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Research Article

IMPROVING AIR NAVIGATION AT CHLEF AERODROME BY IMPLEMENTING A NEW INSTRUMENT LANDING SYSTEM (ILS)

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ABSTRACT

This work presents the study of the improving air navigation at chlef aerodrome by Implementing a new Instrument Landing System (ILS). At present, the radio navigation systems at Chlef aerodrome can handle the air traffic load adequately (air traffic controllers are able to manage the airspace for which they are responsible). Nevertheless, in the very near future the traffic load will become so important that it will require the implementation of an ILS beacon. To this reason, we will study the current situation, which is based on a general presentation of Chlef aerodrome (the situation and position of the airspace, and the existing airport infrastructure), followed by the choice of equipment to be installed and the method of implenting the ILS system (composition, technical characteristics and arrangements), in accordance with standards and recommended practices. From these results we can find: Implementation of glide path (GP) on the runway 26, implementation of the localizer on the runway 26, setting a new equipment DME. The previous systems contribute largely for improving the air navigation at the aerodrome of Chlef.

Keyworks: Air Navigation, Airspace, Aerodrome, ILS, Implementation.

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List of abbreviations

Words	**Signification**
ILS	Instrument Landing System
ICAO	International Civil Aviation Organisation
VHF	Very high frequency [30 to 300 MHz]
UHF	Ultra high frequency [300 to 3 000 MHz]
GP	Glide path
MHz	Megahertz
FL	Flight level
DAOI	Chlef international Airport
RWY	Runway
DAAG	Alger international Airport
LOC	Localiser
DME	Distance measuring equipment
CVOR	VHF omnidirectional radio range (conventionnal)
ENNA	National Air Navigation Establishment

1. INTRODUCTION

Landing an aircraft is the most difficult operation in terms of precision, orientation and guidance to the runway [1]. The nature of the terrain and the facilities next to the runway are the main sources of landing error [2]. In order to overcome these difficulties and to expand the operational envelope of aircraft, much research has been devoted to the landing zone and consequently to the effective use of more precise and efficient landing aid systems, including the Instrument Landing System (ILS) [3-4]. Thus, a more optimum location for the ILS must be found in compliance with the standards defined by ICAO. The Instrument Landing System (ILS) precision approach beacon system is standardized according to ICAO ANNEX 10 and allows for [5].

- Creating a route plan,
- Creating a flight plan,
- Transmit information on the overview of the points relevant to the approach.

The ILS precision approach beacon system consists of three parts:

- The VHF localizer transmitter
- UHF Glide Path Transmitter
- VHF tracking beacons

Each locator transmitter must assign a frequency in the range 108 - 117.975 MHz according to the ICAO ANNES 10 Table [6-7]. This frequency is also assigned to a fixed frequency of the glide path transmitter in the range 328.6 - 335.4 MHz, and the locator beacons operate at the 75 MHz frequency. At present, air traffic operating capabilities at Chlef aerodrome are limited or saturated, and there are many operational constraints: lack of navigational aid equipment (radio navigation averages, radar screen, visibility problems due to fog (especially in winter), obstacles at FL100 (this level receives the A, B, C and D aircraft categories and often controllers are faced wiyh heterogeneous traffic that is difficult to manage).To satisfy the needs of the users and take into account the particular conditions of implementation of this equipment. We can prove that the Instrument Landing System (ILS) is a system that operates as a ground-based instrument approach, that provides precision and guidance to an aircraft approaching and landing on a runway [8]. The purpose of our study is to improve the air navigation, while maintaining or enhancing the current level of safety. Aircraft position data is the primary air navigation tool for the efficient execution of air traffic control [9-10]. The following are some of the elements that could improve air navigation:

- Enhancing safety
- optimizing the management of space and traffic flows
- Improve automated controller support

Our work has been divided into three parts; the first part is a study of the existing situation, which consists of a general presentation of the Chlef aerodrome with regard to the position of the aerodrome, the Chlef airspace and its infrastructure. The second is reserved for the choice of equipment and methods of implementation of the ILS. The third part is dedicated to the results and discussions.

2. CURRENT ILS STATUS

2 .1 Presentation of chlef aerodrome

Chlef aerodrome is an Algerian international airport classified as a mixed airport. Located in the north of Algeria, this aerodrome is 6 km north of the city of Chlef. It also shelters in its southern part an Algerian Air Force base where the 6th regiment of maneuver helicopters is posted. This airport is open to civil and military air traffic 24 hours a day. It is called Aboubakr Belkaid with the DAOI location indicator [11].

2. 2 Chlef Airspace

The airspace of Chlef is located between 2 sectors: WESTERN ORAN sector and CENTRE ALGER sector belonging to the D classification [12] (See figure.1)**.**

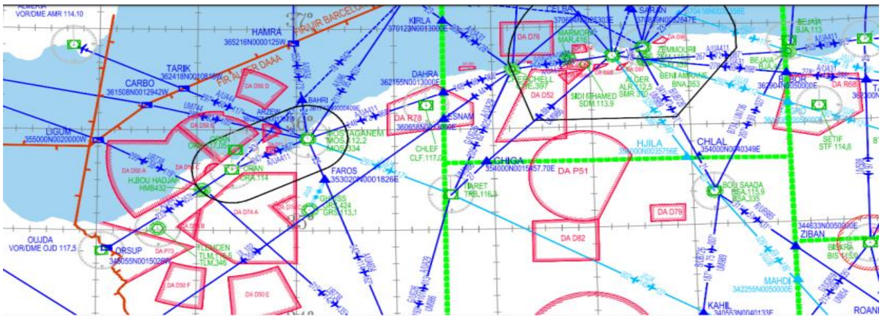

Fig.1. Part of the cruise chart

2.3 Aerodrome Infrastructure

The aerodrome belongts 4D category, laid out and equipped in such a way to satisfy the corresponding activities, related to its geographical location and nature of operation. It includes the following infrastructure [11,12].

- Two runways (RWY 08/26) with a length of 2800 meters and a width of 45 meters with a bituminous concrete surface and a pavement strength of 66F/C/W/T.
- ET (RWY 07/25) with a length of 1650 meters and a width of 30 meters with an asphalt concrete pavement and a pavement strength of 27/S/I/W/L (See figure.2)**.**

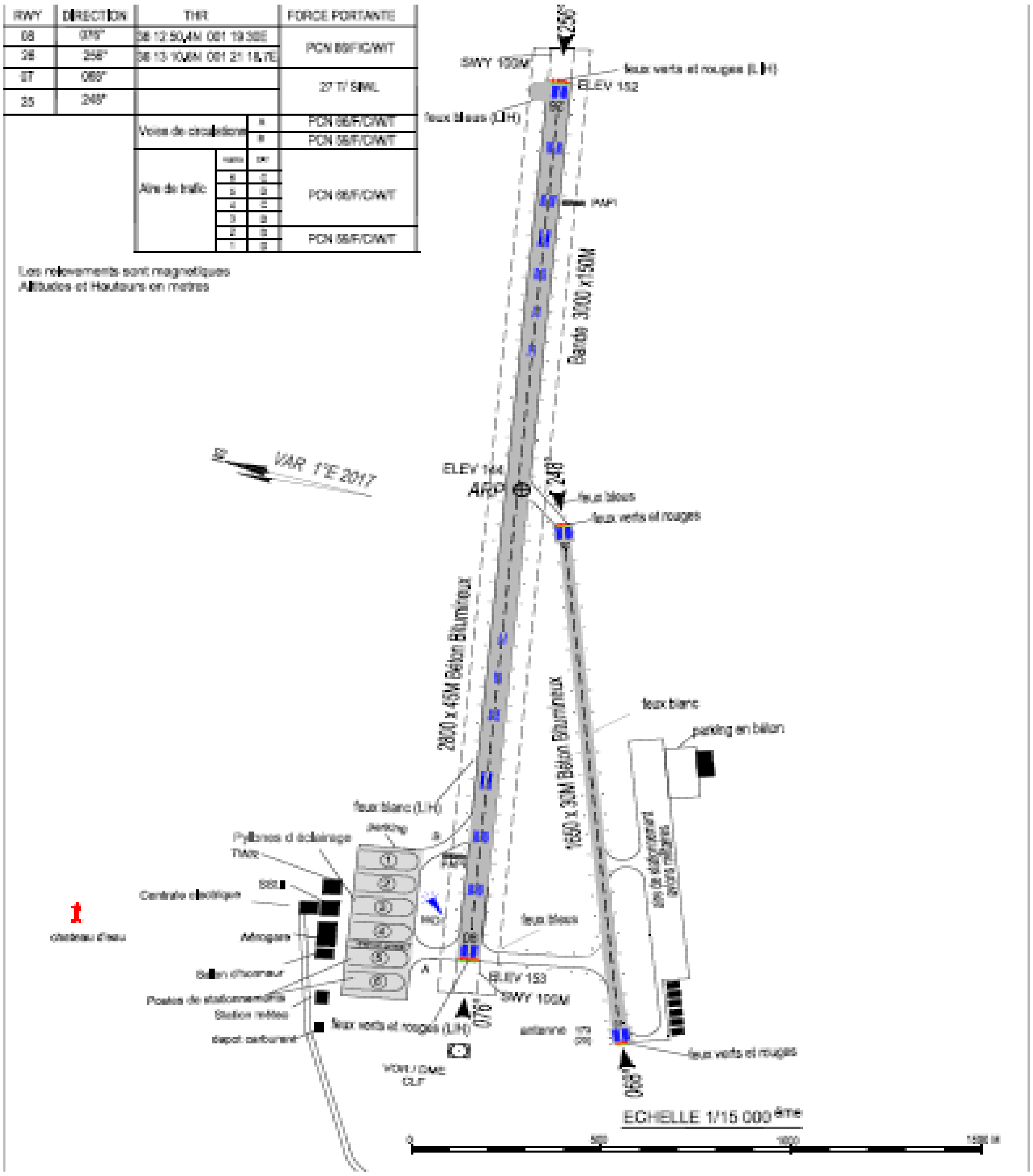

Fig.2. Chlef aerodrome infrastructure

3. METERIALS AND METHODS

The ILS implementation method is carried out in accordance with the requirements and standards decreed and defined by the International Civil Aviation Organization (ICAO) [13].

3.1 Choice of equipment and technical specifications

Concerning the choice of the equipment to be installed, it will be identical to the one already installed at HAOUARI BOUMEDIENE International Airport (DAAG) taking into account the Localizer (LOC), Glide Path (GP) and DME components. The characteristics of the latter are shown in the two tables (1, 2) [14].

3.1.1 Localizer

A system with a dual-frequency, 12-element NORMARC 7212C, serving Runway 26, will be installed. The antenna system can be installed 200 meters from threshold 08. The equipment shelter may be installed on the south side of the extended centerline. The most appropriate position can be evaluated in accordance with infrastructure planning (See figure.3). [15].

Fig.3. Localizer

Table 1. Configuration of the localizer equipment

Element	Description	Configuration
1	Antenna system	NORMARC 7212C
2	Frequency	108.9Mhz
3	Nearest distance THR	200 m
4	Antenna height	3,2 m
5	Cable passage between shelter and antenna system	<70 m
6	Cable path near field (direct)	<130 m

3.1.2 The glide path:

The Glide path that will be installed is a dual frequency NORMARC 3545 antenna system. The area on the south side of the runway is ideal for the installation of glide path, as less levelling will be required on this side. The terrain is always very uneven on this side and a position 100 meters from the runway is proposed to reduce the amount of levelling required [15].

Table 2. Configuration of glide path equipment

Element	Description	Configuration
1	Antenna system NORMARC	3545
2	frequency	329.3Mhz
3	Glide path angle	3.0 °
4	withdrawal from threshold	estimated at 343 m *
5	Offset from runway center	100m
6	downhill slope (FLS)	estimated at + 0,27 *
7	side slope track (SSL)	Inconnue
8	Distance between mast and equipment shelter	<10 mètres
9	Cable path, near-field	<100 mètres

3.1.3 Distance measuring equipment (DME)

The recommended EMR system is the Indra LDB-103 LP DME, dual monitor / dual system transmitter with a unidirectional antenna installed on the glide path mast.

3.2 Methods of arrangement of the various subsystems equipping ILS

The layout of the various subsystems equipping the ILS instrument landing system is indicated as follows:

- Typically, the LOC antenna array is approximately 25 meters wide and is located 300 meters from the end of the runway.
- The GP antennas are mounted on a mast of approximately 9 meters, generally located 300 meters downstream of the runway threshold and 150 meters on either side of the runway centreline. The associated GP transmitter is housed in a shelter near the antenna [16].

4. IMPLEMENTATION RESULTS

In order to carry out the ILS implementation study, it is necessary to study the implementation site, while taking into account all the existing constraints, namely the nature of the land, the existence of a CVOR and the presence of a drainage channel, in order to have a more adequate implementation site for the ILS. For the calculation of our results, we used the AUTOCAD tool for tracing two LOC and Glide elements of the ILS System. And we used Google Earth 2020 for the acquisition of maps and determination of the study area. The complexity of implementing the ILS system is that the existence of a CVOR in the vicinity of runway 08 may have the risk of interference between ILS and CVOR.

4.1 Airport arrangement

The runway and taxiways are layed out on relatively flat terrain. The general layout of the airport is illustrated in the following figure (Fig.4)

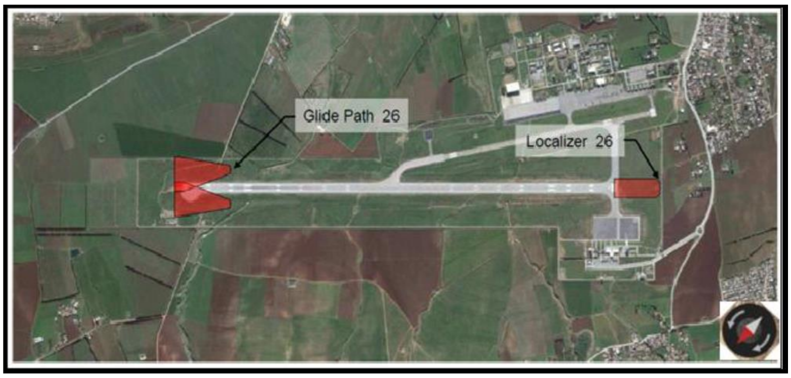

Fig.4. Localizer (Loc) and glide path (GP) layed outs on runway 26

Our implementation study is obviously carried out on runway 26 because it has a high density of air traffic, compared to 08, despite the existence of certain natural and technical constraints. The new site is located in an area where the terrain elevation is slightly lower than the runway

4.1.1 Property

The terrain slopes slightly from threshold 08 towards the Localizer site. Localizer is about 1.0 meter below the nearest point of the runway. The required antenna height is 3.2 meters. With a 200 metres distance from threshold 08, the localizer will be below the obstruction clearance requirement. Figure 5 shows the vertical terrain of the localizer.

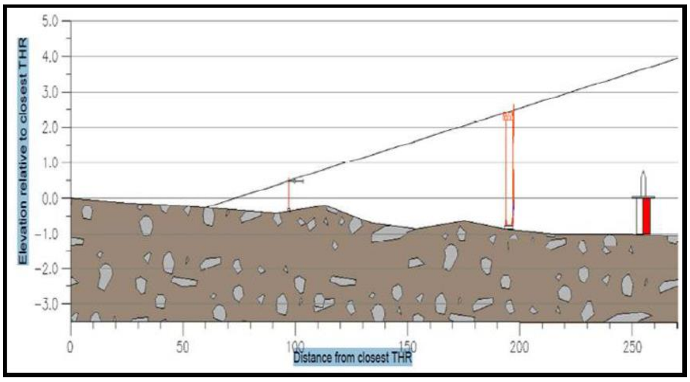

Fig.5. Vertical terrain of the localizer

4.1.2 The existence of CVOR systems

CVOR is installed approximately 255 meters from the threshold of the runway 08. The localizer cannot be installed further than the CVOR. In order to reduce the risk of interference between the localizer and the CVOR a distance between the two as far as possible is desirable. It is not known how sensitive the CVOR will be interfered from a signal of the localizer or the mechanical structure of the localizer. It is desirable to analyze the possible effects on the CVOR.

4.2 Installing the localizer (LOC)

During the site investigation, a position approximately 200 meters from the point of the runway 08 was indicated as the most appropriate. Foundations should be created to facilitate the installation of the NORMARC 7212C localizer. The antenna should be close to the equipment shelter. The equipment shelter can be installed on the north side. The distance to power and communication infrastructure is assumed to be closer to this side of the extended centerline (See figure.6).

Fig.6. Lay-out of the localizer

The critical area of the localizer and the installation dimensions of the proposed antenna system are shown in red in the figure below. This area does not move during the operation of the localizer. The service channel must be diverted around the critical area.

4.3 Installation of Glide path (GP)

GP installation is closely related to certain elements that should be taken into consideration. The terrain is very irregular while, a drainage channel is inconvenienty located next to the runway centreline and a Glide path signal beam.

4.3.1 NORMARC M-Array

GP site will be on the south side of the runway, see the following figure (Fig.7).

Fig.7. Proposed position of glide path and beam-forming zone

Figure 7 shows the beam-forming area required for a glide path image placed on the south side of the runway. The terrain is very irregular and is found at 100 meters from the runway, and proposed to reduce the required amount of levelling.

4.3.2 Presence of a Drainage Channel

A drainage channel is located 70-80 meters from the runway centreline and extends parallel to the track as shown in figure 8.

Fig.8. Images of the drainage channel

This drainage channel must be covered or removed to avoid any negative effect on glide path performance.

4.3.3 Beam forming area and signal quality

Altitude is scaled to emphasize the characteristics of the terrain. There are many irregularities in the terrain. Parallel to the runway, about 70-80 meters from the runway, there is a drain and a suppression in the terrain. This suppression will create negative effects on the glide path signal.

A ridge is located parallel to the runway, next to the drain. The terrain must be levelled to create a uniform flat surface suitable for the beam forming area. Levelling must be done in accordance with applicable requirements.

4.3.4 Installation of glide path

After changing the terrain, it will be advantageous to confirm the final positioning result. A new topographical survey must be carried out on the final terrain to provide a basis for the final calculations.

The equipment building will be a prefabricated shelter installed near the Glide Path mast. The estimated values must be confirmed after levelling. The new topography will give final values. Sensitive and critical areas of the glide path must be as described in ICAO Annex 10.

4.4. The new DME

The DME system is the Indra LDB-103 low power, dual monitor / dual transmitter DME system with a unidirectional antenna. The new DME will be installed in the Glide Path equipment building, with the DME antenna installed in the Glide Path mast. It is recommended to install the DME antenna between the lower and middle Glide Path antennas.

5. CONCLUSION

The work presented enabled us to study the problem of a landing aid system at Chlef aerodrome by implementing a new ILS system to improve air navigation. The latter allows a very close integration between the system on the ground and the airspace users. Air navigation using this system would benefid from:

- Improved the accuracy of four-dimensional navigation
- Better use of airports and runways
- Reduced pilot workload
- Rational use of airspace

The choice of the site for the installation of the ILS is made

- Given its geographical position
- In view of the technical and safety constraints and the radio navigation facilities that are currently on Chlef aerodrome
- Standards and recommended practices.

The results of our study show that the implementation of a new ILS beacon makes a significant contribution to the improvement of air navigation.

As a perspective of our study, it is proposed to make the test of localizer and glide by the ENNA laboratory plane, and it is necessary to make a new approach procedure of instruments of Chlef aerodrome

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