Department of Trade

ACCIDENTS INVESTIGATION BRANCH

IBERIA DC 9 EC-BII
SPANTAX CORONADO EC-BJC
Report on the collision in the Nantes area, France, on 5 March 1973

Reprint of the report published by
The French Secretariat of State for Transport

LONDON: HER MAJESTY'S STATIONERY OFFICE
1975

List of Aircraft Accident Reports issued by AIB in 1975

No	*Short title*	*Date of Publication*
1/75	Beechcraft 95-B55 (BARON) G-AZZJ at Cholesbury cum St Leonards, Bucks, January 1974	May 1975
2/75	Westland Sea King MK 41 89-61 at Yeovil Airfield, Somerset, January 1974	May 1975
3/75	Piper PA-23 Series 250, (Aztec) G-AYDE and BAC 111 Type 518 G-AXMJ at Luton Airport, Beds, April 1974	*(forthcoming)*
4/75	Boeing 707-436 G) APFH at Heraklion Airport, Crete, June 1974	*(forthcoming)*
5/75	Rollason Druine D31 (Turbulent) G-APLZ at Grange Farm, Latchingdon, Maldon, Essex, April 1974	*(forthcoming)*

ISBN 0 11 511424 6

C O N T E N T S

1. ACCIDENT DETAILS

Date of accident

Monday, 5 March 1973

at 1252 hrs GMT (1)

Location

Over La Planche (Loire Atlantique)

25 km S.E. of

Nantes VOR (NTS)

4702N - 0125W

Aircraft

a) DC 9/30 EC-BII

b) CV 990.30A EC-BJC

Owners and Operators

a) IBERIA Company

b) SPANTAX Company

Type of operation

a) International scheduled public transport
Palma-London

b) International charter flight
Madrid-London

Persons on board

a) Captain CUETO and
6 crew members
61 passengers

b) Captain ARENAS and
7 crew members
99 passengers

Summary of accident

Collision between IBERIA DC 9 at flight level 290 on route W132 and SPANTAX Coronado which was leaving route W187 in a 360° right-hand turn.

Consequences

Persons		Killed	Injured	Aircraft	Cargo	Third party
Crew	a)	7	-	a) Wrecked	a) Destroyed	Some crops trampled down
	b)	-	-	b) Substantial damage	b) No damage	
Passengers	a)	61	-			
	b)	-	-			

(1) All times in this Report are given in GMT. One hour should be added for local time.

2. COMPOSITION OF THE COMMISSION OF INQUIRY AND SUMMARY OF THE WORK

2.1. Commission of Inquiry

By Arrêté of 7 March 1973 the Minister for Transport appointed the following Commission of Inquiry:

M. René LEMAIRE, Ingénieur Général des Ponts et Chaussées
Head of the Inspectorate General of Civil Aviation — President

M. Jean FORESTIER, Ingénieur Général de l'Armement — Vice-President

M. Fernand ANDREANI, Inspector Pilot of the Organisme du Contrôle en Vol (Flight Inspectorate)

M. Paul CAROUR, Ingénieur Général de l'Aviation Civile

M. Paul GUILLEVIC, Ingénieur en Chef de l'Aviation Civile

Docteur Jean LAVERNHE, Member of the Civil Aviation Medical Council

Général Michel LORIDAN, President of the French Air Force Permanent Air Safety Council

The Commission's mandate was to study the circumstances, investigate the causes and draw the appropriate conclusions and lessons from the accident which occurred on 5 March 1973 and entailed a collision in the Nantes area between a Coronado aircraft, registration EC-BJC, of the Spanish airline SPANTAX, and a DC.9 aircraft, registration EC-BII, of the Spanish airline IBERIA.

Colonel ALFONSO GARCIA RODRIGUEZ CARRACIDO was appointed as the Accredited Representative of the Spanish Government, under the provisions of Annex 13 to the Convention on International Civil Aviation.

2.2. Experts

Under Article 4 of the Arrêté of 3 November 1972 relating to Commissions of Inquiry, the President nominated civil and military experts to take part in the investigations. The relevant Decision is appended to this Report.

2.3. Summary of the work

The Commission called for the documents relating to the aircraft and their flight crews.

It took written and oral statements from the Coronado's flight crew.

Accompanied by French and foreign experts, it visited the installations of the French Air Force Control Centres at Mont-de-Marsan and Brest.

It interviewed the military personnel who took part in the operations and took their statements.

The Commission arranged for the expert examination or check of the ground radio installations and the airborne equipment.

The Commission also arranged for the read-out of the tapes of the flight recorders installed in the two aircraft.

Transcripts were made of the recordings of the air/ground communications at Mont-de-Marsan and Brest and also of the recordings of Bordeaux Area Control Centre.

Transcripts were also made of the recordings of the telephone communications between the control centres concerned.

The flight paths of the aircraft were reconstructed by means of the photographic recordings of the scopes of the Mont-de-Marsan, Brest, Tours and Bordeaux radars.

Nevertheless, the Commission was not able to see either the crew's flight log or all the Coronado aircraft documents of which a large number were not traced after the landing at Cognac, although there was no explanation for their disappearance. When questioned by the Commission, the aircraft commander and the airline stated that these documents were as follows:

- extracts from RAC-7
- an extract from the Air France Manual for the Clément Marot Plan
- the Jeppesen chart of the routes of the Clément Marot Plan.

3. INVESTIGATION

Because of the strike by the civil aviation air traffic control services the contingency system, known as the Clément Marot system, provided for by Instruction RAC-7, was set up at 1100 hrs GMT on 24 February 1973 by Notam A 96 of the same date.

3.1. Summary history of the flights before (1) and after the collision (2)

3.1.1. IBERIA DC.9 EC-BII

This aircraft was carrying out scheduled flight IB 504. It had taken off from Palma at 1124 hrs for London. The first contact with the Marina (Mont-de-Marsan) Control Centre was established at about 1219 hrs. The aircraft reported that it was at flight level 310. At 1225 hrs it reported that it estimated Nantes (VOR) at 1252 hrs.

At 1232 hrs, at the request of Menhir (Brest) Control Centre, Marina asked the aircraft to descend to flight level 290.

At 1236 hrs Marina asked the aircraft to contact Menhir. Contact was established at 1241 hrs. Flight level 290 was confirmed. The aircraft reported that it would pass Nantes at the later time of 1254 hrs.

The collision occurred at 1252 hrs.

3.1.2. SPANTAX Convair 990 Coronado EC-BJC

3.1.2.1. Before the Collision

This aircraft was carrying out flight BX 400 (charter flight). It had taken off from Madrid at 1201 hrs for London, but neither Marina nor Menhir had received its flight plan. The first contact with Marina was established at 1224 hrs on an incorrect frequency and fresh contact was made at 1228 hrs on the correct frequency. The aircraft reported that it

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(1) The detailed history is given below (paragraph 3.8.)

(2) The detailed history and the analysis of the circumstances relating to the flight after the collision are given in a separate document.

was at flight level 260 and that it estimated Nantes at 1252 hrs.
At 1230 hrs Marina asked it to take flight level 290.
At 1237 hrs, particulars of the flight were passed by telephone to Menhir which stated that there was no other flight level available except 290 and gave instructions to Marina for the aircraft to arrange to arrive at Nantes at 1300 hrs.
At 1243 hrs the pilot received confirmation that he was to report at Nantes at 1300 hrs and acknowledged receipt.
At 1250 hrs, the pilot asked to carry out a 360° turn, the speed reduction being insufficient to delay the flight as instructed. The air/ground communications with Marina were poor and as the pilot had not yet contacted Menhir he was practically cut off from the control services.
At 1251 hrs, the pilot reported that he was beginning his right-hand turn.
The collision occurred at 1252 hrs under conditions of very bad visibility.

3.1.2.2. After the collision

Shortly after the collision, Menhir informed Tours Control Centre (RAKI) that an aircraft was arriving over Nantes and was turning on to heading 090° and Menhir asked RAKI to identify the aircraft.

At 1256 hrs BX 400 transmitted the distress call "Mayday" which was heard by a Spanish aircraft IB 163 and re-transmitted by Marina.
The pilot of BX 400, losing height, said he intended to land at Bordeaux.
A French Air Force T 33, in flight south of Tours, received instructions from RAKI to intercept the aircraft in distress - which took place at 1307 hrs - and to guide it to Tours. But radio communication was not established between the two aircraft.
At 1318 hrs, BX 400 was taken under radar control by Bordeaux Approach.
It received clearance to begin the approach to Bordeaux when it was in sight

of Cognac. But this military aerodrome, which had ordered out the emergency services, fired green pyrotechnic signals and the aircraft landed at Cognac. at 1328 hrs; the landing was heavy but no damage was sustained. The passengers were evacuated by the aircraft escape chutes.

3.2. Consequences of the accident

3.2.1. DC 9

The DC 9 broke up in flight and crashed below the point of the collision. The 7 crew members and the 61 passengers were killed.

3.2.2. Coronado

In spite of the loss of the outer part of the port wing which fractured near the attachment of the pylon of No. 1 engine, the Coronado was able to reach BA 709/Cognac (French Air Force Base). The crew succeeded in landing the aircraft without further damage under extremely difficult conditions.

The 8 crew members and the 99 passengers escaped uninjured.

3.2.3. Third party damage

The third party damage was confined to crops trampled underfoot or crushed during the operations for the rescue and the removal of the wreckage of the DC 9.

3.3. Crew information

3.3.1. Information regarding the crew of the IBERIA DC 9

The flight crew was composed of two pilots and a pilot under training. The cabin personnel consisted of a chief steward, an air hostess and two stewards.

Flight crew

Aircraft Commander (in front left-hand seat):

Senor CUETO CAPELLA (Luis), born 24 February 1936 at INFIESTO (Asturias), married, 4 children, joined IBERIA on 8 February 1966.

Certificates and licences:

Airline Transport Pilot's Licence No. 733 dated

28 July 1967.

Licence valid until 11 June 1973 after a medical check

on 23 November 1972.

International radiotelephony qualification valid until 11 June 1973.

Qualified for DC 9 on 11 January 1972 as aircraft commander.

Last line check 29 January 1973; base check: 20 December 1972.

Total flight time:

6,612 hours as pilot, including 1,562 in the Air Force.

Flight time for each of the five months preceding the accident:

October 1972 : 77 hours

November 1972 : 64 hours

December 1972 : 64 hours

January 1973 : 34 hours

February 1973 : 64 hours

During the 48 hours preceding the accident: 2 hours 35 minutes.

Flight time in the type of aircraft to which the accident occurred: 823 hours, including 302 hours during the five months preceding the accident.

Number of flights over Nantes to the United Kingdom since 1 January 1972: 28.

Not known to have had any previous accident.

Rest time before the take-off: $12\frac{1}{2}$ hours.

Co-pilot (in the front right-hand seat)

Senor LAFITA RUEDA (Octavio) born 11 October 1937 at Saragossa, married, three children, joined IBERIA on 11 August 1969.

Certificates and licences:

Airline Transport Pilot's Licence No.1021 dated 15 January 1972.

Licence valid until 3 July 1973, after medical check on 12 December 1972.

International radiotelephony qualification valid until 3 July 1973.

Qualified for aircraft type DC 9 on 25 March 1970.

Last line check: 18 February 1973; base check: 2 November 1972.

Total flight time:

3,778 hours as pilot, including 1,500 in the Air Force.

Flight time for each of the five months preceding the accident:

October 1972 : 78 hours

November 1972 : 66 hours

December 1972 : 75 hours

January 1973 : 53 hours

February 1973 : 54 hours

Flight time for the 48 hours preceding the accident: 2 hours 35 minutes.

Flight time in the type of aircraft to which the accident occurred: 2,278 hours, including 326 during the five months preceding the accident.

Number of flights over Nantes to the United Kingdom during 1972 and 1973: 14.

No information of any previous accident.

Rest time before the take-off: $12\frac{1}{2}$ hours.

Pilot under training

Senor ALCUBIERRE CAMACHO (Victor José) born 27 December 1943 at LERIDA, married, no children, joined IBERIA on 16 December 1971.

Certificates and licences:

Airline Transport Pilot's Licence No. 7492, dated 17 December 1970.

Licence valid until 17 December 1974.

International radiotelephony qualification valid until 17 December 1974.

Total flight time (type ratings not given): 950 hours as pilot.

Flight time for each of the five months preceding the accident:

October 1972 : 81 hours

November 1972 : 59 hours

December 1972 : 14 hours

January 1973 : 88 hours

February 1973 : 50 hours

Flight time for the 48 hours preceding the accident: 2 hours 35 minutes.

Flight time in the type of aircraft to which the accident occurred: 950 hours, including 292 hours during the five months preceding the accident.

Number of flights over Nantes to the United Kingdom during 1972 and 1973: 30.

No information regarding any previous accident.

Rest time before the take-off: 12½ hours.

Cabin staff

Chief steward

Senor GARCIA RAMIREZ (José), born 31 July 1931 at LUCENA (Cordoba), married, three children, joined IBERIA on 30 June 1966.

Safety and Rescue Certificate issued on 16 February 1972.

Licence No. 589 issued on 24 June 1966 and renewed 23 June 1972.

Total flight time: 4,990 hours 18 minutes.

Rest time before the day of the accident: 40½ hours.

Steward

Senor GOMEZ GUTIERREZ (Tobirio Gerardo), born 16 April 1946 at VILLAFRANCO de la SIERRA (Avila), bachelor, joined IBERIA 29 March 1972.

Safety and Rescue certificate issued on 4 March 1972.

Licence No. 1930 issued on 22 March 1972 and renewed on 3 February 1973.

Total flight time: 649 hours 36 minutes.

Rest time before the day of the accident: 16½ hours.

Steward:

Senor OCHOA CAMPILLO (Antonio), born 17 November 1942 at Madrid, married, 2 children, joined the airline on 30 October 1971.

Licence No. 1829, issued on 27 October 1971 and renewed on 26 August 1972.

Safety and Rescue certificate issued on 27 October 1971.

Total flight time: 911 hours 2 minutes.

Rest time before the day of the accident: 40½ hours.

Air Hostess

Senorita GONZALEZ GONZALEZ (Concepción) born 5 September 1944 at Madrid,

spinster, joined the airline on 1 March 1973.

Safety and Rescue Certificate issued on 27 February 1973.

Total flight time : 13 hours 57 minutes.

3.3.2. Information relating to the crew of SPANTAX Convair CV 990 Coronado

The flight crew was composed of two pilots and a flight engineer.

The cabin staff consisted of a chief air hostess and four other air hostesses.

Flight crew

Aircraft Commander (in front left-hand seat):

Senor ARENAS RODRIGUEZ (José Antonio) born 25 March 1933 at BARCELONA, married, three children, joined SPANTAX on 20 May 1966.

Certificates and licences:

Airline Transport Pilot's Licence No. 766 dated 9 April 1968.

Licence valid until 8 April 1973 after a medical check on 27 September 1972.

International radiotelephony qualification valid until 8 April 1973.

Qualified for CV 990 on 2 April 1967 as co-pilot and 8 July 1969 as aircraft commander.

Total flight time: 8,555 hours 24 minutes as pilot, including 3,252 hours 7 minutes in the Air Force.

Flight time for each of the five months preceding the accident:

October 1972 : 62 hours 12 minutes

November 1972 : 0 hours

December 1972 : 51 hours 45 minutes

January 1973 : 0 hours

February 1973 : 74 hours 43 minutes.

Flight time for the 48 hours preceding the accident: 11 hours 56 minutes.

Flight time in the type of aircraft to which the accident occurred: 4,681 hours 5 minutes, including 188 hours 40 minutes during the five months preceding the accident.

Number of flights over Nantes to the United Kingdom since 1 January 1972: 24, and since entry into force of RAC 7 system: 1.

No information of any previous accident.

Rest time before the day of the accident: 34 hours.

Co-pilot (in front right-hand seat):

Senor SAAVEDRA MARTINEZ (Esteban), born 8 September 1933 at LA LAGUNA (Tenerife), married, 8 children, joined SPANTAX on 4 April 1966.

Certificates and licences:

Airline Transport Pilot's Licence No. 615 issued on 10 July 1968.

Licence valid until 4 September 1973 after medical check on 12 February 1973.

International radiotelephony qualification valid until 4 September 1973.

Qualified for CV 990 on 29 June 1972 as co-pilot.

Total flight time: 9,501 hours 47 minutes as pilot, including 3,060 hours 30 minutes in the Air Force.

Flight time for each of the five months preceding the accident:

October 1972 : 60 hours 35 minutes

November 1972 : 34 hours 26 minutes

December 1972 : 0 hours

January 1973 : 76 hours 10 minutes

February 1973 : 59 hours 43 minutes

Flight time for the 48 hours preceding the accident: 11 hours 53 minutes.

Flight time in the type of aircraft to which the accident occurred: 1,790 hours 16 minutes including 320 hours 54 minutes during the five months preceding the accident.

Number of flights over Nantes to the United Kingdom since 1 January 1972: 16, and since entry into force of RAC 7 system: 1.

No information of any previous accident.

Rest time before the day of the accident: 9½ hours.

Flight engineer

Senor GONZALEZ ZARAUS NAVAS (José Maria) born 6 March 1935 at Toledo, married, 3 children, joined SPANTAX on 8 April 1967.

Certificates and licences:

Flight Engineer's certificate No. 294.

Licence valid until 3 May 1973, after medical check on 13 May 1972.

Qualified for CV 990 on 9 April 1969.

Total flight time; 5,093 hours 31 minutes.

Flight time for each of the five months preceding the accident:

October 1972 : 0 hours

November 1972 : 48 hours 30 minutes

December 1972 : 80 hours 2 minutes

January 1973 : 62 hours 17 minutes

February 1973 : 82 hours 13 minutes.

Flight time for the 48 hours preceding the accident: 11 hours 44 minutes.

Rest time before the day of the accident: 33 hours 45 minutes.

Cabin staff

Chief air hostess:

Senorita ZARAGOZA RAMOS (Pilar), born 12 November 1942 at Saragossa, spinster, joined SPANTAX on 4 June 1965.

Safety and Rescue certificate No.506, renewed 30 July 1972.

Total flight time: 6,500 hours.

Air Hostess:

Senorita RUIS FERNADES (Dolores), born 17 February 1953 at SEVILLE, spinster, joined SPANTAX on 22 June 1972.

Safety and Rescue Certificate No. 685, issued on 27 July 1972.

Total flight time: 729 hours.

Air Hostess:

Senorita DEL RIO (Carmen) born 20 April 1951 at MADRID, spinster, joined SPANTAX on 22 June 1971.

Safety and Rescue Certificate No. 633, renewed 20 May 1972.

Total flight time: 1,600 hours.

Air Hostess:

Senorita GIL FERRER (Isabel), born 5 August 1952 at LEÓN, spinster, joined SPANTAX on 9 April 1971.

Safety and Rescue Certificate renewed 20 May 1972.

Total flight time: 1,200 hours.

Air Hostess:

Fröken CARLSSON (Kathy) born 27 May 1947 at KARLSHORNA (Sweden), spinster, joined SPANTAX on 24 March 1971.

Safety and Rescue Certificate No. 633, renewed 20 May 1972.

Total flight time: 1,600 hours.

3.4. Aircraft information

3.4.1. DC 9 EC-BII

Owner and operator: Spanish National Airlines IBERIA, calle Velasquez 130, MADRID.

AIRFRAME

Manufacturer: Douglas McDonnell

Type: Douglas DC 9 - 32

Maker's serial number: 47 077

Production number: 148

Certificate of registration: No. 442, dated 26 August 1967.

Certificate of airworthiness: No. 834 dated 30 August 1967 and valid until 16 October 1973.

Classified in the normal Public Transport of Passengers 1 category.

Aircraft radio installation certificate: radio certificate without a number signed by the Spanish aeronautical authorities on 22 July 1967.

Last pre-flight check carried out at Palma de Mallorca on 5 March 1973.

Total flying time: 10,852 hours 45 minutes and 9,452 landings since 1 September 1967.

Engines

Manufacturer: Pratt and Whitney

Type: JT 8 D - 7

Maker's serial number	1	2
	P 657543 D	P 656849 D
Total operating time since the last inspection	3542 hours 40 minutes	2765 hours 15 minutes

Flight instruments and radio navigation equipment

EC-BII carried in particular the following equipment:

1 x Collins 61 8 T 2 HF transmitter/receiver

3 x Collins 61 8 M 2 VHF transmitter/receivers

2 x Collins 51 Y 4 ADF receivers

2 x RCA AVQ 65 ATC transponders

2 x Collins 860 E2 VOR/DME transmitter/receivers.

3.4.2 Convair Coronado EC - BJC

Owner and operator: SPANTAX, Generalisimo 89, MADRID

Airframe

Manufacturer: General Dynamics, Convair

Type: Convair Coronado 990 - 30 A

Maker's serial number: 10-22

Certificate of registration: No. 210, dated 18 April 1970.

Certificate of airworthiness: No. 853, dated 28 February 1967, valid until 1 January 1974.

Classified in the normal Public Transport of Passengers 1 category. Aircraft radio installation certificate No. 1 - 27/TA-20 N dated 28 October 1964.

Last pre-flight check carried out at Madrid on 5 March 1973.

Total flying time: 24,775 hours and 1,108 landings since the last general overhaul.

Engines

Manufacturer: General Electric

Type: CJ-805-23

Maker's serial number	1	2	3	4
	175,140	175,103	175,127	175,152
Total operating time since the last inspection	4211 hours	4791 hours	5189 hours	373 hours

Flight instruments and radio navigation equipment

EC-BJC carried Spantax standard equipment. It comprised in particular :

2 x Collins 61 8T2 HF transmitter/receivers

2 x Bendix TA 20 B.1/RA 18C3 VHF transmitter/receivers

2 x Collins 51 73 ADF receivers

1 x Collins 621 A3 ATC transponder

2 x Collins 51 R3 VOR receivers

1 x Collins 860 E 2 DME transmitter/receiver

1 x Compass System.

This equipment has been examined by experts of the Air Navigation Technical Service.

The whole of the equipment - VHF transmitters/receivers, DME, VOR receiver automatic radio compass and compass system - was found to be in excellent operating condition from the standpoint of sensitivity, precision of emitted radio frequencies and correctness of the indications.

3.5 Meteorological information

Nantes-Chateau Bougon aerodrome meteorological station, located twenty kilometres away from the small town of la Planche, provided the following information for the period between 1100 hrs and 1200 hrs GMT, for the altitudes close to the flight level of the aircraft at the time of the collision.

Wind 7,000 metres: 240°/39 knots

8,000 metres: 250°/46 knots

9,000 metres: 250°/53 knots

(ballon sonde radar wind measurement)

Cloud: 7/8 cirrostratus at 7,500 metres

Pressure sea level: 1025.5 mbs

Surface temperature: 13°C

3.6 Contingency military air traffic control system

The contingency system to replace the civil air traffic services units, known as the Clément Marot Plan, set up on 24 February 1973 and brought into operation on 26 February 1973 at 0700 hrs GMT, was in force on the day of the accident and is described in Chapter RAC-7 of the Aeronautical Information Publication. In view of the importance of this chapter it is published in the form of a separate document. This document is supplemented by manuals which are not generally distributed and which contain special rules for the internal organisation of the military control services and the arrangements agreed between those services, arrangements which fix the conditions for the application of the various rules at the level of each sector.

3.6.1.

Regulations

The FOREWORD to RAC-7 states that "in a general way, in the interests of simplicity, effectiveness and safety, the usual air traffic rules and

practices have been retained to the greatest extent possible; in consequence, the following provisions are confined to those which differ from the usual rules and practices or to a recapitulation of particularly important points in the regulations".

The services provided for aircraft are control service, flight information service within certain limits and alerting service.

3.6.1.1.

Control service

"The control service is of the procedural control type, with radar surveillance within the detection limits.

Control with radar separation can be provided temporarily, in accordance with the provisions of RAC-3, chapter 10.

Radar sequencing may be used within controlled air space associated in particular with aerodromes (RAC-7 05)."

RAC-3, chapter 10, para. 3.2 reads: "Radar surveillance consists in using the indications of a radar installation in order to improve the provisions of control service to IFR aircraft maintained in a conventional separation system."

With procedural control the normal separation for converging routes is "10 minutes, in cases where position and speed can be determined frequently by means of navigation installations". (RAC-3, 3.04 - 9.2.1.2.).
This minimum separation may be reduced only in cases where:

(a) "by means of special aids, whether electronic or not, the pilot in command of the aircraft is able to determine the aircraft's position accurately and there are installations and services by means of which this position can be communicated without delay to the appropriate air traffic control unit, or

(b) the air traffic control unit knows the aircraft's position as determined by radar and is able to use swift and reliable communication installations and services". (RAC 3.3.04, para 10.1).

It may also be noted that: "The provision of radar surveillance service or radar control service to an aircraft must be subject to the prior identification of that aircraft.

This identification must be maintained and systematically checked for such time as such services are provided to the aircraft." (RAC 3.10.06, para 4.1.)

3.6.1.2. Flight information service

Under RAC-7, "the provision of flight information service is not guaranteed, as the control units may be cut off from certain sources of information" (RAC-7.05, para 3.2.2.).

3.6.1.3. Alerting service

Under RAC-7, "alerting service is provided in accordance with RAC-2, chapter 5. In the contingency system the control sector plays the part which normally devolves upon the flight information centre". (RAC-7.05, para 3.2.3.)

3.6.2. Organisation

3.6.2.1. Sectors

French airspace as a whole is defined in RAC-7 as a volume of the airspace, bounded horizontally by the national frontiers and at sea by the boundaries of the civil flight information regions. Within this volume of the airspace, there are eight different sectors. Each of these sectors is divided into control units or sub-sectors responsible for one or more routes.

3.6.2.2. Planning

In the case of flights within French airspace, an application must be made to the Planning Division and be received on the day before the date prosposed for the flight.

Every day, at a planning meeting, flight authorisations are issued, each flight being assigned a planning number which is communicated to the users and to each sector concerned.

On receipt of the flight plan information, a pending flight progress strip* is prepared by the control centre. This strip is then handed to the controller concerned who as soon as the first contact is made corrects and supplements the strip and provides control.

3.6.2.3. Use of flight levels

The allocation of flight levels is laid down in RAC-7 and re-formulated in detail in the special sector rules.

1. RAC-7

"Vertical separation between flight levels is 1,000 feet up to flight level 300 inclusive and 2,000 feet above that level."

The flight levels are divided into 4 series: assignment is made on the basis of the route heading.

Series 1: 340, 300, 290, 220, 210, 200, 140, 80

Series 2: 360, 320, 250, 240, 180, 100

Series 3: 380, 160

Series 4: 270, 120

The other flight levels (60, 70, 90, 110 130, 150, 170, 190, 230, 260, 280, 400, 420 and 440) may also be used under special circumstances by the control units.

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*Flight progress strip: strip on which the particular relating to the flight are entered successively.

For the routes concerned:

- route W 187 - Bilbao-Nantes, the following flight levels were assigned from series 1:
  340, 300, 290, 220, 210, and 200;
- route W 132 - Agen-Cognac-Nantes: the whole of series 1;
- route W 187 - Nantes to Dinard: 340, 300 and 290.

2. Special rules

The Commission notes, however, that one of the special directives peculiar to the French Air Force (cf 3.6) prescribed that the control units should operate separation of 2,000 feet from flight level 290 upwards.

3.6.2.4. Use of frequencies

"The guarding of the control frequency is obligatory. Change of frequency on passage over the boudary between two sectors shall be carried out on instructions or clearance from the control." (RAC - 7.9.1.10).

3.6.3. Organisation of the Marina and Menhir sectors

Marina Sector (Mont-de-Marsan)

Boundaries

Marina sector comes under the Mont-de-Marsan Traffic Control and Coordination Centre (CCT). Its horizontal boundaries are those of Bordeaux civil flight information region, except on the east side where the boundary is brought back to 02° 25'E as far as the Spanish frontier, instead of 02° 50'E in the case of the civil FIR.

Routes

This sector contains 11 routes, in particular the following routes which converge on Nantes:

- Bilbao ↔ Nantes (both directions) W 187/W 284
- Montélimar ↔ Limoges ↔ Nantes (both directions) W 362/472
- Reus → Agen → Cognac → Nantes (one way only) W 132.

These routes are controlled by 5 syb-sectors to which separate frequencies are assigned; the sub-sectors are under the authority of an officer in charge of the General Air Traffic Military Coordination Section (SMCCAG).

- Organisation of sub-sectors

Each sub-sector has 3 positions: 1 "procedural" controller's position with flight progress strip board, 1 radar controller's position with a radar scope and 1 assistant's position.

The responsibility of each member of the control team is defined by special rules.

In addition, a special unit is responsible for the management of the flight levels.

- Control of routes W 187 and W 132

The routes concerned at the time of the accident are:

- W 187 in the case of Coronado BX 400, between Bilbao and Nantes
- W 132 in the case of DC 9 IB 504, between the frontier and Nantes.

Control of route W 187 is provided by sub-sector D on frequency 128.75; control of route W 132 is provided by sub-sector E on frequency 135.85.

Sub-sectors D and E are coordinated by an "estimates" controller. The whole system is placed under the authority of an officer in charge of the General Air Traffic Military Coordination Section (SMCCAG).

Navigation facilities

For the two routes concerned, the navigation facilities are as follows:

W 187: - Bilbao VOR (BLV 115.9)

- Nantes VOR (NTS 115.5) with which DME equipment is associated on channel 102. There is also an MF NDB (NTS 277 KHz).

The distance between BLV and NTS is 238 NM.

W 132: - REUS NDB (RES 272 KHz) in Spanish territory

- Agen VOR (AGN 117.5 MHz)

XKHz - Cognac VOR (CGC 116.2) and NDB (267 KHz)

- Nantes VOR, DME and NDB.

The distances between the beacons are:

AGN/CGC: 116 NM

CGC/NTS: 104 NM.

On these routes, position checks can also be made by bearings on adjacent radio navigation aids and in particular by abeam:

- Bordeaux VOR.

- Cognac VOR.

Radar

Monte-de-Marsan CCT uses a radar installation which, according to the aerial polar diagram, provides coverage for 140 NM at flight level 300 on the Bilbao-Nantes route. This is confirmed by the radar flight plan plots on which it can be seen that the trace of Coronado BX 400 is lost at 135 NM by the Mont-de-Marsan radar aerial.

Radar surveillance therefore was effective on only part of route W 187. The north boundary of the sector was outside the detection range of Mont-de-Marsan radar at flight level 290 (see Appendix 2).

Special procedures (Manual CDGS 04.930 Mont-de-Marsan)

a) Route W 187: series 1 flight levels

Coordination: according to the special control position rules for route 187, the controller (Marina D - frequency 128.75) must, "as sooon as the aircraft is taken under control, make contact with the Menhir sector concerned in order to obtain, from the controller to whom the aircraft will be transferred, the required flight level for arrival over Nantes."

Prior notice of transfer to Menhir: abeam Bordeaux

Transfer: at the boundary of the Marina/Menhir sectors (46°30')

Preferential flight levels: 300, 210 and the other flight levels of series 1 in that order.

b) Route W 132: series 1 flight levels (one way only)

Coordination: no special rules

Prior notice of transfer: 5 minutes before flight over CGC (Cognac)

Transfer: boundary of Marina/Menhir sectors (46°30')

Preferential flight levels: 290, 200 and the other flight levels of series 1, in that order

Menhir (Brest) Sector

- Boundaries

Menhir sector comes under the Brest Traffic Control and Coordination Centre (CCT), using the civil installations of the Brittany Radar Centre. Its horizontal boundaries are approximately those of the west sector of the civil North UIR, its eastern boundary running alongside the Nantes-Cherbourg route.

- Routes

A description of the complete organisation of this sector would be irrelevant. Only the detailed distribution of the control workload in respect of the Nantes beacon is relevant.

The routes concerned are as follows:

- Quimper ↔ Nantes ↔ Limoges (both directions) W 472 / W 362
- Nantes - Q1 (an Atlantic route)
- Santiago ↔ Nantes (both directions) W 192/W293
- Nantes → Dinard → Jersey (one way only) W 187
- Cherbourg → Nantes (one way only) W 284
- Bilbao ↔ Nantes (both directions) W 187/W284
- Reus → Agen → Cognac Nantes (one way only) W132

In the case of the last two routes followed by the two aircraft involved in the accident, the distance from the sector boundary to Nantes is only 40 NM.

All these routes converging on Nantes and 10 in number are managed by 4 sub-sectors.

- Organisation of sub-sectors

The organisation is approximately the same as that of Marina.
Control is provided in accordance with the same principles and radar separation has to be applied only if the situation so requires.
The duties of the procedural and radar controllers are the same at Marina and Menhir.

In the case of the 4 sub-sectors, the flight levels are assigned by a single "flight level manager" who receives proposals from 2 "estimates" controllers. Each of these two estimates controllers manages 2 sub-sectors, one controller managing A and C and the other B and D.

- Control of sub-sectors concerned in the accident

The sub-sectors concerned are:

- sub-sector B providing control for routes W 192/W 293 on frequency 133.0

  sub-sector D providing control for routes W 132 and W 187/W 284 on frequency 124.05.

These two sub-sectors are coordinated by the same "estimates" controller who, as stated above, is subordinate to one single "flight level manager controller" who deals with the whole of sub-sectors A, B, C and D in which the routes converging on Nantes are located.

Navigational aids

The installation of particular relevance is Nantes VOR/DME, together with a medium frequency NDB; the characteristics have been given earlier in this Report.

Radar

Brittany Radar Centre provides radar coverage for the Menhir sector. Its detection limit at flight level 300 in the direction of Nantes exceeds 150 NM. This theoretical range is confirmed by the radar film on which the plot of Coronado BX 400 appears 80 NM south-south-west of Nantes, ie 180 NM from the Brest antenna.

It should be noted that the overlap of the radar coverages of Brest and Mont-de-Marsan is not sufficient to provide continuous detection. This is why the radar return of BX 400 disappeared from the Marina scopes from the time of its appearance on those of Menhir.

Special Procedures (Manual CDCS 08/927 - Brest)

These are arrangements agreed between control centres. The rules referred to in connection with the special Marina procedures therefore apply to routes W 187 and W 132, on a basis of correlation.

Annex 13 to the special rules states in addition: "when exceptionally two routes of the same series converge on a point identified by a radio beacon, it is the responsibility of the controller to take this fact into account in providing vertical separation".

"The flight levels for control purposes are to be used on the controller's initiative after coordination with the adjacent control units".

3.7. Operation of ground installations

3.7.1. Aids to air navigation

The navigational aids covering the routes followed by the two Spanish aircraft were principally:

In the case of Coronado BX 400 on route W 187:

- Bilbao VOR (BLV 115.9 MHz)
- Nantes VOR (NTS 115.5 MHz) with which a DME was associated (Channel 102)
- Nantes medium frequency radio beacon (NTS 277 KHs)

In the case of DC 9 IB 504 on route W 132:

- REUS medium frequency radio beacon (RES 272 KHz)
- Agen VOR (AGN 117.5 MHz)
- Cognac VOR (CGC 116.2 MHz)
- Cognac medium frequency radio beacon (267.5 KHz)
- Nantes VOR/DME and NDB.

On the day of the accident, no power failure or operating defect was reported in respect of the installations located in French territory.

No particular comment was made by the users.

To the knowledge of the Commission of Inquiry, the same applied to the aids located in Spanish territory.

Study of the flight paths of the two aircraft and the statement of the Coronado flight crew also show that there was no difficulty in the use of these facilities.

3.7.2. Radars

The flight paths of the two aircraft were observed in French territory by:

- Bordeaux Area Control Centre (ACC) civil radar
- Mont-de-Marsan (Marina sector) military radar
- Tours military radar (Raki)
- Brittany joint military/civil radar (Menhir sector)
- Cognac military radar and Bordeaux joint military/civil radar.

These installations functioned normally within the limits of their particular characteristics and the Commission received all their radar films.

It should be noted that only the radars of Mont-de-Marsan and Brittany could be used by the control sectors concerned, because the Tours radar pictures were not re-transmitted to them.

The radar films show that detection at the time of the accident was normal. It should be noted, however, that the controller responsible for the Coronado in the Menhir sector did not locate the trace of this aircraft for reasons which are not clear and in which the quality of the screen was perhaps a factor.

3.7.3. Air/Ground communications

The air/ground communications were carried out on VHF frequencies.

The transcripts of the communications on frequencies 127.85 MHz (Marina and BX 400), 128.10 MHz (Marina and DC 9) and 124.05 MHz (Menhir and DC 9) show no evidence of any special difficulty. Novertheless, it should be pointed out that the frequency of 128.10 is a secondary frequency used to replace on route W 132 the normal frequency of 135.85 which was out of operation at the time in question. It was the fact that the frequency of 128.10 was not transmitted on the forward Cognac antenna which led the Marina controller to transfer IB 504 to the Menhir sector before the aircraft arrived at Cognac, in order to avoid the risk of loss of radio contact.

On the other hand, the use of the frequency of 128.75 for communication between BX 400 and Marine gave rise to serious difficulties in the north part of the sector.

In this connection it should be recalled firstly that when the aircraft in communication with Marine were flying away from the control centre towards the north, the controller was no longer using the Mont-de-Marsan aerial but a forward aerial located at Cognac. In addition, the communications exchanged by means of this aerial were not recorded.

The Commission arranged for ground and flight inspections to be made of the Mont-de-Marsan and Cognac transmission/ reception installations. The results are as follows -

At the time of the flight inspections, the air/ground communications were generally in accordance with the expected performance: Cognac transmission/ reception ensured the normal relay with aircraft.

Ground reception at Cognac, however, was of unequal quality along the whole of the test route and was disturbed by background noise and interference.

The measurements show considerable attenuation on channel 128.75 of the multi-coupler.

It is not possible to determine when this deterioration in the quality of channel 128.75 in the air/ground direction occurred. In the light of study of the recordings of the communications, although they are incomplete, the Commission inclines to the conclusion that this deterioration affected the air/ground communications at the time of the accident.

3.7.4. Telephone communications

The available recordings have not revealed any special difficulties in the use of the telephone lines, in particular during coordinations and transfers between Marina and Menhir.

3.7.5. Time references

In investigating the operation of the ground services, it was found that the time references of the recordings of the radars, air/ground communications and telephone communications were not in agreement.

At Bordeaux the time signals of the control centre recordings - radar films or air/ground communications - are found to be simultaneous; differences have been found, however, not only between the time bases of Bordeaux, Marina, Menhir and Raki, but also, within these last three centres themselves, differences between the times of the radar recordings and the times of the recordings of the air/ground and telephone communications, even differences from the clock of the control room.

Examination of the recordings also shows that in the case of some of them, the amount of these differences is not constant and can even change in some cases from the standpoint of being earlier or later. The causes of these irregularities are various: slippage of the mechanical time distribution system at Marina, addition of pulses distrubuted at Menhir as a result of mains interference; slightly different original settings.

3.8 Reconstruction of the flights up to the collision

3.8.1. Evidence used by the Commission

a) The recordings

The reconstructions made in this paragraph are derived from analysis of all the recordings available which comprise:

- The transcripts of the recordings of the radiotelephony and telephone communications. In certain cases these transcripts have given rise to veritable reconstructions on the basis of several simultaneous recordings (eg: frequency of 128.75: Mont-de-Marsan and Bordeaux recordings).
- On the other hand, the transmission of Marina D on 128.75 by the forward Cognac antenna was not recorded and could not be picked up by Bordeaux because of the distance of the transmitting and receiving aerials. The last orders of Marina D to BX 400 can therefore only be surmised from the messages in reply by BX 400 to Marina and it is

difficult to confirm these orders from the evidence of witnesses, evidence which is sometimes imprecise or conflicting.

- The radar film recordings of Brest, Mont-de-Marsan and Bordeaux.
- The tape of the flight recorder of BX 400.

b) The time references (of 3.7.5.)

The cross-check of the various recordings raised a difficult problem in re-establishing the time, a problem which can be summarised as follows:

- Only the recordings of the Bordeaux civil centre with automatic functioning (radio communications and radar film) are continuous.
- None of the other recordings of communications is continuous.
- The recordings for which there is a cross-check by means of the times of several sectors show discrepancies among themselves, sometimes of as much as 5 minutes, discrepancies which can be evaluated only to within several tens of seconds.
- There can be no certainty about the time references used on board the aircraft and in the Marina and Menhir control rooms. But the choice of Bordeaux time as a base does not lead to any incompatibility in the reconstructions.

In these circumstances:

- Bordeaux has therefore been taken as the only time and is alone used in all the reconstructions of this paragraph.
- The time base of the flight recorder has been determined on the basis of the collision and has an uncertainty of the order of 1 minute.
- In view of the uncertainties described above, the times indicated in this Report are given in hours and minutes only, without any fractions of a minute.

c) The evidence of witnesses

The evidence of the control services and of the flight crew of BX 400 is to be accepted with greater caution and it is practically impossible to set it against the reconstructions from recordings. The evidence is recapitulated and the discrepancies in relation to the reconstructions analysed in each case.

d) Flights studied

The two flights IB 504 (DC 9 EC-BII) and BX 400 (Coronado EC-BJC) directly involved in the collision have been completely reconstructed for the whole of the part carried out under French control. A diagram attached at Appendix 2 indicates the times and the flight paths of these flights, the sub-sectors responsible for their control, the radio frequencies used for communicating with the crews and the principal events relating to the flights, with reference numbers in chronological order.

Partial reconstructions of flight IB 826, IB 912 and BE 212A are also described in so far as the Commission considered that the history of the control of these flights would clarify certain sequences of events in the control of flights IB 504 and BX 400.

3.8.2. IB 504

(a) Reconstruction

DC 9 EC-BII had been assigned planning number CM 7182-11. The aircraft had taken off at 1124 hrs from Palma for London and was to follow route W 132 (Reus-Agen-Cognac-Nantes) and then route W 187 (Nantes-Dinard-Jersey-Alderney-Ortac).

The reconstruction of the part of flight IB 504 under French control is as follows.

The number in the first column refers to the number on the appended diagram.

No.on diagram	Bordeaux Time	Source of the Reconstruction	Nature of the occurrence
	1152	Telephone	Prior notice of transfer from Barcelona to Marina: Flight IB 504 is accepted at 1209 at the frontier at flight level 310 on frequency 128.1
	1216	Bordeaux radar	Actual crossing of frontier

No. on diagram	Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
I	1219	Radio 128.1	First contact between IB 504 and Marina sub-sector E (MAR-E). IB 504 gives its flight particulars: frontier at 1216, FL 310, Agen estimated at 24'. MAR-E asks IB 504 to put its radar transponder on position A02. IB 504 acknowledges receipt.
	1225	Radio 128.1	IB 504 reports over Agen, indicates that it estimates Cognac at 39' and at the request of MAR-E states that it estimates Nantes at 52'.
2	1227 to 1228	Telephone	Prior notice of transfer from Marina to Menhir: flight IB 504 is accepted on frequency 124.05 at 1252 at Nantes but at FL 290.
4	1232 to 1234	Radio 128.1	MAR-E asks IB 504 to descend to FL 290 and to call back again "stabilised at that flight level". IB 504 acknowledges receipt.
5	1236	Radio 128,1	IB 504 reports stabilised at 290; MAR-E asks it to call Manhir on frequency 124.05 (Menhir sub-sector D: MEN-D)
	1237 to 1240	Radio 124.65	IB 504 tries four times to contact MEN-D without success.
8	1241	Radio 124.05	First contact between IB 504 and MEN-D. IB 504 gives its flight particulars: over Cognac; FL 290; Nantes estimated at 54'; MEN-D asks IB 504 to put its transponder on "standby" IB 504 acknowledges receipt.
9		Bordeaux Radar	Disappearance of the secondary radar trace of IB 504 (result of the stand by*)
	1243	Radio 124.05	MEN-D confirms to IB 504 that it should keep its transponder on "stand by"
	1246	Radio 124.05	MEN-D asks IB 504 to maintain FL 290 and to put its transponder on the A02 position; IB 504 acknowledges receipt of the two orders.
		Bordeaux Radar	Reapperance of the secondary radar trace of IB 504
12		Menhir Radar	Appearance and identification by MEN-D of the trace of IB 504 at the range limit

* Waiting position: transmission suspended.

No.on diagram	Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
13	1247	Bordeaux Radar	Crossing of boundary between Marina and Menhir sectors
	1247 to 1248	Radio 124.05	Misunderstanding rapidly corrected between MEN-D and IB 504 regarding the flight level (290) and the radio frequency, IB 504 thinking that MEN-D is asking it to change over at once to frequency 129.0 of MEN-C (sub-sector responsible for route W 187 after Nantes)
16	1252	Bordeaux Radar	Crossing of radar traces of IB 504 and BX 400. A stationary echo remains for a few minutes at the point of interception (an echo doubtless attributable to air mass ionization generated by the collision).

(b) Evidence of witnesses

Two points should be noted:

- The Marina sub-sector E controller explains the early transfer of IB 504 to Menhir (more than 10 minutes before crossing the boundary between the two sectors) as being due to fear of losing radio contact with IB 504 on frequency 128.1, a secondary frequency not transmitted on the forward Cognac antenna.
- The Menhir sub-sector D controller explains that he asked IB 504 to keep the transponder on "standby" throughout the time when he estimated that IB 504 would be out of the radar range and outside his control sector.

3.8.3. BX 400

(a) Reconstruction

Coronado EC-BJC had been assigned planning number CM 7382.3. The aircraft had taken off at 1201 hrs from Madrid for London and was to follow route W 187 (Bilbao-Nantes-Dinard-Jersey-Alderney-Ortac). The flight plan had not been received at the sector concerned.

The reconstruction of the part of flight BX 400 under French control may be summarised as follows:

No. on diagram	Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
	1207 to 1210	Telephone	Prior notice of transfer from Madrid to Marina: flight BX 400 (1) is accepted at 1226 at Bilbao at FL 260 instead of 310 as proposed, without indication of frequency.
	1224 to 1228	Radio 127.85 (2)	Spantax 400 (1) reports its flight particulars to Marina: over Bilbao, frontier estimated at 29', FL 260. Marina obtains details from the aircraft that flight is flight 7382 Madrid-London and orders 6400 (1) to go over to 128.75.
3	1228 to 1229	Radio 128.75	First contact between BX 400 and Marina sub-sector D (MAR-D): Spantax 400 reports that it is approaching the frontier at FL 260 and estimates Nantes at 52'; MAR-D asks 6400 to put its transponder on position A02; Spantax 400 acknowledges receipt.
	1229	Bordeaux Radar	The secondary radar trace of BX 400 crosses the frontier.
4	1230	Radio 128.75	MAR-D asks 6400 to climb to FL 290; Spantax 400 acknowledges receipt.
5	1232	Radio 128.75	Spantax 400 reports that it is stabilised at FL 290; MAR-D acknowledges receipt.
6	1237 to 1239	Telephone (Line 1) (3)	Prior notice of transfer of BX 400 from Marina to Menhir; Menhir says it does not have flight levels available at 1252 at Nantes and it accepts this flight only for 1300 at Nantes at FL 290; Marina acknowledges receipt after discussion.
	1239 to 1240	Telephone (Line 2) (3)	The Menhir head of watch complains to the Marina head of watch about the transfer of an aircraft which is climbing (4), reminds him that Menhir cannot accept BX 400 (or 1400) except at FL 290 and only at 1300 at Nantes. He explains to him that BX 400 under these conditions must fly a race track pattern or reduce speed.

See numbered notes at end of table.

No. on Diagram	Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
7	1240	Radio 128.75	MAR-D asks BX 400 to pass over Nantes at 1300; in answer to the acknowledgement by Spantex 400 which appears to ask for confirmation that it is not to arrive at Nantes before 1300, MAR-D merely replies "Stand by" (5).
	1241	Menhir Radar	Appearance of the secondary echo of BX 400 on the Menhir radar recording.
	1242	Telephone (line 2) (3)	Menhir asks Marina about the situation of BX 400, without obtaining any reply; the speaker does not seem to be concerned.
10	1242 to 1243	Marina Radar	Loss of secondary radar trace of BX 400 at the range limit
		Radio 128.75 (Cognac Antenna) (6)	Spantax 400 reports to MAR-D that it is ready to receive its instructions but that it is reading MAR-D very faintly; then it acknowledges receipt of the instruction to arrive at Nantes at 1300.
	1243	Radio 128.75 (Cognac)	Message probably from Spantax 400 (similar voice, judged to be incomprehensible by some experts, interpreted by others as the report of a speed reduction).
11	1244 to 1247	BX 400 Flight Recorder	Speed reduction from 500 kts to 400 kts in about 3 minutes -
13	1247	Bordeaux Radar	Crossing of boundary between the Marina and Menhir sectors.
14	1247 to 1248	Telephone (Line 1)	At Menhir's request Marina informs Menhir that BX 6400 will arrive at Nantes at 1300 at FL 290, then after a discussion about the flight identification (6400 or 400) obtains confirmation of the frequency 124.05 from Menhir.

See numbered notes at end of table

No. on diagram	Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
15	1249	Radio	Spantax 400 reports to MAR-D that it is ready to receive instructions then acknowledges receipt of authorization for frequency 124.05 and states that it thinks it will have to do a 3600 (complete turn).
	1250		Spantax 400 asks MAR-D if it can make a right-hand 360° in order to pass Nantes at 1300 and twice repeats a call to MAR-D.
	1251		Spantax 400 reports to MAR-D "for information" that it is turning to the right for a 360° at FL 290.
		Radio 128.75	BX 400 asks MAR-D to continue its transmissions: "Go ahead".
16	1252	Flight Recorder	At the time of the collision BX 400 has turned through about 100° in 1½ minutes.
	1256	Radio 128.75	First distress call of Spantax 400

Notes to the Table

1) The flight identification is BX 400; the flight crew always call themselves "Spantax 400"; the other speakers make numerous indentification mistakes, reproduced in the reconstruction (BX 1400, 6400, etc).

2) The reconstruction of flight IB 826 and IB 912 (cf. 3.8.4.) shows that this mistake about the frequency on which to call MAR-D was a current mistake on route W 187.

3) The telephone communications between Marina and Menhir were made on two separate lines (see paragraph 3.8.3. (Evidence of Witnesses)).

4) The aircraft to which the Menhir head of watch is referring is flight IB 826 (paragraph 3.8.4. (Reconstruction of flight IB 826))

5) According to international usage this answer implies that the last instruction is still to be confirmed.

6) The reference "Cognac antenna" or "Cognac" recalls that MAR-D is then transmitting on the forward Cognac antenna and that its transmissions are no longer recorded (paragraph 3.8.1. "The Recordings"). The messages of MAR-D can then only be traced from the evidence of witnesses and do not appear in this reconstruction.

b) Evidence of Witnesses

The Commission has considered the following factors which arise from the statements obtained, statements which contain discrepancies one from the other or even from the facts established by the foregoing reconstruction.

1) No explanation could be found as to why the Spanish crews entering France via Bilbao (IB 826, IB 912, BX 400) regularly confused the frequency of 128.75 (Marina - route W 187) with that of 127.85 (Marina - route W 252).

2) As regards the air traffic control team (procedural controller, radar controller, assistant controller) of Marina sub-sector D:

a) The procedural controller gave as a personal interpretation of his answer "stand by" the explanation that it confirmed the instruction which he had just given, ie Nantes at 1300 hrs (reconstruction 1240 hrs).

b) Confirmation of the latter instruction was given only on the intervention of the assistant to the head of watch after the assistant had himself been alerted by Menhir, which seems to correspond to the reconstruction (1241 hrs to 1243 hrs).

c) This confirmation was given on the forward Cognac antenna by the radar controller.

d) The authorisation to contact Menhir on 124.05 was given later by the radar controller on the intervention of the assistant to the head of watch, still using the forward Cognac antenna.

It was not recorded, but on the basis of the pilot's acknowledgement of receipt, it can be placed at about 1249 hrs.

e) As the answers of BX 400 were unintelligible to the radar controller the latter then passed the transmission controls for the forward Cognac antenna to the procedural controller. This controller stated that he did not understand what the BX 400 messages meant and he merely gave it confirmation of its flight particulars by way of reply: flight level 290, frequency 124.05, Nantes at 1300 hrs., in an order and phraseology which he cannot state exactly.

f) The times stated by the witnesses are incompatible with those of the reconstruction.

3) As regards the assistant to the Marina head of watch:

a) On a call from Menhir he intervened to ensure that confirmation was communicated to BX 400 of the instruction to pass Nantes at 1300 hrs; he puts this intervention at about 1238 hrs which does not appear compatible with the reconstruction (call from Menhir at 1241 hrs).

b) He then describes, as happening at about 1244 hrs, a conversation with Menhir about IB 504 and BX 400, of which no trace in the transcripts of the telephone communications can be found before 1301 hrs, ie 9 minutes after the collision.

4) As regards the crew of BX 400, the main factors emerging from the statement made by the aircraft commander no later than 6 March 1973 are as follows:

a) The statement is in accordance with the reconstruction until about 1240 hrs: use of frequency 127.85, instead of 128.75, for the first call, Nantes estimated at 1252 hrs, flight level 260 and then very shortly 290; but it puts the instruction relating to

the transponder later than in actual fact (1229 hrs), half way between the southern boundary of the sector and Nantes, ie at about 1240 hrs.

b) The statement confirms a request from Marina regarding the delaying procedure by BX 400 and the message of 1243 hrs interpreted by some experts as reporting a reduction in the aircraft's speed.

c) From 1240 hrs onwards, on the other hand, the statement shows significant divergences from what happened in reality:

- No mention is made of any lapse of time between the instruction to pass Nantes at 1300 hrs and its confirmation. According to the pilot, this instruction was received 100 NM away from Nantes and followed by an immediate speed reduction. In point of fact this reduction, according to the flight recording, began only 60 NM away from Nantes (1244 hrs) and was not completed until less than 40 NM from Nantes (1247 hrs).
- The pilot also refers to several requests for clearance to make a 360° turn, requests made before the instruction to go over to the frequency of 124.05, whereas according to the recording it was the instruction which was given first.
- The 360° turn is indicated as beginning at about 30 to 40 nautical miles from Nantes which would put the beginning of the turn at about 1248 hrs, ie nearly 3 minutes or about 25 nautical miles before what happened in reality.
- On the other hand the statement gives good confirmation of the fact that the turn was begun without clearance from Marina.
- When he was interviewed by the Commission on 11 July, the aircraft commander was far less positive and the discrepancies referred to above were not so sharply defined, in particular as regard the time of the first requests for a turn. The aircraft

commander remembered that the frequency was occupied for the purpose of resolving a flight level problem between Marina and another aircraft. On the other hand he confirmed that he had always had the feeling of being in contact with Marina, although he was aware that his messages were not properly understood.

d) As regards the order to change over to frequency 124.05, the statement of 6 March, according to which this change of frequency was not to be made until the aircraft was over Nantes, is confirmed by the answers given by the crew to the Commission's questions during the meeting of 11 July; on that day the co-pilot, who had been responsible for the radio communications, stated that the words used by Marina had been: "over November Tango (NTS is the identification of Nantes beacon) at thirteen zero zero then one two four decimal zero five".

The pilot said that he understood he was to change frequency at Nantes. This statement cannot be verified from any recording. The interpretation was contrary to the instructions of RAC-7 (9.1.10)

e) As regards the execution of the turn itself, it was explained at the meeting of 11 July that it had been made in zero visibility on the automatic pilot with an angle of bank "calculated as 20° to 23° on the automatic pilot", without vertification by the crew of their exact position.

3.8.4. Other flights

Reconstruction of flight IB 826

Flight IB 826 followed the route W 187 (Bilbao-Nantes-Dinard)

Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
1221	Radio 127.85	Call from IB 826 to Marina which asks it to go over to 128.75.
1222	Radio 128.75	IB 826 gives particulars of its flight to MAR-D: FL 310, Nantes estimated at 43', Dinard next, and carries out instruction to put its transponder on "standby".
1227 to 1230	Telephone (Line 1)	Prior notice of transfer from Marina to Menhir (jointly with IB 912). Passed for FL 340, flight IB 826 is accepted at that flight level and at 1243 hrs at Nantes on frequency 124.05.
1233	Radio 128.75	MAR-D asks IB 826 to climb to FL 340 and contact Menhir on 124.05.
1234 to 1236	Radio 124.05	IB 826 gives particulars of its flight to MEN-D: FL 325 climbing to 340. Nantes at 43', Dinard next; it receives the order to put its transponder on "standby". (30") then on A02 and carries out the order.
1235 to 1236	Telephone (Line 1) and Radio 128.75	Marina informs Menhir that at the time of the transfer IB 826 was climbing to flight level 340. Menhir asks for a stabilised flight level for this transfer but receives the reply that Marina is no longer in contact with IB 826 and Menhir protests at these transfer conditions.
1237	Radio 124.05	IB 826 reports that it is stabilised at FL 340.
	Bordeaux Radar	Crossing of boundary between Marina and Menhir sectors.
1242	Radio 124.05	IB 826 reports over Nantes at FL 340. Dinard estimated at 54'. Alderney next; it receives the instruction to go over to the frequency of 129.0 (Menhir sub-sector B) and acknowledges receipt.

Reconstruction of flight IB 912

Flight IB 912 followed route W 187 (Bilbao-Nantes) then W 192 Nantes- Chartres).

Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
1219 to 1221	Radio 127.85	IB 912 reports its flight particulars: Bilbao at 19', FL 280, frontier estimated at 24', Nantes next and after repetition of its particulars receives the instruction to go over to 128.75.
1221	Radio 128.75	IB 912 repeats its particulars then, at the request of MAR-D, states that it estimates Nantes at 49' and carries out the instruction to put its transponder on A02.
1224	Radio 128.75	MAR-D asks IB 912 to climb to FL 290. IB 912 acknowledges receipt.
1226	Radio 128.75	IB 912 reports that it is stabilised at FL 290.
1227 to 1230	Telephone (Line 1)	Prior notice of transfer from Marina to Menhir (jointly with IB 826): flight IB 912 is accepted at 1249 at Nantes, but at FL 280 on frequency 124.05.
1237	Radio 128.75	MAR-D asks IB 912 to descend to FL 280; IB 912 acknowledges receipt.
1238	Radio 128.75	IB 912 reports that it is stabilised at FL 280 and receives the instruction to go over to 124.05.
1239 to 1240	Radio 124.05	IB 912 reports its flight particulars: FL 280, Nantes estimated at 49', Chartres next; it receives the instruction to put its transponder on "standby" (45") then on A02.
1242	Bondeaux Radar	Crossing of the boundary between the Marina and Menhir sectors.
1246	Bordeaux Radar	Flight IB 912 arrives over Nantes
1247	Radio 124.05	IB 912 reports over Nantes at FL 280, Chartres estimated at 1304.
1249 to 1251	Telephone	Prior notice of transfer from Menhir to Raki: flight IB 912 is accepted at FL 280, Chartres at 1304 and on frequency 129.5.
1252	Radio 124.05	MEN-D gives the instruction to IB 912 to contact Raki on 129.5, IB 912 acknowledges receipt.

Reconstruction of flight BE 212 A

Flight BE 212 A was following route W 284 (Nantes-Bilbao)

Bordeaux Time	Source of the Reconstruction	Nature of the Occurrence
1239	Radio 124.05	BE 212 A reports its flight particulars: Nantes at 38', FL 200 and frontier (France/Spain) at 17'.
1243	Radio 124.05	MEN-D asks BE 212 A, which acknowledges receipt, to go over to 128.75.
1244	Radio 128.75 (Cognac)	BE 212 A contacts MAR-D whose transmissions are not recorded. It repeats exactly the same flight particulars as it gave at 1239, confirms its FL 200 and then gives 24" at Bilbao.
1245 to 1249	Radio 128,75 (Cognac)	BE 212 A says that it is ready to receive instructions which are still not recorded, states that it is very happy at FL 200, asks for the reasons for the change of altitude, states that it is a Vanguard and that FL 240 would slow it up very much, while agreeing to climb to FL 240 if necessary, acknowledges receipt of an instruction "A03" (probably transponder position) asks Marina if it can hear it, then agrees to descend to FL 180.
1255	Radio 128.75	BE 212 A reports to MAR-D that it is stabilised at FL 180. This message is followed by a call, with nothing further, from MAR-D to BE 212 A.
1256 to 1308	Radio 128.75	The distress traffic of BX 400 interrupts any other conversations.

3.8.5. Management by Menhir of the northbound routes to Nantes

Management of Flight Levels

One of Menhir's tasks was to provide longitudinal and vertical separation of aircraft converging on Nantes on the routes W 132 (Cognac-Nantes), W 187 (Bilbao-Nantes) and W 192 (Santiago-Nantes).

The situation as regards the upper flight levels assigned to these routes (cf. para 3.6.) was as follows, as regards the times of passage over Nantes:

- FL 340: occupied by flight IB 826 estimating Nantes at 1243 hrs; the flight level was therefore free from 1253 hrs (minimum separation of 10 minutes, cf, paragraph 3.6.).
- FL 300: free. Flight level 300 was assigned only at 1253 hrs to an aircraft coming from the oceanic sector; this aircraft was to fly over Alderney at 1303 hrs.

  Whatever the reason, the Menhir controller, contrary to the general RAC instructions, but in accordance with the special rules already referred to, did not think he should use this flight level.
- FL 290: occupied by flight IB 504 estimating Nantes at 1252 hrs and then 1254 hrs. This flight level would therefore have been free for flight BX 400 at 1300 hrs only in so far as the control had known the precise position of the aircraft (cf. 3.6.1.1.).
- FL 280, not assigned to any particular routes, had been used, in accordance with the general rules of the Clément Marot plan (cf. paragraph 3.6) for flight IB 912 which estimated Nantes at 1249 hrs.

No explanation has been given by the control to justify its choice of delaying the aircraft rather than assigning another flight level to it as provided for under the general rules.

Radar surveillance

On the photographic recordings of the Menhir radar film the secondary radar traces of the aircraft can be seen from 1241 hrs in the case of BX 400 and from 1246 hrs. in the case of IB 504.

According to the statements, the controller of Menhir sub-sector B saw the trace of BX 400 on his scope and told his head of watch at about 1246 hrs that he was concerned about it.

He thought it was the trace of an unidentified aircraft creating a possible conflict with flight RG 820. The controller of sub-sector D did not see the trace of BX 400 on his scope.

Alerted by the controller of sub-sector B, the head of watch ordered a change of heading for flight RG 820, but did not detect any conflict in sub-sector D.

4. ANALYSIS

4.1. General

Because of the particular circumstances of this accident, this chapter has been divided into two parts.

- The first part consists of an analysis of the facts in chronological order, which directly contributed to the collision. The recapitulatory table is given below. A plan of the flight paths with time references is appended to this Report.
- The second part consists of an analysis of the actions by the various parties involved, together with relevant comments.

4.2. Analysis of the facts in chronological order up to the collision

No. on Diagram	Bordeaux Time	Nature of the Occurrence
1	1219	IB 504 which is following route W 132 (Marina E: secondary frequency 128.1) gives its flight particulars: (FL 310); Agen estimated at 24'; Nantes 52').
2	1227	Menhir accepts flight IB 504 from Marina: Nantes at 52' but FL 290.
3	1228	BX 400 which is following route W 187 (Marina D; frequency 128.75) gives its flight particulars (FL 260; near frontier: Nantes estimated at 52').
4	1230 1232	Marina D asks BX 400 to climb to FL 290 Marina E asks IB 504 to descend to FL 290.

No. on diagram	Bordeaux Time	Nature of the Occurrence
5	1232 1236	BX 400 reports that it is stabilised at FL 290. IB 504 reports that it is stabilised at FL 290 and receives the instruction to go over to 124.05 (Menhir D).
6	1237	After discussion Menhir imposes on Marina for BX 400: Nantes at 1300; FL 290.
7	1240	Marina D transmits the instructions to BX 400 and to a request for confirmation answers "stand by". The instructions therefore remain to be confirmed.
8 9	1241	IB 504 gives Menhir D (124.05) its flight particulars (FL 290; Nantes at 54') and on instruction switches off its transponder thereby causing the disappearance of its secondary radar trace. Appearance of the trace of BX 400 on the Menhir radar.
10	1242	The radar trace of BX 400 disappears from the Marina screens at the range limit.
	1243	BX 400 acknowledges receipt of the confirmation of clearance to pass Nantes at 13.00. The transmissions of Marina D (forward Cognac aerial) cease to be recorded.
11	1244	BX 400 begins to reduce speed.
12	1246	Menhir D asks IB 504 to switch on its transponder again. The secondary radar trace of IB 504 then appears on the Menhir screens.
13 11 14	1247	- IB 504 and BX 400 enter Menhir sub-sector D. - End of slowing-up of BX 400. - Transfer frequency of BX 400 established precisely between Marina and Menhir: 124.05.
15	1249 1250	BX 400 acknowledges receipt of a message "OK 124.05" and says that it thinks it needs to make a 360° turn. BX 400 asks to make a right-hand 360° turn in order to pass Nantes at 1300; it calls Marina again twice before reporting that it is making the turn.
16	1252	Collision between BX 400 and IB 504 after a turn through about 100° by BX 400.

4.3 Comments

4.3.1.

The flight plan message was despatched from Madrid-Barajas areodrome at 1255 hrs GMT, ie 54 minutes after take-off of the aircraft, although the latter had already crossed the whole sector. The message was not addressed to all the addressees prescribed by RAC-7, in particular it was not addressed either to Marina or to Menhir. This message showed the identification BX 1400, whereas the flight application for planning purposes and the real flight had the identification of BX 400.

4.3.2.

The Commission noted that Marina control assigned to aircraft BX 400, as soon as it made contact with the aircraft, a flight level which had not been chosen in coordination with Menhir control, contrary to the directives in force (cf.3.6.3). The Commission also found that at about 1230 hrs the two sub-sectors, Marina D and Marina E, assigned the same flight level to the two aircraft BX 400 and IB 504, although the two aircraft had given the same estimated time at Nantes. There was therefore a potential conflict.
At the time of the prior notice of transfer, in view of Menhir's request to delay the aircraft, Marina asked Menhir for a change of flight level. Menhir considered that this was impossible (cf.3.8.5.).
At the end of the discussion, Menhir confirmed that BX 400 was to delay its flight in order to arrive at Nantes at 1300 hrs. The regulation separation of 10 minutes was reduced to 8 minutes, which entailed precise knowledge of the aircraft's position.

4.3.3.

At 1240 hrs, the Marina D controller answered "stand by" to a request for confirmation from the pilot of BX 400. This confirmation was given 2 minutes later on Menhir's intervention.

According to his evidence, the controller, by using the expression "stand by", intended to tell the pilot to carry out his instructions. But, in international phraseology, the expression meant: remain listening pending further instructions.

4.3.4.

At 1241 hrs, IB 504 gave Menhir a corrected time of 1254 hrs for its arrival at Nantes, which reduced to 6 minutes its separation from BX 400.

4.3.5.

At 1244 hrs, BX 400 began to reduce speed, which is apparent on the flight recorder.

A simple calculation should have rapidly shown the crew that the maximum speed reduction possible for the Coronado at FL 290, if begun less than 10 minutes away from Nantes, would produce a difference of only about 1 minute in the time at which it would pass Nantes.

It was only at 1249 hrs that it informed the control, on a call from the latter, that this measure was inadequate if it was to arrive at Nantes at 1300 hrs and that it would have to carry out a 360° turn in order to comply with this timing.

4.3.6.

It was only at 1249 hrs that the Marina control indicated the frequency for transfer to the pilot. At that moment, the aircraft BX 400 was 25 nautical miles from Nantes and beyond the boundary of the sectors, and the air-ground communications were practically unintelligible to both parties to the conversations. It should be recalled that according to RAC-7 (9.1.10), the changes of frequency must be made on passage over the boundary between the two sectors. It should also be noted that Marina control had by then lost the radar trace of BX 400 for 7 minutes.

The control's action was therefore not in accordance with the regulations.

4.3.7.

The pilot of BX 400 acknowledged receipt of the message giving him the transfer frequency. In his evidence, he states that he understood that the change of frequency was to be made only over the Nantes beacon. This interpretation was not in accordance with the regulations.

4.3.8.

At about 1250 hrs, the pilot of BX 400, after two calls addressed to Marina - but to which he received no reply - in order to obtain clearance for a 360° turn (cf.4.3.5), took the decision to carry out the turn, reporting it on the Marina frequency, but without having tried to contact the responsible sector, Menhir, on the frequency of 124.05 which had been passed to him.

This turn, undertaken on the automatic pilot, in zero visibility, at a short distance from Nantes (about 15 nautical miles), led BX 400 to intersect the converging route (W 132) against the traffic flow.

The pilot stated that he had not established his exact position. The delay in informing the control of the manoeuvre required in order to comply with the instruction received and the fact that there was no evaluation of the intersection risk are all the more inexplicable in that BX 400 carried a DME equipment.

4.3.9.

The appearance of the radar trace of BX 400 on the Menhir radar was recorded at 1241 hrs. It was considered by the control of sub-sector B to be that of an unidentified aircraft, at an unknown flight level, which could entail a risk of a collision with an aircraft on the route and under control by sub-Sector B.

On the other hand, neither the control team of sub-sector D nor the head of watch detected the trace of this unidentified aircraft on the scope of sub-sector D or realised the collision risk which threatened IB 504 whose secondary echo they had been receiving since 1246 hrs.

It should be noted that the height-finding radar did not have sufficient range to determine the flight level of the unidentified aircraft, and also that in the absence of radio contact the strip of BX 400 had not been activated and taken into account by the controller.

5. SUMMARY

1. During the study, it became apparent that the complexity of the control organisation, a certain degree of conflict between the directives in force within the control and finally the inadequacy of the facilities available (radio, radar) constituted a source of difficulty in the satisfactory management of the north-bound routes approaching Nantes.

2. The sequence of events which led to the collision is as follows:

H - 22' — Assignment of flight level 290 by Marina to BX 400; this flight level had already been assigned by Menhir to IB 504 estimating Nantes at the same time as BX 400.

H - 15' to H - 13' — Decision by Menhir to maintain BX 400 at flight level 290, delaying its passage at Nantes by 8 minutes, although a simple change in flight level without any change in timing would have been possible.

H - 13' to H - 9' — Lateness of Marina in confirming to BX 400 the instruction to lose time, lateness which increased the urgent, compelling and exceptional nature of this instruction (8 minutes to be lost over a normal flight of 9 minutes).

H - 9' to H - 3' — Delays by :

(a) BX 400, in making known the manoeuvre by means of which it could comply with the accepted instruction (360° turn in about 8 minutes);

(b) Marina, in giving BX 400 the transfer instruction (change to the Menhir frequency, ie 124.05), this instruction being transmitted only 2 minutes after BX 400 had passed the boundary between the two sectors.

H - 3' to H - 1' Failure of Marina and BX 400 to understand one another, leading BX 400 to remain on the Marina frequency and to start the delaying turn too late and without clearance.

3. Analysis of the flight of BX 400 reveals insufficiently strict application of the regulations and also of the special rules peculiar to the control:

- Marina did not carry out the prescribed coordination, before assigning flight level 290 to BX 400.
- Menhir imposed a change of timing on BX 400, whereas priority should have been given to a change of flight level.
- The Marina controller used a term of international phraseology wrongly and left BX 400 for nearly 2 minutes in uncertainty about the final instruction.

As a result of these facts, an exceptional situation arose, necessitating sustained concentration on the part of the pilot and the control, if an instruction of compelling urgency was to be carried out satisfactorily.

- BX 400 did not assess its situation correctly, on confirmation of the delaying instruction.
- Marina authorised the radio transfer when the aircraft was already in the Menhir sector and without knowing the exact position of the aircraft.

This may in part explain the difficulties of radio communication which led to the total failure of the control and BX 400 to understand their communications one with the other.

- BX 400 made no attempt to establish contact with the control of the sector flown over (Menhir).
- BX 400 took the initiative in undertaking a manoeuvre which caused it to leave its route without having been able to obtain the agreement of the control, a manoeuvre which, carried out near Nantes VOR, led it to intercept an adjacent route.

6. CONCLUSIONS

The Clément Marot Plan, the military contingency system to replace the civil air traffic services units in the event of a strike, by the very reason of its exceptional nature implied the use of rigorous planning traffic limitation per sector on the basis of control capacity and particularly strict compliance with the special regulations of the RAC-7 plan.

The assignment of the same flight level by the control to the two aircraft IB 504 and BX 400, due to arrive at Nantes at the same time, created a source of conflict.

The solution chosen by Menhir to resolve the conflict was based on separation in time.

This solution, because of the reduction in normal separation, necessitated either particularly precise navigation by the crew of BX 400 or complete radar coverage and, in both cases, trouble-free communication facilities, conditions which were not realised.

The continuing progress of the flight was affected by delays attributable in part to the control, in part to the crew and also to difficulty in air/ground radio communications resulting in complete failure of the crew and the control to understand one another.

At the critical juncture, the crew, unmindful of their exact position, commenced a turn in order to lose time, without having been able to obtain the agreement of the control, as a result of which the aircraft interesected the adjacent route.

The unidentified aircraft whose return appeared on the radar scope of one of the Menhir sub-sectors was not identified by Menhir control as BX 400.

In this ultimate phase of the flight, the failing radio contact between BX 400 and the control prevented avoidance of the collision.

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