Improve Your Knowledge

EME, EMI and EMC

- Part 3: LIGHTNING -

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When the lightning reaches an aircraft, puts it in series with the current of the discharge circuit, because it enters at one end and exits by another (from wing to wing or from nose to tail, for example). If the lightining traversed the aircraft, without disturbing the systems in the interior of the aircraft, we wouldn't have to worry about. Unfortunately, it does not always happen.

The skin of the aircraft and the metallic structure attached to it behave like a network of resistors, which would trigger voltages along this way. These voltages can be a mechanism for energy spread to the interior of the aircraft, reaching electrical/electronic systems, fuel tanks, etc., if these systems are not adequately protected.

Lightning is actually a powerful electric current and currents, we know, produce electromagnetic fields that can induce voltages in cables and even directly in electrical and electronic equipment. This induction can be enough to change the state of an integrated circuit because the energy required to change the state of these devices is low and continues declining with the technological advances.

There are some cases of catastrophic accidents (with death of persons on board) caused by the incidence of lightning on airplanes. The following is a list of the most notable cases. .

1963 – Boeing 707 of Pan Nam, in flight from Baltimore to Philadelfia, in the United States, crashed near Elkton (MD). Killed 81 people. Most likely cause: ignition of fuel in the tank No. 1 produced by lightning, followed by the explosion.

1967 – Lockheed Jet of Iranian Air Force crashed after being hit by lightning with further fuel tank explosion. Killed 23 people.

1971 – Aircraft of Lansa (Peru), with 91 people, which crashed after being hit by lightning that caused the separation of the right wing. There were no survivors.

1988 – Aircraft of Swearingen Metro, in Germany, lost a wing, after being struck by lightning. 21 people died.

In fact, there are nowadays several design techniques that reduce the possibility of fatal accident. It is evident that it is necessary to eliminate any point of entry (opening) with conductive path to the interior of the aircraft, in an effort to keep the current just in the fuselage, so that lightning enter in a point and exit off some other extremity, without deviations to aircraft inwards.

The cables connected to sensitive and critical equipment such as computers must be shielded and grounded to avoid interference from transients produced by lightning, the so-called indirect effects of lightning.

All these precautions, anyway, must be exhaustively tested (Lightning Tests) to verify their efficiency in relation to lightning.

The radome, that cone in the nose of the aircraft, is a point of concern because it contains the radar and instruments. However, it cannot be surrounded by a conductive material because the antenna in such case could not capture the electromagnetic energy. Protection is done, for example, by setting metal bars next to each other, on the external part of the radome. These strips are sized and spaced carefully according to the results of Lightning tests. In fact, these bars act as a captor for Lightning, i.e. they lead the Lightning current to the aircraft fuselage.

But despite all these techniques, the best thing we can do is avoid flying near the charged electricity clouds, the so-called cumulonimbus.

References:

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See soon Part 4 on EMI and EMC Testing. See you.