



**COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
E INCIDENTES DE
AVIACIÓN CIVIL**

Report IN-040/2016

Incident involving an Airbus A-319-111, registration CS-TTD, operated by TAP Portugal, on approach to the Santiago de Compostela Airport (Spain) on 10 October 2016



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

Report

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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) n° 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

° ' "	Sexagesimal degrees, minutes and seconds
°C	Degrees centigrade
AAL	Above airport level
ACC	Area control center
ADS	Aviation data systems
AENA	Airports and Air Navigation Services Provider
AIP	Aeronautical information publication
AIS	Aeronautical information service
AMC	Acceptable means of compliance
APP	Approach
A/P	Autopilot
ARO	Air traffic services reporting office
ATC	Air traffic control
ATIS	Automatic terminal information service
ATPL	Airline transport pilot license
ATS	Air traffic services
AWO	All-weather operations
BKN	Broken
CAS	Calibrated airspeed
CECOA	Airport coordination center
CEFAL	Airport services center
CEOPS	Operations coordination center
CI	Cost index
CIAIAC	Civil Aviation Accident and Incident Investigation Commission
COA	Surveillance and alert center
COM	Communications
COPS	Security control stations
CYYT	ICAO code for the St. John's Airport in Newfoundland
DAVH	Decision Altitude / Height
DME	Distance Measurement Equipment
EASA	European Aviation Safety Agency
EAT	Estimated Approach Times
EDFH	ICAO code for the Frankfurt-Hahn Airport

EFB	Electronic flight bag
EGKK	ICAO code for the London Gatwick Airport
ETA	Estimated time of arrival
FCL	Flight crew licensing
FCOM	Flight crew operating manual
FD	Flight director
FL	Flight level
FMS	Flight management system
ft	Feet
GM	Guidance Material
GPIAAF	Office for the Prevention and Investigation of Aircraft and Rail Accidents of Portugal
h	Hours
IAF	Initial Approach Fix
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument landing system
INAC	National Civil Aviation Institute of Portugal
IR	Instrument rating
kg	Kilogram
Kt	knots
L	Left
lb	Pounds
LEBL	ICAO code for the Barcelona Airport
LEST	ICAO code for the Santiago Airport
LEVX	ICAO code for the Vigo Airport
LoA	Letter of agreement
LPMA	ICAO code for the Madeira Airport
LPPR	ICAO code for the Porto Airport
LVP	Low Visibility Procedures
M	Mach number
M	Meters
MDA	Minimum descent altitude
MDA / H	Minimum decision altitude / Height
METAR	Aviation routine weather report
MHz	Megahertz
MPA	Multi-pilot aircraft

NAV	ATC services provider in Portugal
NM	Nautical miles
NOTAM	Notice to airmen
OFP	Operational flight plan
OM	Outer marker
OM	Operations Manual
PF	Pilot flying
QAR	Quick access recorder
RVR	Runway visual range
RWY	Runway
SNS	National event system
STG	IATA Code for Santiago airport (Spain)
TACC	Terminal area control center
TAF	Aerodrome forecast
TDZ	Touchdown zone
TOAM	Maneuvering area operations technician
TWR	Control tower
TWY	Taxiway
UTC	Coordinated universal time
VIS	Visibility
VLS	Lowest selectable speed
VOR	VHF omni-directional range

Synopsis

Owner and Operator:	TAP Portugal
Aircraft:	Airbus A-319-111, registration CS-TTD
Date and time of incident:	Monday, 10 October 2016 at 08:28 ¹
Site of incident:	Approach to the Santiago de Compostela Airport (Spain)
Persons onboard:	6 crew and 75 passengers, none injured.
Type of flight:	Commercial air transport – Scheduled – Domestic – Passenger
Phase of flight:	Approach
Date of approval:	27 September 2017

Summary of the incident.

On 10 October 2016, an Airbus A-319-111, registration CS-TTD, operated by TAP Portugal, took off from the Madeira Airport (LPMA) enroute to the Porto Airport (LPPR). Its callsign was TAP1710.

While on approach to the Porto Airport, the crew were instructed to enter a holding pattern over point RETMO, since low-visibility procedures were in effect at the airport due to weather, which was causing delays.

The crew had planned the Vigo Airport (LEVX) as the first alternate and adjusted their fuel management based on that plan, monitoring the weather situation at that airport.

While on approach to runway 17 at the airport, the crew informed both approach control and the Porto control tower of their intention to proceed to Vigo if they were forced to go around.

When they could not establish the required visual reference upon reaching the approach minimums, the crew decided to go around and proceed to Vigo as planned. Once in

¹ All times in this report are in UTC. To calculate local time, add two hours to UTC.

contact with Porto approach control, they were informed that the Vigo Airport had reached its parking capacity, and that they would have to proceed to the Santiago de Compostela Airport.

Once in contact with Santiago approach, the crew declared a fuel emergency, since their fuel management estimate indicated that they were going to land with a fuel amount below the 989 kg specified in the operational flight plan as the final reserve.

After flying the approach to runway 35 at Santiago, the aircraft landed without incident and the crew were instructed to taxi to the assigned parking stand.

This report contains one safety recommendation for the operator, TAP Portugal, and two for the ATS service providers, ENAIRE and NAV Portugal.

1. FACTUAL INFORMATION

1.1. History of the flight

On 10 October 2016, an Airbus A-319-111, registration CS-TTD, operated by TAP Portugal, took off from the Madeira Airport (LPMA) enroute to the Porto Airport (LPPR). Its callsign was TAP1710.

Due to the weather forecast at their destination, which called for fog with reduced visibility, the crew decided to request extra fuel, which would allow them to remain in a holding pattern for 30 minutes.

At the Porto Airport, the low-visibility procedures had been in effect from 00:57 until 10:15 on the day of the incident.

The scheduled departure time was 05:10, but it was delayed until 05:45 due to restrictions at the destination.

The takeoff fuel was 7164 kg, versus the 5973 kg required in the operational flight plan (OFP).

En route the crew maintained a cruise altitude of FL380 and a fuel efficient speed, as required in the OFP.

During the approach to the Porto Airport, the crew were instructed to fly standard arrival route LAVPA 9M and to hold over point RETMO. The weather at the airport was causing delays, as it required operating with low-visibility procedures.

The aircraft entered a holding pattern at FL090 at 07:33:30, and remained in this pattern for 27 minutes.

The first alternate airport considered by the crew was the Vigo Airport (LEVX) due to the favorable weather forecast at that airport.

At 07:57:22 Porto APP controller established a communication with Santiago TACC² asking for a traffic operated by Vueling (VLG8476) request for Vigo Airport (LEVX) availability. Santiago TACC controller replied that, at this time, they were waiting for an answer from Vigo but, for the time being, everything was right and that he would communicate.

At 08:00:11, the crew exited the pattern and started the approach maneuver to runway 17 at the Porto Airport with 2265 kg of fuel. Two minutes later, while executing the maneuver, the crew informed approach control of their intention to proceed to Vigo should they be forced to execute a go-around.

² TACC - Terminal area control center

At 08:07:53, the crew were transferred to the control tower and cleared to land. They were informed that visibility on the runway was 200 meters in the first third, 325 meters at the halfway point and 350 meters at the end of the runway. The crew repeated their message that their required alternate was Vigo in the event of a go-around.

At 08:11:44, the crew decided to go around and proceed to the planned alternate when they did not acquire the required visual reference upon reaching the approach minimums. In their message to the tower controller, they reiterated their request to proceed to the Vigo Airport.

At 08:13:58, they established contact with Porto approach control and were cleared to climb to FL120 and proceed direct to point TURON.

At 08:18:28, after coordinating with Santiago approach control, the Porto approach controller reported that the Vigo Airport was at full parking capacity and that they would have to proceed to the Santiago de Compostela Airport. As a result, they were cleared direct to point NOLMU and transferred to Santiago approach.

At 08:19:15, a "FUEL L WING TK LO LVL" alert was received, indicating a low fuel level in the left wing, and at 08:25:25 a second alert was received, this time for the right tank: FUEL L+R WING TK LO LVL.

At 08:26:34, the crew, in contact with Santiago approach, declared a fuel emergency after estimating that the amount of fuel remaining upon landing would be below final reserve fuel, which the OFP specified as 989 kg.

After flying the VOR approach to runway 35 at Santiago, the aircraft landed at 08:38:20 without incident with 959 kg of fuel remaining. The crew were instructed to proceed to parking stand 04.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				Not applicable
None	6	75		Not applicable
TOTAL	6	75		

1.3. Damage to aircraft

The aircraft was not damaged.

1.4. Other damage

There was no other damage.

1.5. Personnel information

The captain of the aircraft, a 45-year old Portuguese national, had an EU-FCL airline transport pilot license (ATPL (A)), issued by the civil aviation authority of Portugal (INAC, Instituto Nacional da Aviação Civil), with an A320 type rating that was valid until 31/12/2016. He also had a class-1 medical certificate that was valid until 08/11/2017. He had a total of 7905 flight hours, of which 3890 had been on the type.

The first officer of the aircraft, a 29-year old Portuguese national, had an EU-FCL airline transport pilot license (ATPL (A)), issued by the civil aviation authority of Portugal (INAC, Instituto Nacional da Aviação Civil), with an A320 type rating that was valid until 28/02/2017. He also had a class-1 medical certificate that was valid until 22/08/2017. He had a total of 4000 flight hours, of which 2500 had been on the type.

1.6. Aircraft information

The aircraft, an Airbus A-319-111, registration CS-TTD and serial number 790, is equipped with two CFM International CFM56-5B5/P engines. The aircraft had a certificate of airworthiness, number PT 095/09, issued on 18/05/2009 by Portugal's National Civil Aviation Institute. It had been maintained in accordance with its approved maintenance plan, and its last inspection, a type A (A3) and R1 check, had been performed on 19 September 2016 with 60205 hours and 33854 cycles on the aircraft.

1.7. Meteorological information

The crew received the flight dispatch with weather information that included the 03:00 UTC METAR for the destination. There was also a TAF included with the dispatch information that was for 23:00 UTC from the day before. Neither of these reports mentioned the low-visibility conditions that were anticipated for the Porto Airport, though they did mention the low ceiling.

LPPR/OPO PORTO/FRANCISCO SA CARNEIRO

SA 100300 16005KT 7000 FEW001 BKN004 14/14 Q1018=
FT 092300 1000/1024 VRB03KT 5000 BR SCT005
PROB40 1000/1009 2000 BR BKN003
BECMG 1010/1012 9999 NSW FEW012
BECMG 1012/1014 26007KT
BECMG 1017/1019 VRB03KT 5000 BR SCT005=

The air navigation service provider, NAV Portugal, stated that the low-visibility procedures at the Porto Airport were activated at 00:57 UTC. The cloud ceiling (BKN) remained below 400 feet from then on, meaning the activation conditions were satisfied. These procedures were deactivated at 10:15 UTC.

The 04:00 UTC METAR informed of the reduced visibility and the 100 ft cloud ceiling. Subsequent reports, issued every 30 minutes, informed of the presence of fog at the airport, a phenomenon that limited visibility until 09:30 UTC.

The weather conditions contained in ATIS "H", at 07:00 UTC, and written down by the crew in the OFP, described a runway visual range (RVR) of 275 meters in the touchdown zone, 325 meters in the middle zone and 275 meters at the end of the runway, with a vertical visibility of 100 ft. The wind was calm.

The METAR for 08:00 UTC, when the crew made the approach to the Porto Airport, was as follows:

METAR LPPR 100800Z 00000KT 0300 R17/0225N FG VV001 12/12 Q1019=

This report states that the visibility was 300 meters, with a runway visual range of 225 meters, no changes, with fog and a vertical visibility of 100 ft.

Also, the runway visual range provided by approach when the aircraft was transferred to the control tower was 200 meters at the threshold, 250 at the halfway point and 375 meters in the final third. In its next message, the tower only reported an improvement in the RVR for the middle third, to 275 meters.

The weather information available to the crew did not indicate a RVR in the first third of the runway in excess of 300 m during the time that the crew were holding or during the approach maneuver to LPPR.

The condition at the alternate airports, Vigo and Santiago de Compostela, was favorable for the conduct of air operations, as confirmed by the status and forecast information that was available to the crew.

DESTINATION ALTERNATES:

LEVX/VGO VIGO

SA 100300 23003KT 190V260 CAVOK 13/11 Q1018 NOSIG=
FT 092300 1000/1024 VRB04KT 9999 FEW030 TX22/1014Z TN11/1008Z=

LEST/SCQ SANTIAGO

SA 100300 12004KT CAVOK 10/08 Q1019 NOSIG=
FT 092300 1000/1024 VRB05KT CAVOK TX22/1014Z TN10/1004Z=

1.8. Aids to navigation

All of the aids to navigation used by the crew along the route and during the ILS approach to runway 17 at the Porto Airport were in operation on the day of the incident.

At the Santiago Airport, NOTAMs 1E3922/16 and 1E3918/16 were in effect, which informed, respectively, that the CAT I ILS for runway 35 and its corresponding DME were out of service.

There is no indication that the navaids had any effect on the incident considered herein.

1.9. Communications

During the incident, the crew were in contact with the following control stations:

- Porto approach (APP), on a frequency of 121.1 MHz
- Porto Airport control tower (TWR), on a frequency of 118.0 MHz
- Santiago approach (APP), on a frequency of 120.2 MHz
- Santiago Airport control tower, on a frequency of 118.75 MHz

The communications with every station worked correctly, and the contents of the most relevant exchanges are provided in point 1.1.

1.10. Aerodrome information

The Porto Airport (LPPR – Francisco Sa Carneiro) is located 11 km northwest of the city of Porto in Portugal. Its reference point is at an elevation of 69 m (227 ft) and it has one asphalt runway in a 17/35 orientation that measures 3480x45m.

It has a CAT II ILS approach for runway 17.

The information on operating in reduced visibility at the airport is contained in AIP Portugal, which states the following:

The information on operating in reduced visibility at the airport is contained in AIP Portugal, which states the following:

- a. *"ATC will apply safeguards and procedures for ILS operations that will become effective in relation to WX conditions as specified below.*
- b. *When the visibility is less than 2500M and / or the cloud base is below 400 FT, ATC will instruct TFC to perform ILS approaches to RWY 17.*
- c. *When the TDZ RVR is 800M or less and / or the cloud base is at 200FT or below, ATC will ensure that the ILS protection area is clear of (known) TFC before issuing the LDG clearance (normally at OM).*
- d. *RVR Information*

ATC will always give the RVR value for position ALPHA (TDZ). As for either of the two other positions, BRAVO and CHARLIE,

- *less than the TDZ and less than 800M; or*
- *less than 350M, or*
- *requested by the pilot*

Clearances

The above weather conditions and related safeguards are chosen so as to facilitate CAT I and CAT II operations respectively.

During approach, pilots will be informed of:

- *any known unserviceability of aids, or facilities referred on this paragraph above and/or downgrading, when applicable.*
- *significant changes in surface wind (speed and direction).*
- *changes in RVR*

.....

Aircraft awaiting weather improvement in holding area will be stacked from FL60 upward.

When approaches are possible again, new slots will be assigned, based on the original sequence of arrival

The sequence may be adjusted in order to provide for differences in landing criteria e.g. ILS CAT II approaches against ILS CAT I approaches.

ATC may initially allocate more favourable (higher) holding levels when the number and type of aircraft involved in holding allows this procedure."

The Vigo Airport (LEVX) is 8 km east of the city of Vigo, in the province of Pontevedra (Spain). Its reference point is at an elevation of 261 m (855 ft), and it has one asphalt runway in a 01/19 orientation that measures 2385x45m.

The Santiago Airport (LEST) is 10 km northeast of the city of Santiago de Compostela, in the province of A Coruña (Spain). Its reference point is at an elevation of 370 m (1213 ft), and it has one asphalt runway in a 35/17 orientation that measures 3170x45m.

1.11 Flight recorders

The CIAIAC was informed of the incident by way of the report received through the National Event System (SNS) on 21/10/2016. Due to the time that elapsed between the date of the incident and the receipt of the notification, the information from the aircraft's flight recorders was no longer available.

The aircraft has a quick access recorder (QAR) that contained flight data information. The operator supplied the file with the recorded data, as well as the parameter data frame file, needed to convert these data into engineering units.

These data provided information on the progress of the flight and on the timeline for relevant events.

The aircraft commenced its takeoff run at 05:52:51 h with 7164 kg of fuel onboard.

It climbed without interruption to FL380, which it reached at 06:10:59 h. The fuel recorded at that point was 5585 kg. The crew maintained a cruise speed of M 0.78.

At 07:13:03 h, the crew started the descent maneuver with 3372 kg of fuel remaining.

At 07:33:47 h, they reached FL090 and started the holding maneuver, circling six times. Their amount of fuel onboard was 3136 kg.

At 07:54:30, when ATC arranged for the diversion of the last aircraft accepted in Vigo, there were 2465 kg of fuel onboard.

The crew continued to circle until 08:00:11, when they were cleared to start their approach. They had 2265 kg of fuel remaining.

At 08:11:03, when the crew received the final weather report for the airport from the tower controller, the aircraft was at a recorded altitude of 1326 ft.

At 08:11:10, they reached an altitude of 1000 ft with 2066 kg of fuel.

From that point, they made a stabilized approach with both autopilot (A/P) and flight director (FD) systems engaged, the auto-thrust system engaged and selected to SPEED mode, maintaining a CAS of 125 kt (the minimum speed selectable, VLS, was 117 kt and the target speed was 124 kt). The flaps were set to FULL.

They reached the approach minimums, at a radio-altitude of 100 ft, and went around at 08:11:44. The minimum recorded altitude was 65 ft with 2047 kg of fuel.

They flew their diversion route and reached FL120 at 08:17:22 with 1595 kg of fuel onboard.

At 08:19:15, the "FUEL L(R) WING TK LO LVL"³ alert was received. The amount of fuel remaining onboard was 1503 kg, with 673 kg remaining in the left main tank and 830 kg in the right.

At 08:25:25, the "FUEL L+R WING TANK LO LVL"⁴ alert was activated with 1231 kg of fuel remaining.

At 08:26:34, the crew declared a fuel emergency with 1176 kg of fuel remaining.

At 08:38:20, the aircraft landed on runway 35 at the Santiago de Compostela Airport (LEST) with 959 kg of fuel onboard.

The coordinates recorded in the QAR were used to obtain the following diagram with the aircraft's flight path

³ According to the TAP FCOM, this alert is received when the amount of fuel in the left or right tank is below 750 kg. It relies on sensors that detect dry conditions and is independent of the fuel quantity indicators.

⁴ Activated when a low fuel level is detected in both internal wing tanks.

1.12. Wreckage and impact information

Not applicable.

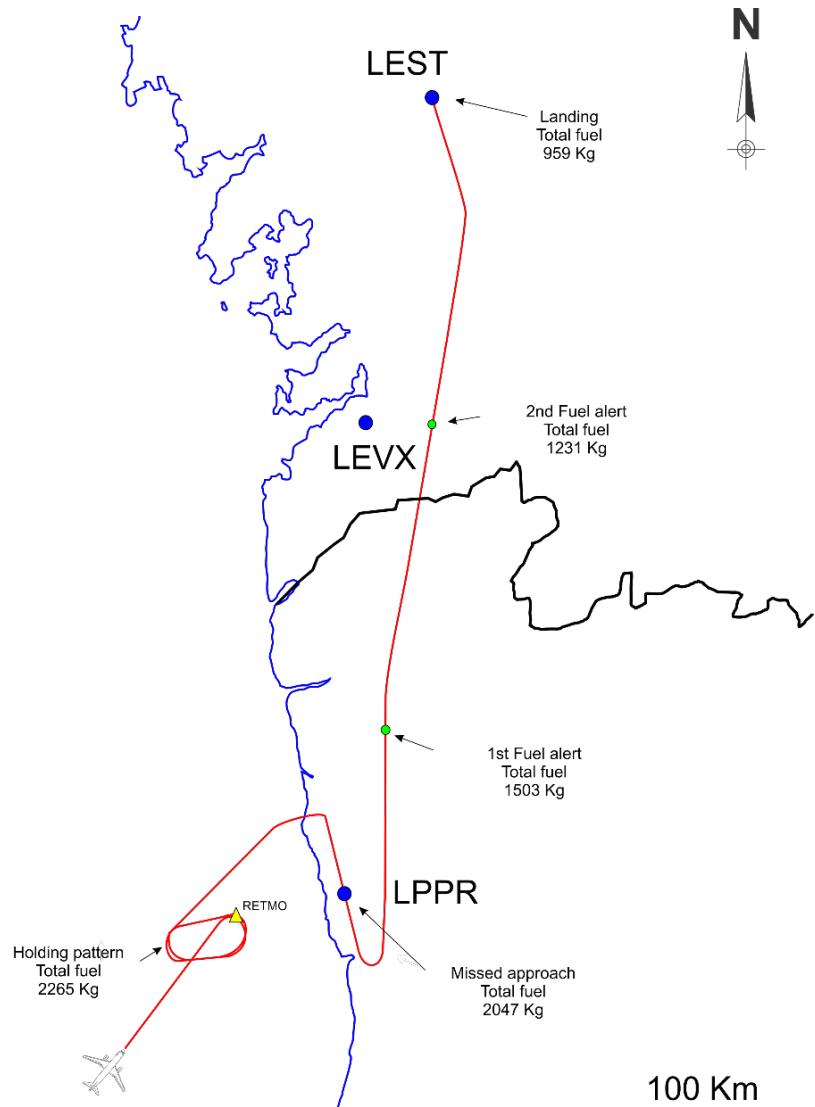


Figure 1 - Aircraft's flight path.

1.13. Medical and pathological information

Not applicable.

1.14. Fire

There was no fire.

1.15. Survival aspects

Not applicable.

1.16. Tests and research

1.16.1. *Reports from the crew of the aircraft*

The aircraft's pilots were asked to provide detailed information on the event for the investigation through Portugal's accident investigation authority (GPIAAF - Gabinete de Prevenção e Investigação de Acidentes com Aeronaves e de Acidentes Ferroviários).

The CIAIAC received a questionnaire that had been answered in English by the crew, whose statements are reproduced below.

The crew went on duty at the Madeira Airport. It was the first time the two pilots had flown together.

They held the operational briefing at the departure airport. Due to the weather forecast at the destination, they decided to add fuel to hold for 30 minutes.

There were no deferred items in the aircraft logbook.

The crew did not question the accuracy of the OFP calculation. They confirmed that the airline's policy is to give full authority to the captain to add however much fuel he deems necessary for the safe performance of the flight. The reasons for adding extra fuel must be explained in a field provided in the EFB⁵.

They received updated weather information on the destination and alternates once they were already in the aircraft.

The flight took off thirty minutes late due to being assigned a slot due to traffic. The pilot flying (PF) was the captain. Both pilots were familiar with operations at the Porto Airport.

The flight progressed normally and they did not encounter significant weather en route. The cruise phase was carried out as required by the OFP, flying at FL380 and a fuel-efficient speed.

Before commencing the descent, the crew held a briefing on the low-visibility

⁵ EFB. - Electronic Flight Bag. Computer used by the crew to receive information and do operational calculations and communications.

procedures (CAT II approach) and the alternates. They also calculated what the minimum fuel would be upon leaving the holding pattern.

They were cleared to fly standard arrival maneuver LAVPA 9M for ILS to runway 17. ATC instructed them to proceed to RETMO and hold at FL090. They left the pattern with 2380 kg of fuel remaining.

During the holding maneuver, they informed the approach controller (APP) of their intentions for the alternate airport, which they repeated to the tower (TWR) once established on the ILS.

They had to go around because the runway visual range (RVR) was below the minimum 300 meters required.

When they went around, they were instructed by ATC to turn left direct to point TURON and climb to FL120. They had 2300 kg of fuel onboard when they went around.

When they reached point TURON, they were told that their planned alternate (Vigo LEVX) was not available.

In their opinion, there was a traffic coordination problem since they were told at least three times that LEVX was available, but once they reached TURON, that was no longer the case.

They proceeded to their second alternate, LEST, and landed on runway 35. Once at the stand with the engines stopped, they recorded 940 kg of fuel remaining, versus the final reserve of 989 kg.

They did not think that fatigue had contributed to the incident. That same day they made the return flight to Porto (LPPR).

1.16.2. Statement from the NAV Portugal control station

The incident log at the Porto control tower contains this statement of the event (translated to English from the Spanish translation):

"Aircraft misses approach while over runway due to weather and requests to divert to LEVX, as per information provided by crew while in holding pattern. Latest information from STG APP at 07:57 is that LEVX would be available to accept diverting traffic until notified otherwise. In coordinating of traffic TAP1710 at 08:17, STG informs LEVX no longer available and that aircraft's destination would have to be LEST."

1.16.3. Statement from the Vigo control tower

In its event notification report, the company FERRONATS, which is the ATS service provider at the Vigo Tower, provides the description of the event from the duty controller:

"There had been diversions from Porto that morning (before TAP 1710 TAP1926 and VLG8476 arrived at LEVX diverted from Porto, awaiting verification from CEFAL of other diversions). They were all coordinated in the same way, LEST calling on the hotline and informing they had a potential deviation to LEVX from Porto. In each case, LEST is told that confirmation that the diverted traffic can be received will be provided after calling Operations-CEFAL⁶. In each case, CEFAL informs LEVX TWR that it is going to be tight and that it will confirm in a little while. In every case CEFAL ends up informing they can go to LEVX with the exception of TAP1710, which it tells TWR cannot be accommodated. LEVX reports this to LEST on the hotline. After a while, with TAP1710 past PIVON and in contact with LEST, CEFAL informs LEVX TWR that TAP1710 could be accommodated. The controller informs CEFAL that TAP1710 has been en route to LEST for a while."

1.17 Organizational and management information

1.17.1. Information in ATC log at Santiago TACC

The ATC log for the Santiago TACC from the day of the incident describes the diversions that this unit had to manage:

Diversions to Vigo Airport LEVX	
Time	Remarks
05:52	CVK7131 from CYYT to LPPR diverted to LEVX due to weather at LPPR
07:48	TAP1926 from LPPT to LPPR diverted to LEVX
08:03	VLG8476 from LEBL to LPPR diverted to LEVX

Diversions to Santiago Airport LEST	
Time	Remarks
07:27	RYR88DD from EDFH to LPPR diverted to LEST due to fog
08:10	EZY67XB from EGKK to LPPR diverted to LEST
08:20	TAP1710 from LPMA to LPPR diverted to LEST.

⁶ CEFAL Airport services center, combines various units (COM, AIS, ARO, ATIS, COA, COPS and ADS).

1.17.2. Information on the control tower at the Vigo airport as an alternate airport

Below is a summary of the coordination messages between the Santiago TACC controller and the Vigo tower controller:

At 07:21, the duty controller at the Santiago TACC called the controller in the Vigo control tower to inquire about the airport's ability to accept more traffic, since traffic inbound to Porto were diverting. The tower controller asked about the types of aircraft that wanted to go to the airport, since the capacity of the stand was limited. Santiago TACC replied that they were A320 and B737 type aircraft.

At 07:22, the tower controller asked the Airport Operations Coordination Center (CEOPS) about the airport's capacity. The Center confirmed that, for the time being, they could accept one more A320-type aircraft. This information was relayed to the Santiago TACC.

At 07:32, the CEOPS called the tower controller to ask if any additional aircraft were coming. Tower asked the TACC, which replied that it was not confirmed yet, since aircraft were attempting to land in Porto.

At 07:44, the TACC confirmed that TAP1926, an A319, was diverting to the Vigo Airport and provided the relevant information. The tower controller informed the CEOPS, which assigned it stand number 6.

At 07:54, the TACC asked the tower if they could accommodate a diverting A320 Vueling aircraft, VLG8476, from Porto. The CEOPS replied that it would need two minutes to coordinate and that it would call back to confirm.

At 08:00, the TACC again asked the tower, since VLG8476 was insisting. The tower called CEOPS, which finally accepted the traffic after confirming the aircraft model. The tower controller relayed the airport's acceptance to the Santiago TACC.

At 08:12, the CEOPS confirmed parking stand 2 for the arriving Vueling aircraft, VLG8476, and asked about the aircraft parked at stand number 10. The tower confirmed that it did not have a departure flight plan for that aircraft yet.

At 08:18, the TACC asked the tower if they could accommodate an A319 in 10 minutes, adding they needed a fast reply or the aircraft would be diverted to the Santiago Airport. The tower asked the CEOPS, which confirmed they could not accommodate any additional aircraft, which the tower relayed to the TACC.

At 08:31, CAVOK AIR flight CVK7131, an AN12 aircraft, called the tower to request airfield information. One minute later it was cleared for start-up.

At 08:35, the CEOPS called the tower to inform that if there were any pending diversions, the airport could accept one more following the departure of CVK7131. The tower replied that the TACC had not requested any more diversions for the moment.

At 08:42, the tower controller cleared CVK7131 to depart, which was transferred to the TACC at 08:45.

1.17.3. Information on apron management by the Airport Operations Coordination Center (CEOPS) at the Vigo Airport

The report issued by the Vigo Airport states that on the day of the incident, the airport's ability to accept inbound traffic was diminished for a period of time due to aircraft being diverted from the Porto Airport.

As a result, the "Procedure for Coordinating and Managing Apron Saturation at the Vigo Airport" was applied. In keeping with said procedure, the CEOPS coordinated the capacity of the parking stand in real time with the control tower, to which end they tracked the number of aircraft parked at any given time, the schedule for arriving and departing aircraft and requests from aircraft that were diverting to Vigo from Porto due to weather. A factor to keep in mind is that they had to reserve capacity for scheduled commercial operations, which required leaving several parking stands available.

The aircraft that had been diverted from Porto and had landed in Vigo, and that were parked when TAP1710 requested clearance to land at Vigo, were:

- CVK7131 (AN12) – stand 7A, code F (required leaving stands 7, 8 and 9 clear)
- TAP1926 (A319) – stand 6
- VLG8476 (A320) - stand 2

The scheduled aircraft that were parked at the airport when TAP1710 requested clearance to land at Vigo

- PR-CSE (FA7X) – stand 1B (affected stands 1 and 1A)

- XY1-EQE – stand 10
- AEA7302 (E190) - stand 5

In order to accommodate upcoming scheduled operations, the airport had to leave stands 3 and 4 vacant.

The information in the "Aircraft parking and docking map", contained in AIP Spain, is included as an appendix to this report. This document shows that parking stand 7, with a maximum capacity for a B738-type aircraft (and thus for an A319, like the incident aircraft), was available as long as an aircraft was already parked in stand 7A, as was the case.

The 08:19 message between the Santiago TACC and the tower requested confirmation on the ability to accommodate an A319-type aircraft in 10 minutes. The TACC reiterated its need for a quick response or the aircraft would be diverted to Santiago. The tower asked the CEOPS, which confirmed there was no additional capacity.

At no point was the Vigo tower informed that TAP1710 had fuel problems, which would eventually result in its crew declaring FUEL MAYDAY to the Santiago TACC.

The report concludes that if the tower and the CEOPS been aware of the fuel problems of the affected aircraft, the Vigo Airport would have cleared said aircraft to land and directed it to park at the taxiway on the apron until a stand became available.

In fact, the "Procedure for Coordinating and Managing Apron Saturation at the Vigo Airport" includes the following measure in point 3.2.2, "Apron saturation condition in real time":

"In the event that a stand cannot be assigned to an aircraft but it is anticipated that a stand will be available within 15 minutes, the aircraft shall, in coordination with TWR ATC, TOAM and handling agent, temporarily remain somewhere on the taxiway in the apron such that it does not obstruct any aircraft being pushed back or taxiing to the runway via TWY C1 or C3.

Said aircraft shall wait for a parking stand to become available."

1.17.4. ENAIRE management procedure

ENAIRE, the ATS service provider, on the date of the occurrence, had a published

document that explains the "Severe adverse weather procedure".

Section 7.2 deals with the "Management of situations with difficulties in landing and takeoff", indicating that these procedures "form general guidelines for action".

The document recognizes that in these cases information can be available on the current and planned situation provided by the meteorological offices of the airports.

Regarding the management of alternates, the procedure assigns the mission to the approach controller (APP) to collect the information from the crews on time to deviations and / or requested alternates, and inform the supervisor of the intentions of the crews.

The ACC / TACC supervisor shall, where possible, keep up-to-date information on the situation regarding number of diversions, and coordinate jointly with the Control Room Chief or at his request, with alternate aerodromes the possibility of deviations to them because of high estimated approach times (EAT).

The differentiated supervisor or the tower controller shall coordinate with the airport manager the number of parking spaces available for possible diversions, at the request of the ACC supervisor or Control Room Chief. It will also communicate any changes that could impact on the ability to handle deviations (deterioration of the weather situation, changes in the number of parking spots, etc.).

Section 8 of said document deals with "Coordination in the event of massive diversions to alternate aerodromes", which states that in those cases where large numbers of aircraft divert or could divert, the flow of information between controllers, pilots and the airport manager must be handled as efficiently and accurately as possible. The document does not define the term "massive diversions" nor in which cases must this procedure be applied.

This procedure assigns the Control Room Chief or the ACC Supervisor, if delegated by the former, the task of obtaining updated information that can be provided without delay to the planning controller in the sector that is handling the diversions, so as to organize the traffic in the sector.

One of the sets of information that has to be available is the number of parking spaces available at potential alternate aerodromes and any possible limitations in terms of maximum aircraft size. To this end, the procedure instructs the Control Room Chief or the ACC Supervisor to coordinate with CEOPS/CECOA/Duty Manager, or with their designees at the airports receiving the diverted traffic within their region or another region or station, and ascertain the number of parking spaces available at that time at the airport and the type of airplane it can accommodate.

In this incident, the alternates were coordinated via communications between Porto APP and the Santiago TACC, the TACC with the tower and the tower with the corresponding CEOPS.

The Letter of Agreement (LoA) in effect between Porto APP and the Santiago TACC does not specify any coordination in this regard between these two dependencies.

The investigation could not ascertain what procedure is used by the ATC services provider in Portugal, NAV, to coordinate alternates.

1.18. Additional information

1.18.1 *Information available to plan the flight*

Investigators analyzed the operational flight plan (OFP) filed, including the crew's notes. For this leg between the Madeira Airport (LPMA) and the Porto Airport (LPPR), four destination alternates were considered, with Vigo (LEVX) and Santiago (LEST) being the first and second airports considered in the event of a diversion. The requested off-blocks time was 05:10 h and the estimated takeoff time was 05:18 h.

Figure 2 shows an excerpt from the OFP involving the fuel planning. These calculations show that:

- In the load sheet document, the takeoff fuel is shown as 7000 kg. Compared with the 5973 kg shown in the OFP, it appears that the crew requested that an additional 1027 kg of fuel be added prior to takeoff.
- The additional fuel would allow the aircraft to remain in a holding pattern for about 30 minutes.
- This extra fuel raised the aircraft's takeoff weight to 56227 kg, versus the estimated 55577 kg used to calculate the takeoff weight in the OFP. There is minor influence on consumption because of this extra fuel, since the OFP itself states that the aircraft will consume 74 additional kg for every 1000 kg of additional weight.
- The contingency fuel allowed for 5 minutes of flight time.
- The fuel taken onboard prior to departure covered the possibilities of diverting to Vigo, Santiago and Lisbon, or to remain in the holding pattern for an additional 30 minutes.
- The final reserve fuel was 989 kg.

- The taxi fuel was estimated at 92 kg.

The OFP was calculated assuming instrument departure DEGUN3N from runway 05 at the Madeira Airport and a cruise level of FL380. The fuel calculation was based on a cost index⁷ of 9 (CI9), which yielded an optimal speed of around M 0.78. The fuel factor⁸ used was +4.5.

The OFP also showed (Figure 2) information on four alternate airports, in order of preference, with Vigo being the first and Santiago the second. For each, the OFP showed the direct heading, distance and wind component, time, flight level and the fuel required. To reach Vigo, the OFP showed a distance of 94 NM and a time of 23 minutes. In the case of Santiago, the distance was 156 NM, requiring an estimated time of 33 minutes.

The crew wrote different notes on the OFP to track fuel consumption and time at four points on the route. The fuel onboard was always more than 900 kg above that planned in the OFP. Specifically, the crew noted that it arrived at the IAF to the expected standard terminal arrival route (LAVPA) with 910 kg more than planned. As concerns the weather information, the crew had the 03:00 UTC METAR and the 23:00 UTC TAF forecast from the day before, which covered the period of operation at the destination airport and in the two alternates.

The conditions detailed in these reports indicated a normal flight and did not mention any significant phenomena. According to the crew's statement, they updated the weather information once in the aircraft at the departure airport. The 04:00 UTC METAR described reduced visibility and a cloud ceiling of 100 ft at the destination airport. Successive reports, issued every 30 minutes, reported the presence of fog at the airport, which limited visibility until 09:30 UTC.

The crew also had weather and wind forecast charts for their route that did not mention any significant phenomena that could have forced them to divert from the planned route.

As for the NOTAMs of relevance to their operation:

- At the Santiago Airport, NOTAMs 1E3922/16 and 1E3918/16 were in effect, informing, respectively, that the CAT I ILS for runway 35 and its associated DME were out of service.

⁷ The cost index is a value that relates the direct operating costs and the fuel costs. This index is used by the FMS to calculate the optimal cruise speed needed to minimize the cost of the flight.

⁸ The fuel factor is a variable that corrects consumption based on the degraded aerodynamic characteristics that affect aircraft over time.

As part of the relevant information for planning the flight, the documentation included correction factors due to increased fuel consumption. In order to calculate the degraded performance, a 1% correction factor had to be entered into the FMS and 4.5% in the OFP (fuel factor).

Oct 10 2016 03:31 OPF TP1710/10/FNC/OPO/											
--- OPF produced at 10.10.2016/03:31 UTC ---											
TAP1710	10OCT2016	LPMA	LPPR	A319	TTD	RELEASE	0255	10OCT16			
OPF 3					PERF 4.5						
	STD	0510	0705	STA		COST INDEX	9				
	ETD	0510	0712	ETA		ROUTE ID	FNCOP01				
CTOT NIL	ETOT	0518	0707	ELDT		GND DIST	682				
						AIR DIST	718				
POB	LOAD	ZFW	LW	TOW		SPEED	ECON				
MAX 19088	14623	57000	61000	68000		AVGE FF	2166				
PLN 6065	7227	49604	51656	55577		AVGE W/C	M020				
						TKOF ALTN				
REMARKS:											
MEL/CDL		DESCRIPTION									
FLIGHT PLAN ROUTE											
-LPMA/05 N0449F380 DEGUN3N DEGUN DCT LAVPA LAVPA9M LPPR/17											
	TO DEST	LPPR		REMARKS:							
TRIP	FUEL	TIME		ALTERNATE ROUTE TO:		VIA		FRSV	989		
RCONT 5 MIN	3921	0149		APT	TRK	DST					
ALTN	162	0005	LPPT	---	---	---					
FRSV	901	0023	LEVX	002	94	TURON7L TURON DCT		160	M006	0023	0901
				---	---	---					
HLDDST	989	0030		LEST	017	156	TURON7L TURON A5 STG	220	M010	0033	1319
ADDT	0	0000		LPPT	191	201	MANIK9R MANIK DCT XAMAX XAMAX6C	310	P010	0036	1522
TOF	5973	0247		LEMD	102	296	PESUL7L PESUL DCT RIVRO DCT HARDI	310	P007	0050	2028
TAXI	92	0008					UZ405 TLD				
FOB	6065										

Figure 2 – Fuel calculations for the incident flight (OFP)

1.18.2.- Operator's Operations Manual, Part A

The operator's Operations Manual (OM 08.01.07) contains its fuel policy in terms of the fuel and oil amounts required for each operation. This policy reflects the contents of CAT.OP.MPA 150, Fuel policy, and its AMC and GM.

It should be noted that TAP Portugal allows adding an additional amount of fuel that permits the aircraft to remain in a holding pattern for 30 minutes at 1500 ft above the destination aerodrome when the weather conditions present there require the implementation of low-visibility procedures (LVP), or the cloud ceiling is at or below 250 ft or visibility is below 800 m.

As concerns in-flight fuel management, the operator's Operations Manual (OM 8.3.7) details the relevant policies and procedures. In compliance with CAT.OP.MPA.280, it instructs crews to monitor the fuel status, which must be compared

against the OFP and written down at regular intervals to determine if the minimum fuel required is available to continue the flight, and if it is not, to decide whether to divert to the alternate. This comparison also serves to identify high consumption or possible fuel losses.

This chapter also contains the procedures to use for minimum fuel or in the event of a fuel emergency. These instructions comply with EASA Safety Information Bulletin 2013-12, which recommends complying with the relevant stipulations in ICAO Annex 6.

"The pilot-in-command shall advise ATC of a minimum fuel state by declaring MINIMUM FUEL when, having committed to land at a specific aerodrome, the pilot calculates that any change to the existing clearance to that aerodrome, or other air traffic delays, may result in landing with less than planned final reserve fuel.

.....

The pilot-in-command shall declare a situation of fuel emergency by broadcasting MAYDAY MAYDAY MAYDAY FUEL, when the calculated usable fuel estimated to be available upon landing at the nearest adequate aerodrome where a safe landing can be performed is less than the planned final reserve fuel."

As for the conditions for starting or continuing an approach maneuver (OM 08.03.01), the instructions in the Manual conform to those in CAT.OP.MPA.305, and state:

"The commander or the pilot to whom conduct of the flight has been delegated may commence an instrument approach regardless of the reported RVR/VIS.

If the reported RVR/VIS is less than the applicable minimum the approach shall not be continued:

- 1. below 1 000 ft. above the aerodrome; or*
- 2. into the final approach segment in the case where the DA/H or MDA/H is more than 1 000 ft. above the aerodrome."*

Chapter OM 08.04 contains the operating procedures to use in all-weather operations (AWO).

It defines a category-II approach as a precision instrument approach and landing with a decision altitude below 200 ft but not below 100 ft and a runway visual range (RVR) not below 300 m.

In those cases where RVR information for all three thirds of the runway is provided, the value for the first third shall be decisive in continuing the operation. If reported and relevant, the RVR values for the middle and final third shall also be decisive in continuing the operation.

1.19. Useful or effective investigation techniques

Not used.

2. ANALYSIS

2.1. *Analysis of the operation.*

The aircraft was flying from the Madeira Airport (LPMA) to the Porto Airport (LPPR). The flight plan listed the Vigo Airport (LEVX) as the first alternate and the Santiago Airport (LEST) as the second.

The weather situation, with reduced visibility and a low cloud ceiling at the Porto Airport, resulted in low-visibility procedures to be in effect from 00:57 h until 10:15 h on the day of the incident.

The crew added extra fuel in addition to that requested in the OFP to allow circling for 30 minutes, in accordance with the instructions contained in the airline's Operations Manual.

The crew flew a flight profile that reflected the OFP and did the recurring fuel checks as demanded by regulations and by their company's procedures.

They held over point RETMO for about 27 minutes as they waited for the weather to improve, before eventually deciding to commence the approach, with sufficient fuel to carry out the approach maneuver and proceed to the first alternate airport.

The crew stated that while holding, they informed ATC twice and then the Porto control tower of their intention to proceed to their alternate, Vigo. There is a record of a call made to approach control at 08:02:21 h to report their intentions in the event of a go-around, as well as of a call made to the control tower, at 08:07:53 h, in their first contact with that station to reiterate said intentions. On neither occasion were the crew told that the Vigo Airport was not available.

During the time when they were in a holding pattern, flew the approach and then the missed approach procedure, the RVR reported for the first third of the runway was below the minimums authorized for a CAT II approach, which is 300 m.

In keeping with the company's procedures, which reflect the contents of the CAT. OP.MPA.305 regulation, they decided to start the approach independently of the reported RVR. The same regulation requires that if the reported RVR/VIS value is below the minimums applicable to the approach, it shall not be continued below 1000 ft above aerodrome level. According to data recorded in the QAR, the crew continued to the approach minimums of 100 ft despite the reported RVR remaining below the minimum required.

At 08:11:03 h, moment when the crew received the final weather report for the airport from the tower controller, the aircraft's recorded altitude was 1326 ft. The crew should therefore have aborted the maneuver at that point or upon reaching 1000 ft AAL.

By the time the missed approach was executed, at 08:11:04 h, the crew's diversion possibilities were limited to the Vigo Airport, their first alternate, without having to use their final reserve fuel. Therefore, the conditions described in the operator's Operations Manual for declaring "MINIMUM FUEL" were satisfied. This would have informed ATC that they were committed to land at a specific airport and that any change to the existing clearance to that aerodrome, or other traffic delays, could result in landing with less fuel than planned; that is, that the situation could transition to one of MAYDAY FUEL.

At 08:18 h, the TACC asked the Vigo tower if it could accept one A319-type aircraft in 10 minutes, requesting a quick reply so it could divert the aircraft to the Santiago Airport, their second alternate, in the event that the answer was negative. The tower asked the CEOPS, which confirmed the airport's inability to accommodate any more aircraft, which the tower relayed to the TACC.

The MAYDAY FUEL declaration was made at 08:26:34 h, and was the first communication that alerted ATC about the aircraft's fuel problems, as the aircraft was en route to the Santiago Airport.

According to AENA's report on the management of the apron by the Airport Operations Coordination Center (CEOPS) at the Vigo Airport, as per the "Procedure for Coordinating and Managing Apron Saturation at the Vigo Airport", had the tower and the CEOPS been aware of the fuel problems of the incident aircraft, the Vigo Airport would have cleared said aircraft to land and instructed it to park on the taxiway on the apron until a stand became available.

Therefore, the proper use of fuel management communications described in the operator's Operations Manual, which comply with the ICAO and EASA recommendations, could have avoided the emergency situation that is the focus of this report. As a result, the following safety recommendation is issued to the operator:

- It is recommended that the operator, TAP Portugal, provide specific training to its crews on the use of MINIMUM FUEL and MAYDAY FUEL declarations and their implications, based on the current EASA and ICAO recommendations.

The investigation has deemed that the status of the navaids did not affect the incident investigated.

2.2. Analysis of alternate airport management

According to the information in the METAR, the weather situation at the Porto Airport kept the airport at minimums due to visibility from 07:30 to 08:30 UTC, impeding its operation.

In these circumstances, the proper management of alternates and smooth communications between crews and controllers is crucial to allowing the former to manage their fuel consumption and make operational decisions.

Therefore, ATC must make an effort to anticipate relevant information in this regard that is otherwise unavailable to crews, such as the availability of alternate airports, so that crews can be given the chance to take suitable measures to ensure the safety of their operation.

At 07:54 h, the Santiago TACC made contact with the Vigo tower to ask about the possibility of accepting a Vueling A320 that had diverted from Porto. This was the last aircraft accepted. The CEOPS could have reported the temporary saturation of the platform at that point, together with its foreseen. With this information the crew could have decided to proceed directly to the Santiago Airport, which the amount of fuel remaining they had at the time would have allowed them to do.

The report on the saturation of the apron also indicated that stand 7A, which was occupied by a code-F aircraft, entailed the use of stands 7, 8 and 9. The information in the "Aircraft parking and docking map" contained in the AIP Spain (Appendix 2) states that parking stand 7, whose maximum capacity is a B738-type aircraft (and could therefore accommodate an A319, like the incident aircraft), is available as long as an aircraft was already parked in stand 7A, which was the case. Therefore, an additional aircraft of the type involved in this incident could have been docked.

The procedure used in the incident to coordinate the alternates involved establishing communications between Porto APP and the Santiago TACC, the TACC with the tower and the tower with the corresponding CEOPS, who was giving information about the availability of parking as he was requested case by case, instead of giving information about their full actual capacity.

This sequence differs from the provisions of the "Severe adverse weather procedure" of ENAIRE, where the ACC / TACC and tower supervisors are assigned the responsibility of coordinating with the airport to know the availability forecast of

parking stands and its limitations, thus anticipating essential information for crews for fuel management.

In addition, the Letter of Agreement (LoA) in effect between Porto APP and the Santiago TACC does not specify any steps to coordinate this action. Since the Vigo and Santiago airports are the main alternates for Porto, and viceversa, this Commission deems it is necessary to recommend that a procedure for coordinating between these stations be written so as to ensure the flow of information concerning the availability of the alternate airports.

The following recommendations are thus issued:

- It is recommended that ENAIRE, ATS service provider, establish a coordination procedure between the Santiago TACC and Porto APP stations that provides information on the availability of potential alternate airports in the event of severe adverse meteorological conditions⁹.
- It is recommended that NAV Portugal, ATS service provider, establish a coordination procedure between the Santiago TACC and Porto APP stations that provides information on the availability of potential alternate airports in the event of severe adverse meteorological conditions.

9 Meteorological conditions that may prevent the aircraft to land safely in the airport.

3. CONCLUSIONS

3.1. Findings

- The crew of the aircraft were properly qualified, experienced, physically fit and had valid licenses.
- The aircraft had been maintained in keeping with its approved Maintenance Program and had a valid Certificate of Airworthiness and a Certificate of Registration.
- The aids to navigation at the Porto and Vigo airports were operational. The CAT I ILS for runway 35 at the Santiago Airport and its associated DME were out of service, though this was of no consequence to the outcome of the incident.
- Ground-air communications worked properly at all times.
- The aircraft's crew had relevant weather information when preparing the flight.
- The aircraft's crew anticipated potential delays by loading extra fuel over that specified in the operational flight plan to allow them to circle for 30 minutes.
- During the approach maneuver, the crew informed ATC twice of their intention to divert to Vigo in the event of a missed approach.
- When the aircraft was holding and during the approach and go-around maneuvers, the RVR reported for the first third of the runway was below the minimums authorized for the CAT II approach.
- The crew flew the approach maneuver to the minimums, where they went around after failing to acquire the required visual reference.
- When they requested diversion, they were told that the stand at Vigo was at full capacity and that they would have to proceed to their second alternate, the Santiago Airport.
- The crew did not report MINIMUM FUEL, and as a result they first alerted ATC that they had fuel problems when they issued a MAYDAY FUEL message while en route to the Santiago Airport.

- The aircraft landed at the Santiago Airport with an amount of fuel remaining that was below final reserve.
- The arrangements to accept the last aircraft diverted to the Vigo Airport were made six minutes before the aircraft left the holding pattern. A notification from CEOPS at the Vigo Airport informing they were at full capacity would have allowed the holding aircraft to be diverted to its second alternate without incurring fuel problems.
- The Letter of Agreement between Porto APP and Santiago TACC does not consider any procedures for managing alternates.

3.2. Causes

The incident was caused by the improper management of the capacity at the alternate airports by the stations involved during adverse weather conditions, and by the failure of the crew to issue a MINIMUM FUEL declaration, as specified in the operator's Operations Manual, which would have allowed the Vigo Airport to adopt temporary extraordinary measures to receive the incident aircraft.

Contributing to the incident was the lack of anticipation at the Vigo Airport Operations Coordination Center to report the saturated condition on the apron, which prevented Air Traffic Control from promptly informing the crew involved.

4. SAFETY RECOMMENDATIONS

The proper use of communications by the crew to manage the fuel, as described in the operator's Operations Manual, which are in keeping with ICAO and EASA recommendations, could have prevented the emergency situation that gave rise to this investigation. The alternate airport selected could have adopted temporary extraordinary measures to receive the aircraft with fuel problems. As a result, the following safety recommendation is issued to the operator:

REC 66/17: It is recommended that the operator, TAP Portugal, provide specific training to its crews on the use of MINIMUM FUEL and MAYDAY FUEL declarations and their implications, based on the current EASA and ICAO recommendations.

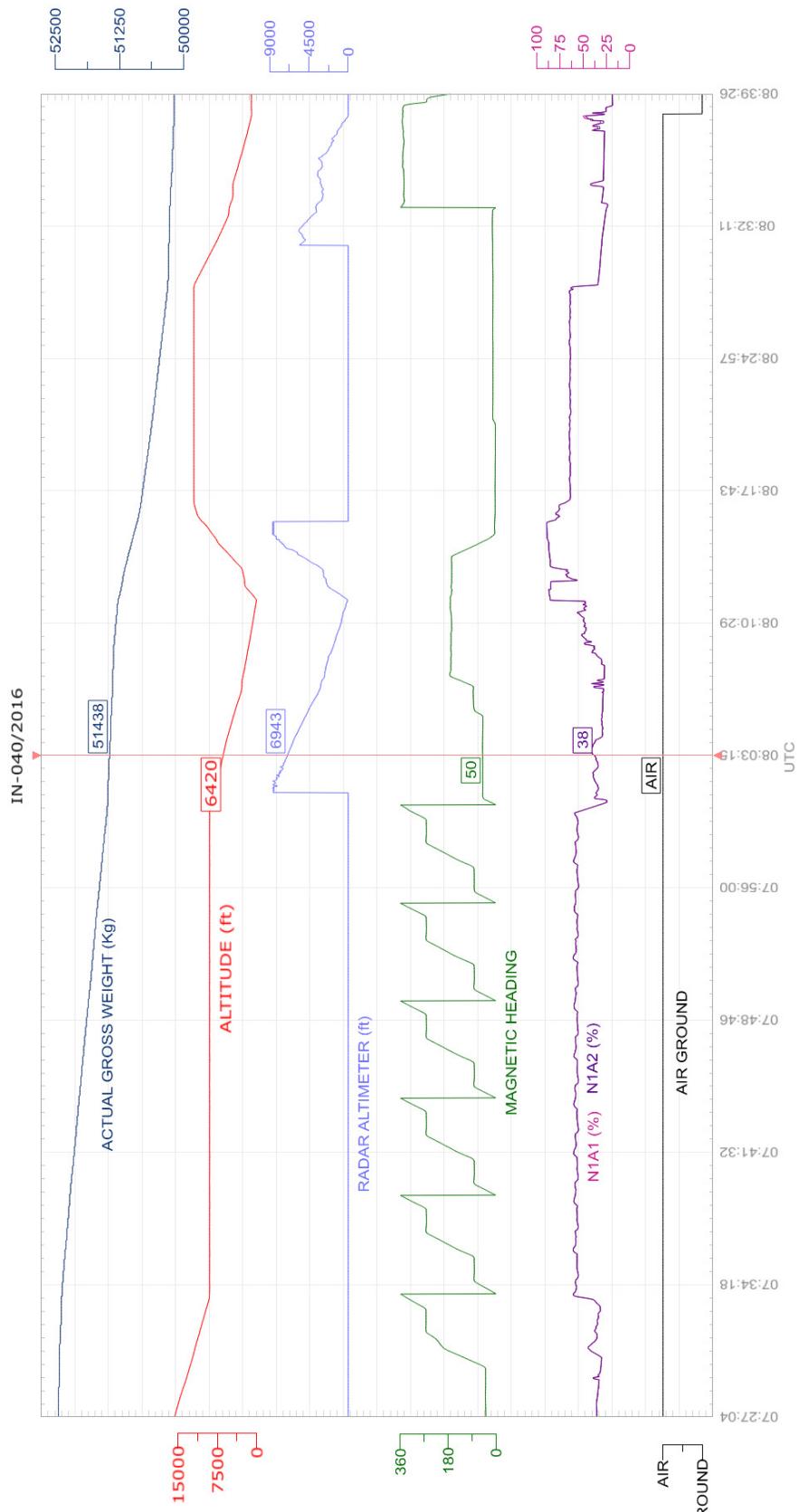
The investigation noted that the Letter of Agreement (LoA) in effect between Porto APP and Santiago TACC does not specify any alternate coordination method. Since the Vigo and Santiago airports are the main alternates for Porto, and vice versa, this Commission deems it is necessary to issue the following safety recommendation:

REC 67/17: It is recommended that ENAIRE, ATS service provider, establish a coordination procedure between the Santiago TACC and Porto APP stations that provides information on the availability of potential alternate airports in the event of severe adverse meteorological conditions.

REC 68/17: It is recommended that NAV Portugal, ATS service provider, establish a coordination procedure between the Santiago TACC and Porto APP stations that provides information on the availability of potential alternate airports in the event of severe adverse meteorological conditions.

APPENDIX 1

Parameters recorded in the QAR



APPENDIX 2

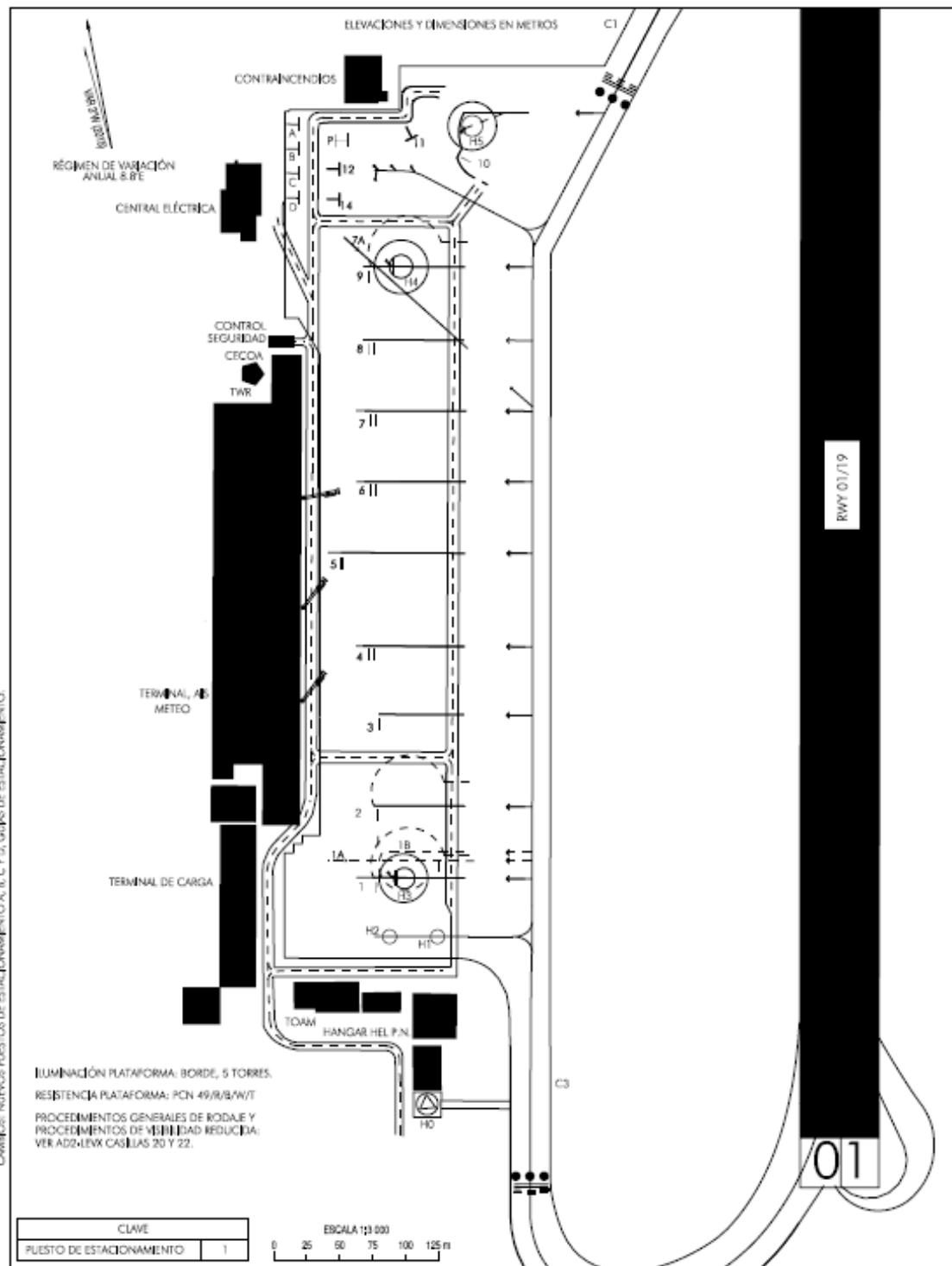
Información AIP Plano de estacionamiento y atraque de aeronaves OACI del aeropuerto de Vigo (LEVX)

PLANO DE ESTACIONAMIENTO
Y ATRAQUE DE AERONAVES-OACI

ELEV
PLATAFORMA
254

TWR 118.450
GMC 121.700

VIGO



CARACTERÍSTICAS DE LOS PUESTOS DE ESTACIONAMIENTO
AIRCRAFT STANDS CHARACTERISTICS

RAMPA RAMP	PUESTO STAND	COORDENADAS COORDINATES	SALIDA EXIT	MAX ACFT	APROAR NOSE TO	OBSERVACIONES REMARKS
-	1	42°13'24.48"N 008°37'56.27"W	R/A (1)	A321	-	INCOMP. 1A y/and 1B INCOMP. Salida autónoma si el puesto de estacionamiento 2 está ocupado / autonomous exit if stand 2 is occupied. INCOMP. H3.
→	1A	-	R	B763	-	INCOMP. 1, 1B, 2 y/and H3.
→	1B	42°13'24.28"N 008°37'54.99"W	A	A320	-	INCOMP. 1, 1A, 2 y/and H3.
→	2	42°13'25.79"N 008°37'55.91"W	R/A (1)	A321	-	INCOMP. 1A y/and 1B INCOMP. Salida autónoma si el puesto de estacionamiento 3 está ocupado / autonomous exit if stand 3 is occupied. INCOMP. Si ACFT en puesto de estacionamiento 1/H3 realiza salida autónoma / if ACFT in stand 1/H3 carries out autonomous exit.
→	3	42°13'27.42"N 008°37'55.47"W	R	B738	-	INCOMP. Si ACFT en puesto de estacionamiento 2 realiza salida autónoma / if ACFT in stand 2 carries out autonomous exit.
→	4	42°13'28.68"N 008°37'55.21"W	R	B738	-	400 Hz
→	5	42°13'30.49"N 008°37'55.55"W 42°13'30.42"N 008°37'55.04"W	R	B738 B763 (2)	-	400 Hz
→	6	42°13'31.66"N 008°37'54.41"W	R	B738	-	400 Hz. INCOMP. Si puesto de estacionamiento 5 está ocupado por B763 / if stand 5 is occupied by B763
→	7	42°13'32.95"N 008°37'54.05"W	R	B738	-	Utilizable si ACFT ya estacionada en puesto de estacionamiento 7A. / Available if ACFT parked in stand 7A
→	7A	-	R/A	A124	-	(3)
→	8	42°13'34.23"N 008°37'53.71"W	R	A321	-	INCOMP. 7A
→	9	42°13'35.56"N 008°37'53.35"W	R/A (1)	A321	-	INCOMP. 7A & H4
→	10	42°13'37.33"N 008°37'50.81"W	A	A320	-	INCOMP. H5; INCOMP. 7A (4) (5)
→	11	-	A	PA34	-	Aviación general / General aviation MAX SPAN 11.86 m INCOMP. 7A (4)
→	12	-	A	CS25	-	Aviación general / General aviation MAX SPAN 14.30 m INCOMP. P; INCOMP. 7A (6)

RAMPA RAMP	PUESTO STAND	COORDENADAS COORDINATES	SALIDA EXIT	MAX ACFT	APROAR NOSE TO	OBSERVACIONES REMARKS
-	14	-	A	C525	-	Aviación general / General aviation MAX SPAN 14.30 m INCOMP. 9; INCOMP. 7A (6)
-	A	-	(8)	C172	-	MAX SPAN 11.5 m (9)
-	B	-	(8)	C172	-	MAX SPAN 11.5 m (9)
-	C	-	(8)	C172	-	MAX SPAN 11.5 m (9) INCOMP. 7A (7)
-	D	-	(8)	C172	-	MAX SPAN 11.5 m (9) INCOMP. 7A (4)
-	P	-	A	C172	-	MAX SPAN 11.5 m Parada de motores de ACFT y mover ACFT / Stop engines of ACFT and push ACFT. INCOMP. 7A (4)
→	H0	-	A	EC35	-	Uso exclusivo SAP (Servicio Aéreo Policia) / exclusive use SAP (Air Police Service).
→	H1	42°13'23.08"N 008°37'55.19"W	A	S76	-	Uso exclusivo Servicio Salvamento Marítimo / exclusive use Maritime Rescue Service.
→	H2	42°13'23.51"N 008°37'56.29"W	A	S76	-	No AVBL si H1 está ocupado / if H1 is occupied. Uso exclusivo Servicio de aduanas / exclusive use of customs service.
→	H3	-	A	EH10	-	INCOMP. 1, 1A, 1B. INCOMP. Salida autónoma si puesto de estacionamiento 2 está ocupado / autonomous exit if stand 2 is occupied.
→	H4	-	A	MI8	-	INCOMP. 7A y / and 9
→	H5	-	A	EH10	-	INCOMP. 10; INCOMP 7A (4)
<p>(1) Salida autónoma para ACFT tipo B717/CRK/CR9 / Autonomous exit for ACFT type B717/CRK/CR9.</p> <p>(2) B763 si puesto de estacionamiento 6 está libre / B763 when stand position 6 is unoccupied.</p> <p>(3) Utilizable excepto cuando ACFT estacionado en estacionamiento 7 / Available except when ACFT parked in stand 7.</p> <p>Salida de ACFT con letra de clave F (AN-124) incompatible con puestos de estacionamiento 10, 11, 12, 14, P, C, D y H5 / Exit of code letter F ACFT (AN-124) incompatible with stands 10, 11, 12, 14, P, C, D and H5.</p> <p>Salida de ACFT con letra de clave E incompatible con puestos de estacionamiento 10, 11, 12, 14, D y H5 / Exit of code letter E ACFT incompatible with stands 10, 11, 12, 14, D and H5.</p> <p>Salida de ACFT con letra de clave D incompatible con puestos de estacionamiento 12 y 14 / Exit of code letter D ACFT incompatible with stands 12 and 14.</p> <p>Entrada de ACFT con letra de clave F (AN-124) incompatible con puesto de estacionamiento 10 / Entry of code letter F ACFT (AN-124) incompatible with stand 10.</p> <p>(4) Si realiza salida desde puesto de estacionamiento 7A ACFT con letra de clave E o superior / If a code letter E ACFT or higher carries out exit from stand 7A.</p> <p>→ (5) Si realiza entrada de ACFT con letra de clave F (AN-124) al puesto de estacionamiento 7A / If a code letter F ACFT (AN-124) carries out entry in stand 7A.</p> <p>(6) Si realiza salida desde puesto de estacionamiento 7A ACFT con letra de clave D o superior / If a code letter D ACFT or higher carries out exit from stand 7A.</p> <p>(7) Si realiza salida desde puesto de estacionamiento 7A ACFT con letra de clave F (AN-124) / If a code letter F ACFT (AN-124) carries out exit from stand 7A.</p> <p>(8) Remolcado a puesto de estacionamiento P con los motores apagados / Towing to stand P with engines off.</p> <p>(9) Entrada a través de puesto de estacionamiento P con los motores apagados / Entry via stand P with engines off.</p>						