Wheels Up Landing Certification By Analysis of Regional Jet Aircraft

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In this paper a building block certification strategy is implemented on Regional Jet for Wheels-Up Landing drop test condition compliance with FAR/CCAR 25.994. Multi-scale progressive Failure Dynamic Analysis (MS-PFDA) is implemented on large scale structural models prepared to predict significant deformations, damage and fracture evolution subject to wheels up landing (WUL) scenario. MS-PFDA was validated for B737 drop test scenario with fuel, and luggage. A building block MS-PFDA simulation validation strategy compared FAA conducted B737 fuselage drop tests for the final shape change, acceleration of floor panel, and velocity versus time for two test conditions: a) With fuel tank deformation; and b) With luggage only deformation. Next ARJ21 fuselage and APU fuel lines including a global FEM of the aircraft and local FEM models of fuel line joints were simulated for wheels up landing on a paved runway to determine possibility of fuel leakage. A sink rate of 5ft/sec based on minimum FAA WUL requirement and 17 ft/sec based on FAA reference documents where FAA performed wheels up landing of a B720 at 17ft/sec was selected for the wheels up landing simulations. Simulation results at 5 ft/sec and six degree pitch angle concluded that: (1) The fairing stays intact; (2) Maximum plastic strain in the fuel line is below the failure strain limits and the fuel tank remains intact; (3) Flex Joints reaches axial, and rotation limits, without major deformation and load bearing capability of flex joints are based on Local Flex Joint FEA results; and (4) The work focused on passenger safety by meeting requirements for floor panel acceleration shock wave duration & distribution due to fuel line leakage. Designated Engineering Representatives (DER) verified no leakage based on local flex joint FE model, and CAAC accepted Type certification by analysis supported by Test.

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