Memorandum for the Record

T-28 System Tests in Severe Storm Environments

Background

The T-28 armored aircraft facility is in the process of upgrading its data acquisition system and several of the meteorological instruments it carries. Funding from the NSF will allow the facility to acquire a new precipitation-particle imaging probe, a new cloud water probe, and to build a new electric field meter system. It has also permitted refurbishment of existing PMS-2D-C and FS SP probes. Recently-completed work, accomplished at the New Mexico Institute of Mining and Technology, has led to the possibility that a precipitation particle-imaging probe equipped also to respond to particle charge can be built for use on the T-28.

Data system upgrades, refurbishment of existing particle probes, and installation of a new cloud water probe will be completed this spring. An offer has been extended to loan to the facility an electric field meter system of the type to be built for permanent installation, as well as a precipitation particle-imaging probe, with charge-measurement capability, of the type we hope to eventually acquire for permanent installation on the T-28. These developments make it desirable to conduct a test flight program this summer in order to test the new and refurbished equipment, and to evaluate the existing versions of the electric field meter system and imaging probe for use in severe storm environments before finalizing the design and installation of permanent equipment on the aircraft.

Such testing should be done in a range of environments from weak convective clouds to severe storms. Severe storm penetration by the armored T-28 can be conducted safely only with guidance from a high-quality meteorological radar; the ability to sector-scan is also desirable so that developments in rapidly-evolving storms can be followed closely. In addition, it is helpful to display the aircraft track directly on the real-time radar display.

We propose to conduct this testing in northeastern Colorado with guidance from the CSU-CHILL radar, located near Greeley, during June, 1998. The radar has all of the capabilities required, plus additional polarimetric features that could be useful in interpreting some of the T-28 observations. This region normally experiences significant convective activity during June. The T-28 armored aircraft has worked with guidance from the CHILL radar during 3 projects in the last decade, with excellent results.

Planned Operations

The aircraft will be based at Fort Collins-Loveland Airport, where a good working relationship has been established with the fixed-base operator during previous T-28 operations in the area. Good hangar and office space can be obtained there. The T-28 facility scientist will direct overall aircraft operations from the CSU-CHILL radar site. The radar will be run from mid-day through late afternoon to routinely monitor convective activity on days when such activity is forecast, while the rest of the crew stands by at the airport. When suitable storms begin to develop, the facility scientist will alert the crew, and the aircraft will be launched. The facility scientist will monitor storm development and direct the aircraft in penetrations of convective storms. Normally penetrations over only a limited range of altitudes will be flown on a given day, in multiple storms on that day. It will be possible, during several days of storm activities, to direct the aircraft through a range of storm environments, from altitudes near cloud base to altitudes near 20,000 ft MSL, by focusing on different altitude ranges on different days. This will maximize the amount of storm penetration data obtained per flight, as little time will be consumed in altitude changes outside of cloud. The focus of these operations will be to acquire a large volume of data during penetrations in a wide range of environments. Detailed observations through the life cycle of a single severe storm will not be the priority.

Data will be reviewed daily in the field and instruments adjusted/modified as required to optimize instrument performance. Information acquired about the loaned instruments will be accumulated for use in refining the design and installation plans for permanent versions of those instruments. Data acquired will also be made available to students participating in a parallel CSU REU program with the CHILL radar, for use in their analysis exercises.

Analysis will focus on several issues:

- Comparison of cloud water measurements between the re-furbished FSSP, the new DMT cloud water probe, and the old J-W cloud water meter. Some clear-air flying will be needed before the DMT instrument can be fully calibrated. The sensing elements in the DMT probe have yet to be tested against impact from sizable graupel or hail particles.

- Evaluation of operating characteristics of, and particle charge data from, a modified HVPS precipitation particle imaging probe on loan from Atmospheric Environment - Canada, through the New Mexico Institute of Mining and Technology. The charge-sensing attachment has not been tested in clouds containing sizable graupel or hail particles.

- Evaluation of operating characteristics and data from wing-mounted pod electric field meters on loan from the New Mexico Institute of Mining and Technology. We plan to mount the borrowed probes on or near the wing tips. We need to find out if clean data

from which all 3 components of the vector electric field, and charge on the airplane, can be obtained from pods mounted in this position.

Expected Outcomes

- Evaluation of new data system, new cloud water probe, and refurbished 2D-C and FSSP, in a program where scientific goals will not be hindered if time is taken to focus on instrumentation issues.

- Refinement of design and installation plans for roughly $60,000 worth of instrumentation yet to be acquired/constructed for use on the T-28.

- Crew proficiency exercise for a crew on a severe storm deployment.

- Interaction with an NSF-sponsored REU program based in the CSU Dept. of Electrical Engineering.