National Aeronautics and
Space Administration

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Langley Research Center
Safety Alert

Date: February 21, 2001

TO: All Facility Safety Heads
All Facility Coordinators

FROM: 429/Head, Office of Safety and Facility Assurance, OSMA

SUBJECT: Transonic Dynamics Tunnel Mishap

On October 11, 2000, a mishap occurred at the Transonic Dynamics Tunnel (TDT) when a blade separated from a rotor (i.e., an airplane propeller). The incident did not result in damage to the TDT, but significant damage occurred to the Wing and Rotor Aeroelastic Testing System (WRATS). This is a reusable testbed placed inside the TDT test section that allows for testing different rotor models. The rotor model being tested at the time was not NASA owned; it had been designed and manufactured by an industry customer. This incident resulted in a Type B mishap (i.e., greater than $250K but less than $1M) and was reported to NASA Headquarters.

A thorough investigation concluded that the most likely cause was using the wrong material to fabricate the cuffs of the rotor model. A cuff is the mechanism that attaches a blade to the rotor hub. The model designer specified aluminum 7075-T7351 as the cuff material, but the part was actually fabricated using aluminum 6061. The stress analysis performed prior to testing indicated that 7075 had the proper material properties for the cuff's intended task. However, an examination of the properties of 6061 showed that a cuff manufactured from 6061 was, "marginal at best for the task intended."

It was clear that the material change was not properly analyzed and that some of the people who needed to be informed about the change had not been informed. The customer stated after the incident, "that the material change was approved, but that information was not incorporated into the original [stress] analysis." Also, an incident that occurred prior to the mishap indicated that the customer's test engineers did not know of the material change until after the mishap occurred.

(This Safety Alert to be posted on Facility Bulletin Boards for a Minimum of 30 days.)

This incident points to a very important lesson learned: When failure of a customer's model can cause significant damage to a LaRC facility, the appropriate quality assurance requirements must be placed upon the customer. Several documents provide guidance for testing models: LAPG 1710.15, "Wind Tunnel Model Systems Criteria;" LMS-CP-0502, "Wind Tunnel Test Planning;" and LMS-CP-0503, "Wind Tunnel Build-up and Installation." These documents provide guidance for model quality assurance. But, it is the responsibility of the Wind Tunnel Test Team, which includes the Facility Safety Head (FSH), to determine, "specific quality assurance criteria in view of model system complexity and criticality with regard to model system design specifications." In accordance with LMS-CP-0502, this shall be done during the initial pre-test meeting. It is the responsibility of the customer to implement the quality assurance requirements and provide evidence of compliance in the Model Systems Report. It is important to remember that the primary party responsible for the safe operation of a Facility is its FSH, and the FSH has final authority for all models tested in a Facility.

Taking into account the complexity and potential damage to a LaRC facility, NASA should provide an independent verification of the customer's quality assurance. This may range from ensuring the evidence of compliance is included in the Model Systems Report for a low-risk model to conducting independent material verification for critical components of a high-risk model. Additional examples of specific quality assurance activities are: requiring material pedigree for all fasteners, spot checking contractor quality assurance activities, and performing detailed receipt inspection.

There are several organizations at LaRC that can assist a Model Test Team in establishing quality assurance requirements and performing independent verification: the Office of Safety and Mission Assurance (OSMA); the Receipt, Inspection, and Quality Assurance (RI&QA) Lab; and the Quality Applications Technology Branch (QATB).

Any questions should be addressed to the Office of Safety and Facility Assurance at extension 47233.

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