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System Safety Assessment (Safety Assessment systems) of the Wonderful electronic Displays of civil aircraft

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It's gorgeous to enjoy the civil aircraft Panel with its wonderful electronic displays, artworks of electronic technology. Fascinating, no doubt, but do you know the requirements of the airworthiness Authority to accept them, in a type certification? This is our subject today. Follow us.

In fact it's beautiful too see an electronic display of a civil aircraft. However, for that display to be there, accepted by the Authority, it is necessary to go a fairly long way in aeronautical certification cycle.

The electronic displays installed in the aircraft have Approval TSO (TSOA), meeting the requirements of TSO-C113a: Airborne Multipurpose Electronic Displays. This approval gives them the necessary condition for the installation, but the sufficiency will only be recognized after the dedicated tests in the aircraft.

Like any system of an aircraft, these displays pass by rigorous authority analysis, whether in operational acceptability and acceptability of installation on the aircraft, either by its admissibility, from the point of view of safety, provided by the Safety Assessment activity. It is this second approach that we will focus on this MSC.

From this point, we're going to abbreviate the term Safety Assessment for its initials SA, for space saving.

We will consider here the case of the aircraft type certification framed in 14 CFR Part 23 Commuter category, whose system safety requirements are the same as the Part 25.

AC 23.1311-1c (Installation of Electronic Display in Part 23 Airplanes) deals with the installation of these systems and makes comments about the the activity applicated to these systems, linking it, however, to the AC 23.1309-1E, which is the document that contains the suggestions for applicants to carry out such activity.

We begin by saying that the safety requirements of systems are established according to the potential effect of failures on the aircraft level functions. On the other hand, the failures that occur at the aircraft level are reflections of the failures that occur in systems level, which are the means to carry out the functions level aircraft.

The potential effect of a failure of an aircraft level function is called failure condition-FC . The FC has a gradient of gravity known by severity, from the FC less severe to the most severe, on the following scale: No Safety Effect, Minor, Major, Hazardous and Catastrophic.

The big concern is undoubtedly with the FC Hazardous and Catastrophic. The first because, in taking place, requires an intense work of the crew, to keep the aircraft under control, with possible serious injuries on board, despite the efforts of the crew. The second because it represents the catastrophe, that is, the end point, the precipitation of the aircraft, with the well-known consequences.

The FC level aircraft are identified by the called Aircraft Functional Hazard Assessment – AFHA , the first analysis to be held in the activity of SA.

In this analysis, we first identify the functions level aircraft and their FC. The identification is made with the infinitive, for example: "To provide the aircraft attitude information, provide altitude information of the aircraft," etc.

But provide to whom? to the pilot, of course, helping he to lead and control the aircraft. It is the pilot, no doubt, the focus, who we hope to be in a good health and happy, whenever he exercise his activity. As engineers in the area of risk, unfortunately we can not control the pilot (at least, for now).

The aircraft level functions are provided by the systems of the aircraft. Formerly, they were provided by discrete systems, but today, many of them have been integrated, being provided visually by the notable electronic displays, especially those of navigation and flight control.

Modern aircraft have on the panel the called PFD (Primary Flight Display), which provide the pilot to the Primary Flight Informations - PFI, which are: Attitude, Altitude, Airspeed and heading (direction), among others, for example, those relating to engine performance

O termo *Primary* significa que se trata do principal display, isto é, aquele que o piloto visualiza em primeiro lugar.

The term "primary' means that it is the main display, i.e., one that the pilot sees at first.

We have to understand that in reality, the display only shows the information generated by the systems that produce them, from dedicated sensors. Put in other words, the display is a component that is part of various systems..

Quando uma dessas informações desaparece do *display*, entende-se, em princípio, que o sistema gerador tenha falhado, em algum ponto, inclusive, porque não, o próprio *display*, parte visual (*pictorial)* desses sistemas.

When one of these information disappears from the display, it means, in principle, that the generator system has failed, at some point, including, why not the display itself, part visual (pictorial) of these systems.

Sucede, no entanto, que a perda das funções de provimento das PFI *attitude, altitude* e *airspeed* são consideradas *failure conditions* de potencial catastrófico, enquanto a perda da informação de *heading (direção)* é de severidade *hazardous*.

It happens, however, that the loss of the functions of providing the PFI attitude, altitude and airspeed are considered failure potentially catastrophic , while the loss of information from heading (direction) is hazardous.

If the display fails as a whole, the situation could be considered of high risk, that is, a catastrophic FC.

Here comes the so-called principle of intolerance to a single failure , from the authority, that a system that has a function with FC catastrophic can not lose that function, in virtue of a singular failure .

Thus, to fit with certainty on this principle, you can not have a single display installed in the aircraft. It is necessary that there is another, at least with the same functions, and may be identical to the first (and even the same manufacturer PN) or different, but separate from the main, in terms of sensors and power supply.

Therefore, it is imperative to be installed in aircraft two displays performing the same functions, whose FC are catastrophic or hazardous. These are called dual or redundant systems.

When the displays are identical, someone can say that it is not good because both have the same failure modes. However, these people will understand that the occurrence of failures, especially in electronic systems, is a random event, i.e. not necessarily happen at the same time, in the two displays, in spite of being "identical".

Instead of these dual displays or in standby, you can also use the so-called Reversionary Flight Displays (Reversible Flight Displays), such as the Multifunction Display (MFD). The primary function of the MFD is to provide the pilot access to various data, or combination of data, used to fly the aircraft, navigate, communicate and/or manage aircraft systems.

But the MFD can have another page to display, that is, it has a reversionary display to present the PFI, acting as an alternative means, in case of failure of the PFD.

Well, friends, we stopped by here, in the space available for the MSC. Soon, we will bring more information on the topic treated in this flash, in a new project for the dissemination of knowledge from DCA-BR.

Stay tuned, thank you and see you later.

References:

1. *CFR 14 Part 23 § 1309 – Equipment, System and Installation, Amdt 23-62, FAA, Dec. 2, 2011; USA.*
2. *CFR 14 Part 23 § 1311 – Electronic Display Instrument Systems, Amdt 23-62, FAA, Dec. 2, 2011; USA.*
3. *AC 23.1311-1E – System Safety Analysis and Assessment for Part 23 Airplanes, FAA, Nov, 2011; USA.*
4. *AC 23.1311-1C – Installation of Electronic Display in Part 23 Airplanes, FAA, Nov., 2011; USA.*