

The aircraft was removed with no damage.

1.16 Test and research

A post-incident operational test of the brake system was conducted and was found satisfactory.

1.17 Organization and management information

1.17.1 SkyBird Air Limited

SkyBird Air Ltd was incorporated in July, 2009 as a Limited Liability Company with the business aims and objectives as Air Charter Operation. The head office is situated at 21 Gana Street, Maitama, Abuja.

SkyBird Air Ltd obtained an Air Operator Certificate (AOC) Number SkyBird/AOC/04-13/08 issued by the Nigerian Civil Aviation Authority (NCAA), operating as a Non Scheduled Carrier, on 26 April, 2012.

The airline has four aircraft in its fleet. This included three Dornier 328 Jet aircraft and one Gulfstream (GIV) airplane (incident aircraft). SkyBird operations mainly covers regional and domestic flights.

1.17.1.1 SkyBird Air Operations Manuals and SOPs

1.17.1.2 SkyBird Operations Manual Part "A"

2.0 Operational Control and Supervision

2.1 Supervision of the Operation by SkyBird Air

The responsibilities of SkyBird Air management as an AOC holder are effectively addressed under the following headings:

a) *Establishment of flight safety policy.*

b) *Allocation of responsibilities and duties and issuing instruction to individuals, sufficient for implementation of company policy and maintenance of safety standards.*

c) *Monitoring of flight safety standards.*

d) *Recording and analysis of any deviations from company standards and ensuring corrective action.*

e) Evaluating the safety record of the company in order to avoid the development of undesirable trends.

2.1.1 SUPERVISION OF THE OPERATION

a) Operational Control and Supervision is exercised through the sound and effective management structure and the allocation of responsibilities to nominated post holders who have proven competency in civil aviation.

b) A suitable management organization has been put in place which is properly matched to the operating network and scale of operations.

c) Sufficient flight and cabin crew have been employed for the planned operation and have been trained and checked in accordance with regulatory requirements. Similarly, competent ground staff for the scale of operations have been employed who have a thorough understanding of their responsibilities within the organization. These responsibilities are spelt out in the relevant manuals.

d) Suitable and sufficient accommodation and facilities are placed at the disposal of those exercising operational control at each operating base.

e) Adequate provisions have been made for the storage and display of essential records and flight planning by crews.

f) The system in place ensures respective distribution of operational instructions and other information to all concerned. In respect of documentation, adequate arrangements are in place for the production of manuals, amendments and other documentation.

2.1.1.1 COMPETENCE OF OPERATIONS PERSONNEL

It is of utmost importance, in the interest of safety and in the company's own interest as well, to maintain a high level of competence, of personnel proficiency and skills. Tools for monitoring competence are:

a. For flight crew:

- check and training flights, simulator sessions,

- ad hoc inspection flight by the Director of Flight Operations, the Crew Training Manager, the Chief Pilot(s) and/or the Cabin Crew Manager.

b. For ground personnel:

- adhoc assessment by supervisory staff participating in a particular tour of duty and/or participating in the performance of particular tasks,

c. collecting and assessing occurrence reports (in cases of high safety relevance, personnel who would otherwise become subject for disciplinary, legal or penal action shall be encouraged to write anonymous reports) and passenger complaints.

Tools for maintaining and improving proficiency are:

a. the system of promulgating operational instructions and information

b. the safety programmes outlined in this Section of the manual,

c. in individual cases, re-training as determined by supervisory staff.

It is most important that the company as represented by its supervisory staff convey to each individual the message that his cooperation within the company team is essential, that his opinion is asked for and that his ideas and suggestions are valuable. Thereby an esprit de corps is generated, and individuals are motivated not only to retain interest in their profession and in the company's welfare, but also keep up-to-date their proficiency, skill and competency.

NOTE: Management attitudes and behaviors have a profound effect on staff: For example, if management is willing to accept a lower standard of maintenance, then the lower standard can easily become the norm. Staff shall never be tempted or pressured into lowering their margins of safety by cutting corners as a gesture of

loyalty to the company or even self-interest in retaining their jobs: in the long run, such practices will be detrimental to safety and, therefore, to the company.

4.0 CREW COMPOSITION

4.1.2 CABIN CREW

a. The minimum Cabin Crew complement on Nigerian registered aircraft for the purposes of public transport is defined in the Nig.CARs. The term "Cabin Crew" corresponds to the term "Cabin Attendants" used in the Nig.CARs.

b. Any SkyBird Air flight operated for the purpose of public transport:

b) shall carry not less than one Cabin Crew member for every 50, or fractions of 50 passenger seats installed in the aircraft, provided that the number of Cabin Crew calculated in accordance with this paragraph need not be carried where the NCAA has granted the airline written permission to carry a lesser number on that flight, and the number specified in that permission are carried and all other terms and conditions subject to which such a permission is granted are complied with.

c) The Aircrew of an aircraft on a flight to which this paragraph applies shall include Cabin Crew carried for the purposes of performing duties assigned by the airline or the aircraft Captain in the interests of the safety of passengers, but who shall not act as members of the Flight Crew.

d) In unforeseen situations the required minimum number of cabin crew may be reduced provided that the number of passengers has been reduced in accordance with procedures specified in the Operations Manual. After completion of the flight a report must be submitted to the Authority.

e) The airline's policy is to operate public transport flights with crew qualified on the aircraft type by virtue of an approved SEP (Safety Equipment & Procedures) *training course. Captains are not to brief other staff, including*

positioning Flight Crew, to act as additional Cabin Crew on a particular flight unless they are SEP qualified on that type.

4.1.2.1 Normal Cabin Crew Complements

a) In addition to the minimum legal requirements, SkyBird Air carry sufficient Cabin Crew to provide a specified level of service. The numbers required on each aircraft type are detailed in the Cabin Safety Manual.

b) Whenever the normal Cabin Crew complement is reduced, at least one of the Cabin Crew members operating is to be a type-qualified No 1 Cabin Attendant. Once on duty, should the No 1 Cabin Attendant become medically unfit to perform his/her duties the next most senior cabin crew member on duty may take over these duties. When the normal Cabin Crew complement is reduced, special Aircrew procedures, and a reduced cabin service, may apply. Specific details, where appropriate, are set out in the Cabin Safety Manual.

c) Cabin Crew rostered as part of the Crew complement are not to be off-loaded to accommodate passengers.

5. 0 Qualification Requirements

5.3 Cabin Crew

A cabin crew member must meet the following requirements:

a. *be at least 18 years old;*
b. *have passed an initial medical examination or assessment and be medically fit to carry out specified cabin crew duties;*
c. *remain medically fit to discharge the specified cabin crew duties;*
d. *have successfully completed initial training, including emergency and first aid training, and the appropriate conversion course before operating as cabin attendant, and*

e. be competent to perform specified cabin crew duties;

b) The following medical requirements are applicable to each cabin crew member:

- *good health,*

- *freedom from any physical or mental illness which might lead to incapacitation or inability to perform cabin attendant duties,*

- *normal cardiorespiratory function,*

- *normal central nervous system,*

- *adequate visual acuity with or without glasses, and*

- *normal function of ear, nose and throat.*

Whenever more than one cabin attendant is assigned to a flight one must be nominated as Senior cabin attendant (C/A). Such designated senior cabin attendant must have at least one year's experience as an operating cabin crew member and must have completed a senior cabin crew training course.

5.3.1 Operation on more than One Type or Variant

A cabin crew member should not operate on more than 3 aeroplane types. He may operate on 4 types only if the safety equipment and emergency procedures for at least two of the types are similar.

5.4 Training, Checking and Supervisory Personnel

5.4.1 The following personnel have a training, checking and supervisory function with respect to operational staff. The training and checking requirements are detailed in the Company's Flight Operations Training Manual. Their respective duties are detailed in the Chapter 1 of this Manual and the Training Manual.

a) Flight pilot

Chief pilot *1.3.3.1*

Training captain *2.1.2.3.2*

b) Cabin crew

Cabin crew manager *1.3.3.1*

Coordinator *2.1.2.3.2*

8.0 Operating Procedures

SkyBird Air shall not operate a civil aircraft within or over Nigeria without complying with the operating limitations specified in our approved AFM, markings and placards, or as otherwise prescribed by the certifying authority for the aircraft's State of Registry.

Each AFM shall be updated by implementing changes made mandatory by the State of Registry.

SkyBird Air shall display in the aircraft all placards, listings, instrument markings or combination thereof, containing those operating limitations prescribed by the certifying authority for the aircraft's State of Registry for visual presentation.

8.1 Flight Preparation Instructions

a) An Operational Flight Plan must be completed for each intended flight and signed by the PIC except as shown in paragraph8.1.10 below and signed for by the Captain before the flight with assigned copy retained in file.

A PIC may sign the operational flight plan only when the PIC and the person authorized by the SkyBird Air to exercise operational control have determined that the flight can be safely completed.

b) The flight preparation before the commencement of each flight, include the complete review by the flight crew members of:

i) The Aircraft Technical Log(ATL) and the MEL/CDL to determine the airworthiness status of the aircraft

ii) The operational flight plan;

iii) Current maps and charts;

iv) Weather information to include en-route and departure, destination and alternate airports;

v) NOTAMS pertinent to the flight;

vi) Aircraft performance, weight and mass.

c) The Commander shall not commence a flight unless he is satisfied that:

i) the aeroplane is airworthy, duly registered and that appropriate certificates are on board the aircraft;

ii) any necessary maintenance has been performed and a certificate of release to service if applicable, has been issued in respect of the aircraft. The PIC has the authority to reject an aircraft prior to departure of a flight if he is dissatisfied with any aspect of the airworthiness and/or maintenance status of the aircraft

iii) The aircraft is airworthy, duly registered and that appropriate certificates are aboard the aircraft;

iv) The instruments and equipment installed in the aircraft are appropriate, taking into account the expected flight conditions; and

v) the aeroplane configuration is in accordance with the Configurations Deviation List;

vi) No pilot may conduct an international flight unless the procedures and signals relating to interception of aircraft, as specified in Nig.CARs IS: 8.8.1.27, are readily available on the flight deck.

vii) the documents, additional information and forms required to be available by paragraph 8.1.11.2 are onboard;

viii) Current maps, charts and associated documents or equivalent data are available to cover the intended operation of the aeroplane including any diversion which may reasonably be expected;

ix) Adequacy of operating facilities has been determined by every reasonable means available that the ground and/or water areas and facilities available and directly required for such flight and for the safe operation of the aircraft, are adequate, including communication facilities and navigation aids.

x) he is familiar with all available meteorological information appropriate to the intended flight after a study of available current weather reports and forecasts and planning for an alternative course of action to provide for the eventuality that the flight cannot be completed as planned, because of weather conditions.

xi) the fuel, oil, and oxygen needed to ensure the safe completion of the flight, including any reserves to be carried for contingencies are adequate.

xii) the load is properly distributed and safely secured;

xiii) the mass of the aeroplane, at the commencement of the take-off roll, will be such that the flight can be conducted in compliance with paragraphs 8.1.1.2 to 8.1.1.10 inclusive.

xiv) any operational limitation in addition to those covered by sub-paragraphs (ix) and (xi) above can be complied with.

xv) any electronic navigation data base installed into aircraft navigation equipment is valid for aircraft with electronic navigation data capabilities.

8.3.2.4 Landing

For the purpose of determining the allowable landing mass at the destination aerodrome, each person determining the landing limit shall ensure that—

(1) The aeroplane is landed on the most favorable runway and in the most favorable direction, in still air; or

(2) The aeroplane is landed on the most suitable runway considering the probable wind velocity and direction, runway conditions, the ground handling characteristics of the aeroplane, and considering other conditions such as landing aids and terrain.

(3) If the runway at the landing destination is reported or forecast to be wet or slippery, the landing distance available shall be at least 115 percent of the required landing distance unless, based on a showing of actual operating landing techniques on wet or slippery runways, a shorter landing distance (but not less than that required by paragraph (a)) has been approved for a specific type and model aeroplane and this information is included in the AFM.

(4) The planned Landing Weight for the flight is not to exceed the Maximum Landing Weight" and is to be based on the type of approach planned in, and is the lowest of;

i) The weight governed by WAT curve considerations;

ii) The weight on the runway for landing instill air-conditions;

iii) The weight on the runway that may be required for landing because of the forecast wind conditions;

iv) The maximum structural landing weight quoted in the Aircraft Flight Manual.

1.17.2 Nigerian Civil Aviation Regulations (NCAA)

NCAA is the overall organisation responsible for safety oversight of the civil aviation industry in Nigeria. It is charged with the regulation of all service providers, including aircraft operators, airport operators, air navigation service providers, their personnel, equipment, etc.

Below are some pertinent regulations to this investigation:

1.17.2.1 Compliance with an Air Operator Certificate (Nig. CARs 9.1.1.4)

(a) No operator may operate an aircraft in commercial air transport unless that operator holds an AOC for the operations being conducted.

(b) No person may operate an aircraft in commercial air transport operations which are not authorised by the terms and conditions of its AOC.

(c) Each AOC holder shall carry a certified true copy of the air operator certificate and a copy of the operations specifications relevant to the aircraft type, issued in conjunction with the certificate on board its aircraft. When the certificate and the associated operations specifications are issued by the State of the Operator in a language other than English, and English translation shall be included.

(d) Each AOC holder shall, at all times, continue in compliance with the AOC terms, conditions of issuance, and maintenance requirements in order to hold that certificate.

1.17.2.2 Aircraft Operated by the AOC Holder (Nig. CARs 9.2.2.7)

(a) The AOC holder shall list in its operations specifications the aircraft make, model and series with the following list of authorisations, conditions and limitations:

(1) Issuing authority contact details;

(2) Operator name and AOC number;

(3) Date of issue and signature of the Authority representative;

(4) Aircraft model;

(5) Types and areas of operations, and

(6) Special limitations and authorisations.

(*b) Each AOC holder shall apply to the Authority for an amendment to its operations specification in advance of any intended change of aircraft.*

(c) Aircraft of another certificate holder operated under an interchange agreement shall be incorporated to the operations specifications as required by paragraph (a) above.

1.17.2.3 Authorised Aircraft (Nig. CARs 9.2.3)

9.2.3.1—(a) No person may operate an aircraft in commercial air transport unless that aircraft has an appropriate current airworthiness certificate, is in an airworthy condition, and meets the applicable airworthiness requirements for these operations, including those related to identification and equipment.

(b) No person may operate any specific type of aircraft in commercial air transport until it has completed satisfactory initial certification, which includes the issuance of an AOC listing that type of aircraft.

(c) No person may operate additional or replacement aircraft of a type for which it is currently authorised unless it can show that each aircraft has completed an evaluation process for inclusion in the AOC holder's fleet.

1.17.2.4 Contents of Air Operator Certificate (Nig. CARs 9.1.1.7)

(a) The AOC will consist of two documents—

(1) A one-page certificate for public display signed by the Authority, and

(2) Operations specifications containing the terms and conditions applicable to the AOC holder's certificate.

(b) The Authority will issue an AOC which will contain—

(1) The State of the Operator and the issuing authority;

(2) The Air Operator Certificate number and its expiration date;

(3) The operator name, trading name (if different) and address of the principal place of business;

(4) The date of issue and the name, signature and title of the Authority representative, and

(5) The location, in a controlled document carried on board, where the contact details of operational management can be found.

(c) See IS 9.1.1.7(c) for detailed requirements on the layout and content of the Air Operator Certificate.

(d) The operations specifications associated with the Air Operator Certificate shall contain the authorisations, conditions, limitations and approvals issued by the authority in accordance with the standards which are applicable to operations and maintenance conducted by the AOC holder.

(e) See IS 9.1.1.7(e) for the layout and content of the Operations Specifications.

(f)Air operator certificates and their associated operations specifications first issued from November 2008 shall follow the layouts of IS 9.1.1.7(c)(e).

1.17.2.4 NCAA Technical Guidance Materials (TGM) Volume 1 General Inspector *-Handbook Revision 3 of 18th March 2015:*

CHAPTER 3The Five Phase Certification and Approval Process

1.0 PURPOSE

This Chapter is issued to provide general information and over-view to the inspector on the recommended Five Phase certification and approval process of operators and organizations incompliance with the Nigeria Civil Aviation Regulations.

3.0 GUIDANCE AND PROCEDURE

3.1 General Information

3.1.1 The following certification and approval process provides for a continuous interaction from the applicant's initial enquiry to the issue or denial of the requested certificate/approval by the Nigeria Civil Aviation Authority. It ensures that the

applicant's proposed programmes, systems, arrangements, facilities, documentation, personnel and intended methods of compliance are thoroughly reviewed, evaluated and tested by use of the five phase process.

3.1.2 The five certification phases are:

a) Pre - application

b) Formal Application

c) Document Evaluation

d) Demonstration and Inspection

e) Approval or Certificate Issue/grant or Denial (Certification)

The Flow Chart for AMO, AOC and ATO certification process is illustrated in the Appendix to this Chapter.

3.7 Certification Phase

3.7.1 When the applicant has met all regulatory requirements the assigned CPM will accomplish the following:

a) Document the following information -

(i) Findings and recommendations;

(ii) Discrepancies noted and comments;

(iii) Date of inspection;

(iv) The assigned CPM and certification team members, office designator and Signature.

b) Prepare the Approval Certificate Form: AC-OPS001Cwhich will be signed by the Authority.

c) Prepare the Specific Operating Provisions (SOPs) or Operations Specifications (OPS Specs) as appropriate showing the approvals and imitations which will be signed by the Authority.

d) Ensure that the certification report contains at least the following -

(i) A completed copy of the PASI form;

(ii) A copy of the statement of compliance;

(iii) A completed copy of the inspection form

(iv) A copy of the certificate issued;

(v) A copy of the SOPs or OPS SPECS issued.

3.8 Results

3.8.1 Successful completion of this task will result into the following:

a) Issue of an Approval Certificate and SOPs or OPS SPEC.

b) Notifying the applicant in writing.

3.8.2 If the certification is unsuccessful, due to either applicant termination or the failure of an inspection the person responsible for safety oversight will be briefed and letters will be written to the applicant describing the reasons.

3.8.3 The original certification report will be retained at the Authority office.

1.17.2.5 Renewal of SkyBird Air Operator Certificate (AOC)

The SkyBird AOC renewal process was conducted by NCAA after which the AOC and its associated Ops Specs were issued to SkyBird Air Ltd. The AOC renewed with effect from 23rdApril 2017 to expire on 16th April 2019.

A review of the Skybird's AOC Operations Specifications (Ops Specs) dated 23rd April 2017 reveals the following:

1. *5N-BOD was included in Part G (aircraft Leasing Arrangements), which stated amongst others that Merrola Nigeria Ltd shall be responsible for the OPERATIONAL CONTROL of all 5N-BOD flights.*
2. *5N-BOD was included in paragraph D44 (Maintenance Contractual Arrangement Authorisation for Entire Aircraft)*
3. *5N-BOD was excluded in paragraph A3 (Aircraft Authorisation)*
4. *5N-BOD was excluded in paragraph D41 (Approved Small Aircraft Inspection Programme)*
5. *5N-BOD was excluded in paragraph D42 (Additional Requirements for small aircraft)*
6. *5N-BOD was excluded in paragraph D43 (Aircraft Listing)*
7. *5N-BOD was excluded in paragraphs D52, D55, D60 and E61*
8. *None of AOC Ops Specs back pages of Parts D and E was signed by NCAA (Director of Airworthiness)*

1.17.2.6 Required Cabin Crew Members (Nig. CARs 9.3.1.7)

(a) The AOC holder shall schedule, and the PIC shall ensure, that the minimum number of required cabin crew members are on board passenger-carrying flights.

(b) The number of cabin crew members may not be less than the minimum prescribed by the Authority in the AOC holder's operations specifications or the following, whichever is greater—

(c) For a seating capacity of 20 to 50 passengers: 1 cabin crew member; and

(d) One additional cabin crew member for each unit, or part of a unit, of50 passenger seat capacity.

(e) When passengers are on board a parked aircraft, the minimum number of flight attendants shall be one-half that required for the flight operation, but never less than one cabin crew member (or another person qualified in the emergency evacuation procedures for the aircraft).

8.14.11. CABIN CREW

8.14.11.1. Assignment of Emergency Duties.

(a) The requirement for cabin crew for each type of aircraft shall be determined by the operator, based on seating capacity or the number of passengers carried, in order to effect a safe and expeditious evacuation of the aircraft, and the necessary functions to be performed in an emergency or a situation requiring emergency evacuation. The operator shall assign these functions for each type of aircraft.

1.17.2.7 Flight Supervision and Monitoring System (Nig. CARs 9.3.1.23)

(a) Each AOC holder shall have an adequate system approved by the Authority for proper dispatch and monitoring of the progress of the flights.

(b) The dispatch and monitoring system shall have enough dispatch centres, adequate for the operations to be conducted, located at points necessary to ensure adequate flight preparation, dispatch and in-flight contact with the flight operations.

(c) Each AOC holder shall provide enough qualified flight operations officers at each dispatch centre to ensure proper operational control of each flight.

(d) See IS: 9.3.1.23 for detailed requirements pertaining to the AOC holder's flight monitoring system.

1.17.2.8 Flight release-commercial air transport (Nig. CARs 8.13)

Operational control is defined by Nig. CARs 9.1.1.2 (a) (36) as the exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of safety of the aircraft and the regularity and efficiency of the flight.

8.13.1.1. Applicability.

(a) This Subpart is applicable to an AOC holder and the person designated by the AOC holder to issue a flight release.

8.13.1.2. Qualified Persons Required for Operational Control Functions

(a) A qualified person shall be designated by the AOC holder to exercise the functions and responsibilities for operational control of each flight in commercial air transport.

(b) For passenger-carrying flights conducted on a published schedule, a licensed and qualified flight operations officer shall be on-duty at an operations base to perform the operational control functions.

(c) For all other flights, the Director of Operations and the PIC are the qualified persons exercising operational control responsibilities, and shall be available for consultation before, during and immediately following the flight operation.

(1) The Director of Operations may delegate the functions for initiating, continuation, diversion and termination of a flight to other employees.

However, the Director of Operations shall retain full responsibility for these functions.

(d) For all flights, the PIC shares in the responsibility for operational control of the aircraft and has the situational authority to make decisions regarding operational control issues in-flight.

(1) Where a decision of the PIC differs from that recommended, the person making the recommendation shall make a record of the associated facts.

8.13.1.3. Functions Associated with Operational Control.

(a) The person exercising responsibility for operational control for an

AOC holder shall—

(1) Authorise the specific flight operation;

(2) Ensure that only those operations authorised by the AOC operations specifications are conducted;

(3) Ensure that an airworthy aircraft properly equipped for the flight is available;

(4) Specify the conditions under which a flight may be dispatched or released (weather minimums, flight planning, aircraft loading, and fuel requirements;

(5) Ensure that qualified personnel and adequate facilities are available to support and conduct the flight;

(6) Ensure that crewmembers are in compliance with the flight and duty time requirements when departing on a flight;

(7) Provide the PIC and other personnel who perform operational control functions with access to the necessary information for the safe conduct of a flight (such as weather, NOTAMS and aerodrome analysis);

(8) Ensure that proper flight planning and preparation is made;

(9) Ensure that flight locating and flight following procedures are followed;

(10) Ensure that each flight has complied with the conditions specified or release before it is allowed to depart;

(11) Ensure that when the conditions specified for a release cannot be met, the flight is either cancelled, delayed, re-routed, or diverted, and

(12) For all flights, ensure the monitoring of the progress of the flight and the provision of information that may be necessary to safety.

Note: See also ICAO Doc 9376, Preparation of an Operations Manual, Chapters 7 and 8.

8.13.1.4. Operational Control Duties

(a) For all flights, the qualified person performing the duties of a flight operations officer shall—

(1) Assist the PIC in flight preparation and provide the relevant information required;

(2) Assist the PIC in preparing the operational and ATC flight plans;

(3) Sign the dispatch copy of the flight release;

(4) Furnish the PIC while in flight, by appropriate means, with information which may be necessary for the safe conduct of the flight; and

(5) In the event of an emergency situation which endangers the safety of the aeroplane or persons becomes known first to the flight operations officer/flight dispatcher, action by that persons shall be in accordance with such procedures as outlined in the AOC holder's operations manual.

Where necessary, immediately notify the appropriate authorities on the nature of the situation, and if required, a request for assistance.

(b) A qualified person performing the operational control duties shall avoid taking any action that would conflict with the procedures established by—

(1) ATC;

(2) The meteorological service;

(3) The communications service; or

(4) AOC holder.

Note: See also ICAO Doc 9376, Preparation of an Operations Manual, Chapters 7 and 8.

8.13.1.8. Flight Release-Weather Reports and Forecasts.

(a) No person may release a flight unless he or she is thoroughly familiar with reported and forecast weather conditions on the route to be flown.

(b) No person may release a flight unless he or she has communicated all information and reservations they may have regarding weather reports and forecasts to the PIC.

(c) No person may issue a flight release for a commercial air transport operation unless the requirements of 8.13.1.5 for operational flight planning have been complied met.

(d) Completed flight preparation forms shall be kept by an operator for a period of 3 months.

8.13.1.10. Flight Release-Under VFR or IFR

(a) No person may release a flight under VFR or IFR unless the weather reports and forecasts indicated that the flight can reasonably be expected to be completed as specified in the release.

8.14.10. Flight Operations Officer/Flight Dispatcher.

(a) An operator shall ensure that any person assigned as a flight operations officer/flight dispatcher is trained and maintains familiarization with all features of the operation which are pertinent to their duties, including knowledge and skills related to Human Factors.

1.17.2.9 Cabin Crew Training Requirements (Nig. CARs 8.14.11.4)

(a) An operator shall ensure that a training programme is completed by all persons before being assigned as a cabin crew member.

(b) An operator shall establish and maintain a cabin crew training programme that is designed to ensure that persons who receive training acquire the competency to perform their assigned duties and includes or makes reference to a syllabus for the training programme in the company operations manual. The training programme should include Human Factors training.

1.17.2.10 Instructor Training Requirements (Nig. CARs 8.10.1.37)

(a) No person may serve nor may any AOC holder use a person as an instructor for flight crew, cabin crew or flight dispatcher, unless he or she has completed the curricula approved by the Authority for those functions for which they are to serve.

(b) Specific training programme requirements for flight crew instructors are contained in IS: 8.10.1.37.

1.17.2.11 Personnel Approved to Conduct Checks (8.10.1.38)

(a) The Authority may approve the following AOC holder personnel to conduct checks when such personnel meet the requirements for the authorised responsibilities, and may be approved for either aircraft or simulator, or both, as applicable, for checking of flight crew—

(1) Check pilot;

(2) Check flight engineer;

(3) Check cabin crewmember; and.

(4) Check flight dispatcher.

(b) The authorized duties of check personnel are to—

(1) Conduct initial and recurrent proficiency checks for flight crew and competency checks for cabin crew and flight operations officers,

(2) Certify as satisfactory, the knowledge and proficiency of the flight crew, and the knowledge and competency of the cabin crew and flight operations officers; and

(3) For all check personnel, supervise operating experience (OE).

(c) No person may serve nor may any AOC holder use a person as check personnel under the AOC holder's crewmember checking and standardisation programme in Nig. CAR Part 9unless that person has:

(1) been identified by name and function and approved in writing by the Authority; and

(2) successfully completed the AOC holders curricula approved by the Authority for those functions for which he or she is to serve.

(d) Once approved, no person may serve nor may any AOC holder use a person as check personnel for any flight crew, cabin crew or flight operations officer checks unless that person has demonstrated, initially and at least biennially to an Authority inspector, the ability to conduct a check for which he or she is approved.

8.10.1.39. Check Personnel Qualifications

(b) Check Personnel for Cabin Crew.

(1) No AOC holder may use a person, nor may any person serve as a check cabin crewmember in an established cabin crew training programme unless, with respect to the aircraft type or position involved, that person—

(i) Holds the qualifications required to serve as a cabin crewmember;

(ii) Has satisfactorily completed the appropriate training phases for the aircraft and or position, including recurrent training and differences training, that are required to serve as a cabin crewmember;

(iii) Has satisfactorily completed the appropriate competency and recency of experience checks that are required to serve as a cabin crewmember;

(iv) Has satisfactorily completed the applicable initial or transitional training requirements and the Authority-observed competency check for the check personnel duties; and

(v) Has been approved by the Authority for the check cabin crewmember duties involved.

1.17.2.12 Continued Serviceability and Inspection (7.8.1.4)

(a) The operator shall conduct operational checks and evaluations of recordings from the flight recorder systems to ensure the continued serviceability of the recorders.

(b) The procedures for the inspections of the flight recorder systems are given in IS 7.8.1.4.

IS: 7.8.1.4—(a) The operator shall, prior to the first flight of the day, monitor the built-in test features for the flight recorders and flight data acquisition unit (FDAU), when installed, by monitored by manual and/or automatic checks.

(b) The operator shall carry out annual inspections as follows :

(1) an analysis of the recorded data from the flight recorders shall ensure that the recorder operates correctly for the nominal duration of the recording;

(2) the analysis of the FDR shall evaluate the quality of the recorded data to determine if the bit error rate (including those errors introduced by recorder, the acquisition unit, the source of the data on the aeroplane and by the tools used to extract the data from the recorder) is within acceptable limits and to determine the nature and distribution of the errors;

(3) a complete flight from the FDR shall be examined in engineering units to evaluate the validity of all recorded parameters. Particular attention shall be given to parameters from sensors dedicated to the FDR. Parameters

taken from the aircraft's electrical bus system need not be checked if their serviceability can be detected by other aircraft systems;

(4) the readout facility shall have the necessary software to accurately convert the recorded values to engineering units and to determine the status of discrete signals;

(5) an annual examination of the recorded signal on the CVR shall be carried out by replay of the CVR recording. While installed in the aircraft, the CVR shall record test signals from each aircraft source and from relevant external sources to ensure that all required signals meet intelligibility standards;

(6) where practicable, during the annual examination, a sample of inflight recordings of the CVR shall be examined for evidence that the intelligibility of the signal is acceptable; and

(7) an annual examination of the recorded images on the AIR shall be carried out by replay of the AIR recording. While installed in the aircraft, the AIR shall record test images from each aircraft source and from relevant external sources to ensure that all required images meet recording quality standards.

(c) Flight recorder systems shall be considered unserviceable if there is a significant period of poor quality data, unintelligible signals, or if one or more of the mandatory parameters is not recorded correctly.

(d) The operator shall make available a report of the annual inspection on request to [the regulatory authorities] for monitoring purposes.

(1) Calibration of the FDR system: for those parameters which have sensors dedicated only to the FDR and are not checked by other means, recalibration shall be carried out at least every five years or in accordance with the recommendations of the sensor manufacturer to determine any discrepancies in the engineering conversion routines for the mandatory parameters and to ensure that parameters are being recorded within the calibration tolerances; and

(2) when the parameters of altitude and airspeed are provided by sensors that are dedicated to the FDR system, there shall be a recalibration performed as recommended by the sensor manufacturer, or at least every two years.

1.17.2.12 Discontinuation of the use of magnetic tape recorders (7.8.3.3)

(a) CVS media not acceptable for use in aircraft registered in Nigeria, or operated in commercial air transport operations in Nigeria, are—

(1) Magnetic tape and wire.

1.18 Additional information

1.18.1 Landing on contaminated runway

Landing on contaminated runways involves increased levels of risk related to deceleration and directional control. Aircraft landing performance data takes account of the deceleration issues in scheduling the Landing Distance Required (LDR), and

the aircraft limitations specified in the AFM can be expected to impose a reduced maximum crosswind limitation. Operator procedures may further restrict all such operations or impose flight crew-specific restrictions or requirements. Despite all procedural precautions, contaminated runway landings are rare events for most flight crew and although this serves to ensure a full focus on the task, the lack of real experience, and the limited ability to create realistic scenarios in most simulators, means that a full understanding of the issues involved can be an additional safeguard. Aircraft type procedures are the correct source of detailed knowledge.

1.18.2 Final approach and touchdown

An approach to land on a contaminated runway requires a fully stabilized final approach and a firm (but not hard) touchdown within the prescribed touchdown zone. If either is not achieved, a go around or rejected landing is appropriate. The challenges of achieving a successful contaminated runway landing are such that there should be no indecision in either case.

Touchdown vertical speed needs to be sufficient to break through the layer of contaminant and find at least some friction so that wheel rotation speeds can reach normal levels quickly. This is necessary so that they will exceed the minimum required to prevent operation of the anti-skid-system. A theoretical target for touchdown rate of descent is in the range 2 to 3 feet per second/120 to 180 fpm. Once main gear touchdown has occurred, de-rotation should start and thrust reverser deployment should occur. Both actions will increase wheel loading, which will ensure the achievement and/or continuation of wheel rotational speeds sufficient to allow lift spoiler deployment and brake activation.

1.18.3 Deceleration

This is a function of both wheel spin up and braking efficiency. Once manual or automatic braking begins, its efficiency may also be indirectly affected by use of thrust reversers/reverse pitch and the manual or automatic deployment of lift

spoilers. Spoiler activation will also be constrained by aircraft on ground logic and probably also by a wheel rotational speed, although usually a lower one than that needed to allow brake application. Absence of sufficient deceleration during a contaminated runway landing is much more likely to be due to low wheel rotational speeds than to brake system failure, (unless there are specific annunciations of this and/or related prior indications which have initiated doubt as to brake system integrity). Any memory drill action to select emergency braking channels should therefore only be followed strictly in accordance with the associated criteria, since one of the effects is likely to be the de-activation of the anti-skid system and an attendant increased risk of locking the wheels; on surfaces contaminated with liquid water, this increases the risk of reverted rubber aquaplaning.

Reverse thrust represents approximately 20 % of the total available braking force when braking on a slippery runway. The international guidelines for operation on contaminated runways are not in accordance with the strict requirements for certification of aircraft which are based on documented performance on dry runways without the use of thrust reversers. Nevertheless, operations on contaminated runways are permitted on the basis of 'advisory' (not 'certified') friction data and the use of thrust reversers.

1.18.4 Directional control

Effective directional control, on a contaminated runway surface during landing, requires that all wheels are firmly on the ground without undue delay and that the control column is then promptly centralized both longitudinally and laterally, so as to avoid inducing asymmetric main gear wheel loading and achieve adequate nose landing gear wheel loading. However, the main initial means of directional control during the landing roll is likely to be the rudder, which on most aircraft types will remain effective until around 80 KIAS, sometimes even less.

If directional control problems are experienced at high speed, then it is normally recommended to cancel reverse thrust/pitch until satisfactory control is regained. Once rudder effectiveness is lost at lower speeds, directional control difficulties on a

contaminated surface may increase, in contrast to what would be expected on a landing roll on a normal friction surface. This is because:

- Thrust Reversers/Reverse Pitch are likely to be more de-stabilizing
- Reduced nose landing gear wheel adhesion directly limits both steering input options and the usual directionally-stabilizing effect of the nose landing gear
- Yaw effects arising from any differential braking effectiveness are exaggerated.

1.18.5 Hydroplaning

Hydroplaning, also referred to as aquaplaning, occurs when a layer of water builds between the aircraft tyres and the runway surface, leading to a loss of traction and preventing the aircraft from responding to control inputs such as steering or braking. Landing at higher than recommended touchdown speeds will expose the aircraft to a greater potential for hydroplaning. Once hydroplaning starts, it can continue well below the minimum initial hydroplaning speed. Generally, 3 types of hydroplaning are distinguished: dynamic, viscous and reverted rubber.

Dynamic hydroplaning is caused by the build-up of hydrodynamic pressure at the tyre-pavement contact area. The pressure creates an upward force that effectively lifts the tyre off the surface. When complete separation of the tyre and pavement occurs, the condition is called total dynamic hydroplaning, and wheel rotation will stop. Total dynamic hydroplaning usually does not occur unless a severe rain shower is in progress. There must be a minimum water depth present on the runway to support the tyre. The exact depth cannot be predicted since other factors, such as runway smoothness and tyre tread, influence dynamic hydroplaning. Both smooth runway surface and smooth tread tyres will induce hydroplaning with lower water depths. While the exact depth of water required for hydroplaning has not been accurately determined, a conservative estimate for an average runway is that water depths in excess of 0.1 inch (2.54 mm) may induce full hydroplaning.

Viscous hydroplaning is more common than dynamic hydroplaning. Viscous hydroplaning may occur at lower speeds and at lower water depths than dynamic hydroplaning. Viscous hydroplaning occurs when the pavement surface is lubricated by a thin film of water. The tyre is unable to penetrate this film and contact with the pavement is partially lost. Viscous hydroplaning often occurs on a smooth runway pavement or where rubber deposits are present, usually in the touchdown area where a thin water film can significantly reduce the coefficient of friction.

2.0 ANALYSIS

2.1 General

The captain and the first officer were properly certificated and qualified under Nig. CARs and company requirements. No evidence indicated any pre-existing medical or behavioral conditions that might have adversely affected the flight crew's performance during the incident flight.

The incident airplane was properly certified, equipped, and maintained in accordance with Nig.CARs and approved company procedures. No evidence indicated pre-existing engine, system, or structural failures before the incident.

This analysis focuses primarily on the flight crew's performance and the airplane's spoiler system. The flight crew's performance during the entire flight especially during the last two segments of the flight (final approach) in the context of the weather information and cues that were available and the airplane's performance during the landing and overrun sequences are also examined. The analysis also addresses the airlines' Air Operator Certificate renewal, the roles of the Lead Crew and the Trainee Cabin Crew, the roles of situational stress and fatigue in the accident sequence; meteorological information provided, including ATC services and emergency response aircraft recovery efforts. The analysis also looks at the airline's last AOC renewal process, the carriage of Cabin Crew and the roles of the Lead Cabin Crew.

2.2 The incident scenario

The flight was cleared for radar vectors ILS RWY 22 approach. The auto throttle and autopilot were disengaged during the approach, about 500 and 200 feet AGL respectively. The flight crew recalled testing the nutcrackers, arming the ground spoilers before landing, and, they confirmed that all applicable and pre-requisite

checklist were accomplished. According to the crew the target airspeed for landing was 140 knots.

After touchdown, the reversers were activated normally. However, as the airplane decelerated below 140 knots, the crew observed that the rate of deceleration was slower than expected and the ground spoilers and thrust reversers would not deploy. Delayed thrust reverser deployment may suggest power levers not being fully aft to idle position. Having realised that the thrust reversers and the ground spoilers would not deploy, the crew might have closed the throttle to idle detent. Their actions came a bit late as the airplane rolled near the end of the runway; the captain shouted, "no spoilers", manually deployed the spoilers and thrust reverser in addition to the brakes. The airplane exited the end of the runway straight on the centerline and came to a stop 71m in grassy mud. The reported wind about the time of the incident was calm (variable at 2 knots).

2.3 The landing

Flight 5N-BOD touched down on runway 22 at 2014 UTC at a speed of about 140 knots. According to GIV landing speeds schedules, for the landing weight of 54,500 lbs (flaps 39°), the reference V_{REF} and approach speeds V_{APP} were 136 and 146 knots respectively See Appendix 8. Therefore, the landing speed of 140 knots was within prescribed GIV speed limits. However, the captain also reported that he made a smooth landing but not as he wanted, because he intended to make a firm positive landing.

The recommended landing on contaminated, wet or slippery runway should be a firm, positive, low speed and full flaps. The ground spoiler control system will automatically extend all six spoiler panels in unison to 55° +4/-3° when the following parameters are satisfied:

• Main DC bus power is available to provide electrical power for the system

• Combined (Utility or Auxiliary) hydraulic pressure is available to provide servo pressure for spoiler control

• Combined or Flight hydraulic pressure is available to provide operational pressure to extend the spoilers

• GND SPLR switch is selected to ARMED

• Both power levers are retarded to ground idle

• Main landing gear Weight-On-Wheels (WOW) is sensed by the nutcracker system

• At wheel spin-up greater than 57 knots (48 knots for aircraft with ASC 307 incorporated) when:

• Flaps position is greater than 22° OR:

• Flaps position is less than 22° and the GND SPLRFLAP ORIDE switch is selected to ON

During the post incident interview, the investigation determined that all of the above conditions were met during the approach and landing except for the main landing gear WOW. The smooth landing of the aircraft at touchdown suggested that one or more of the main landing gear nutcracker was not compressed by WOW, which may have caused one or both main landing gear "nutcracker" not to function properly thereby resulting in auto spoiler system deployment failure. Another reason that might have likely occurred was that during the flare, there was a tendency that the nose landing gear did not contact the runway firmly as a result of which the nose gear nutcracker did not activate to complete the three nutcrackers to sense the ground mode. The investigation, therefore, believes that one or more of the nutcracker system did not function properly after touchdown, which resulted in the failure of the spoilers to deploy automatically after landing. The description and operation of the nutcracker system was discussed in detail in section 1.6.4 of this report.

Also, during the post incident interview, the captain and the duty controller reported that the aircraft touched down within the one-third of the touchdown zone from the threshold down the 11,844-foot runway on the centerline.

The ATIS weather data indicated that surface winds were variable at 02 knots about the time the aircraft touched down, this information was available to the flight crew because the prevailing surface wind data were directly reported by the control tower during final approach. The controller's final wind report to the flight crew "wind calm" (which was transmitted few seconds before touchdown) would not have indicated the possibility of a tailwind component at touchdown. Therefore, approach speeds and winds were not factors to this incident.

2.4 Lack of spoiler deployment

The spoiler system aboard the incident aircraft was reported to be operating properly at the previous flight. According to the flight crew and engineer on duty, during the previous landing roll, all the inboard and outboard spoilers (flight and ground) deployed automatically after touchdown and remained fully deflected until the time it was stowed. However, the crew reported that after touchdown and during landing roll of the incident flight all the spoilers failed to be extended automatically (in response to a pilot input using the auto spoiler arming switch).

2.4.1 Manual spoiler deployment

The investigation could not identify any written procedure in any of the GIV Flight Operating Manuals (FOM) that required either pilot to announce the failure of the spoilers to automatically deploy. However, the FOM indicated that, if the spoilers failed to deploy automatically, the captain was responsible for manually extending the spoilers regardless of which pilot was making the landing.

Even though FOM did not require pilots to announce if the spoilers failed to automatically extend, both flight crew confirmed that the captain shouted "No

spoilers" some seconds after touchdown during the landing roll, after which he manually extended the spoilers accordingly.

The investigation therefore determines that, the flight crew could not verify that the spoilers had not automatically deployed immediately after landing and that the captain manually extended the spoilers few seconds later when they did not deploy which lead to the thrust reversers to deploy late, when the braking was not sufficient to stop the aircraft on the wet runway.

The GIV aircraft (5N-BOD)'s incident flight performance computation by Gulfstream Performance Group demonstrated that spoiler deployment is critical to the aircraft's braking force. For example, when the spoilers on the aircraft weighing 54,500 lbs and traveling at 140 knots with all spoilers and thrust reversers inoperative on a wet runway (5mm depth), the aircraft could stop at 10,281 feet leaving 1,563 feet of available runway remaining See table 1 above. The investigation determined that the ground spoilers and thrust reversers were locked out because all the conditions for the activation of the nutcracker system were not met; therefore, the system remained in air mode.

2.5 The carriage of cabin crew

The aircraft is a VIP configuration with a capacity for 13 passengers. Among the crew of the aircraft were a Lead Cabin Crew (LCC) and a Trainee Cabin Crew (TCC). The LCC stated that during the flight she performed the duties of Cabin Crew and also conducted training for the TCC.

2.5.1 Cabin crew qualification

Nig. CARs 9.3.1.7 prescribes a minimum of one cabin crew for 20 to 50 passenger seating capacity and one additional cabin crew for each unit or part of a unit of 50 passenger capacity on aircraft operated for commercial purposes. In any case, the

number of cabin crew members may not be less than the minimum prescribed by NCAA in the AOC holder's Operations Specifications (Ops Specs) paragraph A3.

Skybird's AOC Ops Specs paragraph A3 did not include 5N-BOD where the required number of Cabin Crew would have been stated See Appendix 9. Skybird's Operations Manual Part A (OMA) paragraphs 4.1.2(b), (c) and (e)state that any SkyBird Air flight operated for the purpose of public transport shall carry not less than one Cabin Crew member for every 50, or fractions of 50 passenger seats installed in the aircraft, and that it is the airlines' policy to operate public transport flights with crew qualified on the aircraft type by virtue of an approved Safety Equipment and Procedures (SEP) training course. Captains are not to brief other staff, including positioning Flight Crew, to act as additional Cabin Crew on a particular flight unless they are SEP qualified on that type. In the same vein, Nig. CARs 8.14.11.4(a) and (b) state that an operator shall ensure that a training programme is completed by all persons and that they have acquired the minimum required competency before being assigned as cabin crew members.

However, according to the records made available to AIB by NCAA and SkyBird, neither the LCC nor the TCC were type rated nor SEP qualified on G-IV.

2.5.2 Conduct of Cabin Crew Training

During post occurrence interview, the Lead Cabin Crew (LCC) stated that in addition to performing the duties of a cabin crew for the flight, she also conducted training for the Trainee Cabin Crew (TCC).

The Nig.CARs 8.10.1.37 (a) requires that before a person is assigned the duties of instructor for cabin crew by an AOC holder, he or she needs to complete the curricula approved by the NCAA for those functions for which they are to serve. And Nig. CARs 8.10.1.39(b) states that no AOC holder may use a person, nor may any person serve as a check cabin crewmember in an established cabin crew training programme unless, with respect to the aircraft type or position involved, that person:

(i) Holds the qualifications required to serve as a cabin crewmember

(ii) Has satisfactorily completed the appropriate training phases for the aircraft and or position, including recurrent training and differences training, that are required to serve as a cabin crewmember;

(iii) Has satisfactorily completed the appropriate competency and recency of experience checks that are required to serve as a cabin crewmember;

(iv) Has satisfactorily completed the applicable initial or transitional training requirements and the Authority-observed competency check for the check personnel duties; and

(v) Has been approved by the Authority for the check cabin crewmember duties involved.

However, according to the records made available to AIB, the LCC was neither trained nor authorised to act as an Instructor or Check Cabin Crew.

2.6 The role of situational stress

The presence of weather as a potential threat to the safety of flight and efforts to expedite the landing were sources of stress to the flight crew. Research has demonstrated that decision-making can be degraded when individuals are under stress because they selectively focus on only a subset of cues in the environment. As a result, any situation assessment may be incomplete, and the resulting decision, even when made by an expert, may be degraded. Stress can also impede an individual's ability to evaluate an alternative course of action, resulting in a tendency to proceed with an original plan even though it may no longer be optimal. Research on decision-making has demonstrated a natural tendency for individuals to maintain their originally selected course of action until there is clear and overwhelming evidence that the course of action should be changed.

Several cues indicated that the weather at the airport had deteriorated. The investigation also believes that any delay in landing would have further extended the pilots' duty time, but there is no evidence to indicate that this factor affected the flight crew's decision to continue the approach.

The flight crews' intention to expedite the return flight (quick turn-around), despite the weather encountered en-route might likely have diverted their attention away from other activities during the last minutes of the flight and, as a result, affected the crew's ability to properly assess the situation and make effective decisions. Therefore, the investigation determined that the flight crew's focus on expediting the landing because of the impending weather around the vicinity of DNAA contributed to their inability to verify that the spoilers had not automatically deployed immediately after landing.

2.7 Runway surface condition and maintenance

Effective maintenance of a runway surface is critical to retaining maximum friction characteristics. Periodic friction measurement, using a continuous friction-measuring device with a self-wetting capability, indicates if the surface is becoming more slippery when wet. This indication allows the airport to plan maintenance action, such as rubber removal, to re-establish runway friction levels. Combined with accurate data on the runway surface profile, the friction reading would also give airport authorities an indication of whether a runway should be considered slippery when wet, so that the appropriate notice to airmen (NOTAM) information can be disseminated. Company operations personnel, including flight crew, could then be forewarned that appropriate landing techniques should be used to reduce the likelihood of hydroplaning.

For flight crew to make proper assessment of landing conditions, they should be made aware of the actual conditions on the runway surface especially during rainy season.

Runway 04/22 had been consistently de-rubberized quarterly for the year 2018. This is in compliance with FAAN runways maintenance manual and applicable provision of Nig.CARs See Appendix 10.

While de-rubberization is being conducted on schedule (quarterly), the investigation determined that the last runway friction test conducted on runway 04/22 was on 17th April, 2017 See Appendix 10. This contravenes the guideline of NCAA on runway friction testing which requires a quarterly exercise to be conducted at both ends of the runway considering the average number of daily aircraft landings (72), at the airport See Appendix 5.

2.8 Meteorological support

2.8.1 Weather information to the aircraft (5N-BOD) before landing

The ATIS kept the crew apprised of the progress of the thunderstorm in particular and weather generally around DNAA. The crew had access to both ATIS transmitted between 2000UTC and 2100UTC. Neither of the transmissions mentioned "Heavy Rain" (See Section 1.7.1).

The Duty Air Traffic Controller (DATCO) responded promptly to the flight crew's requests. The ATC transcript indicated that, between 1954UTC and 2000UTC, the aircraft and the controller were engaged in weather deviation discussion after which the aircraft verified that it was clear of weather and the controller responded with a heading change for vectors and further descend clearance all of which the pilot acknowledged. Subsequently, 5N-BOD was cleared to land with a cautionary information that runway surface was wet.

According to the captain, during the approach "the rain was heavier than they advised". The investigation could not find any instance where the controller did not provide the flight crew with pertinent aviation weather information that was available to him at the tower or any delay in relaying this information, which was

especially noteworthy. However, it is important to note that any pilot that notices an adverse weather condition that is not reported by ATC around the vicinity of an airport is responsible for reporting such adverse weather to the ATC (PIREP). The captain should have therefore reported the increase in rain intensity he observed during the approach to safeguard other landing and departing aircraft at the airport.

Therefore, the investigation believes that the controller provided appropriate, pertinent, and timely weather information to the flight crew regarding the conditions on approach to and at the airport. He did not provide any additional information outside the content of weather report passed to ATC by the appropriate authorities responsible for disseminating the weather information.

2.9 Emergency response and aircraft recovery

The DATCO reported that he called the Aerodrome Rescue and Fire Fighting Services (ARFFS) unit on the radio about 20:15h h after contacting the flight crew after the airplane finally stopped. The DATCO indicated the possibility of the aircraft exiting the active runway via A4 up to A6 exits onto the taxi way. The ARFFS units proceeded to the approach end of runway 22, but the airplane was off the departure end of the runway. As a result, the ARFFS unit had to create an access road in order to move further into the grassy mud where they located the airplane about 2017 h, two minutes after the initial call from the DATCO.

The ARFFS unit had an idea of the approximate location of the airplane when they left the fire station, which saved the time spent traveling to the location of the aircraft. The investigation recognizes that the DATCO had provided a more precise description of the incident location to the ARFFS unit, especially since he knew the direction in which the airplane was landing and had seen the airplane travel past A4 exit.

The aircraft recovery was delayed for almost two days. This is due to lack of adequate special wreckage recovery equipment, tools, manual and manpower by the

Federal Airports Authority (FAAN). Also, over-reliance of the Memorandum of Understanding (MOU) with other stakeholders for assistance with regards to the recovery of aircraft at DNAA contributed to the delay in moving the aircraft out of the muddy grass. The resultant effect was, however, temporary total closure of the airport, downgraded operation of the runway by allowing takeoff only and limiting the runway length for full operations.

2.10 Operational control of the aircraft's flights

The incident aircraft belongs to a non AOC holder- Merolla Nigeria Ltd. In order to enable the use of the aircraft for commercial charter operations, the owner signed an Aircraft Management Agreement (AMA) with SkyBird Air Ltd (an AOC holder). According to the AMA, Merolla Nig. Ltd will pay for the crew, fuel and maintenance while SkyBird Air Ltd will make available its CALL SIGN for all the aircraft flight operations.

According to Nig. CARs 9.3.1.23, the responsibility for proper dispatch and monitoring of the progress of the flights rests with the AOC holder, who shall have approved adequate flight release and monitoring system with enough licensed and qualified Flight Operations Officers (FOOs)/ Flight Dispatcher sat each Dispatch Centre to ensure proper operational control of each flight. For non-scheduled commercial flights, the Director of Operations and the Pilot-In-Command (PIC) are the qualified persons to exercise operational control responsibilities.

However, a review of the SkyBird's AOC Ops Specs Paragraph G, NCAA assigned OPERATIONAL CONTROL of the aircraft commercial flights to Merolla Nig. Ltd- a non AOC holder.

2.11 Flight recorders

The FDR and CVR were successfully retrieved from the aircraft unaffected by the incident. The Flight Recorders were delivered to the AIB Flight Safety Laboratory, Abuja for download, Analysis and read back.

2.11.1 Flight Data Recorder FDR

The last good flight found on the FDR data was that of the maintenance positioning ferry flight from Abuja to Fort Lauderdale(FXE).

In August 2017, NCAA requested for submission of the last FDR readout and FDR Sensor Analysis required by Nig. CARs 7.8.1.4 as part of deficiencies found during the last Certificate of Airworthiness (C of A) renewal inspection conducted on the aircraft at Toledo maintenance facility in Fort Lauderdale, Florida (USA). Apparently, SkyBird Air Ltd did not carry out any FDR readout beforehand citing lack of local capability and instead applied for extension of FDR Readout submission to NCAA. NCAA granted Skybird's request for extension of the FDR readout submission until 27 September, 2018 when the C of A would have expired. It appeared that the FDR has stopped recording good quality flight data prior to the C of A renewal.

The operator having known about lack of local capability should have included the FDR Read out and Sensor Analysis in the Annual Inspection Work Package. The NCAA Principal Maintenance Inspector (PMI) in charge of SkyBird should have ensured that FDR read out and sensor analysis formed part of the work package during his/her review of the Annual Inspection work package. In addition, NCAA should have known that the excuse cited by the operator on non-compliance with Nig. CARs 7.8.1.4 was not acceptable as it was obvious that only a few organisations have such capabilities around the world. Moreover, the aircraft visited the maintenance facility where the FDR would have been downloaded to be sent to an organisation with capability to carry out the readout and analysis.

Thus, the essence of ensuring continued serviceability of the flight recorders required by Nig. CARs 7.8.1.4 could not be realized in this case.

2.11.2 Cockpit Voice Recorder (CVR)

After the teardown of the CVR, it was discovered that the Bulk Erase Coil had melted on top of the plastic tape reel. This resulted in the tape sticking together and some part of it got folded.

The Bureau is of the belief that it is likely: -

I. The CVR might not be serviceable as at the time of the incident

II. At some time in the past, a bulk erase was used on the CVR which caused the bulk erase coil to melt

III. This might likely be that the bulk erase function was faulty.

In addition, Nig. CARs 7.8.3.3 prohibits the use of Magnetic Type CVR media on Nigerian registered aircraft or aircraft operating within Nigeria.

2.12 SkyBird's AOC Renewal

The SkyBird's AOC renewal process was conducted by NCAA after which the AOC and its associated Ops Specs were issued to SkyBird Air Ltd. The AOC had validity of two years with effect from 23 April, 2017.

Every AOC renewal by NCAA follows the five phases of certification in accordance with Chapter 3 of Technical Guidance Material (TGM). The five phases are Pre-application, Formal Application, Document Evaluation, Demonstration and Inspection and lastly Approval or Issuance of Certificate (Certification). When the applicant has met all regulatory requirements, the NCAA should issue a new AOC with its associated Ops Specs signed by the Authority.

However, a review of the AOC Ops Specs issued to SkyBird Air Ltd after completion of the last AOC renewal, indicated that the Authority did not sign the back pages of Parts D and E.

Also, the incident aircraft was not included in the following SkyBird's AOC Ops Specs paragraphs:

(a) A3 (Authorized aircraft) contrary to Nig. CARs 9.2.2.7 and

(b) D41(Approved Small Aircraft Inspection Program), D42 (Additional Requirements for Small Aircraft), D43 (Aircraft Listing), D52, D55, D60 and E61 contrary to Nig. CARs 9.2.3.1.

3.0 CONCLUSION

3.1 Findings

1. The incident flight was from Lagos to Abuja
2. The Captain was the Pilot Flying
3. There were six (6) persons on board
4. The Lead Cabin Crew was not type rated on G-IV
5. The Lead Cabin Crew was neither trained nor authorised to act as Cabin Crew instructor
6. The Lead Cabin Crew was training another cabin crew on the flight who was also not type rated
7. The incident occurred at 2110h
8. Dynamic or reverted rubber hydroplaning did not occur during the accident airplane'slanding roll.
9. The ground spoilers system operated properly, and the ground spoilers automaticallydeployed during the landing roll of the previous flight.
10. The ground spoilers and thrust reversers were locked out because all the conditions for the activation of the nutcracker system were not met. The non deployment of ground spoilers and thrust reversers were the most important factors in the flight crew's inability to stop the incident airplane within the available runway length.
11. The DATCO provided appropriate, pertinent, and timely weather informationto the flight crew regarding the conditions on approach to and at the airport.
12. The Aerodrome Rescue and Fire Fighting Services arrived the incident site promptly.

13. The aircraft is owned by Merrola Nigeria Ltd (a non AOC Holder)

14. Merrola Nigeria Ltd signed an aircraft management agreement with Skybird Air Ltd (an AOC Holder) to use the aircraft for commercial charter operations

15. Merrola Nigeria Ltd pays for crew, engineers, maintenance and fuel

16. AOC Part G stipulates that Merrola Nigeria Ltd shall be responsible for Operational Control of 5N-BOD flights, whereas sub-paragraph 8.1.6 of the Management Agreement stipulates that Skybird Air undertakes to make available its CALL SIGN for both domestic and international flights of the aircraft

17. AOC Ops Specs Parts D and E were not signed by the Authority as required.

18. Aircraft (5N-BOD) not included in AOC Ops Specs paragraphs A3, A031, D40, D41, D42, D43, D44, D52, D55, D60, E61and Part G

19. AOC renewal process Phase 5 (Certification) could not have been deemed completed as the Ops Specs Parts D and E were not signed by NCAA before they were issued to SkyBird Air ltd

20. The FDR and CVR did not record data on this flight

21. The last good flight data found on the FDR was Abuja (ABV) – Santa Maria (SMA) - Fort Lauderdale Executive (FXE)which took place from20 to 21 June2016TheContinued Serviceability and Inspection of Flight Recorder Systems (Annual Flight Data Recorder Readout and Sensor Analysis) was not done as required by Nig. CARs 7.8.1.4.

22. NCAA granted Skybird Air Limited extension on submission of the Flight Recorder Systems (Annual Flight Data Recorder Read-out and Sensor Analysis) report until 28September, 2018, the date when C of A would have expired

23. The CVR installed on the aircraft used Magnetic Tape media.

24. Magnetic tape has been prohibited on Nigerian registered aircraft or aircraft operating in Nigeria (Nig. CARs 7.8.3.3)

25. The CVR Bulk Erase Coil had melted on top of the Plastic Tape Reel.

26. The lower section of the Right inboard flap was damaged. All four main wheel tyres were found in good condition (No cut, No Flat Spot, Threads and Inflation – Normal)

27. Time Since New for both Engines were 500 hours less in the Aircraft Tech log but the records in engines logbooks were correct

3.2 Causal factor

Delayed response by the crew to recognize that the ground spoilers and thrust reversers were locked out led to the runway overrun.

3.3 Contributory factor

The delayed deployment of ground spoilers led to the flight crew's problems in stopping the airplane within the remaining available runway length.

4.0 SAFETY RECOMMENDATIONS

4.1 Safety Recommendation 2020-004

FAAN should ensure that disabled aircraft are promptly removed from the incident site in accordance with Disable Aircraft Recovery Manual NAIA Abuja (Chapter 3 REMOVAL INSTRUCTIONS NAIA).

4.2 Safety Recommendation 2020-005

FAAN should ensure the Roles and responsibilities of stakeholders as stipulated in the Airport Emergency Plan (AEP) are strictly adhered to in case of any occurrence.

4.3 Safety Recommendation 2020-006

FAAN should ensure that ARFFS units are adequately staffed at a level that enables ARFFS personnel, upon arrival at an accident scene, to conduct exterior fire-fighting activities, interior fire suppression attack and a rescue mission concurrently.

4.4 Safety Recommendation 2020-007

NCAA should ensure that all G-IV operators adhere strictly to normal operating procedures regarding the nutcracker system.

4.5 Safety Recommendation 2020-008

NCAA should ensure that all G-IV operators, require flight crew to call-out if the ground spoilers do not automatically deploy and the thrust reversers are not deployed during landing, also a call-out when the ground spoilers have deployed, and verify they include these procedures in their checklists, and training programs.

The procedures should clearly identify which pilot is responsible for making these call-outs and which pilot is responsible for deploying the spoilers if they do not automatically deploy.

4.6 Safety Recommendation 2020-009

NCAA should intensify its oversight function on Skybird's Air Limited operations.

4.7 Safety Recommendation 2020-010

NCAA should comply with the AOC application/renewal process and ensure that the process is completed in accordance with the guidance materials issued by the Authority prior to issuance of the AOC to applicants.

4.8 Safety Recommendation 2020-011

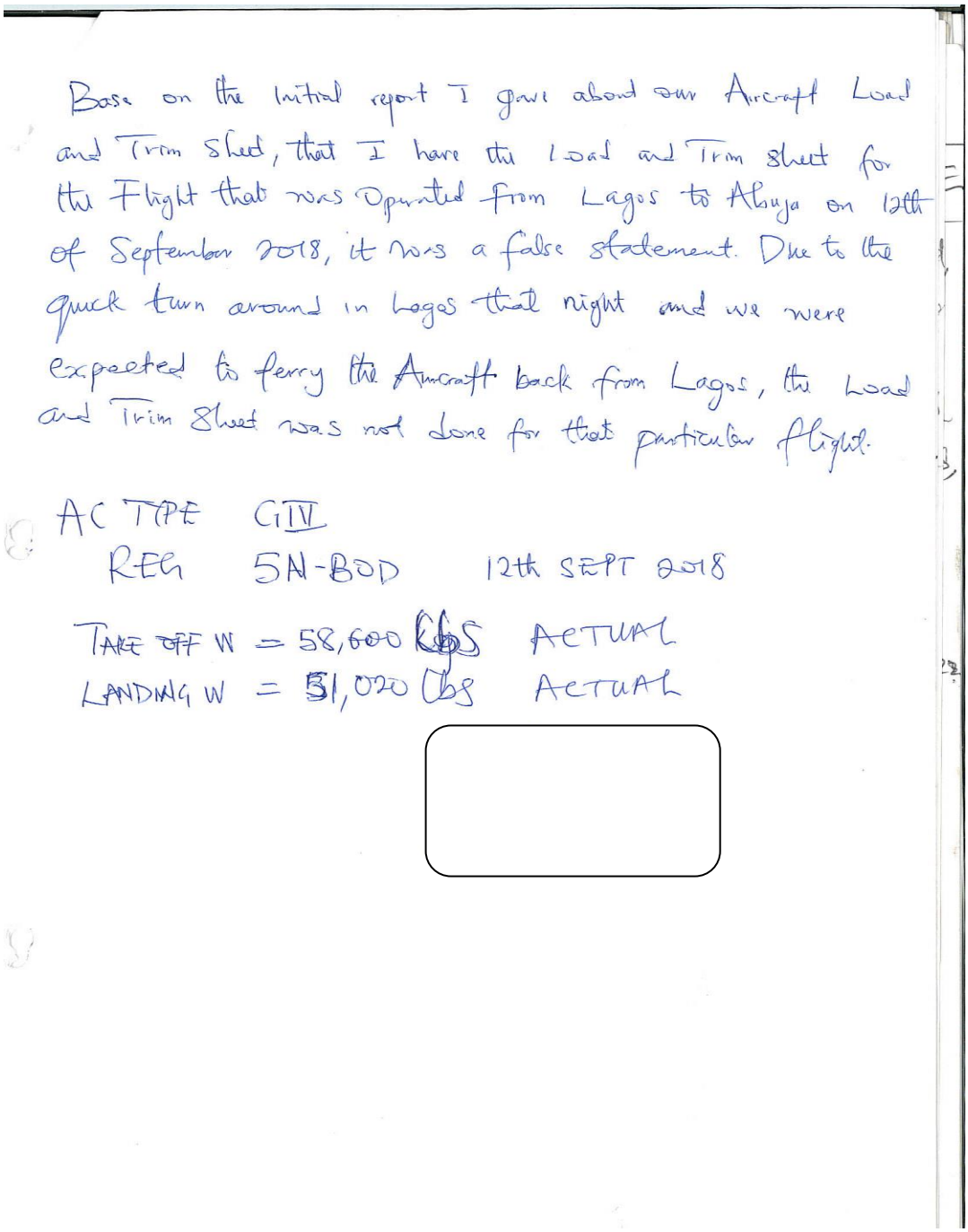
SkyBird Air Limited should ensure that all their cabin crew are adequately and properly type rated on specific aircraft to be flown by a cabin crew member in accordance with the Operations Manual.

4.9 Safety Recommendation 2020-012

SkyBird Air Limited should ensure that all flight release documents are duly signed by the commander of the flight before departure and appropriate copies kept on board the flight.

APPENDICES

Appendix 1: Dispatcher's statement



Base on the initial report I gave about our Aircraft Load and Trim Sheet, that I have the load and Trim sheet for the Flight that was Operated from Lagos to Abuja on 12th of September 2018, it was a false statement. Due to the quick turn around in Lagos that night and we were expected to ferry the Aircraft back from Lagos, the Load and Trim Sheet was not done for that particular flight.

AC TYPE GIV

REG 5N-BOD 12th SEPT 2018

TAKE OFF W = 58,600 Kgs ACTUAL

LANDING W = 51,020 Kgs ACTUAL

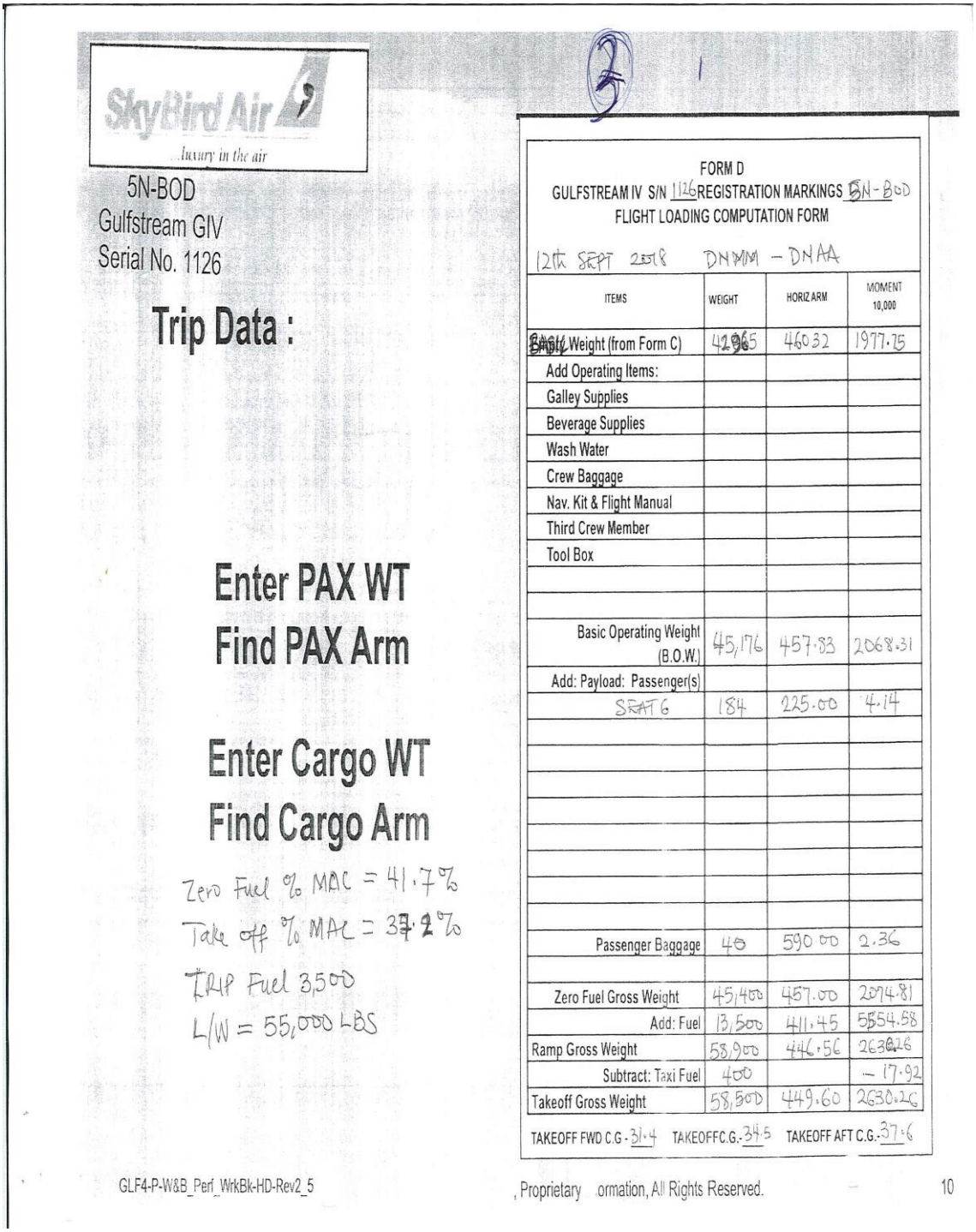
Appendix 2: Actual take-off and landing weights

SkyBird Air
... luxury in the air RC: 831827
21, Gana Street, Maitama Abuja, Nigeria.

5N - BOD

1. CG	= 37.2 and %MAC of 449.60
2. BOW	= 45,176 LBS
Pax	= 184 LBS
Crew	= 170 LBS each
Baggage	= 40 LBS
ZFW	= 45,400 LBS
T/O Fuel	= 13500 LBS
Ramp W	= 58,900
Taxi	= 400
TOW	= 58500
Estimated Fuel burn	= 4000 LBS
Estimated landing weight	= 54500 LBS

Appendix 3: Flight loading computation form



SkyBird Air
luxury in the air

5N-BOD
Gulfstream GIV
Serial No. 1126

Trip Data :

Enter PAX WT
Find PAX Arm

Enter Cargo WT
Find Cargo Arm

Zero Fuel % MAC = 41.7%
Take off % MAC = 37.2%
TRIP Fuel 3,500
L/W = 55,000 LBS

FORM D
GULFSTREAM IV S/N 1126 REGISTRATION MARKINGS 5N-BOD
FLIGHT LOADING COMPUTATION FORM

12th SEPT 2018 DNMM – DNAA

ITEMS	WEIGHT	HORIZ ARM	MOMENT 10,000
~~BASIC~~ Weight (from Form C)	42965	46032	1977.75
Add Operating Items:			
Galley Supplies			
Beverage Supplies			
Wash Water			
Crew Baggage			
Nav. Kit & Flight Manual			
Third Crew Member			
Tool Box			
Basic Operating Weight (B.O.W.)	45,176	457.83	2068.31
Add: Payload: Passenger(s)			
SRAT 6	184	225.00	4.14
Passenger Baggage	40	590 00	2.36
Zero Fuel Gross Weight	45,400	457.00	2074.81
Add: Fuel	13,500	411.45	5554.58
Ramp Gross Weight	58,900	446.56	26306
Subtract: Taxi Fuel	400		– 17.92
Takeoff Gross Weight	58,500	449.60	2630.26

TAKEOFF FWD C.G - 31.4 TAKEOFF C.G. - 34.5 TAKEOFF AFT C.G. - 37.6

GLF4-P-W&B_Perf_WrkBk-HD-Rev2_5

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10

SkyBird Air
luxury in the air

WEIGHT CALCULATIONS 2

5N-BOD
Gulfstream GIV
Serial No. 1126

Where is your ZFW CG ?

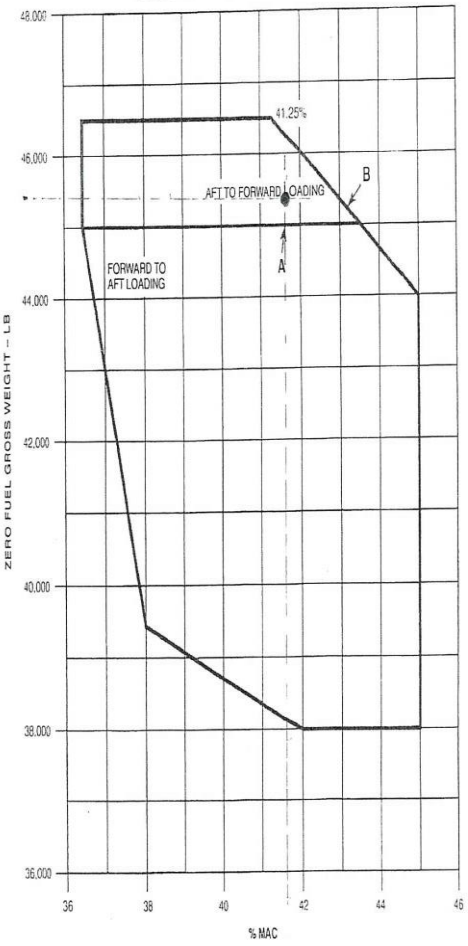
Enter ZFW (LBS)

The Center of Gravity is within the envelope.

Enter % MAC

Allowable Zero Fuel Gross Weight CG Envelope

Serial Number	Envelope
1000 Thru 1071	A
1000 Thru 1071 Having 1159SB41040	B
1072 and Subs	B



Appendix 4: Weather report for Nnamdi AZIKIWE International Airport-Abuja (DNAA) 12th September, 2018 between 1800 UTC to 2030 UTC

NiMet Nigerian Meteorological Agency

NIGERIAN METEOROLOGICAL AGENCY

National Weather Forecasting and Climate Research Centre
Bill Clinton Drive, Nnamdi Azikwe International Airport, Abuja, FCT, Nigeria

ISO 9001 2008 AEROMET

Ref: NIMET/WFS/1034/CI

17th September, 2018.

The Commissioner/CEO
Accident Investigation Bureau (AIB),
MMIA,
Ikeja, Lagos.

Sir,

WEATHER REPORT FOR NNAMDI AZIKIWE INTERNATIONAL AIRPORT
SEPTEMBER, 2018 BETWEEN 1800UTC TO 2030UTC

With reference to your request dated 13th September, 2018. I am directed to provide you with the necessary OPMET information as requested by your good office. Find below the weather report of 12th September, 2018 from 121800UTC- 122030UTC (DNAA), as directed.

HALF HOURLY WEATHER REPORT FOR NNAMDI AZIKIWE INTERNATIONAL AIRPORT ABUJA (DNAA) 12TH SEPTEMBER, 2018 BETWEEN 1800UTC TO 122030UTC

TIME (UTC)	WIND DIRECTION (°N)	WIND SPEED (KT)	VISIBILITY (M)	SIGNIFICANT WEATHER	CLOUD (AMOUNT & HEIGHT OF BASE	TEMPERATURE/ DEWPIONT(®C)	QNH (HPA)	TREND FORECAST
121800Z	VRB	02KT	10000M	Thunderstorm	BKN300M, FEW600MCB (NW-S)	27/22	1013	TEMPO 06015G35KT 5000M –TSRA BKN240m
SPECI 121803Z	080	17KT	10000M	Thunderstorm	BKN300M, FEW600MCB (NW-S)	28/22	1014	TEMPO 06015G35KT 5000M –TSRA BKN240 (SQUALL APPROACHING THE STATION
SPECI 121808Z	080	23G33KT	8000M	Squally Thunderstorm With Rain	BKN240M, FEW600MCB (NW-S)	24/17	1014	TEMPO 5000M SQUALL AT STATION
SPECI 121811Z	080	26G43KT	5000M	Squally Thunderstorm With Rain	BKN240M, FEW570MCB (N-NW)	21/17	1014	TEMPO 3000M
SPECI 121814Z	050	30G43KT	3000M	Squally Thunderstorm With Rain	BKN240M, FEW570MCB (N-NW)	21/16	1014	TEMPO 1500M

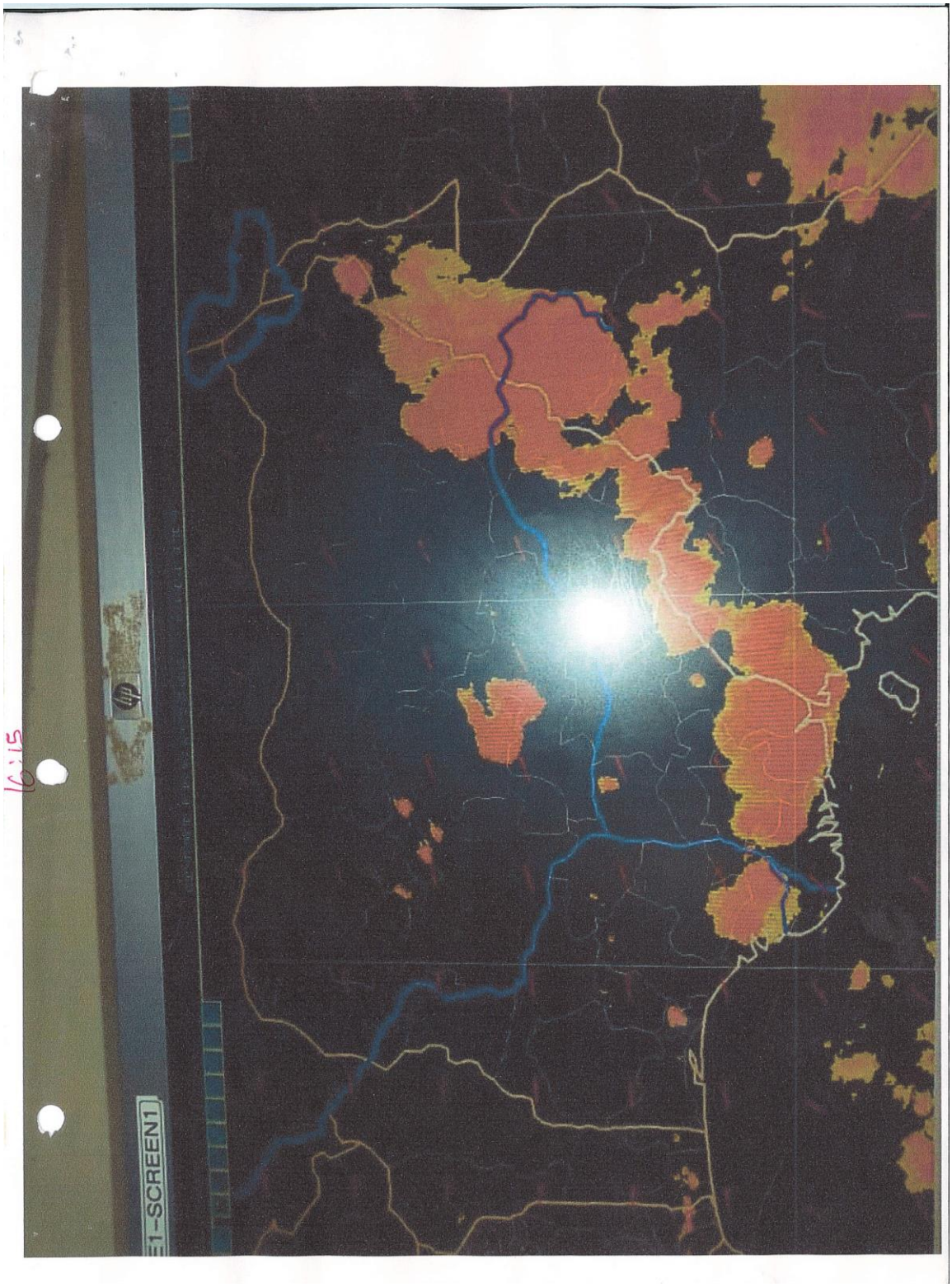
121830Z	040	28G41KT	2000M	Squally Thunderstorm With Rain	BKN210M, FEW570MCB (N-NW)	20/17	1014	TEMPO 1500M
SPECI 121832Z	060	11KT	5000M	Thunderstorm With Rain	BKN210M, FEW570MCB (N-NW)	20/17	1015	NOSIG
121900Z	VRB	02KT	8000M	Thunderstorm With Rain	BKN210M, FEW570MCB (N-NW)	20/17	1014	NOSIG
121930Z	110	07KT	10000M	Thunderstorm	SCT240M, FEW570MCB (N-W)	20/18	1014	NOSIG
122000Z	130	08KT	10000M	Thunderstorm With slight Rain	SCT240M, FEW570MCB (N-W)	21/17	1014	NOSIG
122030Z	VRB	02KT	10000M	Thunderstorm With slight Rain	SCT240M, FEW570MCB (N-W)	20/18	1015	NOSIG

Attached are other relevant OPMET information /documents:

- Terminal Aerodrome Forecast
- Aerodrome warning advisory
- Half hourly weather report
- Satellite imageries.

You may wish to note that the airline or the representative did not pick meteorological report (weather reports) from any of the NiMet office.

Please accept as always the assurances of the Director General/CEO's highest considerations.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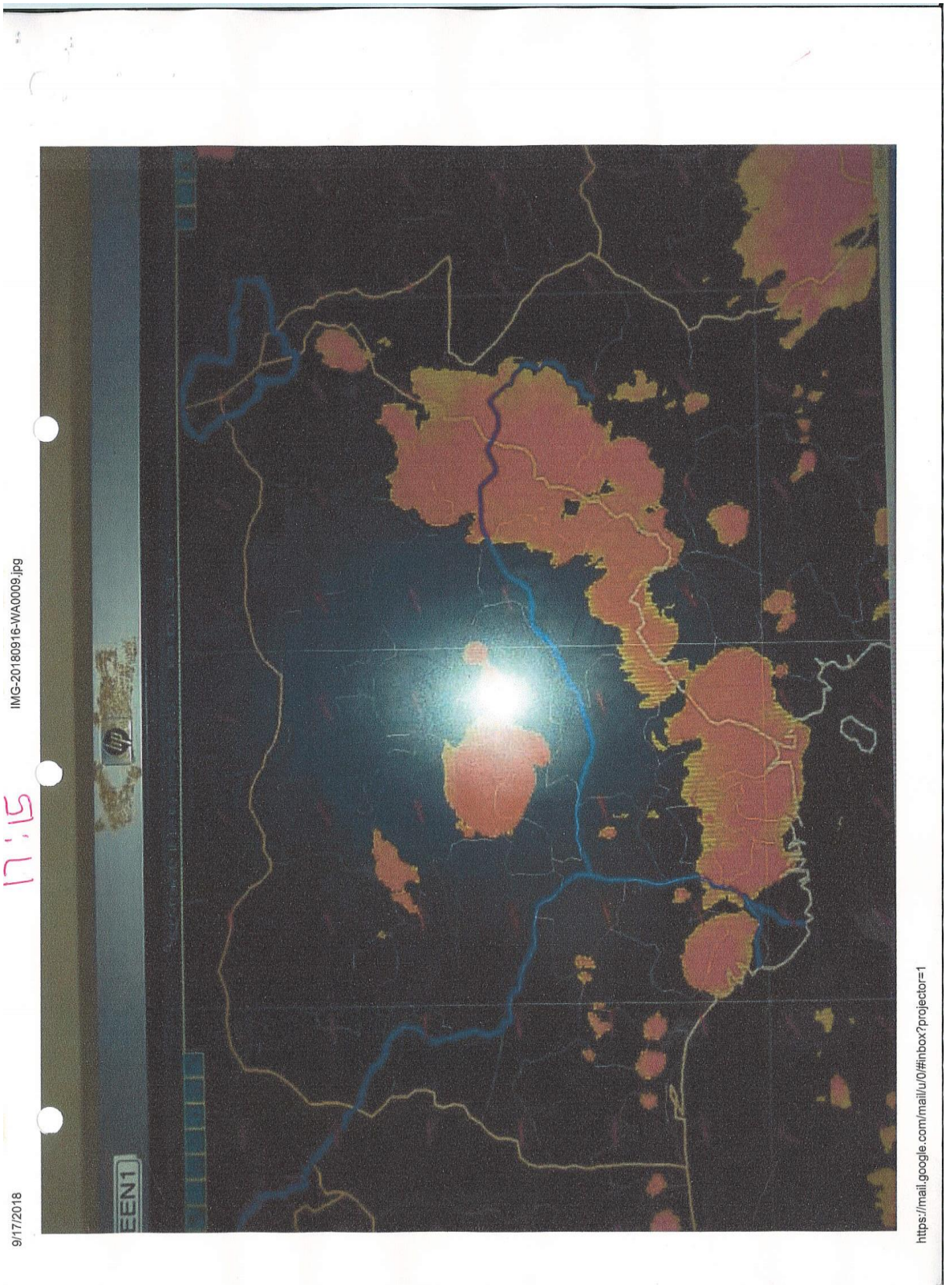
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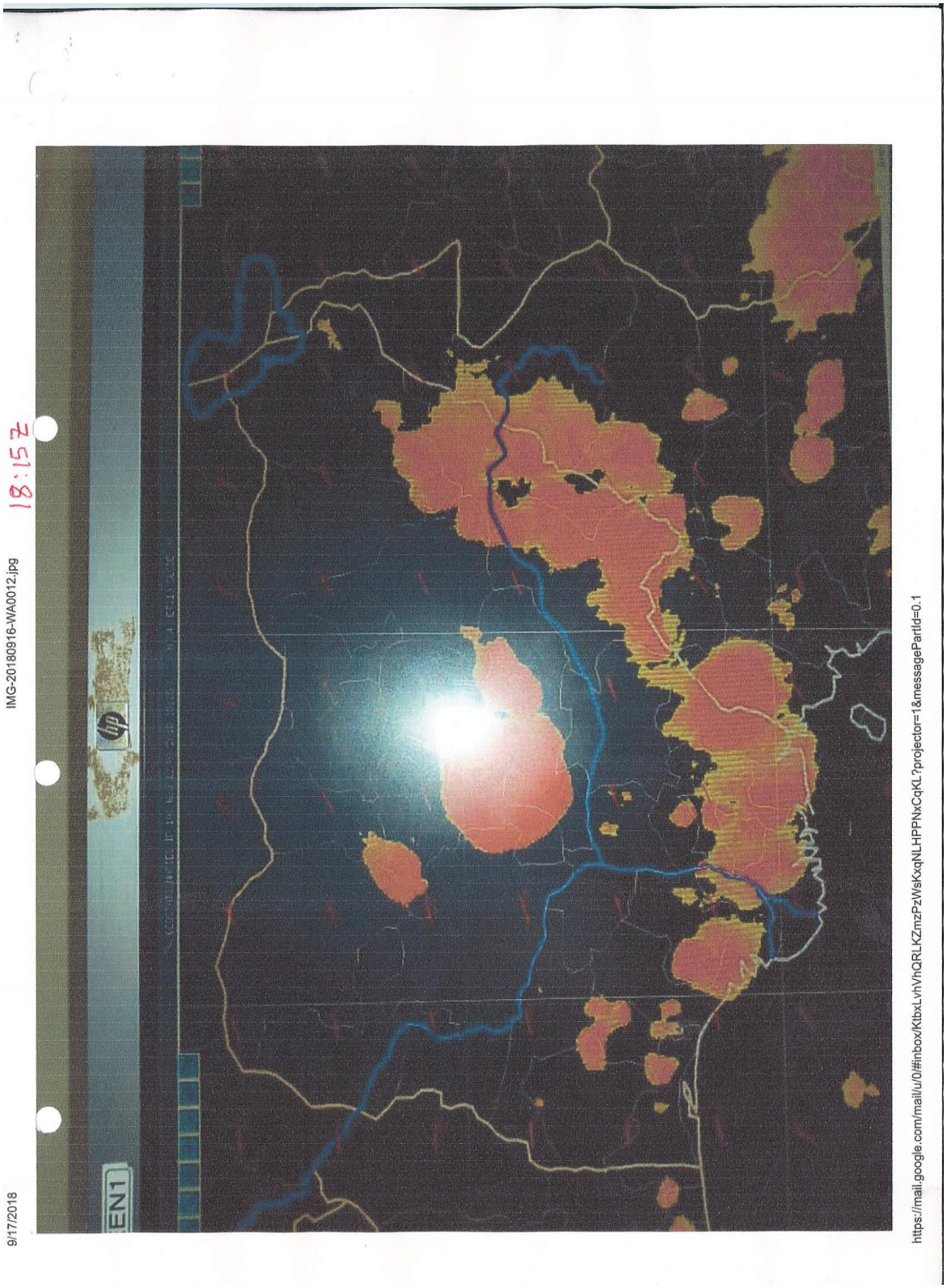
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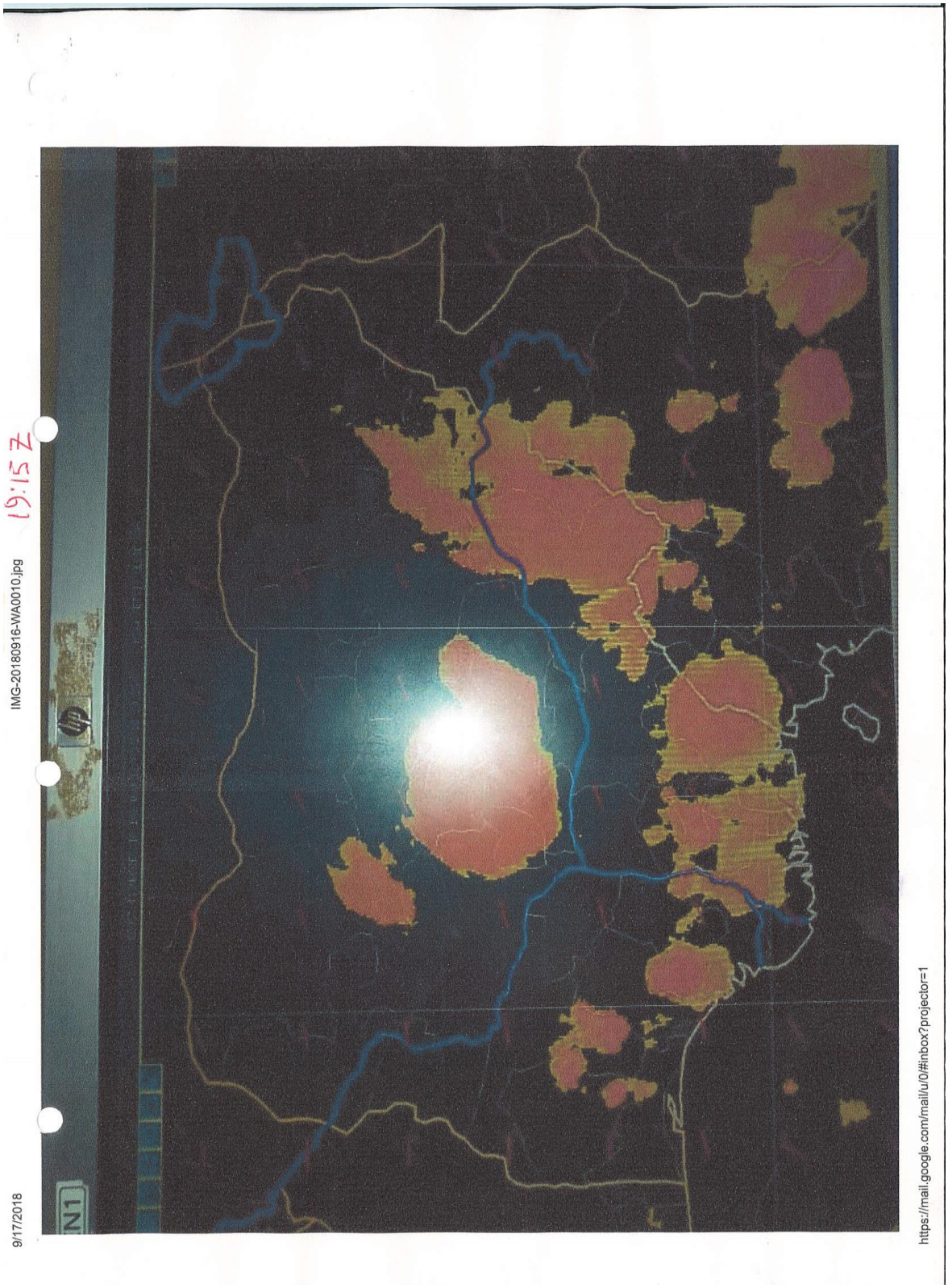
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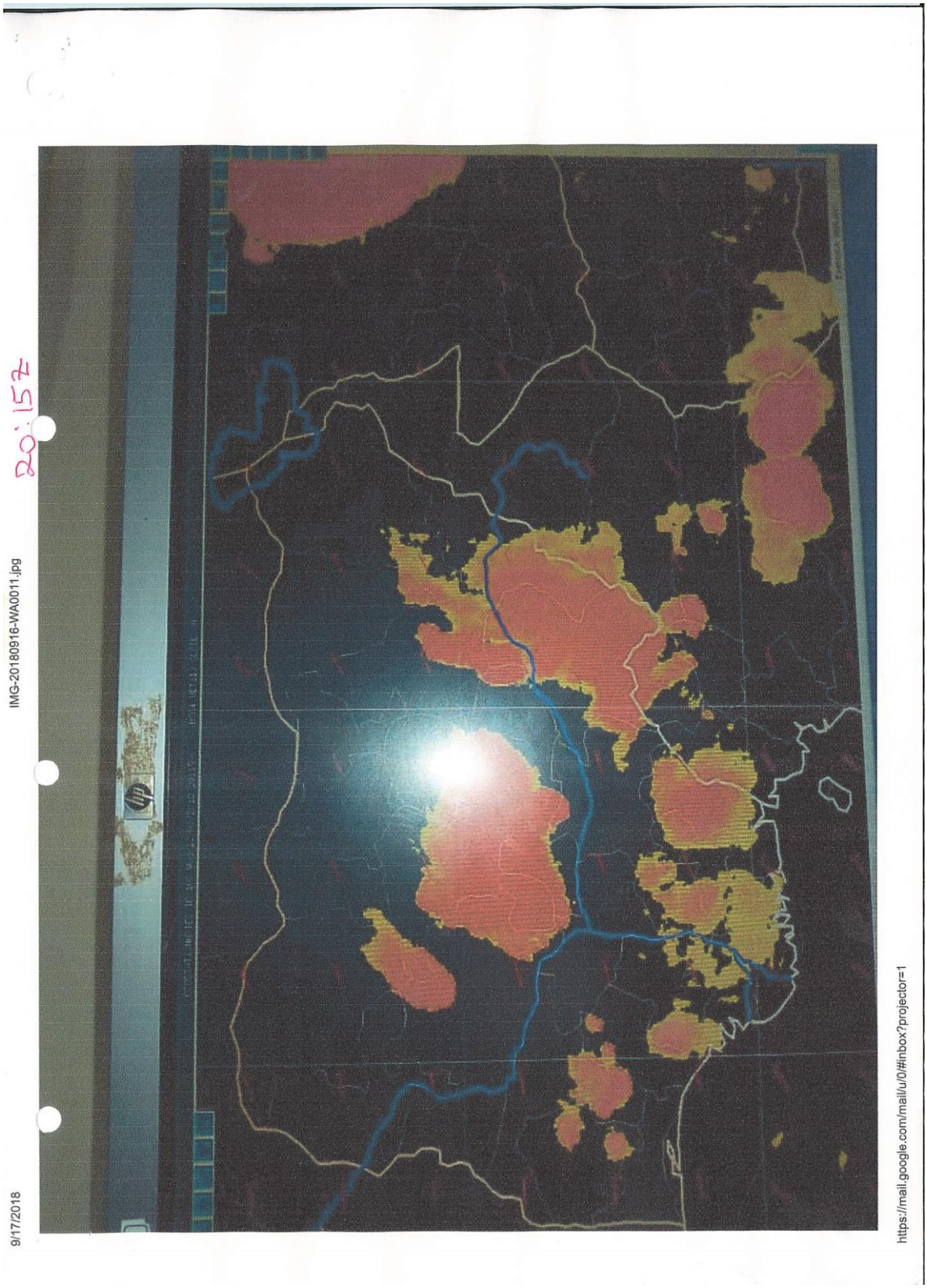
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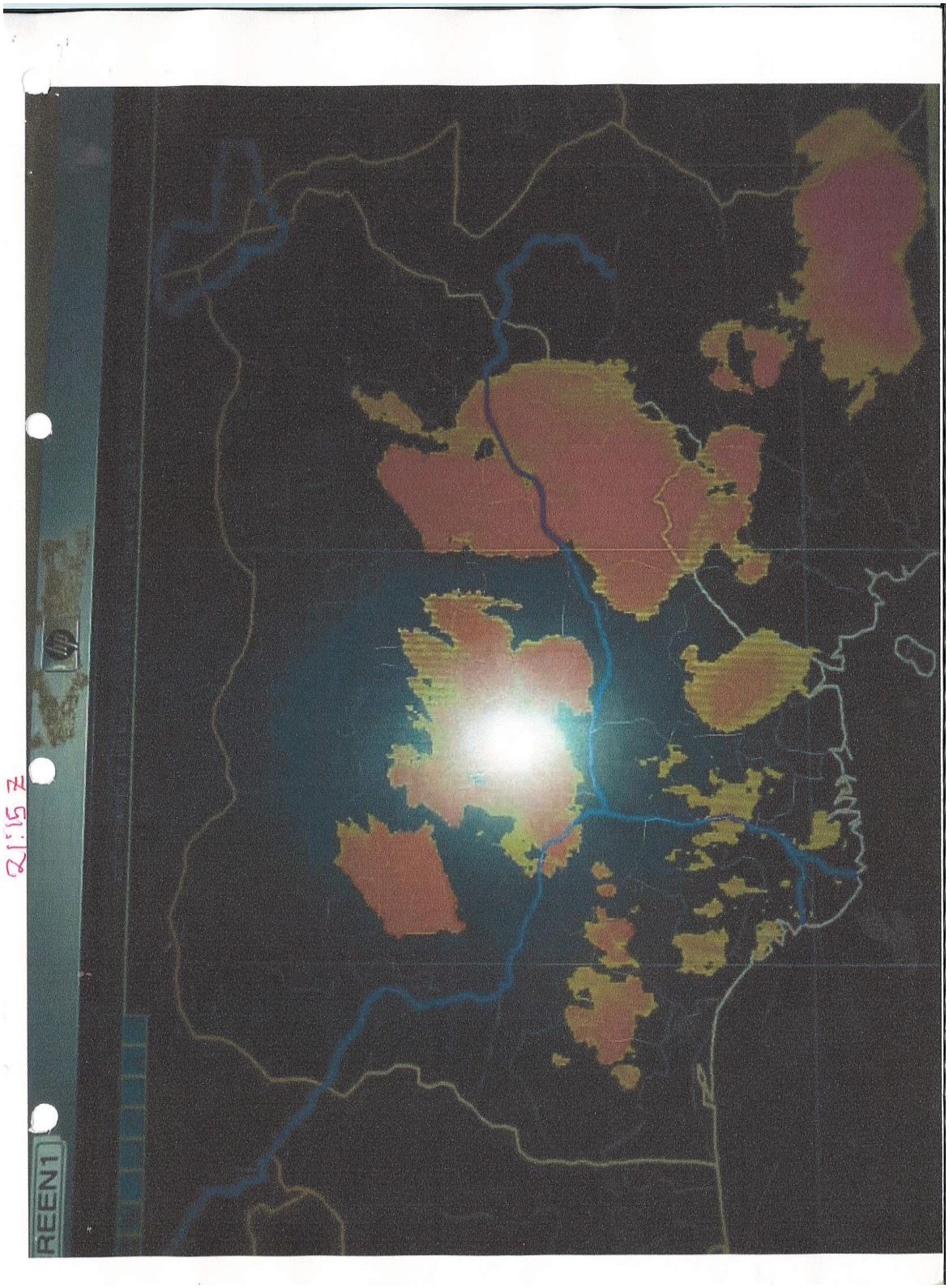
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DNAAYMYX

FTNI31 DNAA 121540Z

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F850C AFTN Headers and Transmission Addresses

Latest Issue November 14, 2016

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DNAAYMYX

FTNI31 DNAA 120940Z

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F850C AFTN Headers and Transmission Addresses

Latest Issue November 14, 2016

Sent via

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WSNI31
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F850C AFTN Headers and transmission Addresses
Latest Issue: November 14, 2016.

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MET: 002

Date: 12/09/2018

F850C AFTN Headers and transmission Addresses
Latest Issue: November 14, 2016.

FF: DNAAYMYX DNKNYMYX DNPOYMYX DNKKZQZX DNMMZQZX DNMMZRZX DNMMZTZX

.....121815Z.....DNAAYMYX

WSNI31
DNAA ADWRNG 02 VALID 121815/122015 SFC WSPD 30KT MAX 50 FCST =

F850C AFTN Headers and transmission Addresses
Latest Issue: November 14, 2016.

FF: DNAAYMYX DNKNYMYX DNPOYMYX DNKKZQZX DNMMZQZX DNMMZRZX DNMMZTZX

.....121815Z.....DNAAYMYX

WSNI31
DNAA WS WRNG 01 121812Z VALID 121815/121915 MBST APRCH RW 22 FCST
=

F850C AFTN Headers and transmission Addresses
Latest Issue: November 14, 2016.

Appendix 5: Friction test report Nnamdi Azikiwe international Airport runway 04/22

Rovaty Aviation Limited
Service with excellence
RC 956429

FRICTION TEST REPORT
NNAMDI AZIKIWE INTERNATIONAL AIRPORT
ABUJA.

CLIENT: FEDERAL AIRPORT AUTHORITY OF NIGERIA

TASK: RUNWAY 22/04 SURFACE FRICTION MEASUREMENTS

LOCATION: NNAMDI AZIKIWE INTERNATIONAL AIRPORT, ABUJA.

Date: April 18, 2017

4 SHOBOGUNROFA STREET, Off AVIATION ESTATE, MAFOLUKU, LAGOS.
Email: [redacted]
Mobile: [redacted] +2348023317458
P.O.BO[redacted]OS.
www.rovatyaviation.com

RC 956429

The Managing Director,
Federal Airport Authority of Nigeria,
Abuja,
Nigeria.

Test Method

The skiddometer principle is used to apply a fixed longitudinal slip on a test wheel. This enables continuous measurement coefficient friction as required by NCAA and ICAO Annex 14.

Equipment
ASFT Vehicle integrated runway friction measuring equipment with wetting capability.
Summary of measurements (dry measurement RY22/04 170418 080300)

RW	Fric. A	Fric B	Fric C	Fric Max	Fric Min	T surface	T Air	Cont.	AvgFric
ALL	0.84μ	0.82μ	0.82μ	0.97μ	0.70μ	-	-	0.00%	**0.83μ**

Summary of measurements (wet measurement RY22/04 170418 084239)

RW	Fric. A	Fric B	Fric C	Fric Max	Fric Min	T surface	T Air	Cont.	AvgFric
ALL	0.62μ	0.61μ	0.60μ	0.75μ	0.53μ	-	-	0.00%	**0.61μ**

Comments and Observations

1. General

The planned surface friction measurement was successfully conducted at 8am on Tuesday, April 18, 2017.

The measurement was programmed to start at 100 meters from the runway threshold after the friction tester stabilized at 65km/h.

The measurements were conducted at 3meters on both sides of the runway center line. Attached to this report are the two friction measurements from the test as listed below;

I. ABJ RWY 22Dry
II. ABJ RWY22 WET

2. Dry measurements:

One run and two measurements were conducted.
The average measured dry friction was 0.83mu.
Minimum measured dry friction is 0.70mu.

3. Wet measurement:

One run and two measurements was conducted.
The average measured friction for the wet run was 0.61mu
Minimum recorded measured friction was 0.53mu

The Managing Director,
Federal Airport Authority of Nigeria,
Abuja,
Nigeria.

Conclusion:
Based on the average friction recorded during the test, the runway surface friction meets with Nigerian Civil Aviation Regulation, NCAA Airport Standards Manual and ICAO Annex 14 at the time of the friction test.

Refer to the guideline below for runway friction test frequency.

The Managing Director,
Federal Airport Authority of Nigeria,
Abuja,
Nigeria.

Guidelines for establishing the design objective, maintenance planning level and minimum friction levels of runways

Test Equipment	Test Tire		Test speed (km/h)	Test water depth (mm)	Design objective for new surface	Maintenance planning level	Minimum friction level
	Type	Pressure					
Runway Friction Tester Vehicle	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.54	0.41

Guidelines for establishing runway friction test frequency

Number of Daily Minimum Turbojet Aircraft Landings Per Runway End	Minimum Friction Survey Frequency
Less Than 15	1 Year
16 To 30	6 Months
31 To 90	3 Months
91 To 150	1 Months
151 To 210	2 Weeks
Greater Than 210	1 Week

Friction Measure Report

Configuration	ABJ RWY	Tyre Type	T49
Date and Time	17-04-18 08:03:00	Tyre Pressure	7.0
Type	ICAO	Water Film	OFF
Equipment	SFT1103	Average Speed	194
Pilot	SUPER	System Distance	7.2
Ice Level	0.4		
Runway Length	3600		
Location	ASFT		

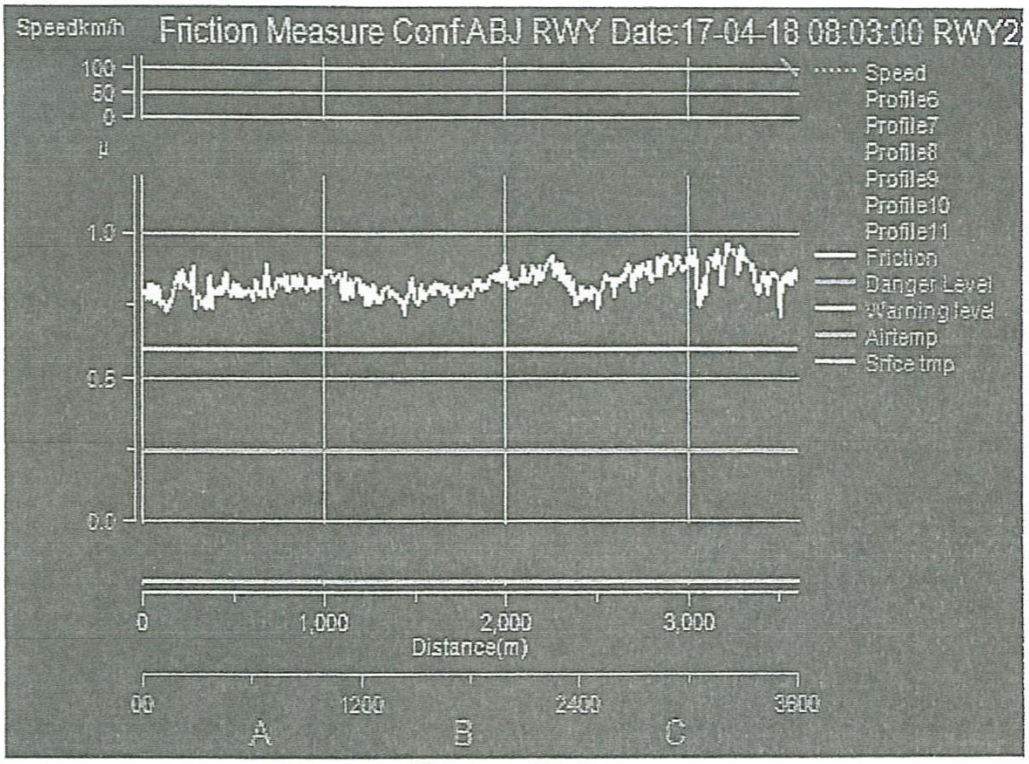
Results

Runway	Fric. A	Fric. B	Fric. C	Fric.Max	Fric.Min	Fric avg	T. surface	T. air	Ice
RWY22	0.81μ	0.82μ	0.86μ	0.97μ	0.71μ	0.83μ	--	--	0.00%
RWY04	0.87μ	0.82μ	0.79μ	0.94μ	0.70μ	0.83μ	--	--	0.00%

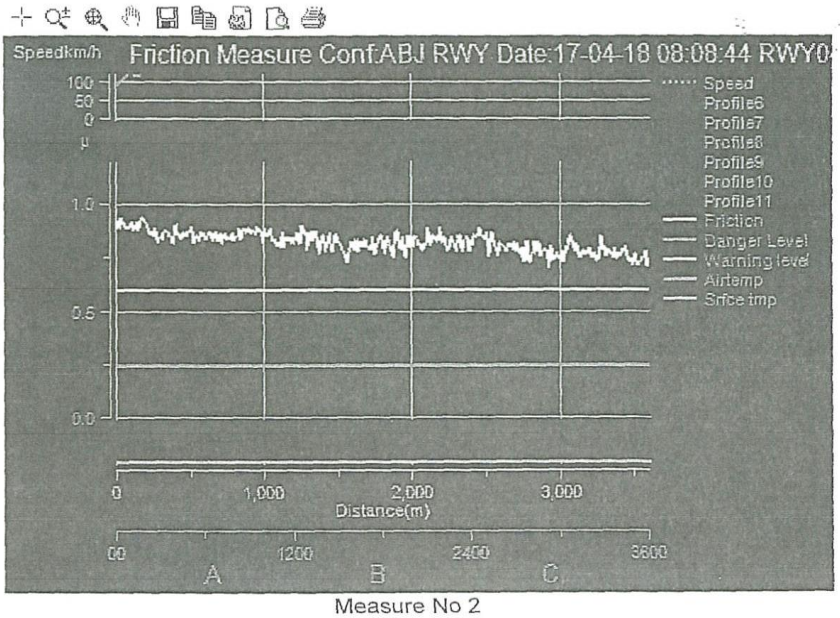
Results Summary

RW	Fric. A	Fric. B	Fric. C	Fric.Max	Fric.Min	T. surface	T. air	Ice	Fric AVG
all	0.84μ	0.82μ	0.82μ	0.97μ	0.70μ	--	--	0.00%	**0.83μ**

Graphs



Measure No 1



Measure No 2

RW22	Lap1					
Distance	Friction	Speed	Tmp Air °C	Tmp Gnd °C	Remark	
100	0.84	121	--	--		
200	0.85	131	--	--		
300	0.87	142	--	--		
400	0.94	155	--	--		
500	0.90	166	--	--		
600	0.85	177	--	--		
700	0.89	178	--	--		
800	0.89	185	--	--		
900	0.87	192	--	--		

1000	0.85	197	--	--		
1100	0.82	201	--	--		
1200	0.79	204	--	--		
1300	0.83	200	--	--		
1400	0.89	202	--	--		
1500	0.86	205	--	--		
1600	0.84	206	--	--		
1700	0.86	207	--	--		
1800	0.82	208	--	--		
1900	0.79	210	--	--		
2000	0.81	210	--	--		
2100	0.79	211	--	--		
2200	0.78	213	--	--		
2300	0.80	216	--	--		
2400	0.79	216	--	--		
2500	0.82	217	--	--		
2600	0.86	218	--	--		
2700	0.83	223	--	--		
2800	0.83	221	--	--		
2900	0.83	223	--	--		
3000	0.81	225	--	--		
3100	0.81	226	--	--		
3200	0.81	223	--	--		
3300	0.78	219	--	--		
3400	0.83	215	--	--		
3500	0.78	216	--	--		
3600	0.80	216	--	--		
RW4	**Lap1**					
Distance	Friction	Speed	Tmp Air °C	Tmp Gnd °C	Remark	

100	0.91	122	--	--		
200	0.91	126	--	--		
300	0.87	141	--	--		
400	0.86	152	--	--		
500	0.86	163	--	--		
600	0.85	160	--	--		
700	0.86	167	--	--		
800	0.85	174	--	--		
900	0.87	179	--	--		
920		180	--	--	Mark,	
1000	0.87	185	--	--		
1100	0.85	190	--	--		
1200	0.83	188	--	--		
1300	0.86	191	--	--		
1400	0.84	194	--	--		
1500	0.83	197	--	--		
1600	0.79	200	--	--		
1700	0.81	202	--	--		
1800	0.82	204	--	--		
1900	0.82	205	--	--		
2000	0.81	207	--	--		
2100	0.83	208	--	--		
2200	0.84	208	--	--		
2300	0.82	210	--	--		
2400	0.82	211	--	--		
2500	0.86	210	--	--		
2600	0.81	211	--	--		
2700	0.81	211	--	--		
2800	0.77	211	--	--		
2900	0.79	211	--	--		
3000	0.76	210	--	--		
3100	0.81	211	--	--		
3200	0.78	210	--	--		
3300	0.78	209	--	--		

3400	0.77	209	--	--		
3500	0.77	208	--	--		
3600	0.75	208	--	--		

Friction Measure Report

Configuration	ABJ RWY	Tyre Type	T49
Date and Time	17-04-18 08:42:39	Tyre Pressure	7.0
Type	ICAO	Water Film	ON
Equipment	SFT1103	Average Speed	185
Pilot	SUPER	System Distance	14.4
Ice Level	0.4		
Runway Length	3600		
Location	ASFT		

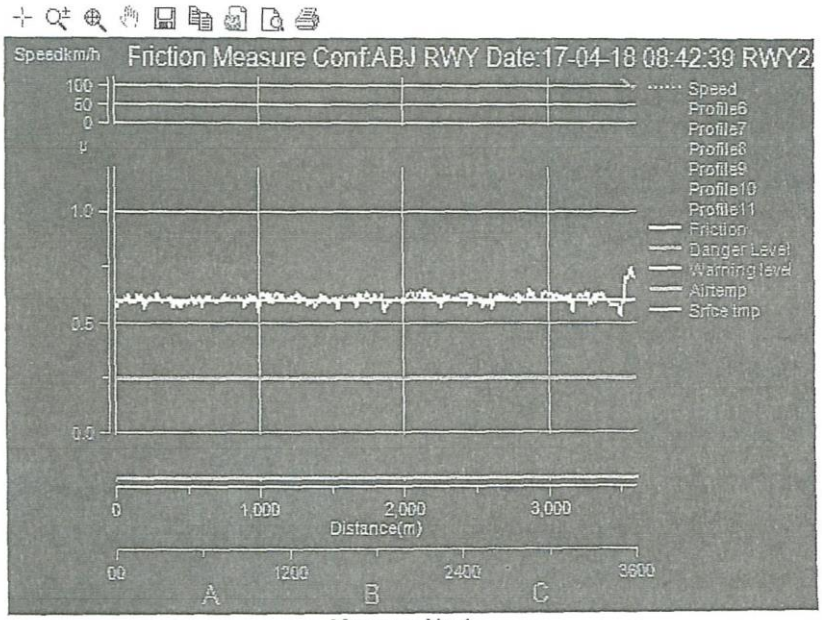
Results

Runway	Fric. A	Fric. B	Fric. C	Fric.Max	Fric.Min	Fric avg	T. surface	T. air	Ice
RWY22	0.61μ	0.61μ	0.62μ	0.75μ	0.53μ	0.61μ	--	--	0.00%
RWY04	0.64μ	0.61μ	0.59μ	0.74μ	0.53μ	0.61μ	--	--	0.00%

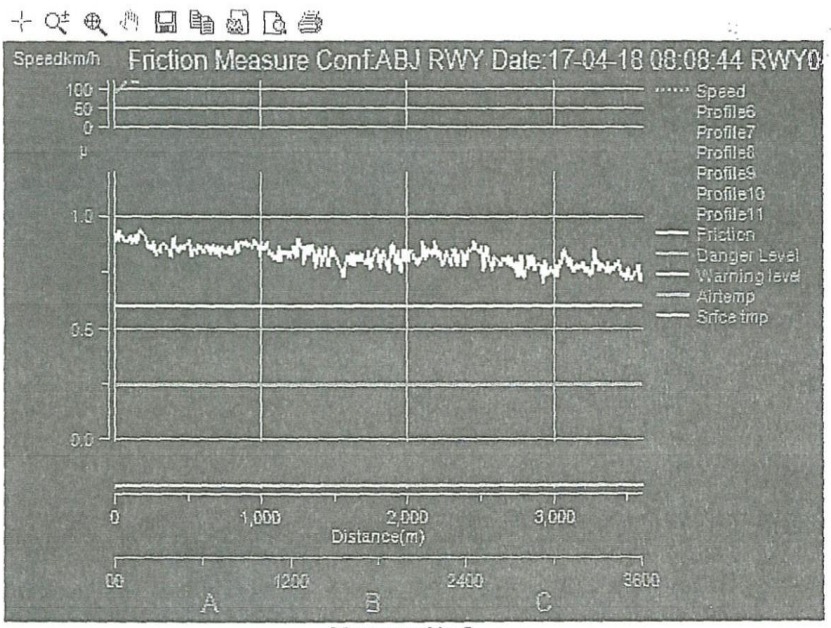
Results Summary

RW	Fric. A	Fric. B	Fric. C	Fric.Max	Fric.Min	T. surface	T. air	Ice	Fric AVG
all	0.62μ	0.61μ	0.60μ	0.75μ	0.53μ	--	--	0.00%	0.61μ

Graphs



Measure No 1



Measure No 2

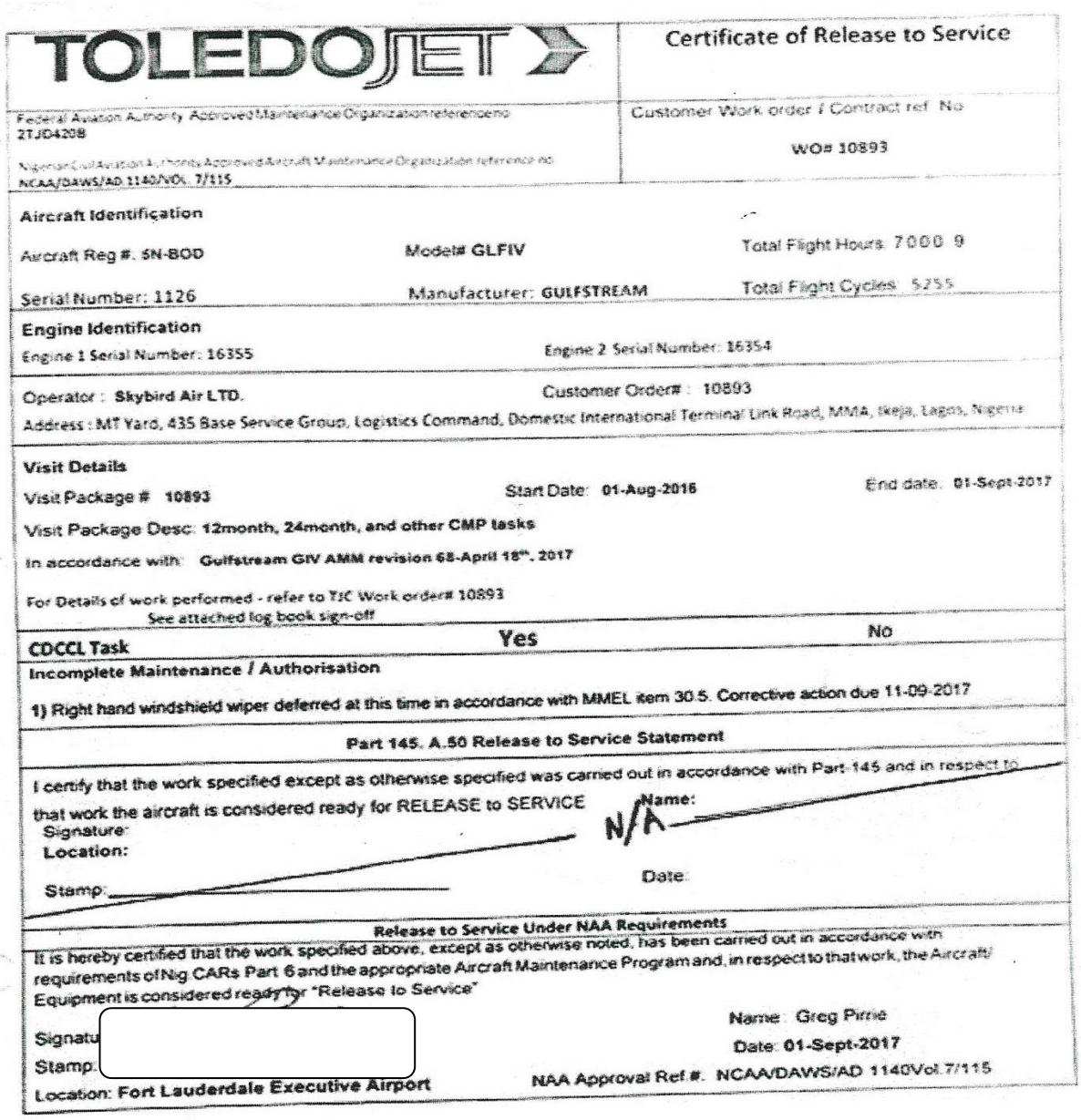
RW22	Lap1					
Distance	Friction	Speed	Tmp Air °C	Tmp Gnd °C	Remark	
100	0.84	121	--	--		
200	0.85	131	--	--		
300	0.87	142	--	--		
400	0.94	155	--	--		
500	0.90	166	--	--		
600	0.85	177	--	--		
700	0.89	178	--	--		
800	0.89	185	--	--		
900	0.87	192	--	--		

1000	0.61	188	--	--		
1100	0.60	191	--	--		
1200	0.61	193	--	--		
1300	0.61	195	--	--		
1400	0.61	191	--	--		
1500	0.63	193	--	--		
1600	0.62	195	--	--		
1700	0.60	196	--	--		
1800	0.60	198	--	--		
1900	0.62	198	--	--		
2000	0.61	199	--	--		
2100	0.60	200	--	--		
2200	0.61	200	--	--		
2300	0.59	202	--	--		
2400	0.62	202	--	--		
2500	0.62	203	--	--		
2600	0.62	204	--	--		
2700	0.60	204	--	--		
2800	0.61	206	--	--		
2900	0.61	207	--	--		
3000	0.61	208	--	--		
3100	0.60	210	--	--		
3200	0.59	211	--	--		
3300	0.61	213	--	--		
3400	0.61	214	--	--		
3500	0.61	215	--	--		
3600	0.60	220	--	--		
RW4	Lap1					
Distance	Friction	Speed	Tmp Air °C	Tmp Gnd °C	Remark	
100	0.72	117	--	--		

200	0.63	123	--	--		
300	0.63	138	--	--		
400	0.63	150	--	--		
500	0.62	151	--	--		
600	0.63	157	--	--		
700	0.63	161	--	--		
800	0.63	167	--	--		
900	0.63	164	--	--		
1000	0.64	167	--	--		
1100	0.64	170	--	--		
1200	0.62	172	--	--		
1300	0.61	174	--	--		
1400	0.61	174	--	--		
1500	0.61	172	--	--		
1600	0.62	176	--	--		
1700	0.62	180	--	--		
1800	0.62	184	--	--		
1900	0.60	187	--	--		
2000	0.62	191	--	--		
2100	0.61	194	--	--		
2200	0.61	197	--	--		
2300	0.60	201	--	--		
2400	0.60	203	--	--		
2500	0.60	206	--	--		
2600	0.60	209	--	--		
2700	0.58	204	--	--		
2800	0.57	204	--	--		
2900	0.57	203	--	--		
3000	0.58	202	--	--		
3100	0.60	203	--	--		
3200	0.59	202	--	--		
3300	0.59	202	--	--		
3400	0.59	207	--	--		
3500	0.58	204	--	--		

3600	0.59	205	–	–		

Appendix 6: The ferry flight to the Toledo Jet Facility in Fort Lauderdale



TOLEDOJET

Certificate of Release to Service

Federal Aviation Authority Approved Maintenance Organization reference no
2TJD4208

Customer Work order / Contract ref No
WO# 10893

Nigerian Civil Aviation Authority Approved Aircraft Maintenance Organization reference no
NCAA/DAWS/AD 1140/VOL. 7/115

Aircraft Identification

Aircraft Reg #. 5N-BOD | Model# GLFIV | Total Flight Hours 7000 9

Serial Number: 1126 | Manufacturer: GULFSTREAM | Total Flight Cycles 5255

Engine Identification

Engine 1 Serial Number: 16355 | Engine 2 Serial Number: 16354

Operator : **Skybird Air LTD.** | Customer Order# : 10893

Address : MT Yard, 435 Base Service Group, Logistics Command, Domestic International Terminal Link Road, MMA, Ikeja, Lagos, Nigeria

Visit Details

Visit Package # **10893** | Start Date: **01-Aug-2016** | End date: **01-Sept-2017**

Visit Package Desc: **12month, 24month, and other CMP tasks**

In accordance with: **Gulfstream GIV AMM revision 68-April 18th, 2017**

For Details of work performed - refer to TJC Work order# 10893
See attached log book sign-off

CDCCL Task | **Yes** | No

Incomplete Maintenance / Authorisation

1) Right hand windshield wiper deferred at this time in accordance with MMEL item 30.5. Corrective action due 11-09-2017

Part 145. A.50 Release to Service Statement

I certify that the work specified except as otherwise specified was carried out in accordance with Part-145 and in respect to that work the aircraft is considered ready for RELEASE to SERVICE

Signature:
Location:
Stamp:

Name: N/A
Date:

Release to Service Under NAA Requirements

It is hereby certified that the work specified above, except as otherwise noted, has been carried out in accordance with requirements of Nig CARs Part 6 and the appropriate Aircraft Maintenance Program and, in respect to that work, the Aircraft/ Equipment is considered ready for "Release to Service"

Signatu
Stamp:

Name: Greg Pirrie
Date: **01-Sept-2017**

Location: **Fort Lauderdale Executive Airport**

NAA Approval Ref.#. NCAA/DAWS/AD 1140Vol.7/115

Appendix 7: letter for extension of Flight Data Recorder readout

10

NIGERIAN CIVIL AVIATION AUTHORITY

NCAA

P.M.B. 21029, 21038, IKEJA-LAGOS.

NCAA/DAWS/AD.1148/Vol.2/19
12th March, 2018

The Managing Director
Skybird Airline Ltd
21, Gana Street Maitama
Abuja

Attention: Quality Manager

RE: APPLICATION FOR EXTENSION OF FDR READOUT SUBMISSION.

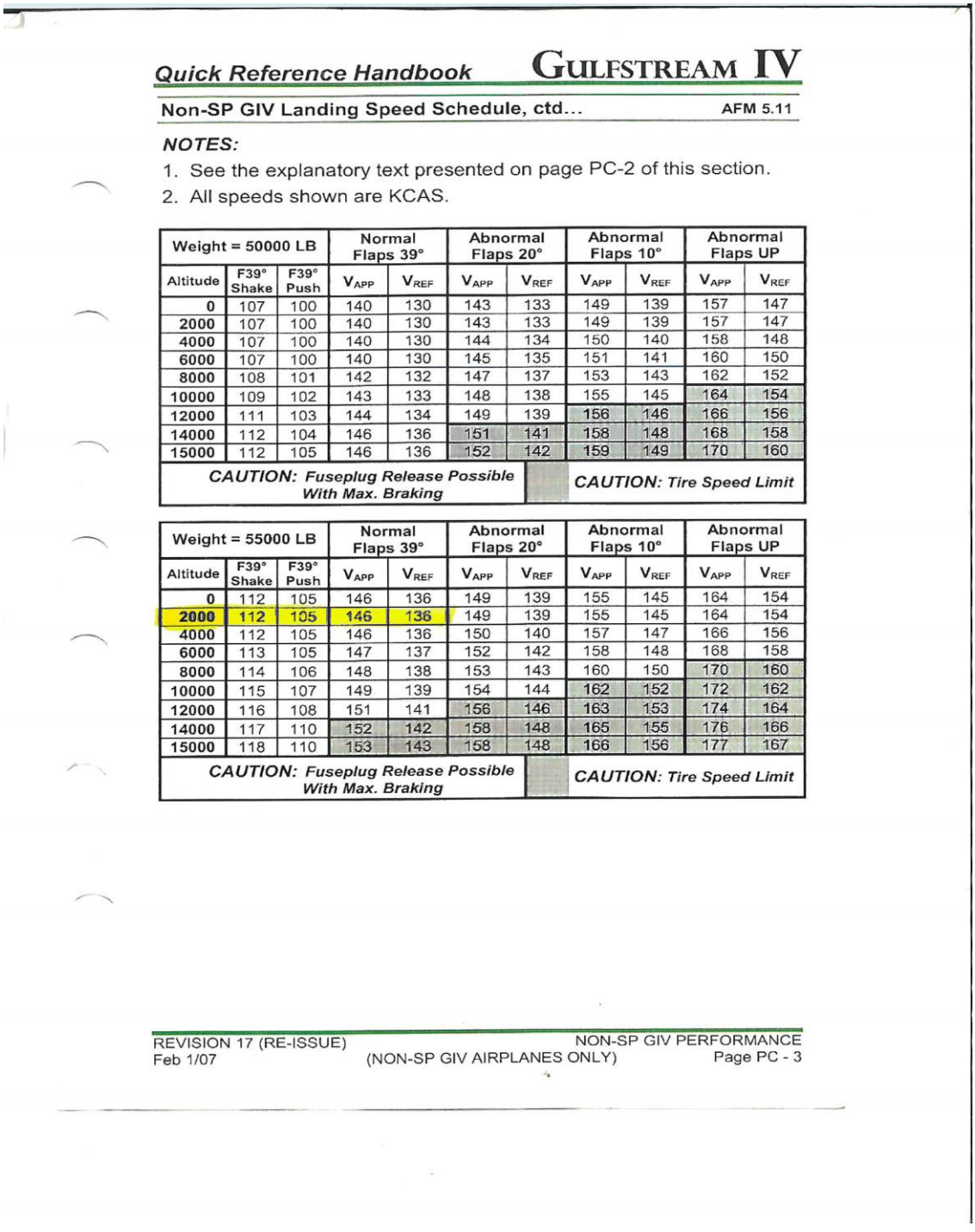
Your letter REF: SBA/NCAA/QS/2018/025dated 5th March 2018 on the above subject matter refers.

I am directed to convey theAuthority's approval of your request for extension for the submission of FDR readout. Note that this extension expires midnight of Thursday 27th September 2018.

Be guided accordingly.

Corporate Headquarters :Nnamdi Azikwe Int'l Airport, Domestic Wing, Abuja.
Tel:+234 (1) 7610041, +234 (1) 7610042, +234 (1) 7610043 , +234 (1) 7610044, **Tel/Fax:** +234 807 729 1113,
Lagos Office: AVIATION HOUSE, Murtala Mohammed International Airport (MMIA) Domestic Wing, Ikeja.
Tel: +234 (1) 4721521 **Fax:** +234 (1) 2790421 **Consumer Protection:** +234 (1) 7607286 (24hrs); **Airworthiness:** +234 (1) 4734482;
Licencing: +234 (1) 7739972; **Operations:** +234 (1) 4714339; **Switch Board:** +234 (1) 7610036, +234 (1) 7610037.
Email: info@ncaa.gov.ng Website:www.ncaa.gov.ng

Appendix 8: G Iv landing speed schedule



Quick Reference Handbook **GULFSTREAM IV**

Non-SP GIV Landing Speed Schedule, ctd... AFM 5.11

NOTES:

1. See the explanatory text presented on page PC-2 of this section.
2. All speeds shown are KCAS.

Weight = 50000 LB			Normal Flaps 39°		Abnormal Flaps 20°		Abnormal Flaps 10°		Abnormal Flaps UP	
Altitude	F39° Shake	F39° Push	V_{APP}	V_{REF}	V_{APP}	V_{REF}	V_{APP}	V_{REF}	V_{APP}	V_{REF}
0	107	100	140	130	143	133	149	139	157	147
2000	107	100	140	130	143	133	149	139	157	147
4000	107	100	140	130	144	134	150	140	158	148
6000	107	100	140	130	145	135	151	141	160	150
8000	108	101	142	132	147	137	153	143	162	152
10000	109	102	143	133	148	138	155	145	164	154
12000	111	103	144	134	149	139	156	146	166	156
14000	112	104	146	136	151	141	158	148	168	158
15000	112	105	146	136	152	142	159	149	170	160

CAUTION: Fuseplug Release Possible With Max. Braking ***CAUTION: Tire Speed Limit***

Weight = 55000 LB			Normal Flaps 39°		Abnormal Flaps 20°		Abnormal Flaps 10°		Abnormal Flaps UP	
Altitude	F39° Shake	F39° Push	V_{APP}	V_{REF}	V_{APP}	V_{REF}	V_{APP}	V_{REF}	V_{APP}	V_{REF}
0	112	105	146	136	149	139	155	145	164	154
2000	112	105	146	136	149	139	155	145	164	154
4000	112	105	146	136	150	140	157	147	166	156
6000	113	105	147	137	152	142	158	148	168	158
8000	114	106	148	138	153	143	160	150	170	160
10000	115	107	149	139	154	144	162	152	172	162
12000	116	108	151	141	156	146	163	153	174	164
14000	117	110	152	142	158	148	165	155	176	166
15000	118	110	153	143	158	148	166	156	177	167

CAUTION: Fuseplug Release Possible With Max. Braking ***CAUTION: Tire Speed Limit***

REVISION 17 (RE-ISSUE) NON-SP GIV PERFORMANCE
Feb 1/07 (NON-SP GIV AIRPLANES ONLY) Page PC - 3

Appendix 9: Nigerian civil Aviation operations specification

Nigerian Civil Aviation Authority
Operations Specifications

OpSpecs Paragraph **A3** is issued to and accepted by:

SKYBIRD/AOC/04-13/08
(AOC No.)

SKYBIRD AIR LIMITED
(Name of Operator)

(Title)

Application For Amendment:

I certify that the statements submitted in connection herewith are true and that I am duly authorised to make application on behalf of the applicant.

(Signature)

Date

(Title)

The amendment to the standard OPS SPEC paragraph on the reverse side hereof is/is not approved.

Amendment No. _____

(Signature)

Date: _____

(Title)

This standard OpSpecs paragraph is issued by the authority of the Director-General, NCAA.

22ND APRIL, 2013
Effective date

Director, Operations and Training
(Title)

Issued by the Nigerian Civil Aviation Authority

Amendment No. ***Original***
Control Date ***7th July, 2010***

13

Nigerian Civil Aviation Authority
Operations Specifications

A3. AIRCRAFT AUTHORISATION

a. The certificate holder is authorised to conduct operations using aeroplanes with the approved passenger seating capacities and the number of required cabin attendant personnel described in the following table:

Type of Aircraft Make/Model/Series	*Reg. No*	*Serial No.*	*Type of Operations*	*Passenger Seating Capacity or Cargo Only*		*Number of Required Cabin Crew*
				Demonstrated	*Approved*	
DO 328-300	5N-SPE	3151	IFR	32	32	1
DO 328-300	5N-SPM	3141	IFR	32	32	1
DO 328-300	5N-BMH	3120	IFR	12	12	1

Amendment No. *Original*
Issued by the Nigerian Civil Aviation Authority — Control Date *7th July, 2010*

Page 1 of 1

Appendix 10: Quarterly de-rubberization exercise of Nnamdi Azikiwe International Airport Abuja Runway 04/22

FEDERAL AIRPORTS AUTHORITY OF NIGERIA
Nnamdi Azikiwe International Airport, Abuja.
P. O. Box 253A, Abuja.
Telephone: 09-7809464

JOB COMPLETION CERTIFICATE

This is to certify that the Job for the quarterly de-rubberization exercise of Nnamdi Azikiwe International Airport, Abuja- Runway 04/22 with job number FAAN/300/BS/V.VIII/056 awarded to M/S Emmanpop Ventures Ltd for the 1st Quarter dated January - March 2018 has been completed satisfactorily.

FAAN
FEDERAL AIRPORTS AUTHORITY OF NIGERIA
Nnamdi Azikiwe International Airport Abuja
P O Box 253A Abuja
Telephone 09 - 7809464

15 March 2018

The General Manager (Environment)
Federal Airports Authority of Nigeria
Headquarters
Lagos.

Through:
The Airport Manager
Nnamdi Azikiwe International Airport
Abuja.

FIRST QUARTER DERUBBERIZATION EXERCISE, (EMMANPOP VENTURES LIMITED)

The First quarter derubberization exercise commenced on the 7th of March 2018. The exercise was jointly supervised by officers from the Environmental Service department, Operations, Safety and the Air Rescue and Firefighting Service department.

The first quarter derubberization exercise was completed on the 14th of March 2018.

With airside safety procedures observed, the exercise was rated by officers who supervised the work as satisfactory.

FEDERAL AIRPORTS AUTHORITY OF NIGERIA
Headquarters:
P. M. B. 21607, Ikeja, Lagos.
Telephone: 4970335-7, Fax: 4970342 Telex: 26567NG

23 June 2018

The General Manager (Environment)
Federal Airports Authority of Nigeria
Headquarters
Lagos.

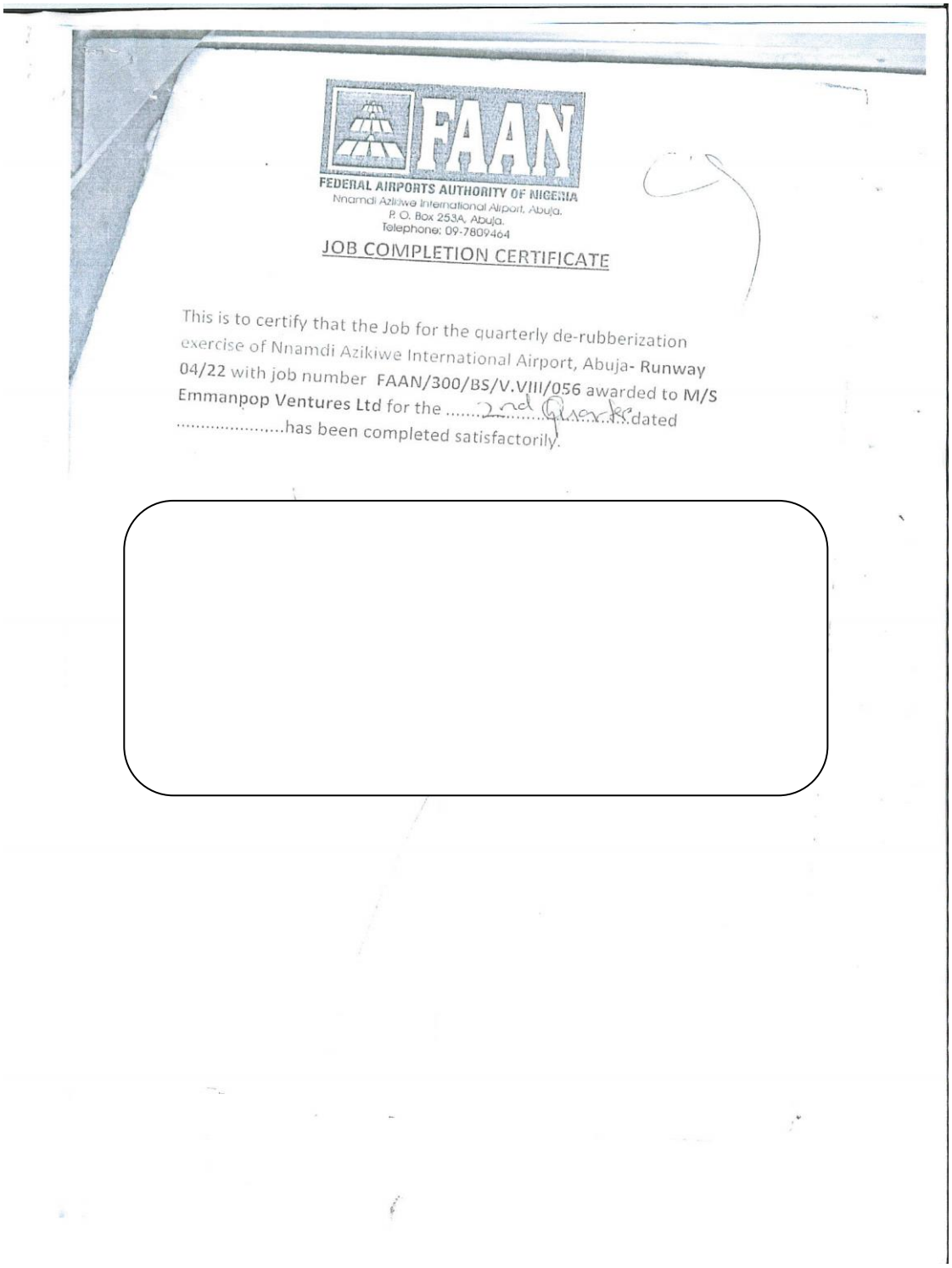
Through:
The Airport Manager
Nnamdi Azikiwe International Airport
Abuja.

SECOND QUARTER DERUBBERIZATION EXERCISE, (EMMANPOP VENTURES LIMITED)

The Second quarter derubberization exercise commenced on the 13th of June 2018. The exercise was jointly supervised by officers from the Environmental Service department, Operations, Safety department.

The second quarter derubberization exercise was completed on the 21st of June 2018.

With airside safety procedures observed, the exercise was rated satisfactory by officers who supervised the work.



FAAN
FEDERAL AIRPORTS AUTHORITY OF NIGERIA
Nnamdi Azikiwe International Airport, Abuja.
P. O. Box 253A, Abuja.
Telephone: 09-7809464

JOB COMPLETION CERTIFICATE

This is to certify that the Job for the quarterly de-rubberization exercise of Nnamdi Azikiwe International Airport, Abuja- Runway 04/22 with job number FAAN/300/BS/V.VIII/056 awarded to M/S Emmanpop Ventures Ltd for the .....2nd Quarter.....dated .....has been completed satisfactorily.

FAAN
FEDERAL AIRPORTS AUTHORITY OF NIGERIA
Nnamdi Azikiwe International Airport Abuja
P.O. Box 253A Abuja
Telephone 09 - 7809464

20 September 2018

The General Manager (Environment)
Federal Airports Authority of Nigeria
Headquarters
Lagos.

Through:
The Airport Manager
Nnamdi Azikiwe International Airport
Abuja.

THIRD QUARTER DERUBBERIZATION EXERCISE, (EMMANPOP VENTURES LIMITED)

The third quarter derubberization exercise commenced on the 7th of September 2018. The exercise was jointly supervised by the Environmental Service department, Operations and Safety department.

The third quarter derubberization exercise was completed on the 13th of September 2018.

With airside safety procedures observed, the exercise was rated by officers who supervised the work as satisfactory.

JOB COMPLETION CERTIFICATE

This is to certify that the Job for the quarterly De-rubberization exercise of Nnamdi Azikiwe International Airport, Abuja- Runway 04/22 with job number **FAAN/300/BS/V.VIII/056** awarded to M/S **Emmanpop Ventures Ltd** for the .....dated .....has been completed satisfactorily.