RISC White Paper on AC33.14

The recent announcement by the Federal Aviation Administration of a new Advisory Circular, AC33.14-1 "Damage Tolerance for High Energy Turbine Engine Rotors" represents the culmination of a multi-year cooperative effort by the engine manufacturing community and the FAA to introduce an enhanced rotor life management process. Through this AC, a new element, known as Damage Tolerance, is added to the OEM's existing design and life management process.

The Damage Tolerance process is designed to increase engine safety by significantly reducing the potential for premature component failure from unanticipated material anomalies. Although this initial release of the AC focuses only on the threat posed by Hard Alpha anomalies in titanium rotors, future updates will address manufacturing and maintenance induced anomalies, as well as inherent anomalies in other rotor materials.

This enhanced lifing approach is an outcome of recommendations stemming from the FAA Titanium Rotating Components Review Team (TRCRT) Report, dated December, 1990. TRCRT was convened following a crash landing of a United Airlines DC-10-10, at Sioux City Gateway Airport, Sioux City, Iowa on July 19th, 1989. Subsequent investigation determined a contributing cause of the accident to be a failure of a high energy titanium component (the fan disk) within one of the General Electric CF6-6D engines.

The enhanced process detailed in AC33.14-1 establishes a new standard for rotor design and life management of all titanium rotor components on new FAA Type Certificate engines. Centric to this new approach is a probabilistic fracture mechanics – based assessment process along with the corresponding Damage Tolerance Design Targets. The engine manufacturers will utilize this new design philosophy to evaluate the acceptability of all future titanium rotor designs and life management plans. The FAA recently announced the release of the software tool, DARWIN, which was specifically developed by Southwest Research Institute (SwRI) under an FAA grant to support this new design process.

The enhanced process is expected to significantly reduce the number of uncontained rotor events on all affected designs. For the titanium melt related anomaly threat currently addressed by the Advisory Circular, at least a factor of 3 reduction relative to the current demonstrated rate is expected.