The use of fire simulation as a tool for regulation evolution: application to Heat Release Rate (OSU) requirements

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In case of post-crash fire, it is essential to sustain survivable conditions long enough to evacuate the aircraft. This evacuation time largely depends on the fire growth and propagation inside the cabin before reaching flash-over conditions and the involvement of the entire cabin.
Currently, real scale testing is the most reliable way to estimate the fire growth rate and time to flash-over. This experimental way is widely used by aircraft Authorities to assess the effect (or benefits) of new materials introduction on fire risk and cabin safety or to justify evolutions in the regulation.
However, full scale testing is not always possible both for time and cost reasons. In order to have some information on fire growth and time to flash-over, various numerical tools are currently available and well known by fire safety engineers and scientists. Even if they have limits, these models provide reliable approximations of test results.

The talk presents a computational approach (realised with the CFD code FDS 5) carried out by DGA Aeronautical Systems, mainly within the framework of the ARAC MFWG committee. The objective was to estimate the effect of various heights of an OSU transition zone, height below which there would be no OSU requirement, on the kinetic of fire growth inside an aircraft cabin. The work presented below was realised considering a simplified geometry of a medium range aircraft cabin (A320 / B737).
In this study several cases were simulated considering OSU characteristics of materials tested at DGA Aeronautical Systems and the different numerical results obtained were compared with two reference simulations. To obtain those reference profiles, two materials were selected. The first one was defined considering different kind of theoretical borderline OSU profiles (65/65) allowed by the regulation to define an upper bound profile on a cabin safety point of view. This profile (65/65), with a very fast HRR growth, can be considered as the hypothetic worst compliant profile admitted by the current regulation. The second one is representative of a just compliant real material (65/65) extracted from our data base. Then, the worst non OSU-compliant profile was selected within our data base to be representative of a non-compliant material used below the OSU transition zone. Fire growths corresponding to various combinations of materials and heights of OSU transition zone were calculated and compared with the ones obtained with the two reference OSU profiles.

In addition, some experimental results and calculated data are presented in order to validate these fire growth calculations.

Due to several hypothesis, simplifications and uncertainties of the simulation code, this approach does not claim to be able to predict the exact time to flash-over, but allows to identify the main trends and assess the sensibility of a fire growth depending on various parameters.
The aim of the talk is to show that, knowing the limits of the code and thanks to a relevant choice of configurations, associated with relevant input data, fire numerical simulations of simplified configurations can provide to engineers and authorities confident data and can constitute an helpful decision-making tool.