What We Do is … ESSENTIAL

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Celebrating more than 34 years in business, Hughes Associates is a global leader offering engineering and consulting services for fire protection and life safety, code compliance, hazard analysis and risk management, research and testing and physical security. Hughes’ experts are committed to providing the most cost-effective, sustainable, and appropriate solutions that meet our clients’ needs.

Founded in 1980, Hughes is headquartered in Baltimore, Maryland with over 35 offices worldwide. On-site laboratory and testing facilities in Baltimore complement our traditional consulting, engineering and forensic services. Hughes offers customers a unique combination of research capabilities and global application expertise.

ENGINEERS. CONSULTANTS. SCIENTISTS.

Our staff consists of a renowned group of more than 270 engineers, scientists, and computer programmers, as well as investigators and other specialists, who are among the best in the field of fire protection engineering and code consulting services. Our engineers serve on numerous National Fire Protection Association (NFPA) committees including the Aircraft Hangar Committee, Life Safety Code, Fire Alarm and Signaling Code.

SUPERIOR FIRE PROTECTION ENGINEERING

The Hughes team is exceptional in meeting the life safety, fire protection, code consulting and security needs and objectives for the sectors we serve. Hughes delivers timely and ground-breaking solutions that support the code-compliant expansion and fire protection systems reliability at government, military, and commercial facilities across the globe. Our fire protection engineers and life safety code consultants work collaboratively to ensure technical and cost-effective solutions.
SPECIALIZED SOLUTIONS FOR AIRSIDE OPERATION SAFETY

In addition to providing traditional fire protection and life safety services, Hughes has extensive experience in providing fire protection engineering services for unique military infrastructure, including aircraft hangars, aviation engine test facilities (hush houses), aircraft production facilities, airports and related support facilities. Services include fire protection design, life safety analysis, code consulting, fire detection and alarm design, smoke modeling, and fire hazard analysis. In particular, Hughes conducts research and testing on aircraft hangar suppression and detection system designs.

Hughes is the leader in applying advanced concepts to military facilities in order to save costs, reduce maintenance, and mitigate environmental impact of fire suppression system agents. Because of our fire science and developmental work in military fire protection R&D, Hughes has a clear understanding of DOD criteria (i.e., the rationale, intent, and interpretation of MIL HDBK 1008C on Fire Protection and associated U.S. Air Force Engineering Technical Instructions). Hughes helped produce these requirements for the U.S. military.

Hughes has worked closely with fire protection engineers in the U.S. Air Force, U.S. Navy, and U.S. Army in applying scientific solutions to military problems.

FIRE PROTECTION – AIRCRAFT HANGARS

Hughes consultants and engineers are recognized authorities in fire and life safety engineering for the aviation industry and are aware of current trends in hangar fire protection design and environmental issues. Our experts apply in-depth knowledge to address the challenges that are unique to aircraft hangars that include:

- Fire suppression and detection system design and criteria
- Operation and maintenance
- Environmental criteria and AFFF containment designs
- Special hazard design experience

NATIONAL AND INTERNATIONAL RECOGNITION IN AVIATION FIRE PROTECTION

Hughes has established a reputation for expertise, ethics, and competency in fire protection engineering and research. We have achieved this through years of active participation with regional, national and international building and fire code committees and regulatory bodies. We continue to contribute to the development of such codes through our representation both on and before many of these committees.

- Committee participation includes the following codes:
- NFPA Aviation Section (Past Chair)
- NFPA 409 Aircraft Hangars
- NFPA 403 Aircraft Rescue and Firefighting
- NFPA 11 Foam Standard
- NFPA 16 Foam Water Sprinklers
- SFPE Handbook: AFFF Design
- NFPA Handbook: Foam
Hughes has been instrumental in conducting initial studies and research for the design and operation of military aircraft hangars. This work has included:

**Policy & Design Criteria Development, U.S. Navy:** A study to develop a rational policy and design criteria to address containment and disposal of aqueous film-forming (AFFF) discharge from facilities having AFFF suppression systems.

**Design Criteria Development, U.S. Navy:** An evaluation of the capabilities of an aircraft hangar fire suppression system consisting of a low level AFFF extinguishing system and an overhead water sprinkler system were evaluated.

**Hangar Research & Testing, U.S. Air Force:** A determination of the technical validity of two proposed alternative systems (water-based system and compressed air foam system) for improvement of overhead suppression systems in hangars to avoid false discharges and environmental concerns. Hughes provided a test plan, test facility description, and test supervision. Results were reported to the U.S. Air Force.

**USAF Hangar Clean Up Guidance:** Develop guidance for new and enhanced response and clean-up criteria for protecting personnel and assets in the aircraft hangar mission area from exposure to fire fighting chemicals and processes.

**Hush House Fire Hazard Evaluation, U.S. Air Force:** A fire hazard analysis of USAF aviation hush houses to determine appropriate protection to replace Halon 1301 total flooding fire suppression systems. The hazard analysis included operational requirements, identification of plausible fire scenarios, fire modeling, and logistics aspects of replacements, and environmental impact of alternatives.

**AFFF Protection of Naval Aviation Assets, U.S. Navy:** A threat assessment to determine the level of protection required of AFFF systems to limit damage to Naval aircraft in the event of a fire. Scenarios considered were aircraft carrier flight decks and naval station airfields. An analysis was performed to determine if the level of protection afforded by the AFFF systems (both fixed and mobile) was embodied in the criteria of small scale AFFF qualification testing (i.e. AFFF MIL SPEC criteria).

**B-2 Bomber Hangar Design, Naval Research Lab, Washington, DC:** An evaluation of hangar design criteria for the USAF, including low-level application of AFFF and damageability criteria for aircraft.

**Optical Detector Response Testing/Performance Specification Development, Naval Research Lab, Washington, DC:** Small and large scale tests to determine appropriate fire signals which should be detected by optical detectors. Large scale tests were conducted to identify detection performance for a range of detector types. Associated tests were conducted to determine which types of detectors were most immune to false alarm signals. Based on test data and hazard analyses, Hughes developed an optical detector performance specification.
Hughes engineers were responsible for the preparation of the Tri-Service UFC 4-610-01, *Fire Protection for Aircraft Hangars*. They were also part of the P141U Aircraft Maintenance Hangar Functional Analysis Concept Development Team, designing the fire suppression and alarm systems for a state-of-the-art aircraft maintenance hangar at NAS Oceana.

**SPECIALIZED RESEARCH AND DEVELOPMENT EXPERIENCE**

- Use of Plastic Pipe for Hangar AFFF Systems (USAF)
- AFFF Environmental Policy and Criteria Development for Facilities (DoD)
- Hangar Water Sprinkler Suppression Tests (USAF)
- Hangar Portable Monitor Tests (USAF)
- High Expansion Foam Drainage Tests (USAF)
- Uniform Aircraft Hangar Facilities Criteria Handbook (USAF, Navy, Army, USMC)
- Unified Fire Protection Performance Technical Specifications (Navy)
- Low-level AFFF Performance and Burnback Resistance (NAVFAC)
- Low-level AFFF Nozzle Design (NAVFAC)
- Optical Detector Tests (NAVFAC and Canadian MOD)

**Joseph L. Scheffey, PE** is Vice President of Research and Development at Hughes. He is past-Chairman of the NFPA Aviation Section, where he chaired the 2010 *NFPA Symposium of Aviation Fire Protection* at the NFPA Annual Meeting in Las Vegas. He is a principal member of the NFPA Foam-Water Sprinkler Committee, Flammable Liquids Committee, and Aircraft Hangar Committee. He has chaired the NFPA 412 Task Group on Foam Test Methods and is a principal member of the NFPA committee on Aircraft Rescue and Firefighting.

Mr. Scheffey has directed the design of an innovative low level AFFF system for military aircraft hangars. His experience includes being tasked by the FAA to independently review test criteria for firefighting foams used at airports. As a result of this review and analysis, standard test and approval methods were validated for use by the FAA.

Mr. Scheffey has considerable large-scale fire test experience in projects involving foams, flammable liquids, and suppression systems. He is a member of SFPE and NFPA, and has authored engineering design criteria on foam fire protection systems for both the NFPA and SFPE handbooks.

*National Fire Protection Association, Aviation Section, Distinguished Member Award, 2010*
Research and Development Experience

NAS Patuxent River, MD (2009)
P263 BAMS Hangar Complex
Code consulting and design services for the development of an RFP for the design and design/build construction of a Research, Development Testing and Evaluation (RDT&E) hangar complex and associated support, administrative, and maintenance facilities. The complex will support the Broad Area Maritime Surveillance (BAMS) Unmanned Air Systems (UAS) program and the NAWC Aircraft Division.

NAS Oceana, Virginia Beach, VA (2001)
Policy & Design Criteria Development
A study was conducted to develop a rational policy and design criteria to address containment and disposal of AFFF discharge from facilities having AFFF suppression systems. A technical analysis of the pollution aspects of AFFF was performed to assess the environmental impact of liquid effluent discharges on soil and water, including toxicity to organisms. The study also addressed waste water treatment and airborne pollutants, and took into consideration local jurisdictional requirements. An environmental impact analysis was made to develop options for containment and disposal. The results of the survey and analysis were submitted as draft design criteria for inclusion in MIL-HDBK-1008C.

Aircraft Hangar Design Study, Naval Research Laboratory, Washington, DC, and the U.S. Navy (2001)
Design Criteria Development
The capabilities of an aircraft hangar fire suppression system consisting of a low level AFFF extinguishing system and an overhead water sprinkler system were evaluated. Full-scale testing was conducted to evaluate the overhead water sprinklers on AFFF foam blankets. Hughes proposed changes to the design criteria for hangar protection to incorporate AFFF application from only the low level system combined with overhead closed head quick response water sprinklers.

Aircraft Rescue and Firefighting Criteria, Federal Aviation Administration (2008)
Policy Review
Review current NFPA, FAA and ICAO requirements for providing aircraft rescue and firefighting services at airports as it applies to new large body aircraft such as the A380 and B787. Fire loss history, tactical requirements and foam effectiveness were considered. Heat transfer modeling of a fire to aircraft was performed.

Aircraft Composite Fire Performance, Federal Aviation Administration
Policy & Design Criteria Development
Identify firefighting agent requirements for composite airframe materials as they are more widely adopted in airframe design. Develop a reduced scale test to evaluate suppression agent requirements as a function of composite material flammability. Flame/fire spread modeling of composite aircraft was included as part of this analysis.

Glass Boarding Bridge Fire Performance, Fire Protection Research Foundation (2013)
Policy & Design Criteria Development
Glass boarding bridges, used in many parts of the world, are restricted in some countries/jurisdictions due to fire safety concerns. Information on the global experience on the use of boarding bridges was gathered, including fire resistance, fire test methods, use of alternate/additional escape routes from the plane, and psychology/sociology of occupants that might egress through a bridge with a large fire below. A performance-based approach was used in evaluating the fire safety to passengers and crew. The resulting data suggests that an appropriate level of fire safety can be achieved, and is being provided to standards making organizations.
AIRCRAFT HANGARS – DESIGN CRITERIA

Hughes uses one or more of the following design criteria when designing fire protection systems for aircraft hangars:

- National Fire Protection Association (NFPA) 409: Standard on Aircraft Facilities
- Air National Guard (ANG) Engineering Technical Letter (ETL) 97-1 Design Policy Section 15: Fire Protection
- NFPA Standard on Heliports
- Other NFPA Codes and Standards such as NFPA 11 and 16
- Client-specific Design Requirements

AQUEOUS FILM-FORMING FOAM (AFFF) AND HIGH EXPANSION (HI EX) SYSTEMS

Hughes has completed the fire protection designs for numerous aircraft hangars involving Aqueous Film-Forming (AFFF) or hi-ex foam systems. The hi-ex foam projects include both water and electrically powered hi-ex generators and utilized bladder tank foam proportioning systems.

Foam systems for other hangar designs have included pumped foam proportioning systems, giving us experience in designing all types of foam proportioning systems and generators. Given the large water flow requirements of fire protection systems for aircraft hangars, many of the projects also included the design of booster fire pump sets and/or extensive water supply analysis. All projects included the design of foam releasing control systems and their integration with building fire detection and alarm systems.

Hughes performed foam system nozzle discharge test in a newly constructed 30,000-sf helicopter hangar at the Flight Operations Building at Bell Aerospace Ozark, AL airport.
V-22 Aircraft Maintenance Hangar,  
MCAS New River, NC  (2008)  
**Fire Protection, Life Safety & Code Consulting**  
Services were provided for the design/build project, P-526/P-651 aircraft maintenance hangar for V-22 aircraft. Work included: a fire protection analysis; life safety plan; code submittal certification; design of fire alarm, automatic sprinkler, fire pump, and low-level low expansion foam fire suppression systems; review of contractor shop drawings; and, final testing and commissioning of fire protection systems.

Wright-Patterson AFB, OH  (2008)  
**Fire Protection Engineering Services**  
Hughes provided fire protection engineering and code consulting services for the construction of a 70,000-sf multi-purpose hangar servicing and maintaining C-5 aircraft. The project included the preparation of a fire protection and life safety code analysis, general fire protection, building, and life safety code consulting, and the design of fire detection and alarm systems, wet-pipe sprinkler systems, pre-action foam/water sprinkler systems in the hangar bay, a low level, high expansion foam system for the hangar bay, and design of a new fire protection water supply.

Singapore International Airlines, Singapore  (2002)  
**Foam Fire Suppression System Design & Code Consulting**  
A fire safety code analysis was performed for Hangars 4 and 5 and an annex building. The design was provided for a fire pump system, an overhead sprinkler system, and a low-level foam fire suppression system in compliance with NFPA 409.

Chambers Field, Naval Station, Norfolk, VA  (2001)  
**Fire Suppression System Design**  
Hughes provided fire protection engineering services for the fire alarm and detection system design for four aircraft maintenance hangars (P-522/P-524 and P-523/P-525) at Chambers Field, Naval Station, Norfolk, VA. All buildings work included new low-level AFFF and sprinkler systems as well as building fire alarm systems. All work was performed in accordance with MIL-HDBK-1008.

NAS Oceana, Virginia Beach, VA  (2000)  
**Fire Suppression System Design:** Design for a state-of-the-art AFFF fire suppression system design for a new F/A-18 aircraft maintenance hangar (Type I, cantilever framed; 7,000-square feet). The state-of-the-art system included under wing spray nozzles located in floor trenches. Work also included the design for a fire pump, AFFF low level suppression systems, and shop drawing review services. The existing water supply was evaluated for adequacy to support the new system. Support and guidance were also provided to the electrical engineer on designing the fire detection and alarm systems. **Received DoD Award for Outstanding Achievement Through Value Engineering.**

Forward Operating Locations, Aruba & Curacao  (2000)  
**Fire Protection Design Analysis**  
Hughes provided fire protection engineering services for the design of USAF hangars and associated buildings for FOL operations. Fire protection systems consisted of low-level AFFF systems, sprinkler systems, and building and base-wide fire alarm systems.

Hangar 250, MCAS Cherry Point, NC  (1999)  
**Fire Suppression System Design**  
Hughes prepared a fire suppression system design which included the design of an AFFF system and an overhead sprinkler system for Hangar 250 and an office wet pipe sprinkler system as part of the renovation of an aircraft maintenance hangar renovation project at MCAS Cherry Point, NC (125,000-sf).
High Expansion Foam Systems Experience

**U.S. Naval Base, Guantanamo Bay, Cuba (2004)**
*High Expansion Foam Fire Suppression System*
High expansion foam and wet pipe sprinkler systems were designed for an aircraft maintenance bay, and a fire alarm system for the building, as part of the renovation and plan to reoccupy the abandoned McCalla Hangar (1,850 m²) hangar at the US Naval Base, Guantanamo Bay, Cuba.

**Aviano Air Base, Aviano, Italy (2003)**
*Fire Protection Engineering Services*
Fire suppression system design was provided for a fuel cell maintenance hangar that met USAF criteria. The design included a high expansion foam system for the fuel cell maintenance bay. Work included specification development, review of shop drawings, and preparation of record drawings.

**Wallops Flight Facility, Wallops Island, VA (2003)**
*High Expansion Foam Fire Suppression System*
A complete design engineering package was supplied for the construction of a new high expansion foam fire suppression system for Buildings D-1. Work included field investigation, design analysis, construction documents preparation (drawings and specifications), and coordination with other project design professionals to complete the bid package.

**Langley AFB, VA (2001)**
*High-Expansion Foam Fire Suppression System*
Fire protection engineering services for the conversion of Building 371 into a static hangar which will be used as an assembly space for VIPs and ceremonial functions. Aircraft would be displayed behind a removable stage during various assembly functions, and will remain at least partially fueled. Hughes installed a high-expansion foam fire suppression system and a wet-pipe sprinkler system throughout the hangar area.

**USAF Air Combat Command, Lajes Field, Azores, Portugal (2001)**
*Hangar Renovation*
A site survey was conducted and cost estimates provided for the renovation of Hangar T-820. Recommendations were made for a new fire protection system to include high expansion foam system and necessary upgrades to the water supply for the building.

**NASA Langley Research Center, Hampton Roads, VA (2001)**
*High Expansion Foam Fire Suppression System*
An analysis was provided of design options for the renovation of fire suppression systems in an existing aircraft maintenance hangar bay. A solution utilizing high expansion foam was selected as the best alternative for this 9,000 m² hangar. Hughes provided design of the new system incorporating the replacement of the existing fire pumps and underground water supply piping.

**Little Rock AFB, AR (2008)**
*Design of High Expansion Foam System*
Design services were provided for this design/build project to construct a new C-130 aircraft hangar. The bay enclosed one C-130 aircraft and is used for periodic aircraft washing and maintenance. Work included design of a high expansion foam system and wet sprinkler design.
Boeing 787 Dreamliner Assembly Plant, North Charleston, SC (2011)

Fire Protection Design Services
Hughes provided fire protection design and safety services for the newly constructed Boeing 787 Dreamliner final assembly facility in North Charleston, South Carolina.

Hughes performed design of fire suppression and fire pump systems, life safety drawings, and smoke code consulting for the assembly and utility buildings.

Completed in 2011, the 1,037-foot long assembly plant has 692,000-square feet of covered space and 1.2 million-square feet of usable space. This project represents the largest single capital investment in South Carolina's history ($750 million).

Project components include a final assembly building, delivery center, administration building and support facilities.

MALPENSA 2000 Hangar, Milan Airport, Italy (2000)

Fire Protection Survey; System Design
A fire protection survey and a detailed design of fire protection systems for the new hangars at MALPENSA 2000 – Milan Airport. The main hangar building contained three parts: the central hangar building containing ten hangars that range in height from 65-100 ft and cover 68,000 ft², and two lateral two-story buildings on opposite sides of the main hangar that each contain six smaller hangars as well as office and storage spaces. The following systems were designed in accordance with NFPA 409: separate deluge foam-water systems for each hangar, dry-pipe sprinkler systems for the external shelters, wet-pipe sprinkler systems to protect the offices and storage areas, water reservoir, diesel driven fire pumps, AFFF foam storage tanks, self-oscillating foam-water monitors, heat and flame detectors.

Camp Lejeune, NC (2004)

Fire Protection Engineering Services
Fire protection engineering design for the renovation of Building AS4100, a helicopter hangar building. New devices and wiring were provided throughout the building to include a new addressable fire alarm system, IR detectors, radio transmitter, fire pump controllers, smoke detectors, pull stations, etc. The existing overhead deluge system was converted to a wet pipe system. Existing foam tanks and pumps were replaced with a bladder tank system. A fixed side wall foam system was provided.

NAS Jacksonville, FL (2003)

Design of a fire suppression, foam suppression, and fire alarm systems for Hangar 1000. Demolition and alteration work was provided to an existing aircraft hangar bay (47,000-square feet), the first of five to be remodeled. Three existing fire pump units and associated components were replaced, and an existing wet-pipe fire sprinkler system was replaced. The sprinkler system was supplemented with four water-foam cannons that are activated by double-zone IR detectors. In addition, the existing underground water supply loop was abandoned upon completion by providing an interior water supply loop to all bays.

Lockheed Martin, Palmdale, CA (2011)

Acceptance Testing / Commissioning
Prepare design documents for the conversion of water deluge systems to closed head wet pipe sprinkler systems at Lockheed's Plant 10 paint hangar.
ADDITIONAL AIRCRAFT HANGAR AND FACILITY FIRE PROTECTION EXPERIENCE

*Fire Protection Design Services*
Generalized code review and fire hazard analysis (FHA) to assess the overall fire safety of the heliport, with emphasis on the impact of the V-22 Osprey. Analyzed hazards, identified mitigation strategies, and determined appropriate level of safety.

Melbourne International Airport, Melbourne, FL (2012)
*Fire Protection Design Services*
Fire sprinkler and fire alarm system design for 74,000-square foot hangar building with approximately 18,500-square foot of mezzanine.

Boeing Company, Long Beach, CA (2012)
*Fire Alarm Design*
Fire Protection Engineering Services for the replacement of the existing fire alarm in Building 58 at Boeing’s C-7 Plant.

Hanscom AFB, Bedford, MA (2010)
*Fire Protection Engineering Services*
Fire protection and life safety consulting services related to a Fire Protection and Life Safety Property Conditions survey, analysis and report for the 30,000-square foot Hangar IIA.

West Virginia Air National Guard, Martinsburg, VA (2010)
*Fire Protection Engineering, Life Safety, and Code Consulting Services*
Fire protection engineering, life safety, and code consulting services for the design and construction of a 80,000-sf C-5 Fuel Cell Maintenance Hangar for the West Virginia Air National Guard.

Embrarer Aircraft Service Center, Multiple Locations in CT, AX, and FL (2007)
*Fire Protection Design Services*
Design of fire protection systems for three hangars for corporate aircraft.

Naval Air Facility, El Centro, CA (2000)
*Fire Protection Design Services*
A base-wide fire protection engineering report evaluating all facilities for code compliance. Facilities include aircraft hangars, residential quarters and assembly occupancies. An assessment of existing fire reporting systems was performed and recommendations were made for a base-wide fire alarm reporting system to interface with existing building systems. Hughes evaluated fire suppression, extinguishing, fire alarm and detection systems for adequacy and compliance with applicable codes. Recommendations were made to upgrade fire protection systems and cost estimates were provided to accomplish corrective actions.

Naval Air Weapons Station, China Lake, CA (1999)
A base-wide fire protection engineering study surveying fire inspection, maintenance and test records. Water flow and fire alarm tests were conducted.
United States Office Locations:
- Arizona: Phoenix
- California: Los Angeles, San Diego, San Ramon
- Colorado: Colorado Springs, Denver
- Florida: Orlando
- Illinois: Chicago
- Maine: Bingham
- Maryland: Baltimore* 
- Massachusetts: Boston
- Minnesota: Rockford
- New Jersey: Woodstown
- New Mexico: Albuquerque
- New York: Armonk, Manhattan
- Nevada: Las Vegas
- North Carolina: Charlotte, Raleigh
- Ohio: Cincinnati, Cleveland
- Pennsylvania: Philadelphia
- Rhode Island: Providence
- Texas: Dallas, Houston
- Virginia: Reston, Virginia Beach
- Washington: Vancouver
- Washington, DC: Library of Congress, Pentagon

International Office Locations:
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- Korea: Seoul
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