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ELEVENTH AIR NAVIGATION CONFERENCE

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Agenda Item 6: Aeronautical navigation issues
6.4 : Directions for future development of aeronautical navigation services

THE ADVANTAGES OF AUTOMATED ASSISTANCE FOR IFR PROCEDURE DESIGN

(Presented by France)

SUMMARY

Based on the French experience, this working paper presents the numerous advantages which can derive from the use of an IFR procedures design software. It aims at encouraging ICAO member States to consider the use of a procedure design software, while stressing the importance of the processes used to select and validate these tools.

Action by the conference is in paragraph 2.

1. THE LIMITS OF TRADITIONAL METHODS FOR PROCEDURES DESIGN, AND THE ADVANTAGES OF PROCEDURES DESIGN AUTOMATION

1.1 IFR procedures are one of the key factors of safety. As part of ICAO's initiative to check and improve safety at the airports, each State must review the processes used to design and publish IFR trajectories. IFR procedure design can generate many different errors, as it involves the management of numerous aeronautical data, the use of intricate rules, wearisome calculations, and requires very precise drawings. A defective knowledge of geographical environment can also lead to a lower level of safety. Publishing, through which the results of procedures design are symbolized, can also be a critical step leading to further loss or damage of information. Finally, coding the IFR trajectories to enable their integration in the

[1] English version provided by France.

on-board databases, is a new crucial step as far as safety is concerned. At each of these various steps, the procedures designer must keep a high level of expertise, while he/she must carry out many other tasks.

1.2 The use of an IFR procedure design software can help reducing tremendously the heterogeneousness of the processes used to design IFR trajectories. It can play an important part in the implementation of a quality assurance process. Once validated, the calculation algorithms are implemented in a standard way, leading to reliable results, in terms of calculation results and drawings (nominal path, protection areas). Procedure design automation can take place in a global information management system, from the basic aeronautical and topographical data, to the design of trajectories and the publication of the corresponding charts. It will make digital coding of IFR procedures for the flight management systems easier, and will then reduce the risks of errors at this step. An automated process allows to control the quality of the aeronautical data produced as trajectories, and can maintain the quality level of the data initially used.

1.3 A procedure designer is more and more expected to react quickly and efficiently to high external constraints (airport environment, aircraft performances,…). One major advantage of automating IFR procedure design lies in the performances (time saving, ability to optimize the trajectories). An automated system enabling the follow up of the studies and making their updates easier can then be a major contribution to the improvement of safety.

2. SELECTION

2.1 When a State wishes to purchase a procedure design software, it should define a selection process in order to choose the best adapted tool. In France this process consisted first in surveying the needs and expectations of future users, and then in assessing the characteristics of the seven software tools already available worldwide.

2.2 The type and level of expertise and the user-friendliness of each tool were reviewed. Particular attention was paid to the capacity of processing of Digital Terrain Models, calculation in WGS-84 system, and the ability of each tool to work with complementary systems (such as aeronautical information management systems).

2.3 The software tools were classified in two groups: dedicated computer aided drawing tools, and the ones providing a high level of expertise and automation to the procedure designers. The French Air Navigation Directorate eliminated those of the first group, since they provided a lower level of assistance and performance than the one of expert tools.

2.4 Among the software tools in the second group, the one developed by the ENAC (Ecole Nationale de l'Aviation Civile) was eventually elected, under the condition that ENAC should add functions to ensure the complete compatibility of the software with the French regulation. This software tool is named GéoTITAN.

3. MAIN CARACTERISTICS OF THE SOFTWARE ELECTED BY FRANCE

3.1 GéoTITAN © embodies a huge amount of expertise and automation. The designer is working in a standard environment involving regulation criteria, navaids, aeronautical and topographic information. It is adapted to the main demands of its users: maintaining safety and regulation controls while saving time and increasing aeronautical suitability.

Design environment

3.2 The software is operating its own reference database with all the data needed for IFR procedures design. This database must be the mirror of the national AIP, and be updated following the AIRAC cycle. Automated link between the national aeronautical database and the software will be implemented to maintain at their highest level accuracy and update of the data, as well as the integrity of the data processed by the software.

Software expertise

3.3 The software has been developed under control of PANS-OPS experts who have checked and approved the algorithms used for calculating flight paths and protection areas. Each procedure leg is created only if it has an aeronautical meaning and if it is compliant with the regulation criteria. Parameter ranges associated with criteria are intentionally extended to fit with strong ATC or environment constraints, but designers receive warning or errors messages as soon as they are using values outside the regulation range. The design process includes the automated computation of the protection areas based on a full speed range corresponding to the phase of flight and the selected aircraft categories.

Time saving

3.4 The software allows tremendous time saving (e.g. it takes less than one minute to compute and draw the protection areas of any holding pattern).

Standardization of results

3.5 Coupled with the use of a geodetic computation library, GéoTITAN elements are computed on the WGS84 ellipsoid with a very good accuracy, and the result is consistent with the projection.

Managing former studies

3.6 The use of a relational database is highly efficient for updates. Thanks to the storage of relations between designed elements, the software can automatically find what are the reference objects which are out of date, and list the impact on existing procedure.

Supplementary advantages to increase safety

3.7 Designed procedures can be exported to ATC simulators, or to noise abatement modeling software. This way, the designer can very quickly, and without any risk of damaging the integrity of the data, evaluate the impact of a planned procedure on the management of air traffic and on the environment of the airport. Charting modules can work directly from the procedure designed by the software.

4. VALIDATION

4.1 Automation can improve safety but an error kept unnoticed in a software may lead to calamitous consequences, as it will be automatically repeated. Each IFR procedure design software must then be validated by the Civil Aviation Authority which purchased it. The validation comprises a functional part to check that the tool meets the expectations of its users, and a regulatory part to ensure that the calculations and drawings are compliant with the State regulation.

4.2 The software tools manage different kinds of data, the processing of which must not damage their integrity and their initial quality. Among these data are the Digital Terrain Models used to compute the minimum flight altitudes; the user must pay particular attention to the integration and process of these topographic data.

4.3 In France, in addition to functional validation through tests of each function the regulatory validation consisted in comparing, in many different cases, the outputs of GéoTITAN with manual calculations and drawings based on the use of French regulation for IFR procedure design. Two pilot sites conducted the validation. Following these tests, a few changes and improvements were introduced in the software which has now been validated. Six other different sites will be equipped with GéoTITAN.

5. CONCLUSION

5.1 The use of a software to design IFR procedures and calculate the associated minimum safety altitudes has a direct impact on flight safety (implementation of validated calculation processes, standardized drawings). It eases the implementation of a complete aeronautical information management system. It takes a natural part in a quality assurance process.

5.2 The selection of such a software must take into account its technical characteristics, and its user-friendliness. These software tools are complex and cannot be operated without a thorough knowledge of IFR procedures design rules. One must pay particular attention to the type and length of the training courses provided to the users, and check that a complete and efficient user's manual or on-line help is provided with the software.

5.3 Such tools must be validated before being operated. The ICAO Obstacle Clearance Panel has started to work on the regulatory validation of the IFR procedures design software tools (Task ANC n° OPS-0303).

6. RECOMMENDATIONS

6.1 The Air Navigation Conference is invited to:

a) encourage member States to start automating IFR procedures design, in order to improve quality and performances in this field; and

b) draw attention of member States on:

1) the care to be taken when selecting an IFR procedure design software;

2) the need to validate a procedures design software before it starts being operated, or to check that this software has already been validated; and

3) the fact that the use of a procedure design software must not lead to any loss of expertise by the procedures designers.

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