

## **BlazeTech Corporation**

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.

## **Lecturers**

**Dr. N. Albert Moussa**, Technical Director of BlazeTech with over 30 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 100 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 suppression and reaction kinetics. He has more than 25 publications in related areas

**Dr. Gangming Zhang**, expert applied mechanics and computational methods such as FDS, ABAQUS, LS-Dyna, and SPH. He improved the latter by developing the MSPH and SSPH methods.

24 Thimble Street, Cambridge, MA 02141-1882  
**BlazeTech**

10<sup>th</sup> Annual Course on:  
**Aircraft Fire & Explosion**  
In Accidents, Combat & Terrorist Attacks

25-28 May 2010  
Register for Any or All Days



## **Lecturers**

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

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

responsible for commercial or military aircraft or unmanned aerial vehicles including design, operation, prevention, maintenance, testing or management of fire and explosion safety, combustible fluids, material specifications, detection and suppression systems, bomb threats and security, structural analysis, survivability, vulnerability, system safety, accident investigation, or risk analysis.

**BlazeTech**

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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:

- An understanding of fundamentals, design, 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. While we recommend taking all four modules, registration can be customized depending on needs. 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

#### **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)
- MANPADS/DHL A300B4 in Baghdad

#### **1.3. Survivability Improvements**

- Aircraft hardening
- Detection and Suppression (AV8-B)
- Lessons learned and trade-offs
- Implications to Homeland Security
- Computation 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**

- 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 (AF 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 and suppression
- Halon replacement agents; clutter effects

#### **2.4. Post-Crash Fires**

- Pool fire: anti-misting fuel (AF358, Toronto)
- Post-crash fire in buildings (Sept. 11)

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

### Day 3. Materials-Related Fires

#### **3.1. Flammability of Polymers & Composites**

- Ignition, flaming, smoldering, smoke, toxicity, flame retardants
- Testing and predictive methods

#### **3.2. Flammability of Assemblies**

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

#### **3.3. Cabin Fires**

- Breached fuselage vs. burn-through
- Flashover (full scale FAA tests)
- Aluminum versus composites
- Passenger evacuation (Manchester, UK)

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

- Wire problems, lithium batteries, electrical fires (Swiss Air 111, UPS Philadelphia)
- Fire detection and suppression
- ValuJet 592 and Fedex 1406

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

### Day 4. Accident Investigation

#### **4.1. Investigative Process**

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

#### **4.2. Fire/Explosion Pattern Recognition**

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

#### **4.3. Human Factors**

- Organizational review (Columbia Shuttle)
- Safety Management System & risk matrix (Buffalo, NY)

#### **4.4. Class Discussion and Wrap-Up**

### Location and Schedule

The course is given at BlazeTech: 29 B Montvale Ave. Woburn MA 01801 from 8am-5pm each day. For info on near-by hotels, direction, free parking and public transport see [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/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.