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From: Vertical Flight Human Factors Program Manager
To: Vertical Flight Human Factors TCRG (POC: Hooper Harris AFS-410)

Subj: Rotorcraft Precision Visual Flight Rules Simultaneous Non-Interfering Human Factors Project Execution Plan

Ref: Vertical Flight Human Factors TCRG 5/31/01 meeting - requirement entitled "Simultaneous Non-interfering Operations - Quantify VFR Navigation Performance"

1) Per reference, the "Inexpensive Night Vision Imaging System Field Evaluation Methodology" was ranked first by the Vertical Flight Human Factors TCRG. The requirement's objective is to "determine navigation performance of visual flight rules helicopter pilots using instrument flight rules qualified global positioning systems receivers. The Federal Aviation Administrations Flight Standards Office AFS-400 needs to quantify helicopter pilot navigation performance for IFR and VFR pilotage which will allow the development of procedures to integrate within the national airspace system."

2) The concept of Precision Visual Flight Rules (PVFR) and Simultaneous Non-Interfering (SNI) Routes for rotorcraft is based on the hypothesis that rotorcraft with Global Positioning System (GPS) navigation capabilities can stay within narrow, defined horizontal airspace limits while operating under Visual Flight Rules (VFR). If the pilot maintains the aircraft within the confines of a PVFR route and if these routes can be designed to keep rotorcraft separated from fixed-wing traffic then PVFR routes offer rotorcraft the possibility of operating in congested airspace simultaneously with fixed-wing aircraft on a non-interfering basis, hence the term SNI operation.

3) The requirement will be divided into two projects. The first project entitled "Rotorcraft Precision Visual Flight Rules Simultaneous Non-Interfering Human Factors Project " will be co-funded by Federal Aviation Administration's Propulsion Systems Branch (AAR-460). The project's objective will be to evaluate the ability of GPS to provide lateral guidance for helicopters flying on PVFR routes while using barometric altitude for vertical guidance. A secondary objective is to develop and

demonstrate PVFR routes and ATC procedures that use GPS to enhance the helicopter pilot's ability to navigate more efficiently in the National Airspace System (NAS). The results of this research and development effort will be used by the Federal Aviation Administration (FAA) to determine airspace requirements, air traffic control procedures, and pilot operational and training considerations. The flight test will assess human factors, flight technical error (FTE), navigation system error (NSE), and total system error (TSE) associated with operating GPS-equipped helicopters during PVFR/SNI operations. FAA can use these assessments to develop policy, criteria and guidance to support implementation of PVFR/SNI operations. Specific operations that may be enhanced by PVFR routes include helicopter transitions through control zones and congested airspace and flights through areas with natural or manmade obstacles, such as mountain passes and valleys.

4) The three year project will be executed as follows:

<u>Tasks to be completed:</u>

i. Evaluate the ability of GPS to provide lateral guidance for helicopters flying under a PVFR mode of flight while using barometric altitude for vertical guidance.
ii. Write a helicopter flight test that contains a non-precision GPS approach into a PVFR route. The primary measure collected will be [Tse = Nse + Fte] of GPS navigation during IFR flight.
iii. Identify test site, evaluate test site, survey site, and coordinate test site with AFS-400 and air traffic services.
iv. Provide testing support and coordination of all equipment installation and integration testing and checkout activities. The testing support activities shall include the review of system procedures, schedules and results reports, and in all test data collection and management activities. Evaluate, review, and finalize the detailed design and installation plans for a GPS receiver that meets TSO-C129A-1 requirements along with a laptop computer for recording via the RS234 port output from the aircraft GPS receiver navigation data.
v. Identify and coordinate test aircraft, subject pilots, and coordinate site-specific problems related to installation and integration of GFE or equipment purchased from this SOW.
vi. Collect all data (latitude/longitude to nearest .01 second, WPT identification, DTW to nearest .01 NM, XTRK to nearest foot, flags/alerts with HDOP > 2, and satellite identification and azimuth/elevation angles), merge flight data, and reduce data in accordance to the flight plan. Characterize Nse of GPS in 2-D helicopter operations, characterize Tse, both measured and calculated (Tsem and Tsec), of GPS during helicopter PVFR operations with the pilot flying raw data inputs (GPS lateral guidance and barometric vertical guidance), and characterize FTE of GPS during helicopter PVFR operations with the pilot flying raw data inputs.

vii. Provide technical assistance to the Naval Postgraduate School, Monterey CA and NASA Ames, Moffet Field, CA who is developing a virtual model of the flight test site. The Contractor shall provide maps, traffic density estimates, SNI flight examples, and other relevant information to model the flight test plan in the virtual environment. The Contract shall not be responsible for computer programming or any other technical issues related to creating the virtual model. Coordinate with the Naval Postgraduate School, Monterey CA. and NASA Ames, Moffet Field, CA who will conduct behavioral tests related to the SNI project.

viii. Ensure that the flight data is compatible with the virtual model data to validate and compare simulation performance.

ix. Provide assistance to the Naval Postgraduate School, Monterey CA and NASA Ames, Moffet Field, CA to ensure that they can collect pilot head and eye movements by the use of a head and eye tracking system during PVFR flight to determine the division of pilot attention to cockpit instrumentation and visual flight as it applies to airspeed, altitude, and flight track performance. The Contractor shall not be responsible for the eye and head tracker or associate costs for installation, maintenance, or operation of equipment. The Contractor shall be responsible in coordinating and assisting with the aircrew to maintain safety of flight.

x. Be responsible for scheduling the aircraft, tracking, communications, and any special requirements for the flight, responsible for confirming TSPI station, airborne receivers, and other test equipment that are required will be ready prior to mission brief.

xi. Be responsible for safety pilot briefs, subject briefs, weather checks, flight plan and ATC coordination.

4) Quarterly (December, March, June, and September) research progress status reports
   - Informal e-mail reports from the AAR-100 vertical flight human factors program manager to Hooper Harris (AFS-410)

5) FY03 annual report summarizing year's activities by grantee. This annual report including other human factors vertical flight projects sponsored by vertical flight TCRG will be electronically submitted to the committee.
   - Grantee will submit an annual report using AAR-100's Productivity Report website (http://www.hf.faa.gov/report/) to the AAR-100 vertical flight human factors program manager.

6) Deliverables:
   - FY03: Flight test plan, June 30th 2003.
   - FY04: Interim report of the October 2003 flight test, March 1st 2004
   - FY05: Final report that evaluates the ability of GPS to provide lateral guidance for helicopters flying on PVFR routes while using barometric altitude for vertical guidance, January 1st 2005.

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