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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

EUROCONTROL Network Manager Safety Review for ALS stakeholders

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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

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Abstract			
The objective of this report is to provide further assurance to the Portuguese Civil Aviation Authorities as to the quality, correctness and completeness of the assessment and mitigation of the potential safety risk to aircraft operations associated to the proposed closure of ALS RWY17/35, as documented in the operational safety reports developed by the Portuguese aviation service providers and the pilot association.			
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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Table of Contents

DOCUMENT CHARACTERISTICS	II
DOCUMENT APPROVAL.....	III
EDITION HISTORY	IV
TABLE OF CONTENTS.....	V
EXECUTIVE SUMMARY	1
1 DOCUMENT PURPOSE AND SCOPE	4
2 REVIEW OBSERVATIONS.....	4
2.1 SUMMARY REPORT FOR CLOSING ALS RUNWAY 17/35 NAV/ANA/TAP/APPLA.....	4
2.2 ANA/ALS ASSESSMENT OF NON-SIMULTANEOUS OPERATION OF ALS RWY35 AND RWY03	5
2.3 NAV PORTUGAL OPERATIONAL SAFETY ASSESSMENT	6
2.4 TAP PORTUGAL OPERATIONAL RISK ASSESSMENT.....	7
2.5 APPLA OPERATIONAL ASSESSMENT	9
2.6 INTERVIEW FEEDBACK	10
3 ANALYSIS OF UPDATED OPERATIONAL STATISTICS	15
4 CONCLUSIONS.....	18
ANNEX 1	20
ANNEX 2	21
ANNEX 3	21
ANNEX 4	21
ANNEX 5	XXII
ABBREVIATIONS.....	XXIV



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

EXECUTIVE SUMMARY

On a request of Lisbon airport operator a team of safety experts from the EUROCONTROL Network Management Directorate carried out a review of the operational safety assessments for the closure of runway 17/35 at Lisbon airport.

The review was complemented by interview with operational and managerial staff from ANA, NAV Portugal, TAP Portugal and the IPMA. The review conclusions were corroborated by analysis of additional statistical data associated to the use of the Lisbon runway system.

The safety assessments of the main Lisbon airport stakeholders have been carried out in compliance with the approved risk assessment and mitigation procedures of the service providers/operators.

The assessments analyse the two main scenarios of runway operations:

- use of RWY03/21 as preferred runway with occasional use of RWY17/35 (current scenario); and
- use of RWY03/21 only (future scenario).

The use of RWY17/35 for take-off and landing of aircraft is very limited. In 2017 it was used by 0,2% of all arriving and departing flights. In 2015 and 2016 its use is below 2%.

Hazards related to the two scenarios have been identified by the safety assessment, their consequences and severity established. A number of risk mitigation measures have been designed in order to reduce or eliminate the identified risk to tolerable and acceptable levels.

The potential for increased safety risk in strong crosswind conditions due to higher probability of RWY03 excursion compared to RWY35 is off-set by the lower severity of the excursion consequences and the suggested additional mitigation measures. Strong crosswind is a threat in the final approach and landing phases of flight, however aircraft operators should manage the associated risk of unstabilised approach and runway excursion by appropriate flight operations procedures and selection of alternate aerodromes. This is an 'usual' threat that is being managed within the scope of operators' SMS.

The NAV Portugal safety assessments identifies also a number of potential ATM safety benefits associated to the closure of RWY17/35.

Taking into account:

- the results of the review of the operational safety assessment reports provided by TAP Portugal, NAV Portugal, Lisbon airport and APPLA,
- the notes from the interview with the representatives of TAP Portugal, NAV Portugal, Lisbon airport and the IPMA,



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

- the findings of the analysis of the updated operational data provided by ANA,

the overall conclusion of EUROCONTROL Network Manager is that following closure of RWY17/35 the safety level of aircraft operations at Lisbon airport will be preserved and may be increased.

The following recommendations are made in relation to the proposed RWY17/35 closure:

1. The Portuguese CAA should notify all aircraft operators that operate to/from Lisbon airport to update the existing or carry out an operational safety assessment for the use of Lisbon airport with single runway (RWY 03/21) only, and to implement any risk mitigation measures, as may be identified by the operational safety assessment. Such measures should address situations of emergencies and of aircraft unable to land on RWY03 due to crosswind and/or turbulence exceeding the aircraft performance limits, which may require diversion to an alternate airport. From safety perspective, diversion to alternate aerodrome is part of the flight planning and flight execution phases.
2. NAV Portugal should, in coordination with Lisbon airport operator and concerned helicopter operators, develop an optimal solution for helicopter operation at Lisbon airport with single RWY configuration (RWY 03/21).
3. The risk mitigation measures, identified in the consolidated operational safety assessment report that are not yet been implemented, should be considered for implementation ahead of the formal closure of RWY17/35.



**REVIEW OF THE OPERATIONAL SAFETY
ASSESSMENT FOR THE CLOSURE OF
RWY17/35 AT LISBON AIRPORT**

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REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

1 Document purpose and scope

This report documents the review of the operational risk assessments for the closure of RWY17/35 prepared by the main aviation service providers and users of Lisbon airport.

The review was carried out by means of desktop review of the operational safety assessment reports provided to EUROCONTROL by ANA and by face-to-face meeting (interview) with operational and managerial staff from ANA, NAV Portugal, TAP Portugal and the IPMA.

The desktop review included the following documents:

- Operational Safety Assessment Summary Report for Closing ALS Runway 17/35, final version of January 2014;
- Non-simultaneous operation of ALS Runways 35 and 03 - Assessment from the Airport Operations Stand Point, MOD 064605 01;
- Closing of Runway 17/35 ALS, ASO-LP_NAV;
- Operational Risk Assessment, TAP Portugal, 11 December 2013
- Operational Assessment - Operational Risk Analysis for the possible closing of Runway 35 LPPT, APPLA, 30 December 2013.

In addition, recent statistical data associated to the use of the Lisbon runway system that were analysed. The data was provided by ANA on EUROCONTROL request.

The review was carried out by senior safety experts of the EUROCONTROL Network Management Directorate.

2 Review observations

This section contains the observations and findings of the review of the operational hazard assessments carried out by the main Lisbon airport operational stakeholders. The hazard assessments are documented in the reports referred to in section 2 above.

The notes from the face-to-face meeting with the representatives from ANA, NAV, TAP and the IPMA Aeronautical meteorology division are provided at the end of this report section.

2.1 Summary report for Closing ALS Runway 17/35 NAV/ANA/TAP/APPLA

The summary report identifies both, hazards that may occur due to the use of RWY35 and hazards that are associated to its closure. A number of mitigation measures are identified to control the safety risk to aircraft operations in case



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

of adverse weather (strong crosswind) and single runway (RWY03/21) operations.

The owners of those mitigation measures are the major operational stakeholders - aircraft operators (e.g. TAP Portugal¹), ATS provider (NAV) and the airport operator (ANA).

The report identifies potential safety benefits due to RWY17/35 closure (e.g. reduced runway excursion risk, reduced complexity of ground movements), but also potential safety drawbacks (e.g. absence of alternative runway for some aircraft types and increased likelihood of missed approaches in case of adverse weather conditions). According to the majority of opinions (all except APPLA) the (risk) balance is in favour of RWY17/35 closure on the assumption that the identified additional risk mitigation measures will be implemented.

2.2 ANA/ALS assessment of non-simultaneous operation of ALS RWY35 and RWY03

The report explains the operational and safety constraints associated to the operational use of RWY17/35 which makes RWY03/21 the preferred RWY for take-off and landing at Lisbon airport.

Simultaneous operation of both runways is NOT considered safe.

RWY35 crosses the airport operating area and is, therefore, considered more exposed to the likelihood of runway incursions by aircraft or vehicles. Crossing of RWY35 by follow-me vehicles, ambulances or maintenance vehicles is reported as quite frequent.

In case of runway excursion (veer-off) of RWY17/35 the severity of the potential outcome is considered higher (compared to excursion of RWY03/21) due to the proximity of Terminal 1 buildings and aircraft parked on stands (perceived higher risk of ground collision).

The location of RWY35 is considered to have a negative business impact, too, due to the increased connection times.

The assessment does not identify any negative impact on safety of the apron area management. However, crossing of RWY17/35 requires coordination with Lisbon TWR, which increases the workload for ATC and concerned airport operations staff.

According to the report non-simultaneous use of both RWY03/21 and RWY17/35 in operation has no negative impact on safety of operations. However, the closure of RWY35 would bring significant increase in operational safety² by removing the risk of RWY17/35 excursions and incursions, and reducing staff coordination workload associated to RWY17/35 crossing.

¹ TAP Portugal contributes to more than 50% of commercial flight operations at ALS

² The above consideration is considered correct in principle, however it is not backed-up by analysis of any reported runway incursion and runway excursion events at Lisbon airport.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

The report identifies 12 operational hazards related to non-simultaneous use of both RWY03/21 and RWY17/35 in operation and analyses the effect of RWY17/35 closure on the safety risk. The scope of the hazard analysis includes airport infrastructure and equipment, RWY surface, runway incursions and runway excursions. The finding is that following RWY17/35 closure the safety risk to aircraft operations is expected to be reduced from Level 2 'Average' to Level 1 'Low' or to non-existent 'N/A', i.e. some hazards would be removed and the risk associated to the other hazards reduced.

Closure of RWY17/35 would require the establishment of new procedures for helicopter operations at Lisbon airport.

The assessment identifies an increased likelihood of RWY03/21 excursion (after RWY17/35 closure) due to operations closer to the allowable limits (e.g. for cross-wind) for aircraft. Alternate runway in the vicinity of Lisbon airport is identified as possible risk mitigation measure.

The closure of RWY17/35 will bring business advantages (shorter connection times, more space for aircraft parking, etc.).

The report concludes that after the change to 'single runway operation' an alternative runway should be found within a reasonable radius of distance to enable flight divergence in emergency situations.

Observation: *According to the above conclusions, the purpose of the 'alternative runway' is to provide opportunity for landing of aircraft in the state of emergency only. This means that aircraft unable to land on RWY03 due to crosswind and/or turbulence exceeding the aircraft performance limits should divert to an alternate airport (e.g. as per filed FPL). From safety perspective, this is a situation (solution) that should be part of the normal flight planning and flight execution.*

2.3 NAV Portugal Operational Safety Assessment

The EUROCONTROL Safety Assessment Methodology is used in the safety assessment.

The report contains a number of assumptions³ related to the traffic mix, runway use and some safety issues (runway incursions and excursions).

Use of RWY35 requires coordination with the control towers of the closely located military bases.

The report provides statistics for the years 2011-2013 of executed RWY03 go-arounds due to unfavourable wind conditions and states that the Go-arounds of RWY03 coincide with prevailing winds of the NNW sector (330° / 360°) with intensities close to 30Kts.

³ The assumptions should be re-validated



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

The assessment identifies one (1) operational hazard related to RWY17/35 closure. The hazard concerns execution of missed approach and go-around. Crosswind and windshear when using RWY03 are identified as causal factors.

The assessment concludes that closure of RWY17/35 will have positive safety impacts on Air Traffic Management (ATM) by:

- removal of the risk factors caused by crossing of RWY17/35;
- reduced complexity of ground movements;
- reduced controller workload due to reduced GND-TWR and TWR-APP coordination;
- reduced coordination with military control towers.

The assessment concludes that closure of RWY17/35 will have also potential negative impact on Air Traffic Management (ATM) by:

- lack of an alternative runway when RWY03/21 is inoperative;
- increased likelihood of go-around and missed approach (the single hazard identified) due to adverse weather conditions for RWY03⁴.

Given the hazard likelihood of occurrence, the assessment concludes that the associated risk is 'tolerable'.

The final conclusion is that there are no drawbacks in the use of a single runway in the ALS.

In an end note the assessment report makes the following point: It is considered necessary to implement a stop-bar system for protecting runways 17/35, which will provide enhanced safety in the prevention of runway incursions.

Observation: Stop bar implementation is considered a strong mitigation of runway incursion risk and is recommended by the European Action Plan for the Prevention of Runway Incursions.

2.4 TAP Portugal Operational Risk Assessment

The assessment is carried out according to the hazard identification and the operational risk management processes defined by TAP SMS.

The report provides a detailed overview of the airport facilities, its working area and its characteristics, and of the associated airport and airspace use

⁴ According to the investment plan, RWY03 is planned to be upgraded from CAT I to CATIIIb operations in September 2018, which will further reduce the impact of low visibility conditions on RWY03 availability.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

constraints. It provides also runway usage statistics by TAP flights in the years 2011-2013⁵.

The hazard identification process considers the following hazardous factors/conditions: intensity and directions of wind, airport layout, use of RWY03 as preferential RWY; design of airspace adjacent to the airport and visual approaches. The hazard consequences considered are Loss of Control/ Aircraft Collision and Runway Excursion.

Crosswind and gusts are considered factors contributing to Hard Landing/ Bounced Landing and are identified as precursors of Runway Excursion.

The airspace design contributes to allocation of late approaches by ATC, which is considered to contribute to unstable approaches, and, in turn, to Runway Excursion by landing with excessive speed and/or long landings.

The visual approaches can be precursors to less stable approaches and thus could contribute to Runway Excursion through Veer-Off after Hard Landings/bounced Landings or Runway Excursion through overrun due to long or floated landing.

The use of RWY03 as preferential runway may lead to a reduction in the operational staff's awareness that is necessary when occasionally using RWY35 and increase the likelihood of runway incursions.

The airport layout (traffic waiting to cross RWY35 near the initial landing area) increases the severity of Veer-Off Runway Excursion consequences after landing on RWY35.

A safety risk matrix is used to assess the risk associated to two runway use scenarios – RWY03 only and RWY03 with occasional use of RWY35. The safety risk associated to the 'RWY03 only' scenario is assessed as moderate before mitigation. The safety risk associated to the 'RWY03 with occasional use of RWY35' scenario is assessed as moderate to high (for wide bodied aircraft using RWY35) before mitigation.

The assessment identifies eight (8) risk mitigation measures owned by NAV P (4) and TAP (4).

After mitigation the safety risk associated to the 'RWY03 only' scenario is assessed as negligible to low and risk associated to the 'RWY03 with occasional use of RWY35' scenario is assessed as low to moderate.

The assessment identifies that hazards common to both runways (strong crosswind) have the same risk index level of tolerability. Probability of runway excursion is higher for RWY03 compared to RWY35, but the severity of the consequences is lower due to the airport layout⁶.

⁵ Updated runway use statistics have been requested, provided by Lisbon airport and analysed in section 3 of this report.

⁶ The above consideration is considered correct in principle, however it is not backed-up by analysis of any reported runway excursion events at Lisbon airport



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

The report identifies a need of a Contingency plan in case of RWY17/35 closure. Such plan should establish the possibility of using and activating the military aerodromes of the Lisbon region, particularly, Montijo Air Base, for emergency situations that do not allow aircraft to deviate to an alternative.

The assessment concludes that having two runways (RWY03 and RWY35) is an advantage in terms of both operations and safety, however the by adopting and implementing the previously mentioned mitigating measures, including the Contingency Plan for use of the military air field, it is possible to maintain the residual risk at acceptable or tolerable levels.

2.5 APPLA Operational Assessment

The assessment is largely based on the "Study of Wind Phenomena Associated to Landing Operations on Lisbon Airport Runway 03" by the National Civil Engineering Laboratory (LNEC).

The report identifies that if RWY17/35 would not available in the period from March to August, landing and take-off operations on runway 03 would take place under conditions of moderate to severe turbulence in 25.36% of the time.

During the approach and landing phase, the wind, turbulence, and possible windshear (when using RWY03) may lead to unstabilised and/or failed approach, thus increasing the workload for pilots and controllers, which is considered a low risk. In case the (unstabilised) approach is continued to landing the risk is higher and includes hard landings with or without structural damage, tire bursting, and ultimately runway excursion (overrun or veer-off).

In strong cross-wind conditions the risk of runway excursion is assessed as average, and the risk of wing or engine collision with the runway or of excessive stress on the landing gear is assessed as high.

The following potential outcomes have been analysed by means of a risk matrix: go around, gear damage, wing damage and hull loss.

Observation: The risk associated to the (RWY03) take-off phase is not addressed by APPLA assessment. This is not considered by APPLA as a point of concern as the risk of taking-off in the above referred cross-wind conditions is significantly lower than the risk associated to the approach and landing phases of flight.

The report concludes that due to the winds orientation and speed in some periods of time (identified above) the definitive closure of runway 17-35 is not advisable as it is an appropriate alternative to landing operations under the conditions identified as potentially hazardous to the operation of aircraft.

The report makes four (4) recommendations:

- A. Keep RWY 35 in operation.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

- B. In case of closing RWY 35, establish the necessary protocols in order to provide a runway in the Lisbon region where the risk identified for runway 03 LPPT is not felt under the same wind conditions.
- C. Set wind limits for operating RWY 03.
- D. Placement of a wind sleeve for RWY 03.

Observation: *Due consideration should be given to recommendations B and C in case of RWY 17/35 closure. Recommendation D has been implemented already.*

2.6 Interview feedback

The information collected through a face-to-face meeting with the representatives of ANA, NAV, TAP and the IPMA, held on 18th April 2018, are summarised in this section.

The list of meeting participants is provided in Annex 1.

Drivers of the planned change

The planning process started in 2013. The main driver is the need to increase the airport capacity limits that have been already reached due to tremendous growth in traffic demand in the past years, both in terms of passenger numbers and aircraft movements.

The number of passengers increased by more than 60 % in the period 2013-2017.

The current maximum declared capacity is 40 aircraft movements per hour (this capacity is sustainable only for a short period of time, in particular between 08:00 10:00 and between 19:00 and 21:00 hours. The goal is to accommodate 48 movements per hour at Lisbon airport and 24 at Montijo airport. To achieve the goal of 48 movements there is a need to expand the apron and the manoeuvring area, which is only possible by closing RWY17/35. The expansion plans of the airport that include developments in ALS airport and Montijo air base have been presented by ANA during the meeting (presentation is available in Annex 2).

Improving safety of airport operations is another important driver. The use of RWY35 increases air traffic controllers' workload due to the need of additional coordination - internal and with external partners. It also requires increased efforts from pilots, air traffic controllers and concerned airport operations staff to maintain correct situational awareness - RWY17/35 is used more than 90% of the time as taxiway. All traffic has to cross RWY17/35 after landing or for departure, which increases the safety risk. The number of safety occurrences increased with the traffic growth.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

In the summer of 2017, RWY17/35 had to be used as aircraft parking lot during 4 months due to high traffic congestion. No operational issues have been reported.

Use of RWY35

RWY 35 is used only on pilot's request; nevertheless, permission to use it may not be granted due to the need to coordinate and obtain approval from the military.

Use of RWY35 is always associated with increased controller workload due to:

- additional coordination required between APP, TWR and GND positions, and with the military at Montijo Air Base and Sintra Air Base;
- application of increased separation minima to impacted traffic;
- restrictions to ground traffic - practically, movements are stopped 4 min before a landing on RWY35.

Procedures for the use of RWY35 exist, but safety risk is higher due to manoeuvring area layout and proximity of RWY35 to the terminal and aprons. Therefore, the severity of consequences of RWY17/35 excursion is considered significantly higher than the severity of consequences of RWY03/21 excursion.

RWY35 excursion risk is perceived even higher during night time. Also, depending on the wing span, the wing-to-wing separation between traffic on the RWY and on the nearby TWY may be below the required minimum.

The aircraft waiting to enter onto the RWY17/35 have to be parallel to the RWY to avoid jet blast impact on the terminal. This creates additional difficulties for ground traffic management.

Departures from RWY35 are not always possible and the climb gradient needs to be higher than the nominal (2%). Use of RWY35 for departure is further limited due to the applicable jet blast restrictions.

RWY35 use by wide-body aircraft is at the limit in terms of available distance during normal operations. Aircraft types, such as A330 and A340 have very small margins to operate on RWY35 because of its length – in some situations (e.g. landing with hydraulic issues), adding 15% buffer in the landing distance calculation (as recommended) is not possible. RWY35 may not be suitable in case of abnormal conditions, runway contamination, emergencies and other complex situations.

With regard to RWY35 RESA, only the minimum Annex 14 requirement for “a distance of at least 90 m” is met and is not possible to extend it to meet the recommended length of 120/240 m on the runway south side.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

RWY35 is mostly used by helicopters, thus increasing RWY03 availability commercial airline operations. In order to achieve the sought operational (including RWY capacity) benefits from the closure of RWY17/35 there is need design an optimal solution for the helicopters operation in single RWY configuration.

In case of RWY35 unavailability (due to closure), strong crosswind is a threat, however aircraft operators should manage the associated risk of unstabilised approach and runway excursion by appropriate flight operations procedures and alternate aerodromes. This is a 'standard' threat that is being (and shall be) managed within the scope of operators' SMS.

None of the operational experts in the meeting could recall the crew of an aircraft in emergency asking for landing on RWY35 because pilots are not used of it 's usage, it is not equipped and in case of emergency is much easier to fly an ILS approach to RWY03 than a visual approach on RWY35.

Overall on RWY17/35 there are fewer safety barrier layers e.g. the lack of equipage limits RIMCAS/ASMGCS usage and risk mitigation potential.

Since 2014, the operation of Beachcraft (more vulnerable in crosswind conditions due to aircraft mass) in-and-out of Lisbon airport have been discontinued by the aircraft operator.

Use of RWY17

RWY17 is not equipped with visual approach and landing aids (no PAPI or visual slope) and therefore it does not meet the EASA certification criteria. Similarly to RWY35, it is used by helicopters and exceptionally on pilot's request. None of the operational specialists present at the meeting could remember when RWY17 was used last time for landing by commercial airline flights.

Use of RWY17 requires coordination with the military.

Use of RWY17/35 is creating operational and safety issues for both ATC and the airport operator.

Use of RWY03/21

Windsocks have been installed at both runway directions (recommended by the operational safety assessment).

RWY03/21 is always reported as the runway in use in ATIS broadcasts. RWY 17/35 is never reported as active runway in ATIS transmissions.

Availability and use of alternate airport

Aircraft operators have their corporate policies on filing alternate airports. TAP policy is to file Porto and Faro as alternate airports as well as Madrid or Malaga



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

when appropriate. Use of these airports as alternates in the summer period requires planning and prior coordination due to limited space (aircraft stands) available in Faro and Porto in case of massive flight diversion from Lisbon. The coordination of alternate aerodromes at tactical level should be facilitated by the ATS units of NAV Portugal. Two further airports are considered for future use as alternates:

- Montijo. The airport has two runways: RWY01/19 (length 2200/45 m) and RWY08/26 (2440/45 m). The meteorological conditions may not be more favourable than those at Lisbon airport. It is a military air base with no regular civil operations.
- Beja. One RWY01/19 (3450/60 m) – it is an airbase with civil operations already conducted. Air traffic service is provided by military on a H24 basis. (The airport is at 15 min flight time from ALS.)

Montijo and Beja airports may provide solution for unusual and emergency situations. For the time being, these are not considered as normal alternate airports for flight plan filing. However, it should be noted the plans for extensions of facilities in Montijo airbase (see Annex 2).

The potential impact of RWY17/35 closure on aircraft emergencies is limited to the crosswind threat. Aircraft emergencies are complex situations, and the threats to be managed by the crew depend on the type of the emergency, i.e. use of a particular alternate airport cannot be pre-planned. Most emergencies require increased landing distance. In such situations, there is a significant probability that RWY17/35 will not be suitable to use, anyway.

NAV representatives stated that they are not able to recall in the past years having an aircraft in emergency selecting RWY35 for landing (non-precision approach to RWY35 only, which is a further runway use-limiting factor). Moreover, there is no guarantee that in case of emergency RWY35 will be available (due to the applicable use restrictions), even if preferred by the flight crew.

Use of stop bars, signage and markings at Lisbon airport

Stop bars have been installed to protect both runways (RWY 03/21 and RWY 17/35) and are used according to the approved procedures. Stop bars installed on taxiways not used for entry to the active runway are always lit. Stop bars are installed on taxiways used for entry to the active runway are operated by Lisbon TWR during LVO. Further means to indicate to pilots that a runway is ahead are the interlaced yellow and green centreline lights on taxiways. RIMCAS alerts for RWY03/21 to controllers on the A-SMGCS display in Lisbon TWR provides an additional safety net.

According to the pilots' reports it is more difficult to see the red stop bar lights at RWY17/35 entry points due to the angles of runway/taxiways intersection.

The EASA requirements regarding runway markings and signage applicable as of 2020 are reported to be already met by ANA.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Meteorological factors (wind)

During the summer period, the prevailing wind direction is north-northwest. The wind direction and speed varies over the years. The analysis proves that strongest wind is in July (greater crosswind component). About 5 % of the time (mostly late afternoon and evening) there are gusts above 15 knots (may cause moderate to severe turbulence on approach).

The meteorologists participating in the meeting reported that the validity of the conclusions about the ALS wind conditions made in the operational safety assessment report (produced in 2013) has been confirmed by the weather observations during the last six years.

Note: During the meeting it was clarified that the “incident” of 19/01/2013 referred to in the operational safety assessment report, is not in fact a traffic incident, but a particular day when there was extreme wind at ALS (values above 50 kts throughout the day). No safety incident was recorded on that day. RWY03 was in use and during that day 36 flights diverted to alternate airports and 46 landed in strong crosswinds conditions.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

3 Analysis of updated operational statistics

In order to verify the validity of the conclusions of the operational safety assessments carried out in 2013, Lisbon airport representatives were asked to provide updated statistical data about:

- the use of RWY17/35 and RWY03/21 in the last 3 years;
- the RWY17/35 and RWY03/21 incursions reported in the last 3 years;
- the missed approach/go-arounds carried out in the last 3 years;
- Crosswind statistics for RWY03 for the last 6 years.

Runway use

The analysis of the runway use data for the years 2015 – 2017 (provided in Annex 2) enables the following findings:

- RWY03 is the most used runway; it is used more than 10 times more than RWY21 and 100 times more than RWY35.
- Use of RWY35 is very limited, in 2017 it was used by 0,2% of the airport traffic and in 2015-2016 its use is consistently below 2%.
- In 2017 RWY35 was used mostly during the period November – March, while in the period 2015-2016 it was used mostly during the period March – November.

Note. According to the study published by the Portuguese Institute for Sea and Atmosphere (IPMA) the predominance of winds with orientation NNW (from 320 to 350) is mainly during the spring and summer months (July – August).

- The majority of landings on and departures from RWY35 occurred in the period 18:00 – 06:00 local time. A possible explanation could be the use of this runway to reduce miles flown during hours of lower traffic demand. A clear link to the prevailing weather/wind conditions could not be established (see above Note).
- The number of flights that used RWY35 for take-off and landing in 2017 is one order of magnitude lower than the number of flights that used it in 2016 and 2015. A possible explanation of this difference in RWY35 use could be the unavailability of RWY03/21 due to reconstruction works.
- Use of RWY17 is extremely limited, i.e. its use is consistently between 0,02% and 0,03% over the 3 year period referred to above.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Runway incursions

The review of the runway incursion statistics (provided in Annex 3) for the period 2011 – 2018 reveals that the number of incursions on RWY03/21 and on RWY17/35 is almost equal. Almost all of RWY17/35 incursions are caused by aircraft entry onto the runway without ATC clearance. The airport layout and possible confusion of RWY17/35 and the parallel taxiway can be considered as contributing factor. The severity of RWY17/35 incursions is lower due to RWY03/21 being the active runway.

Missed approach/go-arounds

The updated missed approach and go-around data for the last 3 years are provided in Annex 5. Taking into account the increase in traffic movements over the last years it can be concluded that the number of RWY03 go-arounds due to weather, including windshear, is consistent with the RWY03 go-around data provided in section 1.7.4 of the NAV Portugal operational safety assessment report. This means that there is no increase trend in the executed RWY03 missed approaches/go-arounds due to strong wind/windshear.

RWY03 crosswind conditions

According to the Portuguese AIP there are no limitations for approach and landing at Lisbon airport. Therefore, the recommended crosswind values referred to in §3.1.3 of Annex 14 - Volume I have been used as reference⁷.

Taking into account the IPMA data about RWY03 crosswind component for the period 2012 - 2017 (provided in Annex 4) and the ICAO Annex 14 recommended values for crosswind at landing, the following conclusions about the availability of RWY03 for landing⁸ have been drawn:

⁷ 3.1.1 Recommendation.— The number and orientation of runways at an aerodrome should be such that the usability factor of the aerodrome is not less than 95 per cent for the aeroplanes that the aerodrome is intended to serve.

3.1.3 Choice of maximum permissible crosswind components

Recommendation.— In the application of 3.1.1 it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

— 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a crosswind component not exceeding 24 km/h (13 kt) should be assumed;

— 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m;

and

— 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

⁸ 'Availability for use' in the context of this analysis means that the crosswind was below the recommended value in Annex 14. Other conditions that may impact on RWY use (e.g. environmental



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

- The worst case availability of RWY03 for landing of aircraft with reference field length of 1 500 m or over (e.g. code D aircraft) was above 99,9% of the time covered by the IPMA statistics;
- The worst case availability of RWY03 for landing of aircraft with reference field length of 1 200 m or up to but not including 1 500 m (e.g. code C aircraft) was above 98,1% of the time covered by the IPMA statistics;
- The worst case availability of RWY03 for landing of aircraft with reference field length is less than 1 200 m (e.g. code A aircraft) was above 96,1% of the time covered by the IPMA statistics.

The above numbers demonstrate that in case of closure of RWY17/35 Lisbon airport can easily meet the ICAO recommendation about the airport usability factor (see footnote 6).

It is also important to note that, in reality, the overall availability (see footnote 7) of RWY03 for landing of aircraft has been higher due to:

- the use of the worst case hourly values provided in the IPMA statistics to calculate RWY03 availability (average values over the 24-hour period are significantly higher);
- the actual crosswind limitations for landing of aircraft are established in the aircraft operation manuals, and usually those limits exceed the generic values, recommended by ICAO and used as reference in this analysis;
- the actual traffic mix (type of aircraft) using the airport (the share of light aircraft is low).

constraints, construction works, ATC constraints, etc.) are not relevant to and have not been considered for the purpose of this analysis.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

4 Conclusions

The safety assessments of the main Lisbon airport stakeholders have been carried out in compliance with the approved risk assessment and mitigation procedures of the service providers/operators.

The assessments analyse the two main scenarios of runway operations:

- use of RWY03/21 as preferred runway with occasional use of RWY17/35 (current scenario); and
- use of RWY03/21 only (future scenario).

The use of RWY17/35 for take-off and landing of aircraft is very limited. In 2017 it was used by 0,2% of all arriving and departing flights. In 2015 and 2016 its use is below 2%.

Hazards related to the two scenarios have been identified, their consequences and severity established. A number of risk mitigation measures have been designed in order to reduce or eliminate the identified risk to tolerable and acceptable levels.

The potential for increased safety risk in strong crosswind conditions due to higher probability of RWY03 excursion compared to RWY35 is off-set by the lower severity of the excursion consequences and the suggested additional mitigation measures. Strong crosswind is a threat in the final approach and landing phases of flight, however aircraft operators should manage the associated risk of unstabilised approach and runway excursion by appropriate flight operations procedures and selection of alternate aerodromes. This is an 'usual' threat that is being and shall be managed within the scope of operators' SMS.

According to the NAV Portugal operational safety assessment, the closure of RWY17/35 is expected to bring about safety benefits in terms of:

- removal of the risk factors caused by crossing of RWY17/35;
- reduced complexity of ground movements;
- reduced controller workload due to reduced GND-TWR and TWR-APP coordination;
- reduced coordination with military control towers;
- reduced runway excursion risk.

Taking into account:

- the results of the review of the operational safety assessment reports provided by TAP Portugal, NAV Portugal, Lisbon airport and APPLA,
- the notes from the interview with the representatives of TAP Portugal, NAV Portugal, Lisbon airport and the IPMA,



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

- the findings of the analysis of the updated operational data provided by Lisbon airport,

the overall conclusion of EUROCONTROL Network Manager is that following closure of RWY17/35 the safety level of aircraft operations at Lisbon airport will be preserved and may be increased.

The following recommendations are made in relation to the proposed RWY17/35 closure:

1. The Portuguese CAA should notify all aircraft operators that operate to/from Lisbon airport to update the existing or carry out an operational safety assessment for the use of Lisbon airport with single runway (RWY 03/21) only, and to implement any risk mitigation measures, as may be identified by the operational safety assessment. Such measures should address situations of emergencies and of aircraft unable to land on RWY03 due to crosswind and/or turbulence exceeding the aircraft performance limits, which may require diversion to an alternate airport. From safety perspective, diversion to alternate aerodrome is part of the flight planning and flight execution phases.
2. NAV Portugal should, in coordination with Lisbon airport operator and concerned helicopter operators, develop an optimal solution for helicopter operation at Lisbon airport with single RWY configuration (RWY 03/21).
3. The risk mitigation measures, identified in the consolidated operational safety assessment report that are not yet been implemented, should be considered for implementation ahead of the formal closure of RWY17/35.



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Annex 1

List of participants at the Meeting held on 18 April 2017 at Lisbon airport

1. João Nunes, AHD Airport Director
2. Rui Alves, AHD Deputy Director
3. Carlos Silva, AHD Head of Security and Safety Office
4. Paulo Medo, AHD Safety Manager
5. Carlos Mateus, IPMA Head of Aeronautical Meteorology Division
6. Ana Macara, IPMA Meteorological Specialist in Aeronautical Meteorology
7. Carlos Reis, NAV - DOPLIS, Director of “Operações da Região de Lisboa”
8. Paulo Encarnação, NAV – NASO, Head of Safety Assessment unit
9. Ana Lima, NAV, Head of AHD Control Tower
10. Gonçalo Nápoles, TAP Safety Manager
11. Vasco Carvalho, DTA - ANA, Director of the Technical Services Directorate
12. Vitor Figueiredo, DTA, Head of Safety and Operations of Technical Services Directorate
13. Pedro Reis, DTA, Safety and Operations Expert
14. Tony Licu, EUROCONTROL, Head of NOM Safety Unit
15. Alexander Krastev, EUROCONTROL, Senior Safety Expert at NOM Safety Unit



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Annex 2

Runway use statistics for the years 2015 – 2017 for Lisbon airport



Movimentos Pista -
Mês - 2017 2016 2015

Annex 3

Runway incursion statistics for the years 2011 – 2017 for Lisbon airport



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Annex 4

Crosswind statistics for the years 2012 – 2017 for Lisbon airport



Lisbon_airport_RWY
03_crosswind_2012_



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

Annex 5

Missed approach/go-arounds statistics for the years 2015 – 2017 for Lisbon airport

2017	RWY 03		RWY21		RWY17		RWY35		
	WEATHER	OTHER	WEATHER	OTHER	WEATHER	OTHER	WEATHER	OTHER	
JAN	1	(W)	12		1				
FEV	3	(W)	6	2	(W)	2			
MAR	1	(WS)	10	3	(LVO+WS)	9			
ABR	6	(W)	11		3				
MAI			6		13				
JUN	5	(WS+W)	18		2				
JUL	2	(WS)	18		3				
AGO	3	(WS+W)	21		2				
SET	4	(WS+W)	15						
OUT			9	4	(LVO)	8			
NOV	4	(LVO+W)	8		8			2	
DEZ	7	WS+W)	7	7	(NR)	5			
TOTAL	36		141	16	56	0	0	0	2

2016	RWY 03		RWY21		RWY17		RWY35		
	WEATHER	OTHER	WEATHER	OTHER	WEATHER	OTHER	WEATHER	OTHER	
JAN			4	2	(WS+V)	6			
FEV	6	(W)	8	4	4(W)	2	3	(W)	1
MAR	4	(WS)	4			2			
ABR	3	(WS)	8	4	2(W)	3			
MAI			6			4			
JUN	3	(WS)	18			6			5
JUL	2	(WS+W)	9			4			
AGO			15						3
SET			9			1			
OUT			12			10			
NOV			12			9			
DEZ	2	(LVO)	9	6	(W+LVO)	5			
TOTAL	20		114	16	52	0	0	3	9

EUROCONTROL Network Manager Safety Review for ALS stakeholders



Network Manager
nominated by
the European Commission

REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

2015	RWY 03			RWY21			RWY17		RWY35		
	WEATHER		OTHER	WEATHER		OTHER	WEATHER	OTHER	WEATHER		OTHER
JAN	2	(WS)	10	2	(LVO)	3					
FEV	14	(WS+W)	3								
MAR	7	(WS+W)	4								
ABR			7								
MAI	1	(WS)	10			3					1
JUN	1	(WS)	11			1			2	(VIS)	1
JUL	1	(WS)	4						4	(VIS)	2
AGO			8						3	(VIS)	
SET			10	1	(W+CBH)						
OUT			5	4	(W+)	5					
NOV	1	(W)	3			1					
DEZ	5	(W+V)	6	8	(WS+W)	6					
TOTAL	32		81	15		19	0	0	9		4



REVIEW OF THE OPERATIONAL SAFETY ASSESSMENT FOR THE CLOSURE OF RWY17/35 AT LISBON AIRPORT

ABBREVIATIONS

Abbreviations and acronyms used in this document are available in the EUROCONTROL Air Navigation Inter-site Acronym List (AIRIAL) which may be found here:

<http://www.eurocontrol.int/airial/definitionListInIt.do?skipLogon=true&glossaryUid=AIRIAL>

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**REVIEW OF THE OPERATIONAL SAFETY
ASSESSMENT FOR THE CLOSURE OF
RWY17/35 AT LISBON AIRPORT**

DOCUMENT FINAL PAGE