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Report IN-038/2013

Incident involving a Bombardier CRJ900 (CL-600-2D24) aircraft, registration EC-JYA, operated by Air Nostrum, at the San Sebastian airport (LESO, Spain) on 25 October 2013

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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SUBSECRETARÍA
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Tel.: +34 91 597 89 63
Fax: +34 91 463 55 35

E-mail: ciaiac@fomento.es
http://www.ciaiac.es

C/ Fruela, 6
28011 Madrid (España)

Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

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Abbreviations

AAL	Above Aerodrome Level
AEMET	Spanish National Weather Agency
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMC	Acceptable Means of Compliance
AMM	Aircraft Maintenance Manual
AOG	Aircraft on Ground
APP	Approach
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATPL (A)	Airline Transport Pilot Licence
CAS	Computed Airspeed
CAVOK	Ceiling and Visibility OK
CPL(A)	Comercial Pilot Licence
CVR	Cabin Voice Recorder
DFDR	Digital Flight Data Recorder
DGAC	Dirección General de Avión Civil
DOW	Dry Operating Weight
EAS	San Sebastián airport (IATA code)
EASA	European Aviation Safety Agency
EICAS	Engine Indication and Crew Alerting System
EGPWS	Enhanced Ground Proximity Warning System
FA	Flight Attendant
FADEC	Full Authority Digital Engine Controls
FCOM	Flight Crew Operations Manual
Ft	Feet (s)
ft/min	Feet per minute
ft/s	Feet per second
FMS	Flight Management System
FSTD	Flight Simulation Training Device
g	Gravity
GLD	Ground Lift Dumping
GS	Glide Slope
IAS	Indicated Airspeed
ILS	Instrumental Landing System
IMC	Instrumental Meteorological Conditions
IR	Instrumental Rating
JAR-FCL	Joint Aviation Regulations – Flight Crew Licenses
Kg	Kilograms
KIAS	Calibrated Airspeed
Km	Kilómeters
Kt	Kt(s)
LEMD	Madrid airport (ICAO code)
LESO	San Sebastián airport (ICAO code)
LEVC	Valencia airport (ICAO code)
LOC	Localizer
m	Meters
METAR	Meteorological Terminal Air Report
MLW	Maximum Landing Weight
MTOW	Maximum Take Off Weight
MSA	Minimum Safety Altitude
N2	Vertical load factor
N/A	Not affect
NM	Nautical Miles
NOTAM	Notice to Airmen

OFP	Operational Flight Plan
OM	Operations Manual
PAPI	Precision Approach Path Indicator
PPL (A)	Private pilot Licence
QNE	Standard pressure at sea level
QNH	Atmospheric Pressure (Q) at Nautical Height
RESA	Runway End Safety Area
S/N	Serial Number
t	Tons
TDZE	Touchdown Zone Elevation
TO	Take Off
TRE	Type Rating Examiner
UTC	Universal Time Coordinated
VHF	Very High Frequency
VMC	Visual Meteorological Condition
VOR	VHF Omni Directional Radio Range
VS	Vertical Speed
WOW	Weight On Wheels

Synopsis

Owner and Operator:	Air Nostrum
Aircraft:	Bombardier CRJ900 (CL-600-2D24), registration EC-JYA[1]
Date and time of incident:	Wednesday, 25 October 2013 at 15:04[2]
Site of incident:	San Sebastian Airport (LESO)
Persons onboard:	4 flight crew (2 as extra crew[3]), 2 flight attendants (FA) and 65 passengers. No injuries reported.
Type of flight:	Commercial air transport – Scheduled – Domestic - Passenger
Date of approval:	October 26th, 2015

Summary of the incident

The aircraft was flying from the Madrid-Barajas Airport (LEMD) to the San Sebastian Airport (LESO). After receiving the weather information from the control tower at the destination airport, the crew decided to make a visual approach to runway 04 at LESO. During the landing the crew noticed that the landing had been harder than usual, and they decided to conduct a more thorough walkaround inspection[4] of the main landing gear than usual, finding nothing out of the ordinary. They thus decided to continue the stopover and return to Madrid, where they reported the event to maintenance personnel. Upon conducting a more exhaustive inspection, maintenance personnel detected damage to the landing gear that required grounding the aircraft. Subsequently, after a specific "hard landing" inspection[5] (by both maintenance and the manufacturer), the gear components were replaced. None of the crew or passengers were injured.

Following the initial study of the data, the characteristics of the airport and the aircraft were specifically analyzed, as well as the airline's special procedures for operating at this airport.

It was concluded that the approach maneuver was not stabilized and exhibited a high rate of descent in the final segment, causing the aircraft to make a hard landing.

[1] Image taken from http://www.airliners.net.

[2] All times in this report are in UTC unless otherwise specified. To obtain local time, add 2 hours to UTC.

[3] Extra crew- crew that has no flight duties on a flight but that is being transported to the destination to commence their flight duties.

[4] Walkaround inspection-a general check conducted from ground level to detect discrepancies and to determine general condition and security

[5] *Post Hard-Landing Inspection*: specific inspection carried out after landing with a high vertical speed (sink rate in excess of 600 ft/min (10 ft/s)).

1. FACTUAL INFORMATION

1.1.. History of the flight

The aircraft was flying from the Madrid-Barajas Airport (LEMD) to the San Sebastian Airport (LESO), the second flight scheduled for that day. The information provided below pertaining to the flight is based on the crew's statements.

The crew had the METAR information from the 13:00 ATIS (ATIS W), as well as the real-time weather information provided by the control tower (010/7-11 kts CAVOK 20/17 Q1009[6]). As per their statements, the weather was "irregular". There was a mass of clouds moving in from the Hondarribia mountains that was bringing stormy weather to the Pamplona VOR (PPN). Beyond those clouds the crew stated they could see the airport clearly. They had been cleared by ATC to fly above the San Sebastian VOR (SSN) while observing the minimum safety altitude (MSA[7]) and make an instrument approach to runway 22 at LESO. However, since they had the runway in sight and the wind conditions allowed them to do so, they decided to make a visual approach to runway 04. At that point the aircraft was too high to start the approach maneuver, so they decided to make a descending 360º turn to a height that would allow them to make a stabilized approach. Upon completing the 360º maneuver they placed the aircraft in its final landing configuration. The onboard Flight Management System (FMS) showed a tailwind component of about 16 kts, but the information received from the control tower on the weather at the airport indicated a headwind (010º shifting to 020º at 8 to 9 knots). Visibility was 5 km and the cloud ceiling was at 2000 ft.

As per his statement, the pilot flying (first officer) varied the aircraft's flight path slightly to the left to avoid some hills along the approach route and thus avoid activating the EGPWS[8]. He did not follow the PAPI[9] reference reading, since the glide slope it required (3.9º) was beyond the stabilization parameters shown by the NOTAM in the OFP[10]. As a result the landing was conducted with all four PAPI lights showing red.

According to the crew, the approach was stabilized[11] and made extensive use of standard callouts. The captain was constantly monitoring the wind, given the difference between the cockpit readout and the wind information provided by ATC, and on several occasions, including during the final approach, requested updated wind data from the control tower.

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6 According to information entered in the operational flight plan.
7 7000 ft in this area, within a 25-NM radius of the SSN VOR.
8 EGPWS- Enhance Ground Proximity Warning System
9 PAPI- Precision Approach Path Indicator
10 OFP- Operational Flight Plan
11 See information on stabilized approach in Section 1.18.4.

According to the crew's accounts, the reference speed they used for the landing was the reduced V_{REF}[12], specified in the special procedure for operating at EAS. During the flare, starting at a height above the runway of 50 ft, the aircraft moved sharply downward, causing the two main gear legs to touch down hard. The stick shaker[13] did not activate (according to the crew they had a 13-kt wind gust), neither did the sink rate[14]. The captain had asked the first officer to raise their pitch angle, which reached 7º, but the first officer did not want to raise the nose any further, fearing a tail strike. They did not consider increasing thrust since the engines were at idle and they did not think they would respond in time.

After the landing, despite not having any specific references to check if they had exceeded the established hard landing limits[15] but due to the firm touchdown, the crew decided to do a thorough walkaround inspection of the aircraft. They checked the wheels, tires and main landing gear leg assemblies and saw nothing out of the ordinary. They also reviewed the synoptic hydraulic diagram shown on the EICAS[16] display and noticed no damage or leaks. The amount of hydraulic fluid in the tanks was within normal limits (87-91%) and the fluid temperature was normal. In light of this information, the crew decided to make the return flight to Madrid-Barajas (LEMD) and notify its maintenance personnel there. At 15:27 the aircraft took off en route to Madrid from runway 04. The first officer stated that during this maneuver they received a windshear warning[17] between 500 and 1000 ft. In his opinion, this confirmed the ongoing dynamic wind conditions at the airport.

During the return flight, the gear retraction and extension sequences were normal and gave no indications in the cockpit that the gear was damaged in any way. Upon arriving at their destination airport (LEMD), the crew made a soft landing on runway 18R and then taxied to parking. The proximity of their parking stand made for a short taxi phase. They noticed no damage to the tires, wheels or the hydraulic system. They notified maintenance and it was the mechanics who detected the damage to the left gear leg.

[12] V_{REF}- approach speed. The landing reference speed at a height of 50 ft above the runway threshold in a normal landing configuration.

[13] Activates to vibrate the control stick and warn of an imminent stall.

[14] Excessive rate of descent close to the ground, issued by the EGPWS.

[15] A hard landing is defined as a landing made with a descent rate in excess of 600 ft/min (10 ft/s).

[16] Engine Indicating and Crew Alerting System.

[17] Issued by the EGPWS

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				N/A
None	4+2 (extra crew)	65		N/A
TOTAL	6	65	71	

1.3. Damage to aircraft

The aircraft's landing gear and the panels above the wings were damaged, as detailed in Section *1.6.3 Maintenance Information*.

1.4. Other damage

There was no damage beyond that detected in the aircraft.

1.5. Personnel information

1.5.1. Information on the flight crew

The captain, a 38-year old Spanish national, had a JAR-FCL airline transport pilot license (ATPL(A)) with CRJ100 and instrument ratings (IR). His license and ratings were all valid and in force. He also had class 1 and 2 medical certificates, also valid and in force. He had a total of 4249 flight hours, 475 of them on the type. He also had a commercial pilot license (CPL(A)) and a private pilot license (PPL(A)). He had been a CRJ captain for five years and had experience on the 200 and 900 models. He was based at the Valencia Airport (LEVC) and had flown with the first officer on several occasions. According to his statement, the captain had the certifications and training[18] needed to fly into the San Sebastian airport (Category C[19]).

The first officer, a 46-year old German national, had a JAR-FCL airline transport pilot license (ATPL(A)) with CRJ100 and instrument ratings (IR). His license and ratings were all valid and in force. He also had class 1 and 2 medical certificates, also valid and in force. He had a total of 4038 flight hours, 448 of them on the type. It was his first time

[18] Special training and a simulator test.

[19] Airports requiring considerations in addition to category B airports due to presenting certain problems during the approach/landing or takeoff.

landing a CRJ900 at LESO, though he stated having done it in a CRJ200. According to his statement, first officers did not have to be supervised when operating in category C airports, though the airline did carry out a selection process, allowing only trusted first officers to carry out flights at these airports.

1.6. Aircraft information

1.6.1. General information

The aircraft, a Bombardier CRJ900 (CL-600-2D24[20]), with registration EC-JYA and serial number (S/N) 15090, was manufactured in 2006. It is outfitted with two General Electric CF34-8C5 engines and has a maximum takeoff weight (MTOW) of 37995 kg and a dry operating weight (DOW) of 21935 kg.

The aircraft had a Registration Certificate, Certificate of Airworthiness, Aircraft Station License, Noise Certificate and Insurance Certificate, all of them valid and in force. Its last maintenance inspection (100-hour check) had been on 20 October 2013, with 16431 hours on the aircraft.

Photograph 1: Photograph of the aircraft[21]

1.6.2. Maintenance information

According to the information provided, upon arriving in Madrid the captain made the following entry into the aircraft's technical logbook: "HARD LANDING WITH 31,400 Kg AND V/S BETWEEN 400 AND 600 ft/minute".

[20] Designation on the Type Certificate
[21] Image taken from http://www.planespotters.net

The data from the DFDR were downloaded and used to determine[22] that the aircraft landed with a vertical speed in excess of 600 ft/min, meaning a hard landing inspection[23] was required.

According to the report sent by the operator to the manufacturer, the front panels (above the wing) were found slightly bent. A detailed inspection of the landing gear revealed that the orifice support tube for the left gear had collapsed, the anti-rotation sleeve on the right gear was broken and the number 1 wheel was bent. In addition, all of the data downloaded from the DFDR were sent to the Engineering Department at Bombardier (the aircraft manufacturer) for analysis and determination of additional measures. After analyzing the DFDR data and comparing it against the damage reported, the manufacturer concluded that the shock struts in both legs had been subjected to loads above their design limits. They thus recommended disassembling the shock strut, the shimmy dampers and side stay assemblies, and disassembling and inspecting the four wheels on both main gear legs[24]. Once the replaced components were installed, an operational test of the braking and gear retraction/extension system was carried out.

The manufacturer likewise asked the operator to carry out additional detailed visual inspections of the wheel well and the wing ribs. These inspections did not reveal any other kind of damage.

The incident was also reported to the engine manufacturer, General Electric, which was also supplied with the DFDR data. The manufacturer recommended doing a general visual inspection of the engines on the aircraft[25], the result of which was satisfactory.

1.7. Meteorological information

The weather information at the time of the landing was as follows:

METAR LESO 251430Z 01004KT 320V040 CAVOK 20/17 Q1009

METAR LESO 251500Z 35004KT 310V030 CAVOK 19/17 Q1009

Between 14:30 and 15:00, the wind direction had changed from 010º to 350º, though it remained at 4 kts. The wind direction was varying from 320º to 040º at 14:30, and from 310º to 030º at 15:00. Visibility was in excess of 10 km with no clouds below

[22] As per AMM task 05-51-01

[23] As per AMM task 05-51-01-210-801- General Visual Inspection After a Hard/Overweight Landing

[24] The operator reported that the aircraft experienced a hard landing. Detailed inspection of the landing gear revealed that the left-hand main landing gear orifice support tube had collapsed and that the right-hand main landing gear anti-rotation sleeve was broken.

[25] As per INSPECTION 001 OVERLIMIT CONDITION INSPECTION Subtask 72-00-00-280-001

5000 ft or below the MSA, and there were no adverse weather phenomena. The temperature was 19-20º C and the dew point was 17º C.

According to information provided by the AEMET, the wind direction between 14:00 and 16:00 UTC was from 350 and 360º at a speed of 5 kt and gusting to 8 kt. There was very good visibility on the ground and the skies were clear or mostly clear. The relative humidity was 85% and there was no precipitation or any adverse weather expected.

According to the AEMET, the average and maximum wind speeds, as well as its direction, measured at the 04 and 22 thresholds at around the time of the landing were as shown below[26].

CAB04	kt	º<	kt	º<	CAB22	kt	º<	kt	º<
	HVMEDIA	HDMEDIA	HVMAX	HDVMAX		HVMEDIA	HDMEDIA	HVMAX	HDVMAX
14:50	7	10	11	18	14:50	5	350	10	354
15:00	6	10	10	28	15:00	4	350	9	344
15:10	5	10	12	18	15:10	4	350	8	350

At the threshold where the airplane was going to land, the wind readings indicated it was coming from the northeast. The reading at the other threshold showed more of a cross component.

The various wind data reported to the crew by the controller are shown in Section 1.9 Communications. The last wind information provided before landing was wind from 010º at 8 kts.

1.8. Aids to navigation

A visual approach was made to runway 04, meaning the crew did not use the aids available for an instrument approach to runway 22.

The information on LESO contained in the crew's operational flight plan (OFP) makes

RWY22 PAPI SLOPE IS NOT COINCIDENTAL WITH THE NOMINAL SLOPE OF THE APPROACH FINAL SEGMENT.

In other words, the PAPI slope for runway 22 did not match the nominal slope of the final approach segment published in the AIP[27].

[26] Ten-minute readings from 14:00 to 16:00 UTC

[27] Aeronautical Information Publication

According to the information in the AIP, the PAPI slope is 4.75º for runway 04 and 4.15º for runway 22[28].

The information in the OFP made no reference to the approach to runway 04 or to the fact that its PAPI slope (as with the runway 22 PAPI) did not match the nominal slope for the final approach.

On the date of the incident there was no NOTAM in effect that made reference to the PAPI.

1.9. Communications

According to the log for the San Sebastian Airport control tower, the configuration was changed at 12:30 on the day of the incident to place runway 04 in use due to the wind.

ATC personnel were not aware of any incident during the landing of the aircraft in question in this report, stating that visual flight conditions were in effect. The crew did not report any problems and after its stopover, it took off at 15:30 to return to Madrid.

The ATC strip showed that the aircraft's first communication with the tower was at 14:54, and that it was cleared to land at 15:04.

According to the communications (Appendix B), at 14:52:38 the crew contacted the control tower while descending to 9000 ft, 13 NM out from point MALOB[29]. ATC then reported the data for the airfield: "*runway at discretion, wind from 010º at 7 kts, gusting to 11 kts, CAVOK, temperature 20º C, dew point 17º C and QNH 1009*". This was followed by conversations regarding the runway and the approach to use, and the fact that there was no traffic in their vicinity.

At 15:01:59 the crew reported 3 NM out on final to runway 04, and the controller cleared them to land with wind 010º at 4 kts. A minute later the controller informed the crew that it was starting to rain, to which the crew replied that it was also raining where they were. The crew then asked for a new wind check, and the controller reported the wind was from 020º at 4 kts, immediately followed by 010º at 8kts, which the crew acknowledged.

[28] These angles are calculated based on environmental requirements and on a Franco-Spanish agreement on flying over the town of Hendaye.

[29] MALOB Reporting point

1.10. Aerodrome information

The San Sebastian airport (LESO) is located 22 km northeast of the city of San Sebastian, at an elevation of 5 m / 16 ft. The airport has one 1754-m long, 45-m wide runway in a 04/22 orientation. Instrument approaches are only authorized on runway 22. Runway 04 requires a visual approach. Each runway has a PAPI system (see Section *1.8 Aids to navigation*).

Located 1.5 NM northwest of the airport is Mount Jaizquibel, which is 545 m (1788 ft) high (see photograph below).

Photograph 2: Location of Mount Jaizquibel in relationship to the airport[30].

On the date of the incident, the airline had categorized the airport as a type C and had a special procedure in place for operations at this airport.

Based on the airport's AIP, as of the date of this writing, specific information was included regarding the operations category for commercial traffic: "*Commercial air transport (CAT) operations at the San Sebastian Airport shall be regarded by air operators as category C (as per AMC[31] 1 ORO.FC.105-b-2-c[32]) due to the lack of RESAs[33] and to the limited length of the runway strip*". These two limitations allow for the presence of obstacles in the vicinity of the approach, in particular to runway 04, as the following photograph shows.

[30] Image taken from http://www.airliners.net

[31] AMC- Acceptable Means of Compliance- Medios aceptables de cumplimiento

[32] This document contains the necessary training and the captain's specific designation for operating at category-C airports.

[33] RESA: Runway End Safety Area

Photograph 3: Approach to runway 04

1.11. Flight recorders

1.11.1. General information

The aircraft had a digital flight data recorder (DFDR) and a cockpit voice recorder (CVR), the contents of which were preserved and subsequently downloaded. Both the DFDR and CVR were in good condition and had no obvious damage.

When the CVR was downloaded, it was found to contain no information of use to the investigation, since the information on the incident flight had been recorded over.

1.11.1.1. Information on the approach to LESO

Below is a summary of the DFDR parameters from the time the aircraft was at 500 ft until it landed. The graphs of the most significant parameters and their progression are contained in Appendix C.

The DFDR was synchronized with ATC time using the transmission made by the crew at 15:02:58 to inquire about the wind before landing.

UTC TIME	Remarks
14:52:30	The crew make initial contact with the San Sebastian control tower, reporting they are 13 miles out from point MALOB and descending to flight level 90. Altitude 17750 ft (QNE[33])
14:52:35	ATC clears them to continue and provides wind data 010 at 07 gusting to 11. Informs crew that the runway is at their discretion. QNH[34] 1009.
14:52:37	The crew report they are heading to DITOP and will inform ATC of their runway choice as they near the airfield.
14:52:45	ATC asks if they want to fly direct and to coordinate with Bilbao. The crew rejects the proposal.
14:54:14	ATC clears them to descend at their discretion, QNH 1009 in contact to the VOR.
14:56:27	The crew report intention to head 340 to avoid clouds, after which, if they see the airfield, will inform if they continue with the VOR APP or not; ATC tells them there is no traffic and leaves it to their discretion. Seconds later ATC reports the wind had abated a little and was from 360º at 4 knots, gusting to 9 knots. Altitude 8996 ft.
14:57:14	The crew inform they would accept a visual to 04. ATC clears them for the approach to 04 and instructs them to report when on final.
14:59:12	The crew report they will chase the imaginary localizer for 04 because they are a little high. Their altitude is 6640 ft.
14:59:44	ATC reports slight change in wind, 340-03 knots. Altitude 5340 ft.
14:59:50	The crew report they are doing a 360º turn. Altitude 5081 ft
15:01:59	The crew reported being 3 NM out on final. Altitude 1709 ft (QNH).
15:02:02	ATC clears them to land on runway 04. Altitude 1653 ft.
15:02:48	The crew ask for a wind check. Descent rate 1168 ft/min. Altitude 537 ft.
15:02:50 500 ft	ATC reports 020º at 4 kts. Descent rate 960 ft/min. Altitude 504 ft.
15:02:54	ATC corrects wind information to 010º at 8 knots. Vertical speed 1056 ft/min. Altitude 432 ft.
15:02:56	Altitude 394 ft, CAS 142 kts, descent rate 1072 ft/min.
15:03:02	Altitude 275 (radioaltitude 214 ft), CAS 141 kts, descent rate 1296 ft/min.
15:03:14	Altitude 105 ft, CAS 135 kts, descent rate 976 ft/min
15:03:16	Altitude 79 ft, CAS 134 kts, descent rate 848 ft/min
15:03:17 50 ft	Radioaltitude 55ft, CAS 134 kts, descent rate approximately 800 ft/min

[34] Standard pressure at sea level- 1013 mb/29.92"

[35] Pressure at sea level deduced from pressure at aerodrome (1009 mb). This corrected altitude will be used when referring to the stabilized approach criteria.

UTC TIME	Remarks
15:03:19	Radioaltitude 29 ft, CAS 128 kts, descent rate 720 ft/min
15:03:20	Radioaltitude 11 f, descent rate 848 ft/min. Pitch goes from 3° to 5°.
15:03:21	Radioaltitude -4 ft and pitch 7°, CAS 125 kts, descent rate approx. 800 ft/min. Main gear compressed (GROUND) signal. 3-g vertical acceleration.
15:03:22	Radioaltitude 0ft. Bounce – main gear strut extended (AIR signal) 0.25 sec. 2.1-g vertical acceleration. Pitch varies goes from 5° to 4°.
15:03:28	On the ground (main gear compressed signal (GROUND signal)), CAS 111 kts, climb rate (positive vertical speed).
15:03:34	CAS 66 kts, descent rate (negative vertical speed).

During the flare and the first contact, the N1 readings were different from the values for Approach Idle (35% versus 26%).

1.11.1.2. Operator's and manufacturer's analysis of DFDR data

The operator informed the manufacturer that a review of the DFDR data showed an initial impact with a maximum vertical load factor (Nz) of 2.988 g's. This was followed by a bounce with the spoilers deployed that resulted in a second impact with Nz equal to 2.14 g's. The nose gear did not contact the ground for an additional five seconds after the second impact, with the pitch angle gradually decreasing until contact was made. Before the initial landing, the aircraft was in a wings-level attitude. The descent rate during the landing was probably between 13 and 15 ft/s, higher than the limit load (corresponding to 12 ft/s). The conclusion was that both main gear legs withstood forces in excess of the maximum load.

1.12. Wreckage and impact information

N/A

1.13. Medical and pathological information

N/A

1.14. Fire

There was no fire during the incident.

1.15. Survival aspects

There was no evacuation.

1.16. Tests and research

N/A

1.17. Organizational and management information

N/A

1.18. Additional information

1.18.1. Procedure for operating at LESO with the CRJ900 and assigning crews

Operating at the San Sebastian with an CRJ900 requires a category C aircraft. The CRJ900 is a category D aircraft due to its maximum landing weight and its reference speeds at the threshold. The possibility exists, however, to constrain the landing weight within certain limits to achieve speeds at the threshold that allow the CRJ900 to operate as if it were a category C aircraft. This must be approved by the authority, and in this case the airline had a certificate from the DGAC that permanently changed this aircraft's category by reducing its maximum landing weight. The aircraft manufacturer offers this possibility to its users by operating at a reduced reference speed (V_{REF})[36], which allows for an improved (i.e. shorter) landing distance and for operating with category C minimums.

According to the CRJ900 special operating procedure for EAS[37] (San Sebastian Airport) contained in Part B of the company's Operations Manual, the crew has to have training on the special approach procedure with a reduced V_{REF}. Before initiating the descent, a crew has to hold a briefing indicating the use of the special procedure, the conditions required to continue and the go-around procedure. The other conditions considered include that the approach phase must be done at the reduced V_{REF} and special V_{2GS} specified in the Speeds Booklet (see figure below):

[36] Supplement 18 of the AFM, "Operating with Reduced Landing Reference Speed (V_{REF})"

[37] EAS is the IATA code for the San Sebastian Airport. In this report the ICAO code (LESO) is used.

AIR NOSTRUM LINEAS AEREAS — APROX. ESPECIAL V_{REF} REDUCIDA

Peso (kg)	V_{2GA} (Flaps 20º) (KIAS)	V_{REF} (Flaps 45º) (KIAS)
25000	124	118
26000	126	120
27000	129	122
28000	131	124
29000	134	127
30000	136	129
31000	138	131
32000	140	133
33000	142	135
34000	144	137

ATENCION: Las aproximaciones especiales con Velocidad V_{REF} Reducida sólo pueden ser efectuadas por Tripulaciones debidamente autorizadas por la Dirección de Operaciones de Vuelo.

Table 1: Table with reduced approach V_{REF}

The reduced reference speed for the aircraft's weight was 133 kt, and the associated stall speed was 108 kts[38].

Instrument approaches to runway 04 in IMC were not authorized by the company.

According to the EASA's AMC1 ORO.FC.105 (c), before operating at a category C aerodrome, the pilot in command/captain must be briefed and visit the aerodrome as an observer and/or undergo training in a suitable simulator (FSTD[39]). The completion of the briefing, visit and/or training must be recorded.

Operations Manual A, sent after the event by the company, contained the following requirement for operating at Category C airports:

> F.3. CATEGORY C (Airports with requirements in addition to those for Category B airports)
>
> Before operating at a Category C airport, the pilot in command must first receive instructions (briefing) and visit the Category C airport as an observer in the cockpit, and/or receive training in a simulator approved by the authority for this purpose. This training must be certified by the Training Department.

[38] Reduced V_{REF} =1.23Vs

[39] Flight Simulation Training Device

*Before being able to operate at a Category C airport as the **pilot flying**, the first officer must first receive instructions (briefing) and visit the Category C airport as an observer in the cockpit, and/or receive training in a simulator approved by the authority for this purpose. This training must be certified by the Training Department.*

After the incident the company issued a technical memo in November 2013 and modified the CRJ900 procedure for EAS to include the following:

- The approach and landing shall only be done by the captain.
- The flight crew must have been trained on the special approach procedure with a reduced V_{REF}.
- Reminder that the approach must be carried out using the "stabilized approach" concept; otherwise, a go around must be initiated.

According to information from the company, and as a result of this incident, scheduled and nighttime flights into LESO with the CRJ900 would no longer be conducted, and both flights into LESO as well as crew assignments would have to be approved by the Operations Department.

The incident crew received two days of refresher training on flying into LESO. Both pilots then did a simulator session; furthermore, the captain did a flight into LESO with a company TRE[40] and the first officer's operations at said airport were restricted.

1.18.2. Landing criteria

The manufacturer's Flight Crew Operations Manual (FCOM) recommends the following landing technique:

"The reduced thrust during landing is influenced by several variables, including the aircraft's weight, the altitude density at the airport, the angle of approach, the wind and runway surface conditions. Starting from a normal approach attitude (approximately 1° nose up and a V_{REF} with 45° flaps and landing gear down), reduce engine thrust slowly to idle thrust below 50 ft AGL. The flare is started between 20 and 30 ft AGL, the goal being to land at idle thrust and a pitch angle of approximately 5°. Reducing thrust too early or aggressively, combined with an excessive pitch attitude, can cause the aircraft to float, high landing rates, lateral control problems with a crosswind and, in extreme conditions, a tailstrike".

According to the manufacturer, reducing V_{REF} until landing is a function of several

[40] TRE Type Rating Examiner

factors, including pilot technique (changing thrust as the levers are moved to idle and movement of the controls to carry out the flare), weather conditions and the angle of the approach trajectory. Test flights to determine landing performance indicate that the aircraft's speed is reduced between 1% and 5% from 50 ft until landing.

1.18.3. Bounce Landing

In its Operations Manual Part B, the operator refers to the contents of the FCOM Vol. 2 07-25 SUPPLEMENT 25 BOUNCED LANDING PROCEDURE in the event of an improper landing technique resulting in a bounce.

This manual states that the aircraft is equipped with a ground lift dumping (GLD) system that relies on extending four multi-function spoilers and the four ground spoilers. In order to be automatically deployed, the thrust levers must be in the IDLE position before contact is made with the runway, as required by the landing techniques presented.

If the pilot believes that thrust must be maintained to make the landing and/or the aircraft bounces, then a go around must be carried and a pitch angle established similar to that required for a normal landing (5º).

Using an improper landing technique and touching down on the runway with the thrust in a position other than idle can cause a bounce landing. This situation is aggravated if once contact is made, the pilot retards the throttles to idle during the possible bounce, as this could deploy the GLD with the aircraft still in the air and cause a hard landing.

The FCOM states that a badly executed approach and making a landing with a high descent rate can cause a bounce landing, leading to an accident due to a hard landing. In this case a go around should always be performed after such a bounce.

1.18.4. Stabilized approach criteria

The company's stabilized approach criteria are in keeping with those specified by the Flight Safety Foundation[41], and are contained in its Operations Manual Part A, "Q.6.2.5 Alignment and Stabilization of the Final Approach".

- In order to achieve a final approach and a safe landing, the crew must maintain:
- A stabilized approach
- The required configuration

[41] See http://flightsafety.org/files/alar_bn7-1stablizedappr.pdf

- The airplane aligned with the runway.
- An approach is stabilized when all of the following criteria are met:
- The aircraft is on the correct flight path (aligned with the runway)
- Speed under VREF+20 and above VREF
- Sink rate less than 1,000 feet per minute
- ILS within one for of the LOC/GS
- Briefings and checklists complete
- Proper landing configuration (gear and flaps) as per the corresponding OM(B)
- An airplane is aligned with the runway when:
- It is within ±5° of the runway centerline on non-precision approaches
- It is within ±1 dot of the localizer on precision approaches.

If during an instrument approach without visual references (IMC) the airplane is **NOT** stabilized 1,000 feet above the touchdown zone elevation (TDZE), **A GO AROUND MUST BE EXECUTED.**

If during an instrument approach with visual references (VMC) or a visual approach the airplane is **NOT** stabilized 500 feet above the touchdown zone elevation (TDZE), **A GO AROUND MUST BE EXECUTED**

In any event, the wings shall always be level 300 feet above the TDZE. If reasons beyond the crew's control (ATC requirements, emergency or any other unforeseen circumstance) require deviating from any of the stabilized approach elements, the captain shall conduct a special briefing so as to ensure a safe approach.

1.18.5. Checks after a hard landing

The "Normal Procedures" section in the FCOM Vol. 2 specifies the following:

An overweight landing is defined as landing with more than the MLW. This type of landing must be avoided. However, an inspection is not required unless a hard landing or a hard derotation[42] has occurred, either of which can cause damage to the airplane's structure and systems. Such damage may or may not be visible. In such a case, it is highly recommended that the airplane be checked for damage before the next flight as per the checks in the "Hard/Overweight Landing" section in the maintenance manual, AMM CSP B-001.

1.19. Useful or effective investigation techniques

N/A

[42] *Hard derotation* – a very sudden change in the aircraft's rotation during landing. According to the FCOM, Vol. 2, the factors contributing to a hard derotation are:
1 – Applying the brakes before the nose gear contacts the runway, which causes a high, uncontrolled rate of change in attitude.
2 – Excessive or full application of the elevator to lower the nose gear before it contacts the runway.
3 – Exerting pressure on the control column after the nose gear contacts the runway without controlling the attitude rate of change when lowering the nose.

2. ANALYSIS

The aircraft was flying from the Madrid-Barajas airport (LEMD) to the San Sebastian airport (LESO). In light of the weather conditions, the crew decided to make a visual approach to runway 04 at LESO. During the landing, the two main gear legs impacted the ground at a high vertical speed. The landing took place at 15:04. There were no injuries. The crew carried out a thorough check of the landing gear system and, finding nothing out of the ordinary, decided to continue with their schedule and make the return flight to LEMD. Once there they notified maintenance personnel, who detected damage to the gear due to a hard landing.

Based on the weather information provided, the wind was light and from the north-northeast. This matches the airfield data provided by the controller to the crew (see Appendix B) at 14:53:38 (wind from 010º at 7 kt gusting to 11) and at the time of the landing clearance (15:02:48, wind from 020º at 4 kt, and seconds later, 010º/8). In contrast, according to the crew's accounts and to the data taken from the DFDR (see Section *1.11 Flight recorders*), the wind aloft was from the south at 20-25 kt. Mount Jaizquibel is located north of the airport. Due to this mountain's location and to the characteristics of the area in the approaches to runway 04/22, the airport is prone to turbulence and shifting winds, meaning it was possible for there to exist turbulence to leeward due to the geography of the area, which could have affected the prevailing wind conditions in the final part of the approach. In addition, based on the weather information available, there could have been some fog (temperatures close to the dew point), which would have hampered the crew's maneuvers during the final approach.

The San Sebastian Airport is categorized by the company as a type C airport. As such, it has its own Special Procedure in the Operations Manual: Operations at EAS with the CRJ900. The pilot flying was the first officer, who had never landed this aircraft type at that airport. It was his first time landing at LESO in a CRJ900, though he stated that he had landed there previously in the CRJ200. According to the Operations Manual, Part A, and in keeping with European requirements, captains are mandated to receive special training and to be qualified on a simulator. And before first officers are allowed to operate at a category C airport as the **pilot flying**, they must first be briefed on the airport and visit the airport as an observer in the cockpit and/or receive instruction in a flight simulator approved by the authority for this purpose. This training must be certified by the Training Department. There is no record that the first officer met these requirements. He stated that such training was not needed by first officers to fly into LESO, though the airline did carry out a selection process when choosing first officers for this operation.

After the incident the airline issued a technical memo changing the procedure at EAS with the CRJ900, which included, among other things, that the approach and landing must be made by the captain. In the specific case of the incident crew, both pilots

received two days of refresher training on a simulator, the captain did a flight into LESO with a company TRE and the first officer's operations at said airport were restricted. As a result, no safety recommendation is issued in this regard.

During the approach, starting at about 2000 ft, the winds aloft recorded in the aircraft indicated a tailwind (180-190º) at an average speed of 27 kt. As a result of this tailwind, the ground speed (GS) was higher than the IAS (CAS). Below a QNH-corrected altitude of 426 ft (QNH 1019), the GS started to drop below the IAS, as the wind shifted from a tailwind to a headwind, a wind condition on the runway in use that was reported by the controller in the tower.

The descent rate was very high during the final approach, exceeding 1000 ft/min on several occasions past the 500 ft threshold, and reaching 848 ft/min at a radioaltitude of 11 ft[43].

Based on the Flight Safety Foundation's definition of a stabilized approach, in VMC (below an AAL[44] of 500 ft), the criteria to be used are those presented in Section *1.18.2 Stabilized approach criteria*. The DFDR data show that below 500 ft, the sink rate exceeded 1000 ft/min, reaching 1296 ft/min at 214 ft AGL. This may have been because the tailwind was making them approach the runway too fast, though the aircraft's speeds during the approach did not exceed the established criteria and were in keeping with the reduced reference speed specified in the special approach procedure for LESO.

The operator requires its crews to have an approach briefing, as specified in the FCOM and in the special operating procedure. The briefing must be conducted before starting the descent and specify the use of said special procedure, the conditions required to continue the approach and the go-around procedure. Although the CVR recording was not available, it is likely that the crew held a briefing on the approach to runway 22, since they had been cleared for this maneuver, which was the usual approach. The fact that they had to do a 360º turn to lose some of their excess altitude indicates that the approach maneuver to runway 04 was not expected. It thus seems unlikely that they did the briefing after deciding to make a visual approach to said runway.

The crew were surprised by the tailwind conditions indicated by the FMS, which did not match those reported by the tower. This disparity in the tailwind component should have forewarned them to the possibility of windshear at some point during the approach, meaning the most prudent decision would have been to go around and do a visual circuit for runway 22 or a full instrument approach, which is a normal operation. The average wind reported of 360º at 4 kts would have allowed landing on this runway[45].

[43] The manufacturer regards a landing made at a sink rate in excess of 600 ft/min as a hard landing.

[44] AAL Above Aerodrome Level.

[45] The tailwind limit for landing the CRJ900 is 10 knots.

The presence of a strong tailwind component forced the crew to maintain a steep descent rate to stay on the nominal approach glide slope, which was close to 3º. The PAPI indications were of no use, as the crew stated they had done the final approach with all four PAPI lights red, since according to the a NOTAM the PAPI approach slope was excessive (3.9º). In reality this NOTAM was a note reflected in the OFP and it referred to the PAPI for runway 22, not 04, though in this particular case, environmental requirements forced the glide slope on the PAPI for runway 04 to also be higher than normal. As a result, the decision to land with four red lights was correct.

The presence of obstacles on the approach to runway 04, which has no RESA, forces crews to make an approach at an angle that is steeper than usual. Making this type of approach gives the impression that the runway is shorter than it is. In the operating conditions at San Sebastian, with its shorter runway, this illusion could affect how the aircraft is operated, forcing an approach to land on the runway threshold that uses a descent gradient higher than required for a normal glide slope.

Continuing with the maneuver in unforeseen adverse conditions denotes a lack of planning by not opting for an alternate solution that should have been considered in keeping with the instructions in the special procedure.

After the incident the company issued a technical memo that modified this procedure, reminding crews that if the approach cannot be made in keeping with the "stabilized approach" concept, a go around must be executed. As a result, no safety recommendation is issued in this regard.

The manufacturer recommends doing the landing by reducing engine thrust to idle below 50 ft AGL, starting the flare between 20 and 30 ft at a pitch angle of about 5º. Based on this information, under normal conditions, and depending on other factors, the speed is reduced between 1% and 5% between 50 ft and the landing (that is, to around 126 kts). According to the DFDR data, the crew executed this procedure with 134 kts at 50 ft and 125 kt at touchdown, though at a high sink rate. The crew varied the aircraft's pitch angle from 3 to 5º at 11 ft, but it rose to 7º at the instant of landing. The aircraft's speed did not drop below the stall speed (108 kts) for that configuration, meaning the aircraft did not fall to the ground, but it did impact the runway with considerable energy.

During the flare and the initial contact, the values of N1 exhibited values that differed from approach idle (35% versus 26%). This indicates that the levers were not in the idle position at first contact. Putting back the levers to such position after the first impact caused the ground lift dumping (GLD) system to deploy, resulting in a second hard landing. In keeping with the instructions in the FCOM, the crew should have gone around after bouncing or when they realized they had to apply thrust to make the landing.

After the landing, the crew decided to do a more thorough walkaround inspection of the gear, since they knew the landing had not been normal. After this inspection they decided to return to Madrid. As stated in the FCOM procedure applicable if a hard landing is suspected, the aircraft could have sustained damage to its structure and systems that were not apparent to the naked eye. In this case, the FCOM strongly recommends that the airplane be inspected for damage before its next flight using the "Hard/Overweight Landing" checks specified in the Maintenance Manual. According to the crew's statements, they did not notify the company of their suspicions and decided to return to Madrid based solely on their inspection of the gear after the landing and on the absence of any EICAS messages. A safety recommendation is issued in this regard.

3. CONCLUSIONS

3.1. Findings

An analysis of the information available yielded the following findings:

- The aircraft's documentation was valid and in force.
- The aircraft was airworthy at the time of the incident. The flight crew's licenses, ratings and medical certificates were valid and in force.
- The crew had experience on the aircraft type and had flown together.
- The LESO airport is a category C airport.
- The company assigns it this category in its Operations Manual, which lists specific requirements for operations there and for crews.
- The captain was rated/authorized to fly into LESO.
- In the case of first officers, the company required them to first land there as observers and to become familiar with the airfield.
- There is no record that the first officer fulfilled this requirement.
- After the incident the company issued a technical memo, later incorporated into the Operations Manual, which specified, among other changes, that only the captain may make the approach and landing.
- Visibility was good, though fog formation was likely due to the high relative humidity.
- The wind was from the northeast, favorable to landing on runway 04 (headwind).
- The wind data for the approach taken from the DFDR showed the wind was from the south (tailwind) at 20-25 kt.
- The wind conditions reported by ATC (headwind) were different from those observed by the crew during the flight.
- These tailwind conditions could have sped up the approach, forcing the crew to increase the sink rate.
- The location of Mount Jaizquibel favors the formation of turbulence downwind, in the approach area.

- The crew made the visual approach below the PAPI slope, alleging there was a NOTAM stating that its glide slope was excessive.

- There was no such NOTAM, though there was a notice in the OFP about the usual approach that referenced runway 22, and not 04 (non-typical approach).

- The crew did not prepare properly for the approach as they did not hold a briefing suited to the approach they were going to make.

- Below a radioaltitude of 500 ft, the approach was made at a sink rate close to 1000 ft/min, reaching 1296 ft/min at a AGL of 214 ft.

- According to the company, a stabilized approach is one with a sink rate of less than 1000 ft/min when below 500 ft over the TDZE (touchdown zone elevation) in a visual approach.

- If the approach is not stabilized as per these criteria, a go around must be performed.

- The approach was not stabilized and the crew did not execute a go around.

- The company issued a technical memo to modify this procedure, reminding crews that an approach must be made as per the "stabilized approach" concept; otherwise, a go around must be initiated.

- The CAS was consistent with the reduced V_{REF} specified in the procedure (reached when 50 ft above the runway).

- The crew reduced the speed as recommended by the manufacturer, to the 125 kts recorded on touchdown.

- Based on the DFDR information, the crew did not start the flare until an altitude of 11 ft, reaching a pitch angle of 7º on touchdown.

- The manufacturer recommends flaring at an AGL of 20 to 30 ft and not to exceed a 5º pitch angle.

- The crew used an improper landing technique by contacting the runway with the throttles not at idle.

- The aircraft bounced on the ground. In such a case, as recommended by the manufacturer, the crew should have executed a go around.

- The crew realized the landing had not been standard and had been harder than usual.

- The crew did not report this fact to the company despite conducting a more thorough walkround inspection of the gear, which revealed no apparent damage.

- The manufacturer and the airline strongly recommend inspecting the aircraft for damage prior to the next flight in such conditions.

- The crew decided to continue with the return flight to Madrid.

- The aircraft was not airworthy after the incident.

3.2. Causes/Contributing factors

The incident was caused by the performance of a non-stabilized approach maneuver with a high sink rate in the final segment that resulted in the aircraft making a hard landing.

The following contributed to the incident:

- The presence of a southerly wind (tailwind) during the approach, which probably sped up the approach and forced the crew to increase the sink rate.

- By not holding a briefing on the maneuver they were going to execute, the crew did not prepare adequately for the approach.

- The crew did not do a go around, as required by the Operations Manual for a non-stabilized approach.

- The first officer's lack of experience at that airfield and on that aircraft in particular.

4. SAFETY RECOMMENDATIONS

During the investigation, the company took steps relating to the training of its crews and it updated its procedures in this regard. It likewise assessed the advantages/drawbacks of flying with the type of aircraft involved in this incident, as a result of which this Commission decided not to issue any recommendations in this regard. However, after the incident the crew decided to make the return flight to Madrid after conducting a visual inspection of the gear and seeing no anomalies in the EICAS. In the FCOM, the manufacturer and the operator recommend that in cases like these, the aircraft be inspected for damage, as per the Maintenance Manual, before the next flight. This inspection did not take place until the aircraft's arrival in Madrid. As a result, the following safety recommendation is issued:

REC 62/15 It is recommended that Air Nostrum establish the measures needed so that crews can efficiently and objectively assess if a given landing constitutes a hard landing[46], which would require declaring the aircraft AOG[47] before making the next flight.

[46] As defined by the manufacturer
[47] Aircraft on Ground

5. APPENDICES

APPENDIX A: AIRCRAFT FLIGHT PATH.

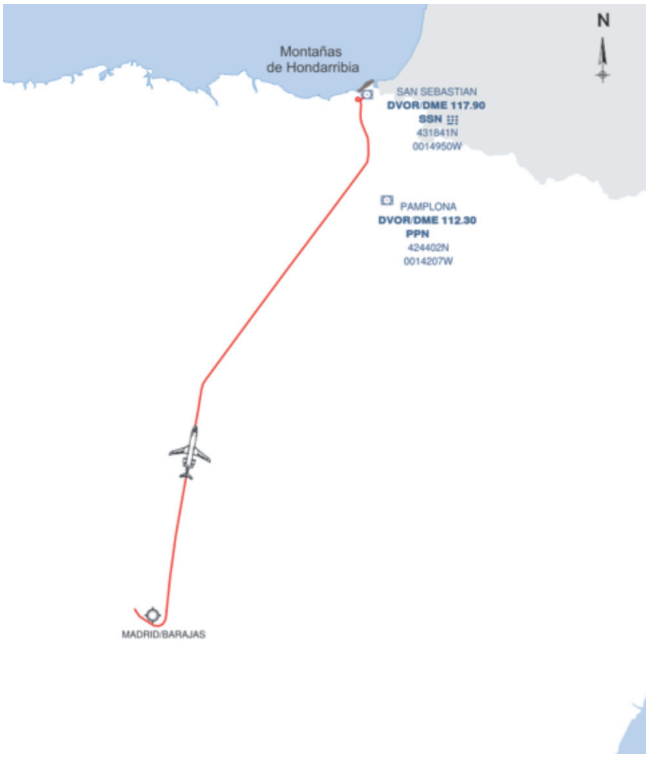
APPENDIX B: TRANSCRIPT OF COMMUNICATIONS.

APPENDIX C: DFDR DATA-GRAPHS.

APPENDIX D: OPERATIONS AT EAS WITH THE CRJ900.

APPENDIX A

AIRCRAFT FLIGHT PATH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MADRID/BARAJAS


N
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Ab
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Zimizarga
Donostia-Hondarribia
aireportua
Henda
D912
Amute-Kosta
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Irun
E-5
Jaizkibel
GI-3440
GI-636
Pasaia
Lezo
Pasai Antxo
GI-636
GI-2134
Gurutze
SSN
Errenteria
GI-2134
Oiartzun
Iturriotz
Ergoien
E-5
Landarbaso
EUSKADI
NAVARRA

APPENDIX B

TRANSCRIPT OF COMMUNICATIONS

IN- 038-2013-LESO

LESO APP/TWR frequency 119.85Mhz

14:52:38	ANE8322	San Sebastian, hello, ANE 8322 descending to 90 13 miles out from MALOB.
	ATC	Hello ANE 8322. Continue as cleared. Copy field information: runway at discretion, wind 010-7 knots, gusting to 11 knots, CAVOK, temperature 2', dew point 17 and QNH 1009.
	ANE8322	Very good, we have 1009 at the field and runway at pilot's discretion. We're going to get a little closer to see the field and then I'll inform you as to runway 04 or 22. For now continuing standard to DITOP[48].
	ATC	Acknowledged. Do you want direct? Shall I coordinate with Bilbao?
	ANE8322	No, this is good for now. Let's wait until we're out of the clouds and we can see the field and I'll let you know. Thanks.
14:53:47	ATC	ANE 8322 you can fly direct to SSN and descend at discretion, QNH 1009.
14:54:14	ATC	ANE 8322, descend at discretion, QNH 1009, you can fly in contact to the VOR.
	ANE8322	Descend at discretion, QNH 1009, and fly where? To the VOR?
	ATC	Acknowledged, yes.
	ANE8322	Copy, to the VOR, 1009.
14:56:28	ANE8322	We're heading on course 340 to go around this cloud. I'll let you know if we see the field or continue with the VOR APP. I'll get right back to you.
	ATC	As you wish 8322. There's no traffic, so fly at discretion.
	ANE8322	Thanks a lot.
14:56:57	ATC	The wind has come down a bit, now 360-4 knots, gusting to 9 knots.
	ANE8322	OK, thanks.
14:57:14	ANE8322	OK, we have the airport in sight. We would accept visual if that's ok.

All the communications were held in Spanish. English translation is provided for information purposes only. In case of any doubts or incongruences Spanish version prevails.

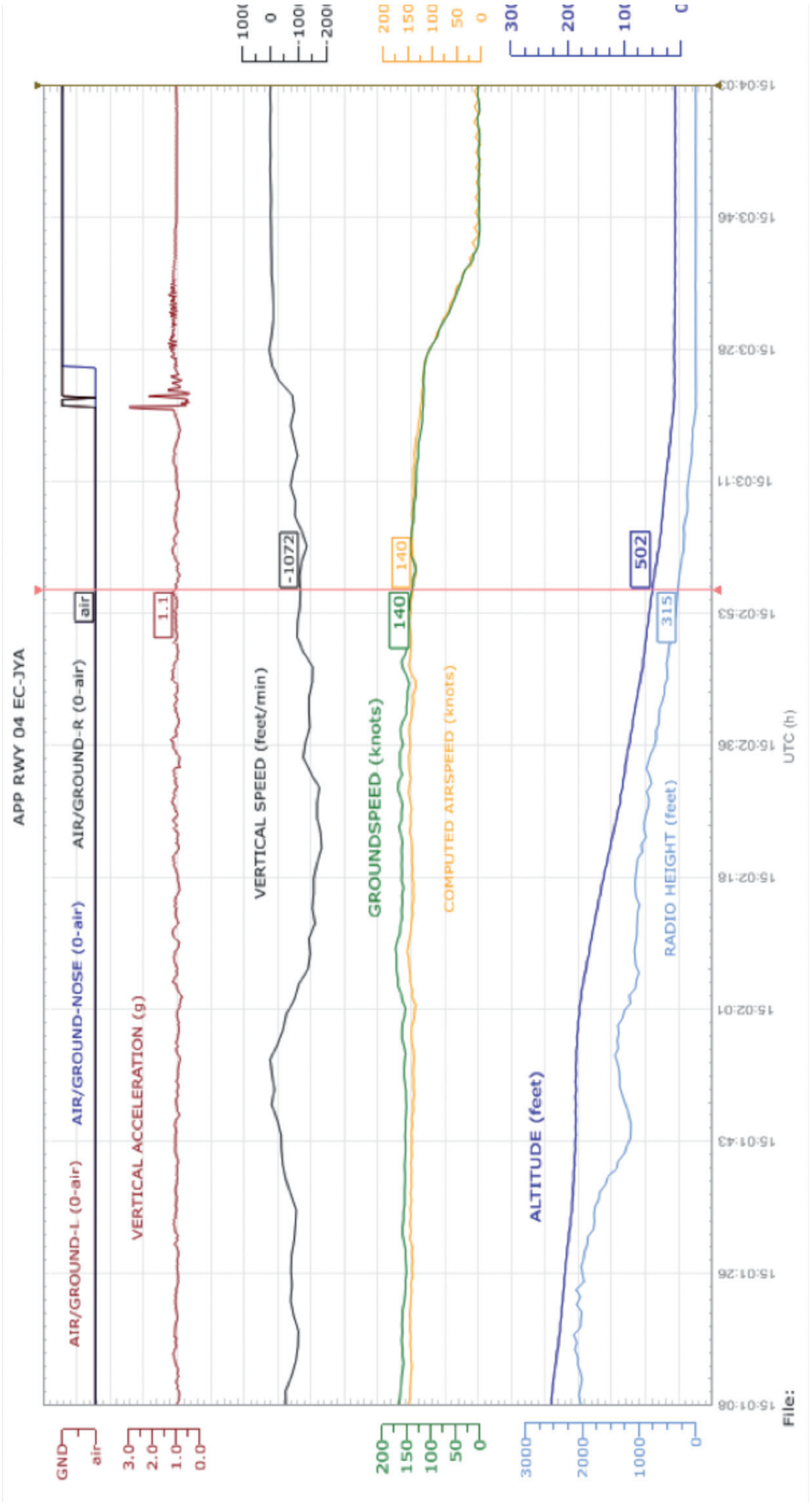
[48] DITOP- Reporting point located 18 NM south of the SSN VOR.

	ATC	To which runway
	ANE8322	Well, with this wind we'll land on 04 if you don't mind.
	ATC	Not at all, ANE 8322. Cleared to APP in contact runway 04. Call when on final.
14:59:12	ANE8322	Will do, will call back when established on final.
	ANE8322:	We are going to chase the imaginary localizer at 04, because we're a little high. We're still very close, ANE 8322.
14:59:43	ATC	Copy 8322, at discretion.
	ATC	Wind now 340-3 knots. If you prefer to enter right downwind to 22, no problem.
	ANE8322	Thanks a lot. Well, we're already here, doing a 360 and we'll go in just fine. Thanks a lot.
15:01:59	ATC	OK
	ANE8322	3 miles out on final 04, 8322.
	ATC	8322, you are cleared to land runway 04, wind 010-4 knots.
15:02:14	ANE8322	Cleared to land 04, ANE 8322
	ATC	It's starting to rain, some drizzle.
	ANE8322	Yes, here too, thanks.
15:02:48	ANE8322	Wind check?
	ATC	020-4 knots
	ANE8322	Thanks
	ATC	010-8 knots now
	ANE8322	Copy
15:03:40	ATC	8322, back track approved and then gate A to stand "6B".
15:03:48	ANE8322	"A" and to "6B", 8322

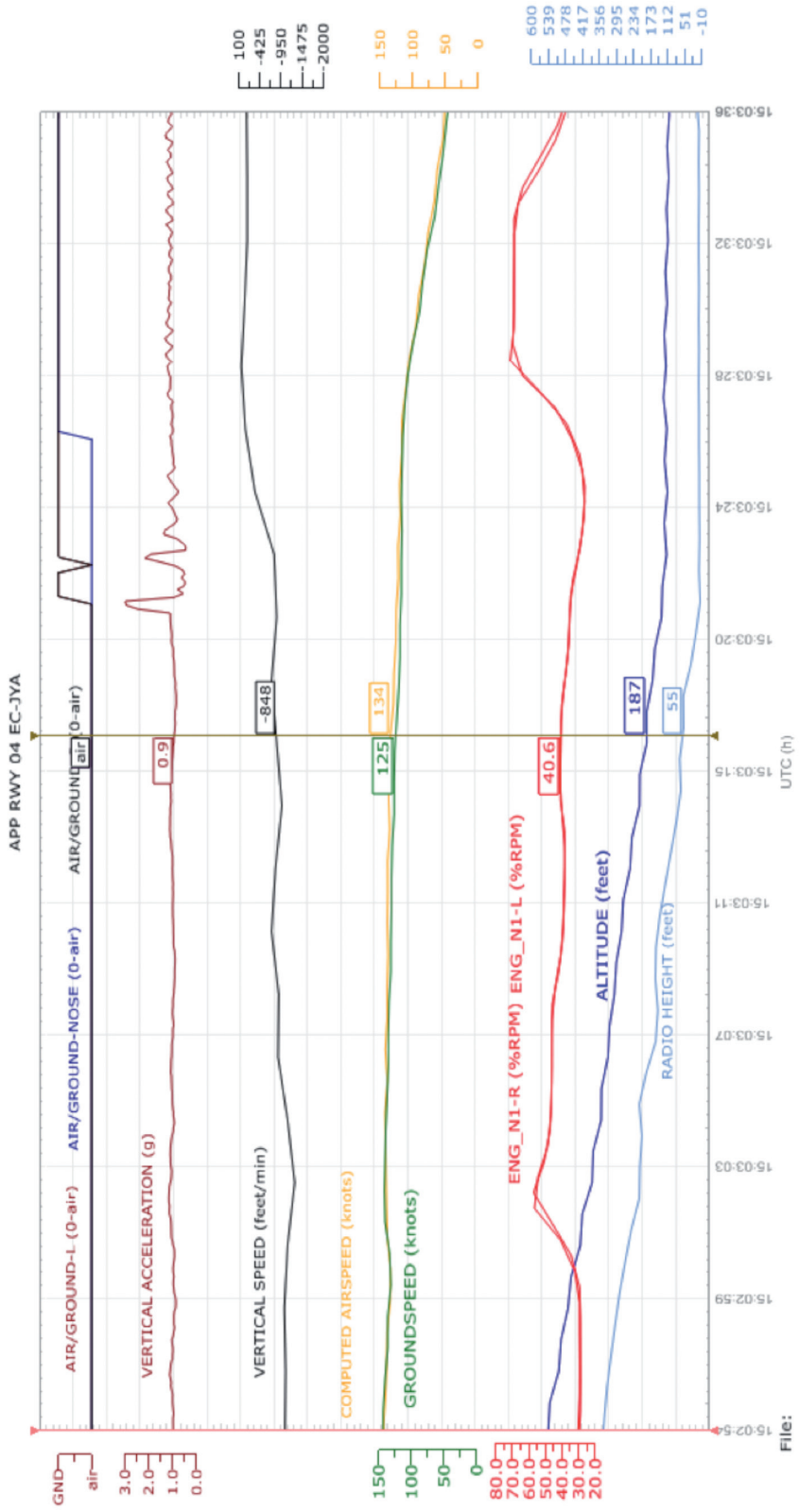
APPENDIX C

DFDR DATA-GRAPHS

Final approach



Landing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AIR/GROUND-NOSE (0-air)
AIR/GROUND (air/0-air)
VERTICAL ACCELERATION (g)
VERTICAL SPEED (feet/min)
COMPUTED AIRSPEED (knots)
GROUNDSPEED (knots)
ENG_N1-R (%RPM) ENG_N1-L (%RPM)
ALTITUDE (feet)
RADIO HEIGHT (feet)
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134
125
40.6
187
55
UTC (h)
File:

APPENDIX D

OPERATIONS AT EAS WITH THE CRJ900

OPERATIONS AT EAS WITH THE CRJ900

The following must be considered when operating at the airport:

A. GENERAL

The flight crew must comply with the following:

- The approach and landing shall be made by the captain.
- The flight crew shall have been trained on the special Approach with Reduced VREF procedure.
- The flight crew shall have specific knowledge of the topography of the area.
- It shall not be used as an alternate airport for the CRJ900 fleet.
- Initially nighttime operations at the airport shall not be allowed until sufficient experience in the operation is gained.

B. PRE-FLIGHT PHASE

- The flight crew shall do a pre-flight briefing, detailing the use of the special procedure and the conditions required to continue to the destination.
- The flight to EAS shall not be conducted with a CRJ900 if the airplane has a fault in any of the following systems:
  - — Primary flight controls and related systems (pitch, feel…)
  - — Secondary flight controls (flaps, slats, spoilers and similar) and related systems
  - — Throttle controls and related systems (FADEC, reversers…)
  - — Deicing and related systems
  - — Radioaltimeter
  - — Braking (including parking brake), WOW and related systems
  - — Hydraulic systems
  - — EGPWS

C. DURING THE FLIGHT

- If the pilot in command is incapacitated, the crew will proceed directly to the alternate airport.

- The flight to EAS with the CRJ900 shall not be continued if any of the following systems has a fault:

  — Primary flight controls and related systems (pitch, feel…)

  — Secondary flight controls (flaps, slats, spoilers and similar) and related systems

  — Throttle controls and related systems (FADEC, reversers…)

  — Deicing and related systems

  — Radioaltimeter

  — Braking (including parking brake), WOW and related systems

  — Hydraulic systems

  — EGPWS

  — Stall warning and protection system

- The flight crew shall hold a briefing before starting the descent into the airport that notes the use of the special procedure, the conditions required to continue and the go-around procedure.

D. APPROACH PHASE

To achieve approach speeds that allow the CRJ900 to operate at the EAS airport, the flight crew must apply the special procedure Approach with Reduced V_{REF}, bearing in mind the following:

- The landing and approach limits contained in the special version of the airports analysis for this airport shall be used.

- If a go around is required, it shall be made with a flaps setting of 20º.

- The special V_{REF} and V_{2GA} speeds shown in the last page of the Speeds Booklet shall be used.

The crew shall also consider the following:

- If the pilot in command is incapacitated, they shall proceed directly to the alternate airport.

- Approaches are to be made using the "stabilized approach" concept, rigorously observing the parameters required for an approach to be considered stabilized. If any of the parameters is violated, the flight crew must abort the approach immediately and initiate the go-around procedure.

- Instrument approaches to Runway 04 in IMC are not authorized by the company.
- Approaches to runway 22 with circling to 04 require a minimum visibility of 3 km and a minimum ceiling of 2500'.

E. LANDING

During the landing the following must be considered:

- The crosswind limits are:

  — 20 kt DRY RUNWAY

  — 15 kt WET RUNWAY

- The landing must be at the TDZ, if not a go around shall be executed.
- The reversers shall be armed for all landings and used as required.
- Braking shall be commenced immediately after the front gear wheel touches down.

F. TAKEOFF

During takeoffs from EAS the following must be considered:

- All takeoffs shall be executed with 20º flaps, no FLEX, using the full available runway. Once lined up and cleared to take off, thrust shall be applied with the brakes engaged until N1 reaches a minimum of T/O Thrust - 5%.
- The crosswind limits are:

  — 20 kt DRY RUNWAY

  — 15 kt WET RUNWAY

- Minimum requirement for taking off from runway 22:

— It must be possible to execute the engine failure procedure while keeping the surrounding terrain in visual contact.