



**ITEA LVC Conference**

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**CoLD: ARMS Sensor Package T&E Tool**

Topic: Applying T&E to Civil-Military  
Operations –

Enhancing the T&E community with robust  
tools that can be used in more than one  
environment.

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# ARMS HISTORY

## T & E With Unmanned Aircraft



*1946-48: "...Air Force and the Navy used unmanned B-17s and F6Fs...to fly into nuclear clouds within minutes after bomb detonation to collect radioactive samples..." {DoD UAS Roadmap 2005-2030}*

☢ 1960: AEC contracts EG&G to develop ARMS.

☢ 1960s ARMS had two problems:

1. Radiation levels on the ground must be reliably determined from measurements made in the air.
2. Accurate geo-spatial positioning of the aircraft relating to the radiation measurement must be achieved.

USAAF B-17G "Flying Fortress"



US Navy F6F "Hellcat"





# OBJECTIVE



Research & develop UAV integrated sensor package to facilitate network-centric nuclear & radiological consequence management in civil & military environments.

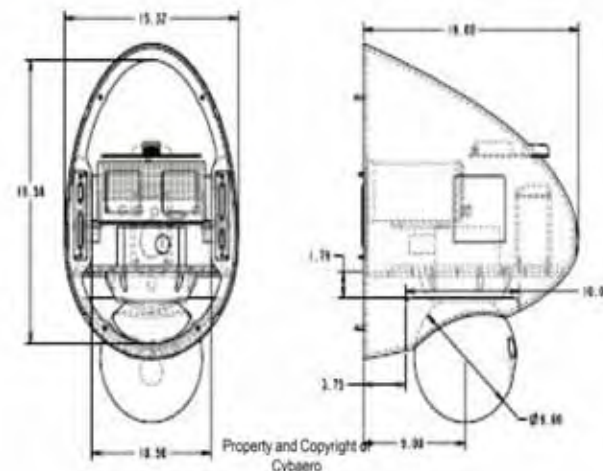
☢ To calculate accurate ground levels, three critical pieces of information must be established from the air:

1. Accurate geo-spatial position [coordinates].
2. Distance (altitude) above ground.
3. Radiation level (dose rate) R/hr or cGy/hr.

☢ Known distance (altitude) is applied to mathematical formula to calculate AGCF for that distance.

☢ ACGF is applied to aerial radiation reading to calculate extremely accurate ground levels to within 0.001 of a cGy/RAD.

 Payload Space





# SENSOR PACKAGE

USPTO Provisional Patent # 60/959,094



Radiation Detector



GPS module



Laser distance measuring module

UAV integrated payload sensor package main components:

- ☢ Radiation detection instrument
- ☢ Laser distance measuring device
- ☢ GPS



# CoLD: ARMS FIELD TEST DEFENSE NUCLEAR WEAPONS SCHOOL



KIRTLAND AFB, NM

11-15 February 2008

- ☢ Demonstrate validity of CoLD:  
ARMS for civil/military operations.
- ☢ Method: Simulated aerial surveys  
over radiological contaminated area.
- ☢ Calculations verified with over 90%  
accuracy.
- ☢ Unanticipated Issues with “shine  
areas” noted and attributed to errors  
(8%). Will be adjusted for in Phase  
II.





# SW Version 1.0



GUI displaying calculated ground (GDC) dose rate readings in real-time during DNWS Field Test:

GDC Data is used by EMs in civil/military consequence management operations.

Resulting software is in stand-alone executable format.





# Version 1.0

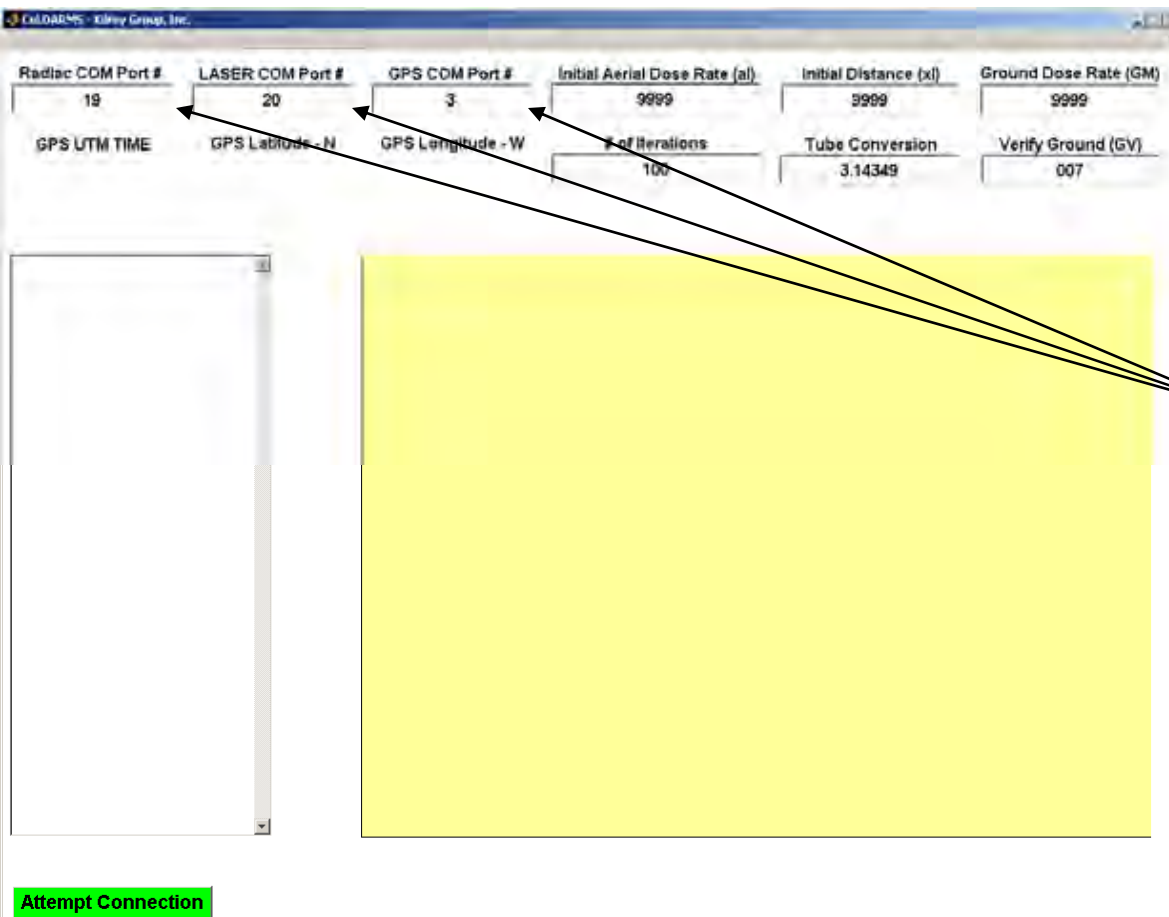
# CoLD:ARMS Software

# Interface



GUI representing interface used during Feb, 2008 test at Kirtland AFB, NM.

3 inputs represent the Virtual COM Port # for the RADIAC, Laser, & GPS necessary to establish communication between all 3 devices and SW.





# Version 1.0 Synchronization

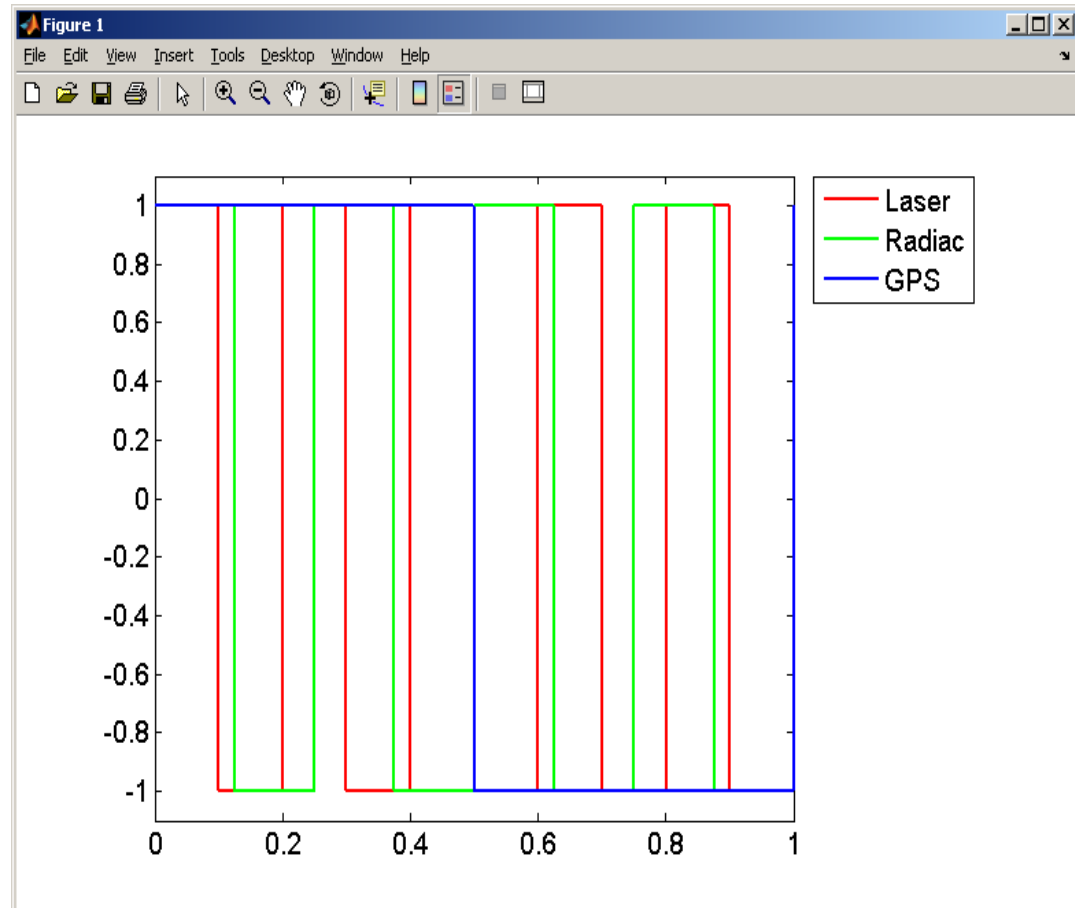


Three devices with three different sampling rates ( $F_s$ ) required the data to be synchronized.

Laser = 5 Hz   Radiac = 4Hz   GPS = 1Hz

The solution was to simply decimate the data from the laser and the Radiac to 1 Hz and to select their corresponding data closest to the clock pulse of the GPS receiver.

Version 2.0 will include a GPS with a much faster  $F_s$ .





# SW Version 1.0

## Menu Selections



Version 1.0 provided menu selections for various display features used during the February, 2008 testing at Kirkland AFB in NM to include features, data display and functionality.

GPS readings are also displayed.

**CoLDARMS - Kilroy Group, Inc.**

Display Initial Values    Display Data in Listbox    Display Data in Plot    Stop Everything    Zoom

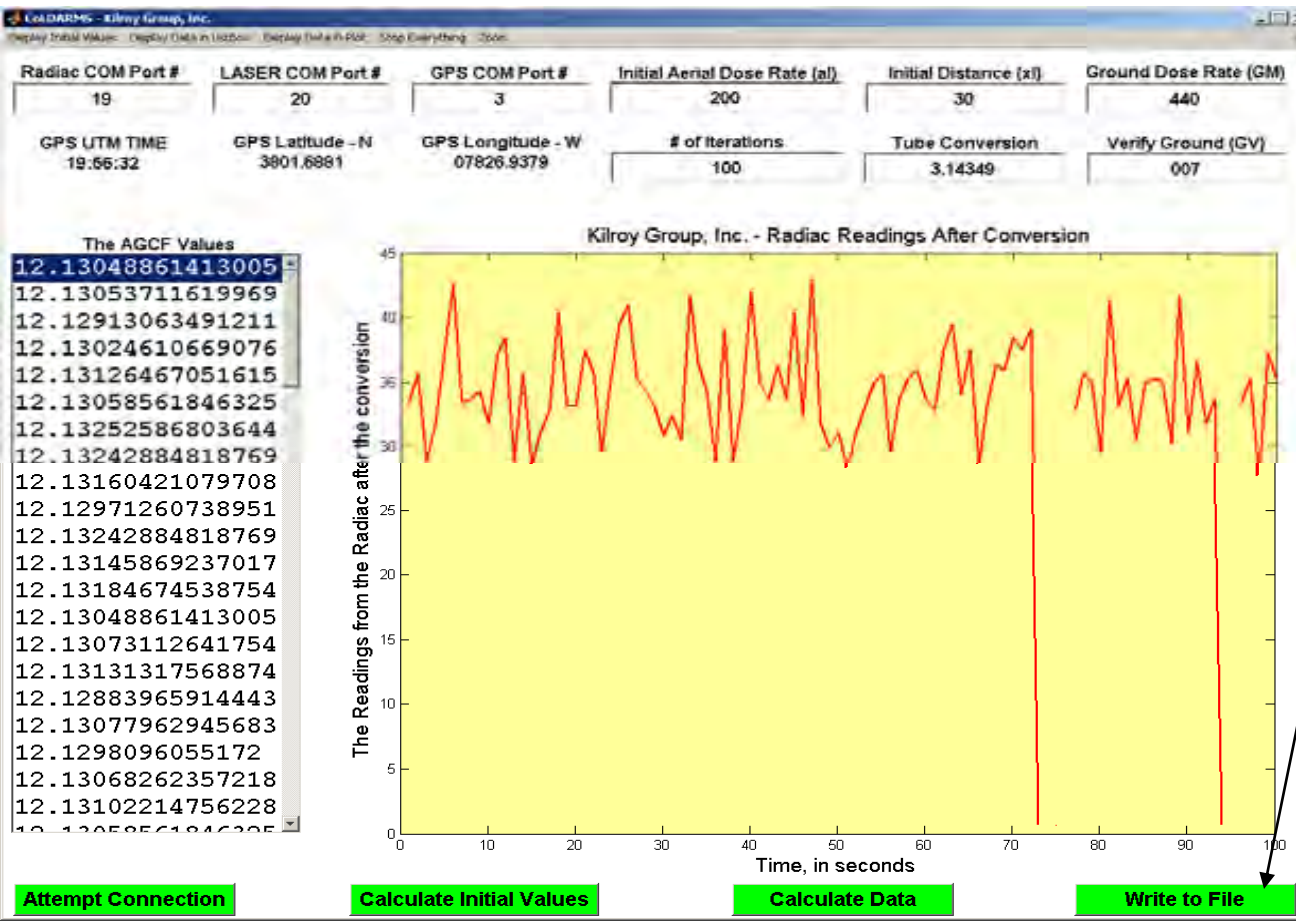
<b>Radiac COM Port #</b>	<b>LASER COM Port #</b>	<b>GPS COM Port #</b>
19	20	3
<b>GPS UTM TIME</b>	<b>GPS Latitude - N</b>	<b>GPS Longitude - W</b>
19:56:32	3801.6881	07826.9379



# SW Version 1.0



Air to Ground Correlation Factor (AGCF) data real time during Kirtland, AFB test.



Notice the capability to write results to text file.

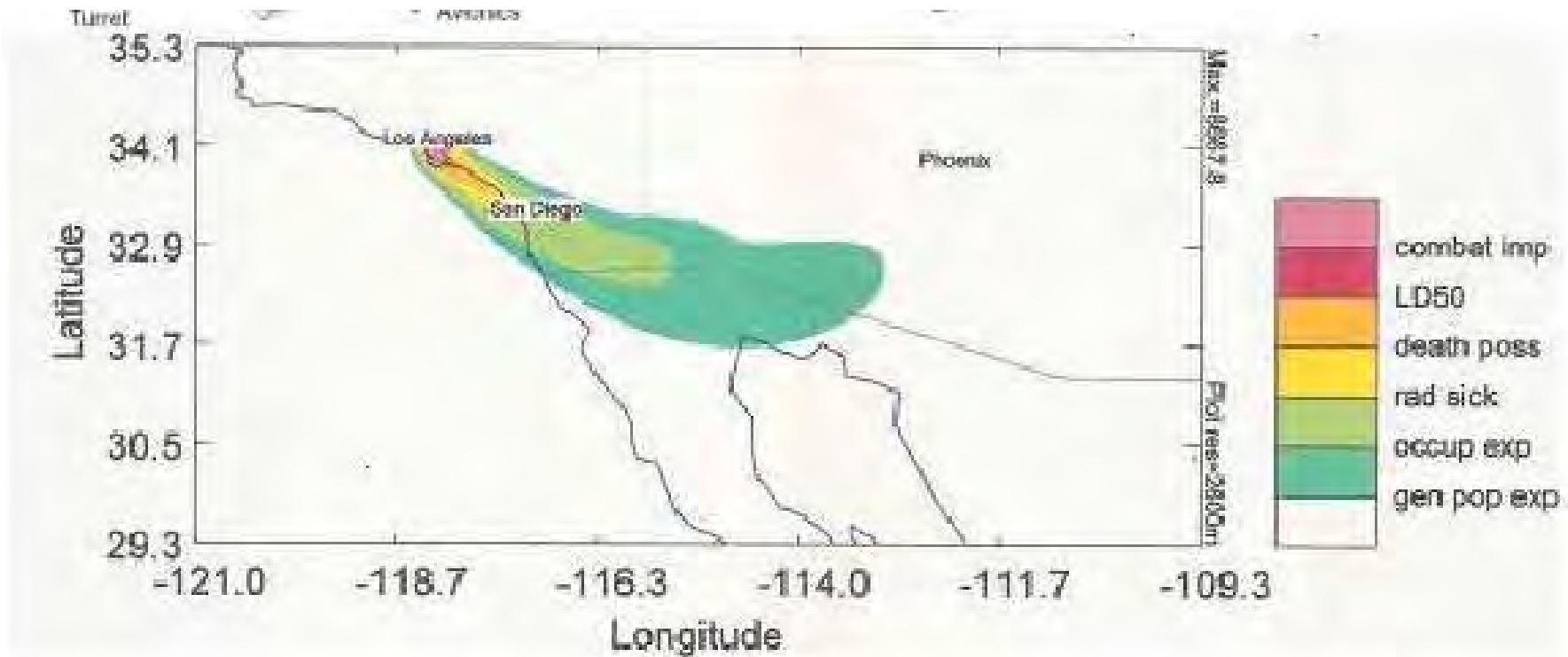
Program is stand-alone executable & can be distributed freely.



# Version 2.0 2-D Contaminate Concentration Visualization



Data sent from the sensor package on the UAV will transmit data that can be used to display 2-D nuclear fallout.



## 2-D Nuclear Fallout Visualization

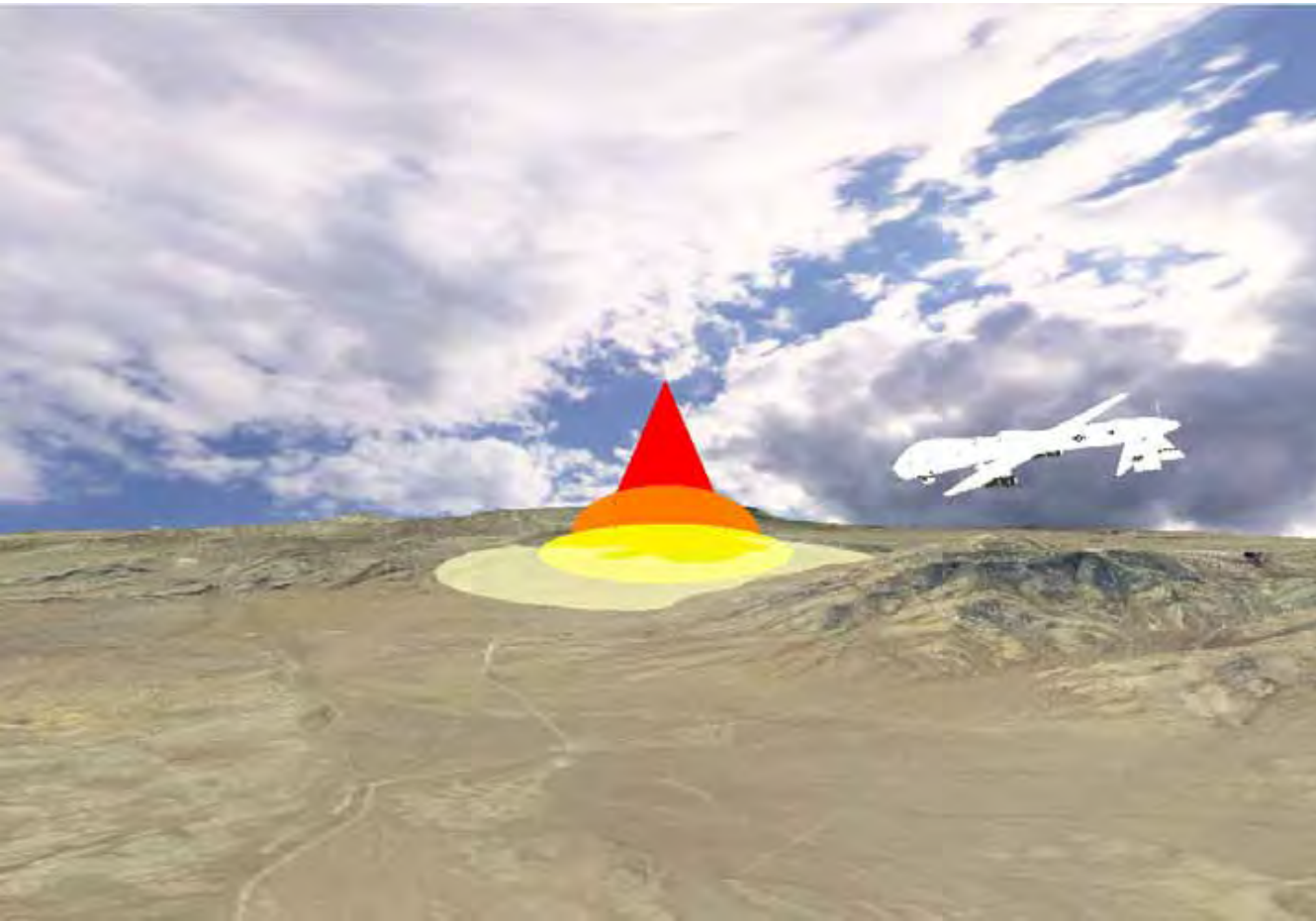
- [UAV image courtesy of Insitu, Inc. <http://www.insitu.com/scaneagle>]



# Proposed Version 2.0 3-D Visualization



The proposed 3-D visualization system will be driven by the data gathered by the sensor package and transmitted by the communications system.



Here, a Predator flies over Nevada.

The red cone represents Ground Zero and the greatest level of contamination.

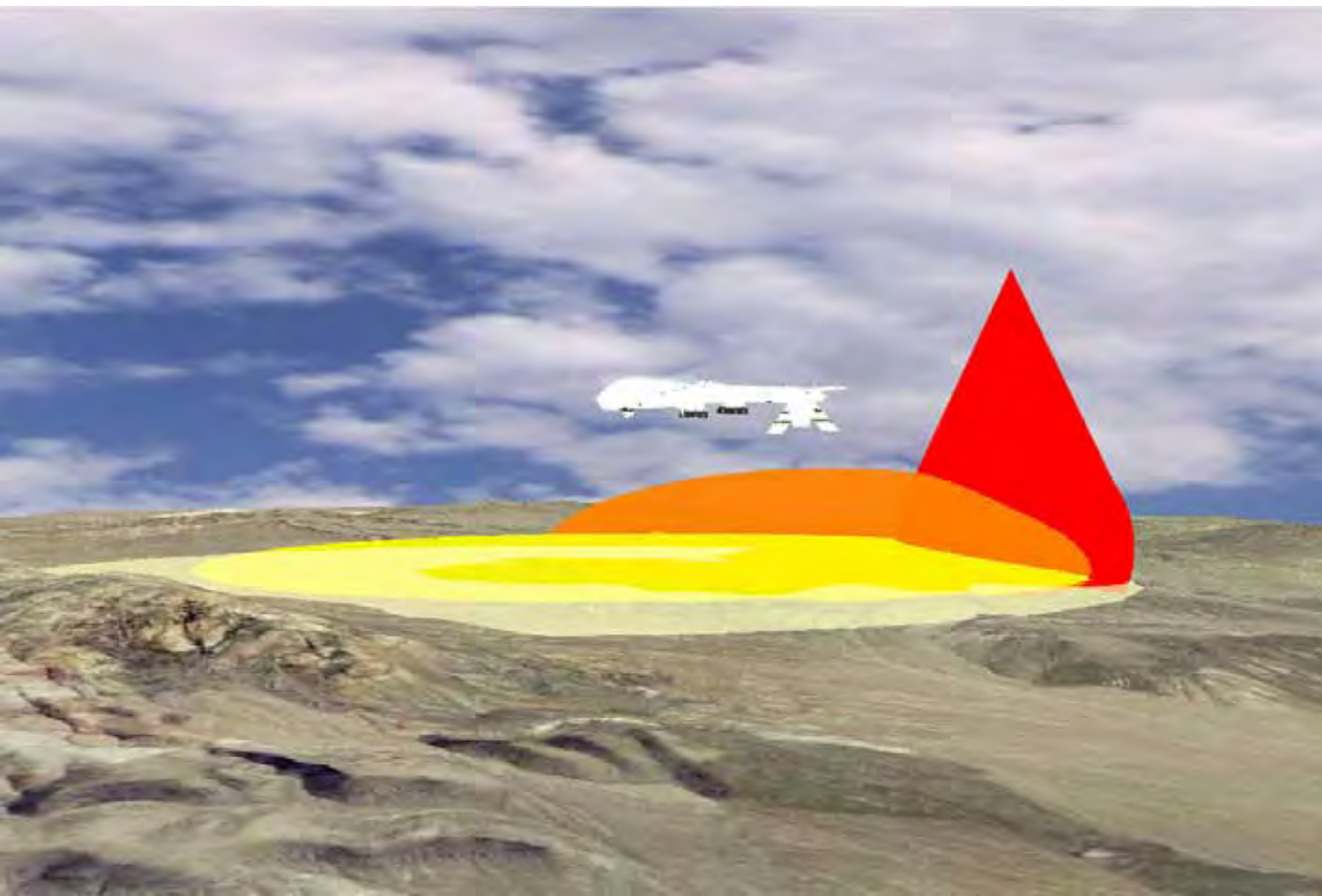


# Proposed Version 2.0

## 3-D Visualization



The proposed 3-D visualization system could be used to display gamma radiation contamination from the fallout of a given event. The level of concentration can be indicated by color.



This example displays four different levels of gamma radiation.

The height and placement of each “cloud” is adjustable.



# Proposed Version 2.0

## 3-D Visualization



Fly-overs are also possible using this method of visualization. These high-altitude missions are critical for determining safe routes of evacuation. Transparency levels are adjustable.



The lowest levels of contamination, indicated here by light yellow, have the lowest height and usually conform to the terrain more so than other levels.



# Proposed UAV Platform



- Phase II prototype-UAV integrated
- UAV platform: CybAero Vantage
- Vantage: VTOL UAV developed by CybAero & Naval Research Lab
- Minimal training & crew requirements





# CybAero

## Civil & Military Applications



### **Civilian & Commercial**

- Power/Pipe line inspection
- Forest and industry surveillance
- Mapping and agricultural survey
- Traffic surveillance
- Search and Rescue services
- Aerial photography
- Chemical and biological hazard monitoring

### **Military**

- Reconnaissance
- Surveillance
- Target Acquisition
- Communications relay
- Radio jamming
- Border control
- Coast guard Mine detection



# CybAero

## Specifications



- VTOL Capability
- Digitally Controlled Starter/Generator
- Heavy-fuel engine
- EW payload expansion
- Exchangeable payload nose for quick mounting of CoLD:ARMS system
- Autonomous Takeoff & landing capability
- Digitally Controlled Electric Tail Rotor
- Body Length: 112"
- Rotor Diameter: 109"
- Gross Weight: 380 lbs
- Payload Capacity: 25 – 35 lbs
- Endurance: 3-5 hours
- Dash Speed: 100 knots
- C2 Radio Link: 400 and 900 MHz,
- Radio Range: 50 nm
- Payload Comm: 2.4 GHz & Ethernet



# Civilian and Military Applications



## CoLD: ARMS Application Environments:

- Anti-Terrorism-Force Protection – DoD/DHS
- Border Security – DHS
- Chemical, Biological, Radiological, & Nuclear Defense & Preparedness (CBRN) – DoD/DHS/Civilian
- Nuclear Consequence Management– DoD/DHS
- Radiological Intelligence, Surveillance, and Reconnaissance (ISR) Programs - Military
- Naval and Maritime Security – DoD/DHS
- Uranium Exploration Industry for Energy Production - Civilian



# Contact Information



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