



N₂Towers Inert Gas Generation System for Fire Protection in Enclosed Aircraft Spaces



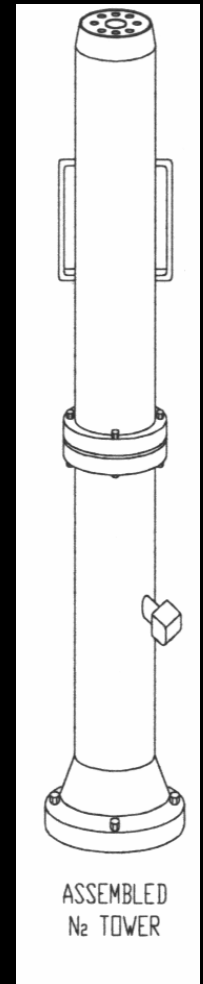
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***INTERNATIONAL AIRCRAFT SYSTEMS FIRE
PROTECTION WORKING GROUP MEETING***

October 2006

N₂ Tower Gas Generator Fire Protection System

- **Patented Solid-Propellant Based Inert Gas Generator System – Nitrogen/Water Vapor Blend – Suitable for Occupied Spaces**
- **Unique Propellant Formulations Under Development by ATK Launch Systems (ATK)**
- **Designed to Meet Commercial Building “Total Flood” Market for Occupied Spaces, Additional Applications**
- **Designed to Meet Toxicity, Environmental, Performance Requirements for Market at an Affordable Price**
- **Potential Benefits for Aerospace Applications Identified**



Multiple Propellant Cartridges Housed in One or More “Towers” Placed in Protected Area (Commercial Applications)

Advantages of N₂ Solid Propellant Generator Approach

- **Solid Storage Medium More Dense, Compact Than Compressed Inert Gases**
 - Gas cylinder “footprint” space an issue with other inerts
- **Unit Not Stored Under Pressure**
- **Generates Inert Nitrogen, Water Vapor Blend**
 - Extremely high heat extraction per lb. material
 - Exploits water/nitrogen combo benefits observed by others
- **Gas Discharges at Elevated Temperature Safe For Exposure (NFPA 2010, where relevant)**
 - Most water mass remains in vapor form, flows like a gas; small amount forms atomized aerosol that exits ventilation, little wetting
- **Commercial Tower Design – “In Room” Protection**
 - No plumbing, engineering, installation requirements
 - Negligible maintenance, low cost of ownership, very reliable
- **Effluents Meet SNAP, No Acid Gases, Cardiotoxicity, No Ozone Depletion or Global Warming**
- **Cost Effective - Tower/Modules Mass Production-Friendly**
- **Good Low Temperature Performance Anticipated**

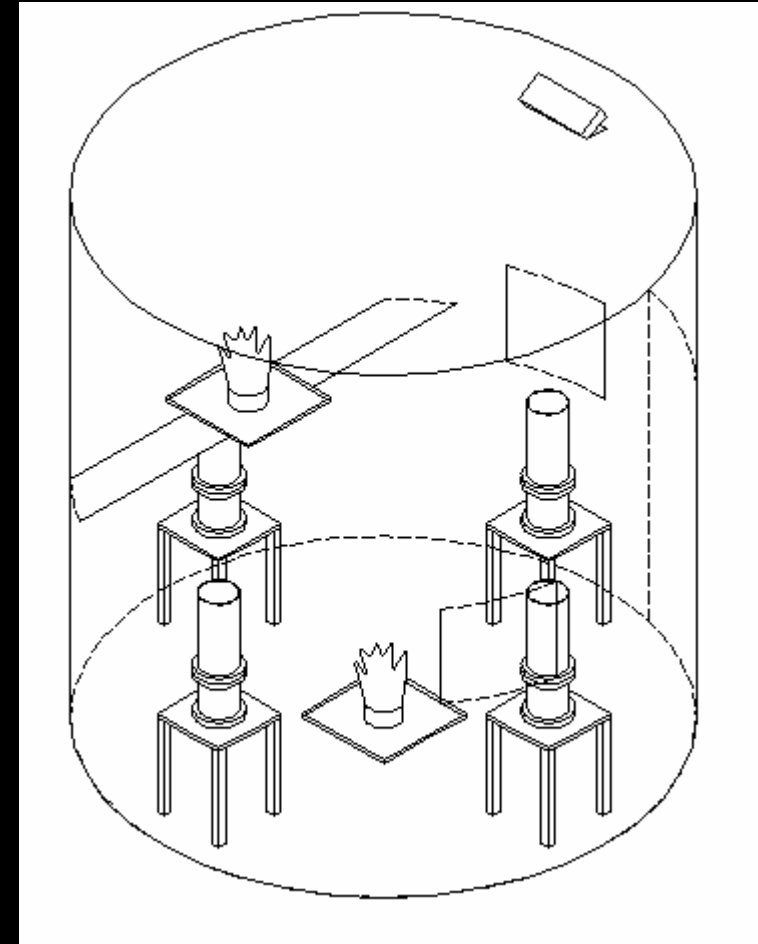
Demonstration of Fire Suppression



Fire Tests at ATK Facility


40 lbs. Propellant Extinguishes
Fire in 10-14 Seconds After
Initiation (fast for inert)

Additional Tests To Expand
Protection Range Underway



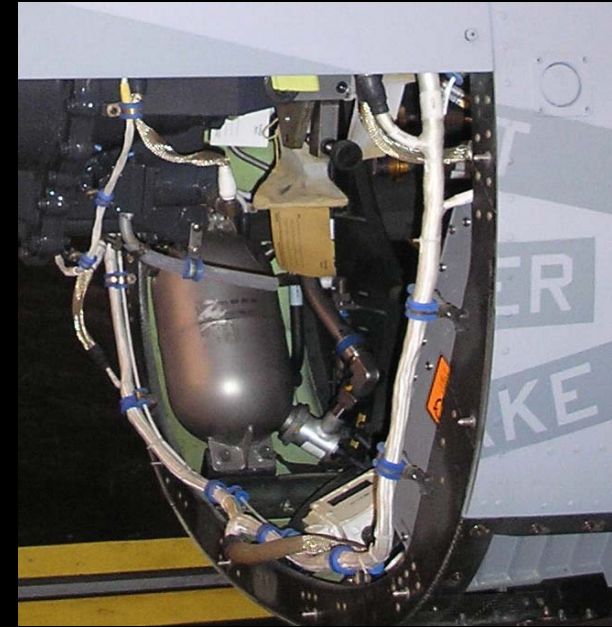
1000 cubic foot space, with fuel fires on
the floor, six foot elevation; four sub-
scale towers with one full-scale
generator in each

Potential Cargo Bay Application

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- **Compact, Light Weight System Anticipated For Aircraft**
 - **Highly Efficient Nitrogen/Water Vapor**
 - Rapid cooling, shown to work well in cargo bay tests
 - **Vapor State of Water Promotes Good Distribution to Hidden Areas**
 - Use with Electrical Cable Fires to Be Explored
 - **Cartridges Sequenced To Manage Gas Release Rate**
 - **Can Be Mated With Misting System For Sustained Suppression Period**
 - **Nitrogen/Water Vapor Mixture Inherently Safe for Stowed Animals, Passengers if Liner Compromised**

Potential Engine Nacelle Application

- **Space Efficient To Fit in Tight Quarters**
 - Solid; no “ullage” above liquid
- **Highly Efficient in Performance**
- **Warm Water Vapor Gas Floods Well In Tight Areas, Mitigates Impact of Cold Air**
- **Good Cold Storage Performance Anticipated, Pressure Variation Minimal, Compared to Stored Bottles**
- **No Corrosion Issues, Rapid Cooling, Maintenance Safe**



Potential Portable Application

- **Cartridge May Be Possible To Be Packaged As a Portable Unit**
 - Awaits further assessment
- **Size Efficient, No Ullage Space, Dip Tube, Etc.**
- **Efficient Suppression, Without Notable Hazards To Passengers**
 - e.g. Acid Gases, Cardiotoxicity, Frostbite, Corrosion
- **Will Not Leak, Not a Hazard if Punctured**



Status and Summary

- **Considerable In-House Investment, Research To Date Continues To Meet Commercial “Total Flood” Fire Suppression System Planned Production Schedule**
 - SNAP, DOT, UL Fire Tests Planned Soon
 - Production Planning Underway
- **Partners Being Sought For Distribution Through Commercial Channels to Support Various Markets**
- **Opportunities Exist for Development Partnering for Aerospace Applications, Including End Users**