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## **BlazeTech Corporation**

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Our services to the aircraft industry include R&D, testing, model and simulation, safety audits, consulting, accident investigation/reconstruction and product/technology assessment. Our products include FuelShield™ that protects fuel tanks against ullage explosion and hydrodynamic ram; unique laser light scattering instrument, mass flux gage and pyrometer to characterize flows containing aerosols; and a variety of fire, explosion and structural damage software such as BlazeTank™ for fuel tank explosion calculations.

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## **Lecturers**

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**Dr. N. Albert Moussa**, Course developer, main instructor and Technical Director of BlazeTech with over 35 years of experience in fire and explosion in civilian and military aircraft. His credentials include: William Lockwood Memorial Lecture Award, Engineer of the Year by the NE Section of AIAA, AIAA Distinguished Lecturer, Best Papers by SAE and ASEI, and several ASME citations. He served on national committees and was Associate Editor of an ASME Journal. He authored one book and over 150 publications and reports. He investigated the major aircraft fire accidents since 1996. His forewarning about aircraft fuel system vulnerabilities has gained him prominence in the media, including CBS and BBC. He received a B.S. from Stanford University and M.S./Ph.D. from MIT, with both dissertations on fire.

**Mr. Chuck Leonard**, former NTSB Senior Investigator and a consultant to BlazeTech. He has investigated over 200 aircraft accidents around the world. He was a pilot with the Air Force and a major air carrier, accumulating over 17,000 flight hrs. He has taught professional courses on aircraft accident investigation at the FAA Academy and universities.

**Dr. Venkat Devarakonda**, Vice President of BlazeTech. His areas of specialization include fuels and combustion, fire and explosion effects, fire detection and suppression, reaction kinetics and optical instrumentation. He has more than 50 publications in related areas.

**Dr. Timothy Zhang**, expert in applied mechanics and computational methods such as FDS, ABAQUS, LS-Dyna, and SPH. He worked on structural response to impact, explosion and crash.

Occasionally guests will lecture on specific issues.

**BlazeTech**

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12th Annual Course on:

# **Aircraft Fire & Explosion**

## **Investigation/Vulnerability/Protection**

in

### **Accidents, Combat & Terrorist Attacks**

8 – 11 November 2011  
Register for Any or All Days



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### **Lecturers**

**Dr. N. Albert Moussa**  
**Mr. Chuck Leonard**  
**Dr. Venkat Devarakonda**  
**Dr. GangMing Zhang**

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### **Course Benefits Those Who Are:**

responsible for commercial/military aircraft, helicopters or Unmanned Aerial Vehicles including design, operation, prevention, maintenance, testing or management of fire and explosion safety, combustible fluids, material specifications, certifications, detection and suppression systems, bomb threats and security, structural analysis, survivability, vulnerability, safety management system, accident investigation, risk mitigation team and risk analysis.

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**BlazeTech**

29 B Montvale Ave. Woburn, MA 01801  
Tel: 781-759-0700 Fax: 781-759-0703  
firecourse@blazetech.com | www.blazetech.com

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## Course Objective & Organization

Expect comprehensive evaluation of aircraft fires and explosions in accidents, combat and terrorist attacks. Our fundamental and integrated approach enables us to address all these situations for both commercial and military aircraft in an effective manner. We use case studies of major accidents illustrated by videotapes and photographs, and complemented by well-characterized full-scale tests by the FAA, NTSB, DOD, NASA and BlazeTech. We determine quantitatively what governs the initiating event, accident evolution, system survivability and the potential success of protection methods. We bridge the gap between theory and practice through:

- Understanding of fundamentals, design trade-offs practical considerations and calculation methods
- Dynamic class exchange; attendees are encouraged to discuss their current problems

Course is organized into four one-day modules that are standalone, yet complementary. Aircraft systems and related tests, accidents and analyses are discussed on Days 1 to 3 while the investigative process is presented on Day 4. A certificate of completion will be given. Each day is equivalent to one Continuing Education Credit Unit.

### Day 1. Vulnerability to Combat/Terrorism

#### 1.1. Threats Characterization

- Projectile, explosive & hazardous materials
- Blast from spherical vs. cylindrical charges
- Internal explosions and hydrodynamic ram
- Toxic: chemical and biological agents
- Pocket green laser pointers

#### 1.2. Response to Threats

- Shock tube, air/ram gun & flyer plate tests
- Penetration and perforation
- Local deformation vs. complete collapse
- Dry bay fires; cook-off and blast (PAN AM 103)
- MANPADS/DHL A300 in Baghdad

#### 1.3. Survivability Improvements

- Aircraft hardening
- Fire detection and suppression (AV8-B)
- Concealed explosives and their detection
- Lessons learned and trade-offs
- Implications to Homeland Security
- First principle vs. engineering models

#### 1.4. Class Discussion and Wrap-Up

### Day 2. Fluids-Related Fire and Explosion

#### 2.1. Flammability of Fuels, Oils and Hydraulics

- New fuels: biofuels, Synthetic Paraffinic Kerosene

- Additives and contaminants
- Vapor pressure, flash/ fire points, flame speed
- Deflagration vs. detonation

#### 2.2. Fuel Tank Safety

- SFAR 88: lessons learned (TWA 800)
- N<sub>2</sub> Inerting: 9% vs. 12% O<sub>2</sub> (FRS 747)
- Predict fire/overpressure using BlazeTank
- Debris impact (Air France Concorde)

#### 2.3. Engine Fires

- Engine burst (UA232, Sioux City, IA)
- Hot surface vs. auto ignition temperatures (full-scale tests on F-16, F-18 and AV8-B)
- Fire detection vs. false alarm
- Suppression: Halon replacement, clutter effects

#### 2.4. Post-Crash Fires

- Pool fire: anti-misting fuel (Air France, Toronto)
- Postcrash fire in buildings (Sept. 11)

#### 2.5. Class Discussion and Wrap-Up

### Day 3. Materials-Flammability and Related Fires

#### 3.1. Polymers, Composites and Metals

- Thermal degradation, ignition, flaming, smoldering, smoke, toxicity, flame retardants
- Testing and predictive methods
- Composites vs. Aluminium structures; Mg

#### 3.2. Flammability of Assemblies

- Acoustic insulation
- Seats fabrics/foams and panel materials
- FAR 25.853 test methods

#### 3.3. Cabin Fires

- Breached fuselage vs. burn-through
- Flashover (full scale FAA tests)
- New materials: Magnesium, composites
- Passenger evacuation (Manchester, UK)

#### 3.4. Fires in Cargo and Hidden Areas

- Wire problems, electrical fires, Lithium ion battery fires, (Swiss Air 111; Saudi, Riyadh)
- Fire detection and suppression
- ValuJet, Everglades and FedEx, Boston

#### 3.5. Class Discussion and Wrap-Up

### Day 4. Accident Investigation

#### 4.1. From Accidents to Regulations

- Accident/incident databases
- Statistics/lessons learnt
- AC, AD, NPRM, FAR

#### 4.2. Investigative Process

- NTSB and corresponding agencies overseas
- On-site protocols (ICAO Annex 13)
- Forensic tools
- Timeline and pathline reconstruction

#### 4.3. Fire/Explosion Pattern Recognition

- In-flight vs. ground fires: broomstrawing and splatter (Air Canada, Cincinnati)
- Pre- vs. post-crash fires (Com Air, Lexington, KY)
- Fuel vapor explosion vs. explosives
- Use of scale tests & computational models

#### 4.4. Human Factors

- Organizational review (Columbia Shuttle)
- Safety Management System & risk matrix (United, Salt Lake City)

#### 4.5. Class Discussion and Wrap-Up

### Location and Schedule

Location in Woburn, MA to be announced to confirmed registrants. 8am-5pm each day. For near-by hotels, see Directions/Hotels at [www.blazetech.com](http://www.blazetech.com).

### Register\* for Any Combination of Days

one day: \$800. two days: \$1,400.  
three days: \$1,900. four days: \$2,200.  
Selection:  Day 1  Day 2  Day 3  Day 4  
Discount \$50/day if paid by check 1 month in advance. Fill out, fax and mail payment to BlazeTech.

Name: \_\_\_\_\_

Title/Position: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Country: \_\_\_\_\_

Phone/Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

Payment:  Check  Credit Card  Form1556

Card Number: \_\_\_\_\_

Expiration Date: \_\_\_\_\_ Amount: \_\_\_\_\_

Name on Card: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Billing Address for Card: \_\_\_\_\_

\* Registration cancellation fee: \$150 if within 2 weeks of course starting date. We reserve the right to cancel course.