INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

March 26-27, 2003

Hosted By Goodrich Corporation, Phoenix, Arizona

WEDNESDAY, MARCH 26, 2003

LOC Testing – Work Update

This work was done by Steve Summer at the FAATC. Compiled a more complete set of spark ignition data at sea level conditions at a range of THC concentrations and oxygen concentrations at and around 12%. Plotted results of both as a function of altitude and as Fuel Concentration Vs. O_2 Concentration at request of Boeing/Dr. Shepherd. Conducted a series of sea level hot surface ignition tests. Still no ignitions below 12% O_2. A photo of the pressure chamber facility at the FAATC was provided for reference. A diagram of the test apparatus was presented and reviewed. A diagram of the thermocouple locations was presented. The test program was explained. JP-8 fuel was used in this test program.

Hot Surface Ignition (HSI) Testing (Conducted by Steve Summer at FAATC)

The purpose, test set-up, and results of these tests were presented. At 21%, O_2 ignition was achieved at a hot surface temperature (HST) of approximately 1350F. A half-dozen other tests were conducted at O_2 concentrations ranging from ~11.5-14%.

NASA OBIGGS/ Update OBOGS– B. McKnight

Bob briefly reviewed the following NASA topics:

Aviation Fire/Fuel Security Workshop

State of the NASA OBIGGS/OBOGS Contract

Alternate OBOGS technology leveraging

Fire-safe fuel research status

Aviation Fire/Fuel Security Workshop (March 11-12, 2003, Alexandria, VA)

Scenarios: Shoe bomb, API sniper round through tank, MANPAD

Technologies: Fuel foam, solid polymer fuel, active suppression, reticulated foam, inerting MCK, metal mesh

Board evaluation of ideas to help NASA sort out technologies for security program from FY04-07.

Security program – Aircraft Hardening – Fire Prevention: 1 to 2 M/year funding

OBIGGS/OBOGS Program Status

Retarget from B757-200 to B737-700
6-month feasibility study finishing on 3/26/03
No new technology entrant:
- Higher-temperature membranes
- System-level performance improvement
- Oxygen waste stream for emergency-cruise breathing

Phase II evaluation and selection by 4/26/03

Enough funding for 3 of 4 proposed Phase II contracts

There is currently no suitable means for OBOGS to satisfy surge load:
- Surge load requires some form of stored oxygen
- Higher-altitude emergency cruising (20-25kft) requires better member selectivity or PSA-type enrichment

Enriched oxygen for hybrid fuel cell APU
- This research is being conducted at NASA Glenn Research Center

Repeatable Minimum Ignition Energy Measurement – M. Rabinowitz (NASA)

Program Goals:

1) Reduce likelihood and severity of fuel tank fires

2) Increase time for passenger evacuation after survivable impact

3) Do all this without degrading aircraft operations, emissions or profitability

Minimum Ignition Energy:

Develop a surrogate fuel
Develop a deeper understanding of spark ignition

A photo of the NASA Combustion Vessel Apparatus was presented and described. The NASA testing is done at sea level. A photo of the internal configuration of the test apparatus was also shown.

Flight Testing – R. Hill

The FAATC flight tests will no longer be conducted using a B747-SP. The FAATC will now be conducting a joint flight test program with Airbus using the FAATC designed system. The tentative start date for this program is June 2003. An A-320 aircraft will be used for these flight tests.

The FAATC is negotiating with NASA for use of the B747s used to transport the space shuttle across the country for some flight tests possibly in the fall or early winter 2003.

NASA/FAA/TSA Fuels Security Conference FAATC Fire Safety Presentation Summary – R. Hill

Define Hazards:

Type of Hazard

- Using aircraft as a weapon
  - 9/11 scenario again unlikely
  - hijack attempt may cause loss of an aircraft
- Explosive device used on aircraft
  - Flammable liquid poured out on-board and ignited
  - Aerosol cans
- Devices fired at aircraft
  - Small arms
  - missiles

Level of Hazard

R&D Needed:

1. Improve efficiency of the membranes
2. Better filters
3. Higher temperature membranes
4. Study nitrogen used within fuselage
5. Develop cabin water mist requirements

Inerting of a Scale 747-SP Center-Wing Fuel Tank During a Typical Commercial Flight Profile – B. Cavage

Bill briefed the group on the background of this project and described the model (this information has been presented in previous Working Group meetings in more detail). The instrumentation was then described. The Scale Tank Testing Block Diagram was shown and explained. Bill explained the Deposit Scheme Comparison. The data collected during these tests was presented and explained. Summary: scale model data shows FAA inerting methodology is sound given predicted system performance (system could be slightly undersized); using high flow mode only, decent held buy you very little in terms of average of worst bay oxygen concentrations; running system on ground after touchdown in high flow mode will decrease oxygen concentration spread, but has diminishing returns (when average oxygen concentration is near 12%); more elaborate deposit schemes and system methodologies

give relatively small performance benefit, but could improve inerting capability significantly of a marginal system.

Natural Diffusion of NEA in a 747SP Center Wing Fuel Tank During Ground Operations – B. Cavage

The background was provided. A diagram of the 747SP CWT Sample Port Locations with Bay Numbering was presented. The Full-Scale 747SP CWT Inert Gas Diffusion Data was presented. Summary: Diffusion across the wall of a CWT can be significant with high oxygen concentration differences; when the oxygen concentration between two bays becomes close (1-2%), diffusion becomes slow; and ACM stimulation improves diffusion.

Engine Nacelle Halon Replacement Update – (Doug Ingerson)

Dick informed the group that the engine nacelle is now ready for agent testing to begin. The basis for the final decision on environmental test parameters was provided. The basis for quantifying a halon replacement was presented. The Near Term Plans were outlined. Equivalency testing of HFC-125 and CF_3I will be conducted in approximately one month (or so).

Cargo Smoke Detection Update – D. Blake (FAATC)

A diagram of the DC-10 test article was shown. Main deck tests were conducted since the October 2002 WG meeting. Dave presented the CO data from these tests. Ceiling smoke data was also presented. The potential background levels of CO were investigated. The future activities are to determine flow schedules and necessary additions to mimic flaming resin gas signatures using compressed CO and CO_2, and continue CFD validation testing.

Modeling Smoke Transport in Aircraft Cargo Compartments – J. Suo-Anttila (Sandia)

A diagram of the software design was presented and explained. Version 1 of the Pre-processor is complete. Version 2 is currently in progress. The capabilities of the pre-processors were presented. The Smoke Transport Analysis Code capabilities were presented including: curvature of compartment is resolved on grid; location and type of fire can be selected, simulation time on the order of hours, validated using FAA full-scale experiments. The post-processor allows users to manipulate data in a variety of ways including contour plots and 3D smoke visualization. The FAA Full-Scale validation experiments are conducted in the 707 test article. The instrumentation used in this test article was discussed. The Validation Metrics were presented including: thermocouple temperature rise, light transmission, and gas species concentrations rises. Jill reviewed the preliminary temperature comparisons, the preliminary smoke meter comparisons, and the preliminary concentration comparisons at 60 seconds (and at 120 seconds and 180 seconds). The conclusions were presented. Model additions are required: recessed areas and heat transfer to ceiling (sub-model will be added). Future activities include: continue validation of the smoke transport code; finish implementation of user interface in December 2003. The documentation and release of code to a small user

community is scheduled for February 2004, revisions and final release of code is scheduled for February 2005.

Multi Criteria Fire/Smoke Detectors for Cargo Holds – K. Schmoetzer (Airbus)

Klaus reviewed the background for this research (cargo compartment false smoke alarms history). The general principle of this multi criteria system was presented and explained. The performance of this system includes: balanced response to all types of fires and high immunity to fog and condensation. The use of multi criteria fire/smoke detectors within cargo compartments: will enhance false alarm immunity; could provide a more sensitive fire/smoke detection; needs carefully developed & algorithms. Airbus has decided to use Multi Criteria Fire/smoke detectors in A380 cargo compartments.

Fire Suppression System Scaling – (J. Reinhardt) – Presented by R. Hill

The New Task Group Objective is to determine the critical parameters required to scale a water mist system combined with nitrogen, used as an aircraft cargo compartment fire suppression system that have met the MPS. Dick Hill provided a detailed explanation of this new objective in order to apply the scaled MPS to a different sized cargo compartment. The water mist system is the most viable at the current time. John will investigate the use of a system in a 737 and a 747 cargo compartment given the MPS (using the FAATC Fire Safety Branch 737 and 747 test aircraft). John Reinhardt is currently seeking Task Group members for this program. If you are interested in participating, contact John Reinhardt at 609-485-5034, or via email at john.reinhardt@faa.gov.

FAATC Lithium Battery Fire Tests (H. Webster) – Presented by R. Hill

Dick gave the background for the development of this test program. The previous test results were briefly reviewed. Results of Multiple Battery Failure Mode: the ignition of a single battery was sufficient to ignite the adjacent batteries. The halon suppression results were reviewed. The cargo liner integrity during these tests was investigated and results were recorded. Explosion tests were also conducted in the FAATC pressure chamber. The conclusions: a relatively small fire source is sufficient to start a lithium battery fire, the ignition of a single battery produces enough heat to ignite multiple battery packs, cargo liner is vulnerable to penetration by molten lithium, batteries fuse together when exposed to flame promoting propagation between batteries, halon 1301 chemically interacts with the burning lithium batteries, the temperatures found in a suppressed smoldering cargo compartment fire could ignite the lithium batteries. The FAATC will be meeting with the Department of Transportation (DOT) to discuss the results of these tests. The DOT regulates the carriage of hazardous materials.

FAATC Hidden Fire Test Program (T. Marker) – Presented by R. Hill

Basis for this FAATC Program: NTSB review of crew actions during in-flight fires has resulted in a series of recommendations calling for improved crew training and modification of cabin interiors to improve access to fires burning behind panels – January 2002. Dick

described several incidents that brought about the NTSB investigation and these recommendations. The new recommendations for 2002 were reviewed individually. The FAATC Coordinated Approach to Hidden Fire Protection includes: Material Flammability, Accessibility, Detection, Suppression, and the Fire Fighting Procedures. The FAATC has a B727 to use as the test article for the hidden fire test program. Tim Marker will do some initial testing in the FAATC B747 until the B727 test article is relocated at the FAATC.

Status of Handheld Extinguisher User Preference Survey – Rich Mazzone (Boeing)

Rich explained the basis for the establishment of this Task Group and who the participating organizations were in this Task Group. This Task Group was established in October 2002. Topics addressed in this survey will be: seat fire tests, cargo fire tests, human interaction (in use of extinguishers), Halon 1211 interchangeability with water. The survey will reference the MPS. Rich reviewed the survey briefly. ACTION: He requested that Dick Hill prepare a cover letter for the survey as he intends to send the survey out to quite a few organizations in the international aviation community. He showed Dick a sample of a letter sent with a previous survey.

THURSDAY, MARCH 27, 2003

Task Group Reports

User Handheld Survey Task Group – R. Mazzone

Handheld User Preference Survey Task Group agreed to minor wording changes to the survey, and it should be sent to the perspective airlines through Boeing and Airbus. The Air Transport Association of Canada will also send out the survey to the Regional Airlines of Canada.

The Action Item: The members of the Handheld Task Group will look at issues of using handheld extinguishers in the fighting of hidden fires. The FAA Hidden Fire Task Group will also look into these issues.

Engine Nacelle Task Group – C. Roseburg

Issues/Concerns: (These concepts are the consensus of the Task Group after reviewing the Boeing comments).

The FAATC Engine Nacelle simulator test sequence should include a range of conditions to demonstrate the adequacy/equivalency of the new alternate replacement agents.

CMR Proposing Additional Test Conditions:

Bottle temperatures – consider the need for FAA Simulator Fire tests with –65F agent. Rationale for this concern was then explained.

Suggestions/Recommendations:

Boeing suggests/recommends that the Task Group consider a wider range of severe fire conditions to demonstrate equivalency.

Testing the cold bottles would increase the number of tests from 4 to 8 or a total of 40 tests. Dick noted that there would be an impact on the time required to run the additional tests as well as an eventual cost.

Hydrostatic Test Task Group – H. Humfeldt

Kidde has provided service information data. Pacific Scientific will also provide service information data within one week of the end of this meeting. Hydrostatic testing will now be required every 10 years as a result of the efforts of this Task Group. This item is now closed.

Fuel Tank Task Group – B. Cavage

Exchanged comments on fuel and discussed possibility of some future workshops.

Cargo MPS Task Group – D. Hill

The approach to go from the MPS on Water Mist to certification in aircraft was discussed. The Task Group will list the variables of the system (detection means, sizing of zonal grid) and geometry (height, volume, shape, width of cargo compartments) to be considered in scaling from the MPS to aircraft. The Task Group was asked to supply this list to John Reinhardt within one month.

Next Meeting:

The next meeting will be hosted by Transport Canada, July 8-9, 2003, in Ottawa, Canada. A list of local hotels in the Ottawa area will be posted to the FAATC Fire Safety Branch Website.

Working Group Member Presentations

Aircraft Fire Sensing based on Optical Detection of Key Species – D. Oh (Southwest Sciences)

Oxygen Sensor System for Fire Environment – D. Oh (Southwest Sciences)

FAST-PORT: A Solution to Fight Inaccessible Fires – C. Fleece (LTMC)

Fiber Optic Oxygen Sensor for Fuel Tank Monitoring – M. Shahriari (Ocean Optics)

Introduction of ECS Air Cabin Distribution Simulation for Smoke Detection Purpose – D. Cannoletta (Alenia)