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Report # F60011  
Rapport

OPERATIONS GROUP REPORT  
PACIFIC WESTERN AIRLINES  
HERCULES L100-20 C-FPWX  
ACCIDENT AT OKASA, REPUBLIC OF ZAIRE  
21 NOVEMBER 1976

AVIATION  
SAFETY BUREAU

AVIATION SAFETY  
INVESTIGATION

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A9  
F60011  
c.1

BUREAU DE LA SÉCURITÉ  
AERONAUTIQUE  
ENQUÊTE SUR LA SÉCURITÉ  
DE L'AVIATION

AVIATION SAFETY BUREAU

BUREAU DE LA SECURITE AERONAUTIQUE

Aviation Safety Investigation

Enquête sur la sécurité de l'aviation

R E P O R T

R A P P O R T

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# CONFIDENTIAL

Report # F60011

Rapport

OPERATIONS GROUP REPORT  
PACIFIC WESTERN AIRLINES  
HERCULES L100-20 C-FPWX  
ACCIDENT AT OKASA, REPUBLIC OF ZAIRE  
21 NOVEMBER 1976

This report is prepared for  
accident prevention purposes only

*Le présent rapport est rédigé a seule  
fin de contribuer à la prévention des  
accidents*

Date 22 April 1977

Prepared by - *Rédigé par*

N. D. Hull



W. R. Bowie



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I N D E X

Synopsis	1
Introduction	2
History of Flight	3
Weight and Balance	9
Duty Time	11
Air Traffic Services	12
Communications and Radio Navigation	19
Safety Proposals	21

APPENDIX I FLIGHT RECORDER GROUP REPORT

Aircraft Make and Model		Registration	Date/Time	
Hercules L100-20		C-FPWX	21 November 1976 0420 hours GMT	
Place		Latitude	Longitude	
OKASA, Republic of Zaire		00°58'18"S	24°03'00"E	
<p>The aircraft was enroute from Kano, Nigeria to Kisangani, Zaire. Navigation and approach aids were out of operation upon arrival at destination. Additionally, aeronautical ground-to-air communications were not available. The aircraft passed within 8 miles of its intended destination then descended to low altitude. The crew searched unsuccessfully for Kisangani for one hour. The aircraft crashed 111 NM southwest of Kisangani when fuel was exhausted. Five of the six occupants lost their lives in the crash; the Aircraft Maintenance Engineer survived.</p>				
	Total	Fatality	Serious Injury	Minor Injury
Crew	5	4	1	
Passengers	1	1		
Others				

- 2 -

OPERATIONS PERFORMANCE GROUP

Members:	Norman D. Hull	Transport Canada Aviation Safety Bureau
	W. Ross Bowie	Transport Canada Aviation Safety Bureau
	Captain T. Lambourne	Pacific Western Airlines Hercules Check Pilot
Consultant:	R. M. Greenwood	Transport Canada Airspace & Procedures
Advisor:	Captain V. Bentley	Pacific Western Airlines CALPA Safety Chairman

Introduction

Critical evidence which was necessary for a comprehensive analysis of the final segment of the flight of C-FPWX was not available to the members of the post-crash investigating teams due to the rapidly changing political atmosphere in the geographical areas involved.

This report was compiled from material included in the preliminary Pacific Western Airlines Accident Report, the Flight Data and Cockpit Voice Recorders, plus interview evidence and data obtained by Aviation Safety Bureau Investigators.

The members gratefully acknowledge the assistance of the National Research Council Flight Recorder Playback Centre, Pacific Western Airlines, the Canadian Airlines Pilots Association and the International Federation of Airline Pilots Associations for their helpful contribution in this investigation.

## HISTORY OF FLIGHT

### Dispatch

The charter contract for the flight of C-FPWX was agreed to in a Telex dated 1151Z on November 18. The routing was established in a Telex at 1535Z on the same day. The flight was to proceed from Ostend, Belgium to Algiers, Algeria to Tamanrasset, Algeria to N'Djamena, Chad to Kisangani, Zaire to Lubumbashi, Zaire. The itinerary provided only one hour on the ground at each enroute refuelling stop. This would allow insufficient time to examine the information pertinent to the safe conduct of a flight of this nature, and to carry out other required functions.

The London office is responsible for marketing, but it does not serve as a dispatch office. The Project Manager apparently obtains overflight and entry clearances under the direction of sales personnel. No specific definition of the duties, responsibilities or authority of the Project Manager exists. The Captain is responsible for all preparations, and for having copies of the required clearances in written form before departure.

The earliest time that the carrier's London office could have requested overflight clearances would have been 1151Z on November 18th. The London office was notified verbally by unofficial sources on November 19 at 1715Z that overflight and landing rights clearances for Zaire had been obtained. It is significant that a telex from the proper authorities in Kinshasa dated 22 November indicated a possible delay of 48 hours before clearances could be expected; this meant that official clearances had not been granted.

While in Ostend, the Captain was notified, in a telephone call from the carrier's London office that clearances had been received from Zaire; it is not known whether he was given the impression that other clearances had been granted. The London office had not received overflight clearance from the other African countries on the proposed route.

The carrier's London representatives were aware of difficulties experienced by previous flights attempting to enter Algeria without the required clearances. Some flights had been denied entry and were obliged to divert to Marseille to await authorization. It appears that the Captain was advised to depart without hard copies of clearances; this conflicts with Section 4-3 of the carrier's Operations Manual.

The country of Chad requires that requests for clearance be submitted 72 hours before entry; this information was available in the Jeppeson publications used for flight planning. Thus clearances for Chad could not be expected before 1151Z on November 21, yet C-FPWX was scheduled to enter that country's airspace at 2200Z on November 19.

s.19(1)

- 4 -

s.24(1)

#### Ostend to Algiers

The aircraft departed Ostend on November 19 at 1932Z with the contract load and 28000 lbs of fuel and landed in Algiers at 2242Z, after a flight of 3 hours and 10 minutes; fuel burn-off was 18,000 lbs. The crew was met by Algerian authorities who confined them to the aircraft for failing to comply with entry requirements. This was the first indication to the crew that clearances had not been obtained; according to the survivor, [REDACTED]. Ten hours elapsed before the flight was authorized to continue.

#### Algiers to Tamanrasset

The aircraft was refuelled to 28,000 lbs and departed Algiers at 1109Z on November 20, landing in Tamanrasset at 1425Z after a flight of 3 hours and 16 minutes; fuel burn-off was 18,000 lbs. At Tamanrasset the intended turn-around time was extended to 4 hours due to delays in clearing customs. The aircraft was refuelled to 28,000 lbs for the next leg.

#### Tamanrasset to Kano

The flight departed Tamanrasset at 1819Z, presumably for N'Djamena. A partially completed "Flight Crew Advisory Form" found in the wreckage designated N'Djamena, Chad, as the destination. In addition, a flight log from N'Djamena to Kisangani was found in the wreckage, and the survivor [REDACTED]. Nevertheless the aircraft subsequently landed in Kano, Nigeria after a flight of 2 hours and 35 minutes. It was initially assumed that C-FPWX had diverted from its track to N'Djamena to land in Kano, but this was not the case. The flight data recorder heading trace indicated that the flight proceeded to Kano via designated airways (DUA-17), on a magnetic track of 161° out of Tamanrasset, and 178° into Kano.

The carrier's Stansted operation did not employ a flight watch system to monitor the progress of each flight or any diversions therefrom; nor to provide information to the crew necessary for the safe conduct of the flight. It was thus impossible to determine the reason for this deviation from the planned route. The most likely reasons would be that fuel or landing rights were unavailable at N'Djamena. The diversion to Kano must have been essential, for it added 210 n.m. to the next leg to Kisangani.

In order to use Kano as an unscheduled technical stop, it was apparently necessary for the Captain to declare a "fuel emergency" which did not in fact exist. The Captain expected an on-board inspection after landing, and instructed [REDACTED]

[REDACTED] The aircraft landed at 2059Z with 14000 lbs fuel remaining. Police and customs officials boarded and inspected the aircraft immediately after shutdown.

Flight planning in Kano

The Captain and the First Officer spent approximately 30 minutes at the flight planning centre while the aircraft was refuelled to 32,000 lbs. It is not known what meteorological information was available to the crew at Kano. The estimated arrival time of C-FPWX at Kisangani was 0300Z on November 21. It was determined that no terminal forecast was issued for Kisangani for the period 0001Z to 0900Z. For the 9 hour period before 0001Z the lowest condition forecast for Kisangani was a sky condition of 1800 feet scattered and a visibility greater than 6 miles. The actual weather reported by the Kisangani Meteorological Bureau between 0300Z and 0500Z was an overcast stratus ceiling at 400 feet, with visibility greater than 6 miles, with no wind. It can be assumed that the Captain anticipated better conditions at Kisangani than actually prevailed; he would not anticipate a diversion to Bunia, his alternate. Bunia is 314 n.m. east of Kisangani, was listed as operational from sunrise to sunset but was reported as closed for runway repairs since 15 October 1976. There was no published instrument approach procedure to Bunia in the Jeppeson publications used by the crew. The aircraft would have required 5000 lbs more fuel than was carried in order to meet minimum alternate fuel requirements.

The flight planned routing out of Kano was direct TJN (N'Gaoundere), direct BT (Berberati), direct LIB (Libenge), direct GEM (Gemena), direct LIS (Lisala) direct FZIA (Kisangani). The estimated time of arrival at Kisangani was 0300Z and the alternate aerodrome was listed as FZKA (Bunia). The flight plan showed 6 hours fuel and 6 persons on board. Due to the limited time on the ground at Kano it was improbable that the crew could meet ICAO requirements for filing flight plans at least 30 minutes before departure.

Two high/low altitude enroute charts were recovered from the wreckage: a Jeppeson chart, revised 8 October 1976 and a United States Department of Defence flight information publication (FLIP) chart, effective 15 July 1976 to 9 September 1976. The Jeppeson chart shows that the beacons at Gemena and Lisala were reported unserviceable or shut down, and that they might not be available for navigation. The Jeppeson chart also indicates that Kisangani Tower (118.1 MHz) was not in continuous operation. The DOD FLIP chart depicts the beacons at Gemena and Lisala as being shut down until further notice; the status of the KE beacon at Kisangani (285 KHz) is shown as abnormal, which could mean de-commissioned or shut down; the BUN beacon at Bunia (285 KHz) is shown as shut down. Libenge is shown on the Jeppeson chart, but not on the DOD FLIP chart. Since the flight planned route included Libenge it is concluded that the Jeppeson chart was used by the crew. This is supported by the fact that the aircraft's track was plotted on the Jeppeson chart.

s.24(1)

[REDACTED]

Since C-FPWX was not equipped with self-contained navigation systems (GNS or INS), the flight required a navigator to meet the minimum requirements of ANO Series VII Number 2. This requirement is mentioned in the carrier's sales manual regulations for international flights.

s.19(1)

s.24(1)

- 6 -

The Jeppeson chart is somewhat deceptive in that direct routes are depicted in almost the same manner as designated airways. At first glance it appears that 18 airways lead into and out of Kisangani, when in fact there is only one. This could have misled the crew into believing that Kisangani was a major airport where one could expect 24 hour service.

The DOD FLIP Enroute Supplement effective 4 November 1976, indicated that Kisangani was operational from sunrise to sunset for all traffic, and at night for scheduled traffic. It is specified that non-scheduled traffic must request prior permission from FCIAYD (Airport Authority at Kisangani) prior to 1300Z. The original flight schedule of C-FPWX indicated an arrival time of 0330Z on November 20; in actuality the aircraft arrived 23 hours 30 minutes later. There is no evidence that this revised ETA was transmitted to Kisangani, and so it is assumed that prior permission was not requested. The Jeppeson approach chart for Kisangani dated 25 June, 1976 indicates that the Tower may be contacted on 118.1 MHz and that Kisangani is an airport of entry. On the revised chart dated 14 January 1977 a note has been added after the Tower frequency: "operation not continuous". The airport of entry designation does not appear on the revised chart. Thus the Jeppeson enroute chart contained information about the limited hours of operation of Kisangani Tower that did not appear on the Jeppeson approach chart.

#### Kano to Kisangani

Despite the lack of navigational radio aids over the last 439 n.m. of the leg to Kisangani, there is no evidence to suggest that the crew used the airborne weather radar for ground mapping. The aircraft's route from Lisala to Kisangani follows the path of the Zaire River for a distance of 240 n.m. This river is not shown on the DOD chart, but is depicted on the Jeppeson chart as leading directly to Kisangani. The city of Kisangani, with a population of over 100,000, has several large buildings which would provide a significant return on radar. The data recorder indicated that the aircraft passed within 8 n.m. of the city. Other Hercules crews recounted instances of receiving a radar return from the city of Luanda, Angola (population 300,000) at a range of 150 n.m. at 28,000 ft.

[REDACTED] Had Kisangani been identified on radar, the Captain would not have initiated descent 38 n.m. southeast of the city and then continued to the southwest for 140 n.m. Examination of the wreckage revealed that all nav aids were selected on with the exception of the radar, which was selected to the "off and up" position.

[REDACTED] This beacon transmits a powerful signal on a frequency of 258 KHz, 3 KHz above that of the KW beacon at Kisangani, which transmits on 255 KHz with a power of 100 watts. The crew had no reason to suspect that the KW beacon would be off the air, since both the Jeppeson and DOD enroute charts indicated normal continuous operation. The flight passed within 8 n.m. of the KW beacon at 17000 ft asl and continued southeast before turning to the southwest and descending. During this time the crew would have

s.19(1)

s.24(1)

been attempting to tune all of the published radio aids. They were unsuccessful because [REDACTED]

[REDACTED]. At this time the aircraft was descending to the southwest, [REDACTED]

[REDACTED]. It is likely that while attempting to tune the KW beacon the ADF bearing needle gave a positive indication which the crew followed because it was the only one available, [REDACTED]

[REDACTED] The bearing indication was leading the aircraft toward Luanda, [REDACTED]

[REDACTED], but there was no indication that any crew member attempted to determine the location of the LU NDB; this could easily have been done using publications on board. The crew believed or hoped that the bearing indication was from the KW beacon, but that for some reason, the LU identifier was covering the KW identifier.

Sunrise on the morning of the accident was at 0404Z, and twilight was at 0342Z. At 0257Z, when C-FPWX was within 8 n.m. of Kisangani, witness reports confirm the existence of the low ceiling reported by the Meteorological Bureau at 0300Z. Thus the city and the airport would not have been visible to the crew. One witness reported hearing an aircraft over Kisangani at about 0300Z which sounded like a Hercules at high altitude. As the aircraft continued to the southeast and then turned and descended to the southwest, the city would have been behind the aircraft, precluding visual contact by the crew.

There was no evidence that C-FPWX had penetrated cloud during descent, but it was evident that weather conditions were better in the area south of Kisangani where the aircraft reached 1500 ft agl. [REDACTED]

[REDACTED] This is known from the survivor's statement in which [REDACTED]

[REDACTED] There is no evidence that the crew used topographical maps in an attempt to determine their position.

[REDACTED] The Kindu VOR was well beyond reception range and the NDB was shut down.

s.19(1)

- 8 -

s.24(1)

[REDACTED]

The voice and data recorders stopped at this point.

A total of 95 seconds elapsed from overhead the selected landing area to engine failure. This would be insufficient time to conduct a complete circuit for a controlled forced landing, and so it is assumed that the aircraft crashed short of the intended area.

The right wing of the aircraft initially struck a large tree 60 feet above ground, shearing off 30 feet of the wing. The aircraft then rolled to the right, cutting a descending swath for a distance of 530 feet through trees up to 2 feet in diameter before striking the ground. It then disintegrated over the next 220 feet, with the main wreckage coming to rest in a confined area 700 feet from the initial contact with the tree. The rear fuselage section, containing the survivor, remained relatively intact and came to rest 65 feet beyond and to the left of the main wreckage.

The aircraft crashed 6 hours and 5 minutes after departure from Kano, 111 n.m. southwest of Kisangani, at 00°58'18"S, 24°03'00"E, near the village of Okasa.

#### CONCLUSIONS

1. The flight departed Ostend before overflight clearances and landing permits had been obtained for the route. The Captain believed that authorizations had been received by the London office, after speaking to the London representative.
2. There is no effective dispatch or flight watch system established by the carrier for overseas cargo operations.
3. The flight proceeded directly from Tamanrasset to Kano rather than following its planned routing to N'Djamena.
4. In order to justify landing at Kano the crew had to declare a false fuel emergency.
5. The crew had insufficient time in Kano to fully plan the leg to Kisangani, taking into account all of the factors affecting the safety of the flight.
6. The aircraft did not carry enough fuel to comply with the minimum alternate requirements.

7. The selected alternate (Bunia) was not suitable.
8. The selected route depended on enroute radio aids which were published as being unlikely to be available. This information was available to the crew during the planning and conduct of the flight.
9. There was no evidence available to the crew that the KGI VOR and the KW NDB, the navigation and approach aids at Kisangani, would be off the air.
10. The aircraft's flight plan was not passed to Kisangani, and so the flight was not expected on the morning of the accident.
11. Prior permission to use Kisangani was not requested nor received on the night of the accident.
12. The crew did not use radar for navigation during the last leg of the flight.
13. The weather conditions which existed at Kisangani upon arrival of C-FPWX would have permitted a landing using the Jeppeson published approach procedure.
14. The crew was misled by a bearing indication from the LU NDB at Luanda, whose frequency almost coincided with that of the KW NDB at Kisangani. This led them to descend to low altitude and to continue predominately southwest for the remainder of the flight.
15. The weather during the last hour of flight would have been suitable for celestial navigation. The aircraft did not carry a navigator, VLF or INS navigation systems.

#### WEIGHT AND BALANCE

##### Contract Load

The carrier's London representative negotiated the charter agreement with the consignor by telephone and Telex. The agreement was to transport two machines weighing 8800 Kg and 8900 Kgs, for a total of 17,700 Kgs, from Ostend, Belgium to Lubumbashi, Zaire, departing on 19 November 1976. Additional freight to a maximum payload of 48000 lbs. (21,800 Kgs) was to be carried subject to loadability. The charter was considered urgent because the consignee was incurring a loss of 100,000 Belgian francs (\$3000.00) per day of delay.

Analysis of the charter information and manifest determined that the two machines actually weighed 20,200 Kgs. Three additional boxes weighing 1600 Kgs, 328 Kgs and 75 Kgs were carried, bringing the load to 22,203 Kgs. (48,949 lbs). A representative of the consignor and his baggage added 91 Kgs for a total contract load of 22294 Kgs (49,149 lbs).

Marketing

The carrier's sales manual and sales brochure used as guides in negotiating charter agreements quote the Hercules Empty Operational Weight (EOW) as 74,365 lbs, and the maximum payload (with rollers) of 43,500 lbs. A note states that under certain circumstances the payload may be increased to 52,000 lbs. In fact the EOW of C-FPWX with a four-man crew, according to the weight and balance carried out on 8 September 1975, was 77,564 lbs. The aircraft carried a fifth crew member (200 lbs) as well as spares including a wheel, a jack and other components weighing a total of at least 1000 lbs. Thus the true EOW was 78,764 lbs, or 4400 lbs more than advertised. It follows that the company sales manual should quote a maximum payload with rollers of 39,100 lbs (17735 Kgs).

Aircraft Limitations

The load on board C-FPWX was calculated as follows:

EOW	78764 lbs	
Contract load	49149 lbs	
Rollers	2500 lbs	
	<hr/>	
	130413 lbs	Zero fuel weight

The maximum take-off weight (MTOW) of the L100 aircraft is 155,000 lbs, and the maximum landing weight (MLW) is 135,000 lbs. In order to comply with aircraft limitations the maximum fuel on take-off would be 24,587 lbs, and the maximum on landing 4587 lbs. Thus endurance was limited to only 4 3/4 hours without reserves, and if MLW limitations were observed, the aircraft would arrive over destination with less than stand-off fuel remaining and without any fuel to proceed to an alternate.

Fuel sheets recovered from the wreckage reveal that the aircraft departed with a fuel load of 28,000 lbs from Ostend, Algiers and Tamanrasset. Since the leg from Kano to Kisangani was about 300 n.m. longer than the previous legs, the Captain elected to take-off with 32,000 lbs. fuel, giving a ramp weight of 162,413 lbs. and a take-off weight of 161,613 lbs. Thus the aircraft was overweight by 6613 lbs.

Information obtained from company personnel indicates that there could have been additional spares aboard C-FPWX which would add 4000 lbs to the EOW. This is substantiated by comparing the times to altitude out of Algiers, Tamanrasset and Kano recorded by the FDR with Flight Manual performance charts. Interviews with Hercules crews further substantiate the contention that the aircraft's take-off weight was well over 160,000 lbs. It was established that company sales representatives lacked the operational expertise necessary to determine the feasibility of contracting loads considering the routing and segment distances involved. As a result it was

necessary for the project managers to attempt to influence Captains to carry loads which resulted in take-off weights which exceeded the MTOW by 14000 lbs. Some Captains estimated that they had on occasion exceeded the MTOW by 20000 lbs.

#### CONCLUSIONS

1. The carrier's marketing and sales literature overstates the payload capability of the aircraft.
2. Due to a lack of operational expertise, the carrier's marketing and sales managers are overselling the aircraft for the stage lengths involved.
3. Hercules Captains are knowingly exceeding MTOW limitations.
4. Hercules Captains are knowingly flying with insufficient fuel for stand-off and alternate requirements.
5. There is direct and indirect pressure on the crews to exceed aircraft limitations and to take-off without sufficient fuel to meet normal stand-off and alternate requirements.
6. C-FPWX departed Kano approximately 6600 lbs over the Maximum Take-off Weight.

#### DUTY TIME

The carrier's London representative outlined the schedule of C-FPWX in a Telex sent on 18 November at 1535Z. The flight was to leave Ostend on November 19th at 1000Z and arrive at Lubumbashi on November 20th at 0720Z. The total scheduled duty time was thus 21 hours and 20 minutes. Adding pre-flight and post-flight activities would extend the duty time to approximately 24 hours.

The flight departed Stansted at 1520Z on November 18th, landing at Ostend at 1559Z. The crew probably received adequate rest on the night of November 18th. The flight did not depart as scheduled at 1000Z due to delays in obtaining overflight clearances, but it is assumed that the crew was awake and preparing to depart at that time. The aircraft did not depart until 1932Z on November 19th, landing in Algiers at 2242Z.

Due to a lack of overflight clearances the crew was confined to the aircraft throughout the night in Algiers. According to the survivor [REDACTED]. The Captain and First Officer remained in their seats overnight, and so this rest period did not satisfy the recognized crew rest requirement. The flight departed Algiers at 1109Z on November 20th, landing in Tamanrasset at 1425Z. Local authorities delayed the departure for three hours; the flight departed at 1819Z. Twenty-four hours duty time had elapsed since the flight began, [REDACTED] to the survivor at this point.

s.19(1)

s.24(1)

The flight arrived at Kano at 2059Z on November 20th, and departed at 2215Z. The aircraft crashed at 0420Z on November 21st. Thus the duty time of the crew of C-FPWX from the scheduled departure time to impact was in excess of 42 hours. If the crew were resting and commenced duty 1 1/2 hours prior to the actual Ostend departure time, the crew duty time was 34 hours.

The initial VHF calls to Kisangani Tower by C-FPWX were monitored by the crew of an overflying airliner. In an unsolicited comment, a member of the airliner's crew reported that he was readily able to recall these transmissions by [REDACTED]

Interviews conducted with colleagues of the Captain indicated that he did not adhere strictly to duty time limitations, and that he did more flying than was necessary. During Arctic tours he occasionally flew his regular 12 hour shift and then flew into the next 12 hour shift, flying continuously for 18 to 24 hours despite the availability of a rested crew standing by.

The aircraft Journey Log for the previous cargo flight flown by the Captain indicates departure from the ramp at 1431Z on November 16th and a return to the ramp at 1243Z on November 17th for a duty time in excess of 22 hours. Adding normal pre-flight and post-flight duties extends the duty time to at least 24 hours.

#### CONCLUSIONS

1. Company representatives scheduled cargo flight crews to exceed flight duty time limitations on charter operations out of Stansted.
2. The Captain knowingly exceeded duty time limitations on the accident flight and on a number of prior occasions.
3. The crew duty time on the accident flight was at least 34 hours and probably 42 hours.
4. There was evidence of crew fatigue 14 hours before the accident.
5. Crew fatigue was evident 2 hours before the accident.

6. [REDACTED]

#### AIR TRAFFIC SERVICES

##### Flight Plan

A flight plan message originated at Kano, Nigeria at 2227Z on November 20th for the proposed flight of C-FPWX from Kano to Kisangani, Republic of Zaire, with alternate aerodrome Bunia, Zaire. This message was addressed to:

- 13 -

FCBBZQ - Brazzaville FIC/ACC  
FZAAZQ - Kinshasa/N'Djihi FIC/ACC  
FZIAZQ - Kisangani FIC/ACC  
FZQAQA - Lubumbashi Alidair Ltd.  
FZKAZT - Bunia (alternate aerodrome) Tower  
FZAAQC - Kinshasa Societe Air Zaire  
FZIAZT - Kisangani Tower

It requests: "Notify EGSSPWOW FZAQAQ" (AQ = Air Anglia Ltd.) ICAO Annex 11 provides for the flight plan message and others to be forwarded to the operator if requested and agreed by the ATS authority. No evidence was found of this being done.

The Kano Airport is listed by ICAO and in the Nigerian AIP as available for use in International aircraft operations as specified in Article 10 of the ICAO Convention. The AIP indicates Kano has a pre-flight information service unit and information for Kano and adjacent FIR's. NOTAMs are exchanged with International NOTOF including Brazzaville.

A PWA representative has stated that information sources used in planning this flight were the International Flight Information Manual Vol. 24, April 1976 and the CAA Aeronautical Information, United Kingdom, July 31, 95/1972.

There is no evidence that the Captain was in possession of AIP information for the proposed route or what additional information he obtained before departing Kano. Jeppeson and DOD publications were carried aboard the aircraft which clearly indicated the unreliability of the radio aids in Zaire which were selected for navigational purposes. These publications also indicated part time operation of Kisangani tower.

The AIP is a basic internationally recognized source of civil aviation information published by a State with respect to its aerodromes, ATS, Communications, Navigation Aids, Meteorological Services, Airspace Designation, facilitation and Search and Rescue. The information in it, as well as NOTAM, AIC and changes notified by ATS supercede other published information such as the International Flight Information Manual and Jeppeson Charts.

The planned route of C-FPWX traversed approximately 1256 n.m. The flight, as planned would leave controlled airspace approximately 120 n.m. southeast of Kano; traverse approximately 20 n.m. of uncontrolled airspace in the N'Djamena (Chad) FIR; traverse the TJN TMA; re-enter uncontrolled airspace until crossing the southern portion of Bangui TMA; then re-enter uncontrolled airspace until reaching the Kisangani TMA approximately 40 n.m. before destination.

### Flight Information Service Requirements

No relevant "differences" have been filed between ICAO SARPS and the standards and recommended practices of the countries over which the flight of C-FPWX was planned. An IFR flight plan for C-FPWX was required.

ICAO SARPS (Annex 11) specify that flight information service shall be provided to all aircraft which are likely to be affected by the information and which are provided with ATC service or otherwise known to the relevant ATS units. Similarly, alerting service shall be provided for, inter alia;

- a) all aircraft provided with air traffic control service and
- b) in so far as practicable, to all other aircraft having filed a flight plan or otherwise known to the air traffic services.

Flight information for IFR flights includes provisions of pertinent:

- a) SIGMET information
- b) Information on changes in the serviceability of nav aids
- c) Information on changes in conditions of aerodromes and associated facilities
- d) Weather conditions reported or forecast at departure, destination and alternate aerodrome
- e) Collision hazards to aircraft operating outside of control areas and control zones
- f) Any other information likely to affect safety

In this case the enroute ATS units responsible for provision to C-FPWX of flight information and alerting service were Kano, Brazzaville and Kinshasa FIC's. The flight was not notified of changes in the status of ground facilities at Kisangani.

### ATS Coordination/Communication

Close coordination is essential between adjacent ATS units. It was essential that Brazzaville FIC provide pertinent information to Bangui TMA concerning the progress of C-FPWX in order that the flight could be provided approach control service including separation, information and alerting service.

Bangui should have been provided an estimate on C-FPWX before the flight entered the Bangui TMA. The aircraft should have been instructed to contact Bangui TMA on 119.7. Brazzaville FIC should have notified Bangui TMA of C-FPWX's change in altitude to FL170. At this altitude it was reasonable to have requested C-FPWX to report over Libenge to Bangui TMA on 119.7. Although

- 15 -

not specifically required by ICAO procedures, the Libenge radio contact could have provided an opportunity for C-FPWX to be notified that communications disruption had so far prevented notification of the flight's ETA to Kisangani. Had the crew been informed of the communication breakdown at this time, sufficient fuel remained for an emergency diversion as far as N'Djamena, 650 miles north.

No evidence has been obtained concerning application of the above coordination or radio reporting procedures.

It was essential that Brazzaville FIC fully coordinate the progress of C-FPWX with Kinshasa FIC with respect to FIR boundary ETA, any communications difficulties and the revised altitude. There is no record of these services but witnesses at Kinshasa FIC indicate they were made aware of these facts and were in a position to anticipate radio communications difficulties with the flight. There is no evidence that Kinshasa FIC took any steps to arrange communications procedures beyond the normal air-ground HF contact.

Kinshasa FIC was responsible for notifying Kisangani TMA of the intended flight of C-FPWX into the Kisangani TMA.

Witnesses state that the normally required procedure of notifying the Kisangani Tower of the aircraft's ETA and obtaining the actual time of arrival was not possible due to a complete lack of normal communications between Kinshasa FIC and Kisangani Radio/Tower. No evidence was obtained of what procedures have been established to provide for alternative communications such as relay through aircraft, use of commercial, military, or emergency services communications facilities.

The ATS requirements for communications pertinent to the flight of C-FPWX includes the following as reflected in ICAO Annex 11, Chap 6.

Aeronautical Mobile Service (air ground) Requirements (AMS)

A. Flight Information Services

Radiotelephony, or other rapid direct and reliable communications methods, or both in combination, shall be used in air-ground communications for air traffic services purposes.

Air-ground communication facilities used for flight information services shall enable two-way communications to take place between a flight information centre (FIC) and appropriately equipped aircraft flying anywhere within the FIR or control area.

Whenever practicable, air-ground communications facilities for Flight Information Services should permit direct, rapid and continuous static-free two-way communications between an FIC and appropriately equipped aircraft flying anywhere within the FIR.

B. Aeronautical Fixed Service (AFS)

For ATS purposes, this capability refers to direct or indirect communications between ATS Units to permit exchange of information and/or instructions pertaining to Control Services or Information and Alerting Services. These shall comprise:

- a) communications by direct speech with automatic recording; the speed with which the communications can be established being such that any of the above mentioned points may normally be contacted within approximately 15 seconds; and
- b) printed communications; when a written record is required, the speed with which the communications can be established being such that the time between delivery of the message to the transmitting agency at the point of origin and the time of delivery to the addressee does not exceed 5 minutes.

It should also be noted that ICAO procedures specify that when so prescribed by the appropriate ATS authority, ATS units shall ensure that the aeronautical telecommunications stations serving the centres concerned, are informed regarding transfers of communications contact by aircraft. Unless otherwise provided, information to be made available shall comprise the identification of the aircraft (including SELCAL code, when necessary), the route or destination (where necessary) and the expected or actual time of communications transfer. No evidence was obtained concerning the application of these procedures with respect to C-FPWX.

Alerting Service

Personnel interviewed at Kinshasa, and the flight progress strip, indicate no evidence of ATS difficulties or deficiencies relevant to the safety of C-FPWX, other than inability to contact Kisangani, until after its last position report. The last ATS information available is a report by the aircraft reaching FL170 over Berberati (BT) at 0043Z, with no change in the pilot's estimate of 0300Z for Kisangani.

The Zaire AIP indicates that subsequent radio stations and navigation aids on the route of flight cannot be expected to be in operation during night except for the Kisangani Tower, VOR and locator NDB's.

Witnesses state that after the aircraft's estimated time of arrival over Libenge (0118Z) near the Kinshasa FIR boundary, attempts to make radio contact with the aircraft were unsuccessful. A record of these attempts and the agencies which initiated or performed them was not obtained.

In this regard, ICAO procedures specify:

"When no report from an aircraft has been received within a reasonable period of time (which may be a specified interval prescribed on the basis of regional air navigation agreements) after a scheduled or expected reporting time, the ATS unit shall, within 30 minutes, endeavour to obtain such reports in order to be in a position to apply the provisions relevant to the 'uncertainty phase' (Annex 11, 5.2.1) should circumstances warrant such application."

ICAO SARPS specify that FIC's or ACC's shall serve as the central point for collecting all information relevant to a state of emergency of an aircraft operating within the FIR or ACC concerned, and for forwarding such information to the appropriate rescue coordination centre.

Further, when alerting service is required in respect of a flight operated through more than one flight information region, or control area, and when the position of the aircraft is in doubt, responsibility for coordinating such service shall rest with the ATS unit of the FIR or ACC:

- a) within which the aircraft was flying at the time of last air-ground radio contact (in this case, Brazzaville FIR);
- b) that the aircraft was about to enter when last air-ground contact was established at or close to the boundary of two FIR's or ACC's;
- c) within which the aircraft's intermediate stop or final destination point is located:
  - (i) if the aircraft was not equipped with suitable two-way radio communications equipment; or
  - (ii) was under no obligation to transmit position reports.

With regard to the above noted ICAO provisions, it is clear that no report from C-FPWX was received within a reasonable time after 0118Z. The time interval prescribed as "reasonable" is not known but in any case the "uncertainty phase" begins within 30 minutes after a communication should have been received or within 30 minutes after an unsuccessful attempt to establish communication, whichever is earlier. Thus the uncertainty phase should have commenced by 0148Z unless no doubt existed as to the safety of the aircraft. In this case there was no reason to assume that the safety of the aircraft and its occupants was not in jeopardy through the uncertainty phase, the alert phase and after fuel was exhausted.

- 18 -

With regard to the ATS unit responsible for coordinating the alerting service, the ICAO procedure noted above would point to either Brazzaville FIC or Kinshasa FIC. Evidence obtained by the investigation team established that this responsibility was clearly assumed by the Kinshasa FIC.

In accordance with ICAO procedures, therefore, Kinshasa FIC was responsible for the following:

- a) notify units providing alerting service in other affected flight information regions, or ACC's, of the emergency phase or phases in addition to notifying the RCC associated with it;
- b) request those units to assist in the search for any useful information pertaining to the aircraft presumed to be in an emergency by all appropriate means;
- c) collect the information gathered during each phase of the emergency and after verifying it as necessary, transmit it to the RCC.
- d) announce the termination of the state of emergency as circumstances dictate.
- e) give particular attention to informing the relevant RCC of the distress frequencies available to the survivors, as listed in the flight plan.

In accordance with ICAO procedures, Kinshasa FIC should have considered the aircraft in the uncertainty phase by 0148Z and performed at least those actions specified in the above paragraph. There is no evidence of any of these actions being taken until 0440Z with the formulation of a distress message enquiry to FZJAZT and FZKAZT. There is no evidence as to when this message was transmitted. The aircraft crash landed at approximately 210420Z.

The statements of witnesses in Kinshasa indicate that the procedure in case of an aircraft being overdue is first to contact the destination airport and the alternate airport for confirmation as to whether or not the aircraft has landed. It was stated that first contact with Kisangani on November 21, 1976 occurred at 0535Z at which time the Flight Plan was transmitted to the Kisangani radio operator. It was further stated that a message confirming that the aircraft had not landed was received in Kisangani at 0837Z. After a futile wait for a message from Bunia as to the whereabouts of C-FPWX, the Kinshasa operator started distress procedures at 1300Z. This consisted of advising the military, Air Zaire, aircraft in flight and all addressees on the flight plan of the circumstances of the overdue flight. A copy of a distress message with filing time 1040Z addressed to Kisangani FIC and other concerned agencies was obtained by the investigating team.

No other evidence concerning alerting action taken was obtained by the investigating team. No evidence was obtained concerning notification of the Rescue Coordination Centre regarding the state of emergency.

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- 19 -

### Conclusions

1. The flight plan and ETA of C-FPWX were not forwarded to the Kisangani ATS unit due to lack of adequate communications between Kinshasa and Kisangani tower.
2. Navigational Aids (GEM NDB, LIS NDB) along the last 439 n.m. of planned route from Libenge to Kisangani were published in Republic of Zaire AIP as not being available during the time of flight.
3. The VOR and NDB's at Kisangani are normally in operation on a 24 hour basis.
4. Use of the Kisangani aerodrome is restricted to VFR only.
5. Use of the Bunia aerodrome (filed alternate) is restricted to VFR only.
6. Communications with radio operators at significant points along the route of flight in Zaire are published as not available during night.
7. C-FPWX was unable to maintain radio contact either directly or indirectly with the Kinshasa FIC due to inadequate HF signal reception.
8. C-FPWX did not communicate with any aeronautical ground station in Zaire.
9. No air traffic services (Control Service, Flight Information Service or Alerting Service) were provided for C-FPWX by Zaire ATS authorities during the aircraft's flight due to inadequate communications facilities.
10. Alerting Service for C-FPWX was begun by Kinshasa FIC at 0440Z on 21 November, 2 hours 52 minutes after entering the uncertainty phase - 20 minutes after the aircraft had crashed.
11. Alerting service for the flight did not conform to International Standards and Recommended Practices as detailed in ICAO Annex 11, Chapter 5.

### COMMUNICATIONS AND RADIO NAVIGATION

During the second last hour of flight C-FPWX maintained an altitude of 16,000 feet agl enroute to Kisangani. At this altitude the theoretical VHF and VOR reception range would be 155 n.m. The data recorder information indicates that the aircraft was within 155 n.m. and as close as 8 n.m. to Kisangani for 48 minutes, from 0224Z to 0312Z, prior to a 5 minute descent to 1500 ft agl.

The crew of C-FPWX was unable to contact Kisangani on 118.1 MHz between 0224Z and 0317Z. The Captain was able to conduct two-way communications with an overflying aircraft on 118.1 MHz during the same period. Neither aircraft was able to establish contact with Kisangani Tower or receive navigation signals from the KGI VOR or the NDB's at Kisangani. It is noteworthy that 2 1/2 hours later, between 0530Z and 0555Z, a third aircraft was unable to get any response from Kisangani Tower on 118.1 MHz or to receive signals from any of the radio aids to navigation.

During the final hour of flight the aircraft maintained an average altitude of 1500 feet agl; at this height the VHF and VOR reception range is 46 n.m. Data recorder information indicates that C-FPWX was no closer to Kisangani than 63 n.m. during this time. The first VHF MAYDAY calls on 121.5 MHz and 118.1 MHz were made when the aircraft had 26 minutes fuel remaining and was 110 n.m. to 126 n.m. southwest of Kisangani. This placed the aircraft beyond VHF range of any known ground receiving facility.

[REDACTED]

This beacon, located at Luanda Angola, was 900 n.m. southwest of the aircraft at the time. This freak reception, made possible by the night effect phenomenon, confirmed the serviceability of the ADF receivers aboard C-FPWX.

[REDACTED]

It was established that Berna Radio has excellent communication capabilities in the area of the accident, and information on its use is contained in the "Hercules Work Book" carried by the crews.

[REDACTED]

Kinshasa's attempts to contact Kisangani on HF/CW from 2255Z, November 20, to 0100Z, November 21, were unsuccessful despite the contention of local authorities that reception is good both night and day. These authorities also stated that the KGI VOR and the KE NDB were serviceable "in principle" since no one had communicated with Kisangani Tower to report malfunctions. This is the only method of determining the status of the Kisangani radio aids in the absence of automatic monitoring. This system proved inadequate on the night of the accident, since 3 aircraft and one ground station were unable to contact Kisangani on VHF or HF/CW. Kinshasa was able to contact the Kisangani Administration Building on HF at 0535Z, at which time the flight plan of C-FPWX was passed. There had been a power failure in the Kisangani region the previous evening, but power was restored at 2300Z, 5 hours prior to the accident.

- 21 -

### CONCLUSIONS

1. C-FPWX was within reception range of VHF, VOR and NDB facilities at Kisangani for 53 minutes between 0224Z and 0317Z on the morning of the accident.
2. The crew of C-FPWX attempted unsuccessfully to contact Kisangani Tower on 118.1 MHz while within reception range. One other aircraft failed to make contact during the same period. Both aircraft had functional VHF transceivers at the time.
3. C-FPWX and the other aircraft attempted unsuccessfully to receive navigational signals from the KGI VOR, KE NDB, KW NDB and KGI NDB while within reception range. C-FPWX had functional ADF receivers during this time. The other aircraft had functional VOR receivers.
4. The VHF receiver (118.1 MHz) and the HF/CW receiver at Kisangani were either unserviceable or unmanned during the 6 hour and 40 minute period between 2255Z on November 20 and 0535Z on November 21.
5. None of the navigational radio aids at Kisangani was functioning on the morning of the accident.
6. The crew did not make full use of available HF/SSB facilities in an emergency situation.
7. The crew delayed their declaration of an emergency unnecessarily. The aircraft was beyond VHF reception range of Kisangani during all VHF emergency calls. They did not manually activate their ELT or select the emergency transponder code.

### SAFETY PROPOSALS

The Hercules cargo operation should be supported by the Company to the same extent as its other operations. The following areas should be given immediate attention:

- A) Dispatch - The world wide cargo operation should have a dispatch system of the same standard provided to the other Company operations. There should also be an effective flight watch system. There should be a full dispatch facility in London for European, Middle East and African operations, or the Company's System Operations Centre in Vancouver should provide a full dispatch service using readily available communications facilities. Flight watch should be maintained by using a reliable agency such as Berna Radio.

- B) Aircraft Equipment - The Hercules aircraft should be equipped with an approved, reliable, self-contained navigation system. At present, INS is the only system meeting this requirement. The aircraft should also be equipped with SELCAL to facilitate flight watch.
  
- C) Flight Crew Training - The flight crews should be given adequate training to prepare them for the difficulties encountered in overseas operations. A feedback system should be set up to ensure that pertinent information about facilities and services is available to all crews. It should be emphasized in the training that Air Traffic Services and Radio Aids to Navigation in Africa generally and in Zaire in particular, are unreliable, and do not conform to ICAO standards.
  
- D) Marketing - The Company should ensure that sales personnel are fully conversant with all operational requirements of the cargo operations, and that these requirements are applied in all cases.
  
- E) Personnel - The duties, responsibilities and authority of the project managers should be clearly defined. Project managers should be trained to qualify as dispatchers for those instances in which the full dispatch system is unavailable.
  
- F) Miscellaneous - A full set of up to date topographical maps should be carried aboard each aircraft.

APPENDIX I

AVIATION SAFETY BUREAU  
Aviation Safety Investigation

BUREAU DE LA SECURITE AERONAUTIQUE  
Enquête sur la sécurité de l'aviation

R E P O R T

R A P P O R T

Report # F60011  
Rapport

FLIGHT RECORDER GROUP REPORT  
PACIFIC WESTERN AIRLINES  
LOCKHEED L-100 HERCULES C-FPWX  
ACCIDENT AT OKASA, ZAIRE  
21 NOVEMBER 1976

This report is prepared for  
accident prevention purposes only

*Le présent rapport est rédigé à seule  
fin de contribuer à la prévention des  
accidents*

Date 22 April 1977

Prepared by - *Rédigé par*

W. R. Bowie

*WRBowie*

**Pages 29 to / à 53  
are withheld pursuant to section  
sont retenues en vertu de l'article**

**24(1)**

**of the Access to Information Act  
de la Loi sur l'accès à l'information**



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